

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

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

**Number / Nama 57**

**Apoidea**  
**(Insecta: Hymenoptera)**

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**Manaaki  
Whenua  
P R E S S**

**Lincoln, Canterbury, New Zealand  
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Front cover: Female *Leioproctus* (*Leioproctus*) *huakiwi* Donovan foraging on *Hebe brachysiphon*  
(Photograph Robert Lamberts, Crop & Food).

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## POPULAR SUMMARY

## HE WHAKARĀPOPOTOTANGA

Class **Insecta**Order **Hymenoptera**Superfamily **Apoidea**Families **Apidae, Colletidae,  
Halictidae, Megachilidae****Bees**

The bees present in New Zealand are not as colourful nor as conspicuous compared to the range of species of bees that occurs in many other countries of comparable size. Exceptions are the big, burly buzzing queen bumble bees which are recognised immediately by most people, but native species are superficially rather fly-like when on the wing, and even honey bees might sometimes be confused with vespid wasps. The only occasions under which some native bees have been noticed by the public are when nest tumuli have appeared in nearly-bare soil of lawns and unsealed driveways, and gardens, and foredune areas of beaches where people might be sunbathing. However, in New Zealand a characteristic that distinguishes female bees (except queen honey bees) and the worker caste of bumble and honey bees is that they collect nectar and pollen with which to feed themselves and their young. When collecting pollen and nectar, pollen grains are often moved from the anthers or the male parts of flowers, to the stigmas or female parts, a process which is called pollination. The pollen grains on stigmas then germinate, and eventually seeds and/or fruits are formed. Seed production is of course essential for the maintenance of both our native and introduced flora, and for many commercially valuable crops bees are by far the number one pollinators. Because bees are tied to flowers for their food, and more so than any other group of insects, as a group they are probably the most important pollinators, and therefore are often considered to be 'keystone' species in the whole chain of events that results in seeds and fruits. But not all characteristics of bees are beneficial. Almost everyone has been stung by a honey or bumble bee, annually hundreds have to seek medical treatment, and once in a while someone dies. Also, seed production of some species of weeds might be increased. On the other hand most people know that honey bees produce honey and beeswax, and even royal jelly, and increasingly both introduced and native bees are being recognised as essential pollinators of some very valuable crops, for example kiwifruit, and onion seed crops, without which yields would be uneconomic.

*(continued overleaf)*

**Illustration / Whakaahua:** Larva of *Leioproctus (Nesocolletes) fulvescens* (Smith) on a pollen ball in a cell. Dillons Point, Blenheim MB, 8 January 1980. Photograph B. J. Donovan.

**Ngā Pī**

Kāore i pērā rawa te muramura o ngā tae o ngā pī ka kitea i Aotearoa, kāore hoki he āhuatanga kōhure ina whakaritea ki te huhua o ngā momo o te pī ka kitea i te maha atu o ngā whenua he rite te rahi ki Aotearoa. Hāunga anō ngā kuini pī rorohū, he rahi, he tetere, ka wawe te mōhiotia atu e te nuinga o te tangata. Ko ngā momo māori hei titiro atu e rere ana, he āhua rite kē ki te rango. Ko ngā pī honi kei pōhēhētia he wāpi nō te whānau Vespidae. Ko ngā wā anake e kitea ai e te tangata, kia puta ake nei ngā kōhanga ahuahua ki te oneone o te pātītī, ki ngā ara kāinga e noho hīrakore ana, ki ngā māra, me ngā tāhuna o te tahamoana e pāina rā ana pea ētahi tāngata. Heoi anō, i Aotearoa ko tētahi āhuatanga e mōhiotia ai ngā pī uwaha (kaua ngā kuini pī honi) me te hunga kaimahi pī rorohū, pī honi, ko tō rātou kohi miere kohi hae hei kai mā rātou ko ā rātou uri. I te wā e kohi hae ana me te miere, ka mauria ngā pata hae atu i ngā hematoa ngā wāhanga toa o te puāwai, ki ngā tauhae ngā wāhanga uwaha, e kīia nei ko te tukanga ruinga hae. Kātahi ngā pata hae kei ngā hematoa ka tūnaku, ā nāwai ka puta ko ngā kākano, ko ngā hua. He tino kaupapa hoki te whai kākano kia mauritau tonu ai ā tātou tipu māori me ā tātou tipu rāwaho. ā, mō te nuinga o ngā tipu māra nui te wāriu arumoni ko ngā pī ngā tino kairuihae. Nā te noho paihere o te pī ki ngā puāwai hei pātaka kai, i tua atu i ētahi atu rōpū pepeke ko tō rātou rōpū te mutunga kē mai o ngā kairuihae. Nā reira rātou e kīia ai ko te momo pupuri i te mana i roto i te tukanga e hanga mai ai ngā kākano me ngā hua. Kāore ko te katoa o ngā āhuatanga o te pī i pai. Ko tātou katoa pea kua werohia e te pī honi, e te pī rorohū rānei, e hia rau ka tirohia e te rata ia tau ā, he wā anō e mate ai tētahi tangata. Arā anō pea ko te kaha ake o te whakaputa kākano a ētahi taru. Engari tērā e mōhio pai ana te nuinga o ngāi tangata ko tā te pī honi he mahi miere me te wākihi arā te ware pī, ā me te tiere ariki. Kua kaha ake te kitea he tino kairuihae ngā pī

*(haere tonu)*

The general resemblance of many of our native bees to some flies has not only limited their recognition as bees by the public, but within the group of large hairy species the close similarity among a number of species has made identification difficult even by entomologists.

Now, a total of 41 species of bees are known from the greater New Zealand biogeographical area, of which 27 are endemic, that is they are found only in New Zealand, and of these, 14 are new to science. Another five species are also present in Australia and clearly have originated from there, one other species is European in origin, and eight species have been purposely imported from the Northern Hemisphere. Of the endemic species, 18 are considered to be as primitive as any anywhere. Also, with five species which reached New Zealand assisted inadvertently by humans, and eight species which have been purposely imported, New Zealand has more species of introduced bees than most countries, and what is more, some of these species and especially the honey bee are very advanced. While the native bees have thus been confronted with new and often numerous competitors for pollen and nectar, with which they appear to have competed very successfully, they have also been exposed to several new enemies, which were imported with or now affect the honey bee or bumble bees, but which seem not to affect them.

In addition to identifying all the species of bees in New Zealand, this revision presents a key, drawings and photographs that will allow specimens to be identified, delineates the areas over which each species has been found and at what time of year they occur, lists all the flowers with which the species have been associated, records the enemies of each species of bee, and presents all known biological information, including conservation status.

Because all bees construct and provision nests, they need to follow a specific chain of activities in order to reproduce. For the species with some form of social organisation where adults live together in nests, this includes care of the young, and for honey bees even communication about suitable nesting locations and the distance and direction of flowers producing abundant pollen and nectar. These kinds of activities are closer than those of any other insects and indeed most animals to similar activities exhibited by humans. It is hoped that the presentation of this information in one publication will stimulate even more interest and research into this fascinating and valuable group of insects.

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Contributor **Barry Donovan** was born in Taumarunui in the west central North Island of New Zealand. Apart from the usual stings bare-footed children receive by stepping on bees foraging on clover, his first memory of really noticing bees was the arrival of a swarm of honey bees that clustered on a tree at Piriaka Primary School, which he was attending. This was the first swarm he had ever seen, and to his great apprehension he was asked to help hive it by an older pupil who lived on a neighbouring property. Barry then became captivated by the bees as they established their colony in a wooden apple crate, and before long his father

*(continued overleaf)*

(*ērā i whakaurua mai me ngā pī māori*) o ngā māra kai whai wāriuru rawa atu arā te huakiwi, te aniana, ka kore hoki he huānga kua tino raru te taha arumoni.

Nā te rite o te āhua o te nuinga o ā tātou pī māori ki te rango e kore ai e mōhiotia he pī tūturu e te marea tūmatanui, engari i roto i te rōpū o ngā momo pūhuru huri nei ko te tino riterite o ētahi momo ka uaua tonu te tautuhia e ngā kaimātai pepeke hoki.

I tēnei wā, 41 ngā momo pī e mōhiotia ana i te whenua nei o Aotearoa, 27 o ēnei he toiwhenua, arā ka kitea i Aotearoa anake, ka mutu 14 o ēnei he hōu ki te ao pūtaiao. E rima atu ngā momo kei Ahitereiria hoki me te mōhiotia i pūtaka mai i reira, kotahi atu momo i pūtaka mai i Ūropi, me ngā momo e waru he mea āta whakauru mai nō te Tuakoi Raki. O ngā momo toiwhenua, 18 e kiia ana he pērā tahi te tūāuri i ētahi atu ahakoa ko hea. E rima ngā momo nā tūpono noa rāua ko tangata i tae mai ai ki Aotearoa, e waru ngā momo he kaupapa i whakaurua mai ai. He maha ake ngā pī rāwaho kei Aotearoa nei i te nuinga o ngā whenua, ka mutu ko ētahi o ēnei momo, arā te pī honi kei mua kē te whanaketanga. Ko te wāhi ki ngā pī māori kua tau mai ētahi kaiwhakataetae i te miere, he hou, he maha hoki, me te aha anō e angitū ana ngā pī māori i roto i tēnei whakataetae. Tērā hoki kua tau mai ētahi hoariri hōu ki mua i a rātou, i whakaurua mai i te taha o te pī honi me te pī rorohū, he pānga e puta ana ki te pī honi me te pī rorohū engari kua ki ngā pī māori.

I tua atu i te tautuhi i te katoa o ngā momo pī i Aotearoa, e whakatakoto ana te arotakenga nei i tētahi kī, i ētahi tānga whakaahua, ētahi whakaahua tūturu e taea ai ngā tautauira te tautuhi, ka whakaatu hoki i ngā takiwā i kitea ai ia momo me tēhea wā o te tau i puta ai. E rārangi mai ana ngā puāwai katoa i whai wāhi atu ngā momo, kua tuhia mai ngā hoariri o ia momo pī, kua whakaatuhia ngā pārongo kōiora katoa e mōhiotia ana, me ngā āhuatanga hoki o te kaitiakitanga.

Ko ngā pī katoa ka hanga kōhanga, ka manaaki i ngā āhuatanga o te noho ora i te kōhanga nō reira me whai rātou i ētahi tikanga e taea ai te whakaputa uri. Ko ngā momo e whai āhuatanga pāpori ana arā, te noho tahi o ngā pakeke i ngā kōhanga, te tiaki kōhunga, te whakawhiti mōhiotanga a ngā pī honi mō ngā wāhi pai hei hanga kōhanga, te tawhiti, te ahunga e kitea ai ngā puāwai he rahi te hae me te miere. He tata ake ēnei mahi ki a te tangata i ētahi atu pepeke, me kī te nuinga o ngā kararehe. Ko te wawata nā te puta o tēnei pārongo ki te tānga kotahi ka kaha ake te arongia, te rangahautia o tēnei rōpū pepeke mīharo, whai take.

---

I whānau mai te kaituhi a **Barry Donovan** i Taumarunui i te hauāuru o te puku o Te Ika a Māui, i Aotearoa. Hāunga ngā werotanga pī o te tamariki i hīkoi kore hū atu ki ngā pī e hura karauwha ana, ko tana maharatanga tuatahi i oho ai ana whatu ki ngā pī ko tētahi kāhui pī honi i tau ake ka huihui ki tētahi rākau i te Kura Tuatahi o Piriaka i haere ai ia. Ko te kāhui tuatahi rawa atu tēnei i kite ia, me tana tino manawapā i tonoa ia e tētahi ākonga pakeke ake nō tētahi  
*(haere tonu)*

took him to visit the local commercial beekeeper. For the next eight years Barry worked on weekends and through the summers for the beekeeper, and during this time acquired 12 beehives of his own. Observations of insects visiting flowers revealed the occurrence of other bees that were not honey bees or bumble bees, and which could not be identified by anyone. After a BSc in Zoology from the University of Auckland, his MSc thesis studied the nesting biology of native bees at a nest site on the northern shore of the Waitemata Harbour. His PhD from the University of California, Davis, was a taxonomic revision of a subgenus of solitary ground-nesting bees, the species of which were similar to most of the native bee species in New Zealand. The next 22 years were spent as an entomologist with the New Zealand Department of Scientific and Industrial Research (DSIR) at the Canterbury Agriculture and Science Centre at Lincoln, where he specialised in the introduction and management of new species of bees for pollination of introduced crops, and also the biological control of wasps. During this period his interest in the taxonomy of native bees was pursued whenever possible. With the dissolution of the DSIR in mid-1992, he moved briefly to Landcare Research Ltd, and following his liberation from the constraints imposed by Landcare management, established himself as an independent entomologist. Fortunately, the new Foundation for Research, Science and Technology saw fit to fund him to continue his two main interests. In February 2003 his contribution to the study of bees and pollination was recognised by the presentation in Teheran, Iran, of the Khwarizmi International Award by the President of Iran. His research on bees in New Zealand has finally culminated in this revision of all the species of bees known from New Zealand.



kāinga nohotata kia āia ngā pi ki rō whare pi. Ka riro katoa ngā whakaaro o Barry i ngā pi i ā rātou e whakatau ana i tō rātou pūreirei ki tētahi pāka wahie āporo. Kāore i roa ka haria ia e tana pāpā kia kite i te kaitiaki pi arumoni o te rohe. E waru tau ka hipa i mahi a Barry mā te kaitiaki pi, i ngā pito wiki me te raumati ā, i roto i tēnei wā ka 12 āna ake whare pi. I ngā mātakitanga pepeke e toro puāwai ana ka kitea te putaputa o ētahi pi ehara i te pi honi, i te pi rorohū rānei ā, kāore i taea e tētahi te tautuhi. Whai muri i tana BSc Mātai Kararehe mai i te Whare Wānanga o Tāmaki Makaurau, ko te take kōrero o tana MSc he mātai i te koiora o te noho kōhanga o ngā pi māori i tētahi taunga kōhanga i te takutai ki te taha raki o te whanga o Waitematā. Ko tana PhD mai i te Whare Wānanga o Karapōnia, i Davis, he arotakenga tātai hono o tētahi puninga iti o ngā pi mohaha hanga kōhanga ki te whenua, o ngā momo rite ki te nuinga o ngā pi māori o Aotearoa. Ko ngā tau 22 whai ake he kaimātai pepeke te mahi i Te Tari Rangahau Pūtaiao me te Ahumahi o Aotearoa (DSIR) i Te Pūtahi Ahuwhenua, Pūtaiao o Waitaha i Lincoln. I arotahi ai ia ki te whakauru mai me te whakahaere i ngā momo hōu o ngā pi hei rui hae ki ngā kai māra ka whakaurua mai me te whakatina koiora i ngā wāpi. I tēnei wā i whāia e ia i ngā wā katoa i taea, tana aronga nui ki te tātai hono o ngā pi māori. Nō te whakakorenga o te DSIR i waenga i te tau 1992, i nuku ia ki Manaaki Whenua he wā poto i reira. Whai muri i tana wetenga mai i ngā here a ngā kaiwhakahaere o Manaaki Whenua ka whakatū ai i a ia hei kaimātai pepeke motuhake. Waimarie, i tautoko Te Tūāpapa Toha Pūtea, Whakatakoto Kaupapa Rangahau, Pūtaiao i whai tonu ai ia i ana aronga nui e rua. I Huitanguru i te tau 2003, i mihia te wāhi ki a ia mō ngā mātaitanga pi me te ruinga hae i Terāna, Īrāna i whakawhiwhia e te perehitini o Īrāna ki te Khwarizmi International Award. Ko tana rangahau i ngā pi o Aotearoa kua oti te whakakao ki tēnei arotakenga o ngā momo pi katoa e mōhiotia ana i Aotearoa.

#### Kupu Āwhina

huānga	yields
kaimātai pepeke	entomologist
kairuihae	pollinator
kohure	conspicuous
mohaha	solitary
pāpori	social
pūreirei	colony
ruinga hae	pollination
tātai hono	taxonomic
tautauira	specimen
tiere ariki	royal jelly
toiwhenua	endemic
tūāuri	primitive
wākihi pi, ware pi	beeswax
wāriu arumoni	commercial value

Translation by **W. Te Rakihowea**  
Ngaruawahia



**Frontispiece** Female *Leiproctus (Leiproctus) huakiwi* Donovan foraging on *Hebe brachysiphon* (Plantaginaceae). Canterbury Agriculture and Science Centre, Lincoln. Collector B. J. Donovan, 7 January 2004. Photograph Robert Lamberts, Crop and Food Research Ltd.

*Beyond the appreciable facts of their life we know but little of the bees. And the closer our acquaintance becomes, the nearer is our ignorance brought to us of the depths of their real existence. But such ignorance is better than the other kind, which is unconscious and unsatisfied.* Maurice Maeterlinck, 1901: *The life of the bee*, p. 6. Kessinger Publishing 2004, 432 pp. Translated by Alfred Sutro.



## ABSTRACT

The superfamily Apoidea in New Zealand is represented by 41 species in 4 families. The 28 species of the family Colletidae are represented by 12 previously described endemic species (*Leioproctus* (*Leioproctus*) *boltoni*, *L. (L.) imitatus*, *L. (L.) metallicus*, *L. (L.) purpureus*, *L. (L.) vestitus*, *L. (Nesocolletes) fulvescens*, *L. (N.) hudsoni*, *L. (N.) maritimus*, *L. (N.) monticola*, *Hylaeus (Prosopisteron) agilis*, *H. (P.) capitosus*, and *H. (P.) relegatus*), 12 newly described endemic species (*Leioproctus* (*Leioproctus*) *huakiwi*, *L. (L.) kanapuu*, *L. (L.) keehua*, *L. (L.) otautahi*, *L. (L.) pango*, *L. (L.) waipounamu*, *L. (Nesocolletes) nunui*, *L. (N.) paahaumaa*, *L. (N.) pekanui*, *Hylaeus (Prosopisteron) kermadecensis*, *H. (P.) matamoko*, and *H. (P.) murihiku*), and 4 adventive species from Australia (*Hylaeus (Prosopisteron) asperithorax*, *H. (P.) perhumilis*, *Hyleoides concinna*, and *Euryglossina (Euryglossina) proctotrypoides*). The 5 species of the family Halictidae are represented by the imported *Nomia (Acunomia) melanderi melanderi*, the previously described endemic species *Lasioglossum (Austrevylaeus) sordidum*, the 2 newly described endemic species *L. (A.) mataroa* and *L. (A.) maunga*, and the indigenous species *L. (Chilalictus) cognatum*, which is also found in Australia. The 3 species of the family Megachilidae consist of the adventive *Anthidium (Anthidium) manicatum*, and the imported *Osmia (Helicosmia) coerulescens*, and *Megachile (Eutricharaea) rotundata*. The 5 species of the family Apidae are represented by the imported species *Bombus (Bombus) terrestris*, *B. (Megabombus) hortorum*, *B. (M.) ruderatus*, *B. (Subterraneobombus) subterraneus*, and *Apis mellifera*. 10 new synonymies are established (valid name listed after equal sign): *Paracolletes maorium* Cockerell, 1913 and *Paracolletes viridibasis* Cockerell, 1936 = *Leioproctus (Leioproctus) imitatus* Smith, 1853; *Dasycolletes hirtipes* Smith, 1878, *Paracolletes waterhousei* Cockerell, 1905, and *Paracolletes opacior* Cockerell, 1936 = *Leioproctus (Nesocolletes) fulvescens* (Smith, 1876); *Prosopis maorica* Kirkaldy, 1909 and *Hylaeus (Prosopisteron) laevigatulus* Mitchener, 1965 = *Hylaeus (Prosopisteron) agilis* (Smith, 1854); and *Prosopis cameroni* Cockerell, 1905, *Prosopis maoriana* Cockerell, 1909, and *Hylaeus hudsoni* Cockerell, 1925 = *Hylaeus (Prosopisteron) relegatus* (Smith, 1876).

Data are presented and discussed on the origin, biogeography, history of research, the evolutionary relationships among endemic bees, life cycles, economic value, impact on human health, conservation status, and, for imported bees, their environmental impacts. Keys are given according to sex to families, subfamilies, genera, subgenera, and species, and by nests to genera.

For the endemic, indigenous, and adventive species except *Anthidium manicatum*, all known references are presented with annotations, while for *Anthidium manicatum* and the imported species, the most important references are selected. All 27 previously named species and 14 new species are described, and distribution data with maps and details of biology are presented. For all species except *Bombus* and *Apis*, all flower visiting records for New Zealand are listed separately for native plants and introduced plants, while for *Bombus* flower visiting records for native plants are presented. The appendices provide information on species recorded in New Zealand but not established, species recorded incorrectly for New Zealand, and a subjective evaluation of the occurrence and abundance of the species throughout New Zealand.

During this study 24,529 bees were inspected microscopically, many scores of thousands of *Leioproctus* spp., *Hylaeus* spp., and *Lasioglossum* spp. were observed on the wing, and for *N. melanderi*, *O. coerulescens*, *M. rotundata*, *Bombus* spp., and *Apis mellifera* collectively, millions have been handled and observed.

Keywords. Insecta, Hymenoptera, Apoidea, Apidae, Colletidae, Halictidae, Megachilidae, New Zealand, classification, distribution, biology, flower visitation records, fauna.

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## Bees: Angels of the Environment

### INTRODUCTION

The Apoidea, or bees, were defined by Michener (1965) as being basically sphecoid wasps that use pollen as a protein source rather than insects or spiders. Some of the primitive bees are very similar to the sphecoid wasps, but are distinguishable by the presence of at least a few branched hairs on the body, by having the hind basitarsi wider than the following segments, and by the absence of a strigilis on the hind legs. However, because of the close physical similarities between sphecoid wasps and bees, some authorities have placed bees with the sphecids within the superfamily Sphecoidea (e.g., Brothers 1975, Lomholdt 1982, Alexander 1992). Conversely, Gauld & Bolton (1988) believed that the Sphecidae and Apidae should be grouped together in the Apoidea. However, Cardale (1993) retained Apoidea as a superfamily for bees of Australia, and Harris (1994) retained Sphecoidea as a superfamily for sphecoid wasps of New Zealand. Michener (2000), in a major work on the bees of the world, believed that similarities between sphecoid wasps and bees were so great they should all belong in the same superfamily, and that because a family-group name based on the generic name *Apis* antedates a name based on *Sphex*, the name of a bee-sphecoid superfamily should be Apoidea. Bees were confirmed as belonging to the Series Apiformes of Brothers (1975), and the sphecoid wasps to the Series Spheciformes. For reasons given below, this revision of the bees of New Zealand retains the name Apoidea for bees, as defined by Michener (1965).

Bees have long been regarded as constituting a monophyletic unit, and Michener (2000) detailed 14 synapomorphies that demonstrate this. There is of course some overlap with characters of various groups of wasps, such as the utilisation by several species of the genus *Trigona*, subgenus *Trigona*, partially or exclusively, of carrion as a protein source instead of pollen, and conversely, the use of pollen by Masaridae (Vespoidea) instead of animal protein. The 14 characters also help to define the distinctiveness of bees from other insects. However, there are two other major characters not listed by Michener (2000) that further emphasise the unique nature of bees. These characters are not morphological, and are displayed by only a relatively small number of species, but I believe them to be none the less as valid as standard morphological characters as representative of the Apoidea as a whole. One is the widespread development of sociality among bees. Michener (2000) believed that of the seven families recognised by him, eusociality (where many individuals live intimately, there is division of labour, and in highly

eusocial forms castes are morphologically differentiated) has evolved in the Halictidae and Apidae at least eight times, and probably many more. Several hundred species in the Meliponini (Apidae) alone are eusocial, with up to scores of thousands of individuals per colony. In contrast, according to Bohart & Menke (1976), sociality in Sphecidae (the sphecoid wasps) is developed only slightly. Representatives of several subfamilies may maintain nests over several generations, and in nests of *Microstigmus comes* up to 18 adults of both sexes and 18 cells with brood of all ages were present. However, there was no indication of caste differentiation. A second and very major character is the use by species of *Apis* of a dance 'language' by which information about distance and direction of food sources and nesting sites is transmitted between foragers (Frisch 1950). The dance language hypothesis has been challenged (e.g., Wenner & Wells 1990), but a new, comprehensive hypothesis which presents a resolution to the controversy, suggests that bees use the dance information more comprehensively than had hitherto been supposed (Donovan 2000). Some stingless bees (Meliponinae), of which there are at least several hundred species, have been reported to guide bees more directly to forage and to nest sites, using odours to mark pathways, but recently *Melipona panamica* has been found to possess the ability to indicate food location without using a scent trail (Nieh & Roubik 1995, 1998). The possession of a language by *Apis* and probably one or more *Melipona* is a feature otherwise unknown in the Arthropoda, and indeed elsewhere, apart from humans and possibly some great apes and cetaceans. I believe the possession of this character is a valid reason to justify the retention of the superfamily Apoidea for bees.

### Bees of the world and New Zealand

Michener (2000) puts the number of described species of bees from throughout the world at about 17,000, and thinks that the total number of species could be about 30,000. He recognises 7 families, which when ranked from most primitive to most advanced are often presented in the following order: Stenotritidae, Colletidae, Andrenidae, Halictidae, Melittidae, Megachilidae and Apidae. Only 41 species of bees are established in New Zealand, and these belong to just 4 families, i.e. Colletidae: 28 species, Halictidae: 5 species, Megachilidae: 3 species, and Apidae: 5 species.

### DIAGNOSIS FOR NEW ZEALAND BEES

**Adults:** Head orthognathous; compound eyes large; females with 12 antennal segments, males with 13. Pronotum immovably joined to the mesothorax; posterior lateral margin with a rounded extension, the pronotal lobe, which covers the spiracle and which is well separated from the tegula. First true abdominal segment fused to the metathorax so that the pro-, meso-, and metathoracic segments plus the first true abdominal segment or propodeum, constitute the mesosoma. A constriction posterior to the propodeum separates the mesosoma from the remaining abdominal segments, which constitute the metasoma. Hind leg without a cleaning pecten or brush in a depression basally on inner side of basitarsus (present in sphecoid wasps). Hind basitarsus wider than following tarsi (scarcely wider in sphecoid wasps). At least some body hairs branched, although often difficult to distinguish in *Hylaeus*, and particularly *Euryglossina* (hairs simple in sphecoid wasps). Females (except for *Hylaeus*, *Hyleoides*, and queens of *Apis*) with areas of hairs modified to form pollen-carrying scopae or corbiculae (absent in sphecoid wasps). Michener (2000) pointed out that the lower face of nearly all bees is dull, whereas that of most sphecoid wasps has short golden or silvery hairs that glitter in the light.

**Eggs:** Elongate, tubular, gently curved, laid in a cell or cup, on pollen/nectar, or if not laid on pollen/nectar, adult bees later supply food to the larvae.

**Larvae:** Soft, white or near-white, and legless; growth often rapid; shed skins very flimsy and therefore difficult to see, but probably about 4 moults.

**Prepupae:** White or near-white, legless.

**Pupae:** Initially pearly white, rapidly darkening as adult features mature within pupal skin.

### ORIGIN OF NEW ZEALAND BEES

The 41 species of bees present in New Zealand can be divided into 4 groups according to their origin.

1. **Endemic**, which occur only in New Zealand: 27 species (all 18 species of *Leioproctus* (although the status of *L. otautahi* is uncertain), 6 of the 8 species of *Hylaeus*, and 3 of the 4 species of *Lasioglossum*).

2. **Indigenous**, which also occur in Australia and which originated from there, but which probably reached New Zealand without human involvement: 1 species (*Lasioglossum cognatum*). This species is ground-nesting, so it is possible that nests containing immatures and/or adults reached New Zealand in ballast in sailing ships.

However, the smaller size of bees from New Zealand suggests the species has been in New Zealand for sufficient time for the development of some divergence from the Australian population, which in turn suggests adults must have somehow crossed the Tasman Sea, perhaps through being caught in a rare cyclonic windstorm, a long time ago.

3. **Adventive**, assisted inadvertently by humans: from Australia, *Hylaeus asperithorax*, *H. perhumilis*, *Hyleoides concinna*, and *Euryglossina proctotrypoides*: from Europe originally but which has colonised other areas including parts of North and South America and the Canary Islands, *Anthidium manicatum*. The 4 species from Australia could have crossed the Tasman Sea unaided as presumably did *Lasioglossum cognatum*, but because they construct their nests in blind tunnels in plant material, there may be a greater possibility that whole nests were carried across the Tasman Sea in timber or plant stems, by ships or aircraft. Similarly nests of *A. manicatum* which are constructed in blind cavities in plant and other materials could have reached New Zealand from any part of its extended range.

4. **Imported**, purposely from the Northern Hemisphere by humans for economic reasons: 8 species (*Nomia melanderi*, *Osmia coerulescens*, *Megachile rotundata*, *Bombus terrestris*, *B. hortorum*, *B. ruderatus*, *B. subterraneus*, and *Apis mellifera*).

**Endemic and indigenous** bees are **native** to New Zealand and total 28 species, and **adventive and imported** bees are **introduced** to New Zealand, and total 13 species.

## BIOGEOGRAPHY OF NEW ZEALAND BEES

### Colletidae

This family is most abundant and most diversified in temperate parts of Australia and South America (Michener 2000). There are 5 subfamilies, of which 3, the Colletinae, Hylaeinae, and Euryglossinae, are represented in New Zealand.

**Colletinae.** For the world, 17 genera are listed in Colletinae, and formerly these were divided into 2 tribes, the Colletini and the Paracolletini. However, due to a number of factors, including the possession of overlapping characters between some groups previously thought to be distinct, and in particular the large number of Australian species which are yet to be described, the allocation of genera to tribes has been abandoned. The genus *Leioproctus* is huge, and has 33 subgenera, with only the

subgenus *Leioproctus* common to both South America and the Australian subregion.

There are about 125 specific names in the subgenus *Leioproctus*, of which Cardale (1993) listed 113 from Australia. The remaining species occur in New Guinea, Misool (an island west of New Guinea), Lord Howe Island, Tasmania, and New Zealand. A single species from Brazil differs in several characters that might place it outside the subgenus. The type species of the subgenus is *Leioproctus imitatus* Smith from New Zealand, by designation of Cockerell (1905a). In this revision, 11 species from New Zealand, all of which are endemic (apart from possibly *L. otautahi*), are assigned to the subgenus *Leioproctus*. Because the bulk of species in the subgenus *Leioproctus* occur in Australia, there seems no doubt that the New Zealand species are derived from Australia.

The subgenus *Nesocolletes* occurs only in New Zealand, so the 7 species assigned to it in this revision are endemic. Most species possess characters that clearly separate them from the subgenus *Leioproctus*, such as a long malar space, and in profile a declivous propodeum, but a short malar space and/or a slightly rounded propodeum in a couple of species suggest an origin from the subgenus *Leioproctus*. Whether the origin is from the subgenus *Leioproctus* in New Zealand, or from the subgenus in Australia, is unknown.

**Hylaeinae.** According to Michener (2000), this subfamily is world-wide, but is most abundant and diversified in the Australian region. There are 9 genera, of which *Hylaeus* with 46 subgenera is by far the largest. *Hylaeus* occurs almost everywhere, and all 8 species in New Zealand belong to the subgenus *Prosopistemon*. This subgenus has 76 named species (Michener 2000), of which 55 are listed from Australia (Cardale 1993). Six of the 8 species are endemic, and 2 are adventive. There can be little doubt that the progenitors of the endemic species originated in Australia.

Houston (1975) listed 8 species of *Hyleoides* from Australia, and 1 specimen from Lord Howe Island. There can be no doubt that *H. concinna*, which occurs in New Zealand and which is otherwise found only in Australia, originated from Australia.

**Euryglossinae.** Historically this subfamily was known only from Australia, including Tasmania, where about 348 species are known in 15 genera, but according to Michener (2000), 1 species has been taken in South Africa, and 1 species is established in New Zealand (Donovan 1983a). Several species also occur in New Caledonia (Donovan pers. obs.) The New Zealand species is conspecific with an Australian species, so undoubtedly the New Zealand species originated from Australia.

## Halictidae

Some bees of this family are sometimes referred to as sweat bees because they will sip moisture from skin on hot days. In temperate areas the numbers of individuals can be greater than other bees except honey bees. There are 4 subfamilies, of which 2, the Nomiinae and the Halictinae, are represented in New Zealand.

**Nomiinae.** The 11 genera in this subfamily are centred in the palaeotropical and Old World austral regions, with just 2 genera in North America. There is just 1 introduced species, *Nomia melanderi*, the alkali bee, which was imported from the United States as a manageable pollinator of lucerne seed crops.

**Halictinae.** This is an enormous, widely distributed group, of which some species and numbers of individuals can be common. There are 2 tribes, with only the Halictini represented in New Zealand and Australia. There are 12 genera in the Eastern Hemisphere, with just *Lasioglossum* in New Zealand. In this genus in Australia there are 8 subgenera and about 250 species. Two subgenera and 4 species occur in New Zealand. Three species, which are in the subgenus *Austrevylaeus*, are endemic. There are 6 other described species in this subgenus in Australia, and 13 others are known (Michener 2000). Presumably the ancestor(s) of the New Zealand species was/were Australian. There are 134 species in the subgenus *Chilalictus*, with a distribution of Australia including Tasmania, at least 1 species in New Caledonia, and *Lasioglossum (Chilalictus) cognatum* present in both Australia and New Zealand. This species is ground nesting, so it seems unlikely that it reached New Zealand as immatures within nests. Adults probably crossed the Tasman, and could have done so at any time unassisted by humans, so this species is here regarded as indigenous.

## Megachilidae

This family of leafcutting bees is widely distributed. There are 2 subfamilies, of which the Megachilinae is divided into 5 tribes. The Osmiini, Anthidiini and Megachilini are each represented in New Zealand by 1 species. The species in Osmiini was purposely imported from Europe for pollination of red clover, and the species in Megachilini was purposely imported from North America for pollination of lucerne, but the species in Anthidiini is very recently adventive from an extended foreign range.

## Apidae

As conceived of by Michener (2000), this is a hugely diverse family, which has been divided by many other workers into a range of families and many subfamilies and tribes. Two tribes of Apinae are represented in New Zealand. The Bombini are distributed primarily over the

Northern Hemisphere and also Central and South America, and 4 species have been imported with the purpose of improving the pollination of red clover. The Apini is represented by the European or western honey bee, which was imported for honey production.

## HISTORY OF RESEARCH ON NEW ZEALAND BEES

### Taxonomy

**Families.** The history of bee classifications world-wide is outlined by Michener (2000). Latreille (1802) recognised 2 families which became the Andrenidae and the Apidae. Of relevance to the native bees of New Zealand, the genera *Colletes*, *Hylaeus*, and *Andrena* were assigned to the Andrenidae. Over the next nearly 200 years there were many changes, both in numbers of names for various categories of higher names, and their status and combinations. During about the first 100 years the number of families increased, with Ashmead (1899) naming 14, and Robertson (1904) naming 18. Lepelletier (1835, 1841), under the family Merilegides, assigned the genus *Halictus* to the tribe Andrenites, and used the name Colletides for a tribe for the genus *Colletes*; whereas *Hylaeus* was placed in the tribe Prosopites in the family Monomorphides among the parasitic bees. Ashmead (1899) assigned *Paracolletes* to the family Colletidae, *Prosopis* = *Hylaeus* to the Prosopidae, and *Halictus* to the Andrenidae. Robertson (1904) made one change by placing *Halictus* in the Halictidae.

In a major work, Michener (1944) established a classification of all bees which is followed by most workers today. The genera *Paracolletes* and *Hylaeus* were placed in the Colletidae, and the genus *Lasioglossum* was placed in the Halictidae. However, this system has not been universally followed, and as pointed out by Michener (2000), Warnke (1977) assigned the genera *Colletes* and *Hylaeus* to the subfamily Colletinae within the Andrenidae, and the genus *Halictus* to the subfamily Halictinae, again within the Andrenidae. Except for the superfamily name, this present revision follows the classifications of Michener (1944, 1965, 2000).

### Native and adventive bees

**Genera and species.** The first record of a bee collected from New Zealand appears to be the name *Andrena trichopus* and a drawing of a female made in manuscript by White. Publication was in Butler (1874), where under Andrenidae the name *Dasycolletes metallicus* is followed beneath by “*Andrena trichopus White Ms., tab. 7, f. 12.*”, and under this, “*Dasycolletes metallicus, Smith, Cat. Hymen. Ins. I., p. 15, n.1 (1853).*” The indication is that

the work by White was completed before that of Smith but not published. The insects described were collected during the voyage of H.M.S. *Erebus* and H.M.S. *Terror*, supplemented with other insects collected by Dr Sinclair, Mr Earl, and others. The *Erebus* and the *Terror* were in the Bay of Islands from 17 August to 23 November 1841, and after reaching Folkstone, England, on 4 September 1843, various authors were assigned to different zoological groups. White was responsible for the insects other than Lepidoptera, and most were published in White (1846). However, financial problems arose delaying publication of White's final part of his contribution until it appeared under the authorship of Butler in 1874 (Andrews 1986, Crosby pers. comm.).

Dr Sinclair was in the Bay of Islands at the same time as the *Erebus* and *Terror* expedition, and subsequently sent plant and animal material to the British Museum (Andrews 1986). Mr Earl arrived at Wellington on 23 September 1842 and left in October 1844. Most of his collecting seems to have taken place in the south of the South Island, and on his return to England, insects and other organisms ended up in the British Museum (Andrews 1986). Among several other collectors mentioned by Andrews from the 1840s and 1850s was Lt Col Bolton, after whom Cockerell (1904a) named *Leioproctus boltoni*, from female and male specimens collected by him. Bolton toured New Zealand with Governor Grey in 1847, and was stationed in Wellington between 1848 and 1850. He was then based in Auckland between March 1850 and November 1853 and commanded the Royal Engineers: this is most likely when he did his insect collecting (Dugdale 1988). He embarked for England in November 1853, and his collection reached the British Museum early in 1854. According to Andrews (1986) there were also many other, lesser known collectors during this period. The last organised collecting expedition of the era was that of the *Acheron*, which reached Auckland on 7 November 1848, and visited Akaroa, Lyttelton, the east coast of Otago, Cook Strait, and Tasman Bay before departing for Sydney and England. While the ship was at Akaroa and Lyttelton, Frederick Strange collected in the area and as far afield as the Torlesse Range in Canterbury. Over 100 insects from collections made by David Lyall and a few collected by Frederick Strange passed to the British Museum.

The first published descriptions of bees from New Zealand were by Frederick Smith (1853). The new genera relevant to New Zealand, *Paracolletes*, *Leioproctus*, *Lamprocolletes*, and *Dasycolletes*, were also described, to which were assigned the new species *Leioproctus imitatus*, *Dasycolletes metallicus*, and *D. purpureus*. A fourth species, *Halictus sordidus*, was also described. Smith (1854) described *Prosopis laevigata* from New Zealand.

However, on the next page a species with the same name is recorded as being described from Russia in 1852. Subsequently, Smith's species from New Zealand proved to be conspecific with *Prosopis agilis* Smith 1876.

*Dasycolletes metallicus* (= *Leioproctus metallicus*) occurs over much of New Zealand, so unfortunately no light is cast on possible collectors or collection areas. However, for *L. imitatus* and *D. purpureus*, W. F. Kirby, who was an assistant in the Zoology Department of the British Museum, names Churton as the collector (and in addition to New Zealand for both species, also gives Australia for *L. imitatus*), and for *Prosopis laevigata* and *Halictus sordidus*, Bolton is named as the collector and the locality is Auckland (Kirby 1881). The Reverend J. F. Churton arrived in New Zealand at Port Nicholson (Wellington) on 20 April 1840, but by 10 January 1841 was colonial chaplain in Auckland. He died in Auckland on 26 January 1853 (Blain 1999).

The next species of bee to be described as from New Zealand was *Prosopis vicina* Sichel (1867). The *Novara* expedition visited Auckland from 22 December 1858 to 8 January 1859. On board was geologist Ferdinand von Hochstetter: he left the *Novara* to make a rapid geological survey for the New Zealand government and collected extensively. However, this species was later found to be from Tasmania (Cameron 1902).

Hutton (1874) listed the bees from New Zealand, but incorrectly included *Lamprocolletes obscurus*, which Smith (1853) described from Van Diemen's Land (= Tasmania), as well as repeating the incorrect record of *Prosopis vicina*.

The first descriptions for which locality data are given are those of Smith (1876) for "Hymenopterous Insects of New Zealand, collected by C. M. Wakefield, Esq., principally in the neighbourhood of Canterbury". *Prosopis agilis*, *P. relegatus*, *P. capitatus*, *Lamprocolletes fulvescens*, and *Halictus familiaris* are from Canterbury, and *Dasycolletes vestitus* is from Wellington. All are placed in Andrenidae. Two years later, Smith (1878) described *Dasycolletes hirtipes*, which was collected by Prof. Hutton at Otago.

Hutton (1881) provided a brief description of Andrenidae, a key to the genera of bees in New Zealand, and a description of the genera and all species. *Prosopis vicina* was said to occur in both Auckland and Tasmania. Kirby (1884) also listed the bees from New Zealand, and pointed out that *Lamprocolletes obscurus* described by Smith (1853) is from Tasmania, not New Zealand. Cameron (1898) described *P. sulcifrons* and *P. innocens* from Greymouth, and listed *P. agilis*, *Dasycolletes vestitus* and *D. hirtipes* from the same locality, while Cameron (1900) described *Halictus huttoni* from Christchurch, and



provided a key to this species and for *H. sordidus* and *H. familiaris*.

Early in the 20<sup>th</sup> century, lists of bees from New Zealand and re-descriptions and keys to some species were published by workers such as Alfken (1903), Cameron (1903), Hutton (1904), Meade-Waldo (1923), and Meyer (1931). However, the period from 1904 to 1936 was dominated by T. D. A. Cockerell, who, during this period published 16 papers that dealt to some extent, and often in detail, with the endemic bees of New Zealand. Among the most important was the unification with the genus *Paracolletes* Smith of the genera *Leioproctus*, *Dasycolletes*, and *Lamprocolletes* Smith (Cockerell 1905a). He also described 7 new species of *Paracolletes*, 4 of which, *P. boltoni* (Cockerell 1904a), *P. monticola* and *P. hudsoni* (Cockerell 1925), and *P. maritimus* (Cockerell 1936), are still valid specific names. The new hyaline species *Prosopis maoriana* (Cockerell 1909) and *Hylaeus hudsoni* (Cockerell 1925) and the halictine *Halictus smithii* var. *a* (Cockerell 1916a) are not valid names. The last descriptions of New Zealand bees were those published 70 years ago by Cockerell (1936).

The next major work relevant to the taxonomy of the bees of New Zealand was that of Michener (1965), who placed all the species formerly assigned to *Paracolletes* in a redefined genus *Leioproctus*, and allocated some species to a subgenus *Leioproctus*, and others to a newly described subgenus *Nesocolletes*, which was restricted to New Zealand. Also, New Zealand species previously assigned to *Prosopis* were placed in *Hylaeus*, which has priority, and all species were assigned to the subgenus *Prosopisteron*. In addition, species previously placed in the genus *Halictus* were assigned to the genus *Lasioglossum* and the subgenus *Austrevylaeus*. These classificatory arrangements are maintained in the present work.

The Australian species *Euryglossina proctotrypoides* was first reported to be present in New Zealand by Callan (1979) based on observations made by B. J. Donovan, and Donovan (1983b) discovered that *Hyleoides concinna*, also from Australia, was established. This revision records for the first time that 3 more Australian species (*Hylaeus asperithorax*, *H. perhumilis*, and *Lasioglossum cognatum*) are also established in New Zealand. Also, Donovan, Burnip & McCarthy (2006), and this revision, record the discovery in January and February 2006 of the wool-carder bee *Anthidium manicatum*, originally from Europe, at Napier, HB and Nelson, NN respectively.

### Imported bees

The alkali bee, *Nomia melanderi* Cockerell, and the lucerne leafcutting bee, *Megachile rotundata* (F.), were

imported and established during the early 1970s for the pollination of lucerne seed crops, *Medicago sativa* L. (Donovan 1975a). Research concentrated on maximising bee propagation, and subsequent seed yield increases were very good, but the dissolution of the Department of Scientific and Industrial Research in mid-1992 resulted in the collapse of the Government-funded promotion of both species of bees. Husbandry of alkali bees is now minimal, and lucerne leafcutting bee numbers are too few to provide an economic return to the handful of bee owners.

The red clover mason bee *Osmia coerulescens* (L.) was field-released in 1996 as a potentially manageable pollinator of red clover seed crops (Purves *et al.* 1998). However, numbers are still small, and management methods are still being developed.

The history of the introduction of bumble bees to New Zealand has been outlined by Farr (1889), Hopkins (1914), and Macfarlane & Griffin (1990). According to Hopkins (1914), the objective of introducing bumble bees was to “bring about the fertilization and seeding of red clover (*Trifolium pratense*)”. At the time, however, the identity of the species imported was uncertain.

As outlined by Macfarlane & Griffin (1990), from 1883 to 1885, 1,490 bumble bee queens of at least 3 species were imported from England. Most queens died during transport, but in 1883, 2 live queens were liberated near Pareora, SC, and in 1884, 2 live queens were liberated at Matamata, WO. There was apparently no establishment near Pareora, and none at Matamata. In 1885, 93 live queens were released at 2 sites near Christchurch, MC, from which Gurr (1957) believed that *B. terrestris* and *B. ruderatus* established. According to Macfarlane and Griffin (1990), this resulted in the establishment of *B. terrestris*, *B. ruderatus* and perhaps *B. subterraneus*. In 1906, 3 species, including *B. hortorum*, were imported from England. A total of 180 queens was liberated at Lincoln College, MC, of which 81 were alive, and another 145 were liberated at Tai Tapu, MC, of which 62 were alive. It seems that *B. hortorum* established from these liberations.

In the first few years following the establishment of bumble bees, their progeny spread over the country with remarkable rapidity. Whole nests, and queens, were sent from Canterbury to various parts of the North Island (Hopkins 1914). Gurr (1957) surveyed the South Island, and found that 4 species were extant: *B. terrestris* and *B. ruderatus* were present throughout the island, whereas *B. subterraneus* and *B. hortorum* appeared to be confined to the eastern side of the main divide south of Balcairn, NC. During the following decades bumble bees were moved to several new areas (Gurr 1972, Macfarlane & Gurr 1995). Macfarlane & Gurr (1995) reported on their observations

on the identity of over 28,000 bumble bees on over 300 species of flowers throughout New Zealand, and their examination of 707 specimens from 17 insect collections. The same 4 species were present as reported by Gurr (1957), but the range of *B. hortorum* had greatly increased.

Honey bees were first successfully imported to New Zealand from England when 2 straw hives were taken to Mangungu in Hokianga, ND, North Island, on 18 March 1839, by Miss Mary Anna Bumby (Barrett 1996). Because the bees were from England, they would have been the so-called English 'brown bee', *A. m. mellifera*. This subspecies is also found on the European continent north of the Italian Alps, where it is often called the black bee. The first bees to reach the South Island were imported from Australia to Nelson, NN on 18 April 1842 by Dr Imlay. According to Barrett (1996), honey bees were first established in Australia when hives from England were landed at Port Jackson on 9 March 1822. Other importations to Australia, all from England, were made between then and 1842, so the first bees that were imported to the South Island were also *A. m. mellifera*. Barrett (1996) relates reports of a number of subsequent importations of bees to New Zealand from many areas of the world. Some introductions were of colonies, but later importations were of queens with and without attendant workers. One of the most important was the introduction of 2 colonies of the yellow Italian subspecies *A. m. ligustica* from Los Angeles County, California, 1 to Coromandel, CL and the other to Christchurch, MC, in September 1880. Also, more recently, some feral colonies may have reached New Zealand in shipping containers. Yanke (2005) detailed the legal importation in 1988 and 1989 of small amounts of Italian-type semen from Western Australia, and in 2004, 2 importations of semen of the Carniolan bee, *A. m. carnica*, from Germany and Austria.

Soon after their introduction, honey bees began to thrive, due to the temperate climate, the absence of most natural enemies, and the abundance of both native and introduced nectar- and pollen-bearing flowers. Cotton (1848) reported that a 10-fold increase in hives could be expected, and a swarm and its offspring during 4 years yielded 983 kg of honey. Swarms that escaped from managed hives colonised the environment, so that soon honey bees could be expected almost throughout the vegetated areas of the country. Today, many North Island colonies both wild and managed, are being killed by the mite *Varroa destructor* Anderson & Trueman, and the discovery of the mite in beehives at Nelson NN in June 2006 means that many South Island colonies will die.

### Biology of native bees

Meyer (1931), with his sketch of a nest of *Prosopis*

*laevigata*, was the first to illustrate a nest of a New Zealand bee. The nest had been sent to him from Nelson by E. S. Gourlay. The first substantive description of the biology of an endemic New Zealand bee was that of Raymond Hansen in Rayment (1935). Mr Hansen outlined the biology and nest structure of a species identified by Tarlton Rayment as *Paracolletes boltoni* (but see 'Remarks' in the treatment of *Leioproctus paahaumaa*). Specimens of both adults and immatures from Orini, Taupiri, WO, were sent by Mr Hansen to Tarlton Rayment in Australia, who illustrated larvae and pupae and parts thereof, and pollen grains from the larval food. Tarlton Rayment also includes a description by Mr E. S. Gourlay of the activity of *Paracolletes metallicus* at a nest site in sand dunes at Tahuna(nui) near Nelson, NN.

In 1967 I completed an MSc thesis on the bionomics of *Leioproctus boltoni* at Island Bay Road, Auckland, AK (Donovan unpublished). Subsequent study showed that several closely related species of bees were involved. Since then I have published a number of papers on both native and introduced bees, either alone or with co-authors. Primary amongst these, which present most details of the biology of endemic bees, are Donovan (1980) on the interactions of native and introduced bees, Donovan (1983a) on the comparative biogeography of the Apoidea of New Zealand and New Caledonia, and Donovan & Macfarlane (1984) on bees and pollination. These papers reported that on the basis of their flower visiting preferences, most Colletinae could be divided into three groups: those that visited Compositae (= Asteraceae), Leguminosae (= Fabaceae), or Myrtaceae. During this period Quinn (1984) surveyed the native bees in the Mackenzie Basin, MK, in the inland South Island. Some species were abundant, with an estimated 840,000 nests of *Leioproctus fulvescens* along 6.5 km of a little-used unsealed road.

### Botanical view of native bees as pollinators

From the plant pollination point of view, until recently native bees were not mentioned (e.g., Cheesman 1873, 1875, 1877, 1878, 1880, Thomson 1879, 1881a), or were only occasionally mentioned (e.g., Thomson 1881b, 1927, Heine 1937, Garnock-Jones 1976, Godley 1979, Primack 1979, Bocher & Philipp 1985, Webb 1985). However, Primack (1978, 1983) reported tremendous numbers of *Lasioglossum sordidum* foraging on *Discaria* flowers, great numbers of *Leioproctus* and *Hylaeus* on flowering manuka, and abundant native bees on a wide range of mountain flora, and Webb (1994) found that *Lasioglossum sordidum* appeared to be an effective pollinator of *Corokia contoneaster*. Dugdale (1975) reported an observation by Dr E. J. Godley of small bees prising open the appressed

corolla lobes of Loranthaceae, and of his own observations of similar bees doing the same thing to unexpanded flowers on racemes of *Hebe gracillima*. Godley (1979) identified the Loranthaceae as *Elytranthe flavida* (now *Alepis flavida*) and the bees as *Prosopis agilis*. Kelly *et al.* (1996) found the same bee (as *Hylaeus agilis*) opening flowers of *Peraxilla tetrapetala*. They further found that fruit set was increased above that in unopened buds. The female *Leioproctus* photographed by Robertson *et al.* (2005) on a *P. tetrapetala* flower which it has just partially opened is probably *L. pango*.

## EVOLUTIONARY RELATIONSHIPS AMONG ENDEMIC BEES

### *Leioproctus* (*Leioproctus*)

Morphologically there is little variation among the 11 species, apart from *L. otautahi*, and nothing to suggest which species, if any, may have given rise to the others. Indeed, the lack of morphological differentiation has led to a great deal of reliance on the differences in colour of various areas of the vestiture for species discrimination. The lack of morphological variation is particularly marked between males of *L. boltoni*, *L. huakiwi*, *L. kanapuu*, and *L. metallicus*, which makes identification of old males particularly difficult when vestiture is worn away. However, several features shared by one or more species are indicative of close relationships. The overall similarity between *L. boltoni* and *L. kanapuu*, apart from the lack of punctuation of the clypeus of *L. kanapuu*, and the more restricted distribution of the latter, suggests it may have originated from *L. boltoni*. Some large females of *L. pango* from HB are very similar to small *L. boltoni*, which may be indicative of a recent divergence. The variation in the sculpturing of the propodeal triangle of females and the form of the apical lobes of the 7<sup>th</sup> metasomal sternum of male *L. pango* in different geographical regions suggests this widespread species may either already have diverged into several closely related cryptic species, or is in the process of doing so. The similarity of the 'dented' clypeus of female *L. imitatus* and *L. metallicus*, and the possession by both of white scopal hairs indicates a sister-group relationship between these 2 species; however, the facial vestiture of young males is quite different, with that of *L. imitatus* short, dense, and orange, but longer, not dense and white, in *L. metallicus*. Another sister group is that of *L. purpureus* and *L. vestitus*, which both possess a 'bow wave' appearance to their clypeal vestiture, and the overall structure of the clypeus with a median vertical ridge flanked by large punctures is common to both. On the other hand, the pygidial plates of *L. metallicus* and *L.*

*purpureus* are both similarly very broad basally and irregularly ridged longitudinally, and that of *L. vestitus* less so, but these similarities may be due to their nesting in sand, where convergent evolutionary forces may have selected for a similar form best suited to the excavation of sand grains from tunnels of nests. The general appearance of the face of female *L. keehua* and *L. waipounamu* is similar, in that the clypeus of both is rather smoothly rounded from side to side, and is shiny, and for males the gonostyli of the genital capsule in dorsal and ventral views are similarly incurved. The restriction of *L. keehua* to saline estuarine habitats suggests a possible origin from the much more widespread *L. waipounamu*.

The single male *L. otautahi* fits into this subgenus using the key of Michener (2000), yet it possesses several characters not shared with the other 10 species, nor with the 7 species of *L. (Nesocolletes)*. The light tessellation throughout the clypeus, the golden yellow-orange of the tegulae and wing veins out to about 1 tegular diameter (apart from a slight similarity in this character of some male *L. vestitus*), and the narrow, widely divergent apical lobes of the 7<sup>th</sup> metasomal sternum, are possibly sufficiently different to suggest *L. otautahi* should be placed in a third subgenus. The occurrence of just one specimen might suggest the bee originated in Australia and was found here through an incursion into New Zealand perhaps by shipping or aircraft, and perhaps from an as yet undescribed species in a new subgenus (see comments under species treatment). There is also a possibility that the specimen was collected in Australia and was incorrectly labelled. However the collector, E. S. Gourlay, was an entomologist of long-standing, so this seems unlikely. These issues cannot be resolved until further specimens become known, particularly females.

### *Leioproctus* (*Nesocolletes*)

According to Michener (2000), *L. (Nesocolletes)* is unique to New Zealand, and is the only subgenus of the 32 subgenera with a long malar space, apart from the quite different South American *L. (Torocolletes)*, which has 2 species. Michener (2000) states that *L. (Nesocolletes)* is related to *Leioproctus* proper, and more specifically to the *metallicus* group. He also says that some undescribed Australian species of *Leioproctus* *sensu stricto* also have elongate malar areas, but in other characters they are unlike both *L. (Nesocolletes)* and *L. (Torocolletes)*. It is interesting that 1 male *L. (Leioproctus) vestitus* from Blue Stream, Tasman Valley, MK, has the malar space half as long again as normal, and 5 other males from the same site have the malar space twice as long as normal. This suggests quite some flexibility in this character even among New Zealand bees, so *L. (Nesocolletes)* could have origi-

nated from Australian or New Zealand *L. (Leioproctus)*.

Three species of *L. (Nesocolletes)* are clearly closely related by overall similarities of morphology, and in particular by the unique very small size and quadrate form of the apical lobes of the 7<sup>th</sup> metasomal sternum of the males. These are: *L. fulvescens*, which is abundant over much of the South Island and is known from Stewart Island, *L. nunui*, of which only 6 specimens are known, all from the Awatere Valley, KA at the northern end of the South Island, and *L. paahaumaa*, which is common over the North Island. The overall orange-yellow vestiture of *L. fulvescens* is unique among all New Zealand *Leioproctus*, but interestingly *L. paahaumaa* shows a little of the same colour on the mesosoma, while much more is displayed on *L. nunui*. Another character indicative of a close similarity between *L. fulvescens* and *L. paahaumaa* is that both forage primarily on Asteraceae, and *L. nunui* has been captured both on Asteraceae and on Myrtaceae, although numbers are very small. The malar space of *L. nunui* is less than half as long as that of *L. paahaumaa*, which in turn is somewhat shorter than that of *L. fulvescens*. One interpretation of these factors is that *L. fulvescens* and *L. paahaumaa* evolved from a common ancestor, perhaps as a result of geographical separation after the formation of Cook Strait, and that *L. nunui* has evolved following an incursion of *L. paahaumaa* across Cook Strait into the northern end of the South Island. If this is true, then the more orange-yellow of the vestiture of *L. nunui* compared with that of *L. paahaumaa* may be due to whatever environmental factors that selected the orange-yellow of *L. fulvescens* acting similarly on *L. nunui*.

The short malar space of *L. nunui*, a species whose characters otherwise clearly categorise it in *L. (Nesocolletes)*, indicates that the length of the malar space can be a flexible character of the subgenus. Thus *L. maritimus* which has a short malar space can, due to the possession of a declivous propodeal triangle, the possession of a well-developed metabasitarsal scopa, a peaked supraclipeus on females, and some development of a pseudopygidium in males, be regarded as a legitimate member of *L. (Nesocolletes)*. Conversely, despite the lack of a metabasitarsal scopa and the presence of an elongate rounded supraclipeus in females, the long malar space, declivous propodeal triangle, and in males an incipient pseudopygidium, place *L. monticola* in (*Nesocolletes*). However, there appear to be no obvious characters that might suggest the direction of evolutionary relationships between and/or among the 3 obviously related species discussed above and *L. hudsoni*, *L. maritimus*, *L. monticola*, and *L. pekanui*. On the other hand, the form of the apical lobes of the 7<sup>th</sup> metasomal sternum of the males

of these 4 species is more like that of the males of *L. (Leioproctus)* (excluding *L. otautahi*) than are the very small apical lobes of *L. fulvescens*, *L. nunui*, and *L. paahaumaa*, which suggests that these latter 3 species are more derived than are the former 4 species.

### ***Hylaeus (Prosopisteron)***

On the basis of the form of the apex of the 8<sup>th</sup> metasomal sternum of males, the 6 endemic species can be divided into 2 groups: *H. agilis* and *H. capitosus* with the apex rounded, and *H. kermadecensis*, *H. matamoko*, *H. murihiku*, and *H. relegatus* with the apex bifid. Males of the first 2 species also are without any development of ridges or tubercles on metasomal sterna, whereas at least some specimens of all the species in the second group show some development of this character. In the second group, *H. kermadecensis*, which is restricted to the Kermadec Islands, generally appears to be quite similar to *H. relegatus*, which is widespread throughout the 3 main islands of New Zealand, and also the Chatham Islands and the Three Kings Islands. Possibly a dispersion event of an ancestral species followed by isolation of the bees on the Kermadec Islands has resulted in divergence into 2 species. The comparatively restricted distributions of *H. matamoko* and *H. murihiku* in the South Island may also indicate the isolation of parts of the same ancestral stock in different regions of the South Island.

However, the form of the apex of the 8<sup>th</sup> metasomal sternum of males, and the presence or absence of ridges or tubercles on metasomal sterna are not correlated; the adventive *H. asperithorax* has a bifid apex, but no ridges or tubercles, and *H. perhumilis* has a bifid apex, and sometimes paired tubercles. It is possible that ridges and/or tubercles are more a function of the size of males, rather than a character determined by genetics.

### ***Lasioglossum (Austrevylaeus)***

According to Dr K. L. Walker (pers. comm. March 2004), Australian and New Zealand species of *Austrevylaeus* share characters in common. This suggests the New Zealand species could have originated from more than 1 incursion of more than 1 species from Australia. However, *L. sordidum* is widespread and common over the 3 main islands and also 3 smaller islands, while *L. mataroa* and *L. maunga* are restricted, or are nearly restricted, to parts of the South Island, raising the possibility that these latter 2 species have originated from isolated populations of *L. sordidum*.

## LIFE CYCLES

All bees in New Zealand consume pollen and nectar, or processed materials derived from pollen and nectar. Pollen is the primary source of protein, and nectar is the source of sugars. Honeydew, which is a sugary secretion of a number of sap-feeding insects, may also be consumed by some bees. All collection of pollen and nectar is undertaken by female bees, or in the case of social species, worker bees, which are genetically female. Male bees spend all their time seeking to mate, feeding or being fed, and resting. They play no part in foraging for the nest, nest construction, tending brood, or nest defence. However, male *Anthidium manicatum* drive other flower-visiting insects from patches of bloom, which makes more pollen and nectar available for collection by female *A. manicatum*. Although the life cycle of all non-parasitic bees is broadly similar because of the reliance on pollen and nectar, there are wide differences both within and between species in the different families.

All bees construct a nest within which their young are raised. For solitary species and native, partly social species, a nest consists of a blind tunnel that female bees excavate in soil, or a pre-existing, blind tunnel in plant material such as dead branches and stems. The introduced, partly social bumble bees, and the social honey bee occupy much larger spaces such as abandoned rodent nests, or large hollow trees and sometimes cavities in cliffs. All bee nests contain cells, within which larvae are raised, and for bumble bees and the honey bee, food surplus to immediate requirements is stored. The cells of solitary bees, and partly social native bees, are individual chambers that are excavated in the soil either terminally from tunnels, or off the sides of tunnels, or are built in tunnels in plant material where they lie end-to-end in the tunnel, or for *Anthidium manicatum*, are rather jumbled in a mass of plant fibres in larger blind cavities. For bumble bees and the honey bee, the cells are separate but adjacent (bumble bees), or are completely integrated into combs (honey bee).

Solitary and partly social native bees mass-provision their cells with all the pollen and nectar their larvae will need, an egg is deposited on the food, and the cell is sealed, so there is no contact with the remainder of the nest until the new bee emerges. Bumble bees and the honey bee, however, feed their larvae progressively, so the cells are not sealed until the larvae have reached full size.

### Colletidae

The Colletidae are often considered to be one of the most primitive families of bees (Michener 2000). The life cycle is annual, with females and males emerging in spring/early

summer, nest construction occurring until mid-late summer, adults dying by autumn, and prepupae surviving the autumn and winter.

Female Colletinae range in size from about 1/3 the size of a worker honey bee, to about as large. They are quite stout and densely covered in vestiture, and pollen is carried externally primarily in scopae on the metalegs. Males are generally a little smaller and slimmer than females of the same species. Females excavate nesting tunnels and cells in bare or near-bare ground, such as cliff faces, silt in river beds, and ocean beaches from beyond high tide level to the line of dense vegetation. The substrate must be dry and free draining, although nests in river beds and near the high tide level on beaches can survive inundation for at least several hours. Tunnels that have been examined have always been at least partly filled with loose soil, through which bees have to dig to exit and return to a cell. In flat ground tunnels always slope well away from the vertical. The cells are lined with cellophane-like material, and occur singly at the end of individual tunnels. During the period of adult nesting activity, nest entrances are frequently surrounded by a tumulus of excavated soil particles up to about 10 mm high and 30–40 mm across. Nests are usually aggregated, so hundreds or even thousands may occur within a few square metres, even though other areas of ground without nests appear similar or even identical to the occupied area.

Females forage primarily on native Asteraceae, Myrtaceae, and Fabaceae, with some bee species restricted to just a few species in one family. However, some species have adapted to introduced plants such as kiwifruit (Actinidiaceae), onions (Alliaceae), some Asteraceae, and many others, on which they are now found foraging in large numbers.

Female Hylaeinae carry pollen internally, and both sexes are relatively naked compared with Colletinae. The lack of vestiture makes many Hylaeinae appear rather slim, much like some sphecoid wasps, although *Hyleoides concinna*, which is quite stout, was first described as a vespidae wasp. Adults range in size from just a few mm long to longer than a worker honey bee. Nests are constructed in hollow plant material, such as tunnels and cavities made and abandoned by other insects, and pith cavities. The tunnels are cleaned out and filled with cells with walls of a cellophane-like material which is painted on by the mother bee. As with Colletinae, there appears to be just one generation per year, with species surviving the winter as prepupae, although it seems new nests exposed to the sun may produce adult bees that same year. In addition to foraging on native flowering species, several species of Hylaeinae forage on introduced flowering species such as kiwifruit, Rosaceae, and others.

Little is known of Euryglossinae in New Zealand, but the life cycle is probably much like that of Hylaeinae. Adults have emerged from insect tunnels in kanuka (*Kunzea ericoides*), and have been captured on wood infested with the borer *Anobium punctatum*.

### Halictidae

New Zealand Halictidae are all ground-nesters, so in this respect are similar to the Colletinae. However, the development of a form of social nesting and multivoltinism, at least in *Lasioglossum sordidum*, are major distinguishing features.

The Nomiinae are represented by the alkali bee *Nomia melanderi*, introduced as a specialist, manageable pollinator of lucerne seed crops. Females are about the size of worker honey bees and males are a little larger, and are readily distinguishable by the presence of 3–5 prominent transverse yellow/green bands on the metasomal terga. Females carry pollen in scopae on the tibiae of the metathoracic legs. Prepupae survive the winter in cells in moist soil, and adults begin emerging in early summer. After mating, females may renest in an old tunnel, or may excavate a new tunnel. Tunnels are made only in fine-grained soil that is moist from below right to the surface. The only soils of this type that occur naturally in New Zealand are saline, and so show salt at the surface in dry weather. Nests are aggregated, even where areas of suitable soils are extensive. In contrast to the sloping, partly filled tunnels of Colletinae, tunnels of *N. melanderi* are vertical or near-vertical, and are clear to the cells, which are 100–400 mm below the surface. The species is primarily univoltine, but there can be a small second generation late in summer when the summer has been hot. Females forage mainly on introduced legumes and composites.

The Halictinae are about 1/2–1/3 as long as worker honey bees, but appear much less stout. Pollen is carried primarily in scopae on the metathoracic legs, but also laterally in scopae on the propodeum. An outline of the life cycle is known for only one species, *Lasioglossum sordidum*, but that of other species is almost certainly similar. Fertilised females overwinter in nest tunnels in the ground. The first bees of the new season begin emerging soon after the soil starts warming, which can be as early as late winter, and several females may carry pollen into the same nest. It appears that females may renest in the tunnel within which they have overwintered, or they may initiate new nests. New females and males begin appearing by late spring. Nests are aggregated and, as with Colletinae, there can be many hundreds or thousands in a small area. Because of their long nesting period, Halictinae forage on a very wide range of flowering plant species both native and introduced.

### Megachilidae

The red clover mason bee *Osmia coerulescens* was imported to be developed as a specialist, manageable pollinator for red clover seed crops, and the lucerne leafcutting bee *Megachile rotundata* similarly for lucerne seed crops.

Adults are about 2/3 the size of worker honey bees, and females carry pollen in a scopa on the ventral aspect of the metasoma. Both species nest in blind tunnels in plant material, which in nature are abandoned tunnels of insect larvae, pith cavities in twigs and stems, suitable cracks in dead tree trunks, and gaps between peeling bark and tree trunks. Cell partitions and the nest plug partitions of the red clover mason bee are made of chewed leaf material, whereas the lucerne leafcutting bee uses cut leaf pieces for its cells, and for the nest plug. The red clover mason bees overwinter as adults in cells, and the lucerne leafcutting bees overwinter as prepupae in cells. Adults begin emerging in late spring, and after mating, females clean out a suitable tunnel, and a series of cells is constructed end to end. As with the Hylaeinae, each cell is mass-provisioned. If a nest is constructed in early summer, a second generation of adults may emerge and renest in late summer, but cells made after early summer do not show emergence until the following season. The population of red clover mason bees is very small, and so far females have been observed foraging only on introduced legumes. Leafcutting bees forage primarily on introduced pasture legumes and composites, but some native legumes are also attractive.

Females of the very recently discovered adventive wool-carder bee, *Anthidium manicatum*, are a little larger than female red clover mason bees and lucerne leafcutting bees, but males range in size from just bigger than females to as large as small bumble bees. Based mainly on the species life cycle elsewhere, in New Zealand there are likely to be 2 generations from spring to autumn, and females will probably forage primarily on flowers of some introduced plants. Pollen is carried in a scopa on the ventral aspect of the metasoma, and cells made within plant fibres are mass-provisioned. The only nest as yet known from New Zealand consisted of 5 cells and 30 cocoons in a golfball-sized mass of plant fibres in an irregular cavity in an aluminium window-frame.

### Apidae

The 4 species of Bombini were imported to improve the pollination rates and thereby the seed yield of imported red clover, whereas the single species of Apini, the honey bee, was imported for honey production. All 5 species have 2 usually quite distinct female castes of queens and workers, in addition to males or drones. Female bumble bees and worker honey bees carry pollen in pollen 'baskets' or corbiculae on the metatibiae. The bumble bees are

primitively eusocial, with from 1 to about a few hundred individuals living in specially constructed nests of irregularly arranged waxen cells, whereas the honey bee is highly eusocial, with many thousands of bees living intimately in precisely constructed waxen combs, each comprised of thousands of hexagonal cells.

Bombini are probably the bees that are most readily recognised by the bulk of people. All are from about honey bee size to several times larger, and are stout and densely hairy, with the vestiture arranged in black, yellow, orange-yellow, or lemon-yellow transverse bands, or black and yellow-green, and they fly with a loud buzz. Most fertilised queens of all 4 species pass the winter in small cavities excavated in the ground. Rising spring temperatures stimulate the queens to emerge, and after feeding following their long fast, they begin to search for a dry, sheltered cavity such as an abandoned mouse or rat nest, within which to begin constructing a nest. Queens carry pollen and nectar into a cavity, where over the next 4–5 weeks several dozen worker bees are raised. After a number of workers have emerged, the queen confines her duties to ovipositing, whereas the workers collect all food, tend the larvae, and defend the growing nest. Within about 2 months from the foundation of the colony, drones begin emerging, followed soon after by new queens. Mating occurs outdoors, after which new queens disperse, with some founding new colonies that same summer, and others entering hibernation for the winter. By early-mid summer colonies may number up to a couple of hundred workers, but after producing as many as 100 or more new queens, the old queen, the workers, and any straggling drones all die by late summer. Some queens, workers, and drones of at least 2 species may be on the wing throughout the winter, as the variable New Zealand climate can sometimes upset the nesting cycle.

*Apis* is represented by the honey bee, *Apis mellifera*. Colonies are perennial. During the winter they consist of one fertilised queen, and up to about 20,000 worker bees. By late spring/early summer, the worker population increases to 50–80,000, and several hundred to several thousand drones may also be present. Colonies reproduce by swarming, when up to several tens of thousands worker bees abandon the colony, accompanied by the old queen and a number of drones. They leave behind about half the workers and drones, all the developing brood, stores of honey and pollen, and up to several dozen new queens, which are developing in special queen cells. Sometimes secondary swarms will issue forth, each with a new, virgin queen and a diminishing number of workers and drones. Finally, one new queen leaves the hive alone, and after mating, returns to head the old colony.

Swarms seek out a new cavity such as a dry hollow tree, in which new honey combs will be constructed.

Because adult bees survive the winter in an active state, large quantities of honey and pollen must be stored during summer so there is sufficient food available not only for the winter, but the early spring when inclement weather often limits foraging, and the numbers of larvae are increasing rapidly.

Honey bees possess a ‘language’ that allows the transference between workers of information in a symbolic form about the distance and direction of foraging resources from the colony, and potential nesting sites for a swarm.

## ECONOMIC VALUE

### Native bees

A survey of the insect visitors to flowers of kiwifruit *Actinidia deliciosa* (A. Chev.) C.F. Liang et A.R. Ferguson at 54 orchards in 1980 and 1981, found up to 7 species of *Leioproctus*, several species of *Hylaeus*, and *Lasioglossum sordidum*. *Leioproctus* spp. were present at 30% of sites, and on a per-bee basis were ranked third most effective at transferring pollen after bumble bees and honey bees. *Leioproctus* spp. were sufficiently numerous in some orchards to reduce the number of honey bee hives needed per hectare (Macfarlane & Ferguson 1983). Some growers from most of the kiwifruit-growing regions reported similar numbers. Female bees caught on female flowers carried up to half a million male pollen grains on their bodies, a number comparable to that carried by bumble bees and honey bees. Comparative numbers for *Hylaeus* spp. were 500, and for *Lasioglossum sordidum*, 5,000. At Manutuke, GB, Donovan (1987) caught 100 *Leioproctus* spp. on or over 1 flowering male vine in 80 minutes. The bees were so numerous that a low hum was audible throughout the 1.5 ha vineyard.

The economic value of native bees as pollinators of kiwifruit has not been determined. The net return for the kiwifruit crop for the 2002/03 financial year was \$860 million (J. Lancaster, Zespri Innovation Ltd., pers. comm.). If native bees were responsible for pollinating just a small percentage of flowers, their value would run into the several millions of dollars annually.

Native bees sometimes forage in large numbers on a number of other crops of economic value, such as some Rosaceae (pers. obs.), onion seed crops (Howlett *et al.* 2005), brassica seed crops (B. Howlett pers. comm. and pers. obs.), and chestnuts and avocados (pers. obs.), but their efficacy as pollinators is as yet unknown.

Some species of *Leioproctus* will excavate nests in dirt driveways, sparse domestic lawns, fairways of golf courses, and children’s play areas. The nests can sometimes become sufficiently numerous to prompt efforts to eliminate them. However, when assured that

the bees are not causing damage and that the nests will disappear in a few weeks (only to reappear next year), the affected parties are usually mollified and the bees are let be.

### Introduced bees

There are no reports of benefits or damage for the adventive species.

By the late 1980s alkali bees were readily observable pollinating lucerne flowers near Blenheim, MB, and substantial increases in seed yields were resulting from the managed use of lucerne leafcutting bees (Donovan & Read 1988a). Several hundred thousand leafcutting bee cells had also been exported to Australia. However, following the dissolution of the Department of Scientific and Industrial Research on 30 June 1992, day-to-day contact with and tutoring of bee owners ceased, with a consequent collapse of bee numbers, and a slump in pollination of lucerne seed crops. But, by winter 2006 there were 175,000 managed leafcutting bee prepupae in cool storage, and during summer bees were again being used to pollinate a lucerne seed crop.

After summer 2005, the total number of managed *Osmia coerulescens* was about 900, which was still far too few to impact positively on the yield of red clover seed.

A short time after the 4 species of bumble bees were introduced from England in 1885 and 1906, expressly to improve the pollination of red clover, large increases in seed yields were recorded (Hopkins 1914). For the 2001/2002 season, 989 ha of red clover were projected to be harvested (Anon. 2002), but there is no information as to the overall value of bumble bees as pollinators. However, Donovan (2001) calculated the mean value of tetraploid red clover seed per colony resulting from pollination by 14 colonies of *Bombus hortorum* moved to red clover seed crops, to be \$999.02.

Bumble bees, and especially *Bombus terrestris* on a bee-for-bee basis, are probably the most effective pollinators of a wide range of crops and especially kiwifruit, because their large very hairy bodies carry great numbers of pollen grains. Also, bumble bees are on the wing when low temperatures and adverse weather prevent flight by other species of bees. Colonies of *B. terrestris* are raised under controlled conditions and have been used throughout New Zealand since the early 1990s to pollinate glasshouse tomatoes and several other glasshouse crops. For about 20 years, up to several score colonies of the long-tongued species *B. hortorum* and a few *B. ruderatus* have been field trap-nested and sold to red clover growers for pollination of seed crops. Queen *B. terrestris* and *B. ruderatus* are exported, primarily to Europe, for the production of colonies for pollination of glasshouse crops.

The honey bee was introduced in 1839 for honey production, and at the end of June 2006 there were 2,911 registered beekeepers keeping 294,886 beehives. The honey crop for the last 6 years averaged 8,806 t. The honey crop for 2003 was a record high of 12,252 t (which followed a record low of 4,682 t for 2002) (Anon. 2003), and at an estimated return to the beekeeper of \$3/kg for honey, would have been worth \$36,756,000.00. Much additional revenue accrues from other products such as pollen, wax, royal jelly, propolis, and venom, and sales both within the country and overseas of package and queen bees and hive parts. Services such as crop pollination and tourism return substantial sums. The total income to beekeepers for hive products and pollination services has been assessed as \$48.2 million (Anon. 1994a). However, the main value of honey bees results from their pollination of seed and fruit crops. The annual replacement nitrogen fixed into pastures by honey bee-pollinated legumes has been valued at \$1,872.4 million, fruit crops at \$1,004.8 million, and vegetables and seeds at \$211.3 million (total \$3,088.5 million) (C. van Eaton in Anon. 1994b).

Most species of bees visit and presumably pollinate some plants that are regarded as weeds. A review of available information on reproductive strategies of weeds in protected natural areas concluded that 43% are visited by honey bees, and although honey bees may be important pollinators of some weeds, they probably do not contribute substantially to weed problems (Butz Huryn & Moller 1995).

Bumble bees and the honey bee sometimes occupy compost heaps (bumble bees) and cavities in houses and other buildings (bumble bees and the honey bee) from which people wish them to be removed. Removal is usually undertaken by professional pest controllers, and/or for honey bees, by amateur beekeepers.

## HUMAN HEALTH

Female bees of all species possess a sting. All native bees and the adventive, solitary bees are non-aggressive towards humans, but at least some species will sting if trapped against the skin, for example by clothing. These bees seem to be able to readily withdraw their stings and sting again, and perhaps sting several times. From personal experience and from those half dozen or so subjects I have observed being stung, the maximum pain seemed to be much less than that from a honey bee sting, and skin reactions ranged from a slight reddening a few millimetres around the sting insertion site, to irregular reddening and swelling out to several centimetres.

Bumble bees are non-aggressive when foraging. Several thousand colonies of *B. hortorum* and a few score each of *B. ruderatus* and *B. subterraneus* have been handled by



more than a dozen people over the last 35 years, but only a few stings have been inflicted by the first 2 species when accidentally pressed against the skin. Most reactions were minor, but several people experienced some localised swelling, and dizziness and nausea. Worker *B. terrestris* can be very aggressive when nests are disturbed, and many people have suffered painful stings. Most reactions have been similar to those from the other species of bumble bees, but there is 1 report of anaphylactic shock including a strong cardiac reaction from 2 stings (Donovan 1978).

Worker honey bees inflict stings on many thousands of the general public annually. Foraging bees are rarely aggressive, and if disturbed usually simply fly off. Most stings result from accidental contact by people with bees in such a manner that the bees may be squashed, for example by a foot, which triggers a stinging reflex as a natural self-defence mechanism. Bees will defend their hive and the vicinity of the hive. Intrusion of people into the flight path of foragers near a hive may trigger a stinging response from a number of bees. Direct disturbance of a bee colony or its immediate surroundings will usually result in mass attack by up to many hundreds of very aggressive bees. Beekeepers are stung regularly because of their direct contact with bees as hives are manipulated.

Reactions by people to stings range from localised pain at the sting site, which usually disappears within a few minutes, and which may be followed by slight localised reddening and swelling, to anaphylactic shock and possibly death. Annually, numerous people seek medical treatment and a number are hospitalised. From July 2001 to November 2003, the Accident Compensation Corporation received claims from 13,133 people for losses caused by honey bee stings, for which it paid out \$662,349.00 (Julie McBurney, ACC Communications Manager, pers. comm.) The number of deaths is uncertain as there are no separate statistics for bee stings as a cause of death (Rebecca Kay, New Zealand Health Information Service, pers. comm.), but the frequency of deaths reported by the news media suggests a death occurs about every several years. Many thousands of people who are known to be allergic to bee stings carry pre-loaded adrenaline syringes that can be used immediately after a sting is received. Bees entering vehicles through open windows may also be implicated as the cause of some vehicle crashes, through either stinging the drivers, and/or causing distracting fear to drivers. From the human health aspect, honey bees are the most venomous animals in New Zealand.

On the other hand, recent research has shown that honey has medicinal properties, such as the ability to control some bacteria which are resistant to many antiseptics. General antibacterial activity in all honeys is

due to the production of hydrogen peroxide (Molan 1999), but some honey produced from some stands of manuka, *Leptospermum scoparium*, possesses a non-hydrogen peroxide 'unique manuka factor' (UMF), that is an even more powerful antibacterial agent (Molan 2001). Manuka honey with a high UMF can fetch the beekeeper around \$30/kg, and is sold on as a medicine rather than as a food.

## ENVIRONMENTAL IMPACTS OF INTRODUCED BEES

Whether imported bees, and especially the honey bee, are impacting adversely on native bees because of possible competition for similar resources such as pollen and nectar, was examined by Donovan (1980). Although there is overlap in flower-visiting preferences, peak native bee foraging occurs during the 'honey flow' when pollen and nectar are abundant. It was concluded (in the absence of specific data) that many of man's activities such as the destruction of native flora, the introduction of new flowers, and unintentional creation of nest sites have probably had more impact on native bees, both positive and negative, than competition from introduced bees, and that because some native bee species have the ability to outnumber honey bees and bumble bees after about 140 years of contact (now 167 years for honey bees) they are enjoying considerable competitive success.

However, this study has found that 4 species of native bees are known from very few specimens; *Leioproctus otautahi* (1 male), *L. nunui* (2 females, 4 males), *Hylaeus matamoko* (18 females, 3 males), and *H. murihiku* (2 males). As mentioned elsewhere whether *L. otautahi* is truly native is uncertain, but the lack of more specimens since the collection of just a male 46 years ago from Christchurch, MC, where the environment is being increasingly urbanised may indicate the species is extinct. Because *H. murihiku* is known from only 2 specimens from Secretary I., FD, its conservation status must be in doubt, but of course there has been minimal collecting in such a remote locality. More collecting will probably reveal that the remaining 2 species will be more widespread and abundant than known at present. Whether imported bees have impacted adversely on the population size and distribution of these 4 species is unknown.

Since the discovery of the honey bee mite *Varroa destructor* in beehives near Auckland, AK, in early 2000, the whole North Island and Great Barrier Island have been colonised, with anecdotal reports that nearly all feral colonies have been killed, as well as many managed hives. This reduction in the number of foraging honey bees will reduce any competitive pressure on North Island native

bees for pollen and nectar. The discovery of the mite in beehives at Nelson NN in June 2006 means that South Island native bees will soon also benefit. Because the mite is specific to honey bees, it will not impact adversely on other species of bees.

The occurrence in New Zealand of 5 species of bees from Australia: the indigenous *Lasioglossum cognatum*, and the adventive *Hylaeus asperithorax*, *H. perhumilis*, *Hyleoides concinna*, and *Euryglossina proctotrypoides*, and also *Anthidium manicatum* which originated from Europe, suggests that more species of bees are likely to reach New Zealand, despite the efforts of MAF Biosecurity to protect New Zealand from unwanted organisms. Tube-nesting species which might make nests in holes and cracks in packing crates, etc., rather than ground-nesting species, are the most likely candidates for immigration. It is instructive that all 5 adventive species are tube- or cavity-nesters.

Another possible source of new species of bees is the purposeful/deliberate importation of species that are specialist pollinators of certain crops, as suggested by Donovan (1990). However, since the establishment of the Environmental Risk Management Authority, the financial costs of applying for permission to import are so great that there have been no proposals to do so. In the foreseeable future, New Zealand's native bees are therefore unlikely to face competition from purposely imported species of bees.

The possible impact of introduced bees on other native biota has not been considered, but the removal from the native ecosystem of great quantities of pollen, nectar, and honeydew throughout the year by the honey bee in particular must give cause for concern. However, Butz Huryn (1995) found that the few plant species with specialised plant/pollinator relationships are abundant, with the exception of kaka beak *Clianthus puniceus*. Indeed, if honey bees have caused a reduction in some native biota that are pollinators, it is possible they have at least partly replaced them as pollinators. By occupying cavities in trees, honey bees may displace cavity-nesting birds and other organisms.

## DIAGNOSIS OF SUPRASPECIFIC TAXA IN NEW ZEALAND

The following diagnoses for the bees found in New Zealand are based on those of Michener (2000) with modifications relevant to the representatives of the groups present in New Zealand.

### Family Colletidae

Glossa short, commonly broader than long, truncate, bilobed. The labrum is broader than long, with the apical margin fringed with bristles. One subantennal suture ex-

tends from the lower margin of the antennal socket to the upper margin of the clypeus. The propodeal triangle is naked. Forewings with 2 or 3 submarginal cells. Disc of metasomal sternum 7 of males is much reduced, but supports long basolateral apodemes, and 1 or 2 paired apical lobes. All species solitary, but the ground-nesting species usually aggregating into sometimes giant concentrations of nests. Species nesting in plant material do not mine their own tunnels. Cells are lined with cellophane-like film, and provisions are firm to semiliquid, with the egg deposited on the surface.

Subfamily **Colletinae**. Both sexes very hairy, facial integument black, forewings with 3 submarginal cells. Females with well developed scopa on the metatibia, and with a pygidial plate. All species ground-nesting, with cells more or less horizontal, each at the end of a tunnel. Tunnels partly filled with loose soil, and in flat ground are not vertical.

Genus *Leioproctus*. Integument black or nearly so, facial foveae absent, inner hind tibial spur ciliate with the teeth forming an evenly spaced series.

Subgenus *Leioproctus*. Malar space short, propodeal triangle angular in lateral view, metabasitarsus of females with hairs of outer face short, unbranched, supraclypeus of females more rounded up and rounded, than pointed. Males without pseudopygidium, the apical lobes of the 7th metasomal sternum large, rather narrowly attached to the sternum. Jugal lobe of hind wing about 1/2–2/3 as long as vannal lobe, and reaching or nearly reaching vein cu-v (Fig 36b). About 125 species, centred in Australia and nearby islands, with 1 species in Brazil, and 11 species in New Zealand.

Subgenus *Nesocolletes*. Malar space long in 5 species, relatively short in *L. nunui*, and short in *L. maritimus*. Propodeal triangle declivous in lateral view, or very nearly so, metabasitarsus of females with well developed scopa with long, strongly branched hairs on outer face, supraclypeus of females more pointed than rounded and rounded, except *L. monticola* with these 2 characters much as in *L. (Leioproctus)*. Males with moderately to strongly developed pseudopygidium, except males of *L. monticola* and *L. maritimus* with very weak and weak development respectively of pseudopygidial characters, the apical lobes of the 7th metasomal sternum small in *L. fulvescens*, *L. nunui*, and *L. paahaumaa*, broadly attached to the sternum. Jugal lobe of hind wing about 1/2 to much less than 1/2 as long as vannal lobe, not nearly reaching vein cu-v (Fig 36b). Restricted to New Zealand, with 7 species.

Subfamily **Hylaeinae**. Both sexes with few hairs. Faces and some other areas with maculae yellow, pale yellow, or orange. Forewing with 2 submarginal cells. Anterior face of

1st metasomal tergum convex, without longitudinal median groove. Females without scopae, and pollen carried internally, pygidial plate absent. All species nesting in pre-formed blind tunnels in plant material, with cells in a linear series, separated by cellophane-like partitions.

Genus *Hylaeus*. Maculae yellow, or pale yellow, metasoma black. Nest entrance open while nest is being provisioned, and after construction completed closed with cellophane membrane.

Subgenus *Prosopisteron*. 2nd submarginal cell about 1/2 as long as the 1st or less. Apart from small yellow, or pale yellow maculations, body black. About 75 species distributed throughout Australia including Tasmania, New Guinea, and New Zealand, and the Australian *Hylaeus perhumilis* has been taken in southernmost South Africa. 8 species in New Zealand, 2 of which, *H. asperithorax* and *H. perhumilis*, are conspecific with the same species in Australia.

Genus *Hyleoides*. Females with maculae on face and metasomal terga orange, males with facial macula yellow, metasomal tergal maculae orange. 8 species in Australia including Tasmania, 1 of which, *Hyleoides concinna*, is also found in New Zealand.

Subfamily **Euryglossinae**. Both sexes with few hairs. Body black, without maculae. Forewing with 2 submarginal cells. Anterior face of 1st metasomal tergum concave, with longitudinal median groove. Females without scopae, and pollen carried internally, pygidial plate present. Nests constructed in pre-formed tunnels in wood. Distributed in Australia including Tasmania, with 4 species captured in New Caledonia, 1 specimen collected in South Africa, and 1 species established in New Zealand.

Genus *Euryglossina*. Clypeus of females sloping inward at a distinct angle to the supraclypeus. 1st submarginal cell of forewing more than 2× as long as 2nd.

Subgenus *Euryglossina*. Labrum of females without median apical spine. Costal margin of the marginal cell of the forewing about as long as the stigma, and claws simple. About 54 described species and various undescribed species from all Australian states, with 1 specimen collected in South Africa, and 1 species, *Euryglossina proctotrypoides*, established in New Zealand. In New Zealand nests are apparently formed in tunnels in wood made by small beetles.

## Family Halictidae

Glossa acute. Labrum of females with a strong apical process with a dorsal keel, the apical process fringed with coarse bristles. 1 subantennal suture extends from the lower margin of the antennal socket to the upper margin of the clypeus. The propodeal triangle is naked. Forewing with 3

submarginal cells. Females with pollen-carrying scopae on the propodeum and metalegs. Females with or without pseudopygidium on 5th metasomal tergum, and with pygidium on 6th metasomal tergum. Males with a yellow macula on the lower area of the clypeus and metasomal terga black, or clypeus black and metasomal terga 1–5 with bright yellow-green on posterior margins. At least 1 species is solitary and at least 1 species has some form of social organisation. All species are ground-nesting, sometimes forming very large aggregations of nests. Cells are not lined with cellophane-like material, each is at the end of a tunnel or chamber, and cell provisions are firm, with the egg deposited on the surface.

Subfamily **Nomiinae**. Apex of marginal cell of the forewing rounded, and all wing veins strong. Females without obvious pseudopygidium. Metasomal sterna 7 and 8 of males large and distinct. Both sexes with yellow-green metatergal bands.

Genus *Nomia*. Both sexes with yellow-green posterior margins to metasomal terga 1–4 (females) or 1–5 (males).

Subgenus *Acunomia*. Outer hind tibial spur of females sharply bent preapically and preapical tooth minute. Males with large pale extension to metatibia. About 33 species from much of the world except Europe, South America, and Australia. 1 species, *Nomia melanderi*, introduced to New Zealand from its home range in western North America, for pollination of lucerne. Nests are excavated only in saline soils, with a vertical clear tunnel extending to a close cluster of cells, each of which is accessed individually. Provisions are firm, with the egg deposited on the surface.

Subfamily **Halictinae**. Apex of marginal cell of forewing pointed. Females with obvious pseudopygidium. Metasomal sternum 7 of males small and weakly sclerotised, and almost fused to metasomal sternum 8. Both sexes with metaterga black.

Tribe **Halictini**. 3rd submarginal crossvein weak. Male genitalia with retrorse lobe.

Genus *Lasioglossum*. Metasoma oval in cross section. Female with pollen-carrying scopae laterally on the propodeum and on the metalegs.

Subgenus *Austrevylaeus*. 2nd submarginal crossvein in forewing of both sexes weaker than 1st. Inner hind tibial spur of female finely ciliate. Six species have been described from Australia, 13 others are known there, and 3 occur in New Zealand. Nests are excavated in the ground, and cells are at the ends of branch tunnels. Stores are firm, with the egg deposited on top.

Subgenus *Chilalictus*. 2nd submarginal crossvein in forewing of both sexes as strong as 1st. Inner hind tibial spur of female pectinate. Present throughout Australia with

134 species, 1 of which also occurs in New Caledonia, and 1 other of which, *Lasiglossum cognatum*, also occurs in New Zealand. The only nest known in New Zealand was a near horizontal tunnel in a sandstone cliff, with cells on each side.

### Family Megachilidae

Glossa acute, long. Labrum longer than wide. Forewing with 2 submarginal cells. Females with scopa on metasomal sterna, metatibia without scopa. Nests constructed in pre-existing cavities, mostly in plant material, using leaf material or plant hairs. Cells in a linear series, so the first made is at the bottom of the nest tunnel, or in larger cavities, arranged irregularly. Provisions semiliquid, with the egg laid on top.

Subfamily **Megachilinae**. Subantennal suture directed towards outer margin of the antennal socket. The 2 submarginal cells in the forewing of roughly equal length. Sternal scopa strong. Metaleg of females without long hairs. Female mandible with 4 - 6 teeth.

Tribe **Osmiini**. Body metallic blue or brassy. Arolia present. Apex of metasomal tergum 6 of males without teeth.

Genus *Osmia*. Parapsidal line punctiform. Metasomal sternum 2 of males enlarged, covering most of metasomal sternum 3.

Subgenus *Helicosmia*. Females with 4 tufts of orange hairs beneath the clypeal margin. Males with metasomal tergum 7 bidentate. Cell partitions are made of chewed leaf material. 81 species distributed over much of the northern hemisphere. 1 species, *Osmia coerulescens*, introduced into New Zealand from Italy and Yugoslavia as a potential manageable pollinator of tetraploid red clover. Adults overwinter in the natal cells.

Tribe **Anthidiini**. Body with numerous yellow maculae. Arolia absent. Apex of metasomal tergum 7 of males with 3 large spines.

Genus *Anthidium*. Females with small median notch in posterior margin of metasomal tergum 6. Metasomal sternum 8 of males longer than broad.

Subgenus *Anthidium*. Both sexes with yellow transverse bands on metasomal terga broken medially. Females with strong outer ridge on mandible. Males with apex of metasoma curved downwards. Cells embedded in fine plant fibres from leaves and stems. About 75 species distributed over all the continents except Australia, and also absent from the Indo-Malayan tropics. 1 species, *Anthidium manicatum*, originally from Europe, recently adventive in New Zealand from an extended range including towards Siberia, parts of North and South America, and the Canary Islands.

Tribe **Megachilini**. Body black, not metallic. Arolia absent. Apex of metasomal tergum 6 of males with tooth-like projections.

Genus *Megachile*. Females with scopa present on metasomal sterna 2–6, metasoma not tapering throughout its length. Males with posterior lobe of pronotum with weak transverse ridge.

Subgenus *Eutricharaea*. Female mandible with only 1 complete cutting edge, metasomal sterna with white apical fasciae under the scopa. Male mandible with 3 apical teeth and a ventral projection, procoxa with spine, and protarsi not pale and not expanded. Cells are made of pieces of leaf. Well over 236 species recognised from the Palaearctic, African, Oriental, and Australian areas. One species, *Megachile rotundata*, introduced to New Zealand from North America for pollination of lucerne seed crops.

### Family Apidae

Glossa acute, long. Labrum wider than long. Forewing with 3 submarginal cells. Females with corbicula on metatibia, except for parasitic forms and queens of fully social species. Nests constructed in pre-existing cavities. 2 female castes, queen and worker present in nests, with only the queen mated. Nests of multiple cells side-by-side or many nearly so. Larvae fed progressively.

Subfamily **Apinae**. Females without pygidial plate. Integument black to pale yellow, but without maculae.

Tribe **Bombini**. Compound eyes naked. Mandible with teeth and carinae. Hind tibial spurs present, arolia small. Male with genital capsule sclerotised. Cells of nest vertical or nearly so.

Genus *Bombus*. Females with corbicula on metatibia. Both sexes and worker caste with transverse bands of black, lemon yellow, dull yellow, orange-yellow or orange vestiture on body, or vestiture black and yellow-green.

Subgenus *Bombus*. Malar space shortest of bumble bees in New Zealand. Females with corbicular surface of metatibia entirely bare and shining, and clypeus strongly punctured on almost whole surface. Penis valve of male in form of wide sinuate vertical plate. 10 species, ranging over most of the Northern Hemisphere. 1 species, *Bombus terrestris*, introduced to New Zealand from England.

Subgenus *Megabombus*. Malar space and tongue the longest of bumble bees in New Zealand. Females with 1st flagellar segment a little shorter than combined lengths of 2nd and 3rd segments. Males with anterior lower corner of gonostylus produced upward as sharp spike. 14 species ranging over the Old World and also North Africa. 2 species, *Bombus hortorum* and *B. ruderatus*, introduced to New Zealand from England.

Subgenus *Subterraneobombus*. Malar space and tongue length less than that of *Megabombus*, but much more than that of *Bombus* (*Bombus*). Females with inner dorsal apical angle of metatibia sharp. Penis valve of males somewhat hooked inward, with 2 large teeth on outer side. 9 species ranging across the Holarctic. 1 species, *Bombus subterraneus*, introduced to New Zealand.

Tribe **Apini**. Compound eyes hairy. Mandible without teeth and carinae. Hind tibial spurs absent, arolia present. Males with genitalia membranous. Worker and male cells of nest more or less horizontal.

Genus *Apis*. Cells of nest hexagonal, except natal cells of queens acorn-shaped. Colonies permanent, and possessing a dance and odour 'language'. About 11 species, historically found throughout Africa, Europe, Asia, and areas north of Australia, but not Australia, New Zealand, or the New World. One species in New Zealand, *Apis mellifera*, introduced first from England but then other introductions from many areas.

## METHODS

Since 1953 up to a dozen beehives have been managed annually by me for honey production, and until early 1959 the summers were spent working for a commercial beekeeper near Taumarunui, TO. During these years information on many aspects of the biology of honey bees and the apicultural industry in general was accumulated. From September 1966 to September 1969, various species of bees were studied at the University of California, Davis, as part of a Ph.D. in Entomology. My thesis was a revision of the bees of the subgenus *Cnemidandrena* (genus *Andrena*, family Andrenidae), during which many of the techniques used in this revision of the bees of New Zealand were acquired.

Apart from the years away from New Zealand, native bees were collected from late 1964, whenever there was an opportunity to do so. Native bees are on the wing only during mild to warm weather with little wind and are most abundant in sunny conditions, and most species are active only from about mid spring to early autumn. The majority of bees were taken on or over flowers or nest sites with sweepnets, but a small number were tubed directly on flowers or were captured in excavated nests. The largest sustained collection was of 690 females and 805 males, which were captured in emergence traps on a nest site at Island Bay Road, Birkdale AK, from late September 1965 to early January 1966. Each collected specimen was killed in KCN and pinned, and labels were affixed to each pin with the location, the date, the name of the collector, and the name of the flower (if any) with which the collection was associated. A significant number of bees were also

collected by my colleagues at the Canterbury Agriculture and Science Centre, Lincoln, Dr. R. P. Macfarlane, Mr. P. E. C. Read, and Mrs. R. P. Read (nee Griffin).

During this same period, notes were taken on the activity of bees at nest sites, the characteristics of nest sites, and the timing of bee activity both seasonally and temporally. Bee parasitoids were collected both on nest sites and in the field. Trap nests for *Hylaeus* spp. were placed in the field at Halswell and Lincoln, MC, and near Abut Head, WD, and periodically nests were examined for details of construction, aspects of the bees' life cycle, and the occurrence of parasitoids.

From September 1966 to September 1969, the lucerne leafcutting bee *Megachile rotundata*, and the alkali bee *Nomia melanderi* were studied in California and Utah, U.S.A., and during the 1970s both species were imported and established in New Zealand. In California various species of bumble bees were captured in the field, and nests were raised under controlled conditions. Beginning in September 1995, the red clover mason bee *Osmia coerulea* was imported to New Zealand and propagated.

From 1970, nest boxes for bumble bees were placed in the field at about a dozen sites near Blenheim, MB, Canterbury, MC, and the Mackenzie Basin, MK, from which records were obtained of the life cycles of the 4 species of bumble bees and their associated biota.

From 1970, bees were borrowed from collections wherever they were known to be held. The majority were lent by the Otago Museum and were collected by Mr. A. Harris, while Mr. P. Quinn collected many bees in and around the Mackenzie Basin, MK. All types of New Zealand endemic bees, all of which are held in the British Museum (Natural History) were lent to me 2–3 at a time. The collections which lent me their bees (with abbreviations based on those of Watt (1979) and updated were:

AMNZ	Auckland War Memorial Museum, Auckland, New Zealand.
BMNH	British Museum (Natural History), London, U.K.
CGNZ	Dr Chris Green, Henderson, Auckland, New Zealand.
CMNZ	Canterbury Museum, Christchurch, New Zealand.
FRNZ	Forest Research Institute, Rotorua, New Zealand.
LCNZ	Lincoln University, Canterbury, New Zealand.
NMNZ	Museum of New Zealand Te Papa Tongarewa, Wellington, New Zealand.
NMVA	Museum of Victoria, Melbourne, Australia.
NZAC	New Zealand Arthropod Collection, Landcare Research, Auckland, New Zealand.
OMNZ	Otago Museum, Dunedin, New Zealand.
PANZ	MAF N.Z. Plant Protection Centre, Auckland, New Zealand.

PCNZ	National Plant Pest Reference Laboratory, Lincoln, New Zealand.
USNM	United States National Museum of Natural History, Smithsonian Institution, Washington D.C., U.S.A.
UQBA	Department of Entomology, University of Queensland, Brisbane, Australia.
VUNZ	Zoology Department, Victoria University of Wellington, New Zealand.
WAMP	Western Australia Museum, Perth, Western Australia.
WMNZ	Whangarei Museum, Whangarei, New Zealand.

The great majority of borrowed bees were pinned, but those stored in alcohol were pinned by me to dry, because fluids obscure the diagnostic features of the vestiture. Many hundreds of pins that were corroding were replaced. All bees were sorted to species, and all details on labels were recorded on data sheets. In addition, whether females were carrying pollen, and the number of mites on each bee were also recorded.

## TREATMENT OF SPECIES

### Bibliography

For endemic, indigenous, and adventive species except *Anthidium manicatum*, all known references are presented. A colon after the name of the species indicates that the following reference is not an authority for the name. For the adventive *Anthidium manicatum*, and the imported *Nomia melanderi*, *Osmia coerulescens*, and *Megachile rotundata*, the most significant overseas references are given, plus all those known from New Zealand. However, and inevitably, there will be some omissions. Because of the huge volumes of literature on the 4 species of bumble bees and the honey bee, only the most relevant are presented. All references are annotated.

### Measurements

Bees were examined with a Wild binocular microscope fitted with 25×/13× eyepieces, and objectives of 6, 12, 25, and 50×. One eyepiece was fitted with a measuring scale, and the other with a squared graticule. Measurements were multiplied by factors obtained by measuring metric scales through the eyepiece, and are presented as mm. For each species, up to 20 specimens of each sex were selected by eye for measuring, with an effort to choose the smallest and largest, and a representative range of sizes between these two extremes.

### Descriptions of species

Where possible, descriptions are based on young, unworn

specimens. As hairy bees age, vestiture is lost and the colour of the vestiture fades. The general appearance of old specimens, in particular *Leioproctus* and *Bombus*, may therefore differ somewhat from young specimens.

To examine metasomal sterna 7 and 8 and the genital capsules of males, the bees were first relaxed in a humidifier for at least 24 hours. The sterna and genital capsule were then extracted, and were immersed in a solution of NaOH until the soft tissues were dissolved. Drawings of various physical aspects of each species and of the nests of some were prepared in pencil using the squared graticule and measuring scale, and squared drawing paper, and were then inked onto draughting film. Descriptive terms are those used by Michener (2000).

### Variation

Differences that may be displayed by individuals from the whole population of the specimens at hand are presented.

### Type data

For described endemic species all known type data are included. For new species, holotypes, allotypes, and paratypes are designated. New primary types were generally selected from the 20 representative specimens, but if the condition of the specimens was poor, and other specimens were in better condition, types were chosen from them. Where possible, type data include the sex of the type, the location where collected, the date, the name of the collector, the name of associated flowers, and the abbreviation of the name of the host insect collection. The collections are:

AMNH	American Museum of Natural History, New York, U.S.A.
ANIC	Australian National Insect Collection, CSIRO, Canberra, Australia.
ANSP	Academy of Natural Sciences of Philadelphia, U.S.A.
BMNH	British Museum (Natural History), London, U.K.
BPBM	Bernice P. Bishop Museum, Honolulu, Hawaii, U.S.A.
CESR	Citrus Experimental Station, Riverside, California, U.S.A.
CMNZ	Canterbury Museum, Christchurch, New Zealand.
LSL	Linnaean Society, London, U.K.
NZAC	New Zealand Arthropod Collection, Landcare Research, Auckland, New Zealand.
NHRM	Naturhistoriska Riksmuseet, Stockholm, Sweden.
OMNZ	Otago Museum, Dunedin, New Zealand.
USNM	United States National Museum of Natural History, Smithsonian Institution, Washington DC, U.S.A.
ZMC	Zoological Museum of Copenhagen, Denmark.

## Material examined

The number of specimens of each sex is presented, plus an outline of the geographical and seasonal occurrence of the species throughout the country. The distribution of sites where bees were collected is mapped to the system of area codes established by Crosby *et al.* (1976).

## Biology

Altitude and monthly collections are summarised. A 'collection' is the collection of 1 or more bees of the same sex at the same time by the same collector in association with the same flowers (sometimes referred to as a series). The collections indicate when the adults are active, but of course they may well be more a measure of the activity of collectors.

Under **Host plants**, the flowers named on labels attached to pins are presented in tabular format according to the *Flora of New Zealand* Volumes I (Allan 1961), II (Moore & Edgar 1976), III (Healy & Edgar 1980), subsequent name changes (Connor & Edgar 1987), *Flora of New Zealand* Volume IV (Webb, Sykes & Garnock-Jones 1988). Genera are classified into families following the APG system.

For each bee species except the 8 imported species the number of collections of bees of each sex, the number of bees of each sex, the number of collections that included bees with pollen, and the number of females carrying pollen, are listed.

For example, for *Leioproctus boltoni*, under Hemero-callidaceae, *Phormium tenax*, '♀ 3/23 (3/10 p) ♂ 1/2' means that for females there have been 3 collections of 23 bees, all 3 of the collections include bees with pollen, and that 10 bees carry pollen. For males there has been 1 collection of 2 bees. For the 8 imported species except the honey bee the numbers of bees visiting various flowers is reported more generally, or the species of flowers are listed without an estimate of bee visiting rate. For the honey bee, flowers are not listed because almost every flower can be visited.

Data are first presented for native flowers, followed by data for introduced flowers. The majority of bees will have been collected over or near flowers named on labels, and not directly in flowers, so whether the flowers may have been being visited for pollen and/or nectar is uncertain. This must be borne in mind when considering the flower records presented for each species.

The flower visiting data are summarised separately for native and introduced flowers. For example for *L. boltoni* for native flowers:

**Total** collections/specimens ♀ 48/157 (24/118 p) ♂ 44/121  
Species/genera/families 8/7/3 (8/7/3 p) 10/10/8

means that for females, there have been 48 collections of

157 bees which were captured in association with 8 species of flowers in 7 genera in 3 families, and that 24 collections had 118 bees carrying pollen, which were taken in association with 8 species of flowers in 7 genera in 3 families. For males there have been 44 collections of 121 bees, which were taken in association with 10 species of flowers in 10 genera in 8 families.

Examining the pollen carried on bees to determine whether it originated from the flowers named on the labels was beyond the scope of this work. Further, there is no certainty that the flowers were correctly identified. The flower visiting records of Quinn (1984) and Primack (1978, 1979, 1983) are included from data on their labelled specimens.

Host plant records are almost certainly strongly biased towards plant species with flowers that are readily accessible to collectors. For example, flowers of tall trees are usually out of reach of even insect nets with extendable handles, whereas flowers of most herbs can be approached closely. The flower visiting records for species of bees certainly have not been collected objectively, and the perceived flower preferences of many species will undoubtedly alter as collecting methods improve.

All general flower visiting data for all species of bees are summarised in Appendices 4 and 5.

Information on **Nest sites** was taken from labels, and was observed in the field. For **Associated organisms**, all mites on bees were counted, or, for the few cases where numbers were very high to the point where some mites were obscured, were estimated. Identification of mites to species was outside the scope of this work, but most mites were hypophi, or were 'large', or 'small'. Information is presented on other organisms which are intimately associated with bees, such as the parasitoids *Coelopenecyrtus australis* (Hymenoptera: Encyrtidae), *Melittobia* spp., (Hymenoptera: Eulophidae), and *Monodontomerus obscurus* (Hymenoptera: Torymidae) which breed in or on bee larvae, prepupae, and pupae, and the 2 species of *Pseudofoenus* (Jennings & Austin 1994) and 3 species of *Gasteruption* (Pasteels 1957) (Hymenoptera: Gasteruptionidae). Eggs and larvae of a *Pseudofoenus* sp. have been observed in *Leioproctus* spp. nests, where the first-instar *Pseudofoenus* larvae killed the bee eggs or small larvae, and then consumed all the provisions (Donovan 1967). The larvae of species of *Gasteruption* which attack nests of *Hylaesus* spp. may destroy more than one bee immature (Donovan *pers. obs.* for *H. relegatus*). This type of life cycle is described by Jennings & Austin (2002) as predator-inquiline.

Finally, under **Remarks**, interesting factors regarding the species biology, and other relevant information, are presented.

## MORPHOLOGY OF THE ADULT

The following measurements and ratios for up to 20 specimens of each sex and caste establish basic numerical data for the species. For measurements the smallest and highest values are presented, and the mean and standard deviation, while the ratio of malar length/malar width is of the mean of up to 20 measurements of each value. Because the values for the majority of species are small, standard deviations are not presented for these latter measurements.

**Length:** Measured from the front of the face to the tip of the metasoma, with the face vertical and the metasoma horizontal; where these body parts were not so aligned their lengths were measured separately and then summed.

**Width:** Widest part of the metasoma viewed from directly above or below.

**Forewing length:** Distance between the apex of the tegula and the apex of the marginal cell, with the wing lying lengthwise along the body.

**Facial length:** Distance between the ventral margin of the median ocellus and the ventral median margin of the clypeus.

**Facial width:** Greatest distance between the inner margins of the compound eyes, or if inner margins diverging throughout their length, the distance between immediately below the antennal sockets.

**Malar length and width:** Shortest distance between the lower margin of the compound eye and the mandible (Fig. 53n); greatest width of the base of the mandible.

The basis of modern descriptions of the external morphology of adult bees was established by Michener (1944). Other works of note relevant to this revision of New Zealand bees are Snodgrass (1956) on the honey bee, and Stephen, Bohart & Torchio (1969) primarily on bees of Northwestern America, including the alkali bee *Nomia melanderi*. The terminology used in the major publication of Michener (2000) is that of Michener (1944) modified in various ways. This terminology is certain to be the standard for the foreseeable future. Michener (2000) should be referred to for details of bee morphology. The characters below are listed in the order in which they are used in the descriptions of the species of bees that occur in New Zealand.

### Head

The sclerotised head presents many features of taxonomic value, however in some species, and particularly in males, these can be obscured by dense vestiture.

**Length of scape:** Greatest length of scape, the 1st segment of the antenna.

**Length of 1st flagellar segment:** Measured from base to apex of 1st segment beyond the pedicel, the 2nd segment of the antenna.

**Penultimate flagellar segment of antenna:** The 2nd to last distal segment of the antenna.

**Length of compound eye:** Maximum length measured from frontal view.

**Width of compound eye:** Maximum width measured from frontal view.

**Ocellocular distance:** Distance between lateral margin of lateral ocellus, 1 of 3 simple eyes on the central dorsal aspect of the head, and closest part of compound eye.

**Interocellar distance:** Shortest distance between the margin of a lateral and the median ocellus.

**Distance of antennal sockets from vertex:** With face in frontal view, the distance from upper margin of antennal socket to upper edge of vertex above the lateral ocellus on the same side of the face.

**Distance of antennal sockets from apex of clypeus:** With face in frontal view, the distance from the lower margin of the antennal socket to the apex of the clypeus directly below.

**Supraclypeus:** Usually raised area above the clypeus and between the antennal sockets.

**Frontal ridge:** Raised very narrow ridge-like area of the frontal line extending dorsally from supraclypeus between antennal sockets.

**Frontal line:** Depressed area of frontal line extending from the frontal ridge towards median ocellus.

**Frons:** Area between the antennal sockets and ocelli.

**Vertex:** Area between ocelli and dorsal margin of face, to about half way between lateral ocelli and compound eyes.

**Paraocular area:** In frontal view area of face beside compound eye.

**Clypeus:** Large lower central plate of face, separated laterally from the paraocular areas and dorsally from the supraclypeus by the epistomal suture. May be variously shaped and sculptured.

**Anterior tentorial pit:** A depression in the epistomal suture more or less about half way along the clypeal boundary.

**Labrum:** Central usually transverse plate below clypeus.

**Labral process:** raised median area of labrum, from which rises the keel.

**Keel:** Very narrow prominent median area of labrum.

**Mandible:** 'Jaw' which articulates with the head below or near the lower margin of the compound eye. May have teeth and cutting edges.



**Galea:** Large lateral sclerotised plate of the proboscis.

**Facial macula:** Yellow, pale or light yellow, or orange area of face.

**Facial fovea:** Depressed linear area on the paraocular area parallel and close to about the dorsal 3rd of the compound eye.

**Gena:** In lateral view, area of head posterior to the compound eye. Width is measured at widest part. The width of the compound eye with which the width of the gena is compared is here measured in the same way, and differs from the width of the compound eye measured in frontal view.

### Mesosoma (Fig. 35)

In bees the area between the articulations of the head and metasoma consists of the 3 segments of the thorax, the pro-, meso-, and metathorax, plus the propodeum (Michener 1944).

**Prothorax:** Anterior segment of mesosoma, immediately behind the head.

**Pronotal sulcus:** Angled depression on lateral aspect of pronotum.

**Pronotal suture:** In *Osmia coerulescens* a vertical suture laterally which extends across the dorsal aspect of the pronotum, so dividing the pronotum more or less into 2 halves.

**Pronotal collar:** Raised dorsal posterior area of the pronotum

**Pronotal lobe:** Large rounded lobe on the postero-lateral margin of the pronotum.

**Mesothorax:** 2nd segment of the mesosoma.

**Scutum:** Large subrectangular dorsal plate of the mesothorax.

**Parapsidal line:** Longitudinal line on the lateral aspect of the scutum.

**Scutellum:** Transverse dorsal plate of the mesothorax immediately posterior to the scutum.

**Axilla:** Sclerite lateral to the scutellum.

**Metathorax:** 3rd segment of the mesosoma.

**Metanotum:** Transverse dorsal plate of the metathorax.

**Propodeum:** 4th segment of the mesosoma, lying anterior to the articulation with the metasoma.

**Propodeal triangle:** Triangular median dorsoposterior area of the propodeum, with broad base adjacent to the metanotum and narrowing posteriorly to nothing towards the articulation with the metasoma. If in lateral view the propodeal triangle is angled, the dorsal area is the dorsal face of the propodeum, and the area below the angle which narrows posteriorly is the posterior face of the propodeum. If in lateral view the

propodeal triangle slopes directly to the posterior, it is declivous.

**Lateroposterior area of propodeum:** Lateroposterior area adjacent to the propodeal triangle.

**Lateral area of propodeum:** Lateral area adjacent and anterior to the lateroposterior area.

**Metepisternum:** Lateral area of the metathoracic segment; a rectangular, narrow, almost vertical area on the lateral aspect of the mesosoma immediately anterior to the lateral area of the propodeum, and posterior to the mesepisternum.

**Mesepisternum:** Lateral area of the mesothoracic segment; large lateral area of the mesosoma immediately anterior to the metepisternum and posterior to the prothorax.

**Scrobal groove or suture:** Longitudinal groove near the dorsal aspect of the mesepisternum, above which lies the hypoepimeral area.

**Episternal groove:** More or less dorsoventral groove nearly dividing the mesepisternum in half.

**Strigilis:** Spur on the distal end of the protibia, and semicircular comb-like structure on base of probasitarsus, together forming antenna cleaner.

**Trochanteral floccus:** Area of long, fine, branched hairs on the metatrochanter which carry pollen.

**Basitibial plate:** Depressed area on the outer basal aspect of the metatibia.

**Carina:** A ridge or sharp line.

**Scopa:** Area of stout hairs used for carrying pollen, primarily on the lateral aspect of the propodeum, the metatibia, the metabasitarsus, or ventrally on the metasoma.

**Corbicula:** Wide flat outer face of the metatibia surrounded by stout spines; carries pollen.

**Inner metatibial spur:** The inner of 2 spurs on the apex of the metatibia.

**Arolium:** Protruding pad-like structure between the tarsal claws.

**Tegula:** Rounded plate over the wing articulation.

**Pterostigma:** Thickened, usually elongate area about 2/3 the way along the anterior margin of the forewing (Fig 36a).

**Marginal cell:** Distal marginal cell of the forewing just beyond the pterostigma.

**Submarginal cells:** 2 or 3 cells immediately posterior to the pterostigma and the marginal cell.

**1st, 2nd, and 3rd submarginal crossveins:** Veins that lie between the 1st and 2nd submarginal cells, the 2nd and 3rd submarginal cells, and the outer border of the 3rd submarginal cell respectively.

**Vein 1st m-cu:** The vein that joins the posterior margin of the submarginal cells.

**Jugal lobe:** The lobe on the posterior margin of the hind wing near the wing base (Fig 36b).

**Vannal lobe:** The lobe between the jugal lobe and the more-or-less distal 1/2 of the hind wing on the posterior margin (Fig. 36b).

**Vein cu-v.** The crossvein in the hind wing against which the reach of the jugal lobe is evaluated.

### Metasoma

The metasoma is the area lying posteriorly to the articulation with the mesosoma.

**Terga:** Dorsolateral plates of the segments.

**Post-spiracular gland:** A small depression on the lateral aspect of terga 2–3 posterior to the spiracle of female *Hylaesus*.

**Tergal fovea:** A small circular depression just above and behind the post-spiracular gland on tergum 2 of female *Hylaesus*.

**Gradulus:** A transverse line near the anterior of the tergum.

**Premarginal line:** A transverse line near the posterior of the tergum.

**Pseudopygidium:** Bare, longitudinal, usually narrow area of tergum 5 in female *Lasioglossum*, often fringed with short hairs. Some male *Leioproctus* (*Nesocolletes*) have a pseudopygidial-like area on tergum 7.

**Pygidial plate:** Distinct, usually more or less dorsal triangular plate at the apex of tergum 6 of some females. More or less triangular in *Leioproctus* and *Nomia*, and narrow in *Euryglossina*.

**Sterna:** Ventral plates of the segments.

**Sternum 7:** 7th metasomal sternal plate, internal and much modified compared to plates 2–6.

**Sternum 8:** 8th metasomal sternal plate, internal except for elongated median posterior process.

**Genital capsule:** The male intromittent apparatus, usually concealed within the apex of the metasoma.

**Basal ring:** Sclerotised ring around the base of the gonobase.

**Gonobase:** The base of the genital capsule.

**Gonocoxite:** Lateral, posteriorly directed process distal to the gonobase.

**Gonostylus:** Apical area distal to the gonocoxite. Often there is no obvious distinction between the gonocoxite and the gonostylus.

**Retrorse lobe:** In male *Lasioglossum*, lobe arising from the lateral ventral surface of the gonocoxite.

**VolSELLA:** structure near the base of the penis valves.

**Penis valve:** 1 of 2 lateral median posterior processes between the gonocoxites, which together form the penis.

### Descriptive terms

**Punctures:** Rounded depressions in the cuticle. Punctures may be small, medium, or large, with the sizes relevant to those on the specimen being described. Dense punctures are contiguous.

**Sulcus:** A broad, usually shallow depression in the cuticle.

**Tessellation:** Cuticular surface chequered with regular, close-set ridges, often appearing hexagonal.

**Shagreening:** A close-set roughness of the cuticle, like the rough-surfaced horse leather called shagreen; or shark leather (LaBerge 1967).

The descriptions 'light', 'medium', and 'dense' for tessellation or shagreening refer to the range found on the specimen being described. Sometimes other descriptions such as 'faintly' may be used.

Sometimes light tessellation and light shagreening may approach and intergrade with each other.

### Vestiture

**Apical fimbria:** Narrow transverse band of very short appressed hairs, apical on terga and sterna.

**Prepygidial fimbria:** Dense hairs across the apex of tergum 5 in females.

Many bees are clothed in hairs, the density, length, and colour of which may vary widely. Because the cuticular surface of much of the body may be almost entirely obscured by vestiture, the distribution of the colour of the vestiture can be very important for identification of species. Some male *Leioproctus* are keyed to species on characters of the vestiture. In females hairs may form pollen-carrying structures, the scopae, which can occur on the lateral aspect of the propodeum, the metasomal trochanter, femur, tibia, and basitarsus, and the venter of the metasoma. The vestiture of males is described on the understanding that males are entirely without the structures of females that carry pollen.

## KEY TO BEES OF NEW ZEALAND

- 1 Antennae with 12 segments; apex of abdomen with sting, frequently partially or wholly concealed; metalegs and/or metasomal sterna with prominent pollen-carrying scopae or corbiculae, except for Euryglossinae, Hylaeinae, and queen *Apis mellifera* (Apidae) .....  
..... **FEMALES** ...2
- Antennae with 13 segments; apex of abdomen with genital capsule, usually at least partially concealed; metalegs and metasomal sterna without pollen-carrying scopae or corbiculae ..... **MALES** ...6

## FEMALES

- 2(1) Forewing with 2 submarginal cells ..... 3
- Forewing with 3 submarginal cells (Fig 36a) ..... 4
- 3(2) Body with sparse vestiture so integument clearly visible; no pollen-carrying scopae or corbiculae .....  
..... **Colletidae** (Hylaeinae and Euryglossinae)
- Body with dense vestiture so that some areas of integument such as the clypeus are often obscured; scopa on metasomal sterna ..... **Megachilidae**
- 4(2) Metatibia with scopa ..... 5
- Metatibia with corbicula (except queen *Apis mellifera* where compound eyes hairy) ..... **Apidae**
- 5(4) Metasoma with prominent sub-apical pseudo-pygidium; or metasomal terga with 3–4 bright yellow-green apical bands ..... **Halictidae**
- Metasoma with pygidial plate; metasomal terga black or near black ..... **Colletidae** (Colletinae)

## MALES

- 6(1) Forewing with 2 submarginal cells ..... 7
- Forewing with 3 submarginal cells (Fig. 36a) ..... 8
- 7(6) Apex of metasoma transverse dorsally, not produced to irregular margin or spines .....  
..... **Colletidae** (Hylaeinae and Euryglossinae)
- Apex of metasoma produced dorsally to irregular margin or spines ..... **Megachilidae**
- 8(6) Lower clypeus yellow (e.g., Fig. 23e), or metasomal terga with 4–5 bright yellow-green apical bands .....  
..... **Halictidae**
- Clypeus without yellow and metasomal terga with apical areas concolorous with tergal disc ..... 9
- 9(8) Compound eye hairy or bees large, burly, with dense vestiture on metasomal terga at least partially obscuring surface ..... **Apidae**

- Compound eye naked; bees slim with metasomal tergal vestiture sparse, not at all obscuring surface .....  
..... **Colletidae** (Colletinae)

KEY TO COLLETIDAE: Subfamilies and genera, and species of *Hyleoides* and *Euryglossina*

## FEMALES

- 1 Forewing with 3 submarginal cells (Fig 36a); vestiture abundant ..... Colletinae; **Leioproctus**
- Forewing with 2 submarginal cells; vestiture very sparse, bees almost naked ..... 2
- 2(1) Pygidial plate present, very small; metasomal tergum 1 with longitudinal median groove ..... (p. 115)...  
..... Euryglossinae; **Euryglossina proctotrypoides**
- Pygidial plate absent; metasomal tergum 1 without longitudinal median groove ..... Hylaeinae ...3
- 3(1) Metasomal terga black ..... **Hylaeus**
- Metasomal terga with 2 large orange maculae .....  
..... (p. 112)... **Hyleoides concinna**

## MALES

- 1 Forewing with 3 submarginal cells; vestiture abundant ..... Colletinae; **Leioproctus**
- Forewing with 2 submarginal cells; vestiture very sparse, bees almost naked ..... 2
- 2(1) Face without yellow maculae; metasomal tergum 1 with longitudinal median groove ..... (p. 115)...  
..... Euryglossinae; **Euryglossina proctotrypoides**
- Face with one to several yellow maculae (e.g., Fig. 14c); metasomal tergum 1 without longitudinal median groove ..... Hylaeinae ...3
- 3(1) Metasomal terga black ..... **Hylaeus**
- Metasomal terga with 2 large orange maculae .....  
..... (p. 112)... **Hyleoides concinna**

KEY TO SUBGENERA AND SPECIES OF *Leioproctus*

- 1 In lateral view, propodeal triangle noticeably angled and malar space very short, less than about 1/4 length of base of mandible (e.g., Fig. 37a–d,k), jugal lobe of hind wing reaching or nearly reaching vein cu-v (Fig 36b) .....  
..... **Leioproctus (Leioproctus)**
- In lateral view, propodeal triangle declivous or almost so and malar space long, more than about 1/4 and up to about 1/2 length of base of mandible (except very short in *maritimus* and short in *nunui*) (e.g., Fig. 48a–d, k), jugal lobe of hind wing not nearly reaching vein cu-v (Fig 36b) ..... **Leioproctus (Nesocolletes)**

**Leioproctus (Leioproctus)****FEMALES** (Note: Female *L. otautahi* are unknown)

- 1 Scopa white, or at most with a few brown/black hairs dorsally at base ..... 2  
 —Scopa broadly brown/black on dorsal half ..... 3
- 2(1) Facial vestiture entirely white; clypeus very smooth with few punctures medially, shiny (bees from coastal WI, MC and DN) ..... (p. 54)... **keehua n. sp.**  
 —Facial vestiture black beside compound eye and on vertex; clypeus with depressions medially, giving ‘beaten’ appearance, punctures various (from New Zealand except Chatham and Kermadec Islands) ..... 4
- 3(1) Clypeus with prominent median longitudinal rounded ridge; clypeal vestiture lateral to ridge swept upwards and sideways forming snow-plough appearance ..... 5  
 —Clypeus without or with very little median longitudinal rounded ridge; clypeal vestiture directed forward and down ..... 6
- 4(2) Pygidial plate very large, very broad basally, base as long as side, with strong sub-longitudinal ridging (Fig 42j); metasomal terga black with very dark green tinge ..... (p. 56)... **metallicus (Smith)**  
 —Pygidial plate medium size, base shorter than side, surface shagreened/tessellated, with at most very small irregular sub-longitudinal ridging (Fig 39j); metasomal terga black ..... (p. 48)... **imitatus Smith**
- 5(3) Pygidial plate very large, very broad basally, base longer than side, with about 6–8 very irregular sub-longitudinal ridges, prominent on apical half (Fig 45j); metasomal terga black with purple tinge ..... (p. 64)... **purpureus (Smith)**  
 —Pygidial plate large, base about as long as side, with numerous very fine almost longitudinal ridges (Fig 46j); metasomal terga black ... (p. 66)... **vestitus (Smith)**
- 6(3) Clypeus evenly rounded from side-to-side, with no or at most very slight depressions medially and few or even no punctures medially, mirror-like or shiny .... 7  
 —Clypeus with median longitudinal depressions medially giving ‘beaten’ appearance, or slightly ridged, and many punctures, not mirror-like or shiny ..... 8
- 7(6) Clypeus mirror-like, propodeal triangle with striations extending medially from lateral angles but not reaching mid-line, shagreened, mirror-like ..... (p. 51)... **kanapuu n. sp.**  
 —Clypeus shiny, propodeal triangle with striations extending medially from lateral angles to mid-line, moderately tessellated, dull ..... (p. 70)... **waipounamu n. sp.**

- 8(7) Clypeus with marked ‘beaten’, flattened appearance in broad median area; supraclypeus mound-like ..... (p. 41)... **boltoni Cockerell**  
 —Clypeus without ‘beaten’, flattened appearance in broad median area, curved evenly side-to-side, mostly without slight median longitudinal ridge; supraclypeus viewed best laterally forming longitudinal rounded ridge or rising from lower margin to point between antennal sockets ..... 9
- 9(8) Clypeus without median longitudinal ridge, with very large irregular punctures; vestiture throughout including clypeus long, black, or all gradations to white on clypeus and supraclypeus, obscuring surface; supraclypeus in lateral view forming longitudinal rounded ridge; pygidial plate narrow, base shorter than side, surface usually shiny ..... (p. 60)... **pango n. sp.**  
 —Clypeus with at most a very slight median longitudinal ridge, with large fairly regularly-spaced punctures throughout; central clypeal vestiture very short, sparse, not obscuring surface; clypeal vestiture white to off-white; supraclypeus in lateral view rising to point between antennal sockets; pygidial plate wide basally, base as long as or longer than side, dull ..... (p. 45)... **huakiwi n. sp.**

**Leioproctus (Leioproctus)****MALES**

Note: Old males of *L. boltoni*, *L. huakiwi*, *L. kanapuu*, *L. metallicus*, and *L. pango* with worn vestiture are difficult to key correctly.

- 1 Vestiture white throughout, or with some black hairs along inner margin of compound eye, or brown on vertex ..... 2  
 —At least some black vestiture on dorsum of mesosoma and apical several segments of metasoma ..... 3
- 2(1) Vestiture white throughout (bees from coastal WI, MC, and DN) ..... (p. 54)... **keehua n. sp.**  
 —Vestiture white throughout except some black hairs along inner margin of compound eye, or brown on vertex; (bees from throughout main areas of New Zealand except Chatham and Kermadec Islands) ..... 4
- 3(1) Clypeal vestiture white or black, with white extending at most just onto adjacent paraocular area and supraclypeus, and remaining areas with black vestiture ..... 5  
 —Vestiture on about lower half of face and including lower aspect of frons and supraclypeus white, off-white, yellow or orange, with a few black hairs along margin of compound eye ..... 6

- 4(2) Clypeal vestiture swept up and sideways from mid-line of clypeus, forming snowplough appearance; clypeus without tessellation; hairs on vertex white ..  
..... (p. 66)... **vestitus (Smith)**
- Clypeal vestiture directed forward and downward; clypeus lightly tessellated; some brown hairs on vertex  
..... (p. 59)... **otautahi n. sp.**
- 5(3) Propodeal triangle smooth and shiny or lightly shagreened or tessellated .... (p. 60)... **pango n. sp.**
- Propodeal triangle with anterior lateral area with fine transverse striations ... (p. 70)... **waipounamu n. sp.**
- 6(3) Clypeal vestiture swept upwards and outwards from mid-line of clypeus forming snowplough appearance  
..... (p. 64)... **purpureus (Smith)**
- Clypeal vestiture directed forward and downwards .. 7
- 7(6) Supraclypeal vestiture below antennal socket and on adjacent paraocular area yellow to orange, very short and dense, in young specimens completely obscuring surface ..... (p. 48)... **imitatus Smith**
- Supraclypeal vestiture below antennal socket and on adjacent paraocular area white or off-white, shorter on supraclypeus than on adjacent paraocular area, not completely obscuring surface ..... 8
- 8(7) Propodeal triangle smooth, shiny or nearly so (bees from coast or near coastal North Island and South Island except WD and FD, but including TO, CO, and MK)  
..... (p. 56)... **metallicus (Smith)**
- Propodeal triangle lightly shagreened or shagreened (bees from throughout N.Z. except some offshore islands including the Kermadecs and Chatham Islands) ..... 9
- 9(8) Face appearing broad; clypeal vestiture short throughout, about 1/2 length of scape, slightly orange on new bees but faded to off-white on older bees ....  
..... (p. 51)... **kanapuu n. sp.**
- Face not appearing broad; clypeal vestiture longer than 1/2 length of scape, white to off-white ..... 10
- 10(9) Supraclypeal vestiture below antennal socket about 1/2 length of clypeal vestiture .....  
..... (p. 45)... **huakiwi n. sp.**
- Supraclypeal vestiture below antennal socket about 2/3 length of clypeal vestiture .....  
..... (p. 41)... **boltoni Cockerell**

**Leioproctus (Nesocolletes)****FEMALES**

- 1 Malar space very short to short, about less than 1/5 as long as base of mandible (Fig. 50a–b, 52a–b) ..... 2
- Malar space long, about 1/4–1/2 as long as base of mandible (e.g., Fig. 48a–b) ..... 3
- 2(1) Malar space very short (Fig 50a–b); propodeal triangle shiny; scopa white to about dorsal half light brown (bees from throughout South Island) .....  
..... (p. 79)... **maritimus (Cockerell)**
- Malar space short (Fig 52a–b); propodeal triangle lightly tessellated; more than dorsal half of scopa dark brown (bees from MB only) ..... (p. 84)... **nunui n. sp.**
- 3(1) Vestiture orange-yellow throughout (bees from South Island only) ..... (p. 72)... **fulvescens (Smith)**
- Vestiture white, or with some off-white, brown or black (bees from all major areas) ..... 4
- 4(3) Propodeal triangle shiny (bees from North Island only) ..... (p. 86)... **paahaumaa n. sp.**
- Propodeal triangle lightly shagreened to tessellated (bees from North Island and South Island) ..... 5
- 5(4) About dorsal 2/3 of scopa dark brown to black; metasomal terga without apical fimbria; dorsal vestiture on meso- and metasoma primarily black .....  
..... (p. 81)... **monticola (Cockerell)**
- Scopa white, or with at most dorsal 1/2 light brown; metasomal terga with complete or partly complete white to off-white apical fimbria; dorsal vestiture on meso- and metasoma primarily white or off-white . 6
- 6(5) Propodeal triangle tessellated, slightly rounded (Fig 54k) (bees from WN and South Island) .....  
..... (p. 89)... **pekanui n. sp.**
- Propodeal triangle lightly shagreened, declivous (Fig 49k) (bees from North Island and South Island) .....  
..... (p. 76)... **hudsoni (Cockerell)**

**Leioproctus (Nesocolletes)****MALES**

- 1 Vestiture orange/yellow throughout (bees from South Island and SI) ..... (p. 72)... **fulvescens (Smith)**
- Vestiture white, or primarily off-white, brown, or black, or with some yellow (bees from all major areas) ..... 2
- 2(1) Malar space very short (Fig 50c–d); vestiture white throughout (bees from throughout South Island) .....  
..... (p. 79)... **maritimus (Cockerell)**
- Malar space long or short (e.g., Fig. 48c–d, 52c–d); vestiture primarily white, off-white, brown, or black, or with some yellow (bees from all major areas) ..... 3

- 3(2) Pseudopygidium strongly developed, very much like female pygidium; propodeal triangle smooth, shiny (bees from North Island only) .....  
.....(p. 86)... ***paahaumaa* n. sp.**
- Pseudopygidium not as well developed as female pygidium or scarcely developed; propodeal triangle at least lightly shagreened or tessellated (bees from all major areas) ..... 4
- 4(3) Facial vestiture yellow centrally (bees from MB) ...  
.....(p. 84)... ***nunui* n. sp.**
- Facial vestiture white centrally (bees from North Island and South Island) ..... 5
- 5(4) Propodeal triangle declivous, lightly shagreened .....  
.....(p. 76)... ***hudsoni* (Cockerell)**
- Propodeal triangle very slightly rounded, tessellated ..  
..... 6
- 6(5) Scutum smooth, shiny .....  
.....(p. 81)... ***monticola* (Cockerell)**
- Scutum tessellated (bees from WN and South Island) .  
.....(p. 89)... ***pekanui* n. sp.**

### KEY TO SPECIES OF *Hylaeus*

#### FEMALES

Note: Female *H. murihiku* are unknown

- 1 Face black (bees from Kermadec Islands) .....  
.....(p. 101)... ***kermadecensis* n. sp.**
- Face with yellow or pale yellow maculae (except bees from Three Kings with maculae very faint and possibly absent) (bees from remainder of the New Zealand biogeographical subregion) ..... 2
- 2(1) Central area of clypeus broadly pale yellow (Fig 61a)  
.....(p. 105)... ***perhumilis* (Cockerell)**
- Central area of clypeus black ..... 3
- 3(2) Yellow macula on lower paraocular area with upper margin horizontal or nearly so and about level with upper margin of clypeus (Fig 55a) (except bees from Three Kings with macula very faint and possibly absent, and if so, clypeus with very few small widely-spaced punctures) ..... (p. 92)... ***agilis* (Smith)**
- Yellow macula on lower paraocular area with upper margin not horizontal or near-horizontal and not about level with upper margin of clypeus (e.g., Fig. 56a) ..... 4
- 4(3) Basal area of tibia with at least some yellow .....  
.....(p. 95)... ***asperithorax* (Rayment)**
- Basal area of tibia black ..... 5

- 5(4) Yellow macula on lower paraocular area with boundary against clypeus well above anterior tentorial pit, boundary against compound eye above a line across upper margin of clypeus, with upper margin of macula between these points more or less straight (bees from Three Kings without yellow facial macula, and if so, clypeus with numerous small close punctures); in frontal view head appearing more or less round (Fig 62a) ..... (p. 108)... ***relegatus* (Smith)**
- Yellow macula on lower paraocular area with boundary against compound eye and not reaching clypeus, or if reaching clypeus, boundary on clypeus below anterior tentorial pit; in frontal view head appearing rectangular, somewhat elongated (Fig. 57a, 59a) ..... 6
- 6(5) Yellow macula on lower paraocular area small, more or less half-moon shaped, with rounded boundary towards clypeus (Fig. 57a) ..... (p. 97)... ***capitosus* (Smith)**
- Yellow macula on paraocular area very narrow, ribbon-like, adjacent to compound eye, extending from lowest point of paraocular area as far up as a line above upper margin of antennal sockets (Fig. 59a) .....  
.....(p. 102)... ***matamoko* n. sp.**

#### MALES

- 1 Clypeus yellow except for small vertical, somewhat linear black areas laterally (Fig 58c) (bees from Kermadec Islands). ..... (p. 101)... ***kermadecensis* n. sp.**
- Clypeus without linear black areas laterally (bees from remainder of New Zealand biogeographical subregion) ..... 2
- 2(1) Lower margin of supraclypeus with pale yellow half-moon-shaped macula (Fig 61c) .....  
.....(p. 105)... ***perhumilis* (Cockerell)**
- Supraclypeus black ..... 3
- 3(2) Labrum yellow ..... 4
- Labrum black ..... 5
- 4(3) Yellow macula on lower paraocular area with upper margin on compound eye not reaching a line across dorsal margin of clypeus (Fig. 56c) .....  
.....(p. 95)... ***asperithorax* (Rayment)**
- Yellow macula on paraocular area with upper margin on compound eye reaching well above a line across dorsal margin of clypeus (Fig. 55c)...(p. 92)... ***agilis* (Smith)**
- 5(3) Yellow macula occupying paraocular area with inner margin reaching nearly 1/2 way up subantennal suture (Fig 59c) ..... (p. 102)... ***matamoko* n. sp.**
- Yellow macula on paraocular area with inner margin not reaching above dorsal margin of clypeus (Fig. 57c, 60a, 62c) ..... 6

- 6(5) Clypeus with yellow macula completely occupying all but ventral margin, so clypeus solidly yellow to lateral and dorsal margins (Fig. 62c) .....  
 ..... (p. 108)... *relegatus* (Smith)
- Yellow macula occupying at least most of ventral 1/2 of clypeus, but lateral and dorsal margins of clypeus irregularly black, sometimes very narrowly so (Fig. 57c, 60a) ..... 7
- 7(6) Yellow macula occupying bulk of clypeus (Fig. 57c) .....  
 ..... (p. 97)... *capitosus* (Smith)
- Yellow macula occupying bulk of lower half of clypeus (Fig. 60a) ..... (p. 104)... *murihiku* n. sp.

