

**Fauna of
New Zealand**
Ko te Aitanga Pepeke
o Aotearoa

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**Fauna of New Zealand
Ko te Aitanga Pēpeke o Aotearoa**

Number / Nama 35

**Cydnidae, Acanthosomatidae, and Pentatomidae
(Insecta: Heteroptera) : systematics, geographical
distribution, and bioecology**

M.-C. Larivière

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**Manaaki
Whenua
PRESS**

**Lincoln, Canterbury, New Zealand
1995**

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Cataloguing in publication

LARIVIÈRE, M.-C.

Cydnidae, Acanthosomatidae, and Pentatomidae (Insecta: Heteroptera):
systematics, geographical distribution, and biocology / M.-C. Larivière. —
Lincoln, Canterbury, New Zealand : Manaaki Whenua Press, 1995.

(Fauna of New Zealand, ISSN 0111-5383 ; no. 35).

ISBN 0-478-09301-2

I. Larivière, M.-C. (Marie-Claude) II. Title III. Series

UDC 595.754(931)

Prepared for publication by the series editor and the author using computer-based text processing, layout, scanning, and printing at Landcare Research New Zealand Ltd, Mt Albert Research Centre, Private Bag 92170, Auckland, New Zealand.

Māori text by Pacific International Translations Ltd, Auckland

Printed by GP Print Ltd, Wellington

Published by Manaaki Whenua Press, Landcare Research New Zealand Ltd,
P.O. Box 40, Lincoln, Canterbury, New Zealand

Front cover: The insect depicted is *Hypsithocus hudsonae* (Illustrator: D.W. Helmore)

Aro mua: Ko te pēpeke nei ko *Hypsithocus hudsonae* (Kai-whakāhua: D.W. Helmore)

Class / Karāihe Insecta
 Order / Ōta Heteroptera
 Superfamily/ Whāmere-nui Pentatomoidea

Families / Whāmere Cydnidae Acanthosomatidae, and Pentatomidae

Shield bugs

The superfamily Pentatomoidea includes several families of generally shield-shaped true bugs with a world fauna of several thousands of species. Three families are represented in New Zealand, which has a relatively small fauna—18 species—compared to larger or warmer regions.

The Cydnidae are usually shining black or brown bugs burrowing in the soil and feeding on roots, stems, or fallen seeds. Two species occur only in New Zealand, and two occur also elsewhere in Australasia. The endemic species *Choerocydnus nigrosignatus* lives in threatened habitats such as coastal sand dunes, inland flood plains, and depleted tussock grasslands.

All four species of Acanthosomatidae in New Zealand are endemic. Species of *Rhopalimorpha* inhabit grasses, rushes, and sedges in open habitats bordering streams or marshes, often at the forest edge, from coastal to subalpine environments, including tussock grasslands. Eggs are laid among developing seeds or on the underside of leaves of plants such as cutty grass. The five immature growth stages are usually spent among the seeds of the host plant, which serve as food. The single species of genus *Oncacantias* is our only shield bug inhabiting native forest.

Eight species of Pentatomidae can be found in New Zealand. Two are endemic, and two others are native to New Zealand but occur also elsewhere in Australasia and parts of the South Pacific. The remaining four have been introduced here. One of them, the green vegetable bug *Nezara viridula*, is an important and cosmopolitan pest on a wide range of economically important crops. Most

(continued overleaf)

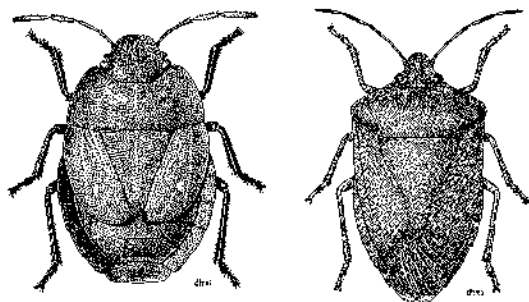


Illustration / Whakāhua: *Hysithocus hudsonae* and *Nezara viridula* (Illustrator / Kai-whakāhua: D.W. Helmore)

Ko te whānau tino rahi o Pentatomoidea, e hia noa atu whāmere kei roto anō āhua pēnei anō i te ngārara pākai te āhua, ngārara momo pono anō tae atu ki te kāhui maha noa e hia nei mano momo i te ao whanui. E toru nga whānau i roto i Niu Tīreni he iti noa te tāhuhu putanga — tekau mā waru momo anahe i nga mea ka noho tini ki nga wāhi rahi, rohe mahana rānei.

Ko te āhua o te Cydnidae he kiri, he mangu he kānapanapa he ngārara parauri rānei ka wiri haere ki roto i te oneone kāikāi haere ai i nga pakiaka, kakau rākau, kākano taka rānei. E rua momo ka noho kei Niu Tīreni anahe, e rua atu ka puta i nga takiwā o Australasia. Ko nga momo tūturu *Choerocydnus nigrosignatus* ka noho i nga wāhi takutaku mo rātou pēnei i nga tupehau onepū o te takutai moana, whenua mānia i roto atu, mānia waipuke ā me nga pā karache toetoe kua tata pau haere.

Ko nga momo e whā o Acanthosomatidae tupu tūturu katoa no Niu Tīreni. Ko nga momo *Rhopalimorpha* ka noho i roto i te rai karache, rahurahu, tākahikahi he pūare haere ana nga wāhi nohoanga i nga tahataha awaawa reporepo he tini ki nga tahataha ngāherehere, mai te takutai moana ki nga takiwā āhua teitei te tupunga rākau i te taiao, tae atu ki nga tupuranga toetoe. Ko nga hēki ka tukua ki nga kākano e tupu ake ana i raro rānei i nga raurau rākau pēnei i nga karache koikoi. Ko nga wāhanga rima e āta tupu kōhungahunga ake ana ka noho i nga kākano o te rākau e ū e rapa nei rātou hei kaikai hoki. Ko te momo nei i ahu mai i te tātai *Oncacantias*, ko ia anahe te ngārara pakeke ka noho rawa i te wao.

He waru nga momo o Pentatomidae ka kitea i Niu Tīreni, e rua ka ū i konei e rua atu tūturu ake no Niu Tīreni, heoi,

(ara haere tonu)

Pentatomidae feed on plant juices, and live above ground on their host plants. Some species are destructive to cultivated plants. One group of species is predaceous, and its New Zealand members are important and beneficial predators on destructive insects.

In New Zealand there is apparently one generation per year in most pentatomid species. Winter is generally passed by the adult stage, sheltering in crevices of plants and grass clumps or under bark, rocks, leaves, and other objects. The majority of species are not hostplant-specific, but in some instances the life cycle is quite intimately linked with certain plant genera, e.g., *Coprosma* or *Pittosporum*.

Mating generally occurs in spring and/or summer, depending on the species. Barrel-shaped eggs are laid in tight clusters glued to the host plant, usually on the underside of leaves. After hatching, young shield bugs often stay together, clinging to the empty egg-shells until they moult. Nymphs of the second instar (growth stage) then disperse in search of food. Nymphs moult five times to become adults. Shield bugs have a number of enemies, several of which are tiny wasps or flies that parasitise the eggs.

Probably the most distinctive shield bug in New Zealand is *Hypsithocus hudsonae* (see illustration). Its relationship to other Southern Hemisphere Pentatomidae is unclear, and very little is recorded about its life history and habits. It is known from only five populations distributed separately in subalpine and alpine environments on the South Island. Males were unknown until quite recently. The species has limited ability to disperse—only males have long forewings, and both sexes lack hind wings—and occupies habitats that are considered to be at risk.

Contributor **Marie-Claude Larivière** was born and educated in Québec, graduating with a PhD in entomology from McGill University, Montréal in 1990. For two years she did postdoctoral work on Nabidae at the Centre for Land and Biological Resources Research of Agriculture Canada, Ottawa. Marie-Claude is now Research Leader of the Invertebrate Systematics programme of the Biodiversity and Conservation group of Manaaki Whenua - Landcare Research, Auckland. She has authored over 50 papers on the systematics of various families of bugs, including faunal and ecological aspects. She has a special interest in the application of computer technology to systematics.

Kaituhi: I whānau a Marie-Claude Larivière ka whai i tana mātāuranga i Québec, ka puta i tana tohungatanga Tākuta taurira ngārara i te Whare Wānanga o McGill i Montreal i te tau 1990. He rua tau ia e mahi ana i nga mahi mai o muri i tana tākutatanga mo Nabidae i te Wāhi Rangahau Whenua me te Rawa Taiao Ahuwhenua i Kānata, Ottawa. Ināinei he kaiarataki a Marie-Claude i te kete tātai Invertebrate Sys-

engari e kitea haere ana i nga takiwā o Australasia, ā, me ētahi wāhi o te South Pacific. Ko te toenga momo e whā, i ahu mai ki konei. Ko tetahi ko te ngārara huawhenua kākariki, *Nezara viridula*, he mea hira noho noa ake ahakoa ki hea kaipatu ngārara whānui ki nga kaihuawhenua hira ka hokoia. Ko te nuinga o Pentatomidae ka kai i te wai rākau ka noho i runga i te whenua rapa haere ai ki te rākau e kainga nei e rātou. Ko etahi momo kanui te mahi kino patu rawa i nga tupu e whakatōria ana. Ko tētahi anō momo ko te rōpū kaipatupatu anā ko ōna mema o Nui Tīreni kanui te hira he toa ngārara kaikai hei painga hoki hei whiunga ngārara patu kino.

I roto i Niu Tīreni kotahi tupuranga ka puta i ia tau mo te nuinga o te momo pentatomid. Ko te hōtoke e kore puta nga ngārara pakeke, ka ruruhau i roto i nga kāpiti rākau raro i nga pū karaehe, raro rānei i te kiri rākau, te kōwhatu, raurau otaota tērā atu mea. Ko te nuinga o nga momo kīhai i ū i rapa rawa ki tētahi rākau anahe, heoi, i ētahi wā ko te wīra ora e hono ana ki ētahi momo rākau anō pēnei i te *Coprosma*, *Pittosporum* rānei.

Ka fimata haere ētahi momo i te mahimahi i te mahuru, i te raumati rānei. Ko nga hēki rite ki te āhua kāho nei te hanga ka tukua haeretia i roto i te tautau kīki ka piri haere ai te nuinga i raro i nga rau rākau. I muri i te pēhinga ko nga ngārara kōhunga ka noho tahi piri tahi ai ki nga whare hēki hore kau nei he mea o roto, ā, taka noa te kiri tuatahi. Ko nga kōhunga tupuranga tuarua ka mirara haere ki te rapurapu kai. He rima takanga kiri o te kōhunga i mua atu i te taenga ki te taumata pakeke. Ko te ngārara kiri pakeke nei kanui anō o rātou hoa riri, ko ētahi nei he katipō iti nei he naro rānei ka noho hei kai patu haere i nga hēki.

Ko te mea pūono o te tini ngārara kiri pakeke ka kitea i Niu Tīreni ko *Hypsithocus hudsonae* (tirohiatē pikitia). Ko tōnā whanaungatanga kia ētahi atu o Pentatomidae i te Takiwā Tonga kāhore e mārara rawa ana, ā, e itiiti noa ake kua rekoatahia mō ōnā tikanga me te āhua noho. Ka mōhiotia anahe na nga rima momo ka noho wehe haere i te wao rākau āhua makariri, ki te wao tino tiketike me te kōpeke rānei i te taiao o Te Waipounamu. No nāinei tata anō ka mōhiotia te tame. Ko te momo nei kīhai i whai wāhanga rawa ki te mirara haere noa — kia nga tame anahe roroa ana nga parirau o mua, ko te tame me te uwaha ngatahi kīhai he parirau i muri — ka mutu ka noho i nga wāhi takutaku kīhai nei i tino pai mo rātou.

tematics i roto i nga mahi momo hunga Taiao Rōpū Kai-tiakitanga o Manāki Whenua, i Ākarana i Tāmaki nei hoki. Ko tuhia kua puta i ai ia maha atu i te rima tekau pepa e pā ana ki te momo āhua o tērā atu tērā atu o nga whānau ngārara tae atu ki nga āhua noho i te wao ki te tikanga ka pā ki te taiao. Ko tētahi o ana tino hira kia whaiwhai i tētahi āhua whakamahi mihini rorohiko ki nga tātai.

ABSTRACT

New Zealand's sixteen species of Pentatomoidea—representing the families Cydnidae, Acanthosomatidae, and Pentatomidae—are revised. A neotype is designated for *Hypsithocus hudsonae* Bergroth, and a lectotype is designated for *Choerocydnus nigrosignatus* F.B. White. All taxa are keyed and described, with information on synonymy, type data, material examined, geographical distribution, bioecology, and economic importance. Illustrations of important structural features, habitus drawings of the adults, and distribution maps are provided. Last-instar nymphs are described and illustrated. Comments on biodiversity and conservation values and graphs of phenological trends are provided for most of the species.

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ACKNOWLEDGMENTS

For the opportunity to borrow and examine specimens in their care I thank R.M. Emberson and J. Marris (Lincoln University), P.M. Johns (University of Canterbury, Christchurch), R.A. Savill (Canterbury Museum, Christchurch), A.C. Harris (Otago Museum, Dunedin), J.W. Early (Auckland Institute and Museum), R.L. Palma (Museum of New Zealand, Wellington), and J. Margerison-Knight (Natural History Museum, London). I am also grateful to L. Huldén (Naturhistorisches Zentralmuseum, Helsinki) for information on Bergroth's type material.

Thanks are extended to G. Hall, R.C. Henderson, K.L. Senner, and J.S. Dugdale (Landcare Research), B.I.P. Barratt (AgResearch, Mosgiel), B.H. Patrick (Department of Conservation, Dunedin), and I.J. Townsend (Levin) for additional material, invaluable biological information, and/or technical support. I express my gratitude to D.W. Helmore for habitus illustrations of adults and last-instar nymphs.

I am particularly grateful to G.H. Sherley (Department of Conservation, Wellington) for his help in obtaining

collecting permits without which much of the biological information presented here would have been unobtainable. Many thanks also to J. Cone and T.K. Crosby (Landcare Research) for their help with the Geographic Information System (GIS).

I am very thankful to G.F. Gross (South Australian Museum, Adelaide) for providing information on Australasian pentatomoids, for the loan of important reference specimens, and for his friendly support during the early phase of my establishment as a scientist in the Southern Hemisphere.

Thanks also to B.H. Macmillan and M.J. Parsons (Landcare Research) for revising the list of current plant names, to M.J. Boyd, I.S. Irwin, and B.M. Smith (Hort-Research, Mt Albert Research Centre Library) for assisting in obtaining important references for this work, and to M.J. Boyd for checking current names for birds.

Finally, I thank my husband A. Laroche for his helpful comments and criticisms on the manuscript, for many highly prolific and enjoyable field ventures, and for his continued encouragement during this project.

This work was supported in part by the Foundation for Research, Science and Technology under contract no. C09308. The computer equipment used in this study was purchased in part with the help of the N.Z. Lottery Board (Science Grant AP31928).

INTRODUCTION

The Pentatomoidea or shield bugs include several families of generally shield-shaped Heteroptera with a prominent, large, and usually triangular scutellum which reaches to and beyond the apex of the clavus.

The families Cydnidae, Acanthosomatidae, and Pentatomidae have been recorded from New Zealand. Adults of these families have five-segmented antennae (except some Cydnidae and extra-New Zealand Pentatomidae) and bi- or tri-articulated tarsi. Nymphs have four-segmented antennae and three pairs of scent gland openings located dorsally on the abdomen between segments 3/4, 4/5, and 5/6.

The most comprehensive treatment of these families for New Zealand has been that of Woodward (1953, 1956), which included a key to the described species, descriptions of new taxa, and additional comments on a number of described taxa, but his work was not of a revisionary nature. The present study is based on over 3300 specimens from twelve New Zealand and overseas collections, and is the first comprehensive revisionary treatment of these groups for New Zealand.

The Cydnidae or burrowing bugs comprise about 400–600 species worldwide. Cydnids are characterised mainly by having fringes of close-set, rigid setae at the apex of the middle and hind coxae, and spiny legs. They are usually shining black or brown bugs burrowing in the soil and feeding on roots, stems, or fallen seeds, and are often attracted to artificial light in large numbers.

Classical treatments of the family are Stål (1876) and Signoret (1881–84). A rationalised classification of the Cydnidae has been published by Dolling (1981), although many modern treatments also follow Froeschner (1960). Four species of the subfamily Cydninae occur in New Zealand.

Aethus thoreyi (Signoret) is here transferred from the genus *Cydnus*, and is recorded from New Zealand for the first time. It occurs also in eastern Australia, and may have been recently introduced (accidentally) into New Zealand. Very little is known about its biology and distribution. Apparently nothing has been written on it since its original description in 1882.

Chilocoris neozealandicus Larivière & Froeschner is the only *Chilocoris* species known from New Zealand, where it is endemic; four species occur in Australia. The genus contains some thirty or more described species, but is mainly restricted to the Old World, where it has been reported from Asia south into Africa, including Madagascar.

Choerocydnus nigrosignatus F.B. White is also apparently native to New Zealand, and quite possibly endemic, although it may also occur in Australia.

Philopodemus australis (Erichson) is native to both Australia and New Zealand, and is also found in New Caledonia and in the Oriental region.

Pangaeus scotti Signoret is an Australian species. Previous workers have reported its occurrence in New Zealand, but it was apparently confused with *C. neozealandicus*. Among all material examined for this study, nothing supports the occurrence of *P. scotti* in New Zealand.

Very little is known about the habits of the New Zealand species, but limited observations suggest that they are univoltine. Eggs are apparently laid on or in the soil, and nymphs probably enter the ground to feed on the roots of plants or, in the case of *P. australis*, may feed on fallen grass seeds on the ground. The degree of host specificity, as for the majority of Cydnidae, is unknown. The biology of *P. australis* has been thoroughly studied in Australia by Hickman (1978), but it is not known whether these results apply equally in New Zealand.

Burrowing bugs are of no known economic importance in New Zealand.

The **Acanthosomatidae** have been variously treated as a full family or as a subfamily or tribe of the Pentatomidae. The current practice is to afford them family status. A world revision and classification, with keys to genera, has been published by Kumar (1974).

These shield bugs, of which about 200 species are known worldwide, are usually less strongly sclerotised than most Pentatomidae and have two-segmented tarsi. Four species occur in New Zealand, all endemic.

The genus *Rhopalimorpha* includes three species that are endemic to New Zealand and a fourth from eastern Australia—suggesting a Gondwana origin for the group. *Rhopalimorpha lineolaris* Pendergrast and *R. obscura* Dallas are widely distributed species occurring mainly on grasses, rushes, and sedges in open habitats. Their life histories are probably the best documented among New Zealand pentatomoids, owing mainly to the work of Pendergrast (1950, 1952, 1960). *Rhopalimorpha alpina* Woodward is an alpine species with a disjunct distribution on the South Island. Practically nothing is known of its life history; indeed, very little is known about any Heteroptera of alpine environments in New Zealand.

New Zealand acanthosomatids are apparently univoltine. Eggs are laid on the undersurface of plant leaves, and nymphs undergo five metamorphoses before becoming adults. Nymphs and adults are phytophagous, on various shrubs and trees (*Oncacontias*) or on lower-growing vegetation, usually on the seeds (*Rhopalimorpha*).

Pentatomoidea generally abandon their eggs immediately after oviposition. In several Acanthosomatidae, however, the female broods the eggs and guards the young nymphs, but this phenomenon has not been studied in New Zealand.

Oncacontias Breddin, with its single species *O. vittatus* (Fabricius), is endemic to New Zealand. It is widely distributed, occurring mainly on trees and shrubs. *O. vittatus* can be regarded as the only true forest dweller among New Zealand pentatomoids.

Acanthosomatids are of no known economic importance in New Zealand.

The **Pentatomidae** are the largest family of shield bugs, with about 5000 described species in the world. Unlike Acanthosomatidae, Pentatomidae have three-segmented tarsi. The most recent generic classification on a larger scale is that of Rolston *et al.* (1979, 1980, 1981, 1984) for the Western Hemisphere. There is also a cladistic analysis of the tribes of Pentatomidae (Hasan & Kitching 1993). No other consensus on the higher classification of Pentatomoidea below the family level is currently available.

The majority of species are phytophagous, and live above ground on their host plants. Some species are de-

structive to cultivated plants. One group is predaceous, and its New Zealand members are important beneficial predators on destructive insects.

Two species of predaceous pentatomids occur in New Zealand. They are characterised by their rostrum, which is directed away from the head and has the first segment robust and thick, apparently an adaptation to their predatory habit. Although adults are essentially predaceous, first-instar nymphs also feed on plant juices.

Cermatulus nasalis nasalis (Westwood) is native to both New Zealand and Australia. In New Zealand two endemic subspecies are recognised: *C. nasalis hudsoni* Woodward, which occurs only on the South Island at altitudes of 1200 metres or more; and *C. nasalis turbotti* Woodward, which is endemic to the Three Kings Islands. *C. nasalis nasalis* has been recorded from a wide range of native and introduced bushes and trees, and has been noted feeding on larvae of various pest insects such as *Paropsis charybdis*, a defoliator of *Eucalyptus*.

Oechalia schellenbergii (Guérin) occurs also in Australia and most of southern Oceania, and is probably one of our most important beneficial insect. It occurs on a wide variety of plants, especially introduced ones including crops, and like *C. nasalis* is an important predator of noxious insects such as caterpillars (including armyworms) and chrysomelid larvae.

The other species occurring in New Zealand are apparently strictly phytophagous; the rostrum has the first segment more slender, and not directed away from the head.

Dictyotus caenosus (Westwood) occurs in Australia and, probably as an introduction, in New Caledonia as well as in New Zealand. It is probably the species most commonly encountered when collecting by general sweeping or beating. It is occasionally noxious to lucerne seed crops on the South Island.

Glaucias amyoti (Dallas) occurs also in Australia, on Lord Howe Island, and in New Guinea. It is about the same size and colour as *Nezara viridula* (L.), and can sometimes be confused with it at first glance, but a close examination of head microsculpture, pronotum shape, and scutellum coloration offers a quick diagnosis. In New Zealand its life history is closely associated with plants of the genus *Coprosma* (Rubiaceae).

Four species of Pentatomidae have been introduced into New Zealand, namely *Cuspicona simplex* Walker, *Dictyotus caenosus*, and *Monteithiella humeralis* (Walker) from Australia, and *Nezara viridula*, a cosmopolitan species. All four are doing rather well here. *Monteithiella humeralis* has a close association with plants of the genus *Pitosporum* (Pitosporaceae). It has not been noted to pose any economic threat to fruit trees in New Zealand. *Cuspicona simplex* is strongly associated with solanaceous plants,

especially the genus *Solanum*, to which it is noxious, although it is not usually a serious pest of tomatoes or potatoes. *Nezara viridula* is an important pest on a wide range of economically important vegetables including beans, cauliflower, marrow, potato, pumpkin, rhubarb, silver beet, sweetcorn, tamarillo, tomato, and tumip.

In New Zealand there is apparently one generation per year in most pentatomid species (two or three in *Nezara*, and perhaps also in *Cuspicona*). Overwintering is generally by the adult, in the crevices of plants and grass clumps or under bark, rocks, leaves, and other objects, especially on the ground. The majority of species are not host-specific, but in some instances the life cycle is quite intimately linked with certain plant genera. Mating occurs in spring and/or summer, depending on the species; barrel-shaped eggs are laid in tight clusters glued to a host plant, usually on the underside of leaves. After hatching, the first instars often are gregarious and stay clinging to the empty egg-shell until they moult and the second instars disperse in search of food. Nymphs undergo five metamorphoses to become adults.

Hypsithocus Bergroth is endemic and contains only one species, *H. hudsonae* Bergroth. It has a restricted, disjunct distribution in subalpine and alpine environments in Central Otago. Only recently have male specimens become available for study. The relationship of *Hypsithocus* to other Southern Hemisphere genera is still unclear. Almost nothing is known of the life history and habits of *H. hudsonae*, despite the fact that it is probably the most unique New Zealand pentatomid.

Pentatomoids have a number of natural enemies, several of which are hymenopterous or dipterous egg parasites.

The scent glands in adults are located in the metathorax, and open on the metapleuron through an opening termed the ostiole. In nymphs the scent gland openings are paired and located dorsally on the abdomen. The relative position of these openings and their structure are often useful in diagnosing nymphs at various level of classification. The scent gland secretions have been chemically analysed for several species around the world, but not in New Zealand. They appear to play a role in discouraging or even harming potential predators, but it has also been suggested that they may primarily serve as alarm or aggregation pheromones.

Pentatomoids are diurnal, but can be attracted to artificial light, and have been reported from high elevations. For example, specimens have been collected that had been wind-blown to the top of high mountains such as Mt Ruapehu in the central North Island. Species such as *Hypsithocus hudsonae* or *Rhopalimorpha alpina* occur only on mountain tops.

MORPHOLOGY AND TERMINOLOGY

The reader may acquire a general knowledge of morphological structures required for identification of New Zealand Pentatomoidea by reference to Fig. 33 and 34, the glossary of technical terms (Appendix A), Larivière (1988), and Torre-Bueno (1989).

METHODS AND CONVENTIONS

Collecting. Adults and nymphs of shield bugs are generally collected by sweeping herbaceous vegetation and beating bushes and trees. Beating or hand-picking from selected plants, especially host plants, yields valuable biological information. Eggs can be collected when the host plants and the oviposition period are known. They are usually laid in batches of a dozen or so on flat surfaces such as the underside of leaves.

Preservation. Adults may be preserved dry or in ethanol. Eggs and nymphs are best preserved in ethanol; they may shrink or distort when dried. A mixture of 70% ethanol and 30% commercial white vinegar will prevent specimens from becoming brittle.

Preparation. Preparation and curation of insects have been fully described by Walker & Crosby (1988). All specimens should be labelled with the locality (including area code: Crosby *et al.* 1976), collection date, collector's name, and ecological data (host plant, how collected, etc.).

Most features of the male and female terminalia can be viewed under an ordinary dissecting microscope simply by holding specimens ventral side up. It may be necessary to relax male specimens to distend their genital capsule (pygophore).

If a closer examination of the male claspers is required, these can be extracted from the pygophore as follows. Pinned specimens are warmed for 2-3 minutes in hot acetic alcohol, a mixture of 70% ethanol and 30% commercial white vinegar. Each specimen is transferred to a watch glass half-filled with acetic alcohol, and the pygophore is pulled from the body using fine forceps. The pygophore is returned to hot acetic alcohol for 2-3 minutes, then it is transferred to another watch glass also containing acetic alcohol. The claspers are extracted from the pygophore in this solution, using fine forceps. Dissected genitalia can subsequently be stored in microvials containing glycerine and remounted on the pin below the specimens.

Measurements. Dimensions are in millimetres (mm) throughout this work, with ranges in parentheses, and

represent up to 50 randomly selected adult individuals of each sex and all available nymphs. Total length was measured along the dorsal midline from tip of tylus to tip of membrane (tip of abdomen in nymphs and brachypterous adults). Humeral width represents the maximum distance between the external tips of humeri.

Type data. In the descriptive part of this work the status, repositories, and full label data of all primary type specimens (and a summary of label information for secondary specimens) that have been examined are cited for each species. One neotype and one lectotype are designated where appropriate to stabilise nomenclature. In the list of label data different labels are separated by a solidus (/) and different lines on a label by a semicolon; all other punctuation is as it appears on the label.

Geographical distribution. For each taxon, area codes of Crosby *et al.* (1976; see p. 108) are followed by collection localities and data listed alphabetically, with repository acronyms (see p. 12). For literature records, references are cited instead of acronyms.

A list of localities with longitude and latitude co-ordinates is given as Appendix B. This constitutes an important source of information, designed to provide more precise geographical data to assist other workers—e.g., conservation biologists or natural resources managers—who need to locate certain populations of a species or subspecies.

Digital images. All illustrations except Fig. 1–32 were prepared using the software package CorelDRAW 4.0 and a Microtek ScanMaker IIXE scanner, as follows.

A clean sketch was made for each illustration using a drawing tube attached to a Wild M-5 stereomicroscope and a dark H pencil, or retraced using a technical pen. A few examples of small structures such as setae, puncturation, or other microsculpture were drawn to be reproduced or multiplied later by the computer program. Symmetrical structures such as pygophores were sketched from one side only and subsequently mirrored using the computer.

Each sketch was scanned at a resolution of 600 dpi (dots per inch). The resulting digitised image was enhanced on the computer as a bitmap or vector image. Any structures needing reproduction, multiplication, or mirroring were dealt with at this stage. High-resolution master copies of final images were kept on hard disk.

Arrows and symbols were added as required, and page layouts were prepared using CorelDRAW 4.0, printed at high resolution, and included in the camera-ready pages for this publication.

Page layouts for habitus drawings (Fig. 1–32) by D.W. Helmore were prepared by high-resolution scanning of the

original artwork and use of CorelDRAW 4.0 to prepare camera-ready copies.

Data management. The software used to record systematic data in this study was dBase IV. Label information accompanying each specimen was standardised and recorded in a specimen database file which is now part of NZACbugs, the New Zealand Arthropod Collection database containing interpreted information on specimens for selected groups of New Zealand arthropods. The Geographic Information System ArcView (see below) was used to integrate systematic and geographical data.

Systematic data from the literature and bibliographic references were also recorded in a similar way. The database files generated from this work are part and parcel of a unique electronic information retrieval system on New Zealand Pentatomoidea that forms the basis of an integrated information retrieval system to be developed for all New Zealand's true bugs.

Computer mapping and Geographic Information System (GIS). Electronic mapping of species distributions was accomplished using the GIS software ArcView.

Data necessary to generate coverages for mapping species distribution were processed in the following way. Information was combined from the above specimen database files and a gazetteer file containing locality names and geographic coordinates. The resulting file was exported to a text-delimited format with a unique identifier for each record. The text file was then translated into a format readable by the GIS software.

Traditionally the use of GIS in systematics has been restricted to the final, postanalytical stages of the research process. In the present work, however, it has been used as a source of systematic data, and was an integral part of the data management system.

Graphs of phenological trends. Although phenology has not been studied quantitatively throughout the year, noteworthy trends emerge from collection data. Graphs illustrating relationships among the numbers of individuals collected, their developmental stage, and dates of collection have been prepared electronically as follows.

The above specimen and literature database files were queried and information on phenology was extracted to a spreadsheet program (Microsoft Excel) which generated draft graphs of general phenological trends. High-resolution graphs were produced using CorelDRAW 4.0.

Biodiversity and conservation. This section is intended to provide conservation biologists, natural resource managers, and policy makers with an information basis for the

development of a sound conservation strategy for Heteroptera and decision-making tools for sustainable land-use in the natural systems of which they are a part.

The two predominant features characterising the New Zealand fauna of Heteroptera are the high degree of endemism of its taxa and the large amount of adaptive radiation which has taken place at the species level.

One way to evaluate the overall diversity of an area like New Zealand is to look at the range of habitats it includes and their diversity. The greater the differences between various component habitats in term of species composition, then the greater the overall diversity will be. Diversity within a site or habitat is referred to as alpha-diversity, while difference between habitats is beta-diversity.

Thus an area such as New Zealand with a fairly wide range of dissimilar habitats will have a high beta-diversity, even if each of its constituent habitats may have low alpha-diversity.

Therefore, New Zealand with relatively low species diversity still makes an important contribution to global diversity because it contains a large number of taxa which do not occur elsewhere (endemics).

Endemism at higher levels of classification reflects the number of original immigrants in the older established groups, and diversity of endemic species reflects the amount of adaptive radiation which has taken place in New Zealand.

Another step in developing conservation strategies might be to determine which taxa and systems are threatened. A wide range of information—distribution, habitats, host plants, biology, dispersal power, etc.—has been included in this work to assist conservation biologists in this task.

It is clear that insect distributions change, that populations fluctuate, that areas of New Zealand have not been surveyed uniformly. All one can hope for is that the information presented here is as up to date and accurate as possible.

On the basis of a critical analysis of all available information, I have attempted to assess the biodiversity and conservation values of all species and subspecies, bearing in mind that ongoing monitoring, including inventories, surveys, ecological studies, etc., will be necessary to reassess the conservation status of these taxa.

Text conventions. The area codes of Crosby *et al.* (1976; sec p. 108) are used to categorise collection records.

Acronyms for repositories are as follows:

- AMNZ Auckland Institute and War Memorial Museum, Auckland, New Zealand
BMNH British Museum (Natural History), now the Natural History Museum, London, England

- CGNZ Chris Green private collection, Auckland, New Zealand
CMNZ Canterbury Museum, Christchurch, New Zealand
FRNZ Forest Research Institute, Rotorua, New Zealand
LUNZ Department of Entomology, Lincoln University, Lincoln, New Zealand
MONZ Museum of New Zealand, Wellington, New Zealand (formerly NMNZ)
NZAC New Zealand Arthropod Collection, Mount Albert Research Centre, Auckland, New Zealand
OMNZ Otago Museum, Dunedin, New Zealand
PANZ MAF Quality Management, Plant Protection Centre, Auckland, New Zealand
UCNZ Department of Zoology, University of Canterbury, Christchurch, New Zealand
USNM United States National Museum of Natural History, Washington D.C., U.S.A.

Abbreviations used in distribution listings are:

- | | | |
|---------------------|-----------------------|----------------------|
| Ck - Creek | E - East | F.P. - Forest Park |
| km - kilometre(s) | I - Island | Is - Islands |
| L - Lake | m - metre | Mt - Mount |
| Mtn - Mountain | N - North | N.P. - National Park |
| Pt - Point | R - River | Ra. - Range |
| Rd - Road | Res. - Reserve | S - South |
| S.F. - State Forest | S.R. - Scenic Reserve | |
| Stm - Stream | Vly - Valley | W - West |

Ecological divisions, including plant community names and altitudinal belts used in this work, follow Wardle (1991). Plants and animals associated with shield bugs in New Zealand are listed in Appendices C and D.

Within the three families treated here there is still considerable uncertainty regarding supraspecific relationships in general, and there is no current modern world classification of Pentatomoidea below the family level that would provide an adequate evolutionary framework to classify all New Zealand taxa. The fragmentary nature of the New Zealand fauna, from a world perspective, and its high proportion of introduced taxa (except in Acanthosomatidae), are also such that a strict phylogenetic treatment, although usually desirable, would not necessarily add significantly to the information content of the present faunistic review.

The order in which supraspecific taxa are treated here reflects my understanding of evolutionary relationships within Pentatomoidea as presented in the abundant literature on this group and prompted by the works of Signoret (1881–84), Kumar (1974), Gross (1975a,b; 1976), and Linnavuori (1993).

KEY TO PENTATOMOIDEA KNOWN FROM NEW ZEALAND

- 1 Tibiae with numerous strong spines; apex of middle and hind coxae with a fringe of close-set, rigid setae (Fig. 35) Cydniidae ... 3
 —Tibiae without numerous strong spines; apex of middle and hind coxae without a fringe of close-set, rigid setae ... 2
- 2(1) Tarsi 2-segmented Acanthosomatidae ... 6
 —Tarsi 3-segmented Pentatomidae ... 9

Family Cydniidae

- 3(1) Head with antecular margin bearing a series of short, stout pegs and longer bristles (Fig. 57) ... 4
 —Head with antecular margin lacking a series of short, stout pegs, but with a number of long bristles (Fig. 56) ... 5

- 4(3) Body dull brown to blackish, with head, pronotum and/or scutellum often of a darker hue; head with 14–24 stout pegs and at least 10 longer bristles along antecular margin; antennae with 2nd segment about as long as 3rd segment; pronotum with anterolateral margins bearing numerous bristles, quadrate apically to receive head (as in *P. australis*, Fig. 37), lacking a median transverse bar of deep dark punctures; metathoracic scent gland opening (Fig. 39) with a small, short auricle ... (p. 15; Fig. 1) *Aethus thoreyi*
 —Body shiny chestnut brown; head with 12–16 stout pegs and 6 bristles along antecular margin; antennae with 2nd segment much smaller than 3rd segment; pronotum with anterolateral margins bearing 3 long, equidistant bristles, U-shaped at apex to receive head, and with a median transverse bar of deep, dark punctures (Fig. 38); metathoracic scent gland opening (Fig. 42) with a long auricle almost reaching external margin of segment ... (p. 19; Fig. 4) *Chilocoris neozealandicus*

- 5(3) Antennae 4-segmented; body brownish-yellow with contrasting dark brown to blackish markings dorsally—a band along midline of head, a spot on posterior lobe of pronotum near each humerus, and 3 spots along base of scutellum; metathoracic scent gland opening (Fig. 40) with a rather broad, short auricle (p. 16; Fig. 2) *Choeracydnus nigrosignatus*
 —Antennae 5-segmented; body dark brown to blackish, with head, pronotum, and/or scutellum often darker; metathoracic scent gland opening (Fig. 41) without an auricle ... (p. 18; Fig. 3) *Philopodemus australis*

Family Acanthosomatidae

- 6(2) Mesosternal carina well developed, quite broad and prominent, extending to anterior end of prosternum (Fig. 55); pronotum with anterior lobe declivous in front, giving a 'hunchbacked' appearance to body in lateral view ... (p. 27; Fig. 8) *Oncacotias vittatus*
 —Mesosternal carina thin, flat, fairly well developed but not extending to anterior end of prosternum (Fig. 54) (*Lentimorpha*) or poorly developed (Fig. 53) (*Rhopalimorpha*); pronotum with anterior lobe not declivous in front, i.e., body not 'hunchbacked' in lateral view *Rhopalimorpha* ... 7

- 7(6) Pronotum with anterolateral angles acute, produced (Fig. 60); ventral spine long, reaching anteriorly slightly beyond middle coxae (Fig. 54); mesosternal carina high, plate-like, notably extended anteriorly (Fig. 54); rostrum reaching hind coxae; dorsal puncturation fine, brown or concolorous with remainder of dorsum (p. 26; Fig. 7) *Rhopalimorpha (Lentimorpha) alpina*
 —Pronotum with anterolateral angles rounded, not produced (Fig. 58, 59); ventral spine short, not reaching beyond middle coxae (Fig. 53); mesosternal carina poorly developed, not notably extended anteriorly (Fig. 53); rostrum reaching about middle coxae; dorsal puncturation conspicuous, dark

Rhopalimorpha (Rhopalimorpha) ... 8

- 8(7) Body slender, narrow, as in Fig. 5; pronotum and scutellum with yellowish median line obscured by a few scattered coarse, dark punctures (Fig. 59); connexivum with 5 segments almost entirely exposed (Fig. 62); maxillary plate process small, tubercle-like, remote from antennal base (Fig. 64); metathoracic scent gland auricle with opening broadest near its middle (Fig. 66); male pygophore with lateral lobes broad, slightly produced, and ventral rim strongly produced caudally (Fig. 69, 70); male clasper as in Fig. 75; female 1st gonocoxae (Fig. 76) with surface undulant, posterior margins nearly rectilinear (p. 21; Fig. 5)

Rhopalimorpha (R.) obscura

- Body more broadly oval, as in Fig. 6; pronotum and scutellum with yellowish median line entirely smooth (Fig. 58); connexivum with less than 4.5 segments exposed (Fig. 61); maxillary plate process large, shelf-like, reaching close to antennal base (Fig. 63); meta-

Note. When bristles close to the margins of the head and pronotum have detached from the body of dry specimens (Cydniidae), setigerous punctures—i.e., the small cuticular impressions that bore the bristles—may be counted instead of the bristles themselves.

thoracic scent gland auricle with opening broadest near its outer margin (Fig. 65); male pygophore with lateral lobes slightly produced, ventral rim subdepressed (Fig. 67, 68); male clasper as in Fig. 73; female 1st gonocoxae (Fig. 74) with surface swollen, posterior margins convex ... (p. 23; Fig. 6) *Rhopalimorpha (R.) lineolaris*

Family Pentatomidae

9(2) Rostrum with 1st segment thick, directed away from head, with at most only base lying between bucculae, which converge beneath (Fig. 83) ... 10

—Rostrum with 1st segment slender, not directed away from head, almost entirely lying in groove between bucculae, which are parallel (Fig. 84) ... 13

10(9) Humeri acuminate, produced into a sharp, outward-directed spine (Fig. 85); connexival segments with posterolateral angles acute, produced posteriorly into a black-tipped spine (Fig. 86); scutellum acuminate apically; metathoracic scent gland opening slit-like, without an auricle; ventral spine strong, reaching forwards near middle coxae (Fig. 90); male (Fig. 95, 97) and female (Fig. 99) genitalia as illustrated

(p. 35; Fig. 12) *Oechalia schellenbergii*

—Humeri triangular or roundish, not produced into a sharp, outward-directed spine (Fig. 87–89); connexival segments with posterolateral angles quadrate or rounded, not produced posteriorly; scutellum broadly rounded apically; metathoracic scent gland opening not slit-like, provided with an auricle; ventral spine smaller, tubercle-like, reaching near or between hind coxae (Fig. 91); male (Fig. 94, 96) and female (Fig. 98) genitalia not as above ... 11

11(10) Body with metallic greenish or bronzy reflections dorsally on head, pronotum, scutellum, and abdomen, and ventrally on mesosternum; pronotum with anterolateral margins angled to humeri, their anterior portion without distinct crenulations (Fig. 89); humeri (Fig. 89) triangular (p. 34; Fig. 11)

Cermatulus nasalis turbotti

—Body without dorsal or ventral, metallic greenish or bronzy reflections; pronotum with anterolateral margins almost rectilinear to humeri, their anterior portion with a few distinct crenulations; humeri (Fig. 87, 88) roundish or slightly sinuate ... 12

12(11) Pronotum with disc undulant, declivous in front; humeri usually (90%) projecting notably beyond base of hemelytra (Fig. 92); dorsal puncturation rather coarse and deep; humeral width subequal to maximum width of abdomen in dorsal view (in South I. specimens this

ratio >0.95 in male, 0.87 in female) (p. 30; Fig. 9)

Cermatulus nasalis nasalis

—Disc of pronotum rather flat or slightly convex, not declivous in front; humeri obtusely rounded, not or scarcely projecting beyond base of hemelytra (Fig. 93); dorsal puncturation fine and shallow; humeral width distinctly less than maximum width of abdomen in dorsal view (this ratio usually (90%) <<0.95 in male, 0.86 in female) (p. 33; Fig. 10)

Cermatulus nasalis hudsoni

13(9) Jugs considerably longer than tylus, wholly or largely enclosing it in front (Fig. 100, 101) ... 14

—Jugs about as long as tylus, not enclosing it in front (Fig. 102, 103) ... 15

14(13) Body yellowish-brown or brown, sometimes with a rusty tinge, and with contrasting transverse black bars at anterior and posterior margins of connexival segments; antennae with segment 2 much longer than segment 3; pronotum with anterolateral angles not produced anteriorly on either side of head (Fig. 100); fully winged; with ocelli; male (Fig. 106, 107) and female (Fig. 118) genitalia as illustrated

(p. 37; Fig. 13) *Dictyotus caenosus*

—Body dark brown or black, with margins narrowly greenish-white or yellowish-white; antennae with segments 2 and 3 subequal in length; pronotum with anterolateral angles produced anteriorly on either side of head (Fig. 101); brachypterous; without ocelli; male (Fig. 110, 111) and female (Fig. 120) genitalia as illustrated; alpine form

(p. 42; Fig. 15, 16) *Hypsithocus hudsonae*

15(13) Pale chocolate-brown, with a conspicuous pale band along anterolateral margins of pronotum (Fig. 14); connexivum with large, irregular, dark spots; rostrum long, extending well back onto venter; venter with scattered dark maculations of various sizes; male (Fig. 108, 109) and female (Fig. 119) genitalia as illustrated ... (p. 40; Fig. 14) *Monteithiella humeralis*

—Green (one uncommon colour form of *N. viridula* orange; overwintering individuals more or less brown); connexivum without large markings, at most with a small black spot at posterolateral angles; venter without scattered dark maculations; male and female genitalia not as above ... 16

16(15) Body up to 11 mm long; humeri triangular, produced (Fig. 19); mesosternal carina well developed, rather wide, deeply cleft behind to receive ventral spine

(Fig. 105); male pygophore with outer margin of ventral rim produced caudally (Fig. 116); male claspers as in Fig. 117; female 1st gonocoxae (Fig. 123) with posterior margin deeply notched (p. 48; Fig. 19)

Cuspicona simplex

—Body 12.5–17 mm long; humeri rounded, not produced (Fig. 17, 18); mesosternal carina low, ridge-like, only slightly notched behind (Fig. 104); male pygophore with outer margin of ventral rim not produced caudally (Fig. 112, 114); male claspers not as above; female 1st gonocoxae (Fig. 121, 122) with posterior margin slightly concave, but not deeply notched ... 17

17(16) Dorsal surface dull, with close-set punctures, on pronotum and scutellum especially, and head not transversely rugulose (Fig. 103); scutellum more narrowly rounded at apex, with 3 small yellowish spots along base and a small black pit at basal angles (Fig. 17); male pygophore with inner margin of ventral rim bearing a shallow, arcuate median depression, and lacking an acute triangular protuberance on either side (Fig. 112); male clasper as in Fig. 113; female 1st gonocoxae (Fig. 121) with posterior margin slightly concave

(p. 44; Fig. 17) *Nezara viridula*

—Dorsal surface shining, with punctures even and widely spaced except on head, which is impunctate but transversely rugulose (Fig. 102); scutellum broadly rounded at apex, without pale or black spots along base (Fig. 18); male pygophore with inner margin of ventral rim bearing a deep, V-shaped median depression and an acute, triangular protuberance on either side (Fig. 114); male claspers as in Fig. 115; female 1st gonocoxae (Fig. 122) with posterior margin convex

(p. 46; Fig. 18) *Glaucias amyoti*

BIOSYSTEMATICS

Family CYDNIDAE

Genus *Aethus* Dallas

Aethus Dallas, 1851: 112. Type species *Cydnus indicus* Westwood, 1837: 19, by designation of Van Duzee (1914).

Aethus Stål, 1864: 19–21. Signoret 1881: 423.

Putonisca Horváth, 1919: 235–236.

Aethus (*Stilbocydnus*) Wagner, 1951: 61.

Description. Head broadly rounded in front of eyes; anteocular margins with a number of short, stout pegs and

longer bristles (New Zealand only); disc convex; juga as long as tylus; antennae 5-segmented; rostrum reaching between fore and middle coxae.

Thorax. Pronotum forming a quadrate depression apically to receive head; anterolateral margins slightly reflexed. Metathoracic scent gland opening with a rather small, short auricle (Fig. 39) (New Zealand). Scutellum somewhat V-shaped, broadly rounded apically. Hemelytra extending or not beyond tip of abdomen; corium with apex rectilinear or sinuate along membrane.

Remarks. A large genus with species in the Ethiopian, Palearctic, Oriental, and Australian regions. *Aethus thoreyi* is the only species known from New Zealand; it also occurs in Australia.

Aethus thoreyi (Signoret) new combination

Fig. 1, 39, 49; Map 1

thoreyi Signoret, 1882: 152, pl. 6 fig. 9c (*Cydnus*). Lethierry & Severin 1893: 68.

Adult (Fig. 1). Body broadly oval, convex above. Dorsum dull brown to blackish, with hemelytra, margins of pronotum, and head sometimes paler brown. Head and pronotum mostly impunctate; scutellum with small punctures more crowded at sides.

Head with 7–12 short, stout pegs and 5 or 6 longer bristles on either side of tylus along anteocular margin, and 2 short, stout pegs on tip of tylus. Antennal segments brown with yellowish incisures or completely dark brown or black; segments 2 and 3 subequal. Ocelli small, yellowish.

Thorax. Pronotum with numerous long bristles along anterolateral margins. Hemelytra attaining or slightly surpassing tip of abdomen; corium densely punctured along veins; membrane well developed, whitish, opaque, with veins evanescent. Legs dark brown, or yellowish with femora infusate; undersurface of femora armed with rather long, slender spines; tibiae armed with stout blackish spines.

Abdomen. Venter brown to almost black, glabrous, mostly impunctate at middle, with fine punctures laterally.

Genitalia. Female: 1st gonocoxae as in Fig. 49.

Body length: male 4.36 mm; female 4.42, 4.75 mm. Humeral width: male 2.60 mm; female 2.60, 2.73 mm.

Other characters as in generic description.

Type data. Original description based on one specimen apparently deposited in the collection of the Naturhistoriska Riksmuseet, Stockholm, Sweden. Attempts at securing this type specimen have been unsuccessful.

Material examined. Three non-type examples (1 male, 2 females).

Geographical distribution (Map 1). North I. AK. Woodhill Forest: Te Pua (NZAC); Rimmer Rd (NZAC). ND. Ruakaka (NZAC).

Bioecology. One male and 1 female collected 13 October – 13 November by pit-trap sampling at base of *Lupinus arboreus*, weeds, and grasses in a sandy coastal terrain; 1 female collected 10 February in a pit trap under *Lolium* and *Trifolium* in a pasture.

Dispersal power. Unknown.

Economic importance. Apparently none.

Biodiversity and conservation. It is not clear whether *Aethus thoreyi* has been introduced or is indigenous to both Australia and New Zealand. Only two populations are known in New Zealand.

Remarks. It seems that nothing has been written about this enigmatic taxon since Signoret's original description of *Cydnus thoreyi* and the subsequent appearance of this name in Lethierry & Severin's catalogue in 1893.

Genus *Choerocydnus* A. White

Choerocydnus A. White, 1841: 472. Type species *Choerocydnus foveolatus* A. White, 1841: 472, by monotypy.

Description. Head broadly rounded in front of eyes, with a number of bristles along anteocular margins; disc somewhat convex; juga as long as tylus; antennae 4-segmented; rostrum reaching between fore and middle coxae.

Thorax. Pronotum forming a wide U or somewhat quadrate apically to receive head; anterolateral margins slightly reflexed. Metathoracic scent gland opening with a rather broad, short auricle (Fig. 40). Scutellum somewhat V-shaped, acutely rounded apically. Hemelytra reaching tip of abdomen or slightly beyond; corium with apex regularly arched along membrane.

Remarks. There are three species described in this genus: *C. nigrosignatus* F.B. White, which is apparently endemic to New Zealand but which may also occur in Australia (G.F. Gross, pers. comm.); and *C. foveolatus* A. White and

C. coleopteroides Bergroth, which occur in Australia but not in New Zealand.

Choerocydnus nigrosignatus F.B. White

Fig. 2, 20, 40, 43, 44, 50, 124; Map 2

nigrosignatus F.B. White, 1878: 275 (*Choerocydnus*).

Adult (Fig. 2). Body ovate, convex above, brownish-yellow with contrasting dark brown to blackish markings and scattered coarse, dark brown punctures dorsally.

Head with 4–6 long bristles on either side of tylus along anteocular margin, and 2 on tip of tylus; a blackish band extending over tylus and parts of adjacent discal area. Antennal segments brown to blackish; segments 1 and 2 sometimes yellow; segment 2 much longer than segment 3. Ocelli minute, almost inconspicuous.

Thorax. Pronotum with 8–12 long, brown bristles along anterolateral margins; posterior lobe with a small blackish spot at base near each humerus; calli smooth, blackish, crescent-shaped. Scutellum V-shaped, acutely rounded apically, with scattered coarse, dark punctures on disc and 3 blackish spots along base. Hemelytra: corium irregularly spotted with blackish, especially in discal area; membrane usually well developed, rarely reduced to a very narrow fringe, milkish, with a few scattered black marks. Legs: femora yellowish-brown, often infusate, with undersurface of fore and middle femora armed with short spines; tibiae yellowish-brown, armed with strong, acute, reddish-brown spines.

Abdomen. Venter uniformly dark brown to black, glabrous, with fine scattered punctures, especially laterally, where surface becomes somewhat rugulose.

Genitalia. Male: pygophore (Fig. 43) opening dorsally, somewhat oval in outline; clasper as in Fig. 44. Female: 1st gonocoxae as in Fig. 50.

Body length: male 3.80–4.86 (4.40) mm; female 4.32–5.25 (4.79) mm. Humeral width: male 2.17–2.83 (2.56) mm; female 2.53–3.30 (2.87) mm.

Other characters as in generic description.

Last-instar nymph (Fig. 20). Head. Dorsal surface brown, with tylus and lateral margins yellowish, and a number of brown bristles along anteocular margins; ventral surface pale yellow with a little brown medially. Antennal segments pale yellow or yellowish-white, slightly infusate at tip. Rostrum pale yellow.

Thorax. Nota brown, somewhat paler yellowish-brown and with a series of brown bristles along outer margins of pronotum and mesothoracic wing pads, which extend onto 3rd abdominal segment. Ventral surface pale yellow on

sterna, shading to dark brown on pleura. Femora pale yellow or yellowish-white, infuscate; tibiae pale yellow or yellowish-white with brown spines; tarsi pale yellow or yellowish-white.

Abdomen. Terga pale yellow or yellowish-white, tinged with pale brown midlaterally, with an oblong brown spot on lateral borders of each segment; tergum 2 with a thin, wide, slender plate on either side of middle; tergum 3 with a thicker, slender median plate on posterior margin; terga 4 and 5 with a large median plate on posterior margin; tergum 7 with a small, oblong median plate. Venter pale yellow or yellowish-white with fine, sparse punctures; lateral borders of segments each with a brown oblong spot; last 3 segments each with a dark brown, rectangular median plate.

Body length: 3.84 mm.

Type data. Lectotype (here designated): male (BMNH) labelled "type (circle with orange border)/*Choerocydnus nigrosignatus*; TYPE B.W./New Zealand/6:*Choerocydnus nigrosignatus*[;] n. sp. (folded) / Pres by; Perth Museum.; BM. 1953-629 / SYN-[;]TYPE (circle with pale blue border) / LECTOTYPE; *Choerocydnus nigrosignatus*; F.B. White; Det. M-C Larivière 1994 (red)." Specimen glued onto card.

Paralectotypes: 1 male and 1 female (BMNH).

Material examined. Type specimens, plus 52 non-type examples (18 males, 33 females, 1 nymph).

Geographical distribution (Map 2). North I. WN. Rona Bay (Myers 1926). Wellington, Red Rocks (NZAC).