### KEY TO HALICTIDAE: Genera and Species

#### FEMALES

- 1 Bee about size of honey bee worker or larger; apex of metasoma without obvious pseudopygidium; dorsum of metasoma with at least 3 and usually 4 very prominent transverse yellow/green bands .....  
 ..... (p. 118)... *Nomia melanderi* Cockerell
- Bee about 1/3 or less size of honey bee worker; apex of metasoma with obvious pseudopygidium; metasoma black ..... *Lasioglossum* ...2
- 2(1) Probasistarsus with an apical process as long as adjacent tarsal segment; face and mesosomal scutum dark green; pseudopygidium wide, width between about 1/3–1/2 length ..... (p. 134)... *cognatum* (Smith)
- Probasistarsus without an apical process; face and mesosomal scutum black, or if with metallic colours, colours other than dark green; pseudopygidium linear or nearly so ..... 3
- 3(2) Face with vestiture long, about 1/3 or more length of scape and erect ..... (p. 125)... *maunga* n. sp.
- Face with vestiture short, about 1/6 or less length of scape, partly recumbent to almost appressed ..... 4
- 4(3) Face and mesosomal scutum with metallic colours, primarily reds and blues; facial vestiture almost appressed ..... (p. 122)... *mataroa* n. sp.
- Face and mesosomal scutum black; facial vestiture partly recumbent ..... (p. 128)... *sordidum* (Smith)

#### MALES

- 1 Bee about size of honey bee worker or larger; dorsum of metasoma with 4–5 transverse yellow/green bands ..  
 ..... (p. 118)... *Nomia melanderi* Cockerell

- Bee less than 1/2 size of honey bee worker; dorsum of metasoma black ..... *Lasioglossum* ...2
- 2(1) Face and mesosomal scutum green/black; metasomal sternum 2 with large raised median apical process ....  
 ..... (p. 134)... *cognatum* (Smith)
- Face and mesosomal scutum black, or with metallic colours, primarily dark blues and reds; metasomal sternum without large raised median apical process ... 3
- 3(2) Labrum black ..... (p. 125)... *maunga* n. sp.
- Labrum yellow ..... 4
- 4(3) Face and mesosomal scutum with metallic dark blues and reds; metasomal sternum 4 and 5 with long dense hairs laterally ..... (p. 122)... *mataroa* n. sp.
- Face and mesosomal scutum without metallic colours; metasomal sternum 4 with just a few hairs laterally, metasomal sternum 5 with a few more hairs laterally ..... (p. 128)... *sordidum* (Smith)

### KEY TO MEGACHILIDAE: Genera and Species

#### FEMALES

- 1 Integument with prominent yellow maculations .....  
 .... (p. 140)... *Anthidium manicatum* (Linnaeus)
- Integument metallic green/blue, or black ..... 2
- 2 Integument noticeably metallic green/blue; metasomal sternal scopa black .....  
 ..... (p. 137)... *Osmia coerulescens* (Linnaeus)
- Integument black; metasomal sternal scopa white .....  
 ..... (p. 144)... *Megachile rotundata* (Fabricius)

#### MALES

- 1 Integument with prominent yellow maculations, distal aspect of metasoma with 5 prominent spines .....  
 .. (p. 140)... *Anthidium manicatum* (Linnaeus)
- Integument metallic bronze or black, distal aspect of metasoma without 5 prominent spines ..... 2
- 2 Integument metallic bronze; dorsal vestiture golden; metasomal tergum 6 with very sparse vestiture .....  
 ..... (p. 137)... *Osmia coerulescens* (Linnaeus)
- Integument black; dorsal vestiture off-white to pale yellow; metasomal tergum 6 with partially divided patch of very short appressed hairs, appearing to naked eye as 2 off-white dots .....  
 ..... (p. 144)... *Megachile rotundata* (Fabricius)

## KEY TO APIDAE: Genera and Species

## FEMALES

- 1 Compound eye hairy; metatibia without spurs; body hairy but integument generally visible; vestiture light yellow to black and not forming transverse bands ...  
 .....(p. 161)... *Apis mellifera* Linnaeus  
 (a) Metatibia without corbicula ..... *Queen*  
 (b) Metatibia with corbicula ..... *Worker*
- Compound eye naked; metatibia with 2 spurs; whole body densely hairy with vestiture so dense that integument mostly obscured; vestiture on apex of metasoma off-white; vestiture on remainder of body of orange, orange-yellow, lemon yellow, or dull yellow transverse bands more or less alternating with black, to vestiture entirely black ..... *Bombus* ... 2
- 2(1) Malar space short compared to other species of *Bombus*, a little more than 1/2 width of base of mandible (Fig 73a–b); broad, parallel-sided orange band across about middle of metasoma; posterior of mesosoma black .....(p. 149)... *terrestris* (Linnaeus)
- Malar space longer than that of *B. terrestris*, a little longer to about 1 1/3 width of base of mandible (Fig. 74a–b, 75a–b, 76a–b); anterior of metasoma, and posterior and anterior of mesosoma orange-yellow, lemon yellow or dull yellow, to vestiture all black .. 3
- 3(2) Malar space a little longer than width of base of mandible Fig 76a–b); sternum 6 with longitudinal keel; orange-yellow transverse band on anterior of mesosoma with black hairs intruding medially .....  
 .....(p. 158)... *subterraneus* (Linnaeus)
- Malar space long, about one and one third width of base of mandible (Fig. 74a–b, 75a–b); sternum 6 without longitudinal keel; if lemon yellow or dull yellow transverse band present on anterior of mesosoma, black hairs not intruding medially ..... 4
- 4(3) Lemon yellow transverse bands present on anterior and posterior of mesosoma, and anterior of metasoma .....(p. 152)... *hortorum* (Linnaeus)
- Dull yellow transverse bands present on anterior and posterior of mesosoma and anterior of metasoma, or all transitions to vestiture black throughout .....  
 .....(p. 155)... *runderatus* (Fabricius)

## MALES

- 1 Compound eye hairy; metatibia without spurs; mesosoma covered in dense, short vestiture so integument nearly obscured; metasomal vestiture sparse, integument readily visible; vestiture light yellow to black, not forming transverse bands .....  
 .....(p. 161)... *Apis mellifera* Linnaeus

- Compound eye naked; metatibia with 2 spurs; whole body densely covered in long hairs so integument generally obscured; vestiture orange-yellow, yellow-green, lemon yellow or dull yellow, forming transverse bands, more or less alternating with black, and/or off-white on apex of metasoma ..... *Bombus* ... 2
- 2(1) Malar space short compared to other species of *Bombus*, somewhat less than length of base of mandible (Fig 73c–d); broad parallel-sided orange band across about middle of dorsum of metasoma; posterior margin of mesosoma black ... (p. 149)... *terrestris* (Linnaeus)
- Malar space longer than that of *B. terrestris*, about 1 1/3–1 1/2 times as long as base of mandible (Fig. 74c–d, 75c–d, 76c–d); posterior and anterior of mesosoma and anterior of metasoma yellow-green, lemon yellow or dull yellow ..... 3
- 3(2) About middle 1/3 of vestiture of mesosoma black, remaining vestiture of body yellow-green .....  
 .....(p. 158)... *subterraneus* (Linnaeus)
- Vestiture of body lemon yellow, dull yellow or all transitions to black throughout ..... 4
- 4(3) Broad lemon yellow transverse bands on anterior and posterior margins of mesosoma and anterior of metasoma ..... (p. 152)... *hortorum* (Linnaeus)
- Broad dull yellow transverse bands on anterior and posterior margins of mesosoma and anterior margin of metasoma, and all transitions to black throughout ....  
 .....(p. 0155)... *runderatus* (Fabricius)

## KEY TO NESTS OF GENERA OF BEES OF NEW ZEALAND

- 1 Nest underground, or pseudo-underground, or on surface in natural or coarse man-made fibrous material, or, rarely, in abandoned bird nests ..... 2
- Nest in cavities in plant material such as trees, branches, or stems, or man-made cavities, rarely suspended beneath branches or rocks ..... 5
- 2(1) Nest in cavity that might have been excavated by small animals such as mice and rats, or similar-sized naturally-occurring cavities in compost heaps, old carpets etc.; cells up to thimble size, piled together, forming mass up to about 250 mm across .... *Bombus*
- Nest a narrow tunnel about as wide as body of female bee and excavated by her; cells separated by substrate ..... 3
- 3(2) Nest tunnel about 7–9 mm across, vertical or nearly so and clear of debris; substrate fine-grained and silty, saline, moist to surface (Fig 65j) .. *Nomia melanderi*



- Nest tunnel about 1–6 mm across, at all angles below horizontal or nearly so and if narrow, clear, or if larger, partly filled with loose substrate; substrate can be same as for *Nomia* but usually beach sand, sandstone, soil, silt or clay, and not saline, and dry ..... 4
- 4(3) Nest tunnel about 4–6 mm across, partly filled with loose substrate; substrate beach sand, sandstone, silt, soil, or clay; cells lined with cellophane-like material (Fig. 41n–o) ..... ***Leioproctus***  
(nests of most *Leioproctus* are unknown, so tunnel diameters are estimated from the size of female bees)
- Nest tunnel about 1–2 mm across, clear, substrate fine sandstone, soil, or silt; cells not lined with cellophane-like material ..... ***Lasioglossum***  
(nests of *Lasioglossum maunga* are unknown, but females are a little larger than females of the next largest species, *L. sordidum*).
- 5(1) Nest of several to a dozen or more vertical waxen combs of two layers of base-to-base hexagonal cells in a large cavity of from about 20–100 litres .....  
..... ***Apis mellifera***
- Nests in blind tunnels from about 1–8 mm across, or somewhat larger irregular blind cavities ..... 6
- 6(5) Nests in holes about 1 mm across .....  
..... ***Euryglossina proctotrypoides***  
(and probably small *Hylaeus*, but nests of these are as yet not known in New Zealand)
- Nests in holes about 3–8 mm across, or somewhat larger irregular blind cavities ..... 7
- 7(6) Nest entrance closed with ‘iris’ of secreted cellophane-like fibres with small slit at centre .....  
..... ***Hyleoides concinna***
- Nest entrance closed with complete sheet of cellophane-like material or leaf material; cells of same material; or entrance not closed ..... 8
- 8(7) Cells of cellophane-like material ..... ***Hylaeus***  
—Cells formed of pieces of leaf up to about 10 mm long, or partitions between cells of chewed leaf, or cells among wool-like mass of fine fibres from surface of leaves and stems ..... 9
- 9(8) Cells among fine fibres from surface of leaves and stems ..... ***Anthidium manicatum***  
—Cells formed of pieces of leaf, or partitions between cells of chewed leaf ..... 10
- 10(9) Partitions between cells, and entrance to nest, closed with chewed leaf material ..... ***Osmia coerulescens***  
—Cells of leaf pieces; nest entrance closed with leaf pieces about 5–6 mm across ..... ***Megachile rotundata***

## DESCRIPTIONS

### Superfamily Apoidea

### Family Colletidae

### Subfamily Colletinae

### Genus *Leioproctus* Smith

#### Subgenus *Leioproctus* Smith s.str.

- Leioproctus* Smith, 1853: 8. Type species: *Leioproctus imitatus* Smith, 1853, by designation of Cockerell, 1905a: 348.
- Dasycolletes* Smith, 1853: 14. Type species: *Dasycolletes metallicus* Smith, 1853, by designation of Cockerell, 1905a: 347.
- Leioproctus* Smith, 1879: 6, unjustified emendation of *Leioproctus* Smith, 1853.
- Paracolletes* (*Heterocolletes*) Rayment, 1935: 184. Type species: *Paracolletes capillatus* Rayment, 1935, by original designation. Synonymised by Michener, 1965: 47.
- Leioproctus* (*Anacolletes*) Michener, 1965: 59. Type species: *Lamprocolletes bimaculatus* Smith, 1879, by original designation. Synonymised by Michener, 2000: 150.

#### *Leioproctus* (*Leioproctus*) *boltoni* Cockerell

Fig. 1a–d, 37a–m; Map 1

- Leioproctus boltoni* Cockerell, 1904a: 203 (describes female and male, comparison with *Leioproctus metallicus* (*Dasycolletes metallicus*), *L. vestitus* (*D. vestitus*), *L. purpureus* (*D. purpureus*), and *L. imitatus*). —1929a: 311 (list). Donovan, 1967: xvii + 218 (bionomics). Miller, 1971: 21 (biology). Primack, 1978: 68, 70 (as *boltonii*, flower records, reach high density). —1983: 319, 326, 332 (as *boltonii*, flower records). Miller, 1984: 21 (repeat of Miller, 1971). Donovan, 1987: 19 (photographs of female on male kiwifruit flower, female with large load of male pollen from kiwifruit). Pinnock, Coles & Donovan, 1988: 387 (larvae and prepupae are associated with the spore cyst fungus *Ascospaera scaccaria*). Early, 2001: 67 (photograph of female).
- Paracolletes boltoni*: Cockerell, 1905a: 348 (new combination, key), 1916b: 361 (list). —1925: 551 (characters distinguishing *Paracolletes monticola*). —1929b: 201 (*P. philonensus* from Lord Howe Island is very close to the New Zealand *P. boltoni*, but smaller). —1934: 16 (key). Rayment, 1935: 148–154 (biology). Wodzicki & Robertson, in Hamilton & Baumgart 1959: 82 (occurrence on White Island, BP). Wise, 1970: 229, 239, 244, 245 (capture records for White Island, BP).
- Leioproctus* (*Leioproctus*) *boltoni*: Michener, 1965: 50 (new combination, list). Valentine & Walker, 1991: 41 (list).

**Female** (n = 20). Length 9.1–11.8 mm (10.4 ± 0.72 mm); width 2.9–3.5 mm (3.2 ± 0.17 mm); forewing length 6.1–6.9 mm (6.7 ± 0.20 mm); facial length 2.0–2.2 mm (2.1 ± 0.05 mm); facial width 2.0–2.2 mm (2.1 ± 0.04 mm); malar length/malar width 0.19.

**Coloration.** Head, mesosoma, and discs of metasomal terga 1–5 black, antennae brown beyond about 3rd flagellar segment, tibial spurs pale; remaining areas, particularly extremities red-black, except wing membranes and apical margins of metasomal terga 1–5 and sterna 1–5 hyaline.

**Structure.** (Fig. 37a–b). Scape equal in length to combined length of flagellar segments 1–6. Compound eyes a little more than 4× longer than wide, with upper 1/3 of inner margins converging strongly above, lower 2/3 converging moderately below. Ocellular distance nearly 3× an ocellar diameter, interocellar distance about equal to 1 ocellar diameter. Antennal sockets somewhat closer to apex of clypeus than to vertex. Face shiny throughout. Supraclypeus rising to a prominent rounded mound between antennal sockets, lateral margins with close, medium-sized punctures, but raised median area impunctate or almost so, smooth; frontal ridge prominent, extending to within about 1 ocellar diameter of median ocellus, frontal line extending to median ocellus. Frons and paraocular areas with medium-sized punctures separated by about 1/2 a puncture diameter. Clypeus scarcely protuberant, extending for about 1/3 its length below a line across lower margins of compound eyes, broad central area with ‘beaten’ appearance like hammered corrugated iron, often with central longitudinal area slightly raised; with very large, very irregular widely-spaced punctures, extreme lateral margins with smaller, closer punctures. Malar space short, about 1/5 as long as wide, impunctate, shiny. Galea very faintly tessellated, shiny. In lateral view, gena a little wider than compound eye, with medium-sized punctures separated by up to several diameters, very shiny.

Pronotum shagreened, sulcus shallow laterally, deep dorsally. Scutum shiny, with medium-sized punctures separated medially by up to about 5 diameters, closer peripherally. Scutellum shiny, with large, irregular, widely-spaced punctures, except punctures smaller, closer towards posterior margin. Metanotum shagreened. Propodeal triangle moderately angled (Fig. 37k), shagreened, with very shallow longitudinal depression; lateral areas of propodeum lightly shagreened, shiny, with small, widely-spaced obscured punctures. Metepisternum lightly shagreened, impunctate, shiny; remaining lateral areas of mesosoma very lightly tessellated, shiny, with medium-sized punctures separated by up to about 4 diameters. Basitibial plate about 1/4 length of tibia, shiny, with fine, longitudinal ridges, very faintly tessellated. Inner tibial spur ciliate (Fig. 37i). Pterostigma about 4× longer than wide; vein 1st m-cu meets 2nd submarginal cell about middle.

Metasomal terga 1–5 and sterna 1–5 shiny, lightly shagreened, with very small punctures separated by 2–4 diameters. Sternum 1 shallowly emarginate mid-apically.

Pygidial plate moderately wide basally, edges and broad central area raised, basal 1/2 shagreened, apical 1/2 smooth (Fig. 37j).

**Vestiture.** Off-white on clypeus, supraclypeus, around antennal sockets, lower margins of paraocular areas, and gena, otherwise black on head; on clypeus vestiture very short, very sparse so surface appears almost naked. Off-white on lateral margins of dorsum and laterally on mesosoma except small area below wing articulation, otherwise black, not obscuring surface. Trochanteral floccus well developed, of long, branched, white hairs (Fig. 37g); femoral vestiture white, basitibial plate with a few very short black hairs. Tibial scopa black on dorsal 1/2, ventral 1/2 white, hairs stout with 4–5 branches (Fig. 37h). Metabasitarsus with hairs on outer face short, unbranched, not forming scopa. Hairs off-white on metasomal terga 1–2, long, sparse, black on remaining terga, very short, very sparse, except prepygidial fimbria dense, moderately long. Sterna 2–4 with anterior 1/2 naked, posterior 1/2 with long sparse white hairs. Vestiture on remaining sterna brown-black.

**Male** (n = 20). Length 7.7–9.2 mm ( $8.4 \pm 0.44$  mm); width 2.1–2.8 mm ( $2.4 \pm 0.16$  mm); forewing length 5.4–6.3 mm ( $5.8 \pm 0.31$  mm); facial length 1.7–2.0 mm ( $1.8 \pm 0.09$  mm); facial width 1.6–2.0 mm ( $1.8 \pm 0.09$  mm); malar length/malar width 0.17.

**Coloration** similar to female except antennae brown beyond about 1st flagellar segment.

**Structure.** (Fig. 37c–d). Scape equal in length to combined length of about first 3.75 antennal segments. Compound eyes 4× longer than wide, with upper 1/5 and lower 4/5 of inner margins converging moderately above and below respectively. Ocellular distance and interocellar distance as in female. Antennal sockets 1.2× further from apex of clypeus than from vertex. Supraclypeus rising to a sharp point between antennal sockets, with medium-sized punctures separated by less than 1 diameter, except for a narrow impunctate area extending about halfway to clypeus from apex of point. Clypeus moderately protuberant, with median central dorsal 1/2 flat, with medium-sized close punctures throughout, except punctures larger towards lower and lateral margins. Malar space short, about 1/6 as long as wide, impunctate, shiny. Remainder of head similar to female.

Mesosoma similar to female except about posterior 1/2 of scutellum with smaller, closer punctures. Basitibial plate and wing similar to female.

Metasomal terga 1–5 and sterna 1–6 similar to female. Sternum 7 (Fig. 37e) with posterior margin of basal and apical lobes moderately angled, the latter with fringe of

stout hairs. Sternum 8 (Fig. 37f) with apical process narrowed medially. Gonocoxites in dorsal and ventral views (Fig. 37l) stout, gonostyli incurved apically; penis valve bluntly rounded apically, in lateral view (Fig. 37m) penis valve expanded dorsally well above gonocoxite.

**Vestiture.** Distribution of off-white and black hairs similar to female, but on face longer, length up to 2× diameter of antennal flagellar segments, and more dense, but not obscuring surface. On mesosoma vestiture a little longer than in female. Metasomal vestiture more sparse than in female.

**Variation.** Very faint tessellation may occur centrally on the clypeus in both sexes. The clypeus of males may show a faint “beaten” pattern similar to that of females. The extent of black colouration of scopal hairs may range from very few just below the basitibial plate, such as is shown by some specimens from GB and HB, to more than half of the dorsal area black.

**Type data.** *Leioproctus boltoni*: holotype female, “New Zealand”, 1854, Colonel Bolton (BMNH).

**Material examined.** Type specimen, plus 704 females and 419 males.

**Distribution** (Map 1). North Island: ND, AK, CL, WO, BP, TK, TO, GB, HB, WI, WN. South Island: SD, NN, BR, MB, KA, WD, NC, MC, MK, SC, FD, OL, DN. Stewart Island. Offshore Islands: TH.

Because of its ubiquity over a wide range of climates over most of New Zealand, the species probably occurs throughout the country. Specimens have been captured from 22 September to 16–20 February, with 38.0% of collections in November, and 30.5% in December.

**Biology.** *Leioproctus boltoni* seems to be most abundant wherever its main native host flowers, *Leptospermum scoparium* and *Kunzea ericoides*, are common.

There are 5 altitude records for live bees, with the highest of 1050 m at Mt Duppa, NN. However, it is clear from other collection records that the species occurs from just above sea level to the altitude given above. In addition, there are records of 3 separate collections of dead bees, each from a different year, from the summit snow on Mt Egmont, TK (Mt Taranaki), 1 record of which gives the altitude as 2400 m. A total of 10 females was taken, of which 5 (3 in 1 collection and 2 in another) were carrying large loads of pollen.

**Flight period.** The 178 collection dates for 704 females range from 27 September to 16–20 February, with 32.6% and 33.7% of collections taken in November and December respectively. The 127 collection dates for 419 males range from 22 September to 11 February, with 45.7% and 26.0% of collections in November and December respectively.

#### Number of collections

	Sep	Oct	Nov	Dec	Jan	Feb
Females	2	10	58	60	40	8
Males	3	10	58	33	21	2

There have been 26 collections of more than 10 bees. The largest is of 2 females and 41 males which were taken at a light during November 1970 at Castaway Camp, Great Island, Three Kings Island, ND, during November 1970 by J. McBurney. One female carries pollen. The next largest is of 40 females, 38 of which carry pollen, which were taken at River Road, Waiwhenua, HB, on 16 November 1983 by J. Charles. Three other collections are of 30–39 bees, 2 are of 20–29 bees, and 19 are of 10–19 bees.

#### Host plants

##### Native plants

<b>Campanulaceae</b>						
<i>Wahlenbergia pygmaea</i>		—				♂ 1/1
<b>Fabaceae</b>						
<i>Carmichaelia</i> sp.		—				♂ 1/1
<b>Hemerocallidaceae</b>						
<i>Phormium tenax</i>		♀ 3/23 (3/10 p)				♂ 1/2
<b>Laxmanniaceae</b>						
<i>Cordyline australis</i>		—				♂ 1/1
<b>Myrtaceae</b>						
<i>Kunzea ericoides</i>		♀ 7/17 (5/7 p)				♂ 9/13
<i>Leptospermum scoparium</i>		♀ 29/97 (8/84 p)				♂ 26/97
<i>Kunzea/Leptospermum</i>		♀ 2/3 (1/2 p)				♂ 1/2
<i>Lophomyrtus obcordata</i>		♀ 3/10 (3/10 p)				—
<i>Metrosideros excelsa</i>		♀ 1/2 (1/1 p)				—
<i>Rata</i>		♀ 1/2 (1/1 p)				♂ 1/1
<b>Plantaginaceae</b>						
<i>Hebe traversii</i>		♀ 1/2 (1/2 p)				—
<i>Hebe</i> sp.		♀ 1/1 (1/1 p)				♂ 1/1
<b>Polygonaceae</b>						
<i>Muehlenbeckia complexa</i>		—				♂ 1/1
<b>Thymelaeaceae</b>						
<i>Pimelea traversii</i>		—				♂ 1/1
<b>Total collections/specimens</b>		♀ 48/157 (24/118 p)				♂ 44/121
<b>Species/genera/families</b>		8/7/3 (8/7/3 p)				10/10/8

##### Introduced plants

<b>Actinidiaceae</b>						
<i>Actinidia deliciosa</i> female		♀ 13/80 (2/15 p)				♂ 1/12
male		♀ 21/129 (9/64 p)				♂ 6/31
female/male		♀ 9/60 (7/44 p)				—
<b>Apiaceae</b>						
<i>Daucus carota</i>		♀ 1/2 (1/1 p)				♂ 1/11
<b>Asteraceae</b>						
<i>Argyranthemum frutescens</i>		—				♂ 1/2
<i>Taraxacum officinale</i>		♀ 1/2				—
‘composite’		—				♂ 2/8
‘thistle’		♀ 1/1				—
<b>Boraginaceae</b>						
<i>Echium vulgare</i>		♀ 1/5 (1/5 p)				—
<b>Caprifoliaceae</b>						
<i>Kolkwitzia</i> sp.		—				♂ 2/4

Ericaceae		
<i>Calluna vulgaris</i>	—	♂ 1/2
Fagaceae		
<i>Castanea sativa</i>	♀ 1/9 (1/8 p)	—
Lamiaceae		
<i>Thymus vulgaris</i>	—	♂ 1/1
Philadelphaceae		
<i>Deutzia gracilis</i>	—	♂ 1/2
Plantaginaceae		
<i>Digitalis purpurea</i>	♀ 1/1	♂ 1/6
Proteaceae		
<i>Leucospermum</i> sp.	♀ 1/1 (1/1 p)	—
Rhamnaceae		
<i>Ceanothus papillosus</i> var.		
<i>roweanus</i>	—	♂ 1/1
Rutaceae		
<i>Diosma</i> sp.	—	♂ 1/3
‘Citrus’	♀ 1/1	—
<b>Total collections/specimens</b>	♀ 51/291 (7/138 p)	♂ 19/83
<b>Species/genera/families</b>	9/9/8 (5/5/5 p)	11/11/10

For native plants, *Leptospermum scoparium* is therefore by far the most favoured by both females and males, while among introduced plants, *Actinidia deliciosa* is most attractive. The number of females carrying pollen of *A. deliciosa* is probably much higher than shown because as part of another project, some bees of at least 9 collections were sonicated to remove pollen.

One female and 6 males were captured bunched together in a *Digitalis purpurea* flower, and a copulating pair were taken in a male *A. deliciosa* flower.

**Nest sites.** There are 14 records of nest sites. At Island Bay Road, Birkdale, AK, 19 females and 1 male were caught in wire mesh cages as they emerged for the first time from overwintering in nests in near-vertical sandstone cliffs on the edge of the Waitemata Harbour. The male was captured on 14–15 October, and females from 14 October–4 December. Nests of *L. boltoni* appeared to be interspersed with nests of several other species, including *L. huakiwi*, *L. imitatus*, *L. kanapuu*, *L. paahaumaa*, *L. pango*, and *Lasioglossum cognatum*. There are 4 records of nests under or on the edge of the canopy of kiwifruit vines, 1 at Opotiki, BP, and 3 at Riwaka, NN. At Riwaka, excavation of a nest on 23 November 1983, uncovered a female in a nest tunnel. Six other bees in nearby nest tunnels were *L. imitatus*. Two other nests sites were in flat ground, under a peach tree at Puketapu, HB, and in a home garden at Ashburton, MC. Nests were also found in a sloping, grassy hillside grazed by sheep at Manutuke, GB, and in a vertical cliff face at Abut Head, WD. At Stewart Island, SI, 4 males were captured over sand at the top of the beach.

**Associated organisms.** Three females taken from areas other than the Island Bay Road, AK site carry 1 mite each, and 1

female carries 4 mites, while 5 males carry 1 mite and 1 male carries 6 mites. Of 45 female bees from Island Bay Road, AK, 32 carry up to 12 large mites and/or sometimes 1 to many small mites, and of 42 males, 37 carry up to 11 large mites and/or sometimes 1 to many small mites. The spore cyst fungus *Ascospaera scaccaria* Pinnock, Coles & Donovan was found attacking larvae and prepupae in nests at Island Bay Road, AK (Donovan 1967, Pinnock, Coles & Donovan 1988).

The gasteruptionid *Pseudofoenus* sp. was common at Island Bay, AK, where it was probably attacking *L. boltoni*. However, nests of several other species of *Leioproctus* were common in the area.

**Remarks.** This species is one of the most widely distributed and abundant native bees. Although the native pollen sources appear to be almost restricted to some Myrtaceae, the 2 most favoured species, *Leptospermum scoparium* and *Kunzea ericoides*, occur throughout most of the country, so pollen (and nectar) are present in most areas. The collection by the species of pollen of Hemerocallidaceae, the flowers of which are quite different morphologically to those of the Myrtaceae, and the collection of pollen by from 1 to 13 females from 6 other native species in 2 families, and by 1 to 8 females from 5 introduced species in 5 families, suggests that there is some plasticity in pollen-collecting behaviour. This is borne out by the ability of females in large numbers to collect pollen from introduced kiwifruit, over many areas of the country. The strong propensity to collect pollen from *A. deliciosa* flowers is surprising, because the flowers do not produce nectar, and further, the pollen grains from female flowers are hollow, which suggests that their nutritional value is less than that of male pollen grains. The further ability of the species to utilize a wide range of nest sites, from sandstone cliffs along the ocean front to sloping sheep-grazed hillsides and flat ground, suggests that the bees' range is unlikely to be restricted by unavailability of suitable nest sites.

Rayment (1935) quotes the life-history of a Maori bee and presents drawings of larvae, pupae, parts of the adult and pollen, and dead flies from the nest tunnel, sent to him in Australia by Raymond Hansen from Orini, Taupiri, New Zealand. He identified the orange-yellow pollen grains as those of the hawkweed *Hypochoeris*. Because *L. boltoni* has not been recorded collecting pollen from Asteraceae, but *L. paahaumaa* has, and it is common in the North Island, the nest was almost certainly of this latter species. Miller (1971) reported that the species is on the wing from early November to March, and that eggs and larvae occur in “puddings” during February and March. See a discussion of the “puddings” of Miller 1971 and 1984, under *Leioproctus (Nesocolletes) fulvescens*.

***Leioproctus (Leioproctus) huakiwi* new species**

Fig. 1e–f, 2a–b, 38a–m; Map 2

**Female** (n = 20). Length 9.5–11.8 mm ( $10.8 \pm 0.65$  mm); width 2.8–3.5 mm ( $3.2 \pm 0.16$  mm); forewing length 6.3–7.4 mm ( $6.8 \pm 0.26$  mm); facial length 1.9–2.4 mm ( $2.2 \pm 0.10$  mm); facial width 2.0–2.4 mm ( $2.2 \pm 0.09$  mm); malar length/malar width 0.23.

**Coloration.** Head and mesosoma black, except antennae brown beyond about 2nd flagellar segment, apex of mandibles and tarsal claws red, wing membranes hyaline, wing veins brown to light brown, tibial spurs pale; metasoma black except apical margins of terga 1–5 and sterna 1–5 hyaline, about basal 2/3 of pygidial plate dark brown to black, apical 1/3 red.

**Structure.** (Fig. 38a–b). Scape a little longer than combined length of first 6 flagellar segments. Compound eyes about 4× longer than wide, with upper 1/4 and lower 3/4 of inner margins converging markedly above and below respectively. Ocellular distance slightly less than 3 ocellar diameters; interocellar distance equal to 4/5 an ocellar diameter. Antennal sockets a little closer to vertex than to apex of clypeus. Face shiny throughout. Supraclypeus rising from below and laterally to form an elongated ridge running from a low just above clypeus to a higher point between antennal sockets, with small to medium-sized, close punctures laterally, ridge broadly smooth, rounded from side-to-side; frontal ridge extending 4/5 of distance to median ocellus, frontal line extending to median ocellus. Frons and paracocular areas with irregular, medium-sized to large, close punctures, frons moderately tessellated, paracocular areas lightly tessellated except area between lateral ocellus and compound eye and extending 1/4 way along compound eye, smooth, impunctate. Clypeus moderately protuberant, short, extending for 1/3 its length below a line across lower ends of compound eyes, lower margin and narrow, longitudinal central area impunctate, the latter slightly raised, not reaching upper margin of clypeus, areas lateral to this with very large, irregular close punctures, punctures becoming smaller laterally. Malar space short, about 1/4 as long as wide, impunctate, shiny. Galea lightly tessellated. In lateral view, gena somewhat wider than compound eye, with irregular-sized punctures variously separated, shiny.

Pronotum moderately shagreened, sulcus prominent dorsally, sharply defined dorsolaterally. Scutum shiny, with broad central area impunctate, surrounded by medium-sized punctures separated by 2–3 diameters, punctures becoming smaller, closer around periphery, periphery narrowly and lightly shagreened. Scutellum with about anterior 1/2 shiny, with large punctures separated by 2–6 diameters, about posterior 1/2 lightly shagreened with irregular close punctures. Metanotum heavily shagreened.

Propodeal triangle moderately angled (Fig. 38k), with fine striae extending from lateral corners towards centre line, slight longitudinal median depression, moderately shagreened; remainder of propodeum heavily shagreened, with small to medium-sized punctures separated by 2–4 diameters; remaining lateral areas of mesosoma lightly tessellated/shagreened to smooth, with shallow, medium-sized punctures separated by 1–3 diameters, except metepisternum moderately shagreened, impunctate. Basitibial plate about 1/4 length of tibia, shiny with small, irregular ridging. Inner metatibial spur ciliate, apex bent slightly downwards (Fig. 38l). Pterostigma 4× longer than wide, vein 1st m-cu meets 2nd submarginal cell at or before middle.

Metasomal terga 1–5 and sterna 1–6 lightly shagreened, with very small, obscure punctures separated by up to about 6 diameters, except punctures larger on sterna; sternum 1 shallowly emarginate apically. Pygidial plate wide basally, narrowing to a rounded apex, edges raised markedly, central area slightly and irregularly raised, with basal 1/2 with fine, irregular longitudinal striae, apical 1/2 lightly tessellated (Fig. 38j).

**Vestiture.** Off-white on lower 1/2 of face to just above antennal sockets, except black beside compound eye to just below level of antennal sockets, black elsewhere on face and vertex; central clypeus almost naked, with short, sparse erect hairs; ridge of supraclypeus naked. Genal vestiture off-white. Dorsum of mesosoma with black vestiture in central, longitudinal area and beneath wing articulation, and mixed black and white hairs on pronotal lobe, otherwise mesosomal vestiture off-white to white, and disc of scutum almost naked, black hairs short, scattered. Trochanteral floccus well developed, of long, very plumose white hairs (Fig. 38g); femoral vestiture white except black apically; basitibial plate with a few, short black hairs. Tibial scopa with dorsal 1/2 black, ventral 1/2 white tinged with yellow near black hairs; hairs stout with 6–8 branches (Fig. 38h). Metabasitarsus with hairs on outer face short, unbranched, not forming scopa. Metasomal vestiture dorsally on terga 1–3 white, becoming black towards prepygidial fimbria, sparse on terga 1–4, long on tergum 1, short on terga 2–4; sternal vestiture white, sparse on discs of sterna 1–5, sterna 2–5 with off-white apical fimbria, that on sternum 5 very dense, tinged with yellow.

**Male** (n = 20). Length 7.7–10.3 mm ( $8.8 \pm 0.78$  mm); width 2.1–3.1 mm ( $2.4 \pm 0.22$  mm); forewing length 4.9–6.3 mm ( $5.7 \pm 0.34$  mm); facial length 1.6–2.2 mm ( $1.8 \pm 0.15$  mm); facial width 1.6–2.3 mm ( $1.8 \pm 0.17$  mm); malar length/malar width 0.18.

**Coloration** similar to female.

**Structure.** (Fig. 38c–d). Scape equal in length to combined

length of first 4 flagellar segments. Compound eyes a little less than 4× longer than wide, with inner margins similar to female. Ocellular distance slightly more than 3 ocellar diameters, interocellar distance about equal to 1 ocellar diameter. Antennal sockets equidistant between vertex and apex of clypeus. Supraclypeus rising steadily from below and laterally to a prominent peak between antennal sockets, punctation similar to female but more extensive so impunctate area is smaller or even absent. Clypeus in ventral view evenly rounded from side-to-side, otherwise similar to female except median longitudinal area not raised, with medium-sized, close punctures throughout. Malar space short, about 1/5 as long as wide, otherwise similar to female. Remainder of head similar to female.

Mesosoma similar to female, except with less shagreening around periphery of scutum. Basitibial plate and wing similar to female.

Metasomal terga 1–5 and sterna 1–6 much as in female. Sternum 7 (Fig. 38e) with basal lobes widened distally, apical lobes with posteromedial margin shallowly emarginate, fringed with long, stout hairs. Sternum 8 (Fig. 38f) with shaft of apical process rather stout. Gonocoxites in dorsal and ventral views (Fig. 38l) stout, gonostyli incurved apically, penis valves acute apically; in lateral view (Fig. 38m) penis valve just projecting below gonocoxite.

**Vestiture.** On head, distribution of off-white and black vestiture similar to female; on clypeus vestiture dense throughout, 1/2 as long as scape, obscuring surface; supraclypeus with vestiture on sides only, 1/2 length of clypeal vestiture, erect, lying somewhat towards compound eyes; paraocular areas lateral to supraclypeus with vestiture as long as on clypeus, lying strongly towards compound eyes. Mesosomal vestiture similar to female, except black on lateral areas of propodeum and more extensively black on dorsal 1/2 of remaining lateral areas of mesosoma, forming a continuous black band. Metasomal vestiture similar to female except less abundant, black on tergum 3; much less abundant on sterna.

**Variation.** On a few females from throughout the range of the species, the portion of the scopa that is black is reduced to as little as 1/3 of the dorsal 1/2 of the scopa. Specimens from the northern tip of the North Island ND are the largest of the species, and, in general, the vestiture of specimens from north of the Auckland isthmus is lighter than that of specimens to the south.

**Type data.** *Leioproctus huakiwi*: holotype female, here designated, “Manutuke GB”, 23 November 1983, **in copula** in male flower of *Actinidia deliciosa*, and another male attempting to mate, B. J. Donovan (NZAC). Allotype male, same data as holotype. Twenty-three female paratypes and 37 male paratypes, same data as holotype

except not attempting to copulate. One male paratype, same data as allotype except attempting to copulate. The allotype male is above the holotype female on the same pin, and the paratype male that was attempting to copulate is on the same pin below the holotype female.

**Material examined.** Type specimens, plus 505 females and 300 males.

**Distribution** (Map 2). North Island: ND, AK, CL, WO, BP, TK, TO, GB, RI, HB, WI, WN. South Island: SD, NN, BR, MB, KA, WD, NC, MC, MK, SC, FD, OL, CO, DN, SL. Stewart Island.

Specimens from the 384 collections were taken from 7–8 October to 13 April, with 39.3% taken in December and 25.0% taken in January.

**Biology.** The species occurs throughout much of the vegetated areas of New Zealand, and from sea level up to 1050 m. There are 2 collection records for females without pollen from the summit snow of Mt Egmont TK, one of 5 on 2–3 January, and the other of 2 on 19 January, and one of 2000 m for 2 females without pollen on snow from Mt Cook National Park MK on 24 February 1976. On 4 January 1987, 1 female without pollen and 10 males were taken clustered on the foliage of *Salix fragilis* (Salicaceae) on the bank of the south branch of the Hurunui River NC. One unworn female without pollen but carrying 9 small mites, 7 of which were on the wings and 2 on the mesosoma, was found dead on dry beach sand 5 km N. of the Whataroa river mouth WD. One unworn female without pollen was found dead on grass which had been killed with the herbicide ‘Roundup’, 5 km E Abut Head WD.

**Flight period.** The first seasonal collection date for both sexes is 7–8 October, with the last for females 15 March, and the last for males 13 April. Of the 226 collections for the 529 females for which dates are available, 17.2% were in November, 42.5% were in December, and 26.1% were in January. For the 158 collections of 339 males, 24.7%, 34.8% and 23.4% were taken in the same 3 months respectively.

	Number of collections						
	Oct	Nov	Dec	Jan	Feb	Mar	Apr
Females	2	39	96	59	28	2	
Males	2	39	55	37	21	3	1

Only 8 collections of more than 10 bees have been made. The largest is of 28 females, 14 of which carry pollen, and 39 males at Manutuke GB, on 23 November 1983, from male flowers of kiwifruit, *Actinidia deliciosa*, by B. J. Donovan. The next largest collection is of 35 females, all without pollen although they may have been washed, from Opotiki BP, during November 1979 on female flowers of kiwifruit by D. Briscoe. Six other collections are of between 11 and 17 bees.

Host plants			
<b>Native plants</b>			
Fabaceae			
<i>Carmichaelia stevensonii</i>	♀ 1/1 (1/1 p)	—	
Laxmanniaceae			
<i>Cordyline australis</i>	♀ 2/5 (2/5 p)	♂ 1/3	
Malvaceae			
<i>Hoheria angustifolia</i>	—	♂ 2/12	
<i>Hoheria glabrata</i>	♀ 1/5 (1/5 p)	—	
<i>Hoheria lyalli</i>	♀ 1/1	—	
<i>Hoheria</i> sp.	♀ 1/13 (1/10 p)	♂ 1/3	
Myrtaceae			
<i>Kunzea ericoides</i>	♀ 4/4 (3/3 p)	♂ 8/16	
<i>Leptospermum scoparium</i>	♀ 2/2 (1/1 p)	♂ 14/25	
<i>Lophomyrtus bullata</i>	♀ 1/4 (1/4 p)	—	
<i>Lophomyrtus obcordata</i>	♀ 1/3 (1/2 p)	—	
<i>Metrosideros excelsa</i>	♀ 8/17 (5/12 p)	♂ 4/9	
<i>Metrosideros perforata</i>	♀ 1/7 (1/5 p)	♂ 1/6	
Plantaginaceae			
<i>Hebe macrocarpa</i>	♀ 1/2	—	
<i>Hebe salicifolia</i>	♀ 1/1	—	
<i>Hebe speciosa</i>	♀ 1/1 (1/1 p)	—	
<i>Hebe stricta</i>	♀ 1/1 (1/1 p)	♂ 3/3	
<i>Hebe</i> sp.	♀ 6/17 (4/13 p)	♂ 4/7	
Ranunculaceae			
<i>Clematis parviflora</i>	♀ 1/1 (1/1 p)	♂ 1/3	
Roussseaeae			
<i>Carpodetus serratus</i>	♀ 1/1	♂ 2/2	
<b>Total collections/specimens</b>	♀ 35/86 (24/64 p)	♂ 41/89	
<b>Species/genera/families</b>	18/10/7 (14/9/6 p)	11/8/6	
<b>Introduced plants</b>			
Actinidiaceae			
<i>Actinidia deliciosa</i> female	♀ 24/57 (3/13 (of 14) p)	—	
male	♀ 24/101 (6/28 (of 51) p)	♂ 4/45	
female/male	♀ 5/42 (1/2 p)	♂ 2/9	
Apiaceae			
<i>Daucus carota</i>	—	♂ 1/2	
Asphodelaceae			
<i>Kniphofia praecox</i>	—	♂ 1/1	
Asteraceae			
'Composite'	♀ 1/1	♂ 1/5	
Fagaceae			
<i>Castanea sativa</i>	♀ 1/1 (1/1 p)	—	
Lauraceae			
<i>Persea americana</i>	♀ 2/2 (1/1 p)	♂ 2/4	
Malvaceae			
<i>Tilia</i> sp.	♀ 1/3 (1/3 p)	—	
Myrtaceae			
<i>Eucalyptus polyanthemos</i>	♀ 1/2 (1/2 p)	—	
<b>Total collections/specimens</b>	♀ 59/209 (14/50 p)	♂ 11/66	
<b>Species/genera/families</b>	6/6/6 (5/5/5 p)	5/5/5	

Another 93 females were previously sonicated to remove pollen as part of another project.

For native plants, most females carrying pollen were taken in association with Myrtaceae with 27, followed by Malvaceae and Plantaginaceae, each with 15.

Pre-eminent among the introduced species is *Actinidia deliciosa* (Actinidiaceae), for which there are 24 collections of 57 female bees from female flowers, 24 collections of 101 female bees and 4 collections of 45 male bees from male flowers, and 7 collections of 42 female bees and 9 male bees from female/male flowers. Most of these records originated from a nation-wide survey of the insects associated with the flowers of kiwifruit. One of these records consists of 28 female bees, 14 of which carry pollen, and 39 male bees, all from one male vine at Manutuke GB.

**Nest sites.** There are 56 references to nest sites. Bees have been associated with nests in ocean beaches below driftwood, sandy and silty areas in riverbeds, soil in domestic gardens, clay banks, sandy soil in a golf course bunker, a vertical ocean cliff of fine silty material, bared sheep tracks in hilly pasture, a clay track, sand in forest, packed gravel, and flat, partly shaded soil beneath kiwifruit vines and avocado trees. At Island Bay, Birkdale, Auckland AK, nests of *L. boltoni*, *L. imitatus*, *L. kanapuu*, *L. paahaumaa*, *L. pango* and *Lasioglossum cognatum* were present in the same cliff. Perhaps the most unusual nest site was at Karangarua WD where females had penetrated through a layer of rain-compacted wood-ash several centimetres thick where a house had recently burned down. Many nests of *L. pango* were also present, and nest tunnels of the 2 species could not be distinguished one from the other by eye. On 7 October 1982, of 14 nests, the depth to the first prepupa ranged from 16 to 250 mm (156.4 mm ± 41.5 mm). Seven cells were associated with 1 nest tunnel, with 10–20 mm between the cells. Two cells near another nest tunnel were 20 mm apart. A total of 136 bee prepupae were found, and several *Pseudofoenus* sp. prepupae.

**Associated organisms.** Twelve females carry from 1 to 12 mites (mean 3.2), and 8 males carry from 1–8 mites (mean 3.1). *Pseudofoenus* sp. prepupae (Hymenoptera: Gasteruptionidae) were present in the Karangarua WD nest site, but whether nests of *L. huakiwi* and/or *L. pango* were attacked is unknown.

**Etymology.** *huakiwi*: Maori name for kiwifruit, *Actinidia deliciosa*. Refers to the very common occurrence of this species on the flowers of kiwifruit.

**Remarks.** Female *L. huakiwi* can be distinguished by the longitudinal, ridge-like appearance of the supraclypeus. This character is most obvious in lateral view, when the top of the ridge describes a straight, rising profile from just above the clypeus to a peak between the antennal sockets. For males, the most distinctive characteristic is the shortness of the vestiture on the sides of the supraclypeus, which imparts a sunken appearance to the vestiture of the area. The apices of the penis valves when viewed from the posterior are very narrow.

Although the number of records of native flowers from which this species collects pollen is limited, the data suggest that there is no obvious specialization to any particular grouping of families. This may partly explain the species' ability to exploit a diversity of introduced flowers for pollen, and particularly kiwifruit.

Nest site requirements are more diverse than for any other *Leioproctus* species. Almost any bare or near-bare particulate, dry substrate appears to be suitable, and at any altitude within the vegetative zone.

This is *Leioproctus* 'B' of Primack (1983), 319, 326, 332 (flower records, reach high density).

### *Leioproctus (Leioproctus) imitatus* Smith

Fig. 2c–f, 39a–m; Map 3

*Leioproctus imitatus* Smith, 1853: 9 (description of female).

Hutton, 1874: 164 (list). —1881: 96 (repeats description of Smith 1853). Kirby 1881: 36 (list, also Australia). —1884: 66 (list). Dalla Torre, 1896: 47 (list, New Zealand, Australia). Cameron, 1898: 3 (also found in Australia). —1903: 299 (list). Cockerell, 1904a: 204 (differences from *L. boltoni* and *L. vestitus*). Hutton, 1904: 96 (list). Cockerell, 1905a: 344 (characters of venation), 348 (*imitatus* is type of *Leioproctus*). —1929a: 311 (type of *Leioproctus* Smith). Sandhouse, 1943: 563 (Type species of *Leioproctus* Smith). Michener, 1965: 47 (Type: *Leioproctus* Smith, 1853). Primack, 1978: 68 (as *imatatus*, on manuka flowers). Donovan, 1980: 106 (visits Myrtaceae). Primack, 1983: 319 (as *imatatus*, flower record), 326, 332 (flower record). Donovan & Macfarlane, 1984: 249 (can be extremely abundant on host flowers, visits myrtaceous natives). Andrews & Gibbs, 1989: 109 (not taken on Cook's *Endeavour* voyage 1769–1770). Michener, 1989: 641 (Type species of *Leioproctus*). —2000: 150 (Type species of *Leioproctus*).

*Paracolletes imitatus*: Cockerell, 1905a: 344 (new combination), 348 (key). —1913a: 277 (*P. maorium* is related). —1916b: 361 (list). —1925: 551 (*Paracolletes monticola* new species, male, cannot be the male of *P. imitatus*).

*Paracolletes maorium* Cockerell, 1913a: 276–277 (description of female, related to *P. confusus*, *P. imitatus*, and *P. metallicus*). —1916b: 361 (list). —1934: 16, 20 (key), 29 (described from New Zealand and probably not Australian, but a specimen seen labelled "New Holland").

#### **New synonymy.**

*Paracolletes viridibasis* Cockerell, 1936: 447 (description of female), 448 (runs to *P. metallescens* Ckll. or *P. providus* Smith, Australian species), 449 (upper part of metathorax on each side of basal area is dull). **New synonymy.**

*Leioproctus (Leioproctus) imitatus*: Michener, 1965: 51 (new combination). Valentine & Walker, 1991: 41 (list).

*Leioproctus (Leioproctus) maorium*: Michener, 1965: 51 (new combination). Valentine & Walker, 1991: 41 (list).

*Leioproctus (Leioproctus) viridibasis*: Michener, 1965: 52 (new combination). Valentine & Walker, 1991: (list).

**Female** (n = 20). Length 9.1–12.5 mm (10.8 ± 0.93 mm); width 3.1–3.7 mm (3.4 ± 0.18 mm); forewing length 6.2–7.5 mm (6.7 ± 0.35 mm); facial length 1.9–2.3 mm (2.2 ± 0.11 mm); facial width 2.0–2.4 mm (2.2 ± 0.11 mm); malar length/malar width 0.22.

**Coloration.** Head, mesosoma, and metasoma black, antennae brown beyond about 2nd–3rd flagellar segment, much lighter ventrally than dorsally, apex of mandibles and tarsal claws red, wing membranes hyaline, wing veins brown, tibial spurs pale, apical margins of terga 1–5 and sterna 1–5 hyaline, pygidial plate red-black.

**Structure.** (Fig. 39a–b). Scape slightly longer than combined length of first 6 flagellar segments. Compound eyes about 4× longer than wide, with upper 1/3 and lower 2/3 of inner margins converging moderately above and below respectively. Ocellular distance about 3 ocellar diameters; interocellar distance 0.6× an ocellar diameter. Antennal sockets a little closer to vertex than to apex of clypeus. Face shiny throughout. Supraclypeus rising rather evenly from below and laterally to a slightly longitudinal mound between antennal sockets, with medium-sized punctures throughout, punctures contiguous around margins, separated by less than 1 diameter medially; frontal ridge extending about 3/4 of distance to median ocellus, frontal line extending to median ocellus. Frons and paracocular areas with close punctures except area between lateral ocellus and compound eye almost impunctate, punctures below ocelli small, punctures ventrally on paracocular areas medium-sized to large. Clypeus slightly protuberant, short, extending for 1/3 its length below a line across lower margins of compound eyes, with 'beaten' appearance in median 1/3, often appearing as 2 irregular longitudinal parallel depressions flanking a median longitudinal strip which appears slightly raised; with large to very large irregular punctures separated by 1 to 0.5 diameters, punctures becoming smaller, closer laterally. Malar space short, somewhat more than 1/4 as long as wide, impunctate, shiny. Galea moderately tessellated. In lateral view, gena somewhat wider than compound eye, smooth, shiny, with small to large shallow, irregular punctures separated by up to 3 diameters.

Pronotum lightly shagreened, with small punctures separated by up to about 5 diameters; sulcus prominent dorsally, well defined dorsolaterally, obscure laterally. Scutum shiny except for anterolateral margins lightly shagreened, with medium-sized punctures separated by about 1 diameter except for broad posteromedian area almost impunctate. Scutellum shiny, with about anterior 1/2 impunctate, posterior 1/2 with very large, irregular close punctures. Metanotum with small punctures separated by 2–3 diameters, moderately shagreened.



Propodeal triangle moderately angled (Fig. 39k), angle rounded, lightly to moderately shagreened; remainder of propodeum moderately shagreened, shiny, with small punctures separated by 1–2 diameters. Remaining lateral areas of mesosoma very lightly shagreened, shiny, with medium-sized punctures separated by 1–2 diameters, except metepisternum moderately shagreened, impunctate. Basitibial plate about 1/4 length of tibia, lightly tessellated with irregular, longitudinal ridging. Inner metatibial spur ciliate, with cilia longest near middle (Fig. 39i). Pterostigma about 4.5× longer than wide, vein 1st m-cu meets 2nd submarginal cell about middle.

Metasomal terga 1–5 and sterna 1–5 shagreened, with small to very small punctures separated by about 2–6 diameters; sternum 1 shallowly emarginate apically. Pygidial plate moderately wide basally, narrowing to a rounded apex, broad central area slightly raised, edges markedly raised, shagreened/tessellated, with very small, numerous, irregular longitudinal ridges (Fig. 39j).

**Vestiture.** Off-white on clypeus, supraclypeus, around antennal sockets and lower 1/2 of paraocular areas; black elsewhere on face including a very narrow strip on lower 1/2 of paraocular areas adjacent to compound eye. Clypeal vestiture very sparse, short, so that clypeus appears almost naked; supraclypeal vestiture very short, with hair length about equal to width of lower 1/2 of scape, edges of supraclypeus obscured but remainder visible. Genal vestiture off-white. On mesosoma, vestiture dense dorsally but not obscuring surface, black on broad median longitudinal dorsal area, off-white elsewhere. Trochanteral flocus of long, white, short-branched hairs (Fig. 39g); femoral vestiture off-white except narrowly brown-black apically, basitibial plate with a few very short, dark hairs. Tibial scopa white to off-white, with a few short dark hairs beside basitibial plate, hairs stout with from 1 to 3–4 branches (Fig. 39h). Metabasitarsus with hairs on outer face short, unbranched, not forming scopa. Metasomal terga 1–4 with sparse vestiture, long on tergum 1, very short on terga 2–4, prepygidial fimbria dense, hairs long; vestiture pale on terga 1–2, becoming darker on terga 2–4, prepygidial fimbria very dark. Sterna 1–5 with moderately long, pale vestiture, moderately dense on discs, sterna 2–4 with well developed apical fimbria.

**Male** (n = 20). Length 8.9–12.6 mm ( $10.8 \pm 0.94$  mm); width 3.1–3.7 mm ( $3.4 \pm 0.17$  mm); forewing length 6.2–7.6 mm ( $6.8 \pm 0.32$  mm); facial length 1.9–2.3 mm ( $2.2 \pm 0.10$  mm); facial width 2.0–2.3 mm ( $2.2 \pm 0.09$  mm); malar length/malar width 0.23.

**Coloration.** Similar to female.

**Structure.** (Fig. 39c–d). Scape a little shorter than combined length of first 4 flagellar segments. Compound eyes

somewhat less than 4× longer than wide, with inner margins similar to female. Ocellocular distance almost 3× an ocellar diameter; interocellar distance equal to about 0.7× an ocellar diameter. Position of antennal sockets similar to female. Supraclypeus rising steadily from below and laterally to a stubby, low peak between antennal sockets, with very close, medium-sized punctures. Clypeus moderately protuberant, extending for 1/4 its length below a line across lower ends of compound eyes, with medium-sized to large, close punctures throughout, very lightly tessellated. Malar space similar to female. Remainder of face similar to female, except frons lightly tessellated, punctures closer. Mesosoma similar to female. Basitibial plate a little less than 1/4 length of tibia. Wing similar to female.

Metasomal terga 1–5 and sterna 1–5 much as in female. Sternum 7 (Fig. 39e) with basal lobes widened apically, apical lobes with posterior inner margins angled, fringed with short, stout hairs. Sternum 8 (Fig. 39f) with shaft of apical process narrowed medially. Gonocoxites in dorsal and ventral views (Fig. 39l) stout, gonostyli moderately acute apically, incurved; in lateral view (Fig. 39m) penis valve just projecting below gonocoxite.

**Vestiture.** On clypeus moderately long, off-yellow, about 1/2-obscuring surface. Remainder of face below a horizontal line about midway between antennal sockets and median ocellus with orange-yellow vestiture except for narrow band of black hairs adjacent to compound eyes; supraclypeus and immediately adjacent paraocular areas with very short, compact, matt-like vestiture, obscuring surface, vestiture on supraclypeus standing erect, that on adjacent paraocular areas directed laterally. Remaining areas of face with black vestiture. Genal vestiture similar to female. Mesosomal vestiture similar to female. Metasomal vestiture similar to female except more sparse, with sterna with apical fimbria scarcely present.

**Variation.** Of the 1868 females, 30 have the dorsal half of the scopa dark or brown/black, and 2 other females have a 1/3 or less of the dorsal 1/2 of the scopa adjacent to the basitibial plate with this coloration. These females are from ND (8), AK (20), CL (1), WO (1) and TO (2). Sixteen of the females with the dorsal 1/2 of the scopa coloured were among the 530 females taken in emergence traps at Island Bay, Birkdale AK, as were the 2 females with less colouring. The vestiture of females from north of the Waitemata area AK becomes increasingly yellow and more extensive with decreasing latitude.

On males the orange-yellow of the short vestiture of the supraclypeal and adjacent paraocular areas which is bright on young bees, rapidly fades with increasing age to off-white on old bees. Young bees of both sexes sometimes display a slight greenish metallic coloration to the abdomen. One male from Whare Creek MB has only 2 submarginal

cells in both forewings.

**Type data.** *Leioproctus imitatus*: holotype female, “New Zealand” (BMNH). *Paracolletes maorium*: holotype female, “New Zealand”, 1909, French (BMNH). *Paracolletes viridibasis*: holotype female, “Wairau River near Lake Rotoiti MB”, 5 December 1934, G. V. Hudson (BMNH).

**Material examined.** Type specimens, plus 1865 females and 2258 males.

**Distribution** (Map 3). North Island: ND, AK, CI, WO, BP, TK, TO, GB, RI, HB, WI, WN, WA. South Island: SD, NN, BR, MB, KA, WD, NC, MC, FD, OL, CO, DN.

However, the abundance of the species wherever it has been collected on *Kunzea ericoides* and *Leptospermum scoparium*, suggests that its lack of occurrence in MK, SC, SL, and SI is probably due to a lack of collecting, rather than a real absence. Collection dates for the total of 838 collections range from 3 September to 4 May, with 52.7% of collections taken in December.

**Biology.** Collection data show that *Leioproctus imitatus* occurs from sea level to 1067 m, almost throughout the country, except possibly for the south central South Island and Stewart Island.

**Flight period.** The earliest seasonal capture record for both sexes is 3 September, and the latest for females is 4 May, and for males, 25 February. For the 437 collections of 1,865 females, 19.0%, 51.9% and 20.8% were taken in November, December and January respectively. There was also 1 collection in March from summit snow on Mt Egmont, but this is excluded from consideration here because the date at which the bees were trapped is unknown. For 401 collections of 2,258 males, 28.7%, 53.6% and 11.7% were taken in the same three months respectively.

#### Number of collections

	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May
Females	2	16	83	227	91	15	2		1
Males	4	12	115	215	47	8			

This species can be extremely abundant. The largest single collection of 359 females, 17 of which are carrying pollen, and 39 males, was taken on the bank of the South Branch, Hurunui River NC, on 4 January 1987, clustered on leaves of *Salix fragilis*, by R. P. Macfarlane. There are 5 other collections of between 50–100 bees, all taken in association with flowers, of which the largest is of 95 males from Conway Flat NC, on 7 November 1970, from *Leptospermum scoparium*, by R. P. Macfarlane. There are also 3 collections of between 30–50 bees.

#### Host plants

##### Native plants

Euphorbiaceae		
<i>Dracophyllum filifolium</i>	—	♂ 2/7
Hemerocallidaceae		
<i>Phormium tenax</i>	—	♂ 1/1
Laxmanniaceae		
<i>Cordyline australis</i>	—	♂ 1/5
Myrtaceae		
<i>Kunzea ericoides</i>	♀ 35/267 (32/206 p)	♂ 33/228
<i>Leptospermum scoparium</i>	♀ 54/234 (46/181 p)	♂ 56/410
<i>Kunzea/Leptospermum</i>	♀ 2/56 (2/55 p)	♂ 4/54
<i>Lophomyrtus obcordata</i>	♀ 1/1 (1/1 p)	—
<i>Metrosideros excelsa</i>	♀ 4/8 (3/3 p)	♂ 1/3
Plantaginaceae		
<i>Hebe</i> sp.	♀ 1/2 (1/2 p)	♂ 1/4
Polygonaceae		
<i>Muehlenbeckia australis</i>	—	♂ 1/1
<i>Muehlenbeckia complexa</i>	♀ 1/1 (1/1 p)	♂ 1/18
<b>Total collections/specimens</b>	♀ 98/569 (86/449 p)	♂ 101/731
<b>Species/genera/families</b>	6/6/3 (6/6/3 p)	9/8/6

##### Introduced plants

Actinidiaceae		
<i>Actinidia deliciosa</i> female	♀ 3/5	♂ 3/7
male	♀ 3/3 (2/2 p)	♂ 3/5
female/male	♀ 4/4	♂ 1/1
Apiaceae		
<i>Daucus carota</i> , wild	♀ 2/5 (1/1 p)	♂ 1/17
Asteraceae		
<i>Carduus nutans</i>	♀ 1/1 (1/1 p)	—
<i>Taraxacum officinale</i>	—	♂ 1/1
Caprifoliaceae		
<i>Kolkwitzia</i> sp.	—	♂ 1/3
Fabaceae		
<i>Lupinus</i> sp.	—	♂ 1/3
Fagaceae		
<i>Castanea sativa</i>	♀ 1/1 (1/1 p)	—
Lauraceae		
<i>Persea americana</i>	♀ 3/3 (3/3 p)	♂ 3/129
Myrtaceae		
<i>Myrtus communis</i>	—	♂ 1/1
Oleaceae		
<i>Ligustrum</i> sp.	—	♂ 3/5
Plantaginaceae		
<i>Digitalis purpurea</i> (bunched on)	—	♂ 1/11
Rutaceae		
<i>Citrus</i> sp.	—	♂ 2/3
<b>Total collections/specimens</b>	♀ 17/22 (5/5 p)	♂ 21/186
<b>Species/genera/families</b>	5/5/5 (5/5/5 p)	10/10/10

For native flowers, all except 39 bees were taken on Myrtaceae, and only 3 of the 39 were female, but all carry pollen. Within the Myrtaceae, *Kunzea ericoides* and *Leptospermum scoparium* are by far the most attractive to both sexes of bees.

Apart from 129 males associated with *Persea*

*americana*, there are no major preferences for any particular introduced plants. Eight female bees carrying pollen have also been captured on the introduced flowering *Actinidia deliciosa*. However, as part of another project, 6 females were sonicated to remove pollen.

In addition to these collection records for bees from flowers, male bees have been captured over non-flowering *Cytisus scoparius*, and *Ulex europaeus* heavy with seed pods (Fabaceae). During late evening, 39 males and 359 females were swept from the foliage of *Salix fragilis* (Salicaceae) on the bank of the South Branch of the Hurunui River NC, on 4 January 1987. Of the females, 17 carry appreciable loads of pollen, and most have traces of pollen.

**Nest sites.** Excluding the Island Bay, Birkdale AK nest site, there are 38 references to nest sites among the collected bees. Fourteen of these refer to nests in banks, 7 to nests in flat or near-flat ground, and 6 each to nests in clay and sandy/saline ground. Three collections were made of female bees over nests under flowering *Actinidia deliciosa*, with males also present in 1 of these. Females were also taken returning to nests outside vines of *Actinidia deliciosa*, and under *Leptospermum scoparium*.

Donovan (1967) described the physical characteristics of sandstone cliffs on the edge of the Waitemata Harbour at Island Bay, Birkdale AK, where thousands of bees nested annually. Nests of *Leioproctus imitatus* were predominant, but *L. boltoni*, *L. huakiwi*, *L. kanapuu*, *L. paahaumaa*, *L. pango* and *Lasioglossum cognatum* also occurred in the same substrate, with many of the nests intermixed.

**Associated organisms.** For all collections except those from Island Bay, Birkdale AK, 49 females carry 1–34 large mites (mean 2.89), and 36 males carry 1–10 large mites (mean 2.50). Three females and 10 males carry 1 small mite each (plus a couple of other mites). For bees taken in emergence cages at Island Bay, Birkdale AK, 206 females of 550 each carry 1–64 large mites, and 104 males of 736 each carry 1–15 large mites.

At Island Bay, Birkdale AK, nests of *Leioproctus* spp. were attacked by *Pseudofoenus* sp.

**Remarks.** Females of this species can be distinguished from *L. metallicus*, which also has white scopae, by their smaller and more smoothly sculptured pygidial plate, their smaller size, and their occurrence away from coastal regions (apart from 2 records from TO, and the south central South Island where *L. metallicus* is also present). Young males are distinctive because of the very short, dense, orange-yellow vestiture of the supraclypeus and adjacent paracocular areas.

*Leioproctus imitatus* is the most abundant species of the genus in New Zealand. This abundance is the result of 2 factors, 1; the ability of the species to utilise a wide range of substrates as nest sites, and 2; the widespread abundance

almost throughout the country of the bees' 2 most preferred host plants, *Kunzea ericoides* and *Leptospermum scoparium*. Of note is the almost exclusive restriction of the species' pollen sources to the native myrtaceous *K. ericoides* and *L. scoparium*, and to a much lesser extent, *Metrosideros excelsa*. However, the collection of pollen by 3 females from 2 other native plants in 2 other families, and by at least 4 females and possibly 10, of pollen from 3 introduced plants, each in a different family, suggests that there is some plasticity, albeit very restricted, in the pollen-foraging habits of the species. The very small level of occurrence of *L. imitatus* on kiwifruit flowers, *Actinidia deliciosa*, is of note, and especially so in contrast to the abundance on kiwifruit flowers of *L. boltoni* and *L. huakiwi*, both of which also occur in large numbers on *K. ericoides* and *L. scoparium*. The lack of occurrence of *L. imitatus* on kiwifruit is not because of lack of opportunity; on several occasions I have observed *L. imitatus* swarming in huge numbers on flowering kanuka and manuka adjacent to extensive commercial orchards of kiwifruit in full flower, yet although *L. boltoni* and *L. huakiwi* were common on the kiwifruit flowers, *L. imitatus* were completely absent.

Of interest is the lack of collection of this species during Cook's *Endeavour* voyage of 1769–1770, when Andrews & Gibbs (1989) found its numbers to be impressive on sandy beaches at Mercury Bay CL and Bay of Islands ND over 200 years later over dates when the *Endeavour* was there, or at least within a few days of those dates.

### *Leioproctus (Leioproctus) kanapuu* new species

Fig. 3a–d, 40a–n; Map 4

**Female** (n = 20). Length 9.2–11.9 mm (10.9 ± 0.68 mm); width 2.8–3.8 mm (3.4 ± 0.24 mm); forewing length 5.8–7.4 mm (6.8 ± 0.36 mm); facial length 1.9–2.3 mm (2.1 ± 0.11 mm); facial width 1.9–2.4 mm (2.2 ± 0.12 mm); malar length/malar width 0.17.

**Coloration.** Head, mesosoma and metasoma black, except antennae dark brown beyond about 2nd flagellar segment, apex of mandibles and tarsal claws red, wing membranes hyaline, wing veins dark brown to black, tibial spurs pale, apical margins of metasomal terga 1–5 and sterna 1–5 hyaline, pygidial plate dark brown.

**Structure.** (Fig. 40a–b). Scape equal in length to combined length of first 6 flagellar segments. Compound eyes about 4× longer than wide, with upper 1/3 of inner margins converging markedly above, lower 2/3 of inner margins converging less markedly below. Ocellular distance 2.5× an ocellar diameter; interocellar distance about 0.60× an ocellar diameter. Antennal sockets a little closer to apex of clypeus than to vertex. Face shiny throughout. Supraclypeus rising rather evenly from below and laterally

to a prominent, elongated, longitudinal rounded ridge between antennal sockets; front margin and lateral slopes with medium-sized punctures, upper 1/2 to 1/3 of ridge smooth, impunctate; frontal ridge extending about 2/3 of the way to median ocellus, frontal line extending to median ocellus. Frons and paraocular areas with medium-sized punctures separated by 1 and sometimes 2 diameters, except area between lateral ocellus and compound eye almost impunctate. Clypeus wide, gently rounded from side to side, short, extending for 1/3 its length below a line across lower margins of compound eyes, mirror-like, lateral and dorsal margins with a few close, medium-sized punctures, remainder with large to very large punctures separated so widely that a broad central area may be impunctate; sometimes central area of clypeus with faint, 'beaten' appearance. Malar space short, about 1/6 as long as wide, impunctate, shiny. Galea faintly tessellated. In lateral view, gena a little wider than compound eye, shiny, with shallow, medium-sized punctures separated by about 1 diameter.

Pronotum moderately shagreened, sulcus shallow laterally, prominent dorsally. Scutum shiny, with very narrow anterior margin lightly shagreened, with medium-sized punctures separated by 1 diameter or less around margins, but becoming more widely separated centrally so a small area appears impunctate. Scutellum shiny, anterior 1/2 impunctate, posterior 1/2 with large, irregular punctures separated by about 1 diameter. Metanotum moderately shagreened. Propodeal triangle moderately angled, angle rounded (Fig. 40k), ridges extending from lateral corners less than halfway towards triangle centre, lightly shagreened, shiny; remainder of propodeum moderately shagreened, small punctures obscured or indistinct. Remaining lateral areas of mesosoma lightly shagreened, shiny, anterior of mesepisternum with medium-sized to large punctures separated by 1–3 diameters, punctures indistinct on remainder of mesepisternum, metepisternum impunctate. Basitibial plate 1/4 length of metatibia, lightly tessellated, irregularly ridged longitudinally. Inner tibial spur ciliate, with cilia more widely spaced beyond middle (Fig. 40i). Pterostigma 4× longer than wide, vein 1st m-cu meets 2nd submarginal cell at middle.

Metasomal terga 1–5 and sterna 1–5 lightly shagreened, with small punctures separated by 2–3 diameters; sternum 1 broadly and shallowly emarginate apically. Pygidial plate moderately broad basally, rounded apically, lateral edges raised, median area almost flat, lightly tessellated/shagreened, shiny (Fig. 40j).

**Vestiture.** Off-white on clypeus, supraclypeus and lower margins of paraocular areas up to antennal sockets, black on remainder of face; on clypeus vestiture very sparse, very short, so clypeus appears almost naked. Genal vestiture

off-white. On pronotal lobe, anterior and lateral margins of scutum and scutellum and ventral areas of mesosoma, vestiture off-white, black on remaining areas; on scutum short, not obscuring surface. Trochanteral floccus of long, white hairs with short branches (Fig. 40g); femoral vestiture white except black apically; basitibial plate with very short black hairs. A little more than dorsal 1/2 of tibial scopa black/brown, remainder off-white, hairs stout with 3–5 branches Fig. 40h). Metabasitarsus with hairs on outer face short, unbranched, not forming scopa. Metasomal vestiture off-white on terga 1–2, black on tergum 3, sparse on terga 1–4, very short on terga 2–4; prepygidial fimbria black, longer. On sterna 1–4 vestiture off-white to white, black/brown on sternum 5, moderately dense on discs of sterna 1–5, forming apical fimbria on sterna 2–5, on sternum 6 black, short.

**Male** (n = 20). Length 7.5–10.0 mm ( $9.2 \pm 0.68$  mm); width 1.7–3.1 mm ( $2.6 \pm 0.31$  mm); forewing length 4.9–6.5 mm ( $6.1 \pm 0.38$  mm); facial length 1.5–2.0 mm ( $1.9 \pm 0.13$  mm); facial width 1.6–2.0 mm ( $1.9 \pm 0.12$  mm); malar length/malar width 0.16.

**Coloration.** Similar to female.

**Structure.** (Fig. 40c–d). Scape about equal in length to combined length of first 4.5 flagellar segments. Compound eyes as in female. Ocellocular distance equal to 3× an ocellar diameter; interocellar distance similar to female. Antennal sockets equidistant between apex of clypeus and vertex. Supraclypeus rising to a moderately sharp point between antennal sockets, narrow area below point to clypeus, and laterally just below point, impunctate; remainder of supraclypeus with medium-sized, close punctures. Clypeus slightly protuberant, extending below a line across lower end of compound eyes as in female, shiny, with medium-sized to large punctures throughout, separated by about 1/2 a puncture diameter, becoming slightly larger ventrally. Remainder of head similar to female.

Mesosoma similar to female except scarcely any shagreening on anterior margin of scutum. Basitibial plate and wing similar to female.

Metasomal terga 1–5 and sterna 1–6 similar to female. Sternum 7 (Fig. 40e) with apical lobes angled on posterior inner margins, margins fringed with short, moderately stout hairs. Sternum 8 (Fig. 40f) with apical lobe rounded, very large, width slightly more than 1/2 width of base. Gonocoxites in dorsal and ventral views (Fig. 40l) bluntly rounded laterally, gonostyli slightly incurved apically, penis valves acute apically; in lateral view (Fig. 40m), penis valve projecting only slightly below upper margin of gonostylus.

**Vestiture.** Similar on head to female except that vestiture that is off-white on female is more yellow, extends further up face to surround antennal sockets, and is much more

dense, partly obscuring surface.

Mesosomal vestiture distributed similarly to female, but longer dorsally.

Metasomal vestiture distributed similarly to female, except very sparse, apical fimbriae absent.

**Variation.** Specimens from Island Bay Road, Birkdale AK, have a much greater yellow tinge to the vestiture that is not black than other specimens, and it is more extensive; on the face the yellow-tinted vestiture extends somewhat above the antennal sockets, and more laterally towards the compound eyes.

**Type data.** *Leioproctus kanapuu*: holotype female, here designated, Abut Head, Whataroa WD, bee nest site in cliff, 7 December 1975, B. J. Donovan, (NZAC). Allotype male, here designated, same data as holotype. Eight paratype females and 21 paratype males, same data as holotype.

**Material examined.** Type specimens, plus 110 females and 130 males.

**Distribution** (Map 4). Coastal and lowland areas. North Island: ND, AK, HB, WN. South Island: SD, NN, BR, MB, KA, WD, NC, MC, SC.

Collection dates for the 94 collection records range from 18 September to 14 January, with 77.6% taken in December. Also, 5 prepupae were excavated from a nest site at Abut Head WD on 25 February 1995.

**Biology.** Collection site data indicate that this species occurs primarily on or near the coast and low-lying adjacent areas, however it has been captured well inland in MC and SC. There is only one altitude record of 30 m, but at Island Bay Road, Birkdale AK, Saltwater Lagoon WD and Abut Head, Whataroa WD, nesting bees were captured at coastal cliffs just above high tide level.

**Flight period.** The 57 collection dates for 119 females range from 18 September to 22 January, with 77.2% in December and 19.3% in January. For 152 males, the 37 collection dates range from 7 November to 18 January, with 13.5% in November and 78.4% in December.

#### Number of collections

	Sep	Oct	Nov	Dec	Jan
Females	1		1	44	11
Males			5	29	3

There are 5 collections of 10 or more bees. The largest is of 3 females and 36 males from the Saltwater Lagoon WD, at a vertical nest site in an ocean-cut cliff, on 7 December 1975 by B. J. Donovan, and on the same day 9 females and 22 males were taken at Abut Head, Whataroa River WD, at a nest site in an ocean-cut cliff, by B. J. Donovan. Eleven males were taken at the same site on 3 December 1974 by B. J. Donovan, and 8 females and 2 males were caught at

the same site on 6 December 1976 by the same collector. Six females and 7 males were captured in a cage installed by B. J. Donovan and which covered 0.25<sup>2</sup> m at Island Bay Road AK, as they emerged for the first time from overwintering nests in a sandstone oceanside cliff on 14 December 1965.

#### Host plants

##### Native plants

###### Myrtaceae

<i>Kunzea ericoides</i>	♀ 2/2 (1/1 p)	♂ 5/7
<i>Leptospermum scoparium</i>	♀ 2/9 (2/9 p)	♂ 2/5
<i>Kunzea/Leptospermum</i>	♀ 1/1 (1/1 p)	♂ 1/3
<i>Metrosideros excelsa</i>	♀ 4/5 (2/3 p)	—

<b>Total collections/specimens</b>	♀ 9/17 (5/13 p)	♂ 8/15
<b>Species/genera/families</b>	3/3/1 (3/3/1 p)	2/2/1

##### Introduced plants

###### Actinidiaceae

<i>Actinidia deliciosa</i> female	♀ 1/1	—
male	♀ 3/3 (1+?/1 + ? p)	—

###### Apiaceae

<i>Daucus carota</i>	♀ 1/1 (1/1 p)	—
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###### Boraginaceae

<i>Echium vulgare</i>	♀ 1/1 (1/1 p)	—
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###### Fagaceae

<i>Castanea sativa</i>	♀ 1/2 (1/2 p)	—
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<b>Total collections/specimens</b>	♀ 7/8 (4/5 p)	—
<b>Species/genera/families</b>	4/4/4 (4/4/4 p)	—

However, 3 other females from *Actinidia deliciosa* were sonicated to remove pollen as part of another study. Male bees have not been captured from introduced plants.

**Nest sites.** There are 6 records of nest sites, all of which are bank, clay bank, vertical nest site, track, or nest site in cliff (2). At Island Bay Road, Birkdale AK, bees nested in vertical sandstone cliffs on the edge of the Waitemata Harbour. Nests were interspersed among those of *L. boltoni*, *L. huakiwi*, *L. imitatus*, *L. paahaumaa*, *L. pango* and *Lasioglossum cognatum*. At Saltwater Lagoon and Abut Head, Whataroa WD, bees were nesting in fine glacial deposits exposed in vertical ocean wave-cut cliffs, from just above beach sand level at the base of the cliffs to 5 or more metres above. On 25 February 1995, 5 prepupae were excavated from the Abut Head nest site (Fig. 40n).

**Associated organisms.** Of 51 females from Island Bay Road, Birkdale AK, 9 carry 1–4 large mites (mean 1.44) and 25 females carry 1 to about 20 small mites (mean 5.4). Four of the females that carry 1–4 large mites also carry 1–20 small mites. Seven males carry 1–3 large mites (mean 1.28), and 12 males carry 1–8 small mites (mean 3). Of these males, 1 carries both 1 large mite and 1 small mite. For 20 females from Abut Head and Saltwater Lagoon WD, 8 have 1–10 large mites (mean 4) and 1 carries 1 small mite, and of 71 males, 17 have 1–3 large mites (mean 1.38) and 5 have 1

small mite. One of these 5 males also carries 1 of the large mites. One female from Kaituna Valley MC has 1 large mite. *Pseudofoenus* sp. was common at Island Bay and the Abut Head area, but whether *L. kanapuu* was attacked is unknown.

**Etymology.** *kanapuu*: Maori = bright, shiny. Refers to the broad, smooth shiny clypeus of females.

**Remarks.** This species appears to be similar in its broad physical characteristics to *L. boltoni*, but females are readily distinguished by their wide, shiny, mirror-like clypeus, and the males by the very large apical process on the eighth metasomal sternum. However unlike *L. boltoni* which nests throughout most of the country, the range of *L. kanapuu* appears to extend only to a limited degree beyond low-lying coastal areas.

### *Leioproctus (Leioproctus) keehua* new species

Fig. 3e–f, 4a–b, 41a–p; Map 5

**Female** (n = 20). Length 6.9–9.5 mm ( $8.0 \pm 0.69$  mm); width 2.2–2.9 mm ( $2.5 \pm 0.18$  mm); forewing length 4.6–5.5 mm ( $5.1 \pm 0.22$  mm); facial length 1.7–2.1 mm ( $1.9 \pm 0.09$  mm); facial width 1.6–2.0 mm ( $1.8 \pm 0.09$  mm); malar length/malar width 0.28.

**Coloration.** Head, mesosoma and metasoma black, except apices of mandibles and tarsal claws red, antennae brown beyond about 2nd flagellar segment to light brown/yellow distally; remaining areas, particularly extremities, brown or red/brown, except wing membranes and apical margins of metasomal terga 1–5 and sterna 1–5 hyaline, tibial spurs pale.

**Structure.** (Fig. 41a–b). Scape as long as combined length of first 6 flagellar segments. Compound eyes a little more than 4× longer than wide, with about upper 1/3 and lower 2/3 of inner margins converging markedly above and below respectively. Ocellular distance a little more than 2 ocellular diameters; interocellar distance equal to about 0.8× an ocellular diameter. Antennal sockets about 1.15× further from apex of clypeus than from vertex. Face shiny throughout. Supraclypeus rising from below to a rounded, smooth, impunctate elongated mound between antennal sockets, lateral areas with medium-sized close punctures; frontal ridge low, extending about 3/4 of the way to median ocellus, frontal line continuing diffusely to median ocellus. Frons very lightly shagreened, with medium-sized punctures separated by less than 1 diameter; area between lateral ocellus and compound eye impunctate. Clypeus somewhat protuberant, moderately long, extending for 1/3 its length below a line across lower ends of compound eyes; irregular longitudinal central area smooth, shiny, impunctate, laterally punctures large, widely and irregularly spaced.

Malar space of medium length, a little more than 1/4 as long as wide, impunctate, shiny. Galea very lightly tessellated. Genal area in lateral view somewhat narrower than compound eye, lightly tessellated, shiny, with indistinct medium-sized punctures separated by less than 1 to about 3 diameters.

Pronotum moderately shagreened, with only a few indistinct, medium-sized widely spaced punctures anteriorly; sulcus very prominent dorsally, prominent dorsolaterally, absent lateroventrally. Scutum with about anterior quarter lightly shagreened, with medium-sized punctures separated by about 1 diameter, disc almost impunctate, smooth, shiny. Anterior 2/3 of scutellum smooth, shiny, with a very few widely spaced, medium-sized punctures; posterior 2/3 lightly shagreened with large, irregular, close punctures. Metanotum moderately shagreened with small punctures separated by up to about 3 diameters. Propodeal triangle strongly angled (Fig. 41k), medially very smooth, laterally very lightly shagreened, very shiny; posterolateral areas lightly shagreened/tessellated, shiny, with indistinct, medium-sized to small, widely spaced punctures. Remaining lateral areas of mesosoma sculptured similarly to posterolateral areas of propodeum, except punctures more distinct, and metepisternum shagreened, impunctate. Basitibial plate about 1/4 as long as tibia, with longitudinal ridges, very lightly tessellated, shiny. Inner metatibial spur ciliate (Fig. 41i). Pterostigma 4× longer than wide; vein 1st m-cu meets 2nd submarginal cell at middle.

Metasomal tergum 1 smooth, shiny, terga 2–5 and sterna 1–5 very lightly shagreened, shiny; terga 1–5 with small punctures, very widely spaced on tergum 1 but becoming closer on terga 2–4, until on tergum 5 separated by about 2–4 diameters; punctation rather similarly distributed on sterna 1–5. Sternum 1 shallowly and broadly emarginate apically. Pygidial plate narrowing from moderately wide base to rounded apex, with edge and broad longitudinal median area raised, lightly tessellated (Fig. 41j).

**Vestiture.** White to near-white, except for a few black hairs on inner margins of compound eye, black on dorsal 1/2 of frons, black intermixed with white to near-white on dorsum of mesosoma, and off-white to brown-black hairs in pre-pygidial fimbria. Facial vestiture moderately long above antennal sockets, short below, with supraclypeus and particularly clypeus with very sparse vestiture, so that almost the whole surface of the clypeus is visible. Central 1/3 of scutum almost naked. Trochanteral floccus moderately well developed, of long white branched hairs (Fig. 41g). Tibial scopal hairs with about 5 branches (Fig. 41h). Metabasitarsus with hairs on outer face short, unbranched, not forming scopa. Metasomal tergum 1 with very sparse, fine vestiture; terga 2–4 with very short, sparse hairs on

disc, and poorly developed apical fimbria of short, appressed hairs, absent in about median 1/3 on terga 2–3. Sternum 1 similar to tergum 1; sterna 2–5 with sparse, long hairs on disc and dense apical fimbria.

**Male** (n = 20). Length 6.6–8.2 mm ( $7.3 \pm 0.44$  mm); width 1.9–2.3 mm ( $2.1 \pm 0.12$  mm); forewing length 4.3–4.9 mm ( $4.7 \pm 0.16$  mm); facial length 1.6–1.9 mm ( $1.7 \pm 0.08$  mm); facial width 1.5–1.9 mm ( $1.6 \pm 0.09$  mm); malar length/malar width 0.26.

**Coloration.** Similar to female, except extremities of antennae, wing veins near base, and tarsi, may be slightly yellow.

**Structure.** (Fig. 41c–d). Scape as long as combined length of first 5.5 flagellar segments. Compound eyes about 4× longer than wide, with inner margins as in female. Ocellular and intercellular distance and position of antennal sockets as in female. Supraclypeus rising from below to a rounded peak between antennal sockets, punctation much as in female. Clypeus weakly protuberant, extending for a little less than 1/3 its length below a line across lower margins of compound eyes; whole surface with large punctures separated by 1/2–1 diameter. Malar space of medium length, about 1/4 as long as wide, impunctate, shiny. Remainder of head similar to female.

Mesosoma similar to female, but dorsal area of propodeal triangle with very small transverse striae. Basitibial plate about 1/5 length of tibia; wings much as in female.

Metasomal terga 1–6 and sterna 1–6 much as in female. Sternum 7 (Fig. 41e) with basal lobes expanded apically, apical lobes almost triangular, with apical margins and ventro-apical 1/2 of lobe with short spines. Sternum 8 (Fig. 41f) with basal area produced markedly apically, apical process very short, apex bluntly rounded. Gonocoxites in dorsal and ventral views (Fig. 41i) short, stout, gonostyli markedly incurved apically; penis valves rounded apically, in lateral view (Fig. 41m) sharply downcurved but scarcely projecting below gonostylus.

**Vestiture.** White throughout. Face partly obscured, especially below antennal sockets. Long on scutum, but disc not obscured, with vestiture less dense than around periphery. Metasomal vestiture much as in female, except less dense so that tergal apical fimbria not apparent.

**Variation.** The propodeal triangle of both sexes may range from completely mirror-like, to lightly shagreened with small transverse striae, and with a shallow median longitudinal depression. In females the ratio of black hairs may be somewhat greater or less than described. The dorsal 1/2 of the scopa of 2 of 9 females from Moeraki Beach DN is very light brown.

**Type data.** *Leioproctus keehua*: holotype female, “Moeraki Beach DN, 18 January 1971, on *Selliera*

*radicans*”, B. J. Donovan and R. P. Macfarlane (NZAC); allotype male, “Birdlings Flat MC, on moist lakeside”, 18 December 1974, R. P. Macfarlane (NZAC). Six paratype females and 3 paratype males have the same data as the holotype female, and 10 paratype males have the same data as the allotype male.

**Material examined.** Type specimens, plus 17 females and 86 males.

**Distribution** (Map 5). The species has been taken only on the coast and around sea level lakes just above sea level. North Island: WI. South Island: MC, DN.

Adults have been taken from 12 December to 27 January. Eggs and larvae were found in 2 nests excavated on the shore of Lake Ellesmere MC on 31 January 1978.

**Biology.** This species has been collected only around Pukepuke Lagoon WI, Lake Ellesmere MC, and at Moeraki Beach DN. The habitat at at least the latter 2 sites consists of saline flats on the edge of bodies of fresh water which occupy areas which were formerly washed by the ocean. The salt-loving *Sarcocornia quinqueflora* (Salicorniaceae) is common where bees have been taken.

**Flight period.** Dates for the 10 collections of 24 females range from 12 December to 27 January, and for the 14 collections of 100 males, from 12 December to 17 January. Females were observed to be still active around nests at Lake Ellesmere MC on 31 January.

#### Number of collections

	Dec	Jan
Females	4	6
Males	9	5

The greatest number of females collected at one site on one day was 9, at Moeraki Beach DN on 18 January 1971 on *Selliera radicans*, by B. J. Donovan and R. P. Macfarlane. There have been 2 large collections of males on the edge of Lake Ellesmere MC; 35 were taken on 18 December 1974 on moist lakeside by R. P. Macfarlane, and 18 were captured on 9 January 1968 on *Mimulus repens* by T. P. Palmer.

#### Host plants

##### Native plants

Goodeniaceae		
<i>Selliera radicans</i>	♀ 3/13 (3/11 p)	♂ 3/16
Phrymaceae		
<i>Mimulus repens</i>	♀ 2/2 (1/1 p)	♂ 5/37
<b>Total collections/specimens</b>	♀ 5/15 (2/12 p)	♂ 8/53
Species/genera/families	2/2/2 (2/2/2 p)	2/2/2

##### Introduced plants

Fabaceae		
<i>Trifolium fragiferum</i>	—	♂ 1/3
Gentianaceae		
<i>Centaurium erythraea</i>	—	♂ 1/1
<b>Total collections/specimens</b>	♀ —	♂ 2/4
Species/genera/families	—	2/2/2

Bocher & Philipp (1985) found that *M. repens* formed extensive populations (of plants) on the summer-dry shores of Lake Ellesmere. *Leioproctus* sp. were seen to always clean themselves of pollen grains as they sat on the lower lip of a flower following a visit.

On 31 January 1978, 5 cells containing pollen were found in a nest of *L. keehua* on the northeastern edge of Lake Ellesmere. Pollen analysis conducted by Dr. N. Moar showed that in 4 cells, between 85% and 97% of pollen was *Mimulus* (mean = 93.75%), and between 0% (1 cell) and 12% was *Selliera* (mean for 4 cells 3.75%). One other cell contained 86% *Selliera* pollen and 13% *Taraxacum*-type pollen, but no *Mimulus* pollen. Traces of *Chenopodium*, *Potamogeton*, *Plantago* and Cruciferae-type pollen were found in most cells, but these were considered to be contaminants.

**Nest sites.** On 31 January 1978, female *L. keehua* were seen flying about 12 nests distributed over several square metres of saline sandy foreshore on the northeastern margin of Lake Ellesmere MC. The surface of the ground was virtually flat, with large, irregular bare patches measuring up to 20 or more metres across, apart from just a few scattered clumps of *Sarcocornia quinqueflora* and *Puccinella stricta*. The presence of nests was indicated by a tumulus of spoil up to 7 mm high and 45 mm across, ejected from the excavated tunnel beneath, with the tunnel entrance almost centrally on the apex. Two nests were excavated. One (Fig. 41n) consisted of a tunnel about 4.5 mm in diameter which dropped almost vertically for 170 mm, before angling a little below the horizontal for 30 mm. Loosely packed sand filled most of the tunnel. About 115 mm from the surface of the lakeside, a side tunnel 40 mm long ran off at about 40° below the horizontal, where it terminated in a cell. Three other tunnels, each terminating in a cell, ran off the main tunnel below the first tunnel. All four side tunnels were so firmly packed with sand that one tunnel could not be distinguished from the substrate with certainty. The cells (Fig. 41o) were elongate-ovoid with the long axis near-horizontal, and were lined with cellophane-like material. Maximum diameter was 5.6 mm, and maximum length to the tunnel end of the cellophane-like material was 11.5 mm. The first 20 mm beyond the cellophane-like material was plugged with very densely compacted sand, and beyond that there was a cone-shaped space with the apex of the cone pointing towards the tunnel, in the less densely packed sand of the tunnel fill. Each cell contained a pollen ball, the diameters of which were 3.5, 3.5, 4 and 4.2 mm, and each pollen ball was surrounded by a narrow ring of nectar. A curved egg (Fig. 41p) which measured 2.37 mm long and 0.75 mm wide at its widest was found on one pollen ball. Two other cells contained very small larvae, and the fourth cell contained a slightly larger larva.

**Associated organisms.** One paratype female carries 3 large mites on the posterior margin of the mesosoma.

**Etymology.** *keehua*: Maori = spirit. Refers to the white, almost ghostly appearance of bees as they fly low over nesting and foraging areas.

**Remarks.** The apparent distribution restriction of this species to coastal saline substrate severely limits the areas that it might be found in compared to the wider potential or actual distributions of most of the other species of *Leioproctus*. The large size of the saline areas around much of the margin of the 25 × 12.75 km Lake Ellesmere should enable the species to survive in good numbers in this area alone, but only if the lake margins are not modified further, and especially if the water level is maintained below the nesting areas at least through the nesting period.

This is the *Leioproctus* sp. of Bocher and Philipp (1985), 143 (flight distance between flowers of *Mimulus repens*), 144 (less numerous than honey-bees), 146 (flower visiting data), 147 (bee always cleaned itself of pollen grains following a flower visit).

### *Leioproctus (Leioproctus) metallicus* (Smith)

Fig. 4c–f, 42a–m; Map 6

*Dasycolletes metallicus* Smith, 1853: 15 (description of female, male closely resembles the female but is smaller). Butler, 1874: 27 (recorded from New Zealand, as *Andrena trichopus* White Ms., tab. 7, f. 12.; drawing of female; synonymy). Hutton, 1874: 164 (list). —1881: 98 (repeats description of Smith 1853). Kirby, 1881: 37 (list). —1884: 67 (list). Dalla Torre, 1896: 49 (list, Australia, New Zealand). Cameron, 1903: 299 (list). Cockerell, 1904a: 203 (*Leioproctus metallicus* (*Dasycolletes metallicus*), differences from *Leioproctus boltoni*). Hutton, 1904: 96 (list). Cockerell, 1905a: 344 (minutely ciliate appearance of hind spur), 347 (*metallicus* is type of *Dasycolletes*). —1934: 10 (discusses characters of *Paracolletes* –hind spur of hind tibia may be minutely ciliate, at first glance appearing simple, as in *P.* (or *Dasycolletes metallicus*)). Sandhouse, 1943: 544 (Type species of *Dasycolletes* Smith). Michener, 1989: 641 (Type species of *Dasycolletes*). —2000: 150 (Type species of *Dasycolletes*).

*Leioproctus metallicus*: Cockerell, 1904a: 203 (= *Dasycolletes metallicus*, differences from *Leioproctus boltoni*). —1929a: 311 (listed in *Leioproctus*). Miller, 1971: 21 (nest sites in beaches). Donovan, 1980: 105 (characteristics of nest sites, photograph of nest site), 106 (visits Myrtaceae, can be extremely abundant on host flowers). Donovan & Macfarlane, 1984: 249 (nest sites in ocean beaches, can be extremely abundant on host flowers, visits native myrtaceous flowers). Miller, 1984: 21 (repeat of Miller, 1971). Pinnock, Coles & Donovan, 1988: 387 (larvae and prepupae are associated with the spore cyst fungus *Ascospaera scaccaria*).



*Paracolletes metallicus*: Cockerell, 1905a: 348 (new combination, key). — 1913a: 277 (*P. maorium* is related to *P. metallicus*, differing in the colour of the hair and in the venation). — 1916b: 361 (list). — 1918a: 390 (records males from Waipara, New Zealand). — 1934: 10 (discusses characters of *Paracolletes* -hind spur of hind tibia may be minutely ciliate, at first glance appearing simple, as in *P.* (or *Dasycolletes*) *metallicus*), 16 (key). Rayment, 1935: 164–166 (females from Nelson NN carried *Pinus* pollen; nest sites in shifting sand dunes).

*Leioproctus (Leioproctus) metallicus*: Michener, 1965: 51 (new combination). Valentine & Walker, 1991: 41 (list).

**Female** (n = 20). Length 10.2–13.4 mm ( $11.8 \pm 0.69$  mm); width 3.5–4.3 mm ( $3.8 \pm 0.21$  mm); forewing length 6.6–9.1 mm ( $7.4 \pm 0.51$  mm); facial length 2.1–2.5 mm ( $2.3 \pm 0.10$  mm); facial width 2.2–2.6 mm ( $2.4 \pm 0.11$  mm); malar length/malar width 0.27.

**Coloration.** Head and mesosoma black, except antennae dark brown beyond about 2nd–3rd flagellar segment, apex of mandibles and tarsal claws red, wing membranes hyaline, wing veins brown, tibial spurs pale; metasoma near black, often with dark green hue dorsally, except apical margins of terga 1–5 and sterna 1–5 hyaline, about basal 1/2 of pygidial plate black, apical 1/2 dark red.

**Structure.** (Fig. 42a–b). Scape long, about equal in length to combined length of first 7 flagellar segments. Compound eyes about 4× longer than wide, with upper 1/3 and lower 2/3 of inner margins converging moderately above and below respectively. Ocellular distance about 2.5× an ocellar diameter; interocellar distance equal to 1 ocellar diameter. Antennal sockets a little closer to vertex than to apex of clypeus. Face shiny throughout. Supraclypeus rising rather evenly from below and laterally to a rounded mound between antennal sockets, with small to medium-sized close punctures on margins, punctures becoming larger, more widely spaced towards summit of supraclypeus, so that summit may be impunctate; frontal ridge prominent, extending 2/3 of the distance to median ocellus, frontal line extending to median ocellus. Frons and paraocular areas with medium-sized punctures separated by about 1/2 a puncture diameter, except area between lateral ocellus and compound eye impunctate, frons very lightly tessellated. Clypeus rather flat, short, extending for a little more than 1/3 its length below a line across lower ends of compound eyes; central 1/2 showing a broad, low, raised longitudinal area flanked by broad, shallow, longitudinal troughs; laterodorsal margins with medium-sized, close punctures, punctures becoming larger, more irregular and widely spaced towards centre of clypeus so that clypeus impunctate centrally and ventrally. Malar space short, about 1/4 as long as wide, impunctate, shiny. Galea moderately tessellated. In lateral view, gena 1.3× wider than compound eye, with irregular, medium-sized close punctures, shiny.

Pronotum moderately shagreened, with a few small, widely-spaced punctures dorsally, sulcus well defined dorsolaterally, prominent dorsally. Scutum shiny except for anterior margin lightly shagreened, small central area almost impunctate, with medium-sized punctures becoming separated by 1 diameter or less around margins. Scutellum with very large, very irregular, close punctures, except anterior margin impunctate, posterior 2/3 lightly shagreened. Metanotum moderately shagreened. Propodeal triangle large, moderately angled, angle smoothly rounded (Fig. 42k), very lightly shagreened, shiny; remainder of propodeum with medium-sized punctures separated by 1–2 diameters, but punctures partially obscured by moderate shagreening. Remaining lateral areas of mesosoma with medium-sized punctures separated by about 1 diameter, shiny, except metepisternum impunctate, lightly shagreened. Basitibial plate 1/4 as long as tibia, with obscure, irregular longitudinal ridging, lightly tessellated. Inner metatibial spur finely ciliate, cilia short (Fig. 42i). Pterostigma 4× longer than wide, vein 1st m-cu meets 2nd submarginal cell at middle.

Metasomal terga 1–5 and sterna 1–5 lightly shagreened, with small punctures separated by 2–4 diameters, those on tergum 1 obscure; sternum 1 broadly emarginate apically. Pygidial plate stout, wide basally, apex squared, edges markedly raised, throughout with very prominent, very irregular longitudinal ridges (Fig. 42j).

**Vestiture.** Black on vertex and paraocular areas, otherwise off-white on head; central area of clypeus naked, vestiture short, sparse, erect laterally; below antennal sockets vestiture lying towards compound eyes, between antennal sockets long, directed upwards. On central longitudinal area of mesosoma, vestiture black, except for posterior central area of mesosoma almost naked; remaining areas of mesosoma with off-white vestiture. Trochanteral floccus poorly developed, vestiture relatively sparse, hairs white with short branches (Fig. 42g); femoral vestiture off-white, basitibial plate with vestiture golden. Tibial scopa entirely off-white to white, hairs stout with 2–4 branches (Fig. 42h). Metabasitarsus with hairs on outer face short, unbranched, not forming scopa. Metasomal vestiture off-white on terga 1–2, sparse, long, on terga 3–4 brown-black, sparse, short; prepygidial fimbria brown-black; sterna 1–5 with off-white to golden vestiture, apical fimbria poorly developed on sterna 2–4, very well developed on sternum 5; vestiture lateral to pygidial plate black to golden.

**Male** (n = 20). Length 8.0–11.2 mm ( $9.6 \pm 0.94$  mm); width 2.5–3.2 mm ( $2.9 \pm 0.27$  mm); forewing length 5.7–7.1 mm ( $6.2 \pm 0.39$  mm); facial length 1.7–2.2 mm ( $2.0 \pm 0.13$  mm); facial width 1.6–2.4 mm ( $2.0 \pm 0.19$  mm); malar length/malar width 0.23.

**Coloration.** Similar to female.

**Structure.** (Fig. 42c–d). Scape about as long as combined length of first 4.5 flagellar segments. Compound eyes, ocellular and interocellar distances, and location of antennal sockets similar to female. Supraclypeus rising to a sharp point between antennal sockets, ventral slope flat-faced, slightly concave; with medium-sized close punctures throughout. Clypeus with central median area flat; short, extending for 1/4 its length below a line across lower margins of compound eyes, with medium-sized to larger, close punctures throughout. Malar space slightly shorter than in female. Remainder of head similar to female.

Mesosoma similar to female, except scutum more widely impunctate medially. Basitibial plate and wings similar to female.

Metasomal terga 1–5 and sterna 1–5 similar to female. Sternum 7 (Fig. 42e) with apical lobes tending towards rectangular, apical margins angled, fringed with stout spines. Sternum 8 (Fig. 42f) with narrow, short waist to apical process. Gonocoxites in dorsal and ventral views (Fig. 42l) stout, gonostyli rounded, slightly incurved apically, penis valves with inner margins more acute apically; in lateral view (Fig. 42m) penis valve not projecting below gonostylus.

**Vestiture.** Distribution similar to female, except clypeal vestiture more dense, rather evenly distributed so that clypeus not appearing near-naked medially. On mesosoma, some brown hairs immediately below wing base. Metasomal vestiture similar to female, except more sparse on sterna.

**Variation.** In both sexes throughout the species' range, vein 1st m-cu may meet the 2nd submarginal cell around the mid point. Otherwise, individuals vary little.

**Type data.** *Dasycolletes metallicus*: holotype female, "New Zealand" (BMNH).

**Material examined.** Type specimen, plus 325 females and 147 males.

**Distribution** (Map 6). North Island: ND, AK, CL, WO, BP, TK, TO, GB, HB, WI, WN. South Island: primarily coastal sites in SD, NN, MB, KA, MC, DN, but also inland in MK, CO.

Collection dates for the 107 collections range from 11 October to 26 March, with 43% taken in December, and 36.4% taken in January.

**Biology.** Site collection data show that the species occurs primarily at the ocean coast, and occasionally inland, with 5 inland collections areas for the North Island and 2 for the South Island. No altitude data are available, but apart from the 7 inland collections, all other collections were just above sea level. However, the occurrence of both sexes in the mountainous south central South Island, indicates that the species may in future be found at other inland localities, and at some altitude.

**Flight period.** The 78 collections of 325 females have been taken from October (no date) to 24 February, with 38.5% taken in December, and 42.3% taken in January. The 29 collections of 147 males have been taken from 11 November to 26 March, with 17.2%, 55.2% and 20.7% taken in November, December, and January, respectively.

#### Number of collections

	Oct	Nov	Dec	Jan	Feb	Mar
Females	1	8	30	33	6	
Males		5	16	6	1	1

At nest sites the species can be very abundant. Apart from the 350 specimens caught by Gourlay (Rayment 1935) (see below under 'introduced plants'), the next largest collections are 4 of similar numbers from 4 areas. The largest is of 45 males from Okains Bay MC at an ocean beach nest site on 19 December 1976 by B. J. Donovan, and 42 females, all carrying pollen, and 1 male, were captured at Tahunanui NN, on 14 January 1928, by E. S. Gourlay. Forty-two females of which 35 carry pollen were taken at the mouth of the Taieri River DN on sand on 14 January 1990, by A. C. Harris, and 41 females of which 10 carry pollen were captured at Conway Flat KA, on 1 January 1971 between 4–5 pm by R. P. Macfarlane. There are 9 other collections of more than 10 bees.

#### Host plants

##### Native plants

Myrtaceae			
<i>Kunzea ericoides</i>	♀	6/23 (4/13 p)	♂ 5/28
<i>Leptospermum scoparium</i>		—	♂ 2/2
<b>Total collections/specimens</b>	♀	6/23 (4/13 p)	♂ 7/30
<b>Species/genera/families</b>		1/1/1 (1/1/1 p)	2/2/1

##### Introduced plants

Asteraceae			
<i>Achillea millefolium</i>		—	♂ 1/1
<b>Total collections/specimens</b>	♀	—	♂ 1/1
<b>Species/genera/families</b>		—	1/1/1

Also, 1 female was found on an African violet in a house.

In addition to the records of bees from introduced flowering plants, Rayment (1935) found that specimens sent to him by Mr. E. S. Gourlay, Entomologist at the Cawthron Institute, New Zealand, (Nelson), carried pollen from a species of pine tree. He quotes Mr. Gourlay saying "I came across thousands of them clustering among the 'needles' of a *Pinus* plantation about eight years old. The bees seemed to be enjoying the bright sunshine, and in ten sweeps of the collecting net I secured three hundred and fifty specimens".

**Nest sites.** Miller (1971) reported the presence of nests in the sand of beaches above high water, as well as in soil beneath any piece of wood, or stone. There are 23 records of bees taken on nest sites, 21 of which are ocean beach

sand on the upper beach, or sand dunes, and 2 of which are clay. At Conway Flat KA, bees were nesting in the flat upper beach of coarse sands and small gravel, among small driftwood, where high tides would occasionally reach. On 2 March 1977, 36 prepupae were uncovered in 40 minutes at depths of 150–470 mm. On 18 November 1977, 2 cells were found at a depth of 400 mm. One cell contained a white pupa, and the other a prepupa. When the site was next visited on 12 December 1977, thousands of nest tumuli in a bed up to 8 m wide were scattered along at least 400 m of the upper beach between a recent high tide mark and the first vegetation. A few tumuli were several metres below the high tide mark. There had been rain earlier that day, but male bees and a few new females were cruising over the nest site in a spot sheltered by a small cliff.

At Okains Bay MC on 19 December 1977, several females carrying large loads of pollen were flying over a beach of very fine, smooth, soft, dry sand between the high tide level and the grass line. There were no signs of nest tumuli. After several minutes a female alighted here and there and inspected the sand carefully. She eventually appeared to clean her back legs, then she dug directly into the sand and disappeared. Later, a female exited from the sand. She left a small depression that within a few minutes was completely obscured by wind-blown sand. Digging showed that the sand was powdery dry for about 120 mm, before becoming somewhat moist and more firm. No traces of nests were found.

**Associated organisms.** One female from Pandora ND that is carrying large loads of pollen, has 25 small mites on its wings, and 4 small mites on its body. Eight other females from throughout the range of the species carry from 1–5 mites (mean 1.5). At Okains Bay MC, 3 *Pseudofoenus* sp. were captured over the *L. metallicus* nest site.

**Remarks.** The general appearance of this species is rather similar to that of *L. imitatus*, in that both have a similar form of clypeus with a central longitudinal raised area, and the scopa is white or near-white. However, apart from their larger size, female *L. metallicus* are readily distinguished by their very broad and ridged pygidial plate, and males by the longer vestiture on the supraclypeus and adjacent paraocular areas. *L. metallicus* also appears to be quite closely related to *L. purpureus* in a number of ways; both nest in ocean beaches above the high tide mark but below the vegetation line, the pygidial plate is very wide and ridged, which probably assists with moving sand, each species forages for pollen on a very limited 1 or 2 species of native flowers, and each has a different metallic colour tinge to its abdomen. Yet the 2 species are quite distinct morphologically.

Females of *L. metallicus* are often a little longer than worker honey bees, and are nearly as stout. Their general

similarity to black worker honey bees has caused some members of the public to believe that these native bees are native New Zealand honey bees. The presence of nesting bees in the upper beach area of popular bathing beaches at Totaranui NN and Tahunanui NN has alarmed some sunbathers.

The incursion into the south centre of the South Island of what otherwise appears to be a species restricted to the coast may be associated with drier, sandy, nesting soils in that area. Similar although less extensive inland occurrences in the North Island may possibly be linked to the presence of suitable sandy nesting sites in river beaches, or possibly fine pumice tuff.

### *Leioproctus (Leioproctus) otautahi* new species

Fig. 5a–b, 43a–g; Map 7

**Male** (n = 1). Length 6.8 mm; width 2.0 mm; forewing length 5.1 mm; facial length 1.5 mm; facial width 1.4 mm; malar length/malar width 0.05.

**Coloration.** Head, mesosoma, and metasoma black, except antennae brown beyond 1st/2nd flagellar segments, apices of mandibles red; legs brown except becoming a little orange-yellow towards tarsi; tibial spurs pale; tegula and base of wing veins out to about one tegular diameter golden orange-yellow, remainder of wing veins and pterostigma brown, about inner 1/2 of wing membranes hyaline, outer 1/2 dusky; apical margins of metasomal terga 1–5 and sterna 1–5 hyaline.

**Structure.** (Fig. 43a–b). Scape short, as long as combined length of first 3.5 flagellar segments. Compound eyes 4× longer than wide, with about upper 1/3 and lower 2/3 converging markedly above and below respectively. Ocellocular distance slightly less than 2 ocellar diameters; interocellar distance equal to 0.7× an ocellar diameter. Antennal sockets equidistant between apex of clypeus and vertex. Face shiny and tessellated throughout. Supraclypeus rising from below and laterally to a sharp point between antennal sockets, with medium-sized, widely-spaced punctures medially, punctures closer laterally; frontal ridge prominent to halfway to median ocellus, with frontal line continuing to median ocellus. Frons with moderately dense tessellation, tessellation light but obvious below antennal sockets. Clypeus moderately rounded side to side, extending for about 1/4 its length below a line across lower ends of compound eyes, lightly tessellated, with large shallow punctures throughout separated by 1–3 diameters. Malar space very short, almost absent. Galea very lightly shagreened. In lateral view, genal area somewhat narrower than compound eye, shiny, moderately tessellated with indistinct punctures partly obscured by tessellation.

Pronotum moderately shagreened, sulcus prominent dorsally, broad, shallow dorsolaterally, obscure lateroventrally. Scutum moderately tessellated, with small, widely-spaced punctures anteriorly, punctures becoming very large posteriorly. Metanotum moderately tessellated, impunctate. Propodeal triangle moderately tessellated, strongly angled, basal surface longer than posterior (Fig. 43e); remainder of propodeum similarly tessellated, with irregular small punctures partly obscured by tessellation. Remaining lateral areas of propodeum shiny, lightly shagreened, with few, widely-spaced small irregular punctures, except metepisternum shagreened, with fine transverse ridges. Basitibial plate about 1/4 length of tibia, shiny, lightly tessellated. Inner metatibial spur ciliate. Pterostigma a little less than 4× longer than wide; vein 1st m-cu meets 2nd submarginal cell a little beyond middle.

Metasomal terga 1–5 lightly shagreened, sterna 1–5 very lightly shagreened, tergum 6 and sternum 6 moderately shagreened; terga 1–5 and sterna 1–5 with very small, widely-spaced punctures, punctures medium-sized, separated by about 4–5 diameters on tergum 6 and sternum 6. Apical lobes of sternum 7 (Fig. 43c) widely divergent, each with 5 prominent spines. Sternum 8 (Fig. 43d) with apical process narrow, rounded apically. Gonocoxites in dorsal and ventral views (Fig. 43f) stout, gonostyli incurved apically, with several prominent stout hairs; in lateral view (Fig. 43g) penis valve downcurved, scarcely projecting below gonocoxite.

**Vestiture.** Except for some light brown hairs on vertex and apex of abdomen, white throughout. Facial vestiture short throughout, sparse, especially on clypeus, not obscuring surface. Vestiture on dorsum of mesosoma similar to face. Metasomal terga 1–5 almost naked, tergum 6 with small apical fimbria; sterna 1–4 with sparse, long hairs, sternum 5 with dense, narrow apical fimbria, sternum 6 with medium-length hairs throughout.

**Type data.** *Leioproctus otautahi*: holotype male, “Christchurch MC”, 16–18 December 1959, E. S. Gourlay (NZAC). The metasoma beyond tergum and sternum 3 is detached, and is in glycerine in a capsule on the pin below the rest of the holotype.

**Distribution** (Map 7). Christchurch MC.

**Material examined.** Holotype.

**Biology.** Apart from the date of capture, from 16–18 December 1959, and the collection site of Christchurch MC, nothing is known of the species’ biology.

**Flight period.** The male is unworn, which indicates that it had recently emerged from its parental nest.

**Etymology.** *otautahi*: The name of the Maori village that existed within the area of what is now Christchurch City, and the collection site of the sole specimen of this species.

**Remarks.** The tessellation over the entire clypeus and supraclypeus, the relatively short scape, the golden orange-yellow coloration of the tegula and wing base, and the large size of the basal surface of the propodeal triangle compared to the posterior surface, and the form of the 7th metasomal sternum, clearly delineate this species from all other *Leioproctus*. Nevertheless, the species probably belongs within the subgenus *Leioproctus*, or if not, possibly to an Australian subgenus.

### *Leioproctus (Leioproctus) pango* new species

Fig. 5c–f, 6a–f, 44a–r; Map 8

**Female** (n = 20). Length 8.3–10.0 mm (8.9 ± 0.46 mm); width 2.5–3.1 mm (2.7 ± 0.17 mm); forewing length 5.5–6.6 mm (6.0 ± 0.33 mm); facial length 1.7–2.0 mm (1.9 ± 0.09 mm); facial width 1.8–2.0 mm (1.9 ± 0.08 mm); malar length/malar width 0.21.

**Coloration.** Head, mesosoma and metasoma black, except antennae brown beyond about 2nd flagellar segment; apices of mandibles, tarsal claws and pygidial plate red; distitarsi dark red, remaining areas brown except wing membranes and apical margins of metasomal terga 1–5 and sterna 1–5 hyaline, tibial spurs very pale.

**Structure.** (Fig. 44a–b). Scape about equal in length to combined length of first 6 flagellar segments. Compound eyes about 4× longer than wide, with upper 1/3 and lower 2/3 of inner margins converging markedly above and below respectively. Ocellular distance a little greater than 2 ocellular diameters; interocellar distance equal to 2/3 an ocellular diameter. Antennal sockets slightly closer to vertex than to apex of clypeus. Face shiny throughout. Supraclypeus rising abruptly from below to an elongated shiny, rounded ridge between antennal sockets, lateral areas with medium-sized punctures separated by less than 1 diameter; frontal ridge prominent to about 2/3 of distance to median ocellus, with frontal line continuing to median ocellus. Frons and paracocular areas with medium-sized to large punctures separated by 1 to less than 1 diameter except area between lateral ocellus and compound eye almost impunctate. Clypeus slightly protuberant, extending for a little less than 1/3 its length below a line across lower ends of compound eyes; very large irregular punctures centrally separated by irregular smooth areas, central area sometimes with “beaten” appearance, punctures becoming smaller to medium-sized and separated by less than 1 diameter dorsolaterally. Malar space short, 1/5 as long as wide, smooth. Galea smooth, very shiny, with sometimes the faintest trace of tessellation. In lateral view, genal area about equal in width to compound eye, shiny, with medium-sized to large punctures separated by 1 to about 4 diam-

eters, sometimes light tessellation adjacent to lower end of compound eye.

Pronotum lightly shagreened, with sulcus prominent dorsally, clearly defined dorsolaterally, obscure lateroventrally, with distinct small to medium-sized punctures separated by about 2–4 diameters. Scutum shiny, with medium-sized punctures around periphery, separated by 1 diameter, disc of scutum impunctate. Scutellum smooth, shiny throughout, to posterior 1/3 with large, close punctures. Metanotum moderately shagreened, shagreening partly obscuring irregular punctures. Propodeal triangle moderately angled (Fig. 44k), ranging from mirror-like shiny to lightly shagreened to moderately tessellated and dull; posterolateral area moderately shagreened/tessellated with obscured, medium-sized punctures. Remaining lateral areas of mesosoma smooth, shiny, with small to medium-sized punctures separated by 1 to about 3 diameters, except metepisternum impunctate. Basitibial plate about 1/4 length of tibia, shiny, with irregular, longitudinal ridging. Inner metatibial spur ciliate (Fig. 44i). Pterostigma 4× longer than wide; vein 1st m-cu meets 2nd submarginal cell at middle.

Metasomal terga 1–5 shiny, very lightly shagreened, with very small, very widely separated punctures except punctures larger, closer on tergum 5. Metasomal sterna 1–5 lightly to moderately shagreened, with small punctures separated by 1–2 diameters, sternum 1 very shallowly emarginate apically. Pygidial plate narrowing from moderately wide base to rounded apex, shagreened with broad median area raised (Fig. 44j).

**Vestiture.** White on clypeus and supraclypeus, black on remainder of face; off-white on posterior of head; black on broad central area of mesosoma, with off-white laterally near wing base and laterally on mesosoma; posterolateral areas of propodeum black to brown-white. Trochanteral floccus poorly developed, of medium-length white hairs with short branches (Fig. 44g). Hairs on apex of femora and basitibial plate dark brown. Tibial scopal hairs strongly branched (Fig. 44h), dorsal 1/2–2/3 of scopa brown to black, remainder off-white. Metabasitarsus with hairs on outer face short, unbranched, not forming scopa. Off-white to brown on metasomal tergum 1 and sometimes tergum 2, black on remaining terga; off-white on metasomal sterna. On face vestiture relatively sparse, short, not obscuring surface. Disc of scutum with very sparse vestiture centrally. Metasomal terga 1–4 with very sparse vestiture, on terga 2–4 very short. Metasomal sterna 1–5 with relatively sparse hairs on disc, sterna 2–5 with moderately well-developed apical fimbria.

**Male** (n = 20). Length 6.5–8.6 mm ( $7.5 \pm 0.56$  mm); width 1.8–2.4 mm ( $2.1 \pm 0.16$  mm); forewing length 4.8–5.8 mm ( $5.3 \pm 0.29$  mm); facial length 1.5–1.8 mm ( $1.7 \pm 0.08$  mm); facial width 1.4–1.8 mm ( $1.6 \pm 0.08$  mm); malar length/malar width 0.19.

**Coloration.** Similar to female.

**Structure.** (Fig. 44c–d). Scape a little shorter than combined length of first 3.5 antennal segments. Compound eyes similar to female. Ocellular distance and interocellar distance similar to female. Antennal sockets somewhat closer to vertex than to apex of clypeus. Supraclypeus sloping upwards from clypeus to a sharp peak between antennal sockets, in lateral view sloping surface flat to slightly concave, peak and narrow median area below peak shiny, impunctate; lateral areas of supraclypeus with medium-sized punctures separated by 1 to less than 1 diameter. Clypeus quite flat, extending for a little less than 1/4 of its length below a line across lower ends of compound eyes, with large punctures centrally, punctures smaller laterally, lower margin narrowly impunctate. Malar space and remainder of head similar to female.

Mesosoma similar to female.

Metasoma similar to female except shagreening absent or almost so, shiny. Sternum 7 (Fig. 44e) with basal lobes expanded apically, apical lobes with almost straight inner margin, to inner margin angled. Sternum 8 (Fig. 44f) with base of apical process widened towards basal area. Gonocoxites in dorsal and ventral views (Fig. 44l) stubby, gonostyli rounded apically, penis valves rounded apically; in lateral view (Fig. 44m) penis valve projecting below gonostylus.

**Vestiture.** White on clypeus, black or white or mixed black and white on supraclypeus below antennal sockets, white between antennal sockets, remainder of face black; black dorsally on gena, white ventrally. Mesosoma similar to female except black on posterolateral areas of propodeum. Metasoma similar to female except sterna 2–5 without apical fimbria.

Density of vestiture similar to female.

**Variation.** At most localities in the South Island both sexes show a range of variation in sculpturing of the propodeal triangle, from mirror-like to shagreened to tessellated. North Island specimens range from shagreened to tessellated. To a lesser extent the sculpturing of the scutellum varies from about the anterior 1/2 smooth and shiny, to almost the entire surface smooth and shiny. The general shape of the apical lobes of sternum 7 of males from Cheviot NC, Lincoln MC and surrounding areas on the mid-east coast and south central regions of the South Island is similar, while from elsewhere the shape varies (Fig. 44n–r).

Some bees from ND, WO, BP, NN, BR, WD and MC have the clypeal vestiture completely black and the supraclipeal vestiture nearly so. Some bees from WO and BP have some black hairs among the near-white clypeal hairs, 1 male from SD has the clypeal vestiture black centrally, and off-white laterally, and some bees from WD have brown clypeal vestiture. The ventral 1/3 of the scopa

of 3 females from Waiho WD is brown rather than off-white.

**Type data.** *Leioproctus pango*: holotype female, "Lincoln, MC", 6 December 1982, flowers of *Carmichaelia* spp., B. J. Donovan (NZAC). Allotype male, 98 paratype females, 10 paratype males, same data as holotype. Ninety-six paratype females have the typical white vestiture of the clypeus and supraclypeus, and shiny propodeal triangle, but one has brown vestiture on the supraclypeus, and another has the propodeal triangle somewhat shagreened. Most male paratypes have the supraclypeal vestiture at least partly brown to brown.

**Material examined.** Type specimens, plus 719 females and 495 males.

**Distribution** (Map 8). North Island: ND, AK, CL, WO, BP, TK, TO, GB, RI, HB, WI, WN. South Island: SD, NN, BR, MB, KA, WD, NC, MC, MK, CO, DN, SL. Stewart Island.

The occurrence of the species on the offshore islands of The Noises, Motuhoropapa AK, Little Barrier CL, Motukoruenga and Ohena CL, Mayor BP, and Codfish SI, suggests that it is likely to occur almost throughout the country. The 402 collections have been captured from 6 October to 15 March, with 25.9%, 51.2% and 16.4% taken in November, December and January respectively.

**Biology.** This species ranges throughout most of New Zealand from about sea level to 1000 m. With a total of 1158 specimens, the species is relatively common in most areas, and can be locally abundant.

**Flight period.** The 244 collection dates for 818 females range from 6 October to 15 March, with 24.6%, 54.5% and 13.9% captured in November, December and January respectively. One male was found freshly dead in a drum of water at Kaeo ND on 14–15 September, but apart from this record the 158 collection dates for 506 males range from 6 October to 25 February, with 27.8%, 46.2% and 20.2% taken in November, December and January respectively.

#### Number of collections

	Sep	Oct	Nov	Dec	Jan	Feb	Mar
Females		5	60	133	34	11	1
Males	1	3	44	73	32	5	

The largest collection is of 99 females, 77 of which carried pollen, and 11 males from *Carmichaelia* spp. at the Canterbury Agriculture and Science Centre, Lincoln NN, on 6 December 1982, by B. J. Donovan. The bees were captured in about 30 min, and many hundreds if not thousands of bees remained. However the *Carmichaelia* spp. had been planted on site by humans so the density of

plants was unusually high. For bees from the wild the largest collection is of 28 females of which 11 carry pollen, and 13 males, at Weka Pass NC, from *Carmichaelia* spp., on 10 November 1982, by B. J. Donovan. Of the other 400 collections, 34 are of between 10 and 31 bees.

#### Host plants

##### Native plants

Araliaceae/Fabaceae			
<i>Pseudopanax</i> sp/			
<i>Carmichaelia</i> sp.	—		♂ 1/1
Asteraceae			
<i>Celmisia semicordata</i>	♀ 1/3 (1/1 p)		♂ 1/1
<i>Ozothamnus leptophyllus</i>	—		♂ 1/2
Fabaceae			
<i>Carmichaelia arborea</i>	—		♂ 2/3
<i>Carmichaelia australis</i>	♀ 3/13 (2/5 p)		♂ 3/27
<i>Carmichaelia carmichaeliae</i>	♀ 1/2 (1/2 p)		—
<i>Carmichaelia crassicaulis</i>	♀ 1/1		—
<i>Carmichaelia kirkii</i>	♀ 1/6 (1/5 p)		—
<i>Carmichaelia petriei</i>	—		♂ 1/1
<i>Carmichaelia</i> sp.	♀ 30/241 (23/163 p)	♂	22/124
Hemerocallidaceae			
<i>Phormium tenax</i>	♀ 1/1 (1/1 p)		—
Laxmanniaceae			
<i>Cordyline australis</i>	—		♂ 1/1
Loranthaceae			
<i>Peraxilla tetrapetala</i>	♀ 3/9 (2/6 p)		♂ 2/5
Myrtaceae			
<i>Kunzea ericoides</i>	♀ 2/20 (1/10 p)		♂ 1/2
<i>Leptospermum scoparium</i>	♀ 5/10 (2/3 p)		♂ 12/75
<i>Lophomyrtus</i> sp.	♀ 1/1		—
<i>Metrosideros excelsa</i>	♀ 11/39 (9/32 p)		♂ 4/15
<i>Metrosideros</i> sp., rata	♀ 1/1		—
Myrtaceae/Fabaceae			
<i>Leptospermum scoparium</i> /			
<i>Carmichaelia</i> sp.	♀ 1/1 (1/1 p)		—
Pennantiaceae			
<i>Pennantia</i> sp.	♀ 1/4 (1/3 p)		—
Plantaginaceae			
<i>Hebe alpina</i>	♀ 1/1		♂ 1/1
<i>Hebe brachysiphon</i>	—		♂ 1/6
<i>Hebe elliptica</i>	—		♂ 1/1
<i>Hebe salicifolia</i>	♀ 1/1		♂ 1/7
<i>Hebe stricta</i>	—		♂ 1/1
<i>Hebe</i> sp.	♀ 2/8 (2/6 p)		♂ 1/1
Polygonaceae			
<i>Muehlenbeckia complexa</i>	—		♂ 1/2
Rousseaceae			
<i>Carpodetus serratus</i>	—		♂ 3/6
Rubiaceae			
<i>Coprosma lucida</i>	—		♂ 1/3
<i>Coprosma</i> sp.	—		♂ 1/2
<b>Total collections/specimens</b>	♀ 68/363 (47/238 p)	♂	63/287
<b>Species/genera/families</b>	17/10/7 (11/9/7 p)		22/13/10

**Introduced plants**

## Actinidiaceae

<i>Actinidia deliciosa</i>	female♀	19/58 (5 + ?/6 + ? p)	♂	1/1
	male	♀ 18/101 (5 + ?/18 + ? p)	♂	1/1
	female/male	—	♂	2/5

## Asteraceae

<i>Achillea millefolium</i>	♀	1/1	—	
<i>Cirsium lanceolatum</i>	♀	1/6 (1/1 p)	♂	1/6
<i>Hieracium pilosella</i>	♀	2/2	—	
<i>Hieracium praealtum</i>	—	—	♂	1/1

## Caryophyllaceae

<i>Cerastium</i> sp.	♀	1/1	—	
<i>Dianthus caryophyllus</i>	—	—	♂	1/1

## Ericaceae

<i>Calluna vulgaris</i>	♀	1/2 (1/2 p)	—	
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## Fabaceae

<i>Medicago sativa</i>	♀	1/2 (1/2 p)	—	
<i>Trifolium repens</i>	♀	2/3 (1/1 p)	—	

## Lauraceae

<i>Persea americana</i>	♀	3/6 (1/1 p)	♂	2/10
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## Philadelphaceae

<i>Deutzia gracilis</i>	—	—	♂	1/4
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**Total** collections/specimens ♀ 48/181 (15/31 p) ♂ 10/29

Species/genera/families 9/9/6 (6/6/5 p) 6/6/5

The behaviour of *L. pango* when foraging on *Peraxilla tetrapetala* is particularly interesting. Ladley & Kelly (pers. comm.) observed and filmed female bees biting open buds that were close to opening. The female photographed on a *Peraxilla* bud by Taylor (2002), and the unidentified female photographed by Robertson et al. (2005), on a flower of *P. tetrapetala* which it has just partially opened, are probably both *L. pango*. Only one other bee, *Hylaeus agilis*, has been observed displaying this behaviour on this flower species.

Of the 159 females captured on *A. deliciosa*, 127 were sonicated to remove pollen as part of another project. It is known that most, if not all these females, were carrying pollen.

Of the 818 females studied, 99 were trapped in cages as they emerged for the first time from overwintering nest sites and so had no opportunity to collect pollen. For the 238 females that carry pollen from native plants, 175, or 73.5%, carry pollen from *Carmichaelia* spp., and 45, or 18.9%, carry pollen from Myrtaceae. *Leioproctus pango* thus displays a very strong preference for Fabaceae, which has extended to the introduced lucerne (*Medicago sativa*) and white clover (*Trifolium repens*). Only one other *Leioproctus* (*L. vestitus*) has been captured collecting pollen from lucerne. *L. pango* also exhibits an ability to collect pollen from a widely disparate range of plant families, the most extreme example of which is kiwifruit. Both sexes of flowers are visited avidly for pollen, despite the total lack of nectar secretion.

**Nest sites.** There are 35 references to nest sites among the

402 collection records. This species nests in a wide variety of substrates, including sandstone cliffs at Island Bay, Birkdale AK, oceanside cliffs of fine mudstone, bare sloping fine sand, golf course fairway scraped bare, bare soil in full sunlight just beyond kiwifruit vines, and partly shaded soil beneath kiwifruit vines at Opotiki BP, animal tracks on a farm at Conway Flat KA, oceanside cliffs of glacial morainic silts and sands, and river bed silts and sands at Abut Head and the Whataroa River bed WD, garden soil at Lincoln MC, and clay/silt roadside partly covered in dry grass at Kyeburn CO. At the Whataroa River bed nest site, 1 female was captured on 6 December 1976 as she emerged from the river bed after it had been covered by about 300 mm of silt-laden floodwaters the day before. At Opotiki BP, 3 pollen balls were found in a nest on 29 November 1980.

**Associated organisms.** Two females and 5 males from areas near Island Bay, Birkdale AK each carry 1 large mite, 2 other females carry 7 and 9 large mites, 1 male carries 13 large mites, 1 female carries about 30 small mites and 1 male carries 1 small mite. Of 99 females trapped upon emergence from their overwintering nests at Island Bay, Birkdale AK, 45 carry from 1 to 5 large mites, and up to several small mites. Of the similarly trapped 36 males, 7 carry 1 or 2 large mites or several small mites. *Pseudofoenus* sp. were present over nest sites at Birkdale AK and Abut Head WD.

**Etymology.** *pango*: Maori = black. The vestiture of some specimens is entirely black or nearly so, and these are the only native bees with this character.

**Remarks** *Leioproctus pango* shows more variation in physical form throughout its range than does any other species of *Leioproctus*. Females from Waiwhenua HB are similar to 'small' *L. boltoni*, while both sexes from cages at Island Bay, Birkdale AK have a distinct yellow tinge to the vestiture. However, this tinge is probably a characteristic of bees that have just emerged from the substrate for the first time, as bees that have been on the wing do not display this yellow tinge. The disappearance of this tinge is presumably the result of weathering and ageing. The occurrence of individuals with entirely black or partially black clypeal vestiture from widely separated areas suggests that this is a coherent species. On the other hand, the variations in sculpturing and male genitalia and associated sterna, suggest that some populations are markedly different. Future work may well delineate more species from what is here identified as *L. pango*.

This is *Leioproctus* 'E' males of Primack (1978: 68 on manuka flowers), 70 (only males collected), (1983: 319, 323, 326 flower records); *Leioproctus* 'C' females of Primack (1983: 319, 324, 326, 332 flower records), and is *Leioproctus* 10 of Robertson et al. 2005.

***Leioproctus (Leioproctus) purpureus* (Smith)**

Fig. 7a–d, 45a–m; Map 9

*Dasycolletes purpureus* Smith, 1853: 15 (description of male).

Hutton, 1874: 164 (list). —1881: 98–99 (repeats description of Smith 1853). Kirby, 1881: 37 (list). —1884: 67 (list). Hudson, 1892: 34 (nests in sand banks), Plate 3, Fig. 10 (drawing of adult). Dalla Torre, 1896: 49 (list, Australia). Cameron, 1903: 299 (list). Cockerell, 1904a: 204 (= *Leioproctus purpureus*). Hutton, 1904: 96 (list).

*Leioproctus purpureus*: Cockerell, 1904a: 204 (new combination, = *Dasycolletes purpureus*).

*Paracolletes purpureus*: Cockerell, 1905a: 347 (new combination, key to male), 348 (comparison with *P. frontalis* (*L. frontalis*)). —1916b: 361 (list).

*Leioproctus (Leioproctus) purpureus*: Michener, 1965: 52 (new combination). Valentine & Walker, 1991: 42 (list).

**Female** (n = 20). Length 9.5–12.0 mm (10.5 ± 0.58 mm); width 2.6–3.5 mm (3.1 ± 0.19 mm); forewing length 6.0–7.1 mm (6.6 ± 0.30 mm); facial length 1.9–2.2 mm (2.0 ± 0.06 mm); facial width 1.9–2.2 mm (2.1 ± 0.09 mm); malar length/malar width 0.20.

**Coloration.** Head and mesosoma black, except antennae dark brown beyond about 2nd flagellar segment, apex of mandibles and tarsal claws red, wing membranes hyaline, wing veins dark brown to black, tibial spurs pale; metasoma black to black-purple, except apical margins of terga 1–5 and sterna 1–5 hyaline, about basal 2/3 of pygidial plate black, apical 1/3 dark red.

**Structure.** (Fig. 45a–b). Scape a little longer than combined length of first 6 flagellar segments. Compound eyes about 4× longer than wide, with upper 1/3 of inner margins converging markedly above, lower 2/3 of inner margins converging less markedly below. Ocellular distance a little more than 2 ocellar diameters; interocellar distance equal to about 0.75× an ocellar diameter. Antennal sockets equidistant between apex of clypeus and vertex. Face shiny throughout. Supraclypeus rising rather evenly from below and laterally to a rounded mound between antennal sockets, with medium-sized punctures separated by up to 1–1.5× a puncture diameter near apex, to close at margins; frontal ridge extending a little more than halfway to median ocellus, frontal line extending to median ocellus. Frons and paraocular areas with close, medium-sized to large punctures, except area between lateral ocellus and compound eye almost impunctate; frons very lightly tessellated. Clypeus somewhat protuberant, short, extending for 0.4× its length below a line across lower ends of compound eyes, lower margin raised medially; with prominent median vertical ridge, areas lateral to median vertical ridge with large punctures separated by about 1/2 a puncture diameter, punctures smaller laterally. Malar space short, 1/5 as long as wide, impunctate, shiny. Galea faintly tessellated. In lateral view, gena a little wider than compound eye, well shagreened with shagreening obscuring punctation.

Pronotum moderately shagreened with a few very small, very widely-spaced punctures; sulcus prominent dorsally, sharply defined dorsolaterally, absent lateroventrally. Scutum shiny except for anterior margin lightly shagreened, with medium-sized punctures throughout, separated by about 2 diameters medially, to about 1 diameter around periphery. Scutellum with anterior 1/3–1/2 shiny, with very large punctures separated by about 1–3 diameters, remainder lightly tessellated with large, irregular close punctures. Metanotum heavily shagreened. Propodeal triangle moderately angled (Fig. 45k), moderately shagreened; remainder of propodeum more heavily shagreened, with shagreening partly obscuring medium-sized punctures separated by 1–2 diameters. Remaining lateral areas of mesosoma moderately tessellated, with medium-sized punctures separated by 2–3 diameters, except metepisternum well shagreened, impunctate. Basitibial plate very prominent, length equal to about 1/4 length of tibia, lightly tessellated, with small punctures separated by 2–3 diameters. Inner tibial spur ciliate, with cilia most prominent near middle (Fig. 45i). Pterostigma 4.5 times longer than wide, vein 1st m-cu meets 2nd submarginal cell about middle.

Metasomal terga 1–5 and sterna 1–6 lightly shagreened, with small punctures, those on tergum 1 separated by about 3–6 diameters, on terga 2–5 separated by 2–4 diameters, punctures on sterna larger, separated by about 1–2 diameters; sternum 1 shallowly emarginate apically. Pygidial plate very wide basally, narrowing to a squared apex, edges markedly raised, throughout with very prominent, irregular longitudinal ridges, numbering about 4–6 near apex, basal 1/2 coarsely tessellated, whole surface appearing very rough (Fig. 45j).

**Vestiture.** Off-white on clypeus, supraclypeus and around antennal sockets, black on remainder of face; on clypeus vestiture not obscuring surface, swept upwards and laterally each side of the longitudinal ridge, like the bow wave of a ship or snow plough. Genal vestiture adjacent to compound eye black, remainder off-white. On anterior and lateral margins of scutum, and lateral margins of scutellum, vestiture off-white, black on remainder of dorsum of mesosoma, not obscuring surface; dorsolaterally on mesosoma vestiture black, off-white lateroventrally and ventrally. Trochanteral floccus of long, white, plumose hairs (Fig. 45g); femoral vestiture off-white except black apically: basitibial plate with a few very short black hairs. Tibial scopa black apart from off-white on lower margin, hairs stout with 5–6 branches (Fig. 45h). Metabasisarous with hairs on outer face short, unbranched, not forming scopa; brown-black. Metasomal vestiture sparse, tergum 1 with off-white moderately long hairs, terga 2–5 with black vestiture, on terga 2–4 very short, longer on tergum 5; vestiture on sterna 1–4 off-white, sparse on sternum 1,



moderately dense on sterna 2–4 with moderately well-developed apical fimbria, vestiture black on sterna 5–6.

**Male** (n = 20). Length 7.1–8.9 mm ( $7.9 \pm 0.53$  mm); width 1.7–2.5 mm ( $2.1 \pm 0.17$  mm); forewing length 4.8–5.7 mm ( $5.3 \pm 0.28$  mm); facial length 1.4–1.8 mm ( $1.6 \pm 0.08$  mm); facial width 1.4–1.8 mm ( $1.7 \pm 0.11$  mm); malar length/malar width 0.15.

**Coloration.** Similar to female.

**Structure.** (Fig. 45c–d). Scape equal in length to combined length of about the first 3.6 flagellar segments. Compound eyes somewhat less than 4× longer than wide, with inner margins as in female. Ocellular distance equal to 2.6× an ocellar diameter, interocellar distance equal to about 0.6× an ocellar diameter. Position of antennal sockets as in female. Supraclypeus rising to a moderately sharp point between antennal sockets, punctation similar to female but punctures closer near point. Clypeus moderately protuberant, extending for 1/4 its length below a line across lower ends of compound eyes, lower 1/3 somewhat rising towards lower edge, with medium-sized to large, close punctures throughout, including lower margin, giving lower margin a rough appearance. Malar space short, less than 1/6 as long as wide. Remainder of head similar to female.

Mesosoma similar to female, except scutum widely impunctate medially, shiny. Basitibial plate and wing similar to female.

Metasomal terga 1–5 and sterna 1–6 much as in female. Sternum 7 (Fig. 45e) with basal lobes widened medially, apical lobes with posterior/inner margins angled, posterior margin irregular. Sternum 8 (Fig. 45f) with lateral margins produced anteriorly, apical process constricted medially. Gonocoxites in dorsal and ventral views (Fig. 45l) very stout, gonostyli bluntly rounded, slightly incurved apically, penis valves with inner margins acute apically; in lateral view (Fig. 45m) penis valve scarcely projecting below gonostylus.

**Vestiture.** Similar on head to female except off-white vestiture more extensive, slightly obscuring lateral surface of clypeus, and completely obscuring supraclypeus just above a line across antennal sockets; clypeal vestiture swept up and laterally more so than in female.

Mesosomal vestiture similar to female but longer.

Metasomal vestiture very sparse, especially on sterna, otherwise similar to female.

**Variation.** The median vertical ridge on the clypeus of females may not reach the upper margin of the clypeus, or the lower edge. Specimens of both sexes from the east coast of the South Island (KA, NC, MC, DN) may have off-white vestiture on the 2nd metasomal tergum, rather than black, and in males the vestiture on the dorsum of the

mesosoma and dorsolaterally may be primarily off-white. In both sexes from any site, vein 1st m-cu may meet the 2nd submarginal cell before or just beyond the middle.

**Type data.** *Dasycolletes purpureus*: holotype male, “New Zealand” (BMNH).

**Material examined.** Type specimen, plus 115 females and 146 males.

**Distribution** (Map 9). Most specimens have been captured in coastal areas. North Island: ND, CL, WN. South Island: NN, BR, KA, WD, NC, MC, FD, DN, SL. Stewart Island.

Collection dates for the 78 collection records range from 27 September to 14 February.

**Biology.** Collection site data for *Leioproctus purpureus* show that the species occurs primarily on sandy coasts, or a short distance up rivers with sandy beds. Exceptions may be Paiaka ND, and Tapawera NN, which are about 36 km and 46 km from the sea respectively. There is just one altitude record of 20 m, and it is clear from the collection records that the species appears to be restricted to no more than a few metres above sea level.

**Flight period.** The 45 collection dates for 115 females range from 15 October to 14 February, with 17.8%, 42.2%, and 28.9% in November, December and January respectively. The 33 collections of 146 males have been taken from 27 September to 3 February, with 27.3% of the 33 collections taken in November, 57.6% in December, and 9.1% in January.

#### Number of collections

	Sep	Oct	Nov	Dec	Jan	Feb
Females		1	8	19	13	4
Males	1		9	19	3	1

The species can be locally abundant, with the biggest collection of 1 female and 44 males at Paiaka ND on 21 December 1949 by ‘NWF’. There are 7 other collections of between 10 and 20 bees.

#### Host plants

##### Native plants

Fabaceae						
<i>Carmichaelia</i> sp.				—		♂ 1/1
Hemerocallidaceae						
<i>Phormium tenax</i>				♀ 2/13 (2/6 p)		♂ 2/5
Laxmanniaceae						
<i>Cordyline australis</i>				♀ 2/4 (1/2 p)		♂ 4/9
Myrtaceae						
<i>Metrosideros excelsa</i>				♀ 1/2		—
Rousseaceae						
<i>Carpodetus serratus</i>				♀ 1/1		♂ 1/1
<b>Total collections/specimens</b>				♀ 6/20 (3/8 p)		♂ 8/16
<b>Species/genera/families</b>				4/4/4 (2/2/2 p)		4/4/4

**Introduced plants**

## Actinidiaceae

*Actinidia deliciosa* male ♀ 2/2 (?/? p) —

One female carrying pollen has also been captured on each of 'coastal dunes and scrub', 'coastal shrub', and 'ex bush'. One male has also been taken from Apiaceae/Umbelliferae. Two females have been captured from kiwifruit. As part of another project, these females were sonicated to remove pollen, which suggests that pollen was being carried in the scopae.

Although only 8 females have been captured collecting pollen from native Hemerocallidaceae, many more have been observed collecting pollen from flowers of *Phormium tenax*. This bee species thus seems to be oligolectic on the Hemerocallidaceae for pollen. However 2 females have been captured on *Metrosideros excelsa*, so possibly more collecting may show that pollen is also collected from this species. The occurrence of 2 females on kiwifruit where nectar is absent, suggests that pollen was being collected.

**Nest sites.** There are 24 references to nest sites, all of which are in ocean beach sand, the shore below driftwood, in foredunes, or at a vertical nest site (in a cliff), sand in a river bed nest site 1 km from the sea, and sand in a forest near the sea. On 7 December 1975, I found several dozen nest tumuli widely scattered over a flat-topped sandy beach more than 200 m wide from the base of a cliff to the slope to the ocean, plus 2 females dead on the sand, at the south-western end of the Saltwater Lagoon WD. Female bees were seen collecting pollen from flowering *Phormium tenax* along the fringe of vegetation just above high tide mark, but none could be caught because the flowers were beyond a barrier of dense gorse. One female not carrying pollen was captured near nest entrances in the vertical cliff, but whether the bee was associated with the nests could not be ascertained. During the previous 5 years, irregular visits to the area had shown the ocean washing directly against the base of the cliff, and a visit during mid 1976 revealed that the beach had completely disappeared. However, opposite the Saltwater Lagoon about 1 km to the north, a permanent sandy beach extended for about 12 km to the north.

On 4 December 1993 I captured 11 females, 3 of which carried pollen, and 1 male, as they returned to nests discovered by Dr. W. D. Pearson in the ocean beach 200 m north of the mouth of the Waitangitona River, WD. Nest tumuli were scattered about 1–3 m apart on a wave-cut platform about 2 m below the tops of old dunes. The substrate was predominantly of coarse grey sand, interspersed with stones of various sizes and buried driftwood. Some nest entrances were under the edges of objects such as stones or pieces of driftwood, but most were in the open. The top 30 mm of sand was dry and free-running, but below that level moisture held the grains

together. Females entering nests dug through loose sand in the nest tumuli. Ten minutes after a bee entered a nest, excavation to 0.5 m failed to locate the tunnel or the bee.

By 23 April when I next visited the site, the sea appeared to have cut further in to the dunes, but the surface of the wave-cut area seemed to be little affected. There was no sign of bee activity, and again, excavation failed to locate nest tunnels or cells.

**Associated organisms.** One female and 1 male from the mouth of the Whataroa River WD each carry 1 small mite. *Pseudofoenus* sp. occurred around nests near Abut Head WD.

**Remarks.** The very distinctive 'bow wave' form of the clypeal vestiture of both *L. purpureus* and *L. vestitus* immediately separates both sexes of these 2 species from all other New Zealand *Leioproctus*. The very broad basal width of the pygidial plate of female *L. purpureus* and the heavy more or less longitudinal ridging immediately separate this species from *L. vestitus*, the females of which have a much narrower, smoother pygidial plate. However, the pygidial plate of *L. purpureus* is similar to that of *L. metallicus*. It is interesting that these 2 species are both restricted to sandy ocean and river bed nest sites. Perhaps the form of the pygidial plate is an advantage when tunnelling in sand? *L. vestitus* also nests in sand, but for bees living inland, most nests are probably in non-sandy substrates. Another characteristic shared with *L. metallicus* is a metallic tinge to the metasoma: that of *L. purpureus* is purple, while that of *L. metallicus* is green.

***Leioproctus (Leioproctus) vestitus* (Smith)**

Fig. 7e–f, 8a–b, 46a–o; Map 10

*Dasycolletes vestitus* Smith, 1876: 485–486 (description of female and male). Hutton, 1881: 99 (repeats description of Smith 1876). Kirby, 1881: 37 (list, the collection was made by Wakefield at Wellington). —1884: 67 (repeat of 1881). Dalla Torre, 1896: 49 (Australia and New Zealand). Cameron, 1898: 50 (records 2 specimens collected at Greymouth, New Zealand). —1903: 299 (list). Cockerell, 1904a: 203–204 (distinction between *Leioproctus boltoni* and *L. vestitus* (*Dasycolletes vestitus*), and between *L. imitatus* and *L. vestitus*. Hutton, 1904: 96 (list).