South I. BR. New R. (NZAC). CO. Bendigo area (NZAC). Cromwell (NZAC), Sand Flat Rd (NZAC). Cromwell Gorge, W bank Clutha R. (NZAC). Great Moss Swamp, SE (Barratt & Patrick 1987). Manuherikia Vly, 3 km SW Omakau (LUNZ). Remarkables Ra., Nevis Burn (LUNZ). Omakau (UCNZ). DN. Oamaru (NZAC). FD. Te Anau, airport (NZAC). KA. Clarence Bridge, 2 km N at Clay Banks (LUNZ). Kaikoura: Armers Beach (UCNZ); First Bay (UCNZ). Oaro, beach (LUNZ). MB. Wairau Vly (upper), S of Hamilton R. (NZAC). MC. Banks Peninsula: Birdlings Flat (NZAC); Coopers Knob (UCNZ); Kaituna (LUNZ). L. Ellesmere, Kaitorete Spit (LUNZ). Methven (NZAC). Rakaia (NZAC). Seafield (NZAC). MK. L. Tekapo (UCNZ). OL. Lake County (AMNZ).

Bioecology. HABITAT. Occurs in rather well drained, often dry, open areas with patchy vegetation, such as coastal sand dunes, South Island lowland, inland flood-plains, and depleted tussock grasslands. Nymphs and adults collected under stones, and adults frequently collected under debris

or at base of plants such as *Festuca novaezelandiae*, *Muehlenbeckia* sp., and *Muehlenbeckia* sp.-*Coprosma* sp. associations. Literature record: collected from a burrow on a sandy beach (Myers 1926).

ALTITUDINAL RANGE. Coastal lowlands to subalpine zone.

SEASONALITY. Phenological trends: see Fig. 124. Adults collected in all months except June and July, but apparently most abundant in October, November, and February. Last-instar nymphs collected in February, above 600 m (CO).

LIFE HISTORY. Life cycle: egg - probably 5 nymphal instars - adult. The egg and all except the last nymphal instar are undescribed. Mating apparently occurs in October and/or November, the time of peak adult abundance. Apparently univoltine.

OVERWINTERING. Overwinters as an adult; collected in mid August in dead whole plants and litter of *Desmoschoenus spiralis* (coastal MC).

Dispersal power. Most specimens studied have highly reduced hind wings, so active dispersal by flight is unlikely.

Economic importance. Apparently none.

Biodiversity and conservation. The closest relatives of this apparently endemic species are two seldom encountered Australian species. *Choerocydnus nigrosignatus* is quite broadly distributed, but occurs in threatened habitats that are vulnerable to all kinds of impacts, and has limited dispersal capabilities.

Genus *Philapodemus* Kirkaldy

Philapodemus Kirkaldy, 1910: 8. Type species *Cydnus australis* Erichson, 1842: 275, by original designation.

Description. Head broadly rounded in front of eyes, with a number of long bristles along antecocular margins; disc convex; juga as long as tylus; antennae 5-segmented; rostrum reaching between fore and middle coxae.

Thorax. Pronotum (Fig. 37) forming a quadrate depression apically to receive head; anterolateral margins slightly reflexed, the reflexed part ending abruptly before humerus. Metathoracic scent gland opening (Fig. 41) without an auricle, opening directly onto metathorax. Scutellum somewhat V-shaped, broadly rounded apically. Hemelytra extending well beyond tip of abdomen; corium with apex slightly sinuate along base of membrane.

Remarks. Monotypic; also occurs in Australia, New Caledonia, and Sri Lanka.

***Philapodemus australis* (Erichson)**

Fig. 3, 21, 35, 37, 41, 45, 46, 51, 125; Map 3

australis Erichson, 1842: 275, 276 (*Cydnius*). Kirkaldy 1910: 8 (*Philapodemus*).

lifuanus Montrouzier, 1861: 62 (*Aethus*). Synonymised by Lethierry & Severin (1894: 71).

leptospermi Butler, 1874: 25 (*Aethus*). Synonymised by Lethierry & Severin (1894: 71).

Adult (Fig. 3). Body broadly oval, subdepressed above, with fine, widely spaced punctures, somewhat more crowded along clavus; head, pronotum, and scutellum impunctate or with a few scattered shallow punctures, always darker than hemelytra and varying from brown to dark brown, approaching black (sometimes pale brown in teneral individuals).

Head with 4–6 bristles on either side of tylus along anteocular margin and 2 on tip of tylus. Antennal segments 1 and 2 yellowish; segments 3–5 brown; segments 2 and 3 subequal. Ocelli small, yellowish.

Thorax. Pronotum with 10–12 long, brown, bristles along anterolateral margins and 1 at anterolateral angles. Hemelytra: membrane well developed, hyaline, slightly dusky, with veins evanescent. Legs yellowish-brown to blackish; undersurface of middle and hind femora armed with short, stout spines; tibiae armed with stout, blackish spines.

Abdomen. Venter dark brown to almost black, glabrous, mostly impunctate in middle, slightly striate and punctate laterally.

Genitalia. Male: pygophore (Fig. 45) opening dorsally; lateral lobes and apical margin slightly produced; clasper as in Fig. 46. Female: 1st gonocoxae as in Fig. 51.

Body length: male 5.75–6.81 (6.22) mm; female 5.73–6.81 (6.25) mm. Humeral width: male 3.04–3.81 (3.41); female 3.15–3.75 (3.43) mm.

Other characters as in generic description.

Last-instar nymph (Fig. 21). Head with dorsal surface dark brown or black, bearing a number of blackish bristles along anteocular margins; ventral surface yellowish-brown to dark brown or black. Antennal segments and rostrum yellowish-brown to dark brown or black.

Thorax. Notae dark brown to black, with a series of long bristles along outer margins of pronotum and base of mesothoracic wing pads, which extend onto 3rd abdominal segment. Ventral surface yellowish-brown on sternae, dark brown to blackish on pleura. Femora yellowish-brown and infusate to dark brown or black; tibiae and tarsi yellowish-brown to dark brown or black; spines concolorous with segment of origin.

Abdomen. Terga pale yellow or yellowish-brown with an oblong, dark brown to blackish spot on lateral borders of each segment; tergum 2 with a thin, narrow, brown or blackish plate on either side of middle; tergum 3 with a thicker, wider median plate on posterior margin; terga 4 and 5 with a large median plate on posterior margin; tergum 7 with a small, narrow median plate. Venter pale yellow or yellowish-brown, with fine punctures; lateral borders of segments with a dark spot; last 3 segments each with a dark brown to black rectangular median plate.

Body length: 4.33–4.90 mm.

Type data. Type material not seen; repository undetermined.

Material examined. 134 non-type examples (45 males, 64 females, 25 nymphs).

Geographical distribution (Map 3). **North I. AK.** Auckland (AMNZ). Howick, beach (AMNZ). **BP.** Maketu, Kaituna R. mouth (OMNZ). Mt Maunganui (FRNZ). Papamoa Beach (OMNZ). Whakatane (LUNZ). **CL.** Cuvier I., N-W Bay (AMNZ). Great Barrier I., Whangaparapara (MONZ). Little Barrier I., Te Titoki Pt (AMNZ). **HB.** Waipawa (NZAC) (Eyles 1960). **ND.** Hen and Chickens Is., Lady Alice I. (NZAC). Moturoa Is., Whale I. (AMNZ). Poor Knights Is., Tawhiti Rahi I., eastern ridge (NZAC). Rocky Bay (AMNZ). Whangarei County (AMNZ). **WI.** Palmerston North (MONZ). **WI/WN.** Paiaka (NZAC). **WN.** Houghton Bay (MONZ). Lyall Bay (Myers 1926). Makara (MONZ). Waitarere, beach (MONZ). Wellington (MONZ).

South I. CO. Arrowtown, Tobins track (LUNZ). Kawarau Gorge, Gentle Annie (NZAC). Knobbly Ra. (NZAC). Salt L. (OMNZ). **DN.** Brighton, S (LUNZ). **MC.** Christchurch, Bromley (LUNZ). Sumner (Kirkaldy 1909b). **MK.** Black Forest Stm, near (UCNZ). Dobson R. (UCNZ). **OL.** Lake County (AMNZ). **OL/CO.** Lindis Pass (LUNZ).

Offshore islands. Three Kings Is.: Great I., East Point (Woodward 1954); South West I. (NZAC).

Bioecology. **HABITAT.** Occurs in open, sandy areas with patchy vegetation, such as seashores, sand spits, vacant lots, forest clearings, South Island inland flood-plains, etc. Often collected under *Muehlenbeckia* sp., rocks, stones, fenceposts and other debris on the ground, and more rarely in rotten wood and rotting legume roots or, at higher elevations, at the base of plants on screes. Literature records: once found "in numbers on the seabeach ... either floating in salt-water pools or crawling on the sand" (White 1878); on roads, running in sunlight, and under stones on foreshore among closely grazed turf (Myers 1926); and

under *Disphyma australe* at the top of a cliff (Woodward 1954).

ALTITUDINAL RANGE. Coastal lowlands to subalpine zone.

SEASONALITY. Phenological trends: see Fig. 125. Adults collected in all months except June and July, but apparently most abundant in October and February, or November and April at higher altitudes and in cooler areas. Myers (1926) reported seeing adults in May. Fourth-instar nymphs collected in February (NN) and April (AK), and 5th instars in December (SD), February, and March (AK, NN).

LIFE HISTORY. Studied in Australia by Hickman (1978). Life cycle: egg - 5 nymphal instars - adult. All stages have been described. Mating observed in October, November, and January. Apparently univoltine over most of its range, but possibly bivoltine in northernmost areas. In the north at least, coastal waste places and sandy areas with a vegetation cover of grasses and *Lupinus arboreus* provide suitable breeding grounds.

OVERWINTERING. Overwinters as an adult, and perhaps also as a late-instar nymph in warmer parts of its range; adults collected in August under stones (CL) and in rotten wood (WI), and penultimate-instar nymphs in late April in litter (AK).

Dispersal power. Adults fully winged. Collection at artificial light in October (ND) provides indirect evidence of flight.

Economic importance. Apparently none.

Biodiversity and conservation. *Philapodemus australis* is indigenous, but not endemic to New Zealand. It is abundant only locally, but has a broad distribution and apparently broad ecological requirements as well as good dispersal capabilities.

Remarks. Previous workers have attributed *Aethus leptospermi*, here a junior synonym, to A. White in Dallas (1851: 119). Dallas (1851) cites "White, Zool. Ereb. & Terror" for the original description of this species. In "The Zoology of the voyage of H.M.S. Erebus & Terror" *Aethus leptospermi* is described on p. 25 from a manuscript name by A. White. Pp. 25-51 and tables 7-10 of the above work were published by Butler in 1874. The species clearly cannot be attributed to A. White. As to Dallas (1851), his work cannot constitute the original description because the name was not accompanied by a description, a definition of the taxon that it denotes, or an indication, e.g., a bibliographic reference to a previously published description (see International Code of Zoological Nomenclature, Art. 12). Consequently, *A. leptospermi* is here attributed to Butler (1874).

Genus *Chilocoris* Mayr

Chilocoris Mayr, 1864: 907. Type species *Chilocoris nitidus* Mayr, 1864: 907, by monotypy.

Description. Head narrowly rounded in front of eyes, with a number of short, stout pegs and longer bristles along antecocular margin (Fig. 57); disc rather flat; juga as long as tylus; antennae 5-segmented, with segment 2 much shorter than the others (Fig. 36); rostrum reaching between fore and middle coxae.

Thorax. Pronotum (Fig. 38) forming a wide U apically to receive head; anterolateral margins bordered by an internal furrow forming a fringe halfway around pronotum. Metathoracic scent gland opening with a long, narrow aricle nearly reaching external margin of segment, with distal third forming a large, recurved, polished lobe (Fig. 42). Scutellum V-shaped, acuminate. Hemelytra reaching or surpassing tip of abdomen; corium with apex sinuate along membrane.

Remarks. *C. australis* Lis, *C. barbarae* Lis, *C. biroi* Horváth, and *C. tasmanicus* Lis are known from Australia (Lis 1995), and *C. pusillus* (Horváth) from Hawaii (Froeschner 1976). One species occurs in New Zealand and Australia.

Chilocoris neozealandicus Larivière & Froeschner

Fig. 4, 36, 38, 42, 47, 48, 52, 57; Map 4

neozealandicus Larivière & Froeschner, 1994: 245 (*Chilocoris*).

Adult (Fig. 4). Body elliptical, subdepressed, shiny chestnut brown, with a few scattered, shallow punctures on head, posterior lobe of pronotum, and scutellum and somewhat more congested punctures on proximal half of hemelytra.

Head with 5-7 short, stout pegs and 3 longer bristles on either side of tylus along antecocular margin, and 2 short, stout pegs on tip of tylus. Antennae yellowish, with segments 3 and 4 infusate in proximal half. Ocelli prominent, whitish-yellow.

Thorax. Pronotum almost impunctate except for a median transverse bar of deep, dark punctures, with 3 equidistant long bristles on anterolateral margins and 1 at anterolateral angles; calli inconspicuous. Scutellum impunctate, concolorous with hemelytra. Hemelytra: corium unicolorous, with scattered fine punctures; membrane well developed, hyaline, slightly dusky, with veins evanescent. Legs: femora yellowish, unarmed; tibiae yellowish to brown, armed with strong, acute, brownish spines.

Abdomen. Venter uniformly brown, impunctate, with contrasting sparse, long silvery pubescence.

Genitalia. Male: pygophore (Fig. 47) opening dorsally, rounded in outline; claspers (Fig. 48) pointed, overhanging apical margin. Female: 1st gonocoxae as in Fig. 52.

Body length: male 4.72, 5.27 mm; female 4.19–5.05 (4.71) mm. Humeral width: male 2.54, 2.73 mm; female 2.17–2.58 (2.45) mm.

Other characters as in generic description.

Type data. **Holotype:** male (NZAC) labelled "NEW ZEALAND AK; Campbells Bch; nr Tawharanui; 11–13 Jan 1981; J.C. Watt / Window trap; under *Vitex*." **Allotype female** (NZAC) labelled as holotype.

Paratypes: 1 male, 2 females (MONZ); 5 females (NZAC); 1 female (USNM).

Material examined. Type series, plus 7 non-type examples (2 males, 5 nymphs).

Geographical distribution (Map 4). **North I. AK.** Auckland (PANZ), Lynfield (NZAC, USNM). Campbell's Beach, nr Tawharanui (NZAC). Noises Is, Motuhoropapa I. (MONZ). Warkworth, Snell's Beach (PANZ). **CL.** Wai-kawau Bay (NZAC). **ND.** Kerikeri, Airport Rd (MONZ).

Bioecology. Very little known.

HABITAT. Collected in pit traps set in native bush on a ridge (Noises Is, AK); in a sheep paddock, under a large *Racosperma mearnsii* tree near native bush (Lynfield, AK); and on strawberries (Warkworth, AK).

ALTITUDINAL RANGE. Apparently restricted to coastal lowlands.

SEASONALITY. Adults collected from end of December to early March. Early instars collected in mid March (AK).

LIFE HISTORY. Life cycle: egg – probably 5 nymphal instars – adult. Immature stages undescribed. Presumably univoltine.

OVERWINTERING probably as an adult; collected in August in soil at base of *Gahnia procera* (Lynfield, AK).

Dispersal power. Adults fully winged. Collection in window traps provides indirect evidence of flight. Observed to fly at dusk and land on standing objects around habitations.

Economic importance. Probably none.

Biodiversity and conservation. This endemic species is known from only seven populations confined to a single ecological region. Additional information about habits and distribution is required before its conservation status can be evaluated.

Remarks. I have seen the type specimen of *Pangaeus scotti*, and it is not conspecific with *C. neozealandicus*: These species are of similar size and colour, and may have been confused by previous workers. The main external characters distinguishing the present genus from *Pangaeus* are the presence, in *Chilocoris*, of a number of stout pegs along the antecocular margin of the head, and the scent gland opening provided with a long, narrow auricle nearly reaching the external margin of the metathoracic segment. In *P. scotti* the anterior margin of the head is ciliated, without pegs, the auricle of the metathoracic scent gland opening does not reach beyond halfway to the margin of the segment, and its apex is not differentiated.

Family ACANTHOSOMATIDAE

Genus *Rhopalimorpha* Dallas

Rhopalimorpha Dallas, 1851: 197. Type species *Rhopalimorpha obscura* Dallas, 1851: 293, by monotypy.

Description. Body slender, narrowly oval to elliptical.

Head acutely rounded or somewhat blunt apically; disc rather flat; antecocular margins slightly concave; juga shorter than tylus; antennae 5-segmented, with segment I not reaching apex of head, or surpassing it by half its own length or less; rostrum reaching about middle or hind coxae.

Thorax. Pronotum trapeziform; anterior lobe slightly convex or rather flat, not declivous in front; anterolateral margins lower than disc, more or less rectilinear with humeri, which are almost quadrate, broadly rounded, or somewhat triangular. Scutellum triangular, acutely tipped. Mesosternal carina poorly developed or, if well developed, then not extending to anterior end of prosternum (Fig. 53, 54). Hemelytra almost attaining or slightly surpassing tip of abdomen.

Abdomen. Connexivum broadly exposed or largely covered by wings. Ventral spine rather short, barely reaching or slightly surpassing middle coxae (Fig. 53, 54).

Remarks. Includes four species, three of them found in New Zealand and the fourth, *R. humeralis* Walker, in southeastern Australia (G.F. Gross, pers. comm.).

Subgenus *Rhopalimorpha* Dallas

Diagnosis. See couplet 7 of key.

Remarks. Comprises *R. lineolaris* and *R. obscura*.

Rhopalimorpha obscura Dallas

Fig. 5, 22, 59, 62, 64, 66, 69, 70, 75, 76, 126; Map 5

obscura Dallas, 1851: 293 (*Rhopalimorpha*).

Adult (Fig. 5) slender, more narrowly oval than *R. lineolaris* (ratio of body length to humeral width 2.38–2.70 (2.50)), usually (90%) pale yellow, sometimes olive-green (especially males) dorsally, with hemelytra often darker, coarsely punctured with black dorsally.

Head broadly rounded apically. Antennal segments 1, 2, and 3 yellowish; segments 4 and 5 mostly dark brown. Maxillary plate process small, tubercle-like, remote from antennal base (Fig. 64).

Thorax. Pronotum with smooth, yellowish median line extending from base to apex obscured by coarse, dark punctures (Fig. 59); calli smooth, concolorous with disc; disc slightly convex; anterolateral margins narrowly reflexed; humeri almost quadrate. Mesosternal carina small, ridge-like. Metathoracic scent gland opening with auricle broadest near middle (Fig. 66). Scutellum acutely tipped, its smooth yellowish median line obscured by coarse punctures (Fig. 59). Hemelytra extending beyond tip of abdomen; membrane pale yellow, with veins brown. Legs yellowish, immaculate.

Abdomen. Coxevivum exposed from segment 2 onwards, yellowish throughout (Fig. 62). Venter hull-shaped, narrowly but strongly convex along midline, yellowish, sometimes darker along midline, impunctate; ventral spine narrow, slender to rather broad, reaching close to hind coxae.

Genitalia. Male: pygophore (Fig. 69, 70) in caudal view with lateral lobes broad (but less so than in *R. alpina*), slightly produced, bearing a subapical patch of hairs on inner side of dorsal margin, their inner sides excavated and transversely striated; ventral rim strongly produced caudally, its external margin with a well developed median tuft of hairs; proctiger without a projection; clasper as in Fig. 75. Female: 1st gonocoxae with surface undulant and posterior margin nearly rectilinear (Fig. 76).

Body length: male 7.42–8.59 (8.11) mm; female 8.33–9.64 (9.02) mm. Humeral width: male 2.86–3.45 (3.22) mm; female 3.13–3.91 (3.58) mm.

Other characters as for genus and subgenus.

Last-instar nymph (Fig. 22). Resembling last-instar nymph of *R. lineolaris* but much more slender and without body pubescence.

Head. Dorsal surface brownish medially, fading to yellowish laterally, glabrous, with a brown patch basally between eyes and 2 elongate blackish marks behind tylus; ventral surface brownish. Antennal segments yellowish or

amber; distal half of segment 3 and entire segment 4 dark brown. Rostrum yellowish, darkening apically.

Thorax. Nota pale yellowish-brown with a pale, irregular median band along pronotum and mesonotum, enclosed by 2 irregular brown bands overlain by fine, scattered dark punctures; outer margins of pronotum and mesothoracic wing pads broadly smooth yellowish-white, glabrous, bordered by an inner area of fine, scattered dark punctures on a pale brown background. Mesothoracic wing pads extending onto 3rd abdominal segment. Ventral surface yellowish-brown medially, shading to dark brown on pleura. Femora yellow or amber, sometimes pale at tip; tibiae yellowish, with pubescence much shorter than tibial width; tarsi yellowish, with tip of last segment sometimes dark.

Abdomen. Terga pale yellowish, impunctate, glabrous, with posterolateral angles of segments brownish; tergum 3 with a rounded brownish plate on either side of midline on posterior margin; terga 4 and 5 with a larger, darker median plate on posterior margin; terga 2–8 sometimes with a faint, reddish longitudinal band on either side; usually 2 broad bands extending across median plates from anterior margin of tergum 3 to posterior margin of tergum 5. Venter pale yellow or yellowish-white, smooth, glabrous, sometimes slightly reddish laterally, usually with a faint longitudinal reddish band along midline; last 4 sterna with brown median spots. Spiracles and trichobothria outlined in brown.

Body length: 6.58–7.06 mm.

Type data. Lectotype (designated by Kumar (1974)): female (BMNH) labelled "type (circular, red-bordered label) / *Rhopalimorpha*; *obscura* (handwritten); Walker's Catal. / N Zeal.; Paniini (circular label, handwritten, bearing the letter 'a' underneath) / 1. *Rhopalimorpha obscura*. (long, single line label, folded) / *Rhopalimorpha*; *obscura* White; R. Kumar det. 1973; LECTOTYPE (red label, handwritten)."

Paralectotype (designated by Kumar (1974)): female (BMNH) labelled "para-; type (circular, yellow-bordered label) / 48; 80 (circular label bearing the number '9' underneath) / *Rhopalimorpha*; *obscura* (handwritten); Walker's Catal."

Material examined. Type specimens, plus 383 non-type examples (153 males, 180 females, 50 nymphs).

Geographical distribution (Map 5). North I. AK. Auckland, Western Springs (NZAC). Bethells Rd, swamp (NZAC). Otahuhu (NZAC). Owairaka (NZAC), swamp (NZAC). Pahi, bay (AMNZ). Riverhead (NZAC). Tahereroa (AMNZ). Tiritiri I. (MONZ). Waiheke I. (NZAC). Wattle Bay (NZAC). BP. Hicks Bay (NZAC). Papatua Bay (NZAC). Rereauria (NZAC). Tokata (NZAC).

Whangaparaoa (NZAC). CL. Coromandel (NZAC). Great Barrier I. (NZAC). Little Barrier I. (NZAC), grass flat E end Te Maracra (AMNZ). Mayor I. (NZAC). Te Anaputa Pt (AMNZ). GB. Awatere (NZAC). East Cape (NZAC). Horoera (NZAC). Mohaka R. (MONZ). Orete Forest (NZAC). Rangiatea (NZAC). HB. Waipatiki Beach (UCNZ). ND. Kaeo (AMNZ). Kaitia (CMNZ). Moturoa I. (AMNZ). Paihia (NZAC). Pakanui (AMNZ). Poor Knights Is: Aorangi I. at Crater Bay (NZAC); Tawhiti Rahi I. (NZAC). Spirits Bay (NZAC). Waipoua (NZAC). Whangarei (CMNZ). Whangarei Heads, Smugglers Cove (NZAC). TO. Ohakune (NZAC). Tarawera (NZAC). Taupo (NZAC). Taurewa (FRNZ). WA. Tinui (LUNZ). WI. Foxton (FRNZ). Wanganui, Longacre Rd (NZAC). WI/WN. Paiaka (NZAC). WN. Kapiti I. (MONZ), trig station (MONZ). Wharekahu Bay (MONZ). Orongorongo Vly (NZAC). Paekakariki (MONZ). Pencarrow Head (MONZ). Plimmerton (MONZ). Terawhiti (NZAC). Wainuiomata (NZAC). Wellington (MONZ). Weraroa (CMNZ). WN/WA. Palliser Bay (MONZ).

South I. BR. Cape Foulwind, nr Okari (LUNZ). Crooked R. S.R. (LUNZ). L. Rotorua (NZAC). Little Totara R. (NZAC). Punakaiki (LUNZ). Bullock Ck (LUNZ). St Arnaud, SH 63 (NZAC). FD/SL. Te Waewae Bay (UCNZ). MB. Molesworth Station (NZAC). MC. Cass (UCNZ). Christchurch (UCNZ). Irwell R. (LUNZ). L. Heron (LUNZ). Banks Peninsula, Little River (NZAC). NC. Amberley Beach (CMNZ). Arthurs Pass N.P., Arthurs Pass summit (LUNZ). Cheviot (UCNZ). Okuku Pass (UCNZ). Rotherham (NZAC). NN. Farewell Spit (LUNZ). Kohaihai R., mouth (LUNZ). Puponga (NZAC). Tarakohe (NZAC). Karama R. (upper), Thor Hut (NZAC). SD. D'Urville I. (MONZ, NZAC). Te Puna lagoon (LUNZ). Ship Cove (NZAC). WD. Fox Glacier, 35 km S (NZAC). Gillespies Beach (NZAC). Harihari (LUNZ), Wanganui R. mouth (UCNZ). L. Ianthe (LUNZ). L. Paringa (NZAC). Mt Hercules (LUNZ). Taylorville-Greymouth Rd (UCNZ). Waimihinihi (NZAC). Wanganui S.F. (LUNZ).

Stewart I. (UCNZ).

Offshore islands. Chatham Is: Pitt I. at Glory Block (NZAC); Rangitira/South East I. (NZAC).

Bioecology. Literature data for *R. lineolaris* also apply to this species, except as noted below.

HABITAT. Occurs in similar habitats to *R. lineolaris*, but apparently not generally in native tussock grasslands. Like *R. lineolaris* apparently favouring monocots, and collected on *Phormium* sp., *Carex* spp., *C. trifida* seed heads, *C. virgata*, coastal sedges, and *Juncus* spp. Also collected on the dicots *Cassinia leptophylla* and *Muehlenbeckia axillaris*. Adults collected occasionally on silverbeet, potato foliage, flowering wild mustard, and once from a nest of fernbird,

Bowdleria punctata. Literature records: in great numbers on lucerne and red clover (Evans 1952), and found on *Carex longibrachiata* (Spiller & Wise 1982). Late-instar nymphs collected on *Carex virgata* (WN). Listed species of *Carex* are confirmed host plants; not believed to reproduce on dicots.

ALTITUDINAL RANGE. Coastal lowlands to montane zone.

ASSOCIATED SPECIES. Frequently found with *R. lineolaris* (Pendergrast 1950), and reportedly found in association with nymphs of the tick *Haemaphysalis bispinosa* (= *H. longicornis*) in winter shelter at base of *Juncus effusus* (Myers 1926).

SEASONALITY. Phenological trends: see Fig. 126. Adults collected in all months except July and September, but apparently most abundant in November and January, or in December and February in cooler areas and at higher altitudes. Late instars collected in January (BP, WN) and February (WD). In the Auckland area eggs found from late October and 1st-instar nymphs in early November; most instars active from December to February, and adults found in February mostly newly moulted (Pendergrast 1952). Eggs collected in November elsewhere on the North Island (Cumber 1964), and in January at high altitudes on the South Island.

LIFE HISTORY. Life cycle: egg - 5 nymphal instars - adult. Egg and all nymphal instars described by Pendergrast (1960). Instars 1-3 and 5 characterised and 5th instar illustrated by Myers (1926). Pendergrast (1952) developed successful rearing techniques: his summer rearing experiments indicated that about 56 days are required for development from egg to adult (egg 8-9 days, 1st instar 6-7 days, 2nd instar 9-12 days, 3rd instar 7-10 days, 4th instar 8-12 days, 5th instar 9-13 days). Apparently univoltine.

MATING. In spring and early summer, as for *R. lineolaris*. Myers (1926) recorded mating pairs in November and December (North Auckland).

OVIPOSITION. Starts around mid October and may continue until early December, with eggs placed on plants as for *R. lineolaris*. In captivity eggs laid on undersurface of *Dactylis glomerata* blades, between midrib and edge (Myers 1926). Eggs laid in batches of 14 (same number as egg tubes in female), reducing to 9-11 later in season; laboratory-held females lay at least 3 batches (Pendergrast 1952). Development apparently a little faster in northern areas (Myers 1926).

OVERWINTERING. Adults overwinter under similar conditions to *R. lineolaris*. One adult collected in early spring under bark (Myers 1926).

FOOD. See under *R. lineolaris*. Carnivory: a starved captive male was observed sucking contents from 3 partially incubated eggs of *R. lineolaris* (Pendergrast 1952).

ACTIVITY. Adults collected at night on *Carex trifida* seed heads (November, AK) and on tree trunks (January and February, CL and HB), e.g., podocarps.

ENEMIES. See *R. lineolaris*.

Dispersal power. Fully winged, and observed flying during the day. Flight activity inferred from light trapping records (April, TO).

Economic importance. Apparently none.

Biodiversity and conservation. As for *R. lineolaris*.

Remarks. Previous workers have attributed *Rhopalimorpha obscura* to A. White in Dallas (1851: 293), where the name is accompanied by a description between quotation marks, alleged to be a citation of White's original description in 'The Zoology of the voyage of H.M.S. Erebus & Terror.'

On p. 26 of 'Zool. Erebus & Terror,' however, there is no such description, and *R. obscura* is there attributed again to A. White in Dallas (1851: 293). To be available, every new scientific name published before 1931 must satisfy the provision of Articles 11 and 12 of the 'International Code of Zoological Nomenclature,' and must be accompanied by a description or a definition of the taxon that it denotes, or by an indication.

In the present instance such indication could have been a bibliographic reference to a previously published description, but pp. 25-51 of 'Zool. Erebus & Terror' were published by Butler in 1874, and thus cannot have priority over Dallas (1851).

What remains is the description provided by Dallas (1851), which I believe he took from a description accompanying a manuscript name by A. White intended for publication in 'Zool. Erebus & Terror.' It is clear, then, that the name *Rhopalimorpha obscura* should be attributed to Dallas, rather than to either Butler or A. White.

What appears to be a melanic form of *R. obscura* occurs on the Chatham Islands. Co-occurrence with *R. lineolaris* is discussed in the Remarks section under that species.

In contrast to *R. lineolaris*, this species does not show a close association with native Poaceae. In general it appears to favour Cyperaceae (except perhaps for the introduced grass *Dactylis glomerata*, to which it seems to accommodate itself in North Island habitats).

This ecological preference may in part explain its absence from eastern OL and MK, southern MC, CO, and DN, an area including the tall-tussock grasslands south of the Rakaia River (MC), with prevailing cover of native Poaceae, especially on mid-montane slopes and at higher altitudes.

Rhopalimorpha lineolaris Pendergrast

Fig. 6, 23, 53, 58, 61, 63, 65, 67, 68, 73, 74, 127; Map 6
lineolaris Pendergrast, 1950: 32 (*Rhopalimorpha*).

Adult (Fig. 5) slender, narrowly oval (ratio of body length to humeral width 2.17-2.38 (2.27)), reddish-brown, greenish-brown, or brick-brown dorsally, contrastingly marked with smooth cream or yellow on antecocular margins of head, anterolateral margins of pronotum, and midline of pronotum and scutellum, finely punctured with black dorsally, except for midline of pronotum and scutellum.

Head somewhat blunt apically. Antennal segments 1-3 yellowish-orange; segments 4 and 5 mostly dark brown. Maxillary plate process large, shelf-like, reaching close to antennal base (Fig. 63).

Thorax. Pronotum with a smooth, creamish-yellow median line extending from base to apex (Fig. 58); calli smooth, concolorous with disc; disc slightly convex; anterolateral margins outwardly declivous, not reflexed; humeri almost quadrate. Mesosternal carina small, although somewhat higher than in *R. obscura*, ridge-like. Metathoracic scent gland opening with auricle broadest near its outer margin (Fig. 65). Scutellum acutely rounded apically, smooth yellowish along midline (Fig. 58). Hemelytra extending beyond tip of abdomen; membrane pale yellow, with veins brown. Legs yellowish to dark brown, often with scattered dark maculations on femora.

Abdomen. Connexivum exposed from segment 3 onwards, brownish-yellow, sometimes with dark brown segmental marks (Fig. 61). Venter regularly convex, brownish-yellow, often reddish, impunctate; ventral spine narrow, slender or rather broad, reaching close to hind coxae.

Genitalia. Male: pygophore (Fig. 67, 68) in caudal view with lateral lobes slightly produced caudally, bearing a subapical patch of hairs on dorsal margin, their inner sides somewhat rugulose medially; external margin of ventral rim subdepressed, with a well developed median tuft of hairs; proctiger with a tubercle-like projection; clasper as in Fig. 73. Female: 1st gonocoxae with surface swollen and posterior margin strongly convex (Fig. 74).

Body length: male 6.49-7.96 (7.23) mm; female 7.34-9.07 (8.18) mm. Humeral width: male 2.87-3.45 (3.18) mm; female 3.26-3.73 (3.59) mm.

Other characters as for genus and subgenus.

Last-instar nymph (Fig. 23). Head. Dorsal surface brownish medially, fading to yellowish laterally, covered with rather long, dense pubescence, and with 2 brown patches basally between eyes; ventral surface brownish medially, fading to yellowish laterally. Antennal segments yellow or brown; distal half of segment 3 and entire segment 4 dark

brown or black. Rostrum yellow, becoming blackish apically.

Thorax. Not a yellowish-brown, with a pale band along midline of pronotum and mesonotum, enclosed by 2 brown, irregular bands overlain by fine, dense, dark punctures; outer margins of pronotum and mesothoracic wing pads broadly smooth yellowish-white, with long pubescence, and bordered by an inner area of fine, dark punctures on brown background. Mesothoracic wing pads extending onto 3rd abdominal segment. Ventral surface yellowish medially, shading to dark brown on pleura. Femora yellow, speckled or not with brown; tibiae yellowish, with pubescence longer than tibial width; tarsi with 1st segment yellow or yellowish-brown, 2nd segment partly or entirely dark brown.

Abdomen. Terga yellowish, with a few concolorous punctures, covered by long, sparse pubescence; a brown, oblong spot on lateral borders of segments; tergum 3 with a rounded, brownish plate on either side of midline on posterior margin; terga 4 and 5 with a larger median plate on posterior margin; usually 6 reddish longitudinal bands extending between segments 2-8, the middle pair broader and running across median plates. Venter yellowish, mostly smooth, sparsely pubescent, with a brown, oblong spot on lateral borders of segments; usually with 1 median and 4 lateral, reddish longitudinal bands between segments 2-8. Spiracles and trichobothria outlined in brown.

Body length: 7.66-8.10 mm.

Type data. **Holotype:** female (AMNZ) labelled "Auckland; 8/7/50 (handwritten) / Rhopalomorpha; lineolaris [female]; J. Pendergrast 1950; HOLOTYPE (handwritten) / Auckland; North Island; NEW ZEALAND: AUCKLAND MUSEUM."

Allotype male (AMNZ) labelled as holotype.

Paratypes: 1 male, 1 female (CMNZ, OMNZ).

Material examined. Type series, plus 493 non-type examples (183 males, 250 females, 60 nymphs).

Geographical distribution (Map 6). **North I. AK.** Auckland (AMNZ). Waitakere Ra., Goldies Bush (AMNZ, NZAC). Orakei (NZAC). Owairaka (NZAC). Purewa Bush (NZAC). Ranui (NZAC). Riverhead S.F. (NZAC). Swanson (NZAC). Titirangi (FRNZ). Waiheke I. (NZAC). Onetangi Reserve (NZAC). Waiuku (MONZ). Warkworth (NZAC). Wattle Bay (NZAC). Woodhill (NZAC). **BP.** L. Tikitapu (Blue L.) (FRNZ). Mt Hikurangi (UCNZ). Papatea Bay (NZAC). Rereauria (NZAC). Tauranga Bay, Butterfly Vly (AMNZ). Tokata (NZAC). Wacnga (NZAC). **CL.** Great Barrier I.: Junction Is (NZAC); Oruawhoro Bay (NZAC). Kirikiri Vly (AMNZ). Te Anaputa Pt (AMNZ). Waikawau

(NZAC). **GB.** Awatere (NZAC). L. Waikaremoana, Manuoha (AMNZ). Tiniroto (NZAC). Waiti Stm (NZAC). **HB.** St Lawrence (NZAC). Takapau (NZAC). **ND.** Kaihu Bush (NZAC). Kaitaia (CMNZ). Mokohinau Is, Burgess I. (NZAC). Pahi Bay, Pahi Block (AMNZ). Paihia (AMNZ): bay E of (AMNZ); beach (NZAC). Poor Knights Is: Aorangi I. (NZAC), Crater Bay (NZAC); Tawhiti Rahi I. (NZAC). Waipoua S.F.: SH12 (NZAC); Te Matua Ngahere (LUNZ). Tutukaka (AMNZ). **TK.** Mt Egmont N.P.: Dawson Falls, near Tourist Lodge (NZAC); Mt Egmont summit (NZAC). **TO.** Kaituna R., Okere Falls (AMNZ). Matca (NZAC). Mt Ruapehu, Taranaki Falls (NZAC). Ohakune (MONZ). Papakai, near Ruapehu (NZAC). Rangataua (FRNZ). Taurewa (FRNZ). Tongariro N.P. (NZAC). **WA.** Timakori Ra. (MONZ). **WI.** Palmerston North (MONZ). **WN.** Breaker Bay (NZAC). Days Bay (NZAC). Kapiti I. (MONZ): trig station (MONZ); Wharekōhu Bay (MONZ). Levin, Weraroa (NZAC). Stokes Valley (MONZ). Titahi Bay (NZAC). Tararua F.P., Waikawa Stm 10 km S of Levin (NZAC). Wellington (MONZ), Botanical Gardens (NZAC). **WO.** Port Waikato (NZAC). Te Kohanga (NZAC).

South I. BR. Boatmans Ck (NZAC). Buller County (AMNZ). Coldwater Hut (NZAC). Fletcher Ck (NZAC). L. Tennyson (LUNZ). Punakaiki (LUNZ), Bullock Ck (LUNZ). Reefton (NZAC). Tawhai S.F., Big River Rd (NZAC). **BR/NC.** Hope R., bridge (NZAC). **CO.** Carrick Ra., Watts Rock (LUNZ). Dansey Pass (LUNZ). Great Moss Swamp: Howell Hut (LUNZ); SE (Barratt & Patrick 1987). Hawkdun Ra. (OMNZ). Horn Ra. (The) (LUNZ). Manor Burn Reserve (upper) (NZAC). Mt Bitterness (NZAC). Obelisk Ra. (OMNZ). Old Man Ra., Shingle Ck (FRNZ). Remarkables Ra.: Nevis Burn (NZAC); Nevis Crossing (LUNZ). Rock and Pillar Ra., McPhees Rock track (LUNZ). Rocklands (NZAC). **DN.** Trotters Gorge (OMNZ). **FD.** Fiordland N.P., Resolution I., Disappointment Cove (NZAC). **MB.** Clarence R., above L. Tennyson (FRNZ). Hammer S.F. (UCNZ): Jacks Pass area (UCNZ); Rogerson Vly (UCNZ). Mt Sebastopol, The Hermitage (NZAC). Wairau Vly (upper), Wairau Bridge above Judges Ck (NZAC). **MC.** Ashley Gorge (UCNZ). Banks Peninsula: Ahuriri and Coopers Knob S.R. (UCNZ); Akaroa, 4 km E (NZAC); Coopers Knob, Ell's Spring (UCNZ); Duvauchelle Bay (NZAC); Herbert Peak S.R. (UCNZ); Hilltop (UCNZ); Kaituna S.R. (UCNZ); Kennedys Bush S.R. (UCNZ); Little River (NZAC); Mt Cavendish S.R. (UCNZ); Mt Sinclair S.R. (UCNZ); Okains Bay (UCNZ); Sign of the Packhorse S.R. (UCNZ); Te Oka Bay, tors above (UCNZ); Te Oka S.R. (UCNZ); Tumbledown Bay (LUNZ). Cass (CMNZ). Craigieburn Ra., Mt Cheeseman, around bottom hut (LUNZ). Goldney Ridge, Waimakariri R. (FRNZ). L. Georgina (LUNZ). L. Heron (LUNZ). L.

Sarah, near Cass (NZAC). McLennans Bush (NZAC). Mt Algidus (NZAC). Mt Hutt (UCNZ). MK. Mt Cook N.P. (LUNZ); Ball Hut (LUNZ); Hooker Vly (LUNZ); Kea Pt walk (LUNZ); Sealy Ra. (LUNZ); Kea Pt track (LUNZ); Unwin Hut (LUNZ). NC. Arthurs Pass N.P., near Village (NZAC). Balmoral (CMNZ). Lees Valley (NZAC). Mt Grey (CMNZ). Okuku Pass (UCNZ). Stoneyhurst Plantation (LUNZ). White Rock (CMNZ). NN. Beebys Knob (NZAC). Dun Mtn (NZAC). Farewell Spit (LUNZ), lighthouse (LUNZ). Flora Stm (NZAC). Pretty Bridge Vly (NZAC). Wharariki Beach (LUNZ). OL. Ahuriri R., near Ben Avon (NZAC). Arrowtown, 2 km S (NZAC). Arthurs Pt (NZAC). Headlong Peak, lower slopes (NZAC). Mt Horrible (NZAC). OL/CO. Lindis Pass (NZAC). SC. Blue Cliffs (CMNZ). Kurow, Little Roderick (UCNZ). Mt Somers (NZAC). Rhoboro Downs (CMNZ). SD. Ship Cove (NZAC). Stephens I. (NZAC). SL. Takitimu Mtns, Cheviot Hills Hut (OMNZ). Clifden Cave (NZAC). Colac Bay (UCNZ). Invercargill (NZAC); estuary (NZAC). Hokonui Ra., Mt Hedgehope (NZAC). Orepuke (NZAC). The Cairn (NZAC). Tiwai Pt (NZAC). WD. Abut Head, 5 km E (NZAC). Arahura Vly (LUNZ). Awatuna Rd (LUNZ). Bullock Ck, Cook R. (NZAC). Callaghans (LUNZ). Goldsborough (LUNZ). Harihari, Wanganui R. mouth (UCNZ). L. Ianthe (LUNZ). L. Matheson: 1 km S (NZAC); 2 km SW (NZAC). Otira (NZAC).

Stewart I. Broad Bay (UCNZ). Ocean Beach (UCNZ).

Bioecology. HABITAT. Inhabits grasses, rushes, and sedges in open habitats bordering streams, swamps, or marshes, often at forest edge or in open forest understorey, from coastal to high-altitude environments, including tussock grasslands. Also found in modified habitats such as pastures and scrublands. Apparently favours monocots; has been found on *Phormium* sp., *Carex* spp., *Scirpus* spp., *Agrostis capillaris*, *Chionochloa* spp., *Dactylis glomerata*, *Festuca novae-zelandiae*, *Phleum pratense*, *Juncus* spp., and *Bubbinella* sp. Also collected on the dicots *Aciphylla* sp. in flower, *Cassinia* sp., *Olearia* sp., *O. virgata*, *Muehlenbeckia* sp., *M. axillaris*, *Hebe* sp., and *H. bollsionsii*. Pendergrast (1952) noted six plants favoured in the Auckland area—*Carex divulsa*, *C. longifolia* (= *C. longibrachiata*), *C. virgata*, *Gahnia* sp., *Mariscus* (= *Cyperus ustulatus*), and *Dactylis glomerata*—and suggested that Cyperaceae are the most favoured group. According to Pendergrast, *Dactylis glomerata* is the only pasture grass to harbour this species. Nymphs collected on *Agrostis capillaris* and *Alopecurus pratensis* (SL). *Dactylis glomerata*, species of *Carex*, and *Cyperus ustulatus* are confirmed host plants, i.e., plants on which *R. lineolaris* breeds and develops. *Agrostis capillaris*, *Alopecurus pratensis*, *Chionochloa* spp., and *Festuca novae-zelandiae* are other likely host

plants. Not believed to reproduce on dicots. The dicots listed here most likely constitute 'sitting' records only. Pendergrast (1952) studied seasonal movement between host plants in the Auckland area. In autumn adults were found crowded together near the base of *Dactylis glomerata*, *Juncus effusus*, and *Carex longifolia* (= *C. longibrachiata*), or along the midrib near the leaf base on the concave upper leaf surface in *Mariscus* (= *Cyperus ustulatus*). From May to August they were found near the ground on the same plants, e.g. in the mass of detritus at the base of *Juncus effusus* or in the leaf-mould at the base of *Dactylis glomerata* and *Carex longifolia* (= *C. longibrachiata*). From September to November a gradual change to summer habits and emergence from winter quarters was observed, and gradually, from December to February, more individuals were found active on top of host plants. In mid October a tendency to move from *Dactylis glomerata* and rushes to *Carex divulsa* was noted.

ALTITUDINAL RANGE. Sea level to subalpine zone.

ASSOCIATED SPECIES. Frequently found with *R. obscura* (Pendergrast 1950; see also Remarks).

SEASONALITY. Phenological trends: see Fig. 127. Adults collected in all months except August, but apparently most abundant from December to end of February. Fourth-instar nymphs collected in January (NC) and February (WD); likewise 5th instars (AK, SL, WD). In the Auckland area eggs found from late October to late December, and first nymphs in early November; most instars are active from December to February (Pendergrast 1952). Pendergrast reported that adults collected in the Auckland area in February were newly moulted.

LIFE HISTORY. Life cycle: egg - 5 nymphal instars - adult. The egg and the five nymphal stages have been described by Pendergrast (1960). All nymphal instars are apparently passed among the seeds of the host plant. According to Pendergrast (1952), who developed successful rearing techniques, about 56 days are required for development from egg to adult (egg 7-9 days, 1st instar 8-10, 2nd instar 8-10, 3rd instar 9-10, 4th instar 9-12, 5th instar 10-18). Pendergrast (1952) also described egg development and hatching, and documented nymphal development and habits. Apparently univoltine.

MATING (see Pendergrast 1952) occurs in spring and early summer. Copulating adults collected around mid December (AK). Pendergrast (1952) observed a pair in September on *Dactylis glomerata* (Auckland area), but noted that mating was not general until October, with the greatest activity during November. In mid October around Auckland he noted numbers in copula on inflorescences of *Carex divulsa*, but few on cocksfoot and rushes nearby. He suggested from laboratory and field observations that mating is stimulated by increased temperatures.

OVIPOSITION (see Pendergrast 1952) starts around mid October and continues until late December in the Auckland area. Eggs are placed irregularly amongst developing seeds of *Mariscus* (= *Cyperus*) *ustulatus* or on the upper surface of leaves of *Carex* species and *Dactylis glomerata*, in a single row along the midrib. Observations in the field and the laboratory indicate that eggs are laid in batches of 8 (the same number as egg tubes in female), declining to 4–6 later in the season, and in the laboratory each female lays at least three batches (Pendergrast 1952).

OVERWINTERING. Overwinters as an adult; individuals collected in July and September under stones (WT), and early October under stones at base of *Chionochloa* sp. at high altitudes (CO). In the Auckland area, Pendergrast (1952) found large numbers in late autumn and winter on *Juncus effusus*, which apparently provides shelter for overwintering. According to Pendergrast overwintering males apparently die earlier in the spring than females, soon after copulation. (See also Habitat.)

FOOD. The feeding process has been described by Pendergrast (1952). Adults have been observed feeding on plantain seedheads in November (AK). According to Pendergrast (1952), in the Auckland area favoured food sources are seeds of *Carex divulsa*, *C. longifolia* (= *C. longibrachiata*), *C. virgata*, *Juncus effusus*, *Mariscus* (= *Cyperus*) *ustulatus*, and *Dactylis glomerata*. *C. divulsa* appears to be the most favoured food during summer, when seed-heads crowded with adults and nymphs have been observed. In some areas *D. glomerata* seeds were noted as the food favoured by adults and nymphs. From December to February nymphs and adults feed on and inhabit the upper parts of host plants. In winter adults feed from seeds and leaves at the base of plants. Pendergrast noted adults feeding on unripe seeds of host plants. He also observed carnivory when 15 eggs put in a jar with starved individuals had their content sucked out.

ACTIVITY. Collected at night by sweeping rushes (December, ND) and tussock (April, CO).

ENEMIES. Eggs collected in the field from *Carex* blades were parasitised by a small species of *Microphanurus* (= *Trissolcus*) (Hym.: Scelionidae), referred to as "species A" by Cumber (1964), which is apparently specific to Acanthosomatidae. Under laboratory conditions, eggs put with *Asolcus* (= *Trissolcus*) *basalis* or an indigenous species of *Asolcus* (*Microphanurus*) (= *Trissolcus*) referred to as "species N," a parasite of *Monteithiella* eggs, were not parasitised (Cumber 1964).

Dispersal power. Fully winged, and observed flying during the day. Flight activity also inferred from light trapping records (November, BR).

Economic importance. Apparently none.

Biodiversity and conservation. *R. lineolaris* and *R. obscura* are highly distinctive, belonging to a genus in which all species but one are endemic to New Zealand, with their closest relative in eastern Australia. They have quite a broad distribution in New Zealand, and occur in a wide range of habitats, although usually showing a preference for certain plants, and have good dispersal capabilities.

Remarks. The main difference in the ecological preferences of this species and *R. obscura* is that *R. lineolaris* is found—and is believed to reproduce and develop—on native Poaceae, whereas there is not one such record for *R. obscura* among all the material studied. On the North Island, however, both species have been observed to reproduce on the introduced grass *Dactylis glomerata*. Recent field observations have led me to hypothesise that the co-occurrence of these species in a given habitat is dependent on the presence of Poaceae as a required food source for *R. lineolaris*. This apparent predilection for Poaceae may in part explain why *R. lineolaris* alone occurs on the South Island in an area covered by the eastern tall-tussock grasslands south of the Rakaia River (MC), especially on mid-montane slopes and at higher altitudes. At lower altitudes, where native grasslands have been depleted, it seems to accommodate itself to a mixture of native and introduced Poaceae.

Subgenus *Lentimorpha* Woodward

Rhopalimorpha (*Lentimorpha*) Woodward, 1953: 302.

Type species *Rhopalimorpha* (*Lentimorpha*) *alpina* Woodward, 1953: 303, by original designation.

Diagnosis. Refer to couplet 7 of key.

Remarks. Comprises a single species, *R. alpina*.

Rhopalimorpha (*Lentimorpha*) *alpina* Woodward

Fig. 7, 54, 60, 71, 72, 77, 78; Map 7

alpina Woodward, 1953: 304 (*Rhopalimorpha* (*Lentimorpha*)).

Adult (Fig. 7). Body elliptical, not as slender as in *R. lineolaris* (ratio of body length to humeral width 1.96–2.08 (2.00)), yellowish-brown, sometimes tinged with reddish or orange dorsally, shallowly and irregularly punctured with brown dorsally, but lacking contrasting markings or a

well defined yellowish median line on pronotum and scutellum.

Head narrowly rounded apically. Antennal segments 1, 2, and base of segment 3 yellowish-orange, with distal half of segment 3 and most of segments 4 and 5 darker. Maxillary plate process in the form of a narrow shelf reaching antennal base, not expanded as in *R. lineolaris*.

Thorax. Pronotum: surface smoother and somewhat paler along midlength of anterolateral margins and on posterior lobe; smooth, yellowish midline very narrow or inconspicuous; calli smooth, undulant, concolorous with remainder of disc; disc rather flat, somewhat undulant; anterolateral margins somewhat reflexed anteriorly; humeri broadly rounded, somewhat triangular. Mesosternal carina well developed, plate-like, expanded anteriorly. Metathoracic scent gland opening with a slender auricle, broadest near its outer margin. Scutellum acutely rounded apically, unicolorous or with a faint yellowish median line. Hemelytra extending beyond tip of abdomen; membrane pale brown, distinctly declivous, with veins indistinct. Legs yellowish-orange, impunctate.

Abdomen. Connexivum scarcely exposed, yellowish-brown throughout. Venter regularly convex, brownish, darker than dorsal coloration, impunctate.

Genitalia. Male: pygophore (Fig. 71, 72) in caudal view with lateral lobes broadly rounded, lacking a patch of hairs on dorsal margin; external margin of ventral rim with a well developed median bunch of hairs; proctiger with a bifurcate projection; clasper as in Fig. 77. Female: 1st gonocoxae with surface undulant and posterior margin slightly convex (Fig. 78).

Body length: male 8.07, 8.20 mm; female 8.98–9.77 (9.38) mm. Humeral width: male 3.91, 3.97 mm; female 4.43–4.95 (4.65) mm.

Other characters as for genus and subgenus.

Type data. **Holotype:** female (AMNZ) labelled "McKinnon; 28.12 Pass 1919 / C.E. Clarke; Collection / Lake Co.; South Island; **NEW ZEALAND**; AUCKLAND MUSEUM / Illustrated; D.W. Helmore; 20.11.84 (green) / Rhopalimorpha (Lentimorpha); alpina Woodward; Holotype [female] (handwritten)."

Material examined. Holotype, plus 7 non-type examples (2 males, 5 females).

Geographical distribution (Map 7). South I. BR. Papanoa Ra., Croesus Knob (LUNZ). Mt Dewar, E (NZAC). Mt Priestly – Mt Dewar basins, Lochnagar Ridge (NZAC). FD. Fiordland N.P., McKinnon Saddle, Milford Track (AMNZ). NN. Dun Mtn (NZAC). Mt Owen (NZAC).

Bioecology. Almost nothing known.

HABITAT. Collected in sod (December, Mt Dewar) and under a rock (January, Croesus Knob).

ALTITUDINAL RANGE. Most commonly found around 1000–1300 m.

SEASONALITY. Adults collected in November, December, and January.

Dispersal power. Hind wings very narrow, about half length of hemelytra. Active dispersal by flight doubtful.

Economic importance. Probably none.