*Leioproctus vestitus*: Cockerell, 1904a: 203–204 (new combination, differences between *L. boltoni* and *L. vestitus* (*Dasycolletes vestitus*), and between *L. imitatus* and *L. vestitus*). —1929a: 311 (list). Donovan, 1980: 106 (visits primarily leguminous genera, abundance on flowers). Primack, 1983: 319 (flower record), 326 (as (*vestitus*), flower record), 332 (as (*vestitus*), flower record). Donovan & Macfarlane, 1984: 249 (abundance on host flow-

ers, visits primarily native legumes). Quinn, 1984: 43 (identification, flight period, host flowers, nest sites).

*Paracolletes vestitus*: Cockerell, 1905a: 348 (new combination, key). —1906a: 29 (key, Greymouth, New Zealand, Koebele, male, female in the U. S. National Museum). —1916b: 361 (list). —1925: 551 (*P. monticola* distinguished from *P. vestitus*, *P. vestitus* male from Greymouth taken by Koebele may prove separable), 553 (not sure that South Island *P. vestitus* is really identical with that from the North Island). —1934: 15 (key).

*Leioproctus (Leioproctus) vestitus*: Michener, 1965: 52 (new combination). Valentine & Walker, 1991: 42 (list).

**Female** (n = 20). Length 7.8–9.7 mm ( $9.0 \pm 0.52$  mm); width 2.2–3.1 mm ( $2.7 \pm 0.20$  mm); forewing length 5.1–6.3 mm ( $5.9 \pm 0.30$  mm); facial length 1.6–2.2 mm ( $1.9 \pm 0.12$  mm); facial width 1.6–2.1 mm ( $1.9 \pm 0.11$  mm); malar length/malar width 0.25.

**Coloration.** Head, mesosoma and metasoma black, except antennae dark brown beyond about 2nd flagellar segment; apices of mandibles and tarsal claws red, wing membranes hyaline, wing veins dark brown to black, tibial spurs pale, apical margins of metasomal terga 1–5 and sterna 1–5 hyaline, pygidial plate sometimes dark red apically.

**Structure.** (Fig. 46a–b). Scape equal in length to combined length of first 6 flagellar segments. Compound eyes 4× longer than wide, with about upper 1/3 of inner margins converging markedly above, lower 2/3 of inner margins converging less markedly below. Ocellular distance about 2.4× an ocellar diameter; interocellar distance equal to 2/3 an ocellar diameter. Antennal sockets equidistant between apex of clypeus and vertex. Face shiny throughout. Supraclypeal area rising rather evenly from below and laterally to a rounded mound between antennal sockets, apex of mound and lower slope almost impunctate, shiny, lateral slopes with medium-sized punctures; frontal ridge extending 3/4 of the distance to median ocellus, frontal line continuing to median ocellus. Frons and paracocular areas with small to medium-sized punctures separated by about 1/2 a puncture diameter, except area between lateral ocellus and compound eye almost impunctate. Clypeus somewhat protuberant, extending for nearly 1/2 its length below a line across lower ends of compound eyes, with prominent median vertical ridge, more or less rounded in cross-section; areas lateral to median vertical ridge with large irregular punctures separated by about 1/2 a puncture diameter, punctures smaller laterally, lower margin impunctate. Malar space short, 1/4 as long as wide, impunctate, shiny. Galea smooth, shiny. In lateral view, genal area a little wider than compound eye, very lightly shagreened, shiny, with large, irregular punctures separated by up to 1 diameter.

Pronotum moderately shagreened, with a few small,

widely spaced punctures dorsally and dorsolaterally; sulcus moderately well-defined dorsolaterally, absent lateroventrally. Scutum shiny with very light shagreening on anterior margin, small central area almost impunctate, remainder with medium-sized punctures which close to within 1–2 diameters around periphery. Scutellum with anterior 1/2 shiny, with a very few, very widely-spaced large punctures, remainder lightly tessellated with large, irregular close punctures. Metanotum heavily shagreened. Propodeal triangle moderately angled (Fig. 46k), moderately shagreened; remainder of propodeum heavily shagreened, with shagreening partly obscuring small punctures separated by 1–2 diameters. Metepisternum moderately shagreened, impunctate; remaining lateral areas of mesosoma smooth, shiny, with medium-sized punctures separated by 1–2 diameters. Basitibial plate 1/4 length of tibia, lightly tessellated, shiny, with irregular longitudinal ridges. Inner hind tibial spur ciliate, with cilia longest medially (Fig. 46i). Pterostigma about 4× longer than wide; vein 1st m-cu meets 2nd submarginal cell at or just beyond middle.

Metasomal terga 1–5 and sterna 1–6 lightly shagreened, tergum 1 almost impunctate, terga 2–4 with very small, widely-spaced punctures, tergum 5 with medium-sized punctures separated by 1–3 diameters; sterna 1–5 with small punctures separated by 2–3 diameters; sternum 1 shallowly emarginate apically. Pygidial plate moderately wide basally, narrowing to a squared apex, edges raised, central triangular area raised with numerous fine almost longitudinal ridges, depressed marginal areas lightly tessellated (Fig. 46j).

**Vestiture.** White on clypeus, supraclypeus and around antennal sockets, black on remainder of face; on clypeus vestiture sparse, short centrally, swept outwards on each side of median longitudinal ridge like the bow-wave of a ship or snow-plough; supraclypeus naked centrally. Genal vestiture adjacent to compound eye black, remainder white. Mesosomal vestiture black dorsally and dorso-laterally, not obscuring surface, with sometimes some off-white hairs dorsally adjacent to wing bases; lateroventrally vestiture white. Trochanteral floccus of long, white, plumose hairs (Fig. 46g); femoral vestiture white except black apically; basitibial plate with very short black hairs. Tibial scopa brown in dorsal 1/2, off-white in ventral 1/2, scopal hairs stout, with 5–6 branches (Fig. 46h). Metabasitarsus with hairs on outer face short, unbranched, not forming scopa. Metasomal terga 1–2 with long, sparse, white vestiture, terga 3–5 with sparse black vestiture, short on tergum 3, becoming longer towards tergum 5; sterna 1–4 with white vestiture, sparse on sternum 1, moderately dense on sterna 2–4, with moderately well-developed apical fimbria, vestiture black on sterna 5–6.

**Male** (n = 20). Length 6.3–8.5 mm ( $7.6 \pm 0.53$  mm); width 1.5–2.3 mm ( $2.0 \pm 0.18$  mm); forewing length 4.2–5.5 mm ( $5.0 \pm 0.28$  mm); facial length 1.3–1.8 mm ( $1.6 \pm 0.11$  mm); facial width 1.3–1.7 mm ( $1.6 \pm 0.10$  mm); malar length/malar width 0.16.

**Coloration.** Similar to female, except galea, tegula and wing veins with yellow tinge.

**Structure.** (Fig. 46c–d). Scape as long as combined length of first 3.5 flagellar segments. Compound eyes about  $3.6\times$  longer than wide, with inner margins similar to female. Ocellocular distance equal to  $3\times$  an ocellar diameter, interocellar distance about equal to an ocellar diameter. Position of antennal sockets similar to female. Clypeus extending for about  $0.4\times$  its length below a line across lower ends of compound eyes. Supraclypeus similar to female but not as raised, with small point between antennal sockets. Clypeus moderately protuberant, with medium-sized punctures separated by about  $1/2$  a puncture diameter, except for sometimes a narrow median vertical impunctate area, and lower margin impunctate. Malar space about  $1/6$  as long as wide. Remainder of head similar to female.

Mesosoma similar to female, except scutum widely impunctate medially, shagreened areas less so than in female. Basitibial plate and wing similar to female.

Metasomal terga 1–5 and sterna 1–6 much as in female. Sternum 7 (Fig. 46e) with basal lobes moderately widened medially, apical lobes sub-rectangular. Sternum 8 (Fig. 46f) with shaft of apical process slightly widened medially. Gonocoxites in dorsal and ventral views (Fig. 46l) stout, gonostyli incurved apically, penis valves with inner margin acute apically; in lateral view (Fig. 46m) penis valve projecting below gonocoxite, anterior margin acute.

**Vestiture.** White throughout except for some black hairs around margins of compound eyes and on vertex. Facial vestiture moderately long, moderately dense, partly obscuring surface; clypeal vestiture swept up and laterally more so than in female. Mesosomal vestiture longer than in female. Metasomal vestiture less dense than in female.

**Variation.** One male from Blue Stream, Tasman Valley MK, taken on ? January 1976, has the propodeal triangle shiny, and the malar space  $1/2$  as long again as normal, and 5 other males taken at the same site on 29 November 1989, have the propodeal triangle shiny, and the malar space about twice as long as normal. Also, the vestiture of these latter 5 males is silver white. The genitalia of 2 of these that were examined conform to that of the species. The clypeus of other males may be punctured throughout, or may display a prominent median longitudinal impunctate area. The distribution of black vestiture on the head of males may range from that described to just a few black hairs on the

inner dorsal margin of the compound eyes.

**Type data.** *Dasycolletes vestitus*: holotype female, “Wellington, WN, North Island”, C. M. Wakefield (BMNH).

**Material examined.** Type specimen, plus 277 females and 570 males.

**Distribution** (Map 10). North Island: ND, BP, WO, WN, WA. South Island: SD, BR, NN, MB, KA, WD, NC, MC, MK, SC, FD, OL, CO, DN, SL. Stewart Island.

Collection dates for the 182 collection records range from 4 November to 14 February. One final instar larva was taken from a nest site in the bed of the Whataroa River WD, 5 km E Abut Head, on 2 March 1995 (Fig. 46n), and a prepupa with the same location data was taken on 9 May 1994 (Fig. 46o).

**Biology.** The species occurs over a very wide climatic range, from the humid, coastal, northernmost tip of the North Island, throughout the South Island including the dry high altitude inland montane basins, the very wet West Coast, the dry eastern coastal plain, and coastal Stewart Island. There are 13 altitude records, the highest of which is 1220 m at Lake Tennyson MB.

**Flight period.** The earliest seasonal capture record for both females and males is 4 November, while the last for females is 14 February, and for males, 11 February. Of the 101 collections for 277 females, 45.5% were in December, and 25.7% in January. For 570 males, 55.5% of the 81 collection dates were in November, and 19.7% in January.

#### Number of collections

	Nov	Dec	Jan	Feb
Females	15	46	26	14
Males	11	45	16	9

Many bees can occur in the same area, with a maximum catch of 14 females and 94 males taken 1 km E. Abut Head WD over a nest site on 6 December 1976, by B. J. Donovan, 10 females and 43 males 1–3 km E. Abut Head, and 3 females and 25 males 2 km E. Abut Head, on the same day by the same collector. At Haast Beach WD, 11 females, 9 of which carry pollen, and 72 males were taken on a foredune on 26 November 1989 by A. C. Harris, and the following day at the Haast Road Turnbull River WD the same collector took 39 females, of which 28 carry pollen, and 9 males, over sand. At Okains Bay MC, 35 males were taken on 19 December 1977 at a nest site at an estuary beach by B. J. Donovan, and at the Karangarua River WD, 24 males were captured on 12 December 1960 by P. Kettle and J. I. Townsend. There are 9 other collections of 10 or more bees.

## Host plants

## Native plants

Asteraceae		
<i>Brachyglottis bennettii</i>	♀ 1/3 (1/3 p)	♂ 1/4
<i>Celmisia semicordata</i>	♀ 1/1	—
<i>Raoulia</i> sp.	—	♂ 1/2
Caryophyllaceae		
<i>Colobanthus</i> sp.	—	♂ 1/1
Fabaceae		
<i>Carmichaelia arborea</i>	♀ 1/1	—
<i>Carmichaelia crassicaulis</i>	♀ 1/1 (1/1 p)	—
<i>Carmichaelia petriei</i>	♀ 1/1	♂ 1/1
<i>Carmichaelia australis</i>	—	♂ 1/1
<i>Carmichaelia</i> sp.	♀ 9/28 (7/16 p)	♂ 6/31
Goodeniaceae		
<i>Selliera radicans</i>	♀ 1/1	♂ 1/1
Laxmanniaceae		
<i>Cordyline australis</i>	♀ 5/16 (4/9 p)	♂ 3/6
Plantaginaceae		
<i>Hebe stricta</i>	♀ 2/2	—
<i>Hebe subalpina</i>	—	♂ 1/1
<i>Hebe</i> sp.	♀ 1/1 (1/1 p)	♂ 1/1
Phrymaceae		
<i>Mimulus</i> sp.	—	♂ 1/1
Rousseaceae		
<i>Carpodetus serratus</i>	♀ 1/4 (1/2 p)	♂ 1/6
<b>Total collections/specimens</b>	♀ 24/59 (15/32 p)	♂ 19/56
<b>Species/general/families</b>	11/7/6 (6/5/5 p)	12/9/8

## Introduced plants

Actinidiaceae		
<i>Actinidia deliciosa</i>	♀ 1/1	—
Apiaceae		
<i>Anethum graveolens</i>	♀ 1/1 (1/1 p)	—
<i>Daucus carota</i>	♀ 1/1 (1/1 p)	♂ 1/1
<i>Pastinaca sativa</i>	♀ 1/2	♂ 1/1
Asteraceae		
<i>Achillea millefolium</i>	♀ 1/1	—
Fabaceae		
<i>Medicago sativa</i>	♀ 2/6 (1/4 p)	—
<i>Melilotus</i> sp.	♀ 1/1	—
<i>Trifolium fragiferum</i>	♀ 1/2 (1/1 p)	♂ 1/4
<i>Trifolium hybridum</i>	♀ 1/1	—
<i>Trifolium repens</i>	♀ 3/4 (2/3 p)	—
<i>Trifolium subterraneum</i>	♀ 1/4 (1/3 p)	—
<b>Total collections/specimens</b>	♀ 14/24 (7/13 p)	♂ 3/6
<b>Species/general/families</b>	11/8/4 (6/4/2 p)	3/3/2

In addition to these records, Quinn (1984) found *L. vestitus* foraging on *Craspedia* sp. but whether females were collecting pollen is not stated.

There is also 1 record of 1 female with pollen from *Linum catharticum*/*Trifolium repens* (Linaceae/Fabaceae).

These records indicate that the primary flower hosts of *L. vestitus* are native Fabaceae, and where these are absent, introduced Fabaceae are preferred. That *L. vestitus* also visits representatives of 5 other plant families for pollen, indicates some plasticity in its flower-visiting habits.

A notable exception to the list of families visited by both sexes is Myrtaceae. Apart from *L. pango*, *L. vestitus* is the only species of *Leioproctus* that has been recorded collecting pollen from New Zealand's primary pasture legume, white clover. Similarly, apart from *L. pango*, *L. vestitus* is the only native bee that has been observed and captured while tripping lucerne flowers (i.e. releasing the reproductive column from the enclosing petals) to obtain pollen. When tripping lucerne flowers, *L. vestitus* females had to struggle to extract their bodies from between the reproductive column and the standard petal. Once free, bees often paused on lucerne foliage to recover and preen, before visiting another flower. As a consequence of the difficulty experienced with working flowers, and the necessity to preen between flowers, the flower visitation rate was only about three per minute. In contrast, bees that co-evolved with lucerne such as the lucerne leafcutting bee *Megachile rotundata*, which do not have to preen between flowers, visit up to about 16 flowers per minute.

**Nest sites.** Among the 182 collection records there are 58 references to nest sites, or ground such as sand dunes and tracks where bees were probably nesting. Nest sites include ocean beaches, fore-dunes, sand dunes, river beds, dirt banks, bare ground on a golf course, farm tracks, and tussock grassland. The species therefore appears to be able to utilize a wide range of soils within which to excavate its nesting tunnels. Ten of the records are for nest sites in the bed of the Whataroa River WD, from 1–5 km east of the mouth. I first caught *L. vestitus* on the river bed on 1 December 1972, and have observed bees nesting there almost annually since. Nests occur in fine silt and sand which after a day without rain will be dry at the surface, but still moist below about 10 mm. The fine silt and sand is deposited and maintained free of vegetation by floods, although clumps of grasses and seedling gorse normally occur at intervals of 200–1000 mm. On 6 December 1976, 10 females, one of which was carrying pollen, and 43 males, were captured over nests which a day earlier had been covered by up to 350 mm of dirty flood waters. On 4 December 1993, male bees were swarming over the substrate at from 10–50 mm above the surface, and were frequently entering and leaving nest holes. Males often dug into nests, in the process expelling spoil which spread out to form tumuli up to 20 mm across. Nest entrances ranged from 10–50 mm apart over several square metres in any one locality. Nearby flowers of white clover and gorse were ignored. Excavations showed that nest tunnels were impossible to distinguish from surrounding substrate because of spoil filling the tunnels. Two cells, each containing a female pupa, were located at depths of 130 and 150 mm, and several bees of both sexes were discovered digging their way to the surface.

When I next visited the nest site on 25 April 1994, adults were not seen, but more than a dozen prepupae were recovered from cells. On 25 October 1994, 12 cells were discovered at from 90–120 mm below the surface. Two cells contained bee prepupae, 8 cells contained bee pupae which ranged in colour from white, indicating very recent pupation, to dull yellow, which is an indication of more advanced pupation. One cell contained a prepupa of a parasitoid, *Pseudofoenus* sp. All stages were placed within gelatine capsules and held in the laboratory, but unfortunately all dehydrated without further significant development.

Thirteen records are of bees at nest sites among sand dunes. At Okains Bay MC on 19 December 1977, hundreds of male bees were flying low over fine dune sands on the edge of the estuary, within a score or so metres of an ocean beach.

**Associated organisms.** One cell at 5 km E. Abut Head WD contained a prepupa of *Pseudofoenus* sp. One male identified by F. W. Hutton as *Dasycolletes vestitus* but with no further data, carries at least 54 large mites, most of which are on the mesosoma. One female collected by Wakefield but with no further data, carries 2 small mites. One female from 1–3 km E. Abut Head WD carries 1 oval mite, 1 male from 5 km E. Abut Head WD carries 1 large mite, and 1 male from 13 km S. Keckerengu KA, carries 1 small mite.

**Remarks.** This species is closely similar to *L. purpureus*, in that the ‘bow wave’ form of the clypeal vestiture is common to both species. However the pygidial plate of the female of *L. vestitus* is not strongly widened basally nor heavily ridged longitudinally, and the ventral margin of the clypeus in males is rounded, and not roughly sculptured as in *L. purpureus*. Nest sites of *L. vestitus*, although occurring in close proximity to those of *L. purpureus* near the shoreline, are found only in more permanent ground. This characteristic may account for the occurrence of *L. vestitus* well inland, such as in WO and MC, whereas *L. purpureus*, which seems to prefer more temporary ground, is more restricted to coastal regions. *Leioproctus vestitus* has been taken collecting pollen from the native *Cordyline australis* (Laxmanniaceae), to which *L. purpureus* is restricted along with *Phormium tenax* (Hemerocallidaceae), but it also occurs on a much wider range of flowers in 4 other native families.

### *Leioproctus (Leioproctus) waipounamu* new species

Fig. 8c–f, 47a–m; Map 11

**Female** (n = 20). Length 7.8–9.5 mm ( $8.5 \pm 0.43$  mm); width 2.3–2.6 mm ( $2.4 \pm 0.10$  mm); forewing length 5.5–6.0 mm ( $5.8 \pm 0.16$  mm); facial length 1.6–1.8 mm ( $1.7 \pm 0.04$  mm); facial width 1.5–1.6 mm ( $1.6 \pm 0.05$  mm); malar

length/malar width 0.16.

**Coloration.** Head black except antennae brown beyond about 2nd flagellar segment, apices of mandibles red; mesosoma and metasoma black with metasoma and sometimes mesosoma with slight metallic blue tinge dorsally; tarsal claws red, tibial spurs very pale, wing membranes hyaline, wing veins brown, apical margins of metasomal terga 1–6 and sterna 1–6 hyaline.

**Structure.** (Fig. 47a–b). Scape as long as combined length of first 6 flagellar segments. Compound eyes 4× longer than wide, with upper 1/3 and lower 2/3 of inner margins converging markedly above and below respectively. Ocellular distance equal to 2.3 ocellar diameters; interocellar distance equal to 0.7× an ocellar diameter. Antennal sockets a little closer to vertex than to apex of clypeus. Face shiny throughout. Supraclypeus rising from below and laterally to a somewhat rounded peak in lateral view between antennal sockets, lower and lateral faces with medium-sized punctures separated by less than 1 diameter; frontal ridge prominent, extending about halfway to median ocellus, frontal line continuing to median ocellus. Frons, paraocular areas and vertex with medium-sized punctures separated by less than 1 diameter, frons and paraocular areas very lightly tessellated, tessellation more pronounced on vertex. Clypeus slightly rounded, extending for about 1/3 its length below a line across lower ends of compound eyes; narrow central longitudinal area shiny, impunctate, laterally with large punctures separated by about 1 diameter. Malar space short, somewhat more than 1/6 as long as wide, shiny, impunctate. Galea noticeably tessellated. In lateral view, gena about equal in width to compound eye, shiny, lightly shagreened on posterior 1/2, with medium-sized punctures separated by about 1 diameter or less.

Pronotum moderately tessellated, sulcus markedly defined dorsally, well defined dorsolaterally, obscure lateroventrally. Scutum with anterior margin lightly shagreened, remainder smooth, shiny, with medium-sized punctures separated by up to about 5 diameters. Scutellum almost impunctate, with at most a few small, very widely-spaced punctures, smooth, shiny. Metanotum shagreened with very small indistinct punctures laterally, separated by about 2–3 diameters. Propodeal triangle moderately angled (Fig. 47k), dorsal 1/2 with fine transverse striations extending towards mid-line from lateral corners, remainder moderately tessellated; dorsolateral areas of propodeum with indistinct, small, widely-spaced punctures. Remaining lateral areas of mesosoma very lightly tessellated, shiny, with medium-sized shallow punctures separated by about 3–4 diameters, except metepisternum shagreened, impunctate. Basitibial plate prominent, about 1/5 as long as tibia, very lightly tessellated, shiny, with a few irregular longitudinal ridges. Inner metatibial spur ciliate (Fig. 47i).

Pterostigma 4× longer than wide; vein 1st m-cu meets 2nd submarginal cell before middle.

Metasomal terga 1–5 and sterna 1–5 lightly shagreened, shiny, with indistinct, shallow punctures separated by about 1–6 diameters, punctures more prominent on tergum 5. Sternum 1 scarcely emarginate apically. Pygidial plate narrowing to rounded apex from moderately wide base, with edge and broad longitudinal median area raised, very lightly tessellated (Fig. 47j).

**Vestiture.** White to near-white except some black hairs among white on clypeus and paracocular areas, black on vertex, black on central dorsal area of mesosoma fringed with white to near-white laterally, black on dorsoposterior faces of propodeum, black on apex of femur and basitibial plate, brown on dorsal 1/2 of basitibial scopa, black on metasomal tergum 5. Facial vestiture short, not obscuring surface. Scutum, scutellum almost naked medially. Trochanteral floccus (Fig. 47g) and femoral pollen-carrying structure well developed, with long, fine, plumose hairs. Tibial scopal hairs very stout, with some branches with recurved tips (Fig. 47h). Metabasitarsus with hairs on outer face short, unbranched, not forming scopa. Metasomal terga 1–4 almost naked, with very sparse, very fine hairs, on terga 2–4 forming very sparse apical fringe. Sterna 2–5 with vestiture much more dense, forming prominent apical fimbria of long white hairs.

**Male** (n = 20). Length 6.3–8.2 mm ( $7.1 \pm 0.44$  mm); width 1.8–2.5 mm ( $1.9 \pm 0.15$  mm); forewing length 4.9–5.8 mm ( $5.1 \pm 0.22$  mm); facial length 1.4–1.7 mm ( $1.5 \pm 0.06$  mm); facial width 1.3–1.7 mm ( $1.4 \pm 0.08$  mm); malar length/malar width 0.11.

**Coloration.** Similar to female with metallic blue tinge more obvious on metasomal terga.

**Structure.** (Fig. 47c–d). Scape a little longer than combined length of first 4 flagellar segments. Compound eyes similar to female. Ocellular distance 2.5× an ocellar diameter, interocellar distance about equal to one ocellar diameter. Position of antennal sockets as in female. Clypeus extending for about 1/4 its length below a line across lower ends of compound eyes, slightly protuberant apically, with large punctures separated by up to 1 diameter centrally, but close laterally. Remainder of head similar to female.

Mesosoma similar to female. Basitibial plate a little more than 1/6 length of tibia, smooth, shiny; wings similar to female.

Metasomal terga 1–6 and sterna 1–6 similar to female terga 1–4 and 1–5 respectively. Sternum 7 (Fig. 47e) with basal lobes narrowing slightly apically, apical lobes near-rectangular but angles rounded. Sternum 8 (Fig. 47f) with basal area large, produced anteriorly, apical process proportionally short, rounded distally. Gonocoxites in dorsal and ventral views (Fig. 47l) stout, gonostyli incurved

and truncate apically; penis valve in lateral view (Fig. 47m) blunt apically, scarcely extending below gonostylus.

**Vestiture.** On vertex, frons and paracocular areas black, with white to off-white hairs on clypeus, supraclipeus and narrowly lateral to and above antennal sockets a few black hairs among the white to off-white hairs. Remaining distribution of hairs similar to female except black more pronounced on dorsum of mesosoma, and some black hairs below wing articulation, including on pronotal lobe. Vestiture on legs off-white. Clypeal vestiture moderately dense but surface not obscured. Density of mesosomal vestiture similar to female. Metasomal tergal vestiture density similar to female, but apical fringe entirely absent. Sternal apical fimbria reduced to about 1/2 the density of that of female.

**Variation.** The extent of black vestiture in males is greater on specimens from Cass MC than from Lincoln MC.

**Type data.** *Leioproctus waipounamu*: holotype female, “DSIR Lincoln, MC”, 30 December 1976, found on *Hebe stricta*, B. J. Donovan (NZAC). Allotype male, 12 paratype females, 4 paratype males, same data as holotype. Seven other paratype females, 2 other paratype males, same data as holotype except found on *Hebe salicifolia* (NZAC). Two other paratype females, 8 other paratype males, same data as holotype except found on *Hebe* sp. (NZAC).

**Material examined.** Type specimens, plus 57 females and 115 males.

**Distribution** (Map 11). South Island: MB, NC, MC, MK.

Of the 39 collection records, altitude data are given for 3 localities; 550 m at Cass MC, 800 m at Mt Cook National Park MK, and 750 m at Lake Tekapo MK. However bees taken on the shore of Lake Ellesmere MC would have been just a few metres above sea level. The 39 collections have been captured from 10 December to 12 March, with more than half the collection dates occurring in January.

**Biology.** This species appears to be confined to the central eastern third of the South Island.

**Flight period.** Females have been caught from 17 December to 12 March and males from 10 December to 19 February. For 79 females, 31.6% of the 19 collections were taken in December, 47.4% in January, and 15.8% in February, while for 130 males 30%, 60% and 10% of the 20 collections were taken in the same 3 months respectively.

	Number of collections			
	Dec	Jan	Feb	Mar
Females	6	9	3	1
Males	6	12	2	

There are 7 collections of 10 or more specimens, with the top 3 of a combined 22 females and 15 males taken at DSIR Lincoln MC on 30 December by B. J. Donovan. Thirteen of these females and 5 males were from *Hebe stricta*, 7

females of which 3 are carrying pollen, and 2 males were from *H. salicifolia*, and 2 females both with pollen and 8 males were from *H. sp.* The next largest collection is of 3 females and 30 males from Cass MC from *Hebe odora* on 15 January 1977 by F. C. Evans.

#### Host plants

##### Native plants

Asteraceae		
<i>Olearia virgata</i>	—	♂ 2/15
<i>Ozothamnus leptophyllus</i>	♀ 1/1 (1/1 p)	♂ 1/1
Hemerocallidaceae		
<i>Phormium tenax</i>	—	♂ 1/1
Malvaceae		
<i>Hoheria angustifolia</i>	—	♂ 1/2
Myrtaceae		
<i>Kunzea ericoides</i>	—	♂ 1/2
<i>Leptospermum scoparium</i>	—	♂ 1/7
Plantaginaceae		
<i>Hebe brachysiphon</i>	♀ 1/1 (1/1 p)	♂ 2/16
<i>Hebe odora</i>	♀ 1/3	♂ 1/30
<i>Hebe salicifolia</i>	♀ 2/8 (1/3 p)	♂ 2/9
<i>Hebe stricta</i>	♀ 1/13	♂ 1/5
<i>Hebe subalpina</i>	♀ 2/6 (1/3 p)	—
<i>Hebe traversii</i>	♀ 1/11 (1/5 p)	♂ 1/5
<i>Hebe sp.</i>	♀ 6/31 (3/11 p)	♂ 4/34
Phrymaceae		
<i>Mimulus repens</i>	♀ 1/1	—
<b>Total collections/specimens</b>	♀ 16/75 (8/24 p)	♂ 18/127
<b>Species/general/families</b>	9/3/3 (6/2/2 p)	12/7/5

Apart from 1 female caught in association with *Ozothamnus leptophyllus*, all 23 other pollen-carrying females have been associated with species of *Hebe*.

No bees have been taken from introduced plants.

**Nest sites.** Nothing is known.

**Associated organisms.** One female from Cass MC carries 2 large mites on the mesosoma, and 3 males from the same site carry 1 large mite each. Two males from Jollies Pass, Molesworth MB each carry 1 large mite, and 1 male from the same site carries 8 large mites.

**Etymology.** *waipounamu*: Maori for the South Island. The species is found only in the South Island.

**Remarks.** The presence of *L. waipounamu* from near sea level on the Canterbury Plains to 750 m among the inland mountains suggests that a wide range of climatic and nesting conditions can be tolerated. There seems no obvious reason why this species should not be found over a much greater range, at least to the north and south of its known range. The apparent near-oligolecty of this species on species of *Hebe* for pollen is matched only by *L. monticola*.

#### Subgenus *Nesocolletes* Michener

*Leioproctus* (*Nesocolletes*) Michener, 1965: 52. Type species: *Lamprocolletes fulvescens* Smith, 1876, by original designation.

#### *Leioproctus* (*Nesocolletes*) *fulvescens* (Smith)

Fig. 9a–d, 48a–m; Map 12

*Lamprocolletes fulvescens* Smith, 1876: 486 (description of female). Hutton, 1881: 97 (repeats description of Smith 1876). Kirby 1881: 36 (list). —1884: 66 (list). Dalla Torre, 1896: 48 (list, Australia). Cameron, 1903: 299 (list). Hutton, 1904: 96 (list). Cockerell, 1905a: 348 (key, *Paracolletes fulvescens* = *Lamprocolletes fulvescens*). Thomson, 1927: 107 (very common, nests in dry banks, seen on many introduced garden flowers but not natives). Michener, 1965: 52 (Type species of *Nesocolletes*).

*Dasycolletes hirtipes* Smith, 1878: 7 (description of female). Hutton, 1881: 98 (repeat of description of Smith 1876). Kirby, 1881: 37 (list). —1884: 66 (list). Hudson, 1892: 33–34 (nests of clay, loud buzzing, cells with honey and pollen), Plate 3, Fig. 1 (drawing of adult). Dalla Torre, 1896: 49 (list, Australia). Cameron, 1898: 50 (records 1 specimen collected at Greymouth, New Zealand). Alfken, 1903: 596 (records 10 females from Waikana Bay). Cameron, 1903: 299 (list). Hutton, 1904: 96 (list, as *D. hirticeps*). Kirkaldy, 1909: 131 (*D. hirtipes*, not *hirticeps*). Friese, 1924: 217 (*Dasycolletes hirtipes* Smith is very similar to *D. curvipes* n. sp. from Australia). **New synonymy.**

*Paracolletes waterhousei* Cockerell, 1905a: 347 (new species, key, it bears the label “*frontalis* Smith. Type” and another label with the remark “clearly not *frontalis*”). The description of *frontalis* – does not at all accord with the present insect). —1929a: 311 (if *Paracolletes* and *Leioproctus* are separated, *waterhousei* is included in *Leioproctus*). —1934: 38 (Victoria. There is a strong resemblance to the New Zealand *P. fulvescens* (Smith). —1936: 446 (I conclude that *P. waterhousei* Ckll., supposed to occur in Victoria, is not distinct), 448 (*P. opacior* runs to *P. waterhousei* Ckll., but is smaller, with dullish abdomen). **New synonymy.**

*Paracolletes hirtipes*: Cockerell, 1905a: 348 (new combination, key, *fulvescens* seems to be only a variety of *hirtipes*). Heine, 1937: 139, 145, 146 (record of collections and/or observations on *Hebe speciosa*, *H. lewisii*, *H. salicifolia* and *H. buxifolia*).

*Paracolletes fulvescens*: Cockerell, 1905a: 348 (new combination, key, = *Lamprocolletes fulvescens*, *fulvescens* seems to be only a variety of *hirtipes*). Cockerell, 1916b: 361 (list). —1925: 553 (was described by Smith from specimens taken by C. M. Wakefield in Canterbury Province, South Island). —1926a: 218 (description of male; “*P. waterhousei* Ckll from Victoria, Australia, is so similar that distinctness is doubted. The described male may not have come from New Zealand.”). —1934: 20 (key, female from Waikana Bay), 38 (*P. waterhousei* from Victoria, Australia, strongly resembles the New Zealand *P. fulvescens* (Smith)). —1936: 446 (collection record, conclusion that *P. waterhousei* Ckll., supposed to occur in Victoria, is not distinct, 447 (*Paracolletes opacior* resembles *P. fulvescens*). Miller, 1955: 34 (often seen laden with golden pollen). Paintin and Murdoch, 1964: 37 (Our most common species – can often be seen returning to



its burrow laden with masses of pollen). Powell, 1987: 47 (has extremely hairy pollen-carrying legs, small drawing of adult).

*Paracolletes opacior* Cockerell, 1936: 446–447 (description of female, resembles *P. fulvescens*), 448 (runs to *P. waterhousei* Ckll., but is smaller, with dullish abdomen).

**New synonymy.**

*Leioproctus waterhousei*: Michener, 1965: 37 (the “type” of *frontalis* Smith, 1853 in B. M. is false, and is in fact the type of *waterhousei* Cockerell).

*Leioproctus (Nesocolletes) fulvescens*: Michener, 1965: 44 (new combination, illustration of forewing), 46 (illustration of inner hind tibial spur of female), 53 (new combination, illustrations of male genitalia and 7th and 8th sterna), pl. 1 (photograph of female face). —2000: 140 (drawing of forewing). Valentine & Walker, 1991: 42 (list).

*Leioproctus (Nesocolletes) waterhousei*: Michener, 1965: 53–54 (new combination, the name was based on a specimen assumed, presumably in error, to be from Australia).

*Leioproctus (Nesocolletes) hirtipes*: Michener, 1965: 53 (new combination, list). Harris, 1994: 33 (not *Pison spinolae* Shuckard. Misidentification of *P. spinolae* by Hudson 1892, Benham 1904, and others following Hudson). Valentine & Walker, 1991: 42 (list).

*Leioproctus (Nesocolletes) opacior*: Michener, 1965: 53 (new combination, list). Valentine & Walker, 1991: 42 (list).

*Leioproctus fulvescens*: Miller, 1971: cover and Plate 4 (colour illustration of female carrying large loads of pollen), 20 (drawing of head and proboscis compared with humble bee and honey bee, photograph of “pudding” from cell), 20–21 (outline of biology). Donovan, 1980: 105 (photograph of cell with larva), 106 (nest site preferences; visits only Compositae (= Asteraceae), both native and introduced; can be extremely abundant on its host flowers). Primack, 1978: 70 (12 out of 25 collected were females). —1983: 319, 323, 326, 328, 332 (flower records). Donovan & Macfarlane, 1984: 248 (photograph of female), 249 (photograph of cell with larva; nest site preferences; can be extremely abundant on host flowers), 250 (visits only native and introduced Compositae (= Asteraceae), collecting pollen). Quinn, 1984: 42 (flight period Nov.–Mar; most abundant species; nest sites; flower hosts). Miller, 1984: Plate 4 (colour illustration of female carrying large loads of pollen), 20 (drawing of head and proboscis compared with humble bee and honey bee, photograph of “pudding” from cell), 20–21 (outline of biology). Early, 2001: 67 (photograph of female).

**Female** (n = 20). Length 8.6–12.2 mm (10.4 ± 0.89 mm); width 2.3–3.2 mm (2.8 ± 0.23 mm); forewing length 6.0–7.4 mm (6.8 ± 0.36 mm); facial length 2.1–2.5 mm (2.3 ± 0.11 mm); facial width 1.6–2.2 mm (2.0 ± 0.12 mm); malar length/malar width 0.56.

**Coloration.** Head, mesosoma, and discs of metasomal terga 1–5 black, antennae light brown beyond about 2nd flagellar segment, tibial spurs and wing veins pale brown; remaining

areas, particularly extremities, black or red-black; wing membranes and apical margins of metasomal terga 1–5 hyaline.

**Structure.** (Fig. 48a–b). Scape as long as combined length of first 6 flagellar segments. Compound eyes 4× longer than wide, upper 1/5 and lower 4/5 of inner margins converging slightly above and below respectively. Ocellular distance about equal to about 2.5× ocellar diameter; interocellar distance about 0.7× diameter of ocellus. Antennal sockets 1.4× further from apex of clypeus than from vertex. Face shiny throughout. Supraclypeus rising to a sharp peak between antennal sockets, with below this a narrow area to clypeus impunctate, laterally with close, medium-sized punctures; frontal ridge extending from peak between antennal sockets to more than halfway to median ocellus, then frontal line extending to median ocellus. Frons with large, close punctures; area between lateral ocellus and compound eye narrowly almost impunctate, area between ocelli and vertex with rough, close punctures, appearing almost tessellate. Paraocular area with medium-sized, close punctures. Clypeus long, extending for a little less than 2/3 its length below a line across lower margins of compound eyes, protuberant apically, with apical edge rounded; upper 1/3 with medium-sized close punctures, these increasing in size and spacing towards apical 1/3 and laterally; lower central 1/2 with irregular depressions; apical central rounded margin impunctate. Malar space long, 1/2 as long as wide, impunctate, shiny. Galea moderately tessellated. In lateral view, genal area somewhat narrower than compound eye, shiny, with close, medium-sized punctures.

Pronotum lightly shagreened with a few small, widely spaced punctures; sulcus broad, deep dorsolaterally, absent lateroventrally. Scutum smooth with medium-sized punctures closely spaced around periphery; punctures larger, more widely spaced medially. Scutellum with anterior face impunctate, medium-sized punctures on remainder, and posterior 1/3 tessellate. Metanotum with small to medium-sized punctures, tessellate. Propodeal triangle appearing almost declivous, slightly rounded (Fig. 48k), shiny, very lightly tessellated; lateral areas of propodeum impunctate adjacent to propodeal triangle, otherwise with medium-sized, widely spaced punctures. Remaining lateral areas of mesosoma shiny, with medium-sized punctures separated by about 1 diameter or more; metepisternum impunctate. Basitibial plate prominent, about 1/4 length of tibia, with irregular longitudinal ridges, lightly tessellated. Inner metatibial spur ciliate (Fig. 48i). Pterostigma about 4× longer than wide; vein 1st m-cu meeting 2nd submarginal cell before middle.

Metasomal terga 1–5 and sterna 1–6 shiny, lightly shagreened throughout, with small, widely spaced

punctures. Sternum 1 shallowly emarginate mid-apically. Pygidial plate narrowing from moderately wide at base to blunt apex, with edges and a broad longitudinal median area raised, moderately tessellated throughout (Fig. 48j).

**Vestiture.** On scutum, scutellum and apex of metasoma orange, elsewhere yellow or yellow-orange, except for black hairs narrowly around compound eyes, and on vertex. Facial vestiture long, dense, almost obscuring surface. Dorsum of mesosoma with hairs of medium length, evenly distributed. Trochanteral floccus well developed, hairs long, thin, 'fluffy' (Fig. 48g); Tibial scopa with hairs of anterior face branched apically, with branch tips recurved (Fig. 48h). Metabasitarsus with hairs on outer face long, strongly branched, forming well developed scopa. Metasomal terga 1–2 with long sparse hairs on disc; terga 2–4 with apical fimbria, absent medially. Metasomal sterna 1–4 with long, branched hairs on posterior 1/2; hairs on sterna 5 and 6 shorter, not branched.

**Male** (n = 20). Length 8.8–11.4 mm ( $10.1 \pm 0.57$  mm); width 2.3–3.1 mm ( $2.7 \pm 0.21$  mm); forewing length 6.2–7.1 mm ( $6.7 \pm 0.23$  mm); facial length 2.1–2.5 mm ( $2.3 \pm 0.09$  mm); facial width 1.6–2.0 mm ( $1.9 \pm 0.11$  mm); malar length/malar width 0.49.

**Coloration.** Similar to female.

**Structure.** (Fig. 48c–d). Scape as long as combined length of first 4.5 flagellar segments. Compound eyes 3.75× longer than wide, with upper 1/5 and lower 4/5 of inner margins converging slightly above and below respectively. Ocellular distance and interocular distance similar to female. Antennal sockets about 1.3× further from apex of clypeus than from vertex. Head otherwise similar to female, except punctures on clypeus smaller and closer.

Pronotum similar to female, except punctures shallow and broad. Scutum shiny, with medium-sized punctures throughout, close around periphery, more widely spaced medially. Remainder of mesosoma as in female. Basitibial plate shiny, with small, evenly spaced punctures. Wings as in female.

Metasomal terga 1–5 and sterna 1–6 as in female; tergum 6 similar to tergum 5; tergum 7 with a flat, V-shaped pseudopygidial plate with acute end directed distally and surface moderately tessellated. Sternum 7 (Fig. 48e) with basal apodemes widest medially, apical lobes poorly delineated from basal apodemes; sternum 8 (Fig. 48f) with basal area almost rectangular, apical process widely expanded, rounded apically. Gonocoxites in dorsal and ventral views (Fig. 48i) stout, sharply angled laterally, gonostyli incurved and acute apically; in lateral view (Fig. 48m) downcurved apically, penis valve projecting very markedly below gonocoxite.

**Vestiture.** Similar in colour to female except sometimes a few black hairs among orange hairs centrally on scutum, and sometimes black hairs laterally on mesosoma, ranging from a few to a broad band from anterior of mesepisternum to lateral areas of propodeum; discs of terga 3–5 frequently with short, black hairs. Facial vestiture below a transverse line about halfway between upper margins of antennal sockets and lower margin of median ocellus long, dense; below lower margins of antennal sockets directed downwards, obscuring surface; above lower margins of antennal sockets directed upwards, obscuring surface below ocelli. Vestiture on basitibial plate less dense than in female. Apical fimbria on metasomal terga 2–5 less distinct than on female terga 2–4, but almost continuous (terga 2–4) or continuous (tergum 5). Hairs on sterna shorter, less dense than on female.

**Variation.** The vestiture on the disc of metasomal terga 3–4 of a female from Lake Ellesmere MC, taken on 17 Dec. 1976, is almost black. Specimens from MK and CO are noticeably smaller than average, while those from MB, NN, and SD are larger than average. On old specimens the original brightness of the orange and yellow vestiture fades to a washed-out pale orange-yellow.

**Type data.** *Lamprocolletes fulvescens*: holotype female, "Canterbury MC", C. M. Wakefield (BMNH). *Dasycolletes hirtipes*: holotype female, "Otago CO", [F.W.] Hutton (BMNH); *Paracolletes opacior*: holotype female, "Mt. Aurum, Lake Wakatipu, OL", G. V. Hudson (BMNH).

**Material examined:** Type specimens, plus 1,019 females and 639 males.

**Distribution** (Map 12). South Island: SD, NN, BR, MB, KA, NC, MC, MK, SC, FD, OL, CO, DN, SL. Stewart Island.

The 634 collections have been taken from 10 September to 9 April.

**Biology.** *L. fulvescens* occurs primarily throughout the drier northwest, east and inland southeast of the South Island, and can be expected wherever suitable nesting soils and floral sources, primarily composites, are available. Numbers can sometimes be very high. Quinn (1984) recorded an estimated 840,000 nests along 6.5 km of little-used unsealed road in the Mackenzie Basin MK at the height of the nesting season. Among the 634 collection records there are 50 altitude records, which range from 209 to 1770 m. However, it is clear that many collections from salty estuarine areas were just above sea level.

**Flight period.** At the Canterbury Agriculture and Science Centre, Lincoln, from 1969 to 1975 (but excluding 1973), bees were first seen at a particular nest site between 17 November and 5 December, with peak female nesting activity by mid to late December. Activity appeared to cease

by late January. However, in the 1976/1977 season, following a very cold summer in early 1976, the first bees were not seen until 1 January 1977.

For 1,022 females the 344 collections have been taken from 27 September to 9 April, with 20.9%, 40.7% and 25.9% taken in December, January and February respectively. For 639 males the 290 collections were taken from 10 September to 22 March, with 21.4%, 41.7% and 29.3% taken in December, January and February respectively.

#### Number of collections

	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr
Females	1	1	19	72	140	89	20	2
Males	1		10	62	121	85	11	

The largest collection is of 85 females, 21 of which are carrying pollen, and 5 males from Coronet Peak OL at 1000 m on clay, on 1 January 1990 by A. C. Harris. The second largest collection is of 46 females, all carrying pollen, which were captured 2.5 km N Lake Tekapo MK, on *Achillea millefolium* on 5 February 1972 by B. J. Donovan. There are 19 other collections of 10 or more bees.

#### Host plants

##### Native plants

###### Asteraceae

<i>Brachyglottis bennettii</i>	♀ 1/4	♂ 1/1
<i>Brachyglottis compactus</i>	♀ 1/1 (1/1 p)	♂ 1/1
<i>Brachyglottis laxifolia</i>	—	♂ 1/1
<i>Brachyglottis</i> sp.	♀ 2/2 (2/2 p)	♂ 2/4
<i>Celmisia coriacea</i>	♀ 1/2	♂ 1/2
<i>Celmisia</i> sp.	♀ 2/3 (1/2 p)	♂ 2/3
<i>Celmisia spectabilis</i>	—	♂ 1/2
<i>Cotula coronopifolia</i>	♀ 1/3 (1/2 p)	♂ 2/7
<i>Cotula</i> sp.	♀ 1/2 (1/2 p)	♂ 1/1
<i>Craspedia uniflora</i>	—	♂ 1/1
<i>Craspedia</i> sp.	—	♂ 1/1
<i>Olearia moschata</i>	♀ 1/1	♂ 1/1
<i>Olearia nummularifolia</i> var. <i>cymbifolia</i>	—	♂ 1/1
<i>Ozothamnus leptophyllus</i>	♀ 2/2 (1/1 p)	♂ 2/4
<i>Pachystegia insignis</i>	♀ 5/7 (2/2 p)	♂ 2/4
<i>Raoulia australis</i>	♀ 1/1 (1/1 p)	—
<i>Raoulia haastii</i>	♀ 1/1	♂ 1/1
<i>Raoulia subsericea</i>	♀ 2/3 (1/1 p)	—

###### Campanulaceae

<i>Wahlenbergia</i> sp.	♀ 1/2 (1/1 p)	♂ 1/4
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###### Gentianaceae

<i>Gentiana bellidifolia</i>	—	♂ 1/1
<i>Gentiana corymbifera</i>	♀ 1/3	—
<i>Gentiana</i> sp.	♀ 1/1 (1/1 p)	—

###### Malvaceae

<i>Hoheria</i> sp.	—	♂ 1/1
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###### Myrtaceae

<i>Kunzea ericoides</i>	♀ 3/7 (2/3 p)	♂ 1/10
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###### Plantaginaceae

<i>Euphrasia</i> sp.	♀ 1/1	♂ 1/1
<i>Hebe subalpina</i>	♀ 1/2	♂ 3/3

###### Phrymaceae

<i>Mimulus</i> sp.	♀ 2/2	♂ 1/1
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<b>Total collections/specimens</b>	♀ 31/50 (15/19 p)	♂ 30/56
<b>Species/genera/families</b>	20/13/6 (12/9/4 p)	23/15/7

##### Introduced plants

###### Apiaceae

<i>Conium maculatum</i>	—	♂ 1/1
<i>Daucus carota</i>	—	♂ 1/1

###### Asteraceae

<i>Achillea millefolium</i>	♀ 17/108 (15/103 p)	♂ 18/65
<i>Calendula officinalis</i>	—	♂ 2/2
<i>Carthamnus lanatus</i>	♀ 1/5 (1/5 p)	♂ 1/1
<i>Cichorium intybus</i>	—	♂ 1/2
<i>Cirsium arvense</i>	♀ 7/15 (6/10 p)	♂ 3/15
<i>Cirsium vulgare</i>	♀ 1/1 (1/1 p)	♂ 1/1
'thistle'	♀ 1/5 (1/2 p)	♂ 2/3
<i>Hieracium pilosella</i>	♀ 4/6 (2/4 p)	♂ 4/4
<i>Hieracium praealtum</i>	♀ 3/3 (2/2 p)	♂ 2/3
<i>Hieracium</i> sp.	♀ 7/12 (5/7 p)	♂ 6/13
<i>Hypochoeris radicata</i>	♀ 5/16 (5/15 p)	♂ 5/9
<i>Tanacetum vulgare</i>	♀ 1/1 (1/1 p)	—
<i>Taraxacum officinale</i>	♀ 15/25 (10/16 p)	♂ 14/24
'composite'	♀ 2/3 (2/2 p)	♂ 3/8

###### Fabaceae

<i>Medicago sativa</i>	♀ 1/1	♂ 1/2
<i>Melilotus alba</i>	—	♂ 1/2
<i>Trifolium repens</i>	—	♂ 1/1

###### Hypericaceae

<i>Hypericum perforatum</i>	♀ 4/13 (2/11 p)	♂ 6/15
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###### Liliaceae

<i>Lilium</i> sp.	♀ 1/1	♂ 1/1
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###### Malvaceae

<i>Malva neglecta</i>	♀ 1/2 (1/1 p)	♂ 1/2
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###### Papaveraceae

<i>Eschscholzia californica</i>	♀ 1/2 (1/2 p)	—
'yellow poppy'	—	♂ 1/1

###### Rosaceae

<i>Potentilla</i> sp.	♀ 1/1 (1/1 p)	♂ 1/3
'rose'	♀ 1/1	—

<b>Total collections/specimens</b>	♀ 74/221 (56/183 p)	♂ 77/179
<b>Species/genera/families</b>	19/16/7 (16/13/5 p)	23/20/8

Despite the collection of 20 pollen-carrying females in association with 14 non-composite species of flowering plants, of a total of 202 pollen-carrying females, composites both native and introduced, are clearly favoured as pollen sources. Indeed, because of their abundance in areas such as MC and MK, some introduced Asteraceae such as *Achillea millefolium*, *Hieracium pilosella*, *H. praealtum*, and *Hypochoeris radicata* may now be the major pollen sources there, and perhaps also in some other areas. Quinn (1984) thought that by foraging on *Hieracium pilosella* and *H. praealtum*, *L. fulvescens* may be assisting the spread of these weeds by acting as a pollinator. The same reasoning would apply to other introduced Asteraceae which are

regarded as weeds, such as some thistles.

However, female bees with pollen that are captured in association with a flowering plant may not necessarily have collected pollen from that plant. For example, a female with pollen that I captured on lucerne was observed to be taking nectar, but was not tripping the flowers. If lucerne flowers are not tripped, pollen cannot be collected. Similarly, males may take nectar from flowers with which they have been associated when collected. Males may also be cruising over non-host flowers when searching for females with which to mate.

**Nest sites.** There are 89 records for nest sites, or sites where bees were nesting. These include beach sand, salt water flats, clay banks, gardens, lawns, shingle driveways, old brickworks, shingle pits, farm tracks, old lucerne stands, dry banks, short grass on a roadside, and man-made nest sites of the alkali bee, *Nomia melanderi*. One female without pollen loads was taken in a rotten log in grass. This very wide range of nest sites indicates that almost any bare or near-bare substrate that is not more than a little moist is acceptable. The surface at the nest entrance may range from flat to vertical, but gently sloping ground appears to be preferred. Tunnel entrances are angled into flat ground at about 45° from the vertical, at least for about the first 50 mm. During the period of nest construction, spoil may be ejected up to 30 mm from a nest entrance on flat ground, with most of it lying to one side of the nest entrance, forming a loose mound about 15 mm high. Where nest density is high, the mounds of spoil may almost cover the surface. Tunnels may penetrate up to 200 mm or more, and usually branch within 100 mm of the entrance, each branch terminating in a cell. The main tunnel is usually at least partly filled with loose spoil, and after completion of a cell the side tunnel leading to it is firmly packed with spoil.

**Associated organisms.** Nineteen females carry from 1–30 mites (mean 3.6), and 8 males have from 1–18 mites (mean 4.5).

**Remarks.** Because of the distinctive orange-yellow of the vestiture, *L. fulvescens* is perhaps our most readily recognisable native bee. The distinctive colour is further enhanced in bees carrying bright yellow pollen from Asteraceae, as the pollen pellets are frequently very large, and pollen may also be dusted over much of the body. The ability to utilise a wide range of substrate for nesting, and a very wide range of introduced Asteraceae for pollen and nectar, makes this species one of the most successful native bees.

Miller (1971, 1984) states that the “pudding” from cells is formed by the female drawing together the mouth of the tissue-paperlike covering in the cell over the globular mixture of pollen and nectar. However, the cellophane-like material lining the cell wall remains attached to the cell wall

after the bee has sealed the cell entrance and departed. The “pudding” is formed if the cellophane-like material is torn from the cell wall when the cell is excavated for inspection, when it collapses onto the stored food. In other words the formation of a “pudding” is the result of human disturbance.

### *Leioproctus (Nesocolletes) hudsoni* (Cockerell)

Fig. 9e–f, 10a–b, 49a–m; Map 13

*Paracolletes hudsoni* Cockerell, 1925: 551–552 (description of male). —1934: 15 (key). Rayment, 1935: 669 (is allied to *Paracolletes confusus* Ckll., but lacks the transverse striation of the inclosed (*sic*) area of the metathorax).

*Leioproctus hudsoni*: Cockerell, 1929a: 311 (new combination, list). Primack, 1983: 319, 323, 324, 325, 329 (flower records).

*Leioproctus (Leioproctus) hudsoni*: Michener, 1965: 51 (new combination, list). Valentine & Walker, 1991: 41 (list).

**Female** (n = 20). Length 7.2–9.4 mm ( $8.2 \pm 0.69$  mm); width 2.2–2.8 mm ( $2.5 \pm 0.16$  mm); wing length 4.9–6.0 mm ( $5.4 \pm 0.29$  mm); facial length 1.8–2.1 mm ( $1.9 \pm 0.09$  mm); facial width 1.6–1.8 mm ( $1.7 \pm 0.07$  mm); malar length/malar width 0.28.

**Coloration.** Head, mesosoma and metasoma black, except apices of mandibles and tarsal claws red, tibial spurs pale, antennae beyond about 2nd flagellar segment and wing veins brown, wing membranes and apical margins of metasomal terga 1–5 and sterna 1–5 narrowly hyaline.

**Structure.** (Fig. 49a–b). Scape a little longer than combined length of first 5 flagellar segments. Compound eyes a little more than 4× longer than wide, with about upper quarter and lower 3/4 of inner margins converging slightly above and below respectively. Ocellular distance equal to about 2.6× ocellar diameter; interocellar distance equal to about 0.6× ocellar diameter. Antennal sockets a little closer to vertex than to apex of clypeus. Face shiny. Supraclypeus rising to a point between antennal sockets, lower face almost impunctate, lateral faces with medium-sized, close punctures; frontal ridge extending about 3/4 of the way to median ocellus, frontal line extending to median ocellus but much obscured by sculpturing. Frons tessellated with close, medium-sized indistinct punctures except area near upper margin of compound eye smooth, almost impunctate. Clypeus slightly protuberant apically, moderately long, extending for 1/2 its length below a line across lower end of compound eyes; upper 1/2–2/3 and lateral areas with large punctures separated by up to 1 diameter, lower area with no or few, widely spaced large punctures. Malar space moderately long, a little more than 1/4 as long as wide. Galea lightly tessellated. Genal area in lateral view about equal in width to compound eye, shiny, lightly tessellated, with small indistinct punctures separated by about 1 diameter.

Pronotum lightly shagreened, with small indistinct punctures separated by 2–4 diameters, sulcus very prominent dorsally, prominent dorsolaterally, shallow, broad lateroventrally. Scutum very lightly tessellated on anterior edge, broad median area shiny, with small to medium-sized punctures throughout, separated by about 1 diameter medially, closer around periphery. Scutellum with anterior 1/2 shiny, with a few medium-sized, widely spaced punctures, posterior 1/2 tessellated with indistinct punctures. Metanotum similar to posterior 1/2 of scutellum. Propodeal triangle declivous (Fig. 49k), shiny, very lightly tessellated; dorsolateral areas of propodeum moderately tessellated with small to medium-sized punctures, about 1 diameter apart dorsally, more widely separated ventrally. Remaining lateral areas of mesosoma lightly tessellated, with medium-sized punctures separated by about 1 diameter, except metepisternum moderately shagreened, impunctate. Basitibial plate prominent, about 1/4 length of tibia, with longitudinal ridges, lightly tessellated. Inner hind tibial spur ciliate (Fig. 49i). Pterostigma a little more than 4× longer than wide; vein 1st m-cu meets 2nd submarginal cell at or a little before middle.

Metasomal terga 1–5 and sterna 1–6 moderately shagreened, terga 1–5 and sternum 1 with small, indistinct, widely spaced punctures, sterna 2–6 with larger, closer punctures separated by less than 1 diameter at closest; sternum 1 shallowly emarginate apically. Pygidial plate narrowing from moderately narrow base to rounded apex, broad central area raised, basal 2/3 shagreened, apical 1/3 lightly tessellated (Fig. 49j).

**Vestiture.** On face, broad central area from halfway between antennal sockets and median ocellus, to apex of clypeus, and laterally to 2/3 of distance between antennal socket and compound eye, white, not obscuring surface; remaining areas of face including vertex black. Posterior margin of compound eye fringed with a few black hairs, remainder of gena with white hairs. Pronotal lobe with black hairs medially, margins of pronotal lobe fringed in dense, white, short appressed hairs. Scutum, scutellum and metanotum with broad medial area with short black hairs not obscuring surface, anteriorly and laterally on scutum, and laterally on scutellum and metanotum, hairs off-white. Dorsolateral face of propodeum and broad area below wing base with black hairs. Remainder of mesosoma with off-white hairs. Trochanteral floccus white, moderately well developed, hairs plumose (Fig. 49g). Femoral vestiture white except apical fimbria black. Vestiture on basitibial plate, black. Dorsal 1/2–2/3 of tibial scopa brown, scopal hairs multi-branched (Fig. 49h). Metabasitarsus with hairs on outer face long, strongly branched, forming well developed scopa, outer face white. Metasomal terga 1–2 with white vestiture on disc, terga 3–5 with short black vestiture on disc, prepygidial fimbria black; terga 1–4 with

prominent apical fimbria of short, appressed white hairs. Sterna 1–5 with moderately dense, moderately long hairs throughout, but hairs more dense sub-apically, sternum 6 with short, black hairs.

**Male** (n = 20). Length 7.2–8.8 mm (7.9 ± 0.39 mm); width 2.0–2.2 mm (2.1 ± 0.07 mm); wing length 4.5–5.4 mm (4.9 ± 0.23 mm); facial length 1.7–1.9 mm (1.8 ± 0.07 mm); facial width 1.4–1.6 mm (1.5 ± 0.07 mm); malar length/malar width 0.20.

**Coloration.** Similar to female.

**Structure.** (Fig. 49c–d). Scape equal in length to combined length of first 4 flagellar segments. Compound eyes a little less than 3.5× longer than wide, with inner margins as in female. Ocellocular distance a little less than 2.5 ocellar diameters; interocellar distance similar to female. Position of antennal sockets as in female. Clypeus extending for 1/5 its length below a line across lower ends of compound eyes. Malar space 1/5 as long as wide. Remainder of head similar to female.

Mesosoma similar to female. Basitibial plate lightly tessellated, with a few small, widely spaced punctures. Pterostigma about 4× longer than wide; remainder of wing as in female.

Metasomal terga 1–5 and sterna 1–6 similar to female, tergum 6 similar to tergum 5. Tergum 7 with a distinct but poorly developed pseudopygidium consisting of a smooth, narrow longitudinal area. Sternum 7 (Fig. 49e) with basal lobes enlarged anteriorly, apical lobes very acute apically, with lateral apical fringe of short, stout spines. Sternum 8 (Fig. 49f) with basal area acute anteriorly, apical process long, narrow, rounded apically. Gonocoxites in dorsal and ventral views (Fig. 49l) narrow, gonostyli incurved, blunt apically, penis valves very acute apically; in lateral view (Fig. 49m) penis valve downcurved, blunt, with anteriorly-directed acute angle, scarcely projecting below gonocoxite.

**Vestiture.** Colour on head and mesosoma similar to female except black slightly more extensive, off-white hair on face longer, obscuring clypeus. Metasomal terga 2–6 with short, black hairs on disc, apical fimbria on terga 1–5 sparse, off-white. Sternal vestiture similar to female.

**Variation** Vein 1st m-cu may meet the 2nd submarginal cell before the middle. The vestiture of bees from the South Island is more lightly coloured than that of bees from the North Island.

**Type data.** *Paracolletes hudsoni*: holotype male, “Mt. Egmont TK, 900 m”, January 1923, G. V. Hudson, No. 1039 (BMNH). Cockerell (1925) recorded 3 male specimens with the same collection data. One of these carries 6 labels. The top label is round with a red border, and carries the word ‘Type’. The second is rectangular, white, and has printed on it ‘B M TYPE’ then beneath that ‘HYM’,

and beneath that '17a 467'. The third label carries in long-hand the wording 'Paracolletes hudsoni Ckll' and beneath this the printed word 'TYPE'. The fourth label says 'New Zealand Mt Egmont Jan 1923 1000 ft G. V. Hudson', the fifth 'Pres. by Imp. Bur. Ent. Brit. Mus. 1925-20' and the sixth label has the number '1039'.

**Material examined.** Type specimen, plus 103 females and 48 males.

**Distribution** (Map 13). Hilly ranges and mountainous areas. North Island: AK, TK, TO. South Island: MB, NC, MC, MK, SC, FD, OL, CO, DN, SL.

Collection dates for the 85 collection records range from 29 November to 22 April.

**Biology.** This species appears to be restricted to the hilly ranges of the northern half of the North Island and the volcanic mountainous areas, and the montane regions of the South Island. There are 17 altitude records, which range from 550-1220 m.

**Flight period.** For 103 females, the 51 collection records range from 9 December to 27 February, with 17.6% taken in December, 27.4% in January, and 54.9% in February. For 49 males the 34 collections dates range from 29 November to 22 April, with 1 each in November and April, and 20.6% in December, 44.1% in January, and 29.4% in February.

#### Number of collections

	Nov	Dec	Jan	Feb	Mar	Apr
Females		9	14	28		
Males	1	7	15	10		1

The species seems to be uncommon, with the largest collection being of 14 females, 10 of which carry pollen, from Mt Luxmore Hut FD, on clay on 15 January 1999, by A. C. Harris. There are no other collections of more than 10 bees, and for males the largest collection is of just 7 (and 1 female) from the Desert Road TO on 30 December 1970, by B. J. Donovan.

#### Host plants

##### Native plants

Apiaceae			
<i>Aciphylla</i> sp.	♀ 1/1 (1/1 p)	—	
Asteraceae			
<i>Celmisia gracilentata</i>	—	♂ 1/1	
<i>Olearia moschata</i>	♀ 1/2 (1/1 p)	♂ 1/1	
<i>Olearia nummularifolia</i> var. <i>cymbifolia</i>	—	♂ 1/1	
<i>Olearia virgata</i>	♀ 1/3 (1/2 p)	♂ 1/3	
<i>Ozothamnus leptophyllus</i>	♀ 3/10 (3/10 p)	♂ 2/2	
<i>Raoulia haastii</i>	—	♂ 1/1	
<i>Raoulia subsericia</i>	♀ 2/6 (2/3 p)	♂ 1/1	
<i>Raoulia</i> sp.	♀ 1/1 (1/1 p)	—	

Campanulaceae			
<i>Wahlenbergia</i> sp.	—	♂ 2/2	
Gentianaceae			
<i>Gentiana</i> sp.	♀ 1/1 (1/1 p)	—	
Myrtaceae			
<i>Leptospermum scoparium</i>	—	♂ 2/4	
Plantaginaceae			
<i>Hebe brachysiphon</i>	—	♂ 1/2	
<i>Hebe odora</i>	—	♂ 1/1	
<i>Hebe salicifolia</i>	—	♂ 1/1	
<i>Hebe subalpina</i>	♀ 3/4 (2/2 p)	—	
Thymelaeaceae			
<i>Pimelea traversii</i>	—	♂ 1/1	
<b>Total collections/specimens</b>	♀ 13/28 (12/21 p)	♂ 16/21	
<b>Species/genera/families</b>	8/6/4 (8/6/4 p)	13/8/5	

##### Introduced plants

Asteraceae			
<i>Achillea millefolium</i>	♀ 7/19 (6/11 p)	♂ 3/4	
<i>Hypochoeris radicata</i>	♀ 1/1 (1/1 p)	—	
<i>Taraxacum officinale</i>	♀ 3/3 (2/2 p)	♂ 1/2	
Hypericaceae			
<i>Hypericum perforatum</i>	♀ 1/1 (1/1 p)	—	
<b>Total collections/specimens</b>	♀ 12/24 (10/15 p)	♂ 4/6	
<b>Species/genera/families</b>	4/4/2 (4/4/2 p)	2/2/1	

Asteraceae, both native and introduced, appear to be the primary flower hosts, but the collection of pollen from 4 species in 3 other native families and 1 introduced family indicates that this species possesses some plasticity in its ability to utilize a range of flower types. The capture of more pollen-carrying females from the introduced *Achillea millefolium* than from any native species (11, vs. 10 from *Ozothamnus leptophyllus*) may be more a reflection of the abundance of the introduced plant in the montane regions of the South Island, rather than a preference for it by the bees.

**Nest sites.** There is no information on nest sites, but the capture of a pollen-carrying female on a 'dirt bank near hut' on the Old Man Range CO, 3/4 of the way to the top, suggests that nests may be excavated in vertical or near-vertical bare ground at some altitude.

**Associated organisms.** One female from Chateau Tongariro TO which was taken on *Taraxacum officinale* on 2 January 1970, carries 2 large mites on her propodeum, and 1 female from Cass MC which was captured on *Ozothamnus leptophyllus* on 15 February 1977 at 550 m, carries 1 large mite on her mesosoma.

**Remarks.** The lighter colour of the vesture of South Island bees suggests that the populations of the two islands may be diverging somewhat. The species is truly montane, with no collections from lowland, maritime areas. The occurrence of the species in the Waitakere ranges just north of Auckland suggests that it should also occur on the ranges north of Wellington.

This is *Leioproctus* 'D' of Primack (1983: 319, 323, 324, 325, 329, 332 flower records), and *Leioproctus* sp. 5 of Quinn (1984: 43 brief description, flight period, flower records).

### *Leioproctus (Nesocolletes) maritimus* (Cockerell)

Fig. 10c–f, 50a–m; Map 14

*Paracolletes maritimus* Cockerell, 1936: 448–449 (description of female, runs to *P. sigillatus* Ckll., or *P. nicholsoni* Ckll.).

*Leioproctus (Leioproctus) maritimus*: Michener, 1965: 49 (in *metallicus* group), 51 (new combination, list). Valentine & Walker, 1991: 41 (list).

*Leioproctus maritimus*: Primack, 1983: 319, 324, 325, 332 (flower records). Quinn, 1984: 43 (size, flight period, host flowers).

**Female** (n = 20). Length 6.5–8.8 mm ( $7.3 \pm 0.69$  mm); width 2.0–2.5 mm ( $2.2 \pm 0.13$  mm); forewing length 4.2–5.4 mm ( $4.6 \pm 0.38$  mm); facial length 1.3–1.7 mm ( $1.5 \pm 0.10$  mm); facial width 1.3–1.7 mm ( $1.5 \pm 0.10$  mm); malar length/malar width 0.13.

**Coloration.** Head, mesosoma and metasoma black, except apices of mandibles, tarsal claws and pygidial plate red; remaining areas including antennae beyond about pedicel light brown, except wing membranes and apical margins of metasomal terga 1–5 and sterna 1–5 hyaline, tibial spurs pale.

**Structure.** (Fig. 50a–b). Scape as long as combined length of first 5.4 flagellar segments. Compound eyes a little more than 3× longer than wide, with upper 1/4 and lower 3/4 of inner margins converging slightly above and below respectively. Ocellular distance about 2.5× an ocellar diameter. Interocellar distance about 2/3 an ocellar diameter. Antennal sockets equidistant between apex of clypeus and vertex. Face shiny throughout. Supraclypeus rising from below to a low peak between antennal sockets, lower 1/2 of slope and lateral areas with medium-sized close punctures, upper 1/2 smooth, shiny, impunctate; frontal ridge low, extending about halfway to median ocellus, frontal line much obscured by sculpturing, but extending to median ocellus. Frons with medium-sized punctures separated by about 1 diameter; area between lateral ocellus and compound eye almost smooth. Clypeus very short, rather flat, extending for 1/6 its length below a line across lower ends of compound eyes, whole surface with large punctures separated by 1/2 a puncture diameter. Malar space short, about one-eighth as long as wide, impunctate, shiny. Galea shiny, with extremely light tessellation. In lateral view, genal area somewhat less than 1/2 as wide as compound eye, shiny, with indistinct, closely spaced medium-sized punctures.

Pronotum lightly shagreened, shiny; sulcus very

prominent dorsally, prominent dorsolaterally, indistinct lateroventrally. Scutum shiny, with medium-sized punctures around the periphery separated by less than 1 diameter, but becoming more widely spaced towards centre of scutum so broad central area almost impunctate. Scutellum with anterior 2/3 similar to central area of scutum, posterior 1/3 as for scutum periphery. Metanotum lightly shagreened, with indistinct small punctures. Propodeal triangle declivous (Fig. 50k), very faintly tessellated, shiny; remainder of propodeum lightly shagreened, shiny, impunctate. Remaining lateral areas of mesosoma similar to lateral areas of propodeum except with medium-sized, irregular punctures separated by about 1 diameter, and metepisternum impunctate. Basitibial plate large, about 1/4 length of tibia, with longitudinal ridges and light tessellation. Inner metatibial spur ciliate (Fig. 50i). Pterostigma slightly more than 4× longer than wide; vein 1st m-cu meets 2nd submarginal cell about middle.

Metasomal terga 1–5 and sterna 1–6 lightly shagreened, terga 1–4 with small, obscure punctures on disc separated by up to about 6 diameters, tergum 5 and sterna 2–5 with small to medium-sized close punctures separated by about 1 diameter or more. Sternum 1 moderately emarginate apically. Pygidial plate narrowing to rounded apex from moderately wide base, broad central area and edges raised, lightly tessellate throughout (Fig. 50j).

**Vestiture.** White, except for some black hairs among white on vertex, and on dorsum of mesosoma; pygidial plate, dorsal 1/2 of tibial scopa and pre-pygidial fimbria light brown. On face vestiture short, evenly distributed, not obscuring surface. Scutum with few hairs medially. Trochanteral floccus with hairs well developed (Fig. 50g), femoral vestiture white except brown apically. Tibial scopal hairs (Fig. 50h) multi-branched. Metabasitarsus with hairs on outer face long, strongly branched, forming well developed scopa, off-white to light brown. Metasomal terga 1–4 with narrow apical fimbria of short, appressed hairs; on terga 1–2 fimbria absent on about median 1/3, on tergum 3 reduced on narrow median area. Sterna 2–6 with sparse vestiture on disc, sterna 2–4 with sparse apical fimbria, sternum 5 with more dense apical fimbria.

**Male** (n = 20). Length 5.2–8.3 mm ( $6.3 \pm 0.62$  mm); width 1.5–2.2 mm ( $1.7 \pm 0.16$  mm); forewing length 3.7–4.9 mm ( $4.0 \pm 0.34$  mm); facial length 1.2–1.7 mm ( $1.4 \pm 0.11$  mm); facial width 1.3–1.6 mm ( $1.3 \pm 0.09$  mm); malar length/malar width 0.34.

**Coloration.** Similar to female.

**Structure.** (Fig. 50c–d). Scape as long as combined length of first 3.2 flagellar segments. Compound eyes about 3× longer than wide, with inner margins as in female. Ocellular distance and interocellar distance as in female. Antennal

sockets a little closer to vertex than to apex of clypeus. Face shiny throughout. Supraclypeus rising to a low point between antennal sockets, whole area tessellated with small, close punctures; frontal ridge very short, not as long as diameter of antennal socket, frontal line virtually obscured by sculpturing. Frons between antennal sockets and ocelli sculptured as for supraclypeal area, otherwise similar to female. Clypeus quite flat, length similar to female, upper 1/2 tessellated, punctation similar to female. Malar space 1/3 as long as wide, otherwise similar to female. Galea smooth, shiny. Remainder of head similar to female. Mesosoma, basitibial plate and wings similar to female.

Metasomal terga 1–6 similar to female terga 1–5, tergum 7 with a smooth, shiny, median longitudinal area forming a pseudopygidial plate. Sterna 1–6 similar to female, except punctures indistinct. Sternum 7 (Fig. 50e) with basal lobes wider basally, apical lobes somewhat triangular, with lateral edge of short, stout hairs. Sternum 8 (Fig. 50f) with basal area narrowing basally, apical process bluntly rounded distally. Gonocoxites and gonostyli in dorsal and ventral views (Fig. 50l) incurved in scimitar shape, penis valves narrowly blunt apically; in lateral view (Fig. 50m) penis valve sharply downcurved, blunt apically, scarcely projecting below gonostylus.

**Vestiture.** White throughout except some brown and black hairs among the white on the metanotum, and most hairs brown to black on the dorsolateral surfaces of the propodeum. Vestiture below antennae long, dense, completely obscuring surface. Disc of scutum almost naked medially. Distribution of metasomal vestiture similar to female except tergal apical fimbriae less distinct.

**Variation.** Both sexes of *L. maritimus* display a range of variation in both physical structure and colour of vestiture. Two females from the Whataroa river bed, 6 km E. Abut Head WD, have black vestiture on the frons, vertex, and laterally between the antennal sockets and compound eyes, and around the margins of the compound eyes, while the vestiture of the dorsal 1/2 of the metatibial scopa and metabasitarsus is brown. Two males from 3 km W of Seddon MB have a similar distribution of black vestiture, plus black hairs mixed with white dorsally on the mesosoma, black hairs laterally on the mesosoma, and black vestiture on the discs of metasomal terga 1–6. Bees taken at Bendigo CO have completely white vestiture and are among the smallest specimens of the species. The males from the same site have a slightly roughened propodeal triangle which may also be slightly angled. Vein 1st m-cu in one male from this site is so far forward that it is almost interstitial with the first transverse cubital vein. Several other males from this site have the vein 1st m-cu forward of the mid-point on the 2nd submarginal cell by varying degrees, and the 2nd submarginal cell almost closed towards the marginal cell.

**Type data.** *Paracolletes maritimus*: holotype female, "Clarence River KA, near the sea", 17 November 1932, G.V. Hudson (BMNH). Cockerell (1936) had 4 female bees with the same collection data, of which 1, the holotype, has six labels. The first has '25a' on the underside, the second is round with a red border and the word 'Type' in the centre. The third is almost square, and has printed 'B. M. TYPE HYM.', and what appears to be '17a412'. The fourth is rectangular, and has written in longhand on two lines 'Paracolletes maritimus', and on a third line beneath this is printed 'TYPE', followed by a handwritten 'Ckl'. The fifth has 'New Zealand (Hudson)' in longhand on 2 lines, and on 2 lines on the sixth is printed 'T. D. A. Cockerell B. M. 1936–415'.

**Material examined.** Type specimen, plus 164 females and 66 males.

**Distribution** (Map 14). South Island: KA, WD, MC, MK, OL, CO.

The species has been taken only in the South Island near the coast in KA and WD, and in mountainous regions of MC, MK, OL and CO. Of the 77 collection records, altitude data are given for 22. Bees have been captured from just above sea level to 1230 m. The 77 collections have been taken from 12 November to 26 March, with most bees collected from November to February.

**Biology.** The species appears to be locally abundant at least in the mountainous areas of its range, but seems to occur in fewer numbers at lower altitudes. Five females, 4 of which carry pollen, were collected at Bayleys Road (as Baley's Road) 8 km S. of road to Little River Banks Peninsula MC, 14 December 1977, "sand dune spit area associated with the mat-like sand dune composite at night". Three females were taken in light traps at Pukaki Flats MK on 8 and 9 January 1995, and 16 January 1996. These records suggest that females may fly at dusk or at night, or may stay out at night.

**Flight period.** The first seasonal collection record for both sexes is 12 November, with the last seasonal collection record for females on 26 March, and for males 5 March. For the 165 females the 51 collection records are fairly evenly distributed from November to February, but for the 66 males most of the 26 captures were during November and December.

	Number of collections				
	Nov	Dec	Jan	Feb	Mar
Females	10	13	13	13	2
Males	10	10	2	3	1

The largest number of specimens collected at any one site on one day is 19 females, all carrying pollen, and 7 males at Bendigo CO from *Raoulia* sp. on 21 November 1974, by



B. J. Donovan and P. E. C. Read. However, many more scores of bees were seen foraging on *Raoulia* sp. Conversely, only 2 females both with pollen, were collected at the Whataroa river bed WD from *R. hookeri* on 31 January 1988 by B. J. Donovan during about 2 hours of intensive searching. There are 5 other collections of between 10 and 15 bees.

#### Host plants

##### Native plants

Asteraceae			
<i>Ozothamnus leptophyllus</i>	♀ 3/7 (1/2 p)	♂ 1/2	
<i>Raoulia australis</i>	♀ 12/47 (6/13 p)	♂ 6/19	
<i>Raoulia hookeri</i>	♀ 1/2 (1/2 p)	—	
<i>Raoulia parkii</i>	—	♂ 1/4	
<i>Raoulia subsericea</i>	♀ 1/1 (1/1 p)	—	
<i>Raoulia youngii</i>	♀ 1/2	♂ 1/6	
<i>Raoulia</i> sp.	♀ 13/52 (9/41 p)	—	
Polygonaceae/Rubiaceae			
<i>Muehlenbeckia</i> sp./			
<i>Coprosma</i> sp.	♀ 1/1 (1/1 p)	—	
<b>Total collections/specimens</b>	♀ 32/112 (19/60 p)	♂ 9/31	
<b>Species/genera/families</b>	7-8/3-4/2-3	(6-7/3-4/2-3 p)	4/2/1

##### Introduced plants

Asteraceae			
<i>Achillea millefolium</i>	♀ 6/22 (5/15 p)	—	
<i>Taraxacum officinale</i>	—	♂ 1/1	
Polygonaceae			
<i>Rumex acetosella</i>	—	♂ 1/1	
<b>Total collections/specimens</b>	♀ 6/22 (5/15 p)	♂ 2/2	
<b>Species/genera/families</b>	1/1/1 (1/1/1 p)	2/2/2	

Apart from the single record of 1 female collecting pollen from mixed Polygonaceae/Rubiaceae, females have been captured collecting pollen from only Asteraceae, both native and introduced, and of the natives, species of *Raoulia* appear to be the prime pollen source.

**Nest sites.** Nests are unknown; however, females have been captured at 'gravel beach edge', Birdling's Flat MC, 'dirt track (no veg.), 1230 m.', Obelisk Range OL, and 'sand, at bridge', Makarora, Pipson's Creek OL. Only the one female taken at Obelisk Range CO carries pollen in her scopae, which suggests that she may have been returning to a nest in the vicinity. The lack of pollen on the other females may indicate that they had just emerged from nests to forage, or were searching for suitable ground within which to excavate nests.

**Associated organisms.** One female from Mt Hay Station MK has 6 small mites on the mesosoma, 1 other female from the same site has 1 mite on the mesosoma, and a male from the same site has 1 mite on the metasoma.

**Remarks.** In general, specimens from coastal sites are larger and have darker vestiture than those from mountainous regions. *L. maritimus* appears to be almost oligolectic upon

some Asteraceae, both native and introduced.

This is *Leioproctus* sp. 4 of Quinn (1984) 42–43 (brief description, flight period, forages exclusively on *Raoulia*).

#### *Leioproctus (Nesocolletes) monticola* (Cockerell)

Fig. 11a–d, 51a–m; Map 15

*Paracolletes monticola* Cockerell, 1925: 551 (description of male). —1934: 15 (key).

*Leioproctus monticola*: Cockerell, 1929a: 311 (new combination, list). Primack, 1983: 319, 323, 326, 328, 329, 332 (flower records). Harris, 1987: 62 (7 nests of *Priocnemis (Trichocurgus) crawi* in bee burrows), 145 (drawing of upper part of bee burrow with nest of 9 cells of *P. carbonarius*).

*Leioproctus (Nesocolletes) monticola*: Michener, 1965: 53 (new combination, list). Valentine & Walker, 1991: 42 (list).

**Female** (n = 20). Length 7.8–11.7 mm ( $9.7 \pm 0.84$  mm); width 2.3–3.2 mm ( $2.8 \pm 0.26$  mm); forewing length 4.1–5.2 mm ( $4.8 \pm 0.27$  mm); facial length 1.9–2.3 mm ( $2.2 \pm 0.11$  mm); facial width 1.6–2.0 mm ( $1.8 \pm 0.11$  mm); malar length/malar width 0.52.

**Coloration.** Head, mesosoma, and discs of metasomal terga 1–5 black; antennae light brown beyond flagellar segments 2–3, tibial spurs and wing veins light brown; wing membranes and apical margins of metasomal terga 1–5 hyaline; apical extremities of mandibles, tarsal claws and pygidial plate red-black; remaining areas black or brown-black.

**Structure.** (Fig. 51a–b). Scape as long as combined length of first 6 flagellar segments. Compound eyes 4× longer than wide, with upper 1/4 and lower 3/4 of inner margins converging slightly above and below respectively. Ocellular distance somewhat less than 3× ocellar diameter; intercellular distance about equal to diameter of ocellus. Antennal sockets 1.45× further from apex of clypeus than from vertex. Face shiny throughout. Supraclypeus rising to a pronounced, elongated rounded peak between antennal sockets, below this to clypeus almost impunctate medially, medium-sized punctures laterally. Frontal ridge extending halfway to median ocellus, frontal line extending to median ocellus. Frons with small, widely spaced punctures, area between lateral ocellus and compound eye almost impunctate; area between ocellus and vertex with medium-sized close punctures. Paraocular areas with medium-sized close punctures. Clypeus long, extending for 2/3 its length below a line across lower ends of compound eyes, protuberant apically with apical edge rounded; median central area often with irregular depressions, with medium-sized punctures throughout, irregularly spaced from 1 to about 4 diameters. Malar space long, 1/2 as long as wide, impunctate, shiny. Galea shiny, lightly tessellated.

lated. In lateral view, genal area about equal in width to compound eye, shiny, with small, widely spaced punctures.

Pronotum lightly shagreened, sulcus deep dorsally, otherwise shallow. Scutum shiny, almost impunctate medially, with small to medium-sized punctures anterolaterally separated by about 1 diameter at margins; anterior 1/3 of scutum lightly shagreened. Scutellum shiny, anterior face impunctate, lateroposterior areas with large, close punctures. Metanotum shagreened, with small, close punctures. Posterior face of propodeum tessellated, declivous, forming one plane except propodeal triangle with very slight rounding (Fig. 51k), and small irregular subtransverse striae in dorsolateral corners. Remaining lateral areas of mesosoma lightly shagreened, metepisternum impunctate, other areas with medium-sized punctures separated by 1–2 diameters. Basitibial plate prominent, about 1/5 as long as tibia, lightly shagreened. Inner metatibial spur ciliate (Fig. 51i). Pterostigma about 4× longer than wide; vein 1st m-cu meets 2nd submarginal cell at or just before middle.

Metasomal terga 1–5 and sterna 1–6 shiny, lightly shagreened, with very small, widely spaced punctures. Sternum 1 scarcely emarginate apically. Pygidial plate narrowing from a moderately wide base to an evenly rounded apex, edges almost flat, broad longitudinal median area raised, lightly shagreened throughout (Fig. 51j).

**Vestiture.** On face sparse, short, so whole surface readily visible, off-white on area from just above antennal sockets to about broad upper 1/2 of clypeus, dark to black elsewhere on face. On gena, vestiture long, off-white, except for area near vertex black. Broad dorsal central area of mesosoma with short, black vestiture not obscuring surface, vestiture off-white on anterolateral margins, black beneath wing base, white ventrally. Trochanteral floccus white, moderately well developed with “fluffy” hairs (Fig. 51g). Femoral vestiture white except apex near-black. Basitibial plate covered with reclining black vestiture obscuring surface. Scopa dark brown dorsally, white ventrally; hairs of anterior face (Fig. 51h) strongly branched. Metabasitarsus with hairs on outer face short, unbranched, not forming scopa, off-white to light brown. Metasomal tergum 1 with a few off-white hairs anterolaterally, terga 2–4 with short, white or black hairs, terga 5–6 with short, dense, black hairs. Metasomal sterna 1–4 with long, off-white vestiture on posterior halves, vestiture on sterna 5–6 black.

**Male** (n = 20). Length 8.0–10.2 mm ( $8.7 \pm 0.55$  mm); width 2.3–2.5 mm ( $2.3 \pm 0.07$  mm); forewing length 4.2–4.8 mm ( $4.5 \pm 0.17$  mm); facial length 1.9–2.1 mm ( $2.0 \pm 0.06$  mm); facial width 1.5–1.6 mm ( $1.6 \pm 0.05$  mm); malar

length/malar width 0.47.

**Coloration.** Similar to female.

**Structure.** (Fig. 51c–d). Scape nearly as long as combined length of first 4 flagellar segments. Compound eyes 3.6× longer than wide, with inner margins as in female. Ocellular distance equal to about 2.7 ocellar diameters; interocellar distance about equal to 1 ocellar diameter. Antennal sockets 1.25× further from apex of clypeus than from vertex. Supraclypeus rising to a sharp peak between antennal sockets, otherwise similar to female. Remainder of head similar to female except area between lateral ocellus and compound eye with few, small, widely spaced punctures; clypeus extending for about 0.6× its length below a line across lower ends of compound eyes, with medium-sized to large punctures throughout, separated by about 1/2 one puncture diameter.

Mesosoma similar to female except anterior 1/3 of scutum smooth. Propodeal triangle slightly more rounded than in female. Basitibial plate about 1/6 as long as tibia, shiny, not shagreened, with small, close punctures. Pterostigma as in female but vein 1st m-cu meets 2nd submarginal cell from at middle to well before middle.

Metasomal terga 1–5 and sterna 1–6 as in female; tergum 6 similar to tergum 5; tergum 7 with a narrow longitudinal area suggestive of an incipient pseudopygidial plate. Sternum 7 (Fig. 51e) with basal apodemes widest basally, apical lobes narrowly attached to basal apodemes; sternum 8 (Fig. 51f) with basal area almost triangular, apical process expanded and rounded apically. Gonocoxites stout, gonostyli in dorsal view (Fig. 51i) blunt, in lateral view (Fig. 51m) somewhat flattened, narrowing apically, apex of penis valve narrowly rounded; in lateral view penis valve projecting below gonostylus.

**Vestiture.** On face more dense than in female, but surface not obscured, white, long between antennal sockets including inner base of scape, supraclypeus and clypeus; remaining areas black. Genal vestiture as in female. Mesosomal vestiture coloured similarly to female, but much longer. Metasomal tergal vestiture similar to female except longer, more dense on terga 1–3. Sterna similar to female but hairs longer.

**Variation.** A male captured at Beeby’s Knob NN at 1,350 m on 23 Feb 1954 has vein 1st m-cu in the left wing extending about 1/4 the way across the 2nd submarginal cell.

**Type data.** *Paracolletes monticola*: holotype male, “Mt. Egmont TK 900 m”, – January 1923, G. V. Hudson (BMNH).

**Material examined.** Type specimen, plus 211 females and 57 males.

**Distribution** (Map 15). North Island: ND, AK, CL, WO, BP, TK, TO, HB, WN. South Island: NN, BR, MB, WD, NC, MC, MK, FD, OL, DN. Stewart Island (Whenua Hou Island).

The 123 collections have been made from 22 November to 6 May.

**Biology.** There are 26 altitude records, which range from 20 m to 1620 m. However, despite the occurrence of the species at low altitudes, its widespread distribution throughout the mountainous regions almost justifies its specific epithet of *monticola*.

**Flight period.** For 211 females the 91 collection records range from 22 November to 6 May, with 37.4% taken in January, and 40.6% taken in February. For the 58 males the 32 collections were taken from 24 November to 1 April, with 43.7% in January, and 46.9% taken in February.

	Number of collections							
	Nov	Dec	Jan	Feb	Mar	Apr	May	
Females	2	9	34	37	5	3	1	
Males	1	1	14	15		1		

The species appears to occur in small numbers in any one locality, with most of the 123 collection records comprising from 1 to 2 or 3 specimens. Two major exceptions are 29 females taken at the Hurunui Gorge NC on *Hebe* sp. on 4 January 1987, by R. P. Macfarlane, and 18 females all with pollen, captured at Arthur's Pass Village NC, on *H. salicifolia* on 23 January 1986 by A. M. Donovan and B. J. Donovan. There are 2 other collections of 14 and 12 bees, and the remaining 119 collections are of 9 or fewer bees.

### Host plants

#### Native plants

Asteraceae								
<i>Ozothamnus leptophyllus</i>				—				♂ 2/2
Gentianaceae								
<i>Gentiana montana</i>				—				♂ 1/1
Myrtaceae								
<i>Leptospermum scoparium</i>	♀ 3/4	(1/2 p)						—
Plantaginaceae								
<i>Hebe brachysiphon</i>	♀ 4/9	(4/7 p)						♂ 1/8
<i>Hebe chathamica</i>		♀ 1/1						—
<i>Hebe elliptica</i>	♀ 2/9	(2/7 p)						♂ 1/1
<i>Hebe macrantha</i>	♀ 2/7	(2/5 p)						—
<i>Hebe odora</i>	♀ 1/11	(1/9 p)						♂ 1/1
<i>Hebe salicifolia</i>	♀ 5/28	(2/20 p)						♂ 2/8
<i>Hebe speciosa</i>	♀ 2/8	(2/3 p)						—
<i>Hebe stricta</i>	♀ 2/2	(2/2 p)						♂ 1/1
<i>Hebe subalpina</i>	♀ 2/10	(2/9 p)						—
<i>Hebe</i> sp.	♀ 17/55	(6/36 p)						♂ 2/3
Thymelaeaceae								
<i>Pimelea traversii</i>				—				♂ 1/3
<b>Total collections/specimens</b>	♀ 41/144	(24/100 p)						♂ 12/28
<b>Species/genera/families</b>	11/2/2	(10/2/2 p)						9/4/4

#### Introduced plants

Asteraceae			
<i>Senecio jacobaea</i>	—		♂ 1/1
Fabaceae			
<i>Cytisus</i> sp.	—		♂ 1/1
Fabaceae/Linaceae			
<i>Medicago sativa</i> /			
<i>Linum catharticum</i>	♀ 1/1		—
Rosaceae			
<i>Rubus</i> sp.	♀ 1/1		—
<b>Total collections/specimens</b>	♀ 2/2		♂ 2/2
<b>Species/genera/families</b>	2-3/2-3/2-3		2/2/2

**Nest sites.** At Karori WN on 10 January 1972, one adult male was found in a horizontal burrow in a vertical clay bank. Harris (1987) illustrated the upper part of a nest burrow at Leith Saddle, Dunedin DN, as near-vertical.

**Associated organisms.** Eighteen females, all but one of which are from the South Island, carry from 1 to 37 mites (mean 4.8), and 7 males, all from the South Island, carry from 1 to 14 mites (mean 3.7).

Harris (1987) illustrated 9 cells of the pompilid wasp *Priocnemis (Trichocurgus) carbonarius* lying horizontally off the upper part of a burrow of *L. monticola*, and recorded the presence of 7 nests of *P. (T.) crawi* in burrows of *L. monticola* at Leith Saddle, Dunedin, DN. These latter nests were not shared with bees, so there was no interaction between the two species. However, as the period of female activity overlaps (December and January for the wasp and January and February for the bee) there would seem to be a possibility that adults would meet at least occasionally in nest tunnels, unless wasps always nested only in abandoned bee nests.

**Remarks.** The very long malar space and the long clypeus, the tessellated, planar propodeal triangle, and the lack of metasomal tergal apical fimbria, readily separate this species from all others. The apparent low numbers in any one place and at any one time may be a consequence of the specialisation of *L. monticola* upon just one genus of host plant. The pollen loads carried by 2 females taken on *Leptospermum scoparium* are the colour of pollen loads carried by females captured on *Hebe odora* at the same site on the same date by the same collector. If the 2 females had indeed collected their pollen from *Hebe odora*, which seems very likely, then this species has been recorded collecting pollen only from species of *Hebe*. If so, *Leioproctus monticola* is therefore oligolectic upon species of *Hebe*. If *Hebe* flowers are limited, then so will be the bee population. The specialization for pollen collection upon species in just one genus of native plants might be nearly matched only by *L. waipounamu* among native New Zealand bee species.

***Leioproctus (Nesocolletes) nunui* new species**

Fig. 11e–f, 12a–b, 52a–m; Map 16

**Female** (n = 2). Length 10.8–11.5 mm ( $11.2 \pm 0.54$  mm); width 3.1–3.2 mm ( $3.15 \pm 0.16$  mm); forewing length 7.4–7.5 mm ( $7.47 \pm 0.10$  mm); facial length 2.1–2.25 mm ( $2.17 \pm 0.01$  mm); facial width 2.25–2.32 mm ( $2.28 \pm 0.05$  mm); malar length/malar width 0.18.

**Coloration.** Black, except apical 1/3 of mandibles dark red, tibial spurs hyaline or nearly so, distitarsi red-brown, wing veins and pterostigma light brown, wing membranes, apical margins of metasomal terga and sterna hyaline.

**Structure.** (Fig. 52a–b). Scape as long as combined length of first 6 flagellar segments. Compound eyes about 4× longer than wide, with inner margins converging slightly above and below. Ocellocular distance equal to about 3× ocellar diameter; interocellar distance about equal to 1/2 ocellar diameter. Antennal sockets a little closer to vertex than to apex of clypeus. Face shiny throughout. Supraclypeus rising to sharp peak between antennal sockets; frontal ridge extending about halfway to median ocellus, frontal line extending to median ocellus. Area of frons close to ocelli tessellated, giving way to medium-sized close punctures on paraocular areas. Clypeus short, extending for about 1/4 its length below a line across lower margins of compound eyes, nearly flat; dorsal 1/2 of clypeus with medium-sized close punctures, punctures becoming large towards clypeal apex except broad apical edge impunctate. Malar space 1/5 as long as wide. Galea lightly tessellated. In lateral view, genal area about equal in width to compound eye, very lightly tessellated.

Pronotum moderately shagreened; sulcus very deep dorsally, broad, shallow dorsolaterally, indistinct lateroventrally. Remainder of dorsum of mesosoma very lightly tessellated; scutum and scutellum with small punctures near margins, large, widely spaced punctures throughout remainder. Metanotum moderately shagreened. Propodeal triangle almost declivous (Fig. 52k), lightly tessellated/shagreened, lateral areas very lightly shagreened to smooth, shiny. Pre- and mesepisternum with large shallow punctures separated by less than 1 diameter throughout; metepisternum shagreened. Basitibial plate prominent, about 1/4 as long as tibia, ridged longitudinally; inner hind tibial spur ciliate (Fig. 52i). Pterostigma 3× longer than wide; vein 1st m-cu meets 2nd submarginal cell about 1/3 distance from proximal end.

Metasoma lightly shagreened throughout, terga with very small, very widely spaced punctures. Sternum 1 shallowly emarginate apically; sterna 2–4 with shallow, medium-sized punctures separated by 2–3 diameters. Pygidial plate broad basally, narrowing to rounded apex, median longitudinal area slightly raised, especially apically,

lateral and apical edges upturned, lightly tessellated throughout (Fig. 52j).

**Vestiture.** Dorsal aspect of frons just below median ocellus, vertex, and narrow paraocular areas black; remainder of face white. Vestiture above a line through antennal sockets directed upwards, below this line directed downwards. Clypeal vestiture not dense, but still partly obscuring surface. Gena near compound eye black, remainder white. Broad central area of mesosoma except for naked propodeal triangle black, erect; anterior and lateral edges of scutum, pronotal lobe, anterior outer edge of tegula, light orange. Small area below wings black, venter of mesosoma off-white. Trochanteral floccus not well developed, hairs white, long, with short branches (Fig. 52g). Femoral vestiture white except near black apically. Basitibial plate with very short black hairs pointing distad, giving plate a strongly ridged appearance. Tibial scopa dense, outer hairs stout, branched (Fig. 52h), dorsal 2/3 dark brown-black, remainder white. Metabasitarsus with hairs on outer face long, strongly branched, forming well developed scopa, outer surface with base off-white, remainder dark brown-black. Metasomal tergum 2 with narrow off-white apical fringe on lateral 3rds, fringe almost continuous medially on terga 3–4; disc of terga 1–2 with vestiture sparse, white, disc of terga 3–4 sparse, black; tergum 5 densely black, long apically. Sternal vestiture long, white, moderately dense throughout.

**Male** (n = 4). Length 11.1–12.3 mm ( $11.8 \pm 0.52$  mm); width 2.9–3.2 mm ( $3.0 \pm 0.14$  mm); forewing length 6.9–7.7 mm ( $7.3 \pm 0.44$  mm); facial length 2.2–2.5 mm ( $2.3 \pm 0.14$  mm); facial width 1.9–2.1 mm ( $2.0 \pm 0.07$  mm); malar length/malar width 0.14.

**Coloration.** As in female, except areas brown in female slightly darker.

**Structure.** (Fig. 52c–d). Scape as long as combined length of first 4.5 flagellar segments. Compound eyes 3.2× longer than wide, upper 1/3 of inner margins converging above, lower 2/3 converging below. Ocellocular distance and interocellar distance similar to female. Antennal sockets slightly higher on face than mid point between vertex and apex of clypeus; supraclypeus raised to a low point between antennal sockets; frontal ridge and line as in female. Clypeus extending below a line across lower margins of compound eyes for about 1/3 its length; lower 1/3 of clypeus moderately protuberant. Facial sculpturing as in female except more strongly marked. Malar space one seventh as long as wide. Galea as in female. In lateral view, gena slightly narrower than compound eye, sculpturing similar to female.

Mesosoma as in female except pronotal sulcus more prominent lateroventrally. Basitibial plate prominent,

length similar to female, not ridged, very lightly tessellate.

Metasoma as in female except tergum 7 with narrow smooth median longitudinal area forming pseudopygidium, and median apical emargination of sternum 1 narrower. Sternum 7 (Fig. 52e) with basal apodemes widest medially, apical lobes widely separated, with apical fimbria of minute hairs. Sternum 8 (Fig. 52f) with basal area almost triangular, apical process short, almost parallel sided, with short, scattered hairs on shaft. Gonocoxites narrowing markedly distally, gonostyli in dorsal and ventral views (Fig. 52l) expanded and rounded apically, vestiture short, sparse, penis valves very sharp apically; in lateral view (Fig. 52m) ventral margin of penis valve slightly evident below gonostylus.

**Vestiture.** Distributon of black vestiture on face similar to female, except entirely black between antennal sockets and vertex; paraocular areas more broadly black. Remainder of face with long, off-yellow, dense hairs, above a line joining antennal sockets directed upwards, below this line directed downwards and outwards. Gena behind dorsal 1/2 of compound eye with broad area of black vestiture, narrowing to meet ventral end of compound eye, remainder of gena densely clothed in long, beard-like yellow hairs reaching to below mandibles. Mesosoma as in female except dorsal aspect of propodeum black, remaining vestiture light yellow; basitibial plate hairs few, not appearing ridge-like. Metasomal tergum 1 and anterior 2/3 of metasomal tergum 2 with long, moderately dense off-yellow hairs dorsally; remainder of terga with short, black hairs, hairs longer laterally with some off-yellow. Metasomal sterna 1–5 with off-yellow hairs, hairs longest laterally.

**Variation.** One male taken in the Awatere Valley MB, 19.3 km W. of Seddon on *Kunzea ericoides* on 8 January 1972 is noticeably smaller than the other 3 males.

**Type data.** *Leioproctus nunui*: holotype female, “19.3 km W. of Seddon MB”, 8 January 1972, on *Kunzea ericoides*, S. S. Wier (NZAC). Allotype male, same data as holotype. Two paratype males have the same data except that they were collected by B. J. Donovan. One female paratype and 1 other male paratype were taken “40.2 km W. of Seddon MB”, 1 February 1973, on *Cassinia vauvilliersii* [= *Ozothamnus leptophyllus*], by B. J. Donovan (NZAC).

**Material examined.** Type series, of 2 females and 4 males.

**Distribution** (Map 16). South Island: MB. Adults were captured only in one valley at 2 sites 20.9 km apart, on 2 occasions in MB, South Island. Several other collecting efforts at these 2 sites and others in the vicinity up to 1988 were unsuccessful.

**Biology.** Apart from the location of the 2 collection sites and the data presented below, nothing is known of the biology of this species.

**Flight period.** One female and 2 males were captured on 8 January, 1 male on 12 January, and 1 female and 1 male on 1 February.

	Number of collections	
	Jan	Feb
Females	1	1
Males	2	1

#### Host plants

##### Native plants

Asteraceae		
<i>Ozothamnus leptophyllus</i>	♀ 1/1	♂ 1/1
Myrtaceae		
<i>Kunzea ericoides</i>	♀ 1/1	♂ 2/3
<b>Total collections/specimens</b>	♀ 2/2	♂ 3/4
<b>Species/genera/families</b>	2/2/2	2/2/2

**Nest sites.** Nothing is known of nests or nest sites, but several other species of bees, and especially the closely related *L. fulvescens* are abundant in the area, where nests are found in dry sloping clear or semi-clear ground.

**Associated organisms.** Two paratype males carry 1 and 6 mites respectively.

**Etymology.** *nunui*: Maori = large size. A reflection of the large size of the bees.

**Remarks.** *Leioproctus nunui* is obviously physically closely related to both the North Island *L. paahaumaa*, and the South Island *L. fulvescens*. The restricted geographic location of *L. nunui* at the north of the South Island, in close proximity to the south end of the North Island, suggests that this species has evolved from a colonisation of the South Island by the North Island *L. paahaumaa*. The presence of some orange vestiture on *L. nunui* further suggests that whatever led to the development of similar vestiture on *L. fulvescens*, may be also operating on *L. nunui* in the same habitat.

*Leioproctus nunui* appears to be rare. If it is indeed closely related to and descended from *L. paahaumaa*, its pollen source or sources are most likely to be Asteraceae. However, many collecting efforts over about 30 years in the Awatere Valley and much further afield on a range of plants, have not taken specimens. It is possible that the species is monolectic, or oligolectic, on a plant or small group of closely-related plants which are now rare. As both *L. paahaumaa* and *L. fulvescens* occur in large numbers on several introduced Asteraceae, and introduced Asteraceae are common in the Awatere Valley, this seems unlikely.

***Leioproctus (Nesocolletes) paahaumaa* new species**

Fig. 12c–f, 53a–n; Map 17

**Female** (n = 20). Length 9.5–12.5 mm ( $10.9 \pm 0.71$  mm); width 2.8–3.5 mm ( $3.1 \pm 0.20$  mm); forewing length 6.1–7.4 mm ( $7.0 \pm 0.28$  mm); facial length 2.1–2.5 mm ( $2.3 \pm 0.09$  mm); facial width 1.8–2.2 mm ( $2.1 \pm 0.01$  mm); malar length/malar width 0.43.

**Coloration.** Black except apical 1/3 of mandibles dark red, antennae dark brown beyond about 2nd flagellar segment, tibial spurs very pale light yellow, distitarsi red-brown, wing veins and pterostigma light brown, wing membranes hyaline to slightly smokey, metasomal terga 1–4 and sterna 1–5 with apical margins hyaline.

**Structure.** (Fig. 53a–b). Scape as long as combined length of first 6 flagellar segments. Compound eyes about 4× longer than wide, with upper 1/5 and lower 4/5 of inner margins converging slightly above and below respectively. Ocellular distance about equal to 3× ocellar diameter; interocellar distance equal to 1/2 ocellar diameter. Antennal sockets slightly closer to vertex than to apex of clypeus. Face shiny throughout. Supraclypeus rising to a sharp point between antennal sockets, below this impunctate, laterally with medium-sized punctures; frontal ridge extending from peak between antennal sockets to 2/3 of distance towards median ocellus, frontal line extending to median ocellus. Frons with large, close punctures; narrow area between lateral ocellus and compound eye almost impunctate; area between ocellus and vertex with rough, close punctures and moderate to light tessellation. Paraocular areas with medium to large, close punctures. Clypeus nearly flat basally with lower edge somewhat protuberant, projecting for about 1/2 its length below a line across lower margins of compound eyes; basal 2/3 with large, close punctures, apical 1/3 with few to no punctures on broad apical edge. Malar space long, about 2/5 as long as wide, impunctate, shiny. Galea moderately tessellated. In lateral view, genal area about as wide as compound eye, shining, with shallow, irregular well-spaced punctures.

Pronotum lightly shagreened with small to medium-sized punctures; sulcus broad, deep dorsolaterally, absent lateroventrally. Scutum with medium-sized punctures closely spaced around periphery, widely spaced centrally so that a small area is almost impunctate, shiny. Scutellum impunctate anteriorly, with irregular close punctures posteriorly. Metanotum with small to medium-sized punctures, irregularly spaced, lightly shagreened. Propodeal triangle declivous (Fig. 53k), mirror-like with extremely light tessellation; dorsolateral areas of propodeum with small, widely-spaced shallow punctures, lightly shagreened, shining. Lateral areas of mesosoma shining, except metepisternum shagreened; remaining areas with small to

large punctures separated by 1 to less than 1 diameter. Basitibial plate prominent, about 1/4 as long as tibia, with irregular longitudinal ridges. Inner metatibial spur finely ciliate (Fig. 53i), lightly tessellated. Pterostigma up to 4× longer than wide; vein 1st m-cu meets 2nd submarginal cell just before or at middle.

Metasomal terga 1–5 and sterna 1–6 shagreened throughout, with very small, very widely-spaced punctures on disc. Sternum 1 shallowly emarginate mid-apically. Pygidial plate narrow, apex rounded, lateral and apical edge raised, broad longitudinal median area raised, shagreened (Fig. 53j).

**Vestiture.** On face from just above antennal sockets and broad paraocular areas black, remainder of face off-white. Above a transverse line through antennal sockets hairs directed upwards, below this line directed downwards; clypeal and supraclypeal vestiture moderately dense, integument not wholly obscured. Dorsal 1/2 of gena black, remainder white. Broad dorsal central area of mesosoma black, erect black vestiture reaching to tegula. Vestiture on pronotal lobe, anterior edge of scutum, anterior edge of tegula and posterior lateral edge of scutum and scutellum white-orange. Dorsal 1/2 of lateral area below wings black, remainder white, lateral mesad 1/2 of lateral area of propodeum black, remainder white, mesosoma white ventrally. Trochanteral floccus with long white “fluffy” branched hairs on ventral aspect (Fig. 53g), branches of hairs often recurved. Femoral vestiture white except black apically. Basitibial plate with very short, black hairs pointing distad, giving plate a strongly ridged appearance. Tibial scopa dense, dorsal 1/2 black, ventral 1/2 white, hairs of outer face stout, with apical 1/2 strongly branched (Fig. 53h). Metabasitarsus with hairs on outer face long, strongly branched, forming well developed scopa, brown-black. Metasomal tergum 1 with sparse, long white hairs; tergum 2 with sparse white hairs basally, shorter sparse brown hairs apically; terga 3–4 with very short, sparse brown hairs; tergum 5 with apical fimbria of long, dense black hairs. Terga 1–5 laterally with long white apical vestiture, tergum 6 with dense black vestiture lateral to pygidial plate. Sternum 1 with long, sparse white hairs throughout; sterna 2–5 with basal 1/3 almost naked, long medium-dense white hairs on remainder; sternum 5 with dense apical fimbria of appressed white hairs; posterior 1/2 of sternum 6 with short, appressed black hairs.

**Male.** (n = 20). Length 9.7–11.7 mm ( $10.7 \pm 0.60$  mm); width 2.8–3.1 mm ( $2.9 \pm 0.11$  mm); forewing length 6.3–7.7 mm ( $7.0 \pm 0.26$  mm); facial length 2.1–2.5 mm ( $2.3 \pm 0.09$  mm); facial width 1.8–2.0 mm ( $1.9 \pm 0.07$  mm); malar length/malar width 0.36.

**Coloration.** As in female.

**Structure.** (Fig. 53c–d). Scape slightly longer than combined length of first 3 flagellar segments. Compound eyes about  $3\times$  longer than wide, upper 1/5 of inner margins converging moderately above, lower 4/5 converging to becoming parallel below. Ocellular distance and interocellar distance similar to female. Antennal sockets slightly closer to vertex than to apex of clypeus. Face shiny throughout. Supraclypeus rising from below to a sharp point between antennal sockets, with medium-sized close punctures throughout except for ridge. Frontal ridge extending from point between antennal sockets to 1/3 of distance towards median ocellus, frontal line extending to median ocellus. Frons with large, close irregular punctures; narrow area extending from lateral ocellus to dorsal aspect of compound eye sometimes depressed, almost impunctate. Area between ocellus and vertex, and ocelli and paraocular areas, as in female. Clypeus moderately flat, extending for about 1/3 its length below a line across lower ends of compound eyes; basal 2/3 with medium-sized close punctures, apical 1/3 impunctate or almost so. Malar space long, about 1/3 as long as wide, impunctate, shiny. Galea as in female. In lateral view, gena a little narrower than compound eye, shining, with small, shallow, widely-spaced punctures.

Pronotum moderately shagreened with punctures small, few, indistinct; sulcus dorsolaterally as in female, reduced to angled depression lateroventrally. Scutum shiny, with medium-sized close punctures anterolaterally, almost impunctate medioposteriorly. Remainder of mesosoma much as in female. Basitibial plate prominent, about 1/5 as long as tibia, shining, with small, shallow punctures. Pterostigma and vein 1st m-cu as in female.

Metasomal terga 1–5 and sterna 1–6 as in female, except sternal shagreening very light; tergum 6 with medium-sized close punctures basally, tergum 7 with a pseudopygidial area very similar to the pygidial plate of females, except central raised area irregular. Sternum 7 (Fig. 53e) with basal apodemes widest medially, apical lobes widely separated; sternum 8 (Fig. 53f) with basal area almost square, apical process short, stout, very wide apically. Gonocoxites in dorsal and ventral views (Fig. 53l) with prominent lateral angle, gonostyli incurved apically to sharp point, penis valves short, blunt; in lateral view (Fig. 53m) penis valve downcurved, rounded apically, projecting well below gonocoxite.

**Vestiture.** Face from just above antennal sockets to vertex and very broad paraocular areas extending narrowly to antennal sockets black. Remainder of face with off-white vestiture, that above a transverse line through antennal sockets directed upwards, below this line directed downwards; very long, dense vestiture below antennal sockets obscuring surface. Gena as in female except off-white vestiture on lower 1/2 of face much longer. Mesosoma

similar to female, except off-white vestiture is without hint of orange. Basitibial plate with sparse, short brown hairs pointing distad. Metasomal terga 1–6 as in female, except white vestiture on terga 1–2 longer; lateral apical vestiture on terga 1–5 longer than in female. Sterna 1–5 similar to female, except vestiture sparse; sternum 6 almost naked except for small lateroposterior patch of very short white hairs.

**Variation.** A female from Opotiki BP has a longitudinal depression extending from the propodeal triangle to the posterior margin of the propodeum, on each side of the mid line of the propodeum. The central region of the pterostigma of one or both wings may be yellow. Males may have short black hairs among the long white vestiture, and black hairs apically on metasomal tergum 2.

**Type data.** *Leioproctus paahaumaa*: holotype female, “Opotiki BP, golf course, sloping nest site”, 18 November 1980, R. P. Griffin (NZAC). Allotype male, “Manutuke BP”, 25 November 1982, on composite, B. J. Donovan (NZAC). One paratype female has the same data as the holotype, and three other paratype females have the same data as the holotype except that they were taken at “golf course nest site, B. J. Donovan”. Two further paratype females have the same data as the holotype except that they were taken at “yellow composite, B. J. Donovan”. Four paratype males have the same data as the allotype (NZAC).

**Material examined.** Type specimens, plus 384 females, and 272 males.

**Distribution** (Map 17). North Island: ND, AK, CL, WO, BP, TK, TO, GB, RI, HB, WI, WN, WA.

Collections include the Poor Knights Islands, Aorangi Island ND, the Noises Islands, Otata Island AK, Cuvier Island, and Alderman Islands, Ruamahua Island CL, and Kapiti Island and Somes Island WN. Of the 213 collection records, altitude data are given for just 7. Bees have been captured from 0–5 m above sea level at port Waikato WO, to 1113 m at Whakapapaiti on Mt Ruapehu TO. Adults have been collected from 15 September to 9 April.

**Biology.** *Leioproctus paahaumaa* ranges throughout the North Island and several islands off the North Island, and it can be expected to occur in almost any locality.

**Flight period.** The first collection date for both sexes is 15 September, and at this date one female was carrying pollen. No bees have been taken in October. The last collection date for females is 10 March, and for males, 9 April. For 389 females of the 91 collection records 14.3% are in November, 29.7% in December, 33.0% in January, and 19.8% in February. For 275 males the corresponding percentages for the 122 collection records are 13.9, 26.2, 37.7, and 17.2.

	Number of collections							
	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr
Females	1	13	27	30	18	2		
Males	1	17	32	46	21	4	1	

Except for 4 collections, the number of bees of both sexes taken together has been fewer than 10. The largest collection is of 138 females and 10 males at Piriaka TO from pumice/tuff on 15 February 1990 by A. C. Harris, and the same collector took 48 females and 9 males at the Patea River dam TK on 19 February 1990. Nine females and 6 males were caught at Waitara TK on *Taraxacum officinale* on 11 December 1981, by N. A. Martin. Eight females and 4 males were taken at Opotiki BP over golf course nests on 6 December 1979 by B. J. Donovan. Scores more bees were present at the Opotiki golf course nest site, and numerous females were observed carrying large loads of pollen into their nests.

### Host plants

#### Native plants

Campanulaceae			
<i>Wahlenbergia pygmaea</i>	♀ 1/1 (1/1 p)	—	
Myrtaceae			
<i>Leptospermum scoparium</i>	—	♂ 2/4	
<i>Lophomyrtus</i> sp.	—	♂ 1/1	
Plantaginaceae			
<i>Hebe salicifolia</i>	—	♂ 1/1	
<i>Hebe stricta</i>	♀ 1/1	♂ 2/8	
<i>Hebe</i> sp.	♀ 1/1	♂ 2/3	
<b>Total collections/specimens</b>	♀ 3/3 (1/1 p)	♂ 8/17	
<b>Species/genera/families</b>	3/2/2 (1/1/1 p)	5/3/2	

#### Introduced plants

Actinidiaceae			
<i>Actinidia deliciosa</i> male	—	♂ 1/1	
Asphodelaceae			
<i>Kniphofia praecox</i>	—	♂ 1/1	
Asteraceae			
<i>Achillea millefolium</i>	♀ 5/15 (2/7 p)	♂ 2/8	
<i>Calendula officinalis</i>	♀ 1/2	♂ 1/7	
<i>Crepis capillaris</i>	♀ 2/5 (1/3 p)	♂ 2/8	
<i>Hypochoeris radicata</i>	—	♂ 1/1	
<i>Senecio jacobaea</i>	♀ 4/13 (1/7 p)	♂ 14/35	
<i>Senecio lautus/Sonchus oleraceus</i>	—	♂ 1/3	
<i>Taraxacum officinale</i>	♀ 4/16 (1/3 p)	♂ 5/17	
Cucurbitaceae			
<i>Cucurbita maxima</i> male	♀ 1/2 (1/1 p)	♂ 1/2	
Nymphaeaceae			
<i>Nymphaea</i> sp.	♀ 1/2 (1/2 p)	—	
Rosaceae			
<i>Rosa</i> sp.	♀ 1/1	—	
<b>Total collections/specimens</b>	♀ 19/56 (7/23 p)	♂ 29/83	
<b>Species/genera/families</b>	8/8/4 (6/6/3 p)	10–11/10–11/4	

The 2 females and 2 males from male flowers of *Cucurbita maxima* were all moribund. It appears that they had been

come chilled after entering the flowers before being captured at about 9.30 am. One female has large loads of *C. maxima* pollen in her scopae, and all bees are copiously dusted with pollen over their entire bodies. The 2 females from *Nymphaea* sp. which have pollen in their scopae were found dead in a flower, which suggests that they died while foraging for pollen. There is a record of 3 males collected over *Ranunculus* sp., but there is no indication as to whether the plant was native or introduced.

Although only 1 female has been captured collecting pollen from a native flower (*Wahlenbergia pygmaea*), the collection of 20 females with pollen from 4 species of introduced Asteraceae, strongly suggests that this species prefers species of Asteraceae as pollen sources, and that native Asteraceae were probably the original major pollen sources. The collection of pollen from 3 other widely disparate pollen sources such as the native *W. pygmaea* and the introduced *Cucurbita maxima* and *Nymphaea* sp. further suggests some plasticity in pollen-collecting abilities.

**Nest sites.** There are 20 records of bees collected from or on or over nest sites. Nest sites are described as a bare clay slope, a domestic lawn, burrows in banks, a dry bank, a golf course sloping surface, and pumice/tuff. Of 4 nest sites known to me, all were man-made. At Piriaka TO, 100 or more female bees were nesting in a near-vertical, silty roadside cutting on a steep cliff-face. At another site at Piriaka TO, several females were nesting in a small nearly-vertical bank of sandy soil about 0.5 m high just outside a fence around a house and above a grazed field. At Ohura TO a nest site which was occupied by several score females was in clay along the edge of the sealed footpath in the middle of the town where a building had been destroyed by fire several years earlier. The Opotiki BP golf course nest site measured an estimated 20 × 25 m on sloping, sandy ground which was bared by close mowing. Several hundred females were seen at any one time in fine weather. Before the advent of European settlement it is likely that all 4 nest site areas were covered in dense native vegetation, and so would not have been occupied by bees. The Ohura nest site could not have been occupied until the building on the site had been destroyed by fire, so prior to 1970 when the bees were observed, this nest site may have been occupied for just a few years at most.

In addition to nest sites, male bees have been found in sawdust, under a log, at a foredune and in a metal pit.

**Associated organisms.** Thirteen females carry from 1–31 mites (mean 6.2), and 22 males have from 1–7 mites (mean 2.1). The bees were taken in AK, BP (including the Alderman Islands), TO, and WN.

**Etymology.** *paahaumaa*: Maori *paahau* = beard, *maa* =



white. Refers to the dense long white clypeal vestiture of the males.

**Remarks** *Leioproctus paahaumaa* is second in size to *L. metallicus*, the largest native bee in the North Island. Bees are very noticeable on ragwort, *Senecio jacobaea*, because the overall black appearance of the bee contrasts sharply with the yellow of the ragwort flower head. Before the widespread clearance of native bush which began nearly 200 years ago and which ceased about a decade ago, nest sites for *L. paahaumaa* throughout much of its present range would have been restricted to the small areas which were naturally free of vegetation, such as watercourse cuttings and slip faces on steep hillsides. The volcanic regions in the centre of the North Island may have provided the only relatively extensive naturally clear areas of ground, but these have been subjected to periodic vulcanism, which probably destroyed many sites. The clearance of bush by man has opened up vast new nesting opportunities, which the bee appears able to make quick use of, as is witnessed by the apparent rapid colonisation of the Ohura nest site, which was exposed by fire. Accompanying the destruction of the bush, was the colonisation of much of the new pastoral land by introduced Asteraceae, and particularly ragwort, which appears to provide *L. paahaumaa* with an abundant source of pollen and nectar, particularly during late summer and early autumn. There seems to be every possibility that the population of *L. paahaumaa* is now much greater, and extends over much more territory, than before the widespread barring of land surfaces, particularly by European colonisers and their descendants.

This species is almost certainly the *P. boltoni* of Rayment (1935) (see under *L. boltoni*).

Harris (1987) recorded the pompilid *Priocnemis (Trichocurgus) carbonarius* using 37 nests at Wellington WN made by an unidentified *Leioproctus (Nesocolletes)*. Generally, abandoned bee burrows were used, but 16 nests were shared, and viable pupae of both species were produced. The abundance of *L. paahaumaa* in the Wellington region, and its large size, suggest that the bee was this species.

### ***Leioproctus (Nesocolletes) pekanui* new species**

Fig. 13a–d, 54a–m; Map 18

**Female** (n = 20). Length 6.6–8.5 mm ( $7.6 \pm 0.45$  mm); width 2.0–2.5 mm ( $2.2 \pm 0.10$  mm); forewing length 3.7–4.1 mm ( $3.9 \pm 0.15$  mm); facial length 1.9–2.2 mm ( $2.1 \pm 0.08$  mm); facial width 1.4–1.6 mm ( $1.5 \pm 0.06$  mm); malar length/malar width 0.47.

**Coloration.** Head, mesosoma and metasoma black, except apices of mandibles red, antennae brown beyond about 2nd flagellar segment; remaining areas, particularly extremi-

ties, brown, except wing membranes and apical margins of metasomal terga 1–5 hyaline, tibial spurs very pale.

**Structure.** (Fig. 54a–b). Scape as long as combined length of first 5 flagellar segments. Compound eyes a little more than 4× longer than wide, with upper 1/5 and lower 4/5 of inner margins converging slightly above, and more markedly below, respectively. Ocellular distance a little more than 3 ocellar diameters; interocellar distance equal to about 0.75× an ocellar diameter. Antennal sockets about 1.2× further from apex of clypeus than from vertex. Face shiny throughout. Supraclypeus rising from below as a wide, smooth impunctate face narrowing to a peak between antennal sockets, lateral areas with medium-sized punctures; frontal ridge low, extending a little more than 1/3 the way to median ocellus, frontal line continuing to median ocellus but somewhat obscured by sculpturing. Frons tessellated with indistinct punctures; area near upper 1/4 of compound eye smooth, in some views resembling facial fovea. Clypeus protuberant, long, extending for more than 1/2 its length below a line across lower ends of compound eyes; large lower central area with very few, very widely-spaced large punctures; punctures very close, smaller dorsolaterally. Malar space long, 1/2 as long as wide, impunctate, shiny. Galea moderately tessellated. In lateral view, genal area somewhat narrower than compound eye, shiny, lightly tessellated with indistinct, medium-sized punctures.

Pronotum lightly shagreened with a few small, widely-spaced punctures; sulcus prominent dorsally and dorsolaterally, absent lateroventrally. Scutum moderately tessellated, shinier medially than around periphery, with distinct medium-sized punctures throughout. Scutellum lightly tessellated on anterior 1/2, posterior 1/2 and punctation as for scutum. Metanotum similar to posterior 1/2 of scutellum. Propodeal triangle slightly angled (Fig. 54k), propodeum moderately tessellated throughout, dull, posterolateral area with small, widely-spaced punctures. Remaining lateral areas of mesosoma shagreened, with widely-spaced, medium-sized punctures except metepisternum impunctate. Basitibial plate prominent, about 1/4 length of tibia, with irregular longitudinal ridges, lightly tessellated. Inner metatibial spur ciliate (Fig. 54i). Pterostigma 4× longer than wide; vein 1st m-cu meets 2nd submarginal cell before middle.

Metasomal terga 1–5 and sterna 1–6 lightly shagreened, with indistinct, small, widely-spaced punctures, except tergum 5 with medium-sized punctures separated by 2–3 diameters. Sternum 1 with posterior margin transverse. Pygidial plate narrowing from moderately wide base to squared apex, with edge and a broad longitudinal median area raised, base lightly tessellated, apical area lightly shagreened (Fig. 54j).

**Vestiture.** White to near-white, except for black narrowly on inner margins of compound eyes, between antennal sockets to vertex, broad central area dorsally from scutum to metanotum, area below wing base, on tergum 5, and laterally to pygidial plate. Facial vestiture moderately long, not obscuring surface. Scutum almost naked medially. Trochanteral floccus (Fig. 54g) and femoral pollen-carrying vestiture well developed. Femoral vestiture white except apex black. Scopal hairs (Fig. 54h) with long branches, about dorsal 1/2 of scopa light brown. Metabasitarsus with hairs of outer face long, strongly branched, forming well developed scopa, a few off-white hairs at base, remainder very light brown. Metasomal tergum 1 with very sparse, long, pale hairs throughout. Terga 2–4 with narrow apical fimbria of short, appressed white hairs, fimbria on terga 2–3 broadly broken medially. Sterna 1–6 with sparse, long white hairs on apical 1/2 of disc, sterna 2–5 with apical fimbria of long white hairs.

**Male** (n = 20). Length 5.5–6.9 mm ( $6.3 \pm 0.43$ ); width 1.5–2.0 mm ( $1.7 \pm 0.13$  mm); forewing length 2.8–3.7 mm ( $3.3 \pm 0.28$  mm); facial length 1.6–2.0 mm ( $1.8 \pm 0.11$  mm); facial width 1.2–1.6 mm ( $1.4 \pm 0.09$  mm); malar length/malar width 0.31.

**Coloration.** Similar to female.

**Structure.** (Fig. 54c–d). Scape a little longer than combined length of first 4 flagellar segments. Compound eyes about 4× longer than wide, with inner margins as in female. Ocellocular distance nearly 2.5× ocellar diameter, interocellar distance as in female. Position of antennal sockets as in female. Area that in female resembles facial fovea much less distinct. Clypeus extending for less than 1/3 its length below a line across lower ends of compound eyes. Malar space a little less than 1/3 as long as wide. Remainder of head similar to female.

Mesosoma similar to female except tessellation more pronounced. Basitibial plate about 1/5 length of tibia; wings much as in female.

Metasomal terga 1–6 similar to female metasomal terga 1–5; tergum 7 with a narrow, median, longitudinal shiny area reminiscent of a pseudopygidial plate. Sterna 1–6 as in female except sternum 1 with apex shallowly emarginate. Sternum 7 (Fig. 54e) with basal lobes of similar width throughout, apical lobes almost rectangular, with apical fringe of short, stout spines. Sternum 8 (Fig. 54f) with basal area narrowing basally, apical process rounded distally. Gonocoxites narrowing distally, gonostyli in dorsal and ventral views (Fig. 54i) incurved in scimitar shape, penis valves very acute apically; in lateral view (Fig. 54m) penis valve with sharp angle anteriorly, blunt apically, scarcely projecting below gonostylus.

**Vestiture.** Similar on face to female, except black hairs adjacent to compound eye opposite clypeus more dense; sur-

face of clypeus, supraclypeus and lower 1/2 of frons obscured by dense, long white hairs. Vestiture on mesosoma similar to female except longer. Metasomal terga 1–2 with long, white sparse hairs throughout, terga 3–5 with short, black moderately dense hairs on disc. Terga 6–7 with pale vestiture. Sternal vestiture similar to female except shorter, less abundant.

**Variation.** A male taken at Porter's Pass MC at 960 m on 13 February 1965 as a 'puparium in soil' by R. M. J. McKenzie, and which emerged as an adult on 16 December 1965, has veins 1st m-cu in both wings interstitial with the first cubital veins. A male captured at South Gully, Tutoko Bench, Darran Mountains FD at 945–1219 m on 9 January 1977 by J. S. Dugdale, has veins 1st m-cu in both wings almost interstitial with the first cubital veins. A male taken at Beeby's Knob NN, 1372 m, on 5 February 1978 by A. K. Walker, has vein 1st m-cu in the left wing interstitial with the first cubital vein, and in the right wing, almost so.

**Type data.** *Leioproctus pekanui*: holotype female, "Mount Cook National Park MK", 4 February 1977, on flowers of *Hebe subalpina*, F. C. Evans (NZAC). Allotype male, one paratype female, one paratype male, same data as holotype. One other paratype female, same data as holotype female except collected on *Hebe salicifolia* (NZAC).

**Material examined.** Type specimens, plus 165 females and 67 males.

**Distribution** (Map 18). North Island: WN? South Island: NN, BR, MB, KA, WD, NC, MC, MK, FD, OL, CO, DN, SL.

One female has a top label 'Wellington 1/2/09', (with the '2' and the '0' indistinct and possibly not that date), and below this a second label 'COLLECTION W. G. Howes'. W.G. Howes was an active entomologist during the period when the bee was collected, but as he was mainly based at and collected around the Dunedin–Southland area (T.K. Crosby pers. comm.) perhaps the bee was mislabelled.

Of the 120 collection records, altitude data are given for 53. Bees have been collected from 610 m in the Hokonui Hills SL to 1463–2072 m at Headlong Creek OL. There are 12 altitude records under 1000 m, 4 with ranges from under 1000 m to under 2000 m, 36 from 1000 m to under 2000 m, and just the one with the highest altitude given above. Adults have been taken from 12 December to 15 March, with the great majority of records for January and February.

**Biology.** *Leioproctus pekanui* appears to be restricted to the mountainous regions of the South Island.

**Flight period.** The earliest seasonal capture record for both females and males is 12 December, with the last seasonal capture record for females on 15 March, and the last for males on 24 February. For 168 females, 31.6% of the

76 collection records are in January, and 56.6% are in February. For the 44 collection records for the 69 males, the corresponding percentages are 40.9 and 52.3.

## Number of collections

	Dec	Jan	Feb	Mar
Females	5	24	43	4
Males	3	18	23	

Fewer than 10 bees have been collected at any one site at any one time, apart from 28 females, 4 of which carry pollen, and 1 male, taken at Mt Luxmore hut FD on 30 January 1990 by A. C. Harris.

## Host plants

## Native plants

Asteraceae			
<i>Celmisia coriacea</i>	♀ 1/1	—	
<i>Celmisia spectabilis</i>	—	♂ 2/3	
<i>Celmisia</i> sp.	—	♂ 1/2	
<i>Craspedia uniflora</i>	—	♂ 1/1	
<i>Leucogenes grandiceps</i>	♀ 1/2 (1/2 p)	♂ 1/6	
<i>Ozothamnus</i> sp.	♀ 1/3 (1/2 p)	—	
<i>Raoulia eximia</i>	♀ 1/3 (1/2 p)	♂ 1/3	
<i>Raoulia subsericea</i>	♀ 1/1 (1/1 p)	—	
Campanulaceae			
<i>Wahlenbergia</i> sp.	♀ 1/1 (1/1 p)	♂ 1/2	
Gentianaceae			
<i>Gentiana corymbifera</i>	♀ 3/10 (3/4 p)	♂ 1/2	
<i>Gentiana</i> sp.	♀ 1/1	—	
Myrtaceae			
<i>Leptospermum scoparium</i>	♀ 1/1 (1/1 p)	♂ 1/1	
Onagraceae			
<i>Epilobium</i> sp.	—	♂ 1/1	
Orobanchaceae			
<i>Euphrasia revoluta</i>	♀ 1/1 (1/1 p)	—	
Plantaginaceae			
<i>Hebe epacridea</i>	♀ 1/1 (1/1 p)	—	
<i>Hebe macrantha</i>	♀ 1/3 (1/2 p)	♂ 1/1	
<i>Hebe ?odora</i>	—	♂ 1/1	
<i>Hebe salicifolia</i>	♀ 1/3 (1/2 p)	♂ 1/1	
<i>Hebe subalpina</i>	♀ 6/14 (2/8 p)	♂ 2/2	
<i>Hebe</i> sp.	♀ 3/5 (2/4 p)	♂ 1/4	
<i>Parahebe decora</i>	♀ 1/3 (1/1 p)	—	
<i>Parahebe linifolia</i>	♀ 1/1	—	
Rosaceae			
<i>Geum uniflorum</i>	♀ 1/2 (1/2 p)	—	
<b>Total collections/specimens</b>	♀ 27/56 (19/34 p)	♂ 16/30	
<b>Species/genera/families</b>	18/11/7 (15/10/7 p)	14/9/6	

## Introduced plants

Asteraceae			
<i>Achillea millefolium</i>	♀ 2/2 (1/1 p)	—	
<i>Chrysanthemum leucanthemum</i>	♀ 1/1 (1/1 p)	♂ 1/1	
<i>Hieracium praealtum</i>	♀ 1/1	—	
<i>Taraxacum officinale</i>	♀ 1/2	—	
Boraginaceae			
<i>Echium vulgare</i>	♀ 1/9 (1/8 p)	—	
Hypericaceae			
<i>Hypericum</i> sp.	♀ 1/2 (1/2 p)	—	

## Rosaceae

<i>Potentilla</i> sp.	♀ 1/7 (1/7 p)	♂ 1/1
<b>Total collections/specimens</b>	♀ 8/24 (5/19 p)	♂ 2/2
<b>Species/genera/families</b>	7/7/4 (5/5/4 p)	2/2/2

Quinn (1984) observed bees visiting *A. millefolium*, *G. corymbifera*, *E. vulgare*, and several Asteraceae from December to February.

**Nest sites.** On 13 February 1965, R. M. J. McKenzie collected a 'puparium' from soil at 960 m at Porters Pass MC, and on 16 December that same year, a male bee emerged. On 10 January 1978, P. Quinn collected 1 female bee with pollen 'ex nest site', in the Cass river valley MK. On 10 February 1985, B. R. Fraser swept 1 female from a clay bank at L. Sylvester NN.

**Associated organisms.** The holotype female carries 3 large mites, and 1 female from Culliford Hill, Marino Mountains NN, has 1 large mite.

**Etymology.** *pekanui*: Maori *peka* = cheek, *nui* = large. Refers to the long malar space.

**Remarks.** This species is readily recognised by its long malar space, the propodeal triangle tessellated, the apices of metasomal terga 2–4 with white apical fimbria, broadly broken medially on terga 2–3, and the face with vestiture primarily white. The confinement of collection records to mountainous areas (except for possibly the female from Wellington WN) suggests that *L. pekanui* is a true montane bee. The restriction of collection dates to just 4 months, and primarily to January and February, is almost certainly a reflection of the shorter summer at high altitudes compared to a longer summer at lower altitudes. *L. pekanui* displays an ability to collect pollen from a wide and disparate range of both native and introduced plants, which contrasts sharply with the almost complete restriction of the closely-related *L. monticola* which shares the montane habitat, to just species of *Hebe*.

This is *Leioproctus* 'A' of Primack (1978) 70 (18 of 29 collected were females), (1983) 319, 323–328, 332 (flower records), and *Leioproctus* sp. 6 of Quinn (1984) 43 (brief description, flower records).

## Subfamily Hylaeinae

Genus *Hylaeus* FabriciusSubgenus *Prosopisteron* Cockerell

*Prosopisteron* Cockerell, 1906b: 17. Type species: *Prosopisteron serotinelum* Cockerell, 1906, monobasic. *Psilylaeus* Snelling, 1985: 28. Type species *Psilylaeus sagiops* Snelling, 1985 = *Prosopis perhumilis* Cockerell, 1914a, by original designation. Synonymised by Michener, 2000: 203.

***Hylaesus (Prosopisteron) agilis* (Smith)**

Fig. 14a–d, 55a–h; Map 19

*Prosopis laevigata* Smith, 1854: 420 (description of female). Kirby, 1881: 37 (list, recorded from Auckland). —1884: 67 (list, repeats description of Smith 1854). Dalla Torre, 1896: 26 (as *levigata*, list, from Australia). Cameron, 1898: 52 (*P. sulcifrons* comes near to *P. laevigata*). —1903: 298 (list). Hutton, 1904: 96 (as *laevigatus*). Cockerell, 1909: 313 (synonymy, *P. laevigata* is a slight variety of *P. agilis*). Kirkaldy, 1909: 131 (*P. maorica*, nom. nov. = *P. laevigatus* Smith). Meyer, 1931: 249 (synonymy), 249–250 (key), 251 (description, localities), 252 (occurrence of nest in abandoned insect gall, illustration of nest in a gall). **Preoccupied.**

*Prosopis agilis* Smith, 1876: 484 (description of female). Hutton, 1881: 99–100 (repeats description of Smith 1876). Kirby, 1881: 37 (list). —1884: 67 (list). Dalla Torre, 1896: 14 (list, also from Australia). Cameron, 1898: 50 (one specimen taken near Greymouth), 52 (*P. innocens* comes near to *P. agilis*). Cameron 1903: 298 (list). Alfken 1903: 620 (*relegata* Smith is a synonym, records one female and one male from the Chatham Islands). Hutton, 1904: 96 (list). Cockerell, 1909: 313 (*P. maoriana* sp. n. is extremely like *P. agilis*, *P. laevigata* is a slight variety of *P. agilis*, key). —1916b: 361 (list). Meyer, 1931: 249 (synonym of *P. laevigata*). Godley, 1979: 445 (bees opened flower buds).

*Prosopis maorica* Kirkaldy, 1909: 131 (nom. nov. = *P. laevigatus* Smith). **New synonymy.**

*Prosopis agilis laevigata*: Cockerell, 1916b: 361 (list).

*Hylaesus agilis*: Meade-Waldo, 1923: 26 (list). Cockerell, 1925: 553 (described by Smith from specimens taken in Canterbury). —1936: 449 (record from Kinloch Lake, Wakatipu). Michener, 1965: 120 (middle segments of male flagellum less than twice as long as broad in subgenus *Prosopisteron* except in *agilis*), 122 (in *Prosopisteron*, *H. agilis* is unusual for the long antennae of the male, the middle flagellar segments being more than twice as long as broad, the record for the Chatham Islands is *H. agilis*). Donovan, 1983a: 515 (foraging on the nectarless male and female flowers of kiwifruit, *Actinidia chinensis* Planch.). Primack, 1983: 328, 332 (flower records). Ladley, Kelly & Robertson, 1997: 350 (bees entering flower buds), 358 (*H. agilis* opens flowers of *T. tetrapetala* at some sites, which increases fruit set). Taylor, 2002: 90–91 (photograph of a bee attempting to open a *Peraxilla* bud). Robertson, Ladley & Kelly, 2005: 299 (discovered in 1996 that this short-tongued bee prised open buds of *Peraxilla*, buds turning pink at the tip open explosively when twisted or squeezed), 300 (photograph of *H. agilis* attempting to open a bud of *Peraxilla tetrapetala*), 301 (determined pollen deposition on flowers newly opened by the bees, discovered that *Leioproctus* species 10, Colletidae; B. Donovan, also opens flowers, and *Lasioglossum sordidum* (Halictidae) is a frequent visitor to previously opened flowers), 302 (activity rate on flowers), 303, 306 (this pollen-ingesting bee significantly less effective at depositing pollen on *P. tetrapetala*

than the more hairy pollen-collecting *Leioproctus* sp.). *Hylaesus laevigatus*: Meade-Waldo, 1923: 28 (list, a variety of *agilis*).

*Hylaesus (Prosopisteron) agilis*: Michener, 1965: 123 (new combination). Valentine & Walker, 1991: 42 (list, synonymy).

*Hylaesus (Prosopisteron) laevigatulus* Michener, 1965: 123 (new combination, new name for *Prosopis laevigata* Smith, 1854, not *P. laevigata* Eversmann, 1852. *P. levigata* Dalla Torre, 1896, is an unnecessary emendation). **New synonymy.**

*Hylaesus (Prosopisteron) maorica*: Valentine & Walker, 1991: 42 (new combination, list, synonymy).

**Female** (n = 20). Length 6.0–8.8 mm (7.3 ± 0.77 mm); width 1.5–2.0 mm (1.8 ± 0.12 mm); forewing length 4.3–6.0 mm (5.1 ± 0.37 mm); facial length 1.2–1.6 mm (1.5 ± 0.01 mm); facial width 1.1–1.5 mm (1.3 ± 0.09 mm); malar length/malar width 0.09.

**Coloration.** Black, except paraocular areas yellow below an irregular line from about opposite dorsal margin of clypeus to an opposite point, often slightly higher, on inner margin of compound eye (Fig. 00); antennae light brown ventrally beyond about pedicel; outer 1/3 to about 2/5 of angle of pronotum yellow, pronotal lobe yellow; apex of mandibles and tarsal claws dark red, metatibial spurs pale, wing membranes slightly darkened, posterior margins of metasomal terga 1–5 and sterna 1–5 hyaline.

**Structure.** (Fig. 55a–b). Scape a little longer than combined length of flagellar segments 1–4, distal antennal segments widest. Compound eyes 4× longer than wide, with about upper 1/3 and lower 2/3 of inner margins converging moderately above and below respectively. Ocellular distance 2× an ocellar diameter; interocellar distance about 0.75× an ocellar diameter. Antennal sockets 1.5× further from apex of clypeus than from vertex. Supraclypeus scarcely rising to a low mound between antennal sockets; frontal line extending to median ocellus. Facial fovea a linear depression extending dorsally from the inner angle of the inner margin of the compound eye, adjacent to the margin of the compound eye, then swinging out to terminate at a distance a little less than 1 ocellar diameter away from compound eye, between lateral ocellus and compound eye. Clypeus flat, short, extending for about 1/7 its length below a line across lower margins of compound eyes. Face below antennal sockets shiny, lightly tessellated, with small punctures separated by 4–8 diameters, except lower margin of clypeus with irregular row of large, close punctures, and punctures on supraclypeus very small, obscure. Above antennal sockets face dull, moderately tessellated, with medium-sized punctures separated by 0.5–1 diameters. Malar space lightly shagreened, short, about 11× wider than long. Galea lightly tessellated. In lateral view, gena about equal in width to compound eye, lightly shagreened,

punctuation as on disc of clypeus.

Pronotum with lateral areas with irregular striae, angled downwards and backwards by about 30°, lightly tessellated. Scutum moderately tessellated, with medium-sized punctures separated by 2–4 diameters. Scutellum similar to disc of clypeus. Metanotum lightly tessellated, impunctate. Propodeal triangle evenly rounded, anterior margin broadly and lightly roughened, remainder lightly tessellated; lateral areas of propodeum lightly shagreened, with medium-sized punctures separated by about 1 diameter. Metepisternum lightly shagreened, dorsal 1/2 with fine, longitudinal striae. Remaining lateral areas of mesosoma similar to clypeus, except punctures medium-sized, area above scrobal groove impunctate. Inner metatibial spur very finely ciliate. Stigma 3× longer than wide. First submarginal cell about 2.3× as long as 2nd.