Biodiversity and conservation. *R. alpina* appears to be highly distinctive in *Rhopalimorpha*, since it forms the basis upon which the monotypic endemic subgenus *Lentimorpha* was created. Only six thinly scattered populations are known, represented by only a few specimens collected over a long period. The species has limited dispersal capabilities, and almost nothing is known about its life history and habits.

Genus *Oncacontias* Breddin

Oncacontias Breddin, 1903: 219. Type species *Cimex vittatus* Fabricius, 1781: 349, by subsequent synonymy.

Description. Body broadly oval, somewhat shield-shaped.

Head broadly rounded apically; antennae 5-segmented; rostrum reaching or slightly surpassing hind coxae.

Thorax. Pronotum: anterior lobe strongly declivous in front, giving a 'hunchbacked' appearance in lateral view; anterolateral margins strongly reflexed. Scutellum triangular, distinctly narrowed before apex, acutely rounded apically. Mesosternal carina quite broad and prominent, extending to anterior end of prosternum (Fig. 55). Hemelytra extending slightly beyond tip of abdomen.

Abdomen. Connexivum covered by wings. Ventral spine very long, strongly arched, usually reaching fore coxae (Fig. 55).

Remarks. A monotypic genus endemic to New Zealand.

Oncacontias vittatus (Fabricius)

Fig. 8, 24, 55, 79–82, 128; Map 8

vittatus Fabricius, 1781: 349 (*Cimex*).

bruneipennis Breddin, 1903: 220 (*Oncacontias*).

Adult (Fig. 8). Body yellowish or greenish (in live individuals) with brown markings on base of pronotum, base of scutellum, and inner sides of coria; pronotum and scutellum with irregular, shallow, brown punctures, these somewhat smaller and more even on coria; disc of head and venter almost impunctate.

Head. Antennal segments brownish throughout.

Thorax. Pronotum: disc rather flat; anterolateral angles acute, produced; anterolateral margins broadly smooth, creamish or yellowish. Metathoracic scent gland opening provided with a slender auricle broadest near its middle; humeri broadly rounded, somewhat triangular. Scutellum often brownish at base and creamish, yellowish, or greenish in distal half, or uniformly yellowish-brown. Hemelytra: corium brownish with a cream, smooth spot near discal area and a cream or yellowish outer margin; membrane hyaline, slightly dusky at times, with veins evanescent. Legs yellowish-brown or greenish, immaculate.

Abdomen. Venter regularly convex, somewhat narrowly raised along midline, uniformly yellowish or greenish.

Genitalia. Male: pygophore (Fig. 79, 80) in caudal view opening dorsally; lateral lobes rather broadly rounded, slightly produced caudally, bearing a patch of hairs on inner dorsal margin near apex; external margin of ventral rim with a well developed median bunch of hairs; proctiger with a prominent bifurcate projection; clasper as in Fig. 81. Female: 1st gonocoxae (Fig. 82) with surface subdepressed and posterior margin convex.

Body length: male 8.70–10.44 (9.77) mm; female 10.33–11.74 (11.13) mm. Humeral width: male 4.15–5.36 (4.86) mm; female 5.34–5.81 (5.58) mm.

Other characters as in generic description.

Last-instar nymph (Fig. 24). Head. Dorsal surface yellowish or greenish, outlined in brown; ventral surface uniformly yellowish or greenish. Antennal segments yellowish to reddish orange, with base of segments 3 and 4 often pale. Rostrum yellowish or greenish lined with brownish ventrally.

Thorax. Not yellowish or greenish with scattered fine, shallow punctures; outer margins of pronotum and proximal half of mesothoracic wing pads narrowly brownish. Mesothoracic wing pads extending onto 3rd abdominal segment. Ventral surface yellowish or greenish with a few fine, scattered punctures. Femora, tibiae, and tarsi yellowish or greenish; last tarsal segment sometimes infuscate at tip.

Abdomen. Terga yellowish or greenish; lateral margins of segments brown; tergum 3 with 2 rounded brownish plates on posterior margin; terga 4 and 5 with a larger median plate on posterior margin; a reddish-orange V-shaped mark extending across median plates between

anterior margin of tergum 3 and posterior margin of tergum 4. Venter rather smooth, yellowish or greenish; lateral margins of segments brown. Spiracles and trichobothria with outlines concolorous with their surroundings.

Body length: 7.14–7.44 mm.

Type data. Lectotype (designated by Kumar (1974)): male (BMNH) labelled "Type (circular red-bordered label) / C.G. Hope (handwritten) / 63; 47 (circular label) / BRIT. MUS.; TYPE No.; HEM. 392 (pink)." Note: male genitalia dissected, in vial with cork stopper beneath all labels.

Material examined. Lectotype, plus 503 non-type examples (185 males, 278 females, 40 nymphs).

Geographical distribution (Map 8). **North I. AK.** Auckland (AMNZ). Destruction Gully (NZAC). Green Bay, cliffs (NZAC). Huia, dam (NZAC). Leigh, hill NE of (AMNZ). Oratia (NZAC). Riverhead (FRNZ). Titirangi (AMNZ). Waiheke I. (NZAC). Waitakere Ra. (NZAC), Exhibition Drive (NZAC). Woodhill S.F. (FRNZ). **BP.** Hicks Bay (NZAC). Kaimai Ra. (NZAC). L. Rotoiti (NZAC), head of (NZAC). L. Tarawera, Karikaria Bay beside W shore (LUNZ). Mt Te Aroha (NZAC). Papatua Bay (NZAC). Rereaurua (NZAC). Rotorua (FRNZ). Te Koau (NZAC). Waenga (NZAC). **CL.** Coromandel, S (NZAC). Cuvier I.: near larger rock, upper W ridge (AMNZ); upper N-W vly (AMNZ). Little Barrier I. (MONZ). Waikawau Bay, road above Little Bay (LUNZ). **GB.** Awatere (NZAC). East Cape (NZAC). Horoera (NZAC). Orangiwhakaia Stm, Route 38 (NZAC). **HB.** Hastings, around showgrounds (NZAC). Tararua Stm, Devils Elbow (NZAC). **ND.** Mangamuka Hills (AMNZ). Paihia (AMNZ). Surville Cliffs (NZAC). Te Pahi, Coastal Park (NZAC). Tutukaka Harbour (NZAC). Unuwaho (NZAC). Waipoua S.F. (NZAC). Whangarei (AMNZ). **RI.** Ruahine Ra.: Maropua Hut (NZAC); Wharite (NZAC). **TK.** Mt Egmont N.P.: Ahukawakawa Swamp (NZAC); Bells Falls Track (NZAC); Dawson Falls, near Tourist Lodge (NZAC); Holly Hut (NZAC); North Egmont (FRNZ); Pouakai, S flank (NZAC); Pouakai Ra. (NZAC). **TO.** L. Taupo (Myers 1926). Tongariro N.P.: Mt Ruapehu, Ohakune Track (NZAC); Taurewa, Victoria University Field Station (LUNZ). Ohakune (MONZ). Te Waka (FRNZ). Urewera N.P., W of pass on SH 38 (NZAC). Waipunga Falls (NZAC). **WA.** Waewaepa Ra. (NZAC). **WI.** Wanganui (Myers 1926). Palmerston North (FRNZ). **WI/WN.** Paia (NZAC). **WN.** Tararua Ra.: below Field Hut (MONZ); Dundas Hut, ridge (NZAC). Johnsonville (MONZ). Kaitoke (NZAC). Karori (MONZ). Korokoro (MONZ). Makara (NZAC); Beach (MONZ); Bush (MONZ); SW Wellington Radio Station (NZAC). Norton, S (NZAC). Orongorongo

Vly, Field Station (NZAC). Petone (MONZ). Tararua F.P., Mt Holdsworth, river track (NZAC). Tokomaru (NZAC). Wellington (NZAC). Wiltons Bush (MONZ).

South I. BR. Cape Foulwind, Okari R. (LUNZ). Capleston (NZAC). Fox R. (LUNZ). Fuchsia Ck (NZAC). Hochstetter S.F. (NZAC). Inangahua S.F., Fletcher Ck (NZAC). Island Ck (LUNZ). L. Hochstetter (FRNZ); Moana (CMNZ). L. Tennyson (NZAC). Maruia Springs (UCNZ). Punakaiki, Bullock Ck (NZAC). Reefton, Big River Rd (NZAC). Shenandoah (UCNZ). Speargrass Ck (FRNZ). Tawhai S.F. (NZAC). Taylorville, W, near Greymouth (NZAC). Waipuna (NZAC). **BR/MB.** Travers Vly (NZAC). **CO.** Kawarau Gorge (NZAC), Roaring Meg (NZAC). Horn Ra. (The) (LUNZ). **DN.** Dunedin (AMNZ, OMNZ). Frasers Gully (OMNZ). Leith Saddle (OMNZ). Ross Ck Reservoir (NZAC). Trotters Gorge (OMNZ). Waitati (AMNZ). **FD.** Bernard Burn (OMNZ). Borland Burn, S branch (NZAC). Borland Saddle (LUNZ). Deep Cove (LUNZ). Doubtful Sound (NZAC). Grebe R. (NZAC). L. Manapouri (NZAC). L. Orbell: N side (NZAC); head, S side (NZAC); head, on right (NZAC). Milford Sound (MONZ). Olivine Ra., W, Simonin Pass (NZAC). Secretary I. (NZAC). Grono Bay (NZAC); Gut Bay (NZAC). Takahe Vly, head basin (NZAC). Wilmot Pass (NZAC). **KA.** Oaro (LUNZ). **MB.** Black Birch Ra. (NZAC). Clarence R., above L. Tennyson (FRNZ). Hanmer (FRNZ). Hanmer S.F. (FRNZ). Saxton Pass (NZAC). **MC.** Ashley R. (UCNZ). Christchurch, Ilam Rd (UCNZ). Banks Peninsula: Coopers Knob (CMNZ); Governors Bay (CMNZ); Kaituna Vly S.R. (UCNZ); Little River (Myers 1926); Montgomery Pk S.R. (UCNZ); Prices Vly (NZAC). Craigieburn F.P. (UCNZ). Craigieburn Ra. (LUNZ, UCNZ). Cave Stm (UCNZ). L. Coleridge, power house (FRNZ). Lincoln College (LUNZ). Otarama (CMNZ). Oxford, Wharfedale track (UCNZ). Christchurch, Riccarton Bush (LUNZ). **MK.** L. Pukaki (UCNZ). Mt Cook N.P., near Ball Hut (UCNZ). **NC.** Arthurs Pass (CMNZ), Dobson Memorial Park (NZAC). Bealey Vly (upper) (LUNZ). Halpin Ck (UCNZ). Hawdon R. (CMNZ), shelter (UCNZ). Klondyke Corner (LUNZ, UCNZ). Mt Grey (NZAC). Okuku Pass (UCNZ). Rough Ck (UCNZ). White Rock (CMNZ). **NN.** Abel Tasman N.P., Totaranui (NZAC). Aniseed Vly (NZAC). Cobb Vly (FRNZ). Denniston, road to (NZAC). Dun Mtn (NZAC). Farewell Spit, Fossil Pt (LUNZ). Golden Downs (FRNZ). Haupiri Ra., Boulder L. (MONZ). Karamea (NZAC). L. Sylvester (LUNZ). Mangarakau, 1 km S (LUNZ). Mt Arthur (NZAC), Flora Hut (NZAC). Nelson (NZAC). Riwaka (FRNZ). Rosedale (Valentine 1964). Takaka Hill saddle (NZAC). Wairoa Gorge (LUNZ). **NN/BR.** Waimangaroa (LUNZ). **OL.** Dart Hut (NZAC). Hollyford Rd, end (NZAC). Kinloch (NZAC). L. Wakatipu (CMNZ). Route Burn, hut (UCNZ). **SC.** Mesopotamia

(LUNZ). Peel Forest (LUNZ), Scotsburn Stm (UCNZ). **SD.** Mt Stokes, Okoha Saddle (LUNZ). Port Underwood (NZAC). Ship Cove (NZAC). Stephens I. (MONZ). **SL.** Beaumont (FRNZ), Beaumont S.F. (LUNZ). Bluff (NZAC). Conical Hill (FRNZ). Dolamore Park (NZAC). Invercargill (NZAC). Pebbly Hills S.F. (FRNZ). **WD.** Awatuna Rd (LUNZ). Canavans Knob (LUNZ). Evans Ck (Valentine 1964). Fox Glacier (LUNZ), moraines below (LUNZ). Franz Josef (NZAC), Alex Knob (LUNZ, NZAC). Gillespies Beach (NZAC). Haast (FRNZ). Harihari (UCNZ); Wanganui R. mouth (UCNZ), L. Janthe S.F. (LUNZ). L. Mapourika (MONZ). L. Paringa (NZAC). Mt Aspiring N.P., Haast Pass road, Greenstone Flat (NZAC). Mungo Peak and Saddle (NZAC). Okarito (UCNZ). Ross (MONZ). South Westland (NZAC). Waiho Gorge (MONZ). **Stewart I.** Bragg Bay (MONZ). Broad Bay (UCNZ). Codfish I. (UCNZ). Halfmoon Bay (UCNZ). Mason Bay (NZAC), near airstrip (UCNZ). North Arm area (FRNZ). Oban (NZAC). Port Pegasus, old hut (NZAC). Rakcahua Vly (NZAC). Shipbuilders Cove (UCNZ). Ulva I. (UCNZ).

Bioecology. **HABITAT.** The only true forest-dwelling pentatomoid in New Zealand, found mainly on trees and shrubs, usually near water, in or at the edge of native and mixed native/exotic forests. Sometimes collected on grasses in forest clearings or on lakeshores, riverbanks, and seashores, but always near forested areas, and more rarely in high-altitude scrub, tussocklands, or subalpine vegetation. Commonly seen basking around habitations, on wooden fences, walls, roads, paths, etc. Often collected on *Coriaria* sp., *C. arborea*, *Dacrydium cupressinum*, *Nothofagus* species including *N. menziesii*, *Pinus radiata*, *Schefflera* sp., and tree ferns. Less commonly recorded on *Astelia nervosa*, *Brachyglottis* sp., *Carex* spp., *Carex/Scirpus* associations, *Celmisia armstrongii*, *C. walkeri*, *Cytisus scoparius*, *Fuchsia* sp., *Geniostoma ligustrifolium*, *Griselinia* sp., *Hebe* species including *H. salicifolia*, *Melicytus* sp., *Metrosideros* species including *M. excelsa* (canopy), *Myoporum laetum*, *Olearia* sp. (in flower), *Phyllocladus* sp., *Pittosporum eugenioides*, *Polystichum vestitum*, and *Pseudowintera* sp. Occasionally found on *Daucus carota* (in flower), *Hordeum vulgare*, *Ribes* spp., and *Rubus australis*. Literature records (Myers 1926): *Cortaderia richardii*, *Fuchsia excorticata*, *Plagianthus divaricatus*, liliaceous epiphytes, *Astelia* sp. in a recently felled rimu, and in *Phormium* swamps; nymphs from *Arundo conspicua* (= *Cortaderia richardii*) and *Fuchsia excorticata*. The foregoing list, although useful in determining ecological preferences, includes mostly 'siting' records. Only *Coriaria arborea* is a confirmed host plant, although *Fuchsia excorticata*, *Melicytus ramiflorus*, *Nothofagus* spp., and *Olearia* spp. are likely to be host plants.

ALTITUDINAL RANGE. Coastal lowlands to subalpine zone.

SEASONALITY. Phenological trends: see Fig. 128. Adults collected in all months, but apparently most abundant in October and January, or in November and February at higher altitudes and in cooler areas. Eggs found from mid to late January (NN, WD) (Valentine 1964). Penultimate-instar nymphs collected in February (HB, WD), and last-instar nymphs in December (AK, CL) and February (BR, WD). Both these instars collected in January on the South Island (Myers 1926).

LIFE HISTORY. Life cycle: egg - 5 nymphal instars - adult. The egg, oviposition and hatching, and all nymphal instars have been described by Myers (1926), who made the following observations in the laboratory. Mating occurs late October to early November; eggs laid at end of October (early November in the field); duration of egg stage 1.5 months; eggs hatch around mid November; 1st instar lasts about 4 days, 2nd instar 24 days. Apparently univoltine.

OVERWINTERING. Overwinters as an adult; individuals collected in July and August in litter, moss, under logs, and at base of tussocks. Adults become active and emerge from shelter on warmer, sunny winter days, and can be found on vegetation.

ACTIVITY. Adults spend the night on foliage of trees and shrubs. Myers (1926) described the activity of 1st-instar nymphs in captivity after ecdysis.

FOOD. Phytophagous. Myers (1926) suggested that nymphs may have a more restricted diet than adults, being more plentiful on grasses and allied plants than on trees and shrubs.

ENEMIES. Adults collected quite fresh and untouched in web of a full-grown epeirid spider, *Araneus pustulosus* (= *Eriophora pustulosa*), from which Myers (1926) suggested that they may be distasteful to spiders. Eggs parasitised by *Asolcus* sp. (= *Trissolcus*) (Valentine 1964).

Dispersal power. Fully winged, and observed flying in hot sunshine in September (WN). Flight also inferred from collection at artificial light in September (WN), November (OL), and February (WI). Cumber (1953) reported adults flying at light in February (ND). Individuals apparently wind-blown have been found on a glacier at Mt Ruapehu (Myers 1926).

Economic importance. Apparently none.

Biodiversity and conservation. Being endemic, highly distinctive, and monotypic at the generic level, *O. vittatus* can be attributed high scientific value from a New Zealand perspective. Since it has a broad distribution, apparently broad ecological requirements, and good dispersal capabilities, its survival in the wild is obviously not threatened.

Family PENTATOMIDAE

Genus *Cermatulus* Dallas

Cermatulus Dallas, 1851: 106. Type species *Aelia nasalis* Westwood, 1837: 32, by monotypy.

Description. Body broadly oval, slightly convex or subdepressed above.

Head blunt or broadly rounded apically, about as long as width through eyes or distinctly shorter; disc subdepressed; antecular margins concave; juga subequal in length to tylus. Antennae 5-segmented. Rostrum reaching between middle and hind coxae.

Thorax. Pronotum: disc slightly convex, undulant, or rather flat, sometimes declivous in front; anterolateral margins with or without a few irregular crenulations, especially along anterior half, almost rectilinear with humeri (Fig. 87-89); humeri triangular or roundish but not produced into prominent spines (Fig. 87-89). Scutellum broadly rounded apically. Metathoracic scent gland opening with an auricle. Hemelytra slightly shorter than or distinctly surpassing tip of abdomen. Legs: tibiae with a distinct groove along dorsal surface.

Abdomen. Posterolateral angles of connexival segments quadrate or rounded. Ventral spine produced into a tubercle reaching to near or between hind coxae (Fig. 91).

Remarks. Monotypic (Gross 1975b). *C. nasalis* occurs in Australia, Timor, and New Zealand.

Cermatulus nasalis nasalis (Westwood)

Fig. 9, 25, 87, 92, 94, 96, 98, 129; Map 9
nasalis Westwood, 1837: 32 (*Aelia*).

Adult (Fig. 9). Body yellowish-brown, orange-brown, or reddish-brown, with dark brown or black markings on head, pronotum, scutellum, disc of hemelytra, and antero- and posterolateral angles of connexival segments, and numerous rather coarse, deep punctures dorsally.

Head. Antennal segments reddish-brown or blackish, usually paler basally, with segments 3, 4, and distal half of segment 5 often infusate.

Thorax. Pronotum: anterior lobe paler smooth yellowish in front of calli; posterior lobe brownish, densely punctured; calli smooth, black, contrasting with surrounding pale areas punctured with brown; disc undulant, declivous in front; anterolateral margins at a slight angle to humeri (Fig. 87); humeri roundish or slightly sinuate, projecting laterally noticeably beyond base of hemelytra (Fig. 92). Scutellum with a deep black pit at basal angles, smooth and

pale apically; disc often with a large, Y-shaped median brown or black mark. Hemelytra: corium with a smooth brown spot on disc; membrane infuscate, with veins well developed. Legs yellowish-brown, tinged with reddish-brown; upper surface of fore femora often densely maculated with brown; middle and hind femora with scattered brown maculations; tibiae reddish-brown.

Abdomen. Connexivum yellowish, with scattered brown maculations in centre of segments and a blackish spot at each angle. Venter yellowish-brown, with dense brown punctures.

Genitalia. Male: pygophore (Fig. 94) in caudal view with lateral lobes rather narrowly rounded, slightly produced laterally, with dorsal margins slightly sinuate; inner margin of ventral rim more or less rectilinear, with a shallow, V-shaped median depression; parandria oblong, sculptured; claspers (Fig. 96) with visible portion of head somewhat C-shaped, acuminate. Female: 1st gonocoxae (Fig. 98) swollen, with angle between inner and posterior margins broadly rounded; paratergites 9 broadly rounded apically, extending beyond tip of abdomen.

Body length: male 9.11–11.06 (9.91) mm; female 10.42–12.23 (11.15) mm. Humeral width: male 5.08–6.12 (5.46) mm; female 5.21–7.03 (5.84) mm.

Other characters as in generic description.

Last-instar nymph (Fig. 25). Head dark reddish-brown or blackish, smooth dorsally and ventrally. Antennal segments 1 and 4 black; segments 2 and 3 brownish-yellow, darkening apically. Rostrum dark brown, with ventral surface yellowish.

Thorax. Notae dark reddish-brown, nearly black, with punctures concolorous; pronotum broadly smooth yellowish-white along proximal half of lateral margins; outer margin of mesothoracic wing pads narrowly yellowish-white in proximal quarter. Mesothoracic wing pads extending onto 3rd abdominal segment. Ventral surface pale reddish-yellow medially, shading to dark reddish-brown on pleura. Legs dark reddish-brown, nearly black.

Abdomen. Terga yellowish-white or brownish-yellow, mostly covered by large, dark, sclerotised plates; a dark crescent-shaped mark on lateral borders of segments; terga 3–6 with large, almost contiguous black median plates; tergum 7 with a smaller median plate. Venter dark reddish-brown medially, becoming paler midlaterally and darkening towards lateral margins, with a dark crescent-shaped mark on lateral borders of each segment; spiracles and trichobothria outlined in blackish.

Body length: 8.44–9.12 mm.

Type data. "One female in the Hope Collection, University of Oxford" (Gross 1975b).

Material examined. 230 non-type examples (104 males, 196 females, 30 nymphs).

Geographical distribution (Map 9). **North I. AK.** Auckland (NZAC). Avondale (NZAC). Birkenhead (AMNZ). Clevedon (NZAC). Grafton Gully (NZAC). Henderson (NZAC). Sunnyvale (AMNZ). Huia, dam (NZAC). Mahurangi (AMNZ). Manukau County (AMNZ). Maraetai (FRNZ). Marotere Is (NZAC). Noises Is, Otata I., central plateau (AMNZ). Orakei (AMNZ). Owhira (NZAC), swamp (NZAC). Pukekohe (Myers 1926). Puketutu I. (NZAC). Rangitoto I. (Myers 1926). Riverhead (FRNZ). Sandringham (AMNZ). Titirangi (NZAC). Waimahia (FRNZ). Waitakere Ra (NZAC). Waituku S.F. (FRNZ). Warkworth (AMNZ). Woodhill (FRNZ). **BP.** Awakeri (NZAC). L. Tikitapu (Blue Lake) (NZAC). Mamaku, beach (FRNZ). Mamaku S.F. (FRNZ). Matahina (FRNZ). Matakana I. (FRNZ). Mount Maunganui (FRNZ). Mt Te Aroha (AMNZ). Omanawa (FRNZ). Rotochu (FRNZ). Rotorua (AMNZ). Te Puke, 8 km S (LUNZ). Waimangu Vly (AMNZ). Waireka (FRNZ). **CL.** Aldermen Is (The), Ruamahuanui I. (NZAC). Cuvier I. (MONZ). Great Barrier I.: Katherine Bay, Kawa Vly (MONZ). Junction Is, Large I., W end of ridge (NZAC). Little Barrier I., west landing (NZAC). Mercury Is, Red Mercury I. (NZAC). Mayor I. (FRNZ). Tairua (FRNZ). Tapu (NZAC). Waikawau Bay, road above Little Bay (LUNZ). Whitianga (NZAC). **GB.** Karaka Bay (MONZ). L. Waikaremoana (MONZ). **HB.** Clifton (MONZ). Haumoana (NZAC). Rukumoana (FRNZ). Kaweka Ra., Wardles Ck (FRNZ). Waipawa (Eyles 1960). **ND.** Dargaville (UCNZ). Glenbervic (FRNZ). Houhora, chalets (NZAC). Kaikohe (NZAC). Maungakaramea (MONZ). Maunganui Bluff (NZAC). Omahuta (FRNZ). Onerahi (NZAC). Puhipuhi (FRNZ). Rangitiki (FRNZ). Tangihua Ra., Tangihua Lodge (NZAC). Tutukaka Harbour, S Gable I. (NZAC). Waipoua S.F. (AMNZ). Whangaroa County (AMNZ). Whau Vly (MONZ). **RI.** Komako (NZAC). Taihape: 4.8 km N (NZAC); Hautapu R. (NZAC). **TK.** Mt Egmont (NZAC), Dawson Falls, near tourist lodge (NZAC). New Plymouth area (FRNZ). Ohangi (MONZ). Pouakai Ra., S flank (NZAC). Stratford (AMNZ). **TO.** Broadlands (FRNZ). Erua (FRNZ), SH 4 (LUNZ). Karioi (FRNZ). L. Otamangakau (NZAC). Makatote (Myers 1926). Mt Tongariro (LUNZ). Ohakune (NZAC). Rangitaiki Plains (NZAC). Taupo (NZAC). Taurewa (FRNZ). Tokaanu (MONZ). Wairapukao (FRNZ). **WA.** Ngaumu (FRNZ). **WI.** Flock House (FRNZ). Himatangi (FRNZ). Ohingaiti (NZAC). Palmerston North (NZAC), Massey College grounds (NZAC). Wanganui (FRNZ). Wanganui R. (Myers 1926). Whirokino (FRNZ). **WI/WN.** Paiaka (NZAC). **WN.** Akatarawa R. (MONZ). Kaitoke (MONZ). Karori (MONZ).

Korokoro (MONZ). Levin (FRNZ). Linton (NZAC). Norton, S (NZAC). Orongorongo S.F. (NZAC). Waikanae (Myers 1926). Waitarere (FRNZ). Wellington (MONZ); Brooklyn (MONZ); Kelburn (MONZ); Wiltons Bush (MONZ). WO. Kawhia, W, Ocean Beach (AMNZ). Pukeatuna bush (NZAC).

South I. BR. Buller County (AMNZ). Fairdown (FRNZ). L. Rotoroa (NZAC). Punakaiki (NZAC), blowholes (LUNZ). Reefton (FRNZ). DN. Dunedin (OMNZ). FD. Greenhills (NZAC). Homer, Saddle or Tunnel (MONZ). KA. Oaro (LUNZ). Puhupuhi Reserve (NZAC). MB. Hanmer (FRNZ). MC. Banks Peninsula, Kaituna Vly (UCNZ). Christchurch (Myers 1926). Lincoln (LUNZ). NC. Eyrewell (FRNZ). Mt Grey (NZAC). NN. Abel Tasman N.P., Anapai Bay track (LUNZ). Atawhai (NZAC). Brightwater, Snowden's Bush (NZAC). Cobb Vly (FRNZ), Iron Hill and Sylvester Track (FRNZ). Dun Mtn (NZAC). Kaihoka Lakes (NZAC). Lee Vly (NZAC). Maitai Vly (UCNZ). Nelson (NZAC), Botanical Hill (NZAC). Tahunanui (NZAC). SC. Peel Forest (UCNZ). SD. French Pass (NZAC). Stephens I. (NZAC). SL. Invercargill (NZAC). Pahia (NZAC). WD. Mt Hercules (LUNZ).

Bioecology. HABITAT. Occurs on a wide range of native bushes and trees during summer, and on lower vegetation such as herbs and tussocks during cooler months. Commonly found on *Kunzea ericoides*, *Leptospermum scoparium*, and exotic trees (often in plantations) such as *Eucalyptus* spp., *Pinus contorta*, *P. muricata*, *P. radiata*, *P. taeda*; to a lesser extent on *Coriaria* sp., *Dracophyllum* sp., *Geniostoma* sp., *Nothofagus* sp., *Pittosporum* sp., *Dacrycarpus dacrydioides*, *Pseudowintera* sp., and *Schefflera* sp. Collected also on garden plants, various agricultural crops, and around orchards, especially with *Kunzea* or *Leptospermum* nearby. Eyles (1960) recorded nymphs on chou and seedheads of *Amaranthus retroflexus*, and Kirkaldy (1909b) on *Metrosideros scandens*.

ALTITUDINAL RANGE. From sea level to around 2000 m on the North Island, or 1200 m on the South Island.

ASSOCIATED SPECIES. *Paropsis charybdis* on blue gum (AK), and *Scolypopa australis* on *Schefflera* (ND).

SEASONALITY. Phenological trends: see Fig. 129. Adults collected in all months except July, August, and September on the South Island; apparently most abundant in October, February, and March. Early instars found in January and February (HB), 4th instars in January (SD), and 5th instars in November (AK) and January (WO, WD).

LIFE HISTORY. Life cycle: egg - 5 nymphal instars - adult. The egg, hatching, and instars 1 and 5 have been described, and the egg and 5th instar illustrated by Myers (1926). Apparently univoltine. Awan (1988) studied the mating behaviour. Myers (1926) observed a batch of a dozen eggs

on the leaf of a fruit-tree, and also a cluster consisting of 2 rows of about 10 eggs each on a slender twig. Thought to undergo a reproductive diapause at 15°C (Awan 1988).

OVERWINTERING. Overwinters as an adult, and possibly also as a 5th-instar nymph. Adults collected on ground under apple tree in October (WN), under a stone in garden in May (WO), and under bark of *Dacrycarpus dacrydioides* log in winter. Adults active on *Geniostoma* sp. and *Rubus ursinus* in August (CL, AK), and on *Pinus radiata* in June and July (ND).

FOOD. Reported often feeding on larva of *Danaus plexippus* (AK, BP, CL, ND). Adults in captivity observed feeding on leafrollers. Also noted feeding on *Vanessa gonerilla* (= *Bassaris gonerilla*) and on larvae of *Asaphodes* (= *Homodotis*) *megaspilata* (Gross 1975b), on *Paropsis charybdis* on *Eucalyptus* sp. (Styles 1970), and on *Caliroa cerasi*, the pear and cherry slug (Valentine 1970). In Australia also feeds on larvae of a native sawfly living on *Eucalyptus* sp. (Gross 1975b).

REARING. Reared from egg to adult on *Heliothis punctiger* (= *Helicoverpa punctigera*) (Awan 1988).

ENEMIES. Eggs apparently parasitised by *Asolcus* (*Microphanurus*) (= *Trissolcus*) *basalis* and an indigenous species of *Asolcus* (*M.*) (= *Trissolcus*), referred to as "species N" by Cumber (1964).

ACTIVITY. Adults found at night by sweeping (February, TK) and beating vegetation (September, WN). Myers (1926) described the behaviour and activities of nymphs.

Dispersal power. Adults are fully winged. Flight inferred from collection at artificial light (October, AK) and indoors (June, MC).

Economic importance. A beneficial insect; one of our most important predatory Heteroptera.

Biodiversity and conservation. *C. nasalis* is an indigenous, widespread, beneficial species which occurs also in Australia.

Remarks. According to Gross (1975b) most South Australian material is typical of the nominate subspecies, but there may prove to be several subspecies in Australia distinct from the two recognised in New Zealand, and another described from Tasmania (Gross 1975b).

Myers (1926) published substantial notes on the egg, nymphs, life history, seasonal occurrence, host plants, and feeding habits of *Cermatulus nasalis*, but the subspecies were not recognised at that time. To avoid confusion, Myers's observations suspected of being based on South Island specimens are omitted here, because it is uncertain to which subspecies they refer.

***Cermatulus nasalis hudsoni* Woodward**

Fig. 10, 88, 93; Map 10

hudsoni Woodward, 1953: 307 (*Cermatulus nasalis*).

Adult (Fig. 10). Differs from *C. nasalis nasalis* and *C. nasalis turbotti* in the following characters.

Body pear-shaped; coloration much as for *C. nasalis nasalis*, but punctures finer. Pronotum: disc rather flat or slightly convex, not declivous in front; anterolateral margins more or less rectilinear to humeri (Fig. 88); humeri roundish, not or scarcely projecting beyond base of hemelytra (Fig. 93). Connexival segments with posterolateral angles rounded.

Body length: male 7.81–9.24 (8.64) mm; female 9.11–10.55 (9.64) mm. Humeral width: male 3.78–4.95 (4.45) mm; female 4.29–5.40 (4.81) mm.

Type data. Holotype: female (MONZ) labelled "Arthur Pass; 20 Jan. 1940; 10 U.; Hudson Coll. (handwritten) / HOLOTYPE; (GVH no. 10 u) (red) / *Cermatulus nasalis*; subsp. *hudsoni* Woodward; Holotype [female] (u) / National; Museum; Wgm NZ."

Paratype: 1 female (MONZ).

Material examined. Type specimens, plus 48 non-type examples (14 males, 32 females).

Geographical distribution (Map 10). **South I. CO.** Great Moss Swamp, SE (Barratt & Patrick 1987). Horn Ra. (The) (LUNZ). Obelisk Ra. (OMNZ). Rocklands (NZAC). **FD.** Gertrude Saddle (FRNZ). **MB.** Wairau Vly (upper): Rag and Famish (NZAC); bridge above Judges Ck (NZAC). **MC.** Bealey, 4.8 km E (NZAC). Mt Bailey (Ramsay 1963). Mt Magog (Ramsay 1963). Rakaja Vly (NZAC). Rolleston Ra. (UCNZ). Wilberforce R.: Burnet Stm (UCNZ); Kakapo Stm (UCNZ). **MK.** Mt Cook N.P. (LUNZ); Ball Hut, near (UCNZ); Liebig Ra. (LUNZ), Ailsa Pass (NZAC); Mt Cook (LUNZ); Mt Wakefield (LUNZ, UCNZ); Hermitage (The), near (MONZ); Red Lakes track (LUNZ); Sealy Ra. (LUNZ), Sealy Tarn (LUNZ); Stocking Stm (LUNZ). **L.** Ohau, Parsons Bush (UCNZ). Rees Saddle (NZAC). **NC.** Arthurs Pass N.P.: Arthurs Pass (CMNZ); Avalanche Basin (NZAC); Bealy Vly (upper) (LUNZ). **NC/MC.** Canterbury (NZAC). **NN.** Mt Owen (NZAC). Nelson (NZAC). **OL.** Ahuriri R. (upper) (CMNZ). **L.** Hawea, The Neck (NZAC). **L.** Wakatipu, Rees Vly, Little Devil Ck (UCNZ).

Ecology. HABITAT. Found on low vegetation and shrubs in montane to subalpine habitats such as tussock grasslands, high-altitude podocarp-broadleaved forests, scrublands, and screes. Collected on *Cassinia* sp., *Chionochoa* sp.,

Muehlenbeckia sp., *Olearia* sp., *O. moschata*, and *Raoulia tenuicaulis*.

ALTITUDINAL RANGE. From about 800 m to over 1900 m, but more common around 1200 m.

SEASONALITY. Adults collected in all months except May, July, and August, but apparently most abundant in October, November, and February. Last-instar nymphs collected in mid January (MC) (Ramsay 1963).

LIFE HISTORY. Life cycle as for nominate subspecies. Mating observed in late October (NC). Apparently univoltine.

OVERWINTERING. Apparently overwinters as an adult.

FOOD. Adults observed sucking body contents from monarch butterfly (*Danaus plexippus*) larvae (NN). Ramsay (1963) saw a 5th instar with its stylets inserted through the thoracic dorsum of a *Crambus vittellus* moth, and two other individuals tussling over a small lepidopterous larva into which they had inserted their stylets.

ACTIVITY. Adults collected at night on tussock in November (MK).

Dispersal power. Most specimens examined have hind wings about one-third shorter than the hemelytra; active dispersal by flight is thus unlikely.

Biodiversity and conservation. *C. nasalis hudsoni* is an endemic subspecies for which we have very little biological information. It has a disjunct distribution in the South Island high country, in habitats currently classed as at risk.

Remarks. A melanic form is completely black except for the antennae, which are reddish-brown with segments 3, 4, and the distal half of segment 5 infuscate, and yellowish markings on antecular margins of head, anterolateral margins of pronotum, outer margins of hemelytra, apex of scutellum, and outer margins of connexivum.

There seems to be no geographical discontinuity between *C. nasalis nasalis* and *C. nasalis hudsoni* on the South Island. Individuals (9 males, 16 females) of what appear to be intergrade populations have, however, been collected in the following locations. **CO.** Kawarau Gorge, Gentle Amie (NZAC). Pisa Ra., Nend (NZAC). Rocklands (NZAC). **DN.** Leith Saddle (OMNZ). Warrington (NZAC); Warrington Beach (NZAC). **FD.** Greenhills (NZAC). Mt Burns (NZAC). Olivine Ra., W. Tempest Spur (NZAC). **MB.** Mt Chrome, plateau (NZAC). **MC.** Banks Peninsula: Birdflings Flat (UCNZ); Little River (AMNZ). **NC.** Arthurs Pass N.P.: Andrews Stm; (NZAC); Shale Peak (UCNZ). **NN.** Cobb Vly, L. Sylvester (NZAC). Dun Mtn (NZAC). Gordons Pyramid (UCNZ). Nelson (NZAC). **SC.** Mt Somers (NZAC). **SD.** Rarangi (AMNZ). Stephens I. (MONZ). **WD.** L. Paringa (NZAC).

Such intermediate zones in which both subspecies might survive or might have co-existed in the past had been hypothesised but never clearly identified by Woodward (1953). The zones of intergrades occupy altitudes roughly in the range 800–1300 m, and are believed to have resulted from secondary intergradation (populations have differentiated in disjunction, and have expanded into secondary contact, with interbreeding). The present range of the two subspecies and of hybrid populations is consistent with events related to alternate expansion and constriction of habitats during the Pleistocene, and adaptation of *C. n. hudsoni* to a distinct, topographically determined subalpine ecology.

Sufficient differentiation (but not speciation) is thought to have occurred in past isolation to have resulted in the 'unbalanced' expression of the phenotype which can be observed in individuals from the above populations, especially with respect to colour, degree of development of humeri, and body form; the body may appear more or less pear-shaped.

Cermatulus nasalis turbotti Woodward

Fig. 11, 89; Map 11

turbotti Woodward, 1950: 24 (*Cermatulus*).

Adult (Fig. 11). Differs from *C. nasalis nasalis* and *C. nasalis hudsoni* in the following characters.

Body yellowish, marked and coarsely punctured with dark brown dorsally, with metallic greenish or bronzy reflections dorsally on head, pronotum, scutellum, and abdomen, and ventrally on mesosternum. Head broadly rounded apically; antennal segment 1 reddish-brown with a black longitudinal streak on sides; other segments reddish-brown, with distal half or two-thirds infuscate. Pronotum: anterolateral margins (Fig. 89) at a sharper angle to humeri than in *C. nasalis nasalis* (Fig. 87), their anterior portion without crenulation; humeri blunt, triangular.

Body length: female 11.33–14.00 mm. Humeral width: 5.73–7.5 mm.

Last-instar nymph. I have seen only 5 nymphs, in poor condition (AMNZ). They appear to be structurally similar to nymphs of the nominate subspecies, except that the dark colour of the cuticle is replaced by a bright metallic green.

Type data. Holotype: female (AMNZ) labelled "Great I., Three Kings; 6 MAY 46 E.G. Turbott; Tea-tree Tasman Valley (handwritten) / Tea-tree; Tasman Vy.; Three Kings Is.; 6.V.1946; EG Turbott (handwritten) / Three Kings Is.; N. of North I.; NEW ZEALAND; Auckland Museum / Holotype (handwritten) / HOLOTYPE [female];

Cermatulus; turbotti Woodw.; T.E. Woodward 1950 (red, handwritten)."

Paratypes: 2 females, same data as holotype (AMNZ).

Material examined. Type specimens and 5 non-type nymphs.

Geographical distribution (Map 11). **Offshore islands.** Three Kings Is, Great I. (AMNZ).

Bioecology. See Remarks for data on habitat and seasonality.

LIFE HISTORY. Life cycle: apparently egg – 5 nymphal instars – adult. Second, 3rd, and last nymphal instars described by Woodward (1954). Adults and nymphs examined all found on kanuka (*Kunzea ericoides*). Third and last instars collected around mid January.

Dispersal power. Unknown, but adults fully winged.

Biodiversity and conservation. This very narrowly endemic subspecies, for which we have very little biological information, is known only from a Three Kings Islands population. This is represented in New Zealand collections by only a few specimens, collected in the early 1950s. The current status of this population is unknown.

Remarks. The material examined suggests that *Cermatulus nasalis turbotti* and *C. n. nasalis* are morphologically quite distinct. In fact, they differ probably as much in external morphology as generally do closely related pentatomid species. In the absence of a universally applicable definition of species and subspecies, however, and in view of the limited amount of material at hand, the distinctive nymphal coloration, and the lack of male specimens, the subspecific status of this taxon is here conserved.

Other specimens, including males and nymphs, were apparently collected by Turbott and Woodward during an Auckland Museum expedition in the summer of 1951. Woodward (1954) described them as follows: "On the 1951 expedition, the following specimens were collected, all from Great Island: 2 adults from near depot (1 [male], 12/1/51 E.G. Turbott; 1 [male], 14/1/51 TEW); 4 last (fifth) instar nymphs (2 from the eastern slopes of Tasman Valley, 12/1/51; 2 from East Point, 14 and 15/1/51, TEW); 3 young nymphs from eastern slopes of Tasman Valley, 12/1/51 (1 second instar, 2 third instars, TEW). All except one of the specimens were taken from kanuka (*L. ericoides*) [= *Kunzea ericoides*]; one of the fifth instar nymph from East Point was on *L. scoparium* Forst. (Manuka)." Unfortunately, except for three of the four last-instar nymphs and the two third-instar nymphs from Tasman Valley and East Point, this additional material could not be located.

Genus *Oechalia* Stål

Oechalia Stål, 1862: 93. Type species *Pentatoma schellenbergii* Guérin, 1831: 166, by monotypy.

Description. Body slender, somewhat triangular in outline, subdepressed above.

Head narrowly rounded apically, much longer than its width through eyes; disc subdepressed; antecular margins concave; jugs subequal in length to tylus. Antennae 5-segmented. Rostrum reaching to about middle coxae or slightly beyond.

Thorax. Pronotum: disc slightly convex, declivous in front; anterolateral margins regularly crenulate, especially along anterior half, forming an obtuse angle to humeri; humeri acuminate, produced into a sharp outward-directed spine (Fig. 85). Scutellum acuminate apically. Metathoracic scent gland opening slit-like, without an auricle. Hemelytra surpassing tip of abdomen. Legs: middle and hind tibiae with a distinct groove along dorsal surface.

Abdomen. Posterolateral angles of connexival segments subacute to acute (Fig. 86). Ventral spine strong, reaching forwards to near middle coxae (Fig. 90).

Remarks. Of the 15 species at present recognised, all but one (*O. schellenbergii*) are restricted to Hawaii. *O. schellenbergii* does not occur in Hawaii, but in Australia (including Tasmania), New Zealand, and most of southern Oceania (Gross 1975b).

Oechalia schellenbergii (Guérin)

Fig. 12, 26, 85, 86, 90, 95, 97, 99, 130; Map 12

schellenbergii Guérin, 1831: 166, pl. 11 fig. 9 (*Pentatoma*).
Stål 1862: 93 (*Oechalia*).

Adult (Fig. 12). Body somewhat triangular, brownish-yellow with paler calloused areas on pronotum, tip of scutellum, and coria; dorsal surface of head with close-set, dark punctures along margins and in rows on disc; humeri with dense, deep, brown to black punctures; remainder of dorsal surface with crowded dark punctures, these coalescing on posterior lobe of pronotum and inner region of coria.

Head. Antennal segments brownish, tinged with orange.

Thorax. Calli brown, inconspicuous. Scutellum: basal angles rather smooth; tip smooth yellowish or cream; disc lacking distinct markings. Hemelytra: membrane infusate, with veins dark brown. Legs yellowish, with a few scattered brownish maculations on femora.

Abdomen. Connexivum yellowish, with more or less triangular dark patches at segmental junctures; posterolateral angles of segments acute, tipped with black (Fig. 86).

Venter pale yellow, almost impunctate at middle, otherwise with rather dense brown punctures.

Genitalia. Male: pygophore (Fig. 95) in caudal view with lateral lobes rounded; dorsal margins strongly arcuate; inner margin of ventral rim strongly sinuate, with a shallow, U-shaped median depression; parandria oval, hollow, with crenulate margins; clasper (Fig. 97) with visible portion of head somewhat triangular, crenulate. Female: 1st gonocoxae (Fig. 99) flat, with angle between inner and posterior margins acute; paratergite 9 narrow, somewhat rectangular apically, short, not attaining tip of abdomen.

Body length: male 8.79–9.78 (9.29) mm; female 9.65–12.59 (11.30) mm. Humeral width: male 5.00–5.70 (5.37) mm; female 5.61–7.76 (6.48) mm.

Other characters as in generic description.

Last-instar nymph (Fig. 26). Head. Dorsal surface black, outlined in whitish, with whitish bands at base along midline, sometimes also in front of ocelli; ventral surface mostly pale yellow or yellowish-white. Antennal segment 1 black; segment 2 black, with tip yellowish; segments 3 and 4 dark reddish-brown, almost black. Rostrum yellowish, shading to pale brown apically.

Thorax. Notae dark reddish brown, nearly black, with fine concolorous punctures and a narrow, pale median line with a series of adjacent whitish spots; pronotum and proximal half of mesothoracic wing pads with smooth, white outer margins. Mesothoracic wing pads extending onto 3rd abdominal segment. Ventral surface pale yellow or yellowish-white, with scattered coarse, brown punctures on pleura. Femora yellowish at base, speckled with dark brown or blackish, solid black at apex; tibiae dark brown or blackish at base and apex, yellowish medially; tarsi dark brown or black.

Abdomen. Terga yellowish-white, tinged with reddish; a triangular blackish mark on lateral borders of segments; tergum 3 with a blackish plate on posterior margin, to either side of middle; terga 4 and 5 with much larger median plate on posterior margin; tergum 7 with a smaller median plate. Ventral surface pale yellowish, tinged with reddish; most sterna with a brown medial spot; a brown, ill defined, crescent-shaped mark on lateral borders of segments. Spiracles and trichobothria outlined in black and reddish.

Body length: 7.56 mm (only 1 specimen studied).

Type data. Undetermined (Gross 1975b).

Material examined. 94 non-type examples (29 males, 64 females, 1 nymph).

Geographical distribution (Map 12). North I. AK. Auck-

land (AMNZ). Bethells, W end of swamp (NZAC). Kourawhero (AMNZ). Pukekohe (NZAC), Research Station (NZAC). Whatipu (AMNZ). Woodhill (FRNZ). **AK/ WO.** Maramarua S.F. (FRNZ). **BP.** Matakana I. (FRNZ). Rotoehu (FRNZ). Whakarewarewa (FRNZ). **CL.** Amodeo Bay (AMNZ). Coromandel (NZAC). Little Barrier I., grass flat E end Te Maraeroa (AMNZ). Thames (NZAC). **GB.** Gisborne (NZAC), Kaiti Hill (NZAC). **HB.** Hastings (NZAC). Hawkes Bay (NZAC). Rukumoana (FRNZ). **ND.** Houhora (NZAC). Kaihu Vly (FRNZ). Kerikeri (NZAC). Mangamuka (NZAC). Paihia (NZAC). Puhupuhi (FRNZ). Puketona (Eyles 1960). Te Pahi, Station (LUNZ). Twin Bridges (NZAC). Waitangi (FRNZ). Whale I. (Quilter 1971). Whangarei (AMNZ). **TK.** Awakino (LUNZ). New Plymouth (NZAC). Waitara (NZAC). **TO.** Broadlands (FRNZ). **WI.** Wanganui, Castlecliff (NZAC). Marton (MONZ). Santoft, Forestry H.Q. (FRNZ). **WN.** Waitare (MONZ). **WO.** Cambridge (AMNZ). Hamilton (NZAC). Kawhia, W. Ocean Beach (AMNZ). Morrinsville (NZAC). Te Kuiti (NZAC). **WO/BP.** Te Aroha (FRNZ).

South I. **CO.** Kawarau Gorge, N (NZAC). **MB.** Blenheim (NZAC). Dumfries (FRNZ). Marlborough (NZAC). Weld Pass (NZAC). **NC.** Eyrewell (FRNZ). **NN.** Annesbrook (UCNZ). Atawhai, Clifton Terrace School (NZAC). Golden Downs (FRNZ). Motueka (Ramsay 1963). Motupiko (NZAC). Nelson (NZAC). Redwoods Valley (NZAC). Richmond (NZAC). **SD.** Rongā Vly (NZAC).

Bioecology. **HABITAT.** Occurs throughout its range on a wide variety of plants, especially introduced crops, horticultural plants, shrubs, and trees. Often collected on *Eucalyptus* sp., *Lupinus arboreus*, and *Pinus radiata*, and also on *Avicennia marina* subsp. *australasica*, *Beta vulgaris*, *Brassicarapa*, *Elaeagnus umbellata* var. *parvifolia*, *Leptospermum scoparium*, *Medicago sativa*, potatoes, *Solanum aviculare*, *Zea mays*, and in orchards, e.g., of macadamia and peach. Literature records: reported on *Rubus fruticosus* and *Cosmos* spp. in gardens (Myers 1926), in apple orchards (Ramsay 1963), and on fodder crops (lucerne, chou, mixed chou and swedes, turnips) (Eyles 1960). Nymphs of various stages and adults found together on *Lupinus arboreus*, which seemingly is used as a host plant.

ALTITUDINAL RANGE. Coastal lowlands to lower montane zone.

ASSOCIATED SPECIES. Found in May on *Cupressus* with tortricid moths. Found in association with *Cermatulus nasalis* in certain habitats (Edwards & Suckling 1980).

SEASONALITY. Phenological trends: see Fig. 130. Adults collected in all months, but most abundant in February and March. Fifth-instar nymphs collected in October (AK). Eggs found in February (Eyles 1960) and March (Valentine 1964).

LIFE HISTORY. Life cycle: egg—5 nymphal instars—adult. Only the egg has been described (Froggatt 1907). Eggs collected on *Rubus* fruits (Cumber 1964, 1975) and chou (Eyles 1960). Mating behaviour and female fertility studied by Edwards & Suckling (1980) and Awan (1988), who also studied development from egg to adult. Diapause apparently not obligatory in New Zealand. Inhibition of oviposition at 15°C, however, suggests a reproductive diapause during winter (Awan 1988). Apparently univoltine.

REARING. Sexually mature adults reared from eggs, in the laboratory, on larvae of *Paropsis charybdis*, a most serious defoliator of eucalypts in New Zealand (Edwards & Suckling 1980) and on *Heliothis punctiger* (= *Helicoverpa punctigera*) (Awan 1988).

OVERWINTERING. In Australia overwinters as an adult (Awan 1988); thought to be the same in New Zealand.

FOOD. Adults collected attacking various caterpillars, e.g., larvae of *Pieris rapae* or *Danaus plexippus*, and preying on early instars of *Pseudaletia separata* (= *Mythimna separata*). Nymphs and adults prey on *Selidosema* (= *Pseudocoremia*) *suavis* (Zondag 1956, Rawlings 1960), and adults prey on *Paropsis charybdis*, the introduced eucalyptus tortoise beetle (Styles 1970, Alma 1980). Ramsay (1963) reported it attacking and preying on larvae and pupae of *Pieris rapae*, feeding on armyworms (*Pseudaletia* (= *Mythimna*) *separata*) which were abundant in oats, feeding in captivity on apple leafrollers, and attacking a large caterpillar of *Heliothis armigera* (= *Helicoverpa punctigera*). Ramsay (1964) reported winemoths and looper caterpillars as food sources. In the laboratory has been fed on the eucalypt defoliators *Antheraea* (= *Opodipthera*) *eucalypti* and *Gonipterus scutellatus* (Edwards & Suckling 1980). Cumber (1975) described the feeding process. Predation rates were studied in the laboratory by Edwards & Suckling (1980). Awan (1984) documented the prey-seeking behaviour against *Heliothis punctiger* (= *Helicoverpa punctigera*) in Australia.

ENEMIES. Cumber (1964) reported the emergence of an indigenous species of *Asolcus* (*Microphanurus*) (= *Trissolcus*), which he referred to as "species N," from eggs collected on *Rubus*. According to Valentine (1964) eggs are also parasitised by *Asolcus* (= *Trissolcus*) *basalis*.

ACTIVITY. Adults collected at night by beating vegetation in February (CO). First-instar nymphs gregarious (Ramsay 1963).

Dispersal power. Unknown, but adults fully winged.

Economic importance. Probably one of our most important beneficial Heteroptera.

Biodiversity and conservation. Although *O. schellenbergii*

seems to be only locally abundant, this probably indigenous beneficial species is not believed to be at risk.

Remarks. Additional useful information on the occurrence, ecology, and biology of *O. schellenbergii*, especially outside New Zealand, can be found in Froggatt (1907), Kirkaldy (1909a), Usinger (1941), Thompson (1944), and Gross (1975b).

Genus *Dictyotus* Dallas

Dictyotus Dallas, 1851: 139. Type species *Pentatoma roei* Westwood 1837: 42, by designation of Kirkaldy (1909c).

Description. Body ovate.

Head broadly rounded apically, usually shorter than its width through eyes; disc flattened; anteocular margins somewhat reflexed; juga longer than tylus, meeting or not in front of it, and if meeting then leaving an apical sinus (Fig. 100). Antennae 5-segmented; segments 1 and 3 much shorter than segment 2. Rostrum reaching about middle coxae or slightly beyond.

Thorax. Pronotum: disc rather flat or moderately convex; anterolateral margins nearly straight or very slightly concave or convex; humeri rounded. Mesosternal keel lacking. Hemelytra slightly surpassing apex of abdomen.