Metasomal terga 1–5 and sterna 1–6 very lightly shagreened, shiny; terga with extremely small, widely-spaced punctures, sterna with punctures as large as medium-sized, separated by about 4 diameters or more. Metasomal terga 2 and 3 with post-spiracular glands, tergum 2 with a small fovea just above and behind post-spiracular gland. Sternum 1 with apical longitudinal median slit extending for about less than 1/2 length of sternum.

**Vestiture.** Short, sparse, white throughout, except brown-black around apex of abdomen, inner face of tarsi with very short, dense, silver hair; sternum 5 with semi-lunar-shaped apical area of very short, dense off-yellow hairs.

**Male** (n = 20). Length 4.6–7.0 mm ( $6.1 \pm 0.60$  mm); width 1.0–1.3 mm ( $1.2 \pm 0.10$  mm); forewing length 3.1–4.6 mm ( $4.1 \pm 0.42$  mm); facial length 1.0–1.3 mm ( $1.2 \pm 0.08$  mm); facial width 0.8–1.2 mm ( $1.1 \pm 0.08$  mm); malar length/malar width 0.07.

**Coloration.** Black, except paraocular area yellow below an irregular line from near upper margin of clypeus to margin of compound eye about opposite antennal sockets; clypeus yellow below a very irregular line inside lateral and upper margins; labrum yellow; mandibles yellow except base narrowly black and apex dark red (Fig. 00); antenna and pronotal lobe similar to female; angle of pronotum usually with some yellow; anterior face of protibia and probasitarsus light yellow, slight yellowing at apex of profemur and articulations between mesofemur and mesotibia, and apex of mesotibia; remainder similar to female.

**Structure.** (Fig. 55c–d). Scape short, about equal in length to combined length of first 2 flagellar segments; first flagellar segment a little longer than wide, remaining flagellar segments nearly twice as long as wide. Compound eyes about 3× longer than wide, with inner margins similar to female but more strongly convergent dorsally and ventrally. Ocellular distance, interocellar distance and position of

antennal sockets similar to female. Supraclypeus rising from below to a small, low, rounded point between antennal sockets. Facial fovea a scarcely discernible short, linear depression near upper inner margin of compound eye. Clypeus slightly rounded in cross-section, short, extending for about one-ninth its length below a line across lower margins of compound eyes. Malar space lightly shagreened, short, about fourteen times wider than long. Galea almost smooth, shiny. In lateral view, compound eye 1.5× wider than gena. Remainder of head similar to female, except face above antennae with dense tessellation.

Mesosoma similar to female, except propodeal triangle slightly angled rather than rounded.

Metasomal terga 1–5 and sterna 1–5 similar to female, except punctuation more pronounced; post-spiracular glands not obvious on terga 2–3, metasomal terga 2–3 with small fovea, that on metasomal tergum 3 smaller than that on metasomal tergum 2. Sternum 7 with basal processes long, narrow, anterior apical lobes acute anteriorly, with lateral fringe of very short hairs, posterior apical lobes produced laterally with patch of short hairs (Fig. 55e). Sternum 8 with basal process short, apical process simple, rounded (Fig. 55f). Gonocoxites in dorsal and ventral views slightly angled laterally, gonostyli short, blunt, stout, with hairs projecting from inner, apical and lateral faces, penis valves stout, blunt apically, projecting beyond end of gonostyli (Fig. 55g); in lateral view (Fig. 55h) penis valve projecting well below gonostylus, very acute apically.

**Vestiture.** Similar to female, except metasomal sternum 5 without semilunar area.

**Variation.** The paraocular maculae of a female from the Three Kings Islands are very faint. The yellow area on the clypeus of males can range from occupying virtually all of the clypeus, to occupying less than the ventral half of the clypeus. The pronotal angle of males can range from black to as yellow as in females.

**Type data.** *Prosopis laevigata*: holotype female, “New Zealand” (BMNH). *Prosopis agilis*: holotype female, “Canterbury, New Zealand”, C. M. Wakefield (BMNH).

**Material examined.** Type specimens, plus 401 females and 212 males.

**Distribution** (Map 19). North Island: ND, AK, CL, BP, TK, TO, GB, RI, HB, WN. South Island: SD, NN, BR, MB, KA, WD, NC, MC, MK, SC, FD, OL, DN, SL. Stewart Island (also Big South Cape Island). Offshore Islands: Three Kings Islands.

There are 39 altitude records for live bees which range from 5 to 1590 m., and for dead bees there are 5 records from the summit snows of Mt Taranaki/Egmont for 9 females and 2 males, of 2400 m. Collection dates for the 261 collections range from 11 October to 10 May.

**Biology.** Collection site data show that *Hylaeus agilis* occurs throughout the vegetated areas of the country from just above sea level to at least 1590 m. The 11 dead bees found at the summit of Mt Taranaki/Egmont were probably swept there by updrafts.

**Flight period.** The earliest seasonal collection record for females is 11 October, and the last, 10 May, and males have been captured from 14 October to 13 April. Of the 177 collections for which records are available for 401 females, about a quarter were taken in each of December, January and February, while for the 212 males the 84 collections were most abundant from November to January.

Number of collections

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May
Females	2	20	41	50	45	11	6	2
Males	4	22	27	19	10	1	1	

There are 5 collections of 10 or more females, and 2 of males. The largest collection of females is 24 from Takaka Hill NN on 19 February 1957 at 600 m by E. S. Gourlay, and for males, 62 from the Wilburg Range WD on 4 February 1922 by J. W. Hende. For these 2 collections, no bees of the other sex were taken.

Host plants

Native plants

Araliaceae			
<i>Pseudopanax</i> sp.	—		♂ 1/1
Asteraceae			
<i>Brachyglottis</i> sp.	♀ 1/1		—
<i>Olearia angustifolia</i>	—		♂ 1/1
Fabaceae			
<i>Carmichaelia</i> sp.	♀ 1/2		♂ 4/6
Hemerocallidaceae			
<i>Phormium tenax</i>	♀ 1/1		—
Loranthaceae			
<i>Peraxilla colensoi</i>	♀ 1/6		—
<i>Peraxilla tetrapetala</i>	♀ 4/14		♂ 1/2
Myrtaceae			
<i>Leptospermum scoparium</i>	♀ 1/1		♂ 2/2
<i>Metrosideros excelsa</i>	♀ 4/4		—
<i>Metrosideros robusta</i>	♀ 1/1		—
<i>Metrosideros</i> sp.	♀ 3/7		—
Pennantiaceae			
<i>Pennantia corymbosa</i>	—		♂ 1/1
Plantaginaceae			
<i>Hebe salicifolia</i>	♀ 2/2		♂ 1/1
<i>Hebe</i> sp.	♀ 3/7		♂ 2/9
<b>Total collections/specimens</b>	♀ 22/46		♂ 13/23
<b>Species/general/families</b>	11/7/6		8/7/7

Introduced plants

Actinidiaceae			
<i>Actinidia deliciosa</i> female	♀ 6/12		—
male	—		♂ 1/1
?sex	♀ 2/8		♂ 1/1
Asphodelaceae			
<i>Kniphofia praecox</i>	♀ 1/13		—

Fabaceae		
<i>Cytisus scoparius</i>	♀ 1/1	—
Fagaceae		
<i>Castanea sativa</i>	♀ 1/1	—
Myrtaceae		
<i>Callistemon</i> sp.	♀ 1/2	♂ 1/1
<i>Eucalyptus</i> sp.	♀ 2/2	—
Rosaceae		
<i>Filipendula palmata</i>	♀ 1/1	—
Scrophulariaceae		
<i>Verbascum thapsus</i>	♀ 1/1	—
<b>Total collections/specimens</b>	♀ 16/41	♂ 3/3
<b>Species/general/families</b>	8/8/7	2/2/2

*Hylaeus agilis* appears to visit a relatively wide range of both native and introduced flowers.

**Nest sites.** Meyer (1931) illustrates a nest sent to him by E. S. Gourlay, and quotes E. S. Gourlay as saying: "The galls we (my note; should be 'were') made by the larvae of one of our native moths: *Morova subfasciata* and the plant on which they are found is a creeping mat-like shrub (*Muhlenbeckia australis*), which climbs up the trees in a dense green mass. After the original occupant has left the gall and it has dried the bees utilise it as a nesting place." An examination of this nest, which is available to me, shows a male *H. agilis* glued to the wood. The nest consists of an entrance hole 2.7 mm across which opens to a cavity about 5 mm long which is lined with cellophane-like material. This is followed by a cell made of cellophane-like material which is 6 mm long, and which tapers from 4.5 mm across at the end nearest the entrance, to 3 mm at the opposite end. Then follows another cellophane-lined cavity 6 mm long that could be another cell. The partition between the 2 cells has a bee emergence hole through it. All cellophane-like material adheres to the walls of the cavity, so that the shape of the nest is dictated by the shape of the cavity. In places, the cellophane-like material appears to be 2 layers thick.

A second piece of branch 34 mm long was collected on 15 July 1930 by E. S. Gourlay. Now pierced by an insect pin and split lengthways, a cavity extending the length of the twig measures about 5 mm across, a small area of which is lined with cellophane-like material. Stuck to a pointed piece of cardboard above the twig is a male *H. agilis*, and the skin of a bee prepupa with a parasitoid exit hole at the head. A label beneath the twig says 'Bee emerged 20-11-30 Parasites Em 3-1-31'. Another label in faded handwriting has what appears to be '15/7/30 larvae inside' '34 Em 3/1/31'. The bee prepupal skin is 7 mm long and about 1.7 mm across, and is empty apart from what may be the remains of a parasitoid pupa.

Two females and 3 males were taken from a dead stem of supplejack, *Ripogonum scandens* (Smilacaceae), from Weheka?, 10 May 1935 by O. H. Swezey. A female emerged

from a blackberry stem on 28 February 1948, which was collected at Whataroa WD by an unknown collector. A male emerged on 26 October 1966 from *Hebe stricta*, which was collected on 14 March 1966 from the Whangamoa Saddle NN by an unknown collector, and another male was extracted from the dead trunk on 13 June 1967. Three females that emerged from *Brachyglottis reinoldii* (Asteraceae) in transit, Codfish Island SI, 21 December 1966, were collected by J. I. Townsend, and 1 female was extracted by an unknown collector on 13 July 1967 from dead branches of the same plant which were collected at the same site on 8 December 1966. One female was ex rotten pocket of miro, *Prumnopitys ferruginea* (Podocarpaceae), from Port Pegasus, Twilight Bay SI, by an unknown collector, in February 1968.

**Associated organisms.** Seven *Coelopencyrtus australis* (Hymenoptera: Encyrtidae) in the NZAC, which were collected by E. S. Gourlay at Nelson on 3 January 1931, are probably part of those recorded emerging from *H. agilis* at Nelson on the same date by E. S. Gourlay. Noyes (1988) when describing *C. australis* recorded 5 females and 1 male from Nelson, 3 January 1931, ESG. Noyes stated that the species was reared from an unknown larva, probably that of a solitary bee.

One female from Golden Bay NN has 3 small mites on the wings, 19 on the mesosoma, and about 192 tightly packed on the metasoma. A female from West Egmont TK has at least 212 tightly packed mites on the metasomal terga. A female from Rough Bush, Ohau MK, has 68 mites. A female from Arthur's Pass NC, has 47 small mites on the metasoma, and another female has 1 small mite on the propodeum and 37 small mites on the metasomal terga. Four other females have 1, 6, 6 and 8 small mites, and 2 males have 1 and 2 small mites.

**Remarks.** Female *H. agilis* can aggressively seek out pollen and/or nectar. Godley (1979) found that many *Prosopis agilis* which were visiting a single plant of *Elytranthe flavida*, prised open the tips of buds and pushed down inside the long tube. They also pushed down into the shorter tube of the opened flowers. Ladley, Kelly & Robertson (1997) saw *H. agilis* opening flowers of *Peraxilla tetrapetala*, which increased fruit set. Taylor (2002) photographed a bee that I here identify as a female *H. agilis*, attempting to open a *Peraxilla* bud.

The occurrence of the species on the Chatham Islands reported by Alfken (1903) has not been supported by additional records, so whether it is present there appears to be uncertain. The wide distribution of *Hylaenus agilis*, which is similar to that of *H. relegatus* (except possibly for the Chatham Islands) and *H. capitosus*, suggests that this species is similarly successful throughout a wide range of climates.

### *Hylaenus (Prosopisteron) asperithorax* (Rayment)

Fig. 14e–f, 15a–b, 56a–h; Map 20

*Euryglossa asperithorax* Rayment, 1927: 75 and Plate IV (description of female, key to Plate, 11 drawings of parts of *E. asperithorax* and 3 drawings of parts of other bees for comparison).

*Hylaenus asperithorax*: Cockerell, 1929a: 315 (new combination, *H. scintilla* is close). —1929c: 9 (taxonomy). Rayment, 1935: 108–109 (same as Plate IV in Rayment 1927). —1939: 266 (flagellum ferruginous, face-marks very obscure, distribution). —1953a: 8 (minute black bees are very near to *H. asperithorax*).

*Hylaenus (Prosopisteron) asperithorax*: Michener, 1965: 123 (new combination, list). Cardale, 1993: 132 (taxonomy, distribution, ecology, references).

**Female** (n = 20). Length 3.4–4.4 mm ( $3.9 \pm 0.32$  mm); width 1.1–1.4 mm ( $1.2 \pm 0.10$  mm); forewing length 2.0–2.9 mm ( $2.4 \pm 0.25$  mm); facial length 0.9–1.2 mm ( $1.0 \pm 0.08$  mm); facial width 0.7–1.0 mm ( $0.8 \pm 0.07$  mm); malar length/malar width 0.13.

**Coloration.** Black, except triangular paraocular area yellow below a line from tentorial pit to margin of compound eye opposite upper margin of clypeus (Fig. 00); outer 1/4 of angle of pronotum yellow; pronotal lobe yellow, tegula with yellow spot centrally on anterior 1/2; protibia with outer basal 2/3 yellow, meso- and metatibia with about basal 1/3 yellow; antenna lighter ventrally; apex of mandibles and tarsal claws red, metatibial spurs pale, wing membranes slightly darkened distally, posterior margins of metasomal terga 1–5 and sterna 1–5 hyaline.

**Structure.** (Fig. 56a–b). Scape equal in length to combined length of first 4.5 flagellar segments; diameter of flagellar segments gradually doubling from basal segment to apical segment. Compound eyes about 4.5× longer than wide, with upper 1/3 and lower 2/3 of inner margins converging moderately above and below respectively. Ocellocular distance equal to 2 ocellar diameters; interocellar distance about 2/3 of an ocellar diameter. Antennal sockets a little closer to vertex than to apex of clypeus. Supraclypeus almost flat; frontal line extending to median ocellus. Facial fovea a linear depression extending from the inner angle of the compound eye adjacent to the margin of the compound eye, to the dorsal margin of the compound eye. Clypeus short, extending for 1/6 its length below a line across lower margins of the compound eyes, slightly rounded in lateral view so that lower margin is recurved. Face shiny throughout, moderately tessellated, dorsal 1/2 of clypeus and supraclypeus and paraocular areas with medium-sized punctures nearly obscured by tessellation and separated by about 1 diameter or less; tessellation on dorsal 1/2 of clypeus and supraclypeus in some lights forming fine, longitudinal striae; lower 1/2 of clypeus with larger, irregular partially-obscured punctures; on frons and vertex punc-

tures more defined, medium-sized, separated by 1 diameter or less. Malar space short, about  $7.5\times$  wider than long, very lightly shagreened. Galea shiny, lightly tessellated. In lateral view, gena a little narrower than compound eye, shiny, moderately shagreened.

Pronotum shagreened dorsally, laterally with irregular striae angled backwards at about  $45^\circ$  from the horizontal. Mesothorax moderately tessellated throughout, with tessellation most pronounced on scutum and scutellum, and least on posterior 1/2 of propodeal triangle, except dorsal 1/2 of metepisternum appearing finely sub-horizontally striate; propodeal triangle rather evenly rounded, anterior margin narrowly and finely irregularly striate. Inner metatibial spur very finely ciliate. Stigma  $3\times$  longer than wide. First submarginal cell  $2.5\times$  as long as 2nd.

Metasomal terga 1–6 and sterna 1–6 moderately shagreened. Sternum 1 with median longitudinal slit extending for about 1/3 its length. Metasomal terga 2–3 with post-spiracular glands about size of ocellus; tergum 2 with a small fovea just above and behind spiracle.

**Vestiture.** Very sparse, very short, white, except brown-black around apex of metasoma, and about lateral 3rds of posterior margin of metasomal terga 1–3 with short, appressed apical band of white hairs; inner face of tarsi with very short, off-white vestiture. Posterior margin of metasomal sternum 5 with semi-lunar area of short, dense off-white vestiture.

**Male** ( $n = 12$ ). Length 3.4–4.1 mm ( $3.8 \pm 0.28$  mm); width 0.9–1.2 mm ( $1.1 \pm 0.09$  mm); forewing length 2.1–2.5 mm ( $2.3 \pm 0.14$  mm); facial length 0.9–1.1 mm ( $1.0 \pm 0.07$  mm); facial width 0.7–0.9 mm ( $0.8 \pm 0.06$  mm); malar length/malar width 0.14.

**Coloration.** Black, except clypeus, labrum and mandibles yellow, paraocular areas yellow below an irregularly horizontal line from the clypeus just below its upper margin across to compound eye; remaining yellow areas similar to female except angle of pronotum much less yellow, apex of mesofemur narrowly yellow, basitarsi yellow, metatibial spurs pale yellow; remaining coloration similar to female.

**Structure.** (Fig. 56c–d). Scape equal in length to combined length of about the first 3.7 flagellar segments. Compound eyes  $3\times$  longer than wide, with inner margins similar to female, except lower 2/3 converging more markedly below. Ocellular distance a little more than 2 ocellar diameters; interocellar distance equal to 1 ocellar diameter. Antennal sockets a little closer to vertex than in female. Supraclypeus and frontal line similar to female. Facial fovea similar to but much less obvious than in female. Clypeus extending for about 1/5 its length below a line across lower margins of compound eyes, lower margin recurved similar to female.

Face shiny except frons with heavy, dull tessellation, tessellation partly obscuring medium-sized, close punctures on paraocular areas; between lateral ocelli and compound eyes punctures larger, more widely spaced. Clypeus with very few, medium-sized, widely-spaced punctures. Remainder of head similar to female.

Mesosoma and stigma similar to female. First submarginal cell a little less than twice as long as 2nd.

Metasomal terga 1–6 and sterna 1–6 similar to female except terga 2–3 without post-spiracular glands, sterna almost shiny. Sternum 7 (Fig. 56e) with basal processes long, narrow, anterior apical lobe squared off laterally and fringed with short hairs, posterior apical lobe directed posteriorly, acute apically with long hairs. Sternum 8 (Fig. 56f) with simple process basally, apical process bifid. Gonocoxites in dorsal and ventral views slightly concave laterally (Fig. 56g). Gonostyli moderately pointed apically, straight, penis valves rounded apically, projecting beyond gonostyli; in lateral view (Fig. 56h) penis valve projecting below gonostylus nearly as far as gonostylus is deep.

**Vestiture.** Very short, sparse, white throughout, except brown around apex of metasoma.

**Variation.** The yellow facial maculations of females can range from absent, to the upper limit extending to just above a point on the compound eye opposite the upper margin of the clypeus. The angle of the pronotum of females may be entirely black. Two of 6 females from the Chatham Islands have some yellow coloration in the middle lower central area of the clypeus. On 4 of 7 male heads available at later inspection, the lateral margin of the clypeus above the anterior tentorial pit is black, and 5 of the 8 male pronotums available have black pronotal angles.

**Type data.** *Euryglossa asperithorax*: holotype female, "Sandringham, Port Phillip, Victoria, Australia", 23 February 1927, on flowers of *Goodenia ovata*, and *Olearia ramulosa*, T. Rayment (USNM).

**Material examined.** 44 females and 18 males, although 6 males lacked the head and/or metasoma.

**Distribution** (New Zealand Map 20). North Island: ND, AK, CL, TO, WI, WN. South Island, MC, MK, SC, OL, DN, SL. Offshore Islands: Three Kings Islands (Great Island), and the Chatham Islands.

For the North Island, bees have been taken on Lady Alice Island, Chicken Group ND, and Somes Island WN. There are 5 altitude records, ranging from 0.5 m to 1000 m. Collection dates for the 37 collections range from 5 November to 26 February.

**Biology.** At Whatipu AK and at 19 km S Palmerston DN, 2 and 1 females respectively were taken by sweeping marshy swards and a salt marsh. On Pitt Island, Chatham



Islands, 1 female was captured in a Malaise trap at the edge of a bush remnant, another was taken by sweeping fern at the forest edge, and 6 females were taken at the Chatham Islands in a pan trap in a rush area. At Colac Bay SL, 1 male was taken on 25 January 1972 under driftwood at the top of the beach, by P. M. Johns.

**Flight period.** For 44 females, the 23 collection dates extend from 16 November to 26 February, and for 18 males, the 14 collection dates range from 5 November to 25 January. Peak flight for females was in December and January, while males were most abundant during November.

#### Number of collections

	Nov	Dec	Jan	Feb
Females	5	7	7	4
Males	6	4	4	

The species has been nowhere abundant, with 2 collections of 6 females, 1 from Birdlings Flat MC on *Selliera radicans* on 18 December 1974 by R. P. Macfarlane, and the other from the Chatham Islands in a pan trap in a rush area on 22 January 1980 by R. Rowe. There has been 1 collection each of 5, 4 and 3, 2 of 2, and the remainder of 1 each. For males, the collections have been 1 of 3, 2 of 2, and the remainder of 1 each.

#### Host plants

##### Native plants

Aizoaceae			
<i>Disphyma</i> sp.	♀ 1/1	—	
Campanulaceae			
<i>Wahlenbergia pygmaea</i>	♀ 1/3	—	
Goodeniaceae			
<i>Selliera radicans</i>	♀ 2/7	♂ 1/2	
Phrymaceae			
<i>Mimulus</i> sp.	♀ 1/1	—	
Plantaginaceae			
<i>Hebe</i> sp.	♀ 1/1	—	
<b>Total collections/specimens</b>	♀ 6/13	♂ 1/2	
<b>Species/genera/families</b>	5/5/5	1/1/1	

##### Introduced plants

Asteraceae			
<i>Taraxacum officinale</i>	♀ 1/1	—	
Lobeliaceae			
<i>Lobelia</i> sp.	♀ 1/1	—	
Malvaceae			
<i>Hibiscus trionum</i>	—	♂ 1/1	
<b>Total collections/specimens</b>	♀ 2/2	♂ 1/1	
<b>Species/genera/families</b>	2/2/2	1/1/1	

In addition, 1 male was taken from a yellow-centred, white composite, in a domestic garden.

**Nest sites.** Nests have not been reported. A female was captured over pumice/tuff on 15 February 1990 at Piriaka TO, a male on a north-facing vertical clay bank on 5 November 1997 at Karori Cemetery Wellington WN, and a

female over clay on 1 Jan 1990 at 1000 m on Ben Lomond, Queenstown OL, all by A. C. Harris. However, as with other *Hylaeus*, nests are most likely constructed in hollow plant material. Interestingly, the description of the species by Rayment (1927), was entitled 'A new Australian cliff-bee'.

**Associated organisms.** None are known.

**Remarks.** The first specimen taken in New Zealand was a female from Mt Cook MK on 4 January 1929 by A. Philpott. A female collected by sweeping a salt marsh 19 km S of Palmerston DN on 19 February 1976 by L. L. Deitz, and a male taken pollinating *Hibiscus trionum* on Lady Alice Is., the Chicken Group ND on 4 January 1982 by R. E. Beever, were identified by T. F. Houston of the Western Australian Museum, Perth, as *Hylaeus (Prosopisteron) asperithorax* (Rayment). According to Cardale (1993), the species is distributed over SE coastal New South Wales and Victoria, Australia, and the only published localities are Woy Woy and Sandringham. T. F. Houston (pers. comm. 24 June 1998) said that it inhabits eastern Australia from SE Queensland to Tasmania.

Although the numbers of the species in New Zealand appear low in comparison with several other species of *Hylaeus*, the wide distribution, which includes the Three Kings Islands and the Chicken Islands ND, Somes Island WN, and the Chatham Islands, suggests that it probably occurs throughout the country wherever conditions are suitable.

This is *Hylaeus* sp. 2 of Quinn (1984: 44) (similar to *H. capitosus*, flight period, flower records).

#### *Hylaeus (Prosopisteron) capitosus* (Smith)

Fig. 15c–f, 57a–h; Map 21

*Prosopis capitosus* Smith, 1876: 485 (description of female). Hutton, 1881: 100 (repeats description of Smith 1876). Kirby, 1881: 37 (list). —1884: 67 (as *capitorus*, list). Dalla Torre, 1896: 17 (as *capitosa*, list, Australia, New Zealand). Cameron, 1903: 298 (list). Hutton, 1904: 96 (list). Cockerell, 1909: 313 (as *capitosa*, key). —1916b: 361 (as *capitosa*, list). Meyer, 1931: 249 (as *capitosa*, key), 252 (as *capitosa*, description, collection records). Paintin & Murdoch, 1964: 37 (is the most common species of this family in New Zealand).

*Prosopis innocens* Cameron, 1898: 52–53 (description of male). —1903: 299 (list). Hutton, 1904: 96 (list). Cockerell, 1909: 313 (key). —1916b: 361 (list). Meyer, 1931: 249 (synonymous with *P. capitosus*).

*Hylaeus capitosus*: Meade-Waldo, 1923: 27 (new combination, list). Cockerell, 1925: 553 (described by Smith from specimens taken by C. M. Wakefield in Canterbury province, South Island). Heine, 1937: 139, 144, 145, 146 (flower records). Donovan, 1980: 106 (photograph of prepupae in cells in plant stems. Lake Tekapo, 25 No-

vember 1977, collected by P. Quinn). Donovan & Macfarlane, 1984: 249 (photograph of nests in plant stems). Quinn, 1984: 44 (has wasp-like appearance, flight period, flower visiting records, nests found in hollow stems).

*Hylaeus innocens*: Meade-Waldo, 1923: 28 (new combination, list).

*Hylaeus (Prosopis) capitosus*: Tillyard, 1926: 303 (new combination, is one of the commonest species, drawing of female).

*Hylaeus (Prosopisteron) capitosus*: Michener, 1965: 123 (new combination). Valentine & Walker, 1991: 42 (list).

*Hylaeus (Prosopisteron) innocens*: Michener, 1965: 123 (new combination). Valentine & Walker, 1991: 42 (list).

**Female** (n = 20). Length 4.9–8.0 mm ( $7.0 \pm 0.79$  mm); width 1.3–2.0 mm ( $1.7 \pm 0.18$  mm); forewing length 3.6–5.1 mm ( $4.5 \pm 0.37$  mm); facial length 1.1–1.7 mm ( $1.5 \pm 0.14$  mm); facial width 0.9–1.4 mm ( $1.2 \pm 0.12$  mm); malar length/malar width 0.17.

**Coloration.** Black, except antennae yellow ventrally beyond pedicel, paraocular areas with yellow, irregular semi-lunar maculae between clypeus and lower end of compound eye, lateral 3rds of pronotal angle, and pronotal lobes yellow, metatibial spurs pale, wing membranes somewhat darkened, apical margins of metasomal terga and sterna hyaline.

**Structure.** (Fig. 57a–b). Head somewhat quadrate in frontal view. Scape about as long as combined length of first 4.3 flagellar segments. Compound eyes about 4× longer than wide, inner margins sub-parallel, lower 2/3 converging a little more than upper 1/3. Ocellular distance equal to 2.75 ocellar diameters; interocellar distance equal to 1 ocellar diameter. Antennal sockets equidistant between apex of clypeus and vertex. Supraclypeus rising only slightly from below and laterally to a rounded mound between antennal sockets, moderately tessellated, with medium-sized punctures separated by about 1–2 diameters, in some lights appearing finely longitudinally striate, dull; frontal line represented by obscure linear depression from apex of supraclypeus to frons. Remainder of face sculptured similarly to supraclypeus, except without striate appearance, frons more densely tessellated, punctures close on vertex. Facial foveae short, terminating just above compound eye. Clypeus flat, extending for 0.25× its length below a line across lower ends of compound eyes, broadly and shallowly emarginate apically. Malar space short, nearly 6× wider than long, lightly tessellated. Galea lightly tessellated, shiny. In lateral view, gena 1.6× wider than compound eye, sculptured similarly to clypeus except tessellation lighter, punctures a little smaller.

Pronotum lightly tessellated dorsally, laterally with irregular angular ridges running somewhat dorsoventrally. Remainder of mesosoma sculptured similarly to clypeus,

except central 1/2 of metanotum and propodeal triangle impunctate, metepisternum with punctures obscure. Propodeal triangle in lateral view evenly rounded. Inner hind tibial spur very finely ciliate. Pterostigma 3× longer than wide; first submarginal cell 2.5× longer than 2nd submarginal cell.

Metasomal terga 1–5 and sterna 1–5 shagreened, sterna with a few large, irregular punctures; sternum 1 with apical longitudinal slit extending for about 1/3 length of sternum. Tergum 2 with circular fovea, up to about size of ocellus, lying posterodorsal to spiracle; terga 2–3 with post-spiracular glands, smaller than tergal fovea.

**Vestiture.** Short, sparse, white throughout, except brown-black around apex of metasoma; most dense on posterolateral face of propodeum; inner face of tarsi with very short, dense vestiture.

**Male.** (n = 20). Length 3.9–6.7 mm ( $5.4 \pm 0.73$  mm); width 1.0–1.7 mm ( $1.2 \pm 0.19$  mm); forewing length 3.1–4.3 mm ( $3.6 \pm 0.38$  mm); facial length 1.0–1.5 mm ( $1.2 \pm 0.12$  mm); facial width 0.8–1.2 mm ( $1.0 \pm 0.10$  mm); malar length/malar width 0.12.

**Coloration.** Black, except for clypeus yellow apart from irregular margins above tentorial pits and lower margin black; lower paraocular areas yellow below a line from compound eye about opposite lower margin of antennal sockets, to clypeal margin about halfway between upper margin of clypeus and tentorial pit; mandibles with broad central area of outer face yellow (Fig. 00 and 00); antennae dull yellow ventrally beyond about distal 1/2 of first flagellar segment; inner face of protibiae yellow; remaining areas similar to female.

**Structure.** (Fig. 57c–d). Scape equal in length to combined length of first 3 flagellar segments. Compound eyes 3× longer than wide, with upper 1/6 of inner margins converging slightly above, remainder of inner margins except for about lowest 1/6 converging strongly below. Ocellular distance 2× an ocellar diameter; interocellar distance a little less than 1 ocellar diameter. Antennal sockets 1.9× further from apex of clypeus than from vertex. Supraclypeus similar to female but rising somewhat more between antennal sockets, punctures sparse, tessellation appearing more obviously longitudinally striate than in female; frontal line as in female. Frons densely tessellated with medium-sized, close punctures; tessellation less pronounced, punctures becoming more obvious on vertex and between ocelli and compound eye. Lower 1/2 of clypeus somewhat protuberant, extending for about 1/5 its length below a line across lower margins of compound eyes, lower margin as in female; clypeus and paraocular area moderately tessellated, clypeus with medium-sized punctures separated by 1–3 diameters, paraocular areas with medium-sized punctures separated

by 2–4 diameters. Malar space short, a little more than 8× wider than long, very lightly tessellated, with 1–3 small punctures. Galea almost smooth, shiny. In lateral view, compound eye a little wider than gena; gena lightly tessellated with shallow, medium-sized punctures separated by about 2–4 diameters.

Mesosoma similar to female, except propodeal triangle with a basal band about 0.75× as wide as metanotum of longitudinal, fine, irregular striae. Stigma 3.6× longer than wide. Submarginal cells similar to female.

Metasomal terga 1–5 and sterna 1–5 similar to female, except terga 2 and 3 without post-spiracular glands. Sternum 7 with basal processes long, narrow, slightly expanded apically, anterior apical lobes narrowing apically, posterior apical lobes with small patch of medium-length hairs on ventral surface (Fig. 57e). Sternum 8 with basal and apical processes simple (Fig. 57f). Gonocoxites and gonostyli in dorsal and ventral views rounded and incurved apically, dorsally with median angle running to apex, with long hairs projecting from inner, apical and lateral faces, penis valves appearing bilobed apically (Fig. 57g); in lateral view (Fig. 57h) penis valve large, projecting well beyond and below gonostylus, acute apically.

**Vestiture.** Similar to female.

**Variation.** The yellow paraoxular maculae of females can range in size from less than that illustrated (Fig. 00) to in a few specimens about as large as that of a typical *H. relegatus* female. In both sexes, pronotal angles and lobes can be yellow or black, and both can be black. The labrum of 1 male from Paiaka ND, 1 from Timaru SC, and 13 from Tekapo MK, is at least partly yellow. In addition, the scapes of 3 of these 13 males from Tekapo MK are partly yellow. The clypeus and supra-clypeus of 1 male from Gorge Road, Southland SL are roughened, and the scutum is partly roughened.

**Type data.** *Prosopis capitosus*: holotype female, “Canterbury, New Zealand”, C. M. Wakefield (BMNH). *Prosopis innocens*: holotype male, “Greymouth, New Zealand”, R Helms (BMNH) (no date given).

**Material examined.** Type specimens, plus 208 females and 219 males.

For the 195 collections there are 23 altitude records, which range from 100–1372 m. However, it is clear that bees have been captured from just above sea level. Collection dates range from 11 November to 20 March.

**Distribution** (Map 21). North Island: ND, AK, CL, TK, TO, GB, WI, WN. South Island SD, NN, BR, MB, KA, WD, NC, MC, MK, SC, OL, CO, DN, SL. Stewart Island.

**Biology.** The capture of specimens from the extreme north of ND (Spirits Bay), through much of the North Island, almost all the South Island and Stewart Island to Big South

Cape Island, strongly suggests that this species is probably present throughout the country. The ability to occur at substantial altitudes suggests that the species may be present throughout vegetated areas. There are just 2 records of time of capture during daylight hours: 3 females were captured at 6 pm on 25 December 1969 on *Kunzea ericoides* at Conway Flat KA by R. P. Macfarlane, and on 28 December with otherwise the same collection data, 4 females were taken at 7 am. One male was taken at night by sweeping rushes on the Poor Knights Islands, Tawhiti Rahi Island ND, on 8 December 1980, by C. F. Butcher. This record suggests that some males may spend the night away from nests.

**Flight period.** For 208 females the first seasonal capture record is 22 November, and the last is 20 March, with 33.9%, 31.3%, and 27.8% of the 115 capture records occurring in December, January and February respectively. The 219 males have been taken from 11 November to 3 March, with 51.2% and 30.0% of the 80 capture records occurring in December and January respectively.

#### Number of collections

	Nov	Dec	Jan	Feb	Mar
Females	4	39	36	32	4
Males	9	41	24	5	1

The largest collection of females is 8, which was taken in a Malaise trap at Mount Cook National Park MK on 24 February 1977, by W. J. Sweney. For males, 8 were taken 8 km S Rata WI on 22 December 1977 from *Leptospermum scoparium*, by B. J. Donovan. The largest swept collections of females are 2 of 6 from 17.6 km N Cromwell CO on 20 December 1969 from *Medicago sativa*, by B. J. Donovan, and at Tekapo Power Station MK on 22 January 1977 from *Achillea millefolium*, by P. Quinn. Also, 22 males emerged in the laboratory from nests collected at Tekapo MK on 11 October 1989 by P. Quinn.

#### Host plants

##### Native plants

Asteraceae		
<i>Olearia virgata</i>	—	♂ 1/1
<i>Ozothamnus</i> sp.	—	♂ 1/1
Fabaceae		
<i>Carmichaelia</i> sp.	—	♂ 2/3
Hemerocallidaceae		
<i>Phormium tenax</i>	♀ 3/8	♂ 6/14
Myrtaceae		
<i>Kunzea ericoides</i>	♀ 4/10	♂ 3/8
<i>Leptospermum scoparium</i>	♀ 4/7	♂ 6/20
<i>Metrosideros</i> sp.	—	♂ 1/1
Plantaginaceae		
<i>Hebe bollonsii</i>	—	♂ 1/3
<i>Hebe brachysiphon</i>	—	♂ 1/5
<i>Hebe divaricata</i>	♀ 1/4	♂ 1/1
<i>Hebe elliptica</i>	—	♂ 1/1

<i>Hebe salicifolia</i>	♀ 1/3	♂ 1/1
<i>Hebe speciosa</i>	♀ 1/1	—
<i>Hebe traversii</i>	♀ 1/1	♂ 1/1
<i>Hebe</i> sp.	♀ 4/4	♂ 3/7
Polygonaceae		
<i>Muehlenbeckia</i> sp.	—	♂ 1/1
<b>Total collections/specimens</b>	♀ 19/38	♂ 30/68
<b>Species/genera/families</b>	8/4/3	15/9/6
<b>Introduced plants</b>		
Actinidiaceae		
<i>Actinidia deliciosa</i> female	♀ 1/1	—
Apiaceae		
<i>Daucus carota</i>	♀ 1/1	—
<i>Pastinaca sativa</i>	♀ 1/3	♂ 2/2
Asteraceae		
<i>Achillea millefolium</i>	♀ 7/20	♂ 3/11
<i>Cirsium arvense</i>	♀ 1/1	—
<i>Taraxacum officinale</i>	—	♂ 1/1
'thistle'	♀ 1/1	—
Boraginaceae		
<i>Echium vulgare</i>	♀ 1/1	—
Brassicaceae		
'mustard'	♀ 1/1	—
Caryophyllaceae		
<i>Cerastium</i> sp.	♀ 1/2	—
Fabaceae		
<i>Lupinus</i> sp.	♀ 1/1	♂ 2/2
<i>Medicago sativa</i>	♀ 2/2	♂ 1/6
<i>Trifolium repens</i>	♀ 1/1	—
Hypericaceae		
<i>Hypericum</i> sp.	♀ 1/1	—
Plantaginaceae		
<i>Linaria purpurea</i>	♀ 2/5	♂ 1/1
Ranunculaceae		
<i>Ranunculus</i> sp.	—	♂ 1/4
Rosaceae		
<i>Potentilla recta</i>	—	♂ 1/1
<i>Rosa rubiginosa</i>	♀ 1/2	♂ 1/2
<i>Rosa</i> sp.	♀ 1/1	—
<b>Total collections/specimens</b>	♀ 24/44	♂ 13/30
<b>Species/genera/families</b>	16/15/10	9/9/6

In addition, Heine (1937) recorded bees from *Olearia lacunosa* (Asteraceae), *Gentiana patula* (Gentianaceae), *Metrosideros robusta*, and *M. excelsa* (as *M. tomentosa*) (Myrtaceae), and *Hebe speciosa* (Plantaginaceae).

The records of Quinn (1984) are included above, apart from his observation of bees visiting *Lupinus polyphyllus* (Fabaceae).

The bees visiting lucerne, *Medicago sativa*, were not seen to trip florets. They appeared to be feeding on pollen and perhaps nectar in florets that were already tripped. From white clover, *Trifolium repens*, bees appeared to be taking only nectar.

Female bees have been taken upon double the number of species of introduced plants compared to natives,

whereas for males the situation is almost reversed.

**Nest sites.** There is 1 record of pupae and/or adult bees from nests in stems of native flax (Hemerocallidaceae), and the introduced *Watsonia* sp. (Iridaceae), blackberry (Rosaceae), and 2 records from raspberry canes (Rosaceae). Quinn (1984) in the Mackenzie Basin MK found nests in the hollow stems of the previous summer's *Linaria purpurea* (purple Linaria) and *Lupinus polyphyllus* (Russell's lupin). Nests in these stems consisted of a series of cells within the pith cavity. Of 12 nests collected during 1977, the greatest depth that showed evidence of bee activity was 260 mm. Cells were frequently separated by gaps of 20–30 mm, with the largest gap measuring 70 mm. Wads of chewed pith up to as long as a cell often lay just towards the nest entrance from cells. Of the 12 nests, 4 contained 3, 5, 5, and 7 live prepupae respectively when examined on 21 November 1977. The remaining 8 nests contained cell, pollen and bee remnants that appeared to date from previous years. The external diameter of stems ranged from about 4–6 mm, and in a nest collected in 1988, 8 contiguous cells were from 2.8–3.5 mm wide, and 5.1–6.6 mm long. Where the stem was 5 mm wide a cell was 3 mm wide and 6.3 mm long. Access to the interior of stems was by a hole in the side of the stem, or from a point where the stem had been broken off. Cells consisted of a cavity lined with cellophane-like material. Pollen and nectar deposited in the base of cells by mother bees is consumed by 1 larva, which then defaecates, usually against the rear wall of the cell. For the nest that contained a series of 8 contiguous cells, on 24 December 1978 the bottom 2 cells contained female pupae, the next 4 contained male pupae, and the outer 2 contained new adult males.

**Associated organisms.** *Melittobia* sp. (Hymenoptera: Eulophidae) adults were present in one of the 12 nests from Tekapo MK, but no other data are available. One female from Dun Mountain NN, carries 10 small mites on the meso- and metasoma, and 1 female from West Plains SL has 1 small mite on the head.

**Remarks.** This species is clearly very successful, in that it occurs throughout most of the country, including at least 4 offshore islands. Its wide range over a variety of habitats suggests that it will be found to occur in those areas where it has not been captured. Its flower-foraging habits, which range across a diversity of both native and introduced species, suggest that forage sources are probably not a major limiting factor for population size. Rather, the small number of bees that appear to occur in any one locality is more likely to be the result of a limitation on naturally-occurring nest sites.

***Hylaues (Prosopisteron) kermadecensis* new species**

Fig. 16a–d, 58a–h; Map 22

**Female** (n = 12). Length 4.4–5.9 mm ( $5.0 \pm 0.47$  mm); width 1.3–1.6 mm ( $1.5 \pm 0.08$  mm); forewing length 3.1–3.5 mm ( $3.2 \pm 0.16$  mm); facial length 1.1–1.3 mm ( $1.2 \pm 0.04$  mm); facial width 0.9–1.1 mm ( $1.0 \pm 0.05$  mm); malar length/malar width 0.18.

**Coloration.** Black, except antennae dull yellow ventrally, apices of mandibles and tarsal claws dark red to brown, inner face of protibia dull yellow, metatibial spurs pale, wing membranes hyaline, pterostigma and wing veins brown, apical margins of metasomal terga 1–5 and sterna 1–5 hyaline.

**Structure.** (Fig. 58a–b). Scape as long as combined length of first 4.5 flagellar segments. Compound eyes about 5× longer than wide, with about upper 1/3 and lower 2/3 of inner margins converging moderately above and below respectively. Ocellular distance a little more than 2 ocellar diameters; interocellar distance about equal to 1 ocellar diameter. Antennal sockets 1.25× further from apex of clypeus than from vertex. Supraclypeus almost flat between antennal sockets; frontal line reaching median ocellus. Facial fovea a prominent linear depression extending from inner angle of compound eye adjacent to the margin of the compound eye, to opposite upper margin of eye. Clypeus extending for one quarter its length below a line across lower margins of compound eyes, upper 2/3 flat, lower 1/3 recurved. Face dull, frons densely tessellated, remainder of face moderately tessellated, with tessellation partly obscuring medium-sized punctures separated by about 1–2 diameters, except punctures large on about lower quarter of clypeus. Malar space short, about 5.5× wider than long, lightly tessellated. Galea lightly tessellated. In lateral view, compound eye about 1.3× as wide as gena; gena moderately tessellated, with indistinct, almost obscured punctures.

Pronotum moderately shagreened dorsally, laterally densely tessellated with sub-horizontal striae throughout. Scutum, scutellum and metanotum moderately to densely tessellated, with indistinct, almost obscured small punctures on scutum and scutellum. Propodeal triangle roundly angled, with posterior face somewhat less than at right angles to anterior face, the 2 faces about equal in length, moderately shagreened, anterior edge of anterior face narrowly roughened. Lateral areas of propodeum and metepisternum moderately tessellated/shagreened. Remaining lateral areas of mesosoma lightly to moderately tessellated. Inner metatibial spur finely ciliate. Stigma 3.5× longer than wide. First submarginal cell nearly 1.8× longer than 2nd.

Metasomal terga 1–6 and sterna 1–6 lightly shagreened; terga 4 and 5 laterally with very small punctures separated by 4–5 diameters. Sternum 1 with apical longitudinal median

slit, extending for about 1/3 its length. Metasomal terga 2 and 3 without post-spiracular glands; tergum 2 with a small spiracular fovea.

**Vestiture.** Short, sparse, white to off-white throughout, except brown-black on vertex and around apex of abdomen; apical 1/2 of sternum 5 with half-moon of dense, short, golden vestiture; inner face of tarsi with very short, dense, off-white vestiture.

**Male** (n = 14). Length 4.1–5.6 mm ( $4.7 \pm 0.44$  mm); width 1.1–1.5 mm ( $1.3 \pm 0.13$  mm); forewing length 2.6–3.3 mm ( $2.9 \pm 0.23$  mm); facial length 1.0–1.2 mm ( $1.1 \pm 0.08$  mm); facial width 0.8–1.0 mm ( $0.9 \pm 0.07$  mm); malar length/malar width 0.17.

**Coloration.** Black, except clypeus yellow apart from small, somewhat linear vertical areas laterally, and narrow lower margin; paraocular areas yellow below about upper limit of clypeus; mandible with band of yellow along most of anterior 1/2; remainder similar to female.

**Structure.** (Fig. 58c–d). Scape a little shorter than combined length of first 4 flagellar segments. Compound eyes 4× longer than wide, with inner margins similar to female. Ocellular distance a little less than 2 ocellar diameters, interocellar distance about 2/3 an ocellar diameter. Antennal sockets 1.35× further from apex of clypeus than from vertex. Supraclypeus similar to female; frontal line reaching about halfway to median ocellus. Facial fovea similar to female but less well defined. Clypeus protuberant between lower margins of compound eyes, with lower margin recurved, length as in female. Sculpturing of face similar to female, except punctures on clypeus a little larger. Malar space short, about 6× wider than long, very lightly tessellated. Galea very lightly tessellated, shiny. In lateral view, compound eye about 1.3× as wide as gena; genal sculpturing similar to female.

Mesosoma very similar to female, except anterior face of propodeal triangle with irregular, more or less longitudinal striae extending posteriorly from anterior edge over most of surface. Stigma and submarginal cells similar to female.

Metasomal terga 1–6 and sterna 1–6 similar to female, except punctures on terga 4–5 slightly larger; sternum 1 with apical longitudinal median split extending for 1/6 length of sternum. Sternum 7 (Fig. 58e) with basal processes narrow, anterior apical lobes quadrate laterally, fringed laterally with very short hairs, large posterior apical lobes rounded laterally. Sternum 8 (Fig. 58f) with anterior process long, acute, posterior process broadly bifid. Gonocoxites in dorsal and ventral views (Fig. 58g) stout, gonostyli acute apically, with dense long hairs projecting posteriorly, primarily from ventral aspect, penis valves broad apically; in lateral view (Fig. 58h) penis valve large, projecting beyond and well below gonostylus.

**Vestiture.** Similar to female except not as dark on vertex and around apex of abdomen, and metasomal sternum 5 without half-moon-shaped character.

**Variation.** The labrum and much of the outer face of 1 male from Raoul Island are yellow. Three males from South Meyer Island show very faint paired protuberances on metasomal sterna 2–3.

**Type data.** *Hylaeus kermadecensis*: holotype female, here designated, “Fishing Rock, Raoul Island, Kermadec Islands, 5 m, sweeping”, 16 September 1962, *Scaevola gracilis*, G. A. Samuelson (Bishop Museum). Allotype male, here designated, same data as holotype. One paratype female and 2 paratype males, here designated, same data as holotype. (Fishing Rock is the main boat landing site on Raoul Island).

**Material examined.** Type specimens, plus 10 females and 11 males, from Meyer Island (4 females), South Meyer Island (2 females and 6 males), and Raoul Island (4 females and 5 males).

There are 2 altitude records, of 5 m at Fishing Rock, Raoul Island, and 100 m summit of South Meyer Island. Collection dates for the 10 collections range from 16 September to 27 December.

**Distribution** (Map 22). Kermadec Islands.

**Biology.** The species is confined to the Kermadec Islands.

**Flight period.** The first seasonal collection date for both sexes is 16 September, and the last for females is 27 December, and for males, 13 December.

	Number of collections			
	Sep	Oct	Nov	Dec
Females	1	2		2
Males	1	1	1	2

There have been 2 collections of 7 bees, 6 females and 1 male on S. Meyer Island, Kermadec Islands, on *Ageratum* and grasses on the summit at 100 m on 15 October 1962 by G. A. Samuelson, and 3 females and 4 males on Raoul Island, Kermadec Islands, on a low flat at annobiid tunnels and trunk of *Myrsine kermadecensis* on 11 December 1966 by J. C. Watt.

	Host plants	
<b>Native plants</b>		
Goodeniaceae		
<i>Scaevola gracilis</i>	♀ 1/2	♂ 1/3
<b>Introduced plants</b>		
Asteraceae		
<i>Ageratum houstonianum</i>	♀ 2/5	♂ 1/6

One other male was swept from roadside weeds.

**Nest sites.** Four females and 4 males were captured at annobiid tunnels (Coleoptera: Anobiidae) and trunk of the native *Myrsine kermadecensis* (Myrsinaceae).

**Associated organisms.** None are known.

**Etymology.** *kermadecensis*: present on the Kermadec Islands.

**Remarks.** This species is the only bee known from the Kermadec Islands. Females are readily distinguished by the pronotum all black, compared to the black-faced females of *H. relegatus* from the Three Kings Islands with their yellow outer angles of the pronotum and yellow pronotal lobes. The linear vertical areas of the clypeus of males separates them from males of all other species. The presence of slightly-developed paired ventral metasomal protuberances on some males allies this species with *H. matamoko*, *H. murihiku*, *H. perhumilis* and *H. relegatus* which can display a similar character.

### *Hylaeus (Prosopisteron) matamoko* new species

Fig. 16e–f, 17a–b, 59a–h; Map 23

**Female** (n = 18). Length 4.6–6.1 mm (5.3 ± 0.53 mm); width 1.3–1.9 mm (1.5 ± 0.17 mm); forewing length 2.8–3.9 mm (3.4 ± 0.34 mm); facial length 1.1–1.4 mm (1.3 ± 0.11 mm); facial width 0.8–1.1 mm (1.0 ± 0.08 mm); malar length/malar width 0.33.

**Coloration.** Black, except for narrow yellow band on paraocular area adjacent to compound eye, extending from opposite antennal sockets to bottom of compound eye (Fig. 00; antennae light yellow ventrally beyond mid-point of first flagellar segment; apex of mandibles and tarsal claws dark red; wing membranes clear, wing veins pale, metatibial spurs pale, tegula and stigma light brown; posterior margins of terga 1–5 hyaline, that of terga 1–4 widely hyaline medially to about 1/3 of dorsal area, posterior margins of sterna 1–5 hyaline.

**Structure.** (Fig. 59a–b). Scape as long as combined length of about first 4.3 flagellar segments. Compound eyes nearly 5.2× as long as wide, with about upper 1/3 and lower 2/3 of inner margins converging slightly above and below respectively. Ocellocular distance equal to 4.3× an ocellar diameter; interocellar distance a little greater than 1 ocellar diameter. Antennal sockets 1.3× closer to apex of clypeus than to vertex. Supraclypeus nearly flat, at most only very slightly raised; frontal line a narrow depression extending from a point between antennal sockets to about 2/3 distance to median ocellus. Facial fovea a pronounced groove extending from opposite widest point between inner margins of compound eyes to level with upper margin of compound eye. In frontal and lateral view face rather flat from median ocellus to line across lower margins of compound eyes; below this clypeus at first slightly protuberant then strongly recurved; clypeus extending for 0.4× its length below a line across lower margins of compound eyes. Face dull, moderately tessellated throughout, upper central area

of clypeus with few, widely-spaced, small indistinct punctures, central area of clypeus almost impunctate; remainder of face with medium-sized to large indistinct punctures separated by about 1–2 diameters. Malar space moderately long, about 3× wider than long, lightly tessellated and appearing finely longitudinally striate. In lateral view, gena 1.3× as wide as compound eye; gena moderately tessellated with obscure, medium-sized punctures separated by 2–4 diameters.

Pronotum shiny, lightly tessellated, pronotal angles prominent, lateroposterior face with sub-horizontal striae. Scutum, scutellum and metanotum densely tessellated, scutum with very obscure small punctures separated by about 2–4 diameters, scutellum with a few widely-spaced, very obscure punctures. Remainder of mesosoma more lightly tessellated; propodeal triangle with posterior surface at about 70° to dorsal surface, angle rounded, anterior margin of dorsal surface widely, finely and irregularly longitudinally striate. Lateral areas of propodeum, and metepisternum, and mesepisternum below scrobal groove, with obscure, medium-sized punctures separated by about 1–4 diameters. Inner metatibial spur very finely ciliate. Stigma 4× longer than wide. First submarginal cell about 2.5× as long as 2nd.

Metasomal terga 1–5 and sterna 1–5 moderately shagreened; tergum 2 with fovea and post-spiracular gland not visible.

**Vestiture.** Sparse, short, white throughout, except dense, very short on inner face of basitarsi.

**Male** (n = 3). Length 4.5–4.9 mm ( $4.7 \pm 0.23$ ); width 1.2–1.3 mm ( $1.2 \pm 0.04$  mm); forewing length 2.6–2.8 mm ( $2.7 \pm 0.11$  mm); facial length 1.1–1.1 mm ( $1.1 \pm 0.02$  mm); facial width 0.8–0.9 mm ( $0.9 \pm 0.03$  mm); malar length/malar width 0.12.

**Coloration.** Black, except clypeus yellow except for lower margin, and small, central, irregular grey spot on the 2 paratypes; paraocular areas yellow below an irregular line from about halfway between upper margin of clypeus and antennal socket, to point where inner margins of compound eyes are furthest apart; mandibles patchily dull yellow except for apex red; antennae light yellow ventrally beyond pedicel; apex of femur of pro- meso- and metalegs narrowly yellow, outer face of protibia broadly yellow, outer face of base of meso- and metatibia narrowly yellow; metatibial spurs pale, tarsal claws dark red, pterostigma and wing veins brown, wing membranes hyaline, metasomal terga 1–5 and sterna 1–5 with apical margins hyaline.

**Structure.** (Fig. 59c–d). Scape about as long as combined length of first 4.5 flagellar segments. Compound eyes 4× longer than wide, with upper 1/3 of inner margins only slightly incurved above, lower 2/3 converging strongly below. Ocellular distance 2.5× an ocellar diameter;

interocellar distance equal to 1 ocellar diameter. Facial fovea an ill-defined linear depression adjacent to upper inner margin of compound eye. Antennal sockets 1.4× closer to apex of clypeus than to vertex. Supraclypeus flat, with frontal line visible between antennal sockets but scarcely reaching frons. Clypeus flat except for recurved lower margin, extending for 1/6 its length below a line across lower margin of compound eyes. Face dull, moderately tessellated below antennal sockets, more densely tessellated above. Supraclypeus and lower margin of clypeus with very few, indistinct, large punctures. Malar space short, about 8× wider than long, lightly shagreened. Galea very lightly tessellated, shiny. In lateral view, gena and compound eye about equal in width, moderately tessellated.

Mesosoma moderately tessellated throughout. Scutum and scutellum with very obscure, medium-sized punctures separated by 2–5 diameters. Propodeal triangle with anterior and posterior faces about equal in length, moderately angled, angle rounded; about anterior 1/3 of anterior face with more or less longitudinal, irregular striae. Metepisternum and mesepisternum with obscure, large punctures separated by 1–2 diameters. Pterostigma 3× longer than wide; first submarginal cell about twice length of 2nd. Inner hind tibial spur finely ciliate.

Metasomal terga 1–5 lightly tessellated, dull, with scattered, obscure small punctures. Sterna 1–5 shiny, sterna 2–6 with paired lateral protuberances, those on sterna 3–5 very large, smooth and shiny, remainder of sterna very lightly tessellated; sternum 1 with apical median longitudinal slit extending for about 1/5 its length. Sternum 7 (Fig. 59e) with basal processes narrow apically, anterior apical lobes pointed anteriorly, posterior apical lobes extending laterally with few hairs on posterolateral edge. Sternum 8 (Fig. 59f) with basal process short, acute, apical process short, wide, very widely bifid apically. Gonocoxites in dorsal and ventral views (Fig. 59g) with lateral margin rounded, gonostyli slightly incurved apically, penis valves expanded laterally to an acute point; in lateral view (Fig. 59h) penis valve projecting beyond and well below gonostylus.

**Vestiture.** Short, sparse, white throughout.

**Variation.** The length and width of the yellow paraocular maculae of females can vary so that in some the length is about 2/3 of the longest, and the width about 1/2 that of the widest.

**Type data.** *Hylaeus matamoko*: holotype female, here designated, “Obelisk Range CO” 1400 m, 4–11 January 1991, A. C. Harris (OMNZ). Allotype male, same data as holotype. Four paratype females, “Rough Creek, Obelisk Range CO”, 1260 m, 29 January 1997, S. J. Morris (CMNZ). One paratype male, “Craigieburn Ski Club, Craigieburn Range MC”, above tree-line in tussock and

Scree, 6 February 1977, *Epilobium* sp., R. B. Primack (NZAC). One paratype male, "Kidd's Bush OL", till, under *Nothofagus* tree, 15 January 1991, A. C. Harris (OMNZ).

**Material examined.** Type specimens, plus 13 females. The species has been taken only in the mountainous areas of the South Island.

There are 10 altitude records, which range from 550–1950 m. Bees have been captured from 22 December to 6 February.

**Distribution** (Map 23). South Island: WD, MC, FD, OL, CO.

**Biology. Flight period.** The 11 collection records for females range from 22 December to 1–6 February, with more than half in January. Of the 3 collection records for the 3 males, 2 were taken from 4–15 January, and 1 on 6 February.

	Number of collections		
	Dec	Jan	Feb
Females	1	6	4
Males		2	1

The largest number of bees taken in one collection is 4 females from Obelisk Range, Rough Creek CO at 1260 m on 29 January 1997 by S. J. Morris.

	Host plants	
<b>Native plants</b>		
Boraginaceae		
<i>Myosotis</i> sp.	♀ 1/1	—
Onagraceae		
<i>Epilobium</i> sp.	—	♂ 1/1
Plantaginaceae		
<i>Hebe</i> sp.	♀ 1/3	—
<b>Total collections/specimens</b>	♀ 2/4	♂ 1/1
<b>Species/general/families</b>	2/2/2	1/1/1

There are no records for introduced plants.

**Nest sites.** Nothing is known.

**Associated organisms.** Nothing is known.

**Etymology.** *matamoko*: Maori *mata* = eye, *moko* = tattooing. Refers to the linear yellow macula beside the compound eye of females.

**Remarks.** This species appears to be uncommon compared to most species of *Hylaeus*, and is confined to the mid- to southern montane areas of the South Island. The presence of metasternal tubercles suggests that it is more related to *H. murihiku*, *H. perhumilis* and perhaps *H. kermadecensis* and *H. relegatus*, than to the other 3 species, *H. agilis*, *H. asperithorax* and *H. capitosus*, that are without tubercles.

### *Hylaeus (Prosopisteron) murihiku* new species

Fig. 17c–d, 60a–f; Map 24

**Male** (n = 2). Length 5.3–5.5 mm (5.4 ± 0.11 mm); width 1.3–1.5 mm (1.4 ± 0.11 mm); forewing length 3.4–3.5 mm (3.5 ± 0.05 mm); facial length 1.3–1.3 mm (1.3 ± 0.00 mm); facial width 0.9–0.9 mm (0.9 ± 0.02 mm); malar length/malar width 0.17.

**Coloration.** Black, except about ventral central 1/2 of clypeus above the lower margin broadly yellow, paraocular areas yellow below a line from about incurved inner margin of compound eye to upper margin of clypeus, with inner margin of maculae very irregular; mandibles yellow except apices red; antennae yellow ventrally beyond pedicel, outer margin of protibia dull yellow; wing membranes, wing veins and pterostigma dark brown, metatibial spur pale, tarsal claws pale red; discs of visible metasomal terga and sterna brown, apical margins widely hyaline.

**Structure.** (Fig. 60a–b). Scape broad, about 0.3× as wide as long, moderately tessellated with medium-sized punctures separated by 1–2 diameters; scape equal in length to combined length of about first 4 flagellar segments, reaching to level of median ocellus. Compound eyes almost 4× longer than wide, with upper 1/3 of inner margins converging moderately above, lower 2/3 converging more strongly below. Ocellular distance nearly as wide as 3 ocellar diameters; intercellular distance equal to 1 ocellar diameter. Antennal sockets 1.5× closer to apex of clypeus than to vertex. Face in frontal view rather sunken between compound eyes and supraclypeus, flat except slightly raised between antennal sockets. Frontal ridge scarcely evident, frontal line faintly visible just below median ocellus. Facial fovea a raised smooth line adjacent to concave upper margin of compound eye. Clypeus extending for 1/3 its length below a line across lower margins of compound eyes, about upper 2/3 flat, lower 1/3 slightly rounded transversely, and lower margin slightly recurved. Face dull, moderately tessellated throughout, with obscure, medium-sized punctures separated by about 1 diameter. Malar space short, 6 times wider than long, lightly tessellated. In lateral view, compound eye 0.8× as wide as gena, gena moderately tessellated.

Pronotum moderately shagreened on dorsal anterior area, lightly to moderately tessellated on dorsal posterior area, lateral sulcus shallow, obscure, lower lateral area with subhorizontal fine striae. Scutum, scutellum and metanotum moderately tessellated. Propodeal triangle moderately angled, densely tessellated, with irregular, fine sublateral striae on about anterior 1/2; lateral areas of propodeum moderately tessellated dorsally to becoming moderately shagreened ventrally. Remaining lateral areas of mesosoma moderately tessellated. Inner metatibial spur



very finely ciliate. Stigma 4× longer than wide. 1st submarginal cell about twice as long as 2nd.

Metasomal terga 1–7 moderately shagreened; tergum 2 with small fovea above and behind post-spiracular gland. Sternum 1 moderately shagreened, with median posterior longitudinal slit about 1/5 its length; sternum 2 very lightly shagreened, sterna 2–6 shiny, with a few small, widely-spaced punctures, sterna 2–4 with medium-sized, lateral paired protuberances. Sternum 7 with basal processes long, narrow, widening gradually towards apex, anterior apical lobes somewhat quadrate with anteriorly-directed process, posterior apical lobes narrow, directed laterally with a few apical hairs (Fig. 60c). Sternum 8 with short, simple basal process, apical process strongly bifid (Fig. 60d). Gonocoxites and gonostyli in dorsal and ventral views almost straight, with fine apical hairs (Fig. 60e); in lateral view (Fig. 60f), penis valves very large, projecting much further below lower margin of gonostylus than above.

**Vestiture.** White, sparse throughout, with some development of lateral apical faciae on metasomal terga 1–5.

**Variation.** The extent and margins of the facial maculae vary between the 2 specimens.

**Type data.** *Hylaesus murihiku*: holotype male, “Secretary I. FD”, pan trap in alpine mats and tussocks, 850 m, 30 November 1981, C. F. Butcher (NZAC). Paratype male, “Secretary I. FD”, ridge towards Mt Grono, pan traps, 27–30 November 1981, C. F. Butcher (NZAC).

**Material examined.** Type specimens. There is 1 altitude record of 850 m.

**Distribution** (Map 24). South Island: FD.

**Biology.** Apart from the data accompanying the types, nothing is known.

**Etymology.** *murihiku*: Maori name of the southern regions of the South Island. Refers to the only 2 specimens being collected in Fiordland.

**Remarks.** An unusual feature is that both specimens were taken in pan traps. It is possible that the immersion in the fluid of the pan traps may have distorted some features such as the extent of the facial maculations, and the colour of vestiture.

The broad scape allies this species with *Hylaesus relegatus*, as do the paired tubercles on metasomal sterna 2–4, of which there is some suggestion of development on metasomal sternum 3 by some male *H. relegatus* (and they are also present on *H. matamoko* and *H. perhumilis*, and perhaps *H. kermadecensis*). However *H. murihiku* is clearly separated from *H. relegatus* by the longer and more sunken face, and by several features of the 7<sup>th</sup> and 8<sup>th</sup> sterna and genitalia, such as the more quadrate form of the anterior apical lobes of the 7<sup>th</sup> sternum and their anteriorly-directed

process, and the penis valves acute apically in dorsal and ventral views.

### *Hylaesus (Prosopisteron) perhumilis* (Cockerell)

Fig. 17e–f, 18a–b, 61a–h; Map 25

*Prosopis perhumilis* Cockerell, 1914a: 53–54 (description of male, both sexes like *P. accipitris* but considerably smaller, habitat Yallingup, S.W. Australia. Also 2 males from Mt Wellington, Tasmania: is this, perhaps, an error?). —1916b: 360 (Tasmania), 364 (*P. aralis* is like it; possibly a variety of *P. perhumilis*), 365 (*P. scintilliformis* is similar; *P. perhumilis* is more robust; *P. trimerops* is of the type of *P. perhumilis* but is very minute). —1918b:163 (occurrence in Tasmania confirmed), 164: (*Prosopis brevior* described from what had been called *Prosopis perhumilis*).

*Prosopis perhumilis* var. *a* Cockerell, 1914b: 306 (at Bridport, Tasmania).

*Hylaesus perhumilis*: Meade-Waldo, 1923: 28 (new combination, list). Cockerell, 1929c: 9 (1 male from Seaford, Victoria. It is like the Tasmanian race). Rayment, 1953a: 8 (some minute black bees are in the *perhumilis* group, the yellow pattern of the male’s face is similar to that of *H. perhumilis*, the *perhumilis* female has a clypeal stripe, *perhumilis* has a polished abdomen), 10 (record of one female and one male, from Easter Daisy (*Aster* sp.)).

*Hylaesus (Prosopisteron) perhumilis*: Michener, 1965: 121 (illustration of genital capsule and 7<sup>th</sup> and 8<sup>th</sup> sternites), 123 (new combination). McGinley, 1981: 5 (list), 113 (description of larva), 266–267 (drawings of right mandible of larva), 276 (omitted in other numerical studies because of extreme similarity to *H. modestus*). Cardale, 1993: 137 (taxonomy, distribution, ecology, references). Michener, 2000: 187 (drawings of male genitalia and metasomal sterna 8 and 7), 203 (synonymy of *Psilylaeus sagiops* pointed out by R. Snelling *in litt.*, 1988; there were 13 collections in South Africa ranging from Cape Town to Port Elizabeth from 1930 to 1948, but lack of recent captures suggests it may have disappeared in Africa).

*Psilylaeus sagiops* Snelling, 1985: 28, 30–32 (description of new genus and species, drawings of head of female and male, and of male 7<sup>th</sup> and 8<sup>th</sup> sterna and genital capsule; from Cape Province, South Africa). Michener, 2000: 203 (synonymised).

**Female** (n = 20). Length 3.8–4.8 mm (4.3 ± 0.28 mm); width 1.1–1.3 mm (1.2 ± 0.07 mm); forewing length 2.8–3.1 mm (3.0 ± 0.13 mm); facial length 0.8–1.0 mm (0.9 ± 0.05 mm); facial width 0.8–0.9 mm (0.8 ± 0.03 mm); malar length/malar width 0.09.

**Coloration.** Black, except clypeus (Fig. 00) with very broad, irregular, vertical pale yellow bar stretching from dorsal clypeal margin to just above lower clypeal margin; paracocular areas with narrow pale yellow band adjacent to compound eyes, reaching from mandibular articulation to

point of greatest distance between compound eyes; mandibular base with small pale yellow macula; antennae dull yellow ventrally beyond pedicel; outer 1/3 of pronotum pale yellow; pronotal lobe pale yellow; proleg with extreme distal end of femur and anterolateral face of tibia pale yellow; base of mesotibia narrowly pale yellow; basal 1/3 of metatibia pale yellow; apices of mandibles and tarsal claws red; wing membranes hyaline, pterostigma and wing veins brown; metatibial spurs pale; apical margins of metasomal sternum 1 broadly hyaline.

**Structure.** (Fig. 61a–b). Scape nearly as long as combined length of first 5 flagellar segments; antennal segments from first to penultimate increasing in diameter by about 3/5. Compound eyes about 4× longer than wide, with upper 1/3 and lower 2/3 of inner margins converging moderately above and below respectively. Ocellular distance twice an ocellar diameter; interocellar distance equal to 1 ocellar diameter. Antennal sockets somewhat closer to vertex than to apex of clypeus. Supraclypeus flat below a line across bottom of antennal sockets; frontal line extending to median ocellus. Clypeus quite flat with lower 1/2 moderately recurved, short, extending for about 1/12 its length below a line across lower margins of compound eyes. Facial fovea a linear depression adjacent to inner margin of compound eye, extending from upper margin of yellow maculation to point where inner margin of compound eye veers laterally. Face shiny below antennal sockets, dull above, lightly tessellated below antennal sockets, with tessellation almost obscuring large shallow punctures separated by about 1 diameter or more on clypeus and paraocular areas, tessellation more dense above antennal sockets. Malar space very short, almost absent, very lightly shagreened. Galea smooth, shiny, with medium-sized punctures separated by 1–3 diameters or more. In lateral view gena about 2/3 width of compound eye, lightly shagreened, shiny, with medium-sized punctures separated by about 1 diameter.

Pronotum moderately shagreened dorsally, laterally with irregular striae angled backwards so posterior ends almost horizontal. Scutum, scutellum and metanotum moderately tessellated, with tessellation almost obscuring small, close punctures. Propodeal triangle with dorsal and posterior faces of about equal length, almost at right-angles, with angle broadly and evenly rounded, dorsal basal area moderately tessellated, much of posterior face tessellated, shiny centrally. Lateral areas of propodeum shagreened, with medium-sized punctures separated by 1 diameter. Remaining lateral areas of mesosoma moderately tessellated; lower 1/2 of metepisternum with medium-sized, close punctures, mesepisternum with medium-sized punctures separated by 2–3 diameters except area above scrobal groove impunctate. Pterostigma wide, 2.6× longer than wide. First submarginal cell 2.5× longer than 2nd.

Metasomal terga 1–5 moderately shagreened, sterna

1–5 lightly shagreened; terga with very small punctures separated by 1–4 diameters, sterna with a little larger, fewer, more widely-spaced punctures. Sternum 1 with apical longitudinal median slit extending for about 1/4 its length. Tergum 2 with a small fovea just above and behind spiracle, but with no obvious post-spiracular gland; tergum 3 with post-spiracular gland behind and below spiracle.

**Vestiture.** Very short, sparse, white throughout, except dense on inner face of tarsi, dense on half-moon-shaped area on posterior margin of metasomal sternum 5, brown dorsally around apex of abdomen.

**Male.** (n = 20). Length 3.6–4.6 mm ( $4.1 \pm 0.35$  mm); width 0.8–1.3 mm ( $1.1 \pm 0.13$  mm); forewing length 2.2–3.2 mm ( $2.8 \pm 0.26$  mm); facial length 0.8–1.0 mm ( $0.9 \pm 0.06$  mm); facial width 0.7–0.9 mm ( $0.8 \pm 0.05$  mm); malar length/malar width 0.06.

**Coloration.** Black, except clypeus and labrum entirely pale yellow; mandibles pale yellow except base narrowly black and apex red; mouthparts distad to base of galea pale yellow; paraocular area pale yellow below a line from point where inner margins of compound eyes are furthest apart, to upper margin of clypeus; half-moon-shaped area on supraclypeus immediately above clypeus with straight margin above clypeus pale yellow; ventrolateral area on scape pale yellow; ventral aspect of remainder of antennae dull yellow, remainder of antennae brown. Outer 1/3 of pronotal angle pale yellow; pronotal lobe pale yellow. Proleg primarily pale yellow beyond about distal 1/3 of femur; mesoleg and metaleg with articulation between femur and tibia, and tibia and basitarsus, broadly pale yellow proximally on tibia and basitarsus; metatibial spurs pale yellow, tarsi red. Wing membranes and wide distal margin of metasomal sternum 1 hyaline; pterostigma and wing veins brown.

**Structure.** (Fig. 61c–d). Scape as long as combined length of first 4.5 flagellar segments. Compound eyes a little more than 3× longer than wide, with inner margins similar to female. Ocellular distance similar to female; interocellar distance a little less than 1 ocellar diameter. Position of antennal sockets as in female. Facial fovea similar to female but less distinct. Clypeus flat, length as in female. Face below antennal sockets lightly tessellated, shiny, with indistinct, medium-sized punctures separated by from less than 1 to about 4 diameters; remainder of face densely tessellated, dull. Malar space very short, almost absent, lightly shagreened, with 1–2 medium-sized punctures. Remainder of head similar to female.

Mesosoma similar to female. Stigma 3× longer than wide. First submarginal cell about 2.2× longer than 2nd.

Metasomal terga 1–5 and sterna 1–5 similar to female, except tergum 3 without post-spiracular gland; sterna 3–4 sometimes with paired, lateral protuberances. Sternum 7

(Fig. 61e) with basal processes slightly enlarged apically, anterior apical lobes produced anterolaterally, rounded apically and fringed with short hairs laterally, posterior apical lobes directed posterolaterally, acute distally with long hairs apically. Sternum 8 (Fig. 61f), with basal process short, acute, apical process short, stout, broadly bifid. Gonocoxites in dorsal and ventral views rounded laterally (Fig. 61g), gonostyli short, bluntly acute, with long hairs apically; in lateral view (Fig. 61h) penis valve projecting beyond and below gonostylus.

**Variation.** The pale yellow maculations on mandible bases and pronotal angles are much reduced or absent on one female from each of Halswell, Lincoln and Kaituna MC. The pale yellow supraclapeal maculation of males can vary markedly in shape. The pale yellow maculations on the angle of the pronotum are much reduced in 3 males from Cashmere MC. Specimens caught at nests in an old door at Auckland AK had white maculations, which a few days after death had become deep cream on the clypeus, and primrose adjacent to the compound eyes (J. Berry pers. comm.). Of the 21 males from Cashmere MC, 16 show the development to a greater or lesser degree of paired protuberances on metasomal sterna 2–5 or 3–5. One male from Lincoln MC, and one male from each of Mt Albert and Northcote AK also show this character.

**Type data.** *Prosopis perhumilis*: holotype male, “Yallingup, S. W. Australia”, 14 September–31 October 1913, R. E. Turner (BMNH). 5 other males and 3 females have the same data as the holotype.

**Material examined.** 33 females and 29 males, all from New Zealand. There are no altitude data, but all collection sites are less than about 150 m above sea level. The 17 collections of bees have been taken from 17 September to 12 April.

**Distribution** (New Zealand, Map 25). North Island: AK. South Island: NC, MC.

**Biology. Flight period.** The first seasonal collection date for both sexes is 17 September. The last for females is 12 April, and for males, 14 March. The 13 collection records for 33 females are rather evenly distributed from September to April, while the 4 collection records for the 29 males range from September to March.

	Number of collections							
	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr
Females	1	2	2	1		2	4	1
Males	1		1			1	1	

The largest number of bees taken at any one time is 7 females and 21 males, which were captured at Cashmere, Christchurch MC, as they emerged from borer holes on 17 September 1973, by P. M. Johns. All other collections are of 7 bees or fewer.

### Host plants

#### Introduced plants

Myrtaceae		
<i>Eucalyptus regnans/</i>	♀ 2/11	—
<i>piperita</i>		
Proteaceae		
<i>Banksia</i> sp.	—	♂ 1/4
<b>Total collections/specimens</b>	♀ 2/11	♂ 1/4
<b>Species/genera/families</b>	1/1/1	1/1/1

**Nest sites.** Both sexes were caught emerging from borer holes on 17 September 1973 at Cashmere MC (see under **Flight period**). At a second locality at Cashmere MC, 5 females were taken at nests in borer holes in boards on 20 February 1980 by W. D. Pearson. One female was collected at each of a second-floor window and ground-floor window, and dead on an office bench, which suggests that they may have been searching the structures for holes within which to nest. One other female was caught by me as she investigated small air bubble holes in a concrete post at Halswell MC on 4 December 1990.

**Associated organisms.** None are known.

**Remarks.** The first collection of this species in New Zealand was of 1 female in a Malaise trap in a garden at Cashmere MC on 16–18 March 1973, by P. M. Johns. The distinctive facial maculations of both sexes make this species readily identifiable. The paired protuberances on 2 metasomal sterna of some males is a character shared with some males of *Hylaeus matamoko*, *H. murihiku*, and perhaps *H. kermadecensis* and *H. relegatus*, which have them on some sterna. The occurrence of the species at just one limited area in each main island suggests that the species may have been introduced separately, and fairly recently because of lack of spread, to each area.

In Australia the range of the species includes NE coastal, SE coastal, SW coastal, Queensland, Victoria, Western Australia and Tasmania, and flower records are *Aster* (Compositae) (= Asteraceae), and *Angophora*, *Callistemon* and *Eucalyptus* (Myrtaceae) (Cardale 1993). According to T. F. Houston (pers. comm. 24 June 1998) it has also been recorded on *Cotoneaster* (Rosaceae) and *Bursaria* (Pittosporaceae), and he has found nests in borer holes in tree trunks and structural timber. The species almost certainly reached New Zealand as overwintering stages within nests in imported timber. The presence of Australian flowers must have promoted the survival of the species here. The widespread occurrence of these flowers, and the existence of native Myrtaceae, which will probably be foraged upon, should allow *H. perhumilis* to spread widely.

***Hylaeus (Prosopistemon) relegatus* (Smith)**

Fig. 18c–f, 62a–h; Map 26

*Prosopis relegatus* Smith, 1876: 485 (description of male).

Hutton, 1881: 100 (repeats description of Smith 1876).

Kirby, 1881: 37 (list). —1884: 67 (list). Dalla Torre,

1896: 31 (as *relegata*, list, Australia, New Zealand).Cameron, 1903: 298 (list). Alfken, 1903: 620 (as *relegata*,a synonym of *P. agilis* Smith). Hutton, 1904: 96 (list, as*P. regelatus*). Cockerell, 1909: 313 (as *relegata*, key).Kirkaldy, 1909: 131 (*relegata*, not *regelatus* (sic)).Cockerell, 1916b: 361 (as *relegata*, list). Meyer, 1931:249 (as *relegata*, key, synonym of *P. laevigata* Smith).*Prosopis sulcifrons* Cameron, 1898: 51–52 (description offemale, comes near to *P. laevigata*). —1903: 299 (list).Hutton, 1904: 96 (list). Cockerell, 1905b: 403 (*Prosopis**cameroni*, new name for *P. sulcifrons* Cameron, not ofSmith, 1853). —1909: 313 (key, *cameroni*, Ckll.(*sulcifrons*, Cam., preocc.)). —1916b: 361 (list, *cameroni*Ckll. (*sulcifrons* Cam.)). Meyer, 1931: 248 (praeocc.).*Prosopis cameroni* Cockerell, 1905b: 403 (new name for*Prosopis sulcifrons* Cameron, not of Smith, 1853). —1909: 313 (key, (*sulcifrons*, Cam., preocc.)). —1916b:361 (list, *cameroni* Ckll. (*sulcifrons* Cam.)). Meyer, 1931:248 (list, synonymy). **New synonymy.***Prosopis maoriana* Cockerell, 1909: 313 (description of fe-male, extremely like *P. agilis*, key). —1916b: 361 (list).Meyer, 1931: 248 (list, synonymy). **New synonymy.***Hylaeus cameroni*: Meade-Waldo, 1923: 27 (new combina-

tion, list).

*Hylaeus maorianus*: Meade-Waldo, 1923: 28 (new combina-

tion, list).

*Hylaeus relegatus*: Meade-Waldo, 1923: 29 (new combina-tion, list). Cockerell, 1925: 552 (*Hylaeus hudsoni* re-

sembles it), 553 (described by Smith from specimens taken

by C. M. Wakefield in Canterbury Province, South Is-

land.). Primack, 1978: 68 (on manuka flowers at Cass

Hill). Donovan, 1980: 106 (at Whataroa, Westland,

prepupae in nests were attacked by the hymenopterous

parasitoid *Gasteruption* sp.), 111 (a leafcutting bee nestin a hole partly occupied by a nest of *Hylaeus relegatus*was attacked by the parasitoid *Gasteruption* sp.).

Macfarlane, 1980: 5 (the only species of native bee on

the Chatham Islands). Donovan, 1983a: 515 (forages on

kiwifruit flowers, *Actinidia deliciosa*). Primack, 1983:

326, 328, 332 (flower records). Macfarlane &amp; Donovan,

1989: 276 (prepupae from Whataroa and Canterbury

have been attacked by *Melittobia* spp.).*Hylaeus hudsoni* Cockerell, 1925: 552 (description of male,resembles *H. relegatus*). **New synonymy.***Prosopis hudsoni*: Meyer, 1931: 248 (new combination, list,

synonymy).

*Hylaeus (Prosopistemon) cameroni*: Michener, 1965: 123

(new combination). Valentine &amp; Walker, 1991: 42 (list).

*Hylaeus (Prosopistemon) hudsoni*: Michener, 1965: 123 (new

combination). Valentine &amp; Walker, 1991: 42 (list).

*Hylaeus (Prosopistemon) maorianus*: Michener, 1965: 123

(new combination). Valentine &amp; Walker, 1991: 42 (list).

*Hylaeus (Prosopistemon) relegatus*: Michener, 1965: 123 (new

combination). Valentine &amp; Walker, 1991: 42 (list).

**Female** (n = 20). Length 6.5–9.1 mm (7.8 ± 0.79 mm); width 1.8–2.3 mm (2.0 ± 0.16 mm); forewing length 4.6–5.8 mm (5.2 ± 0.32 mm); facial length 1.3–1.7 mm (1.5 ± 0.09 mm); facial width 1.3–1.6 mm (1.5 ± 0.10 mm); malar length/malar width 0.09.

**Coloration.** Black, except paraocular area yellow between an irregular line from lateral clypeal margin about halfway between upper margin of clypeus and anterior tentorial pit, to compound eye about opposite a line across lower margins of antennal sockets, and narrowest point between clypeus and compound eye (Fig. 00); outer 1/3 of lateral angle of pronotum yellow, pronotal lobe yellow, apex of mandibles and tarsal claws dark red, metatibial spurs pale with a slight reddening apically on a few specimens, wing membranes slightly darkened; posterior margins of metasomal terga 1–5 and sterna 1–5 hyaline, that of sternum 1 widely so.

**Structure.** (Fig. 62a–b). Scape about equal in length to combined length of first 4.3 flagellar segments. Compound eyes 4× longer than wide, with upper 1/4 of inner margins converging markedly above, lower 3/4 of inner margins converging less markedly below. Ocellular distance equal to 2 ocellar diameters; interocellar distance slightly less than 1 ocellar diameter. Antennal sockets 1/2 as far from vertex as from apex of clypeus. Supraclypeus rising gradually from below and laterally to a low, rounded mound between antennal sockets; frontal line extending to median ocellus. Facial fovea a linear depression extending upwards from the inner angle of the compound eye adjacent to the margin of the compound eye, then swinging outwards at the closest point between the compound eyes to terminate at a distance a little less than 1 ocellar diameter away from the compound eye, between the lateral ocellus and compound eye. Clypeus flat, short, extending for 1/5 its length below a line across lower ends of compound eyes. Yellow maculae shiny, remainder of face dull; frons densely tessellated, remainder of face moderately tessellated, with medium-sized punctures throughout, on paraocular areas below antennal sockets separated by 1–4 diameters, elsewhere separated by about 1 diameter or less. Malar space short, linear, lightly tessellated. Galea lightly tessellated. In lateral view, gena and compound eye about equal in width, gena lightly tessellated, with small to medium-sized indistinct punctures separated by 2–3 diameters.

Pronotum with lateral areas with irregular striae angled backwards at lower ends by about 45°, with light tessellation. Scutum and scutellum similar to clypeus. Metanotum densely tessellated. Propodeal triangle roundly angled with posterior face almost at right angles to anterior face, the 2 faces about equal in length, about basal 1/2 or more of anterior face densely and irregularly longitudinally striate, remainder of triangle densely tessellate. Remaining

lateral areas of mesosoma sculptured similarly to clypeus, except dorsal 1/2 of metepisternum with very fine, sub-longitudinal striae. Inner metatibial spur very finely ciliate. Stigma 3.5× longer than wide; first submarginal cell twice as long as 2nd.

Metasomal terga 1–5 and sterna 1–5 lightly shagreened, terga with very small punctures separated by 3–4 diameters, sternum 1 with apical longitudinal median slit extending less than half sternum length, sterna 2–4 with medium-sized punctures separated by 3–4 diameters. Metasomal terga 2–3 with post-spiracular glands, tergum 2 with a very small fovea just above and behind post-spiracular gland.

**Vestiture.** Short, sparse, white throughout, except dark brown on vertex, brown-black around apex of metasoma; most dense on posterolateral face of propodeum; inner face of tarsi with very short, dense yellow vestiture.

**Male** (n = 20). Length 5.7–7.7 mm ( $6.5 \pm 0.48$  mm); width 1.4–1.8 mm ( $1.6 \pm 0.13$  mm); forewing length 3.8–4.9 mm ( $4.3 \pm 0.28$  mm); facial length 1.3–1.6 mm ( $1.4 \pm 0.07$  mm); facial width 1.0–1.3 mm ( $1.2 \pm 0.07$  mm); malar length/malar width 0.07.

**Coloration.** Black, except clypeus apart from black lower margin entirely yellow, paraocular areas yellow below a line from upper margin of clypeus to compound eye about where reached by a line across upper margins of antennal sockets (Fig. 00); anterior face of mandibles yellow except base black, apices dark red, outer 1/3 of lateral angle of pronotum yellow, pronotal lobe yellow, about central 2/3 of inner face of protibia yellow-orange, metatibial spurs pale, wing membranes slightly darkened, apical margins of metasomal terga 1–5 and sterna 1–5 hyaline, that of sternum 1 widely so.

**Structure.** (Fig. 62c–d). Scape about equal in length to combined length of first 3.3 flagellar segments. Compound eyes about 3× longer than wide, with inner margins similar to female. Ocellular distance equal to 3× ocellar diameter; interocellar distance about equal to 1 ocellar diameter. Position of antennal sockets as in female. Supraclypeus rising to a small, low point between antennal sockets, below this the 2/3 of the supraclypeus above the clypeus flat; frontal line as in female. Facial fovea similar to female but less distinct adjacent to compound eye. Clypeus flat, short, extending for one-eighth its length below a line across lower ends of compound eyes. Yellow maculae and remainder of face below antennal sockets shiny, remainder of face dull; facial sculpturing similar to female. Malar space extremely short, nearly absent, very lightly tessellated. Galea very lightly tessellated, shiny. In lateral view, compound eye about 1.3× wider than gena, genal sculpturing similar to female.

Mesosoma similar to female. Stigma about 4× longer

than wide. Submarginal cell length similar to female.

Metasomal terga 1–5 and sterna 1–5 similar to female, except terga 2–3 without post-spiracular glands. Sternum 7 with basal processes long, narrow, anterior apical lobes directed anteriorly with outer margin with fringe of hairs, posterior apical lobes produced laterally and acute, with long hairs, (Fig. 62e). Sternum 8 with simple process basally, apical process bifid (Fig. 62f). Gonocoxites in dorsal and ventral views stout, gonostyli scarcely incurved, blunt apically, with long hairs projecting around periphery, penis valves stout, blunt apically (Fig. 62g); in lateral view (Fig. 62h), penis valve projecting beyond and well below gonostylus.

**Vestiture.** Similar to female.

**Variation.** All 9 females from the Three Kings Islands ND are without yellow facial maculations, the vestiture is darker, and the metathoracic punctures are spaced about twice as far apart as on other females. The clypeus of 1 female from Levin WN has fine, longitudinal striations. One female from Waiho WD has a ridge adjacent to the upper, incurved margin of the right compound eye. Females from the Chatham Islands may show a reduction in the paraocular maculae down to irregular, blotchy, pale yellow spheres just above the level of the anterior tentorial pits. Three males from Paiaka ND each have a small yellow spot in the middle of the labrum. One male from Warrington DN has a small black spot centrally just above the lower margin of the yellow maculation of the clypeus. Males from all areas may have the prothoracic maculations reduced or absent. One male from Nelson NN has metasomal tergum 3 deformed. One male from Dallington, Christchurch MC has the left antenna deformed apically, the right antenna grossly deformed and the right paraocular maculation much reduced. One very large male from Whitecliffs TK has a large, oval, window-like, very lightly sclerotised area encompassing most of metasomal sternum 2 and the anterior half of sternum 3.

About a 1/3 of males show some degree of a rounded, transverse ridge-like development of the disc of metasomal sternum 3. Although difficult to quantify, the development appears to be most pronounced in the largest bees.

One bee from Nelson NN has the left side of the head, including the antenna and mandible but excluding the clypeus, with male characteristics, while the remainder of the head is female. The metasomal sex characteristics are male.

**Type data.** *Prosopis relegatus*: holotype male, “Canterbury, New Zealand”, C. M. Wakefield (BMNH). *Prosopis sulcifrons*: holotype female, “Greymouth, New Zealand”, R. Helms (BMNH). *Prosopis maoriana*: holotype female, “New Zealand”, (BMNH). *Hylaeus hudsoni*: holotype male, Lake Horocohenua (= Lake Horowhenua), 19 February 1901, G. V. Hudson (BMNH).

**Material examined.** Type specimens, plus 464 females and 197 males. The 346 collection records include 28 altitude records, which range from 3–1500 m. Collection dates for flying bees range from 29 October to 28 April.

**Distribution** (Map 26). North Island: ND, AK, CL, WO, BP, TK, TO, GB, RI, HB, WI, WN. South Island: SD, NN, BR, MB, KA, WD, NC, MC, MK, SC, DN, SL. Stewart Island. Offshore Islands: Three Kings Islands, Chatham Islands.

**Biology.** The wide distribution of the species indicates that a very broad range of vegetational and climatic conditions are favourable to this bee. Unusual collections include 4 females 'at light' Three Kings ND, a female 'ex fruit fly trap' AK, 3 females and 6 males 'metholeugenol traps' AK and WO, and a male from 'beach' DN.

**Flight period.** For the 231 collection records for 464 females the earliest seasonal capture record is 2–7 November, but the earliest single-date record is 4 November, and the last is 28 April. Most collections were made in December (26%), January (26.8%), and February (24.7%). The 115 collection records for 197 males range from 29 October to 13 April, and are most numerous for November (18.3%), December (33.9%), and January (32.2%).

#### Number of collections

	Oct	Nov	Dec	Jan	Feb	Mar	Apr
Females		27	60	62	57	21	4
Males	2	21	39	37	14	1	1

Although widely distributed, the species is never very abundant in any one locality, with only 2 collections with an insect net of 10 or more bees in one locality at one time; 10 females were swept from a flax bush at Iwirua Bay MB on 13 December 1970 by D. N. Smith, and 13 females were taken from female flowers of kiwifruit, *Actinidia deliciosa*, at Auckland AK on 3 December 1981 by C. Wearing. In 28 days' collecting, from 20 December 1975 to 29 January 1976, 56 females and 7 males were captured at Lee Bay, Stewart Island SI, by A. C. Harris. A Malaise trap on the edge of native bush at Prices Valley, Banks Peninsula MC, which was set up by R. P. Macfarlane, caught 33 females from 1 December 1980 to 16 January 1981.

#### Host plants

##### Native plants

Asteraceae		
<i>Cotula</i> sp.	—	♂ 1/1
<i>Oothamnus</i> sp.	♀ 1/2	—
<i>Raoulia australis</i>	—	♂ 1/1
Fabaceae		
<i>Carmichaelia</i> sp.	—	♂ 1/1
Hemerocallidaceae		
<i>Phormium tenax</i>	♀ 6/15	♂ 2/2
Laxmanniaceae		
<i>Cordylone australis</i>	♀ 1/1	—

Myrtaceae		
<i>Kunzea ericoides</i>	—	♂ 1/2
<i>Leptospermum scoparium</i>	♀ 4/4	♂ 2/3
<i>Metrosideros excelsa</i>	♀ 3/3	—
<i>Metrosideros umbellata</i>	♀ 3/6	—
Plantaginaceae		
<i>Hebe chathamica</i>	♀ 1/3	—
<i>Hebe elliptica</i>	—	♂ 1/1
<i>Hebe macrantha</i>	♀ 1/1	—
<i>Hebe odora</i>	—	♂ 1/1
<i>Hebe salicifolia</i>	♀ 2/3	♂ 1/1
<i>Hebe stricta</i>	♀ 1/2	—
<i>Hebe subalpina</i>	♀ 1/4	—
<i>Hebe traversii</i>	♀ 7/14	—
<b>Total collections/specimens</b>	♀ 31/58	♂ 11/13
<b>Species/genera/families</b>	12/6/5	9/7/5

##### Introduced plants

Actinidiaceae		
<i>Actinidia deliciosa</i> female	♀ 7/21	—
male	♀ 3/4	—
female/male	♀ 1/2	—
Alliaceae		
<i>Allium</i> sp.	♀ 1/1	—
Apiaceae		
<i>Conium maculatum</i>	—	♂ 1/1
<i>Daucus carota</i>	♀ 1/1	—
Asphodelaceae		
<i>Kniphofia praecox</i>	♀ 2/4	♂ 1/2
Fabaceae		
<i>Cytisus</i> sp.	—	♂ 1/1
<i>Indigofera potaninii</i>	♀ 2/6	—
Fagaceae		
<i>Castanea sativa</i>	♀ 1/1	—
Malvaceae		
<i>Abutilon</i> sp.	♀ 1/1	—
Rosaceae		
<i>Rubus idaeus</i>	—	♂ 1/1
<i>Rubus</i> sp.	—	♂ 1/5
<b>Total collections/specimens</b>	♀ 19/41	♂ 5/10
<b>Species/genera/families</b>	7/7/7	5/4/4

In addition to these records, one female and 3 males have been captured from *Nothofagus* sp. (Fagaceae), but whether from flowers or honeydew is unrecorded.

**Nest sites.** There are 11 records of nests in natural nest sites. One female was from a 'bee-made hole in flax pith', (*Phormium tenax*, Hemerocallidaceae). Bees of both sexes have been found in 2 nests in *Pseudopanax arboreum* and dead *Pseudopanax* sp. branches (Araliaceae), and there was 1 nest each with bees in dead *Olearia angustifolia* (Asteraceae), *Cortaderia* sp. (Poaceae), a tree branch of *Hebe barkeri*, and small dead branches of *H. stricta* (Plantaginaceae). Two nests were in old tunnels of *Ambeodontus* sp. and *Ambeodontus*?, and 1 was in old workings of *Gastrosaurus* sp. (Coleoptera: Cerambycidae) in a stem of *Ozothamnus* sp. (Asteraceae). One other nest

was in a dead twig. Three other nests were in wood, 1 in holes in weather boarding, and 2 females were captured cleaning out holes in cedar wood planking.

During the late 1970s and the 1980s, 2 types of wooden trap nest blocks were sited at 5 km E Abut Head WD, Conway Flat KA, and Te Pirita MC. One type of trap nest block was 75 mm × 165 mm and 100 mm deep, and was drilled through with 50 holes wide enough to take paper drinking straws with an external diameter of 6 mm. The straws were folded over at the back of the block, and were held in place with a plywood backing screwed on to the block. Each straw thus formed a blind-ended tunnel 5.5 mm in diameter internally and 100 mm long. The second type of trap nest block was of 10, U-shaped grooves 5.0–5.5 mm across and deep and 100 mm long, with 10 mm between the grooves. The boards were topped with a second board, so that each tunnel so formed was flat-topped and blind. The trap nest blocks were covered with a waterproof metal roof, and were mounted on tree trunks, fence posts and buildings so that the tunnels were horizontal.

*Hylaeus relegatus* occupied trap nests at all 3 sites. In addition, nests were formed in grooved, laminated boards placed on flowering lucerne (*Medicago sativa*) (Fabaceae) for occupancy by lucerne leafcutting bees, *Megachile rotundata*. These blind-ended tunnels were 6 mm in diameter and 100 mm long.

In all tunnels nests were similarly constructed, in that during winter, a linear series of cells occupied most of a tunnel cavity. Each cell consisted of a cellophane-like material affixed to the walls of the cavity, and which extended across the tunnel front and rear to separate each cell from others so that each cell formed a complete unit. In the 6 mm wide grooved laminated boards, cells were about 5–6 mm long, and in the 5.5 mm wide drinking straws, 5.5–7 mm long, while cells in the 5–5.5 mm diameter U-shaped tunnels were about 6 mm long. In the widest tunnels, often the rear wall of a cell was without a large central area, but this was closed by the front wall of the cell behind it.

When the base and walls of a cell have been completed, female bees store a mixture of pollen and nectar in about the bottom half or less of the cell. An egg is then laid on the food, and the cell is closed with the completion of an anterior cellophane-like partition across the nest tunnel. Nests in drinking straws collected from Conway Flat KA on 15 March 1977 contained 1 cell with a larva 1.5 mm long, and another cell with a larva 4.5 mm long. The food consisted of quite firm pollen around the periphery of the cells, but graded to a clear liquid towards the centre. Both larvae were almost immersed centrally in the clear area. The small larva was lying straight, but the larger larva was curved into a C-shape.

On 31 October 1986, 7 nests in U-shaped tunnels at 5

km E Abut Head WD, contained between 3 and 14 cells. Six cells contained dead immatures of *H. relegatus* and numerous mould mites, *Tyrophagus putrescentiae* (Acari: Acaridae), 1 cell contained a dead bee prepupa, and 60 cells contained live bee prepupae. Twenty-six prepupae later developed to females, and 34 to males. Of 3 nests where all progeny were living, 1 held 11 male pupae, 1 had 12 female pupae followed by 1 male pupa closest to the entrance, and the third had 8 female pupae in the base of the tunnel, followed by 6 male pupae towards the tunnel entrance.

On 1 November 1994, 10 bee pupae from nests recovered during the previous autumn from Kaituna Valley MC, were placed within paper straw tunnels in a 50-nest-hole wooden block which was sited on a fence on a domestic property in Halswell, Christchurch MC. On 9 November the first male bee to be seen was grooming on the nest block surface, on 10 November the first female was seen flying, and by 21 November, 4 females had filled about 1/3 of their tunnels. By 26 November the tunnels were half full or more, and by 29 November 1 nest hole was sealed at the entrance.

On 7 August 1985, 9 paper straws contained evidence of a total of 75 cells, 11 of which held live bee prepupae. The first male bee for the season was seen on 19 October, and the first sealed nests (2) were noted on 21 November. When nests were opened on 25 December, there were 37 cells in 10 nests. Sixteen cells contained dead bee immatures, 1 held a large larva, 9 had prepupae and 11 contained white pupae. By 10 January 1986, 1 sealed nest had been opened, presumably by a second-generation emerging bee. On 4 April 1986, there was 1 full-sized, pre-defaecation larva and 12 prepupae in the nest block.

**Associated organisms.** Of 13 nest holes used by bees in a trap nest at 5 km E. Abut Head WD which were inspected on 20 April 1976, 4 contained a total of 8 prepupae of the bee parasitoid *Gasteruption* sp. (Hymenoptera: Gasteruptionidae). While the female bee is away, parasitoid females appear to enter nests and lay an egg in a recently provisioned cell. The resultant parasitoid larva consumes the provisions of at least 2 cells before becoming a prepupa, but sometimes more than 2 cells may be destroyed; in the 4 attacked nests, 22 bee cells were destroyed. One large parasitoid larva, which was dead, was among the chewed debris of 4.5 cells.

Three of 35 prepupae recovered from trap nests at Halswell MC on 2 March 1987, and 17 of 446 prepupae recovered from trap nests 5 km E. Abut Head WD on 18 June 1987, were internally parasitised by *Coelopenyrtus australis* (Hymenoptera: Encyrtidae). In 1 nest from 5 km E. Abut Head WD, all 8 prepupae were parasitised, and in a second nest that had contained 10 prepupae, all but the bottom-most prepupa were parasitised. From these latter

9 attacked prepupae, 340 female *C. australis* and 21 males emerged.

*Melittobia* sp. (Hymenoptera: Eulophidae) attacked and killed a few bee prepupae and pupae from Te Piritā MC and Halswell MC.

One female has 4 small mites on her head, and 1 male has 8 small mites on metasomal terga 1 and 2.

Mould mites *Tyrophagus putrescentiae* occurred in nests from all 3 sites, and appeared to kill bee immatures.

The native mason wasp *Pison spinolae* (Sphecidae) and the introduced lucerne leafcutting bee *Megachile rotundata* (Megachilidae) nested in some nest holes also occupied by *H. relegatus*.

**Remarks.** *H. relegatus* is the largest and most common of the endemic hylaeine bees in New Zealand, but because of its black, fly-like appearance in flight, and the lack of occurrence of high numbers in any one area, the species is not as prominent as many *Leioproctus*. The ready occupation of trap nests indicates that numbers can be increased by providing nest holes. The similarly ready utilization of a wide range of native and introduced flowers suggests that a lack of nest sites is probably the main factor limiting its numbers.

### Genus *Hyleoides* Smith

*Hyleoides* Smith, 1853: 32. Type species *Vespa concinna* Fabricius, 1775, by designation of Taschenberg, 1883: 45.

*Hylaeoides* Dalla Torre, 1896: 51, unjustified emendation of *Hyleoides* Smith, 1853.

### *Hyleoides concinna* (Fabricius)

Fig. 19a–d, 63a–h; Map 27

*Vespa concinna* Fabricius, 1775: 367 (description of female?). Taschenberg, 1883: 45 (*Vespa concinna* is Type of *Hyleoides* Sm.).

*Hyleoides concinna*: Smith, 1853: 32 (new combination, list). Cockerell, 1909: 309–310 (key). —1929b: 225 (distribution, first collected by Banks on Captain Cook's first expedition, and described by Fabricius as a wasp, which it much resembles). Michener, 1965: 150 (illustration of male wings, fore tibia, genitalia and 7th and 8th stera), 151 (list). Houston, 1975: 45–68 (revision of *Hyleoides*), 46 (distribution in Australia), 47–48 (key), 52–59 (revision of *H. concinna*, description, drawing of left mandible of female, illustration of heads of male and female, illustration of propodeal triangle of female, drawings of genital capsule and 7th and 8th sterna of male, flower records, and specimens examined). McGinley, 1980: 540 (drawing of glossa). —1981: 5 (list), 53 (key to larva), 117–118 (description of larva), 237 (list), 266–267 (drawing of left maxillary apex of larva), 270–271 (drawings of larval characters). Donovan, 1983b: 345–348 (occurrence in New Zealand, collection data including

flower records, outline of life cycle, photographs of male and female faces and male metasomal terga). Fordham, 1989: 65–67 (further New Zealand records, field characteristics and external features, use of flowers). Valentine & Walker, 1991: 42 (list). Michener, 1992: 6 (characters of glossa). Cardale, 1993: 4 (established in New Zealand), 15 (accidentally introduced to New Zealand), 147–148 (list, synonymy, distribution and ecology in Australia, references). Harris, 1998: 18–19 (further records in New Zealand). Michener, 2000: 181 (drawing of base of metasoma and front tibia), 183 (drawings of male and female faces), 186 (drawing of metasomal sternum 7 of male), 205 (introduced and established in New Zealand). Harris, 2002: 20 (observed making serial nests, and foraging. Present at Seatoun WI and Hawera and Opunake TK).

*Hyleoides concinnus*: Sichel, 1867: 144 (list). Michener, 1965: 140 (side view of base of metasoma). Houston, 1967: 68–70 (biology, illustrations of bee on a eucalyptus flower, longitudinal section of completed nest, iris, comparison of face, head and thorax with eumenid wasp).

*Hylaeoides concinnus*: Dalla Torre, 1896: 51: (list). Meade-Waldo, 1923: 36 (list), 45 and Plate (list, figures of maxilla, lateral view of abdomen, whole female). Friese, 1924: 222 (brief description, including body length).

*Hylaeoides concinnus* var. *collaris* Friese, 1924: 222 (description of male and female).

*Hylaeoides concinna*: Tillyard, 1926: 303 (widespread throughout Eastern Australia). Rayment, 1935: 86–90 (illustration of whole female and many characters, and male genitalia and spur and strigil, biology) —1961: 102–107 (description of nest, "iris" construction, foraging, immatures, life cycle).

*Hylaeoides concinna ruficollaris* Rayment, 1935: 89 (illustration of male genitalia, spur and strigil, claim it is a distinct species), 91 (incorrect spelling for *collaris* Friese 1924; name not available).

*Hylaeodes concinna*: Cane, 1979: 125 (degree of isolation of hind tibial spurs of female).

**Female** ( $n = 20$ ). Length 10.8–13.9 mm ( $12.3 \pm 1.07$  mm); width 3.5–4.6 mm ( $4.0 \pm 0.36$  mm), forewing length 8.0–9.7 mm ( $8.9 \pm 0.56$  mm); facial length 2.5–3.0 mm ( $2.7 \pm 0.16$  mm); facial width 1.9–2.4 mm ( $2.1 \pm 0.14$  mm); malar length/malar width 0.16.

**Coloration.** Black, except antennae becoming brown ventrally towards apex; clypeus with about upper quarter with orange maculation which narrows markedly below and extends almost to clypeal margin; about anterior 1/2 of forewing very dark or steely blue, remaining wing membranes hyaline; tarsi dark brown; posterior 1/2 of metasomal tergum 1 and remainder of metasomal terga 3–6 beyond narrow black base of tergum 3 orange; apex of metasomal sternum 3 broadly yellow.

**Structure.** (Fig. 63a–b). Scape equal in length to combined length of first 5 flagellar segments. Compound eyes about 3.5× longer than wide, with upper 1/3 and lower 2/3 of



inner margins converging markedly above and below respectively. Ocellocular distance  $2.5\times$  an ocellar diameter; interocellar distance  $1.2\times$  an ocellar diameter. Antennal sockets  $1.6\times$  further from apex of clypeus than from vertex. Supraclypeus rising gradually from clypeal margin to form flat raised area between antennal sockets with vertical, almost overhanging lateral margin somewhat less in height than diameter of mid point of scape; central area of supraclypeus with fine longitudinal striations with a few small punctures, lateral area with medium-sized close punctures; deep frontal groove extending from line across mid point of antennal sockets to less than halfway to median ocellus, frontal line extending from there to median ocellus. Face dull; frons, upper paraocular area and vertex irregularly and heavily tessellated, with a few medium-sized widely spaced punctures, punctures largest and closest on vertex. Paraocular area with prominent linear fovea close to about upper inner  $1/3$  of margin of compound eye. Clypeus flat, extending for about  $1/5$  its length below a line across lower margins of compound eyes, with very fine vertical linear striations and small widely-spaced punctures; the fine striations extending to adjacent paraocular area. Malar space short,  $6\times$  wider than long, shagreened; mandible with 3 prominent teeth. Galea moderately tessellated. In lateral view, gena a little narrower than compound eye, close to eye with medium-sized punctures, on remainder punctures large to very large, separated by 0.5 diameters.

Pronotum lightly to moderately tessellated, except anterior lateral area smooth with medium-sized punctures, collar with large punctures separated by about 2–5 diameters. Scutum, scutellum and metanotum densely tessellated, dull, scutum with small to medium-sized punctures separated by 2–3 diameters, scutellum and metanotum with larger punctures separated by 2–5 diameters. Propodeal triangle with horizontal surface very narrow,  $1/10$  length of vertical surface, at right angles to vertical surface, extremely finely tessellated, horizontal surface with very fine longitudinal striae; lateral propodeal areas with close, medium-sized to large punctures with sharp rims. Remaining lateral areas of mesosoma very lightly tessellated with very large punctures with rounded rims, separated by about 0.5 diameters. Dorsal apex of protibia produced to prominent sharp, curved spine, mesotibia with much smaller spine. Basitibial plate absent, but area defined on anterior and distal margin by carina, plate area about  $1/5$  length of tibia. Inner tibial spur very finely ciliate. Pterostigma  $4\times$  longer than wide; vein 1st m-cu meets 2nd submarginal cell about  $1/3$  length of cell from base.

Metasomal terga 1–5 lightly to moderately tessellated, with medium-sized punctures on disc separated by about 2–5 diameters, punctures larger, closer laterally. Apical

terga without pseudopygidium or pygidium. Apex of sternum 1 transverse. Sternum 2 produced on anterior margin to a very prominent blunt, median projection, broad posterior area smooth, shiny; sterna 1–6 moderately to lightly shagreened, punctation much as for terga except punctures very large.

**Vestiture.** White to off-white, very sparse, very short throughout, except very dense, short on anterior dorsal margin of pronotum, around pronotal lobe, and on propodeum except propodeal triangle. Protarsi covered with hairs recurved at tips. Meso- and metatibia and tarsi with very short dense vestiture on inner surfaces.

**Male** ( $n = 20$ ). Length 9.5–12.5 mm ( $11.2 \pm 0.80$  mm); width 3.1–4.3 mm ( $3.8 \pm 0.33$  mm); forewing length 7.4–9.2 mm ( $8.3 \pm 0.53$  mm); facial length 2.4–3.0 mm ( $2.7 \pm 0.17$  mm); facial width 1.6–2.2 mm ( $1.8 \pm 0.15$  mm); malar length/malar width 0.48.

**Coloration.** Similar to female, except clypeus with very large somewhat hour-glass shaped yellow maculation; apices of metasomal sterna 2, 4 and 5 slightly hyaline.

**Structure.** (Fig. 63c–d). Scape about equal in length to combined length of first 3.6 flagellar segments. Compound eyes about  $3.5\times$  longer than wide, with upper  $1/4$  and lower  $3/4$  of inner margins converging moderately above and markedly below respectively. Ocellocular distance a very little more than 2 ocellar diameters; interocellar distance as in female. Antennal sockets  $2.3\times$  further from apex of clypeus than from vertex. Clypeus similar to female. Malar space long, half as long as wide, lightly tessellated, with obscure medium-sized punctures separated by about 1 diameter; mandible with 2 teeth. Remainder of head similar to female, except median supraclypeal groove, median line and facial fovea much less evident; punctures close except on clypeus.

Mesosoma similar to female, except scutal punctures a little larger; mesepisternum and metepisternum with small punctures between the large punctures; metabasitarsus without carina defining basitibial plate.

Metasomal terga 1–5 and sterna 1–6 similar to female, except sternum 2 without broad, smooth shiny posterior area, sternum 3 with low transverse ridge midway on about central  $1/3$ . Sternum 7 (Fig. 63e) with basal lobes very narrow but expanded apically; anterior apical lobes rectangular, posterior apical lobes narrow with recurved apex, both pairs of lobes hirsute laterally. Sternum 8 (Fig. 63f) with basal process blunt, lateral lobes stubby, apex broadly bifid. Gonocoxites and gonostyli in dorsal and lateral views (Fig. 63g) narrow, straight, penis valves broadly expanded apically; in lateral views (Fig. 63h) penis valve projecting a little beyond and below gonostylus.

**Vestiture.** Similar to female.

**Variation.** The length of the malar space in females is quite variable. The apex of metasomal tergum 2 of a male from Manutuke GB has a little orange coloration centrally and laterally, and the apex of metasomal sternum 2 is broadly part-orange. One male from Napier HB has a bright orange spot laterally on the angle of the pronotum, 1 small dull orange spot on the lateral aspect of the 2nd metasomal tergum, a small dull yellow spot on the extreme apical lateral angle of the 2nd metasomal sternum, and a large clear gap in the left side of the yellow band on the 1/3 metasomal sternum. A male from Clive HB has a dull orange spot on the angle of the pronotum, a small orange spot on each side of the scutellum, and an orange spot centrally on the 2nd metasomal tergum.

One male from Hastings HB has a small yellow spot on the left paraocular area opposite the waist of the yellow macula on the clypeus.

**Type data.** *Vespa concinna*: holotype female; according to Houston (1975) a female in the Banks collection, BMNH, is purported to be the holotype, but it is not accompanied by any data.

*Hyleoides concinnus* var. *collaris*: a male labelled 'Typus' by Friese, "Australia, New South Wales, Glenbrook", 14 September 1906, (AMNH).

**Material examined.** Two females from Australia, and 43 females and 34 males. There are no altitude data for the 53 collections, but specimens have been taken from just above sea level to several hundred metres above. Collection dates range from 27 September to 6 May outdoors, and to 27 May in a house, and most bees were captured from December to April.

**Distribution** (New Zealand, Map 27). North Island: ND, AK, CL, WO, TK, TO, GB, HB, WI, WN, WA.

**Biology.** The species occurs primarily in human-modified environments. Because of their large size and prominent black, orange, and yellow, the bees are conspicuous. However, the greatest number taken in one collection is 7, and the majority of collections are of just 1. Harris (1998) reported that large numbers frequented the flowers of *Eucalyptus longifolia* (Myrtaceae) on the property of Mr Cox at Tangowahine ND, so the species apparently can be locally abundant.

**Flight period.** The earliest seasonal capture for females is 20 December, and the last, 7 April, and for males the first record is 27 September, and the last 6 May outdoors and 27 May in a house. The 30 collection records for the 43 females are most numerous from January to March, and the 23 collection records for the 34 males are most common from November to March.

#### Number of collections

	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May
Females				2	8	7	10	3	
Males	1		4	3	5		6	2	2

For females the largest collection is of 7 from Tangowahine, Dargaville ND, from *Eucalyptus longifolia* on 31 March 1998 by J. Cox, while for males the largest collection is of 5 and 1 female at Napier HB on *Tecoma* sp. (Bignoniaceae) flowers on 7 March 1982 by C. Appleton. All other collections are of 3 or fewer bees.

#### Host plants

##### Introduced plants

Apocynaceae									
<i>Nerium oleander</i>						♀ 1/1			♂ 1/1
Asteraceae									
<i>Tanacetum parthenium</i>						—			♂ 1/3
Bignoniaceae									
<i>Campsis</i> sp.						♀ 3/5			—
<i>Tecoma</i> sp.						♀ 1/2			♂ 1/5
Caryophyllaceae									
<i>Saponaria officinalis</i>						—			♂ 1/3
Myrtaceae									
<i>Acmena smithii</i>						—			♂ 1/1
<i>Callistemon</i> sp.						♀ 1/1			♂ 1/2
<i>Eucalyptus longifolia</i>						♀ 2/10			—
<i>Eucalyptus</i> sp.						♀ 1/1			—
Proteaceae									
<i>Leucospermum bolusii</i>						—			♂ 1/1
Rutaceae									
<i>Citrus</i> sp.						♀ 1/1			—
<b>Total collections/specimens</b>						♀ 10/21			♂ 7/16
<b>Species/genera/families</b>						7/6/4			7/7/6

There are no records for native plants.

In addition to these records, Fordham (1989) observed bees on white, orange, and red *Eucalyptus* flowers on warm sunny days with little or no wind. Bees were also observed taking nectar from the base of *Campsis* sp. (Bignoniaceae) flowers, but only 1 gathered pollen from the large anthers. One male, taken on *Campsis*, had a pollinium of an unknown flower attached to its mouthparts. Harris (2002) observed bees taking nectar from the flowers of boxthorn, *Lycium ferocissimum* (Solanaceae).

According to Michener (1965), and Houston (1967, 1975), and Houston pers. comm. 1983, flower records for Australia are: Apiaceae: *Foeniculum vulgare*. Myrtaceae: *Angophora intermedia*, *Callistemon* sp., *Eucalyptus calophylla*, *E. ficifolia*, *E. tessellaris*, *E. sp.*, *Melaleuca* sp., *Tristania conferta*. Fabaceae: *Daviesia* sp., *Jacksonia scoparia*, *Pultenaea villosa*. Pittosporaceae: *Bursaria spinosa*. Proteaceae: *Banksia serrata*. Solanaceae: *Lycium australe*, or *L. ferocissimum*.

**Nest sites.** Harris (2002) found bees making serial nests

in abandoned Cerambycidae (Coleoptera) burrows in stems of *Lupinus arboreus* and *Acacia longifolia* var. *sophorae* (Fabaceae) in the sand dunes at Castlecliff WI.

In Australia Rayment (1961) set out bamboo stems within which bees constructed nests. Houston (1967) found that old longicorn beetle holes in stumps, logs and fallen branches seemed to be preferred nest sites. The species is solitary and univoltine, females can make up to about 8 cells in a suitably deep nest hole (but may fill more than one nest hole) and the prepupae overwinter. The entrance to a nest occupied by a female bee is covered with an "iris" of fine filaments laid down by the female, behind which she shelters.

**Associated organisms.** None have been reported from Australia or New Zealand.

**Remarks.** The first collection of this species in New Zealand was of 1 male from Clive HB on 19 November 1980 on *Leucospermum bollusii* by J. Walker. Rayment (1935) found that in Australia the bees were present on *Eucalyptus* during the hottest months of the year, and their bright colour and flashing purple wings made them very conspicuous on the pinkish blooms. According to Houston (1967) *Hyleoides concinna* is one of Australia's eye-catching species of bee because of its large size and bright colours, which include wings which are a beautiful prismatic dark purple (Rayment 1961). Because it is so visible, it therefore seems unlikely that it occurred in New Zealand much before it was first collected.

Its range in Australia includes most of the eastern and south-eastern areas of the continent, and Tasmania. When first reported in New Zealand by Donovan (1983b) the species was already established near Gisborne GB and Napier HB. Fordham (1989) found that it was established west of the axial ranges of the North Island in Wanganui and Palmerston North WI, and Harris (1998) reported that it was seen in abundance at Dargaville ND. More recently it has been found in many areas of the North Island. Donovan (1983b) thought that the species probably entered New Zealand as diapausing prepupae in nests in imported timber, and that the proximity of the first collection sites to the ports of both Gisborne and Napier suggested that entry may have been through both ports. Donovan (1983b) also thought that its range in Australia, which indicated an association with regions of higher rainfall and an ability to tolerate frosty winters, suggested that much of New Zealand was probably suitable climatically. Also, preferred flowering plants were plentiful, so the bee's future abundance would probably depend largely on the availability of nest sites, for which there would be competition from other insects and spiders. Fordham (1989) cautioned that because foraging appeared to be

restricted to warm sunny days, the bee's distribution and reproductive success could be limited by summer climate.

The wasp-like appearance of the species was attributed by Rayment (1961) to mimicry of eumenid wasps. Indeed, so successful is the mimicry that Fabricius (1775) described the bee in the wasp genus *Vespa*. Donovan (1983b) thought that the bee's large size, prominent yellow-orange markings and wasp-like aspect will cause the public to confuse it with introduced pestiferous social wasps. Nevertheless, because of its colourful appearance and apparent restriction to and preference for introduced flora, *Hyleoides concinna* may be considered by most to be a welcome addition to our bee fauna.

## Subfamily Euryglossinae

### Genus *Euryglossina* Cockerell

#### Subgenus *Euryglossina* Cockerell s. str.

*Euryglossa* (*Euryglossina*) Cockerell, 1910a (August): 211.

Type species: *Euryglossa semipurpurea* Cockerell, 1910, monobasic.

*Turnerella* Cockerell, 1910b (October): 262. Type species:

*Turnerella gilberti* Cockerell, 1910, monobasic.

Synonymised by Michener 2000: 219.

#### *Euryglossina* (*Euryglossina*) *proctotrypoides* Cockerell

Fig. 20a–d, 64a–h; Map 28

*Euryglossina proctotrypoides* Cockerell, 1913b: 392 (description of female). Meade-Waldo, 1923: 11 (list). Callan, 1979: 39 (according to Dr B. J. Donovan, nesting in *Anobium* burrows, and first record of subfamily Euryglossinae in New Zealand). Donovan, 1980: 106 (at Nelson, nested in tunnels of the house borer beetle *Anobium punctatum* (De Geer)).

*Euryglossa minuta* Rayment, 1935: 636 (description of female) (but see comment under **Type data**). Exley, 1968: 937 (synonymy).

*Euryglossina* (*Euryglossina*) *minuta*: Michener, 1965: 109 (new combination, list).

*Euryglossina* (*Euryglossina*) *proctotrypoides*: Michener, 1965: 109 (new combination, list). Exley, 1968: 918 (key to female), 921 (key to male), 937–938 (synonymy, redescription, distribution in Australia), 944 (female, illustration of front and side of head, dorsal view of clypeus), 948 (male, illustration of front and side view of head, dorsal view of clypeus, and antenna), 956 (illustration of male genitalia), 964 (illustration of metasomal sternum 7), 968 (illustration of metasomal sternum 8), 1020 (list). Donovan, 1983a: 512 (also present in Australia; the species is widely distributed throughout NZ). Valentine & Walker, 1991: 42 (list). Cardale, 1993: 4 (established in New Zealand), 14 (accidentally introduced to New Zealand), 93 (list, catalogue data).

**Female** (n = 20). Length 3.3–4.5 mm (3.8 ± 0.32 mm);

width 1.0–1.3 mm ( $1.1 \pm 0.09$  mm); forewing length 2.2–2.8 mm ( $2.5 \pm 0.17$  mm); facial length 0.7–0.9 mm ( $0.8 \pm 0.06$  mm); facial width 0.7–0.9 mm ( $0.8 \pm 0.06$  mm); malar length/malar width 0.9.

**Coloration.** Black, except antennae pale yellow-brown ventrally beyond about scape; apex of mandibles red, otherwise outer face of mandibles yellow; prolegs becoming increasingly yellow beyond tibiae, mesolegs similar except outer face of basitarsi dark brown, metalegs similar except outer face of basitarsi dark brown to black; wing membranes hyaline, pterostigma and wing veins light brown; metasomal terga with hint of purple except apical margins of terga 1–5 almost hyaline, apical margins of metasomal sterna 1–5 similar; pygidial plate red.

**Structure.** (Fig. 64a–b). Scape as long as combined length of first 7 flagellar segments. Compound eyes twice as long as wide, widest in lower 1/3, about upper 1/3 of inner margins converging moderately above, lower 2/3 converging moderately below. Ocellular distance  $3 \times$  diameter of lateral ocellus, median ocellus  $4/5$  diameter of lateral ocellus, interocellar distance a little less than diameter of median ocellus. Antennal sockets about twice as far from vertex as from apex of clypeus. Face shiny. Supraclypeus roundly protuberant; frontal ridge beginning between antennal sockets extending about  $1/4$  of distance to median ocellus, frontal line extending to median ocellus. Distance from a line across posterior margins of lateral ocelli to posterior margin of head  $1.6 \times$  distance from line to anterior margin of median ocellus. A little less than upper half of inner margin of compound eye with linear facial fovea lying parallel about as far away as  $1/2$  diameter of lateral ocellus. Face above clypeus lightly tessellated/shagreened with small indistinct punctures separated by 3–6 diameters. Most of clypeus flat to slightly concave, angling sharply backwards from supraclypeus at about  $60^\circ$ , at mid point of lower margin scarcely extending beyond a line across lower margins of compound eyes, lateral margin with a stout projecting blunt spine nearly as long as diameter of median ocellus; very lightly tessellated/shagreened with punctuation similar to remainder of face except punctures a little larger. Malar space short, about  $11 \times$  wider than long. Galea almost smooth, shiny. In lateral view, gena a little wider than compound eye, narrowing little to just above mandible base, sculpturing similar to vertex except becoming smooth towards mandible base.

Pronotum moderately shagreened. Scutum and scutellum moderately tessellated, metanotum less so, with a few small, obscure, very widely-spaced punctures. Propodeal triangle evenly rounded so dorsal and posterior surfaces at about  $45^\circ$ , central area smooth, shiny, lateral and ventral areas of triangle and lateral area of propodeum lightly shagreened. Remaining lateral areas of mesosoma similar to vertex except metepisternum impunctate.

Basitibial plate ill-defined, outlined by irregular small tubercles extending about halfway along tibia. Inner hind tibial spur finely ciliate. Pterostigma about  $3.5 \times$  longer than wide, vein 1st m-cu entering first submarginal cell just before its distal end, or interstitial.

Metasomal terga 1–5 and sterna 1–5 moderately to lightly shagreened, terga 1–5 with small to medium-sized, obscure, widely-spaced punctures, sterna 2–5 with large, shallow, close punctures separated by 1–2 diameters; tergum 2 with linear fovea on anterior lateral margin about  $1/4$ – $1/3$  length of tergum, sternum 1 with shallow median bifurcation. Pygidial plate narrow, parallel sided, shiny.

**Vestiture.** White throughout, very sparse, so insect appears almost naked, except pronotal lobe fringed with very short dense hairs, lateral aspect of propodeum with some long hairs.

**Male** ( $n = 6$ ). Length 3.0–3.8 mm ( $3.4 \pm 0.27$  mm); width 0.9–1.0 mm ( $0.9 \pm 0.04$  mm); forewing length 2.2–2.2 mm ( $2.2 \pm 0.03$  mm); facial length 0.7–0.7 mm ( $0.7 \pm 0.01$  mm); facial width 0.6–0.7 mm ( $0.6 \pm 0.02$  mm); malar length/malar width 0.40.

**Coloration.** Similar to female, except labrum at least partly yellow, galea with yellow tinge apically.

**Structure.** (Fig. 64c–d). Scape equal in length to combined length of first 5 flagellar segments. Compound eyes twice as long as wide, with inner margins as in female. Ocellular distance  $2 \times$  an ocellar diameter; interocellar distance  $3/4$  diameter of ocellus; lateral, median ocelli of similar diameters; distance from line across posterior margins of lateral ocelli to posterior margin of head only slightly more than distance from line to anterior margin of median ocellus. Position of antennal sockets as in female. Supraclypeus much as in female. Clypeus angled backwards ventrally, continuing curve of supraclypeus, length similar to female, lateral margin with a short bluntly pointed spine less than half length of that of female. Malar space  $2.5 \times$  wider than long. In lateral view, gena a little wider than compound eye, narrowing markedly towards mandible base. Remainder of head similar to female except clypeus lightly tessellated, facial fovea a little shorter dorsally.

Mesosoma similar to female.

Metasomal terga 1–6 and sterna 1–6 similar to female terga 1–5 and sterna 1–5, except sterna impunctate. Sternum 7 (Fig. 64e) with basal lobes expanded medially, narrow basally, apical lobes rounded laterally. Sternum 8 (Fig. 64f) blunt apically, lateral process stubby, posterior process extremely narrow basally, expanded apically. Gonocoxites in dorsal and ventral views (Fig. 64g) angled laterally, gonostyli clear and acute apically, penis valves very rounded apically: in lateral view (Fig. 64h) penis valve projecting well below gonostylus, very acute apically.

**Vestiture.** Similar to female, except long hairs on genal area lateral to proboscoidal fossa.

**Variation.** The extent of yellowing of the labrum of males can vary from about the central 1/3 to very little.

**Type data.** *Euryglossina proctotrypoides*: holotype female, "Australia, Croydon", S. W. Fulton (USNM). *Euryglossa minuta*: holotype male, "Australia, Sandringham, Port Phillip, Victoria", 10 February 1929, Rayment (ANIC). Rayment described the holotype of *E. minuta* as a female but it is a male, according to Exley (1968).

**Material examined.** 33 females and 11 males. There is one altitude record of 20–60 m. Collection dates for the 11 collections in the field range from 29 September to 9 March.

**Distribution** (New Zealand, Map 28). North Island: TO, WI. South Island: NN, KA, MC.

**Biology.** Collection site data which range from the central North Island to the coastal north and north-east of the South Island, suggest that the species could occur much more widely.

**Flight period.** The first 3 of 33 females were captured in the field on 29 September and the last on 9 March, with 4 of the total of 7 collections taken during December. For 11 males the first was taken on 14 November and the last on 18 December, with 3 of the 4 collections taken during December.

	Number of collections						
	Sep	Oct	Nov	Dec	Jan	Feb	Mar
Females	1			4	1		1
Males			1	3			

The largest collection is of 10 females and 5 males from Teal Valley, Nelson, on borer-infested wood on 14 December 1971 by E. W. Valentine, and 8 females and 1 male were taken at the Clarence River KA from *Xyletinus undulatus* workings in kanuka, collected on 20 August 1974 by staff of the Forest Research Institute. Bees emerged indoors on 1 October 1974. All other collections were of 3 or fewer bees.

#### Host plants

##### Native plants

##### Myrtaceae

<i>Kunzea ericoides</i>	—	♂ 1/1
<i>Leptospermum scoparium</i>	♀ 3/7	—

<b>Total collections/specimens</b>	♀ 3/7	♂ 1/1
<b>Species/genera/families</b>	1/1/1	1/1/1

**Nest sites.** On 14 December 1971 10 females and 5 males were taken on borer-infested wood. There is one record of 8 females and 1 male emerging in the laboratory on 1 October 1974 from workings of *Xyletinus undulatus* (Coleoptera: Anobiidae) in *Kunzea ericoides*, from a collection made on 20 August 1974.

**Associated organisms.** There is 1 small mite on the lower right of the face of a female from Nelson NN.

**Remarks.** The first collection of this species in New Zealand was of 1 male from the Dumgree plantation, Seddon KA on 14 November 1942 by D. Spiller. The relatively wide distribution of this species in New Zealand is evidence that it has been here for some time, although the possibility that its origin here may date from the days of sailing ship traffic from Australia to New Zealand, which began about 200 years ago, cannot be discounted. According to Exley (1968) the distribution of *E. proctotrypoides* in Australia includes Australian Capital Territory, New South Wales, South Australia, Tasmania, Queensland and Victoria, which is evidence of its ability to occupy a wide range of habitats. All Australian flower-visiting records are for species of Myrtaceae, as are all New Zealand records. Exley (1968) recognized 50 species in the genus *Euryglossina*, and identified 26 species in the subgenus *Euryglossina*, but remarked that it is evident that many new species remain to be discovered (as) collections made by her in new areas have always included new species. Apart from the occurrence of *E. proctotrypoides* in New Zealand, beyond Australia Euryglossinae is represented in New Caledonia by several species (pers. obs.). Also, one specimen has been taken in South Africa, although the species may not be established there (C. D. Michener pers. comm., Michener 2000). Evidently several species in the subfamily have the ability to cross extensive water barriers.

*E. proctotrypoides* is similar in size, shape and overall general appearance to *Spilomena* (Sphecidae), but in the latter an obvious difference is that the antennal sockets are sited very low on the face, while in *E. proctotrypoides* they are much higher. The close similarity of the bee to *Spilomena* spp. may have resulted in specimens being overlooked in some collections. The capture of 10 females and 5 males on borer-infested wood suggests that this bee also nests in tunnels of the anobiid *Anobium punctatum*, which are utilised by 4 species of *Spilomena* (Harris 1994).

#### Family Halictidae

##### Subfamily Nomiinae

##### Genus *Nomia* Latreille

##### Subgenus *Acunomia* Cockerell

*Nomia* (*Paranomia*) Friese, 1897: 48, not Conrad, 1860.

Type species: *Nomia chalybeata* Smith, 1875, by designation of Cockerell, 1910d: 290.

*Nomia* (*Acunomia*) Cockerell, 1930, in Cockerell and Blair, 1930: 11. Type species: *Nomia nortoni* Cresson, 1868, by original designation.

*Nomia* (*Paranomia*) Michener, 1944: 251, not Hendel, 1907, replacement for *Paranomia* Friese, 1897. Type

species: *Nomia chalybeata* Smith, 1875, by original designation and autobasic.

- Nomia (Curvinomia)* Michener, 1944: 251. Type species: *Nomia californiensis* Michener, 1937 = *Nomia tetrazonata* Cockerell, 1910d, by original designation.  
*Nomia (Maculonomia)* Wu, 1982: 275. Type species *Nomia terminata* Smith, by original designation.

***Nomia (Acunomia) melanderi melanderi* Cockerell**  
 alkali bee

Fig. 21a–d, 65a–j; Map 29

**North America**, selected bibliography.

- Nomia melandri* Cockerell, 1906c: 279 (description of female, *lapsus calami*).  
*Nomia melanderi* Cockerell, 1908: 334 (justified emendation of *N. melandri* Cockerell).  
*Nomia (Acunomia) melandri melandri*: Michener, 1951: 1128 (catalogue).  
*Nomia melanderi melanderi*: Selander & Bohart, 1954: 229–241 (biology, photographs of nest site, adult female, nests, host of *Zonitis atripennis flavida*). Ribble, 1965: 320–332 (description of species, and subspecies *N. m. melanderi*, bibliography, range, parasites, predators and diseases, outline of life cycle) 352–353 (map showing distribution in North America) 354–355 (illustration of right hind tibia, male, side view) 358–359 (illustrations of metasomal sterna 5–8 and genitalia).

**New Zealand**, all references.

- Gurr, 1961: 173 (If importation of a new species is contemplated, consideration should be given to the Alkali Bee, *Nomia melandri*, a proven highly efficient pollinator of lucerne in the United States). Anon, 1965: 10–11, 27 (the alkali bee, *Nomia melanderi*, has been released near Lincoln, Canterbury, life cycle). Anon, 1966: 43 (the alkali bee is being introduced on an experimental basis to New Zealand). Palmer-Jones & Forster, 1965: 348 (it has been decided to introduce the alkali bee *Nomia melanderi* to New Zealand). Thomson & Smirk, 1966: 348–349 (rod-shaped particles associated with diseased alkali bee prepupae imported into New Zealand). Palmer, 1966: 22–24 (life cycle, attempt to establish it in New Zealand but temperatures too low for it to be a very efficient pollinator). Cook, 1967: 96 (adults were unsuccessfully released in New Zealand). Palmer-Jones, 1967: 83 (The alkali bee was first introduced in 1964; summer temperatures may be too low; it would require cultivation in special sites). —1968: 20 (quotes Palmer (1966) that soil temperatures may be too low). Palmer-Jones and Forster, 1972: 193 (the alkali bee (*Nomia melanderi*) has recently been introduced to New Zealand). Donovan, 1974: 989 (photograph of alkali bee prepupa in cell), 990–991 (life cycle, introduction to New Zealand). —1975a: 33–39, 46 (pollination of lucerne, alkali bees in the United States, introduction to and biology in New Zealand, photographs of lucerne florets, nest sites in California and New Zealand, prepupae ready for field release). —1975b: 125–126, 128 (life cycle, manage-

ment in North America, introduction to and propagation in New Zealand). Stark, 1975: 27 (photograph of alkali bee nest site at Spring Creek MB, cultured in North America), 29, 57 (introduction to New Zealand, nest site construction). Donovan, 1976a: 232–234 (biology in North America and New Zealand, drawing of female, photographs of nest site in California, prepupae ready for field release, nest site at Spring Creek, Blenheim MB). Macfarlane & Pottinger, 1976: 22 (Entomology Division, DSIR, has introduced the alkali bee (*Nomia melanderi*) from North America to improve lucerne pollination). Donovan & Read, 1979: 1–11 (establishment and maintenance for lucerne pollination, front cover photograph of alkali bee female pollinating lucerne at Dillons Point, Blenheim MB, and carrying lucerne pollen pellet). Donovan, 1979a: 257–268 (importation, establishment and propagation in New Zealand). —1980: 110–114 (biology, interactions with native bees). Donovan & Read, 1980: 69 (released and established). Read, Donovan & Macfarlane, 1980: 12 (13 managed sites and 14,000 nests). Palmer & Donovan, 1980: 87–90, 91 (use for early seed production of new cultivars). Donovan, 1981: 18 (becoming increasingly available). Donovan, Read & Griffin, 1981: 24 (population increasing, site management). —1982a: 14 (wild bees have doubled, sites need expanding). Wightman & Whitford, 1982: 209–215 (integration of insecticides with bee use). Wightman et al. 1982a: 125, 126; and 1982b: 23, 26 (alkali bees feral or managed pollinate lucerne in New Zealand, alkali bees can be observed visiting, tripping and therefore pollinating lucerne). Donovan, Read & Griffin, 1983: 15 (photograph of wild nests at Dillons Point, Blenheim MB, site management). Donovan & Read, 1983: 1–11 (establishment and maintenance for lucerne pollination, front cover photograph of alkali bee female pollinating lucerne at Dillons Point, Blenheim MB, and carrying lucerne pollen pellet). Donovan, 1984: 5 (quotes Donovan & Read (1983) reporting that sparrows have been observed eating alkali bees at nest sites in New Zealand). Donovan & Read, 1984a: 16 (2000 wild nests, New Zealand alkali bees the only population outside North America). Donovan & Macfarlane, 1984: 251–253 (drawing of female bee, description, life cycle, management, photographs of artificial nest site near Blenheim and nest entrance holes). Donovan, 1991: 25 (since 1985 the number of nests has increased from 1,800 to 31,610).

**Female** ( $n = 20$ ). Length 10.5–13.5 mm ( $11.7 \pm 0.79$  mm); width 3.7–4.6 mm ( $4.2 \pm 0.24$  mm); forewing length 6.5–7.7 mm ( $7.4 \text{ mm} \pm 0.35$  mm); facial length 2.2–2.5 mm ( $2.4 \pm 0.07$  mm); facial width 2.1–2.4 mm ( $2.3 \pm 0.07$  mm); malar length/malar width 0.

**Coloration.** Black, except antennae brown ventrally beyond scape, middle area and apex of mandibles, and tarsal claws red; basal 3/4 of wing membranes hyaline, outer quarter dusky, submarginal vein and pterostigma dark brown or black, remaining wing veins brown; tibial spurs pale. Metasomal terga 1–4 with most of post-gradular area yellow.

low-green, except that on tergum 1 about half width of areas on terga 2–4; tergum 5 with triangular apical area brown.

**Structure.** (Fig. 65a–b). Scape as long as combined length of first 7 flagellar segments. Compound eyes nearly 4× longer than wide, with about upper 1/4 and lower 3/4 of inner margins converging markedly above and below respectively. Ocellular distance a little more than 2 ocellar diameters; interocellar distance equal to 1 ocellar diameter. Antennal sockets 1.5× further from apex of clypeus than from vertex. Face shiny except for paraocular area narrowly moderately tessellated, tessellation extending across between ocelli, tessellated area with small punctures separated by about 1–3 diameters; remainder of paraocular area and frons with large, irregular close punctures. Supraclypeus rising rather evenly from below and laterally to form a median longitudinal rounded ridge extending up to a little below a line across upper margins of antennal sockets, crest of ridge narrowly impunctate, remainder of supraclypeus with medium-sized to large, close punctures; frontal line prominent, extending from ridge to median ocellus. Clypeus somewhat protuberant, short, extending for about 1/6 its length below a line across lower margins of compound eyes, lower margin broadly and shallowly emarginate; with very large punctures separated by about 0.5 diameters, sometimes forming longitudinal lines near centre of clypeus. Labrum with prominent, median longitudinal very narrow keel, rounded distally. Compound eye projecting over part of mandible base, so malar length is zero. Galea very lightly tessellated, shiny. In lateral view, gena a little wider than compound eye, lightly shagreened, with large, close punctures.

Pronotum moderately shagreened, with a few very widely-spaced medium-sized punctures. Scutum with about posterior half with a few very widely-spaced small to large punctures, shiny, appearing almost impunctate, anterior half with large crowded punctures. Scutellum similar to posterior half of scutum. Metanotum moderately tessellated, with large, very deep, very close punctures, dull. Propodeal triangle divided by a sharp transverse ridge into a narrow dorsal face, moderately shagreened, traversed by more or less longitudinal ridges, and narrow posterior, almost vertical triangular face, moderately shagreened; remainder of propodeum divided laterally in lower 1/2 by a sharp sub-longitudinal ridge into a posterior face, heavily shagreened with large deep punctures separated by 0.5–2 diameters, punctures extending to dorsal area of lateral face, and lateral face with heavy sub-horizontal ridges. Metepisternum similar to ridged area of lateral propodeal face. Remainder of lateral aspect of mesosoma with large to very large close punctures. Basitibial plate prominent, extending for about 1/6 length of tibia, concave, moderately

tessellated, central area with small very close punctures. Tibial spurs ciliate, recurved apically towards basitarsus. Pterostigma 2.75× longer than wide, vein 1st m-cu meets 2nd submarginal cell about 1/3 length of cell from distal end.

Metasomal tergum 1 with anterior face impunctate medially, laterally with large punctures separated by 0.5 diameters, disc with small to large widely-spaced punctures; tergum 2 with disc with small to medium-sized punctures, terga 3–4 with small, close punctures. Terga 1–4 with disc tessellated, tessellation decreasing from moderate on tergum 1 to light on tergum 4, Terga 1–4 with small to medium-sized punctures separated by about 1 diameter between yellow-green areas and premarginal line, yellow-green areas extremely lightly tessellated. Tergum 5 with basal half with large, irregular close punctures, brown apical area with medium-sized punctures separated by about 1 diameter or less. Pygidial plate prominent, truncate apically, flat except for thick edges raised and rounded, and a very stout, median rounded longitudinal ridge. Sternum 1 truncate apically; sterna 1–6 moderately shagreened, all of sternum 1 and about apical halves of sterna 2–6 with medium-sized punctures from close to 2 diameters apart.

**Vestiture.** White, except brown-black around naked areas of scutum and scutellum, brown on basitibial plate and adjacent basal area of tibia, golden on inner face of pro- and mesotibia and tarsus, and metatarsus, brown to black on black surface of metasomal terga 4–6 and on pygidial plate. Facial vestiture most dense on paraocular areas but scarcely obscuring surface; about anterior 1/2 of scutum nearly obscured by short, dense vestiture, posterior 1/2 naked, scutellum naked in broad medium area. Metacoxa, trochanter and femur with vestiture long, branched, on femur forming well-developed scopa. Tibia with scopa. Concavity of basitibial plate with appressed, posteriorly-directed vestiture. Median ridge of pygidial plate flanked by appressed vestiture. Metasomal sterna 2–5 with straight, posteriorly-directed hairs on posterior halves.

**Male** (n = 20). Length 10.2–13.1 mm ( $12.1 \pm 0.81$  mm); width 3.7–4.5 mm ( $4.2 \pm 0.20$  mm); forewing length 7.4–9.2 mm ( $8.2 \pm 0.49$  mm); facial length 2.2–2.5 mm ( $2.3 \pm 0.10$  mm); facial width 2.0–2.2 mm ( $2.1 \pm 0.07$  mm); malar length/malar width 0.

**Coloration.** Black, except antennae yellow ventrally beyond pedicel, about apical 1/3 of mandibles dark red-black, wings, tibial spurs and tarsal claws as in female, inner surface of protibia, probasitarsus and mesobasitarsus pale, swollen distal expansion of metatibia and all except outer edge of metabasitarsus almost clear, metasomal tergum 1 with apical lateral margins and terga 2–5 with broad apical margins coloured as in female.

**Structure.** (Fig. 65c–d). Scape a little shorter than com-

bined length of first 2.5 flagellar segments, terminal flagellar segment tapering to thin point. Compound eyes a little more than  $3\times$  longer than wide, with upper  $1/5$  and lower  $4/5$  of inner margins converging markedly above and below respectively. Ocellular distance  $2.5\times$  an ocellar diameter; interocellar distance as in female; diameter of median ocellus  $1.5\times$  diameter of lateral ocellus. Antennal sockets  $1.6\times$  further from apex of clypeus than from vertex. Supraclypeus flat from side-to-side, except for median, rounded longitudinal ridge extending from clypeal margin to prominent point on a line across lower margins of antennal sockets, remainder of supraclypeus with medium-sized close punctures; low ridge extending from point to halfway to median ocellus, frontal line extending from there to median ocellus. Remainder of face except clypeus similar to female. Clypeus protuberant, short, extending for one-twelfth its length below a line across lower margins of compound eyes, lower margin rounded below, about middle  $2/5$  of clypeus delineated from lateral areas by rounded ridges extending  $2/3$  of the way up clypeus from lower margin, lower  $1/2$  of area between ridges impunctate, shiny, remainder of clypeus similar to supraclypeus except punctures becoming large, irregular laterally. Mandible with prominent tooth-like projection on ventral aspect closer to apex of mandible than base. In lateral view, compound eye  $1.4\times$  wider than gena, gena produced to point on posteroventral corner, sculpturing similar to female.

Pronotum lightly shagreened, with mixed small to medium-sized close punctures. Posterior  $1/2$  of scutum and scutellum with large punctures separated by about 0.5 diameters, punctures becoming smaller, closer towards anterior of scutum. Remainder of mesosoma similar to female, except shagreening light on posterolateral face of propodeum, punctures extending to most of lateral face of propodeum. Pterostigma a little more than  $3\times$  longer than wide, vein 1st m-cu meets 2nd submarginal cell as in female. Metatibia produced anteroapically into large, rounded translucent lobe (Fig. 65i), tibial spurs recurved apically towards mid-line of insect.

Metasomal terga 1–5 similar to female 1–4, except without tessellation, punctures larger throughout; tergum 6 with apical margin raised, shiny, with small to large irregular punctures separated by about 1–2 diameters. Tergum 7 bilobed apically, sculpturing similar to tergum 6. Sternum 1 truncate apically, apical margin of sternum 2 produced to a short flat point; sternum 3 near base with lateral raised sub-transverse ridge  $3\text{--}4\times$  as long as wide, sterna 1–4 shagreened, sternum 1 with a very few widely-spaced, medium-sized punctures, sternum 2 with small punctures separated by 3–4 diameters, sternum 3 with a very few, almost obscured, medium-sized punctures on posterior  $1/2$ , sternum 4 with a few scattered larger

punctures anteriorly. Sternum 5 highly modified, with lateral hair pads and projections. Sternum 6 with lateral anteriorly-directed process, apical margin concave. Sternum 7 (Fig. 65e) truncate basally, concave apically. Sternum 8 (Fig. 65f) produced basally, apex with posteriorly-directed blunt process. Gonocoxites and gonostyli in dorsal and ventral views (Fig. 65g) rounded and incurved apically, penis valves large, convoluted apically; in lateral view (Fig. 65h) gonostylus with anteriorly-projecting, recurved acute process on dorsal surface near apex, penis valve not projecting below gonostylus.

**Vestiture.** White, except for slightly yellow on inner faces of pro- and mesotarsus, brown just anterior to coloured band on metasomal tergum 4, brown-black on black areas of terga 5–7. Whole body hirsute except for lower  $1/2$  of clypeus almost naked, translucent area of metatibia naked, apex of metasomal tergum 1 whether coloured or not and coloured apices of terga 2–5 naked, ventrolateral aspects of terga 1–2 naked, sterna 1 and 3–4 naked. Except for lower  $1/2$  of clypeus, remainder of face below a line halfway between antennal sockets and median ocellus completely obscured by short, dense, appressed hairs. Anterior  $1/2$  of scutum almost obscured by erect vestiture.

**Variation.** The colored apical band on metasomal tergum 1 of females may be reduced and even missing medially. On males tergum 1 can have a complete coloured apical band, but it is always less than  $1/2$  the width of the bands on terga 2–5. In both sexes the colour of the tergal apical bands can vary, ranging through iridescent red, bronze, white and gold.

**Type data.** *Nomia melandri*: holotype female, "North Yakima, Washington, United States of America", 10 July 1903, A. L. Melander (CESR).

**Material examined. United States.** One female and 1 male from Idaho, 12 females and 16 males from Utah. The bees developed in quarantine to adulthood at DSIR Lincoln from imported prepupae. **New Zealand.** 341 females and 44 males from areas where bees were liberated, at Dillons Point and the Wairau Valley MB, Lincoln and Lake Ellesmere MC, and Alexandra CO. The species now occurs only at naturally-saline silty bare or semi-bare ground at Dillons Point MB, and one man-made nest site near Wairau Valley MB, and possibly naturally saline areas near Earnsclough and Alexandra CO, South Island. Adults have been collected from 6 November to 22 March.

**Distribution** (New Zealand, Map 29). South Island: MB, CO(?).

**Biology.** The requirement for saline, moist nesting soils greatly limits the areas which the species can colonise.

**Flight period.** Only 10 females have been purposely cap-



tured alive; all 10 were over a nest site on 12 January 1998. The only purposely-captured male was taken as it emerged from a nest on 8 February 1977. Apart from 2 females and 2 males found dead in nests, all remaining bees in collections were found dead on the surface of nest sites. The 62 collections of females were taken from November to March, with the vast majority in January and February. The 14 collections of males were made from December to February, with most in January and February.

#### Number of collections

	Nov	Dec	Jan	Feb	Mar
Females	2	3	27	23	7
Males		2	6	6	

For the first several weeks of each new season of activity, males outnumbered females over and near nest sites. Mating occurred frequently on the surface of nest sites, and infrequently where males patrolled vegetation out to about 50 m from nest sites. The date of maximum number of nests initiated in a day ranged from the last day of December to 24 January, first pollen was carried into nests from 8 December to 15 January, and the last pollen from 22 February to 16 March.

In 4 seasons a small partial second generation appeared. Several fresh males were seen in early March, mating occurred, and a few fresh nests were initiated soon after. However, pollen was not seen to be carried into the nests. Under a clear sky bees nested freely at an air temperature of 20°C, but under heavy cloud bees did not become fully active until 24°C. Flight speed increased with increasing temperature. In good flying weather, sudden threatening adverse changes such as the approach of rain clouds, caused large numbers of bees to enter nests.

#### Host plants

Only 22 females in collections carry pollen, and all were found dead on nest site surfaces. Many hundreds of bees have been observed visiting flowers. Only 5 introduced species of flowers in 4 genera and 2 families were visited, and pollen was collected by many females. Where nest sites occurred near lucerne seed fields, female bees tripped lucerne flowers for pollen at the rate of 13-16 per minute (18 bees), while males supping nectar occasionally tripped a floret in the process. Pollen from lucerne flowers formed cream-coloured pellets on bees' scopa, and where nest

sites were near lucerne seed fields, most females carried cream pellets into nests. However, where weedy yellow composite flowers occurred in or near lucerne seed fields, many females collected yellow composite pollen. One female was observed to collect pollen almost alternately from bristly hawksbeard (*Crepis setosa*) and lucerne flowers. Cream pollen pellets removed from 3 bees were composed exclusively of lucerne pollen, while orange or off-orange pellets removed from 4 other bees contained high percentages of composite pollen.

**Nest sites.** Alkali bees will construct nest tunnels only in silty soils which are sufficiently saline that the surface remains moist, at least while tunnels are being initiated. During the 1970's bees nested in man-made nest sites at Mahoe Road, Manunui TO, the Blenheim-Wairau Valley area MB, Seddon KA, Lincoln, Lake Ellesmere and Kaituna Valley MC, and Alexandra, Earnsclough and Ida Valley CO. By the 1980's bees were nesting in naturally saline silty ground at Blenheim MB and Lake Ellesmere MC. In 1992, the last year of nest number assessment, the number of nests in all areas totalled 27,633 (after peaking at 31,610 in 1991). By 1998 bees were known to persist in only 1 man-made nest site at Wairau Valley MB, and in natural nest sites at Dillons Point MB.

Simple nests consist of a near-vertical tunnel 7-9 mm in diameter and about 100 mm deep. Debris excavated from the tunnel is piled around the nest entrance forming a volcano-shaped tumulus. However, wind and rain frequently remove it. In sharp contrast to the tunnels of *Leioproctus* spp. which contain much loose spoil, the tunnels of alkali bees are open. A tunnel broadens at its lower end and branches to short tunnels, each of which terminate in an oval cell. Cells are about 12-15 mm long and 8-9 mm across and are oriented with the long axis vertical. The number of cells is very variable, but there may be up to about 10. Frequently a second tunnel may branch off the first above the cell cluster, so that one or more cell clusters may be formed at up to about 350 mm deep (Fig. 65j). Nest architecture can be very irregular, especially where nest density is high.

**Associated organisms.** Thomson and Smirk (1966) found that rod-shaped particles were associated with alkali bee prepupae imported into New Zealand that showed signs of disease, whereas healthy prepupae were without the

#### Host Plants

##### Introduced plants

##### Asteraceae

<i>Crepis setosa</i>	♀ many/many (many/many p)	♂ many/many
<i>Taraxacum officinale</i>	♀ tens/scores	♂ tens/tens

##### Fabaceae

<i>Medicago sativa</i>	♀ scores/hundreds (scores/hundreds p)	♂ dozens/scores
<i>Trifolium pratense</i>	♀ tens/dozens (tens/dozens p)	—
<i>Trifolium repens</i>	♀ hundreds/hundreds (scores/hundreds p)	♂ tens/dozens

particles.

From 1971 to 1979, soil-inhabiting fungi in the cosmopolitan genera *Aspergillus*, *Penicillium* and *Cunninghamella* were found in several hundred cells of 2,925 excavated near Blenheim MB, some of which contained pollen and/or dead alkali bee larvae. However, whether the fungi were responsible for larval death or were secondarily invasive after death could not be ascertained, but the latter seems likely. Three prepupae which were alive when collected later turned pink and died. In North America 17 species of yeasts or yeast-like fungi were isolated from the crops of bees and floral nectar, and *Saccharomyces cerevisiae* caused bee larvae feeding on infected provisions to become pink and die (Batra, Batra and Bohart 1973). Because some yeasts are ubiquitous the death of some New Zealand alkali bee larvae after turning pink could have been caused by yeasts.

House sparrows, *Passer domesticus*, killed a few bees at several nest sites. The sparrows appeared to be attracted to the nest sites by the salt, as depressions up to 10 mm deep were pecked into the surface. Bees were attacked when they appeared just within nest entrances prior to flight, and as they alighted on return from flight. Man-made sites were protected with wire mesh that was sufficiently small to exclude sparrows but yet large enough to allow unimpeded access by alkali bees.

Mice, *Mus musculus*, rats, *Rattus* sp., and rabbits, *Oryctolagus cuniculatus* tunnelled in some man-made nest sites. In one site mouse predation of prepupae was severe, and in another site, rabbit burrows disrupted nests. These animals were controlled by exclusion fencing, trapping and poisoning.

Areas nested in by alkali bees frequently also harboured nests of some native bees, particularly *Leioproctus fulvescens* and *Lasioglossum sordidum*. However, no adverse interactions were observed. In most man-made nest sites the pompilid *Priocnemis* (*Trichocurgus*) *carbonarius* built cells off some alkali bee tunnels above the first group of bee cells. No interactions of wasps and bees were seen, and there was no indication that wasps interfered with bees. Earwigs, *Forficula auricularia*, and slaters, *Porcellio* spp., were sometimes present in bee nests, but their effect is unknown.

Ten females collected over a nest site at Dillons Point, Blenheim MB, carry 18–44 mites (mean = 28), and 2 females and 2 males collected dead on nest sites in the same area each carry 1 mite.

**Remarks.** Cockerell (1906b) described the female with “hind margins of abdominal segments 2 to 4 with very broad light emerald-green tegumentary bands; first segment with a little green at the hind corners”. However, Ribble (1965) (p. 323) said the female had “Terga 1 to 5

with apical colored bands, sometimes indistinct on tergum 1”, and Stephen, Bohart & Torchio (1969) said “Metasomal terga 1 through 5 in the females and 1 through 6 in the males ... have apices which ... are a yellowish green colour”. All the females and males studied here, including the specimens from the United States, possessed only black apices to metasomal terga 5 and 6 respectively. Also, Stephen, Bohart & Torchio (1969) figure a triangular pseudopygidium on metasomal tergum 5. However, none could be distinguished on the specimens before me.

The alkali bee is well established in New Zealand, at least in the Blenheim MB area in naturally saline soils. However, since bees were first discovered occupying naturally-occurring saline areas, housing and cultivation have destroyed several of the largest nesting aggregations. Almost certainly a number of undiscovered nesting areas exist, but if reclamation of saline areas was to intensify, and grape cultivation continued to extend into former lucerne seed fields, the future of the alkali bee in New Zealand would be in jeopardy. The New Zealand population is the only population outside the natural and cultivated range of the species in the United States.

## Subfamily Halictinae

### Tribe Halictini

#### Genus *Lasioglossum* Curtis

#### Subgenus *Austrevylaeus* Michener

*Lasioglossum* (*Austrevylaeus*) Michener, 1965: 170. Type species *Halictus sordidus* Smith, 1853, by original designation.

#### *Lasioglossum* (*Austrevylaeus*) *mataroa* new species

Fig. 22a–d, 66a–g; Map 30

**Female.** (n = 20). Length 4.5–6.1 mm (5.2 ± 0.34 mm); width 1.4–1.8 mm (1.6 ± 0.09 mm); forewing length 3.1–3.9 mm (3.4 ± 0.18 mm); facial length 1.2–1.3 mm (1.2 ± 0.05 mm); facial width 1.0–1.1 mm (1.0 ± 0.04 mm); malar length/malar width 0.17.

**Coloration.** Head, mesosoma and metasoma black, except face and mesosoma with metallic colours, on face primarily red-blue, on mesosoma primarily green-bronze, but variable; antennae yellow to light yellow ventrally beyond about first flagellar segment; extreme apex of pro- and mesofemur and extreme base of pro- and mesotibia light yellow; apex of mandibles and tarsal claws red; tegula, wing veins and pterostigma almost hyaline brown-yellow; wing membranes hyaline; apical margins of metasomal terga 1–4 and sterna 1–5 hyaline, that of terga 2–4 broadly so; pseudopygidium red-brown.

**Structure.** (Fig. 66a–b). Scape about as long as combined length of first 7.5 flagellar segments. Compound eyes a little more than 4× longer than wide, with a little less than upper 1/3 of inner margins converging moderately above, and a little more than 2/3 converging moderately below. Ocellular distance 1.7× an ocellar diameter; interocellar distance equal to 1 ocellar diameter. Antennal sockets about equidistant between apex of clypeus and vertex. Face shiny throughout. Supraclypeus rising evenly from below, laterally and above to a rounded mound between a line across lower margins of antennal sockets and lower margin of supraclypeus; frontal ridge extending to less than halfway to median ocellus, with a very slight depression just above termination of frontal ridge; frontal line partly or wholly obscured by sculpturing. Face except lower 1/2 of clypeus moderately tessellated; supraclypeus with medium-sized but indistinct punctures separated by several diameters around lateral and lower periphery, but by much more medially; frons with medium-sized, deep close punctures imparting rough appearance; paraocular area similar to lateral and lower periphery of supraclypeus. Clypeus slightly protuberant but in lateral view less forward than supraclypeus, extending for less than 1/2 to about 3/4 of its length below a line across lower margins of compound eyes, lower margin broadly recurved, about upper 1/2 of clypeus with small to medium-sized punctures separated by about 3–5 diameters, about lower 1/2 of clypeus lightly tessellated to smooth, with a few medium-sized to large punctures separated by about 1–4 diameters. Labrum with raised basal median area very narrow, laterally flattened, keel extending well beyond basal area. Malar space about 6× wider than long, with faint trace of tessellation. Galea smooth, shiny. In lateral view, gena slightly narrower than compound eye, shiny, moderately tessellated, with medium-sized indistinct punctures separated by about 2–4 diameters.

Pronotum lightly shagreened, shiny. Scutum, scutellum densely tessellate, shiny, with medium-sized punctures separated by about 2–5 diameters. Metanotum heavily shagreened, dull. Propodeum strongly angled, dorsal face about 2/3 length of posterior face; dorsal face a little concave, with irregular sub-longitudinal striae except on posterior margin; posterior face flat except for shallow rounded central depression, face delineated from lateral aspect of propodeum by well-defined carinae extending dorsally 3/4 of way to angle with dorsal face; whole propodeum moderately tessellated, lateral face with a very few indistinct, widely-spaced medium-sized punctures. Dorsal 1/2 of metepisternum with strong transverse striae, remainder moderately tessellated. Remainder of lateral aspect of mesosoma similar to lateral face of propodeum. Inner metatibial spur very finely ciliate. Pterostigma a little

more than 3× longer than wide, vein 1st m-cu interstitial with 1st r-m or almost so.

Metasomal terga 1–5 and sterna 1–5 lightly shagreened, tergum 5 with small to medium-sized punctures separated by about 2–4 diameters; pseudopygidium on tergum 5 narrow, linear, extending for just over 1/2 of posterior 1/2 of tergum. Pygidial plate flat, rounded apically, near base with small raised half-moon-shaped ridge with ends facing forward. Sternum 1 emarginate apically, sterna 2–5 with posterior 2/3 with medium-sized punctures separated by 2–3 diameters.

**Vestiture.** White throughout. On face scarcely longer than width of scape, evenly distributed, not obscuring surface; above and lateral to antennal sockets erect to directed dorsally; on remainder of face directed ventrally. Metasomal vestiture as short as on face dorsally and of similar density, except very short, fuzz-like on metanotum apart from a few longer hairs laterally; on lateral aspect of mesosoma longer than dorsally. Vestiture long, plumose, forming pollen-carrying areas on lateral face of propodeum, metatrochanter, metafemur and posterior halves of metasomal sterna 1–3. Pollen may also be carried by shorter, less branched hairs on the bases of meso- and metalegs, and posterior halves of metasomal sterna 4–5. Vestiture of tibial scopa shorter, stouter than that on trochanter and femur, so that in anterior view width of scopa is only a little more than double width of tibia. Metasomal tergum 1 with disc naked, some long hairs laterally, terga 2–3 with extremely short appressed scale-like hairs covering about lateral 3rds, with a few interspersed longer erect hairs, tergum 4 completely covered in similar vestiture which obscures much of the surface. Tergum 5 similar except for pseudopygidium, and hairs longer, not appressed.

**Male** (n = 20). Length 3.9–4.9 mm ( $4.3 \pm 0.27$  mm); width 0.8–1.1 mm ( $0.9 \pm 0.08$  mm); forewing length 2.5–3.2 mm ( $2.8 \pm 0.19$  mm); facial length 1.0–1.2 mm ( $1.1 \pm 0.04$  mm); facial width 0.8–1.0 mm ( $0.9 \pm 0.05$  mm); malar length/malar width 0.14.

**Coloration.** Black/brown except antennae yellow ventrally and laterally beyond pedicel; ventral 1/2 or more of clypeus, whole of labrum, and mandible between black base and red apex, yellow; galea brown; remainder of face, gena and mesosoma very dark metallic blue, except pronotal lobe partly yellow; legs yellow beyond apex of femur except about central 1/2 or more of tibia brown/black, that on proleg not complete laterally; tarsal claws red; tegula almost hyaline, wing membranes hyaline, wing veins and pterostigma pale yellow; metasomal terga 1–5 broadly hyaline apically and laterally, sterna 1–5 broadly hyaline apically; apex of abdomen narrowly yellow.

**Structure.** (Fig. 66c–d). Scape about equal in length to com-

bined length of first 2.5 flagellar segments. Compound eyes somewhat more than 4× longer than wide, with inner margins as in female. Ocellular distance 1.6× an ocellar diameter; interocellar distance about 0.85× an ocellar diameter. Position of antennal sockets as in female. Frons dull, remainder of face shiny throughout. Supraclypeus similar to female but rising slightly higher. Clypeus similar to female but slightly more protuberant, lower 1/2 smooth with very large, irregular close punctures. Remainder of face lightly tessellated; frons with medium-sized, dense, close punctures separated by 1 diameter or less. Malar space short, 7× wider than long. Remainder of head similar to female except labrum simple, without keel.

Mesosoma and wing similar to female.

Metasomal terga 1–5 and sterna 1–5 similar to female, except tergum 5 without pseudopygidium, impunctate; posterior halves of sterna 2–5 with small, widely-spaced punctures. Sternum 7 (Fig. 66e) with anterior lateral processes projecting anteriorly, median apical process rounded; sternum 8 with lateral process rounded laterally, median apical process rounded. Gonocoxites in dorsal and ventral views (Fig. 66f) bluntly rounded laterally, posterior inner angle acute but narrowly rounded, gonostyli small, rounded apically, penis valves longest on outer extremity; in lateral view (Fig. 66g) penis valve projecting well beyond and below gonostylus, narrow, acute apically; retrorse lobe wide basally, apical 1/2 very narrow, acute.

**Vestiture.** White, short. Face from a line below about 1/3 distance above antennal sockets to median ocellus, and excluding yellow area of clypeus almost obscured by thick, scale-like vestiture, that above a line across lower margin of antennal sockets directed dorsally, below this line directed ventrally. The few erect hairs about as long as a little more than 1/2 length of scape. Mesosomal vestiture sparse dorsally, about 1/2 as long as scape, but longer, more dense laterally. Metasomal terga 2–4 with vestiture distribution similar to female but more extensive, more dense and a little longer. Sterna 1–2 with moderately long, moderately dense vestiture, sternum 3 with thicker vestiture partially divided longitudinally, sterna 4–5 laterally with long dense vestiture and median area almost naked, sternum 6 naked except for a few extremely short hairs.

**Variation.** The length of the lower face varies markedly in both sexes, so that in some specimens the face appears much shorter than in others. Metallic colours can be very evident, or may be almost absent.

**Type data.** *Lasioglossum mataroa*: holotype female, here designated, “Tekapo MK, 13 km S”, 5 February 1972, on *Achillea millefolium*, B. J. Donovan (NZAC). Allotype male, same data as holotype. Thirty-two paratype females and 31 paratype males, same data as holotype.

**Material examined.** Type specimens, plus 113 females

and 64 males. There are 15 altitude records which range from 209–1101 m; however, the records for coastal MC must be about 10 m. For the 90 collection records, collection dates range from 15 October to 16 April.

**Distribution** (Map 30). South Island: MC, MK, OL, CO.

**Biology.** The species clearly favours the dry climate of the montane south central South Island, with the only exceptions being the collection of 2 females at one site and 1 male at another in MC. Two females were captured in a pan trap in grassland at Alexandra CO, and 3 females were taken from a window at Tekapo Power House MK.

**Flight period.** There have been 59 collections of 146 females taken from 15 October to 16 April, with most collections from November to February. For 96 males, there have been 31 collections from 3 December to 16 April, with most in January and February.

#### Number of collections

	Oct	Nov	Dec	Jan	Feb	Mar	Apr
Females	4	13	9	14	12	5	2
Males			5	12	10	3	1

The largest collection is of 33 females, of which 32 are carrying pollen, and 32 males, from 13 km S Tekapo MK, on *Achillea millefolium* on 5 February 1972, by B. J. Donovan. The same collector took 15 females, of which 1 is carrying pollen, 16 km S Pukaki MK on the same flowers on 10 February 1970, and another 2 females and 12 males at Twizel MK on the same flowers on 7 February 1970. All other collections are of 10 or fewer bees.

#### Host plants

##### Native plants

Asphodelaceae		
<i>Bulbinella</i> sp.	♀ 1/2 (1/1 p)	—
Asteraceae		
<i>Raoulia australis</i>	♀ 1/3 (1/1 p)	—
<i>Raoulia parkii</i>	♀ 1/1 (1/1 p)	—
<i>Raoulia</i> sp.	♀ 1/4 (1/4 p)	—
<i>Taraxacum magellanicum</i>	—	♂ 1/2
Campanulaceae		
<i>Wahlenbergia</i> sp.	♀ 1/2 (1/2 p)	♂ 1/1
Myrtaceae		
<i>Kunzea ericoides</i>	—	♂ 1/1
Plantaginaceae		
<i>Chionohebe pulvinaris</i>	♀ 1/1	—
Rhamnaceae		
<i>Discaria toumatou</i>	♀ 1/1	—
<b>Total collections/specimens</b>	♀ 7/14 (5/9 p)	♂ 3/4
<b>Species/genera/families</b>	7/5/5 (5/3/3 p)	3/3/3

##### Introduced plants

Asteraceae		
<i>Achillea millefolium</i>	♀ 6/55 (4/35 p)	♂ 7/51
<i>Tagetes</i> sp.	—	♂ 1/2
<i>Taraxacum</i> sp.	♀ 9/13 (7/9 p)	♂ 3/3
‘thistle’	♀ 1/1	♂ 2/2

Brassicaceae		
<i>Capsella bursa-pastoris</i>	♀ 1/1	—
Hypericaceae		
<i>Hypericum perforatum</i>	—	♂ 2/3
<i>Hypericum</i> sp.	♀ 2/4 (1/2 p)	♂ 2/6
Fabaceae		
<i>Melilotus albus</i>	♀ 1/3 (1/1 p)	♂ 1/2
<i>Melilotus</i> sp.	—	♂ 1/4
Ranunculaceae		
<i>Ranunculus</i> sp.	♀ 2/5 (2/4 p)	—
Rosaceae		
<i>Potentilla</i> sp.	♀ 1/5 (1/5 p)	—
<b>Total collections/specimens</b>	♀ 23/87 (16/56 p)	♂ 19/73
<b>Species/genera/families</b>	8/8/6 (6/6/5 p)	8/6/3

*Lasioglossum mataroa* thus displays only a moderately strong preference for 3 native species of Asteraceae, but a very strong preference for 2 introduced species in the family.

**Nest sites.** One female bee carrying pollen was captured over nests at each of an alkali bee (*Nomia melanderi*) nest site, and bare ground at an old brickworks, at Earnsclough CO. At both sites the silty ground was salty at the surface and moist beneath the surface. The alkali bee nest site was artificially watered from below, but the brickworks site was naturally moist. Nest entrances were surrounded by a tumulus of soil several mm high and several mm across.

**Associated organisms.** None are known.

**Etymology.** *mataroa*: Maori *mata* = face, *roa* = long. Refers to the face of females often appearing longer than that of other New Zealand species in the genus.

**Remarks.** Females can be distinguished from those of *L. sordidum* by their slightly smaller size, usually at least some metallic coloration on the head and/or mesosoma, and usually their longer face. They are much smaller than females of *L. maunga*, which are without metallic colours. Males are separable from those of *L. sordidum* by their metallic coloration on head and mesosoma, the presence of dense, appressed vestiture on the face, and the distinctive parted vestiture on metasomal sterna 4–5. They are much smaller than males of *L. maunga*, which have the mandibles and labrum black.

This is *Lasioglossum* sp.1 of Quinn (1984) 43–44 (have iridescent green metallic sheen on head and thorax, flight period, flower records).

### *Lasioglossum (Austrevylaeus) maunga* new species

Fig. 22e–f, 23a–b, 67a–g; Map 31

**Female** (n = 20). Length 4.9–6.4 mm (5.7 ± 0.38 mm); width 1.5–2.0 mm (1.8 ± 0.14 mm); forewing length 3.7–4.4 mm (4.1 ± 0.21 mm); facial length 1.3–1.5 mm (1.4 ± 0.06 mm); facial width 1.1–1.3 mm (1.2 ± 0.06 mm); malar

length/malar width 0.25.

**Coloration.** Black, except antennae dark brown ventrally beyond about 2nd flagellar segment; apex of mandible and tarsal claws dark red; tegula, pterostigma and wing veins brown; wing membranes and apical margins of metasomal terga 1–4 and sterna 1–5 hyaline; pseudopygidium brown.

**Structure.** (Fig. 67a–b). Scape equal in length to combined length of first 7 flagellar segments. Compound eyes about 5.25× longer than wide, with about upper 1/3 and lower 2/3 of inner margins converging moderately above and below respectively. Median ocellus somewhat larger than lateral ocelli: ocellocular distance a little less than 2.5× diameter of lateral ocellus; interocellar distance about 0.7× maximum diameter of median ocellus. Antennal sockets equidistant between apex of clypeus and vertex. Face with frons dull, remainder shiny. Supraclypeus rising from its perimeter to a rather evenly rounded mound, the apex of which is about mid-way between a line across lower margins of antennal sockets and lower margin of supraclypeus; from apex frontal ridge extends about halfway to median ocellus, with frontal line from there to median ocellus almost or completely obscured by dense tessellation; supraclypeus moderately tessellated throughout to almost smooth medially, with medium-sized punctures separated by 5 or more diameters. Frons with very close medium-sized punctures, densely tessellated; punctures becoming more widely separated between lateral ocellus and compound eye, and on vertex. Paraocular area similar to lateral area of supraclypeus, except ventrally becoming almost smooth and punctures a little larger and closer. Clypeus a little protuberant, extending for a little more than 1/2 its length below a line across lower margins of compound eyes; about dorsal 1/2 similar to lateral area of supraclypeus except punctures larger, closer, about ventral 1/2 lightly tessellated to almost smooth, with very large irregular punctures separated by about 1 diameter. Labrum with large, partly bilobed raised basal median area, very narrow laterally flattened keel extending well beyond basal area. Malar space 4× wider than long, with a few faint longitudinal striae, shiny. Galea smooth, shiny, impunctate. In lateral view, gena and compound eye about equal in width, gena moderately tessellated with tessellation partly obscuring large, shallow, irregular punctures separated by 1–3 diameters, in some lights tessellation appearing linear from vertex to margin of compound eye.

Pronotum lightly to moderately tessellated, impunctate. Scutum moderately tessellated, dull, with small to medium-sized punctures separated by 2–4 diameters. Scutellum similar to scutum except punctures less obvious. Metanotum moderately tessellated, dull, impunctate. Dorsal face of propodeum strongly angled with posterior

face, dorsal face a little longer than posterior face, slightly concave, with basal 2/3 roughly and irregularly longitudinally striate, moderately tessellated. Posterior face of propodeum delineated from lateral face from below by well-defined carinae reaching about halfway to angle with dorsal face. Remainder of mesosoma moderately tessellated, although lateral face of propodeum less so with obscure, widely spaced large punctures, and dorsal 1/2 of metepisternum with strong transverse striae, metepisternum impunctate. Remainder of mesosoma with large, irregular punctures separated by about 2–5 diameters. Inner metatibial spur ciliate. Pterostigma slightly more than 3× longer than wide, vein 1st m-cu meets 2nd submarginal cell just before distal boundary.

Metasomal terga 1–5 very lightly shagreened; terga 1–2 impunctate dorsally with a few very small widely-spaced punctures on ventral areas; terga 3–5 with very small widely-spaced punctures dorsally, punctures becoming larger, spacing decreasing to 1–2 diameters on tergum 5, with punctation extending to ventral areas. Tergum 5 with pseudopygidium a narrow bare space about 1/2 length of tergum. Pygidial plate flat, with about apical 1/3 lightly tessellated, apical 1/2 with lateral edges raised; small, raised semicircular area with open end forward near base. Sternum 1 impunctate, posterior margin widely and very shallowly emarginate apically; sterna 2–5 with anterior 1/2 with medium-sized punctures separated by 1–3 diameters.

**Vestiture.** White to off-white, except light brown or golden on lower clypeus, light brown on vertex, scutum and dorsal 1/2 of metatibial scopa. On face vestiture sparse, erect or nearly so, with maximum length about equal to twice diameter of median ocellus. Scutal vestiture shorter than on face but of similar density. Metanotum with very short, fine, fuzz-like vestiture. Moderately long hairs around bases of meso- and metalegs and on lower 1/2 of lateral face of propodeum capable of carrying pollen. On metatrochanter and basal 2/3 of metafemur vestiture long, plumose, forming pollen-carrying scopa. Metatibial scopa of short, stout hairs projecting from dorsal side of tibia for less than 1/2 width of tibia. Disc of metasomal terga 1–3 almost naked, disc of tergum 4 with sparse, short hairs, disc of tergum 5 more densely covered, with vestiture short and thick flanking pseudopygidium. Metasomal sterna 1–5 with long branched hairs forming pollen-carrying areas.

**Male.** (n = 20). Length 5.2–7.4 mm ( $6.3 \pm 0.63$  mm); width 1.0–1.4 ( $1.3 \pm 0.10$  mm); forewing length 3.3–4.3 mm ( $4.1 \pm 0.22$  mm); facial length 1.3–1.6 mm ( $1.4 \pm 0.06$  mm); facial width 1.0–1.4 mm ( $1.3 \pm 0.09$  mm); malar length/malar width 0.18.

**Coloration.** Similar to female, except that about lower 1/2 of clypeus mostly yellow.

**Structure.** (Fig. 67c–d). Scape about as long as combined length of first 2.6 flagellar segments. Compound eyes nearly 4.5× longer than wide, with inner margins converging more strongly than in female. Ocellular distance equal to 2.5× an ocellar diameter; interocellar distance similar to female. Supraclypeus similar to female except with a small peak just below a line across lower margins of antennal sockets. Clypeus markedly protuberant, otherwise similar to female. Malar space short, about 5.5× wider than long. Remainder of head similar to female, except tessellation a little heavier throughout; labrum simple, without keel. Mesosoma similar to female, except tessellation somewhat more dense so that especially on scutum punctation less obvious. Wing similar to female.

Metasomal terga 1–5 and sterna 1–5 similar to female, except punctures much less apparent, tergum 5 without pseudopygidium. Sternum 7 (Fig. 67e) with lateral anterior processes directed anteriorly, median apical process broadly rounded; sternum 8 with lateral processes blunt laterally, median apical process rounded apically. Gonocoxites in dorsal and ventral views (Fig. 67f) rounded laterally, posterior inner angle acute, gonostyli rounded, penis valves projecting beyond gonostyli, blunt apically; in lateral view (Fig. 67g) penis valve long, acute apically, projecting well below elongate gonostylus; retrorse lobe long, narrowing anteriorly to acute apex.

**Vestiture.** White throughout to slightly off-white on face and scutum. On face most dense over widest distance between inner margins of compound eyes, hairs 2/3 as long as scape, partly obscuring surface; elsewhere on face much less dense, shorter, clypeus with very few hairs. On mesosoma vestiture nearly as long as longest on face but much less dense. Metasomal terga 1–5 with short, sparse vestiture throughout, terga 2–3 also with very short almost matt-like vestiture on basal 1/2, this area widest laterally. Sterna 1–3 with moderately dense, moderately long vestiture, sternum 4 similar but with vestiture shorter medially, sternum 5 with long dense vestiture divided medially, so forming a thick longitudinal pad on each side of sternum.

**Variation.** Females from Arthur's Pass and Cass MC have dark facial vestiture, whereas females from Craigieburn Range MC have white to slightly off-white facial vestiture. The length of the lower 1/2 of the face varies in both sexes, but because all parts vary equally, the variation is difficult to quantify. One female from the Hawkdun Range CO has a slight multicoloured metallic tinge to the upper 1/2 of the face and the dorsal aspect of the mesosoma. The face of 1 large female of 2 females taken with 4 males at the Montgomery Scenic Reserve MC, has the face dark metallic blue below the antennae.

**Type data.** *Lasioglossum maunga*: holotype female, here designated, “Mt. Robert, BR, 1340 m”, sweeping tussock, 16 January 1976, A. K. Walker (NZAC). Allotype male, here designated, “Old Man Range CO, near top”, 22 February 1973, on *Gentiana bellidifolia*, B. J. Donovan (NZAC). Three paratype females, same data as holotype; 3 paratype males, same data as allotype, 1 paratype male, same data as allotype except collected by S. S. Wier.

**Material examined.** Type specimens, plus 444 females and 176 males. For the North Island, only 2 males have been taken, 1 from Old West Coast Road Palmerston North WN, and 1 from Renata hut Tararua Range WN. There are 81 altitude records, the highest of which is 1840 m, where 1 female was found on snow. There are 36 other records for 1000 m and over, 42 records between 500–999 m, and just 2 under 500 m. One collection from 10 km S Blenheim MB, which has no altitude record, was probably below 305 m. Collection dates for the 249 collection records range from 28–30 September to 11 April.

**Distribution** (Map 31). North Island: WN. South Island: NN, BR, MB, KA, WD, NC, MC, MK, SC, FD, OL, CO, DN.

**Biology.** This species occurs primarily in mountainous areas, and is not found on lowland plains. The 2 records from the North Island suggests that its distribution in the North Island is greater than records indicate.

**Flight period.** The first seasonal capture record for the 168 collections of 448 females is 28–30 September, and the last 10 April, with the majority of captures made from November to February. The 81 collections of 181 males have been taken from 7 November to 11 April, with just over half of all records in February.

	Number of collections							
	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr
Females	1	12	36	35	44	23	11	6
Males			2		19	42	12	6

The largest collection of females was 28, of which 1 was carrying pollen, from Leith Saddle DN, in a broadleaf forest, on 19 December 1989, by A. C. Harris. For males the largest collection was 26, and also 2 females, which were taken at the Cobb Reservoir NN with a Malaise trap on the edge of a *Nothofagus* forest, during January 1981 by A. R. Curtis. There are 8 other collections of 10 or more bees, and all other collections are of fewer than 10 bees.

#### Host plants

##### Native plants

Apiaceae			
<i>Aciphylla horrida</i>	♀ 1/1 (1/1 p)	—	
‘Apiaceae’	—	♂ 1/1	
<i>Gingidia montana</i>	♀ 1/5 (1/4 p)	—	
<i>Gingidia</i> sp.	♀ 2/2 (1/1 p)	—	

Asteraceae			
<i>Brachyglottis bellidioides</i>	♀ 2/4 (1/1 p)	—	
<i>Brachyscome sinclairii</i>	♀ 2/2	—	
<i>Celmisia discolor</i>	♀ 1/1	—	
<i>Celmisia gracilentia</i>	♀ 2/9 (1/5 p)	—	
<i>Celmisia spectabilis</i>	♀ 1/1	—	
<i>Celmisia</i> sp.	♀ 2/4 (2/2 p)	—	
<i>Celmisia verbascifolia</i>	♀ 1/1	—	
<i>Helichrysum bellidioides</i>	♀ 1/1 (1/1 p)	—	
<i>Leucogenes grandiceps</i>	♀ 5/6	—	
<i>Olearia avicenniifolia</i>	—	♂ 1/1	
<i>Olearia virgata</i>	♀ 1/1 (1/1 p)	—	
Campanulaceae			
<i>Wahlenbergia</i> sp.	♀ 4/8 (3/3 p)	♂ 1/1	
Ericaceae			
<i>Dracophyllum</i> sp.	♀ 1/1	—	
<i>Gaultheria crassa</i>	♀ 1/8 (1/2 p)	—	
Gentianaceae			
<i>Gentiana bellidifolia</i>	—	♂ 4/6	
<i>Gentiana corymbifera</i>	—	♂ 1/2	
<i>Gentiana townsonii</i>	♀ 1/1	♂ 1/1	
Malvaceae			
<i>Hoheria populnea</i>	—	♂ 1/1	
Myrtaceae			
<i>Kunzea ericoides</i>	♀ 1/1	—	
<i>Metrosideros</i> sp.	♀ 1/1	♂ 1/8	
Plantaginaceae			
<i>Hebe</i> sp.	♀ 5/31 (3/20 p)	♂ 5/22	
<i>Ourisia caespitosa</i>	♀ 1/1	—	
<i>Ourisia macrocarpa</i>	♀ 1/2 (1/1 p)	—	
<i>Ourisia macrocarpa</i> var. <i>calycina</i>	♀ 1/3	—	
<i>Parahebe linifolia</i>	♀ 1/6 (1/6 p)	—	
<i>Parahebe lyallii</i>	♀ 1/3 (1/1 p)	—	
Ranunculaceae			
<i>Ranunculus lyallii</i>	♀ 6/14 (3/4 p)	—	
Rhamnaceae			
<i>Discaria toumatou</i>	♀ 1/2 (1/2 p)	♂ 1/1	
Thymelaeaceae			
<i>Pimelea prostrata</i>	♀ 1/1	—	
<i>Pimelea traversii</i>	♀ 2/15 (2/5 p)	—	
<b>Total collections/specimens</b>	♀ 51/136 (25/60 p)	♂ 17/44	
<b>Species/genera/families</b>	29/20/10 (17/14/8 p)	10/8/8	
<b>Introduced plants</b>			
Asteraceae			
<i>Achillea millefolium</i>	♀ 3/8 (3/6 p)	♂ 2/2	
<i>Hieracium</i> sp.	♀ 1/1 (1/1 p)	—	
<i>Hypochoeris radicata</i>	—	♂ 1/1	
<i>Senecio jacobaea</i>	♀ 1/1	♂ 3/11	
Polemoniaceae			
<i>Phlox</i> sp.	♀ 1/2 (1/1 p)	—	
Ranunculaceae			
<i>Ranunculus lappaceus</i>	♀ 1/1	—	
Rosaceae			
<i>Rosa rubiginosa</i>	♀ 1/1	—	
<b>Total collections/specimens</b>	♀ 8/14 (5/8 p)	♂ 6/14	
<b>Species/genera/families</b>	6/6/4 (3/3/2 p)	3/3/1	

A wide range of native plants appears to be favoured as foraging sources, but in contrast the number of introduced plants is much more restricted. This may be more a reflection of the smaller number of introduced plants which inhabit the high country compared to lower altitudes, rather than an indication of the foraging preferences of the bees.

**Nest sites.** Nests are not known, but females have been captured over clay at Scotts Saddle, Mt Hutt MC, at Ben Lomond, Queenstown OL, at Flagstaff, Dunedin DN, and Mt Luxmore hut FD. A male was taken in a sandy clearing in *Nothofagus* at Renata, Tararua Range WN. One other male was found under stones and logs at Canaan Track, Takaka Hills NN.

**Associated organisms.** One female from Caanan Track, Takaka Hills NN carries 5 small mites.

**Etymology.** *maunga*: Maori = mountain. The species is found primarily in mountainous terrain.

**Remarks.** Female *Lasioglossum maunga* are readily separated from *L. sordidum* and *L. mataroa* by their larger size and the upright, relatively long, facial vestiture. Males have a black labrum and black mandibles.

The habitat of this species is clearly primarily montane, but there is considerable overlap (at least in the South Island) with the range of *L. sordidum*, and less so with that of *L. mataroa*. There seems to be no reason why the range of the species in the mountainous areas of the North Island should not be much greater than known at present.

This is *Lasioglossum* 'A' of Primack (1978: 70, all 26 collected were females), (1983: 323–329, 332, flower records).

### *Lasioglossum (Austrevylaeus) sordidum* (Smith)

Fig. 23c–f, 68a–g; Map 32

*Halictus sordidus* Smith, 1853: 56 (description of female). Hutton, 1874: 165 (list). —1881: 101 (repeats description of Smith 1853). Kirby, 1881: 38 (list). —1884: 67 (list). Dalla Torre, 1896: 85 (list, Australia: New Zealand). Cameron, 1900: 17 (key). —1903: 299 (list). Alfken, 1903: 595–596 (collection record and description of male, *Halictus huttoni* is not different to the present species, only somewhat lighter). Cockerell, 1904b: 213 (list, gives main characters). Hutton, 1904: 96 (list). Cockerell, 1916a: 287 (characters of the base of the median segment (metathorax) used by Cameron to separate *smithii* from *sordidus* and *huttoni* are unsatisfactory). —1916b: 361 (list). Meyer, 1931: 253 (*huttoni* is a synonym), 254 (key, seems to be abundant in New Zealand). Heine, 1937: 139, 145, 146 (flower records). Michener, 2000: 359 (Type species of *Austrevylaeus*).

*Halictus familiaris* Smith, 1876: 486 (description of female). Hutton, 1881: 101 (repeats description of Smith 1876). Kirby, 1881: 38 (list). —1884: 67 (list). Dalla Torre, 1896: 85 (list, Australia, New Zealand, synonym of

*smithii*). Cameron, 1900: 17 (key). —1903: 299 (list). Cockerell, 1904b: 213 (list, synonym of *Halictus Smithii*, D. T., gives main characters). Hutton, 1904: 96 (list). Cockerell, 1909: 315–316 (key to *Halictus* of Japan and China, *H. familiaris*, Sm. (preocc.)). Kirkaldy, 1909: 131 (*Halictus smithii* D.T. = *familiaris*, Smith). Cockerell, 1916a: 287 (*H. smithii (familiaris)*, Smith) is a variable species). —1916b: 361 (*smithii (familiaris)*, list). —1925: 553 (described by Smith from specimens taken by C. M. Wakefield in Canterbury Province, South Island). Meyer, 1931: 253 (is a synonym of *Halictus smithii*). Heine, 1937: 139, 142 (flower records).

*Halictus smithii* Dalla Torre, 1896: 85 (new name for *Halictus familiaris* Smith). Cockerell, 1904b: 213 (list, (*familiaris*, Smith), gives main characters). Kirkaldy, 1909: 131 (*Halictus smithii* D.T. = *familiaris*, Smith.). Cockerell, 1916a: 286–287 (description of female of variety *a*, from Waipara, New Zealand; concludes that *H. smithii (familiaris)*, Smith) is a variable species; characters of the base of the median segment (metathorax) used by Cameron to separate *smithii* from *sordidus* and *huttoni* are unsatisfactory). —1916b: 361 (*smithii (familiaris)*, list). Meyer, 1931: 253 (*familiaris* is a synonym), 253–254 (description of both sexes, key). **New synonymy.**

*Halictus huttoni* Cameron, 1900: 17–18 (description of male), 17 (key). —1903: 299 (list). Alfken, 1903: 596 (is not different to the present species (ie *H. sordidus*), only somewhat lighter). Hutton, 1904: 96 (list). Cockerell, 1916a: 287 (characters of the base of the median segment (metathorax) used by Cameron to separate *smithii* from *sordidus* and *huttoni* are unsatisfactory). —1916b: 361 (list). Meyer, 1931: 253 (is a synonym of *Halictus sordidus*). Burrows, 1960: 38–40 (visits *Pimelea* spp. at Cass, nests in clay patches and banks). **New synonymy.**

*Lasioglossum (Austrevylaeus) huttoni*: Michener, 1965: 171 (list, new combination). Valentine & Walker, 1991: 43 (list, synonymy).

*Lasioglossum (Austrevylaeus) smithii*: Michener, 1965: 171 (list, new combination, synonymy). Valentine & Walker, 1991: 43 (list, synonymy).

*Lasioglossum (Austrevylaeus) sordidum*: Michener, 1965: 164 (illustration of labrum and inner hind tibial spur of female), 166 (sketches of lateral and dorsal aspects of male genitalia), 171 (list, new combination). Valentine & Walker, 1991: 43 (list, synonymy).

*Lasioglossum sordidum*: Garnock-Jones, 1976: 297 (visits a wide range of flowers). Primack, 1978: 68 (tremendous numbers on *Discaria* flowers), 70 (all 53 collected were females). —1979: 10–11 (visits flowers of *Discaria toumatou*). Palmer & Donovan, 1980: 89 (at Lincoln numerous bees collect pollen from lucerne flowers that have already been tripped). Donovan, 1980: 107 (life cycle probably primitively eusocial, nest tunnels up to 400 mm deep in ground, broadly generalist flower relationships). —1983a: 515 (visits nectarless flowers of kiwifruit, *Actinidia deliciosa*). Primack, 1983: 323–327, 329, 332 (flower records). Donovan & Macfarlane, 1984: 248 (photograph of female), 250 (life cycle probably primitively eusocial, nest tunnels up to 400 mm deep in



ground, about 80 spp. of flowering plants visited). Quinn, 1984: 43 (in the Mackenzie Basin, adults fly from early October to mid March, investigate yellow or orange flowers, nest sites widespread in more sandy loam areas). Bocher & Philipp, 1985: 143–144, 146–148 (visitation behaviour to flowers of *Mimulus repens*). Webb, 1985: (visits flowers of *Discaria toumatou*, much more common on other species in flower in the same community), 335 (Primack suggested the bee was a most important pollinator of *D. toumatou*; it was more abundant on *Corokia cotoneaster*). Harris, 1987: 62 (8 bee nests shared with *Priocnemis (Trichocurgus) crawi* (Pompilidae), 146 (drawing of a shared nest (but see **Remarks**)). Webb, 1994: 388 (scanning electron micrograph of *Corokia* pollen on the body of *L. sordidum*), 389 (observations show *L. sordidum* appears particularly suited to pollinate flowers of *C. cotoneaster*). Butz Huryn, 1995: 509 (is adapted to *Corokia cotoneaster*). Early, 2001: 67 (2 photographs of bees, outline of biology). Robertson, Ladley & Kelly, 2005: 301 (discovered that it is a frequent visitor to previously opened flowers of *Peraxilla tetrapetala*, but is apparently too small to open the buds), 302 (activity rates on 3 *Peraxilla* mistletoes). Newstrom & Robertson, 2005: 32 (Primack 1983 observed the species visiting broom), 56 (Donovan unpublished has recorded the species from the blossoms of 56 exotic plant species).

**Female** (n = 20). Length 4.9–6.1 mm ( $5.5 \pm 0.38$  mm); width 1.4–1.9 mm ( $1.7 \pm 0.14$  mm); forewing length 3.3–4.3 mm ( $3.8 \pm 0.29$  mm); facial length 1.1–1.4 mm ( $1.2 \pm 0.07$  mm); facial width 1.0–1.2 mm ( $1.1 \pm 0.08$  mm); malar length/malar width 0.11.

**Coloration.** Black, except antennae brown ventrally, apices of mandibles and tarsal claws red, galea, tegula and wing veins brown, wing membranes hyaline, tibial spurs pale, apical margins of metasomal terga 1–4 and sterna 1–5 hyaline.

**Structure.** (Fig. 68a–b). Scape as long as combined length of first 7.5 flagellar segments. Compound eyes about 5× longer than wide, with upper 1/3 of inner margins converging strongly above, lower 2/3 converging less strongly below. Ocellular distance equal to 1.7× an ocellar diameter; interocellar distance equal to 1 ocellar diameter. Antennal sockets equidistant between apex of clypeus and vertex. Supraclypeus rising rather evenly from below and laterally to a low, rounded mound mid-way between upper margin of clypeus and antennal sockets, lightly tessellated, with about 20 medium-sized, obscure, widely-separated punctures; frontal line extending to median ocellus. Frons dull, densely tessellated, with medium-sized, close punctures. Remainder of face shiny. Paraocular areas moderately tessellated, with medium-sized punctures separated by 1–5 diameters. Clypeus flat, short, extending for a little less than 1/2 its length below a line across lower margins of

compound eyes, with large punctures separated by about 1–6 diameters, about upper 1/2 very lightly tessellated, remainder smooth, shiny. Labrum with raised, basal median area, very narrow laterally flattened keel extending well beyond basal area. Malar space short, 9× wider than long, lightly shagreened. Galea smooth, shiny. In lateral view, gena about equal in width to compound eye, moderately tessellated, with tessellation partly obscuring medium-sized punctures separated by 2–5 diameters, shiny. Pronotum heavily shagreened. Scutum and scutellum heavily tessellated, with small punctures separated by 1–4 diameters, shiny. Metanotum moderately shagreened, dull. Dorsal face of propodeum strongly angled with posterior face, dorsal face with irregular, sub-longitudinal striae except for posterior margin; posterior face flat except for longitudinal depression, delineated from lateral face of propodeum by well-defined carina; whole propodeum moderately tessellated, lateral face with almost-obscured widely-spaced medium-sized punctures. Dorsal 1/2 of metepisternum with transverse striae, remainder moderately tessellated. Remainder of lateral aspects of mesosoma similar to lateral face of propodeum. Pterostigma a little more than 3× longer than wide, vein 1st m-cu interstitial with 1st r-m or almost so.

Metasomal terga 1–5 and sterna 1–5 lightly shagreened, tergum 5 with small, widely-spaced punctures, sternum 1 very shallowly emarginate apically, sterna 2–5 with small to medium-sized punctures separated by 2–3 diameters. Tergum 5 with narrow, linear pseudopygidium extending for just over 1/2 length of tergum. Pygidial plate flat, rounded apically, small raised area just above base.

**Vestiture.** White to off-white, except light brown on outer face of metatibial scopa, and lateral to pseudopygidium. On face short, sparse, above antennal sockets scarcely longer than diameter of median ocellus, erect; below antennal sockets a little longer. Mesosomal vestiture short and sparse, except very short and fuzz-like on metanotum. On metatrochanter, metafemur and metasomal sterna 1–3 long, plumose, forming pollen-carrying areas; on bases of meso- and metalegs, and metasomal sterna 4–5, vestiture shorter, less branched. Metatibia with scopa of short, stout vestiture with less branching than vestiture of metatrochanter and metafemur. Metasomal tergum 1 with sparse, long hairs laterally, tergum 2 with extremely short hairs anterolaterally, on tergum 3 these hair patches covering about anterolateral 3rds, on tergum 4 whole surface with short, sparse hairs projecting posteriorly but not recumbent.

**Male** (n = 20). Length 4.0–6.0 mm ( $4.8 \pm 0.46$  mm); width 0.8–1.1 mm ( $1.0 \pm 0.07$  mm); forewing length 2.8–3.5 mm ( $3.2 \pm 0.21$  mm); facial length 1.0–1.2 mm ( $1.1 \pm 0.05$  mm); facial width 0.8–1.0 mm ( $0.9 \pm 0.06$  mm); malar length/malar width 0.07.

**Coloration.** Black, except antennae brown-yellow ventrally beyond pedicel, about lower central 2/3 of clypeus yellow, labrum yellow, about middle 1/3 of mandibles yellow, pronotal lobe partly yellow, tegula partly hyaline, wing veins brown, wing membranes hyaline, apices of mandibles and tarsal claws red, proleg yellow beyond extreme apex of femur except for black or brown central area in outer face of tibia, meso- and metalegs similar except tibia black except for each end narrowly yellow; apex of metasoma narrowly yellow.

**Structure.** (Fig. 68c–d). Scape short, about equal to combined length of first 2.3 flagellar segments. Compound eyes about 4× longer than wide, with about upper 1/3 and lower 2/3 of inner margins converging strongly above and below respectively. Ocellular distance equal to 1.6× an ocellar diameter; interocellar distance similar to female. Antennal sockets a little closer to vertex than to apex of clypeus. Supraclypeus and frontal line similar to female, although frontal line sometimes obscured by dense tessellation on frons. Frons similar to female, with sculpturing extending to compound eyes; remainder of paraocular area similar to female. Clypeus somewhat protuberant, extending for about 1/5 its length below a line across lower margins of compound eyes; about dorsal 1/4 very lightly tessellated, whole clypeus with very large, shallow, irregular punctures separated by about 1 diameter, shiny. Malar space very short, about 14× wider than long, otherwise similar to female. Remainder of head similar to female except labrum simple, without keel.

Mesosoma and wing similar to female, except dorsal face of propodeum slightly concave.

Metasomal terga 1–5 and sterna 1–5 similar to female, except punctures smaller, tergum 5 without pseudopygidium, tergum 6 without pygidium. Sternum 7 (Fig. 68e) with anterior processes scimitar-shaped, median apical process rounded apically; sternum 8 with lateral processes bluntly rounded, median apex bluntly rounded. Gonocoxites in dorsal and ventral views (Fig. 68f) widely expanded and rounded laterally, posterior inner angle acute, gonostyli small, penis valves extending beyond gonostyli, bluntly rounded apically; in lateral view (Fig. 68g) penis valve projecting beyond and below gonostylus, acute apically; retrorse lobe long, narrowing anteriorly, apex acute.

**Vestiture.** White, short. Face above antennal sockets with erect vestiture a little longer than 1–2 ocellar diameters, not obscuring surface; below antennal sockets and excepting yellow area of clypeus, surface obscured by short, thick, scale-like flat vestiture. Metasomal terga 2–3 with distribution of vestiture similar to female; remainder of metasoma with sparse, short vestiture.

**Variation.** Bees from the lowlands of Central Otago through to Canterbury and the Kaikoura and Marlborough areas are shinier, and the females have more metasomal tergal vestiture, than bees from elsewhere. The appressed facial vestiture of males from the same areas is more dense than that of males from elsewhere, and the yellow areas of the legs are more intensely yellow. The metasomal sternal vestiture of all 15 females from Whare Creek, Molesworth MB, 15 females from Rough Island, Nelson NN, and 8 females in one collection from Cass MC, is longer than that of other females. Metallic dark blue-reds occur on the head and/or mesosoma of some females in 12 collections, and most males in 1 collection from South Island localities east of the main divide from MB to MK. Most females in 2 collections from Rukuhia WO, and Annat and Dallington MC, show orange/yellow to a greater or lesser degree in the lower 1/3 of the clypeus.

**Type data.** *Halictus sordidus*: holotype female, “New Zealand”, (BMNH). *Halictus familiaris*: holotype female, “Canterbury, New Zealand”, C. M. Wakefield (BMNH). *Halictus huttoni*: holotype male, “Christchurch, New Zealand”, P. Cameron (BMNH). The BMNH holds 3 males, 1 glued to cardboard on 1 pin, and 2 glued to one other piece of cardboard on another pin. The first 3 labels on each pin carry the same data, including the words ‘Type’, ‘B. M. TYPE’, and ‘Cam. Type’. *Halictus smithii* variety *a*: holotype female, “Waipara, New Zealand”, 21 November 1915, G. Brittin.

Smith (1853) and Cameron (1900) ascribe an obscurely green or greenish tinge to the head and thorax, and vertex, of *H. sordidus* and *H. huttoni* respectively, and in a key Meyer (1931) also described the head and thorax of male *H. sordidus* as of a green appearance. However, the holotypes and all other bees appear black to me.

**Material examined.** Type specimens (except for variety *a*), plus 3853 females and 2613 males. Collection dates for the 1683 collection records range from 1 August to ? June.

**Distribution** (Map 32). North Island: ND, AK, CL, WO, BP, TK, TO, GB, RI, HB, WI, WN. South Island: SD, NN, BR, MB, KA, WD, NC, MC, MK, SC, FD, OL, CO, DN, SL. Stewart Island. Offshore Islands: Three Kings Islands.

**Biology.** The species occurs in abundance throughout most of its range in the east and north of the South Island. There are a total of 163 altitude records, with 55 from 0–499 m, 95 from 500–999 m, 12 from 1000–1499 m, and 1 at 1640 m. Wherever suitable nest sites and forage resources are available, the species can be expected to be present.

**Flight period.** For 3,853 females the 1,063 collection record dates range from 1 August to 13 May, and the 620 collection records for 2,507 males range from 9 October to ? June. Peak female abundance is from October to February, and

peak male abundance is from December to March.

	Number of collections											
	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	
Females	2	21	106	216	280	237	116	56	26	3		
Males			3	21	110	215	163	85	20	2	1	

The largest collection of females is 71 (and also 38 males) at Ashley Gorge NC on 21 January 1960, by C. W. O'Brien. None of the females carry pollen. There are 66 collections of between 50 and 10 females, of which 13 collections have 10–50 females with pollen. The largest collection of males is 210 at Lincoln MC from *Hebe* sp. on 23 March 1970, by R. P. Macfarlane. The next largest collection of males is 92 (and 1 female without pollen) taken on the Mount Sebastopol Walk MK on 8 February 1969 on a Lincoln University College Field Trip. The third largest collection of males is 66 (and 3 females, all without pollen), which were captured at Kaituna, Banks Peninsula MC on *Leptospermum scoparium* on 9 December 1962, by J. L. Gressit. There are 50 collections of between 50 and 10 males. All other collections of females and males are of between 9 and 1 bee.

### Host plants

#### Native plants

Family	Species	♀	♂
Apiaceae	<i>Aciphylla aurea</i>	♀ 1/1	—
	<i>Aciphylla horrida</i>	♀ 1/1 (1/1 p)	—
	<i>Aciphylla subflabellata</i>	♀ 1/22 (1/18 p)	—
	<i>Aciphylla</i> sp.	♀ 2/4 (1/1 p)	—
	<i>Gingidia montana</i>	♀ 1/1	—
Araliaceae	<i>Pseudopanax crassifolium</i>	♀ 1/2	—
Argophyllaceae	<i>Corokia cotoneaster</i>	♀ 3/10 (2/7 p)	—
Asphodelaceae	<i>Bulbinella hookeri</i>	♀ 1/8 (1/7 p)	—
	<i>Bulbinella</i> sp.	♀ 3/22 (2/10 p)	—
Asteraceae	<i>Brachyglottis</i> sp.	♀ 1/1	—
	<i>Brachyscome sinclairii</i>	♀ 1/1	—
	<i>Celmisia du-rietzii</i>	♀ 1/2 (1/2 p)	—
	<i>Celmisia gracilentia</i>	♀ 3/9 (3/6 p)	—
	<i>Celmisia</i> sp.	♀ 1/9 (1/3 p)	—
	<i>Cotula</i> sp.	♀ 3/22 (3/16 p)	♂ 2/15
	<i>Olearia virgata</i>	♀ 3/16 (1/1 p)	♂ 1/1
	<i>Olearia</i> sp.	♀ 1/2	♂ 1/22
	<i>Ozothamnus leptophyllus</i>	♀ 5/13 (2/2 p)	♂ 6/53
	<i>Ozothamnus/Coprosma</i>	—	♂ 1/2
	<i>Pachystegia insignis</i>	♀ 1/1 (1/1 p)	♂ 1/1
	<i>Raoulia australis</i>	♀ 1/1	—
	<i>Raoulia</i> sp.	♀ 1/1	♂ 1/3
	<i>Taraxacum magellanicum</i>	♀ 1/2	♂ 1/2
Campanulaceae	<i>Wahlenbergia albomarginata</i>	♀ 1/1 (1/1 p)	♂ 1/2
	<i>Wahlenbergia pygmaea</i>	—	♂ 1/2
	<i>Wahlenbergia</i> sp.	—	♂ 1/1

Cunoniaceae	<i>Weinmannia</i> sp.	♀ 1/1	—
Ericaceae	<i>Gaultheria crassa</i>	♀ 1/2	—
Fabaceae	<i>Carmichaelia</i> sp.	♀ 5/8 (1/1 p)	♂ 1/4
	<i>Sophora</i> sp.	♀ 3/8 (1/2 p)	—
Fagaceae	<i>Nothofagus</i> sp.	♀ 6/32 (3/6 p)	♂ 2/22
Gentianaceae	<i>Gentiana corymbifera</i>	♀ 1/1	♂ 1/2
Hemerocallidaceae	<i>Phormium tenax</i>	♀ 4/8 (3/4 p)	—
Laxmanniaceae	<i>Cordyline australis</i>	♀ 7/24 (6/16 p)	—
	<i>Cordyline banksii</i>	♀ 1/1	—
Loganiaceae	<i>Geniostoma</i> sp.	♀ 1/3	—
Loranthaceae	<i>Peraxilla colensoi</i>	♀ 1/4 (1/2 p)	—
	<i>Peraxilla tetrapetala</i>	♀ 4/10 (3/8 p)	—
	<i>Tupeia antarctica</i> male	♀ 1/2	—
Malvaceae	<i>Hoheria angustifolia</i>	♀ 3/11 (3/8 p)	♂ 3/9
	<i>Hoheria</i> sp.	♀ 1/1	♂ 1/13
Myrsinaceae	<i>Myrsine australis</i>	—	♂ 1/1
Myrtaceae	<i>Kunzea ericoides</i>	♀ 4/7	♂ 12/57
	<i>Kunzea/Leptospermum</i> sp.	♀ 1/5 (1/1 p)	♂ 1/21
	<i>Leptospermum scoparium</i>	♀ 17/54 (5/9 p)	♂ 17/139
	<i>Lophoyrtus obcordata</i>	—	♂ 1/2
	<i>Lophoyrtus</i> sp.	—	♂ 1/3
	<i>Metrosideros excelsa</i>	♀ 1/2 (1/1 p)	♂ 2/5
Pennantiaceae	<i>Pennantia corymbosa</i>	♀ 1/2 (1/2 p)	—
Phrymaceae	<i>Mimulus repens</i>	♀ 1/1	—
	<i>Mimulus</i> sp.	♀ 2/3 (1/1 p)	♂ 1/4
Plantaginaceae	<i>Chionohebe pulvinaris</i>	♀ 2/4 (1/3 p)	—
	<i>Hebe brachysiphon</i>	♀ 2/11 (1/3 p)	—
	<i>Hebe chathamica</i>	♀ 1/4 (1/3 p)	♂ 1/1
	<i>Hebe elliptica</i>	♀ 1/1 (1/1 p)	—
	<i>Hebe odora</i>	♀ 1/4 (1/2 p)	♂ 1/2
	<i>Hebe pubescens</i>	♀ 1/2	♂ 3/12
	<i>Hebe salicifolia</i>	♀ 2/7 (1/1 p)	♂ 2/7
	<i>Hebe speciosa</i>	♀ 2/2 (1/1 p)	—
	<i>Hebe stricta</i>	♀ 3/26	♂ 1/2
	<i>Hebe subalpina</i>	♀ 3/9 (2/4 p)	♂ 1/1
	<i>Hebe traversii</i>	♀ 1/1 (1/1 p)	♂ 1/6
<i>Hebe</i> sp.	♀ 21/72 (12/33 p)	♂ 9/231	
Polygonaceae	<i>Muehlenbeckia</i> sp.	♀ 1/7 (1/1 p)	♂ 4/17
Ranunculaceae	<i>Clematis</i> sp.	♀ 1/2	—
	<i>Ranunculus godleyanus</i>	♀ 1/4	—
	<i>Ranunculus lappaceus</i>	♀ 3/10 (1/1 p)	—
	<i>Ranunculus lyalli</i>	♀ 3/14 (1/3 p)	—

Rhamnaceae				'Thistle'	♀ 1/10 (1/2 p)	♂ 3/5
<i>Discaria toumatou</i>	♀ 9/67 (7/40 p)	—		Boraginaceae		
Rosaceae				<i>Echium vulgare</i>	♀ 3/4	♂ 1/2
<i>Rubus schmidelioides</i>	♀ 1/3	—		Brassicaceae		
Rubiaceae				<i>Brassica napo</i> var.		
<i>Coprosma repens</i>	♀ 1/1 (1/1 p)	—		<i>napobrassica</i>	♀ 1/18 (1/15 p)	—
Rutaceae				<i>Brassica napus</i>	♀ 2/5 (1/1 p)	♂ 1/1
<i>Melicope simplex</i>	♀ 1/1	—		<i>Brassica oleracea</i>	♀ 2/5 (1/4 p)	♂ 1/1
Scrophulariaceae				<i>Brassica</i> sp.	♀ 2/5 (1/2 p)	♂ 2/30
<i>Myoporum laetum</i>	♀ 1/2	—		<i>Capsella bursa-pastoris</i>	♀ 2/5 (2/2 p)	—
Theophrastaceae				<i>Raphanus sativus</i>	♀ 1/8 (1/8 p)	—
<i>Samolus repens</i>	♀ 1/1 (1/1 p)	—		Caryophyllaceae		
Thymelaeaceae				<i>Dianthus caryophyllus</i>	♀ 1/2	—
<i>Pimelea traversii</i>	♀ 1/1 (1/1 p)	—		Ericaceae		
Urticaceae				<i>Rhododendron</i> sp.	♀ 2/22 (1/7 p)	—
<i>Urtica ferox</i>	♀ 2/10 (1/1 p)	—		Fabaceae		
Winteraceae				<i>Cytisus scoparius</i>	♀ 3/16 (2/9 p)	—
<i>Pseudowintera colorata</i>	♀ 1/1	—		<i>Cytisus</i> sp.	♀ 1/3 (1/2 p)	—
<b>Total collections/specimens</b>	♀ 172/609 (87/227 p)	♂ 84/665		<i>Laburnum</i> sp.	♀ 1/3	—
<b>Species/general/families</b>	71/46/31 (45/30/22 p)	33/20/11		<i>Medicago sativa</i>	♀ 6/10 (1/1 p)	♂ 5/19
<b>Introduced plants</b>				<i>Trifolium repens</i>	—	♂ 1/2
Actinidiaceae				<i>Ulex europaeus</i>	♀ 1/4 (1/3 p)	—
<i>Actinidia deliciosa</i> female	♀ 14/80 (5/38 p)	♂ 3/4		Fagaceae		
male	♀ 11/25 (7/14 p)	♂ 1/1		<i>Castanea sativa</i>	♀ 2/31 (2/29 p)	♂ 1/5
female/male	♀ 8/12 (2/3 p)	♂ 2/6		Grossulariaceae		
Adoxaceae				<i>Ribes nigrum</i>	♀ 1/2 (1/2 p)	—
<i>Viburnum tomentosum</i>	♀ 1/9 (1/1 p)	—		Hypericaceae		
<i>Viburnum</i> sp.	♀ 1/2	—		<i>Hypericum perforatum</i>	♀ 2/7 (1/5 p)	♂ 1/1
Alliaceae				<i>Hypericum</i> sp.	♀ 1/4 (1/1 p)	♂ 2/3
<i>Allium cepa</i>	♀ 3/3 (1/1 p)	♂ 1/1		Linaceae		
Apiaceae				<i>Linum usitatissimum</i>	♀ 1/3 (1/2 p)	—
<i>Anethum graveolens</i>	♀ 1/21 (1/17 p)	♂ 1/4		Malvaceae		
<i>Conium maculatum</i>	—	♂ 3/8		<i>Abutilon</i> sp.	♀ 1/1	—
<i>Coriandrum sativum</i>	♀ 1/6 (1/2 p)	♂ 1/3		Myrtaceae		
<i>Daucus carota</i>	♀ 4/9 (1/2 p)	♂ 3/30		<i>Callistemon</i> sp.	♀ 1/1	—
<i>Daucus carota/Allium cepa</i>	♀ 1/4	—		<i>Eucalyptus regnans/</i>		
<i>Foeniculum vulgare</i>	♀ 2/3 (1/2 p)	♂ 2/6		<i>piperita</i>	—	♂ 1/10
Asphodelaceae				Onagraceae		
<i>Kniphofia praecox</i>	♀ 1/3 (1/3 p)	—		<i>Oenothera glazioviana</i>	♀ 1/8 (1/6 p)	♂ 1/7
Asteraceae				Papaveraceae		
<i>Achillea millefolium</i>	♀ 25/113 (7/61 p)	♂ 25/101		"Wild poppy"	♀ 1/1 (1/1 p)	—
<i>Achillea</i> sp.	♀ 1/7 (1/5 p)	—		Pinaceae		
<i>Bellis perennis</i>	♀ 1/1 (1/1 p)	—		<i>Pinus radiata</i>	♀ 2/2	♂ 4/7
<i>Calendula</i> sp.	♀ 1/1 (1/1 p)	—		Plantaginaceae		
<i>Carthamnus tinctorius</i>	♀ 1/2	♂ 1/1		<i>Digitalis purpurea</i>	♀ 1/1 (1/1 p)	—
<i>Chrysanthemum leucanthemum</i>	♀ 1/1 (1/1 p)	—		<i>Plantago</i> sp.	♀ 1/2 (1/1 p)	♂ 1/2
<i>Cirsium arvense</i>	♀ 7/15 (2/7 p)	♂ 6/11		Rhamnaceae		
<i>Cirsium vulgare</i>	♀ 1/5 (1/4 p)	♂ 2/13		<i>Ceanothus papillosus</i> var.		
<i>Cirsium</i> sp.	♀ 2/18 (1/4 p)	—		<i>roweanus</i>	♀ 1/48 (1/26 p)	—
<i>Crepis</i> sp.	♀ 2/13 (1/9 p)	♂ 1/1		<i>Ceanothus</i> sp.	♀ 16/98 (11/68 p)	♂ 1/1
<i>Hieracium pilosella</i>	♀ 1/6 (1/3 p)	—		Rosaceae		
<i>Hieracium</i> sp.	♀ 3/4 (1/1 p)	♂ 2/13		<i>Fragaria</i> sp.	—	♂ 2/13
<i>Hypochoeris radicata</i>	♀ 2/4 (1/1 p)	—		<i>Malus sylvestris</i>	♀ 3/12 (3/7 p)	—
<i>Hypochoeris</i> sp.	♀ 1/1 (1/1 p)	♂ 2/3		<i>Potentilla anserina</i>	♀ 1/1	—
<i>Senecio jacobaea</i>	♀ 2/2 (1/1 p)	♂ 1/3		<i>Potentilla fruticosa</i>	—	♂ 1/1
<i>Senecio</i> sp.	♀ 1/2 (1/2 p)	♂ 1/1		<i>Potentilla</i> sp.	♀ 1/8 (1/5 p)	—
<i>Solidago</i> sp.	—	♂ 1/4		<i>Prunus lusitanica</i>	♀ 2/2 (2/2 p)	♂ 1/1
<i>Taraxacum officinale</i>	♀ 18/76 (13/26 p)	♂ 10/27		<i>Prunus mahaleb</i>	♀ 2/5	—

<i>Prunus persica</i>	♀ 2/3	—
<i>Pyrus pyrifolia</i>	♀ 1/27 (1/4 p)	—
<i>Rosa rubiginosa</i>	♀ 2/3	—
<i>Rubus</i> sp.	—	♂ 1/1
<i>Sorbus aucuparia</i>	♀ 1/1	—
'Fruit trees'	♀ 1/19	—
Rutaceae		
<i>Citrus</i> sp.	♀ 1/2	—
Salicaceae		
<i>Populus alba</i>	—	♂ 1/4
<i>Salix triandra</i> cv <i>semperflorens</i>	—	♂ 1/9
Sapindaceae		
<i>Aesculus hippocastanum</i> x <i>carnea</i>	♀ 1/1 (1/1 p)	—
Vitaceae		
<i>Vitis vinifera</i>	—	♂ 2/2
<b>Total</b> collections/specimens	♀ 197/861 (100/428 p)	♂ 104/368
Species/genera/families	68/51/25 (52/40/19 p)	40/35/17

In addition to these records, females have been observed collecting pollen from *Solanum laciniatum* (Solanaceae).

Bees have also been collected taking honey dew from:

Nothofagaceae		
<i>Nothofagus</i> sp.	♀ 2/6 (1/2 p)	♂ 2/12

Large numbers of females also have been observed visiting cultivated *Cucurbita* sp. (Cucurbitaceae), and collecting pollen from cultivated strawberries, *Fragaria* sp. (Rosaceae).

*Lasioglossum sordidum* females have thus been captured while visiting a total of 139 species in 56 families, and of these families, 12 are common to introduced and native plants. The polylectic flower-visiting habits indicate that this bee species has the ability to forage on almost any flowering plant to which it can gain access to nectar and/or pollen. This ability is related to the very long annual activity period, which is almost certainly longer than the flowering period of the great majority, if not all, of the flowering plants visited. Because of their small size, pollen and nectar of nearly all flowers is open to access, but there are exceptions. For example, and also because of their small size, females are unable to trip lucerne flowers, *Medicago sativa* (Fabaceae), and so pollen can only be collected from flowers that have been tripped by some other agency such as another bee species, or wind. Similarly, the flowers of white and red clover, *Trifolium repens* and *Trifolium pratense* (Fabaceae) are too narrow to permit access by the body of the bee, and too long for the tongue of the bee to reach the nectar.

**Nest sites.** There are 94 records of nest sites. The substrate ranges from ocean beach and river bed sand through fine silts to glacial till, pumice/tuff, packed gravel and moist clay and crumbling clay which is bare or almost bare of vegetation. In Canterbury MC bee nests are frequently

abundant in flat soil, often among garden shrubs, between rows of horticultural plants such as blackcurrants and strawberries, and beneath shelterbelts where the ground is maintained bare with herbicides. In Westland WD nests occur in glacial silt deposits exposed in coastal cliffs. At Abut Head WD nests are often interspersed with those of several species of *Leioproctus*. At high tide and especially during storms, ocean spray frequently reaches the surface of such nest sites. At Karangarua WD, bees nested in flat ground down through a layer of ash resulting from a house fire a few months earlier. At Mahoe Rd. TO, Seddon KA and Earnsclough CO, bees nested in man-made nest sites built for occupancy by the introduced alkali bee *Nomia melanderi*.

Mature nests in flat ground consist of an entrance hole about 1.5 mm to nearly 2.0 mm in diameter which opens to a near-vertical tunnel about 3 mm in diameter and up to about 400 mm deep, from which horizontal cells radiate from about 40 mm below the surface. Cells are oval chambers about 3.5 mm across and 7 mm long, with a neck about 4 mm long which connects the cell to the tunnel. Females, presumably fertilized, overwinter in nest tunnels. At Lincoln MC in 1977 the first female bee after the coldest part of the winter, was seen on 16 August, on a dandelion flower. On 22 August a few new emergence holes were apparent where nests had been seen the previous summer. On 26 August 2 dissected nests held 2 and 3 female bees respectively. By 18 September emergence holes were numerous, tumuli up to about 5 mm high and more than 20 mm across were appearing around some tunnel entrances, and nest site searching females were readily seen on the nest site surface. Pollen was carried in to a few nests on 3 October, and by 17 October almost all females entering nests were carrying pollen. On 28 October, an egg on a pollen ball, 2 growing larvae and a fully grown larva were found in 4 cells in 1 nest. On 25 November, 42 pupae in various stages of development were found in possibly 14 adjacent nests. No other immature stages were found. However, females were carrying pollen into other nearby nests, and new tumuli were appearing. By 7 December numerous males were flying low over nests, and were rapidly entering and exiting nests. On 14 December males were estimated to number about 50 per square metre. One day later, 6–8 males attempted to mate with a female in a crevice in the soil. Other mating attempts occurred on nearby hemlock flowers, and on 15 February a female without pollen which alighted on a plastic mesh cone over a nest entrance (see below), was pounced on by a male. The pair appeared to be *in copula* for two seconds, before the male flew off, followed a second later by the female.

A nest dissected on 18 January 1978 had 35 cells with all stages of brood. One female with pollen entered just

before dissection began, 3 other females were found in the nest, and 1 other female may have escaped during nest dissection. Small, removeable, plastic mesh cones placed over nests in late January recorded a maximum of 8 males leaving 1 nest in the 23 min. from 9.33 am to 9.56 am, and on 2 March a maximum of 4 females leaving 1 nest in 43 minutes from 1.22 pm to 2.05 pm. A nest excavated on 17 February was 265 mm deep, and had 20 cells from 120 mm to 207 mm. One cell was new and empty, 2 contained female pupae, 7 contained male pupae, bees had emerged from 8, and 2 contained dried pollen balls. One male and 1 female flew from the nest during dissection, and 5 females were crowded in the bottom of the tunnel. On 2 March in 74 min. from 11.44 am to 12.58 pm (and following rain until 9.50 am), 13 females and 45 males left 12 nests; 2 females, 1 with pollen, each entered a different nest. On 7 April spoil was being ejected from some nests, and on 27 April there were mating attempts on flowering yarrow. By 3 May activity appeared to have ceased, although 1 female was seen on 29 May.

**Associated organisms.** On 17 January 1978, a black, elongate beetle was observed pulling a dead female bee into a hole in the soil. The beetle was not captured, but a beetle with a similar appearance, which was captured later in the soil of the bee nest site, was *Xantholinus labralis* (Staphylinidae). Pompilid wasps nesting in the soil among bee nests sometimes investigated bee nest entrances.

Thirteen females carry 1 mite, 1 carries 2 mites, and 2 carry 3 mites. Four males carry 1 mite each.

**Remarks.** For most of the year, and especially over the dry east of the South Island, adults of this species outnumber all other native bees in many areas. However, because of their small size they are frequently overlooked. The high population level results from the ability of the species to obtain nectar and pollen from an extremely wide array of both native and introduced plants, and the acceptability of various substrates as nesting sites. Further, females are able to compete very successfully with the ubiquitous honey bee almost throughout the year for pollen and nectar. There seems every possibility that in many areas the advent of numerous introduced plants has greatly enhanced the nesting success of *L. sordidum*, a consequence of which is increased population size. In turn, a consequence of the large numbers of bees is that some have been captured in unusual situations, such as in pitfall traps, swimming pools, under bark in forest, dead on garage window, from a trout stomach, swarming in a farmhouse, and stinging lower legs of Mrs Gilmore and daughter.

The purported *L. sordidum* nest drawn by Harris (1987), p.146, Fig. 192, is not of this species, as its cells are not clumped in a single chamber. The cell clump illustrated is similar to that of the alkali bee *Nomia melanderi*, but its cells stand vertically, and not horizontally.

### Subgenus *Chilalictus* Michener

*Lasioglossum (Chilalictus)* Michener, 1965: 174. Type species: *Halictus subinclinans* Cockerell, 1915 = *Halictus cognatus* Smith, 1853, by original designation.

#### *Lasioglossum (Chilalictus) cognatum* (Smith)

Fig. 24a–d. 69a–i; Map 33

*Halictus cognatus* Smith, 1853: 59 (description of male).

Cockerell, 1904b: 213 (there are 3 Tasmanian species of halictine bees which I have not examined, including *H. cognatus*). —1914b: 307 (male, Launceston, Tasmania).

*Halictus inclinans* Smith, 1879: 36 (description of female).

Cockerell, 1912a: 386 (distribution). Rayment, 1953b: 70 (distribution, *H. subinclinans* not a larger form). Knerer & Schwarz, 1976: 446 (drawing of nest). Synonymised by Walker, 1995: 101.

*Halictus haematostoma* Cockerell, 1914c: 506–507 (description of male). Synonymised by Walker, 1995: 101.

*Halictus subinclinans* Cockerell, 1915: 8–9 (description of female). —1926a: 226 (taxonomy). Rogers, 1931: 146 (pollinated *Caladenia deformis*). Rayment, 1935: 318–319 (biology, burrow in use for 3 years), 702–703 (description of male). Erickson, 1951: 80 (relates Rogers (1931) description of the bees behaviour as it pollinates the Blue Fairy Orchid). Rayment, 1953a: 24 (brief description, flower records, widely distributed over South-eastern States). —1953b: 70 (distribution). Michener, 1960: 86 (listed as a small metallic species) 90 (not many nests placed together). —2000: 359 (Type species of *Chilalictus*; = *Halictus cognatus* Smith). Synonymised by Walker, 1995: 101.

*Lasioglossum (Chilalictus) cognatum*: Michener, 1965: 175 (list, new combination). Cardale, 1993: 188 (list, catalogue data). Walker, 1995: 24–43 (key), 101–103 (synonymy, description, distribution in Australia, capture records by month, flower-visiting records, remark that the floral foraging record of 35 families and 63 genera is the most diverse of the 134 species of *(Chilalictus)*, and that 3 males display macrocephaly), 250 (measurements), 272 (scanning electron micrograph of female protibial spur), 274 (scanning electron micrograph of female and male forewing), 280 (scanning electron micrograph of median process on male metasomal sternum 2), 282 (scanning electron micrograph of male metasomal vestiture pattern), 326 (scanning electron micrographs of head of female above antennal sockets, labrum, and dorsum of mesosoma; map of Australia showing distribution; line drawings of male metasomal sterna 7–8 and genital capsule).

*Lasioglossum (Chilalictus) haematostoma*: Michener, 1965: 176 (list). Cardale, 1993: 193 (list, catalogue data).

*Lasioglossum (Chilalictus) inclinans*: Michener, 1965: 176 (list). Cardale, 1993: 194 (list, catalogue data).

*Lasioglossum (Chilalictus) subinclinans*: Michener, 1965: 177 (list), 240 (flower record). Cardale, 1993: 202 (list, catalogue data).

*Lasioglossum inclinans*: Knerer & Schwarz, 1978: 321 (life cycle), 322–326 (drawing of nest, drawing of foreleg,

biology), 332 (arrangement of cells and sex of offspring in nest).

**Female** (n = 20). Length 4.4–6.0 mm ( $5.3 \pm 0.38$  mm); width 1.7–2.2 mm ( $2.0 \pm 0.14$  mm); forewing length 3.1–3.8 mm ( $3.4 \pm 0.17$  mm); facial length 1.2–1.4 mm ( $1.3 \pm 0.05$  mm); facial width 1.1–1.4 mm ( $1.2 \pm 0.06$  mm); malar length/malar width 0.10.

**Coloration.** Head black, except antennae light brown-yellow beyond about 2nd flagellar segment, dorsal 1/2 of clypeus, and supraclypeus, with faint metallic colours, mandibles amber except red-brown apically, galea translucent light brown. Mesosoma black except scutum, scutellum dark metallic green with red-blue tinges, tegula, wing veins and pterostigma similar to galea, wing membranes hyaline, legs brown. Metasomal terga 1–5 and sterna 1–5 dark brown except apical margins hyaline, becoming more broadly so posteriorly.

**Structure.** (Fig. 69a–b). Scape as long as combined length of first 7.5 flagellar segments. Compound eyes 5× longer than wide, with about upper 1/3 of inner margins converging markedly above, lower 2/3 of inner margins converging less markedly below; a few minute setae on about lower 1/3. Ocellular distance 2.4× an ocellar diameter; interocellar distance about equal to an ocellar diameter. Antennal sockets a little closer to apex of clypeus than to vertex. Face shiny throughout. Supraclypeus rising rather evenly from below, laterally and above to a low rounded mound midway between upper margin of clypeus and a line across lower margins of antennal sockets, with medium-sized punctures separated by 1–2 diameters, lightly tessellated; frontal ridge originating just below a line across lower margins of antennal sockets, extending about halfway from a line across upper margin of antennal sockets to median ocellus; beyond that frontal line not apparent. Frons lightly tessellated, with close punctures a little larger and deeper than on supraclypeus; paracocular areas smooth with punctures similar in size to frons but a little wider apart; vertex lightly shagreened with punctures shallow, much less discernible than on frons. Clypeus extending for 0.4× its length below a line across lower margins of compound eyes, in lateral view about dorsal 1/2 flat with sculpturing similar to supraclypeus, ventral 1/2 recurved with very light tessellation and very large, irregular punctures about 1 diameter apart. Labrum with basal median area raised to distal margin, surface irregular, distal process widest towards distal margin, with prominent median keel extending well beyond lateral distal margin, lateral curved keels about halfway between lateral margin and median keel, extending to just beyond distal margin; lateral and distal margins fringed with long stout setae. Malar space very short, about 10× wider than long, lightly tessellated. Galea smooth, shiny. In lateral view, gena a little wider than compound eye,

dorsolaterally near compound eye smooth with shallow, medium-sized close punctures, remainder with dorsoventral close striae.

Pronotum with dorsolateral angle produced, pronotal lobe extending laterally to form broad anteriorly-directed face, lightly shagreened laterally, smooth medially. Scutum with anterior margin narrowly impunctate, remainder with large punctures, moderately tessellated; scutellum similar except punctures larger medially. Metanotum rough, heavily tessellated. Angle between dorsal and posterior faces of propodeal triangle about 135°, dorsal face about 75% as long as posterior face, slightly concave, with very rough, irregular longitudinal striae over 80%; dorsal face divided from lateral face by very weak lateral carina, posterior face flat with median longitudinal depression, with lateral carinae reaching dorsal carinae, carinae extending a short distance towards mid-line from junction of lateral carinae define boundary between dorsal and posterior faces; propodeum moderately shagreened excluding about anterior 1/2, which, including remainder of lateral aspect of mesosoma more or less sub-horizontally striate. Probasitarsus with apical process as long as adjacent tarsal segment. Basitibial plate prominent, kidney-shaped, about 1/5 length of tibia; outer apical margin of tibia with 2 short stout teeth. Inner metatibial spur with one large tooth, followed by a slightly wavy margin (Fig. 69h). Pterostigma 3.8× longer than wide, vein 1st m-cu meets 3rd submarginal cell just beyond 2nd submarginal cell.

Metasomal terga 1–2 smooth, shiny on disc with small, close punctures, those on tergum 2 a little smaller and closer than on tergum 1; posterior margin of tergum 2 and terga 3–5 shagreened. Pseudopygidium wide, widest apically, narrowing somewhat anteriorly, about 3× longer than wide medially, extending for almost entire normally-exposed length of tergum 5. Pygidial plate flat, evenly rounded apically, with near base a near-replica of pygidial apex atop it. Metasomal sternum 1 markedly emarginate apically; sterna 1–5 well shagreened/lightly tessellated, with medium-sized punctures separated by about 1–2 diameters.

**Vestiture.** White throughout. On head, mesosoma and dorsum of metasoma shorter than length of last 2 apical antennal flagellar segments, not obscuring surface; metasomal tergum 2 with appressed scale-like vestiture on about anterolateral 3rds, terga 3–4 with similar vestiture anteriorly; metacoxa, trochanter, femur and metasomal sternum 1 with longer plumose hairs forming pollen-carrying scopae, sterna 2–5 with progressively shorter, less branched hairs; in lateral view, metatibial scopa about twice width of tibia.

**Male** (n = 7). Length 4.2–4.5 mm ( $4.4 \pm 0.12$  mm); width 1.3–1.7 mm ( $1.6 \pm 0.12$  mm); forewing length 2.7–3.1 mm ( $2.9 \pm 0.14$  mm); facial length 1.1–1.2 mm ( $1.2 \pm 0.04$  mm);

facial width 1.0–1.1 mm ( $1.1 \pm 0.06$  mm); malar length/malar width 0.08.

**Coloration.** Similar to female except antennae more yellow beyond pedicel, about ventral 1/2 of clypeus, labrum and central 1/2 of mandible yellow; face without obvious metallic colours, scutum and scutellum very dark green/black; legs with apex of femora and base of tibia very narrowly yellow, legs yellow beyond and including apex of tibia; apex of metasoma narrowly orange.

**Structure.** (Fig. 69c–d). Scape as long as combined length of first 5.3 flagellar segments. Compound eyes  $4.5\times$  longer than wide, with about upper 1/4 of inner margins slightly convergent above, lower 3/4 markedly convergent below. Ocellular distance about equal to  $2.5\times$  an ocellar diameter; interocellar distance a little larger than 1 ocellar diameter. Antennal sockets equidistant between vertex and apex of clypeus. Clypeus in lateral view with about lower 1/2 slightly protuberant and recurved, otherwise much as in female. Labrum simple, without keel. Malar space very short, linear, about 12 times wider than long. Remainder of head similar to female except facial tessellation and punctuation less distinct.

Scutum and scutellum with at most very light tessellation/shagreening, scutum with medium-sized punctures except punctures smaller near periphery, separated by 1–2 diameters, shiny; scutellum with central area impunctate, otherwise similar to scutum, shiny. Probasitarsus without apical process of female, metatibia with only 1 much reduced median apical tooth on outer margin. Pterostigma  $3\times$  longer than wide. Remainder of mesosoma similar to female except striae less prominent laterally.

Metasomal terga 1–5 and sterna 1–5 similar to female, except sternum 2 with large raised median apical process with truncate apex flanked by several spines. Sternum 7 (Fig. 69e) very narrow transversely: sternum 8 produced and acute laterally, median apical process well developed. Gonobase in dorsal and ventral views (Fig. 69f) with sides concave; gonocoxites stout, rounded laterally, gonostyli long, apices crossing mid line, expanded apically with 2 long spines on inner surface, retrorse lobes well developed, setose; in lateral view (Fig. 69g) penis valve acute apically, projecting just below gonostylus, retrorse lobe almost rectangular, hirsute.

**Vestiture.** White throughout, with longest hairs a little more than 1/2 length of scape. Much of face except apical 1/2 of clypeus with short, appressed hairs almost obscuring surface. Scutum, scutellum and metasomal terga 1–5 with sparse, short vestiture. Metasomal sterna 2–5 with very short dense hairs directed posterolaterally, forming an inverted V-shape mat on each side of the mid-line.

**Variation.** The metallic colours of the scutum of females may range from almost black, to very green with only a

little blue/red tinge, or almost wholly blue/red. The lateral carinae between the dorsal and lateral surfaces of the propodeum may be absent, or very poorly defined. The median apical process on sternum 2 of males appears a little less prominent and slightly more rounded apically than that of 3 males from Australia which were available for comparison.

**Type data.** *Halictus cognatus*: holotype male, “Tasmania” (as Van Dieman’s Land) (BMNH). *Halictus inclinans*: holotype female, “Western Australia, Champion Bay” (BMNH). *Halictus haematostoma*: holotype male, “Victoria, Windsor”, French (USNM). *Halictus subinclinans*: holotype female, “Tasmania, Launceston”, 15 February 1914, F. M. Littler (USNM).

**Material examined.** New Zealand: 112 females and 10 males. Australian specimens examined were 3 females and 3 males, from 20 km SW Inglewood, Queensland.

**Distribution** (New Zealand, Map 33). North Island: ND, AK, CL, WO, GB, HB. South Island: NN, MB. Collection dates for the 50 collection records range from 17 July to 21 April.

**Biology.** Collection site data show that from central WO north the species is distributed throughout, while the records for GB, HB, NN, and MB are more coastal. One female was captured at 270 m, and 2 collections were made over beach grasses and beach plants.

**Flight period.** The 42 collection records for 112 females range from 17 July to 21 April, with a peak of 33.3% occurring in December. The 8 collection records for 9 males range from 22–26 December to 24 March, with most records in January.

#### Number of collections

	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr
Females	1	1	3	3	4	14	8	4	3	1
Males						1	5	1	1	

The greatest number of females taken at any one time was 18 in a light trap at Ngaruawahia WO on 5 September 1979, by H. A. Oliver, and 9 females and 2 males were taken on onion flowers at Blenheim MB on 14 January 2004 by B. Howlett. All other collections for females are of 5 bees or fewer. Two other males were captured at Mangonui ND on 11 March 1950 by R. A. Cumber.

#### Host plants

##### Native plants

Myrtaceae										
<i>Kunzea ericoides</i>						♀ 1/1			—	
<i>Leptospermum scoparium</i>						♀ 1/1			—	
Plantaginaceae										
<i>Hebe</i> sp.						♀ 2/6 (1,1 sonicated/3 p)			—	
<b>Total collections/specimens</b>						♀ 4/8 (1/3 p)			♂ —	
<b>Species/genera/families</b>						3/3/2 (1/1/1 p)			—	



**Introduced plants**

Actiniadiaceae			
<i>Actinidia chinensis</i> male	♀ 1/1	—	
Alliaceae			
<i>Allium cepa</i>	♀ 2/4 (1/1 p)	♂ 1/2	
Apiaceae			
<i>Daucus carota</i>	—	♂ 1/1	
Asteraceae			
<i>Taraxacum officinale</i>	♀ 1/1	—	
Yellow composite	♀ 1/1 (1/1 p)	—	
Brassicaceae			
<i>Brassica rapa chinensis</i>	♀ 2/8	♂ 1/1	
Fabaceae			
<i>Trifolium repens</i>	♀ 1/3 (sonicated)	—	
<b>Total collections/specimens</b>	♀ 8/28 (2/2 p)	♂ 3/4	
<b>Species/genera/families</b>	6/6/5 (2/2/2 p)	3/3/3	

3 other females from 1 native species were sonicated to remove pollen as part of another study, as were bees from *Trifolium repens*. Males have not been associated with the flowers of native plants.

There is also 1 collection of 5 females, all carrying pollen, from a *Lobelia* sp. (Lobeliaceae). There are a number of native and introduced species in New Zealand, and whether this species is native or introduced is unknown. One female and 2 males in 3 collections were taken over ryegrass/clover pasture.

**Nest sites.** On 14 October 1965, a nest was discovered about 2 m up in a near-vertical sandstone face at Island Bay Road, Birkdale AK. Records are incomplete, but the tunnel which was about 2 mm in diameter ran almost horizontally into the sandstone for about 60 mm. Viewed from above, 4 cells lay just off to the left side of the tunnel, but there may have been another opposite the first cell (Fig. 69i). The first cell contained a pollen ball and an egg, the second an incomplete pollen ball, the 1/3 a pollen ball and either an egg or small bee larva, and the 4th was empty. Loose spoil filled the entrance to the tunnel, and some lay before the first cell and between each cell entrance. Several species of *Leioproctus*, especially, *L. boltoni*, *L. imitatus*, *L. kanapuu* and *L. pango* were nesting in very large numbers in the same sandstone

**Associated organisms.** None are known.

**Remarks.** This species is found in all states of Australia, which suggests that many differing climatic conditions are tolerated. Of the 134 species in the subgenus *Chilalictus* in Australia, this species, with a flower host range of 63 genera in 35 families, has the most diverse foraging record. Because the southern limit of Tasmania is almost as far south as the latitude of Christchurch MC, perhaps the area of the country as far south as Christchurch will eventually be occupied. Knerer & Schwarz (1978) found that in Australia there were two generations of males and females per year, and the long period of activity in New Zealand from July to April suggests that there are also two generations here.

This species was first collected in New Zealand when 4 females and 2 males were captured at Cooper's Beach, Mangonui ND on 26 February 1949 by R. A. Cumber. The length of body of the 20 New Zealand females is about 1 mm less than that of the 10 Australian females measured by Walker (1995), and the males are about 0.75 mm shorter, which suggests that the New Zealand and Australian populations are somewhat different. Of 357 Australian males studied by Walker (1995), 3 were macrocephalic. All 9 New Zealand males are normal, but if the Australian ratio pertains to New Zealand males, then none of the 9 could be expected to be macrocephalic.

**Family Megachilidae**  
**Subfamily Megachilinae**  
**Tribe Osmiini**  
**Genus *Osmia* Panzer**

**Subgenus *Helicosmia* Thomson**

- Osmia* (*Helicosmia*) Thomson, 1872: 233, no included species; Schmiedeknecht, 1885: 22, included species. Type species: *Apis aurulenta* Panzer, 1799, by designation of Michener, 1941: 163.
- Osmia* (*Chalcosmia*) Schmiedeknecht, 1885: 20. Type species *Apis fulviventris* Panzer, 1798 (not Scopoli, 1763) = *Apis niveata* Fabricius 1804, by designation of Sandhouse, 1939: 13.
- Gnathosmia* Robertson, 1903: 165. Type species: *Osmia georgica* Cresson, by original designation.
- Osmia* (*Cryptosmia*) Yasumatsu & Hirashima, 1950: 14. Type species: *Osmia satoi* Yasumatsu & Hirashima, 1950, by original designation.

***Osmia* (*Helicosmia*) *coerulescens* (Linnaeus)**  
**red clover mason bee**

Fig. 25a–d, 70a–g; Map 34

**Northern Hemisphere**, selected bibliography.

- Apis coerulescens* Linnaeus, 1758: 576 (description of female).
- Apis aenea* Linnaeus, 1761: 421 (description of male). Synonymised by Rust, 1974: 38.
- Osmia coerulescens*: Panzer, 1806: 233 (new combination, description, sex not given). Tasei, 1976: 277–300 (pollen collection and nest provisioning throughout the nesting season, on average 66% of pollen is from Papilionaceae (=Fabaceae)). Parker, 1981: 62–65 (population increased on red clover, seed yield high, mortality of overwintered adults high).
- Osmia purpurea* Cresson, 1864: 27 (description of female). Synonymised by Rust, 1974: 38.
- Osmia rustica* Cresson, 1864: 27 (description of male). Synonymised by Rust, 1974: 38.
- Osmia cyanea*: Giraud, 1866: 451 (description of female and male). Synonymised by Rust, 1974: 38.

*Osmia caeruleascens*: Dalla Torre, 1896: 388 (unnecessary emendation, list of Palaearctic references). Day, 1979: 54 (designation of lectotype female).

*Osmia dutti* Cockerell, 1922.

*Osmia caeruleascens dutti*: Cockerell, 1926b: 661 (*Osmia dutti* Ckll. is smaller than *O. caeruleascens* with white hair on head and thorax, but may stand as a race).

*Osmia (Chalcosmia) caeruleascens*: Sandhouse, 1939: 15 (new association). Tasei, 1972: 149–165 (biology, including drawing of trap nests, illustration of nest, pollen collection, life cycle). Rust, 1974: 32–34 (definition of *Chalcosmia* and characters of *O. caeruleascens* which differ), 35 (considered adventive in North America), 37–38 (key), 38–42 (description, drawings of genital capsule and male metasomal sterna 6–8, map of distribution in the eastern United States, flower records which are primarily Leguminosae, biology including nest dimensions, and enemies).

*Osmia (Helicosmia) caeruleascens* Michener, 2000: 464 (new combination in *Helicosmia* Thomson 1872, which has priority).

**New Zealand**, all references.

*Osmia caeruleascens*: Purves, Clifford & Donovan, 1998: 161–164 (introduction to New Zealand).

**Female** (n = 20). Length 6.8–8.6 mm ( $7.8 \pm 0.46$  mm); width 2.6–3.5 mm ( $3.1 \pm 0.25$  mm); forewing length 4.3–5.5 mm ( $5.0 \pm 0.34$  mm); facial length 2.0–2.8 mm ( $2.3 \pm 0.16$  mm); facial width 1.9–2.3 mm ( $2.1 \pm 0.14$  mm); malar length/malar width 0.14.

**Coloration**. Antennae, clypeus, legs, pterostigma and wing veins, metasomal terga 4–6 and exposed sterna brown-black; wing membranes a little dusky; remainder of body metallic blue-green with occasional highlights of red.

**Structure**. (Fig. 70a–b). Scape about as long as combined length of first 5.8 flagellar segments. Compound eyes about 4.5× longer than wide, with upper 1/3 and lower 2/3 of inner margins converging slightly above and below respectively; inner margin flanked by low ridge. Ocellular distance 3.4× an ocellar diameter; interocellar distance very slightly larger than 1 ocellar diameter. Antennal sockets a little closer to apex of clypeus than to vertex. Face shiny. Supraclypeus rising evenly from lateral margins to form a low mound with evenly rounded crest from upper to lower margins; frontal ridge and line absent. Clypeus with about middle area protuberant, extending for nearly 1/3 of its length below a line across lower margins of compound eyes, lower margin truncate. Malar space short, 7× wider than long, shiny, with very small close punctures. Mandibles massive, with 4 teeth, the 2 upper teeth short, rounded, the 2 lower teeth longer, acute. Galea lightly shagreened in median longitudinal region. In lateral view, gena about 1.4× wider than compound eye. Face and gena with large close punctures throughout, on lower 1/2 of supraclypeus punctures

a little less distinct than elsewhere.

Pronotum shagreened, with shagreening obscuring medium-sized, irregular close punctures; pronotal suture obvious laterally and dorsally, more or less dividing pronotum transversely. Scutum, scutellum and lateral areas of mesosoma excluding propodeum and metepisternum, with large close punctures similar to head. Metanotum narrow, moderately tessellated, with small to medium-sized punctures separated by 1–2 diameters. Propodeal triangle declivous, basal area a little wider than metanotum, shagreened, with very short, well-spaced irregular longitudinal ridges extending halfway across from anterior margin, remainder of propodeal triangle mirror-like; posterolateral area very lightly shagreened with close, medium-sized irregular punctures. Metepisternum with larger punctures than posterolateral area of propodeum, punctures close. Apical outer margin of pro- and mesotibia with stout, sharp, upturned spine; metatibia without scopa; inner tibial spur long, ciliate. Pterostigma small, 1/2 as wide as long; vein 1st m-cu meets 2nd submarginal cell about 1/3 length of cell from anterior end.

Metasomal tergum 1 with anterior face concave, mirror-like, sharply delineated from dorsal face; dorsum of metasomal tergum 1 and terga 2–3 shiny with medium-sized to large punctures from close to separated by up to 1 diameter; terga 4–6 lightly tessellated with punctures smaller, closer, less distinct. Median apical margin of sternum 1 very shallowly emarginate; discs of sterna 1–6 roughened.

**Vestiture**. Compound eyes with short, fine, widely-spaced pale hairs. Four tufts of short, dense, golden hair project from beneath apical margin of clypeus. Paraocular area with moderately dense white hairs up to 2/3 length of scape, not obscuring surface; remainder of face and metasomal scutum and scutellum with light golden hairs; inner faces of pro- and mesotibia and tarsi and metatarsi with golden hairs. Metasomal sterna 2–5 with scopa of simple, stout, dark brown to black hairs, sternum 6 with scopa less developed. Remaining vestiture white or off-white; disc of metasomal tergum 1 laterally with long vestiture, terga 1–3 with lateral apical fimbria, terga 4–5 with apical fimbria complete, tergum 6 with very short appressed vestiture throughout, partly obscuring surface.

**Male** (n = 20). Length 5.8–7.5 mm ( $6.7 \pm 0.43$  mm); width 2.2–2.9 mm ( $2.5 \pm 0.18$  mm); forewing length 3.8–4.7 mm ( $4.2 \pm 0.23$  mm); facial length 1.7–2.1 mm ( $1.9 \pm 0.10$  mm); facial width 1.5–1.9 mm ( $1.7 \pm 0.08$  mm); malar length/malar width 0.07.

**Coloration**. Head, mesosoma and metasomal terga dark metallic bronze with blue-green highlights; remainder similar to female.

**Structure.** (Fig. 70c–d). Scape a little longer than combined length of first 3 flagellar segments. Compound eyes about 4 × longer than wide, with inner margins similar to female. Ocellular distance 3 × an ocellar diameter; interocellar distance a little more than 1 ocellar diameter. Position of antennal sockets as in female. Supraclypeus flat. Clypeus similar to female except more protuberant, extending for 1/3 its length below a line across lower margins of compound eyes. Malar space very short, about 14 × wider than long. Mandible large with 2 teeth, the upper tooth short with broad apex, the lower long, acute. In lateral view, gena somewhat wider than compound eye. Remainder of head similar to female.

Mesosoma similar to female except pterostigma 0.4 × as long as wide.

Metasomal terga 1–6 similar to female, except terga 4–6 without tessellation. Tergum 7 deeply emarginate apically, resulting in 2 apparent apical processes. Sternum 1 with small shallow median emargination, sterna 1–4 with shallow, large, close punctures. Sternum 3 deeply emarginate apically, emargination lined with fine vestiture filling emargination; sternum 4 with middle 1/3 of apical margin somewhat produced. Sternum 7 (Fig. 70e) reduced to a simple transverse process: sternum 8 almost rectangular and produced posteriorly. Gonocoxites in dorsal and ventral views (Fig. 70f) very long, narrow, gonostyli incurved apically, penis valves long, slightly incurved apically; in lateral view (Fig. 70g) penis valve just projecting below gonostylus.

**Vestiture.** Compound eyes similar to female except hairs sparser. On body vestiture golden yellow dorsally, fading to white ventrally; on face longer than scape, obscuring surface of clypeus; vestiture on scutum and scutellum similar to clypeus; on metasomal terga disposition similar to female except apical fimbria complete on terga 2–5 and more developed.

**Variation.** The clypeus of females can be coloured similarly to the rest of the face, particularly around the dorso-lateral margins.

**Type data.** *Osmia caerulescens*, lectotype female, “in Europa”, designated by Day (1979) (LSL). Rust (1974) stated that the holotypes of *O. caerulescens*, *O. aenea* and *O. cyanea* were unknown to him. The lectotype female of *O. purpurea* and the holotype male of *O. rustica* both carry only the locality datum “Penn”. (ANSP).

**Material examined.** Imported from France, 2 females and 2 males; imported from Italy, 25 females and 31 males; imported mixed from France and Italy, 15 females and 41 males; New Zealand-raised from the field, 13 females and 14 males.

**Distribution** (New Zealand, Map 34). South Island: MC.

The species has flown in the field only near its release

site at Lincoln MC.

**Biology.** In France Tasei (1972) elucidated the basic biology of the species over three years. It is solitary, with females constructing a linear series of cells in blind tunnels in plant stems or wood. Pith cavities or abandoned beetle burrows are favoured, but cracks and splits may also be utilized. Preferred tunnel diameter ranges from about 4–6 mm, and length from about 20–100 mm. After cleaning a tunnel of loose debris, a female coats the bottom 10 mm of the tunnel wall with a mixture of chewed plant material and saliva. Loads of pollen and nectar are then placed in the tunnel, an egg is laid, and a partition of chewed plant material and saliva is built across the tunnel. This process is repeated with about one cell being made per day until the tunnel is almost filled, then the entrance is sealed with a plug several mm thick made of a number of close partitions. Females, which can live for up to 60 days, may seek out further tunnels within which to build cells. Males spend all their time searching for females to mate with, apart from feeding on pollen and nectar from flowers.

Within cells, eggs eclose after about two days, and during the following week larvae consume all their provisions and spin a fibrous cocoon. If cocoon spinning occurs by early summer, a second-generation bee may emerge from the cocoon later that same summer. Female bees soon begin nesting. However, for cocoons spun after early summer, adult bees that develop within them will remain quiescent over the autumn, winter and early spring, before emerging during mid-late spring to repeat the cycle.

In New Zealand *O. caerulescens* was released in the field for the first time on 1 May 1996; 53 cocoons in their nests which had been produced in quarantine, were placed in a protected shelter on the Crop and Food Research Ltd. farm at the Canterbury Agriculture and Science Centre, Lincoln. During May several male bees emerged, but no females were seen.

**Flight period.** On 11 September 1996, as spring was advancing rapidly, a new emergence hole was seen in a nest plug, and 5 days later a male was flying about the shelter. On 24 September 3 females and 1 male were seen, and 2 days later 2 females were carrying pollen into nest holes. By 13 January 1997 29 bees had emerged from the cocoons placed in the field, 5 new cells had produced emergent second generation bees, and 70 new cells were intact. The last possible sighting of a bee was 10 March. Inspection of all nests and cells on 11 April showed that 73 new cells had been made, from which 22 second generation bees had emerged, and 36 cocoons remained intact to overwinter.

#### Host plants

Females have been observed collecting pollen from 5 introduced plants in one family:

## Fabaceae

<i>Chamaecytisus palmensis</i>	♀ ca 6/ca 6 (ca 6/ca 6 p)	♂ 10s/10s
<i>Medicago arborea</i>	♀ ca 2/ca 2 (ca 2/ca 2 p)	—
<i>Medicago sativa</i>	♀ ca 4/ca 4 (ca 4/ca 4 p)	—
<i>Teline stenopetala</i>	♀ 1/1 (?/? p)	—
<i>Trifolium pratense</i>	♀ 2/2 (2/2 p)	—
<i>Trifolium repens</i>	♀ 20s/20s (20s/20s p)	♂ 10s/10s

Because the aim is to increase the population, bees have not been collected in the field.

**Nest sites.** Nests in the field have been constructed in paper drinking straws, grooved leafcutting bee nest boards, and holes drilled in wood and polystyrene.

**Associated organisms.** Many immature bee stages have been killed by the eulophid parasitoid *Melittobia* sp.

**Remarks.** This species is native to Europe and the Near East, but was adventive in the eastern United States by last century. It was purposely introduced to New Zealand through quarantine in the hope that it could be developed as a managed pollinator of red clover on a commercial scale. As at October 2005, after 9 summers of propagation, managed cells totalled about 900. There is every likelihood that annually some females dispersed from the managed nesting sites, but as yet there is no indication that the species has established elsewhere. However, its wide distribution in the temperate western Old World and its colonisation of much of North America in historical times, suggest that it probably has the ability to colonise much of the drier areas of New Zealand.

## Tribe Anthidiini

Genus *Anthidium* FabriciusSubgenus *Anthidium* Fabricius

- Anthidium* Fabricius, 1804: 364. Type species: *Apis manicata* Linnaeus, 1758, by designation of Latreille, 1810: 439.
- Tetranthidium* Moure, 1947: 15. Type species: *Anthidium latum* Schrottky, 1902, by original designation. Synonymised by Griswold & Michener, 1988: 29.
- Stenanthidium* Moure, 1947: 16. Type species: *Anthidium espinosai* Ruiz, 1938, by original designation. Synonymised by Griswold & Michener, 1988: 29.
- Melanthidium* Cockerell, 1947: 106, not *Melanthidium* Pasteels, 1969. Type species: *Melanthidium carri* Cockerell, 1947, by original designation. Synonymised by Griswold & Michener, 1988: 29.
- Anthidium* (*Melanoanthidium*) Tkalcù, 1967: 91. Type species: *Anthidium montanum* Morawitz, 1864, by original designation. Synonymised by Michener, 2000: 489.
- Anthidium* (*Echinanthidium*) Pasteels, 1969a: 101. Type species: *Anthidium echinatum* Klug, 1832, by original designation. Synonymised by Michener, 2000: 489.
- Anthidium* (*Ardenanthidium*) Pasteels, 1969a: 103. Type species: *Anthidium ardens* Smith, 1879, by original designation. Synonymised by Michener, 2000: 489.

*Anthidium* (*Pontanthidium*) Pasteels, 1969a: 105. Type species: *Anthidium pontis* Cockerell, 1933, by original designation. Synonymised by Michener, 2000: 489.

*Anthidium* (*Morphanthidium*) Pasteels, 1969b: 423. Invalid because no type species designated; 3 included species. According to Michener 2000, synonym of *Ardenanthidium*, to judge by 2 of the included species, and was clearly intended by Pasteels to be the same as *Ardenanthidium*.

***Anthidium* (*Anthidium*) *manicatum* (Linnaeus)****wool-carder bee**

Fig. 26a–e, 71a–k; Map 35

**World**, excluding New Zealand, selected bibliography.

*Apis manicata* Linnaeus, 1758: 577 (description of male).

*Apis manicata*: Fabricius, 1781: 482 (description of male) (not the *Apis maculata* Fabricius, 1781: 482, of Moure & Urban 1964).

*Megachile manicata*: Latreille, 1802: 434 (new combination)

*Anthidium manicatum*: Fabricius, 1804: 364 (new combination, description).

*Anthophora manicata*: Illiger, 1806: 117 (new combination).

*Anthidium manicatum*: Jurine, 1807: 253 (*Apis maculata* of Panzer is the female of *manicata* of Linnaeus; *Apis manicata* female of Panzer is a male) (not the *Trachusa manicatum* Jurine, 1807: 253, of Moure & Urban 1964).

*Anthidium* (*Anthidium*) *manicatum*: Moure & Urban, 1964: 96 (new combination).

**New Zealand**, all references.

*Anthidium manicatum* Donovan, Burnip & McCarthy, 2006: 11 (occurrence in New Zealand).

**Female** (n = 8). Length 7.7–10.2 mm (9.3 ± 0.83 mm); width 3.8–4.8 mm (4.3 ± 0.35 mm); forewing length 5.7–6.6 mm (6.1 ± 0.33 mm); facial length 2.5–3.0 mm (2.8 ± 0.16 mm); facial width 2.1–2.5 mm (2.3 ± 0.16 mm); malar length/malar width 0.17.

**Coloration.** Black, except bulk of outer face of mandibles yellow, 1st tooth dark red; about lower 1/2–2/3 of lateral areas of clypeus yellow except for lateral thirds of lower margin, yellow often extending laterally to upper margins of clypeus, so that black area forms a solid 'V', with point nearly reaching the apical margin of clypeus; paraocular areas below a line across about lower margins of antennal sockets yellow; small transverse areas on vertex above compound eyes and extending medially to above lateral margin of lateral ocelli yellow. About posterior 1/2 of pronotal lobe yellow; lateral margin of scutum with yellow spot to narrow yellow line opposite tegula; scutum with 1 yellow spot on lateral posterior margin; axilla with 1 yellow spot. Tegula with about anterolateral 1/3 yellow and small yellow spot on anterior margin. Pterostigma and wing veins black, wing membrane dark. Profemur with apical dorsal and anterior area orange, posterior apical area nar-

rowly yellow, protibia yellow dorsally except for small darkly hyaline area basal to apical spine, anterior and posterior faces narrowly orange, prodistitarsi orange-red, protarsal claws dark red; meso- and metafemur orange apart from small basal area black, with narrow ventral longitudinal area yellow; remainder of meso- and metalegs similar to proleg, except dorsal aspect of metatibia with yellow not reaching anterior and apical margins. Tibial spurs pale. Metasomal terga 1–6 with broad central lateral areas of disc yellow, on tergum 1 gap between yellow areas greater than 1/3 width of tergum, gap decreasing progressively towards tergum 6 where yellow areas nearly touching. Sternum 1 broadly dark orange laterally; apical margins of sterna 2–4 broadly hyaline.

**Structure.** (Fig. 71a–b). Scape about equal in length to flagellar segments 1–5. Compound eyes about 4× longer than wide, with somewhat more than lower 2/3 of inner margins converging moderately below, remainder slightly incurved above. Ocellular distance somewhat more than 2× diameter of lateral ocellus, interocellar distance 1.3× diameter of median ocellus. Antennal sockets a little further from ventral margin of clypeus than from vertex. Face shiny, with medium-sized, rough, close punctures throughout except punctures large on small area of paraocular area adjacent to upper margin of clypeus, and smaller around ventral aspects of ocelli. Supraclypeus slightly rounded from side-to-side, frontal ridge and line scarcely discernible. Clypeus slightly protuberant, rounded from side-to-side, extending for about 1/5 its length below a line across lower margins of compound eyes; central 1/3 of lower margin with about 5 small yellow tubercles, lateral thirds with 2 larger black projections. Malar space short, about 1/6 as long as wide, shiny, mostly smooth. Labrum large, flat, a little longer than wide. Mandible with 6 prominent teeth, with ridge extending from the upper mandibular articulation to the middle of the row of teeth. Galea shiny, smooth. In lateral view gena sharply delineated from posterior of head, a little narrower than compound eye, punctuation as for bulk of face.

Pronotum with sulcus deep dorsally, shallow laterally, anterolateral aspect nearly smooth and shiny, laterally with irregular punctures partially obscured by shagreening. Scutum, scutellum, and about median 1/2 of axilla dull, with punctuation a little coarser than on bulk of face, outer 1/2 of axilla with smaller, very close punctures. Scutellum projecting just over metanotum (Fig. 71g); metanotum vertical with fine shagreening medially, roughened laterally. Propodeal triangle large, declivous, narrow central area and lower 1/2 with medium tessellation, dorsal lateral areas with medium-sized rough punctures interspersed with medium tessellation. Posterolateral area of propodeum roughly shagreened. Lateral areas of mesosoma shiny, with large, sometimes irregular, close punctures. Dorsal apical

margin of pro- and mesotibia with small sharp spine arising from darkly hyaline area of leg, spine on protibia about 1/2 the length of that on mesotibia. Metatibia with longitudinal carina on ventral anterior margin; inner hind tibial spur finely ciliate (Fig. 71i). Pterostigma small, only slightly longer than wide. Vein 2m-cu meets or is just distal to 2nd submarginal crossvein.

Metasomal tergum 1 with anterior face strongly concave with a median longitudinal groove, area separated from dorsal surface by a well-defined transverse line. Disc of terga 1–5 shiny, with small to medium-sized irregular punctures separated by from about 1/2 a puncture diameter, to close, with very faint shagreening sometimes visible; posterior marginal zone a little depressed, shiny, with small irregular close punctures. Tergum 6 concave in lateral view, in dorsal view with small median apical notch (Fig. 71h), shiny, with very irregular close punctures throughout. Metasomal sternum 1 broadly and very shallowly emarginate apically, shagreened; sterna 1–6 with small to medium-sized punctures except for hyaline areas of sterna 2–4 impunctate, punctures separated by about 1/2 a puncture diameter.

**Vestiture.** Brown to black on frons, vertex, and dorsum of meso- and metasoma, white to off-white elsewhere. Generally short and sparse on face and dorsally on meso- and metasoma, not obscuring surface, but longer laterally on head and mesosoma. Dorsal face of the basitarsus of all legs covered in pale, short, plumose hairs, very dense and obscuring surface of pro- and mesobasitarsi, somewhat less dense, not completely obscuring surface of metabasitarsus; ventral surface of basitarsus of all legs with orange hairs, not quite obscuring surface. Disc of metasomal sterna 2–6 with long pale hairs, forming scopa.

**Male** (n = 17). Length 10.8–15.9 mm ( $12.7 \pm 1.79$  mm); width 4.0–5.4 mm ( $4.7 \pm 0.45$  mm); forewing length 5.7–8.2 mm ( $6.9 \pm 0.77$  mm); facial length 2.6–3.0 mm ( $2.8 \pm 0.11$  mm); facial width 2.0–2.5 mm ( $2.2 \pm 0.17$  mm); malar length/malar width 0.15.

**Coloration** similar to female except about dorsal 1/3 of clypeus with black area forming a solid 'W', about lateral 1/3 of ventral margin produced to a clear projection; scutellum and axillae without yellow maculae; profemur black except extreme anterior dorsal tip yellow; legs with tibiae as in female, remainder black, dorsal face of basitarsus yellow, remainder black.

**Structure.** (Fig. 71c–d). Scape a little shorter than flagellar segments 1–4. Compound eyes about 3× longer than wide, with about lower 6/7 of inner margins converging slightly below, about 1/7 converging slightly above. Ocellular distance 2× an ocellar diameter, interocellar distance about 4/5 diameter of median ocellus. Antennal sockets 1.3× further from apex of clypeus than from vertex. Sculpturing of

face similar to female. Supraclypeus, and frontal line and ridge, similar to female. Clypeus extending for about 1/10 its length below a line across lower margins of compound eyes, about median 1/3 of lower margin slightly concave between lateral rounded black projections. Malar space short, similar to female. Labrum and galea similar to female. Mandibles with 3 prominent teeth. In lateral view gena a little wider than compound eye, otherwise similar to female.

Mesosoma similar to female.

Metasoma with about apical 1/2 habitually flexed forward ventrally, otherwise similar to female, except punctures on discs of terga 1–6 up to several diameters apart, especially on tergum 6; tergum 6 flat in lateral view; lateral margin of terga 1–5 increasingly produced from scarcely discernible on tergum 1 to a rounded flange along whole length of edge of disc, widest at middle, on tergum 5. Tergum 6 produced almost sublaterally to a very large, stout, sharp spine with point directed posteriorly, spine about as long as disc is wide; disc traversed by a ridge angled from near mid-base of spine to posterior median line of disc. Tergum 7 with 3 large spines directed posteriorly, the median spine straight, 1/2 the length of the 2 lateral spines, blunt, the lateral spines slightly angled outwards apically, about as long as spine on tergum 6, very robust, blunt (Fig. 26e). Sterna 1–6 rather similar to female except sternum 6 impunctate medially, shiny. Sternum 7 (Fig. 71e) with basal lobes sclerotised, parallel-sided, directed anteriorly, apical lobes expanded medially, hirsute ventrally. Bulk of sternum 8 (Fig. 71f) subquadrate, with large, well-sclerotised median anterior projection, short, narrow lateral projections, and narrow hirsute posterior projection narrowly bifid apically. Gonocoxites and gonostyli in dorsal and ventral views (Fig. 71j) flattened obliquely; in lateral view (Fig. 71k) penis valve projecting well below gonostylus.

**Vestiture.** Similar to female except white on face; on dorsal aspect of basitarsi longer, much less dense so not obscuring or nearly obscuring surface; about 1/2 as long again on discs of metasomal terga; lateral aspect of terga 2–4 with dense golden vestiture projecting laterally and curled downwards, the effect less developed on terga 1 and 5; sterna 2–5 with white vestiture not forming scopa. Hairs on gonostyli with very short lateral branches.

**Variation.** In both sexes the size, shape and even presence or absence of many yellow maculae can vary considerably. Dark markings can occur in the yellow maculae on the clypeus. The yellow maculae on metasomal terga 2–3 of females can be separated into 2 dots, so that a terga may have 3–4 yellow dots. This can extend to more terga on males. On males the yellow maculae on the lateral aspect of terga 6 may extend to the base of the lateral spine, and

yellow maculae may be present at the base of the lateral spines on tergum 7.

Male size varies so much that the largest is nearly 1/2 as long again as the smallest. The degree of development of the lateral curls on metasomal terga 2–4 in particular seems to be greater the larger the bee. However the tufts seem to suffer increased wear as a bee ages.

The vestiture across the face at the level of the antennal sockets of a male from Nelson NN is orange or partly so, but the presence of orange pollen grains among the bases of the hairs suggests that the colour is derived from the pollen, or from the flowers which produced the pollen.

**Type data.** *Apis manicata*: holotype male, “in Europa” (LSL).

**Material examined.** 9 females and 19 males, of which 2 females and 4 males emerged from a nest from Napier HB, 2 females and 1 male were collected on the wing from Napier, and 4 females and 14 males were taken from Nelson NN.

**Distribution.** (New Zealand, Map 35). Napier HB and Nelson NN.

**Biology.** The species has been taken at just 2 sites, Napier HB and Nelson NN, and for Nelson there is a height record of 80 m.

**Flight period.** Five collection records for 7 females range from 6 February to 7 March, and for 15 males the 5 collection records range from 9 February to 7 March.

	Feb	Mar
Females	3	2
Males	1	4

The largest collection is of 3 females and 10 males from Nelson NN on 7 March 2006 by B. J. Donovan.

Bees have not been captured on native flowers.

### Host plants

#### Introduced plants

Crassulaceae			
<i>Sempervivum</i> sp.	♀	1/1 (?? p)	—
Plantaginaceae			
<i>Linaria purpurea</i>	♀	4/6 (3/5 p)	♂ 5/15
<b>Total collections/specimens</b>	♀	5/7 (3?/5? p)	♂ 5/15
<b>Species/genera/families</b>		2/2/2 (2?/2?/2? p)	1/1/1

*Associated organisms.* None are known.

**Remarks.** This species was discovered present in New Zealand for the first time when on 28 January 2006, Mrs Dale East of Bluff Hill, Napier HB, collected a billiard-ball-sized nest of woolly-looking fibres from a gap in an aluminium window frame on the second story of her house. Later examination by me showed that the nest contained 5 cells with pollen, and 30 cocoons, of which one cocoon had produced a bee before collection. On 9 February 2006 at

2.45 p.m. Mr Graham Burnip (Biosecurity New Zealand) and I collected 1 male on Bluff Hill, Napier, among flowers of *Linaria purpurea*, and 20 minutes later at the same site we collected a female on the same flowers. The day was partly sunny, and the temperature was about 23° C. This collection site was about 130 m from the nest site. The following day a female was captured at 9.58 a.m. on Hospital Hill, Napier, on the same flowers about 1.5 km from the Bluff Hill collection site. The sky was heavily overcast and the temperature was about 17° C. The wings of the male were quite tattered apically, but the wings of the females were intact except for one small notch in one forewing. One female carries much pollen, and the other just a trace.

On 6 February 2006, Ms Joanna Rees of Robinson Road, Nelson NN, collected a female in her home flower garden on *Sempervivum* sp. and saw several more bees. At the same site and nearby on 6–7 March 2006 I captured 1 female and 3 males and saw many more, and 1.8 km away I captured another 3 females and 11 males, and saw several more. All bees were taken on or over *Linaria purpurea*. Over both days the sky was mostly clear, and the temperature during bee activity was between about 18–24° C. All 4 females carry large loads of pollen, and the wings of 3 are markedly worn. The wings of most males show varying degrees of wear.

At Robinson Road, Nelson, I easily observed large males guarding patches of about several square metres of flowering *Linaria purpurea* from other foraging insects. Males were quite noticeable as they hovered completely motionless before targeting and then flying directly at and striking insects foraging in *Linaria purpurea* flowers. Honey bees, worker and male *Bombus terrestris*, and the eumenid wasp *Ancistrocerus gazella* were knocked out of flowers. Nearly all attacked insects immediately flew out of the area, but a few moved to other nearby flowers in the patch, perhaps just 200–400 mm away, where they continued to forage, and where they were often ignored by male *A. manicatum*, at least for a while. Female *A. manicatum* that came to the flowers to forage were soon mated by a male, with mating lasting about 6–10 seconds. After mating, both sexes fed in flowers, and the females soon continued to forage for pollen and presumably nectar.

The recovery of a nest from Napier and the occurrence of nesting females at least 1.5 km apart, the obvious old age of many bees which indicates a long period of mating and nesting, and at Nelson the slightly wider distribution of numerous nesting females, strongly indicates that the species is well established at both sites. Indeed, the construction by presumably 1 female of a nest at Napier of 35 cells suggests that conditions there are very conducive to very successful nesting. Similarly the abundance of both females and males at Nelson suggests that the species has and is nesting there just as successfully.

The home range of *A. manicatum* was originally Europe, the Mediterranean border of North Africa, and western Asia, but it now occurs from Scandinavia to Morocco and east to oriental Siberia (Linnaeus 1758, Smith 1991). By 1901 it was well established at São Paulo, Brazil (Schrottky 1901), and by 1964 it was established in Uruguay, southern Brazil and northern Argentina (Moure & Urban 1964). Lieftinck (1958) identified it from the Canary Islands where it was previously unknown. In 1963 it was nesting near Ithaca, New York, U.S.A. (Jaycox 1967), and it was present about 20 km south of the University of Guelph, Ontario, Canada in 1984, and at Guelph, Canada by 1990 (Smith 1991). Recently it has been found as far west as Utah (pers. comm. Terry Griswold to Bede McCarthy, MAF Biosecurity, Lincoln). Smith (1991) hypothesised that bees reached the University of Guelph through the importation of bricks and their pallets which may have harboured nests, from Ohio. Napier and Nelson both have ports which receive large vessels carrying shipping containers and much other cargo, which may have provided nesting sites for *A. manicatum*.

In Europe *A. manicatum* is known as the wool-carder bee. The name ‘wool-carder’ is derived from the habit of females ‘carding’ fibres from the surface of plant stems, in a manner reminiscent of the process by which wool is ‘carded’ between spiked brushes before being spun. Females pack the fibres into cavities, and cells which are provisioned with pollen and nectar are formed within the mass of fibres. An egg is laid in each cell, and the resulting larva spins a cocoon. In New York the first foraging females were collected on 7 June in both 1970 and 1971, and the last on 14 October in 1971, and there were said to be at least 2 generations per year (Severinghaus *et al.* 1981). These collection dates correspond to 7 December and 14 April in New Zealand, so at least 2 generations per year can be expected here. Indeed, the presence of 5 cells with pollen in the nest collected at Napier on 28 January 2006 indicates that the female bee was still building cells up to that date, and the subsequent emergence of 18 bees from cocoons in the nest constituted a second generation.

In New Zealand females visited at least 44 species of flowering plants in 11 families for pollen and nectar, most of which belonged to Lamiaceae, Fabaceae, and Scrophulariaceae with blue or violet flowers, bees were active from early morning until sunset, and the lowest temperature at which activity was recorded was 15°C (Severinghaus *et al.* 1981). These characteristics, coupled with the proven ability of the species to colonise widely disparate areas in both the Northern and Southern hemispheres, suggest that it has the potential to occupy a great deal of New Zealand’s vegetated area.

A major characteristic of large male wool-carder bees and one which is not exhibited by any other species of bees in New Zealand, or indeed any other insect in New Zealand,

is their aggressive defense of patches of flowers against other flower-visiting insects. In Germany some photographs showed that just before the moment of impact an attacking male curved its abdomen forward and hit the target insect with the 5 spines on the end of its metasoma. Close inspection of the wings of insects unable to fly after an attack showed that several wings had holes corresponding to size of the spines, often the costal wing vein was broken, and sometimes an entire wing was broken off. Of 1,979 honey bees which were attacked, 54.6% left the territory, and 2.5% were wounded. Honey bees unable to fly died within a few hours (Wirtz *et al.* 1988).

The successful establishment of the species at 1 site in each of the North and South Islands means that most of the country will probably be colonised within the foreseeable future. Some of our native and adventive bees, and the alkali bee from North America, may soon be confronted by this new form of aggressive competitive behaviour for foraging sources with which they have no evolutionary experience. However, because female wool-carder bees require existing cavities within which to nest, their numbers should never become excessively high, and quite possibly many native flowers will not be favoured as sources of nectar and pollen.

Because of their large size, bright yellow maculations, the highly visible aggressive flower-patch-defending behaviour of males, and the frequent matings, the wool-carder bee is a noticeable and interesting addition to our apoid fauna. Its possible impact on established pollination syndromes will be interesting to observe as it unfolds.

### Tribe Megachilini

#### Genus *Megachile* Latreille

##### Subgenus *Eutricharaea* Thomson

- Megachile* (*Eutricharaea*) Thomson, 1872: 228. Type species: *Apis argentata* Fabricius, 1793, monobasic.
- Megachile* (*Paramegachile*) Friese, 1898: 198. Type species: *Apis argentata* Fabricius, 1793, by designation of Mitchell, 1934: 298.
- Megachile* (*Paramegalochila*) Schulz, 1906: 71, unjustified emendation of *Paramegachile* Friese, 1898.
- Andrognella* Cockerell, 1911: 313. Type species: *Megachile detersa* Cockerell, 1910e, by original designation.
- Perezia* Ferton, 1914: 233, not Léger & Dubosc, 1909. Type species: *Perezia maura* Ferton, 1914 = *Megachile leachella* Curtis 1828, monobasic.
- Fertonella* Cockerell, 1920: 257, replacement for *Perezia* Ferton, 1914. Type species: *Perezia maura* Ferton, 1914 = *Megachile leachella* Curtis, 1828, autobasic and by original designation.
- Megachile* (*Eurymella*) Pasteels, 1965: 64. Type species: *Megachile eurymera* Smith, 1854, by original designation. Synonymised by Michener, 2000: 556.
- Megachile* (*Digitella*) Pasteels, 1965: 191. Type species: *Megachile digiticauda* Cockerell, 1937, by original designation. Synonymised by Michener, 2000: 556.
- Megachile* (*Neoeutricharaea*) Rebmann, 1967a: 36. Type species: *Apis rotundata* Fabricius, 1787, by original designation. Synonymised by Michener, 2000: 556.
- Megachile* (*Melaneutricharaea*) Tkalcù, 1993: 803. Type species: *Megachile hohmanni* Tkalcù, 1993, by original designation. Synonymised by Michener, 2000: 556.
- Megachile* (*Anodonteutricharaea*) Tkalcù, 1993: 807. Type species: *Megachile larochei* Tkalcù, 1993 = *Megachile lanigera* Alfken, 1933, by original designation. Synonymised by Michener, 2000: 556.

#### *Megachile* (*Eutricharaea*) *rotundata* (Fabricius)

leafcutting bee

Fig. 27a–d, 72a–g; Map 36

World, excluding New Zealand, selected bibliography.

*Apis rotundata* Fabricius, 1787: 303 (description of species).

*Apis pacifica* Panzer, 1798: 56 (description of species).

*Megachile rotundata*: Dalla Torre, 1896: 446 (list, new combination). Hurd, 1967: 3–6 (*Megachile rotundata* as used in the United States and Canada is not *Megachile rotundata* Fabricius, so the species used for alfalfa pollination is without a name). Rebmann, 1967b: 170–171 (*Megachile rotundata* auct. nec Fabricius is *Megachile pacifica* Panzer). Roberts, 1974: 190–192 (proposed suppression of lectotype of *Apis rotundata* and designation of neotype in accord with *Megachile rotundata* auct.). —1978: 392 (notification of the decision of the International Commission on Zoological Nomenclature, published in November 1977, establishing a neotype for *Apis rotundata* Fabricius. *Megachile rotundata* (Fabricius) is the name of the alfalfa leafcutting bee).

*Megachile pacifica*: Rebmman, 1967b: 170–171 (*Megachile rotundata* auct. nec Fabricius is *Megachile pacifica* Panzer). Roberts, 1974: 190–192 (Prof. Fabricius identified specimens of Panzer's *pacifica* as his *rotundata*). —1978: 392 (*Megachile rotundata* (Fabricius), not *Megachile pacifica* (Panzer), is the name of the alfalfa leafcutting bee).

New Zealand, all references.

*Megachile rotundata*: Palmer-Jones & Forster, 1965: 348 (a very efficient pollinator of lucerne in the U.S., but will not be brought into New Zealand because it might cause economic damage). Palmer, 1966: 22–24 (efficacy as a lucerne pollinator in the U.S.A., advocates introduction to New Zealand). Palmer-Jones & Forster, 1972: 193 (recently introduced to New Zealand). Donovan, 1974: 987 (photograph of clover leaves cut by females), 989 (photograph of opened cells), 990 (photograph of ventral aspect of female), 991 (life cycle, introduction to New Zealand —1979a: 258 (introduction to New Zealand advocated by Palmer 1966). —1979b: 63 (correct name is *Megachile rotundata* (Fabricius)). Read & Donovan, 1979a: 1–8 (multiplication, management). —1979b: 1–22 (leafcutting bee life history, allocation de-



tails and management techniques, photograph of durolite shelter). —1980: 1–24 (life history, allocation details, management techniques). Donovan, 1980: 111–114 (biology and possible interactions with native bees). Donovan and Read, 1980: 67, 69, 71–72 (biology, management, allocation to growers). Read, Donovan & Macfarlane, 1980: 1–11 (propagation in the 1980 season, management). Palmer & Donovan, 1980: 87 (keyword), 89–91 (biology, 50,000 needed per hectare). Read, 1981: 1–17 (propagation in the 1981 season, management). Donovan, Read & Griffin, 1981: 17–23 (as leafcutting bees; are becoming increasingly available; more than a million cells destroyed by *Melittobia*; world-wide status of leafcutting beekeeping; efficiency of leafcutting bees as lucerne pollinators; current research at DSIR Lincoln; effect of shelter design on bee propagation rate). Donovan, 1982: 17–20 (as leafcutting bees; biology illustrated with 11 photographs). Wightman et al., 1982a: 123, and 1982b: 23 (lucerne seed yields improved by leafcutting bee introduction), 1982a: 126–128, and 1982b: 26–28 (seed yield diminishes away from bee shelters, timing of bee use). Wightman & Whitford, 1982: 209, 212–213 (leafcutting bees and safe insecticides). Donovan, Read, Wier & Griffin, 1982: 212–222 (introduction and propagation, distribution to the public, enemies and effect on seed yield in New Zealand), 214 (photograph of quarantine canisters), 216 (photograph of hive shelter). Read, 1982: 1–6 (propagation in the 1982 season, management). Donovan, Read & Griffin, 1982b: 7–13 (propagation in 1982, seed yields; the First International Symposium on Leafcutting Bees, Saskatoon, Saskatchewan, Canada, 16–18 August 1982; research at DSIR Lincoln). McKinnon, 1983: 8–10 (as leafcutter bees; biology, use at Seddon for pollination of lucerne, 7 photographs). Read, 1983: 1–10 (propagation in the 1983 season, management). Donovan, Read & Griffin, 1983: 11–14 (bee propagation in 1983, seed yields; acquisition of a cell harvesting machine; possibility that the newly established wasp *Vespula vulgaris* will attack leafcutting bees in the same manner as does *V. germanica*; research at DSIR Lincoln). Donovan, 1984: 5 (as leafcutting bees; record of magpies and sparrows eating bees). Donovan & Macfarlane, 1984: 262–264 (drawing of female, photographs of nests, female entering nest, shelter with hives, outline of life history, flower relationships, economic importance, management), 268 (photograph of female tripping lucerne flowers). Donovan & Read, 1984b: 2–3, and 1984a, 13–14 (as leafcutting bees; economics of use for pollination of lucerne). Read, 1984: 4–10 (propagation in the 1984 season, management). Donovan & Read, 1984a: 11–12, 15–16 (bee propagation in 1984; research at DSIR Lincoln; no reports of *Vespula vulgaris* attacking beehives or leafcutting bees). Read & Donovan, 1984: 1–34 (life history, allocation details and management techniques). Macfarlane & Palma, 1987: 423 (*Melittobia hawaiiensis* was found in cells of the leafcutting bee in New Zealand). Donovan & Read, 1988a: 257–264 (lucerne leafcutting bees are efficacious pollinators of lucerne). —1988b: 9–12 (kiwifruit flowers not pollinated), 10 (photograph of leafcutting bee shelter among kiwifruit

vines), 11 (photograph of female leafcutting bee on kiwifruit flower). Macfarlane & Donovan, 1989: 274–277 (*Melittobia* spp. as parasitoids of leafcutting bees, but are easily controlled). Read, Donovan & Griffin, 1989: 23 (bumble bees forage in weather that would limit leafcutting bee activity on lucerne). Donovan, 1990: 28 (developed for widespread use as a lucerne pollinator in North America, imported to many countries including New Zealand). —1991: 25 (as leafcutting bees; 1,577,440 bees used to pollinate 62.5 ha, but probably fewer than 1 million bees will be recovered). Early, 2001: 68 (as leafcutter bees, outline of life cycle).

*Megachile pacifica*: Donovan, 1975a: 123 (the species is established in New Zealand), 127–128 (life cycle, management, introduction to New Zealand). —1975c: 43–50 (introduction to New Zealand and management, photographs of cut leaves, foraging female, female entering nest, nests, and tray of cells being placed in a hive shelter). Stark, 1975: 27, 29, 57, 59 (introduction to New Zealand, management, photographs of foraging female, female entering nest, nests, and shelter for hives). Donovan, 1976a: 234–239 (drawing of female, biology, photographs of cut leaves, female foraging, female entering nest, nests, bee management in North America for pollination of lucerne, introduction, propagation, biology, parasites and present status in New Zealand, photograph of tray of cells being placed in hive shelter). —1976b: 192 (cells parasitised by *Melittobia hawaiiensis*). Macfarlane & Pottinger, 1976: 22 (Entomology Division, DSIR, has introduced the lucerne leafcutter bee to improve lucerne pollination). Wightman & Rogers, 1978: 245–257 (energetics and nitrogen budget of growing larvae). Donovan, 1979b: 63 (correct name is *Megachile rotundata* (Fabricius)).

**Female** (n = 20). Length 6.6–9.5 mm ( $8.2 \pm 0.55$  mm); width 2.8–2.9 mm ( $2.8 \pm 0.09$  mm); forewing length 4.5–4.9 mm ( $4.7 \pm 0.12$  mm); facial length 1.8–2.0 mm ( $1.9 \pm 0.05$  mm); facial width 1.9–2.1 mm ( $2.0 \pm 0.05$  mm); malar length/malar width 0.03.

**Coloration.** Black, except galea transparent orange, distal tarsal segments and claws yellow-brown, wing veins and pterostigma dark brown, wing membranes a little darkened.

**Structure.** (Fig. 72a–b). Scape about equal in length to combined length of first 4.8 flagellar segments. Compound eyes nearly 4× longer than wide, with about upper 1/3 and lower 2/3 of inner margins converging a little above and below respectively. Ocellular distance 2.5× an ocellar diameter; interocellar distance equal to 1 ocellar diameter. Antennal sockets a little closer to apex of clypeus than to vertex. Face moderately shiny throughout. Supraclypeus somewhat protuberant, rising from perimeter to an evenly rounded mound with most protuberant aspect about midway between a line across upper margins of antennal sockets and lower margin of supraclypeus; with close punc-

tures throughout, medium-sized around perimeter but becoming large centrally, on lower median area separated by about a puncture diameter forming a small impunctate area. Frons and vertex with medium-sized to large close punctures; paraocular area with small, very close irregular punctures. Clypeus slightly recurved, very short, not reaching a line across lower margins of compound eyes by 1/3 its length; lower edge smooth, shallowly emarginate, longitudinal median area narrowly impunctate; remainder sculptured similarly to supraclypeus. Compound eye partly overlapping mandible base. Mandible massive with 4 well-defined teeth. Galea smooth, shiny. In lateral view, gena a little wider than compound eye, shiny, with large irregular close punctures.