Abdomen. Connexivum: exposed segments with posterolateral angles rounded or squarish.

Remarks. There has been much confusion in the past about the status of species of *Dictyotus*, and the genus itself has been confused with *Oncocoris* Mayr. Gross (1975b) offers a helpful discussion on the taxa that should be placed in *Dictyotus*, or which at one time or another were placed in this genus. He lists eight species for southern Australia, of which *D. caenosus* occurs also in New Zealand.

Dictyotus caenosus (Westwood)

Fig. 13, 27, 100, 106, 107, 118, 131; Map 13

caenosa Westwood, 1837: 42 (*Pentatoma*).

bipunctatus Dallas, 1851: 140 (*Dictyotus*).

plebejus Stål, 1859: 223 (*Dictyotus*).

tibialis Walker, 1867: 309 (*Pentatoma*).

vilis Walker, 1867: 309 (*Pentatoma*).

latifrons Walker, 1867: 561 (*Pentatoma*).

polysticticus Butler, 1874: 26 (*Dictyotus*).

Adult (Fig. 13). Body brown or yellowish-brown, sometimes with a rusty tinge, with brownish to black, coarse,

rather deep and dense punctures dorsally, and with paler anteocular margins of head, anterolateral margins of pronotum, patches at base of scutellum, and apex of scutellum.

Head. Antennae dark or brown, with segments 3, 4, and 5 infusate apically.

Thorax. Pronotum: calli concolorous with remainder of pronotum. Humeri broadly rounded. Scutellum concolorous with adjacent coria, except for a prominent black pit at each basal angle. Hemelytra: corium concolorous with remainder of body; membrane somewhat milkish, with brown, contrasting, reticulate markings. Legs: femora yellowish-brown heavily speckled with dark brown or blackish; middle and hind tibiae usually paler medially than at base and apex.

Abdomen. Connexivum yellow, with a black mark at angles of segments. Venter usually paler than dorsum, with scattered small brownish punctures and a contrasting dark patch around spiracles, as well as at angles of segments; ventral spine lacking.

Genitalia. Male: pygophore (Fig. 106) in caudal view with lateral lobes strongly arcuate, not extending laterally beyond edge of pygophore; inner margin of ventral rim with a deep, V-shaped median depression and a broad, triangular projection on either side; internal wall bearing a pair of ill-defined parandria with wavy lines on their surface; clasper (Fig. 107) with visible portion of head having a twisted appearance. Female: 1st gonocoxae (Fig. 118) undulant, somewhat swollen in middle, with inner posterior angle acute, somewhat produced, giving a sinuate appearance to posterior margin; paratergites 9 acutely tipped, reaching or slightly surpassing tip of abdomen.

Body length: male 7.90–8.90 (8.40) mm; female 7.94–10.05 (8.71) mm. Humeral width: male 4.90–5.80 (5.43) mm; female 4.82–5.90 (5.27) mm.

Other characters as in generic description.

Last-instar nymph (Fig. 27). Head. Dorsal surface brown, with reddish-brown or dark brown punctures, sometimes coalescing in patches between eyes, and yellowish-white lateral margins; ventral surface brownish-yellow or yellowish-white, with reddish and brown punctures. Antennal segments 1 and 2 yellowish-brown; segment 2 often darker at tip; segments 3 and 4 mostly black. Rostrum brownish-yellow, darkening apically.

Thorax. Not brown, with reddish-brown or black punctures; outer margins of pronotum and mesothoracic wing pads broadly smooth yellowish-white. Mesothoracic wing pads extending onto 3rd abdominal segment. Ventral surface pale brownish-yellow, with reddish or brown punctures contrasting with finer ones on venter, becoming darker and heavier around appendages and along outer margins of pleura. Femora brownish yellow, speckled with

brown; tibiae brownish yellow medially, dark brown around base and apex; tarsi blackish.

Abdomen. Terga yellowish-white, tinged with reddish, covered by fine, dense, reddish or brown punctures; a brown, crescent-shaped mark on lateral borders of segments, sometimes reduced to a spot on posterolateral angles; tergum 3 with 2 small, dark brown, elongate plates on either side of midline on posterior margin; terga 4 and 5 with a larger, dark median plate on posterior margin; tergum 7 with a small median plate. Venter yellowish-white or pale brownish-yellow with small reddish punctures, almost smooth at middle; an ill-defined crescent-shaped mark on lateral borders of segments; spiracles and trichobothria outlined in blackish.

Body length: 6.10–8.36 mm.

Type data. “[Male] British Museum (Nat. Hist.), [female] Hope Museum, Oxford” (Gross 1975b).

Material examined. 461 non-type examples (177 males, 247 females, 37 nymphs).

Geographical distribution (Map 13). **North I.** **AK.** Auckland (AMNZ). Avondale (NZAC). Bethells Rd, swamp (NZAC); reserve (Te Henga Reserve) (NZAC). Browns Bay (NZAC). Clevedon (AMNZ). Dargaville (LUNZ). Glen Eden (NZAC). Greenlane (NZAC). Grey Lynn (AMNZ). Henderson (NZAC). Huiia, dam (NZAC). Karioitahi, beach (LUNZ). Kaukapakapa (Michaux 1989). Kauri Gully (AMNZ). Leigh, hill NE of (AMNZ). Mangere (NZAC). Mt Eden, crater (NZAC). Mt Wellington (NZAC). Nihotupu, dam (NZAC). Orakei (NZAC). Oratia (NZAC). Orere Point Rd, S (AMNZ). Owairaka (NZAC). Papaloetoc (AMNZ). Parnell (AMNZ). Piha (NZAC). Pukekohe (LUNZ). Rangitoto I. (AMNZ). Ranui (AMNZ). Riverhead (NZAC). Riverhead S.F. (NZAC). Royal Oak (NZAC). Sandringham (AMNZ). Silverdale (NZAC). Takapuna (CMNZ). Pupuke Golf Course (FRNZ). Tamahunga (AMNZ). Titirangi (AMNZ). Waiheke I. (NZAC). Waitakere Ra. (NZAC). Scenic Drive (NZAC). Warkworth (NZAC). Wellsford (NZAC). Woodhill (FRNZ). **AK/WO.** Maramara (NZAC). **BP.** Hicks Bay (LUNZ). Karewa I., summit (NZAC). L. Tarawera, Karikaria Bay, beside W shore (LUNZ). Opotiki (NZAC). Papamoia (NZAC). Parekarangi, near (NZAC). Rotoehu (Anon. 1957). Rotorua (FRNZ). Tauranga (NZAC). Whakatane (NZAC). **CL.** Coromandel (NZAC), S (NZAC). Cuvier I. (MONZ); main ridge track (AMNZ); N-W bay (AMNZ); N-W valley (AMNZ); summit (AMNZ). Great Barrier I.: Arid I. (Rakitu I.) (NZAC); Katherine Bay (MONZ). Kennedy Bay, 10 km N (NZAC). Little Barrier I. (MONZ), caretaker's garden

(NZAC); Te Titoki Point (AMNZ). Mayor I. (Anon. 1954). Thames, beach N of (AMNZ). **CL/BP.** Karangahake Gorge, Waikino, 5 km W (LUNZ). **GB.** Gisborne (NZAC). Gisborne – Tiniroto (NZAC). **HB.** Hawkes Bay (MONZ). Napier (MONZ). Greenmeadows (NZAC). Tutira (NZAC). Waipawa (NZAC). **ND.** Cavalli Is, Motukawanui I. (NZAC). Kaco (AMNZ). Kaitaia (Cumber 1960). Kapiro (NZAC). Kerikeri (Cumber 1960). Mangamuka, forest N side Mangamuka Hills (AMNZ). Maungaturoto (MONZ). Paihia, beach (NZAC). Parengarenga Harbour (NZAC), Dog I. (AMNZ). Poor Knights Is: Aorangi I. (NZAC); Crater Bay (NZAC). Rocky Bay (AMNZ). Ruakaka (NZAC). Spirits Bay (NZAC). Tangihua Ra., Horokaka (NZAC). Tangiteroria, near (Blank & Bell 1982). Waipapa (Eyles 1960). Waipoua S.F. (NZAC). Waipu (NZAC). Whale I. (Quilter 1971). Whananaki (Cumber 1960). Whangarei (CMNZ). **RI.** Kaiangaroa (NZAC). Taihape (NZAC). **TK.** Awakino (LUNZ). Eltham (NZAC). New Plymouth (NZAC), Fitzroy beach (AMNZ). **TO.** Ohakune (NZAC). Papakai, near Ruapehu (NZAC). Rangitai Plains (NZAC). Taumarunui (NZAC). Taupo (NZAC), lake edge (NZAC). **WA.** Carterton (NZAC). Martinborough (NZAC). Masterton (NZAC). Pori (NZAC). Putangirua Stm (MONZ). Whatarangi (NZAC). **WL.** Bulls (NZAC). Foxton (MONZ). Himatangi (NZAC). Hunterville (NZAC). Ohingaiti (UCNZ). Wangahu (NZAC). Wanganui (Myers 1926). **WI/WN.** Paiaka (NZAC). **WN.** Akatarawa (MONZ). Breaker Bay (MONZ). Brooklands (MONZ). Eastbourne (MONZ). Butterfly Ck (MONZ). Kapiti I. (MONZ), trig station (MONZ). Makara (MONZ). Mana I. (MONZ). Paraparaumu (MONZ). Titahi Bay (NZAC). Wellington (NZAC). **WN/WA.** Palliser Bay (MONZ). **WO.** Horotiu (NZAC). Piopio (NZAC). Raglan (Myers 1926). Waitoa (NZAC).

South I. **BR.** Kawatiri (NZAC). Mt Hopeless (NZAC). **CO.** Alexandra (NZAC). Cromwell, Beetle Reserve (NZAC). Dansey Pass (LUNZ). Great Moss Swamp, SE (Barratt & Patrick 1987). Kawarau Gorge, Gentle Annie (NZAC). St Mary's Ra., Mt Bitterness (UCNZ). Pisa Ra., N end (NZAC). Clutha Vly (upper) (NZAC). **DN.** Dunedin, Waverley (NZAC). **KA.** Blue Duck Stm (UCNZ). Charwell R. (NZAC). Kaikoura (UCNZ): Armers Beach (UCNZ); Peninsula (NZAC). **MB.** Awatere R., mouth (LUNZ). Black Birch Ra., Mt Altmarlock (NZAC). Blenheim (NZAC). Hanmer (UCNZ), Hanmer S.F. (UCNZ). Waihopai Vly (lower) (NZAC). Taylor R. (UCNZ). **MC.** Ashburton (NZAC). Banks Peninsula: Birdlings Flat (NZAC); Governors Bay (CMNZ); Hilltop (UCNZ); Kaituna Vly (NZAC); Mt Evans (LUNZ); Okains Bay (UCNZ); Te Oka Bay, tors above (UCNZ). Canterbury (NZAC). Cashmere Hills (CMNZ). Cass (UCNZ), 13 km E (UCNZ). Christchurch (UCNZ). Glenstrae (UCNZ). L.

Ellesmere (UCNZ). Leeston (UCNZ). Lincoln (LUNZ), Lincoln College (LUNZ). Sefton (NZAC). Southbridge (LUNZ). Victoria Pk (UCNZ). MK. Haldon, near L. Benmore (NZAC). NC. Balmoral Forest (Anon. 1955). Eyrewell S.F. (FRNZ). Kaiapoi (CMNZ). Waikari (NZAC). NN. Atawhai (NZAC). Brightwater (NZAC). Cobb Vly (FRNZ). Farewell Spit (UCNZ). Gordons Pyramid (UCNZ). Hope (NZAC), foothills (NZAC). Maitai Vly (NZAC), Mt Rutledge (UCNZ). Nelson (AMNZ); Clifton Terrace School (NZAC). Pretty Bridge Vly (NZAC). Richmond (NZAC). Sherry Vly (NZAC). Tadmor (NZAC). Wakefield (NZAC). Whangamoa Saddle (NZAC). OL. L. Hawea, The Neck (NZAC). L. Wanaka, Matukituki R. delta (OMNZ). Matukituki Vly (UCNZ). SD. D'Urville I. (CMNZ, LUNZ), Te Puna lagoon (LUNZ), Kenepuru Sound (LUNZ). Port Underwood Saddle (NZAC).

Bioecology. **HABITAT.** Apparently favours low herbage and grasses in general. Found commonly on grasses in various environments, e.g., roadsides, edge of cultivated fields, paddocks, swamps, scrubland, and tussock grassland. Recorded from *Brassica rapa*, *Fragaria* sp., fodder beet, grapes, *Medicago sativa*, *Pisum* sp., potatoes, *Rubus* spp. (especially *R. fruticosus* and *R. ursinus*), *Solanum aviculare*, *Trifolium repens*, *Zea mays*, and to a lesser extent native plants such as *Avicennia marina* subsp. *australasica*, *Carmichaelia* sp., *Cassinia* / *Olearia* associations, *Coprosma rhamnoides*, *Cordyline australis*, *Dacrydium cupressinum*, *Festuca novae-zelandiae*, *Hebe salicifolia*, *Muehlenbeckia* sp., and *Myoporum laetum*. In October and November found in groups of up to 6 between leaves and at base of *Verbascum thapsus* in coastal pasture and manuka scrubland (GB, BP). Collected on sunny days on rocks along riverbanks and on objects and walls around human habitation, and a few records from indoors. Literature records: introduced grasses including *Dactylis glomerata*, *Lolium perenne*, *Medicago sativa*, *Trifolium pratense*, pasture, and roadside grasses (Myers 1926); *Triticum aestivum* (Morrison 1939); *Nassella trichotoma* (Healy 1945); lucerne crops (Palmer-Jones & Forster 1958, Pottinger & Macfarlane 1967, Macfarlane & Pottinger 1976; Macfarlane *et al.* 1981); sown pastures, paddocks, and roadsides, and a considerable number of nymphs and adults under dry pats of dung in pastures (Cumber 1959, 1960). Also observed on fodder crops, e.g., maize and chou, and more frequently on lucerne and turnips (Eyles 1960); on grapes (Cumber 1964); in pasture of mainly weeds and small amounts of paspalum, browntop, Yorkshire fog, *Lotus major*, and white clover (Blank & Bell 1982); and on *Cirsium vulgare* (Michaux 1989). Fifth instars sometimes plentiful in open country on *Rubus fruticosus* (Myers 1926).

ASSOCIATED SPECIES. Large numbers found with nymphs of the cattle-tick *Haemaphysalis bispinosa* (= *H. longicornis*) in overwintering shelters at the base of clumps of rushes (Myers 1926).

ALTITUDINAL RANGE. Coastal lowlands to about 1900 m.

SEASONALITY. Phenological trends: see Fig. 131. Adults collected in all months, but apparently most abundant from January to March. Myers (1926) noted adults to be especially abundant in March at most locations he surveyed, and found eggs in late December. Early instars collected in January (AK) and February (MB), 4th instars in January (AK), and 5th instars in December (HB) and January (AK, CL, ND, WI). Cumber (1959, 1960) collected nymphs in January, February, and March on the North Island. Myers (1926) reported the occurrence of 3rd instars in January and March, and of 5th instars from January to March.

RELATIVE ABUNDANCE. Macfarlane *et al.* (1981) studied abundance (as percent frequency distribution) on lucerne and lotus seed crops.

LIFE HISTORY. Life cycle: egg – 5 nymphal instars – adult. Egg development and structure and instars 1 and 5 have been described, and the egg and 5th instar have been illustrated by Myers (1926). Mating occurs in spring, eggs are laid in late spring and summer, and nymphs hatch out near the end of December, developing into adults during the summer months. Several mating pairs observed in groups on *Verbascum thapsus* in October and November (BP, GB). Apparently univoltine, but may be bivoltine in warmer parts of its range.

OVIPOSITION. A batch of 18 eggs on upper lamina surface of an introduced grass (Myers 1926); egg masses collected on herbage (Cumber 1959), from grape leaves (Cumber 1964), or in rosettes of *Cirsium vulgare* (Michaux 1989).

OVERWINTERING. Apparently overwinters as an adult; adults have been collected under stones (CL, WN) and in a tin (BP) in August, and in clumps of *Carmichaelia* sp. in late July (MB). Myers (1926) found large numbers sheltering with cattle-tick nymphs, *Haemaphysalis bispinosa* (= *H. longicornis*), at the base of clumps of rushes. He also reported finding adults in overwintering sites in autumn and winter, but in greater numbers in July than in May. Overwintering adults also found in pine cones, apparently *Pinus radiata* (Anon. 1957).

FOOD. Observed attacking boysenberries (November, AK). Literature records: a 5th instar sucking ripe fruits of *Rubus fruticosus* (Myers 1926); adults feeding on lucerne seed pods (Dumbleton 1956), tussock leaves (Kelsey 1957), developing racemes and/or seed pods of lucerne (Macfarlane & Pottinger 1976), and lucerne seeds (Ferro 1976). Feeding on wheat grains reported (Every *et al.* 1992).

ENEMIES. Eggs parasitised by *Asolcus* (= *Trissolcus*) *basalis* (Cumber 1964). Field and experimental evidence

suggest that eggs are also parasitised by an indigenous species of *Asolcus* (*Microphanurus*) (= *Trissolcus*), referred to as "species N" by Cumber (1964). Adults found in gizzard of rook, *Corvus frugilegus frugilegus*, in Canterbury (Coleman 1971) and of adult starling, *Sturnus vulgaris*, in Hawkes Bay (Moced 1980).

ACTIVITY. Collected at night on *Myoporum laetum* (November, ND). Observed swarming on ripe fruits of blackberry in the Nelson district (Myers 1926). In summer, under hot conditions, adults and nymphs shelter beneath dung pats and take advantage of nearby ungrazed succulent herbs (Cumber 1960).

Dispersal power. Adults fully winged, and good fliers.

Economic importance. Adults occur in great numbers, and have been reported as an annoyance to blackberry pickers (Myers 1926). Reported to be a pest of lucerne by Palmer-Jones & Forster (1958), but according to Ferro (1976) usually occurring in small numbers, although occasionally a problem on lucerne seed crops. On lucerne can cause seed damage and abnormal numbers by feeding on the seed pods (Dumbleton 1956). Chemical control on seed crops is discussed by Scott (1984).

Biodiversity and conservation. Probably an introduced species; apparently thriving throughout its range.

Remarks. There seems to be no record of the first arrival of *D. caenosus* in New Zealand.

Genus *Monteithiella* Gross

Monteithiella Gross, 1976: 344. Type species *Strachia humeralis* Walker, 1868: 562, by original designation.

Description. Body ovate.

Head truncate apically; disc flattened; antecular margins deeply concave; juga subequal in length to tylus. Antennae mostly black; segment 2 shorter than segment 3. Rostrum reaching well beyond hind coxae.

Thorax. Pronotum: disc slightly convex; anterolateral margins more or less rectilinear and oblique behind eyes, somewhat reflexed, the reflexed part ending abruptly before humerus. Scutellum with apex broadly rounded. Mesosternum shallowly sulcate, lacking a keel. Hemelytra surpassing tip of abdomen; membrane brown with veins dark.

Abdomen. Posterolateral angles of connexival segments squarish or slightly rounded.

Remarks. The single species included in this genus has been placed by various authors in *Antestia*, but Gross (1976) showed that it does not belong there, and erected the genus *Monteithiella* for it.

Monteithiella humeralis (Walker)

Fig. 14, 28, 108, 109, 119, 132; Map 14

humeralis Walker, 1868: 562 (*Strachia*).
orbona Kirkaldy, 1909c: 130 (*Antestia*). Synonymised by Gross (1976: 346).

Adult (Fig. 14). Body pale chocolate-brown above, with yellowish or pale greenish markings on base of head, anterolateral margins and apex of pronotum, base of scutellum, and connexivum; punctures brownish, mostly shallow and well separated, although contrastingly coarser and darker on head and proximal third of scutellum.

Head blackish, with 2 longitudinal streaks of yellowish or pale greenish dorsally in proximal half. Antennal segments mostly black; segment 1 yellowish basally.

Thorax. Pronotum: calli black, surrounded by smooth yellowish areas; reflexed part of anterolateral margins broadly yellowish or pale greenish; humeri broadly rounded. Scutellum with 5 small, yellowish or pale greenish spots along base. Legs: femora and tibiae yellowish, with rather large dark maculations, these usually coalescing near midlength of femora and apex of tibiae.

Abdomen. Connexivum alternately brown or black and yellowish, with a large, dark spot at angles of segments. Venter mostly yellowish, with scattered dark brown or black maculations of various sizes, and a dark spot around spiracles and at each posterolateral angle of segments; ventral spine lacking.

Genitalia. Male: pygophore (Fig. 108) in caudal view with lateral lobes triangular, distinctly produced laterally; outer margin of ventral rim with a narrow, squarish notch on either side; inner margin of ventral rim with a shallow, V-shaped median depression and a broad, triangular protuberance on either side; clasper (Fig. 109) with visible portion of head appearing bilobed, with tips curved towards sides. Female: 1st gonocoxae (Fig. 119) somewhat rectangular, with surface undulant, posterior margin concave, and inner posterior angle acute, slightly produced; paratergites 9 squarish apically, barely reaching beyond sternite 10, and with inner edge concave.

Body length: male 8.46–9.50 (9.05) mm; female 8.85–9.64 (9.22) mm. Humeral width: male 4.88–5.27 (5.05) mm; female 5.08–5.98 (5.42) mm.

Other characters as in generic description.

Last-instar nymph (Fig. 28). Head dull yellowish-brown or chocolate brown, often paler yellowish with dark margins in front of eyes dorsally, yellowish-brown or chocolate brown ventrally. Antennal segments 1, 2, and 3 pale brown, purplish at tips; segment 4 purplish-brown basally. Rostrum pale brown.

Thorax. Notum dark brown, with a number of larger yellowish patches, or uniformly chocolate brown; pronotum paler along lateral margins. Mesothoracic wing pads extending onto 3rd abdominal segment. Ventral surface purplish-brown on sternum shading to pale brown on pleura, the latter with irregular patches of brown and dark brown punctures. Femora mottled brown and yellowish-brown; tibiae brown, with pale mottled markings on proximal half; tarsi brown.

Abdomen. Terga purple-brown or yellowish-brown with brown punctures; an oblong brown spot on lateral borders of segments; tergum 3 with a thin, chocolate-brown median plate on posterior margin; terga 4 and 5 with a larger median plate on posterior margin; tergum 7 with a reduced median plate; tergum 8 with a squarish, dark brown plate on either side of midline. Venter pale reddish-brown, with small brown medial spots on sternum; an oblong brown spot on lateral borders of segments. Spiracles and trichobothria outlined in dark brown.

Body length: 5.70–8.24 mm.

Type data. Location of type material unknown: "supposed to be in the National Museum of Melbourne but no longer there" (Gross 1976).

Material examined. 198 non-type examples (84 males, 99 females, 15 nymphs).

Geographical distribution (Map 14). **North I.** AK. Albany (Pendergrast 1963). Auckland, Museum (AMNZ). Mt Albert, Research Centre (NZAC). Mt Eden, Gardens (NZAC). Noises Is: Ika I. (NZAC); Otata I. (NZAC). Owairaka (NZAC). Remuera (Pendergrast 1963). Titirangi (NZAC). Woodhill S.F. (FRNZ). **BP.** L. Tikitapu (Blue Lake) (LUNZ). Rotochu S.F. (FRNZ). Rotorua (FRNZ). Te Puke (LUNZ). **CL.** Great Barrier I., Port Abercrombie. (MONZ). Little Barrier I.: Awaroa Stm (AMNZ); Haowhenua Stm (AMNZ). Tairua, 2 km N (NZAC). Waikawau – Kennedy Bay (NZAC). **HB.** Hastings (AMNZ). Napier (NZAC). **ND.** Poor Knights Is: Aorangi I. (NZAC); Tawhiti Rahi I. (NZAC), summit ridge (NZAC). **TO.** L. Taupo, Mission Bay (NZAC). Taumarunui, S.R. N at Benneydale turn-off (UCNZ). Taupo (NZAC). **WA.** Masterton (AMNZ). **WI.** Palmerston North (NZAC), Massey College grounds (NZAC). Waitotara (MONZ). **WN.** Kapiti I. (MONZ). Khandallah (MONZ).

Wainuiomata (MONZ). Wellington (MONZ).

South I. MC. Akaroa (UCNZ). Christchurch (LUNZ). Erewhon (LUNZ). Halswell (NZAC). Ilam (UCNZ). Leeston (UCNZ). Lincoln (LUNZ); Lincoln College (LUNZ). Riccarton (LUNZ). Sumner (FRNZ). Victoria Park (UCNZ). NN. Boulder Lake, track to (NZAC). Fringed Hill (NZAC). Nelson (NZAC). Pupu Springs (LUNZ). Wairoa Gorge (LUNZ). SD. Chetwode Is (UCNZ). Ship Cove (NZAC). SL. Owaka, near (NZAC).

Bioecology. **HABITAT.** Shows a close association with plants of the genus *Pittosporum*, and to a lesser extent *Coprosma*. Often collected on *P. crassifolium*, and less frequently on *P. ralphii*, *P. tenuifolium*, other species of *Pittosporum*, and *Coprosma* species. Also recorded occasionally on *Brachyglottis* sp. / *Cassinia* sp. associations, *Myrsine australis*, *Nothofagus* sp., *Olearia* sp., *Phormium* sp., *Plagianthus* sp., and more rarely on *Brassica rapa*, *Citrus* sp., *Juncus* sp., *Senecio jacobaea* in orchards, and a number of grasses, and on sunny days on flat stones, fences, walls, and other objects. Literature records: on *Pittosporum* (Cumber 1964), especially *P. crassifolium*, *P. tenuifolium*, on *Podocarpus totara*, and *Coprosma* sp. (Pendergrast 1963). Gross (1976) and McDonald & Grigg (1980) reported similar habitats in Australia.

ALTITUDINAL RANGE. From near sea level to about 900 m.

SEASONALITY. Phenological trends: see Fig. 132. Adults collected in all months, but apparently most abundant in November and March. Eggs collected in February and April (BP), early instars in February (AK, BP, NN, TO) and April (NN), and 4th and 5th instars in February (AK, HB, NN, SD) and July (NN). All nymphal instars found in March and April (BP). Pendergrast (1963) found eggs in February and March, and nymphs from November to April, but in April only 4th and 5th instars.

LAB HISTORY. Life cycle: egg – 5 nymphal instars – adult. Pendergrast (1963) described the egg and all nymphal instars, and studied in the laboratory the average duration of development: 1st instar, 5 days; 2nd instar 8; 3rd instar 8; 4th instar 11; 5th instar 13. Development from egg to adult averages 45 days. McDonald & Grigg (1980) described oviposition, the egg, and the 5 nymphal instars from Australian specimens, and studied the structure of eggs using SEM technology. Mating observed in October on *Pittosporum* sp. (Pendergrast 1963). Eggs collected on *Pittosporum* (Pendergrast 1963, Cumber 1964), where they are laid on the underside of leaves until April (Pendergrast 1963). Cumber (1964) described the egg mass. Apparently univoltine.

REARING. Pendergrast (1963) reared adults in the laboratory, from eggs and nymphs collected in February and March.

OVERWINTERING. Generally overwinters as an adult, but also as the 4th- or 5th-instar nymph. Late instars taken in July on *Pittosporum eugenioides* (NN). In Auckland in September, Pendergrast (1963) observed adults that were confined to *Podocarpus totara*, although *Pittosporum* was available nearby. This, he thought, suggested that *totara* may serve as an overwintering site.

FOOD. Adults and nymphs reported feeding on unripe fruits of *Pittosporum* (Pendergrast 1963). McDonald & Grigg (1980) reported food records for Australia.

ACTIVITY. Adults collected while beating foliage (September, RI; November, ND), sweeping rushes (December, ND), and at night on tree trunks (August, AK; December, ND). The behaviour and activity of nymphs in Australia has been documented by McDonald & Grigg (1980).

ENEMIES. Field and experimental evidence suggests that the egg can be host to *Asolcus* (*Microphanurus*) (= *Trissolcus*) *basalis* and an indigenous species of *Asolcus* (*M.*) (= *Trissolcus*) referred to as "species N" by Cumber (1964).

Dispersal power. Adults fully winged. Collected while flying in sunlight in November (NN).

Economic importance. Not recorded on any crop or tree of economic importance.

Biodiversity and conservation. *M. humeralis* is an introduced species.

Remarks. In the past, *M. humeralis* has been referred to under the name *Antestia orbona* Kirkaldy, the first record of which for New Zealand is that of Woodward (1953). Apparently *M. humeralis* was observed here for the first time in 1950 (Cumber 1964). It is thought to have been introduced from Australia (Woodward 1953, Eyles 1960).

Genus *Hypsithocus* Bergroth

Hypsithocus Bergroth, 1927: 671. Type species *Hypsithocus hudsonae* Bergroth, 1927: 672 (in error for *Hypsithocus*), by monotypy.

Description. Body broadly ovate, blackish.

Head slightly shorter than its width through eyes, flattened, broadly rounded apically, with disc subdepressed; antecular margins sinuate, produced into a short, triangular, blunt, outward-directed lobe in front of eyes; juga longer than tylus, touching or almost touching in front of it (Fig. 101). Ocelli lacking. Antennae 5-segmented, brownish orange to brownish black; segments 3, 4, and 5 often infuscate apically. Rostrum reaching slightly beyond hind coxae.

Thorax. Pronotum: disc rather flat; anterolateral margins slightly convex, strongly reflexed; anterolateral angles produced anteriorly on either side of head (Fig. 101); humeri quadrate. Scutellum triangular, narrowly rounded apically. Mesosternum sulcate, lacking a carina. Hemelytra slightly longer than scutellum, with outer margin of corium arcuate and its apex broadly rounded (brachypter), or reaching tip of abdomen, with outer margin of corium arcuate and its apex acutely rounded (macropter); membrane dark but almost non-existent (brachypter) or dark, quadrate, resembling a square flap at end of corium, with veins evanescent (macropter). Legs dark brown or black; anterior edge of tibiae often tawny.

Abdomen. Connexivum broadly arcuate; posterolateral angles of segments roundish.

Remarks. A monotypic genus endemic to New Zealand.

Hypsithocus hudsonae Bergroth

Fig. 15, 16, 29, 101, 110, 111, 120; Map 15

hudsonae Bergroth, 1927: 672 (*Hypsithocus* [sic]).

Adult (Fig. 15, 16). Body dark brown or black, with coarse irregular punctures on dorsal surface; outer margins of head and pronotum, basal portion of hemelytra, and connexivum narrowly greenish- or yellowish-white.

Thorax. Calli creamy brown. Scutellum sometimes with a whitish spot at basal angles and a creamy white margin around tip. Hemelytra: corium sometimes with a creamy spot on disc. Legs black.

Abdomen. Connexivum dark brown or black, often with outer margin tawny. Venter uniformly black, almost impunctate, lacking a ventral spine.

Genitalia. Male: pygophore (Fig. 110) in caudal view with lateral lobes acutely rounded, slightly produced laterally, thick; inner margin of ventral rim sinuate, with a shallow, U-shaped median depression; a pair of lobate parandria on inner lateral walls; clasper (Fig. 111) with visible portion of head slender, acute apically, sinuate on ectal side of apical portion. Female: 1st gonocoxae (Fig. 120) with surface undulant and posterior margin sinuate; paratergites 9 broadly arcuate apically, very short, barely reaching beyond sternite 10.

Body length: male 6.77–7.55 (7.31) mm; female 8.33–9.24 (8.77) mm. Humeral width: male 4.43–4.69 (4.59) mm; female 4.95–5.34 (5.00) mm.

Other characters as in generic description.

Last-instar nymph (Fig. 29). Head dark brown, approaching black, densely punctured dorsally and ventrally.

Antennal segments brownish-black; segment 3 and base of segment 4 paler brown. Rostrum concolorous with head.

Thorax. Notae dark brown, approaching black, narrowly pale brown along outer margins of pronotum and proximal half of mesothoracic wing pads; pronotum densely punctured laterally, somewhat rugulose medially. Mesothoracic wing pads extending onto 3rd abdominal segment. Ventral surface dark brown, approaching black, somewhat smoother on sterna than on pleura. Femora, tibiae, and tarsi dark brown, approaching black.

Abdomen. Terga brown medially, shading to blackish laterally, with dense, coarse, dark punctures; lateral margins of segments pale brown; scent gland openings surrounded by dark punctures, without any visible sclerotised plates, on posterior margin of terga 3–5. Venter black, almost smooth medially, brown and coarsely punctured with black on either side of midline, shading to blackish laterally; lateral margins of segments pale brown.

Body length: 6.49–7.31 mm.

Type data. Neotype (here designated): female (MONZ) labelled "Lower Slopes; Mt Aurum; Jan 16, 1921; Hudson Coll.; 72a (handwritten) / National; Museum; Wgtn NZ / NEOTYPE; *Hypsithocus*; *hudsonae*; Bergroth; Det. M-C Larivière 1994 (red)."

Material examined. Neotype, plus 21 non-type examples (7 males, 9 females, 5 nymphs).

Geographical distribution (Map 15). **South I. CO.** Ben Lomond (AMNZ, NZAC). Old Man Ra. (NZAC). Remarkables Ra. (NZAC). Rock and Pillar Ra. (NZAC). **OL.** Eyre Mtns, Mt Dick (NZAC).

Bioecology. Very little known. In the Old Man Range 3 adult males found together in late February on *Celmisia viscosa*. Two males, 2 females, 1 penultimate instar, and 2 last-instar nymphs found under *Pimelea* sp. The specimens from The Remarkables Range—3 males, 3 females, 2 penultimate instars, and 1 last-instar nymph—collected in early February at about 1800 m "crawling around on mat plants with weevils etc. ... they were not uncommon at the time" (I. Townsend, pers. comm.). The Rock and Pillar specimen is a female collected around mid January on *Hebe odora*. The specimen from Mt Dick is a male collected around mid November, also on *Hebe odora*, "in a *Chionochloa rigida* – tussock grassland" (B.H. Patrick, pers. comm.). *Hebe odora* is the likely host plant.

Altitudinal range around 1200–1700 m. Mating probably occurs in early summer. Apparently univoltine.

Dispersal power. Apparently limited; only males have

long hemelytra, and in both sexes these are fused along the scutellum. Hind wings absent.

Economic importance. None.

Biodiversity and conservation. Apparently *H. hudsonae* is a genetically highly distinctive taxon: monotypic at the genus level, endemic to New Zealand, and with no nearest overseas relative clearly identified. Only five populations are known, represented in collections by only a few specimens collected over a rather restricted and disjunct range. Very little is known about the biology of this species, which has limited dispersal capabilities and which occupies habitats that are currently at risk.

Remarks. Bergroth's type specimen, a female from Lake Wakatipu presented by S. Hudson, could not be located in the Naturhistorisches Zentralmuseum Collection (Helsinki). L. Huldén (intendant, Division of Entomology) indicated to me that "he [Bergroth] writes about the new species 'two specimens are known, one of which I have seen'" and "this sentence could mean that the specimen was sent back." In the Hudson Collection register (MONZ) are notes about two specimens (72a, b) with the data "lower slopes Mt Aurum Jan 16–18 1921 about 3500 ft (Stella)." In this register Hudson crossed out 'b' and put a date (21 April 1921) and a word that can be read as 'Myers.' I believe that Hudson sent this specimen to J.G. Myers, who probably deposited it in the BMNH collection. The specimen could not, however, be located in that collection nor in any New Zealand collection, and is considered to be lost. I am confident that the second specimen mentioned in Bergroth's description is no. 72a (above), here selected as neotype for *H. hudsonae*.

The female specimen from the Rock and Pillar Range may represent a new species, but this could not be definitively established with the material at hand.

Genus *Nezara* Amyot & Audinet-Serville

Nezara Amyot & Audinet-Serville, 1843: 143. Type species *Cimex smaragdulus* Fabricius, 1775: 711 (= *Cimex viridulus* Linnaeus, 1758: 444), by designation of Kirkaldy (1909c).

Description. Body broadly elliptical; dorsal surface dull green, brownish-green, or dark brown.

Head broadly rounded apically; disc flattened; antecocular margins strongly sinuate; juga as long as tylus or shorter. Antennae 5-segmented. Rostrum reaching to about hind coxae.

Thorax. Pronotum: disc convex; anterolateral margins nearly straight or slightly concave, narrowly reflexed. Mesosternal carina very low. Hemelytra reaching or slightly surpassing tip of abdomen.

Abdomen. Posterolateral angles of connexival segments often in the form of minute, backward-directed, black-tipped spines.

Remarks. Of the many and various species that have been included in this large, worldwide genus only the introduced *N. viridula*, a cosmopolitan pest of great economic importance, occurs in New Zealand.

Nezara viridula (Linnaeus)

Fig. 17, 30, 103, 104, 112, 113, 121, 133; Map 16

viridulus Linnaeus, 1758: 444 (*Cimex*).

torquatus Fabricius, 1775: 710 (*Cimex*).

smaragdulus Fabricius, 1775: 711 (*Cimex*).

The extensive subsequent synonymy of this well known species is omitted to conserve space.

Adult (Fig. 17). Body dull green in warmer months, fading to brownish-green or dark brown in cooler conditions, with close-set, fine punctures dorsally.

Head about as wide through eyes as long. Antennal segments green; apex of segment 3 and most of segments 4 and 5 brown. Eyes protruding laterally from antecocular margin by more than half their width.

Thorax. Pronotum: calli darker green than remainder of disc; anterolateral margins with a thin, yellowish, punctate band from base to apex; humeri broadly rounded. Scutellum rather narrowly rounded apically, with 3 small, yellowish spots along base and a black pit at basal angles. Mesosternal carina (Fig. 104) very low, much lower than thickness of 2nd rostral segment in lateral view. Hemelytra: corium dull green, immaculate; membrane translucent, with veins obscure. Legs largely greenish; proximal half of femora and midportion of tibiae often yellowish or brownish-green.

Abdomen. Connexivum yellowish-green, distinctly punctate. Venter slightly paler than dorsal surface, almost immaculate except for black tips of posterolateral angles of segments, frequently yellowish around coxae and base of venter; ventral spine feeble, reduced to a low bump.

Genitalia. Male: pygophore (Fig. 112) with lateral lobes strongly arcuate, thick, slightly produced laterally, their outer margin sinuate, their inner margin with a tubercle-like protuberance; ventral rim with a shallow, square depression at middle, and at inner margin with a shallow, arcuate median depression and a small, triangular protuberance on either side; clasper (Fig. 113) with visible

portion of head somewhat triangular, and ectal edge sinuate, denticulate. Female: 1st gonocoxae (Fig. 121) regularly convex, with posterior margins slightly concave; paratergites 9 with edges sinuate, reaching well beyond sternite 10 but not to tip of abdomen.

Body length: male 12.56–15.63 (14.52) mm; female 13.60–16.87 (15.47) mm. Humeral width: male 7.35–8.92 (8.11); female 7.58–9.31 (8.55) mm.

Other characters as in generic description.

Last-instar nymph (Fig. 30). Head. Dorsal surface green, narrowly outlined in black, sometimes black at base; ventral surface yellowish-green. Antennal segments 1 and 2 yellowish-green, often with a pink tinge; apex of segment 2 and entire segments 3 and 4 blackish. Rostrum yellowish-green, darkening apically.

Thorax. Notae green, narrowly outlined in black, tinged with reddish along outer margins of pronotum and mesothoracic wing pads; a transverse series of dark brown or black spots across disc of pronotum and mesonotum, and blackish longitudinal marks on mesothoracic wing pads. Mesothoracic wing pads extending onto 3rd abdominal segment. Ventral surface yellowish-green, with a longitudinal line of blackish spots next to coxae. Femora yellowish-green, sometimes infuscate at tip; tibiae brownish, often tinged with pink, darker at base and apex; tarsi black.

Abdomen. Terga brownish-yellow or greenish, often with a pink tinge, with small, dark punctures on either side of midline; large, darkly outlined pink spots on lateral borders of segments; often with white spots, 1 beside each pink spot and in 2 rows along midline; tergum 3 with a thin, elongate, dark median plate on posterior margin; terga 4 and 5 with a larger median plate on posterior margin; tergum 7 with a small median plate; tergum 8 with 2 dark, sometimes pink, often fused plates on either side of middle. Venter brownish-yellow or green, often tinged with pink, with scattered minute brown punctures; a large, darkly outlined pink spot on lateral borders of segments. Spiracles outlined in black; trichobothrial outline concolorous with surroundings.

Body length: 10.01–11.74 mm.

Note: pinkish, orange, and white marks tend to fade to dull yellowish on dried specimens.

Type data. "Probably in the collection of the Linnean Society of London" (Gross 1976).

Material examined. 262 non-type examples (109 males, 113 females, 40 nymphs).

Geographical distribution (Map 16). North I. AK. Auckland (LUNZ), Bethells; Te Henga Reserve (NZAC); Manuku

Reserve (NZAC). Ellerslie (UCNZ). Mt Albert (NZAC). Noises Is, Maria I. (Ruapuke I.) (NZAC). Owairaka (NZAC). Point Chevalier (AMNZ). Takapuna (NZAC). Tiritiri Matangi I. (MONZ). Titirangi (NZAC). Waiheke I., Onetangi Reserve (NZAC). Wattle Bay (NZAC). BP. L. Rotorua, Mokoia I. (FRNZ). Tauranga (LUNZ). Waireka (FRNZ). Whakatane (NZAC). CL. Amodeo Bay (NZAC). Coromandel (NZAC). Little Barrier I., caretaker's garden (NZAC). Mt Moehau, track to (LUNZ). GB. Gisborne (UCNZ). Ngatapa (UCNZ). Whatatutu (NZAC). HB. Cape Kidnappers (NZAC). Hawkes Bay Forest (FRNZ). Tangoio (FRNZ). ND. Bay of Islands (NZAC). Cavalli Is, Motukawanui I. (NZAC). Kaitaia (NZAC). Kamo (NZAC). Kawakawa (LUNZ). Kawerua, beach (LUNZ). Kerikeri (LUNZ). Leigh (NZAC). Mangamuka Hills (AMNZ). Mokohinau I. (NZAC). Northland (LUNZ). Omahuta S.F., Kauri Sanctuary (NZAC). Paihia (FRNZ). Pakaraka (NZAC). Parengarenga Harbour (NZAC). Peria (NZAC). Poor Knights Is, Aorangi I. (NZAC). Puketona (NZAC). Te Pahi Stm (LUNZ). Tutukaka, 2 km W (NZAC). Waitangi (NZAC). TK. Mahoeui (NZAC). New Plymouth (NZAC). TO. Taumarunui (FRNZ). Wall (UCNZ). WI. Wanganui (MONZ). Castlecliff (OMNZ). Palmerston North (NZAC). Manawatu R. (UCNZ). WN. Petone (LUNZ). Stokes Valley (MONZ). Wellington (MONZ). WO. Oparau (UCNZ). Te Kuiti (NZAC).

South I. KA. Conway Flat (LUNZ). Mt Fyffe (UCNZ). Oaro (LUNZ). MC. Canterbury (NZAC). Christchurch (NZAC). NN. Brightwater (NZAC). Ligar Bay (UCNZ). Maitai Vly (UCNZ). Nelson (LUNZ, UCNZ). Puponga, Farm Park (LUNZ). Stoke (UCNZ). SD. Moenui Bay (UCNZ).

Offshore islands. Kermadec Is, Raoul I. (MONZ).

Bioecology. Only a summary from the extensive literature on this cosmopolitan pest can be presented here. Most of the information on New Zealand has been well summarised by Allan (1976), and extensive bibliographies are given by Dewitt & Godfrey (1972) and Ramsay & Crosby (1992). Additional information can be sought in Jones (1988), Todd (1989), Cameron (1989), and Clarke (1992).

HABITAT. Infests a considerable range of economically important plants. New Zealand literature (Allan 1976, Cumber 1949, Everett 1958) commonly records beans, capsicum, corn, peas, tomatoes, passionfruit, and tamarillos. Also on other vegetables, including brassicas, potatoes, pumpkin, and silver-beet (Cameron 1989).

ALTITUDINAL RANGE. Coastal lowlands to lower montane zone.

SEASONALITY. Phenological trends: see Fig. 133. All life stages found from December to May (Allan 1976). Adults apparently most abundant from February to April.

LIFE HISTORY. Life cycle: egg – 5 nymphal instars – adult. Mating occurs in spring and summer, and oviposition from December to May. 'Rafts' of 40–80 eggs glued to underside of leaves or other sheltered locations. Eggs hatch in about 20 days, and nymphal instars develop in about 40–60 days during the most favourable summer conditions, allowing at least 2 generations per year (Cumber 1949), possibly 3 generations in warmer parts of the range.

OVERWINTERING. Adults overwinter on a variety of crop plants and weeds.

FOOD. Feeds on almost any plant from which it is able to suck sap, i.e., from most fruits, developing seeds, stems, and foliage.

ENEMIES. Predation not recorded in New Zealand, and no indigenous parasitoids known (Cameron 1989). Several biological control programmes have introduced scelionid (Hymenoptera) and tachinid (Diptera) parasitoids. Numerous attempts at chemical control are reported, but recommendations for this type of control in New Zealand are few.

Dispersal power. An active flier that may travel considerable distances. Attracted to artificial light.

Economic importance. The most noxious pentatomid in New Zealand. A sporadic pest in warmer areas, particularly Auckland, Bay of Plenty, and Northland (Cameron 1989). In Northland, at one time a severe pest on almost any kind of vegetables, as well as tamarillos and peaches (Everett 1958). Plant damage has declined over the years (Cumber 1964), and remains sporadic (Cameron 1989).

Remarks. *Nezara viridula* was first recorded in New Zealand in 1944 (Cumber 1949). Its subsequent spread throughout the North Island and to Marlborough and Nelson is described in detail by Everett (1958).

Genus *Glaucias* Kirkaldy

Zangis Stål, 1867: 514.

Amblybelus Stål, 1876: 93 (not Montrouzier).

Glaucias Kirkaldy, 1908: 124 (new name). Type species *Rhaphigaster amyoti* Dallas, 1851: 278, by designation of Kirkaldy (1909c).

Description. Body broadly elliptical, shining green.

Head narrowly rounded apically; disc flattened; antecocular margins slightly concave in proximal half; juga subequal in length to tylus. Antennae 5-segmented. Rostrum reaching slightly beyond hind coxae.

Thorax. Pronotum: disc slightly undulant; anterolateral margins nearly straight or slightly convex. Mesosternal carina low. Hemelytra surpassing tip of abdomen.

Abdomen. Posterolateral angles of connexival segments squarish, tipped with blackish.

Remarks. Ranges from India eastwards through Australia and Polynesia (Ruckes 1963). *Glaucias amyoti* is indigenous to New Zealand, but also occurs in Australia.

Glaucias amyoti (Dallas)

Fig. 18, 31, 33, 34, 102, 114, 115, 122, 134; Map 17

amyoti Dallas, 1851: 278 (*Rhaphigaster*). Stål 1867: 93 (*Zangis*). Kirkaldy 1908: 124 (*Glaucias*).

Adult (Fig. 18). Body shining green, with punctures even, separated by at least their own width, and shallow except on head, which is impunctate and appears transversely rugulose.

Head shorter than its width through eyes. Antennal segments green; segment 2 much shorter than segment 3. Eyes protruding laterally from anteoocular margin by less than half their width.

Thorax. Pronotum: calli concolorous with remainder of disc; anterolateral margins with a thick, yellowish, impunctate band from base to apex; humeri acutely rounded. Scutellum uniformly green, rather broadly rounded apically. Height of mesosternal carina comparable to thickness of 2nd rostral segment in lateral view. Hemelytra: corium shining green, immaculate; membrane translucent, with veins obscure. Legs green, impunctate.

Abdomen. Connexivum yellowish-green, almost impunctate. Venter slightly paler than dorsal surface, immaculate except for black tips of posterolateral angles; ventral spine acute, short, hardly reaching hind coxae.

Genitalia. Male: pygophore (Fig. 114) in caudal view with lateral lobes strongly arcuate and thick, scarcely produced laterally, their inner margin bearing a large, squarish protuberance; inner margin of ventral rim with a deep, V-shaped median depression and an acute, triangular protuberance on either side; a pair of triangular parandria on inner lateral walls; clasper (Fig. 115) with visible portion of head acuminate, ectal surface denticulate. Female: 1st gonocoxae (Fig. 122) with surface and posterior margin convex; paratergites 9 broadly rounded apically, reaching or slightly surpassing tip of abdomen.

Body length: male 13.50–15.84 (15.05) mm; female 13.50–15.90 (15.12) mm. Humeral width: male 7.75–8.86 (8.27) mm; female 8.13–9.05 (8.05) mm.

All other characters as in generic description.

Last-instar nymph (Fig. 31). Head amber, outlined in black dorsally and ventrally. Antennal segments black;

segment 1 and base of segment 2 sometimes amber. Rostrum amber, darkening apically.

Thorax. Nota amber, heavily marked with black along margins, on disc of pronotum, and in a Y-shaped pattern on mesothoracic wing pads; pronotum paler at sides. Mesothoracic wing pads extending onto 3rd abdominal segment. Ventral surface yellowish-orange to amber, often tinged with greenish; pleura somewhat darker than sterna. Femora dark amber or blackish; tibiae and tarsi often darker than femora.

Abdomen. Terga yellowish, often tinged with greenish (live specimens); an oblong dark amber or blackish spot on lateral borders of segments; tergum 3 with a thin, elongate, blackish median plate on posterior margin; terga 4 and 5 with a larger median plate on posterior margin; tergum 7 with a small, sometimes evanescent median plate; tergum 8 with a very small plate on either side of middle. Venter yellowish, tinged with orange or greenish, slightly infuscate at midline; an oblong, dark amber spot on lateral borders of segments. Spiracular outline concolorous with surroundings; trichobothria outlined in black.

Body length: 8.06–10.18 mm.

Type data. Type material probably in BMNH.

Material examined. 146 non-type examples (60 males, 67 females, 19 nymphs).

Geographical distribution (Map 17). **North I. AK.** Auckland (NZAC). Avondale (NZAC). Clevedon (AMNZ). Dargaville (Myers 1926). Henderson (NZAC). Howick, beach (AMNZ). Kauri Gully (Stoner 1924). Kelston (NZAC). Mangere (NZAC). Mt Albert (NZAC). Noises Is (NZAC): Motuoropapa I. (AMNZ), near hut (NZAC), snail flat (NZAC); Otata I. (AMNZ). One Tree Hill (AMNZ). Ponsonby (NZAC). Rangitoto I. (NZAC). Riverhead S.F. (FRNZ). Titirangi (NZAC). Waitakere Ra. (NZAC). Whangaparaoa (AMNZ). Woodhill (FRNZ). Waiheke I., Onetangi Reserve (NZAC). **BP.** Matakana I. (FRNZ). **CL.** Kauaeranga (NZAC). Little Barrier I. (MONZ). Mercury Is: Double I. (Moturehu) (MONZ); Red Mercury I. (Moed & Meads 1987a). Te Kouma (AMNZ). **GB.** Gisborne (NZAC). **ND.** Hen I. (AMNZ). Kerikeri (NZAC). Onerahi (MONZ). Paihia (NZAC). Whale I. (AMNZ). Whangarei (MONZ). **WN.** Orongorongo Vly (Moed & Meads 1987b).

South I. NN. Nelson (MONZ, NZAC), Cawthron Park (NZAC). **SD.** Blumine I. (Moed & Meads 1987a). French Pass (Kirkaldy 1909b). Pickersgill I. (Moed & Meads 1987a). Ship Cove (NZAC).

Offshore islands. Kermadec Is (MONZ).

Bioecology. **HABITAT.** Closely associated with plants of the

genus *Coprosma*, especially *C. macrocarpa* and *C. robusta*, and to a smaller extent *Pittosporum*. Also found on *Geniostoma* sp., *Myrsine australis*, and *Vitex lucens*, and more rarely on *Passiflora edulis*, *P. mollissima*, and *Solanum aviculare* (berries). Literature records: *Coprosma robusta*, *Pittosporum colensoi*, and *Pseudopanax arboreum* (Myers 1926). According to Myers, *Coprosma* berries seem to be the chief attraction since more specimens can be found on female than male plants.

ALTITUDINAL RANGE. Coastal lowlands to lower montane zone.

SEASONALITY. Phenological trends: see Fig. 134. Adults collected in all months except July, but apparently most abundant in March. Eggs and all nymphal instars found in late January (CL). Early instars collected in January (CL) and February (NN, SD), 4th instars in January (CL), February (NN), March (GB), and April (NN), and 5th instars in January (CL), February, and April (AK). Myers (1926) found eggs and all nymphal instars in December and February, and collected a late instar in March.

LIFE HISTORY. Information can be found in Myers (1926). Life cycle: egg - 5 nymphal instars - adult. The egg, hatching, and instars 1-5 have been described by Myers (1926), and the egg mass by Cumber (1964). Brien *et al.* (1955) dealt with the morphology of two nymphal instars. Development of the egg and nymphs has been studied by Myers (1926). Mating occurs in spring. Apparently univoltine (perhaps also bivoltine in the northern part of its range). Bred from nymphs on sow thistle. Reproduces and develops naturally on *Coprosma robusta*.

OVIPOSITION. Batches of 12-14 close-set, beige eggs collected on underside of *Coprosma robusta* leaves (CL). Literature reports: eggs laid in a batch of 14 arranged irregularly, but all touching, on upper surface of a *Coprosma robusta* leaf near tip, another arranged more regularly near base of a small leaf, and a third deposited fairly regularly near base of a large leaf (Myers 1926). Other egg masses found on upper surface of *Pittosporum* leaves, probably *P. colensoi* [AK] (Myers 1926), on *Coprosma* sp. (Cumber 1964), and on leaves on *C. robusta* in December [ND] (Myers 1926).

OVERWINTERING. Believed to overwinter as an adult.

FOOD. Late-instar nymphs observed with the beak inserted through leaf and fruit tissues of *Coprosma robusta* (CL). Individuals allegedly attacking banana passionfruit (AK) and passionfruit (ND) have been collected. Predation: a nymph was observed preying on another undergoing ecdysis (Myers 1926); and nymphs and adults have been reported feeding on pear-slug, *Caliroa limacina* (= *C. cerasi*) (Gourlay 1930).

ENEMIES. Field and experimental evidence suggest that eggs are parasitised by *Asolcus* (= *Trissolcus*) *basalis* and

by an indigenous species of *Asolcus* (*Microphanurus*) (= *Trissolcus*) referred to as "species N" by Cumber (1964).

Dispersal power. Adults fully winged. One adult collected at artificial light in an area with heavily fruiting *Coprosma robusta*, and in March one flew into a lighted room at night [AK] (Myers 1926).

Economic importance. Not observed to pay any attention to fruit or fruit trees of economic importance.

Biodiversity and conservation. An indigenous species closely associated with indigenous species of plants, and although not rare apparently abundant only locally.

Remarks. Records do not suggest a first arrival of *G. amyoti* in New Zealand, and it is apparently truly indigenous.

Previous workers have attributed *Glaucias amyoti* to A. White in Dallas (1851). In this latter work, however, the species *Rhaphigaster amyoti* is said to have been described originally as *Nezara amyoti* by A. White in 'The Zoology of the voyage of H.M.S. Erebus & Terror,' but there is no such description in that work. *Nezara amyoti* apparently was a manuscript name of A. White, intended for publication in 'Zool. Erebus & Terror.' To be available, every new scientific name published before 1931 must satisfy Articles 11 and 12 of the 'International Code of Zoological Nomenclature,' and must be accompanied by a description or a definition of the taxon that it denotes, or by an indication. From the publication date, 1874, of 'Zool. Erebus & Terror,' the fact that no description appears in it, and that A. White clearly did not intend to describe the new species in Dallas (1851), I conclude that the description provided by Dallas (1851) on page 278 constitutes the original description of this species, and that *Glaucias amyoti* should be attributed to Dallas, not to A. White.

Genus *Cuspicona* Dallas

Cuspicona Dallas, 1851: 296. Type species *Rhynchocoris thoracica* Westwood, 1837: 30, by designation of Kirkaldy (1909c).

Description. Body somewhat kite-shaped, in life greenish fading to yellowish or yellowish-brown.

Head narrowly rounded apically; disc flattened or somewhat convex; antecocular margins nearly straight or rather sinuate; juga subequal in length to tylus. Eyes rather triangular, touching anterior margin of pronotum. Antennae 5-segmented. Rostrum reaching well beyond hind coxae.

Thorax. Pronotum: anterolateral margins straight or very slightly concave; humeri acute, often produced into a conical or spinous process. Mesosternal carina well developed, rather wide, its ventral surface only gently sinuate, and apically not or hardly surpassing middle coxae (Fig. 105). Hemelytra attaining or surpassing tip of abdomen.

Abdomen. Posterolateral angles of connexival segments often in the form of black-tipped spines.

Remarks. This genus is divided up into several groups of species. About 20 species are known in Australia, of which *C. simplex* occurs in New Zealand. Its range extends to Norfolk Island, New Caledonia, the New Hebrides, New Guinea, Indonesia, and the Philippines. Species of *Cuspicona* occurring in Australia and nearby island areas are described in Gross (1975a, 1976).

Cuspicona simplex Walker

Fig. 19, 32, 105, 116, 117, 123, 135; Map 18

simplex Walker, 1867: 388 (*Cuspicona*).

virescens Tryon, 1889: 189 (*Cuspicona*) (not Westwood, not Dallas).

Adult (Fig. 19). Body bright green in life, fading to yellow or yellowish-brown in preserved specimens; dorsal punctures even and fine except on head, which appears rugulose.

Head shorter than its width through eyes. Antennal segments yellowish, often tinged with orange; segments 2 and 3 subequal. Rostrum reaching well beyond hind coxae.

Thorax. Pronotum: disc rather flat on anterior lobe, slightly convex on posterior lobe; calli concolorous with remainder of pronotum; humeri triangular, acute, produced into a conical or spinous process (in New Zealand). Scutellum acutely rounded apically, concolorous with adjacent coria. Hemelytra attaining or surpassing tip of abdomen; corium dull green; membrane translucent, sometimes dusky, with veins clear, not contrasting with membrane. Legs yellowish, immaculate.

Abdomen. Connexivum clear yellowish; posterolateral angles of segments in the form of small, black-tipped spines (New Zealand). Venter yellowish, mostly immaculate; ventral spine small, acute, barely reaching hind coxae.

Genitalia. Male pygophore (Fig. 116) in caudal view with lateral lobes triangular, slightly produced laterally; outer margin of ventral rim produced caudally, with a rectangular notch on either side; inner margin of ventral rim regularly arched, without a visible median depression; clasper (Fig. 117) with visible portion of head rectangular. Female: 1st gonocoxae convex, with posterior margin deeply notched; paratergites 9 acutely rounded apically,

short, barely reaching beyond sternite 10 (Fig. 123).

Body length: male 8.25–10.38 (9.17) mm; female 8.62–10.40 (9.52) mm. Humeral width: male 5.39–6.73 (6.11) mm; female 5.50–6.73 (6.04) mm.

Other characters as in generic description.

Last-instar nymph (Fig. 32). Head. Dorsal surface green, with reddish-brown punctures and blackish margins; ventral surface pale green. Antennal segments 1, 2, and 3 translucent pale brown; distal half of segment 4 black. Rostrum pale green, darkening apically.

Thorax. Notae pale green, with brown punctures; sides of pronotum pale brown overlaid by heavier puncturation. Mesothoracic wing pads extending beyond middle of 3rd abdominal segment. Metathoracic wing pads with a black spot showing along distal third of inner margin of mesothoracic wing pads. Ventral surface pale green; intersegmental sutures darker, sometimes blackish. Femora and tibiae pale brown; tarsi pale brown, with middle segment often dark brown.

Abdomen. Terga pale green with scattered brown punctures, these becoming darker and heavier around posterior margins of terga 3–5; lateral margins of segments outlined in black; a pale brown blotch on lateral borders of segments. Venter pale green, often tinged with reddish; a pale brown to amber blotch on lateral borders of segments. Spiracles and trichobothria faintly outlined in pale brown.

Body length: 6.57–7.01 mm.

Type data. "The holotype is a [male] specimen bearing the information 'South Australia, presented R. Bakewell' and is located in the British Museum (Natural History), London" (Gross 1975a).

Material examined. 156 non-type examples (63 males, 81 females, 12 nymphs).

Geographical distribution (Map 18). **North I. AK.** Auckland (AMNZ). Greenlane (NZAC). Grey Lynn (AMNZ). Kaipara Head, S (AMNZ). Mt Albert (NZAC). Noises Is, Otata I. (NZAC). Owairaka (AMNZ). Parnell (AMNZ). Pukekohe (NZAC). Remuera (MONZ). Sandringham (AMNZ). Takapuna (AMNZ). Titirangi (AMNZ). Waiheke I. (NZAC). Onctangi Reserve (NZAC). Waiuku (FRNZ). Wattle Bay (NZAC). Woodhill (FRNZ). **BP.** Mt Maunganui (NZAC). Mt Te Aroha (NZAC). Ohope (NZAC). Opotiki (NZAC). Rotochu S.F. (FRNZ). Rotorua (FRNZ). **BP/TO.** Murupara (FRNZ). **CL.** Kauaeranga (FRNZ). Little Barrier I. (NZAC). Thames (NZAC). **GB.** Wairoa (NZAC). **HB.** Havelock North (UCNZ). Hawkes Bay (FRNZ). Waipawa (NZAC). Wallingford (NZAC). **KA.** Blue Duck Stm (UCNZ). Oaro (LUNZ). **ND.** [H] Okianga (Spiller &

Turbott 1944). Omahuta (FRNZ). Paihia (FRNZ). TO. Mt Ruapehu (AMNZ), lower Tama L. (AMNZ). Taupo (NZAC). Waipawa (NZAC). TK. New Plymouth (NZAC). Frankleigh Park (AMNZ). Tikorangi (NZAC). WI. Ashhurst (NZAC). Bulls (FRNZ). Palmerston North (FRNZ). Wanganui (NZAC). WN. Eastbourne (MONZ). Karori (MONZ). Paekakariki, near beach (MONZ). Wellington (MONZ). WO. Morrinsville (AMNZ). Te Awamutu (NZAC).

South I. BR. Punakaiki (LUNZ), Bullock Ck (LUNZ). MC. Banks Peninsula, Sugarloaf S.R. (UCNZ). Cashmere (UCNZ). Tai Tapu (UCNZ). NC. Rangiora, Ashley R. (UCNZ). NN. Collingwood (NZAC). Farewell Spit, lighthouse (LUNZ). Kaikeriteri (UCNZ). Nelson (NZAC). Pretty Bridge Vly (NZAC). Puponga, Farm Park (LUNZ). SD. Ship Cove (NZAC).

Offshore islands. Kermadec Is: Meyer I. (NZAC); Raoul I. (MONZ), Blue Lake (NZAC). Three Kings Is: South West I. (AMNZ); Point Howard (Woodward 1954).

Bioecology. HABITAT. Strongly associated with solanaceous plants, especially the genus *Solanum* itself. Collecting records include mainly potatoes, tomatoes, and wild tobacco, with *Solanum aviculare* and *S. nigrum*. Recorded occasionally on grape vine, mangels, *Ranunculus* sp., *Ribes rubrum*, runner beans, silver beet, and on grasses, e.g., in gardens and swamps; also indoors, or in the sun on walls and other objects around habitations. Literature reports: *Lycopersicon lycopersicum* (= *L. esculentum*) and *Solanum sodomaeum* (= *S. linnaeanum*) (Spiller & Turbott 1944), cape gooseberry (Helson 1952), mixed growth of *Solanum nigrum* and *S. aviculare* (Woodward 1954), and mangels (Eyles 1960).

ALTITUDINAL RANGE. Coastal lowlands to montane zone.

SEASONALITY. Phenological trends: see Fig. 135. Adults collected in all months except August, but apparently most abundant in November and from January to March. Eggs found in February (Valentine 1964). Early instars (NN), 4th instars (NN, WI), and 5th instars (NN) collected in February.

LIFE HISTORY. Life cycle: egg - 5 nymphal instars - adult. Development has been studied in Australia; the egg and egg-batch (14 eggs) were described and the five nymphal instars were measured, diagnosed, and illustrated by McDonald & Grigg (1980), who also studied egg microsculpture using SEM technology. Mating occurs in spring. Apparently univoltine, but possibly bivoltine in warmer parts of its range. In New South Wales there may be 2 or 3 generations per summer (McDonald & Grigg 1980).

REARING. In Australia reared on *Solanum nigrum* under controlled and uncontrolled conditions of temperature and daylength (McDonald & Grigg 1980).

OVERWINTERING. Apparently overwinters as an adult. In Australia, overwintering adults shelter at base of plants in grass or loose soil (McDonald & Grigg 1980).

FOOD. Observed attacking tomatoes as they change colour (Spiller & Turbott 1944), and other solanaceous plants.

ENEMIES. A dead adult collected in a spider web in November (AK). In the laboratory, eggs parasitised by an indigenous species of *Asolcus* (*Microphanurus*) (= *Trissolcus*) and *A. (M.) basalis* (= *Trissolcus basalis*); Cumber (1964) gave morphological and biological characters for these scelionids. Eggs collected in the field were also parasitised by these 2 scelionid species (Cumber 1964, Valentine 1964).

ACTIVITY. Collected by sweeping ferns at night in October (BP).

Dispersal power. Adults fully winged. Evidence of flight is provided by collection at artificial light (February, NN) and indoors (April, NN).

Economic importance. Noxious to solanaceous plants.

Biodiversity and conservation. An introduced pest.

Remarks. *C. simplex* is believed to have been introduced from Australia in the 1940s. Historical notes can be found in Eyles (1960).

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APPENDIX A: Glossary of technical terms

- abdomen** - 3rd and posterior division of the insect body
- acuminate** - tapering to a long point
- angle** - a region of the body where two edges or surfaces meet
- anteocular margin** - margin of head in front of eyes
- anterior lobe** - anterior part of pronotum, usually most of area in front of humeri
- anterolateral** - located anteriorly and to the side
- anterolateral angles** - angles formed by front and lateral margins of pronotum
- anterolateral margins** - lateral margins of pronotum in front of humeri
- apex** (plural: apices) - end of any structure away from its point of attachment
- auricle** - a lobe or structure resembling a small ear, in pentatomoids associated with external opening of metathoracic scent gland
- basal** - at or pertaining to the base (cf. 'apical')
- base** - that part of any structure nearest to its point of attachment
- bifurcate** - forked, branching into two
- bioecology** - study of living organisms in relation to the totality of their environment
- buccula** (plural: bucculae) - more or less elevated ridge or plate on underside of head, on either side of rostrum
- calloused** - furnished with hard lumps or swellings of the cuticle
- callus** (plural: calli) - a thick, swollen lump or raised spot on dorsal surface of pronotum
- caudal** - of or pertaining to the tail, or anal end of body
- clavus** - sharply pointed triangular subdivision of thickened section of hemelytron, next to scutellum
- clasper** - each of a pair of appendages situated in male genital capsule (pygophore), on sides of 9th abdominal segment lateral to aedeagus (penis)
- clypeus** - middle part of head behind and between juga
- connexivum** - prominent, more or less flattened lateral margin of abdomen, at juncture of dorsal and ventral sclerites (hence 'connexival segment')

corium (adj. 'corial') - portion of thickened basal part of hemelytron, at rest lying exterior to clavus, forming outer front part of hemelytron and extending as far as membrane

coxa (plural: coxae) - basal segment of leg, articulating with body

crenulation - small, evenly rounded, rather deeply carved scallops

declivous - sloping downwards

depression - a hollow or low place on a surface

disc (adj. 'discal') - central upper surface of any structure

distal - away from base or origin (cf. 'proximal')

dorsocaudal - towards the upper hind end

dusky - somewhat darkened

ectal - outward-facing (cf. 'ental,' inward-facing)

endemic (of a taxon or taxonomic group) - restricted to a given geographical area

femur (plural: femora) - 3rd and usually stoutest leg segment, bearing the tibia at its apex

fore - anterior

genitalia - structures involved in copulation, fertilisation, and in females oviposition

gonocoxae, 1st - paired articulated plates on female 8th laterotergites, carrying laterally the 1st valvulae (terminal portions of outer blade on either side of ovipositor)

hemelytron (plural: hemelytra) - anterior wing of Heteroptera, with proximal part normally more or less hardened and coriaceous, and distal part entirely membranous

host plant - plant on which an organism breeds and develops

humerus (plural: humeri) - shoulder; in Heteroptera, posterolateral angle of pronotum

impunctate - without punctures or puncturation

incisure - impressed line marking junction of 2 segments

indigenous - native (q.v.)

infusate - smoky grey-brown with a blackish tinge

jugum (plural: juga) - lateral lobe of head at either side of tylus (cf. 'clypeus')

laterotergites, 8th - sclerites formed by ventrolateral folding of sides of tergum 8, on which gonocoxae articulate (syn. 'paratergites')

maculation - pattern of marks or spots

maxillary plate process - prolongation of maxillary plate (region of head between juga and bucculae)

medial - near or including the middle

median - in or at the middle

melanic - with an exceptional development of dark pigmentation in the cuticle, resulting in dark individuals (n. 'melanism')

membrane - thin tissue forming distal part of hemelytra

mesosternal carina - elevated keel or ridge along midline of mesosternum

mesosternum - lower (ventral) surface of mesothorax

mesothoracic wing pads - encased, undeveloped anterior wings of nymphs, apparent behind thorax as 2 flattish structures

mesothorax - 2nd or middle segment of thorax, bearing middle pair of legs and hemelytra

metathoracic scent gland opening - orifice on metathorax through which secretion from an internal scent gland escapes

midlaterally - halfway towards or along the side

mottled - marked with blotches, streaks, and spots of different colours

native (n.) - an original or indigenous inhabitant of a region

notum (plural: nota) - tergum of a thoracic segment

ocellus (plural: ocelli) - simple eye, usually present and frequently 2 in number in Heteroptera

parandrium (plural: parandria) - in male Heteroptera, one of a pair of expansions of external wall of pygophore in lateroventral position

parasite - an organism living on or within another, from which it derives sustenance and protection without making compensation

parasitoid - parasitic insect that lives in or on a host and kills the host as a consequence of its own development

paratergite(s) - sclerite(s) formed by ventrolateral folding of sides of tergum, especially of tergum 8 and 9, on which gonocoxae articulate

phenology - (study of) relationship between climate and periodic occurrences in nature, such as development of various life stages

- plate** - any broad, flattened, hardened piece of cuticle
- pleuron** (plural: pleura) - lateral region of any body segment
- posterior lobe** - posterior part of pronotum, usually most of area behind humeri
- posterolateral** - towards the rear and side
- proctiger** - abdominal segment 10, surrounding the invaginated 9th segment
- pronotum** - dorsal surface of prothorax
- prosternum** - lower (ventral) surface of prothorax
- prothorax** - 1st segment of thorax, bearing forelegs
- protuberance** - any excrescence above the body surface
- proximal** - towards base or origin (cf. 'distal')
- pubescence** - filmy covering of soft, short hairs
- puncturation** - pattern of small pits or punctures on the cuticle
- puncture** - small impression on the cuticle
- pygophore** - strongly sclerotised 9th abdominal segment, appearing as a double-sided box more or less open dorsally and posteriorly, containing male genitalia
- rectilinear** - in the form of a straight line
- reflexed** - bent upwards or backwards
- rostrum** - beak; extended mouthparts
- rugulose** - minutely wrinkled
- sclerotised** - hardened (through sclerotisation)
- scutellum** - dorsal, more or less triangular part of mesothorax, usually between bases of hemelytra
- seasonality** - occurrence and relative abundance of various life stages according to regularly recurring divisions of the year
- sinuate** - wavy
- smooth** - having no roughness or projections that can be seen or felt
- species** (in this work) - populations with a common heredity; groups of actually or potentially interbreeding populations which are reproductively isolated from other such groups
- spiracle** - external opening of tracheal system
- sternum** (plural: sterna) - entire ventral surface of a body segment
- subdepressed** - slightly depressed, or less than depressed (of a surface)
- subspecies** (in this work) - geographically defined aggregate(s) of local populations differing demonstrably from other such subdivisions of a species
- subovate** - not quite egg-shaped
- tarsus** (plural: tarsi) - final leg segment, attached to apex of tibia; consisting of 2 or 3 segments in Pentatomoidea
- tawny** - brownish-yellow
- tergum** - dorsal sclerotised surface of a body segment
- terminalia** - terminal abdominal segments (and their parts), modified to form genital segments
- thorax** - 2nd of the 3 main divisions of insect body, bearing wings and legs; divided into pro-, meso-, and metathorax
- tibia** (plural: tibiae) - segment of leg, between femur and tarsus
- trapeziform** - in the shape of a trapezium, i.e., an irregular 4-sided figure
- trichobothrium** (plural: trichobothria) - specialised slender sensory seta(e) arising from spots, tubercles, or pits on abdominal venter
- tubercle** - a small, knob-like or rounded protuberance
- tylus** - distal part of clypeus, margined laterally by deep sutures separating it from juga; usually the anteriormost structure along midline in dorsal view
- undulant** - wavy
- veins** (of hemelytron) - sclerotised, tubular structures supporting wing membrane
- ventral spine** - spine-like anterior projection of 1st and 2nd ventral segment, lying between or towards coxae
- venter** - entire undersurface of abdomen

APPENDIX B: Geographical co-ordinates of collection localities

Co-ordinates should be read as 00°00'S/000°00'E, unless otherwise specified. Two-letter area codes follow Crosby *et al.* (1976) – see map on p. 108. 'O' denotes outlying islands.

Abut Head, WD, 4307/17015	Bernard Burn, FD, 4453/16735	Cheviot, NC, 4249/17316
Ahukawakawa Swamp, TK, 3915/17403	Bethells, AK, 3653/17429	Cheviot Hills, SL, 4238/16745
Ahuriri and Coopers Knob S.R., MC, 4340/17237	Bethelis Rd, AK, 3655/17430	Christchurch, MC, 4330/17245
Ahuriri R., upper, OL, 4430/16945	Bethells Res., AK, 3655/17430	Clarence Bridge, KA, 4207/17354
Ahuriri Vly, OL, 4419/16939	Birdlings Flat, MC, 4349/17242	Clarence R., MB, 4211/17243
Ailsa Pass, MK, 4454/16815	Birkenhead, AK, 3649/17441	Clevedon, AK, 3700/17501
Akaroa, MC, 4349/17258	Black Birch Ra., MB, 4144/17350	Clifden Cave, SL, 4603/16743
Akatarawa, WN, 4058/17506	Black Forest Stm, MK, 4425/17015	Clifton, HB, 3938/17701
Akatarawa Rd, WN, 4058/17506	Bienheim, MB, 4130/17358	Clutha Vly, upper, CO, 4502/16915
Alex Knob, WD, 4326/17009	Blue Cliffs, SC, 4430/17058	Cobb R., NN, 4106/17235
Alexandra, CO, 4515/16924	Blue Duck Stm, KA, 4217/17346	Cobb Vly, NN, 4106/17235
Amberley Beach, NC, 4310/17247	Bluff, SL, 4636/16820	Codfish I., SL, 4647/16738
Amodeo Bay, CL, 3640/17526	Boatmans Ck, BR, 4203/17154	Colac Bay, SL, 4622/16752
Anapai Bay, NN, 4048/17300	Borland Burn, FD, 4546/16731	Coldwater Hut, BR, 4152/17249
Anawhata, AK, 3655/17427	Borland Saddle, FD, 4542/16728	Collingwood, NN, 4041/17241
Aniseed Vly, NN, 4123/17309	Boulder Lake, NN, 4054/17235	Conical Hills, SL, 4603/16913
Annesbrook, NN, 4118/17315	Bragg Bay, SL, 4653/16808	Conway Flat, KA, 4237/17328
Aorangi I., ND, 3529/17444	Breaker Bay, WN, 4120/17450	Coopers Knob, MC, 4340/17237
Arahura Vly, WD, 4240/17101	Brighton, DN, 4557/17020	Coromandel, CL, 3645/17530
Arrowtown, OL, 4459/16850	Brightwater, NN, 4123/17306	Craigieburn F.P., MC, 4309/17143
Arthurs Pass, NC, 4255/17133	Broad Bay, SL, 4551/17037	Craigieburn Ra., MC, 4310/17140
Arthurs Pass N.P., NC, 4254/17141	Broadlands, TO, 3831/17620	Croesus Knob, BR, 4218/17123
Arthurs Pt, OL, 4459/16840	Bromley, MC, 4332/17242	Cromwell, CO, 4503/16913
Ashburton, MC, 4354/17145	Brooklands, WN, 4324/17242	Cromwell Gorge, CO, 4510/16918
Ashhurst, WI, 4018/17545	Brooklyn, WN, 4118/17446	Crooked R. S.R., BR, 4238/17135
Ashley Gorge, MC, 4314/17213	Browns Bay, AK, 3643/17445	Cuvier I. (Repanga I.), CL, 3626/17546
Ashley R., MC, 4307/17213	Buller County, BR, 4220/17200	D'Urville I., SD, 4050/17350
Atawhai, NN, 4114/17319	Bullock Ck, BR, 4206/17124	Dansey Pass, CO, 4457/17022
Auckland, AK, 3651/17446	Bullock Ck, WD, 4328/16948	Dargaville, ND, 3556/17352
Avalanche Basin, NC, 4257/17132	Bulls, WI, 4011/17523	Dart Hut, OL, 4431/16834
Avondale, AK, 3654/17442	Burgess I., ND, 3554/17506	Dawson Falls, TK, 3919/17406
Awakeri, BP, 3800/17653	Butterfly Ck, WN, 4119/17454	Days Bay, WN, 4117/17454
Awakino, TK, 3839/17437	Callaghans, WD, 4240/17109	Deep Cove, FD, 4528/16710
Awatere, GB, 3741/17821	Cambridge, WO, 3753/17528	Denniston, NN, 4144/17148
Awatere R., MB, 4137/17410	Cameron Flat, OL, 4410/16920	Destruction Gully, AK, 3702/17432
Awatuna, WD, 4238/17104	Canavans Knob, WD, 4323/17010	Dobson R., MK, 4411/16952
Awatuna Rd, WD, 4238/17104	Canterbury, NC/MC, 4330/17200	Dolamore Park, SL, 4604/16849
Ball Hut, MK, 4339/17010	Cape Foulwind, BR, 4149/17128	Double I. (Moturehu), CL, 3638/17554
Balmoral, AK, 3653/17445	Cape Kidnappers, HB, 3938/17705	Doubtful Sound, FD, 4517/16655
Balmoral S.F., NC, 4250/17244	Capleston, BR, 4204/1715	Douglas Ck, WD, 4358/16920
Bay of Islands, ND, 3518/17404	Carterton, WA, 4100/17533	Dumgree, MB, 4137/17400
Bealey, MC, 4301/17141	Cashmere, MC, 4335/17238	Dun Mtn, NN, 4119/17320
Bealey Vly, upper, NC, 4252/17135	Cashmere Hills, MC, 4335/17238	Dundas Hut, WN, 4043/17528
Beaumont, SL, 4549/16933	Cass, MC, 4302/17145	Dunedin, DN, 4553/17030
Beaumont S.F., SL, 4554/16926	Castlecliff, WI, 3957/17459	Duvauchelle, MC, 4345/17256
Beebys Knob, NN, 4144/17256	Cavalli Is, ND, 3500/17356	Eastbourne, WN, 4118/17454
Bells Falls, TK, 3916/17403	Cave Stm, MC, 4311/17144	East Cape, GB, 3741/17833
Ben Lomond, CO, 4456/17030	Cawthron Park, NN, 4116/17317	Ellerslie, AK, 3654/17448
Bendigo, CO, 4456/16920	Charleston, BR, 4201/17133	Eltham, TK, 3926/17418
	Charwell R., KA, 4230/17318	Erehwon, MC, 4331/17052
	Chetwode Is, SD, 4054/17405	Erua, TO, 3914/17524

Evans Ck, WD, 4307/17037
Eyrewell, NC, 4323/17218
Eyrewell S.F., NC, 4325/17215
Fairdown, BR, 4144/17142
Farewell Spit, NN, 4031/17254
Field Hut, WN, 4056/17516
Fitzroy, TK, 3903/17406
Fletcher Ck, BR, 4159/17150
Flock House, WI, 4016/17517
Flora Strm, NN, 4110/17242
Fox Glacier, WD, 4330/17007
Fox R., BR, 4203/17123
Foxton, WI, 4029/17517
Franz Josef, WD, 4325/17010
Frasers Gully, DN, 4513/16914
French Pass, SD, 4055/17350
Fringed Hill, NN, 4119/17319
Fuchsia Ck, BR, 4234/17112
Gertrude Saddle, FD, 4444/16801
Gillespies Beach, WD, 4325/16949
Gisborne, GB, 3840/17801
Glen Eden, AK, 3655/17439
Glenbervie, ND, 3540/17421
Glenstrae, MC, 4232/17328
Golden Downs, NN, 4133/17253
Goldies Bush, AK, 3650/17428
Goldney Ridge, NC, 4254/17131
Goldsborough, WD, 4241/17107
Gordons Pyramid, NN, 4112/17241
Governors Bay, MC, 4338/17239
Grafton Gully, AK, 3652/17446
Great Barrier I., CL, 3607/17530
Great I., O, 3410/17208
Great Moss Swamp, CO, 4534/16956
Grebe R., FD, 4535/16722
Green Bay, AK, 3656/17441
Greenhills, FD, 4632/16818
Greenlane, AK, 3653/17447
Greenmeadows, HB, 3932/17651
Grey Lynn, AK, 3652/17444
Haast, WD, 4353/16903
Haast Pass Rd, WD, 4356/16905
Haldon, MK, 4420/17016
Halfmoon Bay, SI, 4654/16809
Halpin Ck, NC, 4258/17135
Halswell, MC, 4344/17235
Hamilton, WO, 3747/17517
Hanmer, MB, 4232/17251
Hanmer S.F., MB, 4233/17253
Harihari, WD, 4309/17034
Hastings, HB, 3939/17651
Haumoana, HB, 3936/17657
Haupiri Ra., NN, 4054/17239
Havelock North, HB, 3940/17653
Hawdon R., NC, 4300/17145
Hawdon Shelter, NC, 4259/17145

Hawkdun Ra., CO, 4451/17001
Hawkes Bay, HB, 3930/17630
Hawkes Bay Forest, HB, 3928/17654
Headlong Pk, OL, 4432/16835
Hen I., ND, 3558/17443
Henderson, AK, 3653/17437
Herbert Pk S.R., MC, 4342/17245
Hicks Bay, BP, 3735/17817
Hikuai Settlement Rd, CL, 3704/17550
Hilltop, MC, 4345/17252
Himatangi, WI, 4024/17519
Hochstetter S.F., BR, 4224/17135
Holly Hut, TK, 3916/17403
Hollyford Rd, OL, 4440/16810
Homer, FD, 4446/16759
Hooker Vly, MK, 4343/17007
Hope, NN, 4121/17309
Hope R., BR/NC, 4236/17434
Horoera, GB, 3738/17827
Horokaka, ND, 3552/17408
Horotiu, WO, 3742/17512
Houghton Bay, WN, 4121/17447
Houhora, ND, 3448/17306
Howick, AK, 3654/17457
Huia, AK, 3700/17434
Hunterville, WI, 3957/17534
Ike I., AK, 3641/17458
Invercargill, SL, 4625/16822
Irwell R., MC, 4345/17223
Island Ck, BR, 4149/17138
Johnsonville, WN, 4114/17448
Junction Is, CL, 3614/17519
Kaeo, ND, 3506/17346
Kaiangaroa, RI, 3937/17559
Kaiapoi, NC, 4322/17239
Kaihoka Lakes, NN, 4034/17236
Kaihu Bush, ND, 3546/17342
Kaihu Vly, ND, 3557/17352
Kaikohe, ND, 3524/17348
Kaikoura, KA, 4224/17341
Kaikoura Peninsula, KA, 4225/17342
Kaimai Ra., BP, 3752/17556
Kaipara Head, AK, 3624/17408
Kaitaia, ND, 3507/17316
Kaiteriteri, NN, 4102/17301
Kaiti, GB, 3840/17802
Kaitoke, WN, 4105/17510
Kaituna, MC, 4347/17240
Kaituna R., TO, 3801/17620
Kaituna S.R., MC, 4344/17242
Kaituna Vly, MC, 4345/17241
Kaituna Vly S.R., MC, 4344/17242
Kamo, ND, 3541/17418
Kapiro, ND, 3511/17355
Kapiti I., WN, 4051/17456
Karaka Bay, GB, 3821/17820

Karamea, NN, 4115/17206
Karamea R., upper, NN, 4121/17226
Karamu Walkway, WO, 3749/17504
Karangahake Gorge, CL/BP, 3725/
17543
Karewa I., BP, 3732/17608
Karioi, TO, 3927/17531
Karioitahi, AK, 3716/17441
Karori, WN, 4117/17444
Kauaeranga, CL, 3709/17536
Kauri Gully, AK, 3649/17442
Kawakawa, ND, 3455/17319
Kawarau Gorge, CO, 4502/16908
Kawatiri, BR, 4142/17237
Kawerua, ND, 3538/17327
Kawhia, WO, 3804/17446
Kea Pt, MK, 4342/17004
Kelburn, WN, 4118/17445
Kelston, AK, 3654/17440
Kenepuru Sound, SD, 4110/17358
Kennedy Bay, CL, 3641/17534
Kennedys Bush S.R., MC, 4336/17237
Kerikeri, ND, 3514/17357
Kermadec Is, O, 2916/17755
Khandallah, WN, 4114/17448
Kinloch, OL, 3840/17555
Kirikiri Vly, CL, 3712/17534
Klondyke Corner, NC, 4300/17135
Knobbly Ra., CO, 4526/16924
Kohaihai R., NN, 4107/17206
Komako, RI, 4006/17554
Korokoro, WN, 4113/17452
Kourawhero, AK, 3625/17436
Kumara, WD, 4234/17108
Kurova, SC, 4444/17028
L. Coleridge, MC, 4320/17134
L. Ellesmere, MC, 4347/17231
L. Georgina, MC, 4319/17134
L. Hawea, OL, 4426/16914
L. Heron, MC, 4328/17109
L. Hochstetter, BR, 4227/17140
L. lanthe, WD, 4303/17037
L. lanthe S.F., WD, 4259/17038
L. Kirkpatrick, OL, 4500/16836
L. Manapouri, FD, 4531/16719
L. Mapourika, WD, 4319/17013
L. Matheson, WD, 4327/16958
L. Ohau, MK, 4415/16949
L. Orbell, FD, 4517/16740
L. Otamangakau, TO, 3901/17538
L. Paringa, WD, 4343/16925
L. Pukaki, MK, 4405/17007
L. Rotiti, BP, 3802/17625
L. Rotoroa, BR, 4149/17237
L. Rotorua, BP, 3805/17617
L. Sarah, MC, 4303/17147

L. Sylvester, NN, 4106/17238
 L. Tarawera, BP, 3813/17624
 L. Taupo, TO, 3854/17556
 L. Tekapo, MK, 4352/17034
 L. Tennyson, BR, 4212/17243
 L. Tikitapu (Blue Lake), BP, 3812/
 17620
 L. Waikaremoana, GB, 3846/17705
 L. Wakatipu, OL, 4504/16840
 L. Wanaka, OL, 4435/16855
 Lady Alice I., ND, 3554/17444
 Lady Lake, BR, 4236/17135
 Lake County, OL, 4502/16840
 Lee Vly, NN, 4124/17309
 Lees Valley, NC, 4309/17212
 Leeston, MC, 4346/17218
 Leigh, AK, 3616/17450
 Leith Saddle, DN, 4548/17031
 Levin, WN, 4037/17517
 Liebig Ra., MK, 4337/17021
 Ligar Bay, NN, 4049/17254
 Lincoln, MC, 4338/17229
 Lindis Pass, CO/OL, 4435/16939
 Linton, WN, 4026/17533
 Little Barrier I., CL, 3612/17505
 Little River, MC, 4652/16808
 Little Totara R., BR, 4152/17129
 Lynfield, AK, 3656/17443
 Mahinapua, WD, 4247/17054
 Mahoenui, TK, 3834/17450
 Mahurangi, AK, 3629/17444
 Maitai Vly, NN, 4117/17322
 Makara, WN, 4118/17442
 Maketu, BP, 3745/17623
 Mamaku, BP, 3806/17605
 Mamaku S.F., BP, 3808/17602
 Mana I., WN, 4105/17447
 Mangamuka, ND, 3513/17333
 Mangamuka Bridge, ND, 3514/17333
 Mangaokahu Stm, AK, 3746/17502
 Mangarakau, NN, 4039/17229
 Mangere, AK, 3658/17447
 Manor Burn Res., upper, CO, 4515/
 16925
 Manuherikia Vly, CO, 4505/16936
 Manukau County, AK, 3514/17313
 Maratai, AK, 3653/17502
 Maramarua, AK/WO, 3715/17514
 Maramarua S.F., AK/WO, 3719/17517
 Maria I. (Ruapuke I.), AK, 3642/17500
 Marlborough, MB, 4200/17300
 Maroepa Hut, RI, 3947/17609
 Marotere Is, AK, 3553/17444
 Martinborough, WA, 4113/17527
 Marton, WI, 4005/17523
 Maruia Springs, BR, 4223/17220
 Mason Bay, SI, 4655/16745
 Masterton, WA, 4057/17539
 Matahina, BP, 3810/17647
 Matai Vly, NN, 4116/17317
 Matakana I., BP, 3731/17601
 Matea, TO, 3844/17631
 Maungakaramea, ND, 3551/17413
 Maunganui Bluff, ND, 3546/17333
 Maungaturoto, ND, 3607/17421
 Mayor I., CL, 3717/17615
 McKinnon Saddle, FD, 4449/16748
 McLennans Bush, MC, 4334/17132
 McPhees Rock, CO, 4528/16959
 Mesopotamia, CC, 4338/17054
 Methven, MC, 4338/17139
 Meyer Is, O, 2915/17752W
 Milford Sound, FD, 4441/16756
 Moana, BR, 4235/17129
 Moenui, SD, 4117/17348
 Mohaka R., GB, 3906/17710
 Mokohinau I., ND, 3555/17506
 Molesworth, MB, 4209/17311
 Montgomery Pk S.R., MC, 4344/17252
 Morrinsville, WO, 3739/17532
 Motuhoropapa I., AK, 3641/17457
 Motukawanui I., ND, 3500/17356
 Motupiko, NN, 4127/17249
 Moturoa I., ND, 3446/17321
 Mount Maunganui, BP, 3738/17610
 Mt Albert, AK, 3653/17443
 Mt Algidus, MC, 4314/17121
 Mt Altmarlock, MB, 4145/17346
 Mt Arthur, NN, 4113/17241
 Mt Aurum, OL, 4451/16843
 Mt Bitterness, CO, 4445/17018
 Mt Burns, FD, 4545/16725
 Mt Cavendish S.R., MC, 4335/17243
 Mt Cheeseman, MC, 4310/17139
 Mt Chrome, MB, 4142/17302
 Mt Cook, MK, 4336/17009
 Mt Cook N.P., MK, 4337/17010
 Mt Dewar, BR, 4205/17133
 Mt Dick, OL, 4516/16840
 Mt Dundas, WN, 4044/17527
 Mt Eden, AK, 3653/17446
 Mt Egmont, TK, 3918/17404
 Mt Evans, MC, 4339/17247
 Mt Fyffe, KA, 4219/17337
 Mt Grey, NC, 4307/17233
 Mt Hedgehope, SL, 4606/16843
 Mt Hercules, WD, 4310/17027
 Mt Hikurangi, BP, 3755/17804
 Mt Holdsworth, WN, 4052/17525
 Mt Hopeless, BR, 4157/17244
 Mt Horrible, OL, 4435/17002
 Mt Hutt, MC, 4328/17132
 Mt Moehau, CL, 3634/17524
 Mt Owen, NN, 4128/17233
 Mt Priestly-Mt Dewar basins, BR, 4204/
 17133
 Mt Ruapehu, TO, 3916/17534
 Mt Sebastopol, MB, 4215/17253
 Mt Sinclair S.R., MC, 4338/17045
 Mt Somers, SC, 4337/17122
 Mt Stokes, SD, 4103/17406
 Mt Te Aroha, BP, 3732/17545
 Mt Tongariro, TO, 3908/17538
 Mt Wellington, AK, 3655/17449
 Mungo Peak and Saddle, WD, 4303/
 17113
 Murupara, BP/TO, 3828/17642
 Napier, HB, 3930/17654
 Nelson, NN, 4117/17317
 Nevis Burn, CO, 4510/16900
 Nevis Crossing, CO, 4511/16900
 New Plymouth, TK, 3904/17404
 New R., BR, 4234/17111
 Ngatapa, GB, 3835/17747
 Ngaumu, WA, 4107/17549
 Nihotupu, AK, 3658/17435
 Noises Is, AK, 3642/17458
 North Arm, SI, 4752/16800
 North Egmont, TK, 3916/17403
 Northland, ND, 3530/17400
 Norton, WN, 4027/17515
 Oamaru, DN, 4505/17059
 Oaro, KA, 4231/17330
 Oban, SI, 4654/16807
 Obelisk Ra., CO, 4518/16912
 Ohakune, TO, 3925/17525
 Ohanga, TK, 3935/17423
 Ohingaiti, WI, 3952/17542
 Ohope, BP, 3759/17705
 Okains Bay, MC, 4343/17303
 Okarito, WD, 4314/17010
 Okuku Pass, NC, 4307/17227
 Old Man Ra., CO, 4523/16913
 Olivine Ra., FD, 4418/16829
 Omahuta, ND, 3514/17335
 Omahuta S.F., ND, 3515/17337
 Omakau, CO, 4506/16936
 Omanawa, BP, 3748/17605
 One Tree Hill, AK, 3654/17447
 Onerahi, ND, 3546/17422
 Oparau, WO, 3803/17456
 Opotiki, BP, 3800/17717
 Opoutere, CL, 3706/17553
 Opurehu R., ND, 3512/17335
 Orakei, AK, 3651/17450
 Orangihikoia Stm, GB, 3840/17702
 Oratia, AK, 3655/17437
 Orepuki, SL, 4617/16744

Orere Point Rd, AK, 3658/17514
 Orongorongo Field Station, WN, 4121/
 17458
 Orongorongo S.F., WN, 4125/17454
 Orongorongo Vly, WN, 4125/17454
 Otahuhu, AK, 3657/17450
 Otarama, MC, 4317/17156
 Otata I., AK, 3642/17458
 Otira, WD, 4250/17134
 Owairaka, AK, 3653/17443
 Owaka, SL, 4627/16940
 Oxford, MC, 4318/17211
 Paekakariki, WN, 4059/17457
 Pahi Bay, ND, 3610/17414
 Pahia, SL, 4620/16745
 Paiaka, WN/WI, 4032/17520
 Paihia, ND, 3517/17405
 Pakanae, ND, 3530/17325
 Pakaraka, ND, 3522/17357
 Palliser Bay, WN/WA, 4126/17504
 Palmerston North, WI, 4022/17537
 Papakai, TO, 3903/17537
 Papamoa, BP, 3744/17618
 Papamoa Beach, BP, 3744/17618
 Papatea Bay, BP, 3739/17751
 Papatoetoe, AK, 3659/17451
 Paraparaumu, WN, 4055/17501
 Parekarangi, BP, 3826/17619
 Parengaronga Harbour, ND, 3431/
 17255
 Parnell, AK, 3651/17447
 Pebbly Hills S.F., SL, 4615/16837
 Peel Forest, SC, 4354/17115
 Pencarrow Head, WN, 4122/17451
 Peria, ND, 3506/17329
 Petone, WN, 4114/17452
 Piha, AK, 3657/17429
 Piopio, WO, 3827/17501
 Pisa Ra., CO, 4450/16915
 Pitt I., O, 4419/17612W
 Pleasant Flat, WD, 4401/16924
 Plimmerton, WN, 4105/17452
 Point Chevalier, AK, 3652/17442
 Ponsonby, AK, 3651/17444
 Pori, WA, 4036/17556
 Port Pegasus, SI, 4713/17640
 Port Underwood, SD, 4120/17406
 Port Underwood Saddle, SD, 4118/
 17407
 Port Waikato, WO, 3723/17444
 Pouakai Ra., TK, 3915/17401
 Pretty Bridge Vly, NN, 4126/17256
 Prices Valley, MC, 4340/17230
 Puhipuhi, ND, 3529/17416
 Puhipuhi Res., KA, 4216/17345
 Pukeatuna, WO, 3804/17533
 Pukekohe, AK, 3712/17454
 Pukekohe Research Station, AK, 3712/
 17452
 Pukekohe Stm, ND, 3602/17413
 Puketona, ND, 3518/17358
 Puketutu I., AK, 3658/17445
 Punakaiki, BR, 4207/17120
 Punaruku Rd, ND, 3523/17418
 Punaruku Stm, ND, 3522/17419
 Puponga, NN, 4031/17243
 Pupu Springs, NN, 4051/17246
 Purewa Bush, AK, 3652/17450
 Rakaia, MC, 4345/17202
 Rakaia Vly, MC, 4345/17202
 Rakeahua Vly, SI, 4700/16753
 Rangataua, TO, 3926/17527
 Rangatira I. (South East I.), O, 4421/
 17610W
 Rangiora, NC, 4318/17236
 Rangitaiki, TO, 3853/17622
 Rangitihī, ND, 3508/17320
 Rangitoto I., AK, 3648/17452
 Ranui, AK, 3652/17436
 Raoul I., O, 2916/17755W
 Rapahoe, BR, 4222/17115
 Rarangi, SD, 4124/17403
 Red Lakes track, MK, 4344/17007
 Red Mercury I., CL, 3637/17556
 Red Rocks, WN, 4121/17443
 Redwoods Valley, NN, 4118/17305
 Reefton, BR, 4207/17151
 Rees Saddle, MK, 4433/16833
 Remarkables Ra., CO, 4506/16850
 Remuera, AK, 3653/17448
 Resolution I., FD, 4537/16639
 Rhoboro Downs, SC, 4411/17005
 Riccarton, MC, 4332/17235
 Riccarton Bush, MC, 4332/17236
 Richmond, NN, 4121/17311
 Riverhead, AK, 3645/17436
 Riwaka, NN, 4105/17300
 Roaring Billy forest walk, WD, 4356/
 16918
 Roaring Meg, CO, 4459/16904
 Rock and Pillar Ra., CO, 4523/17006
 Rocklands, CO, 4540/16959
 Rocky Bay, ND, 3536/17432
 Ronga Vly, SD, 4113/17336
 Ross, WD, 4254/17048
 Ross Ck Reservoir, DN, 4537/17016
 Rotherham, NC, 4242/17257
 Rotoehu, BP, 3802/17632
 Rotoehu S.F., BP, 3755/17631
 Rotorua, BP, 3809/17615
 Rough Ck, NC, 4257/17134
 Route Burn, OL, 4445/16815
 Royal Oak, AK, 3655/17447
 Ruakaka, ND, 3554/17427
 Ruamahuanui I., CL, 3657/17606
 Rukumoana, HB, 3917/17640
 Russell Forest, ND, 3523/17418
 Salt L., CO, 4535/17005
 Sandringham, AK, 3654/17444
 Saxton, WI, 4008/17515
 Saxton Pass, MB, 4204/17313
 Scuffle I., SD, 4047/17349
 Seafield, MC, 4355/17454
 Sealy Ra., MK, 4346/17003
 Sealy Tarn, MK, 4343/17004
 Secretary I., FD, 4514/16655
 Sefton, MC, 4315/17240
 Shale Peak, NC, 4236/17238
 Shenandoah, BR, 4152/17215
 Sherry Valley, NN, 4132/17242
 Shingle Ck, CO, 4525/16917
 Ship Cove, SD, 4106/17414
 Sign of the Packhorse S.R., MC, 4342/
 17242
 Silverdale, AK, 3736/17441
 Simonin Pass, FD, 4420/16821
 South East I., O, 4421/17610W
 South West I., O, 3411/17204
 South Westland, WD, 4353/16903
 Southbridge, MC, 4349/17215
 Speargrass Ck, BR, 4150/17245
 Spirits Bay, ND, 3427/17247
 St Arnaud, BR, 4148/17251
 St Lawrence, HB, 3953/17644
 Stephens I., SD, 4040/17400
 Stewart I., SI, 4700/16800
 Stoke, NN, 4119/17314
 Stokes Valley, WN, 4111/17459
 Stonehurst Plantation, NC, 4258/
 17310
 Stratford, TK, 3920/17417
 Sumner, MC, 4335/17246
 Surville Cliffs, ND, 3424/17301
 Swanson, AK, 3652/17434
 Tadmor, NN, 4126/17245
 Tahekeroa, AK, 3632/17434
 Tahunanui, NN, 4117/17315
 Taihape, RI, 3941/17548
 Taipo R. (Route 73), WD, 4245/17123
 Tairua, CL, 3700/17551
 Taitapu, MC, 4340/17234
 Takahe Vly, FD, 4517/16740
 Takaka Hill, NN, 4102/17251
 Takapau, HB, 4001/17620
 Takapuna, AK, 3648/17447
 Tamahunga, AK, 3618/17443
 Tangihua Lodge, ND, 3551/17408
 Tangoio, HB, 3918/17653

Tapu, CL, 3659/17530
 Tarakohe, NN, 4050/17254
 Tararere Stm, HB, 3916/17653
 Tarawera, TO, 3902/17634
 Taumarunui, TO, 3853/17516
 Taupo, TO, 3841/17605
 Tauranga, BP, 3741/17610
 Tauranga Bay, BP, 4146/17127
 Taurewa, TO, 3905/17533
 Tawhai S.F., BR, 4210/17152
 Tawharanui, AK, 3623/17446
 Tawhiti Rahi I., ND, 3528/17444
 Taylor R., MB, 4131/17358
 Taylorville, BR, 4226/17119
 Te Anaputa Pt, CL, 3632/17532
 Te Anau, FD, 4531/16739
 Te Aroha, WO/BP, 3732/17543
 Te Awamutu, WO, 3800/17519
 Te Henga, AK, 3654/17427
 Te Huahua, ND, 3521/17329
 Te Kohanga, WO, 3719/17451
 Te Kouma, CL, 3649/17529
 Te Kuiti, WO, 3822/17504
 Te Matua Ngahere, ND, 3537/17331
 Te Oka Bay, MC, 4351/17247
 Te Oka S.R., MC, 4349/17248
 Te Paki, ND, 3433/17247
 Te Paki Stm, ND, 3743/17507
 Te Pua, AK, 3641/17426
 Te Puke, BP, 3747/17620
 Te Waewae Bay, FD/SL, 4613/16730
 Te Waka, TO, 3914/17639
 Tempest Spur, FD, 4422/16825
 Terawhiti, WN, 4118/17437
 Thames, CL, 3709/17533
 Thar Lodge, MK, 4344/17005
 The Cairn, SL, 4618/16911
 The Horn Ra., CO, 4505/16900
 Three Kings Is, O, 3411/17204
 Tikorangi, TK, 3902/17417
 Tinakori Ra., WN, 4116/17446
 Tiniroto, GB, 3846/17734
 Tinui, WA, 4053/17604
 Tiritiri Matangi I., AK, 3636/17453
 Titahi Bay, WN, 4106/17450
 Titirangi, AK, 3656/17440
 Tiwai Pt, SL, 4636/16822
 Tokaanu, TO, 3858/17546
 Tokata, BP, 3737/17819
 Tokomaru, WN, 4028/17530
 Tokoroa, WO/TO, 3814/17552
 Tongariro N.P., TO, 3913/17536
 Totaranui, NN, 4049/17300
 Travers Valley, BR/MB, 4152/17249
 Trotters Gorge, DN, 4524/17048
 Tuahu Track, BP, 3536/17551
 Tumbledown Bay, MC, 4351/17246
 Tutira, HB, 3912/17653
 Tutukaka, ND, 3537/17431
 Tutukaka Harbour, ND, 3537/17432
 Twin Bridges, ND, 3537/17351
 Ulva I., SI, 4656/16808
 Unuwaho, ND, 3426/17253
 Unwin Hut, MK, 4346/17007
 Upper Wairau, MB, 4204/17256
 Urewera N.P., TO/GB, 3830/17700
 Victoria Park, MC, 4335/17239
 Vining Track, AK, 3709/17515
 Waenga, BP, 3732/17810
 Waewaepa Ra., WA, 4025/17605
 Waiheke I., AK, 3648/17508
 Waiho Gorge, WD, 4322/17010
 Waihopai Vly, lower, MB, 4131/17344
 Waikari, NC, 4258/17241
 Waikawa Stm, WN, 4041/17509
 Waikawau, CL, 3636/17531
 Waikawau Bay, CL, 3637/17533
 Waikawau - Kennedy Bay, CL, 3638/
 17534
 Waimahia, AK, 3703/17452
 Waimangaroa, NN/BR, 4143/17146
 Waimangu Vly, BP, 3817/17623
 Wainihinihi, WD, 4246/17120
 Wainuiomata, WN, 4116/17457
 Waioka Gorge, BP, 3815/17715
 Waipatiki Beach, HB, 3918/17658
 Waipawa, HB, 3957/17635
 Waipoua, ND, 3540/17335
 Waipoua S.F., ND, 3539/17333
 Waipu, ND, 3559/17426
 Waipuna, BR, 4219/17143
 Waipunga Falls, TO, 3857/17631
 Wairapukao, TO, 3832/17634
 Wairau Vly, upper, MB, 4209/17250
 Waireka, BP, 3816/17612
 Wairoa, GB, 3902/17725
 Wairoa Gorge, NN, 4126/17307
 Waitakere Ra., AK, 3659/17432
 Waitakere Scenic Drive, AK, 3656/
 17434
 Waitangi, ND, 3516/17405
 Waitara, TK, 3900/17414
 Waitarere, WN, 4033/17512
 Waitati, DN, 4545/17034
 Waitoa, WO, 3736/17538
 Waitotara, WI, 3948/17444
 Waiuku, AK, 3715/17444
 Waiuku S.F., AK, 3721/17443
 Wakefield, NN, 4125/17303
 Wakefield (Mt), MK, 4341/17008
 Wall, TO, 3900/17516
 Wallingford, HB, 4012/17635
 Wangaehu, WI, 4000/17510
 Wanganui, WI, 3957/17503
 Wanganui S.F., WD, 4303/17027
 Wardles Ck, HB, 3917/17620
 Warkworth, AK, 3624/17440
 Warrington, DN, 4543/17035
 Wattle Bay, AK, 3703/17435
 Watts Rock, CO, 4510/16905
 Waverley, DN, 4553/17032
 Weld Pass, MB, 4136/17403
 Wellington, WN, 4115/17445
 Wellsford, AK, 3618/17431
 Weraroa, WN, 4038/17516
 West Coast, WD, 4330/17000
 Western Springs, AK, 3652/17443
 Whakarewarewa, BP, 3810/17615
 Whakatane, BP, 3758/17659
 Whale I., ND, 3447/17323
 Whangamoa Saddle, NN, 4113/17326
 Whangaparaoa, AK, 3638/17445
 Whangaparaoa, BP, 3734/17800
 Whangarei, ND, 3543/17419
 Whangarei County, ND, 3543/17419
 Whangarei Heads, ND, 3552/17432
 Whangaroa County, ND, 3503/17345
 Wharariki Beach, NN, 4030/17240
 Wharite, RI, 4015/17551
 Whatarangi, WA, 4129/17513
 Whatatutu, GB, 3823/17752
 Whatipu, AK, 3702/17430
 Whau Valley, ND, 3542/17419
 Whirokino, WI, 4032/17519
 White Rock, NC, 4310/17227
 Whitianga, CL, 3650/17540
 Wilberforce R., MC, 4304/17120
 Wilmot Pass, FD, 4531/16711
 Wilton, WN, 4116/17445
 Woodhill, AK, 3645/17426
 Woodhill S.F., AK, 3644/17423

APPENDIX C: Systematic affiliation of associated plants and status in New Zealand

(E, endemic; N, native but not endemic; A, adventive or naturalised; G, garden plant only; ?, origin doubtful)