Pronotum moderately shagreened, with obscure medium-sized punctures separated by about 1 diameter. Scutum and scutellum similar to frons and vertex; metanotum very narrow with smaller, close, irregular punctures. Propodeal triangle in lateral view slightly curved, posterior face narrow, densely tessellated, dull; area lateral to posterior face lightly tessellated with small punctures separated by up to about 4 diameters, lateral surface of propodeum and metepisternum shiny with large, close punctures. Mesepisternum with very large close punctures. Inner hind tibial spur ciliate. Pterostigma small, slightly more than twice as long as wide, vein 1st m-cu meets 2nd submarginal cell about one-eighth length of cell from proximal end.

Metasomal tergum 1 broadly concave anteriorly, about lower 1/2 moderately shagreened with small punctures separated by about 4 diameters, upper 1/2 and lateral area smooth, shiny. Tergum 2 with a transversely aligned, elongated pear-shaped area on lateral 1/3 just posterior to gradulus, area finely tessellated, impunctate, dull. Anterior margin of terga 2–5 narrowly and lightly tessellated; remainder of terga 1–5 with medium-sized to large close punctures, punctures increasing in size on subsequent terga, shiny. Tergum 6 with medium-sized, close punctures throughout, shiny. Sternum 1 shallowly emarginate apically, lightly shagreened, with small punctures close laterally but widely spaced medially. Sculpturing of sterna 2–5 similar to terga 3–5. Sternum 6 lightly shagreened, with small to medium-sized punctures variously spaced.

**Vestiture.** Compound eye with very fine, widely-spaced pale hairs, about as long as width of punctures on vertex. On body off-white or white except light brown on vertex, black on discs of metasomal terga 2–6, lateral margin of sternum 5 and all of sternum 6; on face short vestiture adjacent to compound eye, clypeus almost naked medially, scutum, scutellum with vestiture short, sparse, disc of metasomal tergum 1 with long vestiture, the black vestiture of terga 2–6 very short, terga 1–5 with apical

fimbria of very short, appressed vestiture. Sternum 1 with short, sparse fine hairs, discs of sterna 2–6 with long, stout, posteriorly-directed hairs forming scopa, apex of sterna 1–5 similar to terga 1–5.

**Male.** (n = 20). Length 6.5–8.9 mm (7.0 ± 0.60 mm); width 2.3–3.1 mm (2.6 ± 0.20 mm); forewing length 3.8–4.9 mm (4.3 ± 0.25 mm); facial length 1.7–2.2 mm (1.8 ± 0.10 mm); facial width 1.7–2.2 mm (1.8 ± 0.12 mm); malar length/malar width 0.

**Coloration.** Similar to female.

**Structure.** (Fig. 72c–d). Scape about equal in length to combined length of about the first 2.75 flagellar segments. Compound eyes about 3× longer than wide, with about upper 1/3 of inner margins very slightly convergent above, lower 2/3 of inner margins moderately convergent below. Ocellular distance 3× an ocellar diameter, interocellar distance equal to 1 ocellar diameter. Antennal sockets 1.3× further from apex of clypeus than from vertex. Face below upper limit of supraclypeus dull with medium-sized, very close punctures, above supraclypeus punctures becoming larger. Supraclypeus almost flat with at most a very small peak on a line across lower margins of compound eyes. Clypeus recurved, short, not reaching a line across lower margins of compound eyes by about one-tenth its length, about lower median 1/3 broadly and shallowly emarginate, smooth, shiny. Compound eye overlapping mandible base. Mandibles massive, with 3 obvious teeth; with large spine projecting from ventral margin near base. Galea similar to female. In lateral view gena about 3/4 width of compound eye, shiny, with large irregular shallow close punctures. Mesosoma similar to female. Procoxa with prominent tooth projecting forward from lower median margin. Wing similar to female.

Metasomal terga 1–5 similar to female except concavity of tergum 1 very shiny throughout with a very few widely-spaced extremely small punctures. Tergum 6 with sharp posteroventral angle produced to an irregular posteriorly-directed dentate margin; with medium-sized to large irregular close punctures. Sternum 1 with apical emargination similar to but broader than female, with small punctures separated by about 1 diameter. Sterna 2–4 with similar punctation but punctures a little larger. Sternum 7 (Fig. 72e) a narrow transverse sclerite projecting laterally to sternum 8; sternum 8 broad, acute basally, lateral process narrow, apex bluntly rounded. Gonocoxites and gonostyli in dorsal and ventral views (Fig. 72f) elongate, narrow, appearing twisted, penis valves stout; gonostylus in lateral view (Fig. 72g) expanded penultimately, downcurved to almost below horizontal penis valve.

**Vestiture.** Compound eyes similar to female except hairs sparser. Vestiture golden on face, dorsolaterally on remain-

der of head, mesothorax, metasomal terga 1–2 and apical fimbria of metasomal terga 3–4; black on disc of metasomal terga 3–4, off-white on ventral aspect of whole insect. On face very dense below about halfway between antennal socket and median ocellus, on clypeus hairs directed downwards, on paraocular area downwards opposite clypeus, towards compound eye opposite supraclypeus, upwards above antennal sockets, on supraclypeus directed upwards. On dorsum of mesothorax not obscuring surface. Vestiture on metasomal terga 1–4 similar in distribution to female; tergum 5 with short vestiture basally just obscuring surface laterally, apical margin without fimbria medially; tergum 6 with thick appressed vestiture appearing to naked eye as 2 spots joined in mid line.

**Variation.** Compound eyes of live and freshly dead males are light green. Apart from size variation, individuals of both sexes appear particularly homogeneous physically.

**Type data.** *Apis rotundata*: neotype female, “Simontoryna Hu. occ. leg. Pillich, 12:8.33 *C. can.*” (= Simontoryna, Hungary west, collected by Pillich, 12 August 1933.), designated by R. B. Roberts, 1973. (ZMC) (Roberts 1974).

**Material examined.** Pinned specimens: 22 females and 1 male from Calgary, Alberta, Canada, 79 females, 41 males and 4 hermaphrodites from Lethbridge, Alberta, Canada, 1 female and 3 males from Davis, California, U.S.A., 30 females and 18 males from Parma, Idaho, U.S.A., and 200 females and 200 males from managed populations incubated and emerged from cells at the Canterbury Agriculture and Science Centre, Lincoln, from 1971–1977.

**Distribution** (New Zealand, Map 36). South Island: MB, MC, CO.

From 1971–1977 a total of 874,585 cells was imported from North America, from which 682,444 bees emerged in quarantine, and apart from the collected bees mentioned above, were released in the field (Donovan et al. 1982). Although the species has been field-released onto flowering lucerne seed fields in many areas in both main islands, it is known to persist in the wild only in MB, MC, and CO in the South Island.

**Biology.** The species occurs naturally in the Middle East and Europe. Early last century it reached North America inadvertently through agencies of man’s transport. By the 1950’s the realisation that the species was an excellent manageable pollinator of lucerne (= alfalfa) led to a rapid increase in the bee population throughout the drier western areas of the United States and Canada. Cells containing prepupae were soon exported to many countries throughout the world where lucerne is grown for seed, so that the range of the species is now very extensive. The bee’s biology has been intensively studied, particularly in North America and Europe.

The species overwinters as prepupae in cells in blind tunnels from about 4–8 mm in diameter and 40–120 mm deep. In nature bees use tunnels such as those made by beetles in dead wood, pith cavities of plant stems, or even gas emission holes in cold lava. Man-made cavities are gaps between overlapping shingles and boards, rubber or metallic tubes in farm sheds, drilled holes in wood, and cavities in locks on doors. For the large managed populations used for lucerne pollination, laminated wooden and polystyrene boards, paper drinking straws and corrugated cardboard are provided in shelters placed on the lucerne seed fields.

As temperatures rise in spring, prepupae gradually change into bees. Normally about the outer 60% of cells in a nest tunnel produce male bees, and the inner 40% produce female bees. Emerged bees mate, and females soon begin re-nesting in a new tunnel, or often in an old tunnel from which they remove remnants of old nests. The cup-shaped cells are made of about 15 pieces of leaf, and about 17 foraging trips are required to provision the cell with pollen and nectar. An egg is then laid, and the cell is sealed with a few leaf pieces. Up to a dozen or more cells may be constructed in a linear sequence in a tunnel by one female. Female bees complete about a cell a day in favourable flying weather, and may make 30 or more over 6–8 weeks. Cells constructed before about the longest day of the year often produce adult bees later that same summer (a second generation for the ‘season’), but most cells built much after the longest day do not produce bees until after the winter.

In New Zealand most imported bees were released near Blenheim MB, with substantial releases in Mid- and North Canterbury, lesser releases in Otago, South Canterbury and Nelson, and minor releases in many other places including the North Island. Wild bees have been seen and/or collected at or near the Wairau Valley MB, Awatere Valley KA, Kaituna Valley and Lincoln MC, and Alexandra and Bannockburn CO.

**Flight period.** The first wild male bees have been observed on 21 October, with the first females carrying leaves and pollen into nests by late October. The vast majority of managed bees are released into the field on or soon after 10 January, with most females beginning nesting activity within 7–10 days. Adult bees are usually not seen after the end of April. Because bees are managed by the thousands, specimens are readily available. Consequently there have been only 3 collections of wild bees: 17 females and 10 males from inside a house at Seddon KA in early February, and 1 female from each of Bannockburn and Alexandra CO on 3–4 January and 19 January respectively. All females were without pollen.

#### Host plants

There are no collection records for bees from native flow-

ers. However, females have been observed collecting pollen from 2 species of native flowers in 2 genera and 2 families, and males have been observed foraging upon 1 species.

#### Fabaceae

*Carmichaelia* sp. ♀ 12s/12s (12s/12s p) ♂ 10s/10s

#### Plantaginaceae

*Hebe* sp. ♀ few /few (few/few p) —

Managed bees placed upon flowering lucerne collect pollen and nectar primarily from lucerne, but many will forage upon other plants within flight range of their liberation sites. Females have been observed foraging upon 10 introduced species in 9 genera in 4 families, from which pollen was collected from 9 species in 9 genera in 4 families. Males have been observed foraging upon 9 species in 9 genera in 4 families.

#### Asteraceae

*Crepis* sp. ♀ 20s/100s (20s/100s p) ♂ 20s/100s

*Hieracium* sp. ♀ 10s/20s (10s/20s p) ♂ 10s/20s

*Taraxacum officinale* ♀ 10s/10s (10s/10s p) ♂ 10s/10s

#### Brassicaceae

*Brassica* sp. ♀ 10s/20s (10s/10s p) ♂ 10s/20s

#### Crassulaceae

*Sedum reflexum* ♀ 20s/20s (20s/20s p) ♂ 10s/10s

#### Fabaceae

*Lotus pedunculatus* ♀ 20s/100s (20s/20s p) ♂ 10s/10s

*Medicago sativa* ♀ 100s/1000s (100s/1000s p) ♂ 100s/1000s

*Melilotus alba* ♀ 10s/100s (10s/100s p) ♂ 10s/20s

*Trifolium pratense* ♀ dozen/20 + —

*Trifolium repens* ♀ 100s/100s (100s/100s p) ♂ 20s/100s

**Nest sites.** Wild bee nests have been found in naturally-occurring abandoned beetle holes in a tree stump at Spring Creek MB, abandoned cells of *Pison spinolae* at Seddon KA, and in man-made cracks between boards on buildings and rubber and metal tubes in a barn at Seddon KA. Managed bee nests are constructed in the range of man-made tunnels mentioned above.

**Associated organisms.** Within 8 weeks of the first field release on 2 February 1971 of bees legally imported through quarantine, 3 cells in one nests were attacked by the eulophid parasitoid *Melittobia hawaiiensis*. Subsequently, thousands of cells were destroyed annually in some large managed populations, probably by *M. acasta*. Appropriate early cold-storage of cells at the end of the season can eliminate all *Melittobia* while preserving the great majority of immature bees. At Lincoln MC the hay itch mite *Pyemotes tritici* killed 8 prepupae in one population of about 3000 cells in 1976. An endemic gasteruptionid *Gasteruption* sp. parasitized one cell in a nest hole that was otherwise occupied by its native bee host *Hylaeus relegatus* (cells of which were also attacked). The adventive German wasp

*Vespa germanica* has removed pollen from nest holes, and psocids, *Lepinotus patruelis* and *Liposcelis* sp., and earwigs, *Forficula auricularia*, have occurred in some nest holes near Blenheim MB and Seddon KA. A few worker honey bees, *Apis mellifera*, have entered nests being provisioned by female leafcutting bees. Magpies, *Gymnorhina* spp., and house sparrows, *Passer domesticus*, have fed on sunning bees at commercial bee shelters on lucerne seed fields, and mice, *Mus musculus*, have consumed cells in drinking straw nest holes and loose cells removed from grooved boards for storage.

**Remarks.** The morphological homogeneity of adults of this species is probably a result of the apparently very small gene pool from which the species established in North America, and the constant mixing of bees in the commercially-managed populations from which our bees were derived.

In 1971 a honey bee keeper illegally imported cells from Calgary, Alberta, Canada. After incubation the cells were placed in the field in Canterbury MC. Nests were seized by the Ministry of Agriculture, and passed to me for inspection. Several cells contained live prepupae of the North American chalcidoid parasitoid of leafcutting bees, *Monodontomerus obscurus*. This showed that leafcutting bee immatures had been killed in the field in New Zealand, which suggests that the parasitoid had been imported with the bee cells. Trap-nesting for 3 subsequent years captured one bee nest in each of the first and third years, but the parasitoid was not taken. The parasitoid has not been seen since the first recovery.

Sporadic shipments of up to 100,000 cells at a time to Australia have resulted in the establishment of at least one small managed population near Keith, South Australia.

Until 1992 several million bees which were raised from the imported bees, were being managed commercially each year for pollination of lucerne seed crops. However with the disestablishment of the Department of Scientific and Industrial Research in mid 1992 and the loss of the research programme and experienced bee managers and extension personnel, bee numbers plummeted, so that by winter 2001, the number of cells in cold storage was 130,000. After the 2005–2006 summer there were about 175,000 cells.

### Family Apidae Subfamily Apinae Tribe Bombini

#### Genus *Bombus* Latreille

#### Subgenus *Bombus* Latreille s. str.

*Bremus* Jurine, 1801: 164. Type species: *Apis terrestris* Linnaeus, 1758, by designation of Morice & Durrant,

1915: 428. Invalidated by Commission Opinion 135 (1939).

*Bombus* Latreille, 1802: 437. Type species: *Apis terrestris* Linnaeus, 1758, monobasic. [Westwood, 1840: 86, designated *Apis muscorum* Linnaeus, 1758, as type species; it was not originally included species.]

*Bremus* Panzer, 1804: 19. Type species *Apis terrestris* Linnaeus, 1758, by designation of Benson, Ferriere & Richards, 1937: 93.

*Bombus* (*Leucobombus*) Dalla Torre, 1880: 40. Type species: *Apis terrestris* Linnaeus, 1758, by designation of Sandhouse, 1943: 564.

*Bombus* (*Terrestribombus*) Vogt, 1911: 55. Type species: *Apis terrestris* Linnaeus, 1758, by designation of Frison, 1927: 67.

## **Bombus (Bombus) terrestris (Linnaeus)**

### **twobanded bumble bee**

Fig. 28a–f, 73a–h; Map 37

#### Selected bibliography.

*Apis terrestris* Linnaeus, 1758: 578 (description of females).

*Apis terrestris audax* Harris, 1776: 130 (description of queen?).

*Bombus* (*Bombus*) *terrestris*: Latreille, 1802: s. str. 437 (new combination).

**Queen** (n = 20). Length 17.9–23.7 mm ( $20.4 \pm 1.32$  mm); width 9.2–11.2 mm ( $10.1 \pm 0.57$  mm); forewing length 12.5–14.5 mm ( $13.7 \pm 0.52$  mm); facial length 4.0–4.3 mm ( $4.2 \pm 0.11$  mm); facial width 3.4–3.8 mm ( $3.6 \pm 0.10$  mm); malar length/malar width 0.64.

**Worker** (n = 20). Length 9.7–15.1 mm ( $12.6 \pm 1.64$  mm); width 5.1–7.5 mm ( $6.3 \pm 0.79$  mm); forewing length 6.6–10.9 mm ( $9.1 \pm 1.19$  mm); facial length 2.7–3.6 mm ( $3.1 \pm 0.25$  mm); facial width 2.2–2.9 mm ( $2.6 \pm 0.21$  mm); malar length/malar width 0.65.

**Coloration.** Black, except galea dark red with inner margin widely hyaline, mandibles towards apex and tarsal segments red black, scopal face of tibia and basal 1/3 of tarsal claws dark red, pterostigma and wing veins dark brown, wing membranes dusky.

**Structure.** (Fig. 73a–b). Scape equal in length to combined length of first 6 flagellar segments. Compound eyes 3.5× longer than wide, with about lower 2/3 of inner margins converging moderately below, about upper 1/3 converging strongly above. Ocellular distance 2× an ocellar diameter; interocellar distance about 3/5 an ocellar diameter. Antennal sockets a little closer to vertex than to apex of clypeus. Face shiny. Supraclypeus in lateral view almost flat, with small, close irregular punctures throughout. Between antennal sockets frontal line produced to a low ridge which extends about 1/3 distance to median ocellus, frontal line then becoming very deep, extending to median ocellus. Frons, paraocular area and vertex with small to medium-

sized close punctures except punctures larger near compound eye, narrow area between lateral ocellus and compound eye and along deep frontal line almost impunctate. Clypeus strongly protuberant, moderately long, extending for 2/5 its length below a line across lower margins of compound eyes; central 5/7 of lower margin transverse, lateral 1/7 strongly recurved; dorsal margin broadly punctured similarly to supraclypeus, lateral margin with small to medium-sized close punctures, some punctures becoming larger towards centre of clypeus, some punctures separated by up to about 6 diameters so central lower area of dome of clypeus appears partly impunctate, smooth. Labrum deeply divided medially with extremely large, close irregular punctures. Malar space short relative to other New Zealand species of bumble bee, 2/3 as long as wide, shiny, almost smooth except for a few small irregular marks and small irregular close punctures encroaching from gena. Galea shiny, smooth, with a few widely spaced small punctures and with faint transverse striations on distilateral 4/5. In lateral view gena about 1.6× wider than compound eye, shiny, with small to medium-sized punctures separated by 1–2 diameters.

Pronotum anterior to sulcus shiny, dorsally with small punctures separated by about 2 diameters, laterally punctures similarly spaced but larger; posterior to sulcus punctures about medium-sized, close, with faint tessellation dorsally, except pronotal lobe with smaller, closer punctures dorsally, lower central area almost impunctate. Scutum with small posterocentral area smooth, shiny, impunctate, surrounded by large punctures which become smaller, very dense around periphery of scutum, except for very small area lateral to parapsidal line with large punctures separated by 1 diameter or more. Scutellum large, produced over metanotum so that in dorsal view metanotum completely obscured; small median longitudinal area almost impunctate, flanked by medium-sized punctures widely spaced, punctures becoming small, very close towards wing base. Metanotum very narrow, parallel sided, very lightly shagreened, with a very few, very widely spaced small obscure punctures. In lateral view propodeum rather evenly rounded, propodeal triangle smooth with very small shiny area posteromedially, laterally with very small punctures separated by 1–2 diameters, lightly shagreened; posterolateral area shiny, with very small indistinct punctures posteriorly, anteriorly punctures about medium-sized, separated by about 1–3 diameters. Metepisternum shiny, about upper 1/2 sculptured as for adjacent posterolateral area of propodeum, small middle area smooth, shiny, except for a few small, widely spaced punctures, lower area moderately shagreened. Mesepisternum above scrobal suture shiny, with medium-sized punctures near lower margin separated by about 2–4 diameters, punctures

becoming much smaller, closer dorsally; below scrobal suture medially with large punctures separated by about 0.5-1 diameter, punctures smaller towards periphery, shiny. Metatibia very broad, flattened laterally, outer surface very shiny, with stout fringing hairs and spines, forming highly developed corbicula; metabasitarsus similarly broad, flattened laterally, with outer surface with small punctures separated by about 1 diameter, lightly shagreened. Pterostigma short, a little less than twice as long as wide, vein 1st m-cu meets 2nd submarginal cell 2/5 distance along posterior margin from proximal end. Metasomal tergum 1 with anterior face strongly concave, moderately shagreened, with longitudinal median line extending from anterior margin to beyond centre of concavity. Metasomal terga 1-5 shiny, tergum 1 with very small posteromedian area lightly shagreened, dorsally with small, widely spaced punctures medially, punctures becoming very close laterally; terga 2-6 with small to medium-sized close punctures, except medially punctures becoming increasingly widely spaced towards posterior terga. In lateral view tergum 6 concave near apex, small median central area tessellated. Sternum 1 shallowly emarginate apically, large lateral area moderately shagreened, impunctate; sternum 2 with narrow lateroposterior area moderately shagreened, median area of sternum 1, and sterna 2-6 with medium-sized to very large close punctures.

**Vestiture.** Dense, long on body, obscuring surface throughout or nearly so, except protuberant area of clypeus, malar area, upper 1/2 of frons, small impunctate area of scutum, propodeal triangle, and discs of sterna 2-5 almost naked. Black, except for orange band between a line across pronotum about halfway between sulcus and posterior margin, and a line on scutum across anterior margins of tegulae, orange band extending laterally to include pronotal lobe; orange parallel sided band on anterior 2/3-3/4 or more of dorsal area of metasomal tergum 2, off-white dorsally on about posterior 1/2 of tergum 4 and all of tergum 5, and extending to lateral margins of adjacent sterna and tergum 6; short, very dark red on inner faces of meso- and metabasitarsi; short, off-white on remaining tarsal segments, outer face of metabasitarsus with short, off-white vestiture with a few widely spaced black hairs throughout.

**Male** (n = 20). Length 12.3-16.3 mm ( $14.0 \pm 0.96$  mm); width 6.0-7.7 mm ( $7.1 \pm 0.45$  mm); forewing length 9.5-12.0 mm ( $11.2 \pm 0.69$  mm); facial length 2.8-3.4 mm ( $3.2 \pm 0.13$  mm); facial width 2.4-2.8 mm ( $2.7 \pm 0.12$  mm); malar length/malar width 0.85.

**Coloration.** similar to queen and worker, except metasomal terga 1-6 and sterna 1-5 noticeably hyaline apically.

**Structure.** (Fig. 73c-d). Scape as long as combined length of first 5 flagellar segments. Compound eyes a little more

than 3× longer than wide, with inner margins similar to queen and worker. Ocellular distance 2.5× an ocellar diameter; interocellar distance 2/3 an ocellar diameter. Antennal sockets a little closer to apex of clypeus than to vertex. Remainder of head similar to queen and worker, except clypeus extending for a little more than 1/3 its length below a line across lower margins of compound eyes, with close, medium-sized to large punctures throughout; labrum not divided medially, punctures widely spaced; malar space 0.85× as long as wide with somewhat more punctures; in lateral view gena nearly twice as wide as compound eye and punctures a little larger.

Mesosoma and wing similar to queen and worker. Legs similar to queen and worker except metatibia not modified for pollen transport.

Metasomal terga 1-6 similar to queen and worker terga 1-5, except terga 2-6 lightly shagreened; tergum 7 similar to tergum 6 except punctures larger, elongate. Sterna 1-5 similar to queen and worker sterna 1-6, except lightly shagreened, punctures less distinct; sternum 6 concave in lateral view, apex heavily shagreened, remainder smooth with small punctures separated by 2-6 diameters. Sternum 7 (Fig. 73e) broadly concave basally, roundly truncate apically. Sternum 8 (Fig. 73f) truncate basally and apically, produced laterally, with large central oval area. Gonocoxites in dorsal and ventral views (Fig. 73g) with sides curved inwards towards apex, gonostyli and volsellae with apices directed towards mid line, penis valves slightly expanded apically; in lateral view (Fig. 73h) penis valve projecting a little above projection of volsella, but not below.

**Vestiture.** Similar to queen and worker, except mandible with dense, off-white beard; orange band on anterior of mesosoma extending about halfway down mesepisternum; orange band on metasomal tergum 2 originating on all but narrow posterior margin; metasomal vestiture off-white beyond posterior margin of tergum 4; sterna with vestiture becoming increasingly off-white towards apex of metasoma.

**Variation.** The size of the more or less impunctate area on the dome of the clypeus of queens and workers can vary. Males can have a small impunctate area on the clypeus. The orange band on the anterior of the mesosoma can be much reduced in queens in particular, but also workers. The colour of the off-white apical vestiture of the metasoma is often called 'buff' by British authors, and is said to be characteristic of the subspecies *B. t. audax*.

**Type data.** *Apis terrestris*: neotype queen, Sweden, 'Upl. Radmanso Vasternas 7.8.1970 leg. S. Erlandsson' (NHRM). Opinion 1828 (1996). *Apis audax*: holotype queen?, England. If a holotype exists, its location appears to be unknown.

**Material examined.** 39 queens, 73 workers, and 79 males.

These specimens were taken from AK and TO in the North island, and MB, KA, NC, MC, MK, and CO in the South Island, and SI.

**Distribution** (New Zealand, Map 37). According to Macfarlane & Gurr (1995), the species breeds in all areas apart from the subalpine zone. North Island: ND, AK, CL, WO, BP, TK, TO, GB, RI, HB, WI, WN, WA. South Island: SD, NN, BR, MB, KA, WD, NC, MC, MK, SC, FD, OL, CO, DN, SL. Stewart Island.

Workers forage up to 2500 m in the Mount Cook MK region. It is also present on up to 23 islands that are 2.5–30 km offshore from the 3 main islands. It is not present on the Chatham Islands despite an almost certain introduction in 1890 (Thompson 1922, Macfarlane & Gurr 1995).

**Biology.** Collection dates for specimens in museums range from 27 August to 20 May, but queens and workers can be seen on sunny days in lowland regions at any time of the year. However post-hibernating queens are most numerous from early to late spring, workers are most abundant from mid spring to late summer, and male numbers peak in late summer/early autumn. Nests can be initiated at any time of year, but the great majority are founded from early to late spring. It is possible that some new queens produced in spring may found nests without undergoing a period of hibernation, or aestivation. This species is the most common bumble bee in most parts of the country.

**Flight period.** Queens of the museum specimens examined were collected from 27 August to 21 March, workers from 6 October to 20 May, and males from 12 September to 20 May. However as indicated above, queens and workers can be on the wing at any time of year. During winter, bees may fly while frost is still on the ground. Sometimes early in a day queens can be seen sunning and vibrating flight muscles preparatory to taking wing.

### Host plants

R. P. Macfarlane has recorded the species from 46 species of native flowers in 36 genera and 28 families. In addition, I have observed bees collecting pollen from 1 species of *Carmichaelia*.

Family	Genus and species
Apocynaceae	<i>Parsonsia heterophylla</i>
Asphodelaceae	<i>Arthropodium cirratum</i> <i>Bulbinella</i> sp.
Asteraceae	<i>Celmisia</i> sp. <i>Helichrysum glomeratum</i> <i>Olearia</i> sp.
Boraginaceae	<i>Myosotidium hortensia</i>
Convolvulaceae	<i>Calystegia soldanella</i>
Coriariaceae	<i>Coriaria arborea</i>
Cornaceae	<i>Corokia cotoneaster</i>

Corynocarpaceae	<i>Corynocarpus laevigatus</i>
Ericaceae	<i>Gaultheria rupestris</i>
Fabaceae	<i>Carmichaelia</i> sp. <i>Clianthus puniceus</i> <i>Sophora microphylla</i>
Hemerocallidaceae	<i>Phormium tenax</i>
Laxmanniaceae	<i>Cordyline australis</i>
Malvaceae	<i>Hoheria angustifolia</i> <i>Hoheria populnea</i> <i>Hoheria sexstylosa</i>
Myrtaceae	<i>Kunzea ericoides</i> <i>Leptospermum scoparium</i> <i>Lophomyrtus obcordata</i> <i>Metrosideros excelsa</i> <i>Metrosideros perforata</i> <i>Metrosideros robusta</i>
Onagraceae	<i>Fuchsia excorticata</i>
Orobanchaceae	<i>Euphrasia</i> sp.
Pennantiaceae	<i>Pennantia corymbosa</i>
Plantaginaceae	<i>Hebe elliptica</i> <i>Hebe salicifolia</i> <i>Parahebe hulkeana</i> <i>Parahebe loganioides</i>
Polygonaceae	<i>Muehlenbeckia australis</i>
Pittosporaceae	<i>Pittosporum crassifolium</i> <i>Pittosporum eugenioides</i> <i>Pittosporum tenuifolium</i>
Ranunculaceae	<i>Clematis afoliata</i> <i>Clematis paniculata</i> <i>Discaria toumatou</i>
Rhamnaceae	<i>Rubus australis</i>
Rosaceae	<i>Rubus australis</i>
Roussseaceae	<i>Carpodetus serratus</i>
Sapindaceae	<i>Alectryon excelsus</i>
Scrophulariaceae	<i>Myoporum laetum</i>
Solanaceae	<i>Solanum aviculare</i> <i>Solanum laciniatum</i>
Verbenaceae	<i>Vitex lucens</i>

Queens and workers have been observed and heard, biting holes through the petals of *Sophora* sp. to reach the nectar.

Large numbers of queens, workers, and males have been observed feeding on honeydew secreted from beech trees (*Nothofagus* spp.) by the scale insect *Ultracoelostoma assimile*.

R. P. Macfarlane (pers. comm.) has records of *B. terrestris* foraging on over 500 species of introduced plants. These records will be presented elsewhere.

**Nest sites.** In England nest sites are underground, usually in cavities approached by a long, downward-sloping tunnel (Alford 1975). On November 4, at Nelson NN, Cumber (1949) found a nest about 250 mm in diameter that was 300 mm below the ground in a warm northerly slope. The nest was connected to the surface by a tunnel some 45 mm

long. There was a total of 1,057 emerged cocoons, of which 355 had produced new queens. The original queen was still present, with 120 workers, and 51 new queens, but there was no worker brood, which suggested that after surviving the winter, the nest would soon die out. Donovan & Wier (1978) collected 16 naturally-occurring nests in suburban Christchurch MC. Of 14 underground nests, 10 were in disused mouse or rat nests, 2 were in holes in compost or hay and 2 were in cavities under boards. Of the above ground nests, 1 was 50 mm above a floor in sacking, and the other was 120 mm up between a hay bale and concrete. All 10 nests in rodent nests, 1 nest in hay, and 1 nest in compost had entrance tunnels which were from 40 to 1,200 mm long.

Donovan & Wier (1978) obtained 8 nests in hives especially designed for occupancy by bumble bees, however only 1 nest produced new queens.

**Associated organisms.** Cumber (1949) found large numbers of mites swarming over the comb, occupying egg cups, and clinging to all individuals in the nest excavated at Nelson NN. The mites were almost certainly the small external mite, *Kuzinia laevis* (Dujardin)(Acaridae). There were few of these mites in 5 naturally-occurring nests collected by Donovan & Wier (1978), and many in 2 nests. Also, excessive numbers of mites were thought to be the cause of termination of 1 nest founded in a hive that failed to produce new queens. Of the large external mites, Macfarlane & Ramsay (pers. comm.) took 39 female *Pneumonyssus bombicolens* (Canestrini)(Laelapidae) from 12 of 14 queens. Also, 1 *Amblyseius cucumeris* (Oudemans)(Phytoseiidae) and 1 *Parasitus fimetorum* (Berlese)(Parasitidae) were found on separate queens. Another 4, and possibly a total of 7 species of mites were associated with nests. In 1993, large mites, almost certainly *P. bombicolens*, were found with collapsed eggs in egg cups of laboratory-raised nests, which suggested that the mites were feeding on the eggs (B Donovan pers. obs.).

Between 7–23 November 1970, 7 of 14 overwintered queens from near Lincoln and Christchurch MC were found to be infected with the nematode *Sphaerularia bombi* Dufour (Sphaerulariidae) (Macfarlane 1975). Subsequently the nematode was found to be confined to an area about 30–40 km around Christchurch, within which 67 of 978 queen *B. terrestris* were infected (and 3 of 148 *B. hortorum*) (Macfarlane & Griffin 1990). The microsporidian *Nosema bombi* Fantham and Porter was found in 20 of 204 queens caught in the field near Palmerston North WI, and 46 of 76 nests which were initiated indoors and taken to the field were also infected. However, no detrimental effect on nest productivity was apparent (Fisher & Pomeroy 1989).

A number of small nests initiated in hives in the field

are destroyed by mice (B. Donovan pers obs.).

**Remarks.** *B. terrestris* is the most common bumble bee over most of New Zealand. This is possibly a result of its ability to obtain food from a much wider range of native flowers than the other 3 species combined. Also, the 500 species of introduced plants foraged upon by this species is many more than for any of the other 3 species of bumble bees. The ability of bumble bees to forage at very low temperatures and under other weather conditions that confine honey bees to their hives makes this commonest species of bumble bee a very valuable pollinator of a wide range of crops in New Zealand, for example lucerne, kiwifruit, and many fruit trees (Donovan & Macfarlane 1984).

Colonies of this species are reared on a very large scale in Europe, Israel and New Zealand for pollination of glasshouse crops, and especially tomatoes. During the 1990s many thousands of queens were exported annually from New Zealand to Europe, and this trade continues, although at a reduced level, but to more countries.

In February 1992 2 bees were collected in Tasmania, and a year later establishment was confirmed. It was thought that the species might have come ashore from a ship or yacht from New Zealand (Simmens et al. 1993).

### Subgenus *Megabombus* Dalla Torre

*Bombus* (*Megabombus*) Dalla Torre, 1880: 40. Type species: *Bombus ligusticus* Spinola, 1805 = *Apis argillacea* Scopoli, 1763, monobasic.

*Bombus* (*Megalobombus*) Schulz, 1906: 267, unjustified emendation of *Megabombus* Dalla Torre, 1880.

*Bombus* (*Hortobombus*) Vogt, 1911: 56. Type species: *Apis hortorum* Linnaeus, 1761, by designation of Sandhouse, 1943: 559.

*Hortibombus* Skorikov, 1938: 146, unjustified emendation of *Hortobombus* Vogt, 1911.

*Bombus* (*Odontobombus*) Kruger, 1917: 61. Type species: *Apis argillacea* Scopoli, 1763, by designation of Williams, 1994: 339.

### *Bombus* (*Megabombus*) *hortorum* (Linnaeus)

#### garden bumble bee

Fig. 29a–f, 74a–h; Map 38

Selected bibliography.

*Apis hortorum* Linnaeus, 1761: 424 (description of female).

*Bombus hortorum*: Latreille, 1802: 437 (new combination).

*Bombus* (*Megabombus*) *hortorum*: Dalla Torre, 1880: 40 (new combination).

**Queen** (n = 20). Length 16.0–21.7 mm (19.2 ± 1.52 mm); width 7.7–9.7 mm (8.8 ± 0.51 mm); forewing length 11.6–12.9 mm (12.2 ± 0.42 mm); facial length 4.3–4.7 mm (4.4 ±



0.12 mm); facial width 2.7–3.0 mm ( $2.8 \pm 0.08$  mm); malar length/malar width 1.36.

**Worker** ( $n = 20$ ). Length 9.5–16.5 mm ( $13.6 \pm 2.01$  mm); width 4.2–8.2 mm ( $6.3 \pm 1.05$  mm); forewing length 6.5–11.4 mm ( $9.4 \pm 1.27$  mm); facial length 2.7–4.1 mm ( $3.6 \pm 0.38$  mm); facial width 1.9–2.7 mm ( $2.3 \pm 0.21$  mm); malar length/malar width 1.27.

**Coloration.** Black, except galea dark red apart from inner margin widely hyaline, tarsal segments a little red-black, basal 1/3 of tarsal claws red, distal 2/3 of tarsal claws black; tegula, pterostigma and wing veins dark brown, wing membranes dusky.

**Structure.** (Fig. 74a–b). Scape as long as combined length of first 6.2 flagellar segments. Compound eyes  $3.3\times$  longer than wide, with lower 3/4 of inner margins converging slightly above, upper quarter of inner margins converging strongly above. Ocellular distance a little less than 2 ocellar diameters; interocellar distance about 3/4 an ocellar diameter. Antennal sockets a little closer to vertex than to apex of clypeus. Face shiny. Supraclypeus flat in lateral view, with close, small to medium-sized punctures, shiny. Between antennal sockets lower end of frontal ridge produced to a sharp point; frontal ridge extending about 1/5 of distance to median ocellus, frontal line becoming very deep, extending to median ocellus. Frons, paraocular area and vertex sculptured similarly to supraclypeus except area below median ocellus lateral to and including about upper 60% of frontal line smooth, area lateral to lateral ocellus a little wider than ocellus, smooth. Clypeus very strongly protuberant, long, extending for 2/3 its length below a line across lower margins of compound eyes, central 2/3 of lower margin straight transversely, lateral sixth strongly recurved, about dorsal 1/3 with slight irregular median longitudinal depression with small irregular close punctures, laterodorsal margin and narrow ventral margin with large to very large punctures, dome of clypeus smooth, shiny, with a very few very widely spaced small to larger punctures. Labrum stout, deeply depressed medially, anterior face irregularly punctured, lateral protuberant area similar to dome of clypeus. Malar space very long,  $1.27\text{--}1.36\times$  longer than wide, smooth, shiny, with a very few, very small widely spaced punctures. Galea shiny, smooth near base, with a few widely-spaced small punctures, distally with very fine transverse striations. In lateral view, gena 1/3 wider than compound eye, shiny, with small to medium-sized punctures separated by about 0.5–1 diameters.

Pronotum shiny dorsally with small close punctures anterior to pronotal sulcus, posterior to sulcus punctures medium-sized, separated by about 0.5 diameters, laterally moderately shagreened, with small to medium-sized punctures separated by about 1–3 diameters. Scutum with

small posterocentral area smooth, shiny, impunctate, surrounded by large punctures which become smaller, very close around periphery of scutum, except for very small smooth shiny area lateral to parapsidal line. Scutellum large, produced over metanotum so that in dorsal view metanotum completely obscured, about anterior 1/2 with large punctures separated by up to 1 diameter which become smaller, very close towards lateral and posterior margins. Metanotum very narrow, parallel-sided, lightly shagreened, about median 1/3 appearing impunctate, lateral 1/3 with a few small variously spaced punctures. In lateral view propodeum rather evenly rounded; propodeal triangle almost shiny, lightly shagreened laterally and posteriorly, with very small punctures separated by about 1 diameter; posterior area moderately shagreened; posterolateral area with medium-sized punctures separated by about 0.5 diameters. Metepisternum shiny, about upper 1/2 sculptured as for posterolateral area, lower 1/2 moderately shagreened. Mesepisternum above scrobal suture with about dorsal 3/5 with punctures, medium-sized on upper margin, becoming larger, more widely spaced below, about lower 2/5 impunctate, smooth, shiny; below scrobal suture medially with very large punctures separated by about 0.5 diameters, shiny, except anterior face moderately tessellated. Metatibia very broad, flattened laterally, outer surface shiny, posteroventral area very lightly tessellated, with stout fringing hairs and spines, forming highly developed corbicula; metabasistarsus similarly broad, flattened laterally but with outer surface somewhat concave, lightly shagreened, with medium-sized punctures separated by about 0.5–4 diameters. Pterostigma short, about  $1.5\times$  longer than wide, vein 1st m-cu meets 2nd submarginal cell over 1/3 distance along posterior margin from proximal end.

Metasomal tergum 1 with anterior face strongly concave, moderately shagreened, with longitudinal median line extending from anterior margin to beyond centre of concavity. Dorsum of metasomal tergum 1 and about anterior 1/2 of tergum 2 moderately shagreened, terga 3–5 lightly shagreened basally, unshagreened areas shinier, terga 1–5 with ill-defined medium-sized punctures separated by 0.5–1 diameters, punctures becoming larger on posterior terga. Tergum 6 concave in lateral view, irregularly roughened. Metasomal sternum 1 very shallowly emarginate apically, about lateral 1/3 with almost longitudinal tessellation, sternum 2 with about lateral posterior 1/3 heavily shagreened; median area of sternum 1, and sterna 2–6 with medium-sized to large close punctures.

**Vestiture.** Dense, long on body, obscuring surface or nearly so throughout, except protuberant area of clypeus, malar area, upper 1/2 of frons, small impunctate area of scutum and propodeal triangle bare, discs of sterna 2–5 almost

naked. Black, except lemon yellow on prothorax between prothoracic sulcus and scutum anterior to a line across anterior margins of tegulae, and laterally to almost halfway down mesepisternum; lemon yellow on about posterior 1/2 of scutellum and immediately posterior to wing base; short, dark red on inner faces of basitarsi, outer surface of metabasitarsus with very short fine off white vestiture interspersed with stouter dark hairs; lemon yellow on metasomal tergum 1 and narrow anterior margin of tergum 2 to lateral margins of the terga; white on posterior margin of tergum 3 and all of terga 4–5; off-white on posterior margin of sterna 2–5.

**Male** (n = 20). Length 7.5–16.2 mm ( $13.2 \pm 2.13$  mm); width 4.0–7.4 mm ( $6.0 \pm 0.96$  mm); forewing length 6.2–11.2 mm ( $9.7 \pm 1.30$  mm); facial length 2.5–3.9 mm ( $3.4 \pm 0.38$  mm); facial width 1.7–2.5 mm ( $2.2 \pm 0.22$  mm); malar length/malar width 1.61.

**Coloration.** Similar to queen/worker, except apical margins of metasomal terga 1–6 narrowly hyaline, sterna 1–6 more widely hyaline apically.

**Structure.** (Fig. 74c–d). Scape as long as combined length of first 3.7 flagellar segments. Compound eyes  $3.3\times$  longer than wide, with about lower 80% of inner margins more or less parallel, upper 20% converging markedly above. Ocellular distance about  $2.4\times$  an ocellar diameter; interocellar distance about  $0.7\times$  an ocellar diameter. Antennal sockets equidistant between vertex and apex of clypeus. Clypeus long, extending for  $3.5\times$  its length below a line across lower margin of compound eyes; clypeal punctures encroaching further onto dome of clypeus than in queen/worker. Labrum scarcely divided medially. In lateral view gena  $1.4\times$  wider than compound eye. Malar space  $1.6\times$  longer than wide. Remainder of head similar to female.

Mesosoma similar to queen/worker, except legs without pollen-carrying structures. Wing similar to queen/worker.

Metasomal terga 1–6 similar to queen/worker terga 1–5; tergum 7 a little concave in lateral view, otherwise similar to tergum 6. Sterna 1–5 similar to queen/worker 1–6, except shagreening lighter on lateral 1/3 of sternum 2, and sterna with very light shagreening throughout; sternum 6 moderately shagreened. Sternum 7 (Fig. 74e) broadly concave basally, roughly rounded apically, with lateral process well-developed. Sternum 8 (Fig. 74f) with truncate basal and apical processes. Gonocoxites in dorsal and ventral views (Fig. 74g) with outer margins slightly converging apically, gonostyli and volsellae with inwardly-directed projection, outer margin of penis valves markedly serrate; in lateral view (Fig. 74h) penis valve apically not projecting above or below gonostylus; inner aspect of gonostylus with stout, vertical acute projection.

**Vestiture.** Similar to queen/worker, except some vestiture present on dome of clypeus; off-white on metasomal tergum 6 except for posterior median half-moon-shaped black area; off-white on metasomal sterna 2–4 except short, black on lateral 1/3 of sternum 2.

**Variation.** The ventral metasomal vestiture on queens and workers may be all black. Males are remarkably uniform except for size.

**Type data.** *Apis hortorum*: holotype female, Sweden (LSL).

**Material examined.** 155 queens, 151 workers, and 171 males. These specimens were taken from MC, MK, and CO in the South Island.

**Distribution** (New Zealand, Map 38). According to Macfarlane & Gurr (1995), the species is present in the south of the North Island and in the South Island. North Island: WI, WN, WA. South Island: NN, MB, NC, MC, MK, SC, OL, CO, DN, SL.

Macfarlane & Gurr (1995) state that workers foraged at up to 1250 m in the Mount Cook area CO, and there have been numerous observations of queens, workers and males on lowland plains down to just above sea level. Adults can be present throughout the year, but on sunny winter days numbers are very few.

**Biology.** Near Christchurch MC queens become common by early October, and most nests are founded from mid-October to mid-November, with worker numbers rapidly increasing soon after. New queens can be on the wing from about mid-spring, and if a period of hibernation before nesting is not obligatory, there could conceivably be 3 generations of nests in a calendar year (Donovan and Wier 1978).

**Flight period.** As stated above, adults can be present throughout the year, but numbers of all forms of adults are at their greatest in spring and early summer.

#### Host plants

Macfarlane (pers. comm.) has observed visits to 3 species of native plants in 3 genera in 3 families.

Family	Genus and species
Onagraceae	<i>Fuchsia excorticata</i>
Fabaceae	<i>Sophora microphylla</i>
Plantaginaceae	<i>Hebe loganioides</i>

Preferred flowers are those with deep, tubular corollas, especially introduced clovers, where bees with shorter tongues are often unable to reach the nectar. Red clover, *Trifolium pratense* (Fabaceae) is particularly favoured as a source of both pollen and nectar.

**Nest sites.** Donovan & Macfarlane (1971) and Donovan & Wier (1978) found naturally-occurring nests in a fur coat,

underfelt, fibreglass, a mouse nest, a fowl nest, and a handbag in sheds and a carport, in mouse nests in gardens and under a shed, and in compost. Other nests have been observed in an abandoned bird nest in a garage wall at the top of a door, and in dense clumps of dead grass. Many hundred nests have been formed in purposely-designed bumble bee nest boxes, which provide a dry cavity, and fibrous material which is protected from wind and sunlight.

**Associated organisms.** The parasitoid *Melittobis acasta* (Hymenoptera: Eulophidae) infested some colonies in the field, and even some colonies being reared in the laboratory in Canterbury MC (Macfarlane and Donovan 1989). The nematode *Sphaerularia bombi* was found in 3 of 148 queens (and 67 of 978 queen *B. terrestris*) in an area confined to within 30–40 km around Christchurch MC (Macfarlane and Griffin 1990). The small external mite *Kuzinia laevis* is common on queens, workers, and on nests, and 1 large external mite, probably *Pneumoysus bombycolens* was found on each of 3 queens. These mites and 11 other species were also found in colonies and senescent nests (R. P. Macfarlane & G. W. Ramsay, pers. comm. 1999). When the small external mite was present in large numbers, nest development ended prematurely (Donovan & Wier 1978). Donovan & Wier (1978) found that a nest of *B. hortorum* containing a dead queen *B. hortorum* also contained a dead queen *B. ruderatus*, which suggests that both queens died from combat during an attempt by the *B. ruderatus* queen to usurp the nest (and the converse had also occurred). Seven other nests initiated in field hives were terminated by mice.

**Remarks.** Workers are not differentiated from queens by size, and the largest workers can be as large as the smaller queens. Specimens selected as queens and workers were chosen by eye, so it is possible that the largest ‘worker’ may in fact be a small queen, which would account for the 0.5 mm overlap in size between the 2 groups. *B. hortorum* is a very common bumble bee in domestic gardens in Christchurch MC, and occupies nest boxes more readily than other species, both in the city and at nearby country sites. This has resulted in a small supply of colonies to red clover seed crops for pollination (*Trifolium pratense*; Fabaceae). Donovan (2001) calculated that the mean value per colony of seed produced on the tetraploid cultivar ‘Pawera’ was NZ\$999.02. The bees are also valuable pollinators of some other crops such as broad and field beans (*Vicia faba*; Fabaceae) where their managed use is beginning.

The reasons for the lack of spread of the species into areas north of Christchurch MC after nearly a century are unknown, but may be due to its poor adaptation to regular early summer droughts, and a limited sequence of favoured

flowers (Macfarlane & Gurr 1995). The increasing irrigation of farmland and movement of managed colonies into these areas may allow colonisation of much of this region in the foreseeable future.

### ***Bombus (Megabombus) ruderatus* (Fabricius) variably banded bumble bee**

Fig. 30a–f, 31a–d, 75a–h; Map 39

#### Selected bibliography

*Apis ruderata* Fabricius, 1775: 380 (description, sex not stated).

*Bombus ruderatus*: Latreille, 1802: 437 (new combination).

*Bombus (Megabombus) ruderatus*: Dalla Torre 1880: 40 (new combination).

**Queen** (n = 20). Length 18.0–24.2 mm ( $20.7 \pm 1.68$  mm); width 8.5–10.8 mm ( $9.7 \pm 0.58$  mm); forewing length 12.5–14.0 mm ( $13.6 \pm 0.38$  mm); facial length 4.4–4.8 mm ( $4.6 \pm 0.10$  mm); facial width 3.0–3.3 mm ( $3.1 \pm 0.07$  mm); malar length/malar width 1.29.

**Worker** (n = 20). Length 10.2–17.1 mm ( $14.0 \pm 1.82$  mm); width 5.1–8.0 mm ( $6.5 \pm 0.88$  mm); forewing length 6.2–12.5 mm ( $9.8 \pm 1.50$  mm); facial length 3.1–4.3 mm ( $3.6 \pm 0.37$  mm); facial width 2.1–2.8 mm ( $2.4 \pm 0.22$  mm); malar length/malar width 1.26.

**Coloration.** Black, except outer aspect of galea dark red, inner aspect hyaline, mandibles towards apex and tarsal segments red-black, scopal face of tibia and basal 1/3 of tarsal claws dark red, pterostigma and wing veins red-brown, wing membranes dusky.

**Structure.** (Fig. 75a–b). Scape a little shorter than combined length of first 6 flagellar segments. Compound eyes 3.5× longer than wide, with lower 3/4 of inner margins converging slightly below, upper 1/4 of inner margins converging strongly above. Ocellular distance a little more than 2 ocellar diameters; interocellar distance about 2/3 an ocellar diameter. Antennal sockets somewhat closer to vertex than to apex of clypeus. Face shiny. Supraclypeus flat in lateral view, with close, small to medium-sized punctures. Between antennal sockets frontal line produced to a low, blunt point, frontal ridge extending about 1/3 of distance to median ocellus, frontal line then becoming very deep, extending to median ocellus. Frons, paraocular area and vertex sculptured similarly to supraclypeus except area below median ocellus lateral to and including about 60% of frontal line smooth, area lateral to lateral ocellus about as wide as lateral ocellus, smooth. Clypeus very strongly protuberant, long, extending for a little less than 3/4 of its length below a line across lower margins of compound eyes; central 2/3 of lower margin transverse, lateral sixth strongly recurved; about dorsal 1/3 with slight, ir-

regular median longitudinal depression with small irregular close punctures; wide laterodorsal margin and narrow lower margin with large to very large punctures; dome smooth, shiny, with a scatter of widely and irregularly spaced small to large punctures. Labrum stout, deeply depressed medially, with irregularly sized and spaced punctures. Malar space very long, 1.26–1.29× longer than wide, smooth, shiny, lower central longitudinal area with small to medium-sized punctures variously spaced. Galea shiny, smooth, with a few widely-spaced small punctures and faint transverse striations. In lateral view gena 1/2 as wide again as compound eye, with medium-sized punctures separated by about 0.5 diameter.

Pronotum shiny dorsally, with small close punctures anterior to pronotal sulcus, posterior to sulcus with medium-sized punctures separated by about 0.5 diameter, laterally moderately shagreened, with small to medium-sized punctures separated by 1–2 diameters. Scutum with small posterocentral area smooth, shiny, impunctate, surrounded by large punctures which become smaller, very dense around periphery of scutum, except for very small area lateral to about posterior 1/2 of parapsidal line smooth, shiny, impunctate. Scutellum large, produced over metanotum so that in dorsal view metanotum completely obscured; very small median anterior area smooth, shiny, impunctate, about remainder of anterior 1/2 with large punctures separated by up to 1 diameter, which become smaller, very close towards lateral and posterior margins. Metanotum very narrow, parallel-sided, lightly shagreened, about middle 1/3 appearing impunctate, lateral 1/3 with a few small, variously spaced punctures. In lateral view propodeum rather evenly rounded, propodeal triangle almost shiny, lightly shagreened on central posterior area, with very small punctures separated by about 1 diameter; posterior area moderately shagreened, posterolateral face with medium-sized to large punctures separated by about 0.5 diameter. Metepisternum shiny, about upper 1/2 sculptured as for adjacent posterolateral area of propodeum, lower 1/2 moderately shagreened. Mesepisternum above scrobal suture with about dorsal 4/5 with punctures medium-sized, close on upper margin, becoming larger, more widely spaced below, about lower 1/5 impunctate, smooth, shiny; below scrobal suture medially with large punctures separated by about 0.5–1 diameters, shiny, except anterior face moderately tessellated. Metatibia very broad, flattened laterally, outer surface shiny, posteroventral area moderately tessellated, with stout fringing hairs and spines, forming highly developed corbicula; metabasitarsus similarly broad, flattened laterally, concave, lightly shagreened, with medium-sized punctures separated by about 0.5 diameter. Pterostigma short, about twice as long as wide; vein 1st m-cu meets 2nd submarginal cell over 1/3 distance along posterior margin from proximal end.

Metasomal tergum 1 with anterior face strongly concave, moderately shagreened, with longitudinal median line extending from anterior margin to beyond centre of concavity. Dorsum of metasomal tergum 1 moderately shagreened, about anterior 1/2 of tergum 2 moderately shagreened, terga 3–5 lightly shagreened basally, remaining areas shiny, terga 1–5 with ill-defined medium-sized punctures but punctures becoming larger towards posterior terga, punctures separated by 0.5–1 diameters; tergum 6 concave in lateral view, heavily roughened. Metasomal sternum 1 very shallowly emarginate apically, large lateral area moderately shagreened, impunctate, sternum 2 with about lateroposterior 1/3 heavily shagreened, median area of sternum 1, and sterna 2–6 with medium-sized to large, close punctures.

**Vestiture.** Dense, long on body, obscuring surface or nearly so throughout, except protuberant area of clypeus, malar area, upper 1/2 of frons, small impunctate area of scutum, propodeal triangle, discs of sterna 2–5 almost naked. Black throughout, or ranging to broad parallel sided dull yellow band from most of pronotum to a line on scutum just anterior to tegulae, and extending laterally to include pronotal lobe; dull yellow on posterior 1/2 of scutellum, dull yellow on posterior 1/2 of metasomal tergum 1, off-white on narrow posterior margin of terga 2–3 and all of terga 4–5, off-white apically on sterna 2–5; short, dark red on inner faces of basitarsi, outer face of metabasitarsus with very short fine pale vestiture interspersed with longer darker stouter hairs.

**Male** (n = 20). Length 11.5–17.7 mm (14.8 ± 1.47 mm); width 5.5–7.1 mm (6.3 ± 0.43 mm); forewing length 9.2–11.5 mm (10.7 ± 0.67 mm); facial length 3.3–3.8 mm (3.6 ± 0.13 mm); facial width 2.1–2.5 mm (2.3 ± 0.10 mm); malar length/malar width 1.52.

**Coloration** similar to queens and workers, except apical margins of metasomal terga 1–6 and sterna 1–5 narrowly hyaline, sternum 6 more widely hyaline apically.

**Structure.** (Fig. 75c–d). Scape as long as combined length of first 3.5 flagellar segments. Compound eyes about 3× longer than wide, with about lower 2/3 of inner margins near parallel, upper 1/3 moderately converging above. Remainder of head similar to female, except clypeus extending for 2/3 of its length below a line across lower margins of compound eyes, punctured areas larger, labrum broadly smooth, shiny centrally, malar space 1.52× longer than wide, in lateral view gena a little wider than compound eye with punctures a little further apart.

Mesosoma similar to female. Legs similar to female except metatibia not modified for pollen transport. Wing similar to female.

Metasomal terga 1–6 similar to female terga 1–5; tergum 7 a little concave in lateral view, otherwise similar to tergum

6. *Sterna* 1–5 similar to female *sterna* 1–6 except shagreening lighter on lateral 1/3 of sternum 2, remaining areas of *sterna* 2–5 very lightly shagreened, sternum 6 moderately shagreened. Sternum 7 (Fig. 75e) broadly concave basally, rounded apically, well-developed laterally. Sternum 8 (Fig. 75f) with truncate basal process, subtruncate apical process. Gonocoxites in dorsal and ventral views (Fig. 75g) with outer margins nearly parallel, gonostyli and volsellae incurved apically, outer margin of penis valves markedly serrate, teeth pointed; in lateral view (Fig. 75h) penis valve apically not projecting above or below gonostylus; inner aspect of gonostylus projecting vertically as spine-like structure.

**Vestiture.** Dense, long, obscuring surface throughout except malar area naked; fine short, sparse on propodeal triangle and just laterally to it. Coloration similar to queen/worker except dull yellow areas more extensive; at greatest extent dull yellow on vertex forming arrowhead shape towards median ocellus, on mesepisternum dull yellow band extending from below posterior margin of wing base to ventral aspect, completely dull yellow on scutellum except for very small lateral area, dull yellow laterally just posterior to wing base, some off-white and brown vestiture on coxae and trochanters; entirely dull yellow on dorsal aspect of metasomal tergum 1, broadly off-white on posterior margins of terga 2–3, entirely white on terga 4–6, white on broad median area of sternum 2, entirely white on *sterna* 3–6. At the other extreme ‘black’ bees may have some light brown to off-white vestiture beyond metasomal segment 2.

**Variation.** The degree of development of the depressed median longitudinal area dorsally on the clypeus can range from absent to extending to about 1/3 the length of the clypeus. The vestiture can range in colour from individuals that have almost as much dull yellow as *B. hortorum* has lemon yellow, to those that are almost completely black. A nest discovered near Lincoln MC contained new queens with the extremes of coloration, and many stages in between.

**Type data.** *Apis ruderata*: lectotype female, Madeira, designated by O.W. Richards, 17 May 1952 (BMNH).

**Material examined.** 61 queens, 20 workers, and 56 males. These specimens were taken from TO in the North Island, and SD, MB, KA, NC, MC, MK and CO in the South Island.

**Distribution** (New Zealand, Map 39). According to Macfarlane & Gurr (1995), and personal observations, the species occurs in — North Island: ND, AK, CL, WO, BP, TK, GB, RI, HB, WI, WN, WA. South Island: NN, BR, WD, SC, OL, DN, SL.

Macfarlane & Gurr (1995) did not find the species in

southern WD, nor FD, and they advocated further collecting from favoured flowers between November and March to determine if the species is truly absent. The species was found at up to 960 m at Lindis Pass OL, but it was most common in lightly settled districts with the warmest and driest climates in both islands. It is not established on the Chatham Islands, despite the liberation of a colony in 1955, and 7 queens in 1976 (Macfarlane & Gurr 1995).

In the warmest areas a few individuals can be on the wing at any time of year, but hibernation of queens is complete in cool and cold areas.

**Biology.** Where most or all queens hibernate, emergence begins in late spring with nest founding occurring soon after. Workers become common by early summer, and males and new queens appear soon after. In cool and cold regions, bees have gone by mid-autumn. Unlike its close relative *B. hortorum*, there seems to be just one nesting cycle per year.

**Flight period.** As already outlined, the climate appears to determine whether some adults can be active at any time of the year, or whether most or all new queens hibernate, and for how long.

#### Host plants

As with its close relative *B. hortorum*, favoured flowers are those with deep, tubular corollas. Macfarlane (pers. comm.) has recorded this species visiting just 1 species of native plant.

Family	Genus and species
Fabaceae	<i>Clianthus puniceus</i>

For introduced plants, pasture legumes with deep corollas are favoured, in particular red clover (*Trifolium pratense*) (Fabaceae).

**Nest sites.** Donovan & Wier (1978) found 1 naturally occurring nest beneath a concrete slab, but it could not be reached to determine the origin of the cavity. Pomeroy (1981) found 3 nests, one on the surface of the ground in dead vegetation, a second among sheep’s wool under wood, and a third in a torn plastic bag of hay. Another 9 nests were underground, of which the entrance tunnels of 3 may have been made by mice (*Mus musculus* (L.)), 5 by rats (*Rattus rattus* L. or *R. norvegicus* Berkenhout), and 1 by a rabbit (*Oryctolagus cuniculus* (L.)).

Donovan & Wier (1978) and Pomeroy (1981) found that a variety of hive designs from surface to underground were readily occupied.

**Associated organisms.** Macfarlane (1975) discovered an overwintered queen from Lake Pukaki MK with the mite *Locustacurus buchneri* (Stammer) (Podapolipidae) in its abdominal air sacs. About half the 137 collection specimens examined carry from 1 to hundreds of the small mite,

*Kuzinia laevis*. One queen, 1 worker and 2 males each carry 1 large mite, probably *Pneumonyssus bombicolens*. R. P. Macfarlane & G. W. Ramsay (pers. comm. 1999) found that 3.2% of 185 queens collected around Christchurch and Lincoln MC carried large mites, and the maximum number carried by a queen was 8. The eulophid parasitoid *Melittobia acasta* attacked 3% of colonies near Tai Tapu MC between 1978 and 1984 (Macfarlane & Donovan 1989). Donovan & Wier (1978) found that a *B. ruderatus* nest containing a dead queen *B. ruderatus* also contained a dead queen *B. hortorum*, which suggests that both queens died from combat during an attempt by the *B. hortorum* queen to usurp the nest (and the converse also had occurred). Donovan & Wier (1978) also found that 2 nests initiated in field hives were terminated by earwigs, *Forficula auricularia* L. (Dermaptera), and 1 nest was terminated by mice.

**Remarks.** Over most of the county, *B. ruderatus* ranks behind *B. terrestris* in abundance. However, in and around Christchurch MC on the Canterbury Plains it ranks third behind *B. hortorum*. *Bombus ruderatus* appears to prefer hilly, broken countryside, where it can be as numerous as *B. hortorum* is in flat, suburban gardens. Melanic queens can form a large proportion of the population along the northeastern coast of the South Island KA in late spring, but queens with a range of proportions of dull yellow to black vestiture can occur anywhere.

This species has been introduced to Chile from New Zealand for pollination of red clover (Arretz & Macfarlane 1982).

### Subgenus *Subterraneobombus* Vogt

*Bombus (Subterraneobombus)* Vogt, 1911: 62. Type species: *Apis subterranea* Linnaeus, 1758, by designation of Frison, 1927: 68.

*Subterraneibombus* Skorikov, 1938: 145, unjustified emendation of *Subterraneobombus* Vogt, 1911.

### *Bombus (Subterraneobombus) subterraneus* (Linnaeus) shorthaired bumble bee

Fig. 32a–f, 76a–h; Map 40

#### Selected bibliography

*Apis subterranea* Linnaeus, 1758: 579 (description of female).

*Apis latreillella* Kirby, 1802: 330 (description of male).

*Bombus subterraneus*: Latreille, 1802: 437 (new combination).

*Bombus (Subterraneobombus) subterraneus*: Vogt, 1911: 62 (new combination).

**Queen** (n = 20). Length 17.6–22.8 mm (20.0 ± 1.43 mm); width 8.8–9.5 mm (9.1 ± 0.23 mm); forewing length 11.8–12.9 mm (12.5 ± 0.29 mm); facial length 4.1–4.5 mm (4.3 ±

0.08 mm); facial width 3.0–3.2 mm (3.1 ± 0.06 mm); malar length/malar width 1.10.

**Worker** (n = 20). Length 13.1–16.2 mm (15.1 ± 1.31 mm); width 6.5–8.5 mm (7.3 ± 0.59 mm); forewing length 8.9–11.4 mm (10.3 ± 0.66 mm); facial length 3.3–4.0 mm (3.7 ± 0.19 mm); facial width 2.3–2.9 mm (2.6 ± 0.14 mm); malar length/malar width 1.13.

**Coloration.** Black, except galea dark red with inner margin widely hyaline, tarsal segments beyond basitarsi very dark red-black, pterostigma and wing veins black/brown, wing membranes dusky, apical ventral margin of metasomal tergum 1 hyaline.

**Structure.** (Fig. 76a–b). Scape about as long as combined length of first 6.4 flagellar segments. Compound eyes 3.4× longer than wide, with about lower 3/4 of inner margins converging slightly above, upper quarter of inner margins converging strongly above. Ocellular distance slightly more than 2 ocellar diameters; interocellar distance a little less than 1 ocellar diameter. Antennal sockets about equidistant between apex of clypeus and vertex. Face mainly dull throughout. Supraclypeus below a line across midpoint of antennal sockets concave in lateral view, with close, irregular small to medium-sized punctures throughout; between antennal sockets produced to prominent ridge which, just above a line across upper margin of antennal sockets, becomes frontal line, very deep and prominent to median ocellus. Frons, paracocular area and vertex sculptured similarly to supraclypeus except area below median ocellus lateral to and including frontal line smooth, shiny; area lateral to lateral ocellus about as wide as ocellus, smooth, shiny. Clypeus very strongly protuberant, long, extending for 3/5 its length below a line across lower margins of compound eyes, central 2/3 of lower margin straight transversely, lateral 1/6 strongly recurved; bulk of lower central 2/3 smooth, impunctate, with upper margin sculptured similarly to supraclypeus; lateral margin narrowly with larger punctures, lower margin with a small area on lateral margin above straight apex with small to medium-sized close punctures. Labrum stout, median 1/3 depressed, lateral 1/3 protuberant, similar to dome of clypeus. Malar space long, 1.10–1.13 times longer than wide, smooth and shiny with at most a few very small widely-spaced punctures. Galea shiny, smooth near base, distally with very fine transverse striations, with a few very widely spaced small punctures. In lateral view, gena about 1.5× wider than compound eye, shiny, with small to large punctures separated by about 0.5 to 1 diameters.

Pronotum anterior to the pronotal sulcus moderately shagreened, with small to large irregular punctures separated by about 0.5–1 diameters; posterodorsally to sulcus and extending to pronotal lobe with small to medium-sized close punctures; posterolaterally to sulcus shagreened with

indistinct medium-sized punctures separated by about 1 diameter. Scutum with postero-central area smooth, shiny, impunctate, surrounded by large punctures which become smaller, very dense around perimeter of scutum. Scutellum large, produced over metanotum so that in dorsal view metanotum completely obscured; very small anterocentral patch shiny, impunctate, larger close punctures laterally and posteriorly becoming small, very dense. Metanotum very narrow, parallel-sided, moderately shagreened with very small, widely-spaced punctures. In lateral view propodeum rounded quite evenly dorsoventrally; propodeal triangle almost shiny, laterally with very small close punctures; posterolateral area with medium-sized punctures from close to separated by 1 diameter. Metepisternum shiny with medium-sized very close punctures on about upper 1/2, punctures becoming larger, further apart on about lower 1/2. Mesepisternum above scrobal suture similar to upper 1/2 of metepisternum except about lower 1/3 impunctate, below scrobal suture with medium-sized close punctures on posterior margin, punctures becoming very large, separated by about 0.5 diameter on outer anterior aspect. Metatibia very broad, flattened laterally, outer surface shiny, bare, with stout fringing hairs and spines forming highly developed corbicula; metabasitarsus similarly broad, flattened laterally, outer surface a little concave and lightly shagreened with medium-sized punctures separated by about 1 diameter. Pterostigma short, 1.6× longer than wide, vein 1st m-cu meets 2nd submarginal cell a little more than 2/5 distance along posterior margin from proximal end.

Metasomal tergum 1 with anterior face strongly concave, heavily shagreened, with longitudinal median line extending from anterior margin to centre of concavity; remainder of metasomal tergum 1 lightly shagreened dorsomedially, with medium-sized punctures separated by about 1 diameter, punctures smaller, closer laterally, larger, wider on ventral aspect. Terga 2–3 lightly shagreened, with close, ill-defined medium-sized to large punctures; tergum 4 with narrow apical area lightly shagreened, remainder and tergum 5 smooth, shiny, puncturing on tergum 4 similar to terga 2–3; on tergum 5 punctures smaller, up to 1 diameter apart. Tergum 6 concave in lateral view, surface irregularly roughened, dull. Apical margin of sternum 1 transverse; sterna 1–5 shiny with large, close punctures, except sternum 1 impunctate and shagreened laterally, sternum 2 with lateral 1/3 heavily tessellated; sternum 6 with medium-sized close punctures, apical 1/2 with prominent longitudinal keel.

**Vestiture.** Dense, moderately long on body, obscuring surface throughout or nearly so, except protuberant area of clypeus, malar area, upper 1/2 of frons, propodeal triangle and impunctate area of scutum naked. Black-brown throughout except dull orange-yellow transverse band on dorsal aspect of pronotum including pronotal lobe and

anterior of scutum from just in front of tegula, black hairs intrude in mid-line from scutum to head; dull orange-yellow on posterior margin of scutellum, this band less than 1/2 width of anterior mesosomal band. Inner face of basitarsi with stout, very short, dark red vestiture, outer face of metabasitarsus with very short fine off-white vestiture interspersed with stouter dark hairs. Apical margins of metasomal terga 1–3 narrowly orange-yellow-off-white, except for narrow median area black, terga 4–5 off-white, tergum 6 black.

**Male.** (n = 20). Length 10.9–16.6 mm ( $13.9 \pm 1.41$  mm); width 5.1–6.9 mm ( $6.4 \pm 0.47$  mm); forewing length 7.8–10.2 mm ( $9.5 \pm 0.51$  mm); facial length 2.7–3.4 mm ( $3.2 \pm 0.17$  mm); facial width 2.1–2.5 mm ( $2.4 \pm 0.08$  mm); malar length/malar width 1.29.

**Coloration.** Similar to female, except apical margins of metasomal terga 1–6 and sterna 1–5 narrowly hyaline.

**Structure.** (Fig. 76c–d). Scape a little shorter than combined length of first 4 flagellar segments. Compound eyes about 3× longer than wide, with about lower 5/6 of inner margins slightly diverging, to sub-parallel or slightly converging above, upper 1/6 of inner margins converging slightly above. Ocellular distance equal to nearly twice an ocellar diameter; interocellar distance almost 1/2 an ocellar diameter. Antennal sockets a little closer to vertex than to apex of clypeus. Remainder of face similar to female except supra-clypeus almost flat in lateral view, clypeus slightly less protuberant, extending 1.2× its length below a line across lower margins of compound eyes, lower central smooth impunctate area very small. Malar space 1.29× longer than wide. Remainder of head similar to female, except gena in lateral view about 1.3× wider than compound eye.

Mesosoma similar to female, except impunctate shiny area of scutum about 1/2 as large. Wing similar to female.

Metasomal terga 1–6 similar to female terga 1–5 but a little more shiny; tergum 7 slightly concave in lateral view, moderately shagreened with large irregular punctures separated by up to about 1 diameter. Sterna 1–6 similar to female sterna 1–5 except shinier, punctures less distinct. Sternum 7 (Fig. 76e) concave basally, well-developed laterally, truncate apically. Sternum 8 (Fig. 76f) produced and truncate basally, bilobed apically. Gonocoxites in dorsal and ventral views (Fig. 76g) with sides near parallel, gonostyli projecting inwards, apex of volsellae projecting inwards, acute apically, outer margin of penis valves angular; in lateral view (Fig. 76h) penis valve visible dorsally.

**Vestiture.** Long, dense over most of body except lower impunctate area of clypeus, malar space and propodeal triangle naked; yellow-green with a few black hairs on upper 1/2 of clypeus and vertex, broad band of yellow-green on mesothorax anterior to a line across anterior margin of

tegulae and beneath tegula to about 1/2 way down mesepisternum, off-white below this point; yellow-green on posterior margin of scutum; yellow-green dorsally on metasomal terga 1–6 except small central apical area of tergum 6 with black hairs; tergum 7 with black hairs except for a few yellow-green hairs laterally; ventral vestiture on legs from coxae to trochanters primarily off-white; apical margins of sterna 2–6 light yellow-green, except vestiture becoming brown in mid-line towards apex of abdomen; all remaining vestiture black or dark brown.

**Variation.** In queens and workers the amount of black vestiture in the mid-line of the dull orange/yellow transverse band on the anterior of the mesosoma can vary from scarcely apparent to very obvious. Wear on old queens and workers can give the impression of a black median line extending forward on the metasomal terga from the apex of the abdomen. In males there can be varying numbers of black hairs among the yellow/green on the metasomal terga, to the point where faint black transverse bands are present.

**Type data.** *Apis subterranea*: holotype female, Sweden (LSL). *Apis latreillella*: holotype male, England, but existence unknown.

**Material examined.** 24 queens, 30 workers, and 24 males. These specimens were from MC, MK, SC, OL and CO in the South Island.

**Distribution** (New Zealand, Map 40). According to Macfarlane & Gurr (1995), the species occurs in: — South Island: MC, MK, SC, OL, CO, DN, SL.

The species is not found on the eastern plains of MC including the 2 release sites in Christchurch and the possible Tai Tapu and Lincoln University release sites, nor on Banks Peninsula. There is just 1 record for SL, on the southern bank of the lower reaches of the Clutha River boundary with DN. According to Macfarlane & Gurr (1995), the species occurs from 80 m to above 1000 m. On 17 December 1965, 38 queens collected at Lake Tekapo MK were released in the grounds of Massey University WN. Workers were seen by the end of January 1966, but not males or new queens, and the species failed to establish (Gurr 1972).

**Biology.** Collection dates for specimens in museums range from 10 December to 20 March. Two nests were founded in nest boxes near Twizel MK in the first half of December (Donovan & Wier 1978). Because the area is in the southern half of the South Island, and is inland and hilly to mountainous, the annual warm period begins late and terminates early, and consequently there seems to be only 1 generation of *B. subterraneus* per 12 month period.

**Flight period.** Data from museum specimens are few, but queens have been captured from 10 December to 18 February, workers from 18 January to 13 March, and males from 12–14 February to 20 March. However, the flight period is more extensive than this.

### Host plants

There are no records of visits to flowers of native species. Favoured introduced flowers are Fabaceae, especially *Lupinus* spp. and pasture legumes.

**Nest sites.** In England nests were formed below ground (Alford 1975). A nest was found near Hakataramea MK (Dumbleton 1948), but its location wasn't noted. Donovan & Wier (1978) obtained 6 nests in above-ground hives sited in MK in 1971 and 1972. All 6 nests produced new queens, the number of which ranged from 16–49, mean 29.5, which suggests that the hives were suitable for all stages of nest development.

**Associated organisms.** Macfarlane (1975) discovered an overwintered queen from 16 km south of Lake Pukaki MK with the mite *Locustacurus buchneri* Stammer in its abdominal air sacs. A few of the museum specimens of queens and most of the workers and males carry from a few to hundreds of small external mites, *Kuzinia laevis*.

**Remarks.** *B. subterraneus* is our least-known species of bumble bee. This is probably because of its restricted distribution, and its short period of activity compared to that of the other 3 species. The species has not been seen in England for several years, and importation from New Zealand is being considered in an attempt to re-establish the same genotype.

### Tribe Apini

#### Genus *Apis* Linnaeus

*Apis* Linnaeus, 1758: 343, 574. Type species: *Apis mellifica* Linnaeus, 1761 = *A. mellifera* Linnaeus, 1758, by designation of Latreille, 1810: 439.

*Apicula* Rafinesque-Schmaltz, 1814: 27, unjustified replacement for *Apis* Linnaeus, 1758. Type species: *Apis mellifera* Linnaeus, 1758, autobasic.

*Apiarus* Rafinesque-Schmaltz, 1815: 123, unjustified replacement for *Apis* Linnaeus, 1758. Type species: *Apis mellifera* Linnaeus, 1758, autobasic.

*Megapis* Ashmead, 1904: 120. Type species: *Apis dorsata* Fabricius, 1793, by original designation.

*Micrapis* Ashmead, 1904: 122. Type species *Apis florea* Fabricius, 1787, by original designation.

*Apis* (*Synapis*) Cockerell, 1907: 229. Type species: *Apis henschawi* Cockerell, 1907 (fossil), monobasic.

*Hauffapis* Armbruster, 1938: 37. Type species *Hauffapis scheuthlei* Armbruster, 1938 = *Apis armbrusteri* Zeuner, 1931 (fossil), by designation of Zeuner & Manning, 1976: 243.

*Apis* (*Sigmatapis*) Maa, 1953: 556. Type species: *Apis cerana* Fabricius, 1793, by original designation.



***Apis mellifera* Linnaeus****honey bee**

Fig. 33a–f, 34a–f, 77a–g

Selected bibliography.

*Apis mellifera* Linnaeus 1758: 576 (description of species).*Apis mellifica* Linnaeus 1761: 421 (unjustified emendation).

Ruttner (1988) lists 24 'races' (= subspecies) of which the following 2 are the origin of most honey bees in New Zealand.

*Apis mellifera mellifera* Linnaeus 1758: 576 (description).*Apis mellifera ligustica* Spinola 1805: 35 (description).

**Queen** (n = 20). Length 14.0–17.2 mm ( $15.5 \pm 0.85$  mm); width 4.7–5.7 mm ( $5.1 \pm 0.30$  mm); forewing length 8.5–9.5 mm ( $9.0 \pm 0.31$  mm); facial length 2.5–2.8 mm ( $2.6 \pm 0.07$  mm); facial width 2.6–2.8 mm ( $2.7 \pm 0.07$  mm); malar length/malar width 0.98.

**Coloration.** Body ranging from almost black throughout, to head and scutum and lateral aspect of mesosoma light brown and remainder of body golden, apex of mandibles and distal 1/2 of tarsal claws black to red, inner 1/2 of galea hyaline, pterostigma and wing veins light brown to pale yellow, wing membranes hyaline, legs light pale yellow, apical margins of metasomal terga 1–5 narrowly hyaline, apical margins of sterna 1–5 broadly hyaline.

**Structure.** (Fig. 77a–b). Scape about equal in length to combined length of first 5.7 flagellar segments. Compound eyes about 4× longer than wide, with inner margins convex so that they converge slightly below and more markedly above. Ocellular distance 1.5× an ocellar diameter; interocular distance equal to 1 ocellar diameter; lateral ocellus nearly 1 ocellar diameter away from apex of vertex. Antennal sockets 1.3× further from vertex than from apex of clypeus. Face moderately shiny. Supraclypeus scarcely extending below a line across lower margins of antennal sockets, flat to just above a line across upper margins of antennal sockets; just above this line frontal line represented by a very low small rounded mound which dorsally for a short distance becomes a faint line before becoming a depression between bulging lateral frons areas before petering out a short distance prior to median ocellus. Clypeus moderately protuberant, extending for slightly more than 1/3 its length below a line across lower margins of compound eyes, lower margin transverse with lateral edge narrowly recurved. Labrum quadrate, simple. Mandible with long cutting edge and one apical tooth. Malar space as wide as long. Galea with marked transverse striations on about distal 2/3 of opaque area, shiny. In lateral view, gena about equal in width to compound eye, lightly shagreened/tessellated with very obscure medium-sized punctures separated by 1–3 diameters. Head shagreened throughout, shagreening lightest on malar space, moderate between ocelli and vertex where it almost grades to light tessellation obscuring small, close punctures.

Pronotum moderately shagreened/tessellated, with a few very small punctures separated by 2–5 diameters.

Scutellum very large, expanded dorsally and posteriorly so that in dorsal view metanotum completely obscured. Metanotum very narrow but widest medially, lightly shagreened. Propodeal triangle poorly delineated anterolaterally, slightly concave in lateral view. Mesosoma otherwise lightly to moderately shagreened/tessellated; posterior face of scutellum with a few medium-sized punctures separated by 1–3 diameters; metepisternum with medium-sized punctures from close to separated by about 1 diameter. Areas immediately posterior to wing base with some small to medium-sized punctures separated by about 1 diameter or more. Legs simple with no adaptations for pollen transport. Pterostigma very small, scarcely wider than marginal adjacent veins towards wing base, about 2.5× longer than wide, vein 1st m-cu meets 2nd submarginal cell about 1/4 distance along posterior margin of cell from proximal end.

Metasomal terga 1–6 and sterna 1–6 moderately shagreened throughout, sternum 1 with small to medium-sized punctures separated by up to about 3 diameters, transverse apically; remaining sterna increasingly emarginate apically from 2–6.

**Vestiture.** Compound eyes with pale, dense erect hairs evenly spaced throughout, length similar to width of antennal flagellum. Remainder of body with white to off-white vestiture throughout, except some bees that have dark integument have dark vestiture on vertex; vestiture longest, most dense on mesosoma, at longest about 1/2–2/3 as long as scape; extremely short on metasomal terga 2–4.

**Worker** (n = 20). Length 10.5–13.6 mm ( $11.6 \pm 0.71$  mm); width 4.2–4.8 mm ( $4.5 \pm 0.16$  mm); forewing length 8.2–8.8 mm ( $8.6 \pm 0.14$  mm); facial length 2.7–2.9 mm ( $2.8 \pm 0.06$  mm); facial width 2.6–2.8 mm ( $2.7 \pm 0.05$  mm); malar length/malar width 1.10.

**Coloration.** Similar to queen, but banding on metasomal terga more prominent on bees that are partly black and partly yellow and/or golden, but apparent banding of integument frequently also partly due to bands of short, white or near white vestiture. Legs of bees of all but the most lightly colored bodies are darker than those of queens of similar body colour.

**Structure.** (Fig. 77c–d). Scape nearly as long as first 5.5 flagellar segments. Compound eyes 5× longer than wide, with inner margins similar to queen. Ocellular distance equal to 2× an ocellar diameter; interocular distance similar to queen; lateral ocellus almost reaching apex of vertex. Antennal sockets about 1.2× further from vertex than from apex of clypeus. Remainder of head similar to queen except in frontal view face longer, clypeus a little less protuberant, frontal line more developed; mandible with one long almost straight edge on inner margin apically; clypeus

with obscure small to medium-sized punctures separated by about 2–4 diameters, area below lateral ocellus with small to medium-sized punctures, punctures close towards compound eye, very widely spaced towards mid-line of face.

Scutellum similar to queen except lightly tessellated, with punctures extending to dorsal aspect; remainder of mesosoma moderately tessellated; pronotum with obscure medium-sized to large punctures, largest and closest towards posterior margin; mesepisternum with obscure small punctures separated by about 2–4 diameters. Wing similar to queen except vein 1st m-cu meets 2nd submarginal cell a little less than 1/6 distance along posterior margin from proximal end. Metatibia very broad distally, flattened laterally, anterior surface lightly shagreened/tessellated, distal 1/2 convex, whole anterior face with stout fringing hairs and spines and one hair or bristle towards lower distal corner, forming highly developed corbicula. Metabasitarsus very broad, flattened laterally throughout, anterior surface convex, lightly shagreened, about distal 2/3 with small punctures separated by about 2–5 diameters.

Mesosoma similar to queen except with small punctures throughout, separated by about 2–6 diameters.

**Vestiture.** Similar to queen except longer, more dense on mesosoma, almost obscuring surface; on bees with yellow/golden integument vestiture light yellow or off-white except for light brown on vertex, brown to black on metasomal terga 5–6; on bees with much black integument, vestiture black on vertex and adjacent areas, brown to black on compound eye, long vestiture on metasomal terga 4–6 and sternum 6 black. Metatibia with very short off-white dense vestiture on posterior face; metabasitarsus with about 11 more or less transverse rows of short, golden pollen raking hairs on posterior surface. Discs of metasomal terga 2–5 with extremely short mat-like vestiture, appearing as transverse bands, that on tergum 5 often partly concealed beneath tergum 4.

**Male** (n = 20). Length 13.6–15.4 mm ( $14.4 \pm 0.56$  mm); width 5.4–6.3 mm ( $5.8 \pm 0.23$  mm); forewing length 10.9–11.9 mm ( $11.4 \pm 0.23$  mm); facial length 2.0–2.2 mm ( $2.1 \pm 0.05$  mm); facial width 1.8–2.2 mm ( $2.0 \pm 0.10$  mm); malar length/malar width 0.48.

**Coloration** similar to queen and worker, except apical margin of metasomal terga 1–5 very widely hyaline in broad median apical area, sterna 1–5 very widely hyaline apically, tergum 6 and sternum 6 narrowly hyaline apically.

**Structure.** (Fig. 77e–f). Scape length equal to first 4 flagellar segments. Compound eyes huge, 2.8× longer than wide, inner margins converging moderately below, converging and meeting above so that in frontal view vertex wholly obscured. Lateral ocellus impinging laterally on inner margin of compound eye; interocellar distance 0.4× an ocellar diameter. Antennal sockets 1.6× further from merging point of compound eyes than from apex of clypeus.

Supraclypeus similar to queen and worker, frontal line with small depression halfway between a line across upper margins of antennal sockets and median ocellus, above this frons flat to median ocellus with frontal line very obscure. Clypeus a little protuberant, very short, scarcely reaching a line across lower margins of compound eyes, lower margin a little recurved laterally. Labrum and galea similar to queen and worker, mandible rather similar to queen. In lateral view gena not or scarcely visible, compound eye extending to posterior face of head. Head lightly to moderately shagreened throughout, with obscure medium-sized punctures except malar space and labrum impunctate; on supraclypeus punctures separated by about 0.5 diameter, clypeus with punctures separated by about 1 diameter on upper 1/2, becoming much more widely spaced towards ventral margin; remainder of face with punctures separated by about 1 diameter.

Pronotum, scutellum and metanotum similar to queen and worker, except punctures on pronotum more obvious; scutellum with obscure small punctures separated by 1–2 diameters, punctures less obvious towards anterior margin; propodeal triangle with obscure small punctures separated by about 4 diameters or more; lateral area of propodeum posterior to wing base moderately shagreened with medium-sized punctures separated by about 1 diameter, dorsal area of metepisternum similar, ventral area smooth, shiny; remaining areas of mesosoma similar to scutellum. Pterostigma very small, not wider than preceding marginal veins towards wing base, 1/2 as wide as long; vein 1st m-cu meets 2nd submarginal cell about one sixth distance along posterior margin from proximal end. Metabasitibia enlarged apically, metabasitarsus enlarged throughout to about width of apex of metabasitibia.

Metasomal terga 1–3 moderately shagreened, with small punctures separated by about 2–4 diameters, punctures a little larger on tergum 3, terga 4–6 moderately tessellated, tergum 4 with punctures similar to tergum 3, tergum 5 with large punctures separated by about 2–6 diameters, tergum 6 with medium-sized punctures separated by about 0.5–1 diameter. Sternum 1 slightly emarginate apically, sterna 1–6 very lightly shagreened with small, widely spaced punctures. Genital capsule and associated structures fleshy, quite unlike those of bees of other genera when exposed by application of pressure to sides of metasoma (Fig. 77g).

**Vestiture.** White or off-white throughout, except sometimes dark on compound eyes, inner margin of eye on face lined with dark hairs, dark hairs scattered throughout facial vestiture, brown on anterior face of pro- and mesotibia and pro- and mesobasitarsus, golden on posterior of metabasitarsus, brown to black on metasomal terga 3–4. Vestiture dense, even on compound eye, about as long as width of antennal flagellum, dense on face almost obscuring surface, very dense, short, matt-like, obscuring surface of scutum and lateral and ventral aspects of mesosoma, longer on scutellum obscuring surface, sparser on propodeal

triangle not obscuring surface; anterior face of metatibia and metabasitarsus almost naked; metasomal tergum 1 with long vestiture anteriorly, terga 2–3 almost naked, terga 4–6 and sterna 2–5 with long vestiture not obscuring surface; sternum 6 with little vestiture.

**Variation.** The colour of individuals can vary from almost black to very golden and any combination, between colonies, and even within colonies, although within a colony the bees are usually quite similarly coloured. The point at which vein 1<sup>st</sup> m-cu meets the posterior margin of the 2nd submarginal cell can vary widely.

**Type data.** *Apis mellifera*: lectotype worker, “in Europa” designated by Day (1979) (LSL).

**Material examined.** 28 queens, 68 workers, and 47 males.

**Distribution.** All of New Zealand.

Honey bees can be seen virtually throughout the vegetated areas of the three main islands of New Zealand, and also many offshore islands, and the Chatham Islands. Queens are on the wing during mating flights and in swarms from early spring until mid autumn. Workers fly in fine weather whenever the air temperature is above about 10° C. Drones are on the wing from early spring until late autumn.

**Biology.** Honey bee biology has been studied intensively throughout much of the world, because of the high economic value of products of the hive such as honey, wax, royal jelly, propolis and bee venom, and the very great economic value of crops produced following pollination effected by worker bees foraging for pollen and nectar. The study of honey bee biology and the maximising of hive products has been greatly facilitated by the development of moveable frame hives which allow manipulation of all parts of a hive, and so provide access to the interior of a colony.

As at the end of June 2005, the 2911 registered beekeepers had 294,886 registered beehives, and the annual average honey production for the last 6 years was 9044 t. However, it is well known that a considerable number of beekeepers and their hives are unregistered, so that perhaps 400,000 hives are maintained by beekeepers. The number of wild colonies prior to the advent of *V. destructor* can be only generally estimated based upon observations in many areas of the country, but with a land area of 268,000 square kilometres, New Zealand may have had about 200,000. The bees in almost all colonies maintained by beekeepers are predominantly yellow, and are said to be ‘Italian’, ie. *A. m. ligustica*, whereas the bees of most feral colonies are black or predominantly black, and so are thought to be the English *A. m. mellifera*. However both groups almost certainly contain genes from many, if not all, the disparate genotypes imported into the country.

**Flight period.** Queens are present in hives throughout the year, but are on the wing to orient to the hive, to mate, or to accompany swarms only infrequently from about early spring to mid autumn. Workers are also present in the hive throughout the year, and will fly in fine weather whenever the temperature rises above about 10° C. In general, most workers fly from about mid morning to mid afternoon. Drones are normally present only from about mid spring to late autumn, and most are on the wing from late morning to mid afternoon. Museum specimens of queens and drones are captured only from colonies, and not on the wing, as neither visits flowers. Workers are readily captured both within colonies, and on flowers.

### Host plants

Worker honey bees will collect pollen and/or nectar from nearly all native and introduced flowers, and pollen from some podocarps, grasses and corn, from which it is accessible. Indeed, so strong is the drive to collect pollen and nectar, that in a pollen dearth, workers will collect pollen-like materials such as fungal spores and fine sawdust. The major sources of nectar and pollen in New Zealand are presented by Walsh (1967). Honeydew secreted by aphids and scale insects is also readily collected, even when nectar is available in flowers. Plant exudates such as some resins and gums are collected to make propolis, which is used as a sealant and adhesive within the hive. Propolis may also inhibit the growth of some damaging microorganisms.

**Nest sites.** Swarms that escaped from imported hives soon occupied cavities in both native and introduced trees. Native trees which are commonly occupied are *Cordyline australis*, *Nothofagus* spp., and *Podocarpus dacrydioides*, while among introduced trees, cavities in crack willows *Salix fragilis*, and poplars *Populus* spp., frequently harbour wild colonies. Hollows in rocky cliffs and under boulders are also occupied, and as buildings were erected, cavities in walls and roofs often proved suitable. Where cavities are lacking, combs are sometimes built beneath tree limbs and overhanging rocks. Managed colonies are housed in movable frame hives.

**Associated organisms.** The following organisms have been identified from New Zealand honey bees. Most viruses were first identified present in New Zealand by Anderson (1988), the presence of many of the remaining organisms was recorded by Palmer-Jones (1964), and the others are presented in the MAF Biosecurity ‘Import Risk Analysis: Honey bee (*Apis mellifera*) Genetic Material’, June 2003, 138 pp.

Acute paralysis virus  
Bee virus X  
Bee virus Y  
Black queen cell virus

Chronic paralysis virus  
 Chronic paralysis associate virus  
 Cloudy wing virus  
 Filamentous virus  
 Kashmir bee virus  
 Sacbrood virus (Sacbrood)

*Paenibacillus larvae larvae* (American foulbrood)  
 (Bacteria)

*Pseudomonas aeruginosa* (Septicaemia)  
 (Pseudomonadaceae: Bacteria)

*Ascosphaera apis* (Chalkbrood) (Fungi)  
*Aspergillus flavus* and other species (Stonebrood)(Fungi)  
 Melanosis (a yeast-like entity (Fungi)), systematic  
 position uncertain

*Nosema apis* (Nosema disease, or nosema) (Protozoa)  
*Malpighamoeba mellificae* (Amoeba disease, or amoebic  
 dysentery) (Protozoa)

*Acarapis dorsalis* (Dorsal acarine mite) (Acari)  
*Acarapis externus* (External acarine mite) (Acari)  
*Mellitiphis alvearius* (Pollen mite) (Acari)  
*Neocyphoaelaps novaehollandiae* (Acari)  
*Varroa destructor* (Varroa) (Acari)

The following are also pests of honey bees in New Zealand.

*Achroia grisella* (Lesser wax moth) (Insecta: Lepidoptera)  
*Galleria mellonella* (Greater wax moth) (Insecta:  
 Lepidoptera)

*Mus musculus* (Mice) (Mammalia)  
*Vespula germanica* (German wasp) (Insecta: Hymenoptera)  
*V. vulgaris* (Common wasp) (Insecta: Hymenoptera).

**Remarks.** The honey bee is one of the mostly widely distributed, common, and easily recognised insects not only in New Zealand, but in much of the temperate and even the tropical world. The volume of literature on the honey bee is enormous. In New Zealand more than in most other countries because of the lack of most groups of bees, it is a vital pollinator of numerous horticultural and agricultural crops, and particularly of white clover which is a mainstay of pastures. As such, the value of the honey bee to the New Zealand economy is worth many many times annually the value of direct products from hives.

However, honey bee stings cause serious pain, swelling and other adverse effects on people. Unfortunately concise statistical data seem not now to be available, but there are many hundreds of hospitalisations annually, and about every year or so there is a death. Many thousands of people carry adrenaline with which to stimulate the heart if it begins to fail from anaphylactic shock resulting from the injection of venom from one or more bee stings. Honey bees are the most dangerous animal to humans in New Zealand. The occupation of cavities within buildings also causes economic losses. Despite these adverse aspects of honey bees, the keeping of bees is encouraged and fostered because of their huge economic benefits. Without the honey bee, New Zealand's agricultural economy would falter.

## NOTE ADDED IN PROOF

### *Euryglossina* (*Euryglossina*) *hypochroma* Cockerell

On 25 November 2006, Mr Stephen Thorpe collected a live female bee on a window ledge of the East Wing of the Clock Tower of Auckland University AK. The area is open to the outdoors, so the bee could have been free-flying in the field. During December 2006 the bee was identified by Dr Jo Berry of Landcare Research, Auckland, as *Euryglossina* (*Euryglossina*) *hypochroma* Cockerell (Hymenoptera: Colletidae: Euryglossinae), and in February 2007 the identification was confirmed by Dr Ken Walker, Museum of Victoria, Melbourne, Australia. Subsequent searches by Mr Stephen Thorpe and Dr Jo Berry have not found further specimens. I have not seen the bee, but a female in my collection which was collected in Australia and identified by Dr E. Exley is very similar in length (3.7 mm) to female *Euryglossina* (*Euryglossina*) *proctotrypoides* (3.8 ± 0.32 mm), the only species in the subfamily which is known to be established in New Zealand.

*Euryglossina hypochroma* is widely distributed in Australia including Tasmania, where it occurs on flowers of some species of Myrtaceae (Exley 1968). At Tusmore, Adelaide, South Australia, on 24 December 1967 nests were found in a post and in soft, pulpy wood of branches in a wood pile. Three entrances gave access to anastomosing tunnels 1.4 mm in diameter throughout the terminal 100 mm of a branch, and cells which occurred either singly or in series of 2–3 at the ends of tunnels were 1.75–2.1 mm in diameter. A pupa, which was white when collected, was an adult by February, which suggested that there were two generations of bees a year (Houston 1969).

In the event that more specimens are collected, they can be readily distinguished from *E. (E.) proctotrypoides* by the clypeus being yellow in both sexes, whereas it is black in *E. (E.) proctotrypoides*.

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## APPENDIX 1. Additional species of bees recorded in New Zealand.

### *Peponapis pruinosa* (Say) (Apidae: Apinae: Eucerini)

Donovan, 1980: 107 (has been recently released in New Zealand, but establishment is uncertain). Tepedino, 1981: 360 (the introduction of squash bees is underway in New Zealand (B. Donovan, pers comm.)). Donovan, 1990: 29 (listed as potential for introduction to New Zealand for pollination of pumpkins and squashes).

From 18 December 1971 to 20 October 1978, 4 shipments totalling 1,428 prepupae in cells were imported from Gridley, California, U.S.A., to quarantine at the Canterbury Agriculture and Science Centre, Lincoln. The first 3 shipments of 500, 474, and 292 prepupae respectively were collected by Professor A. E. Michalbacher, and the 4<sup>th</sup> shipment of 162 was collected in the same area by me. Only the 4<sup>th</sup> shipment produced perfect live bees, of which 107 flew in the field at Lincoln from 21 January to 6 March 1980. Males and females were seen in and over pumpkin flowers at the release site and at another site 1 km away, and several females were seen carrying large loads of pollen. However, bees have not been seen since, so it appears that the species failed to establish. Bees habitually excavate most of their nests in soil around pumpkin plants, so it is likely that nests in pumpkin fields would have been destroyed by cultivation after crop harvest.

### *Xylocopa sonorina* Smith (Apidae: Xylocopinae:

#### Xylocopini).

Donovan, 1988: 21 (about 20 males collected from nests in Onehunga, Auckland, New Zealand). Manson, 1988: 4-5 (about 20 male bees collected plus 2 or 3 pupae, identified by Dr Charles D. Michener as agreeing with specimens from Hawaii).

Because only males were produced, it seems likely that the mother bee or bees were not mated. There are no other reports of the species in New Zealand.

## APPENDIX 2. Species recorded from New Zealand, but not present.

### *Leioproctus (Leioproctus) obscurus* (Smith)

*Lamprocolletes obscurus* Smith, 1853: 11 (description of female and male, habitat Van Diemen's Land (= Tasmania)). Sichel, 1867: 144 (Auckland (= Auckland)). Hutton, 1874: 164 (recorded from New Zealand). Kirby, 1881: 36 (New Zealand (Hutton's List); Van Diemen's Land). Kirby, 1884: 66 (New Zealand (Hutton's List); Tasmania (The New Zealand habitat is a mistake. — Ed.)). Dalla Torre, 1896: 48 (Australia: Tasmania). Cameron, 1898: 3-4 (common to New Zealand and Tasmania). Cameron, 1903: 299 (New Zealand). Hutton, 1904: 96 (New Zealand).

All subsequent locality records are for Tasmania, apart from:

*Paracolletes obscurus*: Tillyard, 1926: 302 (is a common species found from Western Australia to Tasmania and New Zealand).

### *Leioproctus (Leioproctus) confusus* Cockerell

*Leioproctus confusus* Cockerell, 1904a: 204 (description of female, habitat New Zealand).

*Paracolletes confusus*: Cockerell, 1905a: 348 (new combination, New Zealand, key). —1913a: 277 (*Paracolletes maorium* is related to *P. confusus*). —1916b: 361 (listed from New Zealand). —1925: 552 (several characters associate *Paracolletes hudsoni* with *P. confusus* Ckll., of which only the female is known). Rayment, 1935: 668-669 (description of male from Nelson, New Zealand, allotype in the collection of the author, paratypes are in the Cawthron Institute, New Zealand, *P. hudsoni* is allied but lacks the transverse striation of the inclosed area of the metathorax).

*Leioproctus (Leioproctus) confusus*: Michener, 1965: 50 (described as from New Zealand, but "N. Holl." is on label on type; undoubtedly Australian, to judge by pectinate spur as well as label). (Note: "N. Holl" = New Holland = mainland Australia).

### *Hylaeus (Euprosopoides) vicinus* (Sichel)

*Prosopis vicina* Sichel, 1867: 143 (description of female and male, a female and 2 males from Auckland (*sic*), 5 females and 1 male from Tasmania). Hutton, 1874: 165 (recorded from New Zealand). —1881: 99 (brief description of male and female, Auckland and Tasmania). Kirby, 1881: 38 (Auckland, Tasmania, no other New Zealand species has a yellow scutellum and post-scutellum). —1884: 67 (repeat of Kirby 1881). Dalla Torre, 1896: 35 (list, Tasmania, New Zealand). Cameron, 1898: 4 (common to New Zealand and Australia). —1902: 27 (recorded from Auckland and Tasmania, has not been found by anyone recently in New Zealand; and so considered to be an accidental introduction or an error in labelling). —1903: 299 (list, from New Zealand). Cockerell, 1910c:

133 (when preparing a Table of Australian species of *Prosopis*, *P. vicina* Sichel not before him), 135 (*P. vicina* Sichel is almost certainly based on a mixture of species; the name should be restricted to the New Zealand specimens). —, 1912b: 599 (*Prosopis vicina* Sichel (in part), listed from Tasmania). —, 1916b: 361 (listed from New Zealand).

*Hylaeus vicinus*: Meade-Waldo, 1923: 29 (listed from New Zealand. The Tasmanian record is to be excluded). Cockerell, 1925: 553 (Sichel confused another Tasmanian species with it. This is the only New Zealand representative of an Australian group of *Hylaeus*).

*Hylaeus (Euprosopoides) vicinus*: Michener, 1965: 132 (a female in the Naturhistorisches Museum, Vienna, which was collected by Sichel and which must have come from Sydney, Australia, is selected as the lectotype. The species is thus removed from the New Zealand list).

### ***Hylaeus (Meghylaues) chalybaeus* (Friese)**

*Prosopis chalybaea* Friese, 1924: 222 (description of male and female, the female is from New Zealand, the male is from Australia). Cockerell, 1926b: 663 (the species is based on a female from New Zealand and a male from Australia. They are presumably different species, and the name should be restricted to the New Zealand insect).

*Hylaeus (Meghylaues) chalybaeus*: Michener, 1965: 134 (the specimen supposedly from New Zealand must have been labelled in error, the species is Australian).

### ***Nomia (Rhopalomelissa) floralis* (Smith)**

*Halictus floralis* Smith, 1853: 57 (description of female, habitat New Holland (= mainland Australia)). Dalla Torre, 1896: 62 (Australia, New Zealand). Cockerell, 1904b: 212 (*H. floralis* is from Australia; Dalla Torre erroneously gives the locality as New Zealand).

*Nomia (Rhopalomelissa) floralis*: Michener, 1965: 159 (the subgenus distributed in Africa and southern Asia and nearby, and Australia south to southern Queensland, new association, authentic material has been examined).

### ***Bombus* spp.**

Gurr, 1957: 999 (a summation of the information gained on a recent survey showed that of the 7 species either claimed or thought to have been liberated in New Zealand, *B. lucorum*, *B. lapidarius*, and *B. derhamellus* were not found).

**APPENDIX 3.** Occurrence and abundance of bees (subjective abundance scale, 1 = rare to 10 = abundant). Abbreviations: NO = North Island, SO = South Island, SI = Stewart Island, KE = Kermadec Is, CH = Chatham Is, TH = Three Kings Is.

Species	Occurrence and abundance					
	NO	SO	SI	KE	CH	TH
<i>Leioproctus</i> ( <i>Leioproctus</i> )						
<i>boltoni</i>	9	9	2			1
<i>huakiwi</i>	9	9	3			
<i>imitatus</i>	10	8				
<i>kanapuu</i>	3	3				
<i>keehua</i>	1	2				
<i>metallicus</i>	4	4				
<i>otautahi</i>		1?(status uncertain)				
<i>pango</i>	10	9	5			
<i>purpureus</i>	5	6	4			
<i>vestitus</i>	4	9	4			
<i>waipounamu</i>		4				
( <i>Nesocolletes</i> )						
<i>fulvescens</i>		10	4			
<i>hudsoni</i>	3	4				
<i>maritimus</i>		5				
<i>monticola</i>	7	6	3			
<i>nunui</i>		1				
<i>paahaumaa</i>	8					
<i>pekanui</i>	1	7				
<i>Hylaeus</i> ( <i>Prosopistemon</i> )						
<i>agilis</i>	6	6	4		?	3
<i>asperithorax</i>	3	3			2	2
<i>capitosus</i>	4	7	5			
<i>kermadecensis</i>				2		
<i>matamoko</i>		3				
<i>murihiku</i>		1				
<i>perhumilis</i>	1	2				
<i>relegatus</i>	8	8	7		3	3
<i>Hyleoides</i> <i>concinna</i>	3					
<i>Euryglossina</i> ( <i>Euryglossina</i> )						
<i>proctotrypoides</i>	2	2				

(continued next column)

Species	Occurrence and abundance					
	NO	SO	SI	KE	CH	TH
<i>Nomia</i> ( <i>Acunomia</i> ) <i>melanderi</i>	?	1				
<i>Lasioglossum</i> ( <i>Austrevylaeus</i> )						
<i>mataroa</i>		4				
<i>maunga</i>	1	5				
<i>sordidum</i>	8	10	3			3
( <i>Chilalictus</i> ) <i>cognatum</i>	2	1				
<i>Osmia</i> ( <i>Helicosmia</i> ) <i>coerulescens</i>		1				
<i>Anthidium</i> ( <i>Anthidium</i> ) <i>manicatum</i>	1	2				
<i>Megachile</i> ( <i>Eutricharaea</i> ) <i>rotundata</i>	?	3				
<i>Bombus</i> ( <i>Bombus</i> ) <i>terrestris</i>	9	9	5			
( <i>Megabombus</i> ) <i>hortorum</i>	2	7				
<i>ruderatus</i>	6	6				
( <i>Subterraneobombus</i> ) <i>subterraneus</i>		4				
<i>Apis</i> ( <i>Apis</i> ) <i>mellifera</i>	10	10	6		3	3

#### Number of species

Endemic	18+2?	24+1?	11	1	1+1?	4
Indigenous	1	1				
Adventive	5	4			1	1
Imported	4	8	2		1	1

<b>Total species</b>	28	37	13	1	3	6
	+ 2?	+ 1?			+ 1?	

**Total species recorded for the  
New Zealand subregion = 41**

#### APPENDIX 4. Alphabetic list of species of plants associated with each species of bee.

##### *Leioproctus (Leioproctus) boltoni* Cockerell

Native species and family

<i>Carmichaelia</i> sp.	Fabaceae
<i>Cordyline australis</i>	Laxmanniaceae
<i>Hebe traversii</i>	Plantaginaceae
<i>Hebe</i> sp.	
<i>Kunzea ericoides</i>	Myrtaceae
<i>Kunzea/Leptospermum</i>	
<i>Leptospermum scoparium</i>	
<i>Lophomyrtus obcordata</i>	
<i>Metrosideros excelsa</i>	
<i>Muehlenbeckia complexa</i>	Polygonaceae
<i>Phormium tenax</i>	Hemerocallidaceae
<i>Pimelea traversii</i>	Thymelaeaceae
<i>Rata</i>	Myrtaceae
<i>Wahlenbergia pygmaea</i>	Campanulaceae

Introduced species and family

<i>Actinidia deliciosa</i>	Actinidiaceae
<i>Argyranthemum frutescens</i>	Asteraceae
<i>Calluna vulgaris</i>	Ericaceae
<i>Castanea sativa</i>	Fagaceae
<i>Ceanothus papillosus</i> var. <i>roweanus</i>	Rhamnaceae
<i>Citrus</i> sp.	Rutaceae
'composite'	Asteraceae
<i>Daucus carota</i>	Apiaceae
<i>Deutzia gracilis</i>	Philadelphaceae
<i>Digitalis purpurea</i>	Plantaginaceae
<i>Diosma</i> sp.	Rutaceae
<i>Echium vulgare</i>	Boraginaceae
<i>Kolkwitzia</i> sp.	Caprifoliaceae
<i>Leucospermum</i> sp.	Proteaceae
<i>Taraxacum officinale</i> 'thistle'	Asteraceae
<i>Thymus vulgaris</i>	Lamiaceae

##### *Leioproctus (Leioproctus) huakiwi* new species

Native species and family

<i>Carmichaelia stevensonii</i>	Fabaceae
<i>Carpodetus serratus</i>	Rousseaceae
<i>Clematis parviflora</i>	Ranunculaceae
<i>Cordyline australis</i>	Laxmanniaceae
<i>Hebe macrocarpa</i>	Plantaginaceae
<i>Hebe salicifolia</i>	
<i>Hebe speciosa</i>	
<i>Hebe stricta</i>	
<i>Hebe</i> sp.	
<i>Hoheria angustifolia</i>	Malvaceae
<i>Hoheria glabrata</i>	
<i>Hoheria lyallii</i>	
<i>Hoheria</i> sp.	
<i>Kunzea ericoides</i>	Myrtaceae
<i>Leptospermum scoparium</i>	
<i>Lophomyrtus bullata</i>	
<i>Lophomyrtus obcordata</i>	
<i>Metrosideros excelsa</i>	
<i>Metrosideros perforata</i>	

Introduced species and family

<i>Actinidia deliciosa</i>	Actinidiaceae
<i>Castanea sativa</i>	Fagaceae
'composite'	Asteraceae
<i>Daucus carota</i>	Apiaceae
<i>Eucalyptus polyanthemos</i>	Myrtaceae
<i>Kniphofia praecox</i>	Asphodelaceae

<i>Persea americana</i>	Lauraceae
<i>Tilia</i> sp.	Malvaceae

##### *Leioproctus (Leioproctus) imitatus* Smith

Native species and family

<i>Cordyline australis</i>	Laxmanniaceae
<i>Dracophyllum filifolium</i>	Epacridaceae
<i>Hebe</i> sp.	Plantaginaceae
<i>Kunzea ericoides</i>	Myrtaceae
<i>Kunzea/Leptospermum</i>	
<i>Leptospermum scoparium</i>	
<i>Lophomyrtus obcordata</i>	
<i>Metrosideros excelsa</i>	
<i>Muehlenbeckia australis</i>	Polygonaceae
<i>Muehlenbeckia complexa</i>	
<i>Phormium tenax</i>	Hemerocallidaceae

Introduced species and family

<i>Actinidia deliciosa</i>	Actinidiaceae
<i>Carduus nutans</i>	Asteraceae
<i>Castanea sativa</i>	Fagaceae
<i>Citrus</i> sp.	Rutaceae
<i>Daucus carota</i> , wild	Apiaceae
<i>Digitalis purpurea</i> (bunched on)	Plantaginaceae
<i>Kolkwitzia</i> sp.	Caprifoliaceae
<i>Ligustrum</i> sp.	Oleaceae
<i>Lupinus</i> sp.	Fabaceae
<i>Myrtus communis</i>	Myrtaceae
<i>Persea americana</i>	Lauraceae
<i>Taraxacum officinale</i>	Asteraceae

##### *Leioproctus (Leioproctus) kanapuu* new species

Native species and family

<i>Kunzea ericoides</i>	Myrtaceae
<i>Kunzea/Leptospermum</i>	
<i>Leptospermum scoparium</i>	
<i>Metrosideros excelsa</i>	

Introduced species and family

<i>Actinidia deliciosa</i>	Actinidiaceae
<i>Castanea sativa</i>	Fagaceae
<i>Daucus carota</i>	Apiaceae
<i>Echium vulgare</i>	Boraginaceae

##### *Leioproctus (Leioproctus) keehua* new species

Native species and family

<i>Mimulus repens</i>	Phrymaceae
<i>Selliera radicans</i>	Goodeniaceae

Introduced species and family

<i>Centaurium erythraea</i>	Gentianaceae
<i>Trifolium fragiferum</i>	Fabaceae

##### *Leioproctus (Leioproctus) metallicus* (Smith)

Native species and family

<i>Kunzea ericoides</i>	Myrtaceae
<i>Leptospermum scoparium</i>	

Introduced species and family

<i>Achillea millefolium</i>	Asteraceae
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##### *Leioproctus (Leioproctus) otautahi* new species

No records.

##### *Leioproctus (Leioproctus) pango* new species

Native species and family

<i>Carmichaelia arborea</i>	Fabaceae
<i>Carmichaelia australis</i>	
<i>Carmichaelia carmichaeliae</i>	
<i>Carmichaelia crassicaule</i>	
<i>Carmichaelia kirkii</i>	
<i>Carmichaelia petriei</i>	
<i>Carmichaelia</i> sp.	

<i>Carpodetus serratus</i>	Rousseaceae
<i>Celmisia semicordata</i>	Asteraceae
<i>Coprosma lucida</i>	Rubiaceae
<i>Coprosma</i> sp.	
<i>Cordyline australis</i>	Laxmanniaceae
<i>Hebe brachysiphon</i>	Plantaginaceae
<i>Hebe elliptica</i>	
<i>Hebe salicifolia</i>	
<i>Hebe stricta</i>	
<i>Hebe subalpina</i>	
<i>Hebe</i> sp.	
<i>Kunzea ericoides</i>	Myrtaceae
<i>Leptospermum scoparium</i>	
<i>Leptospermum scoparium/</i> <i>Carmichaelia</i> sp.	Myrtaceae/Fabaceae
<i>Lophomyrtus</i> sp.	Myrtaceae
<i>Metrosideros excelsa</i>	Myrtaceae
<i>Metrosideros</i> sp., <i>rata</i>	
<i>Muehlenbeckia complexa</i>	Polygonaceae
<i>Ozothamnus leptophyllus</i>	Asteraceae
<i>Pennantia</i> sp.	Pennantiaceae
<i>Peraxilla tetrapetala</i>	Loranthaceae
<i>Phormium tenax</i>	Hemerocallidaceae
<i>Pseudopanax</i> sp/ <i>Carmichaelia</i> sp.	Araliaceae/Fabaceae

## Introduced species and family

<i>Achillea millefolium</i>	Asteraceae
<i>Actinidia deliciosa</i>	Actinidiaceae
<i>Calluna vulgaris</i>	Ericaceae
<i>Cerastium</i> sp.	Caryophyllaceae
<i>Cirsium lanceolatum</i>	Asteraceae
<i>Deutzia gracilis</i>	Philadelphaceae
<i>Dianthus caryophyllus</i>	Caryophyllaceae
<i>Hieracium pilosella</i>	Asteraceae
<i>Hieracium praealtum</i>	
<i>Medicago sativa</i>	Fabaceae
<i>Persea americana</i>	Lauraceae
<i>Trifolium repens</i>	Fabaceae

***Leioproctus (Leioproctus) purpureus* (Smith)**

## Native species and family

<i>Carmichaelia</i> sp.	Fabaceae
<i>Carpodetus serratus</i>	Rousseaceae
<i>Cordyline australis</i>	Laxmanniaceae
<i>Metrosideros excelsa</i>	Myrtaceae
<i>Phormium tenax</i>	Hemerocallidaceae

## Introduced species and family

<i>Actinidia deliciosa</i>	Actinidiaceae
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***Leioproctus (Leioproctus) vestitus* (Smith)**

## Native species and family

<i>Brachyglottis bennettii</i>	Asteraceae
<i>Carmichaelia arborea</i>	Fabaceae
<i>Carmichaelia australis</i>	
<i>Carmichaelia crassicaule</i>	
<i>Carmichaelia petriei</i>	
<i>Carmichaelia</i> sp.	
<i>Carpodetus serratus</i>	Rousseaceae
<i>Celmisia semicordata</i>	Asteraceae
<i>Colobanthus</i> sp.	Caryophyllaceae
<i>Cordyline australis</i>	Laxmanniaceae
<i>Hebe stricta</i>	Plantaginaceae
<i>Hebe subalpina</i>	
<i>Hebe</i> sp.	
<i>Mimulus</i> sp.	Phrymaceae
<i>Raoulia</i> sp.	Asteraceae
<i>Selliera radicans</i>	Goodeniaceae

## Introduced species and family

<i>Achillea millefolium</i>	Asteraceae
<i>Actinidia deliciosa</i>	Actinidiaceae
<i>Anethum graveolens</i>	Apiaceae
<i>Daucus carota</i>	
<i>Linum catharticum/</i> <i>Trifolium repens</i>	Linaceae/ Fabaceae.
<i>Medicago sativa</i>	Fabaceae
<i>Melilotus</i> sp.	
<i>Pastinaca sativa</i>	Apiaceae
<i>Trifolium fragiferum</i>	Fabaceae
<i>Trifolium hybridum</i>	
<i>Trifolium repens</i>	
<i>Trifolium subterraneum</i>	

***Leioproctus (Leioproctus) waipounamu* new species**

## Native species and family

<i>Hebe brachysiphon</i>	Plantaginaceae
<i>Hebe odora</i>	
<i>Hebe salicifolia</i>	
<i>Hebe stricta</i>	
<i>Hebe subalpina</i>	
<i>Hebe traversii</i>	
<i>Hebe</i> sp.	
<i>Hoheria angustifolia</i>	Malvaceae
<i>Kunzea ericoides</i>	Myrtaceae

## Introduced species and family

<i>Leptospermum scoparium</i>	
<i>Mimulus repens</i>	Phrymaceae
<i>Olearia virgata</i>	Asteraceae
<i>Ozothamnus leptophyllus</i>	
<i>Phormium tenax</i>	Hemerocallidaceae

There are no records for introduced plants.

***Leioproctus (Nesocolletes) fulvescens* (Smith)**

## Native species and family

<i>Brachyglottis bennettii</i>	Asteraceae
<i>Brachyglottis compactus</i>	
<i>Brachyglottis laxifolius</i>	
<i>Brachyglottis</i> sp.	
<i>Celmisia coriacea</i>	
<i>Celmisia spectabilis</i>	
<i>Celmisia</i> sp.	
<i>Cotula coronopifolia</i>	
<i>Cotula</i> sp.	
<i>Craspedia uniflora</i>	
<i>Euphrasia</i> sp.	Plantaginaceae
<i>Gentiana bellidifolia</i>	Gentianaceae
<i>Gentiana corymbifera</i>	
<i>Gentiana</i> sp.	
<i>Hebe subalpina</i>	Plantaginaceae
<i>Hoheria</i> sp.	Malvaceae
<i>Kunzea ericoides</i>	Myrtaceae
<i>Mimulus</i> sp.	Phrymaceae
<i>Olearia moschata</i>	Asteraceae
<i>Olearia nummularifolia</i> var. <i>cymbifolia</i>	
<i>Ozothamnus leptophyllus</i>	
<i>Pachystegia insignis</i>	
<i>Raoulia australis</i>	
<i>Raoulia haastii</i>	
<i>Raoulia subsericea</i>	
<i>Wahlenbergia</i> sp.	Campanulaceae

## Introduced species and family

<i>Achillea millefolium</i>	Asteraceae
<i>Calendula officinalis</i>	
<i>Carthamnus lanatus</i>	
<i>Cichorium intybus</i>	
<i>Cirsium arvense</i>	

<i>Cirsium vulgare</i> 'composite'			
<i>Conium maculatum</i>	Apiaceae		
<i>Daucus carota</i>			
<i>Eschscholzia californica</i>	Papaveraceae		
<i>Hieracium pilosella</i>	Asteraceae		
<i>Hieracium praealtum</i>			
<i>Hieracium</i> sp.			
<i>Hypericum perforatum</i>	Hypericaceae		
<i>Hypochoeris radicata</i>	Asteraceae		
<i>Lilium</i> sp.	Liliaceae		
<i>Malva neglecta</i>	Malvaceae		
<i>Medicago sativa</i>	Fabaceae		
<i>Mellilotus albus</i>			
<i>Potentilla</i> sp. 'rose'	Rosaceae		
<i>Tanacetum vulgare</i>	Asteraceae		
<i>Taraxacum officinale</i> 'thistle'			
<i>Trifolium repens</i>	Fabaceae		
'yellow poppy'	Papaveraceae		
<b><i>Leioproctus (Nesocolletes) hudsoni</i> (Cockerell)</b>			
Native species and family			
<i>Aciphylla</i> sp.	Apiaceae		
<i>Celmisia gracilenta</i>	Asteraceae		
<i>Gentiana</i> sp.	Gentianaceae		
<i>Hebe brachysiphon</i>	Plantaginaceae		
<i>Hebe odora</i>			
<i>Hebe salicifolia</i>			
<i>Hebe subalpina</i>			
<i>Leptospermum scoparium</i>	Myrtaceae		
<i>Olearia moschata</i>	Asteraceae		
<i>Olearia nummularifolia</i> var. <i>cymbifolia</i>			
<i>Olearia virgata</i>			
<i>Ozothamnus leptophyllus</i>			
<i>Pimelea traversii</i>	Thymelaeaceae		
<i>Raoulia haastii</i>	Asteraceae		
<i>Raoulia subsericea</i>			
<i>Raoulia</i> sp.			
<i>Wahlenbergia</i> sp.	Campanulaceae		
Introduced species and family			
<i>Achillea millefolium</i>	Asteraceae		
<i>Hypericum perforatum</i>	Hypericaceae		
<i>Hypochoeris radicata</i>	Asteraceae		
<i>Taraxacum officinale</i>			
<b><i>Leioproctus (Nesocolletes) maritimus</i> (Cockerell)</b>			
Native species and family			
<i>Muehlenbeckia</i> sp./ <i>Coprosma</i> sp.	Polygonaceae/ Rubiaceae		
<i>Ozothamnus leptophyllus</i>	Asteraceae		
<i>Raoulia australis</i>			
<i>Raoulia hookeri</i>			
<i>Raoulia parkii</i>			
<i>Raoulia subsericea</i>			
<i>Raoulia youngii</i>			
<i>Raoulia</i> sp.			
Introduced species and family			
<i>Achillea millefolium</i>	Asteraceae		
<i>Rumex acetosella</i>	Polygonaceae		
<i>Taraxacum officinale</i>	Asteraceae		
<b><i>Leioproctus (Nesocolletes) monticola</i> (Cockerell)</b>			
Native species and family			
<i>Gentiana montana</i>	Gentianaceae		
<i>Hebe brachysiphon</i>	Plantaginaceae		
<i>Hebe chathamica</i>			
<i>Hebe elliptica</i>			
<i>Hebe macrantha</i>			
<i>Hebe odora</i>			
<i>Hebe salicifolia</i>			
<i>Hebe speciosa</i>			
<i>Hebe stricta</i>			
<i>Hebe subalpina</i>			
<i>Hebe</i> sp.			
<i>Leptospermum scoparium</i>	Myrtaceae		
<i>Ozothamnus leptophyllus</i>	Asteraceae		
<i>Pimelea traversii</i>	Thymelaeaceae		
Introduced species and family			
<i>Cytisus</i> sp.	Fabaceae		
<i>Medicago sativa</i> /Linum <i>catharticum</i>	Fabaceae/ Linaceae		
<i>Rubus</i> sp.	Rosaceae		
<i>Senecio jacobaea</i>	Asteraceae		
<b><i>Leioproctus (Nesocolletes) nunui</i> new species</b>			
Native species and family			
<i>Ozothamnus leptophyllus</i>	Asteraceae		
<i>Kunzea ericoides</i>	Myrtaceae		
There are no records for introduced species.			
<b><i>Leioproctus (Nesocolletes) paaahumaa</i> new species</b>			
Native species and family			
<i>Hebe salicifolia</i>	Plantaginaceae		
<i>Hebe stricta</i>			
<i>Hebe</i> sp.			
<i>Leptospermum scoparium</i>	Myrtaceae		
<i>Lophomyrtus</i> sp.			
<i>Wahlenbergia pygmaea</i>	Campanulaceae		
Introduced species and family			
<i>Achillea millefolium</i>	Asteraceae		
<i>Actinidia deliciosa</i>	Actinidiaceae		
<i>Calendula officinalis</i>	Asteraceae		
<i>Crepis capillaris</i>			
<i>Cucurbita maxima</i>	Cucurbitaceae		
<i>Hypochoeris radicata</i>	Asteraceae		
<i>Kniphofia praecox</i>	Asphodelaceae		
<i>Nymphaea</i> sp.	Nymphaeaceae		
<i>Rosa</i> sp.	Rosaceae		
<i>Senecio jacobaea</i>	Asteraceae		
<i>Senecio lautus</i> / <i>Sonchus oleraceus</i>			
<i>Taraxacum officinale</i>			
<b><i>Leioproctus (Nesocolletes) pekanui</i> new species</b>			
Native species and family			
<i>Celmisia coriacea</i>	Asteraceae		
<i>Celmisia spectabilis</i>			
<i>Celmisia</i> sp.			
<i>Craspedia uniflora</i>			
<i>Epilobium</i> sp.	Onagraceae		
<i>Euphrasia revoluta</i>	Orobanchaceae		
<i>Gentiana corymbifera</i>	Gentianaceae		
<i>Gentiana</i> sp.			
<i>Geum uniflorum</i>	Rosaceae		
<i>Hebe epacridea</i>	Plantaginaceae		
<i>Hebe macrantha</i>			
<i>Hebe ?odora</i>			
<i>Hebe salicifolia</i>			
<i>Hebe subalpina</i>			
<i>Hebe</i> sp.			
<i>Leptospermum scoparium</i>	Myrtaceae		

- Leucogenes grandiceps* Asteraceae  
*Ozothamnus* sp.  
*Parahebe decora* Plantaginaceae  
*Parahebe linifolia*  
*Raoulia eximia* Asteraceae  
*Raoulia subsericea*  
*Wahlenbergia* sp. Campanulaceae
- Introduced species and family  
*Achillea millefolium* Asteraceae  
*Chrysanthemum leucanthemum*  
*Echium vulgare* Boraginaceae  
*Hieracium praealtum* Asteraceae  
*Hypericum* sp. Hypericaceae  
*Potentilla* sp. Rosaceae  
*Taraxacum officinale* Asteraceae
- Hylaeus (Prosopisteron) agilis* (Smith)**  
 Native species and family  
*Brachyglottis* sp. Asteraceae  
*Carmichaelia* sp. Fabaceae  
*Hebe salicifolia* Plantaginaceae  
*Hebe* sp.  
*Leptospermum scoparium* Myrtaceae  
*Metrosideros excelsa*  
*Metrosideros robusta*  
*Metrosideros* sp.  
*Olearia angustifolia* Asteraceae  
*Pennantia corymbosa* Pennantiaceae  
*Peraxilla colensoi* Loranthaceae  
*Peraxilla tetrapetala*  
*Phormium tenax* Hemerocallidaceae  
*Pseudopanax* sp. Araliaceae
- Introduced species and family  
*Actinidia deliciosa* Actinidiaceae  
*Callistemon* sp. Myrtaceae  
*Castanea sativa* Fagaceae  
*Cytisus scoparius* Fabaceae  
*Eucalyptus* sp. Myrtaceae  
*Filipendula palmata* Rosaceae  
*Kniphofia praecox* Asphodelaceae  
*Verbascum thapsus* Scrophulariaceae
- Hylaeus (Prosopisteron) asperithorax* (Rayment)**  
 Native species and family  
*Disphyma* sp. Aizoaceae  
*Hebe* sp. Plantaginaceae  
*Mimulus* sp. Phrymaceae  
*Selliera radicans* Goodeniaceae  
*Wahlenbergia pygmaea* Campanulaceae
- Introduced species and family  
*Hibiscus trionum* Malvaceae  
*Lobelia* sp. Lobeliaceae  
*Taraxacum officinale* Asteraceae
- Hylaeus (Prosopisteron) capitosus* (Smith)**  
 Native species and family  
*Carmichaelia* sp. Fabaceae  
*Gentiana patula* Gentianaceae  
*Hebe bollonsii* Plantaginaceae  
*Hebe brachysiphon*  
*Hebe divaricata*  
*Hebe elliptica*  
*Hebe salicifolia*  
*Hebe speciosa*  
*Hebe traversii*  
*Hebe* sp.  
*Kunzea ericoides* Myrtaceae  
*Leptospermum scoparium*
- Metrosideros excelsa*  
*Metrosideros robusta*  
*Metrosideros* sp. Polygonaceae  
*Muehlenbeckia* sp. Asteraceae  
*Olearia lacunosa*  
*Olearia virgata*  
*Ozothamnus* sp.  
*Phormium tenax* Hemerocallidaceae
- Introduced species and family  
*Achillea millefolium* Asteraceae  
*Actinidia deliciosa* Actinidiaceae  
*Cerastium* sp. Caryophyllaceae  
*Cirsium arvense* Asteraceae  
*Daucus carota* Apiaceae  
*Echium vulgare* Boraginaceae  
*Hypericum* sp. Hypericaceae  
*Linaria purpurea* Plantaginaceae  
*Lupinus polyphyllus* Fabaceae  
*Lupinus* sp.  
*Medicago sativa* 'mustard' Brassicaceae  
*Pastinaca sativa* Apiaceae  
*Potentilla recta* Rosaceae  
*Ranunculus* sp. Ranunculaceae  
*Rosa rubiginosa* Rosaceae  
*Rosa* sp.  
*Taraxacum officinale* Asteraceae  
 'thistle'  
*Trifolium repens* Fabaceae
- Hylaeus (Prosopisteron) kermadecensis* new species**  
 Native species and family  
*Scaevola gracilis* Goodeniaceae
- Introduced species and family  
*Ageratum houstonianum* Asteraceae
- Hylaeus (Prosopisteron) matamoko* new species**  
 Native species and family  
*Epilobium* sp. Onagraceae  
*Hebe* sp. Plantaginaceae  
*Myosotis* sp. Boraginaceae
- There are no records for introduced plants.
- Hylaeus (Prosopisteron) murihiku* new species**  
 There are no flower records.
- Hylaeus (Prosopisteron) perhumilis* (Cockerell)**  
 There are no native flower records.
- Introduced species and family  
*Banksia* sp. Proteaceae  
*Eucalyptus regnans/piperita* Myrtaceae
- Hylaeus (Prosopisteron) relegatus* (Smith)**  
 Native species and family  
*Carmichaelia* sp. Fabaceae  
*Cordyline australis* Laxmanniaceae  
*Cotula* sp. Asteraceae  
*Hebe chathamica* Plantaginaceae  
*Hebe elliptica*  
*Hebe macrantha*  
*Hebe odora*  
*Hebe salicifolia*  
*Hebe stricta*  
*Hebe subalpina*  
*Hebe traversii*  
*Kunzea ericoides* Myrtaceae  
*Leptospermum scoparium*  
*Metrosideros excelsa*  
*Nothofagus?* sp. Nothofagaceae

<i>Ozothamnus</i> sp.	Asteraceae
<i>Phormium tenax</i>	Hemerocallidaceae
<i>Raoulia australis</i>	Asteraceae

## Introduced species and family

<i>Abutilon</i> sp.	Malvaceae
<i>Actinidia deliciosa</i>	Actinidiaceae
<i>Allium</i> sp.	Alliaceae
<i>Castanea sativa</i>	Fagaceae
<i>Conium maculatum</i>	Apiaceae
<i>Cytisus</i> sp.	Fabaceae
<i>Daucus carota</i>	Apiaceae
<i>Indigofera potaninii</i>	Fabaceae
<i>Kniphofia praecox</i>	Asphodelaceae
<i>Rubus idaeus</i>	Rosaceae
<i>Rubus</i> sp.	

***Hyleoides concinna* (Fabricius)**

There are no records for native species.

## Introduced species and family

<i>Acmena smithii</i>	Myrtaceae
<i>Callistemon</i> sp.	
<i>Campsis</i> sp.	Bignoniaceae
<i>Citrus</i> sp.	Rutaceae
<i>Eucalyptus longifolia</i>	Myrtaceae
<i>Eucalyptus</i> sp.	
<i>Leucospermum bolusii</i>	Proteaceae
<i>Lycium ferocissimum</i>	Solanaceae
<i>Nerium oleander</i>	Apocynaceae
<i>Saponaria officinalis</i>	Caryophyllaceae
<i>Tanacetum parthenium</i>	Asteraceae
<i>Tecoma</i> sp.	Bignoniaceae

***Euryglossina (Euryglossina) proctotrypoides* Cockerell**

## Native species and family

<i>Kunzea ericoides</i>	Myrtaceae
<i>Leptospermum scoparium</i>	

There are no records for introduced flowers.

***Nomia (Acunomia) melanderi melanderi* Cockerell**

There are no records for native flowers.

## Introduced species and family

<i>Crepis setosa</i>	Asteraceae
<i>Medicago sativa</i>	Fabaceae
<i>Taraxacum officinale</i>	Asteraceae
<i>Trifolium pratense</i>	Fabaceae
<i>Trifolium repens</i>	

***Lasioglossum (Austrevylaeus) mataroa* new species**

## Native species and family

<i>Bulbinella</i> sp.	Asphodelaceae
<i>Chionohebe pulvinaris</i>	Plantaginaceae
<i>Discaria toumatou</i>	Rhamnaceae
<i>Kunzea ericoides</i>	Myrtaceae
<i>Raoulia australis</i>	Asteraceae
<i>Raoulia parkii</i>	
<i>Raoulia</i> sp.	
<i>Taraxacum magellanicum</i>	
<i>Wahlenbergia</i> sp.	Campanulaceae

## Introduced species and family

<i>Achillea millefolium</i>	Asteraceae
<i>Capsella bursa-pastoris</i>	Brassicaceae
<i>Hypericum perforatum</i>	Hypericaceae
<i>Hypericum</i> sp.	
<i>Melilotus albus</i>	Fabaceae
<i>Melilotus</i> sp.	
<i>Potentilla</i> sp.	Rosaceae
<i>Ranunculus</i> sp.	Ranunculaceae

<i>Tagetes</i> sp.	Asteraceae
<i>Taraxacum</i> sp. 'thistle'	

***Lasioglossum (Austrevylaeus) maunga* new species**

## Native species and family

<i>Aciphylla horrida</i>	Apiaceae
<i>Aciphylla</i> sp.	'Apiaceae'
<i>Brachyglottis bellidioides</i>	Asteraceae
<i>Brachyscome sinclairii</i>	
<i>Celmisia discolor</i>	
<i>Celmisia gracilentia</i>	
<i>Celmisia spectabilis</i>	
<i>Celmisia</i> sp.	
<i>Celmisia verbascifolia</i>	
<i>Discaria toumatou</i>	Rhamnaceae
<i>Dracophyllum</i> sp.	Ericaceae
<i>Gaultheria crassa</i>	
<i>Gentiana bellidifolia</i>	Gentianaceae
<i>Gentiana corymbifera</i>	
<i>Gentiana townsonii</i>	
<i>Gingidia montana</i>	Apiaceae
<i>Hebe</i> sp.	Plantaginaceae
<i>Helichrysum bellidioides</i>	Asteraceae
<i>Hoheria populnea</i>	Malvaceae
<i>Kunzea ericoides</i>	Myrtaceae
<i>Leucogenes grandiceps</i>	Asteraceae
<i>Metrosideros</i> sp.	Myrtaceae
<i>Olearia avicenniifolia</i>	Asteraceae
<i>Olearia virgata</i>	
<i>Ourisia caespitosa</i>	Plantaginaceae
<i>Ourisia macrocarpa</i>	
<i>Ourisia macrocarpa</i> var. <i>calycina</i>	
<i>Parahebe linifolia</i>	
<i>Parahebe lyallii</i>	
<i>Pimelea prostrata</i>	Thymelaeaceae
<i>Pimelea traversii</i>	
<i>Ranunculus lyallii</i>	Ranunculaceae
<i>Wahlenbergia</i> sp.	Campanulaceae

## Introduced species and family

<i>Achillea millefolium</i>	Asteraceae
<i>Hieracium</i> sp.	
<i>Hypochoeris radicata</i>	
<i>Phlox</i> sp.	Polemoniaceae
<i>Ranunculus lappaceus</i>	Ranunculaceae
<i>Rosa rubiginosa</i>	Rosaceae
<i>Senecio jacobaea</i>	Asteraceae

***Lasioglossum (Austrevylaeus) sordidum* (Smith)**

## Native species and family

<i>Aciphylla aurea</i>	Apiaceae
<i>Aciphylla horrida</i>	
<i>Aciphylla subflabellata</i>	
<i>Aciphylla</i> sp.	
<i>Brachyglottis</i> sp.	Asteraceae
<i>Brachyscome sinclairii</i>	
<i>Bulbinella hookeri</i>	Asphodelaceae
<i>Bulbinella</i> sp.	
<i>Carmichaelia</i> sp.	Fabaceae
<i>Celmisia du-rietzii</i>	Asteraceae
<i>Celmisia gracilentia</i>	
<i>Celmisia</i> sp.	
<i>Chionohebe pulvinaris</i>	Plantaginaceae
<i>Clematis</i> sp.	Ranunculaceae
<i>Coprosma repens</i>	Rubiaceae
<i>Cordyline australis</i>	Laxmanniaceae
<i>Cordyline banksii</i>	
<i>Corokia cotoneaster</i>	Argophyllaceae
<i>Cotula</i> sp.	Asteraceae



<i>Discaria toumatou</i>	Rhamnaceae	<i>Allium cepa</i>	Alliaceae
<i>Gaultheria crassa</i>	Ericaceae	<i>Anethum graveolens</i>	Apiaceae
<i>Geniostoma</i> sp.	Loganiaceae	<i>Bellis perennis</i>	Asteraceae
<i>Gentiana corymbifera</i>	Gentianaceae	<i>Brassica napus</i>	Brassicaceae
<i>Gingidia montana</i>	Apiaceae	<i>Brassica napus</i> var.	
<i>Hebe brachysiphon</i>	Plantaginaceae	<i>napobrassica</i>	
<i>Hebe chathamica</i>		<i>Brassica oleracea</i>	
<i>Hebe elliptica</i>		<i>Brassica</i> sp.	
<i>Hebe odora</i>		<i>Calendula</i> sp.	Asteraceae
<i>Hebe pubescens</i>		<i>Callistemon</i> sp.	Myrtaceae
<i>Hebe salicifolia</i>		<i>Capsella bursa-pastoris</i>	Brassicaceae
<i>Hebe speciosa</i>		<i>Carthamnus tinctorius</i>	
<i>Hebe stricta</i>		<i>Castanea sativa</i>	Fagaceae
<i>Hebe subalpina</i>		<i>Ceanothus papillosus</i>	
<i>Hebe traversii</i>		var. <i>roweanus</i>	Rhamnaceae
<i>Hebe</i> sp.		<i>Ceanothus</i> sp.	
<i>Hoheria angustifolia</i>	Malvaceae	<i>Chrysanthemum</i>	
<i>Hoheria</i> sp.		<i>leucanthemum</i>	Asteraceae
<i>Kunzea ericoides</i>	Myrtaceae	<i>Cirsium arvense</i>	
<i>Kunzea</i> sp./		<i>Cirsium vulgare</i>	
<i>Leptospermum</i> sp.		<i>Cirsium</i> sp.	
<i>Leptospermum scoparium</i>		<i>Citrus</i> sp.	Rutaceae
<i>Lophomyrtus obcordata</i>	Myrtaceae	<i>Conium maculatum</i>	Apiaceae
<i>Lophomyrtus</i> sp.		<i>Coriandrum sativum</i>	
<i>Melicope simplex</i>	Rutaceae	<i>Crepis</i> sp.	Asteraceae
<i>Metrosideros excelsa</i>	Myrtaceae	<i>Cucurbita</i> sp.	Cucurbitaceae
<i>Muehlenbeckia</i> sp.	Polygonaceae	<i>Cytisus scoparius</i>	Fabaceae
<i>Mimulus repens</i>	Phrymaceae	<i>Cytisus</i> sp.	
<i>Mimulus</i> sp.		<i>Daucus carota</i>	Apiaceae
<i>Myoporum laetum</i>	Scrophulariaceae	<i>Daucus carota</i> / <i>Allium cepa</i>	Apiaceae/Alliaceae
<i>Myrsine australis</i>	Myrsinaceae	<i>Dianthus caryophyllus</i>	Caryophyllaceae
<i>Nothofagus</i> sp.	Nothofagaceae	<i>Digitalis purpurea</i>	Plantaginaceae
<i>Olearia virgata</i>	Asteraceae	<i>Echium vulgare</i>	Boraginaceae
<i>Olearia</i> sp.		<i>Eucalyptus regnans/piperita</i>	Myrtaceae
<i>Ozothamnus leptophyllus</i>	Asteraceae	<i>Foeniculum vulgare</i>	Apiaceae
<i>Ozothamnus</i> /	Asteraceae/	<i>Fragaria</i> sp.	Rosaceae
<i>Coprosma</i>	Rubiaceae	Fruit trees	-
<i>Pachystegia insignis</i>	Asteraceae	<i>Hieracium pilosella</i>	Asteraceae
<i>Pennantia corymbosa</i>	Pennantiaceae	<i>Hieracium</i> sp.	
<i>Peraxilla colensoi</i>	Loranthaceae	<i>Hypericum perforatum</i>	Hypericaceae
<i>Peraxilla tetrapetala</i>		<i>Hypericum</i> sp.	
<i>Phormium tenax</i>	Hemerocallidaceae	<i>Hypochoeris radicata</i>	Asteraceae
<i>Pimelea traversii</i>	Thymelaeaceae	<i>Hypochoeris</i> sp.	
<i>Pseudopanax crassifolium</i>	Araliaceae	<i>Kniphofia praecox</i>	Asphodelaceae
<i>Pseudowintera colorata</i>	Winteraceae	<i>Laburnum</i> sp.	Fabaceae
<i>Ranunculus godleyanus</i>	Ranunculaceae	<i>Linum usitatissimum</i>	Linaceae
<i>Ranunculus lappaceus</i>		<i>Malus sylvestris</i>	Rosaceae
<i>Ranunculus lyallii</i>		<i>Medicago sativa</i>	Fabaceae
<i>Raoulia australis</i>	Asteraceae	<i>Oenothera glazioviana</i>	Onagraceae
<i>Raoulia</i> sp.		<i>Pinus radiata</i>	Pinaceae
<i>Rubus schmidelioides</i>	Rosaceae	<i>Plantago</i> sp.	Plantaginaceae
<i>Samolus repens</i>	Theophrastaceae	<i>Populus alba</i>	Salicaceae
<i>Solanum laciniatum</i>	Solanaceae	<i>Potentilla anserina</i>	Rosaceae
<i>Sophora</i> sp.	Fabaceae	<i>Potentilla fruticosa</i>	
<i>Taraxacum magellanicum</i>	Asteraceae	<i>Potentilla</i> sp.	
<i>Tupeia antarctica</i>	Loranthaceae	<i>Prunus lusitanica</i>	
<i>Urtica ferox</i>	Urticaceae	<i>Prunus mahaleb</i>	
<i>Wahlenbergia albomarginata</i>	Campanulaceae	<i>Prunus persica</i>	
<i>Wahlenbergia pygmaea</i>		<i>Pyrus pyrifolia</i>	
<i>Wahlenbergia</i> sp.		<i>Raphanus sativus</i>	Brassicaceae
<i>Weinmannia</i> sp.	Cunoniaceae	<i>Rhododendron</i> sp.	Ericaceae
Introduced species and family		<i>Ribes nigrum</i>	Grossulariaceae
<i>Abutilon</i> sp.	Malvaceae	<i>Rosa rubiginosa</i>	Rosaceae
<i>Achillea millefolium</i>	Asteraceae	<i>Rubus</i> sp.	
<i>Achillea</i> sp.		<i>Salix triandra</i>	
<i>Actinidia deliciosa</i>	Actinidiaceae	cv <i>semperflorens</i>	Salicaceae
<i>Aesculus hippocastanum</i>	Sapindaceae	<i>Senecio jacobaea</i>	Asteraceae
<i>x carnea</i>		<i>Senecio</i> sp.	