	Family	Status	
<i>Aciphylla</i> spp.	Apiaceae	E	
<i>Agrostis capillaris</i> L.	Poaceae		A
<i>Alopecurus pratensis</i> L.	Poaceae		A
<i>Amaranthus retroflexus</i> L.	Amaranthaceae		A
<i>Astelia</i> spp.	Asteliaceae	E	
<i>Astelia nervosa</i> Hook. f.	Asteliaceae	E	
<i>Avicennia marina</i> (Forsk.) Vierh. subsp. <i>australasica</i> (Walp) J. Everett	Avicenniaceae		N
<i>Beta vulgaris</i> L.	Chenopodiaceae		A
<i>Brachyglottis</i> spp.	Asteraceae	E	
<i>Brassica rapa</i> L.	Brassicaceae		A
<i>Bulbinella</i> spp.	Asphodelaceae	E	
<i>Carex</i> spp.	Cyperaceae	E	N A
<i>Carex divulsa</i> Stokes	Cyperaceae		A
<i>Carex longibrachiata</i> Boeck.	Cyperaceae		A
<i>Carex trifida</i> Cav.	Cyperaceae		N
<i>Carex virgata</i> Boott in Hook. f.	Cyperaceae	E	
<i>Carmichaelia</i> spp.	Fabaceae	E	
<i>Cassinia</i> spp.	Asteraceae	E	A
<i>Cassinia leptophylla</i> (Forst. f.) R. Br.	Asteraceae	E	
<i>Celmisia armstrongii</i> Petrie	Asteraceae	E	
<i>Celmisia viscosa</i> Hook. f.	Asteraceae	E	
<i>Celmisia walkeri</i> Kirk	Asteraceae	E	
<i>Chionochloa</i> spp.	Poaceae	E	
<i>Cirsium vulgare</i> (Savi) Ten.	Asteraceae		A
<i>Coprosma</i> spp.	Rubiaceae	E	N
<i>Coprosma macrocarpa</i> Cheesem.	Rubiaceae	E	
<i>Coprosma rhamnoides</i> A. Cunn	Rubiaceae	E	
<i>Coprosma robusta</i> Raoul	Rubiaceae	E	
<i>Cordyline australis</i> (Forst. f.)	Asteliaceae	E	
<i>Coriaria</i> spp.	Coriariaceae	E	
<i>Coriaria arborea</i> Lindsay	Coriariaceae	E	
<i>Cortaderia richardii</i> (Endl.) Zotov	Poaceae	E	
<i>Cosmos</i> spp.	Asteraceae		A
<i>Cyperus ustulatus</i> A. Rich.	Cyperaceae	E	
<i>Cupressus</i> spp.	Cupressaceae		A
<i>Cytisus scoparius</i> (L.) Link	Fabaceae		A
<i>Dacrycarpus dacrydioides</i> (A. Rich.) Laubenf.	Podocarpaceae	E	
<i>Dacrydium cupressinum</i> Lamb.	Podocarpaceae	E	
<i>Dactylis glomerata</i> L.	Poaceae		A
<i>Daucus carota</i> L.	Apiaceae		A
<i>Desmoschoenus spiralis</i> (A. Rich.) Hook. f.	Cyperaceae	E	
<i>Disphyma australe</i> (W.T. Aiton) N.E. Br.	Aizoaceae	E	A
<i>Elaeagnus umbellata</i> Thunb. var. <i>parviflora</i> (Royle) C. Schneid.	Elaeagnaceae		G
<i>Eucalyptus</i> spp.	Myrtaceae		A
<i>Festuca novaezelandiae</i> (Hack.) Cockayne	Poaceae	E	
<i>Fragaria</i> spp.	Rosaceae		A
<i>Fuchsia</i> spp.	Onagraceae	E	A

	Family	Status
<i>Fuchsia excorticata</i> (J.R. et G. Forst.) L. f.	Onagraceae	E
<i>Gahnia</i> spp.	Cyperaceae	E N
<i>Gahnia procera</i> J.R. et G. Forst.	Cyperaceae	E
<i>Geniostoma rupestre</i> J.R. et G. Forst. var. <i>ligustrifolium</i> (A. Cunn.) Conn.	Loganiaceae	E
<i>Griselinia</i> spp.	Griselinaceae	E
<i>Hebe</i> spp.	Scrophulariaceae	E N
<i>Hebe boltonii</i> (Ckn.) Ckn. et Allan	Scrophulariaceae	E
<i>Hebe odora</i> (Hook. f.) Ckn.	Scrophulariaceae	E
<i>Hebe salicifolia</i> (Forst. f.) Pennell	Scrophulariaceae	N
<i>Hordeum vulgare</i> L.	Poaceae	A
<i>Juncus</i> spp.	Juncaceae	E N A
<i>Juncus effusus</i> L.	Juncaceae	A
<i>Kunzea ericoides</i> (A. Rich.) J. Thompson	Myrtaceae	E
<i>Leptospermum scoparium</i> J.R. et G. Forst.	Myrtaceae	N
<i>Lolium</i> sp.	Poaceae	A
<i>Lolium perenne</i> L.	Poaceae	A
<i>Lotus pedunculatus</i> Cav.	Fabaceae	A
<i>Lupinus arboreus</i> Sims	Fabaceae	A
<i>Lycopersicon esculentum</i> Miller	Solanaceae	A
<i>Medicago sativa</i> L.	Fabaceae	A
<i>Melicytus</i> spp.	Violaceae	E N
<i>Melicytus ramiflorus</i> J.R. et G. Forst.	Violaceae	E
<i>Metrosideros excelsa</i> Sol. ex Gaertn.	Myrtaceae	E
<i>Metrosideros scandens</i> (J.R. et G. Forst.) Druce	Myrtaceae	E
<i>Muehlenbeckia</i> sp.	Polygonaceae	N
<i>Muehlenbeckia axillaris</i> (Hook. f.) Walp.	Polygonaceae	N
<i>Myoporum laetum</i> Forst. f.	Myoporaceae	E
<i>Myrsine australis</i> (A. Rich.) Allan	Myrsinaceae	E
<i>Nassella trichotoma</i> (Nees) Hack. ex Arechav.	Poaceae	A
<i>Nothofagus</i> spp.	Fagaceae	E
<i>Nothofagus menziesii</i> (Hook. f.) Oerst.	Fagaceae	E
<i>Olearia</i> spp.	Asteraceae	E
<i>Olearia moschata</i> Hook. f.	Asteraceae	E
<i>Olearia virgata</i> Hook. f.	Asteraceae	E
<i>Passiflora edulis</i> Sims	Passifloraceae	A
<i>Passiflora mollissima</i> (Kunth) L. Bailey	Passifloraceae	A
<i>Phleum pratense</i> L.	Poaceae	A
<i>Phormium</i> spp.	Phormiaceae	E N
<i>Phyllocladus</i> sp.	Podocarpaceae	E
<i>Pimelea</i> spp.	Thymelaeaceae	E
<i>Pinus contorta</i> Loudon	Pinaceae	A
<i>Pinus muricata</i> D. Don	Pinaceae	A
<i>Pinus radiata</i> D. Don	Pinaceae	A
<i>Pinus taeda</i> L.	Pinaceae	A
<i>Pisum</i> sp.	Fabaceae	A
<i>Pittosporum</i> spp.	Pittosporaceae	E
<i>Pittosporum colensoi</i> Hook. f.	Pittosporaceae	E
<i>Pittosporum crassifolium</i> Banks et Sol. ex A.Cunn.	Pittosporaceae	E
<i>Pittosporum eugenioides</i> A. Cunn.	Pittosporaceae	E
<i>Pittosporum ralphii</i> Kirk	Pittosporaceae	E
<i>Pittosporum tenuifolium</i> Sol. ex Gaertn.	Pittosporaceae	E
<i>Plagianthus divaricatus</i> J.R. et G. Forst.	Malvaceae	E

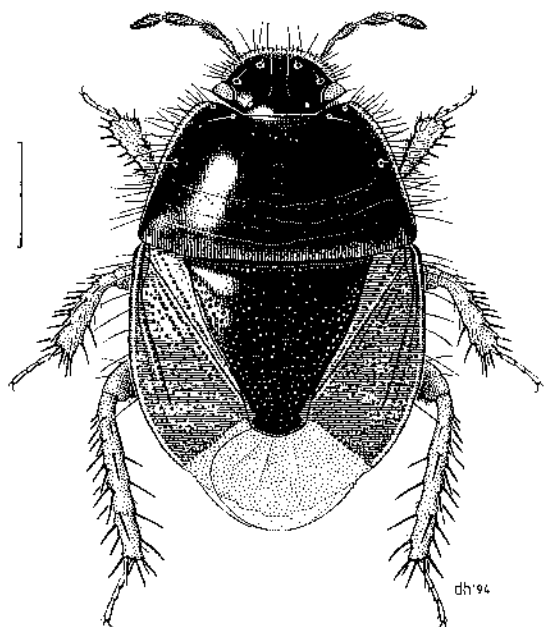
(continued overleaf)

	Family	Status		
<i>Podocarpus totara</i> G. Benn. ex D. Don in Lamb.	Podocarpaceae	E		
<i>Polystichum vestitum</i> (Forst. f.) Presl.	Dryopteridaceae	E		
<i>Pseudopanax arboreus</i> (Murr.) Philipson	Araliaceae	E		
<i>Pseudowintera</i> spp.	Winteraceae	E		
<i>Racosperma mearnsii</i> (De Wild.) Pedley	Fabaceae		A	
<i>Ranunculus</i> spp.	Ranunculaceae	E	N	A
<i>Raoulia tenuicaulis</i> Hook. f.	Asteraceae	E		
<i>Ribes</i> spp.	Grossulariaceae			A
<i>Ribes rubrum</i> L.	Grossulariaceae			A
<i>Rubus</i> spp.	Rosaceae	E	A	
<i>Rubus australis</i> Forst. f.	Rosaceae	E		
<i>Rubus fruticosus</i> L.	Rosaceae			A
<i>Rubus ursinus</i> Cham. et Schltr.	Rosaceae			G
<i>Schefflera digitata</i> J.R. et G. Forst.	Araliaceae	E		
<i>Scirpus</i> spp.	Cyperaceae		A	?
<i>Senecio jacobaea</i> L.	Asteraceae		A	
<i>Solanum</i> spp.	Solanaceae		A	?
<i>Solanum aviculare</i> Forst. f.	Solanaceae		N	
<i>Solanum mauritianum</i> Scop.	Solanaceae		A	
<i>Solanum nigrum</i> L.	Solanaceae		A	
<i>Solanum linnaeanum</i> Hepper et P.G.M. Jaeger	Solanaceae		A	
<i>Trifolium</i> sp.	Fabaceae		A	
<i>Trifolium repens</i> L.	Fabaceae		A	
<i>Trifolium pratense</i> L.	Fabaceae			A
<i>Triticum aestivum</i> L.	Poaceae			A
<i>Verbascum thapsus</i> L.	Scrophulariaceae			A
<i>Vitex lucens</i> Kirk	Verbenaceae	E		
<i>Zea mays</i> L.	Poaceae			A

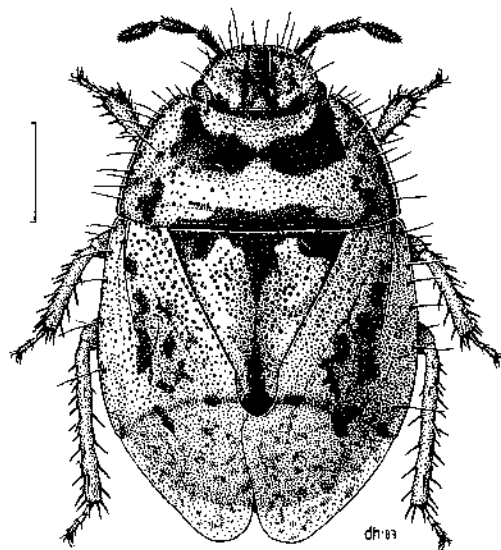
APPENDIX D: Systematic affiliation of associated animals

	Order	Family
<i>Bassaris gonerilla gonerilla</i> Fabricius	Lepidoptera	Nymphalidae
<i>Bowdleria punctata</i> (Quay & Gaimard)	Aves	Sylviidae
<i>Caliroa cerasi</i> (Linnaeus)	Hymenoptera	Tenthredinidae
<i>Corvus frugilegus frugilegus</i> Linnaeus	Aves	Corvidae
<i>Danaus plexippus</i> Linnaeus	Lepidoptera	Nymphalidae
<i>Eriophora pustulosa</i> (Walckenaer)	Araneae	Araneidae
<i>Gonipterus scutellatus</i> (Gyllenhal)	Coleoptera	Curculionidae
<i>Haemaphysalis longicornis</i> Neumann	Acarina	Ixodidae
<i>Helicoverpa punctigera</i> (Wallengren)	Lepidoptera	Noctuidae
<i>Homodotis megaspilata</i> (Walker)	Lepidoptera	Geometridae
<i>Mythimna separata</i> (Walker)	Lepidoptera	Noctuidae
<i>Opodiphthera eucalypti</i> (Scott)	Lepidoptera	Saturniidae
<i>Orocrambus vittellus</i> (Doubleday)	Lepidoptera	Crambidae
<i>Paropsis charybdis</i> Stål	Coleoptera	Chrysomelidae
<i>Pieris rapae rapae</i> Linnaeus	Lepidoptera	Pieridae
<i>Pseudocoremia suavis</i> Butler	Lepidoptera	Geometridae
<i>Scolypopa australis</i> (Walker)	Hemiptera	Ricaniidae
<i>Sturnus vulgaris</i> Linnaeus	Aves	Sturnidae
<i>Trissolcus</i> sp.	Hymenoptera	Scelionidae
<i>Trissolcus basalis</i> (Wollaston)	Hymenoptera	Scelionidae

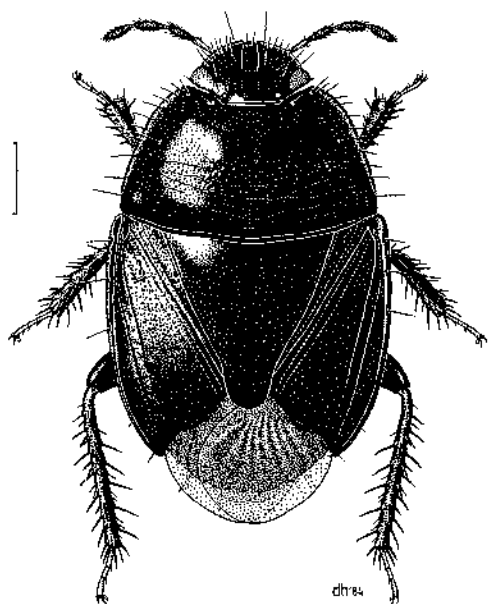
ILLUSTRATIONS



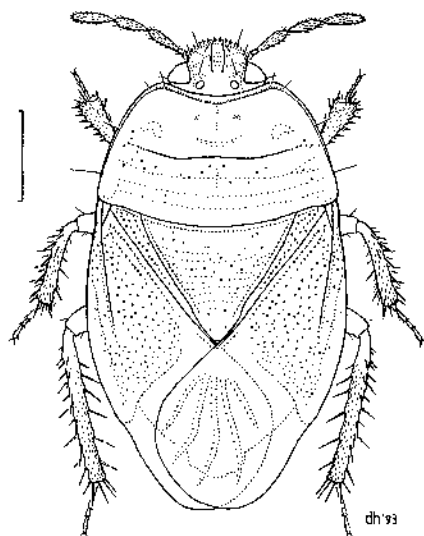
(1) *Aethus thoreyi*



(2) *Choerocydnus nigrosignatus*

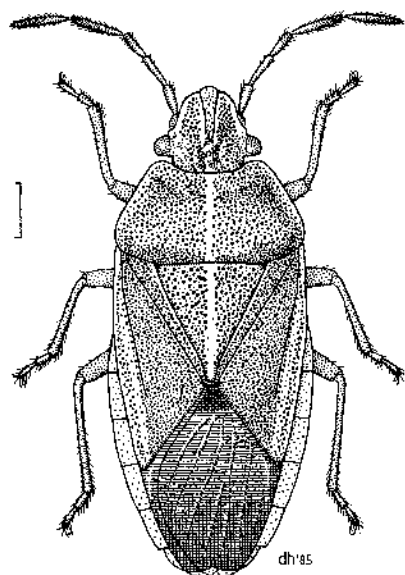


(3) *Philapodemus australis*

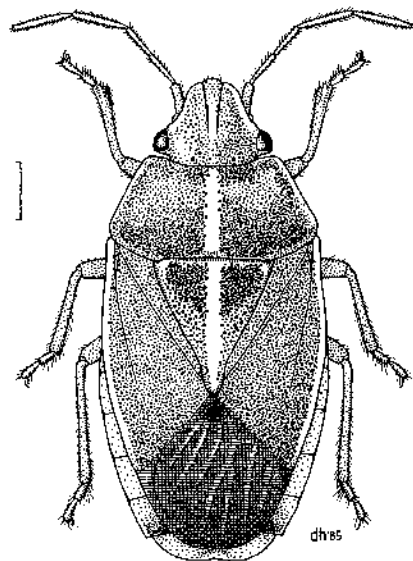


(4) *Chilocoris neozealandicus*

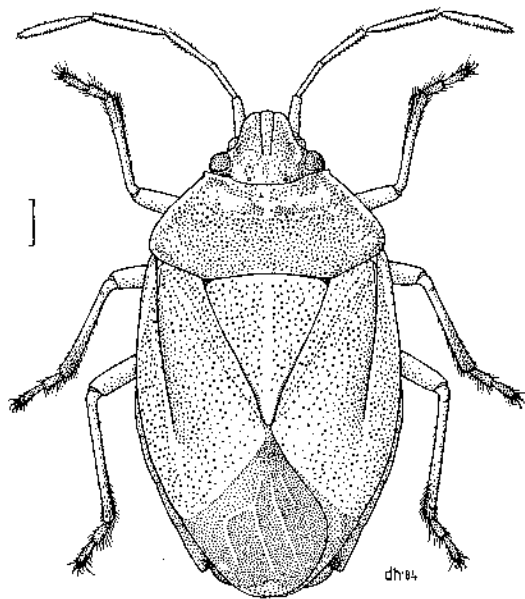
Fig. 1-32 Habitus drawings of Pentatomoides known from New Zealand: (1-19) adult females; (20-32) last-instar nymphs. Scale lines are 1 mm. Illustrator: Des Helmore.



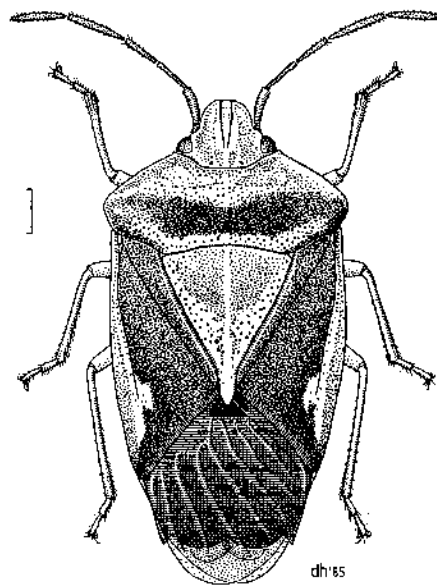
(5) *Rhopalimorpha obscura*



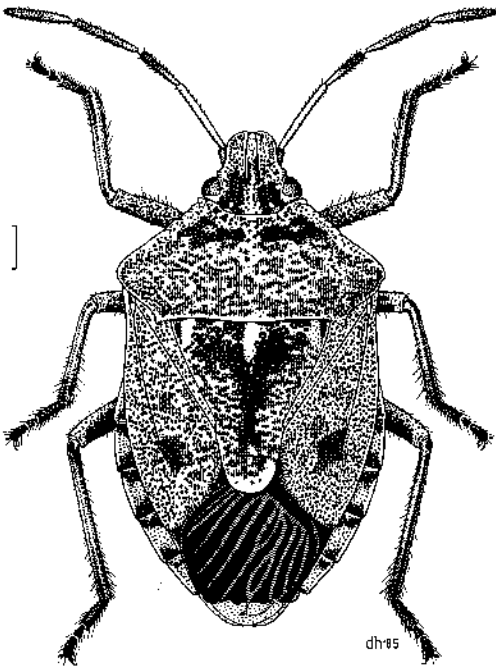
(6) *Rhopalimorpha lineolaris*



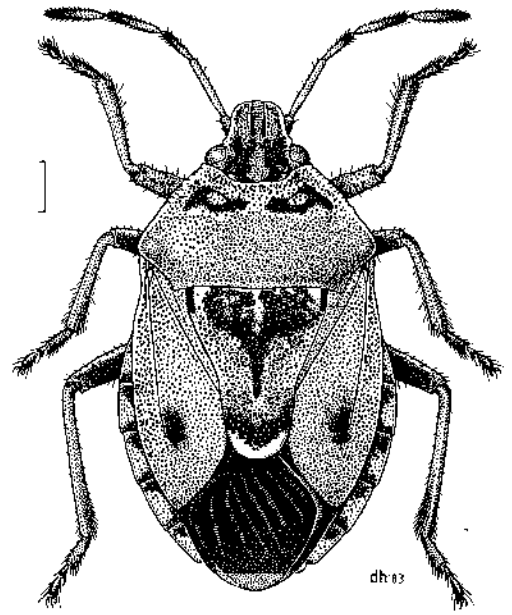
(7) *Rhopalimorpha alpina*



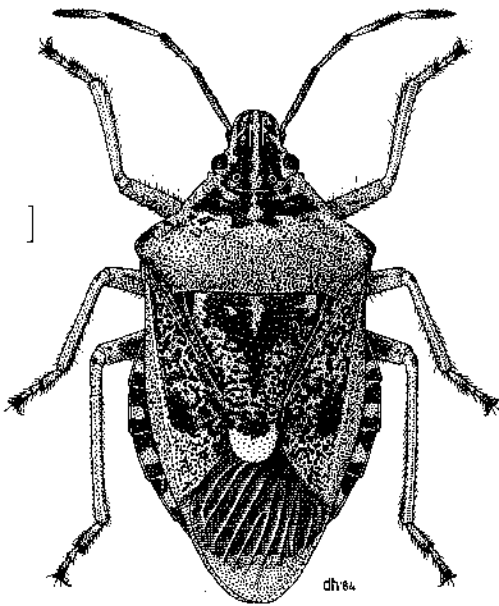
(8) *Oncacontias vittatus*



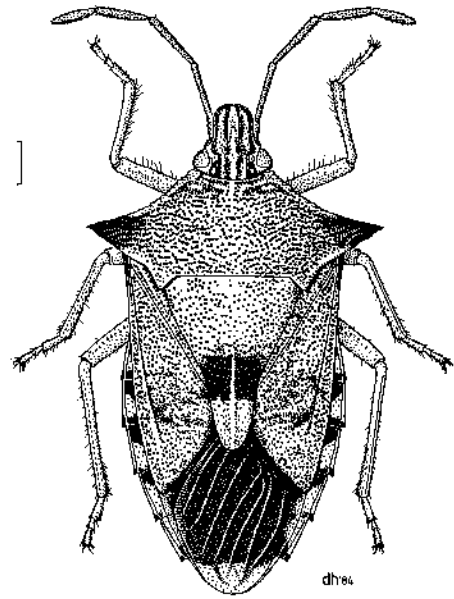
(9) *Cermatulus nasalis nasalis*



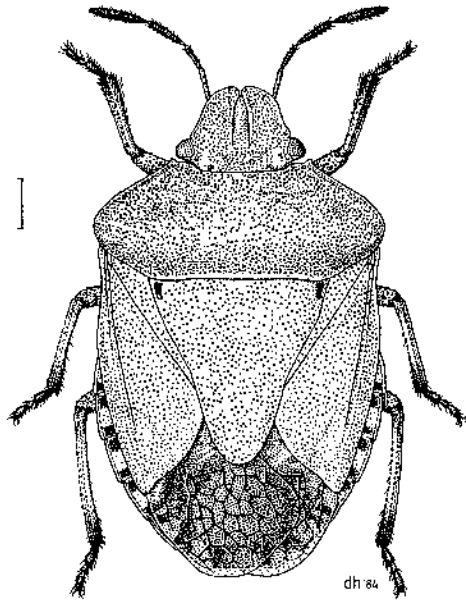
(10) *Cermatulus nasalis hudsoni*



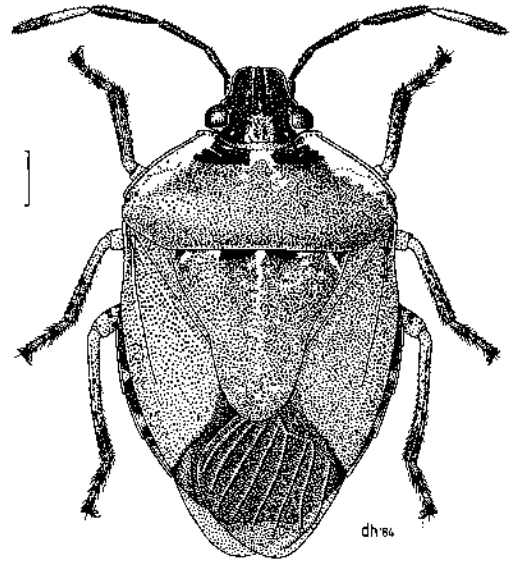
(11) *Cermatulus nasalis turbotti*



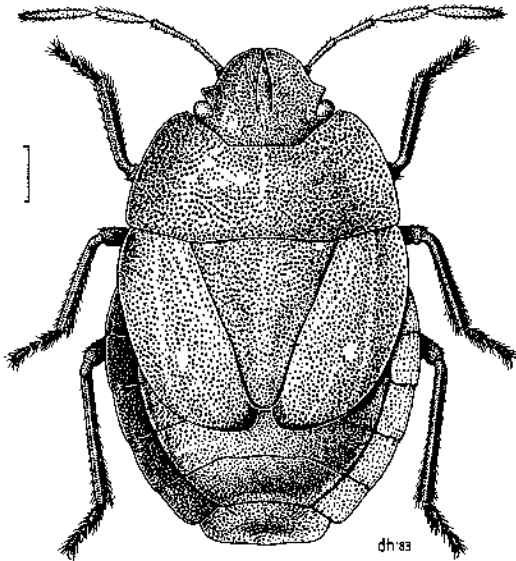
(12) *Oechalia schellenbergii*



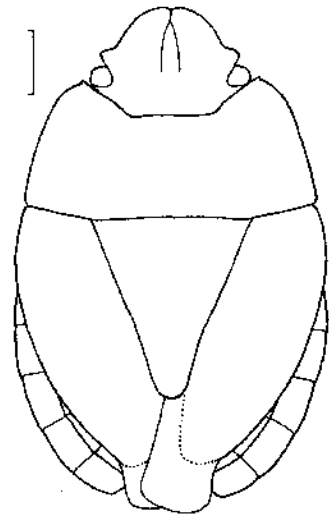
(13) *Dictyotus caenosus*



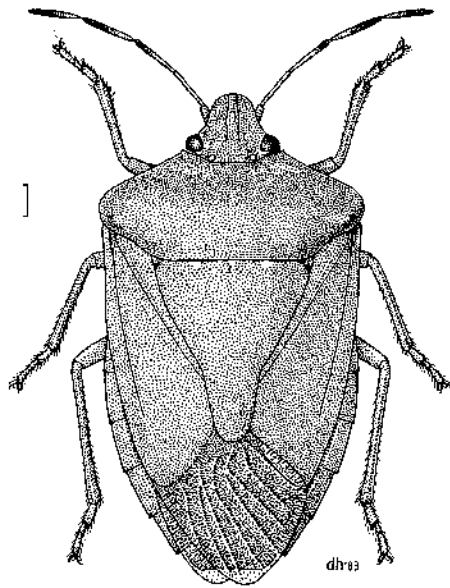
(14) *Monteithiella humeralis*



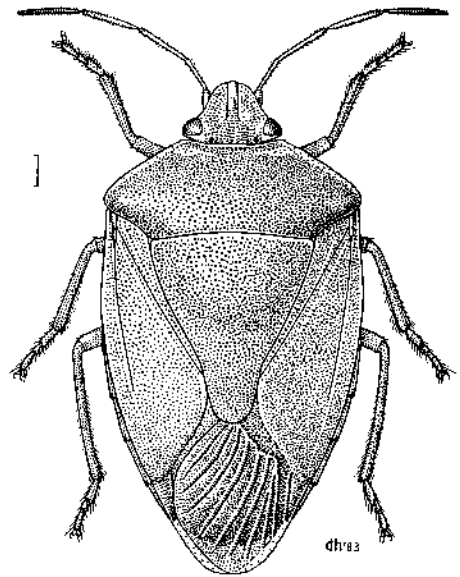
(15) *Hypsithocus hudsonae*



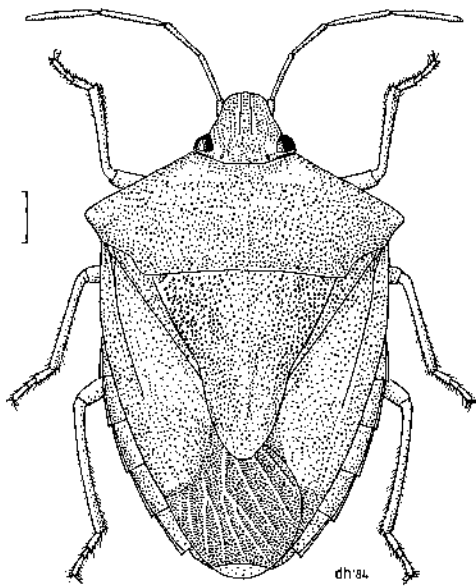
(16) *H. hudsonae* (male, outline)



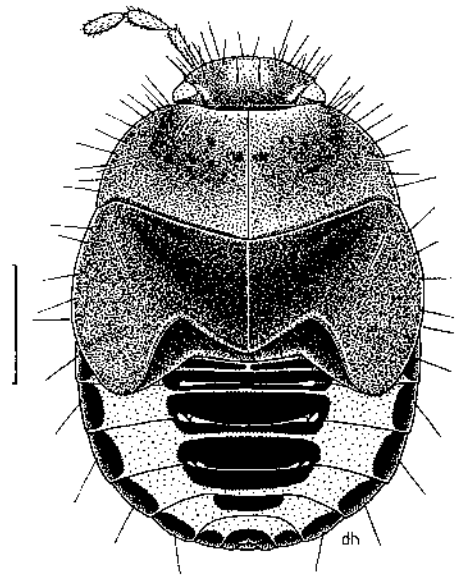
(17) *Nezara viridula*



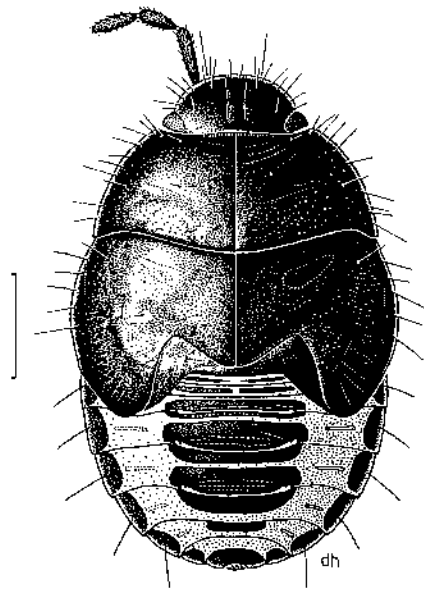
(18) *Glaucias amyoti*



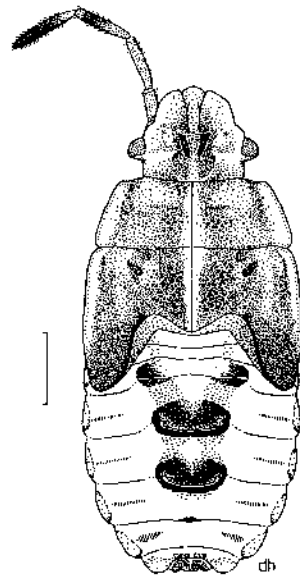
(19) *Cuspicona simplex*



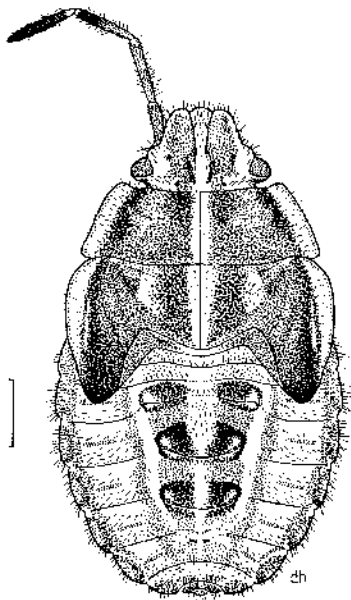
(20) *Choerocydnus nigrosignatus*



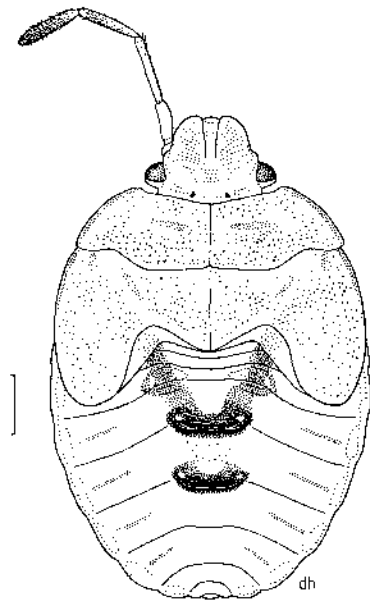
(21) *Philapodemus australis*



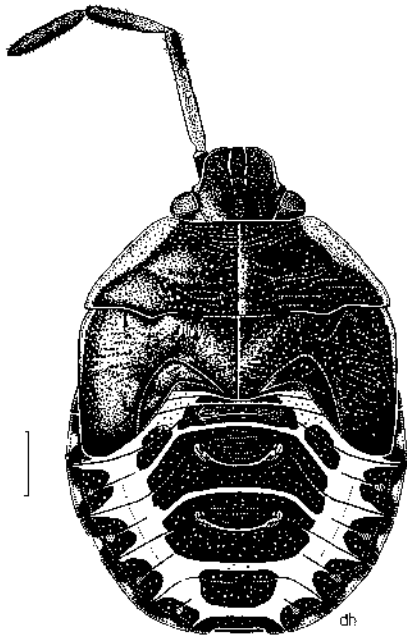
(22) *Rhopalimorpha obscura*



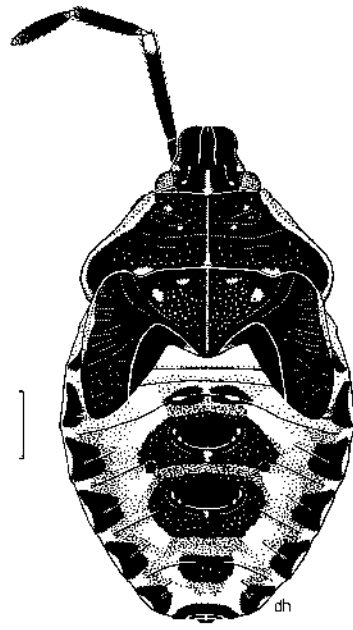
(23) *Rhopalimorpha lineolaris*



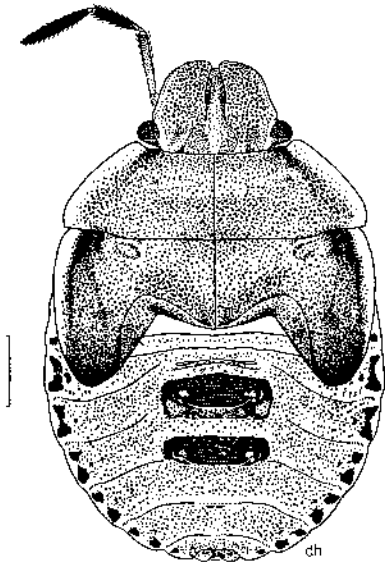
(24) *Oncaontias vittatus*



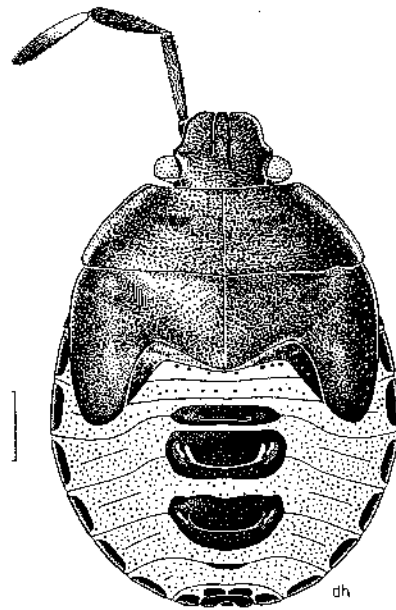
(25) *Cermatulus nasalis nasalis*



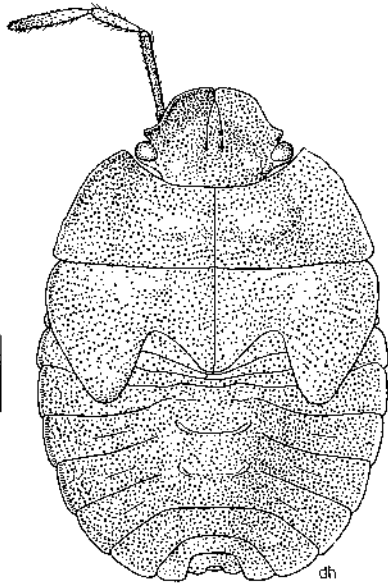
(26) *Oechalia schellenbergii*



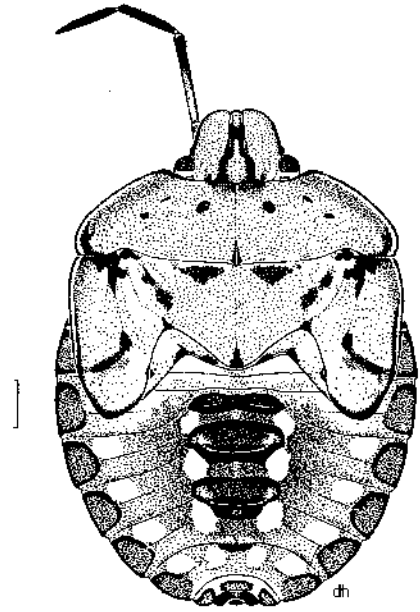
(27) *Dictyotus caenosus*



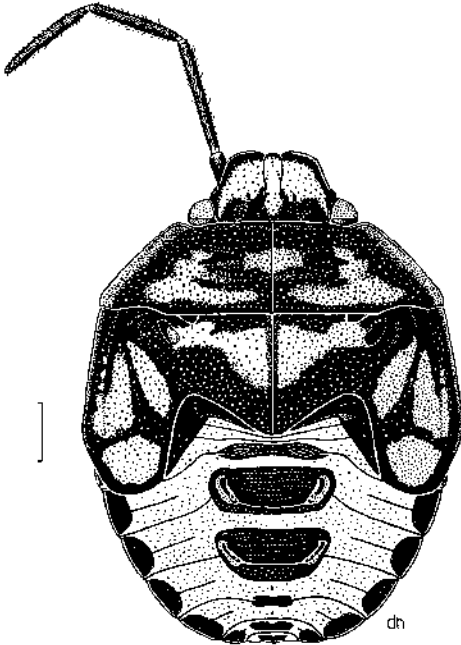
(28) *Monteithiella humeralis*



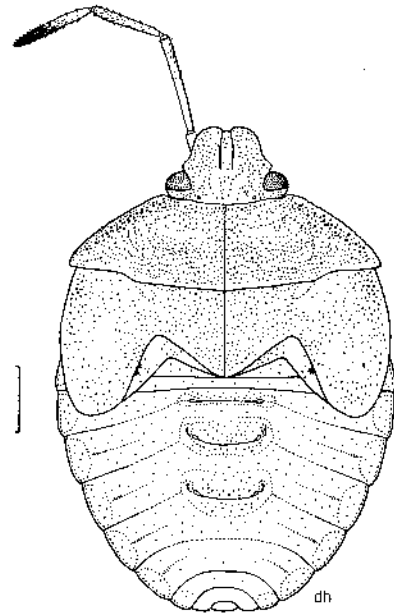
(29) *Hypsithocus hudsonae*



(30) *Nezara viridula*



(31) *Glaucias amyoti*



(32) *Cuspicona simplex*

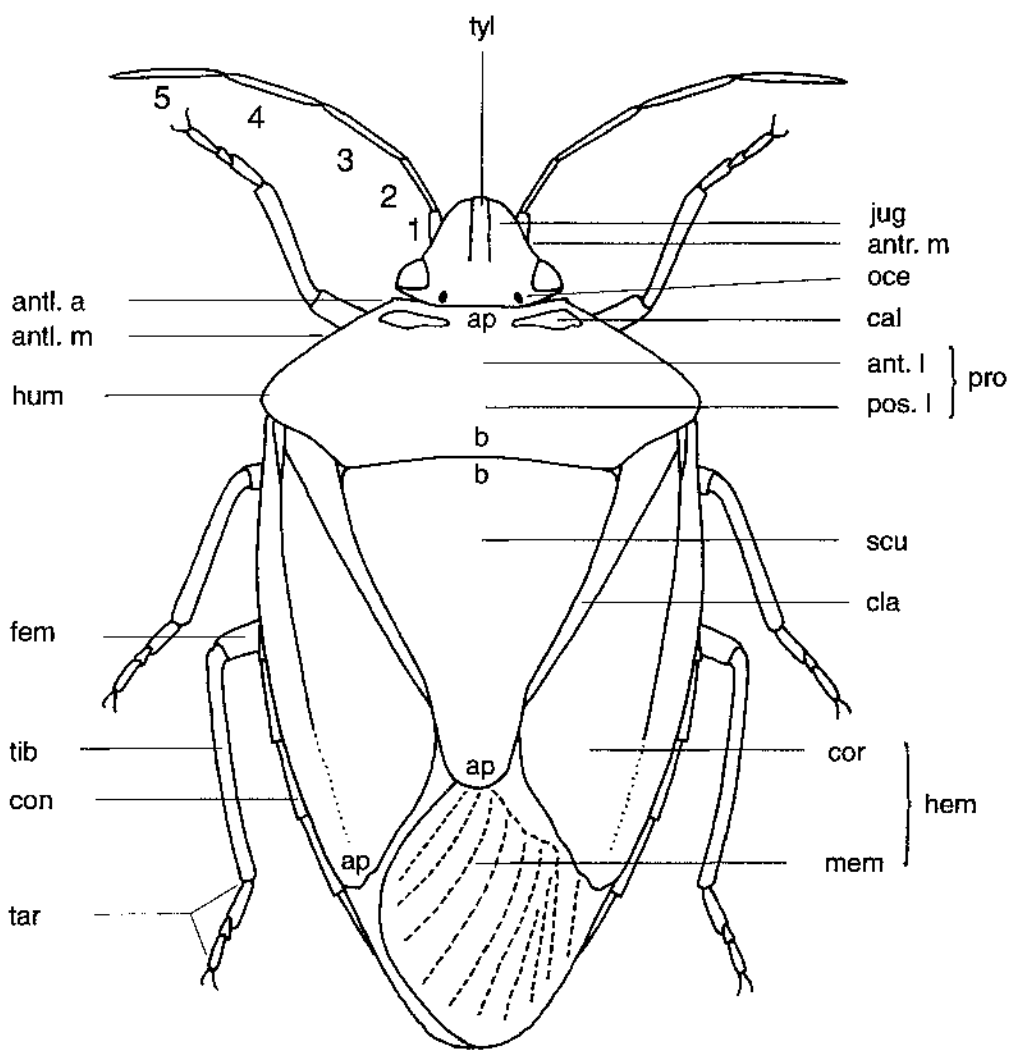


Fig. 33 Schematic dorsal view, *Glaucias amyoti* (ant. l - anterior lobe; antl. a - anterolateral angle; antl. m - anterolateral margin; antr. m - anteocular margin; ap - apex; b - base; cal - callus; cla - clavus; con - connexivum; cor - corium; fem - femur; hem - hemelytron; hum - humerus; jug - jugum; mem - membrane; pos. l - posterior lobe; pro - pronotum; oce - ocellus; scu - scutellum; tar - tarsus; tib - tibia; tyl - tylus; 1, 2, 3, 4, 5 - antennal segments).

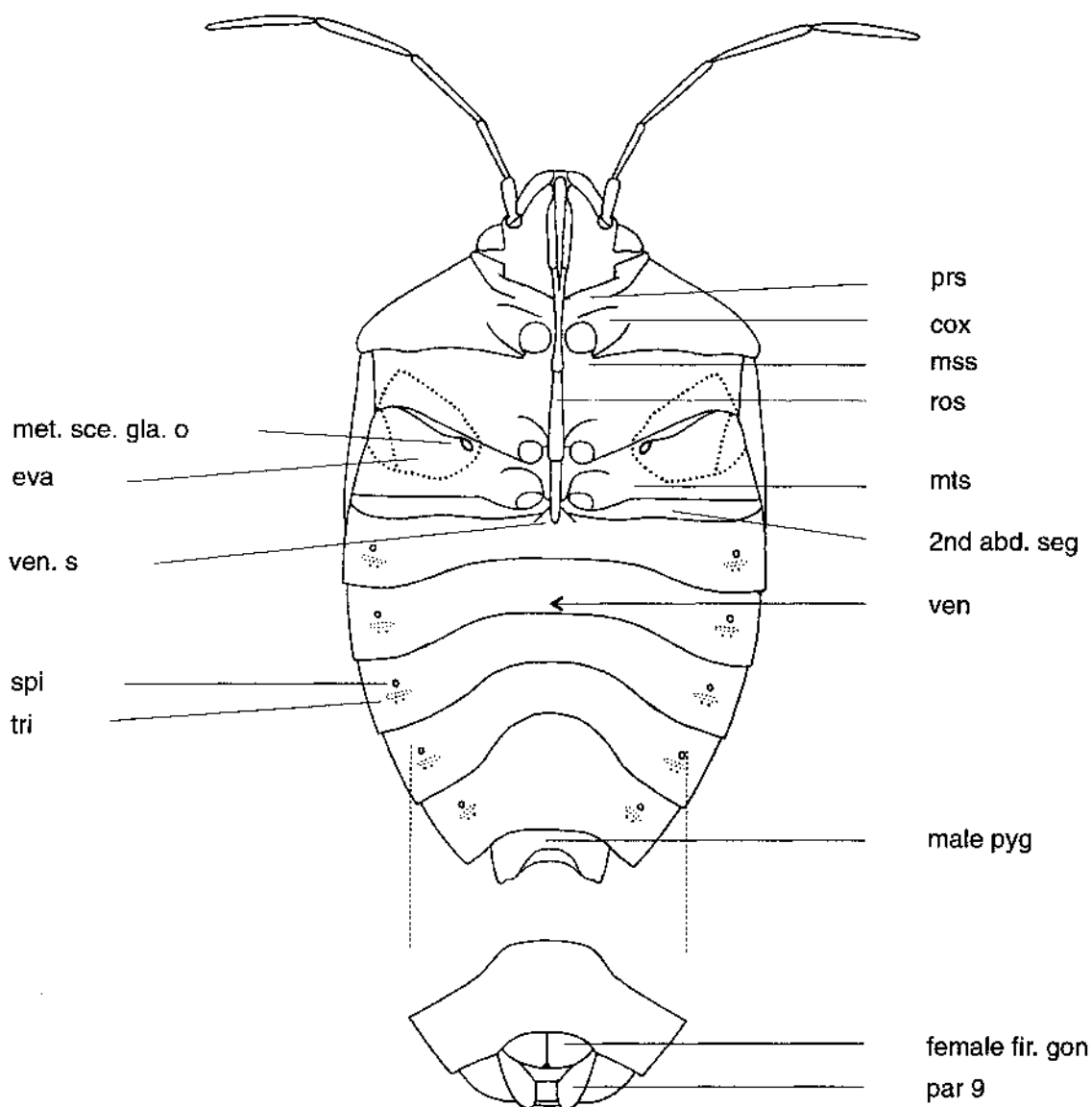
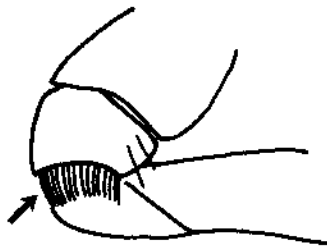
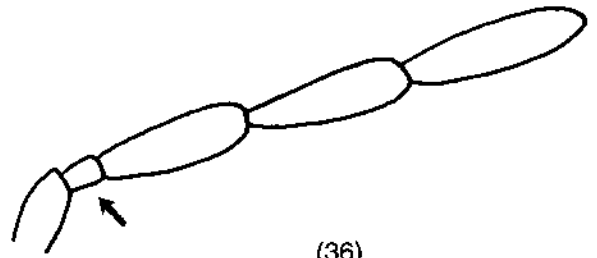


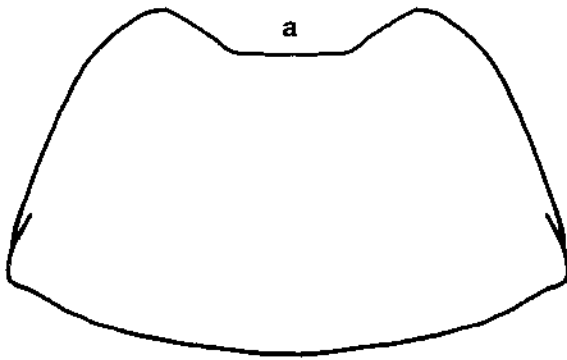
Fig. 34 Schematic ventral view, *Glaucias amyoti* (cox - coxa; eva - evaporatorium; female fir. gon - female first gonocoxa; male pyg - male pygophore; met. sce. gla. o - metathoracic scent gland opening; mss - mesosternum; mts - metasternum; par 9 - paratergite 9; prs - prosternum; ros - rostrum; spi - spiracle; tri - trichobothrium; ven - venter; ven. s - ventral spine; 2nd abd. seg - second abdominal segment).



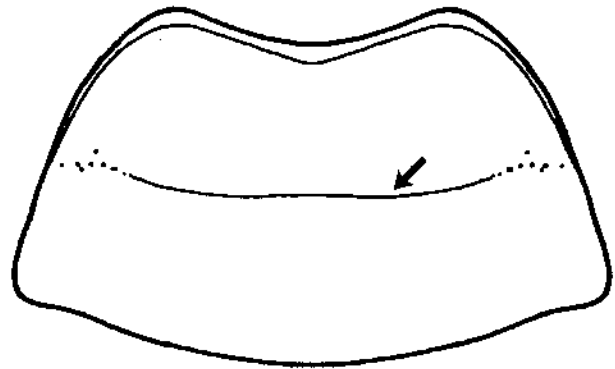
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(36)

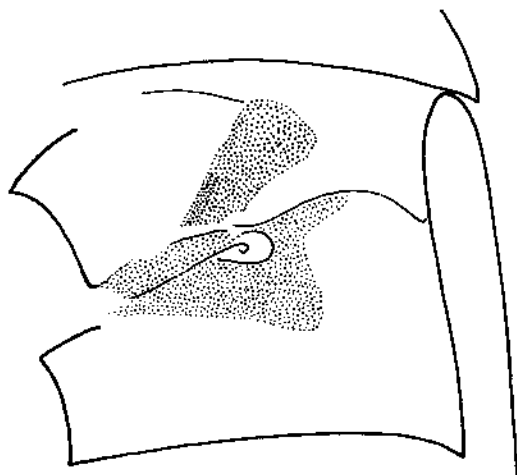


(37)

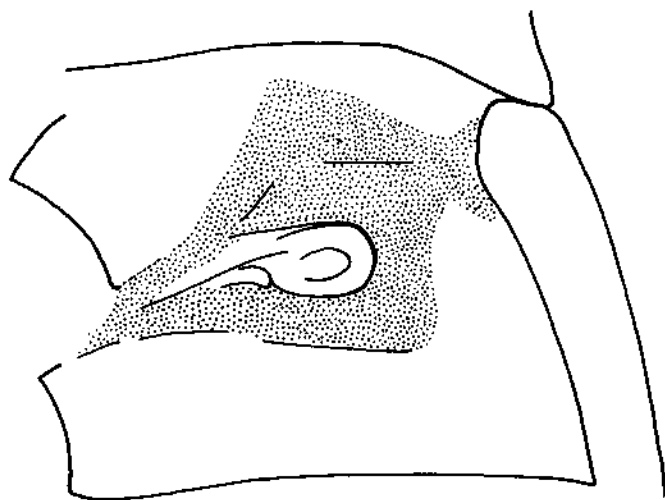


(38)

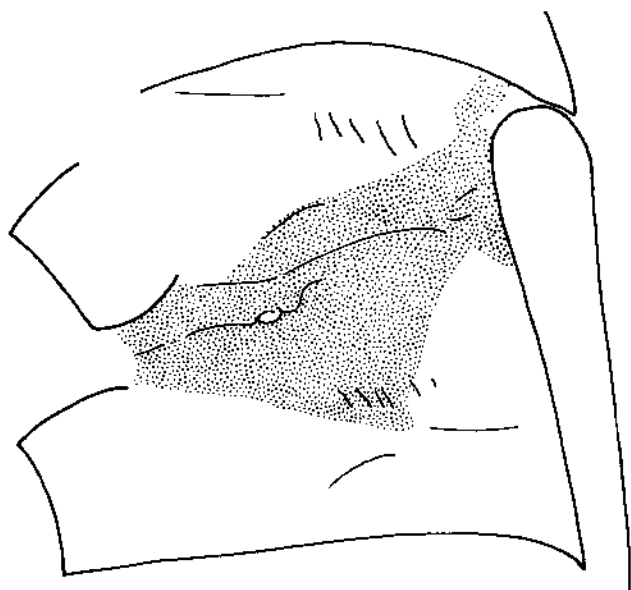
Fig. 35 *Philapodemus australis*: middle coxa, showing fringe of rigid setae. **Fig. 36** *Chilocoris neozealandicus*: right antenna (arrowed - reduced 2nd segment). **Fig. 37, 38** Pronotum: (37) *P. australis* (a - quadrate apex); (38) *C. neozealandicus* (arrowed - transverse bar of punctures).



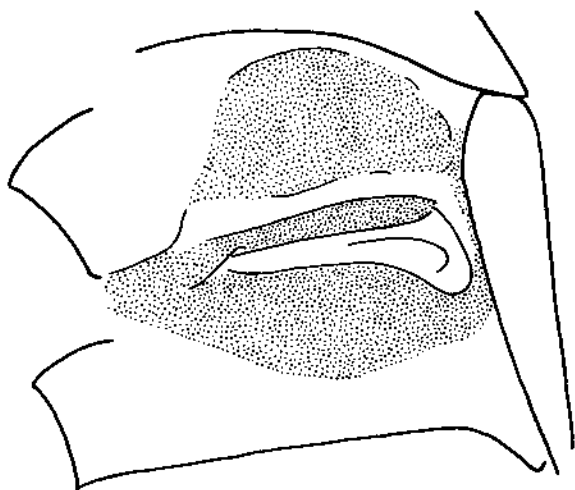
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(40)

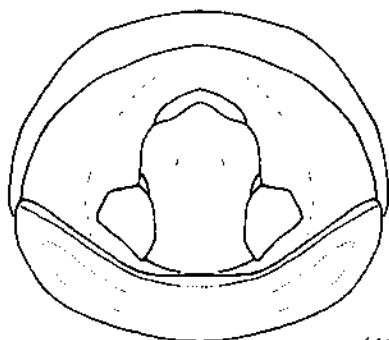


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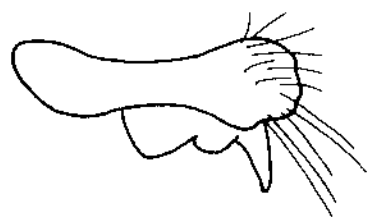


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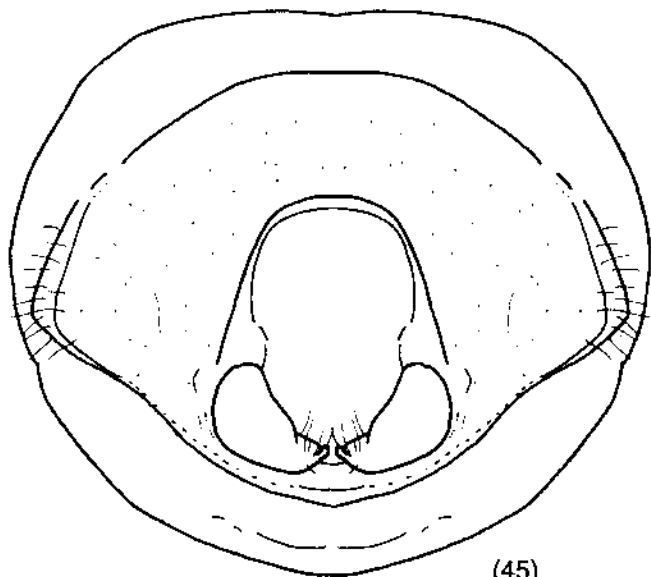
Fig. 39-42 Metathoracic scent gland opening: (39) *Aethus thoreyi*; (40) *Choerocydnus nigrosignatus*; (41) *Philapodemus australis*; (42) *Chilocoris neozealandicus*.



(43)



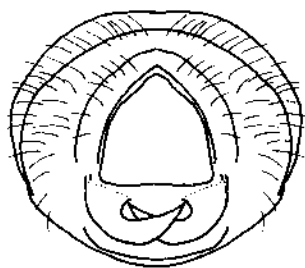
(44)



(45)



(46)

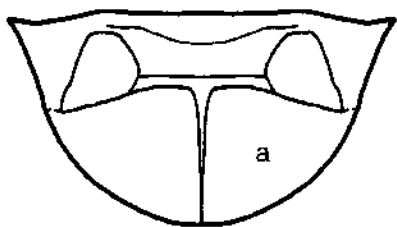


(47)

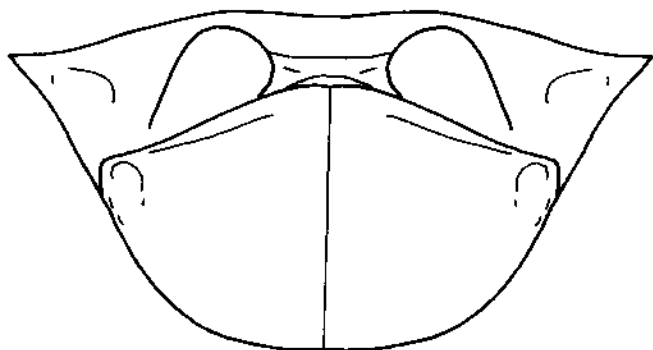


(48)

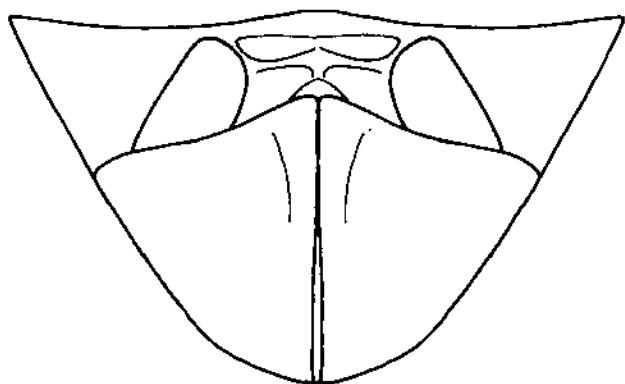
Fig. 43-48 Male pygophore, caudal (left) and left clasper, ental (right): (43, 44) *Choerocydnus nigrosignatus*; (45, 46) *Philapodemus australis*; (47, 48) *Chilocoris neozealandicus*.



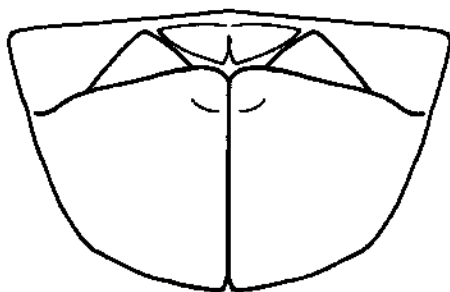
(49)



(50)

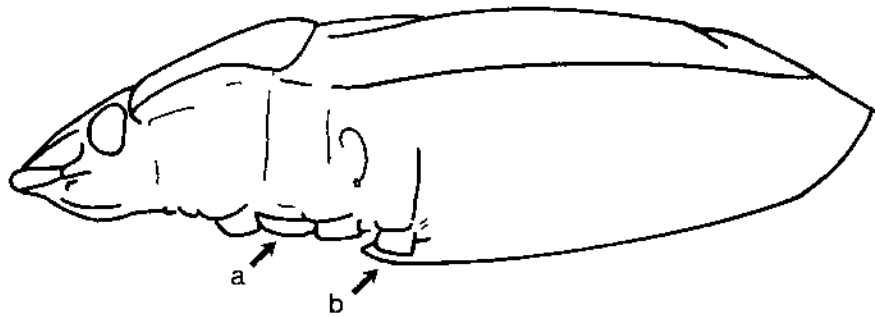


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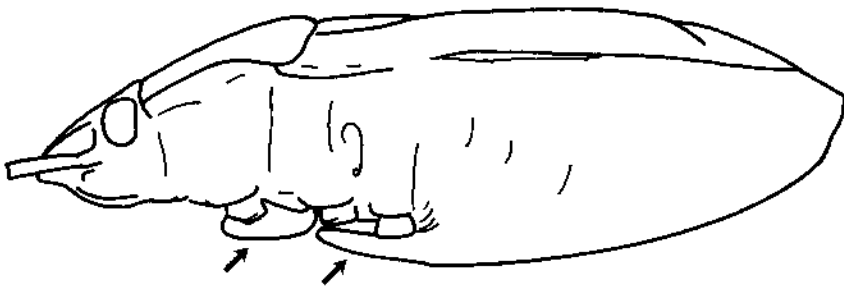


(52)

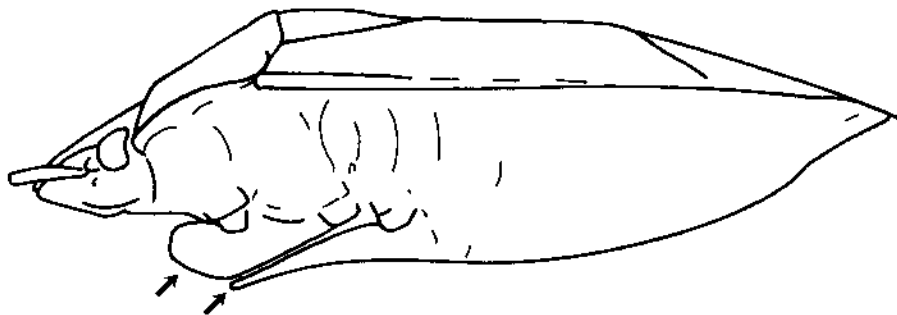
Fig. 49-52 Female terminalia, ventral: (49) *Aethus thoreyi* (a - 1st gonocoxa); (50) *Choerocydnus nigrosignatus*; (51) *Philapodemus australis*; (52) *Chilocoris neozealandicus*.



(53)

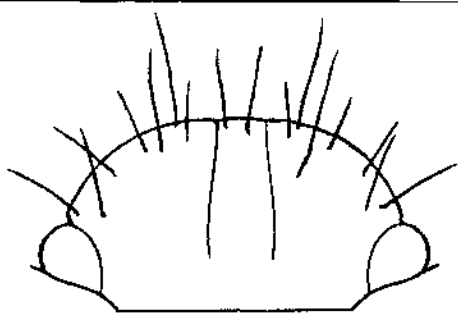


(54)

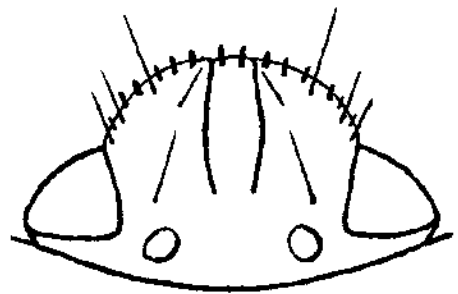


(55)

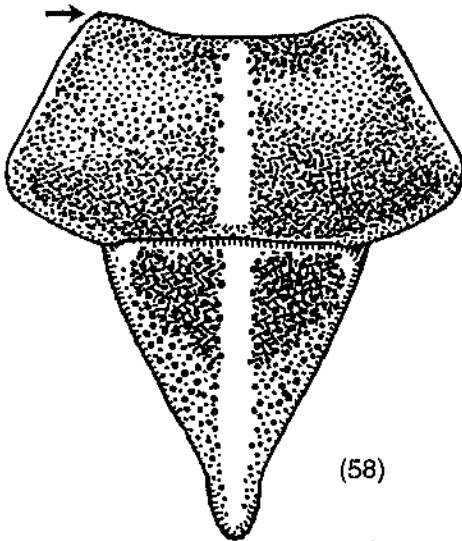
Fig. 53-55 Body, lateral view showing mesosternal carina (a) and ventral spine (b): (53) *Rhopalimorpha lineolaris*; (54) *R. alpina*; (55) *Oncacontias vittatus*.



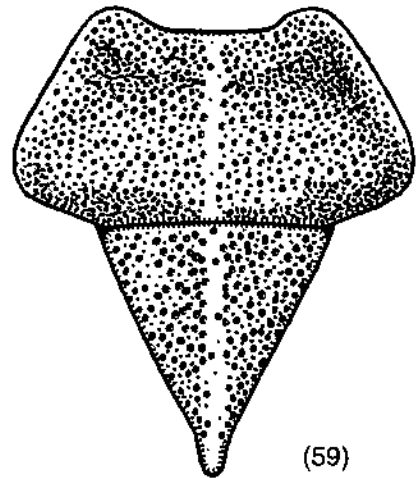
(56)



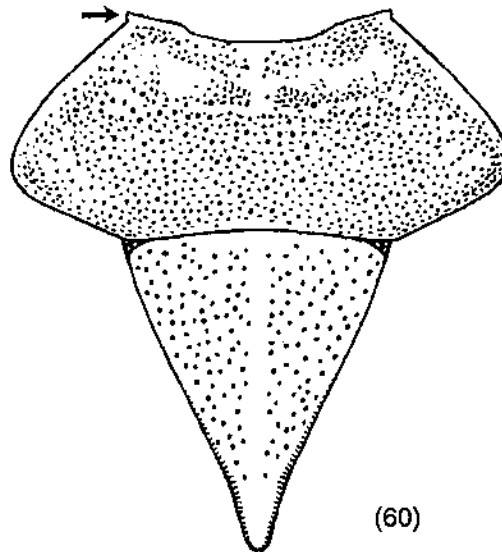
(57)



(58)



(59)

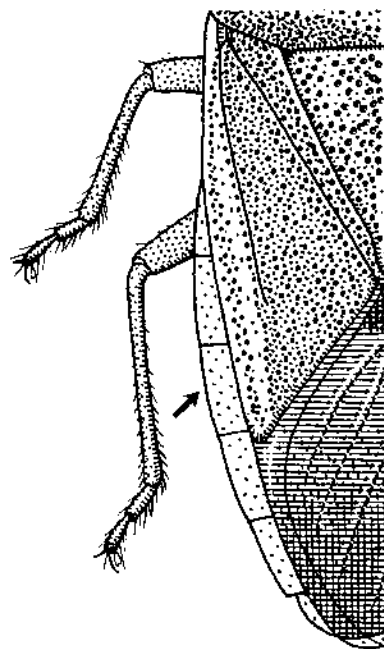


(60)

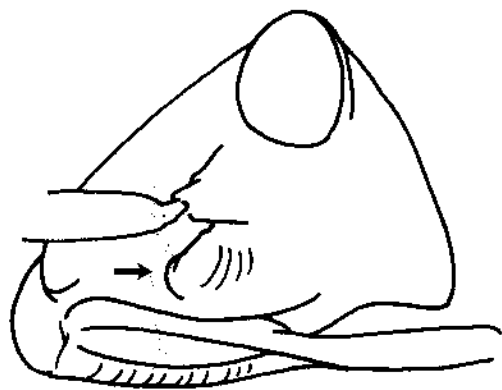
Fig. 56, 57 Outline of head, dorsal: (56) *Choerocydnus nigrosignatus*; (57) *Chilocoris neozealandicus*.
Fig. 58-60 Pronotum and scutellum, dorsal: (58) *Rhopalimorpha lineolaris*; (59) *R. obscura*; (60) *R. alpina*.



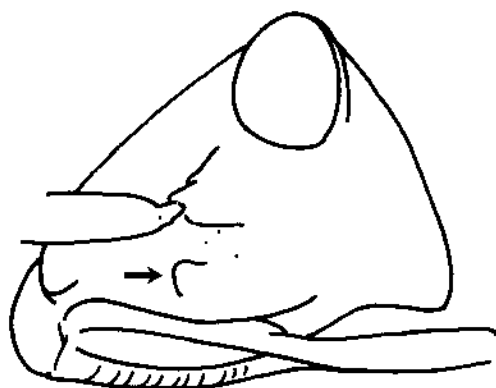
(61)



(62)

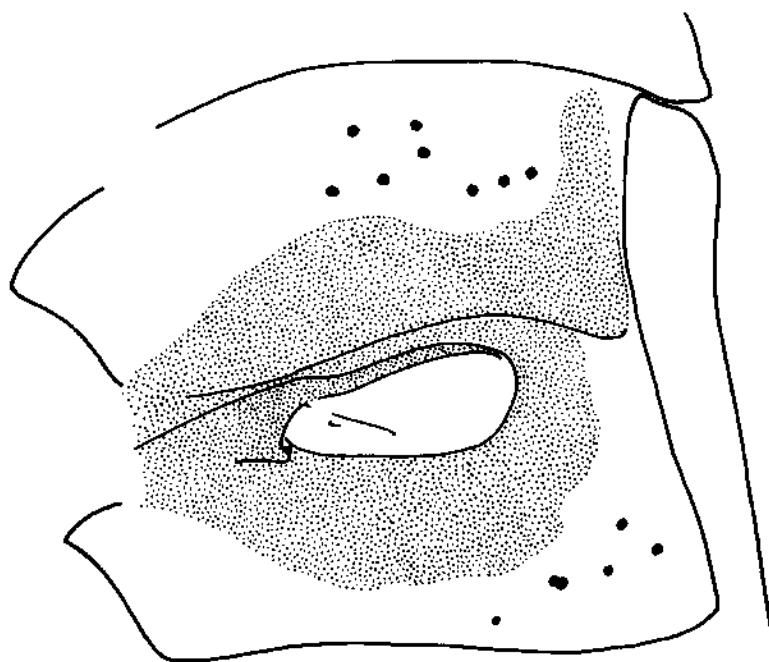


(63)

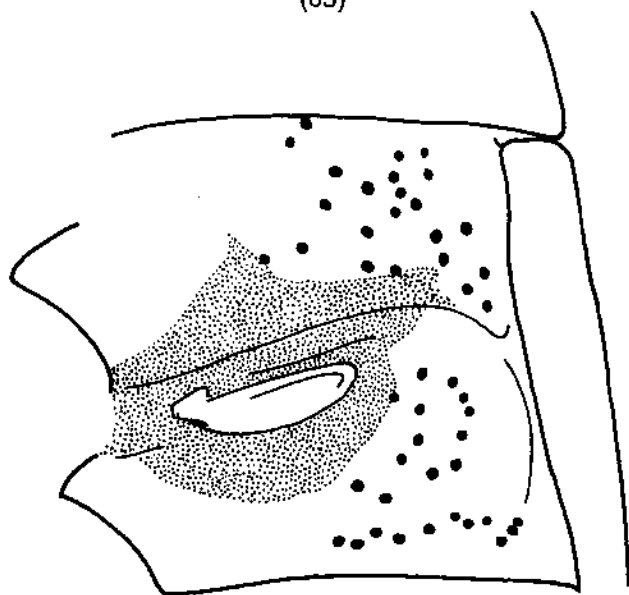


(64)

Fig. 61, 62 Left side of dorsum, showing connexivum (arrowed): (61) *Rhopalimorpha lineolaris*; (62) *R. obscura*.
Fig. 63, 64 Head, lateral view, showing maxillary plate process (arrowed): (63) *R. lineolaris*; (64) *R. obscura*.

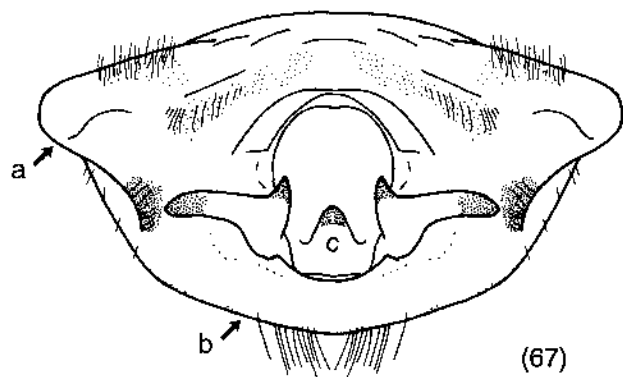


(65)

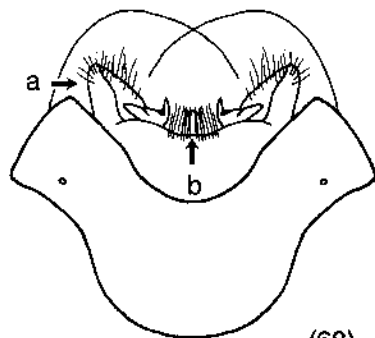


(66)

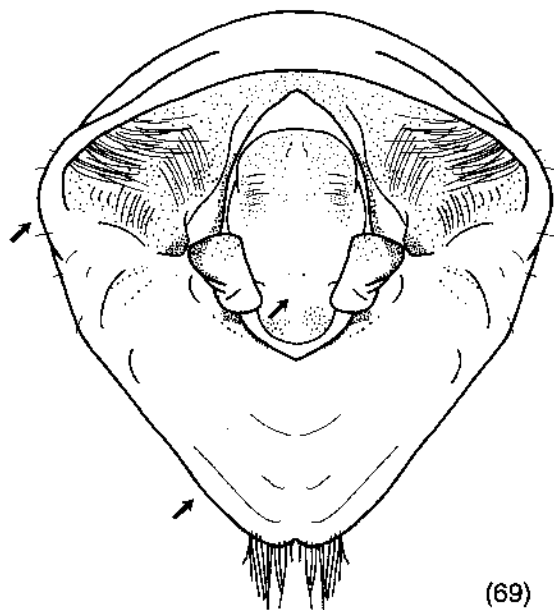
Fig. 65, 66 Metathoracic scent gland opening: (65) *Rhopalimorpha lineolaris*; (66) *R. obscura*.



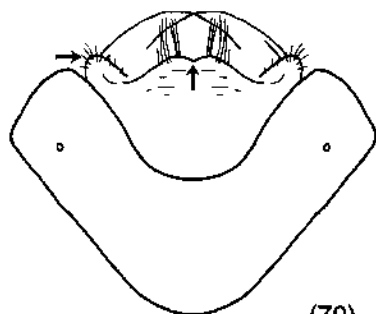
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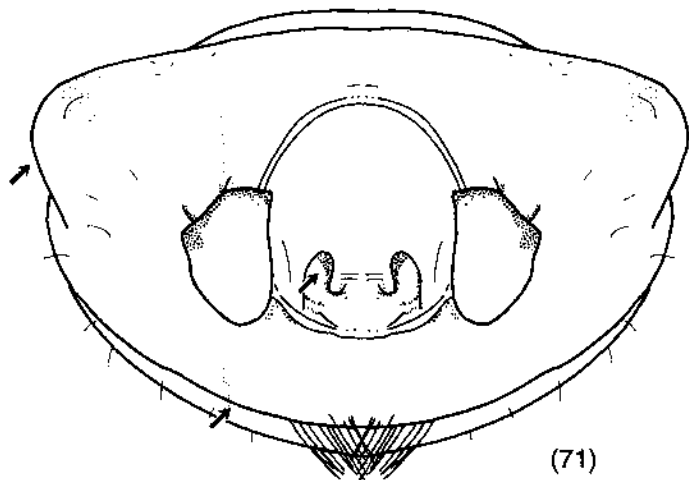
(68)



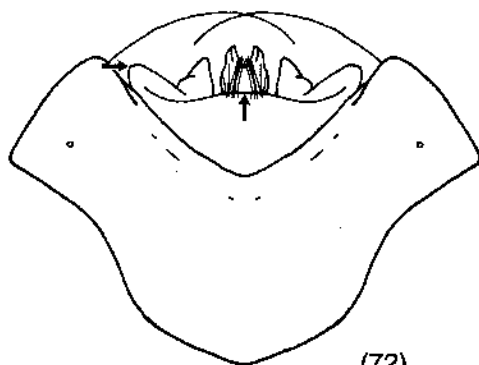
(69)



(70)

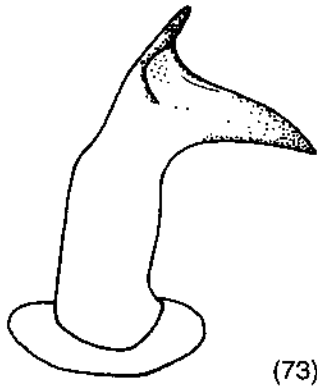


(71)

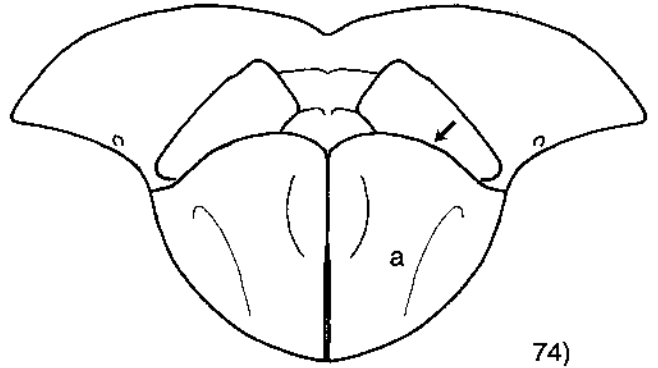


(72)

Fig. 67-72 Male pygophore, caudal (left; a - lateral lobe; b - ventral rim; c - proctiger) and end of abdomen, ventral (right; a - lateral lobe; b - ventral rim): (67, 68) *Rhopalimorpha lineolaris*; (69, 70) *R. obscura*; (71, 72) *R. alpina*.



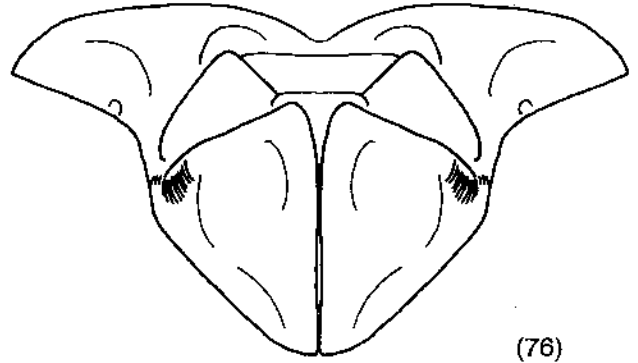
(73)



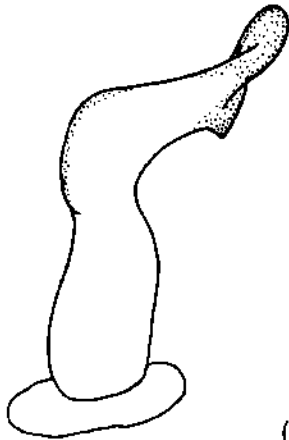
(74)



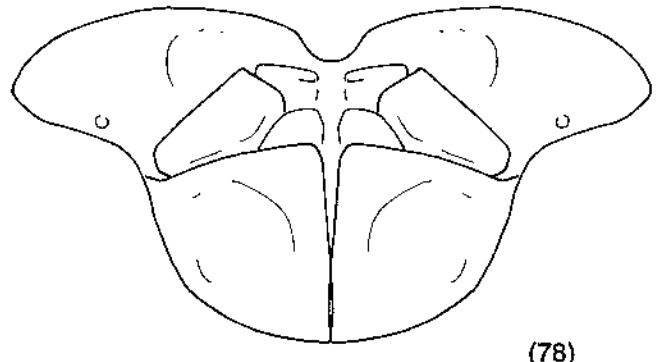
(75)



(76)

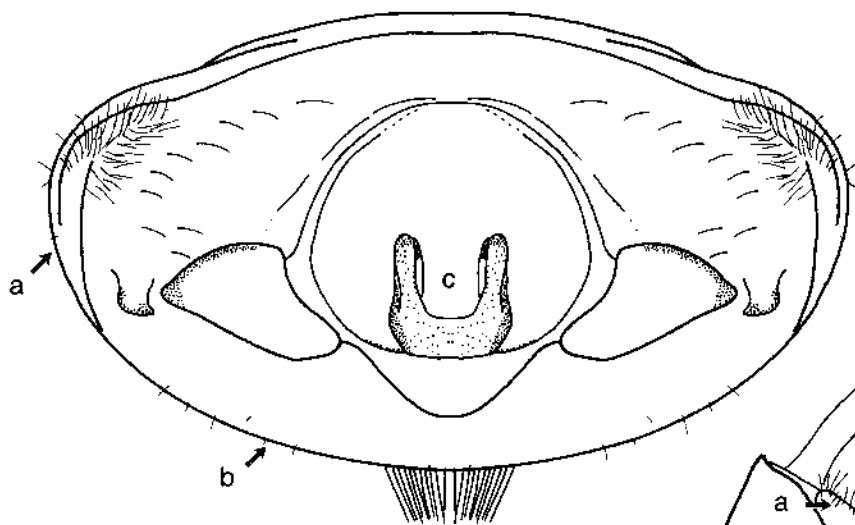


(77)

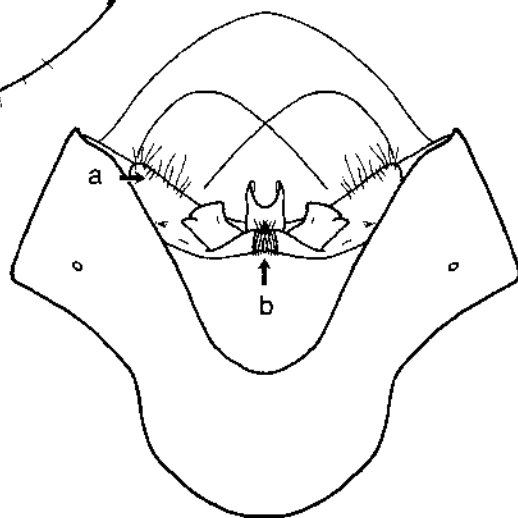


(78)

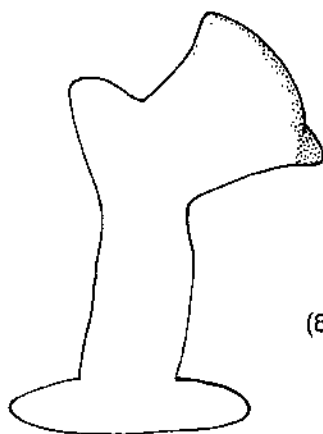
Fig. 73-78 Left clasper of male, ental (left) and female terminalia, ventral (right; a - 1st gonocoxa): (73, 74) *Rhopalimorpha lineolaris*; (75, 76) *R. obscura*; (77, 78) *R. alpina*.



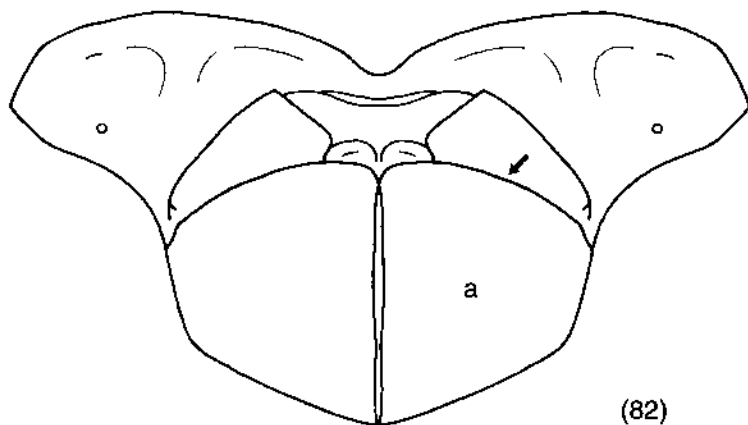
(79)



(80)



(81)



(82)

Fig. 79-82 *Oncacontias vittatus*: (79) male pygophore, caudal (a - lateral lobe; b - ventral margin; c - proctiger); (80) end of abdomen of male, ventral (a - lateral lobe; b - ventral rim); (81) left clasper of male, ental; (82) female terminalia, ventral (a - 1st gonocoxa).

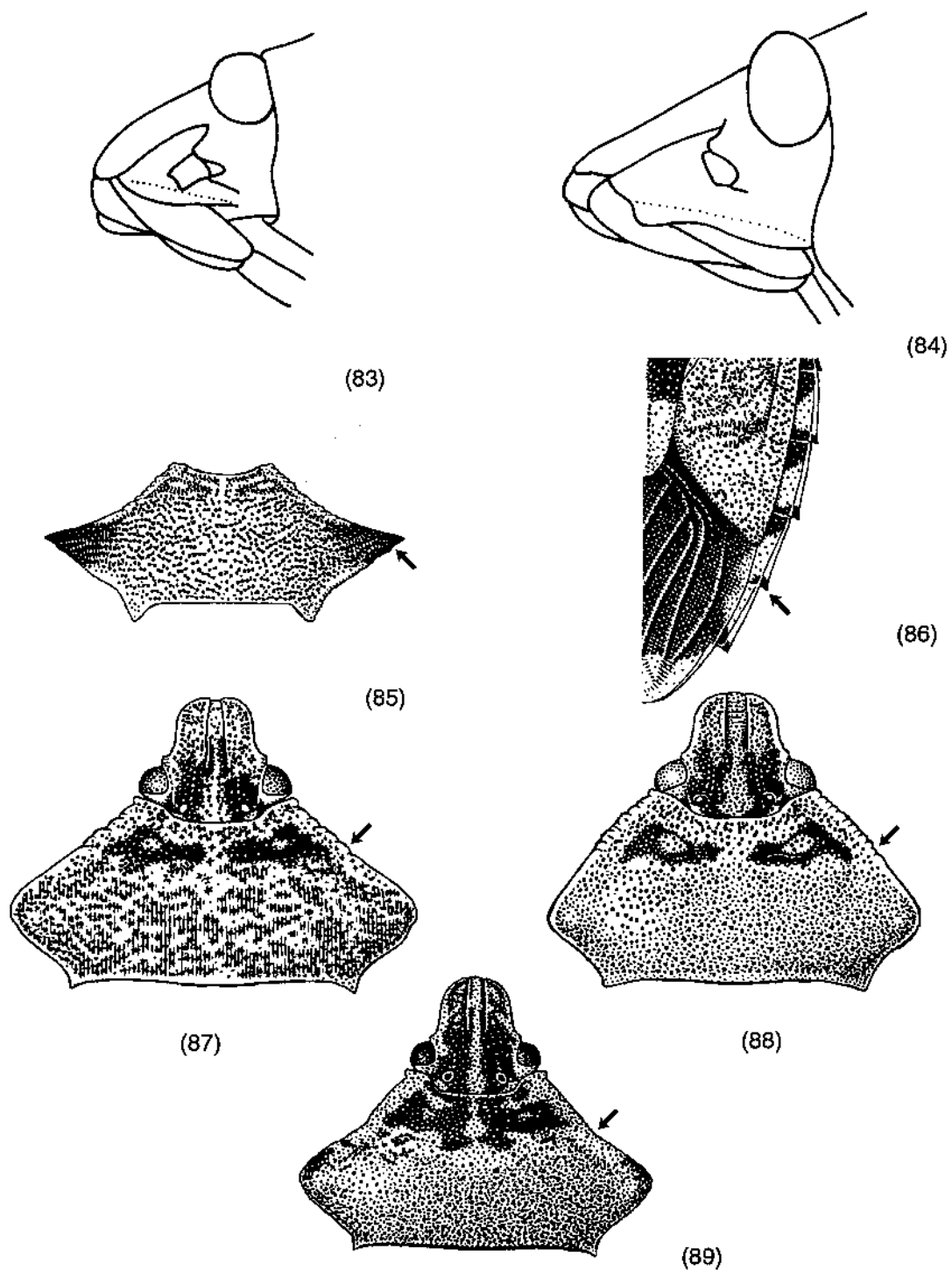
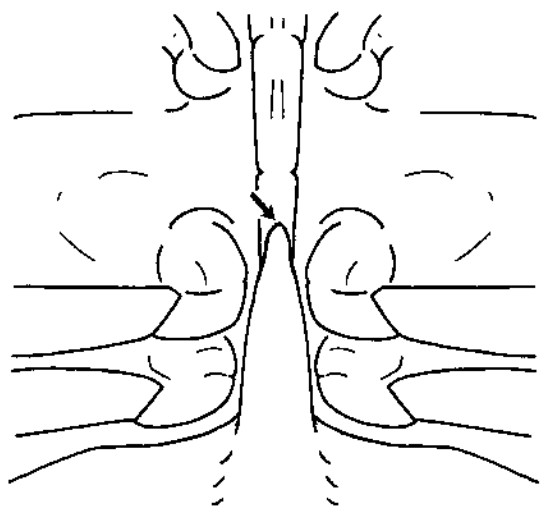
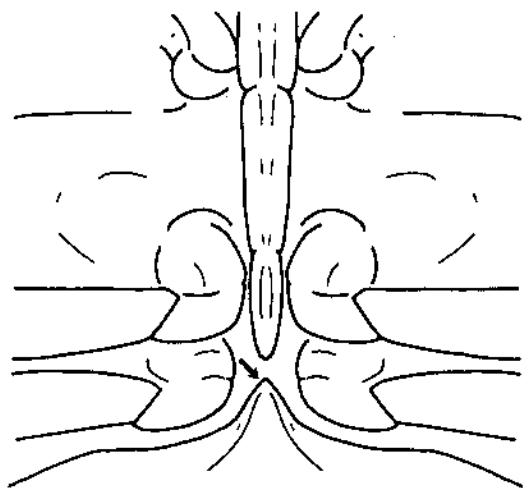


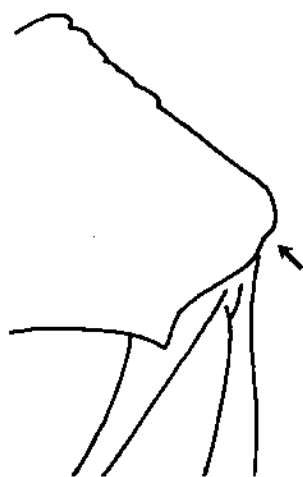
Fig. 83, 84 Head, lateral view, showing 1st segment of rostrum: (83) Asopinae; (84) Pentatominae. Fig. 85, 86 *Oechalia schellenbergii*: (85) pronotum; (86) part of connexivum, showing posterolateral angle of segment. Fig. 87-89 Head and pronotum: (87) *Cermatulus nasalis nasalis*; (88) *C. n. hudsoni*; (89) *C. n. turboti*.



(90)



(91)

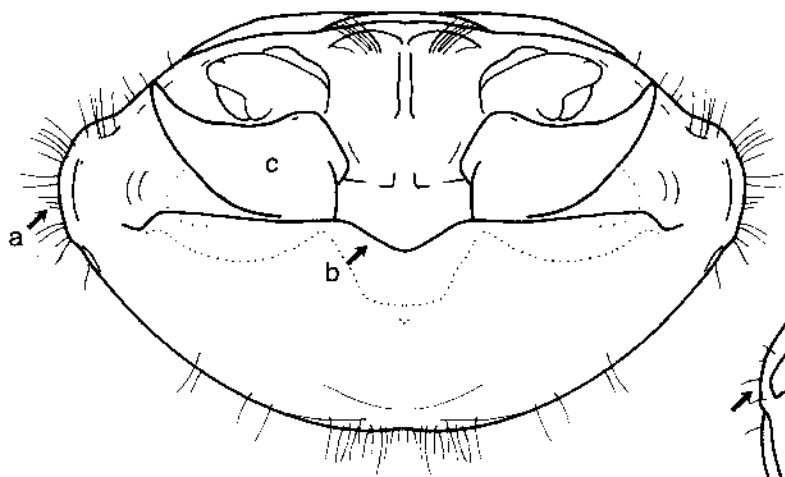


(92)

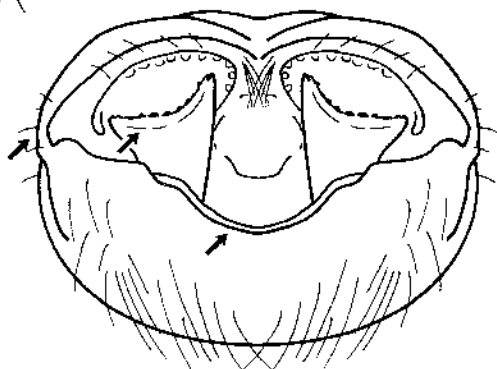


(93)

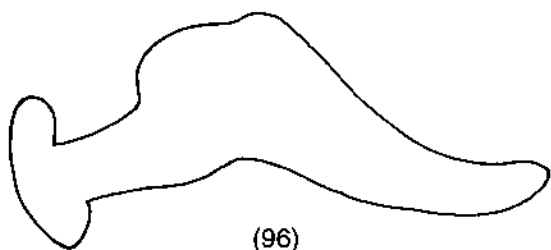
Fig. 90, 91 Underside of thorax, showing ventral spine (arrowed): (90) *Oechalia schellenbergii*; (91) *Cermatulus nasalis*.
Fig. 92, 93 Right side of pronotum and base of hemelytron, showing development of humerus (arrowed): (92) *Cermatulus nasalis nasalis*; (93) *C. n. hudsoni*.



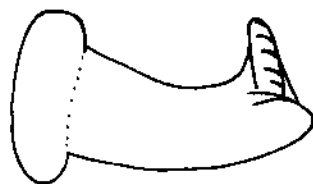
(94)



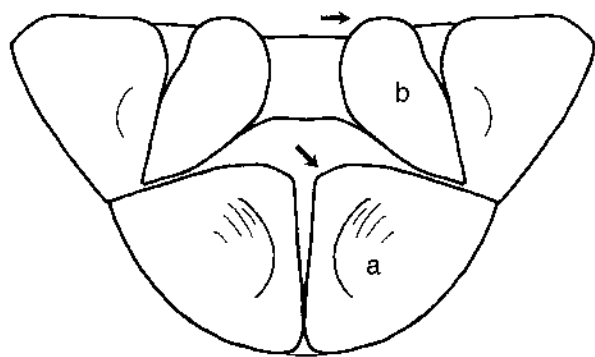
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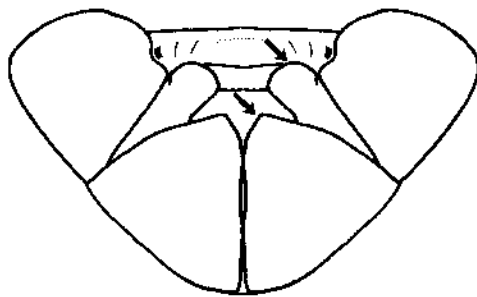
(96)



(97)

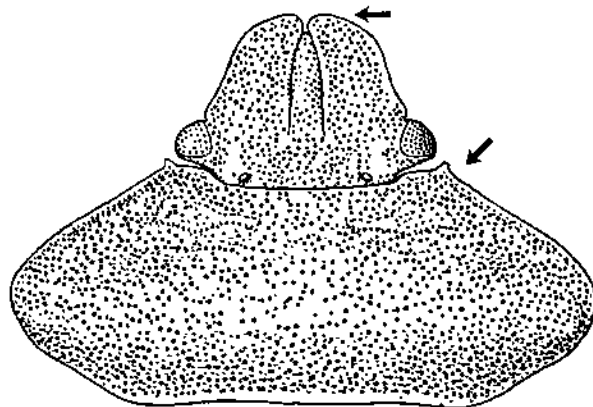


(98)

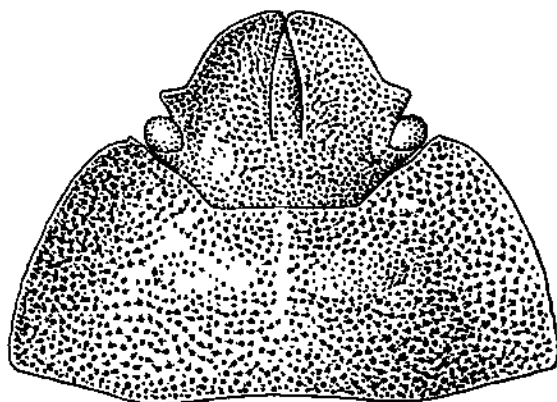


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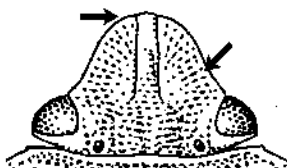
Fig. 94, 95 Male pygophore, caudal: (94) *Cermatulus nasalis* (a - lateral lobe; b - ventral rim; c - clasper); (95) *Oechalia schellenbergii*. **Fig. 96, 97** Left clasper of male, ental: (96) *C. nasalis*; (97) *O. schellenbergii*. **Fig. 98, 99** Female terminalia: (98) *C. nasalis* (a - 1st gonocoxa; b - paratergite 9); (99) *O. schellenbergii*.



(100)



(101)

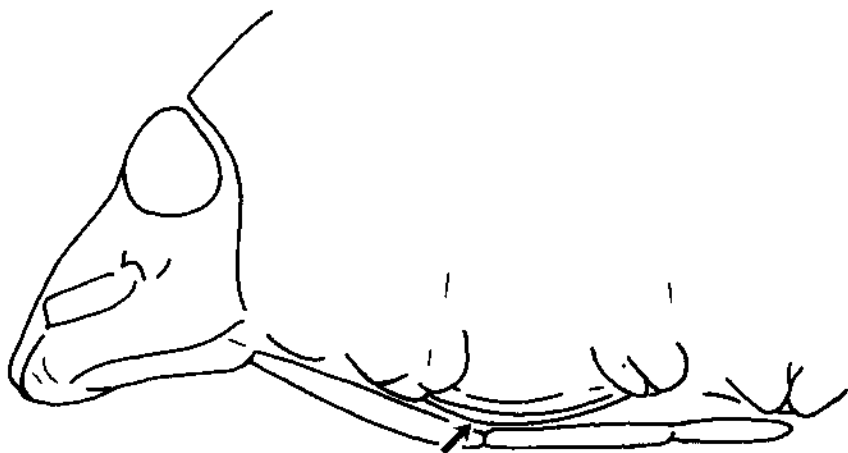


(102)

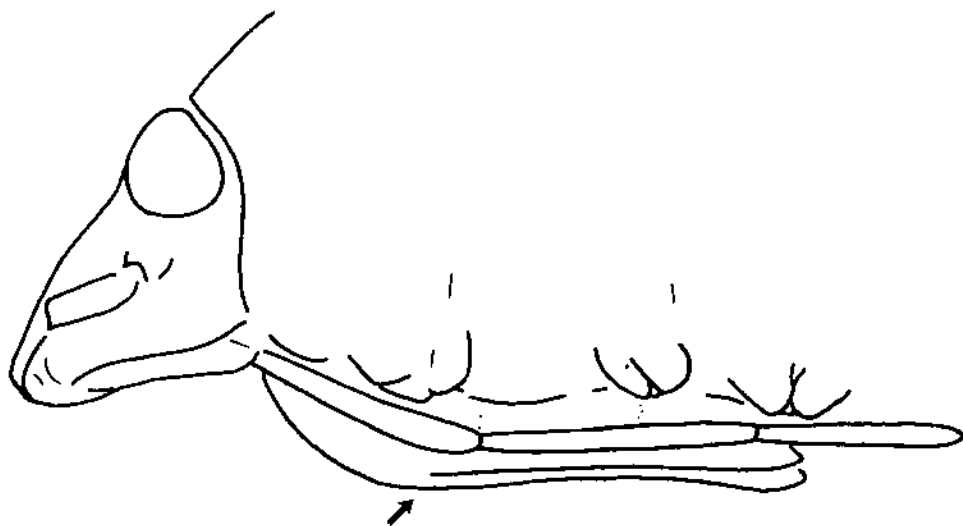


(103)

Fig. 100, 101 Head and pronotum: (100) *Dictyotus caenosus* (arrowed - tip of jugum, anterolateral angle of pronotum); (101) *Hypsithocus hudsonae*. Fig. 102, 103 Head, dorsal: (102) *Glaucias amyoti* (arrowed - tip of jugum, rugulose surface of head); (103) *Nezara viridula*.

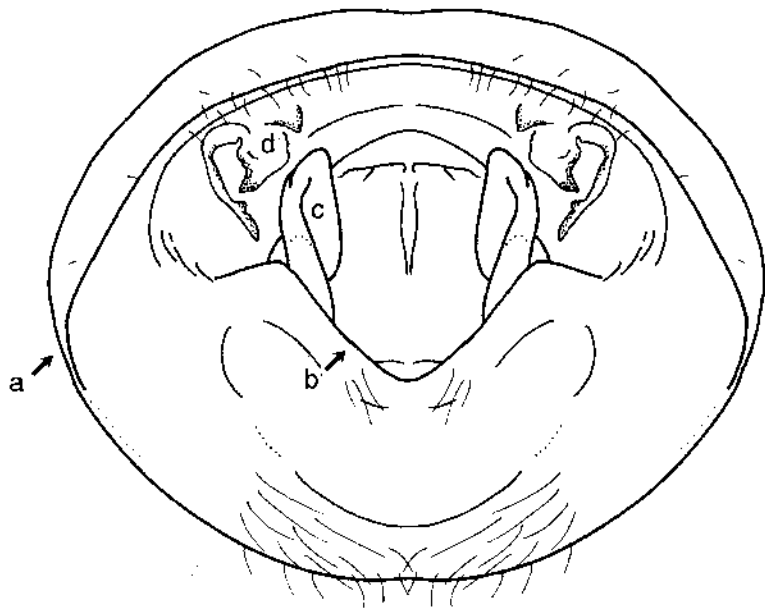


(104)

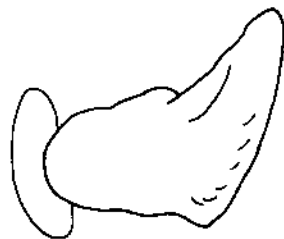


(105)

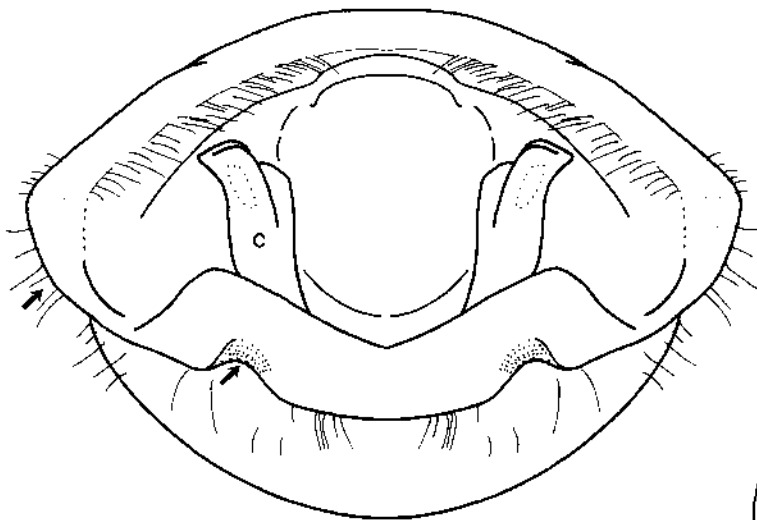
Fig. 104, 105 Body, lateral view, showing mesosternal carina (arrowed): (104) *Nezara viridula*; (105) *Cuspicona simplex*.



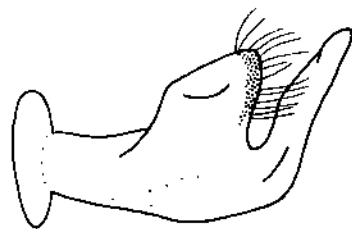
(106)



(107)

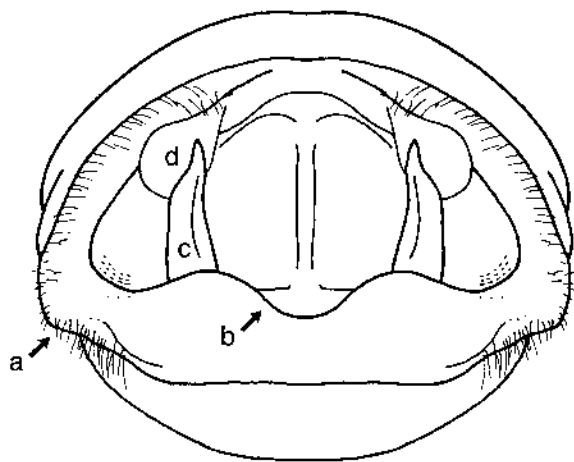


(108)

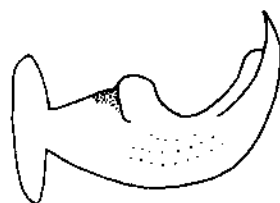


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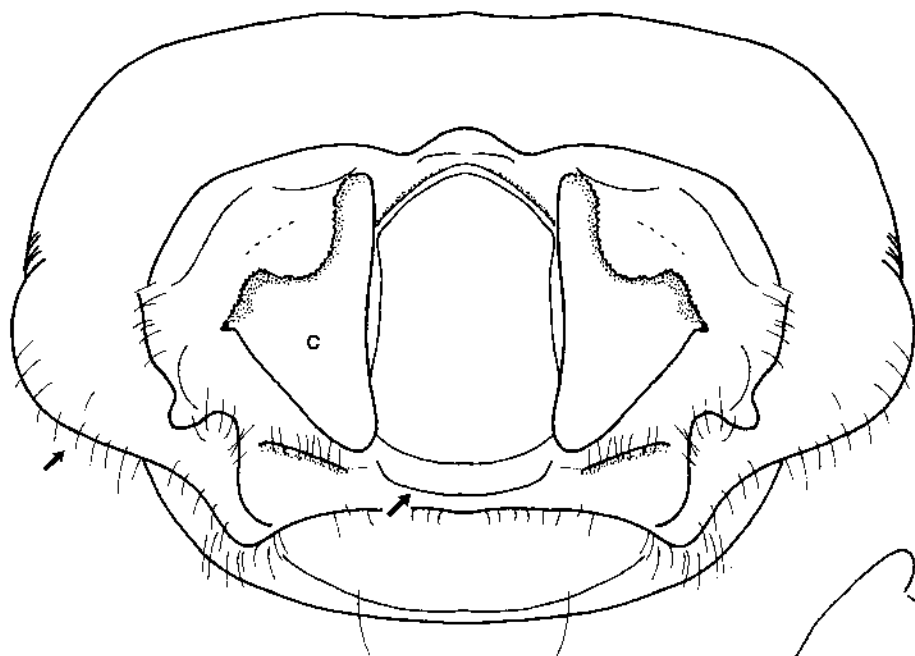
Fig. 106-109 Male pygophore, caudal (left; a - lateral lobe, b - ventral rim, c - clasper, d - parandrium) and left clasper, ental (right): (106, 107) *Dictyotus caenosus*; (108, 109) *Monteithiella humeralis*.