<i>Solidago</i> sp.	
<i>Sorbus aucuparia</i>	Rosaceae
<i>Taraxacum officinale</i> 'thistle'	Asteraceae
<i>Trifolium repens</i>	Fabaceae
<i>Ulex europaeus</i>	
<i>Viburnum tomentosum</i>	Adoxaceae
<i>Viburnum</i> sp.	
<i>Vitis vinifera</i>	Vitaceae
'wild poppy'	Papaveraceae

**Lasioglossum (Chilalictus) cognatum (Smith)**

Native species and family

<i>Hebe</i> sp.	Plantaginaceae
<i>Kunzea ericoides</i>	Myrtaceae
<i>Leptospermum scoparium</i>	

Introduced species and family

<i>Actinidia deliciosa</i>	Actinidiaceae
<i>Allium cepa</i>	Alliaceae
<i>Brassica rapa chinensis</i>	Brassicaceae
<i>Daucus carota</i>	Apiaceae
<i>Taraxacum officinale</i>	Asteraceae
<i>Trifolium repens</i>	Fabaceae
'yellow composite'	Asteraceae

Native or introduced status uncertain.

<i>Lobelia</i> sp.	Lobeliaceae
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**Osmia (Helicosmia) coerulescens (Linnaeus)**

There are no records for native plants.

Introduced species and family

<i>Chamaecytisus palmensis</i>	Fabaceae
<i>Medicago arborea</i>	
<i>Medicago sativa</i>	
<i>Teline stenopetala</i>	
<i>Trifolium pratense</i>	
<i>Trifolium repens</i>	

**Anthidium (Anthidium) manicatum (Linnaeus)**

There are no records for native plants.

Introduced species and family

<i>Linaria purpurea</i>	Plantaginaceae
<i>Sempervivum</i> sp.	Crassulaceae

**Megachile (Eutricharaea) rotundata (Fabricius)**

Native species and family

<i>Carmichaelia</i> sp.	Fabaceae
<i>Hebe</i> sp.	Plantaginaceae

Introduced species and family

<i>Brassica</i> sp.	Brassicaceae
<i>Crepis</i> sp.	Asteraceae
<i>Hieracium</i> sp.	
<i>Lotus pedunculatus</i>	Fabaceae
<i>Medicago sativa</i>	
<i>Melilotus albus</i>	
<i>Sedum reflexum</i>	Crassulaceae
<i>Taraxacum officinale</i>	Asteraceae
<i>Trifolium pratense</i>	Fabaceae
<i>Trifolium repens</i>	

**Bombus (Bombus) terrestris (Linnaeus)**

Native species and family

<i>Alectryon excelsus</i>	Sapindaceae
<i>Arthropodium cirratum</i>	Asphodelaceae
<i>Bulbinella</i> sp.	
<i>Calystegia soldanella</i>	Convolvulaceae
<i>Carmichaelia</i>	Fabaceae
<i>Carpodetus serratus</i>	Rousseaceae
<i>Celmisia</i> sp.	Asteraceae

<i>Clematis afoliata</i>	Ranunculaceae
<i>Clematis paniculata</i>	
<i>Clianthus puniceus</i>	Fabaceae
<i>Cordyline australis</i>	Laxmanniaceae
<i>Coriaria arborea</i>	Coriariaceae
<i>Corokia cotoneaster</i>	Cornaceae
<i>Corynocarpus laevigatus</i>	Corynocarpaceae
<i>Discaria toumatou</i>	Rhamnaceae
<i>Euphrasia</i> sp.	Orobanchaceae
<i>Fuchsia excorticata</i>	Onagraceae
<i>Gaultheria rupestris</i>	Ericaceae
<i>Hebe elliptica</i>	Plantaginaceae

*Hebe loganioides* (?)

<i>Hebe salicifolia</i>	
<i>Helichrysum glomeratum</i>	Asteraceae
<i>Hoheria angustifolia</i>	Malvaceae

<i>Hoheria populnea</i>	
<i>Hoheria sexstylosa</i>	
<i>Kunzea ericoides</i>	Myrtaceae

*Leptospermum scoparium*

<i>Lophomyrtus obcordata</i>	
<i>Metrosideros excelsa</i>	
<i>Metrosideros perforata</i>	
<i>Metrosideros robusta</i>	
<i>Muehlenbeckia australis</i>	Polygonaceae
<i>Myoporum laetum</i>	Scrophulariaceae
<i>Myosotidium hortensia</i>	Boraginaceae
<i>Olearia</i> sp.	Asteraceae
<i>Parahebe hulkeana</i>	Plantaginaceae
<i>Parsonsia heterophylla</i>	Apocynaceae
<i>Pennantia corymbosa</i>	Pennantiaceae
<i>Phormium tenax</i>	Hemerocallidaceae
<i>Pittosporum crassifolium</i>	Pittosporaceae

*Pittosporum eugenioides*

<i>Pittosporum tenuifolium</i>	
<i>Rubus australis</i>	Rosaceae
<i>Solanum aviculare</i>	Solanaceae

<i>Solanum laciniatum</i>	
<i>Sophora microphylla</i>	Fabaceae
<i>Vitex lucens</i>	Verbenaceae

Records for over 500 species of introduced plants will be presented elsewhere by R. P. Macfarlane

**Bombus (Megabombus) hortorum (Linnaeus)**

Native species and family

<i>Fuchsia excorticata</i>	Onagraceae
<i>Hebe loganioides</i> (?)	Plantaginaceae
<i>Sophora microphylla</i>	Fabaceae

Introduced species and family

<i>Trifolium pratense</i>	Fabaceae
<i>Vicia faba</i>	

**Bombus (Megabombus) ruderatus (Fabricius)**

Native species and family

<i>Clianthus puniceus</i>	Fabaceae
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Introduced species and family

<i>Trifolium pratense</i>	Fabaceae.
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**Bombus (Subterraneobombus) subterraneus (Linnaeus)**

There are no records for native plants.

Introduced species and family

<i>Lupinus</i> spp.	Fabaceae
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**Apis mellifera Linnaeus**

Worker honey bees visit an extremely wide range of native and introduced plants, including some podocarps, grasses and corn.

**APPENDIX 5. Alphabetic list of species of bees associated with each species of plant.**

**Native plant species and family**

- Aciphylla aurea**                    **Apiaceae**  
*Lasioglossum (Austrevylaeus) sordidum* (Smith)
- Aciphylla horrida**                **Apiaceae**  
*Lasioglossum (Austrevylaeus) maunga* new species  
*L. (A.) sordidum* (Smith)
- Aciphylla subflabellata**        **Apiaceae**  
*Lasioglossum (Austrevylaeus) sordidum* (Smith)
- Aciphylla sp.**                    **Apiaceae**  
*Leioproctus (Nesocolletes) hudsoni* (Cockerell)  
*Lasioglossum (Austrevylaeus) sordidum* (Smith)
- Alectryon excelsus**                **Sapindaceae**  
*Bombus (Bombus) terrestris* (Linnaeus)
- Anaphalioides bellidioides**      **Asteraceae**  
*Lasioglossum (Austrevylaeus) maunga* new species
- Anisotome sp.**                    **Apiaceae**  
*Lasioglossum (Austrevylaeus) maunga* new species
- 'Apiaceae'**                        **Apiaceae**  
*Lasioglossum (Austrevylaeus) maunga* new species
- Arthropodium cirratum**          **Asphodelaceae**  
*Bombus (Bombus) terrestris* (Linnaeus)
- Brachyglottis bellidioides**      **Asteraceae**  
*Lasioglossum (Austrevylaeus) maunga* new species
- Brachyglottis bennettii**        **Asteraceae**  
*Leioproctus (Leioproctus) vestitus* (Smith)  
*L. (Nesocolletes) fulvescens* (Smith)
- Brachyglottis compactus**       **Asteraceae**  
*Leioproctus (Nesocolletes) fulvescens* (Smith)
- Brachyglottis laxifolius**       **Asteraceae**  
*Leioproctus (Nesocolletes)* (Smith)
- Brachyglottis sp.**                **Asteraceae**  
*Leioproctus (Nesocolletes) fulvescens* (Smith)  
*Hylaeus (Prosopistemon) agilis* (Smith)  
*Lasioglossum (Austrevylaeus) sordidum* (Smith)
- Brachyscome sinclairii**        **Asteraceae**  
*Lasioglossum (Austrevylaeus) maunga* new species  
*L. (A.) sordidum* (Smith)
- Bulbinella hookeri**               **Asphodelaceae**  
*Lasioglossum (Austrevylaeus) sordidum* (Smith)
- Bulbinella sp.**                    **Asphodelaceae**  
*Lasioglossum (Austrevylaeus) mataroa* new species  
*L. (A.) sordidum* (Smith)  
*Bombus (Bombus) terrestris* (Linnaeus)
- Calystegia soldanella**          **Convolvulaceae**  
*Bombus (Bombus) terrestris* (Linnaeus)
- Carmichaelia arborea**          **Fabaceae**  
*Leioproctus (Leioproctus) pango* new species  
*L. (L.) vestitus* (Smith)
- Carmichaelia australis?**        **Fabaceae**  
*Leioproctus (Leioproctus) pango* new species
- L. (L.) vestitus* (Smith)
- Carmichaelia carmichaeliae**    **Fabaceae**  
*Leioproctus (Leioproctus) pango* new species
- Carmichaelia crassicaulis**      **Fabaceae**  
*Leioproctus (Leioproctus) pango* new species  
*L. (L.) vestitus* (Smith)
- Carmichaelia kirkii**            **Fabaceae**  
*Leioproctus (Leioproctus) pango* new species
- Carmichaelia petriei**            **Fabaceae**  
*Leioproctus (Leioproctus) pango* new species  
*L. (L.) vestitus* (Smith)
- Carmichaelia stevensonii**      **Fabaceae**  
*Leioproctus (Leioproctus) huakiwi* new species
- Carmichaelia sp.**                **Fabaceae**  
*Leioproctus (Leioproctus) boltoni* Cockerell  
*L. (L.) pango* new species  
*L. (L.) purpureus* (Smith)  
*L. (L.) vestitus* (Smith)  
*Hylaeus (Prosopistemon) agilis* (Smith)  
*H. (P.) capitosus* (Smith)  
*H. (P.) relegatus* (Smith)  
*Lasioglossum (Austrevylaeus) sordidum* (Smith)  
*Megachile (Eutricharaea) rotundata* (Fabricius)  
*Bombus (Bombus) terrestris* (Linnaeus)
- Carpodetus serratus**            **Rousseaceae**  
*Leioproctus (Leioproctus) huakiwi* new species  
*L. (L.) pango* new species  
*L. (L.) purpureus* (Smith)  
*L. (L.) vestitus* (Smith)  
*Bombus (Bombus) terrestris* (Linnaeus)
- Celmisia coriacea**                **Asteraceae**  
*Leioproctus (Nesocolletes) fulvescens* (Smith)  
*L. (N.) pekanui* new species
- Celmisia discolor**               **Asteraceae**  
*Lasioglossum (Austrevylaeus) maunga* new species
- Celmisia du-rietzii**              **Asteraceae**  
*Lasioglossum (Austrevylaeus) sordidum* (Smith)
- Celmisia gracilentia**            **Asteraceae**  
*Leioproctus (Nesocolletes) hudsoni* (Cockerell)  
*Lasioglossum (Austrevylaeus) maunga* new species  
*L. (A.) sordidum* (Smith)
- Celmisia semicordata**          **Asteraceae**  
*Leioproctus (Leioproctus) pango* new species  
*L. (L.) vestitus* (Smith)
- Celmisia spectabilis**            **Asteraceae**  
*Leioproctus (Nesocolletes) fulvescens* (Smith)  
*L. (N.) pekanui* new species  
*Lasioglossum (Austrevylaeus) maunga* new species
- Celmisia verbascifolia**        **Asteraceae**  
*Lasioglossum (Austrevylaeus) maunga* new species
- Celmisia sp.**                    **Asteraceae**  
*Leioproctus (Nesocolletes) fulvescens* (Smith)  
*L. (N.) pekanui* new species  
*Lasioglossum (Austrevylaeus) maunga* new species

- L. (A.) sordidum* (Smith)  
*Bombus (Bombus) terrestris* (Linnaeus)
- Chionohebe pulvinaris** Plantaginaceae  
*Lasioglossum (Austrevylaeus) mataroa* new species  
*L. (A.) sordidum* (Smith)
- Clematis afoliata** Ranunculaceae  
*Bombus (Bombus) terrestris* (Linnaeus)
- Clematis paniculata** Ranunculaceae  
*Bombus (Bombus) terrestris* (Linnaeus)
- Clematis parviflora** Ranunculaceae  
*Leioproctus (Leioproctus) huakiwi* new species
- Clematis sp.** Ranunculaceae  
*Lasioglossum (Austrevylaeus) sordidum* (Smith)
- Clanthus puniceus** Fabaceae  
*Bombus (Bombus) terrestris* (Linnaeus)  
*B. (Megabombus) ruderatus* (Fabricius)
- Colobanthus sp.** Caryophyllaceae  
*Leioproctus (Leioproctus) vestitus* (Smith)
- Coprosma lucida** Rubiaceae  
*Leioproctus (Leioproctus) pango* new species
- Coprosma repens** Rubiaceae  
*Lasioglossum (Austrevylaeus) sordidum* (Smith)
- Cordyline australis** Laxmanniaceae  
*Leioproctus (Leioproctus) boltoni* Cockerell  
*L. (L.) huakiwi* new species  
*L. (L.) imitatus* Smith  
*L. (L.) pango* new species  
*L. (L.) purpureus* (Smith)  
*L. (L.) vestitus* (Smith)  
*Hylaeus (Prosopisteron) relegatus* (Smith)  
*Lasioglossum (Austrevylaeus) sordidum* (Smith)  
*Bombus (Bombus) terrestris* (Linnaeus)
- Cordyline banksii** Laxmanniaceae  
*Lasioglossum (Austrevylaeus) sordidum* (Smith)
- Coriaria arborea** Coriariaceae  
*Bombus (Bombus) terrestris* (Linnaeus)
- Corokia cotoneaster** Argophyllaceae  
*Lasioglossum (Austrevylaeus) sordidum* (Smith)  
*Bombus (Bombus) terrestris* (Linnaeus)
- Corynocarpus laevigatus** Corynocarpaceae  
*Bombus (Bombus) terrestris* (Linnaeus)
- Cotula coronopifolia** Asteraceae  
*Leioproctus (Nesocolletes) fulvescens* (Smith)
- Cotula sp.** Asteraceae  
*Leioproctus (Nesocolletes) fulvescens* (Smith)  
*Hylaeus (Prosopisteron) relegatus* (Smith)  
*Lasioglossum (Austrevylaeus) sordidum* (Smith)
- Craspedia uniflora** Asteraceae  
*Leioproctus (Nesocolletes) fulvescens* (Smith)  
*L. (N.) pekanui* new species
- Discaria toumatou** Rhamnaceae  
*Lasioglossum (Austrevylaeus) mataroa* new species  
*L. (A.) maunga* new species  
*L. (A.) sordidum* (Smith)  
*Bombus (Bombus) terrestris* (Linnaeus)
- Disphyma sp.** Aizoaceae  
*Hylaeus (Prosopisteron) asperithorax* (Raymont)
- Dracophyllum filifolium** Ericaceae  
*Leioproctus (Leioproctus) imitatus* Smith
- Dracophyllum sp.** Ericaceae  
*Lasioglossum (Austrevylaeus) maunga* new species
- Epilobium sp.** Onagraceae  
*Leioproctus (Nesocolletes) pekanui* new species  
*Hylaeus (Prosopisteron) matamoko* new species
- Euphrasia revoluta** Orobanchaceae  
*Leioproctus (Nesocolletes) pekanui* new species
- Euphrasia sp.** Orobanchaceae  
*Leioproctus (N.) fulvescens* (Smith)  
*Bombus (Bombus) terrestris* (Linnaeus)
- Fuchsia excorticata** Onagraceae  
*Bombus (Bombus) terrestris* (Linnaeus)  
*B. (Megabombus) hortorum* (Linnaeus)
- Gaultheria crassa** Ericaceae  
*Lasioglossum (Austrevylaeus) maunga* new species  
*L. (A.) sordidum* (Smith)
- Gaultheria rupestris** Ericaceae  
*Bombus (Bombus) terrestris* (Linnaeus)
- Geniostoma sp.** Loganiaceae  
*Lasioglossum (Austrevylaeus) sordidum* (Smith)
- Gentiana bellidifolia** Gentianaceae  
*Leioproctus (Nesocolletes) fulvescens* (Smith)  
*Lasioglossum (Austrevylaeus) maunga* new species
- Gentiana corymbifera** Gentianaceae  
*Leioproctus (Nesocolletes) pekanui* new species  
*Lasioglossum (Austrevylaeus) maunga* new species  
*L. (A.) sordidum* (Smith)
- Gentiana sp.** Gentianaceae  
*Leioproctus (Nesocolletes) fulvescens* (Smith)  
*L. (N.) hudsoni* (Cockerell)  
*L. (N.) pekanui* new species
- Gentianella montana** Gentianaceae  
*Leioproctus (Nesocolletes) monticola* (Cockerell)
- Gentianella patula** Gentianaceae  
*Hylaeus (Prosopisteron) capitosus* (Smith)
- Gentianella stolonifera** Gentianaceae  
*Lasioglossum (Austrevylaeus) maunga* new species
- Geum uniflorum** Rosaceae  
*Leioproctus (Nesocolletes) pekanui* new species
- Gingidia montana** Apiaceae  
*Lasioglossum (Austrevylaeus) maunga* new species  
*L. (A.) sordidum* (Smith)
- Hebe bollonsii** Plantaginaceae  
*Hylaeus (Prosopisteron) capitosus* (Smith)
- Hebe brachysiphon** Plantaginaceae  
*Leioproctus (Leioproctus) pango* new species  
*L. (L.) waipounamu* new species  
*L. (Nesocolletes) hudsoni* (Cockerell)  
*L. (N.) monticola* (Cockerell)  
*Hylaeus (Prosopisteron) capitosus* (Smith)  
*Lasioglossum (Austrevylaeus) sordidum* (Smith)

- Hebe chathamica** Plantaginaceae  
*Leioproctus (Nesocolletes) monticola* (Cockerell)  
*Hylaeus (Prosopisteron) relegatus* (Smith)  
*Lasioglossum (Austrevylaeus) sordidum* (Smith)
- Hebe divaricata** Plantaginaceae  
*Hylaeus (Prosopisteron) capitosus* (Smith)
- Hebe elliptica** Plantaginaceae  
*Leioproctus (Leioproctus) pango* new species  
*L. (Nesocolletes) monticola* (Cockerell)  
*Hylaeus (Prosopisteron) capitosus* (Smith)  
*H. (P.) relegatus* (Smith)  
*Lasioglossum (Austrevylaeus) sordidum* (Smith)  
*Bombus (Bombus) terrestris* (Linnaeus)
- Hebe epacridea** Plantaginaceae  
*Leioproctus (Nesocolletes) pekanui* new species
- Hebe loganioides** Plantaginaceae  
*Bombus (Bombus) terrestris* (Linnaeus)  
*B. (Megabombus) hortorum* (Linnaeus)
- Hebe lyallii** Plantaginaceae  
*Leioproctus (Leioproctus) huakiwi* new species  
*Lasioglossum (Austrevylaeus) maunga* new species
- Hebe macrantha** Plantaginaceae  
*Leioproctus (Nesocolletes) monticola* (Cockerell)  
*L. (N.) pekanui* new species  
*Hylaeus (Prosopisteron) relegatus* (Smith)
- Hebe macrocarpa** Plantaginaceae  
*Leioproctus (Leioproctus) huakiwi* new species
- Hebe odora** Plantaginaceae  
*Leioproctus (Leioproctus) waipounamu* new species  
*L. (Nesocolletes) hudsoni* (Cockerell)  
*L. (N.) monticola* (Cockerell)  
*Hylaeus (Prosopisteron) relegatus* (Smith)  
*Lasioglossum (Austrevylaeus) sordidum* (Smith)
- Hebe ?odora** Plantaginaceae  
*Leioproctus (Nesocolletes) pekanui* new species
- Hebe pubescens** Plantaginaceae  
*Lasioglossum (Austrevylaeus) sordidum* (Smith)
- Hebe salicifolia** Plantaginaceae  
*Leioproctus (Leioproctus) huakiwi* new species  
*L. (L.) pango* new species  
*L. (L.) waipounamu* new species  
*L. (Nesocolletes) hudsoni* (Cockerell)  
*L. (N.) monticola* (Cockerell)  
*L. (N.) paahaumaa* new species  
*L. (N.) pekanui* new species  
*Hylaeus (Prosopisteron) agilis* (Smith)  
*H. (P.) capitosus* (Smith)  
*H. (P.) relegatus* (Smith)  
*Lasioglossum (Austrevylaeus) sordidum* (Smith)  
*Bombus (Bombus) terrestris* (Linnaeus)
- Hebe speciosa** Plantaginaceae  
*Leioproctus (Leioproctus) huakiwi* new species  
*L. (Nesocolletes) monticola* (Cockerell)  
*Hylaeus (Prosopisteron) capitosus* (Smith)  
*Lasioglossum (Austrevylaeus) sordidum* (Smith)
- Hebe stricta** Plantaginaceae  
*Leioproctus (Leioproctus) huakiwi* new species  
*L. (L.) pango* new species  
*L. (L.) vestitus* (Smith)  
*L. (L.) waipounamu* new species  
*L. (Nesocolletes) monticola* (Cockerell)  
*L. (N.) paahaumaa* new species  
*Hylaeus (Prosopisteron) relegatus* (Smith)  
*Lasioglossum (Austrevylaeus) sordidum* (Smith)
- Hebe subalpina** Plantaginaceae  
*Leioproctus (Leioproctus) pango* new species  
*L. (L.) vestitus* (Smith)  
*L. (L.) waipounamu* new species  
*L. (Nesocolletes) fulvescens* (Smith)  
*L. (N.) hudsoni* (Cockerell)  
*L. (N.) monticola* (Cockerell)  
*L. (N.) pekanui* new species  
*Hylaeus (Prosopisteron) relegatus* (Smith)  
*Lasioglossum (Austrevylaeus) sordidum* (Smith)
- Hebe traversii** Plantaginaceae  
*Leioproctus (Leioproctus) boltoni* Cockerell  
*L. (L.) waipounamu* new species  
*Hylaeus (Prosopisteron) capitosus* (Smith)  
*H. (P.) relegatus* (Smith)  
*Lasioglossum (Austrevylaeus) sordidum* (Smith)
- Hebe sp.** Plantaginaceae  
*Leioproctus (Leioproctus) boltoni* Cockerell  
*L. (L.) huakiwi* new species  
*L. (L.) imitatus* Smith  
*L. (L.) pango* new species  
*L. (L.) vestitus* (Smith)  
*L. (L.) waipounamu* new species  
*L. (Nesocolletes) monticola* (Cockerell)  
*L. (N.) paahaumaa* new species  
*L. (N.) pekanui* new species  
*Hylaeus (Prosopisteron) agilis* (Smith)  
*H. (P.) asperithorax* (Rayment)  
*H. (P.) capitosus* (Smith)  
*H. (P.) matamoko* new species  
*Lasioglossum (Austrevylaeus) maunga* new species  
*L. (A.) sordidum* (Smith)  
*L. (Chilalictus) cognatum* (Smith)  
*Megachile (Eutricharaea) rotundata* (Fabricius)
- Helichrysum lanceolatum** Asteraceae  
*Bombus (Bombus) terrestris* (Linnaeus)
- Hoheria angustifolia** Malvaceae  
*Leioproctus (Leioproctus) huakiwi* new species  
*L. (L.) waipounamu* new species  
*Lasioglossum (Austrevylaeus) sordidum* (Smith)  
*Bombus (Bombus) terrestris* (Linnaeus)
- Hoheria glabrata** Malvaceae  
*Leioproctus (Leioproctus) huakiwi* new species
- Hoheria populnea** Malvaceae  
*Lasioglossum (Austrevylaeus) maunga* new species  
*Bombus (Bombus) terrestris* (Linnaeus)
- Hoheria sexstylosa** Malvaceae  
*Bombus (Bombus) terrestris* (Linnaeus)

- Hoheria sp. Malvaceae**  
*Leioproctus (Nesocolletes) fulvescens* (Smith)  
*Lasioglossum (Austrevylaeus) sordidum* (Smith)
- Kunzea ericoides Myrtaceae**  
*Leioproctus (Leioproctus) boltoni* Cockerell  
*L. (L.) huakiwi* new species  
*L. (L.) imitatus* Smith  
*L. (L.) kanapuu* new species  
*L. (L.) metallicus* (Smith)  
*L. (L.) pango* new species  
*L. (L.) waipounamu* new species  
*L. (Nesocolletes) fulvescens* (Smith)  
*L. (N.) nunui* new species  
*Hylaeus (Prosopistemon) capitosus* (Smith)  
*H. (P.) relegatus* (Smith)  
*Euryglossina (Euryglossina) proctotrypoides* Cockerell  
*Lasioglossum (Austrevylaeus) matoroa* new species  
*L. (A.) maunga* new species  
*L. (A.) sordidum* (Smith)  
*L. (Chilalictus) cognatum* (Smith)  
*Bombus (Bombus) terrestris* (Linnaeus)
- Kunzea/Leptospermum Myrtaceae**  
*Leioproctus (Leioproctus) boltoni* Cockerell  
*L. (L.) imitatus* Smith  
*L. (L.) kanapuu* new species  
*Lasioglossum (Austrevylaeus) sordidum* (Smith)
- Leptospermum scoparium Myrtaceae**  
*Leioproctus (Leioproctus) boltoni* Cockerell  
*L. (L.) huakiwi* new species  
*L. (L.) imitatus* Smith  
*L. (L.) kanapuu* new species  
*L. (L.) metallicus* (Smith)  
*L. (L.) pango* new species  
*L. (L.) waipounamu* new species  
*L. (Nesocolletes) hudsoni* (Cockerell)  
*L. (N.) monticola* (Cockerell)  
*L. (N.) paahaumaa* new species  
*L. (N.) pekanui* new species  
*Hylaeus (Prosopistemon) agilis* (Smith)  
*H. (P.) capitosus* (Smith)  
*H. (P.) relegatus* (Smith)  
*Euryglossina (Euryglossina) proctotrypoides* Cockerell  
*Lasioglossum (Austrevylaeus) sordidum* (Smith)  
*Lasioglossum (Chilalictus) cognatum* (Smith)  
*Bombus (Bombus) terrestris* (Linnaeus)
- Leptospermum scoparium/ Myrtaceae/ Carmichaelia sp. Fabaceae**  
*Leioproctus (Leioproctus) pango* new species
- Leucogenes grandiceps Asteraceae**  
*Leioproctus (Nesocolletes) pekanui* new species  
*Lasioglossum (Austrevylaeus) maunga* new species
- Lophomyrtus bullata Myrtaceae**  
*Leioproctus (Leioproctus) huakiwi* new species
- Lophomyrtus obcordata Myrtaceae**  
*Leioproctus (Leioproctus) boltoni* Cockerell  
*L. (L.) huakiwi* new species  
*L. (L.) imitatus* Smith  
*Lasioglossum (Austrevylaeus) sordidum* (Smith)  
*Bombus (Bombus) terrestris* (Linnaeus)
- Lophomyrtus sp. Myrtaceae**  
*Leioproctus (Nesocolletes) paahaumaa* new species  
*Leioproctus (Leioproctus) pango* new species  
*Lasioglossum (Austrevylaeus) sordidum* (Smith)
- Melicope simplex Rutaceae**  
*Lasioglossum (Austrevylaeus) sordidum* (Smith)
- Metrosideros excelsa Myrtaceae**  
*Leioproctus (Leioproctus) boltoni* Cockerell  
*L. (L.) huakiwi* new species  
*L. (L.) imitatus* Smith  
*L. (L.) kanapuu* new species  
*L. (L.) pango* new species  
*L. (L.) purpureus* (Smith)  
*Hylaeus (Prosopistemon) agilis* (Smith)  
*H. (P.) capitosus* (Smith)  
*H. (P.) relegatus* (Smith)  
*Lasioglossum (Austrevylaeus) sordidum* (Smith)  
*Bombus (Bombus) terrestris* (Linnaeus)
- Metrosideros perforata Myrtaceae**  
*Leioproctus (Leioproctus) huakiwi* new species  
*Bombus (Bombus) terrestris* (Linnaeus)
- Metrosideros robusta Myrtaceae**  
*Hylaeus (Prosopistemon) agilis* (Smith)  
*H. (P.) capitosus* (Smith)  
*Bombus (Bombus) terrestris* (Linnaeus)
- Metrosideros sp. rata Myrtaceae**  
*Leioproctus (Leioproctus) boltoni* Cockerell  
*L. (L.) pango* new species
- Metrosideros sp. Myrtaceae**  
*Hylaeus (Prosopistemon) agilis* (Smith)  
*H. (P.) capitosus* (Smith)  
*Lasioglossum (Austrevylaeus) maunga* new species
- Mimulus repens Phrymaceae**  
*Leioproctus (Leioproctus) keehua* new species  
*L. (L.) waipounamu* new species  
*Lasioglossum (Austrevylaeus) sordidum* (Smith)
- Mimulus sp. Phrymaceae**  
*Leioproctus (Leioproctus) vestitus* (Smith)  
*L. (Nesocolletes) fulvescens* (Smith)  
*Hylaeus (Prosopistemon) asperithorax* (Rayment)  
*Lasioglossum (Austrevylaeus) sordidum* (Smith)
- Muehlenbeckia australis Polygonaceae**  
*Leioproctus (Leioproctus) imitatus* Smith  
*Bombus (Bombus) terrestris* (Linnaeus)
- Muehlenbeckia complexa Polygonaceae**  
*Leioproctus (Leioproctus) boltoni* Cockerell  
*L. (L.) imitatus* Smith  
*L. (L.) pango* new species
- Muehlenbeckia sp. Polygonaceae**  
*Hylaeus (Prosopistemon) capitosus* (Smith)  
*Lasioglossum (Austrevylaeus) sordidum* (Smith)
- Muehlenbeckia sp./ Coprosma sp. Rubiaceae**  
*Leioproctus (Nesocolletes) maritimus* (Cockerell)
- Myoporum laetum Scrophulariaceae**  
*Lasioglossum (Austrevylaeus) sordidum* (Smith)  
*Bombus (Bombus) terrestris* (Linnaeus)

- Myosotidium hortensia** Boraginaceae  
*Bombus (Bombus) terrestris* (Linnaeus)
- Myosotis** sp. Boraginaceae  
*Hylaeus (Prosopistemon) matamoko* new species
- Myrsine australis** Myrsinaceae  
*Lasioglossum (Austrevylaeus) sordidum* (Smith)
- Nothofagus** sp. Nothofagaceae  
*Lasioglossum (Austrevylaeus) sordidum* (Smith)
- Nothofagus?** sp. Nothofagaceae  
*Hylaeus (Prosopistemon) relegatus* (Smith)
- Olearia angustifolia** Asteraceae  
*Hylaeus (Prosopistemon) agilis* (Smith)
- Olearia avicenniifolia** Asteraceae  
*Lasioglossum (Austrevylaeus) maunga* new species
- Olearia lacunosa** Asteraceae  
*Hylaeus (Prosopistemon) capitosus* (Smith)
- Olearia moschata** Asteraceae  
*Leioproctus (Nesocolletes) fulvescens* (Smith)  
*L. (N.) hudsoni* (Cockerell)
- Olearia nummularifolia** var. **cymbifolia** Asteraceae  
*Leioproctus (Nesocolletes) fulvescens* (Smith)  
*L. (N.) hudsoni* (Cockerell)
- Olearia virgata** Asteraceae  
*Leioproctus (Leioproctus) waipounamu* new species  
*L. (Nesocolletes) hudsoni* (Cockerell)  
*Hylaeus (Prosopistemon) capitosus* (Smith)  
*Lasioglossum (Austrevylaeus) maunga* new species  
*L. (A.) sordidum* (Smith)
- Olearia** sp. Asteraceae  
*Lasioglossum (Austrevylaeus) sordidum* (Smith)  
*Bombus (Bombus) terrestris* (Linnaeus)
- Ourisia caespitosa** Plantaginaceae  
*Lasioglossum (Austrevylaeus) maunga* new species
- Ourisia macrocarpa** Plantaginaceae  
*Lasioglossum (Austrevylaeus) maunga* new species
- Ourisia m.** var. **calycina** Plantaginaceae  
*Lasioglossum (Austrevylaeus) maunga* new species
- Ozothamnus leptophyllus** Asteraceae  
*Leioproctus (Leioproctus) pango* new species  
*L. (L.) waipounamu* new species  
*L. (Nesocolletes) fulvescens* (Smith)  
*L. (N.) hudsoni* (Cockerell)  
*L. (N.) maritimus* (Cockerell)  
*L. (N.) monticola* (Cockerell)  
*L. (N.) nunui* new species  
*L. (N.) pekanui* new species  
*Lasioglossum (Austrevylaeus) sordidum* (Smith)  
*Hylaeus (Prosopistemon) capitosus* (Smith)  
*H. (P.) relegatus* (Smith)
- Ozothamnus/** Asteraceae/  
**Coprosma** Rubiaceae  
*Lasioglossum (Austrevylaeus) sordidum* (Smith)
- Pachystegia insignis** Asteraceae  
*Leioproctus (Nesocolletes) fulvescens* (Smith)  
*Lasioglossum (Austrevylaeus) sordidum* (Smith)
- Parahebe decora** Plantaginaceae  
*Leioproctus (Nesocolletes) pekanui* new species
- Parahebe hulkeana** Plantaginaceae  
*Bombus (Bombus) terrestris* (Linnaeus)
- Parahebe linifolia** Plantaginaceae  
*Leioproctus (Nesocolletes) pekanui* new species  
*Lasioglossum (Austrevylaeus) maunga* new species
- Parsonsia heterophylla** Apocynaceae  
*Bombus (Bombus) terrestris* (Linnaeus)
- Pennantia corymbosa** Pennantiaceae  
*Hylaeus (Prosopistemon) agilis* (Smith)  
*Lasioglossum (Austrevylaeus) sordidum* (Smith)  
*Bombus (Bombus) terrestris* (Linnaeus)
- Pennantia** sp. Pennantiaceae  
*Leioproctus (Leioproctus) pango* new species
- Peraxilla colensoi** Loranthaceae  
*Hylaeus (Prosopistemon) agilis* (Smith)  
*Lasioglossum (Austrevylaeus) sordidum* (Smith)
- Peraxilla tetrapetala** Loranthaceae  
*Leioproctus (Leioproctus) pango* new species  
*Hylaeus (Prosopistemon) agilis* (Smith)  
*Lasioglossum (Austrevylaeus) sordidum* (Smith)
- Phormium tenax** Hemerocallidaceae  
*Leioproctus (Leioproctus) boltoni* Cockerell  
*L. (L.) imitatus* Smith  
*L. (L.) pango* new species  
*L. (L.) purpureus* (Smith)  
*L. (L.) waipounamu* new species  
*Hylaeus (Prosopistemon) agilis* (Smith)  
*H. (P.) capitosus* (Smith)  
*H. (P.) relegatus* (Smith)  
*Lasioglossum (Austrevylaeus) sordidum* (Smith)  
*Bombus (Bombus) terrestris* (Linnaeus)
- Pimelea prostrata** Thymelaeaceae  
*Lasioglossum (Austrevylaeus) maunga* new species
- Pimelea traversii** Thymelaeaceae  
*Leioproctus (Leioproctus) boltoni* Cockerell  
*L. (Nesocolletes) hudsoni* (Cockerell)  
*L. (N.) monticola* (Cockerell)  
*Lasioglossum (Austrevylaeus) maunga* new species  
*L. (A.) sordidum* (Smith)
- Pittosporum crassifolium** Pittosporaceae  
*Bombus (Bombus) terrestris* (Linnaeus)
- Pittosporum eugenoides** Pittosporaceae  
*Bombus (Bombus) terrestris* (Linnaeus)
- Pittosporum tenuifolium** Pittosporaceae  
*Bombus (Bombus) terrestris* (Linnaeus)
- Pseudopanax crassifolius** Araliaceae  
*Lasioglossum (Austrevylaeus) sordidum* (Smith)
- Pseudopanax** sp. Araliaceae  
*Hylaeus (Prosopistemon) agilis* (Smith)
- Pseudopanax** sp./  
**Carmichaelia** sp. Fabaceae  
*Leioproctus (Leioproctus) pango* new species

- Pseudowintera colorata** Winteraceae  
*Lasioglossum (Austrevylaeus) sordidum* (Smith)
- Ranunculus godleyanus** Ranunculaceae  
*Lasioglossum (Austrevylaeus) sordidum* (Smith)
- Ranunculus lyallii** Ranunculaceae  
*Lasioglossum (Austrevylaeus) maunga* new species  
*L. (A.) sordidum* (Smith)
- Ranunculus multiscapus** Ranunculaceae  
*Lasioglossum (Austrevylaeus) sordidum* (Smith)
- Raoulia australis** Asteraceae  
*Leioproctus (Nesocolletes) fulvescens* (Smith)  
*L. (N.) maritimus* (Cockerell)  
*Hylaeus (Prosopistemon) relegatus* (Smith)  
*Lasioglossum (Austrevylaeus) mataroa* new species  
*L. (A.) sordidum* (Smith)
- Raoulia eximia** Asteraceae  
*Leioproctus (Nesocolletes) pekanui* new species
- Raoulia haastii** Asteraceae  
*Leioproctus (Nesocolletes) fulvescens* (Smith)  
*L. (N.) hudsoni* (Cockerell)
- Raoulia hookeri** Asteraceae  
*Leioproctus (Nesocolletes) maritimus* (Cockerell)
- Raoulia parkii** Asteraceae  
*Leioproctus (Nesocolletes) maritimus* Cockerell  
*Lasioglossum (Austrevylaeus) mataroa* new species
- Raoulia subsericea** Asteraceae  
*Leioproctus (Nesocolletes) fulvescens* (Smith)  
*L. (N.) hudsoni* (Cockerell)  
*L. (N.) maritimus* (Cockerell)  
*L. (N.) pekanui* new species
- Raoulia youngii** Asteraceae  
*Leioproctus (Nesocolletes) maritimus* (Cockerell)
- Raoulia sp.** Asteraceae  
*Leioproctus (Leioproctus) vestitus* (Smith)  
*L. (Nesocolletes) hudsoni* (Cockerell)  
*L. (N.) maritimus* (Cockerell)  
*Lasioglossum (Austrevylaeus) mataroa* new species  
*L. (A.) sordidum* (Smith)
- Rubus australis** Rosaceae  
*Bombus (Bombus) terrestris* (Linnaeus)
- Rubus schmidelioides** Rosaceae  
*Lasioglossum (Austrevylaeus) sordidum* (Smith)
- Samolus repens** Theophrastaceae  
*Lasioglossum (Austrevylaeus) sordidum* (Smith)
- Scaevola gracilis** Goodeniaceae  
*Hylaeus (Prosopistemon) kermadecensis* new species
- Selliera radicans** Goodeniaceae  
*Leioproctus (Leioproctus) keehua* new species  
*L. (L.) vestitus* (Smith)  
*Hylaeus (Prosopistemon) asperithorax* (Rayment)
- Solanum aviculare** Solanaceae  
*Bombus (Bombus) terrestris* (Linnaeus)
- Solanum laciniatum** Solanaceae  
*Lasioglossum (Austrevylaeus) sordidum* (Smith)
- Bombus (Bombus) terrestris* (Linnaeus)
- Sophora microphylla** Fabaceae  
*Bombus (Bombus) terrestris* (Linnaeus)  
*B. (Megabombus) hortorum* (Linnaeus)
- Sophora sp.** Fabaceae  
*Lasioglossum (Austrevylaeus) sordidum* (Smith)
- Taraxacum magellanicum** Asteraceae  
*Lasioglossum (Austrevylaeus) mataroa* new species  
*L. (A.) sordidum* (Smith)
- Tupeia antarctica** Loranthaceae  
*Lasioglossum (Austrevylaeus) sordidum* (Smith)
- Urtica ferox** Urticaceae  
*Lasioglossum (Austrevylaeus) sordidum* (Smith)
- Vitex lucens** Lamiaceae  
*Bombus (Bombus) terrestris* (Linnaeus)
- Wahlenbergia albomarginata** Campanulaceae  
*Lasioglossum (Austrevylaeus) sordidum* (Smith)
- Wahlenbergia pygmaea** Campanulaceae  
*Leioproctus (Leioproctus) boltoni* Cockerell  
*L. (Nesocolletes) paahaumaa* new species  
*Hylaeus (Prosopistemon) asperithorax* (Rayment)  
*Lasioglossum (Austrevylaeus) sordidum* (Smith)
- Wahlenbergia sp.** Campanulaceae  
*Leioproctus (Nesocolletes) fulvescens* (Smith)  
*L. (N.) hudsoni* (Cockerell)  
*L. (N.) pekanui* new species  
*Lasioglossum (Austrevylaeus) mataroa* new species  
*L. (A.) maunga* new species  
*L. (A.) sordidum* (Smith)
- Weinmannia sp.** Cunoniaceae  
*Lasioglossum (Austrevylaeus) sordidum* (Smith)

### Introduced plant species and family

- Abutilon sp.** Malvaceae  
*Hylaeus (Prosopistemon) relegatus* (Smith)  
*Lasioglossum (Austrevylaeus) sordidum* (Smith)
- Achillea millefolium** Asteraceae  
*Leioproctus (Leioproctus) metallicus* (Smith)  
*L. (L.) pango* new species  
*L. (L.) vestitus* (Smith)  
*L. (Nesocolletes) fulvescens* (Smith)  
*L. (N.) hudsoni* new species  
*L. (N.) maritimus* (Cockerell)  
*L. (N.) paahaumaa* new species  
*L. (N.) pekanui* new species  
*Hylaeus (Prosopistemon) capitatus* (Smith)  
*Lasioglossum (Austrevylaeus) mataroa* new species  
*L. (A.) maunga* new species  
*L. (A.) sordidum* (Smith)
- Achillea sp.** Asteraceae  
*Lasioglossum (Austrevylaeus) sordidum* (Smith)
- Acmena smithii** Myrtaceae  
*Hyleoides concinna* (Fabricius)



- Actinidia deliciosa** Actinidiaceae  
*Leioproctus (Leioproctus) boltoni* Cockerell  
*L. (L.) huakiwi* new species  
*L. (L.) imitatus* Smith  
*L. (L.) kanapuu* new species  
*L. (L.) pango* new species  
*L. (L.) purpureus* (Smith)  
*L. (L.) vestitus* (Smith)  
*L. (Nesocolletes) paahaumaa* new species  
*Hylaeus (Prosopisteron) agilis* (Smith)  
*H. (P.) capitosus* (Smith)  
*H. (P.) relegatus* (Smith)  
*Lasioglossum (Austrevylaeus) sordidum* (Smith)  
*L. (Chilalictus) cognatum* (Smith)
- Aesculus hippocastanum** Sapindaceae  
 x *carnea*  
*Lasioglossum (Austrevylaeus) sordidum* (Smith)
- Ageratum houstonianum** Asteraceae  
*Hylaeus (Prosopisteron) kermadecensis* new species
- Allium cepa** Alliaceae  
*Lasioglossum (Austrevylaeus) sordidum* (Smith)  
*L. (Chilalictus) cognatum* (Smith)
- Allium sp.** Alliaceae  
*Hylaeus (Prosopisteron) relegatus* (Smith)
- Anethum graveolens** Apiaceae  
*Leioproctus (Leioproctus) vestitus* (Smith)  
*Lasioglossum (Austrevylaeus) sordidum* (Smith)
- Argyranthemum fruticans** Asteraceae  
*Leioproctus (Leioproctus) boltoni* Cockerell
- Banksia sp.** Proteaceae  
*Hylaeus (Prosopisteron) perhumilis* (Cockerell)
- Bellis perennis** Asteraceae  
*Lasioglossum (Austrevylaeus) sordidum* (Smith)
- Brassica napus** var. *napobrassica* Brassicaceae  
*Lasioglossum (Austrevylaeus) sordidum* (Smith)
- Brassica napus** Brassicaceae  
*Lasioglossum (Austrevylaeus) sordidum* (Smith)
- Brassica rapa chinensis** Brassicaceae  
*Lasioglossum (Chilalictus) cognatum* (Smith)
- Brassica oleracea** Brassicaceae  
*Lasioglossum (Austrevylaeus) sordidum* (Smith)
- Brassica sp.** Brassicaceae  
*Lasioglossum (Austrevylaeus) sordidum* (Smith)  
*Megachile (Eutricharaea) rotundata* (Fabricius)
- Calendula officinalis** Asteraceae  
*Leioproctus (Nesocolletes) fulvescens* (Smith)  
*L. (Nesocolletes) paahaumaa* new species
- Calendula sp.** Asteraceae  
*Lasioglossum (Austrevylaeus) sordidum* (Smith)
- Callistemon sp.** Myrtaceae  
*Hylaeus (Prosopisteron) agilis* (Smith)  
*Hyleoides concinna* (Fabricius)  
*Lasioglossum (Austrevylaeus) sordidum* (Smith)
- Calluna vulgaris** Ericaceae  
*Leioproctus (Leioproctus) boltoni* Cockerell  
*L. (L.) pango* new species
- Campsis sp.** Bignoniaceae  
*Hyleoides concinna* (Fabricius)
- Capsella bursa-pastoris** Brassicaceae  
*Lasioglossum (Austrevylaeus) mataroa* new species  
*L. (A.) sordidum* (Smith)
- Carduus nutans** Asteraceae  
*Leioproctus (Leioproctus) imitatus* Smith
- Carthamnus lanatus** Asteraceae  
*Leioproctus (Nesocolletes) fulvescens* (Smith)
- Carthamnus tinctorius** Asteraceae  
*Lasioglossum (Austrevylaeus) sordidum* (Smith)
- Castanea sativa** Fagaceae  
*Leioproctus (Leioproctus) boltoni* Cockerell  
*L. (L.) huakiwi* new species  
*L. (L.) imitatus* Smith  
*L. (L.) kanapuu* new species  
*Hylaeus (Prosopisteron) agilis* (Smith)  
*H. (P.) relegatus* (Smith)  
*Lasioglossum (Austrevylaeus) sordidum* (Smith)
- Ceanothus papillosus** var. *roweanus* Rhamnaceae  
*Leioproctus (Leioproctus) boltoni* Cockerell  
*Lasioglossum (Austrevylaeus) sordidum* (Smith)
- Ceanothus sp.** Rhamnaceae  
*Lasioglossum (Austrevylaeus) sordidum* (Smith)
- Centaurium erythraea** Gentianaceae  
*Leioproctus (Leioproctus) keehua* new species
- Cerastium sp.** Caryophyllaceae  
*Leioproctus (Leioproctus) pango* new species  
*Hylaeus (Prosopisteron) capitosus* (Smith)
- Chamaecytisus palmensis** Fabaceae  
*Osmia (Helicosmia) coerulescens* (Linnaeus)
- Chrysanthemum leucanthemum** Asteraceae  
*Leioproctus (Nesocolletes) pekanui* new species  
*Lasioglossum (Austrevylaeus) sordidum* (Smith)
- Cichorium intybus** Asteraceae  
*Leioproctus (Nesocolletes) fulvescens* (Smith)
- Cirsium arvense** Asteraceae  
*Leioproctus (Nesocolletes) fulvescens* (Smith)  
*Hylaeus (Prosopisteron) capitosus* (Smith)  
*Lasioglossum (Austrevylaeus) sordidum* (Smith)
- Cirsium lanceolatum** Asteraceae  
*Leioproctus (Leioproctus) pango* new species
- Cirsium vulgare** Asteraceae  
*Leioproctus (Nesocolletes) fulvescens* (Smith)  
*Lasioglossum (Austrevylaeus) sordidum* (Smith)
- Cirsium sp.** Asteraceae  
*Lasioglossum (Austrevylaeus) sordidum* (Smith)
- Citrus sp.** Rutaceae  
*Hyleoides concinna* (Fabricius)  
*Lasioglossum (Austrevylaeus) sordidum* (Smith)

- 'citrus'** **Rutaceae**  
*Leioproctus (Leioproctus) boltoni* Cockerell  
*L. (L.) imitatus* Smith
- 'composite'** **Asteraceae**  
*Leioproctus (Leioproctus) boltoni* Cockerell  
*L. (L.) huakiwi* new species  
*L. (Nesocolletes) fulvescens* (Smith)
- Conium maculatum*** **Apiaceae**  
*Leioproctus (Nesocolletes) fulvescens* (Smith)  
*Hylaeus (Prosopisteron) relegatus* (Smith)  
*Lasioglossum (Austrevylaeus) sordidum* (Smith)
- Coriandrum sativum*** **Apiaceae**  
*Lasioglossum (Austrevylaeus) sordidum* (Smith)
- Crepis capillaris*** **Asteraceae**  
*Leioproctus (Nesocolletes) paahaumaa* new species
- Crepis setosa*** **Asteraceae**  
*Nomia (Acunomia) melanderi melanderi* Cockerell
- Crepis* sp.** **Asteraceae**  
*Lasioglossum (Austrevylaeus) sordidum* (Smith)  
*Megachile (Eutricharaea) rotundata* (Fabricius)
- Cucurbita maxima*** **Cucurbitaceae**  
*Leioproctus (Nesocolletes) paahaumaa* new species
- Cucurbita* sp.** **Cucurbitaceae**  
*Lasioglossum (Austrevylaeus) sordidum* (Smith)
- Cytisus scoparius*** **Fabaceae**  
*Hylaeus (Prosopisteron) agilis* (Smith)  
*Lasioglossum (Austrevylaeus) sordidum* (Smith)
- Cytisus* sp.** **Fabaceae**  
*Leioproctus (Nesocolletes) monticola* (Cockerell)  
*Hylaeus (Prosopisteron) relegatus* (Smith)  
*Lasioglossum (Austrevylaeus) sordidum* (Smith)
- Daucus carota*** **Apiaceae**  
*Leioproctus (Leioproctus) boltoni* Cockerell  
*L. (L.) huakiwi* new species  
*L. (L.) kanapuu* new species  
*L. (L.) vestitus* (Smith)  
*L. (Nesocolletes) fulvescens* (Smith)  
*Hylaeus (Prosopisteron) capitatus* (Smith)  
*H. (P.) relegatus* (Smith)  
*Lasioglossum (Austrevylaeus) sordidum* (Smith)  
*L. (Chilalictus) cognatum* (Smith)
- Daucus carota*, wild** **Apiaceae**  
*Leioproctus (Leioproctus) imitatus* Smith
- Daucus carota*/** **Apiaceae/**  
***Allium cepa*** **Alliaceae**  
*Lasioglossum (Austrevylaeus) sordidum* (Smith)
- Deutzia gracilis*** **Philadelphaceae**  
*Leioproctus (Leioproctus) boltoni* Cockerell  
*L. (L.) pango* new species
- Dianthus caryophyllus*** **Caryophyllaceae**  
*Leioproctus (Leioproctus) pango* new species
- Lasioglossum (Austrevylaeus) sordidum* (Smith)
- Digitalis purpurea*** **Plantaginaceae**  
*Leioproctus (Leioproctus) boltoni* Cockerell  
*Lasioglossum (Austrevylaeus) sordidum* (Smith)
- Digitalis purpurea* (bunched on)** **Plantaginaceae**  
*Leioproctus (Leioproctus) imitatus* Smith
- Diosma* sp.** **Rutaceae**  
*Leioproctus (Leioproctus) boltoni* Cockerell
- Echium vulgare*** **Boraginaceae**  
*Leioproctus (Leioproctus) boltoni* Cockerell  
*L. (L.) kanapuu* new species  
*L. (Nesocolletes) pekanui* new species  
*Hylaeus (Prosopisteron) capitatus* (Smith)  
*Lasioglossum (Austrevylaeus) sordidum* (Smith)
- Eschscholzia californica*** **Papaveraceae**  
*Leioproctus (Nesocolletes) fulvescens* (Smith)
- Eucalyptus longifolia*** **Myrtaceae**  
*Hyleoides concinna* (Fabricius)
- Eucalyptus polyanthemos*** **Myrtaceae**  
*Leioproctus (Leioproctus) huakiwi* new species
- Eucalyptus regnans/piperita*** **Myrtaceae**  
*Hylaeus (Prosopisteron) perhumilis* (Cockerell)  
*Lasioglossum (Austrevylaeus) sordidum* (Smith)
- Eucalyptus* sp.** **Myrtaceae**  
*Hylaeus (Prosopisteron) agilis* (Smith)  
*Hyleoides concinna* (Fabricius)
- Filipendula palmata*** **Rosaceae**  
*Hylaeus (Prosopisteron) agilis* (Smith)
- Foeniculum vulgare*** **Apiaceae**  
*Lasioglossum (Austrevylaeus) sordidum* (Smith)
- Fragaria* sp.** **Rosaceae**  
*Lasioglossum (Austrevylaeus) sordidum* (Smith)
- Fruit trees** -  
*Lasioglossum (Austrevylaeus) sordidum* (Smith)
- Hibiscus trionum*** **Malvaceae**  
*Hylaeus (Prosopisteron) asperithorax* (Rayment)
- Hieracium pilosella*** **Asteraceae**  
*Leioproctus (Leioproctus) pango* new species  
*L. (Nesocolletes) fulvescens* (Smith)  
*Lasioglossum (Austrevylaeus) sordidum* (Smith)
- Hieracium praealtum*** **Asteraceae**  
*Leioproctus (Leioproctus) pango* new species  
*L. (Nesocolletes) fulvescens* (Smith)  
*L. (N.) pekanui* new species
- Hieracium* sp.** **Asteraceae**  
*Leioproctus (Nesocolletes) fulvescens* (Smith)  
*Lasioglossum (Austrevylaeus) maunga* new species  
*L. (A.) sordidum* (Smith)  
*Megachile (Eutricharaea) rotundata* (Fabricius)
- Hypericum perforatum*** **Hypericaceae**  
*Leioproctus (Nesocolletes) fulvescens* (Smith)  
*L. (N.) hudsoni* (Cockerell)

- Lasioglossum (Austrevylaeus) mataroa* new species  
*L. (A.) sordidum* (Smith)
- Hypericum sp. Hypericaceae**  
*Leioproctus (Nesocolletes) pekanui* new species  
*Hylaeus (Prosopisteron) capitosus* (Smith)  
*Lasioglossum (Austrevylaeus) mataroa* new species  
*L. (A.) sordidum* (Smith)
- Hypochoeris radicata Asteraceae**  
*Leioproctus (Nesocolletes) fulvescens* (Smith)  
*L. (N.) hudsoni* (Cockerell)  
*L. (N.) paahaumaa* new species  
*Lasioglossum (Austrevylaeus) maunga* new species  
*L. (A.) sordidum* (Smith)
- Hypochoeris sp. Asteraceae**  
*Lasioglossum (Austrevylaeus) sordidum* (Smith)
- Indigofera potaninii Fabaceae**  
*Hylaeus (Prosopisteron) relegatus* (Smith)
- Kniphofia praecox Asphodelaceae**  
*Leioproctus (Leioproctus) huakiwi* new species  
*L. (Nesocolletes) paahaumaa* new species  
*Hylaeus (Prosopisteron) agilis* (Smith)  
*H. (P.) relegatus* (Smith)  
*Lasioglossum (Austrevylaeus) sordidum* (Smith)
- Kolkwitzia sp. Caprifoliaceae**  
*Leioproctus (Leioproctus) boltoni* Cockerell  
*L. (L.) imitatus* Smith
- Laburnum sp. Fabaceae**  
*Lasioglossum (Austrevylaeus) sordidum* (Smith)
- Leucospermum bolusii Proteaceae**  
*Hyleoides concinna* (Fabricius)
- Leucospermum sp. Proteaceae**  
*Leioproctus (Leioproctus) boltoni* Cockerell
- Ligustrum sp. Oleaceae**  
*Leioproctus (Leioproctus) imitatus* Smith
- Lilium sp. Liliaceae**  
*Leioproctus (Nesocolletes) fulvescens* (Smith)
- Linaria purpurea Plantaginaceae**  
*Hylaeus (Prosopisteron) capitosus* (Smith)  
*Anthidium (Anthidium) manicatum* (Linnaeus)
- Linum catharticum/ Linaceae/**  
**Trifolium repens Fabaceae**  
*Leioproctus (Leioproctus) vestitus* (Smith)
- Linum usitatissimum Linaceae**  
*Lasioglossum (Austrevylaeus) sordidum* (Smith)
- Lobelia sp. Campanulaceae**  
*Hylaeus (Prosopisteron) asperithorax* (Rayment)
- Lotus pedunculatus Fabaceae**  
*Megachile (Eutricharaea) rotundata* (Fabricius)
- Lupinus polyphyllus Fabaceae**  
*Hylaeus (Prosopisteron) capitosus* (Smith)
- Lupinus spp. Fabaceae**  
*Bombus (Subterraneobombus) subterraneus* (Linnaeus)
- Lupinus sp. Fabaceae**  
*Leioproctus (Leioproctus) imitatus* Smith  
*Hylaeus (Prosopisteron) capitosus* (Smith)
- Lycium ferocissimum Solanaceae**  
*Hyleoides concinna* (Fabricius)
- Malus sylvestris Rosaceae**  
*Lasioglossum (Austrevylaeus) sordidum* (Smith)
- Malva neglecta Malvaceae**  
*Leioproctus (Nesocolletes) fulvescens* (Smith)
- Medicago arborea Fabaceae**  
*Osmia (Helicosmia) coeruleascens* (Linnaeus)
- Medicago sativa Fabaceae**  
*Leioproctus (Leioproctus) pango* new species  
*L. (L.) vestitus* (Smith)  
*L. (Nesocolletes) fulvescens* (Smith)  
*Hylaeus (Prosopisteron) capitosus* (Smith)  
*Nomia (Acunomia) melanderi melanderi* Cockerell  
*Lasioglossum (Austrevylaeus) sordidum* (Smith)  
*Osmia (Helicosmia) coeruleascens* (Linnaeus)  
*Megachile (Eutricharaea) rotundata* (Fabricius)
- Medicago sativa/ Fabaceae/**  
**Linum catharticum Linaceae**  
*Leioproctus (Nesocolletes) monticola* (Cockerell)
- Melilotus albus Fabaceae**  
*Leioproctus (Nesocolletes) fulvescens* (Smith)  
*Lasioglossum (Austrevylaeus) mataroa* new species  
*Megachile (Eutricharaea) rotundata* (Fabricius)
- Melilotus sp. Fabaceae**  
*Leioproctus (Leioproctus) vestitus* (Smith)  
*Lasioglossum (Austrevylaeus) mataroa* new species
- 'mustard' Brassicaceae**  
*Hylaeus (Prosopisteron) capitosus* (Smith)
- Myrtus communis Myrtaceae**  
*Leioproctus (Leioproctus) imitatus* Smith
- Nerium oleander Apocynaceae**  
*Hyleoides concinna* (Fabricius)
- Nymphaea sp. Nymphaeaceae**  
*Leioproctus (Nesocolletes) paahaumaa* new species
- Oenothera glazioviana Onagraceae**  
*Lasioglossum (Austrevylaeus) sordidum* (Smith)
- Pastinaca sativa Apiaceae**  
*Leioproctus (Leioproctus) vestitus* (Smith)  
*Hylaeus (Prosopisteron) capitosus* (Smith)
- Persea americana Lauraceae**  
*Leioproctus (Leioproctus) huakiwi* new species  
*L. (L.) imitatus* Smith  
*L. (L.) pango* new species
- Phlox sp. Polemoniaceae**  
*Lasioglossum (Austrevylaeus) maunga* new species
- Pinus radiata Pinaceae**  
*Lasioglossum (Austrevylaeus) sordidum* (Smith)
- Plantago sp. Plantaginaceae**  
*Lasioglossum (Austrevylaeus) sordidum* (Smith)

- Populus alba** Salicaceae  
*Lasioglossum (Austrevylaeus) sordidum* (Smith)
- Potentilla anserina** Rosaceae  
*Lasioglossum (Austrevylaeus) sordidum* (Smith)
- Potentilla fructicosa** Rosaceae  
*Lasioglossum (Austrevylaeus) sordidum* (Smith)
- Potentilla recta** Rosaceae  
*Hylaeus (Prosopisteron) capitosus* (Smith)
- Potentilla sp.** Rosaceae  
*Leioproctus (Nesocolletes) fulvescens* (Smith)  
*L. (N.) pekanui* new species  
*Lasioglossum (Austrevylaeus) mataroa* new species  
*L. (A.) sordidum* (Smith)
- Prunus lusitanica** Rosaceae  
*Lasioglossum (Austrevylaeus) sordidum* (Smith)
- Prunus mahaleb** Rosaceae  
*Lasioglossum (Austrevylaeus) sordidum* (Smith)
- Prunus persica** Rosaceae  
*Lasioglossum (Austrevylaeus) sordidum* (Smith)
- Pyrus pyrifolia** Rosaceae  
*Lasioglossum (Austrevylaeus) sordidum* (Smith)
- Ranunculus laplaceus** Ranunculaceae  
*Lasioglossum (Austrevylaeus) maunga* new species
- Ranunculus sp.** Ranunculaceae  
*Hylaeus (Prosopisteron) capitosus* (Smith)  
*Lasioglossum (Austrevylaeus) mataroa* new species
- Raphanus sativus** Brassicaceae  
*Lasioglossum (Austrevylaeus) sordidum* (Smith)
- Rhododendron sp.** Ericaceae  
*Lasioglossum (Austrevylaeus) sordidum* (Smith)
- Ribes nigrum** Grossulariaceae  
*Lasioglossum (Austrevylaeus) sordidum* (Smith)
- Rosa rubiginosa** Rosaceae  
*Hylaeus (Prosopisteron) capitosus* (Smith)  
*Lasioglossum (Austrevylaeus) maunga* new species  
*L. (A.) sordidum* (Smith)
- Rosa sp.** Rosaceae  
*Leioproctus (Nesocolletes) paahaumaa* new species  
*Hylaeus (Prosopisteron) capitosus* (Smith)
- 'rose'** Rosaceae  
*Leioproctus (Nesocolletes) fulvescens* (Smith)
- Rubus idaeus** Rosaceae  
*Hylaeus (Prosopisteron) relegatus* (Smith)
- Rubus sp.** Rosaceae  
*Leioproctus (Nesocolletes) monticola* (Cockerell)  
*Hylaeus (Prosopisteron) relegatus* (Smith)  
*Lasioglossum (Austrevylaeus) sordidum* (Smith)
- Rumex acetosella** Polygonaceae  
*Leioproctus (Nesocolletes) maritimus* (Cockerell)
- Salix triandra** cv *semperflorens* Salicaceae  
*Lasioglossum (Austrevylaeus) sordidum* (Smith)
- Saponaria officinalis** Caryophyllaceae  
*Hyleoides concinna* (Fabricius)
- Sedum reflexum** Crassulaceae  
*Megachile (Eutricharaea) rotundata* (Fabricius)
- Sempervivum sp.** Crassulaceae  
*Anthidium (Anthidium) manicatum* (Linnaeus)
- Senecio jacobaea** Asteraceae  
*Leioproctus (Nesocolletes) monticola* (Cockerell)  
*L. (N.) paahaumaa* new species  
*Lasioglossum (Austrevylaeus) maunga* new species  
*L. (A.) sordidum* (Smith)
- Senecio sp.** Asteraceae  
*Lasioglossum (Austrevylaeus) sordidum* (Smith)
- Senecio lautus/ Sonchus oleraceus** Asteraceae  
*Leioproctus (Nesocolletes) paahaumaa* new species
- Solidago sp.** Asteraceae  
*Lasioglossum (Austrevylaeus) sordidum* (Smith)
- Sorbus aucuparia** Rosaceae  
*Lasioglossum (Austrevylaeus) sordidum* (Smith)
- Tagetes sp.** Asteraceae  
*Lasioglossum (Austrevylaeus) mataroa* new species
- Tanacetum parthenium** Asteraceae  
*Hyleoides concinna* (Fabricius)
- Tanacetum vulgare** Asteraceae  
*Leioproctus (Nesocolletes) fulvescens* (Smith)
- Taraxacum officinale** Asteraceae  
*Leioproctus (Leioproctus) boltoni* Cockerell  
*L. (L.) imitatus* Smith  
*L. (Nesocolletes) fulvescens* (Smith)  
*L. (N.) hudsoni* (Cockerell)  
*L. (N.) maritimus* (Cockerell)  
*L. (N.) paahaumaa* new species  
*L. (N.) pekanui* new species  
*Hylaeus (Prosopisteron) asperithorax* (Rayment)  
*H. (P.) capitosus* (Smith)  
*Nomia (Acunomia) melanderi melanderi* Cockerell  
*Lasioglossum (Austrevylaeus) sordidum* (Smith)  
*L. (Chilalictus) cognatum* (Smith)  
*Megachile (Eutricharaea) rotundata* (Fabricius)
- Taraxacum sp.** Asteraceae  
*Lasioglossum (Austrevylaeus) mataroa* new species
- Tecoma sp.** Bignoniaceae  
*Hyleoides concinna* (Fabricius)
- Teline stenopetala** Fabaceae  
*Osmia (Helicosmia) coeruleascens* (Linnaeus)
- 'thistle'** Asteraceae  
*Leioproctus (Leioproctus) boltoni* Cockerell  
*Leioproctus (Nesocolletes) fulvescens* (Smith)  
*Hylaeus (Prosopisteron) capitosus* (Smith)  
*Lasioglossum (Austrevylaeus) mataroa* new species  
*L. (A.) sordidum* (Smith)
- Thymus vulgaris** Lamiaceae  
*Leioproctus (Leioproctus) boltoni* Cockerell
- Tilia sp.** Malvaceae  
*Leioproctus (Leioproctus) huakiwi* new species

- Trifolium fragiferum***      **Fabaceae**  
*Leioproctus (Leioproctus) keehua* new species  
*L. (L.) vestitus* (Smith)
- Trifolium hybridum***      **Fabaceae**  
*Leioproctus (Leioproctus) vestitus* (Smith)
- Trifolium pratense***      **Fabaceae**  
*Nomia (Acunomia) melanderi melanderi* Cockerell  
*Osmia (Helicosmia) coerulescens* (Linnaeus)  
*Megachile (Eutricharaea) rotundata* (Fabricius)  
*Bombus (Megabombus) hortorum* (Linnaeus)  
*B. (M.) ruderatus* (Fabricius)
- Trifolium repens***      **Fabaceae**  
*Leioproctus (Leioproctus) pango* new species  
*L. (L.) vestitus* (Smith)  
*L. (Nesocolletes) fulvescens* (Smith)  
*Hylaeus (Prosopistemon) capitosus* (Smith)  
*Nomia (Acunomia) melanderi melanderi* Cockerell  
*Lasioglossum (Austrevylaeus) sordidum* (Smith)  
*L. (Chilalictus) cognatum* (Smith)  
*Osmia (Helicosmia) coerulescens* (Linnaeus)  
*Megachile (Eutricharaea) rotundata* (Fabricius)
- Trifolium subterraneum***  
*Leioproctus (Leioproctus) vestitus* (Smith)
- Ulex europaeus***      **Fabaceae**  
*Lasioglossum (Austrevylaeus) sordidum* (Smith)
- Verbascum thapsus***      **Scrophulariaceae**  
*Hylaeus (Prosopistemon) agilis* (Smith)
- Viburnum plicatum* var. *tomentosum***      **Adoxaceae**  
*Lasioglossum (Austrevylaeus) sordidum* (Smith)
- Viburnum* sp.**      **Adoxaceae**  
*Lasioglossum (Austrevylaeus) sordidum* (Smith)
- Vitis vinifera***      **Vitaceae**  
*Lasioglossum (Austrevylaeus) sordidum* (Smith)
- Vicia faba***      **Fabaceae**  
*Bombus (Megabombus) hortorum* (Linnaeus)
- 'wild poppy'**      **Papaveraceae**  
*Lasioglossum (Austrevylaeus) sordidum* (Smith)
- 'yellow composite'**      **Asteraceae**  
*Lasioglossum (Chilalictus) cognatum* (Smith)
- 'yellow poppy'**      **Papaveraceae**  
*Leioproctus (Nesocolletes) fulvescens* (Smith)
- Native or introduced status uncertain**
- Lobelia* sp.**      **Campanulaceae**  
*Lasioglossum (Chilalictus) cognatum* (Smith)

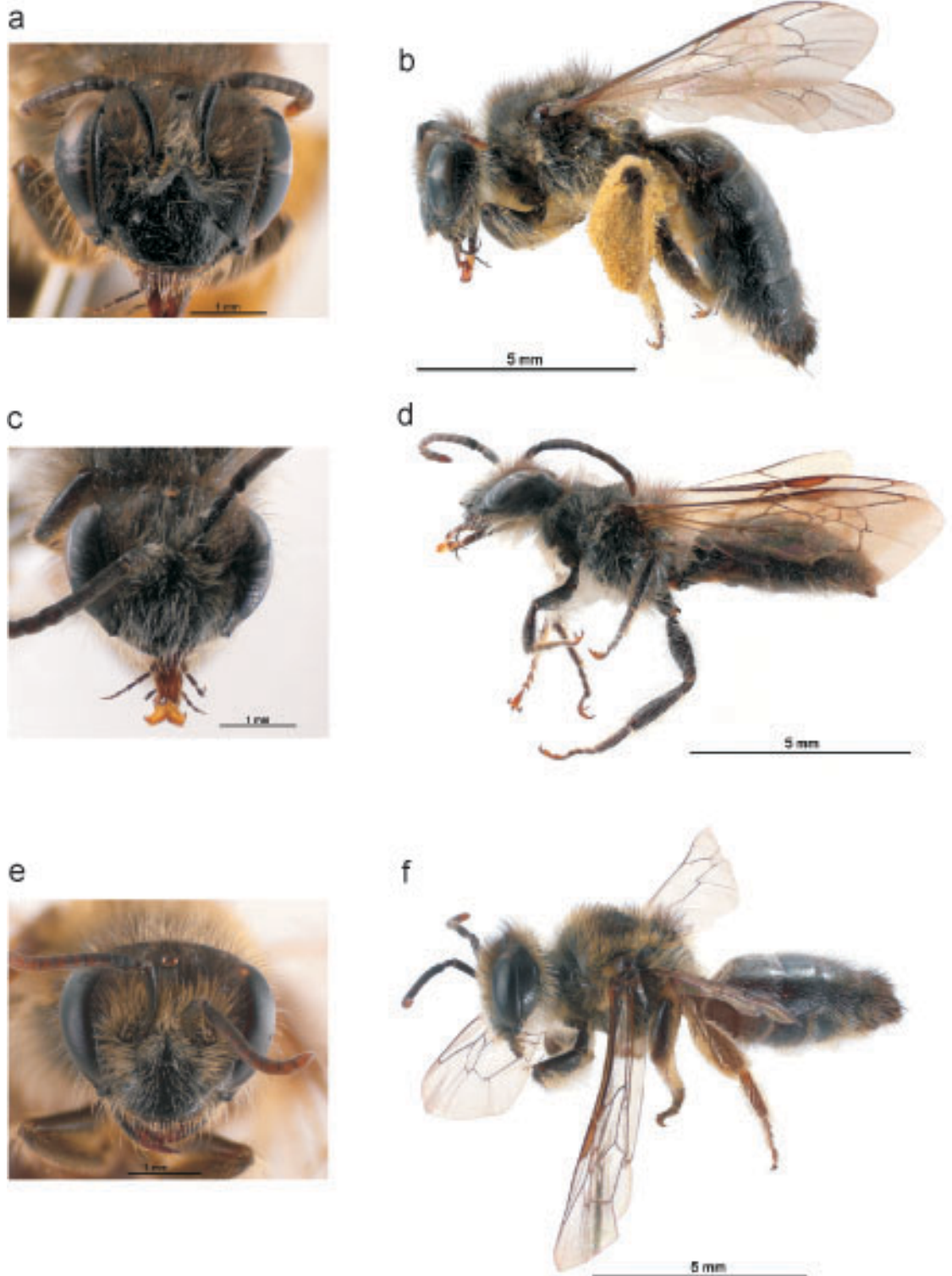
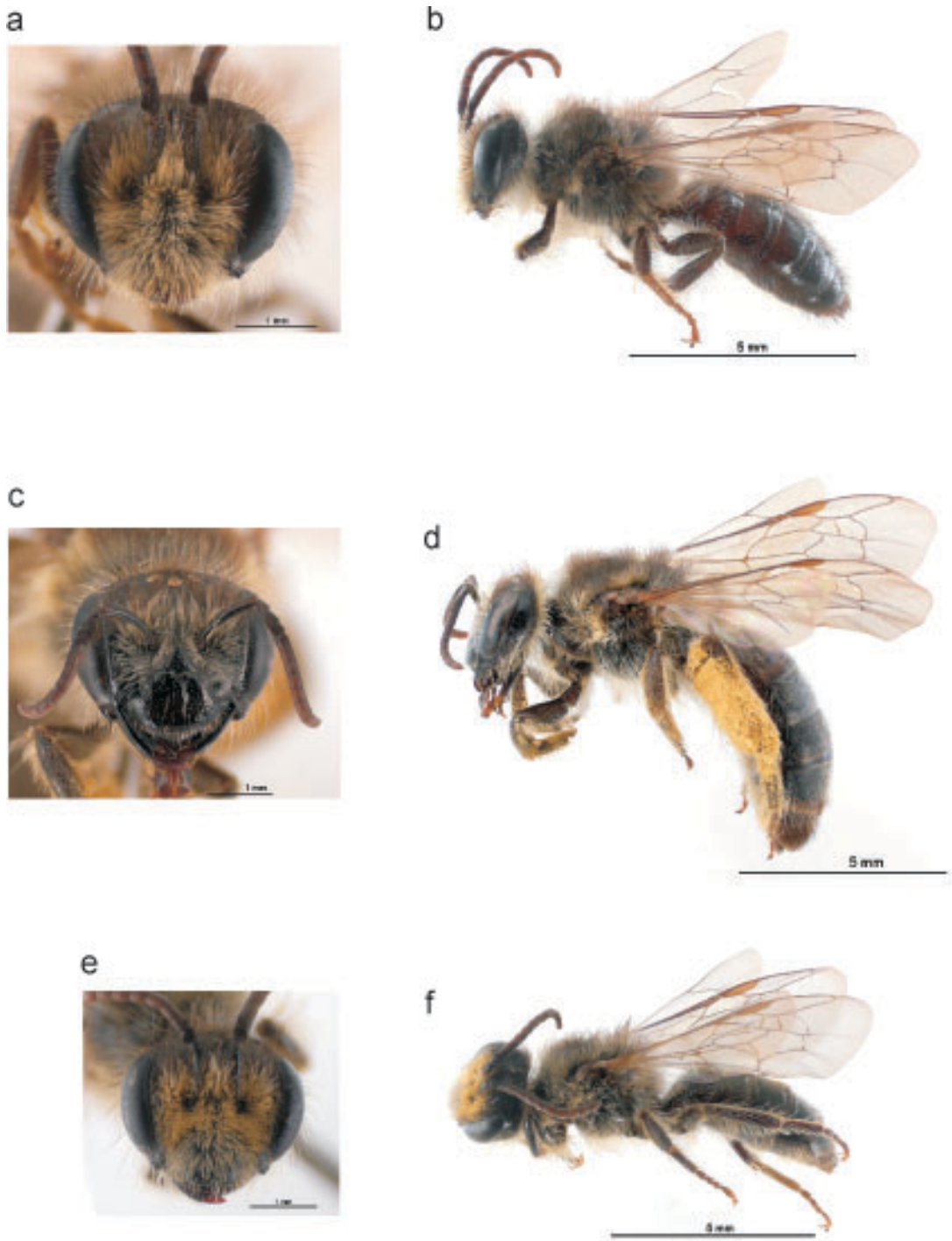
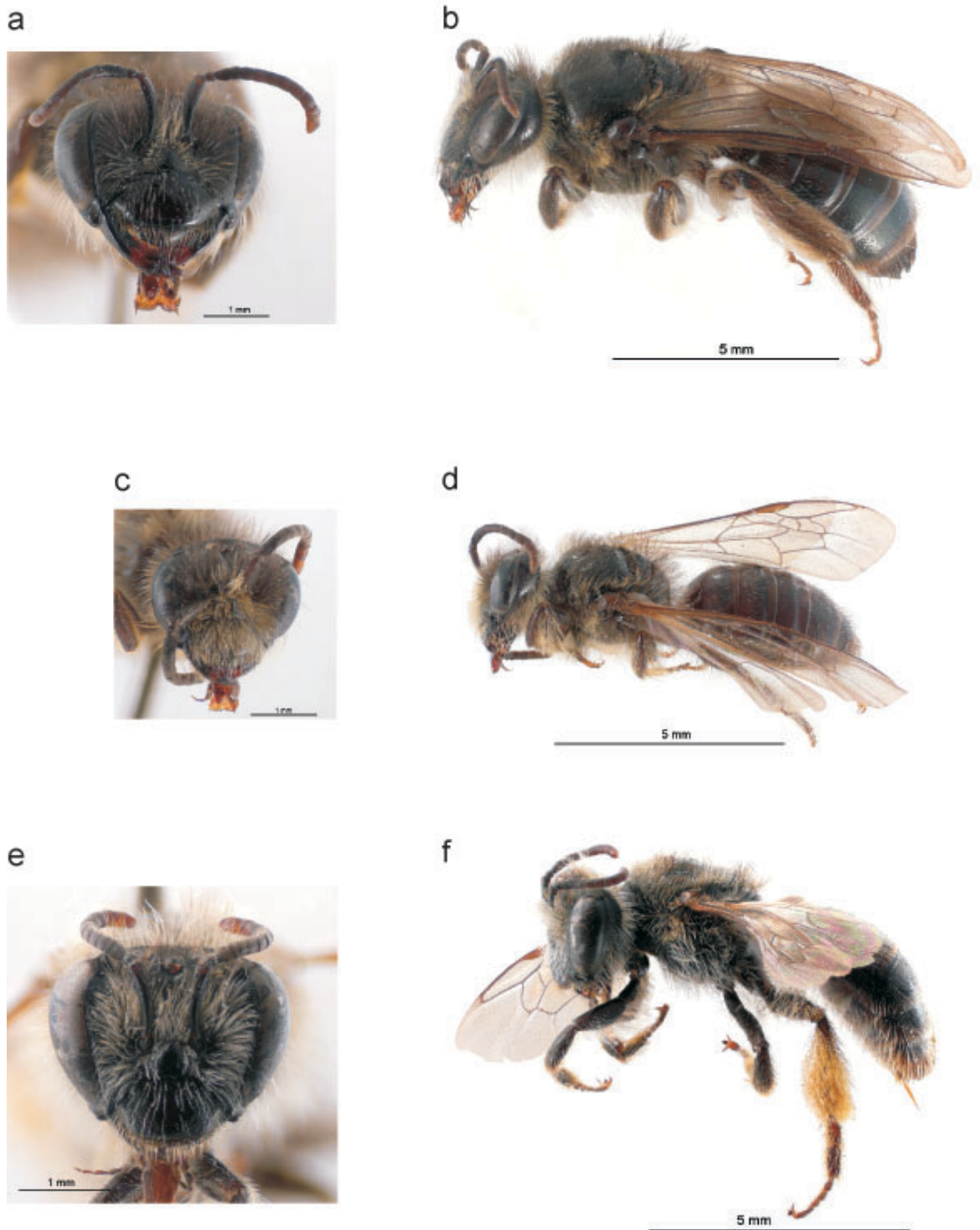


Fig. 1 a–d *Leioproctus boltoni*, a–b female; c–d male. e–f *Leioproctus huakiwi*, female (holotype).

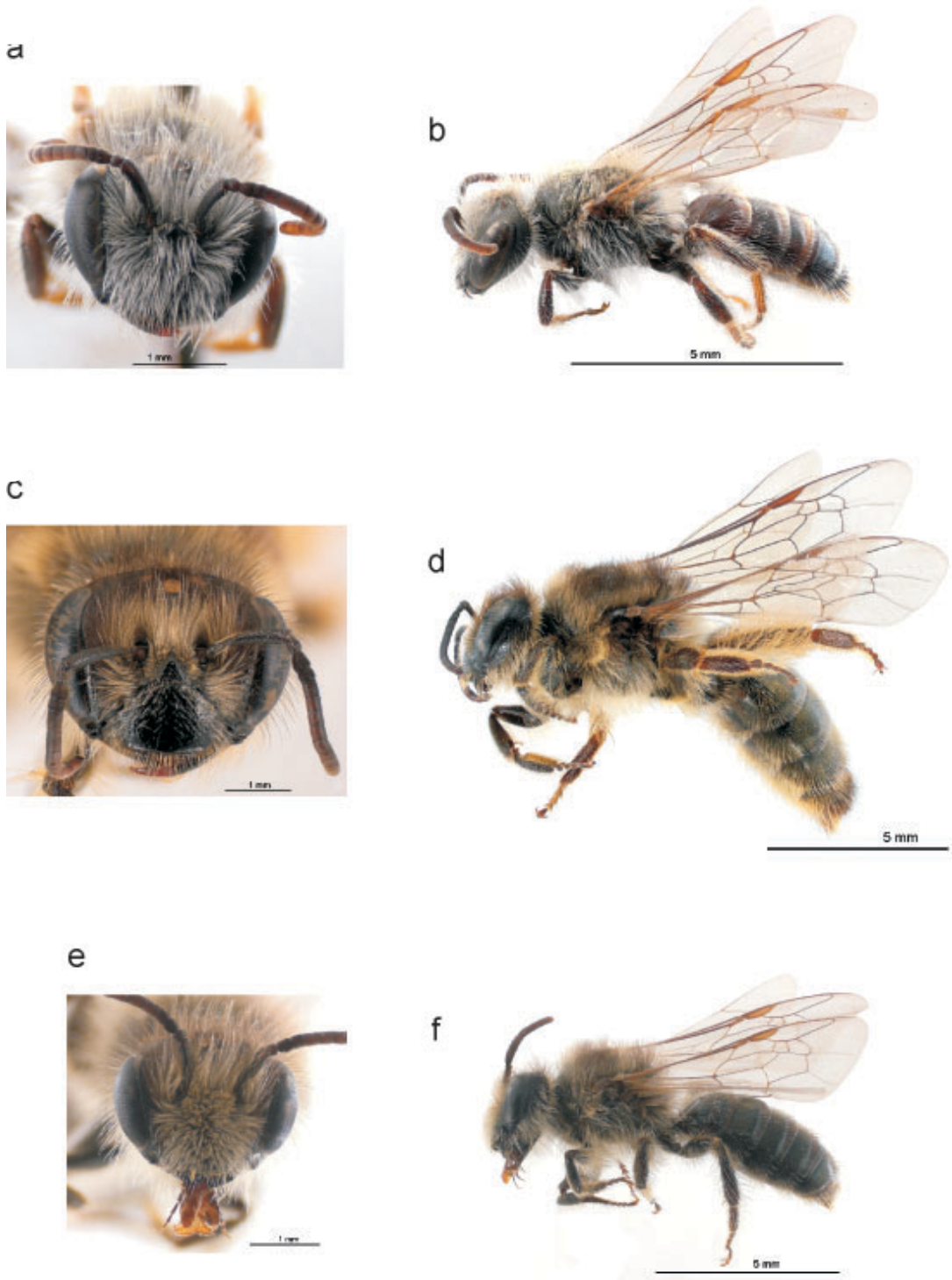


**Fig. 2** a–b *Leiproctus huakiwi*, male (allotype). c–f *Leiproctus imitatus*, c–d female; e–f male.

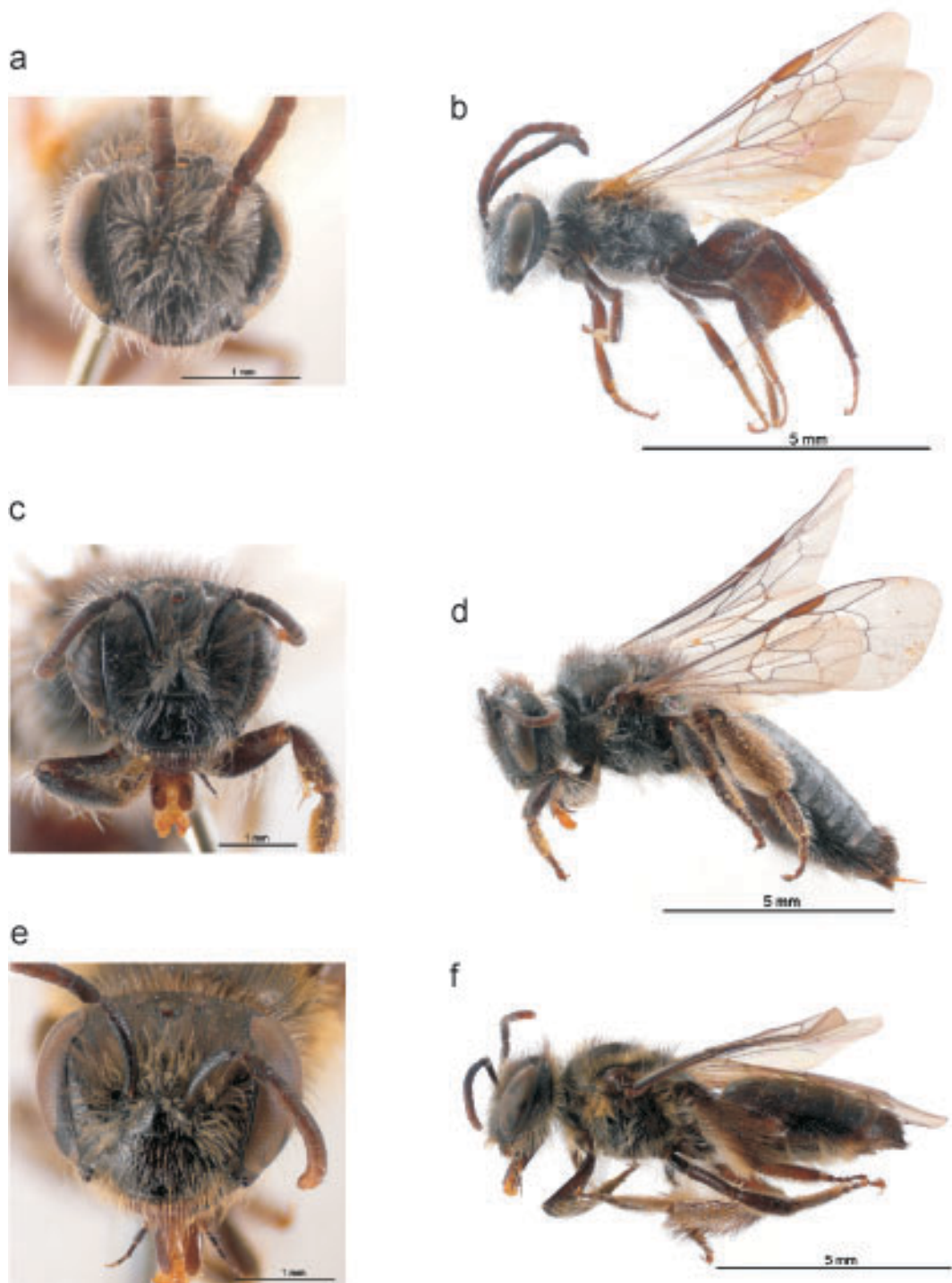


**Fig. 3** a–d *Leiproctus kanapuu*, a–b female (holotype); c–d male (allotype). e–f *Leiproctus keehua*, female (holotype).

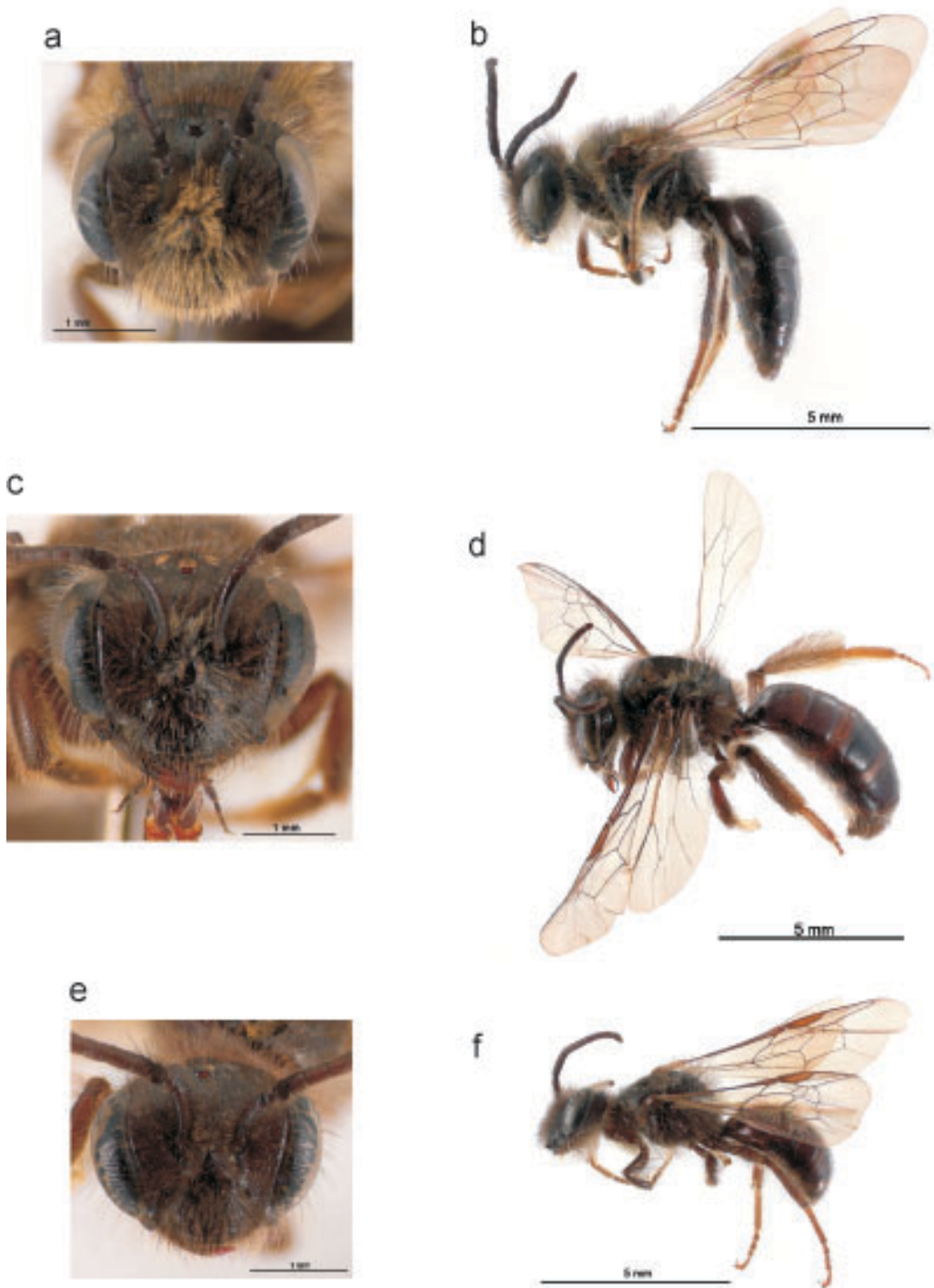




**Fig. 4** a–b *Leioproctus keehua*, male (allotype). c–f *Leioproctus metallicus*, c–d female; e–f male.



**Fig. 5 a–b** *Leioproctus otautahi*, male (holotype). **c–f** *Leioproctus pango*, **c–d** female (holotype); **e–f** male (allotype).



**Fig. 6** a–f *Leioproctus pango*, a–b male (North Island); c–d female (black form); e–f male (black form).

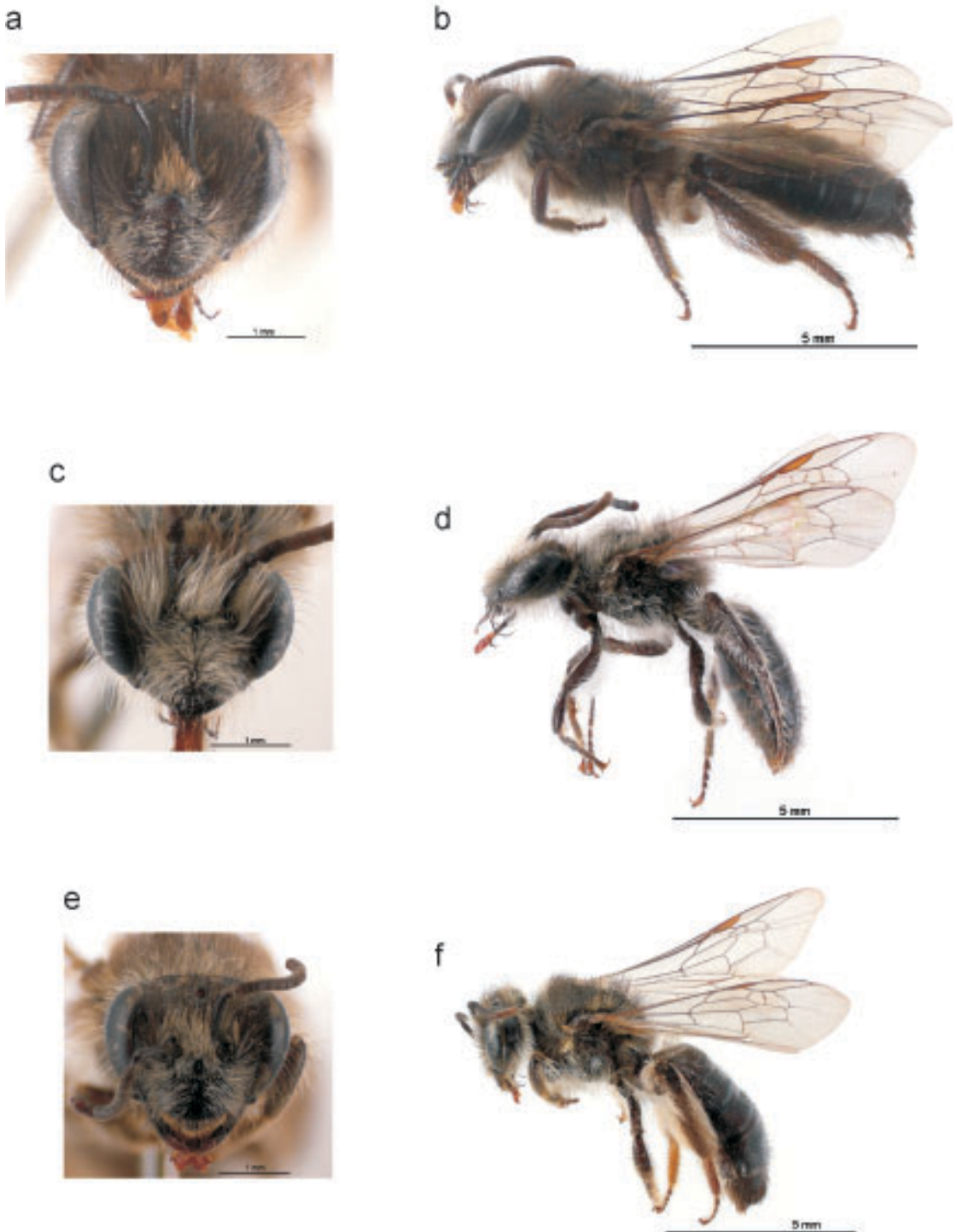


Fig. 7 a–d *Leiproctus purpureus*, a–b female; c–d male. e–f *Leiproctus vestitus*, female.

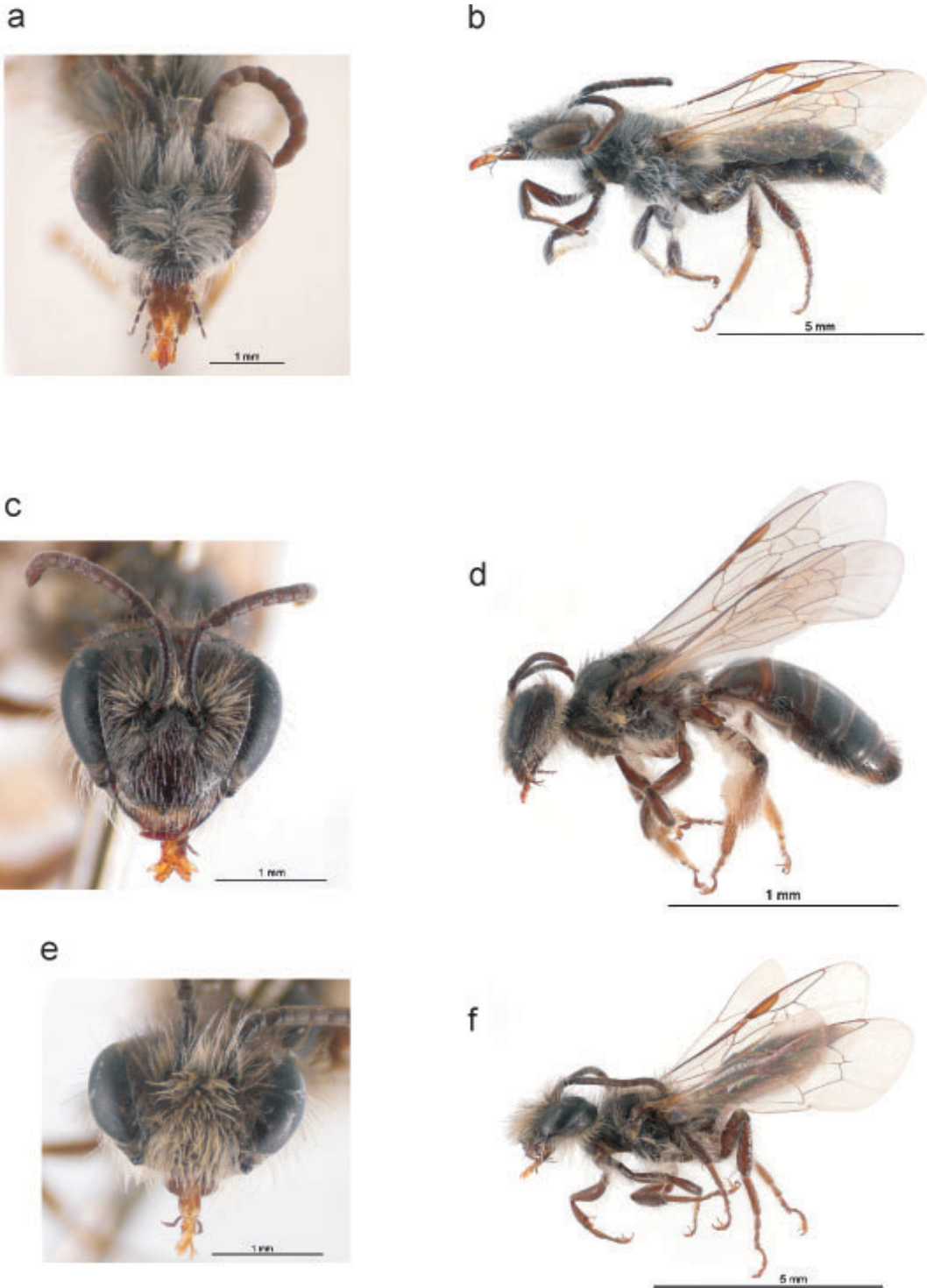


Fig. 8 a–b *Leioproctus vestitus*, male. c–f *Leioproctus waipounamu*, female (holotype); male (allotype).

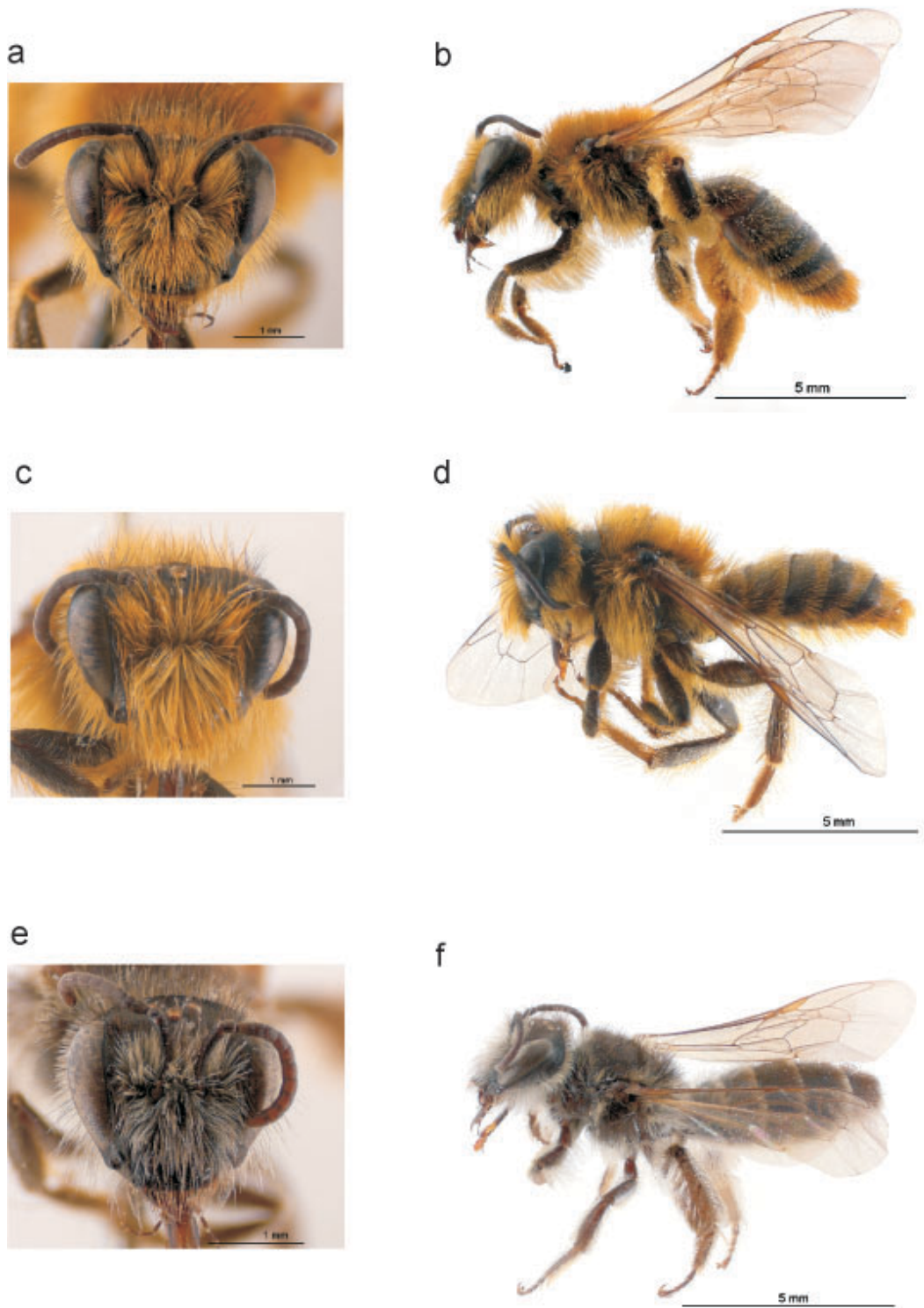


Fig. 9 a–d *Leiproctus fulvescens*, a–b female; c–d male. e–f *Leiproctus hudsoni*, female.

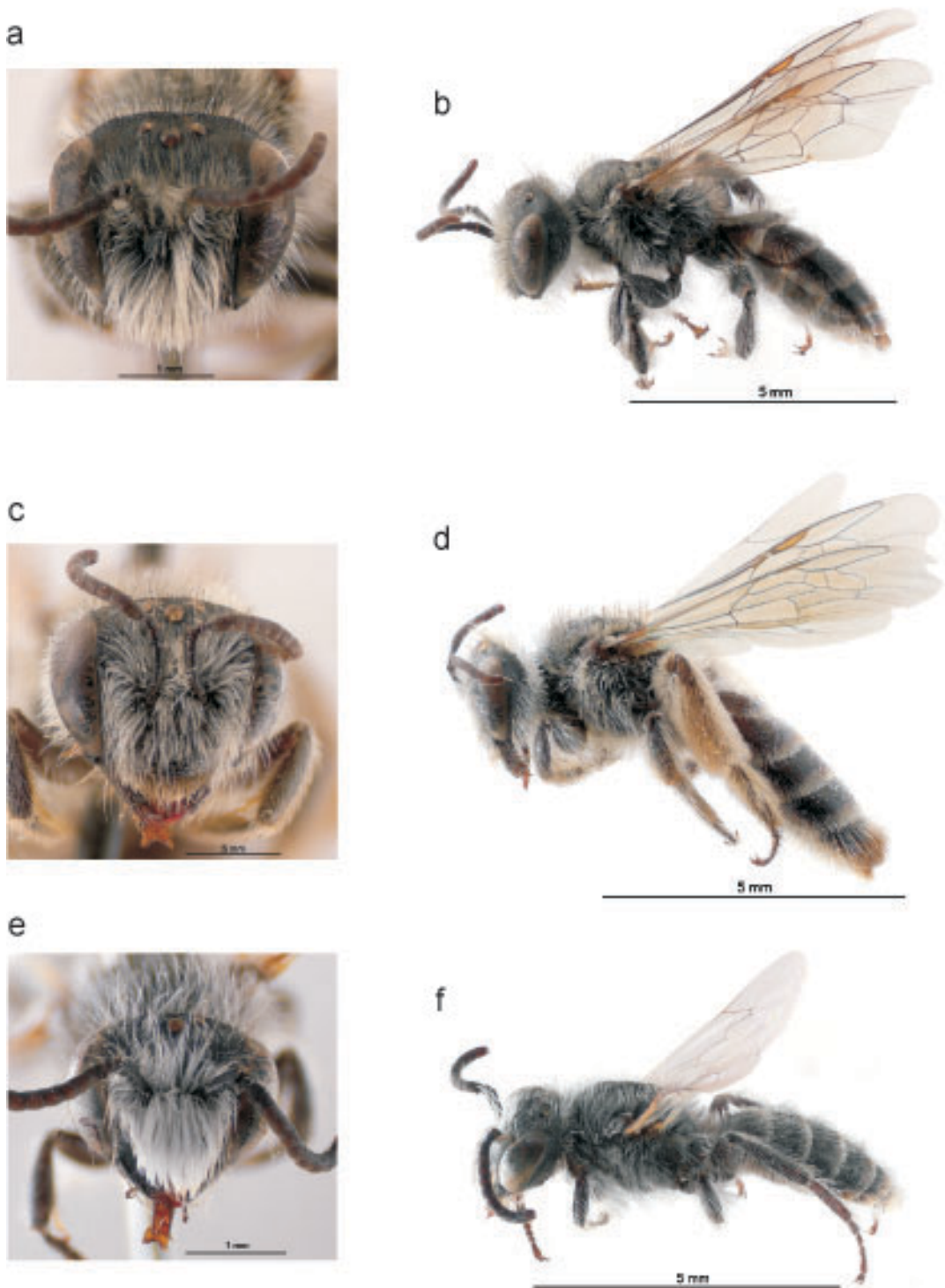


Fig. 10 a–b *Leioproctus hudsoni*, male. c–f *Leioproctus maritimus*, c–d female; e–f male.

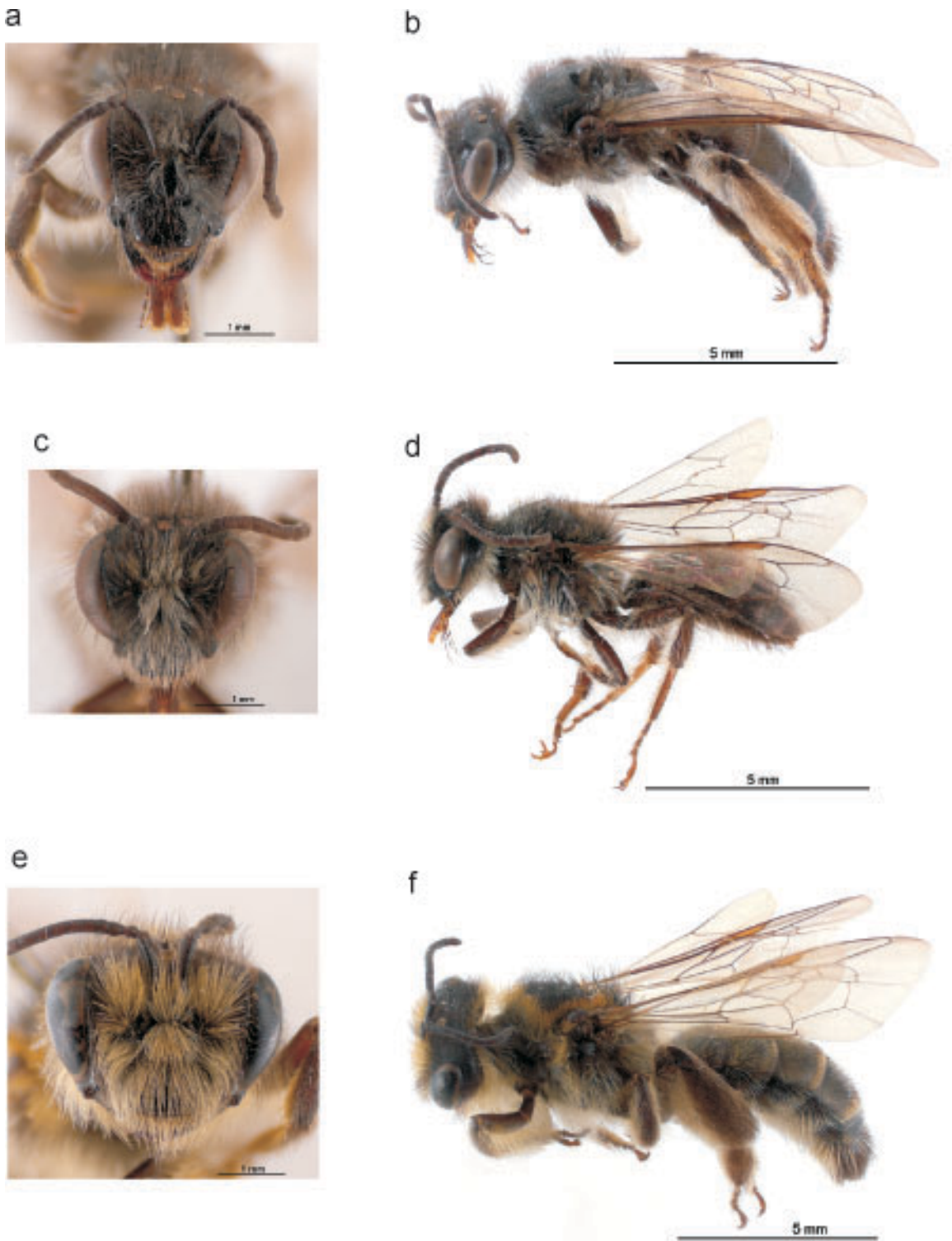
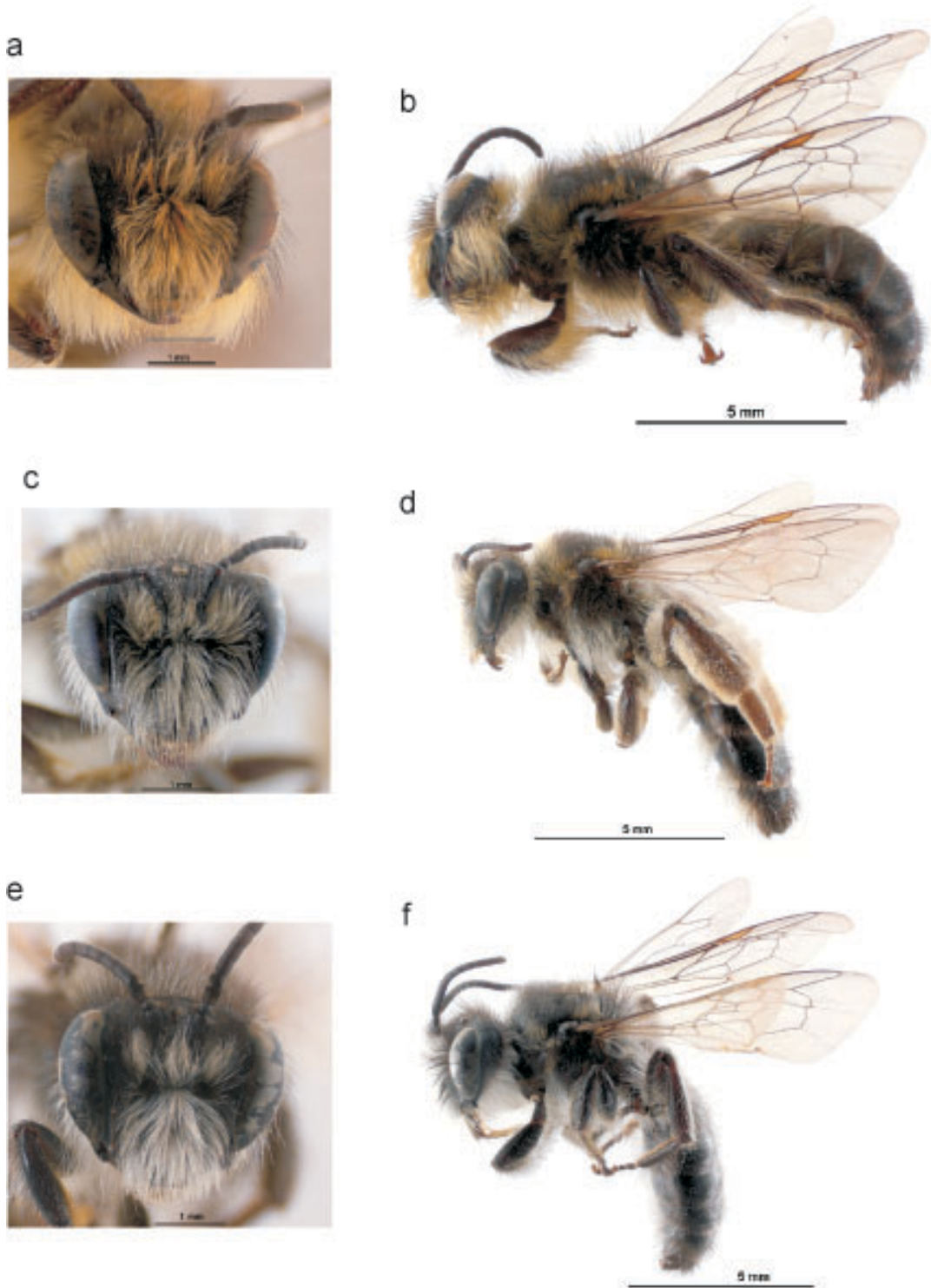


Fig. 11 a–d *Leiproctus monticola*, a–b female; c–d male. e–f *Leiproctus nunui*, female (holotype).





**Fig. 12 a–b** *Leioproctus nunui*, male (allotype). **c–f** *Leioproctus paahaumaa*, **c–d** female (holotype); **e–f** male (allotype).

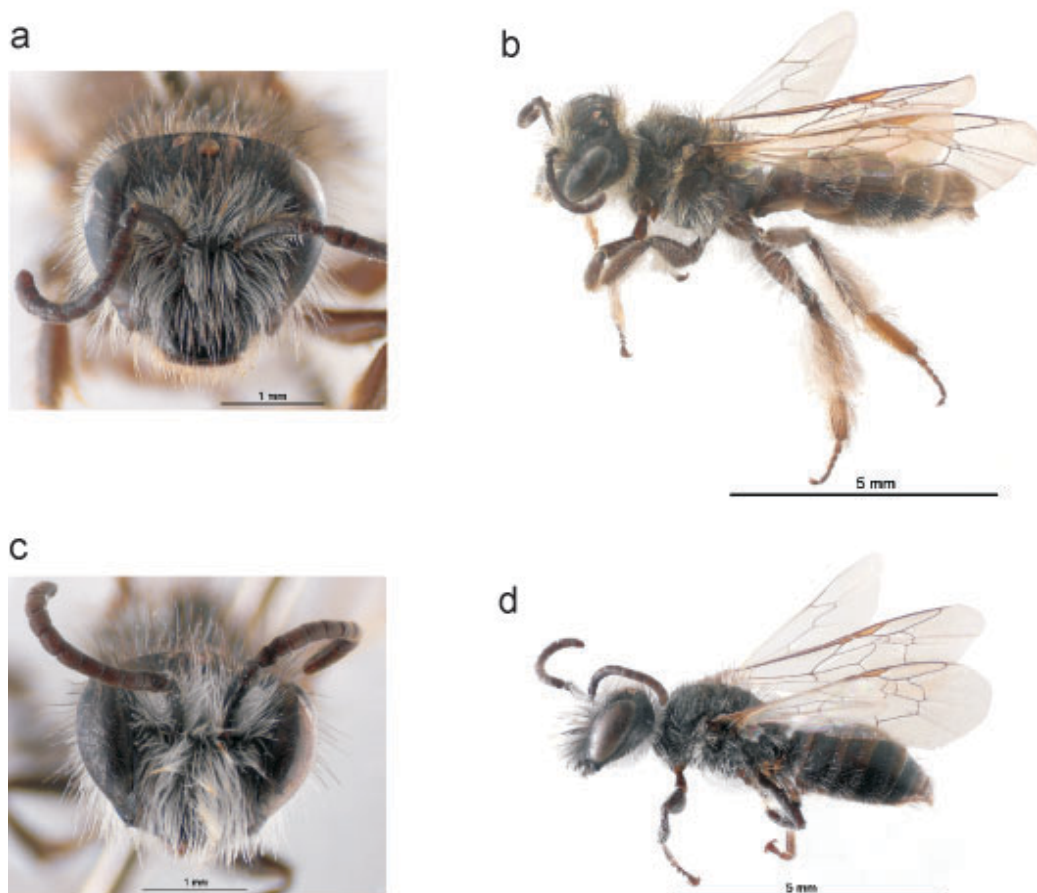
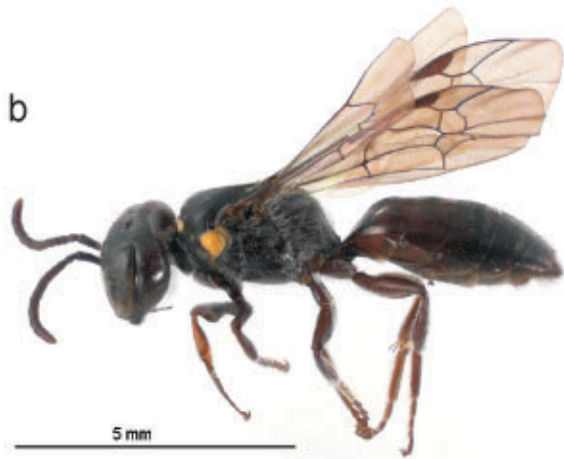


Fig. 13 a–d *Leioproctus pekanui*, a–b female (holotype); c–d male (allotype).

a



b



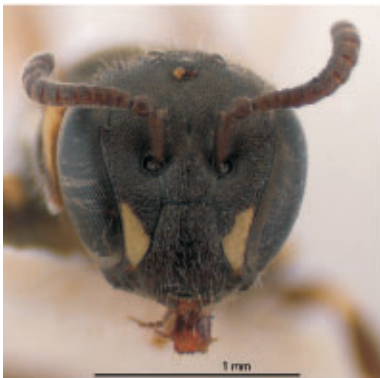
c



d



e



f



Fig. 14 a–d *Hylaeus agilis*, a–b female; c–d male. e–f *Hylaeus asperithorax*, female.

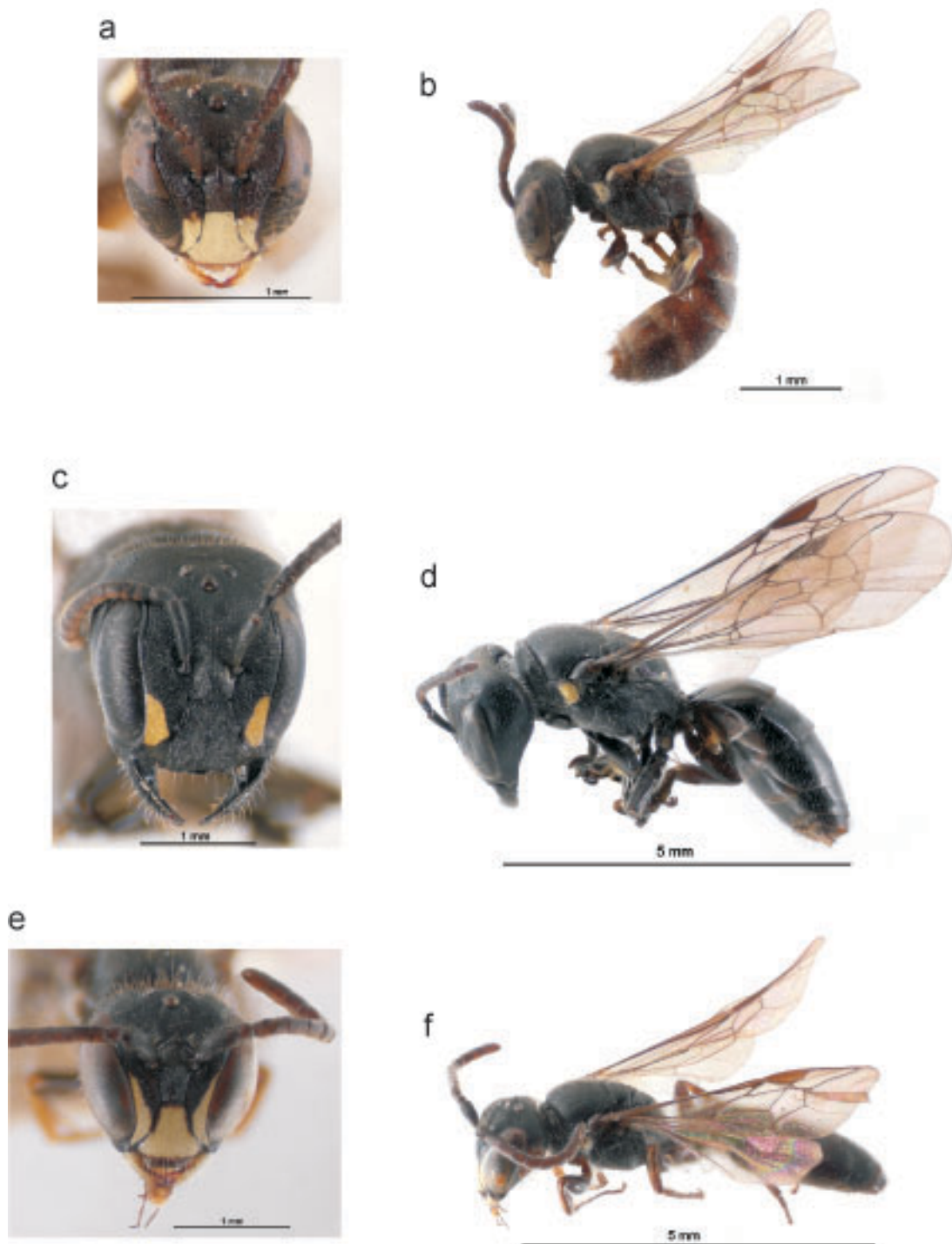
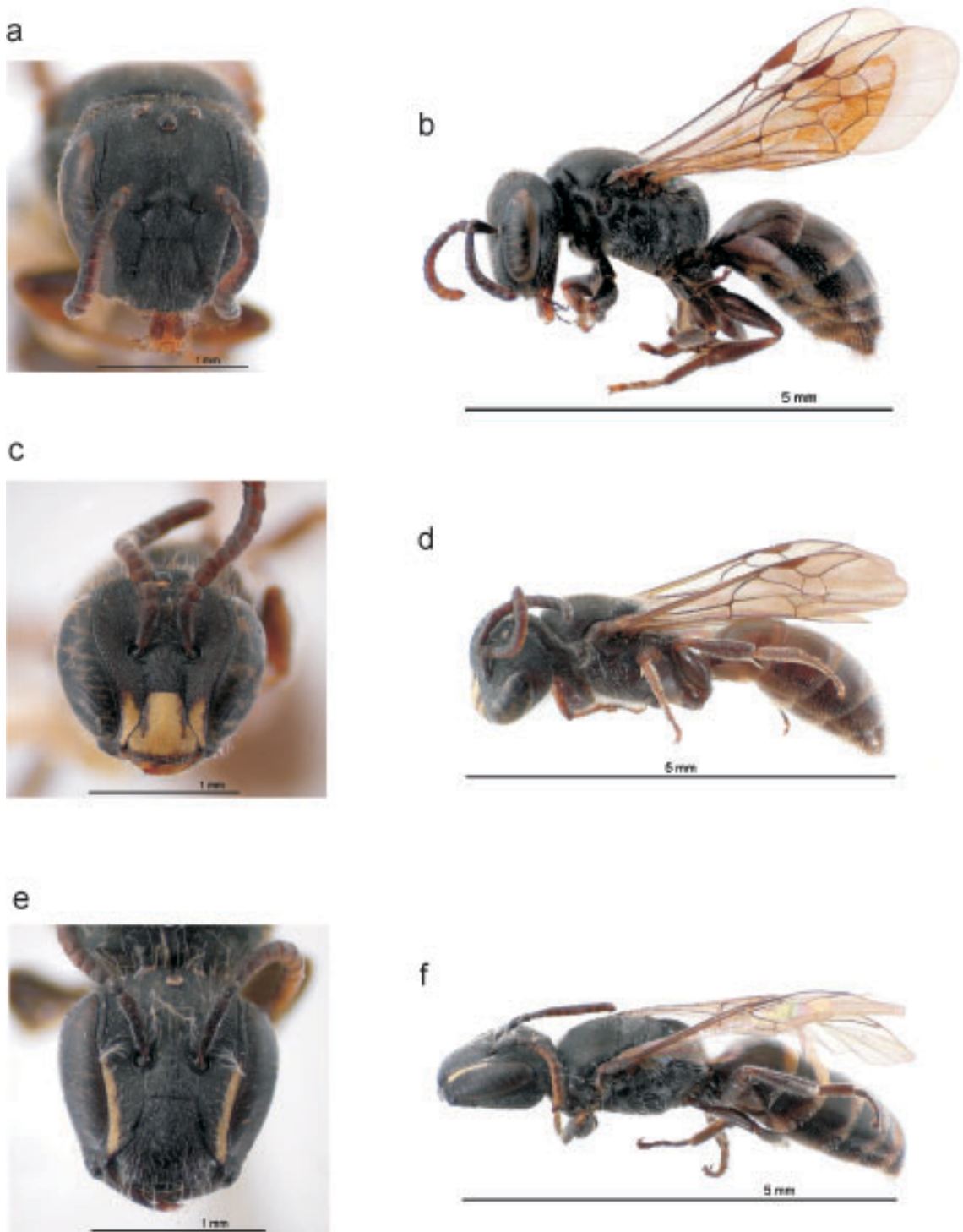


Fig. 15 a–b *Hylaeus asperithorax*, male. c–f *Hylaeus capitosus*, c–d female; e–f male.



**Fig. 16 a–d** *Hylaeus kermadecensis*, **a–b** female (holotype); **c–d** male (allotype). **e–f** *Hylaeus matamoko*, female (holotype).

a



b



c



d



e



f



**Fig. 17** a–b *Hylaeus matamoko*, male (allotype). c–d *Hylaeus murihiku*, male (holotype); e–f *Hylaeus perhumilis* female.

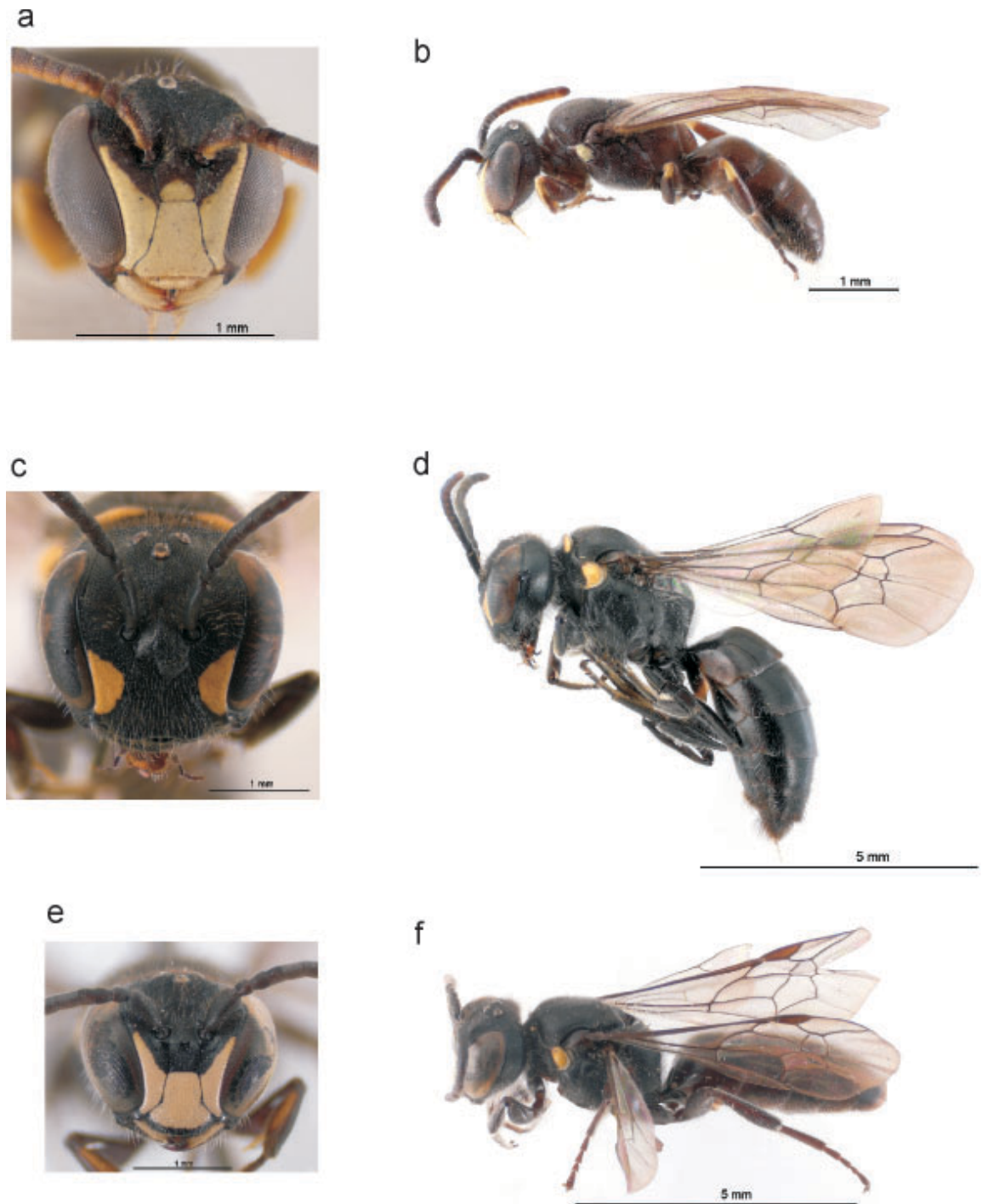


Fig. 18 a–b *Hylaeus perhumilis*, male. c–f *Hylaeus relegatus*, c–d female; e–f male.

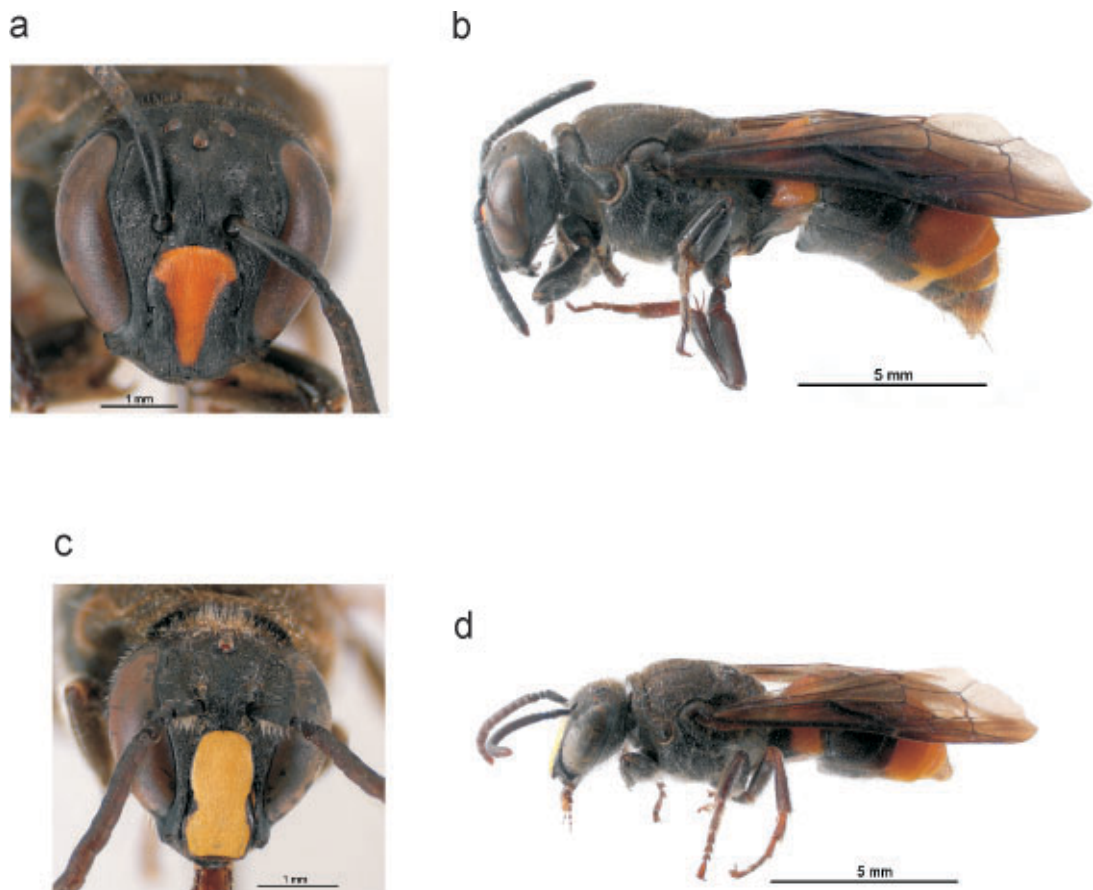


Fig. 19 a–d *Hyleoides concinna*, a–b female; c–d male.



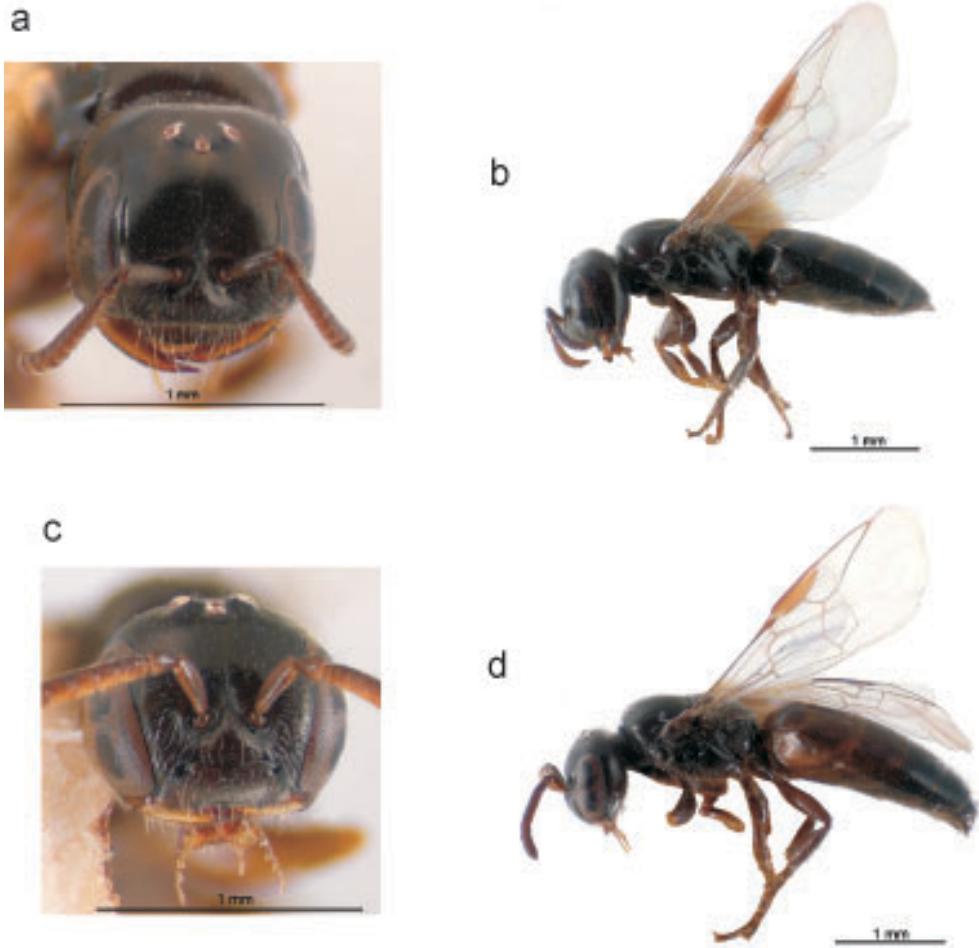


Fig. 20 a–d *Euryglossina proctotrypoides*, a–b female; c–d male.

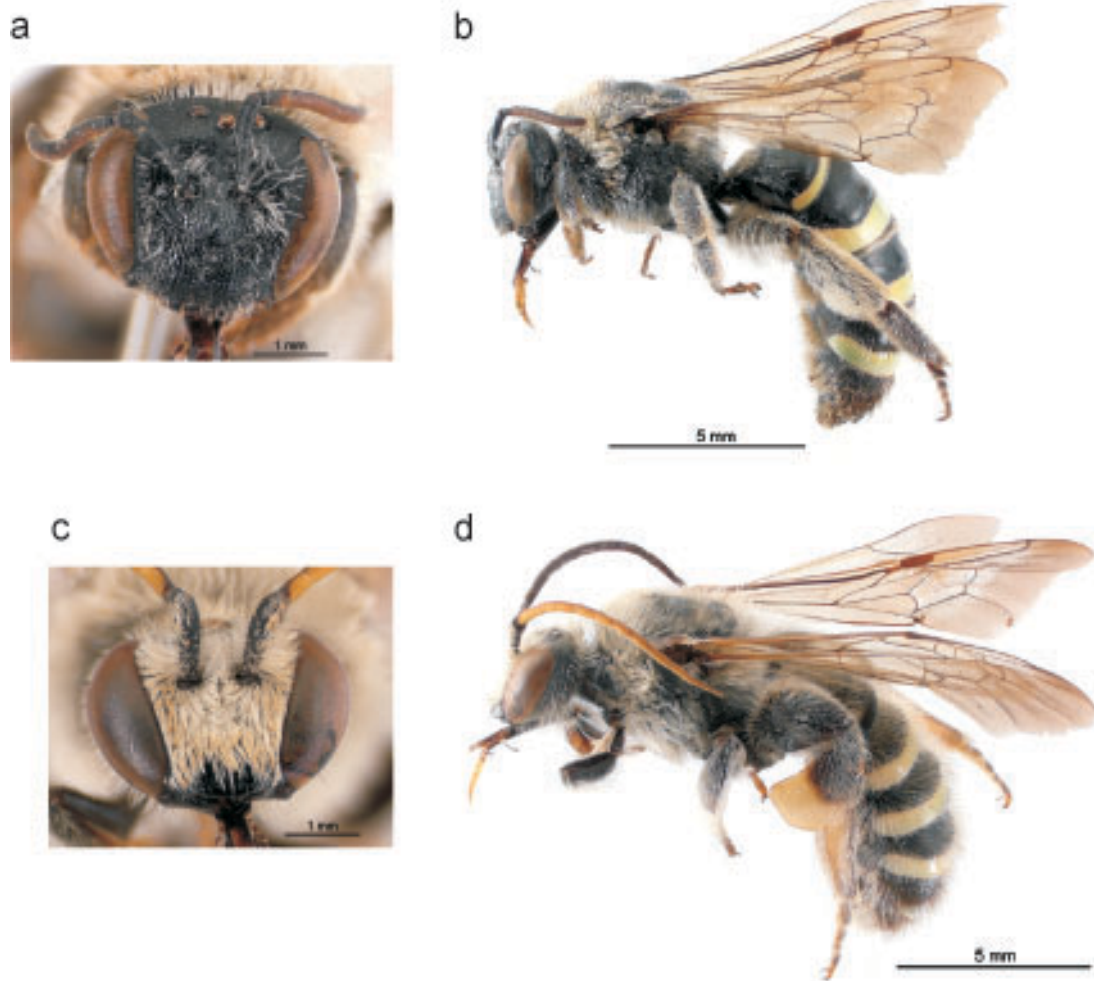
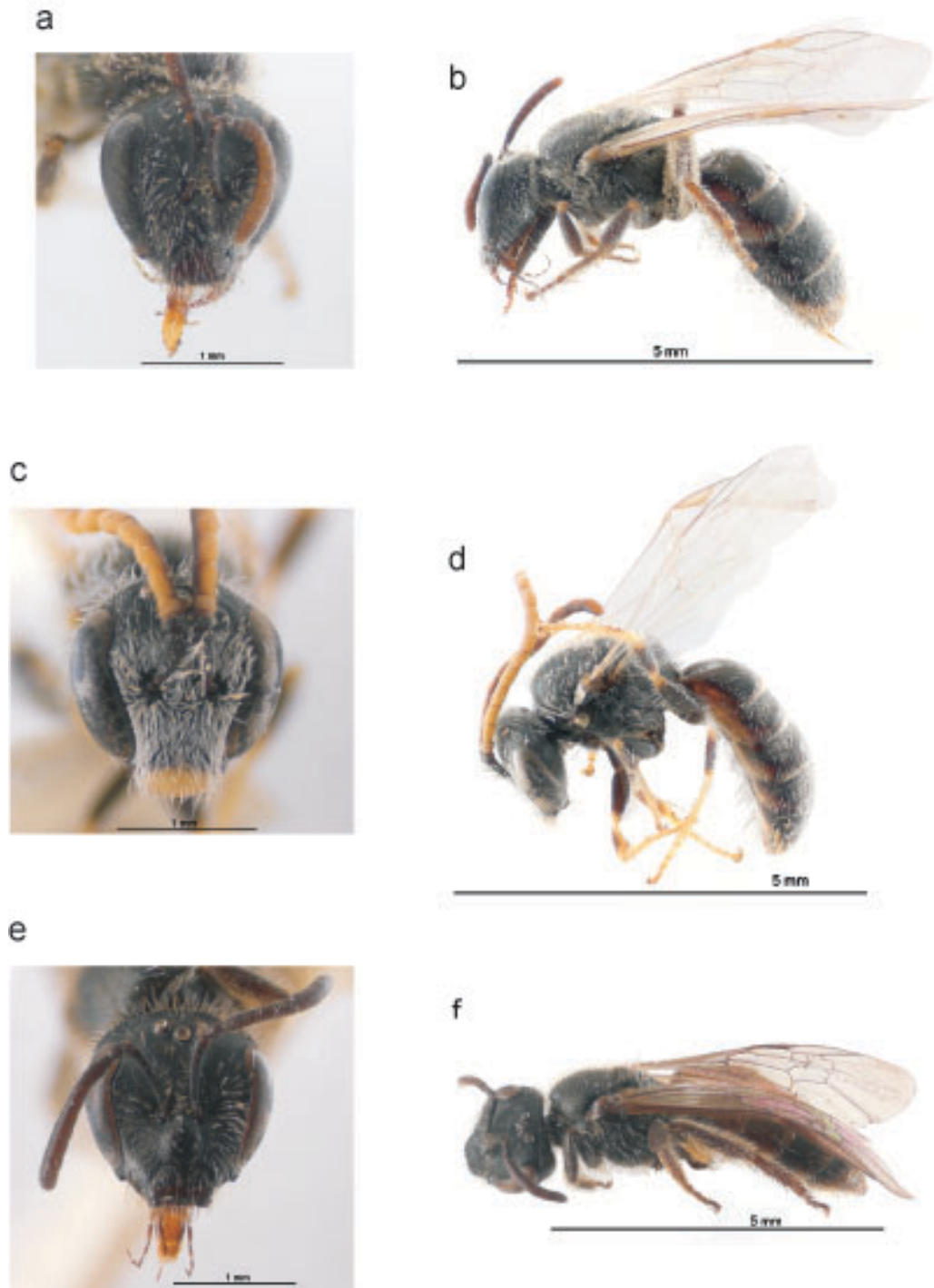


Fig. 21. a–d *Nomia melanderi melanderi*, a–b female; c–d male.