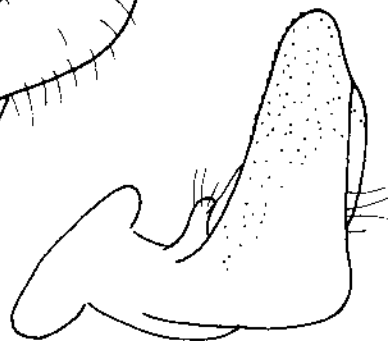
(110)



(111)

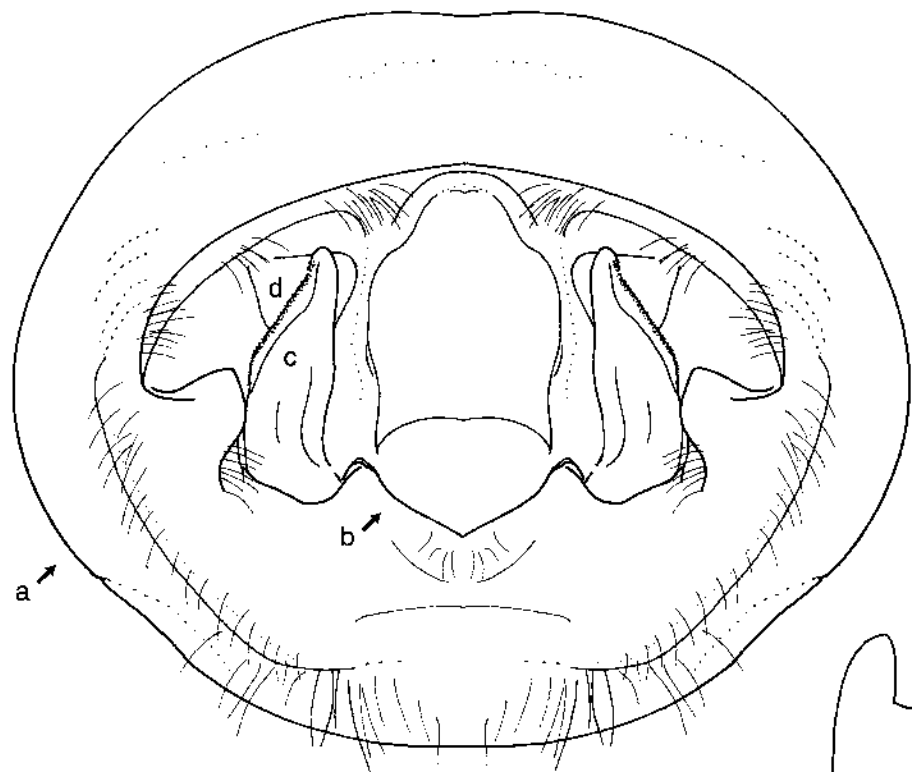


(112)

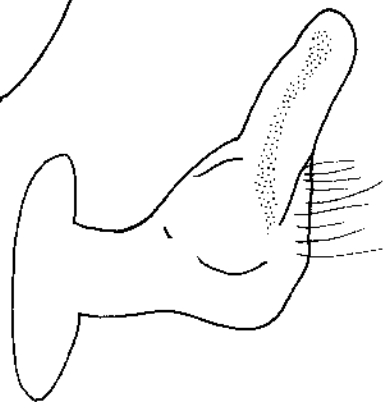


(113)

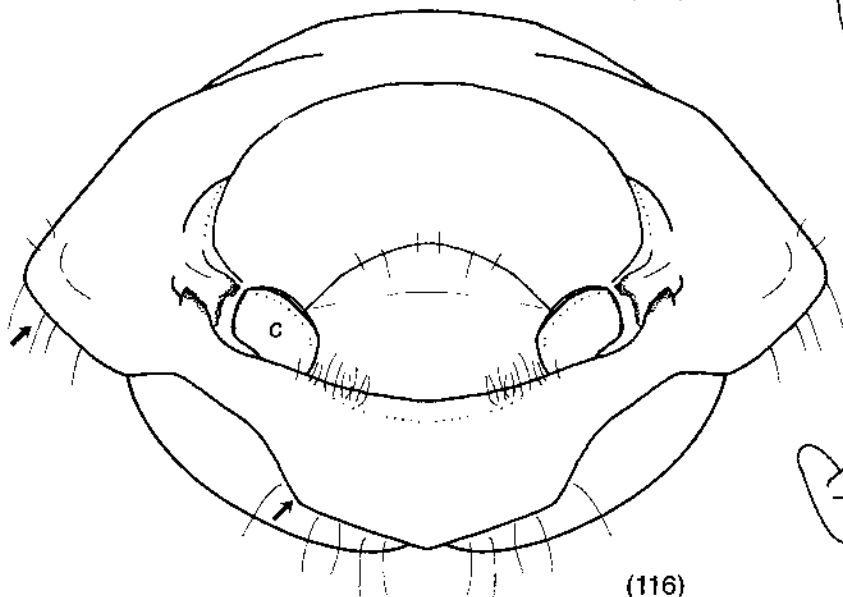
Fig. 110-113 Male pygophore, caudal (left; a - lateral lobe, b - ventral rim, c - clasper, d - parandrium) and left clasper, ental (right): (110, 111) *Hypsithocus hudsonae*; (112, 113) *Nezara viridula*.



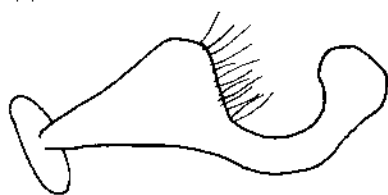
(114)



(115)

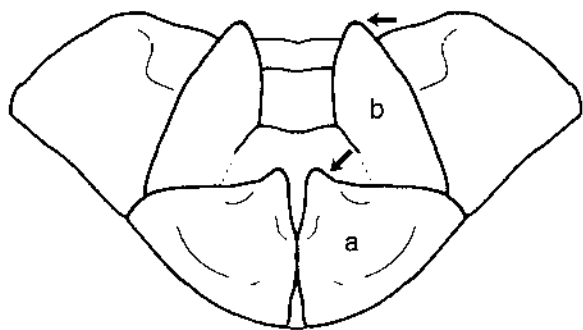


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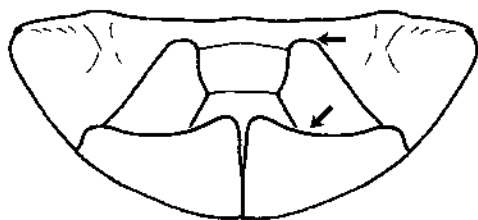


(117)

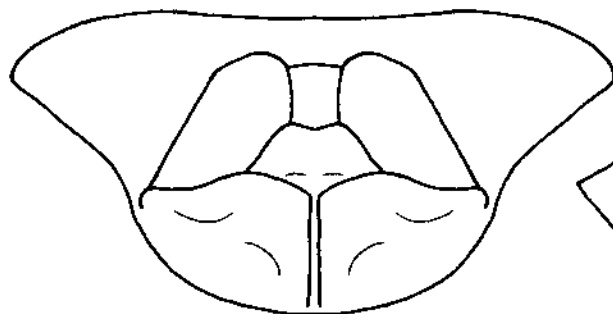
Fig. 114-117 Male pygophore, caudal (left; a - lateral lobe, b - ventral rim, c - clasper, d - parandrium) and left clasper, ental (right): (114, 115) *Glaucias amyoti*; (116, 117) *Cuspicona simplex*.



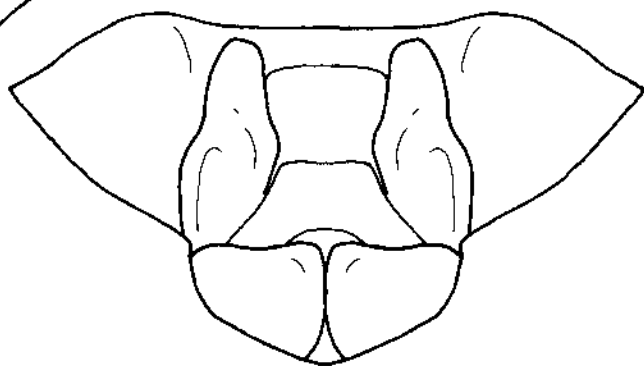
(118)



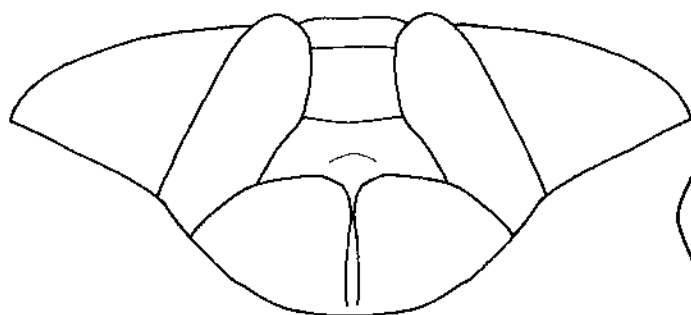
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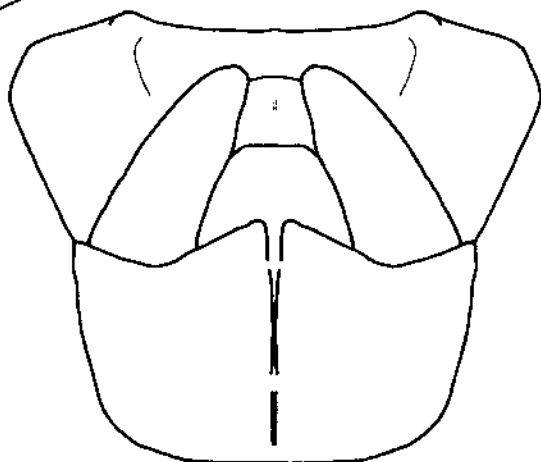
(120)



(121)

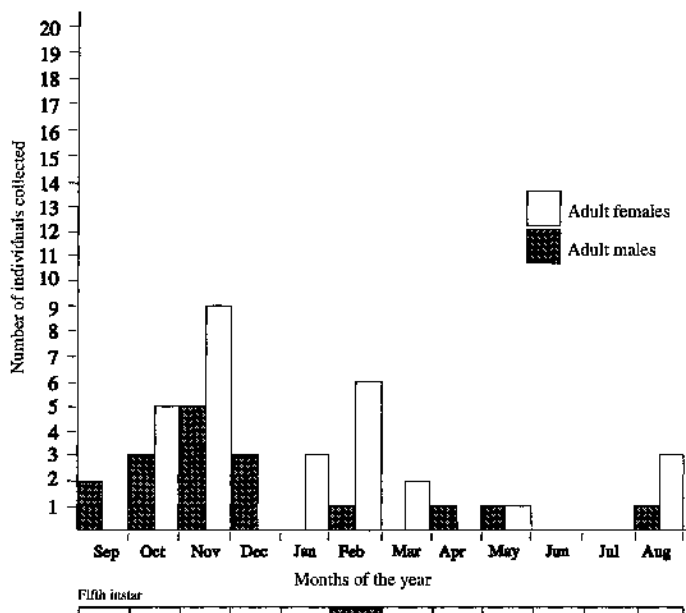


(122)

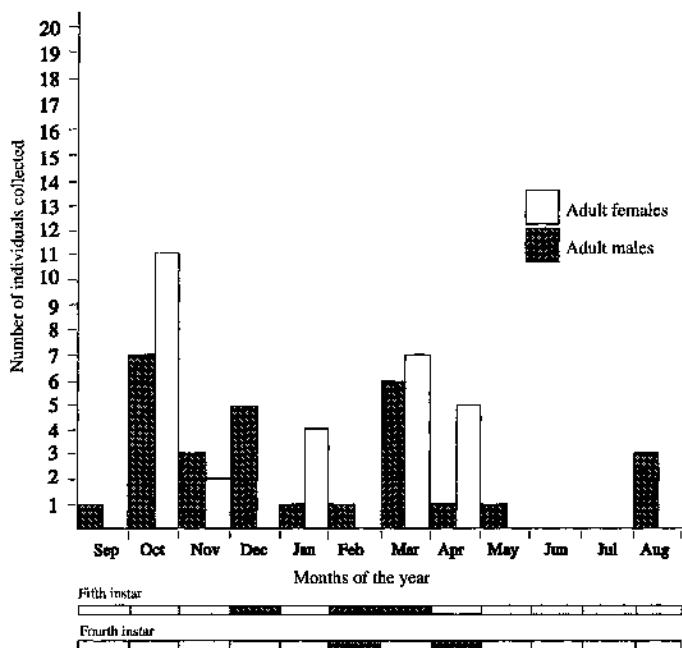


(123)

Fig. 118-123 Female terminalia, ventral: (118) *Dictyotus caenosus* (a - first gonocoxa; b - paratergite 9; arrowed - tip of gonocoxa, inner posterior angle of paratergite); (119) *Monteithiella humeralis*; (120) *Hypsithocus hudsonae*; (121) *Nezara viridula*; (122) *Glaucias amyoti*; (123) *Cuspicona simplex*.

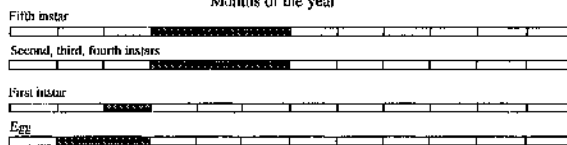
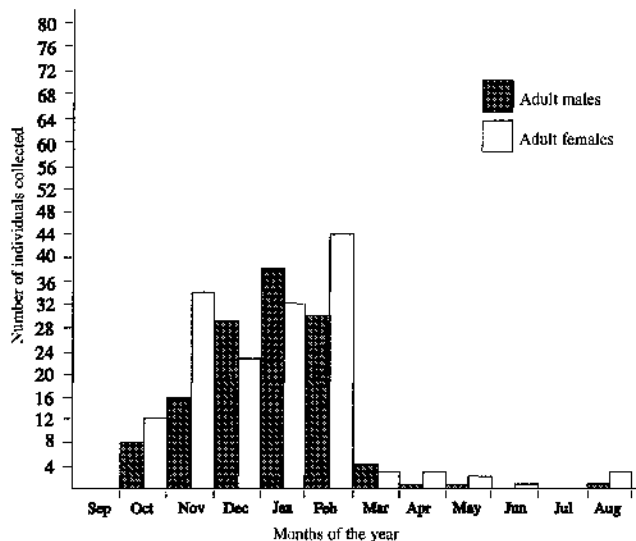


(124) *Choerocydnus nigrosignatus*

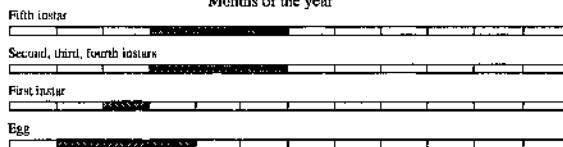
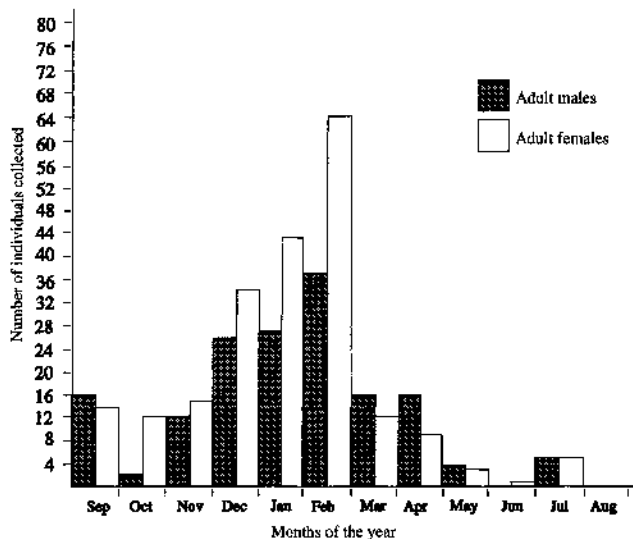


(125) *Philapodemus australis*

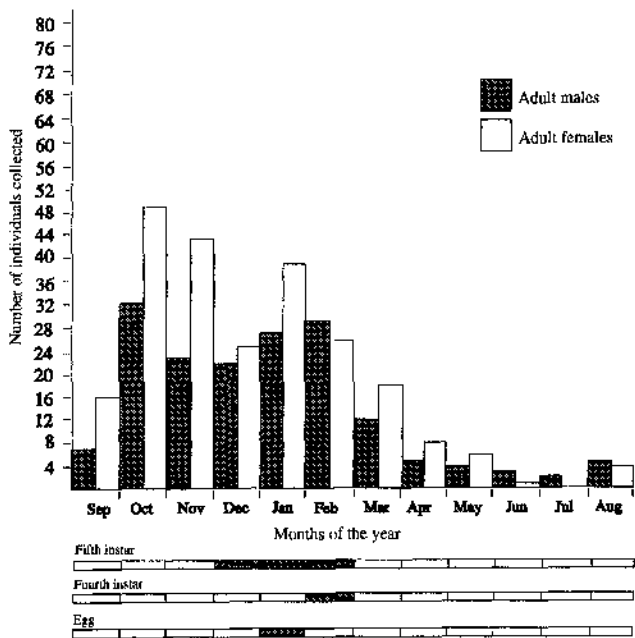
Fig. 124-135 General trends in phenological cycles of Pentatomoidea in New Zealand, based on number of individuals collected, sex, developmental stage, and month of capture.



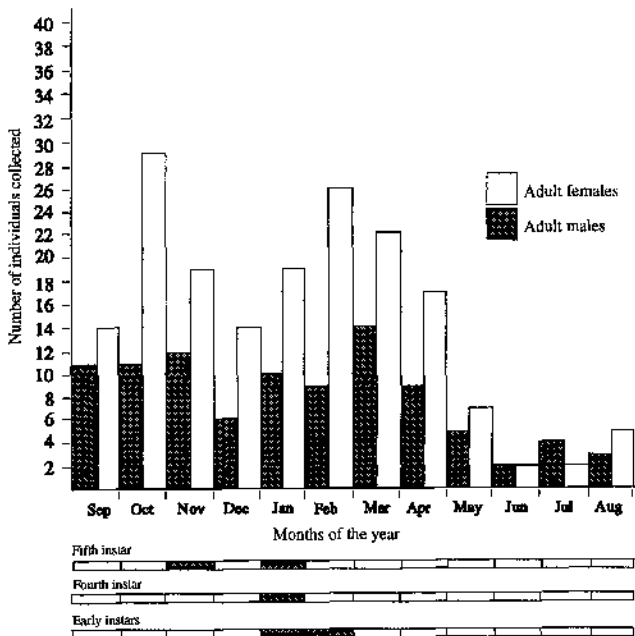
(126) *Rhopalimorpha obscura*



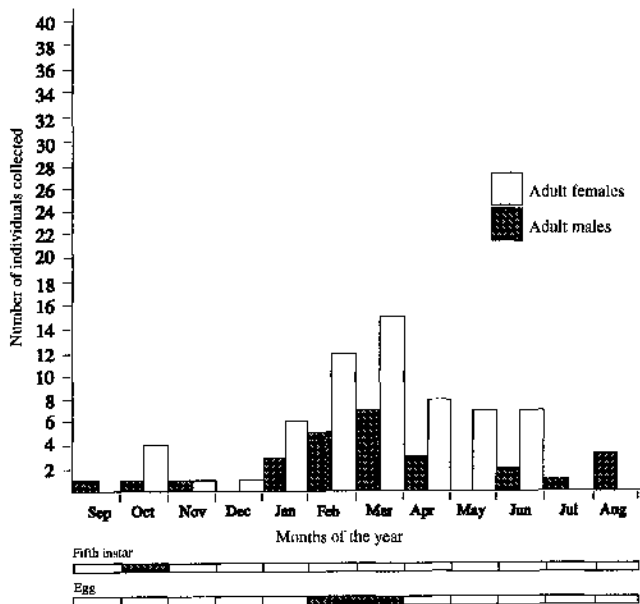
(127) *R. lineolaris*



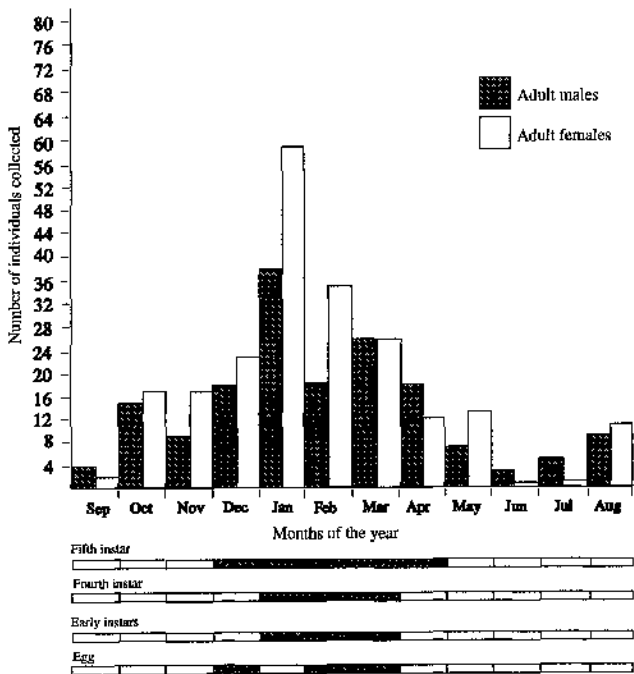
(128) *Oncaontias vittatus*



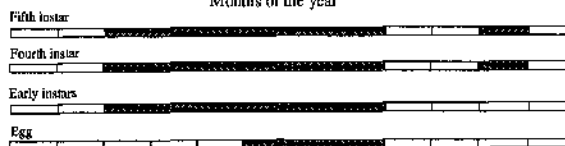
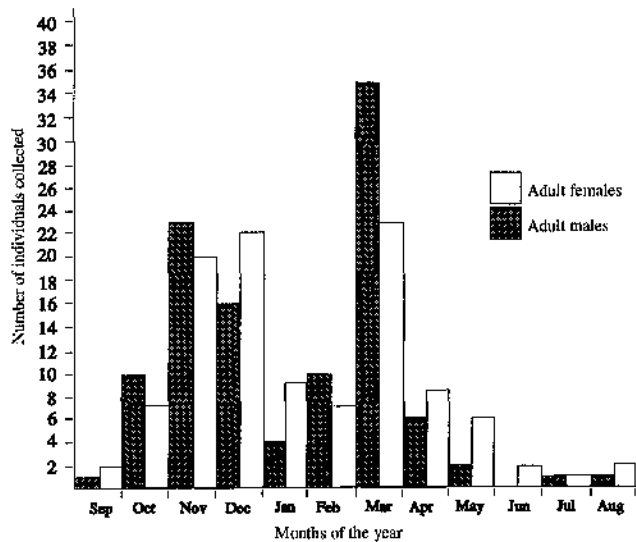
(129) *Cermatulus nasalis nasalis*



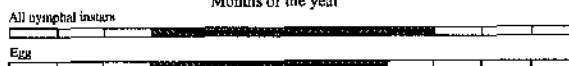
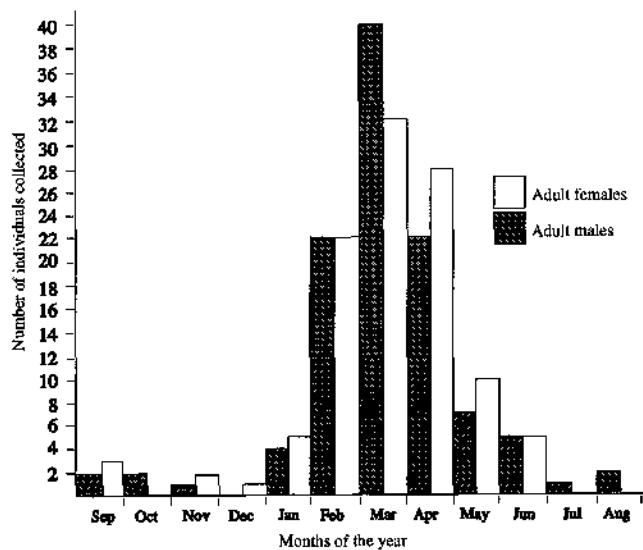
(130) *Oechalia schellenbergii*



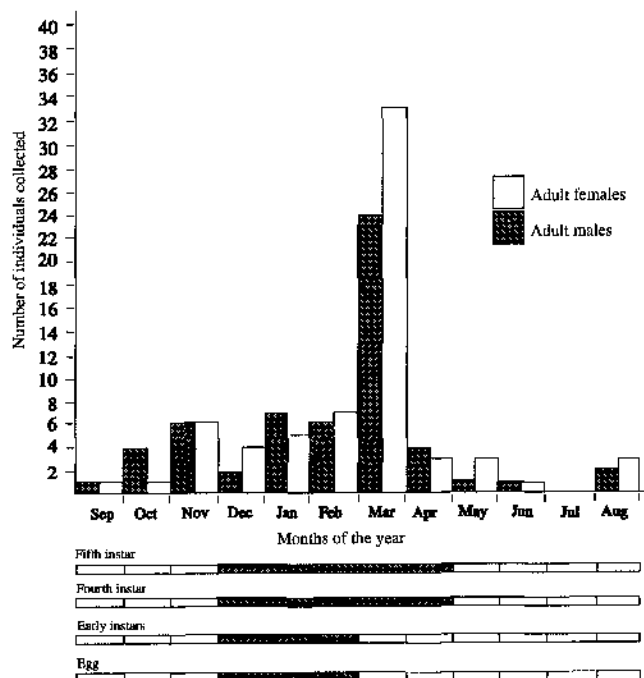
(131) *Dictyotus caenosus*



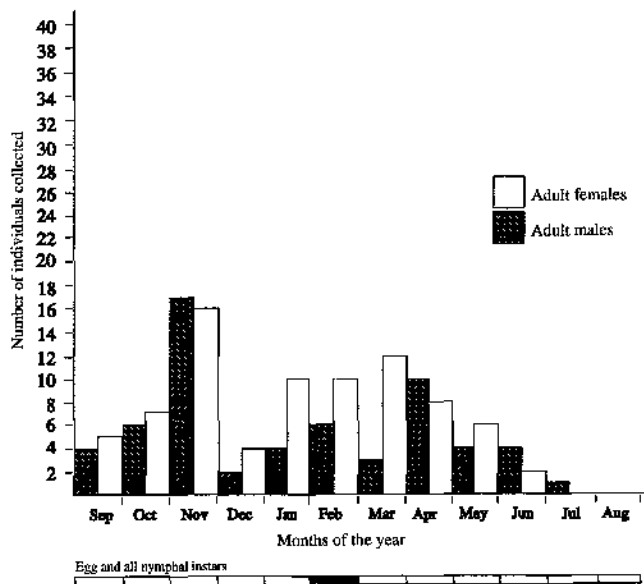
(132) *Monteithiella humeralis*



(133) *Nezara viridula*



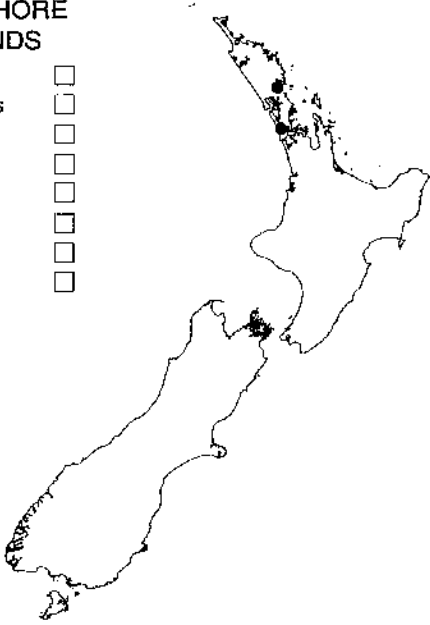
(134) *Glaucias amyoti*



(135) *Cuspicona simplex*

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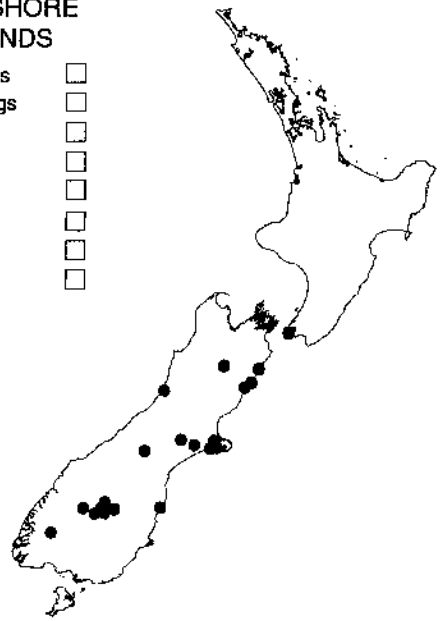
- Kermadecs
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- Snares
- Bounty
- Antipodes
- Aucklands
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Map 1 Collection localities, *Aethus thoreyi*.

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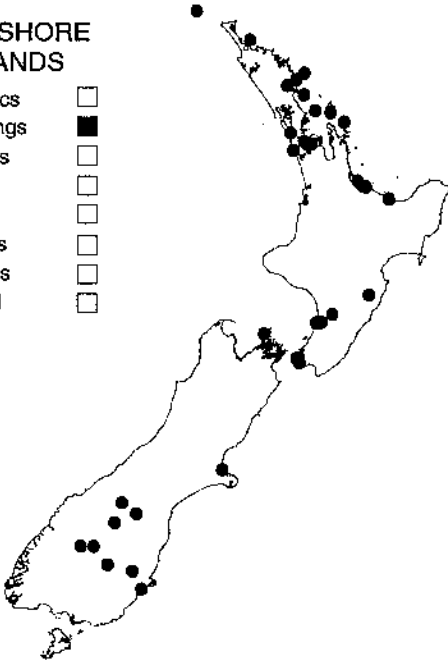
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Map 2 Collection localities, *Choerocydnus nigrosignatus*.

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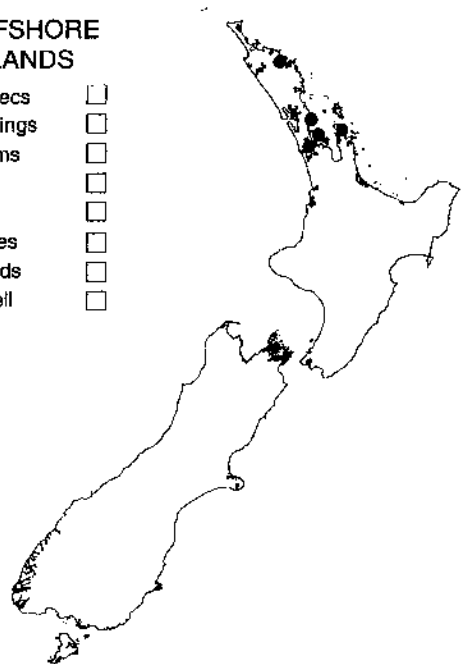
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Map 3 Collection localities, *Philapodemus australis*.

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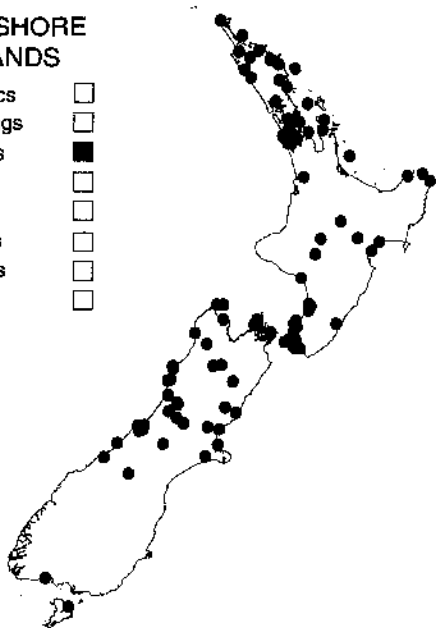
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Map 4 Collection localities, *Chilocoris neozealandicus*.

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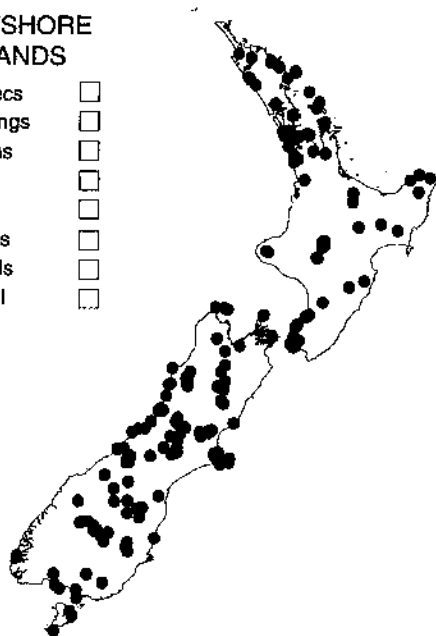
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Map 5 Collection localities, *Rhopalimorpha obscura*.

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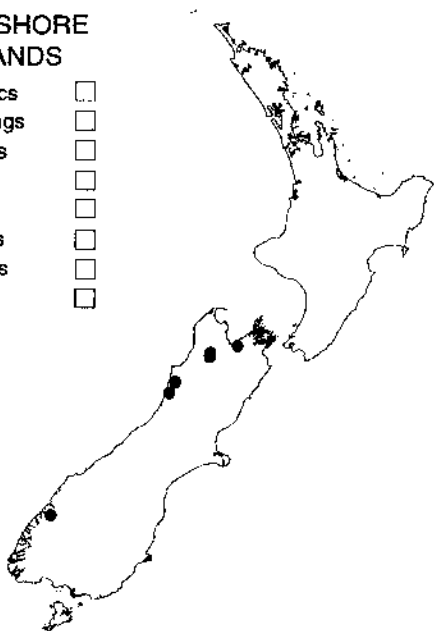
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Map 6 Collection localities, *R. lineolaris*.

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Map 7 Collection localities, *R. alpina*.

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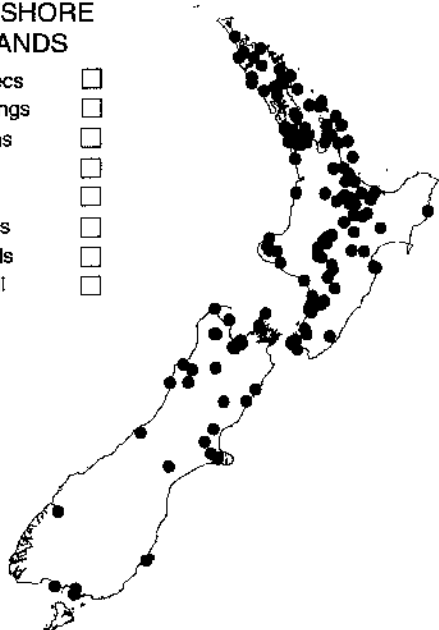
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Map 8 Collection localities, *Oncacontias vittatus*.

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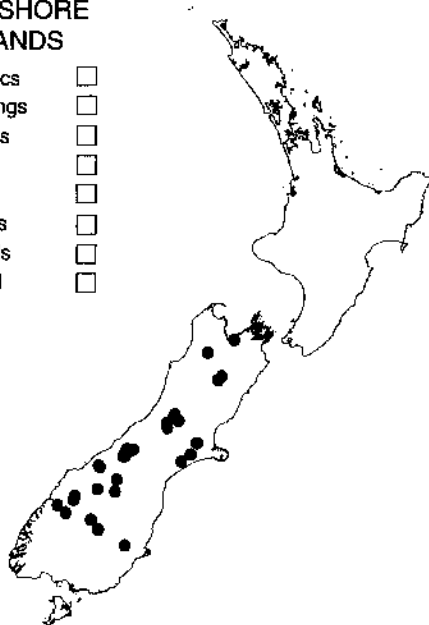
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Map 9 Collection localities, *Cermatulus nasalis nasalis*.

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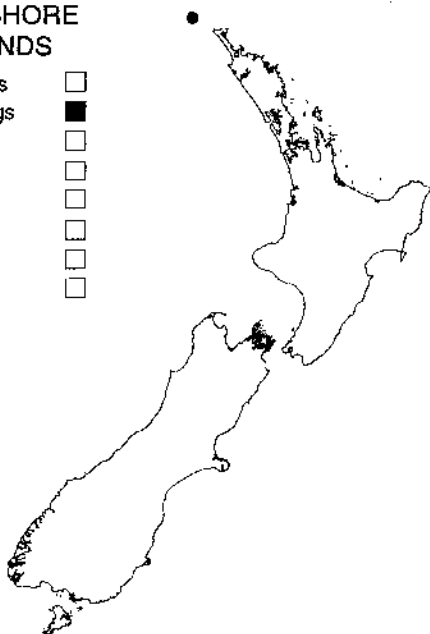
- Kermadecs
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- Snares
- Bounty
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- Aucklands
- Campbell



Map 10 Collection localities, *C. nasalis hudsoni*.

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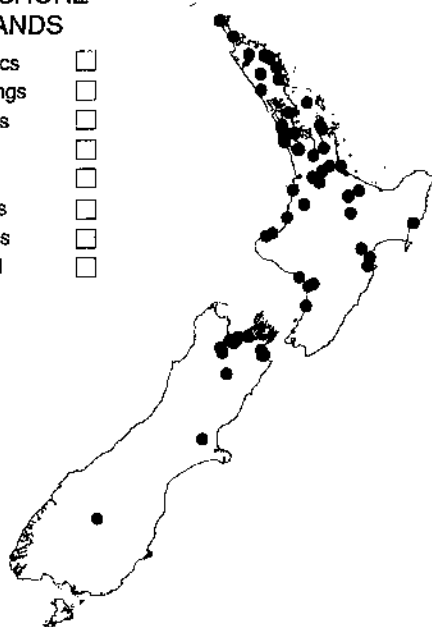
- Kermadecs
- Three Kings
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- Snares
- Bounty
- Antipodes
- Aucklands
- Campbell



Map 11 Collection localities, *C. nasalis turbotti*.

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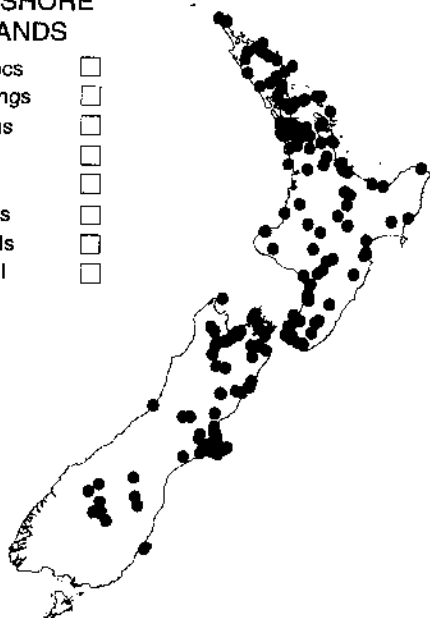
- Kermadecs
- Three Kings
- Chathams
- Snares
- Bounty
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Map 12 Collection localities, *Oechalia schellenbergii*.

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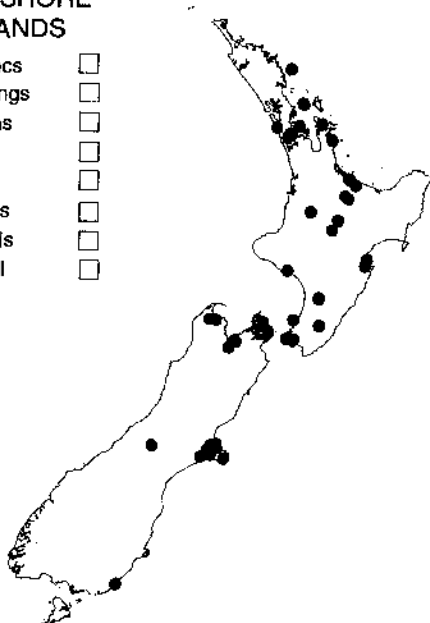
- Kermadecs
- Three Kings
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- Snares
- Bounty
- Antipodes
- Aucklands
- Campbell



Map 13 Collection localities, *Dictyotus caenosus*.

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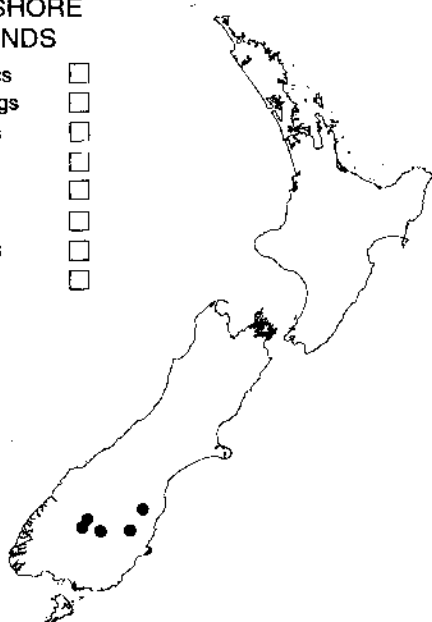
- Kermadecs
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Map 14 Collection localities, *Monteithiella humeralis*.

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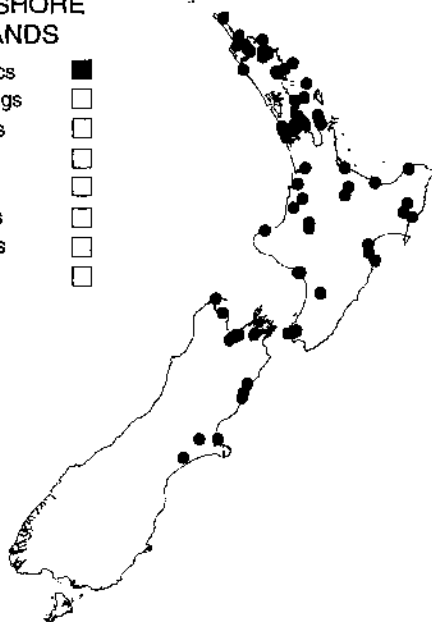
- Kermadecs
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- Chathams
- Snares
- Bounty
- Antipodes
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Map 15 Collection localities, *Hypsithocus hudsonae*.

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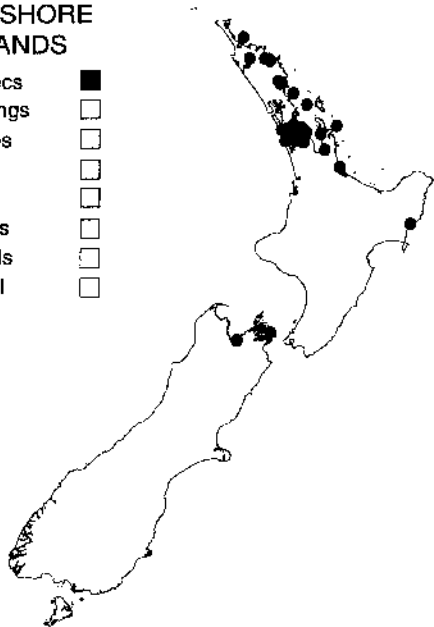
- Kermadecs
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- Chathams
- Snares
- Bounty
- Antipodes
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- Campbell



Map 16 Collection localities, *Nezara viridula*.

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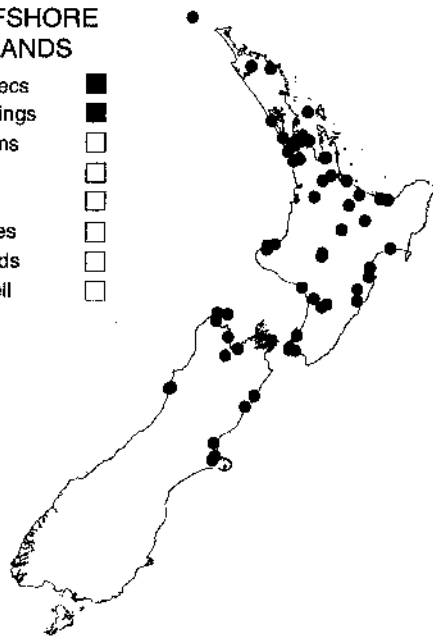
- Kermadecs
- Three Kings
- Chathams
- Snares
- Bounty
- Antipodes
- Aucklands
- Campbell



Map 17 Collection localities, *Glaucias amyoti*.

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- Kermadecs
- Three Kings
- Chathams
- Snares
- Bounty
- Antipodes
- Aucklands
- Campbell



Map 18 Collection localities, *Cuspicona simplex*.

TAXONOMIC INDEX

This index covers the nominal taxa mentioned in the text, regardless of their current status in taxonomy. Page numbers in bold type denote a description, and in italic type illustrations. A suffixed letter 'k' indicates a key, and 'm' a map. Additional names of higher taxa may be found in Appendices C and D (pp. 62-64), where plant and animal associates are listed.

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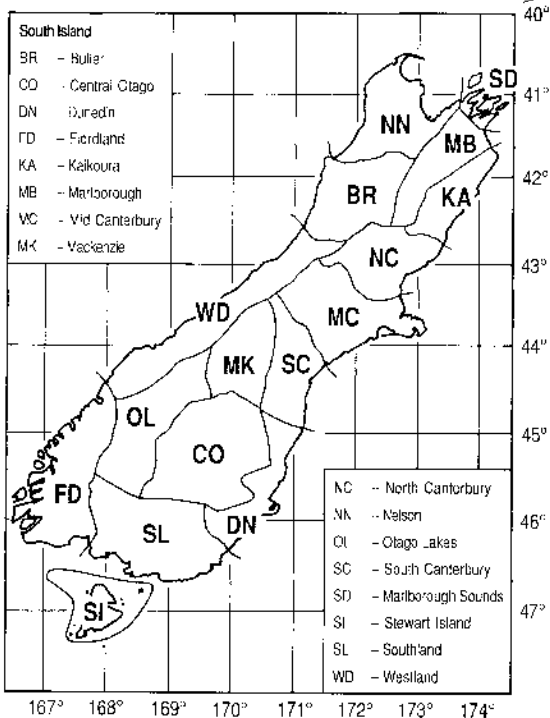
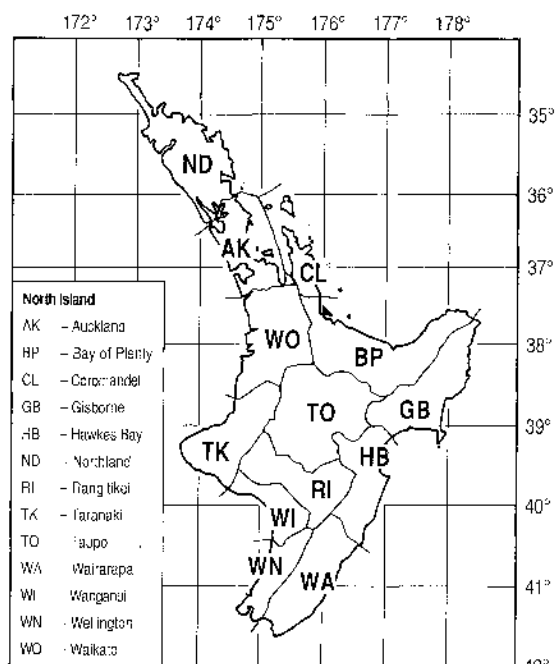
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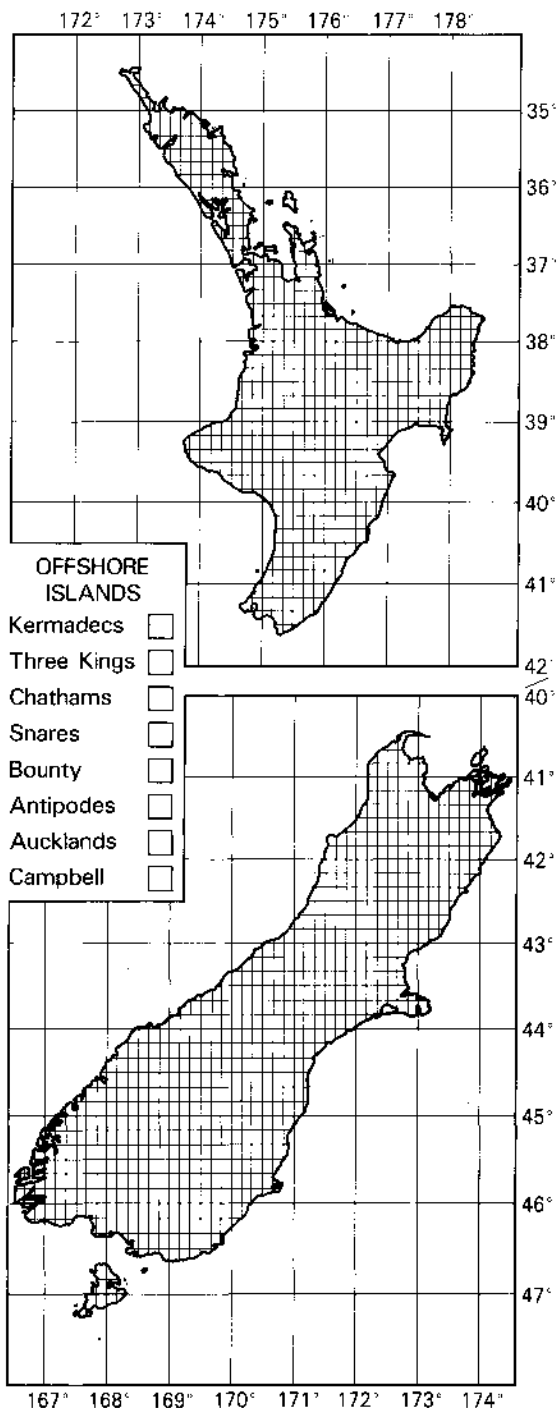
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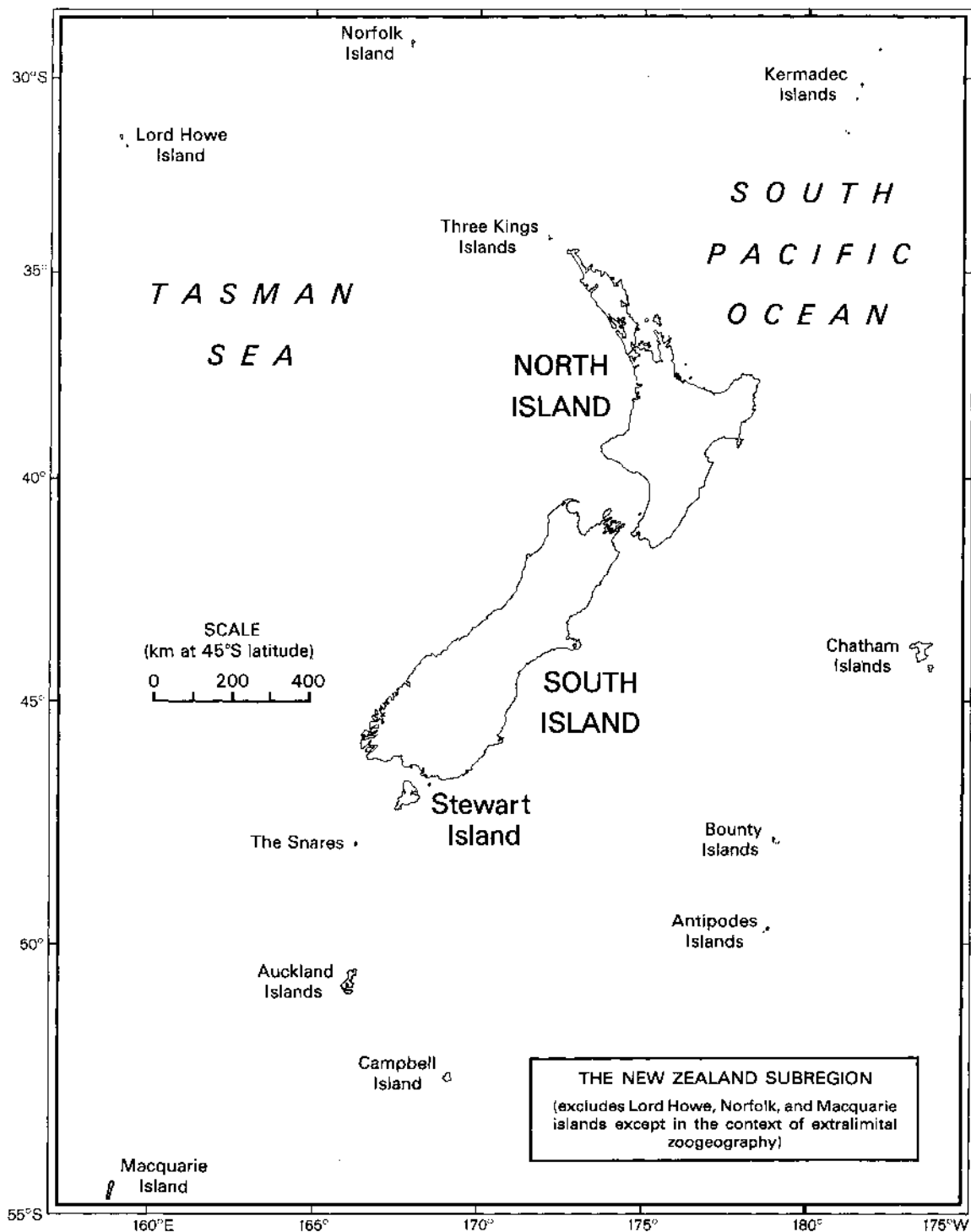
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Area codes and boundaries used to categorise specimen locality data (after Crosby *et al.* 1976)



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



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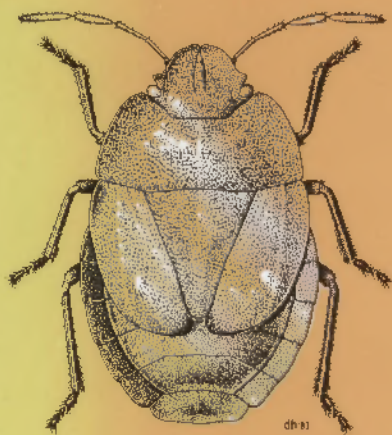
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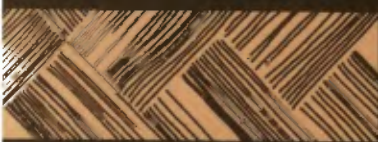
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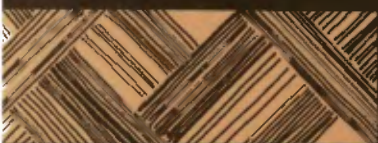
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Larivière, M.-C. 1995: Cydnidae, Acanthosomatidae, and Pentatomidae (Insecta: Heteroptera): systematics, geographical distribution, and bioecology. *Fauna of New Zealand* 35, 112 pp.

Date of publication: 23 November 1995

Fauna of New Zealand, ISSN 0111-5383; 35
ISBN 0-478-09301-2

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