**Fig. 22** a–d *Lasioglossum mataroa*, a–b female (holotype); c–d male (allotype). e–f *Lasioglossum maunga*, female (holotype).

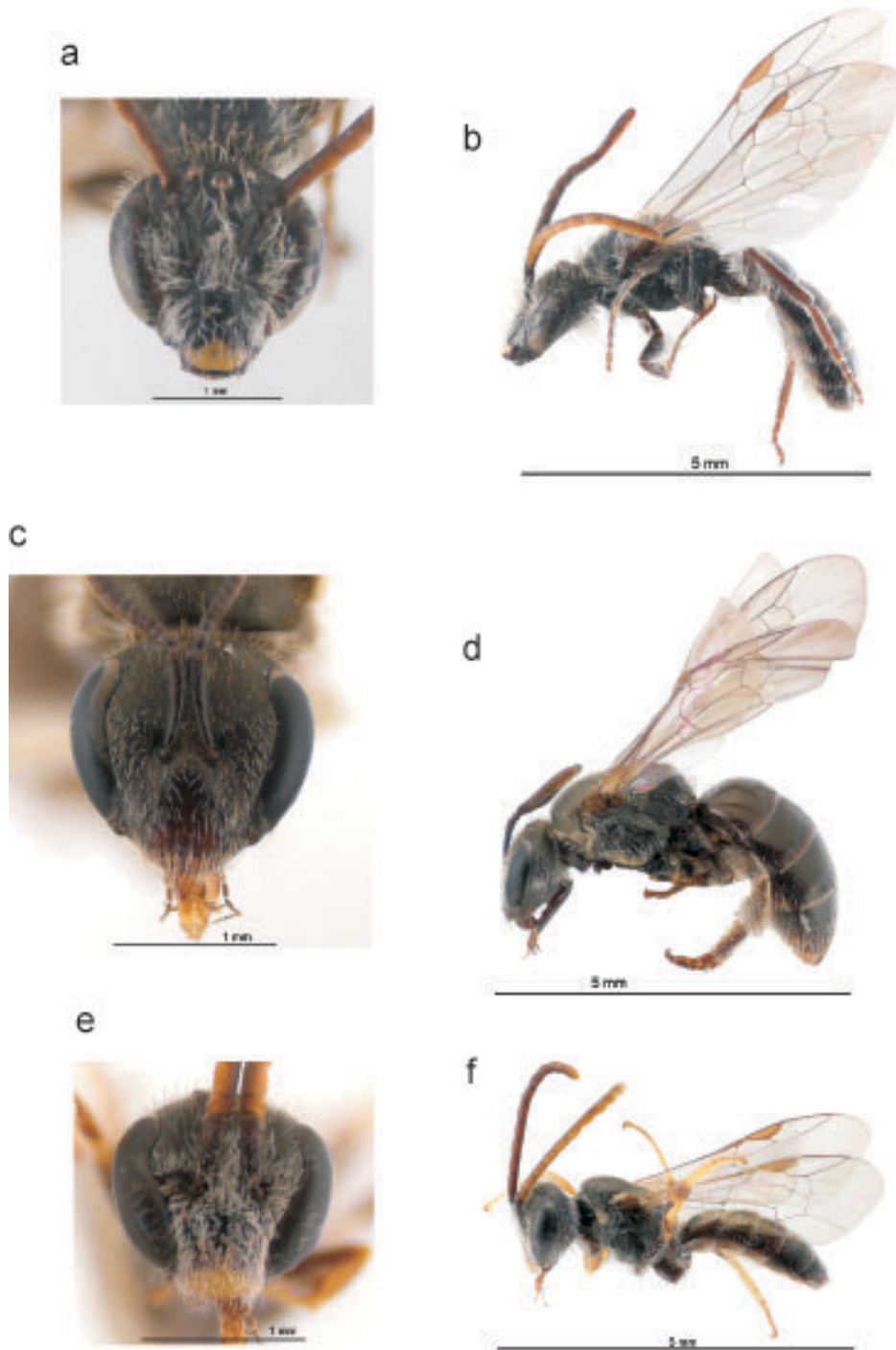


Fig. 23 a–b *Lasioglossum maunga*, male (allotype). c–f *Lasioglossum sordidum*, c–d female; e–f male.

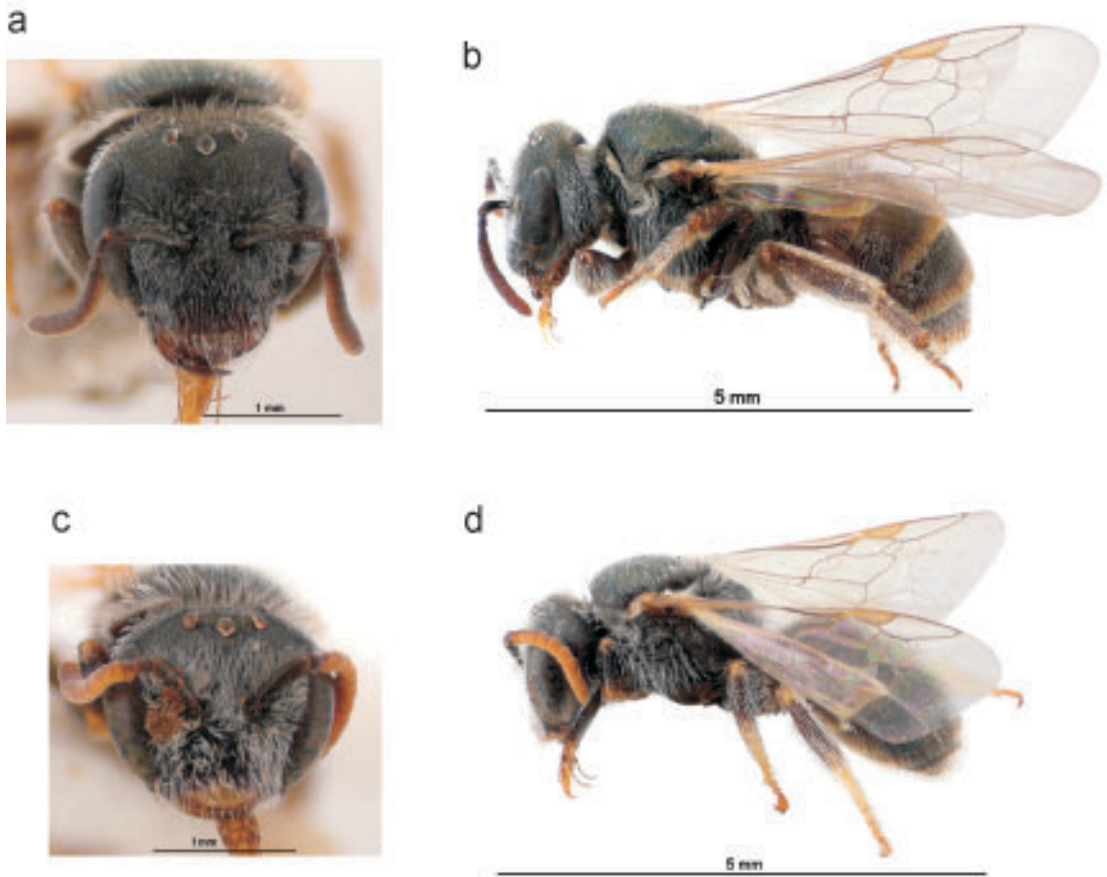


Fig. 24. a–d *Lasioglossum cognatum*, a–b female; c–d male.

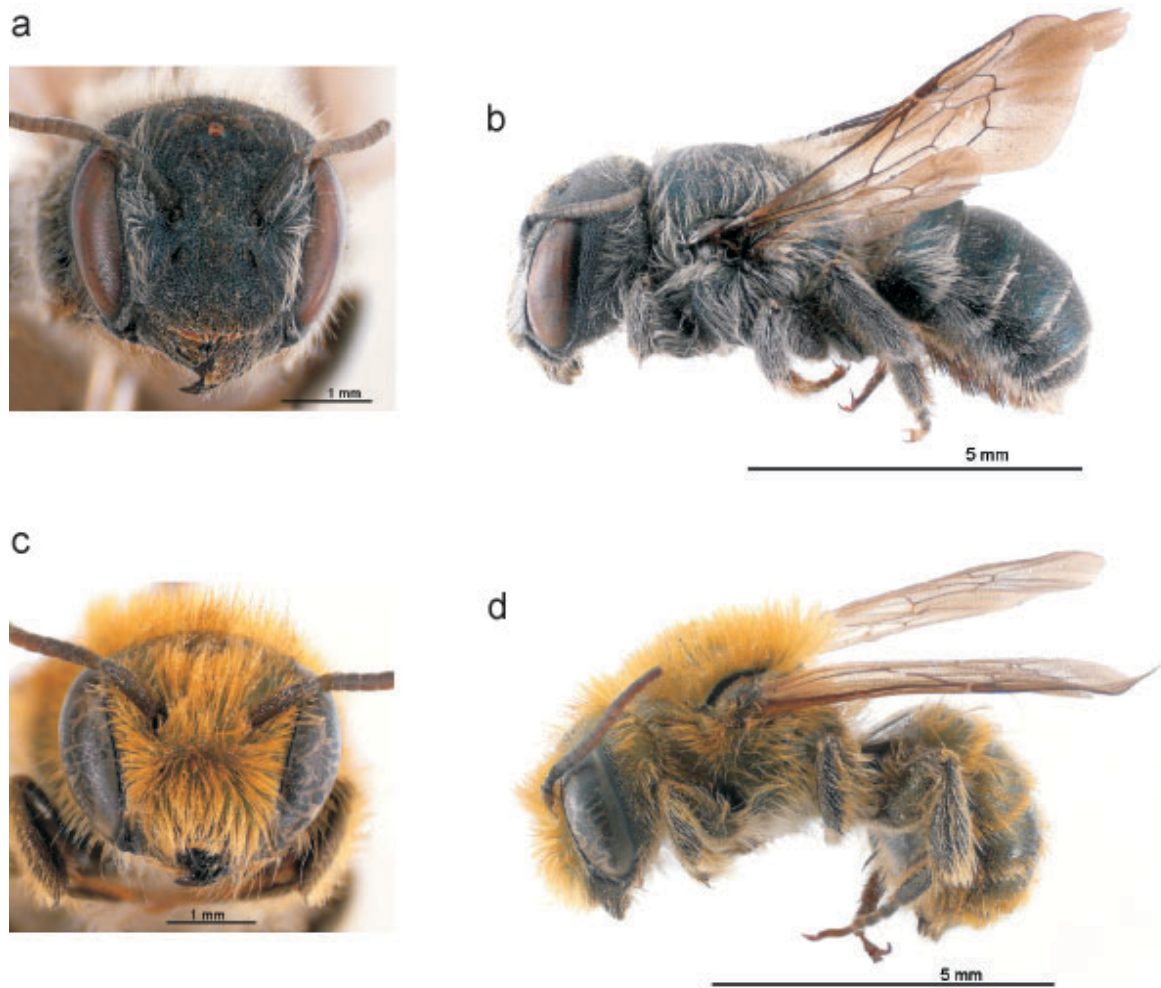
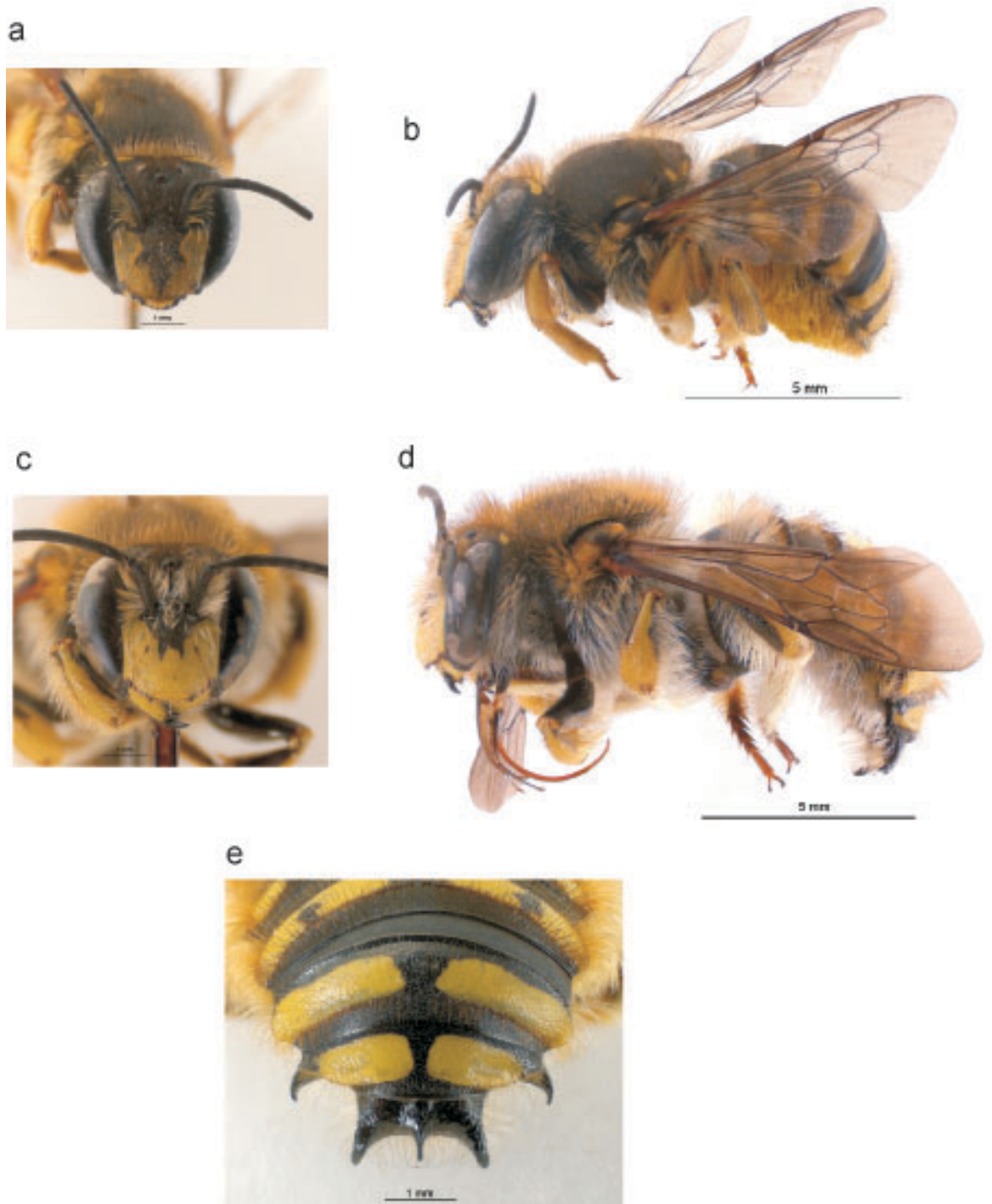
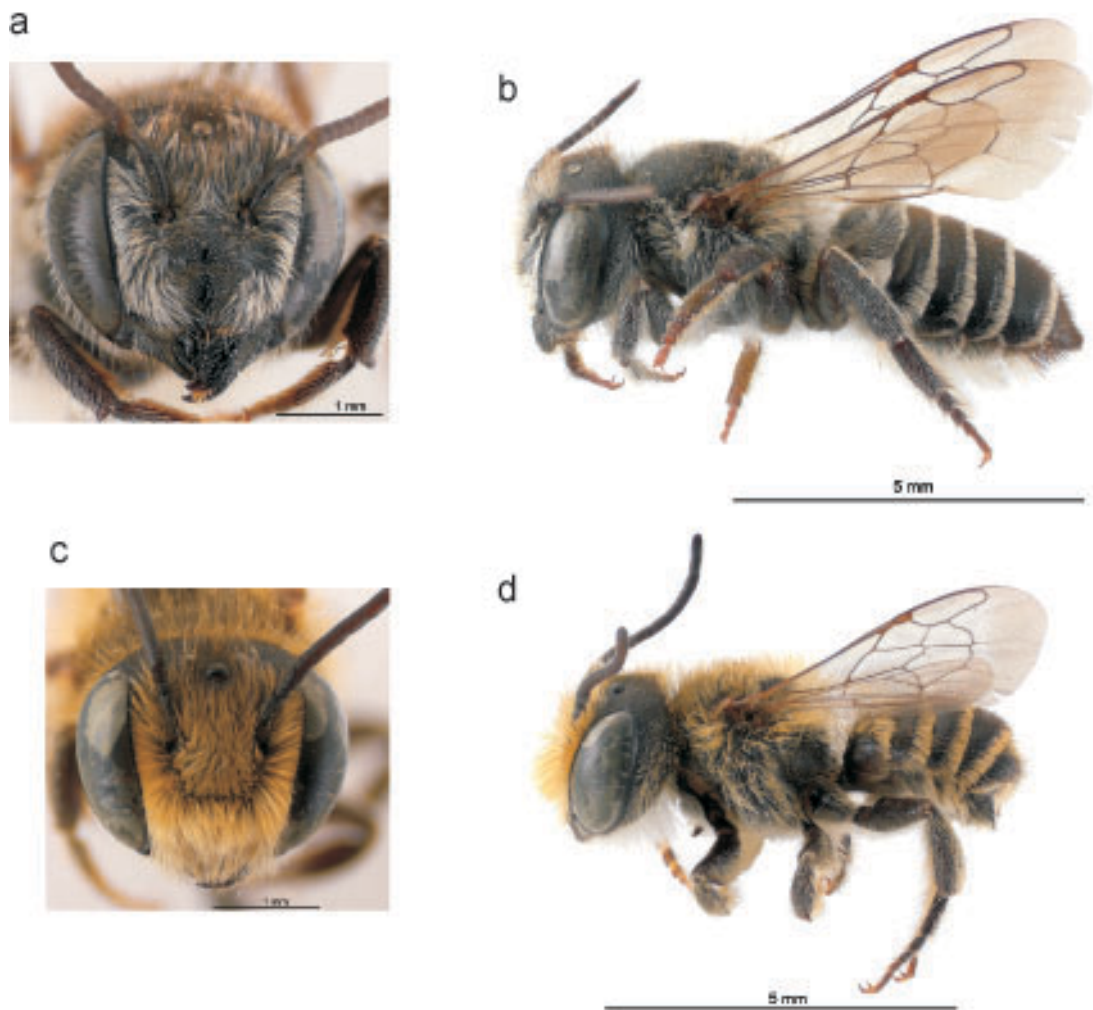


Fig. 25 a–d *Osmia coerulescens*, a–b female; c–d male.



**Fig. 26** a–e *Anthidium manicatum*, a–b female; c–d male; e male, apex of metasoma, dorsoposterior aspect.



**Fig. 27** a–d *Megachile rotundata*, a–b female; c–d male.



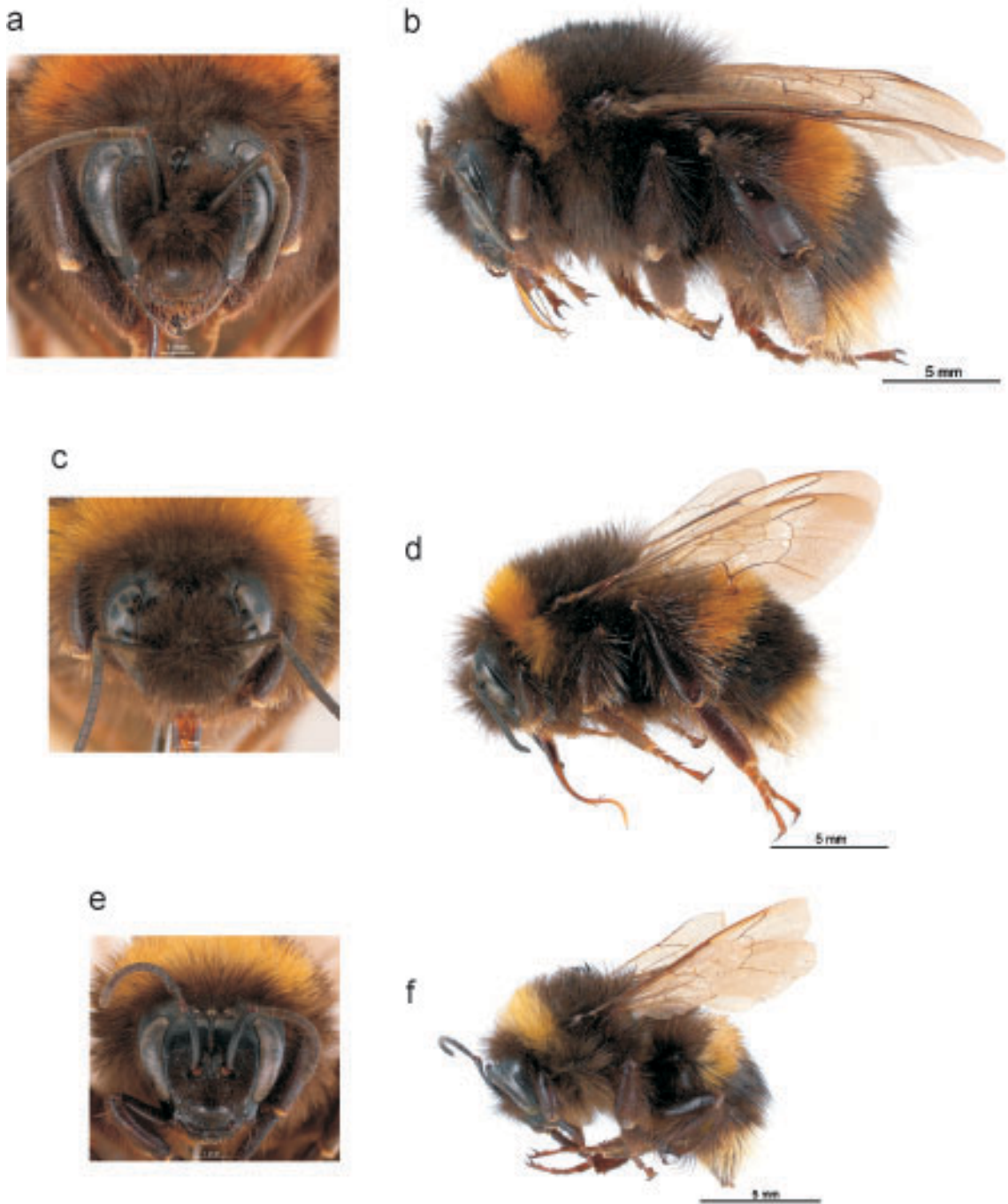


Fig. 28 a–f *Bombus terrestris*, a–b female; c–d male; e–f worker.

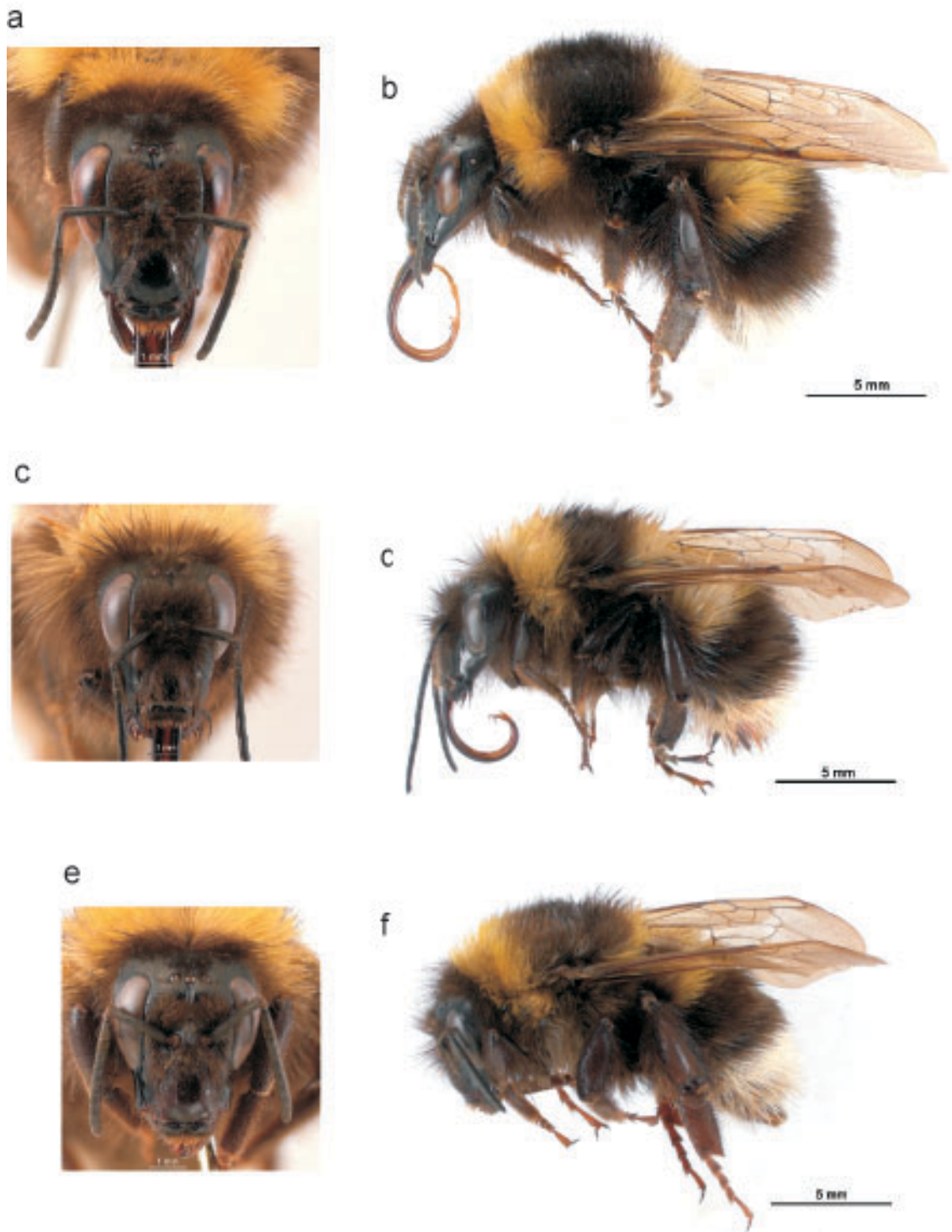
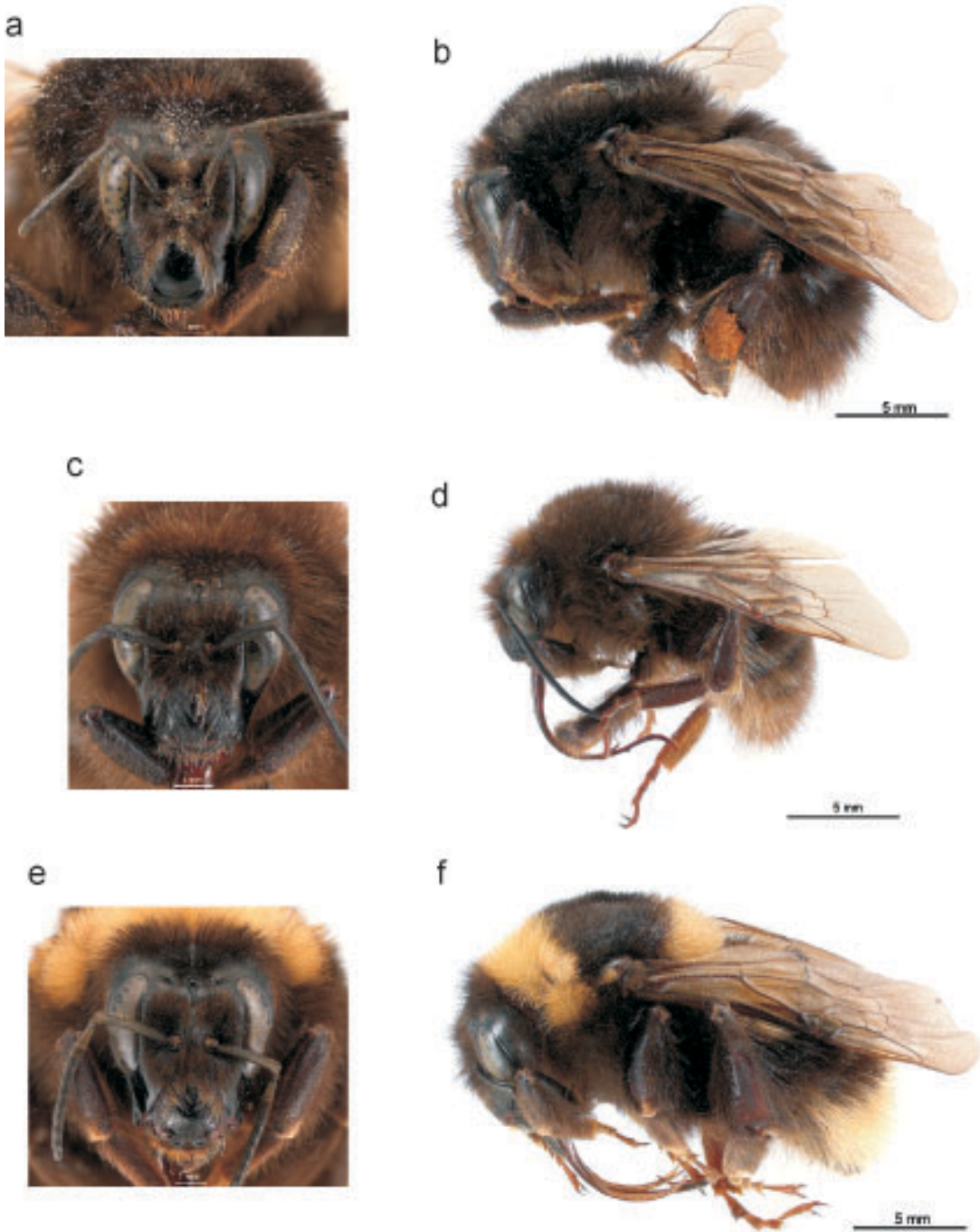
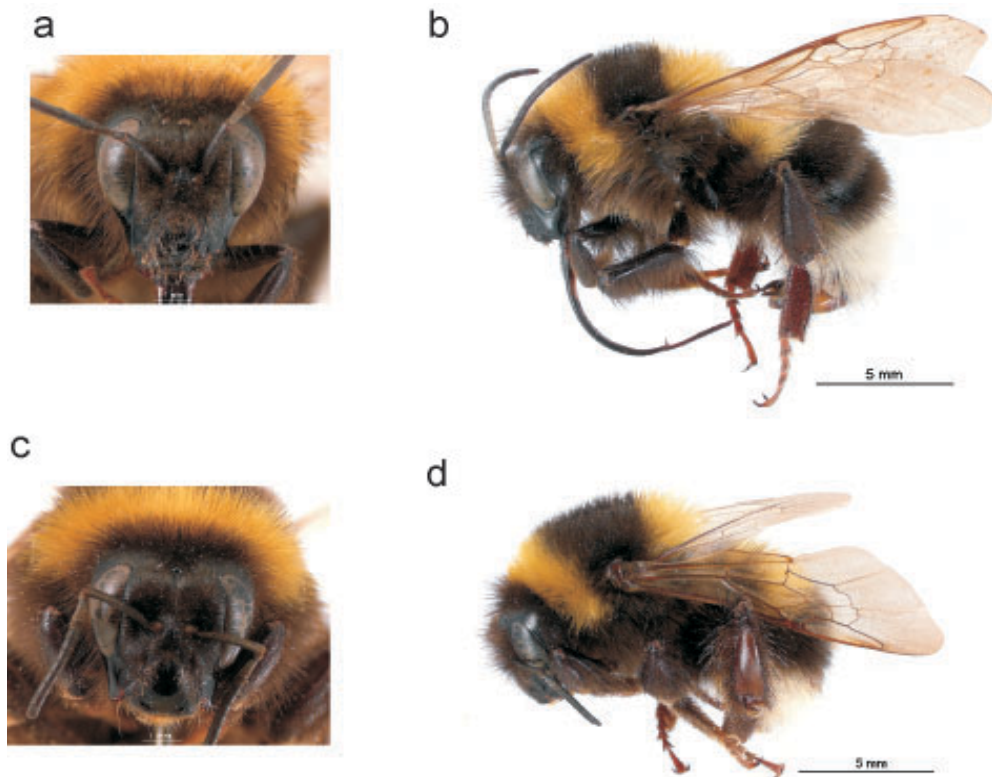


Fig. 29 a–f *Bombus hortorum*, a–b female; c–d male; e–f worker.



**Fig. 30 a–f** *Bombus ruderatus*, **a–b** female (black form); **c–d** male (black form); **e–f** female (coloured form).



**Fig. 31** a–d *Bombus ruderatus*, a–b male (coloured form); c–d worker.

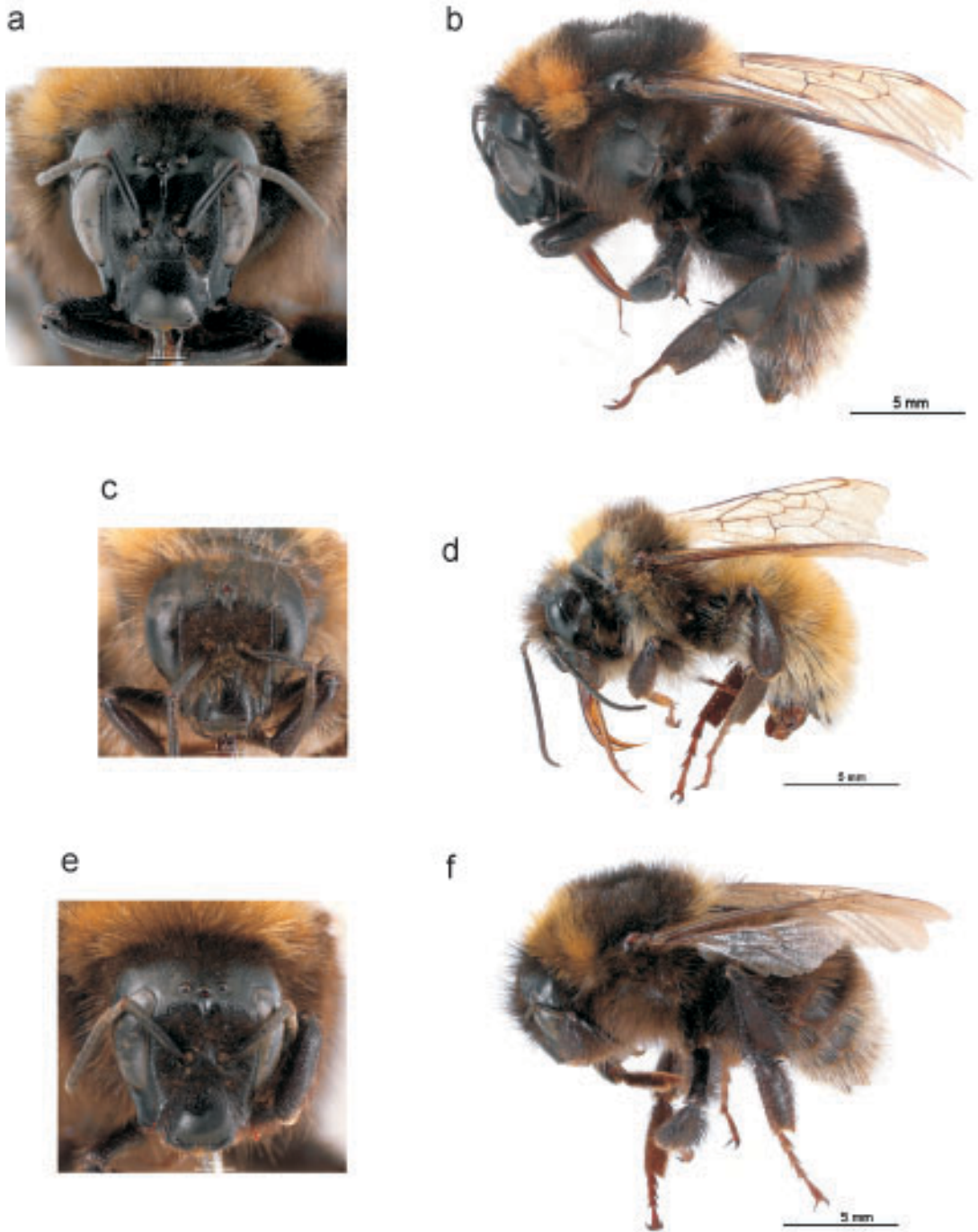
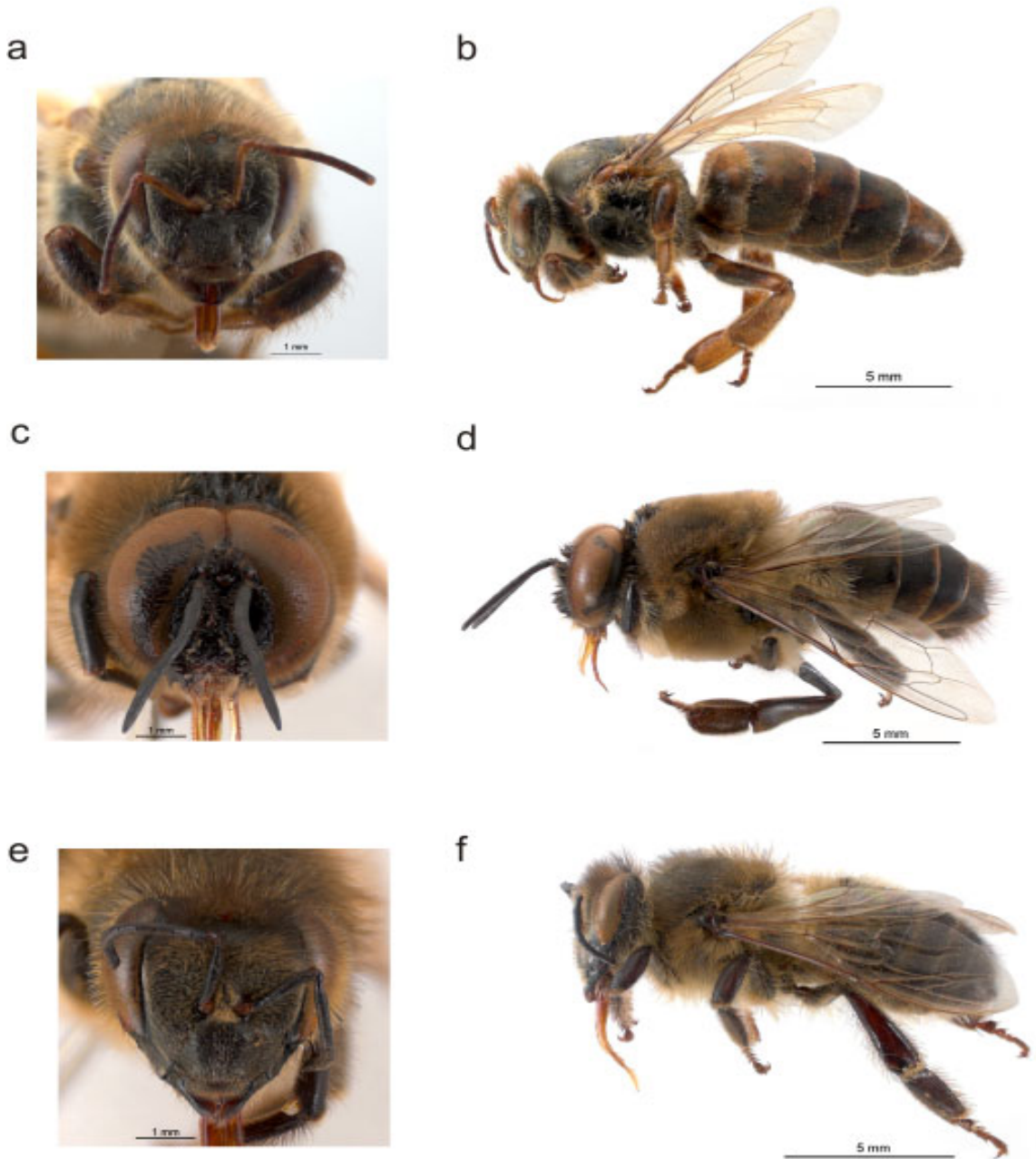


Fig. 32 a–f *Bombus subterraneus*, a–b female; c–d male; e–f worker.



**Fig. 33 a–f** *Apis mellifera mellifera*, **a–b** queen; **c–d** drone; **e–f** worker..

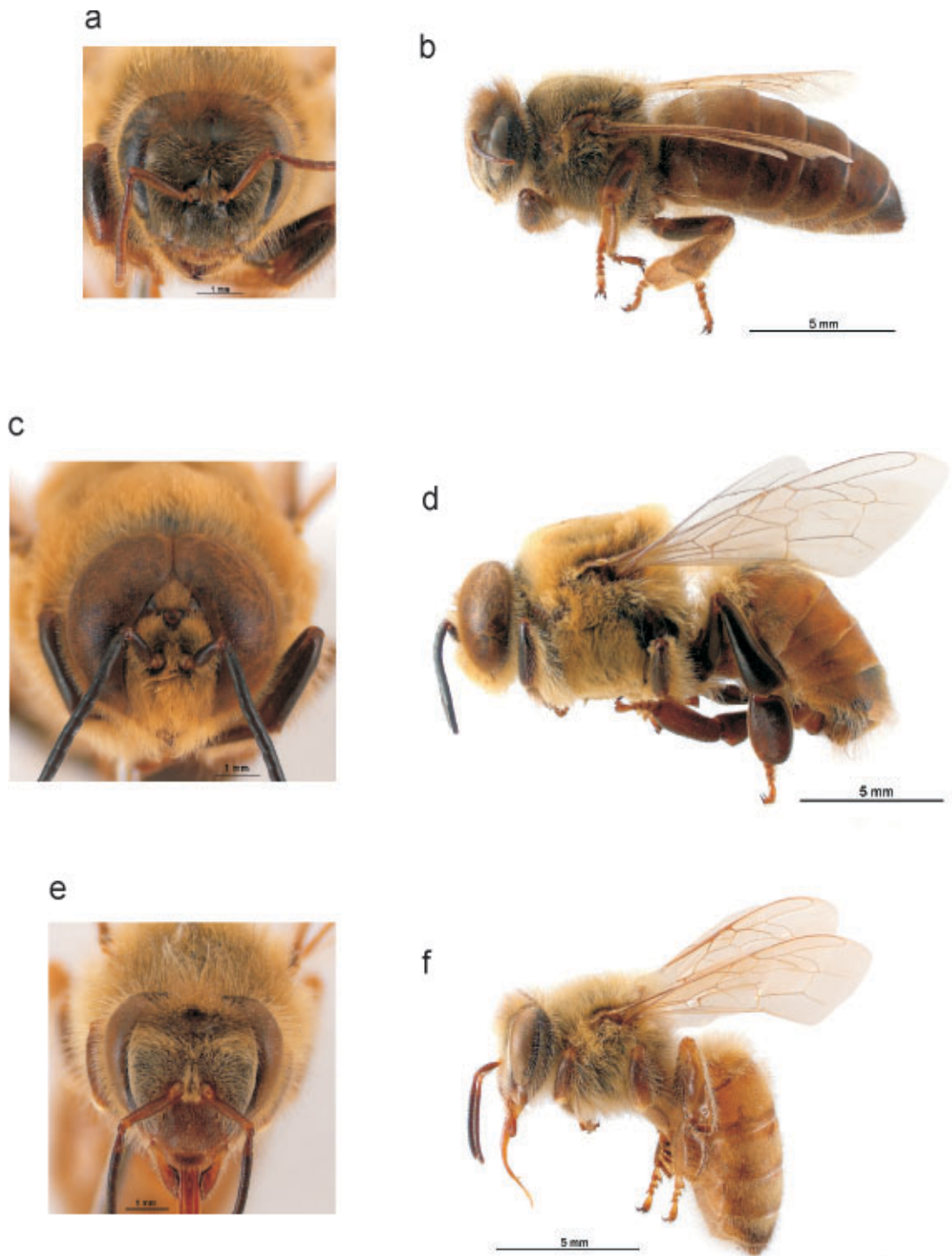
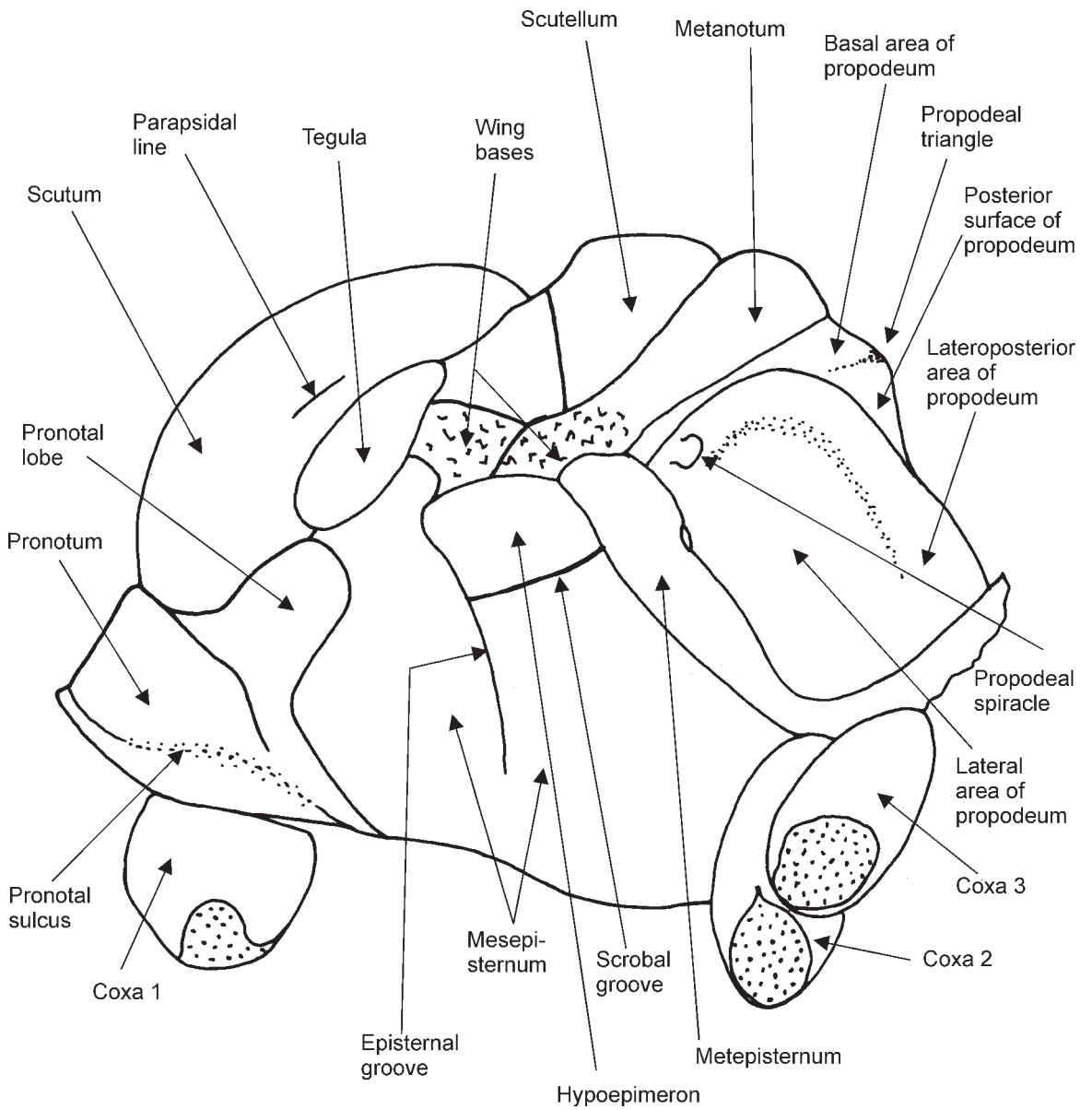
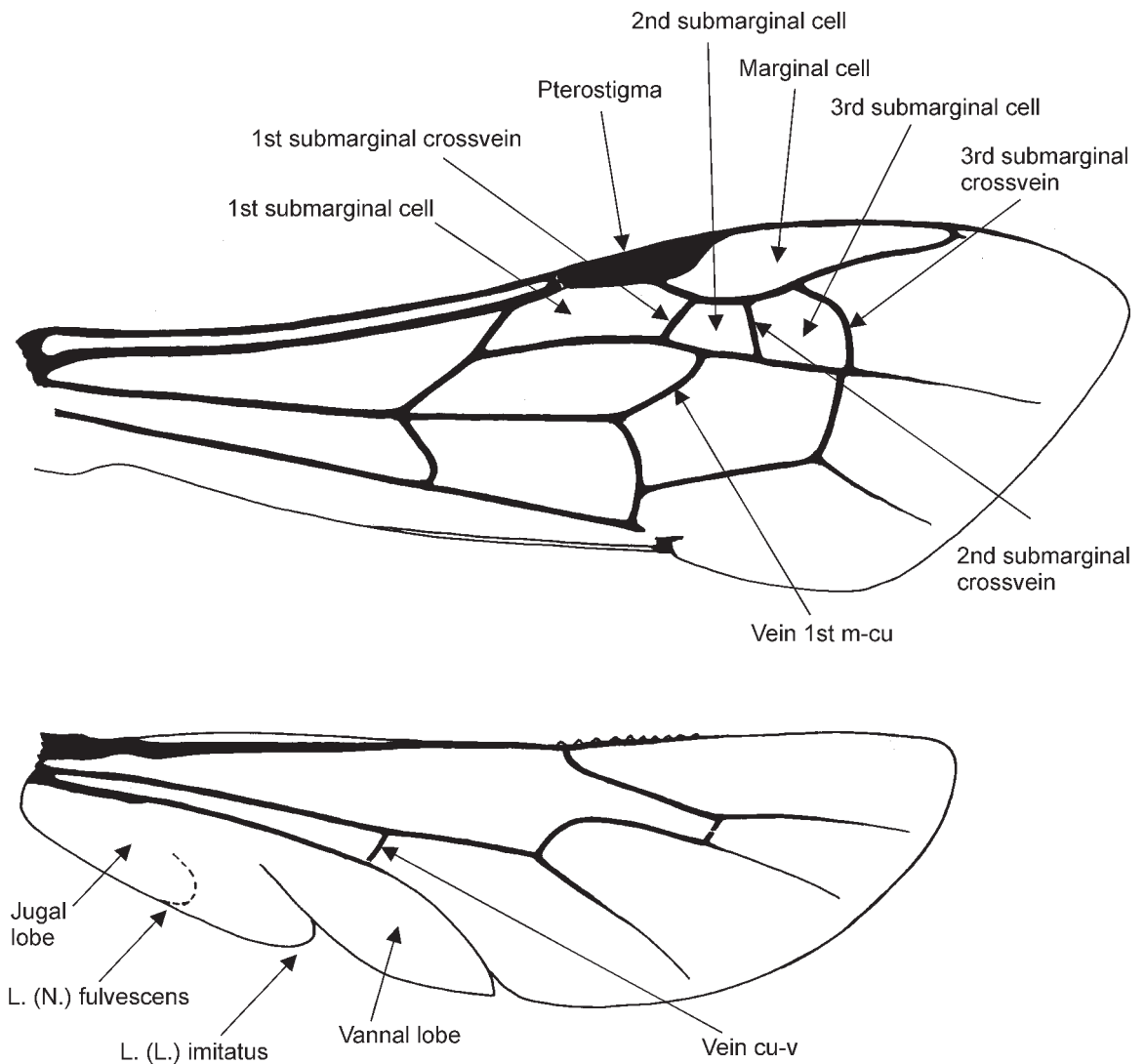


Fig. 34 a–f *Apis mellifera ligustica*, a–b queen; c–d drone; e–f worker.

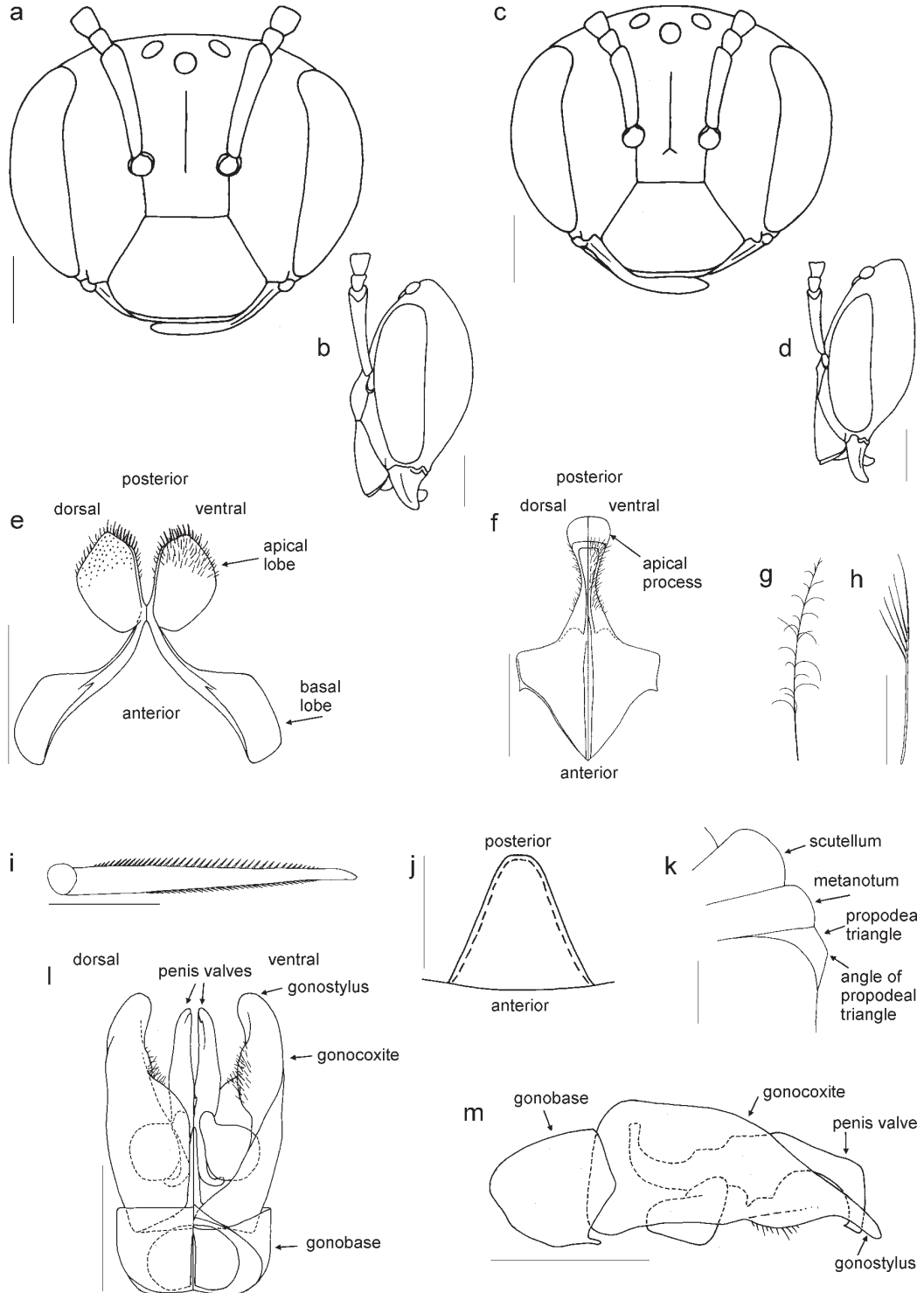


**Fig. 35** Thorax, lateral view to show names of structures.

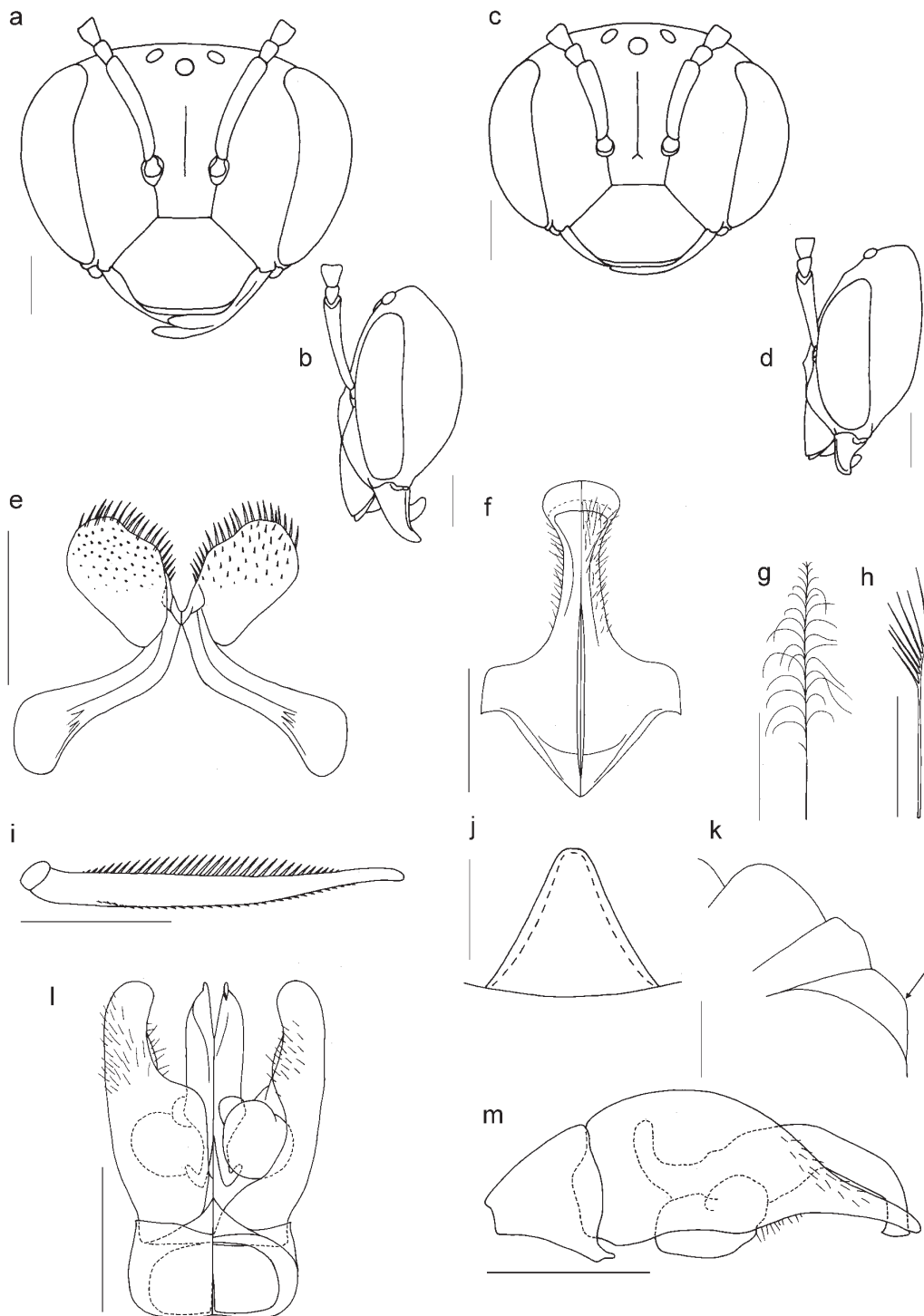




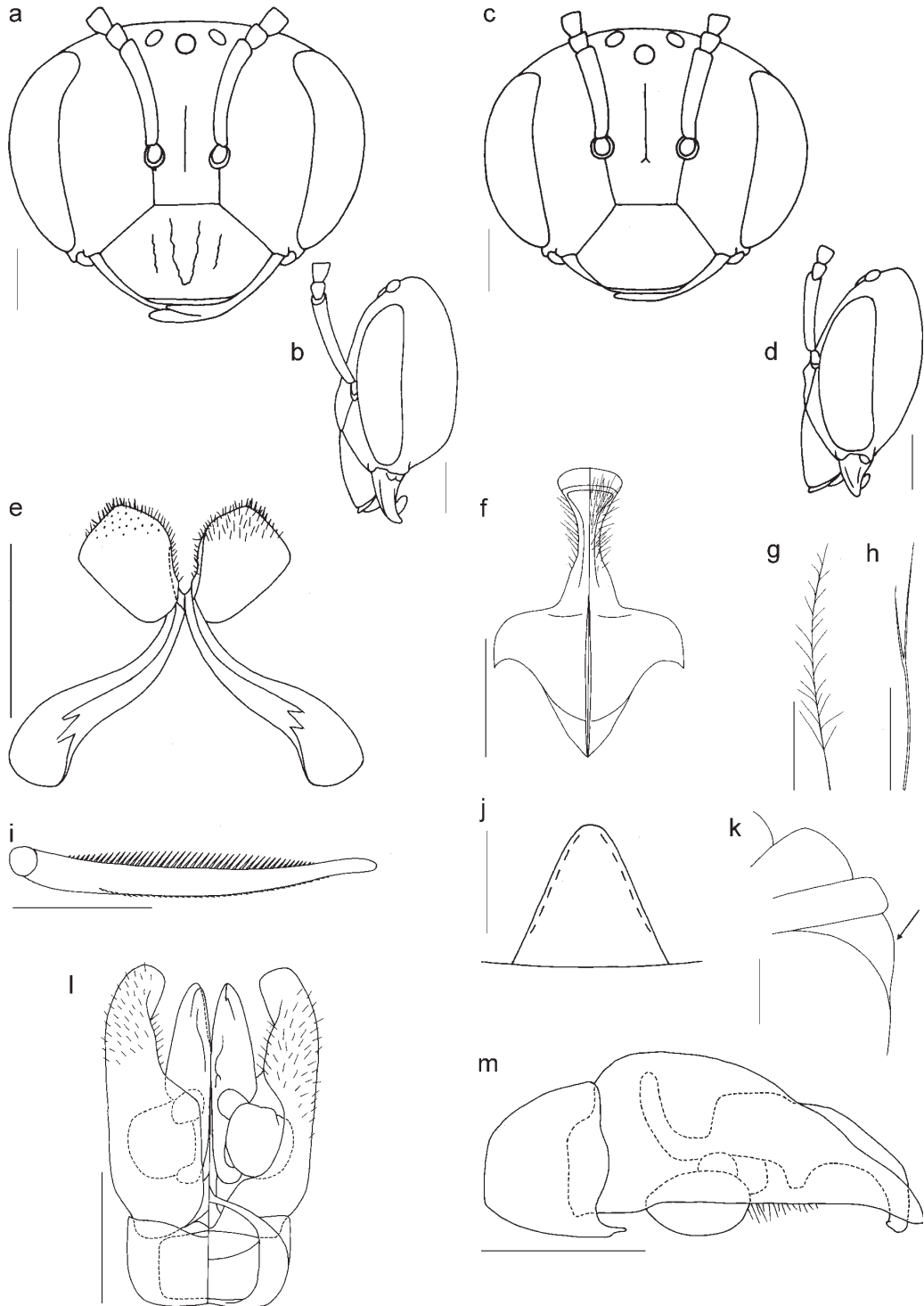
**Fig. 36** Wings, to show names of veins and cells. **a** forewing. **b** hind wing.



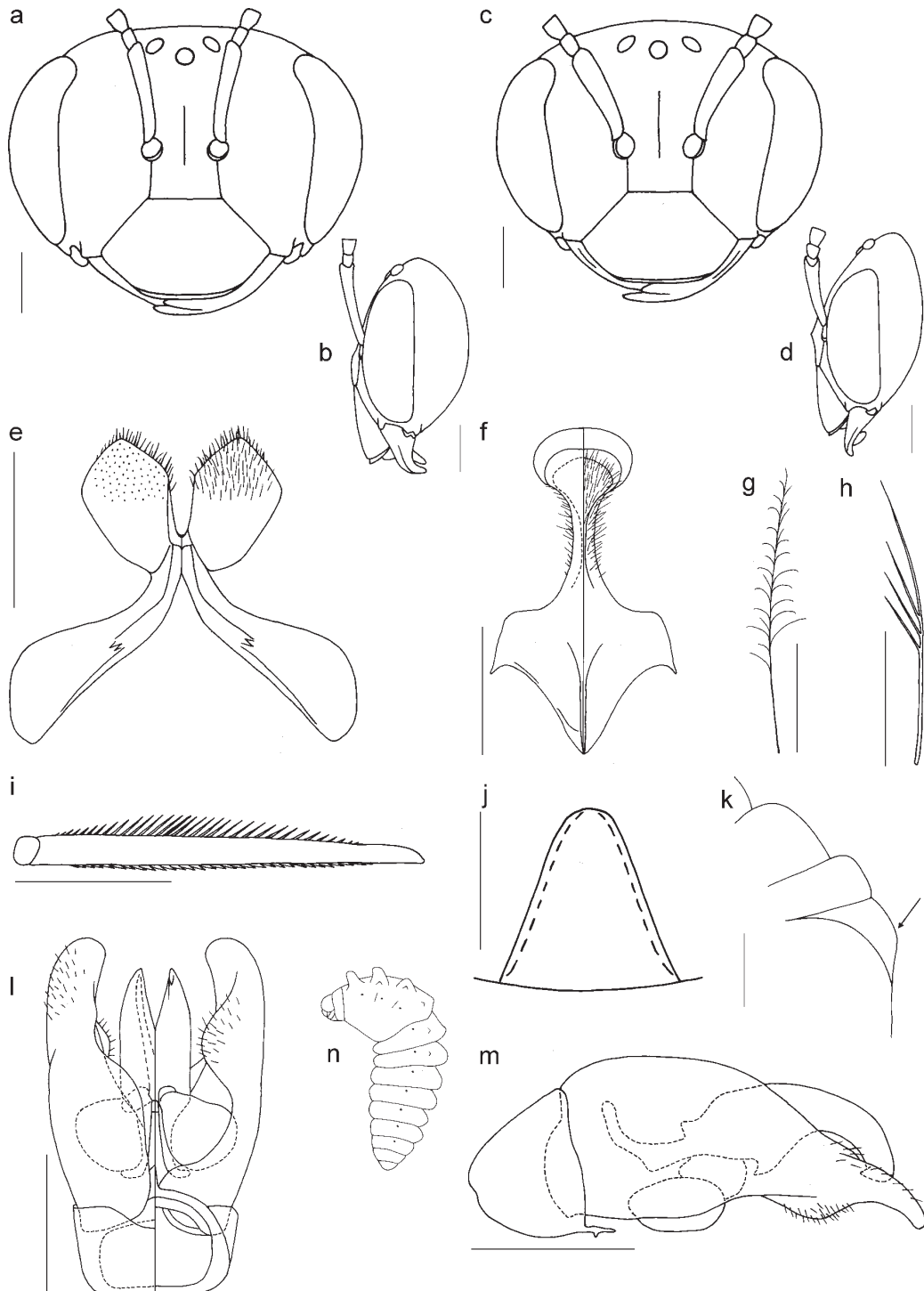
**Fig. 37** *Leiproctus boltoni*. **a–b, g–k** female, **a** head, frontal; **b** head, lateral; **g** hair of trochanteral floccus; **h** hair of basitibial scopa; **i** inner hind tibial spur; **j** pygidial plate; **k** posterior of mesosoma showing propodeal triangle, lateral. **c–f, l–m** male, **c** head, frontal; **d** head, lateral; **e** metasomal sternum 7, dorsal and ventral; **f** metasomal sternum 8, dorsal and ventral; **l** genital capsule, dorsal and ventral; **m** genital capsule, lateral. Scale bars = 1 mm; g, i = 0.5 mm.



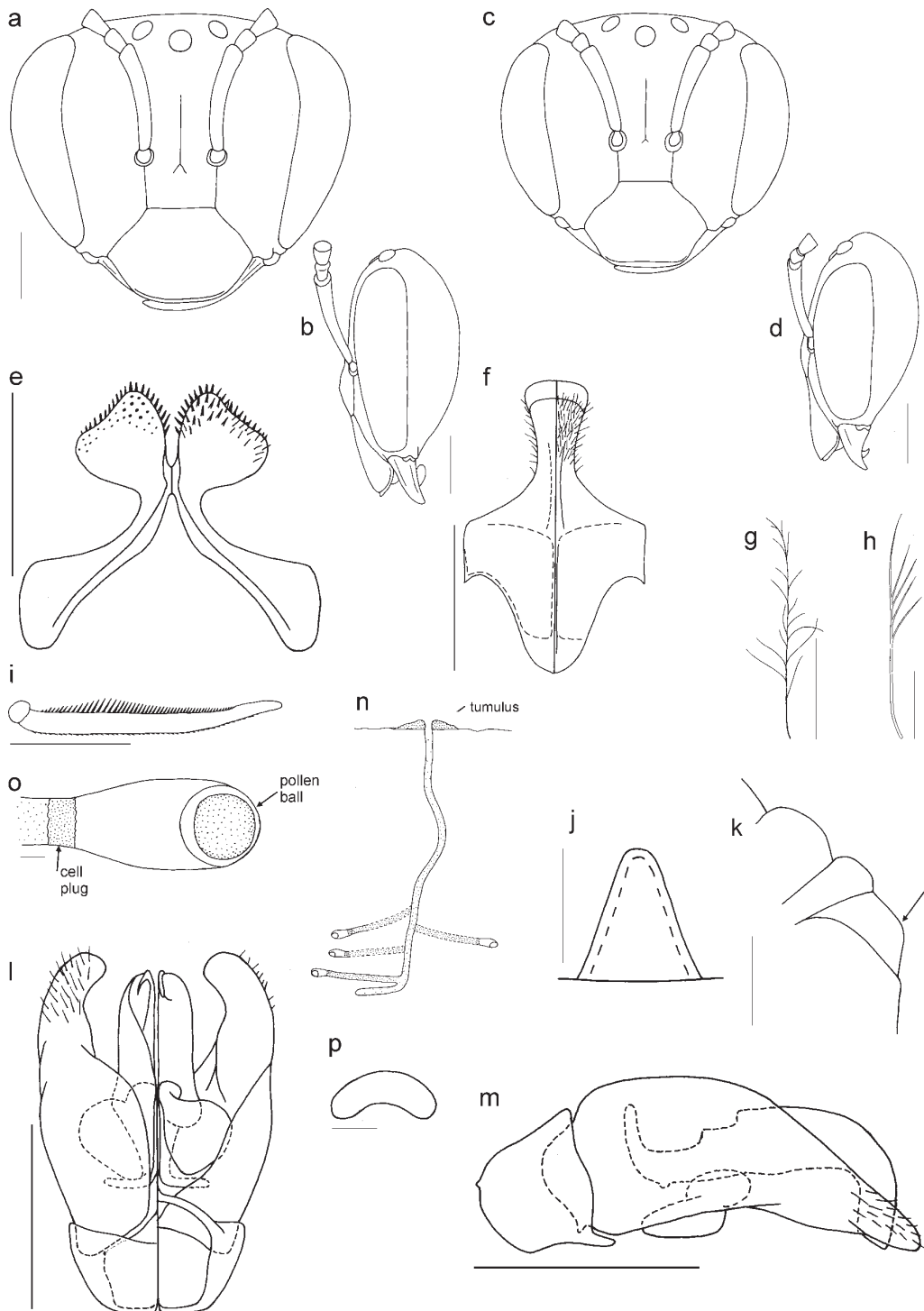
**Fig. 38** *Leioproctus huakiwi*. **a–b, g–k** female, **a** head, frontal; **b** head, lateral; **g** hair of trochanteral floccus; **h** hair of basitibial scopa; **i** inner hind tibial spur; **j** pygidial plate; **k** propodeal triangle (arrow), lateral. **c–f, l–m** male, **c** head, frontal; **d** head, lateral; **e** metasomal sternum 7, dorsal and ventral; **f** metasomal sternum 8, dorsal and ventral; **l** genital capsule, dorsal and ventral; **m** genital capsule, lateral. Scale bars = 1 mm; **g, i** = 0.5 mm.



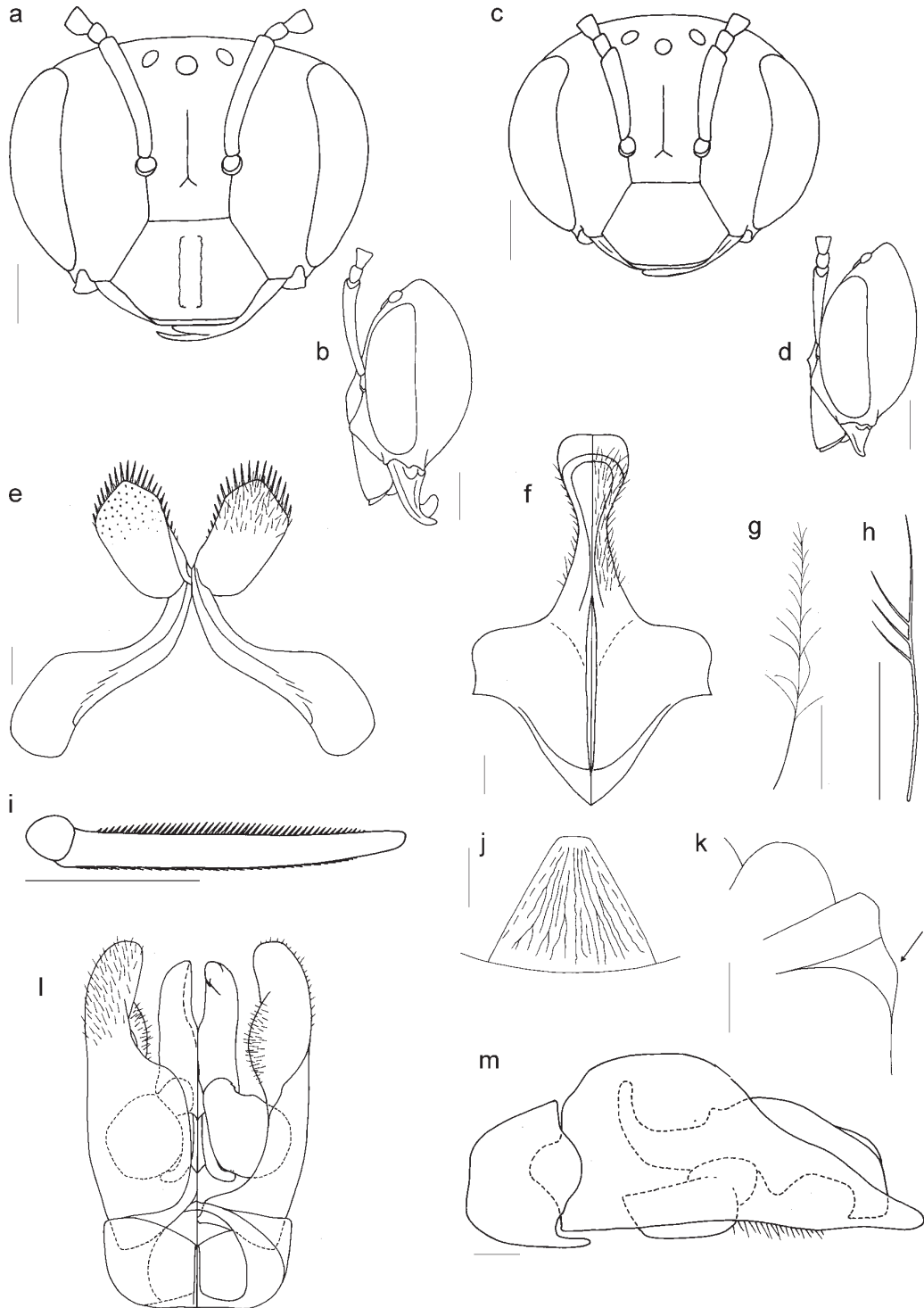
**Fig. 39** *Leiproctus imitatus*. **a–b, g–k** female, **a** head, frontal; **b** head, lateral; **g** hair of trochanteral floccus; **h** hair of basitibial scopa; **i** inner hind tibial spur; **j** pygidial plate; **k** propodeal triangle (arrow), lateral. **c–f, l–m** male, **c** head, frontal; **d** head, lateral; **e** metasomal sternum 7, dorsal and ventral; **f** metasomal sternum 8, dorsal and ventral; **l** genital capsule, dorsal and ventral; **m** genital capsule, lateral. Scale bars = 1 mm; g, i = 0.5 mm.



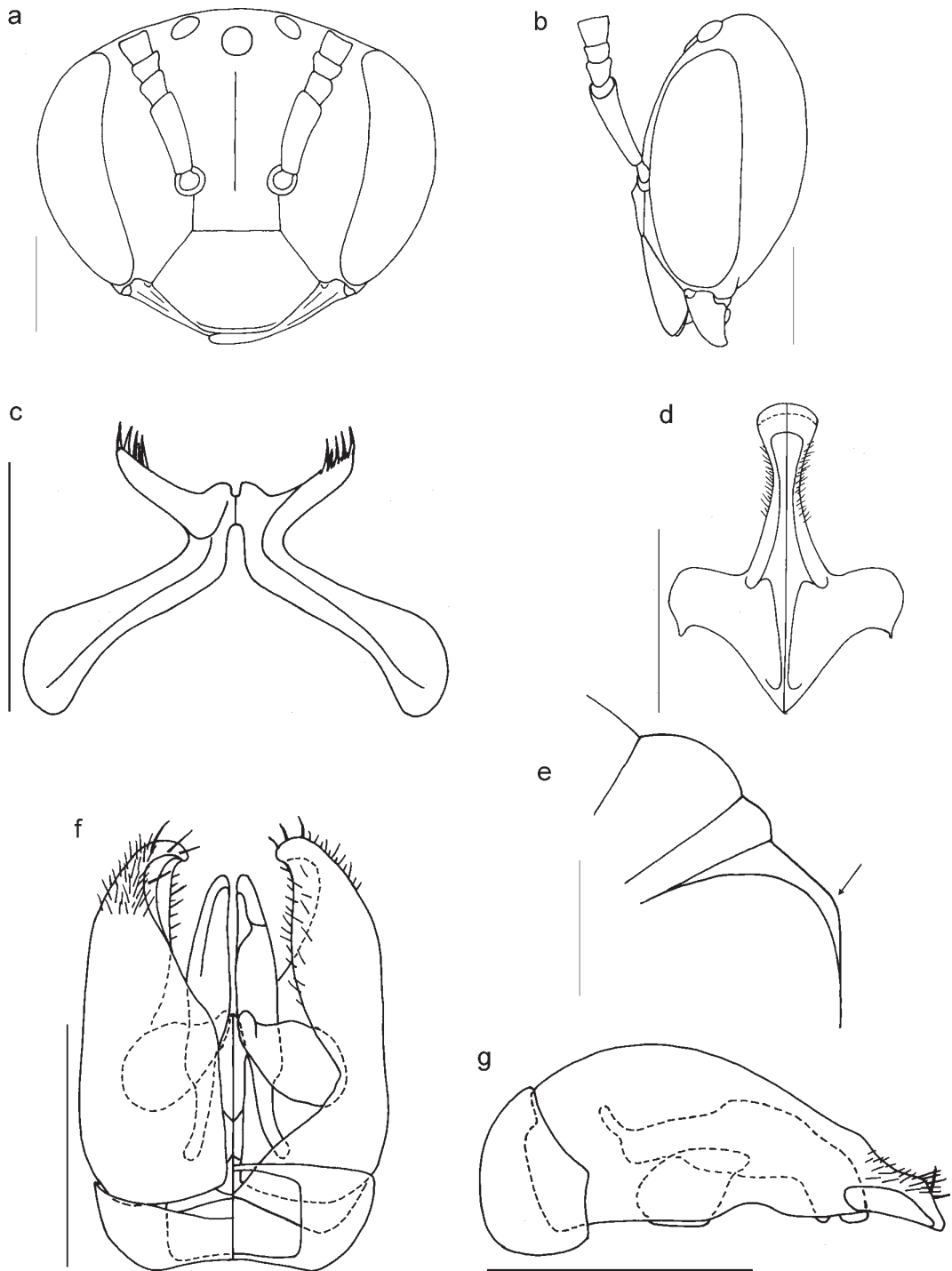
**Fig. 40** *Leioproctus kanapuu*. **a–b, g–k** female, **a** head, frontal; **b** head, lateral; **g** hair of trochanteral floccus; **h** hair of basitibial scopa; **i** inner hind tibial spur; **j** pygidial plate; **k** propodeal triangle (arrow), lateral. **c–f, l–m** male, **c** head, frontal; **d** head, lateral; **e** metasomal sternum 7, dorsal and ventral; **f** metasomal sternum 8, dorsal and ventral; **l** genital capsule, dorsal and ventral; **m** genital capsule, lateral. **n** prepupa from nest site in cliff, Abut Head, WD, 25 Feb 1995. Scale bars = 1 mm; g, i = 0.5 mm.



**Fig. 41** *Leioproctus keehua*. **a–b, g–k** female, **a** head, frontal; **b** head, lateral; **g** hair of trochanteral flocus; **h** hair of basitibial scopa; **i** inner hind tibial spur; **j** pygidial plate; **k** propodeal triangle (arrow), lateral. **c–f, l–m** male, **c** head, frontal; **d** head, lateral; **e** metasomal sternum 7, dorsal and ventral; **f** metasomal sternum 8, dorsal and ventral; **l** genital capsule, dorsal and ventral; **m** genital capsule, lateral. **n–p** nest, edge of Lake Ellesmere, MC, 31 Jun 1978, **n** nest; **o** cell with pollen ball and ring of nectar, dorsal view; **p** egg. Scale bars = 1 mm; **g, i** = 0.5 mm.

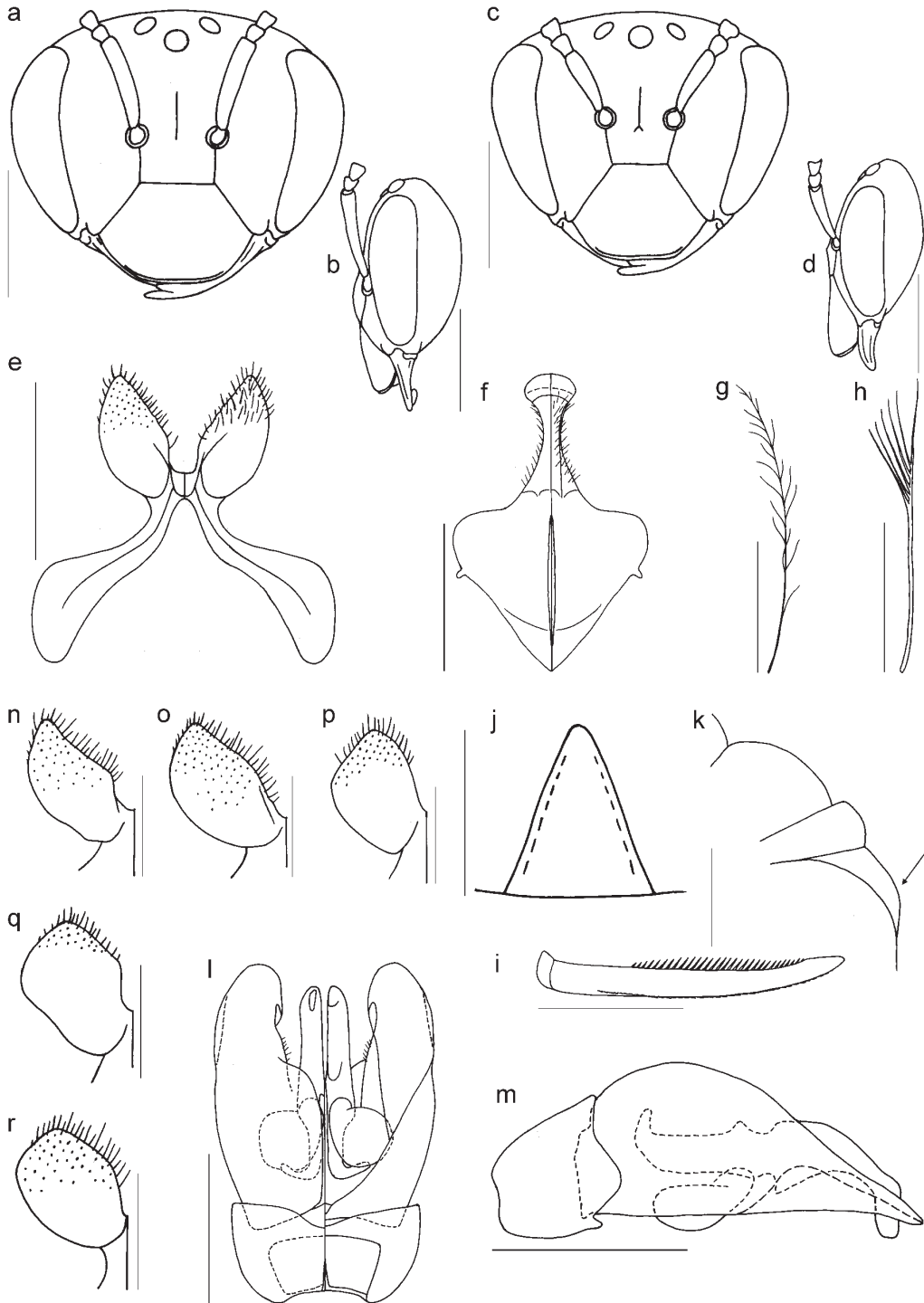


**Fig. 42** *Leioproctus metallicus*. **a–b, g–k** female, **a** head, frontal; **b** head, lateral; **g** hair of trochanteral floccus; **h** hair of basitibial scopa; **i** inner hind tibial spur; **j** pygidial plate; **k** propodeal triangle (arrow), lateral. **c–f, l–m** male, **c** head, frontal; **d** head, lateral; **e** metasomal sternum 7, dorsal and ventral; **f** metasomal sternum 8, dorsal and ventral; **l** genital capsule, dorsal and ventral; **m** genital capsule, lateral. Scale bars = 1 mm; **g, i** = 0.5 mm.

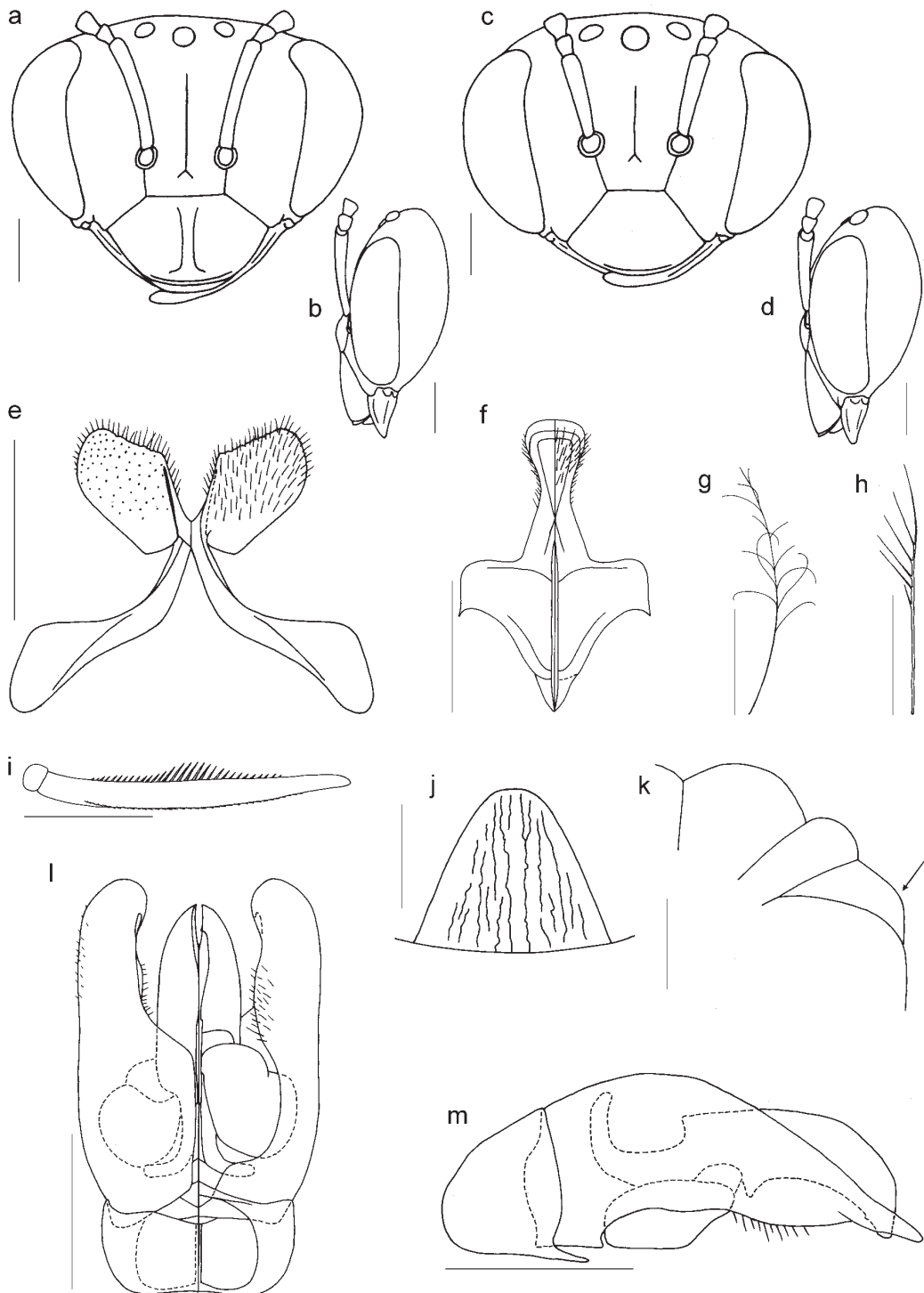


**Fig. 43** *Leioproctus otautahi*. **a–g** male, **a** head, frontal; **b** head, lateral; **c** metasomal sternum 7, dorsal and ventral; **d** metasomal sternum 8, dorsal and ventral; **e** propodeal triangle (arrow), lateral. **f** genital capsule, dorsal and ventral; **g** genital capsule, lateral. Scale bars = 1 mm.

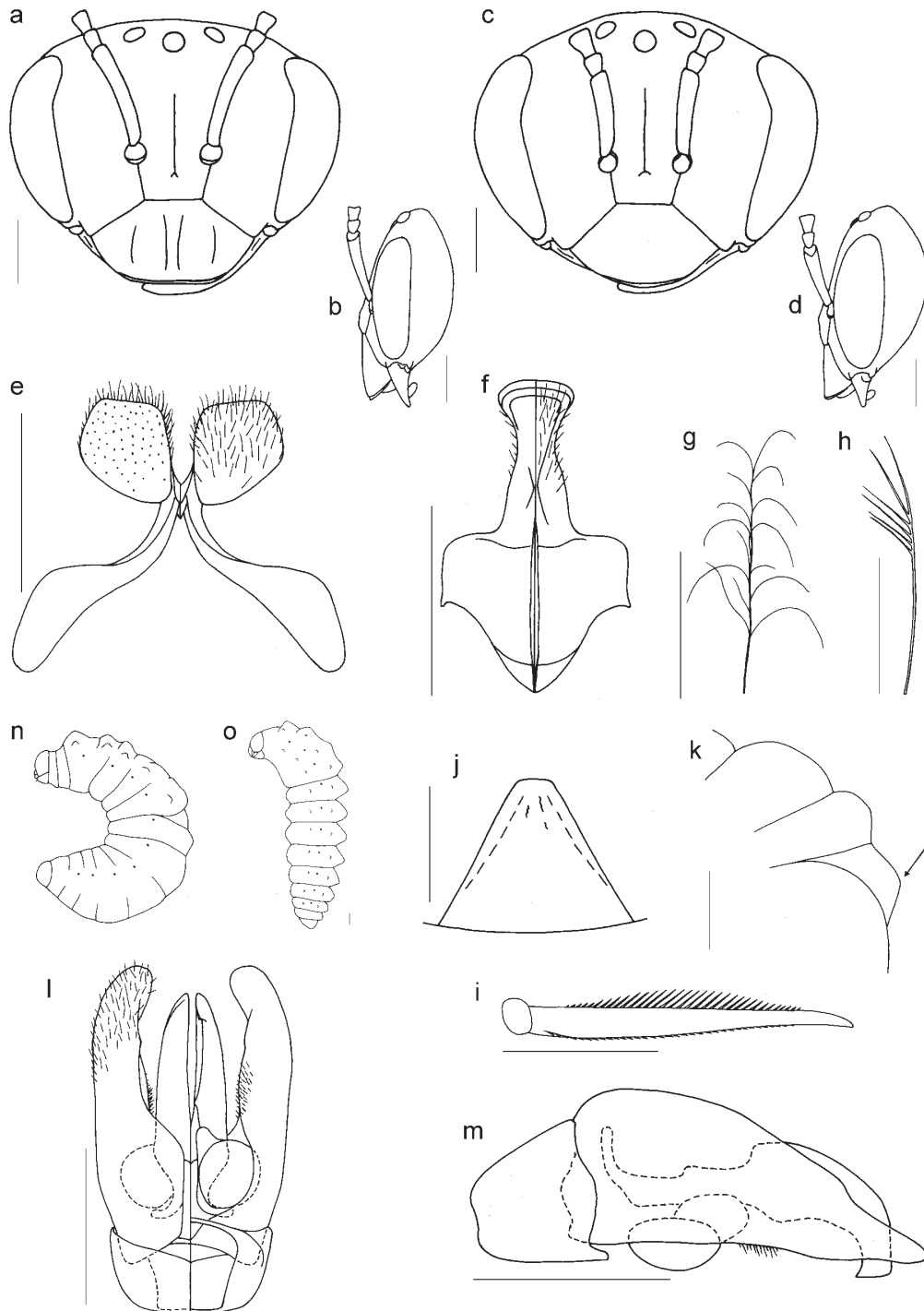




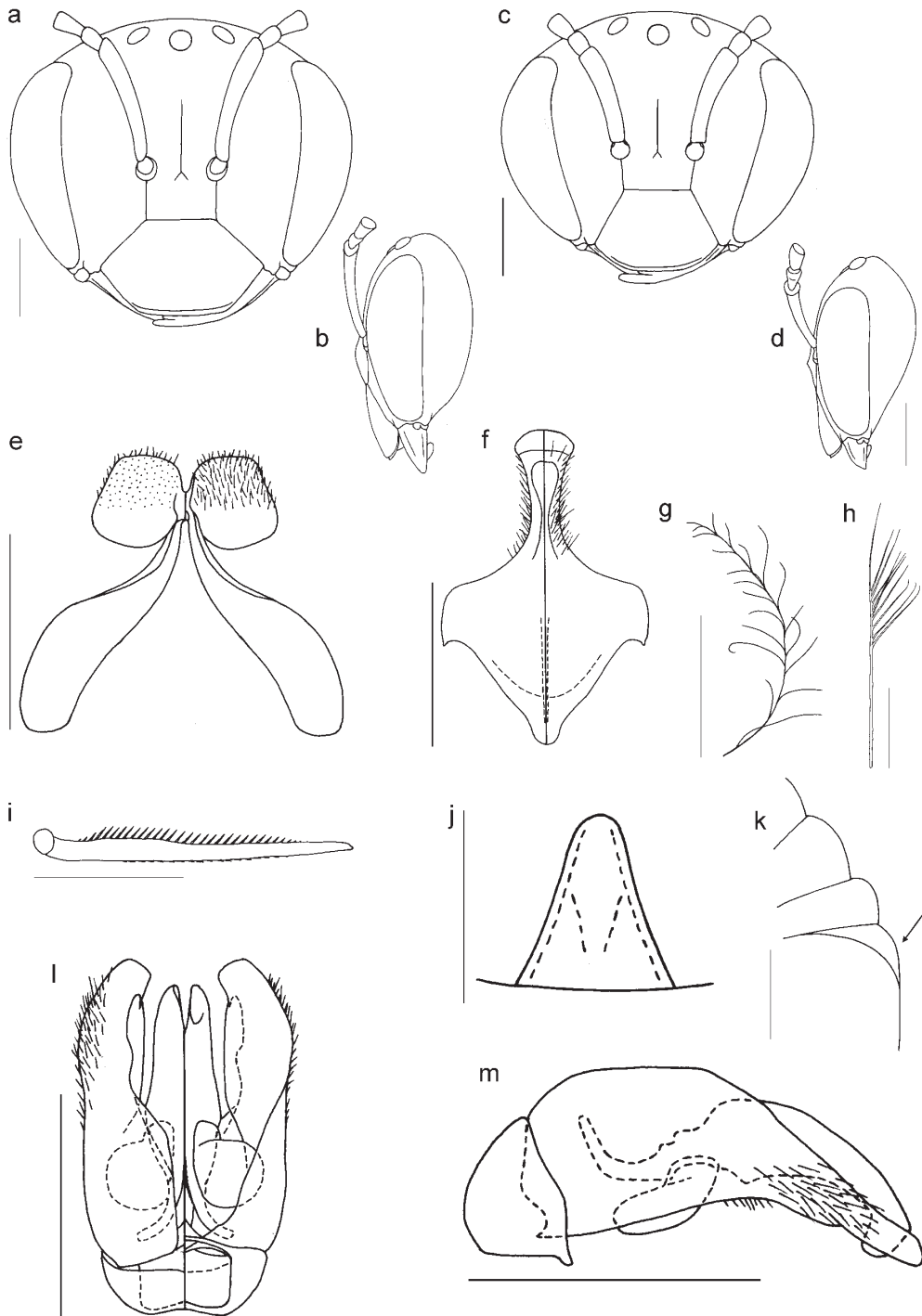
**Fig. 44** *Leioproctus pango*. **a–b, g–k** female, **a** head, frontal; **b** head, lateral; **g** hair of trochanteral floccus; **h** hair of basitibial scopa; **i** inner hind tibial spur; **j** pygidial plate; **k** propodeal triangle (arrow), lateral. **c–f, l–r** male, **c** head, frontal; **d** head, lateral; **e** metasomal sternum 7, dorsal and ventral; **f** metasomal sternum 8, dorsal and ventral; **l** genital capsule, dorsal and ventral; **m** genital capsule, lateral. **n–r** metasomal sternum 7, apical lobe variation, **n** Cheviot, NC; **o** Lindis Pass, CO; **p** Birkdale, AK; **q** Manutuke, GB; **r** Abut Head, WD. Scale bars = 1 mm; g, l, n–r = 0.5 mm.



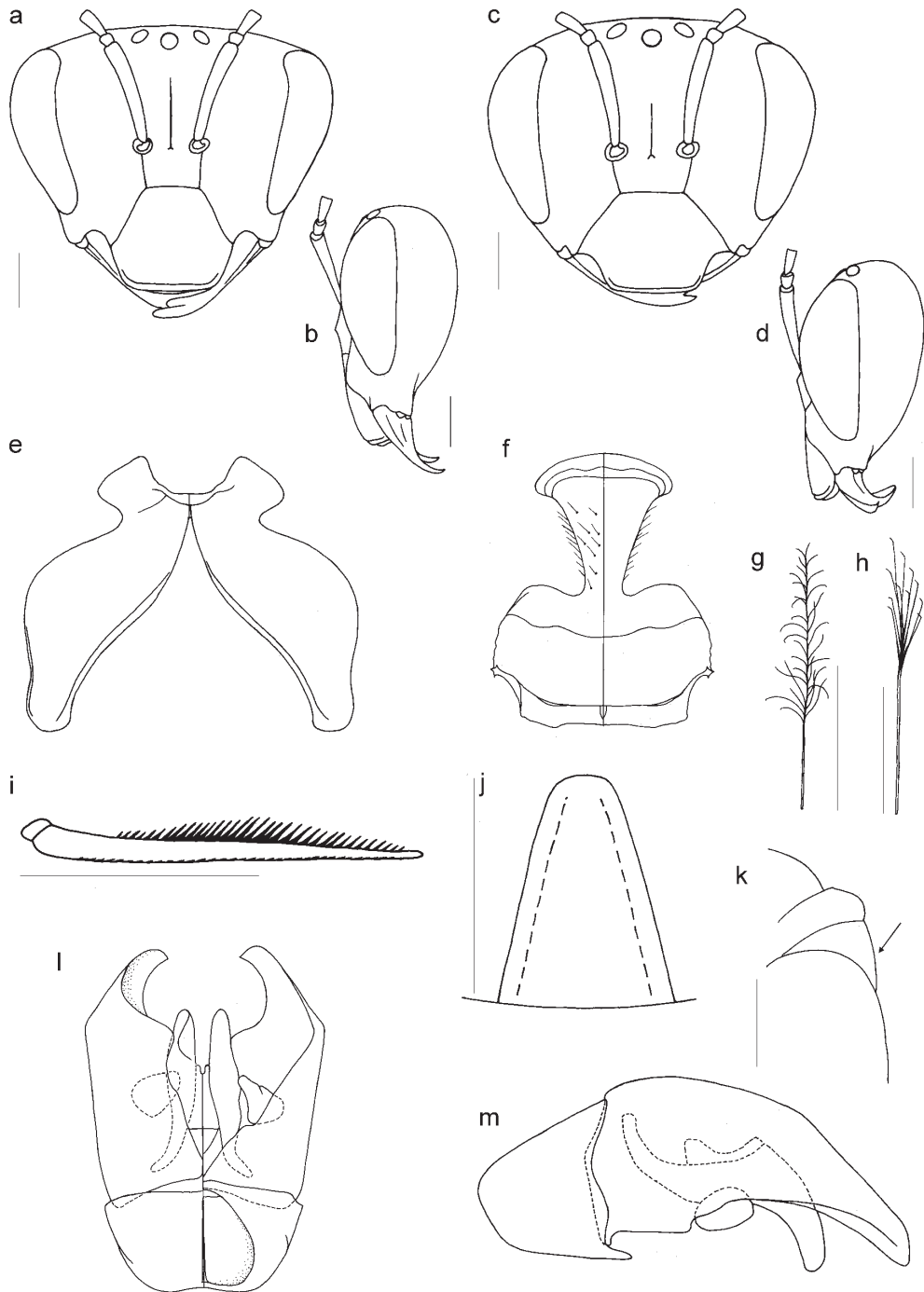
**Fig. 45** *Leioproctus purpureus*. **a–b, g–k** female, **a** head, frontal; **b** head, lateral; **g** hair of trochanteral floccus; **h** hair of basitibial scopa; **i** inner hind tibial spur; **j** pygidial plate; **k** propodeal triangle (arrow), lateral. **c–f, l–m** male, **c** head, frontal; **d** head, lateral; **e** metasomal sternum 7, dorsal and ventral; **f** metasomal sternum 8, dorsal and ventral; **l** genital capsule, dorsal and ventral; **m** genital capsule, lateral. Scale bars = 1 mm; g, i = 0.5 mm.



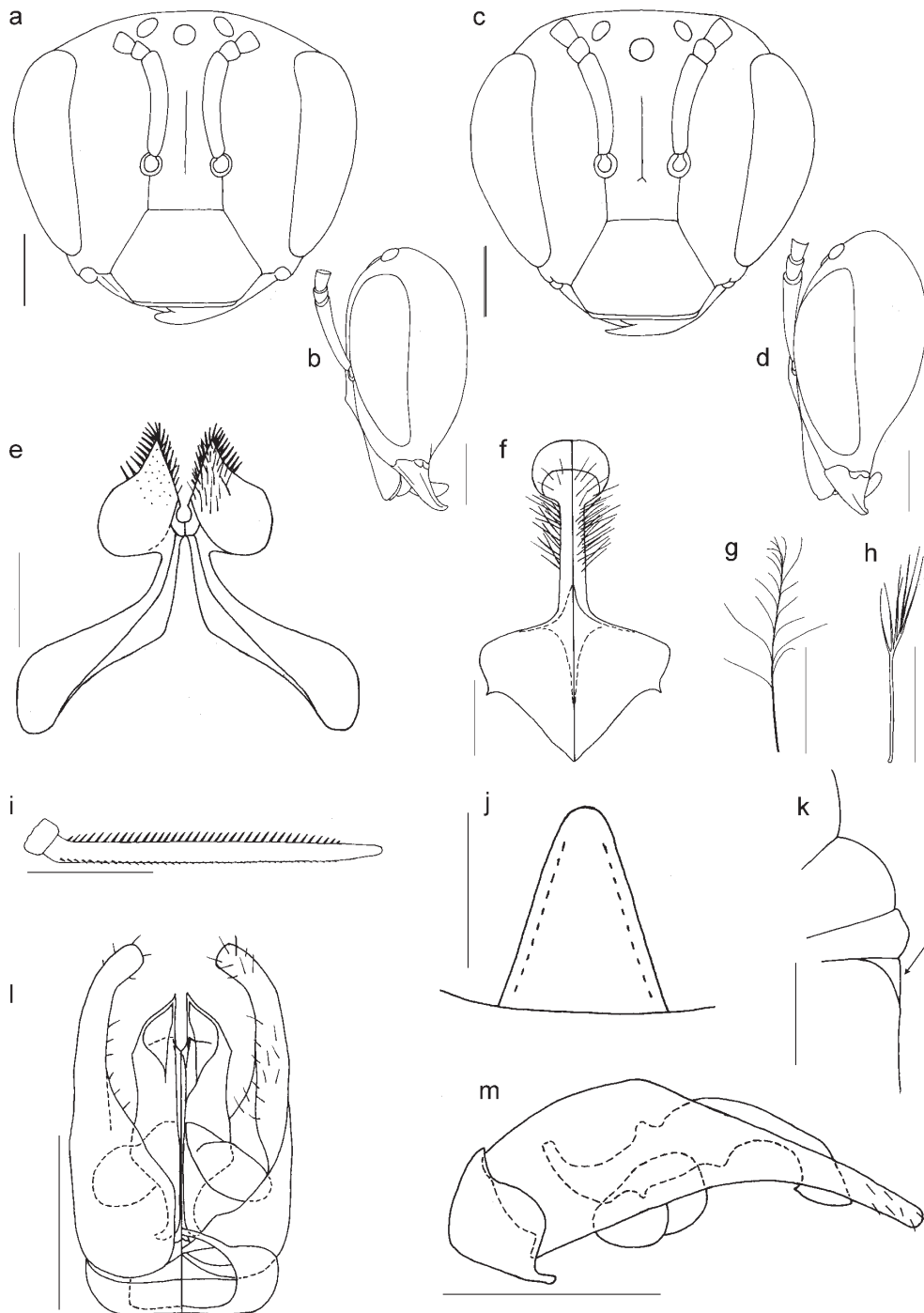
**Fig. 46** *Leioproctus vestitus*. **a–b, g–k** female, **a** head, frontal; **b** head, lateral; **g** hair of trochanteral floccus; **h** hair of basitibial scopa; **i** inner hind tibial spur; **j** pygidial plate; **k** propodeal triangle (arrow), lateral. **c–f, l–m** male, **c** head, frontal; **d** head, lateral; **e** metasomal sternum 7, dorsal and ventral; **f** metasomal sternum 8, dorsal and ventral; **l** genital capsule, dorsal and ventral; **m** genital capsule, lateral. **n** last instar larva from nest site in the bed of the Whataroa R, 5 km E Abut Head, WD, 2 March 1995. **o** prepupa, same data as in **n** except 9 May 1994. Scale bars = 1 mm; **g, i** = 0.5 mm.



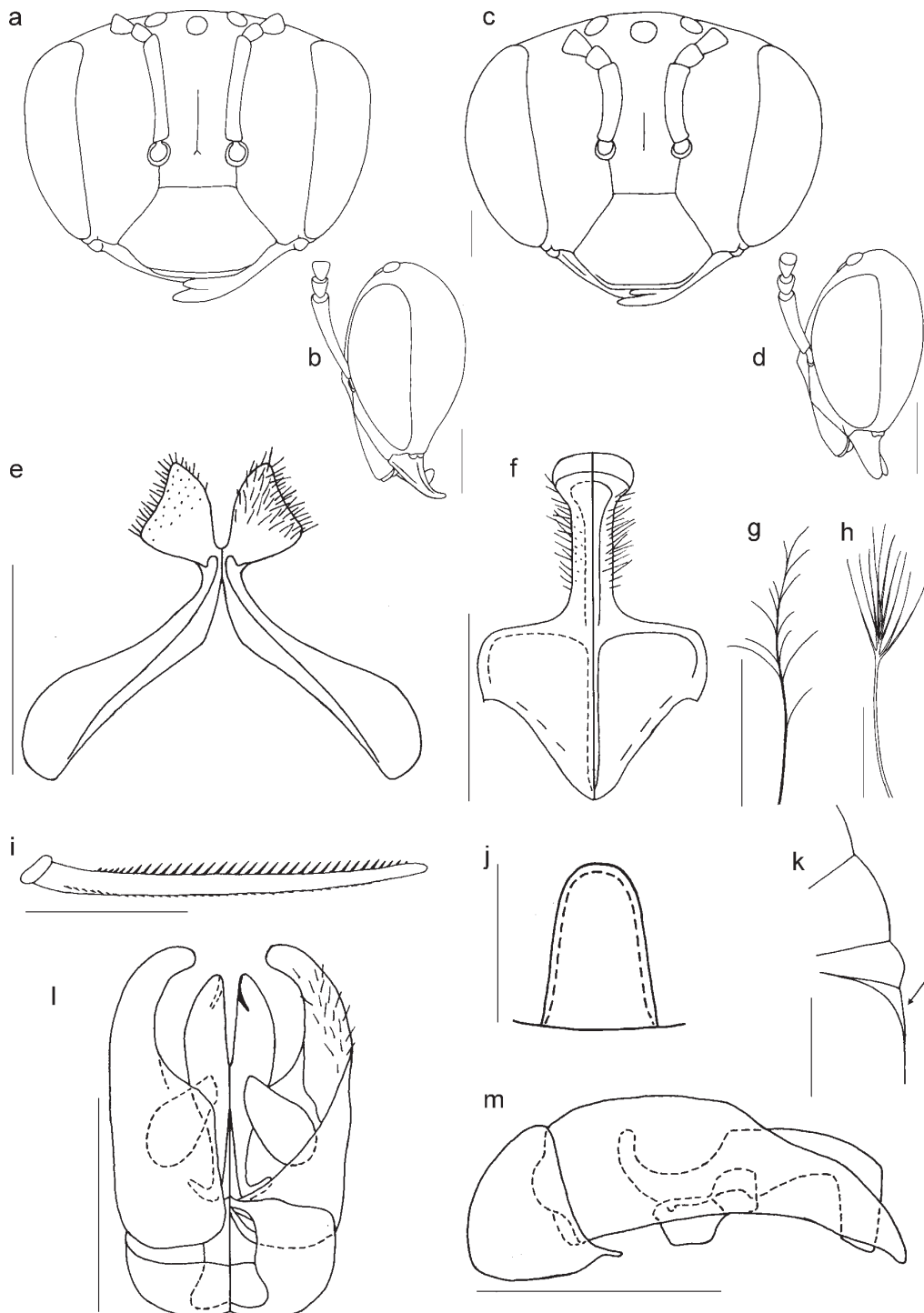
**Fig. 47** *Leioproctus waipounamu*. **a–b, g–k** female, **a** head, frontal; **b** head, lateral; **g** hair of trochanteral floccus; **h** hair of basitibial scopa; **i** inner hind tibial spur; **j** pygidial plate; **k** propodeal triangle (arrow), lateral. **c–f, l–m** male, **c** head, frontal; **d** head, lateral; **e** metasomal sternum 7, dorsal and ventral; **f** metasomal sternum 8, dorsal and ventral; **l** genital capsule, dorsal and ventral; **m** genital capsule, lateral. Scale bars = 1 mm; g, i = 0.5 mm.



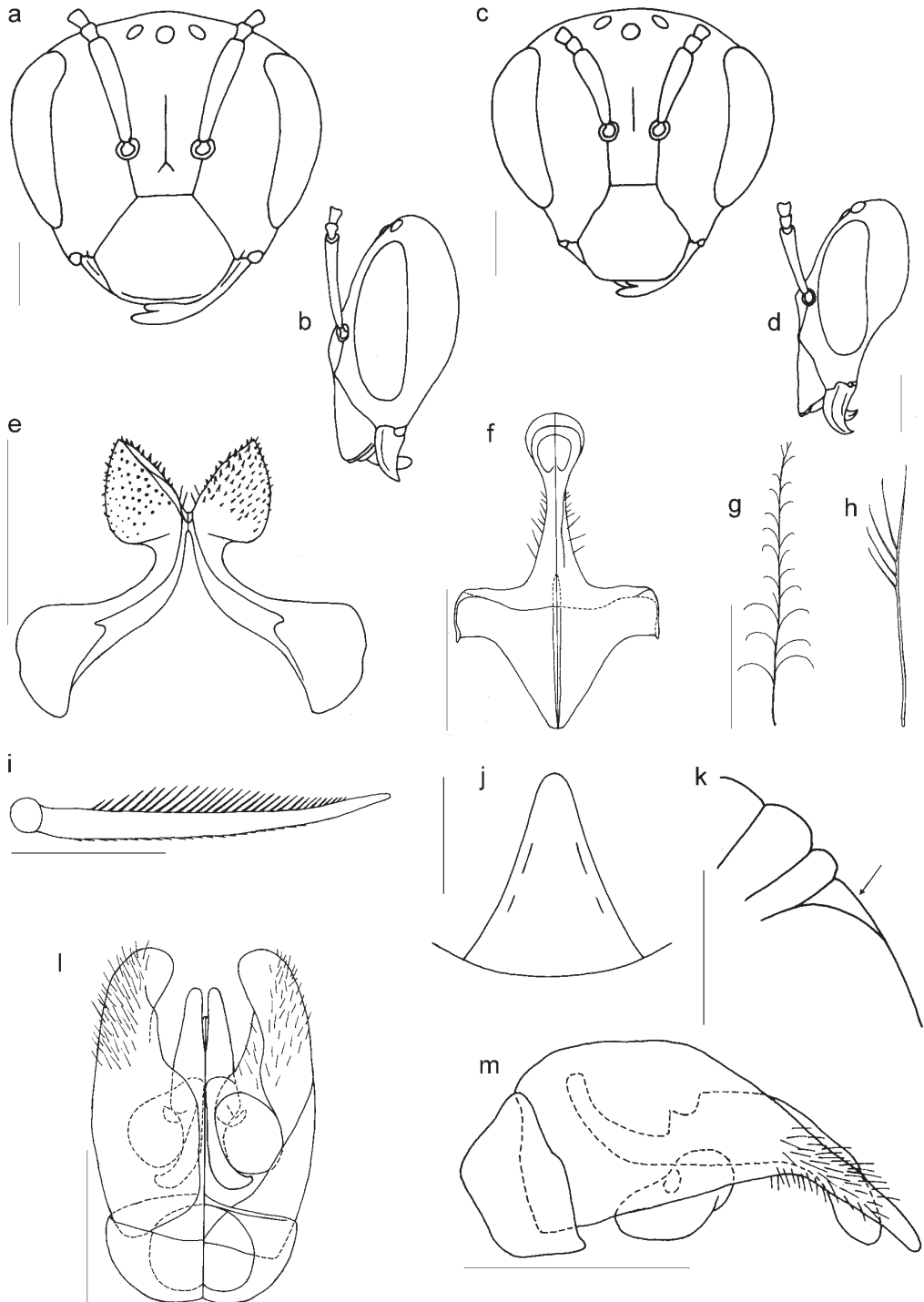
**Fig. 48** *Leioproctus fulvescens*. **a–b, g–k** female, **a** head, frontal; **b** head, lateral; **g** hair of trochanteral floccus; **h** hair of basitibial scopa; **i** inner hind tibial spur; **j** pygidial plate; **k** propodeal triangle (arrow), lateral. **c–f, l–m** male, **c** head, frontal; **d** head, lateral; **e** metasomal sternum 7, dorsal and ventral; **f** metasomal sternum 8, dorsal and ventral; **l** genital capsule, dorsal and ventral; **m** genital capsule, lateral. Scale bars = 1 mm.



**Fig. 49** *Leioproctus hudsoni*. **a–b, g–k** female, **a** head, frontal; **b** head, lateral; **g** hair of trochanteral floccus; **h** hair of basitibial scopa; **i** inner hind tibial spur; **j** pygidial plate; **k** propodeal triangle (arrow), lateral. **c–f, l–m** male, **c** head, frontal; **d** head, lateral; **e** metasomal sternum 7, dorsal and ventral; **f** metasomal sternum 8, dorsal and ventral; **l** genital capsule, dorsal and ventral; **m** genital capsule, lateral. Scale bars = 1 mm; **g, i** = 0.5 mm.

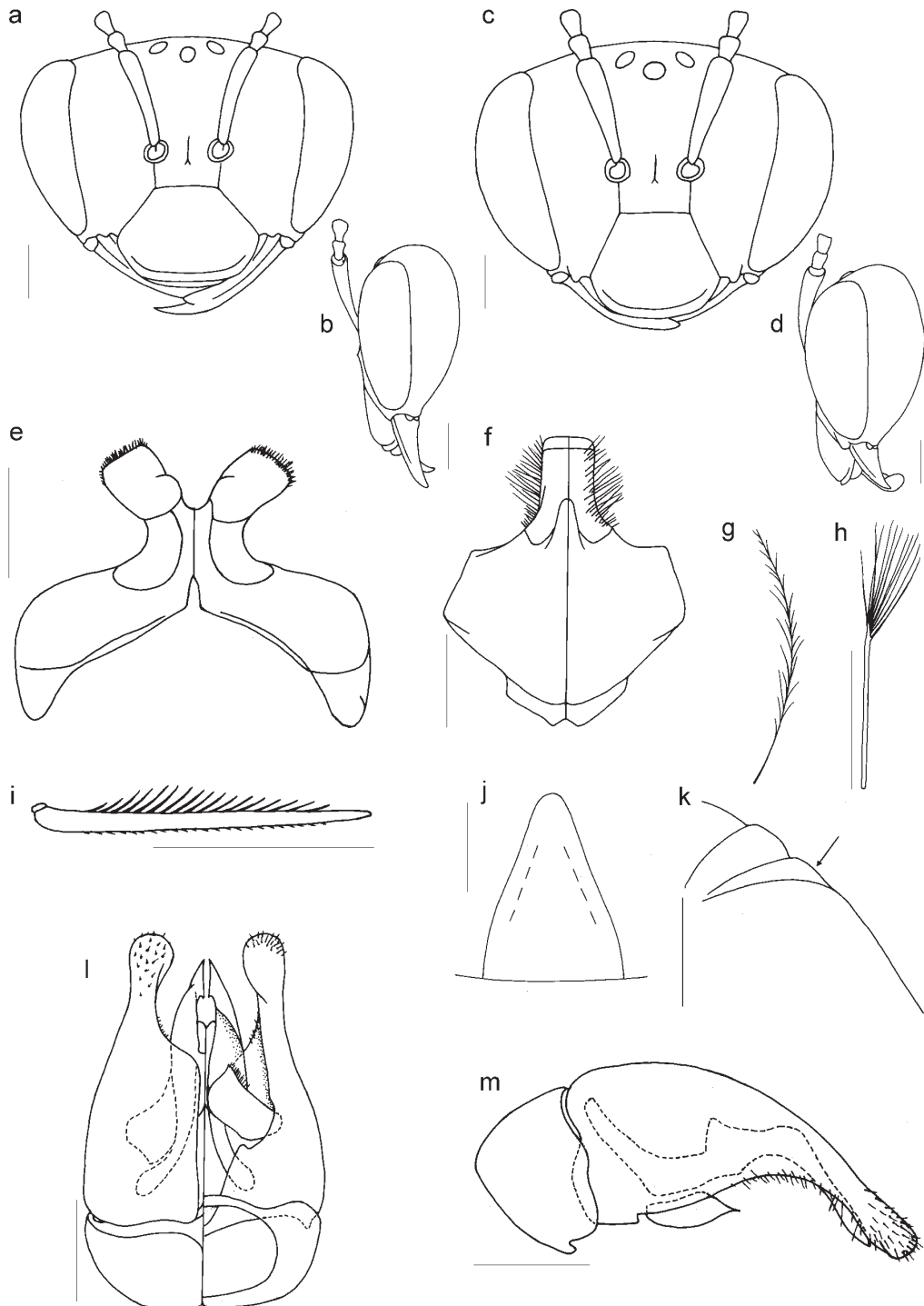


**Fig. 50** *Leioproctus maritimus*. **a–b, g–k** female, **a** head, frontal; **b** head, lateral; **g** hair of trochanteral floccus; **h** hair of basitibial scopa; **i** inner hind tibial spur; **j** pygidial plate; **k** propodeal triangle (arrow), lateral. **c–f, l–m** male, **c** head, frontal; **d** head, lateral; **e** metasomal sternum 7, dorsal and ventral; **f** metasomal sternum 8, dorsal and ventral; **l** genital capsule, dorsal and ventral; **m** genital capsule, lateral. Scale bars = 1 mm; g–i = 0.5 mm.

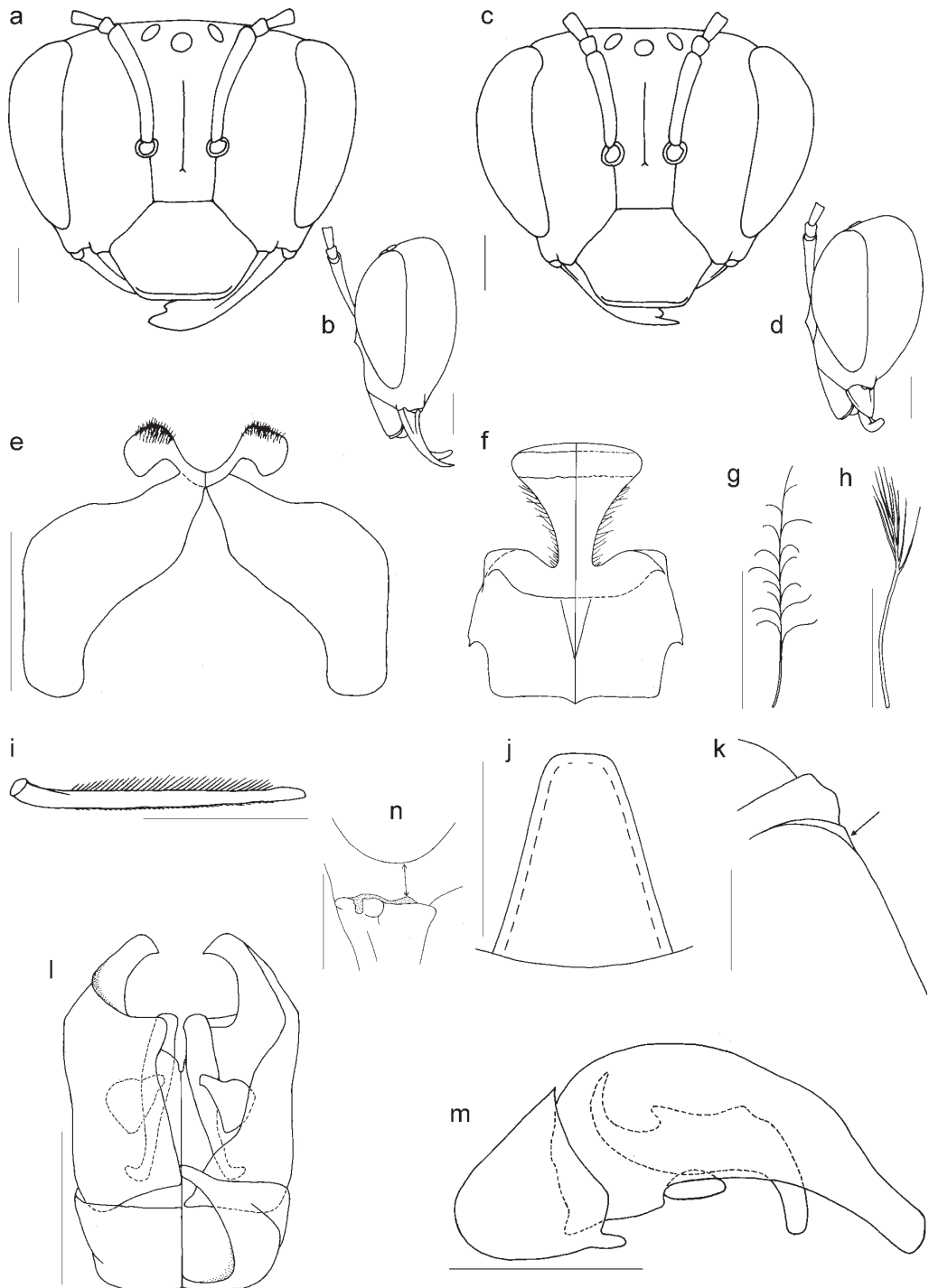


**Fig. 51** *Leiproctus monticola*. **a–b, g–k** female, **a** head, frontal; **b** head, lateral; **g** hair of trochanteral floccus; **h** hair of basitibial scopa; **i** inner hind tibial spur; **j** pygidial plate; **k** propodeal triangle (arrow), lateral. **c–f, l–m** male, **c** head, frontal; **d** head, lateral; **e** metasomal sternum 7, dorsal and ventral; **f** metasomal sternum 8, dorsal and ventral; **l** genital capsule, dorsal and ventral; **m** genital capsule, lateral. Scale bars = 1 mm; g, i = 0.5 mm.

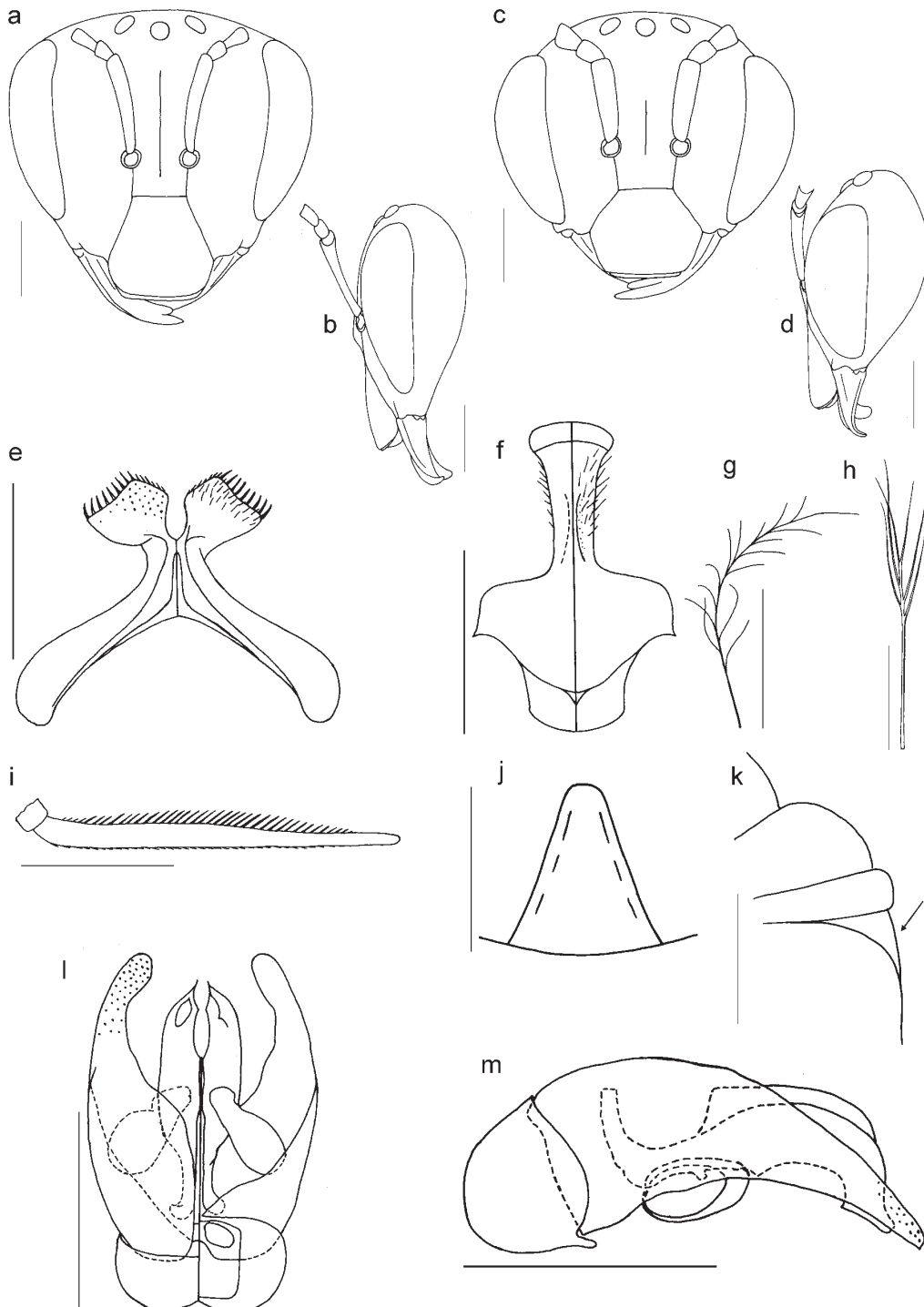




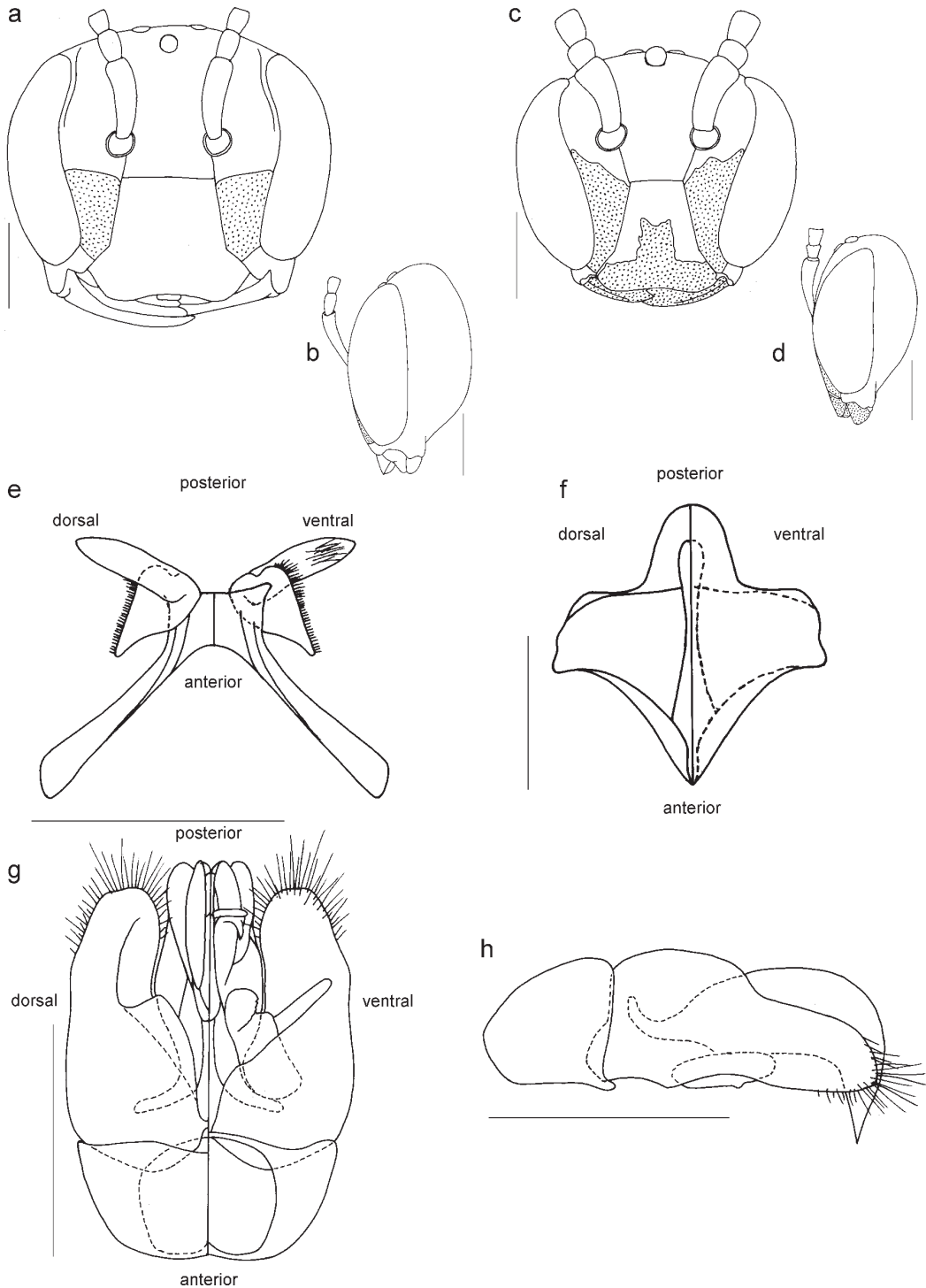
**Fig. 52** *Leioproctus nunui*. **a–b, g–k** female, **a** head, frontal; **b** head, lateral; **g** hair of trochanteral floccus; **h** hair of basitibial scopa; **i** inner hind tibial spur; **j** pygidial plate; **k** propodeal triangle (arrow), lateral. **c–f, l–m** male, **c** head, frontal; **d** head, lateral; **e** metasomal sternum 7, dorsal and ventral; **f** metasomal sternum 8, dorsal and ventral; **l** genital capsule, dorsal and ventral; **m** genital capsule, lateral. Scale bars = 1 mm



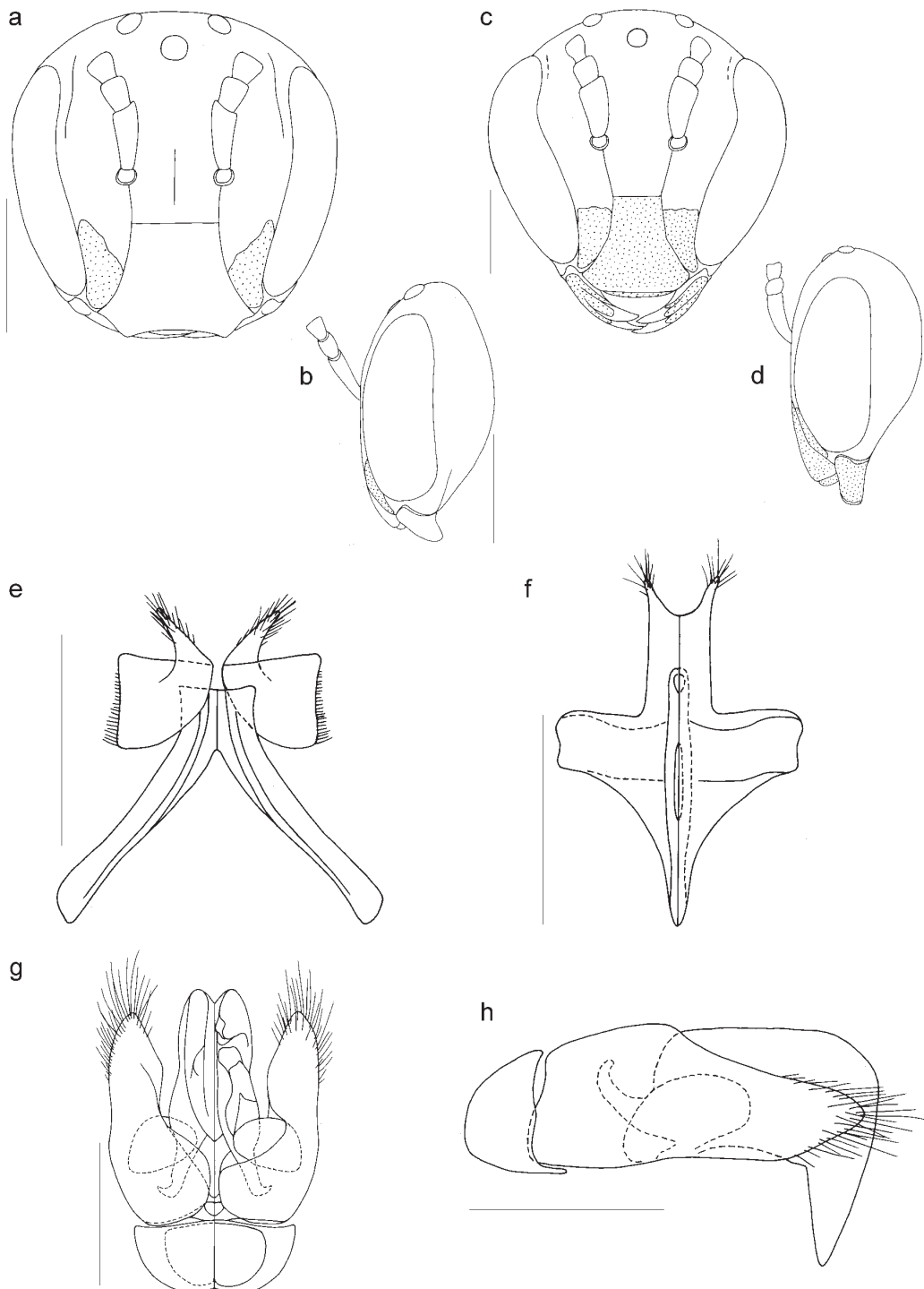
**Fig. 53** *Leiproctus paahaumaa*. **a–b, g–k, n** female, **a** head, frontal; **b** head, lateral; **g** hair of trochanteral floccus; **h** hair of basitibial scopa; **i** inner hind tibial spur; **j** pygidial plate; **k** propodeal triangle (arrow), lateral; **l** propodeal triangle (arrow), lateral; **n** malar length (arrow). **c–f, l–m** male, **c** head, frontal; **d** head, lateral; **e** metasomal sternum 7, dorsal and ventral; **f** metasomal sternum 8, dorsal and ventral; **l** genital capsule, dorsal and ventral; **m** genital capsule, lateral. Scale bars = 1 mm.



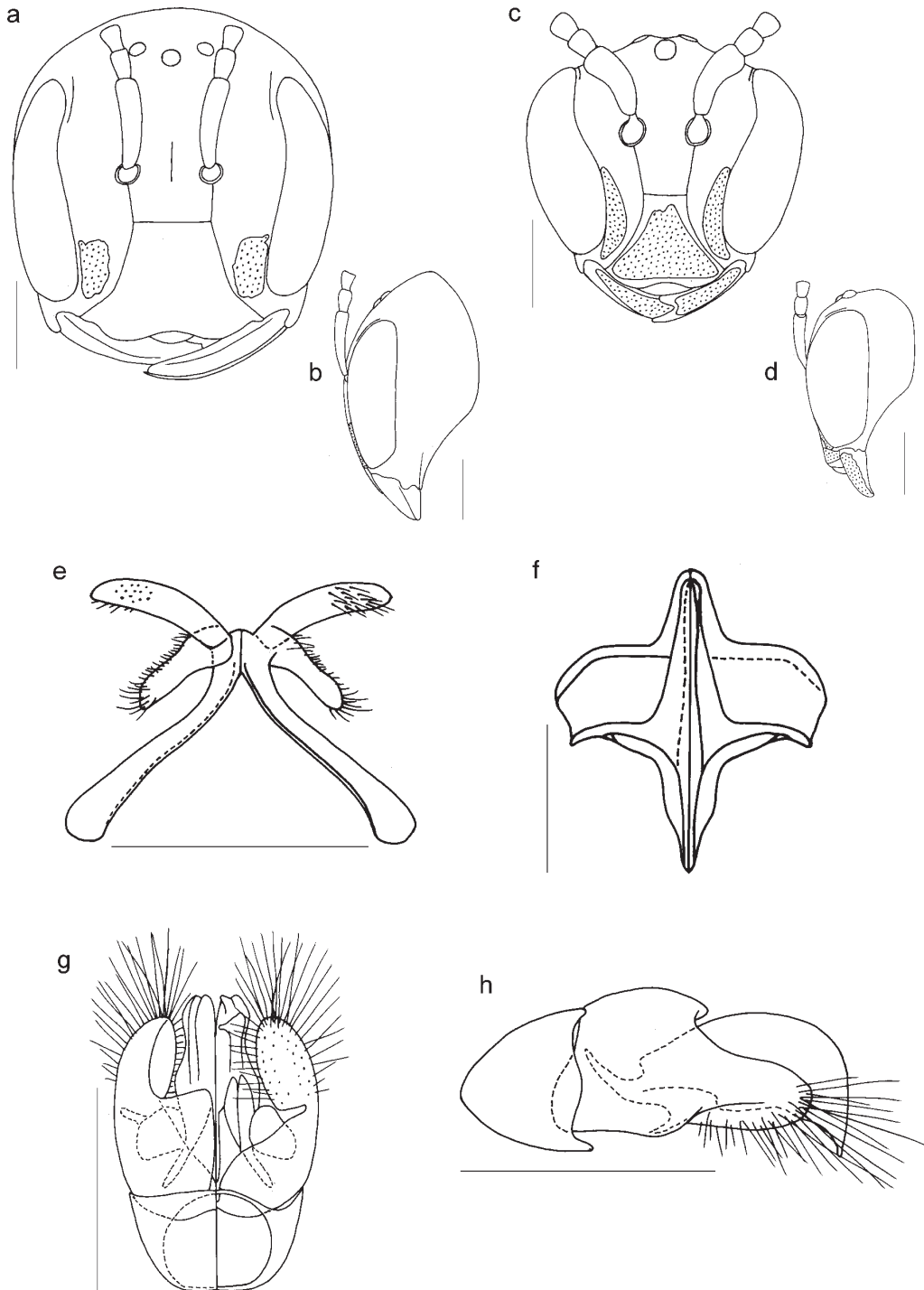
**Fig. 54** *Leioproctus pekanui*. **a–b, g–k** female, **a** head, frontal; **b** head, lateral; **g** hair of trochanteral floccus; **h** hair of basitibial scopa; **i** inner hind tibial spur; **j** pygidial plate; **k** propodeal triangle (arrow), lateral. **c–f, l–m** male, **c** head, frontal; **d** head, lateral; **e** metasomal sternum 7, dorsal and ventral; **f** metasomal sternum 8, dorsal and ventral; **l** genital capsule, dorsal and ventral; **m** genital capsule, lateral. Scale bars = 1 mm; **g–i** = 0.5 mm.



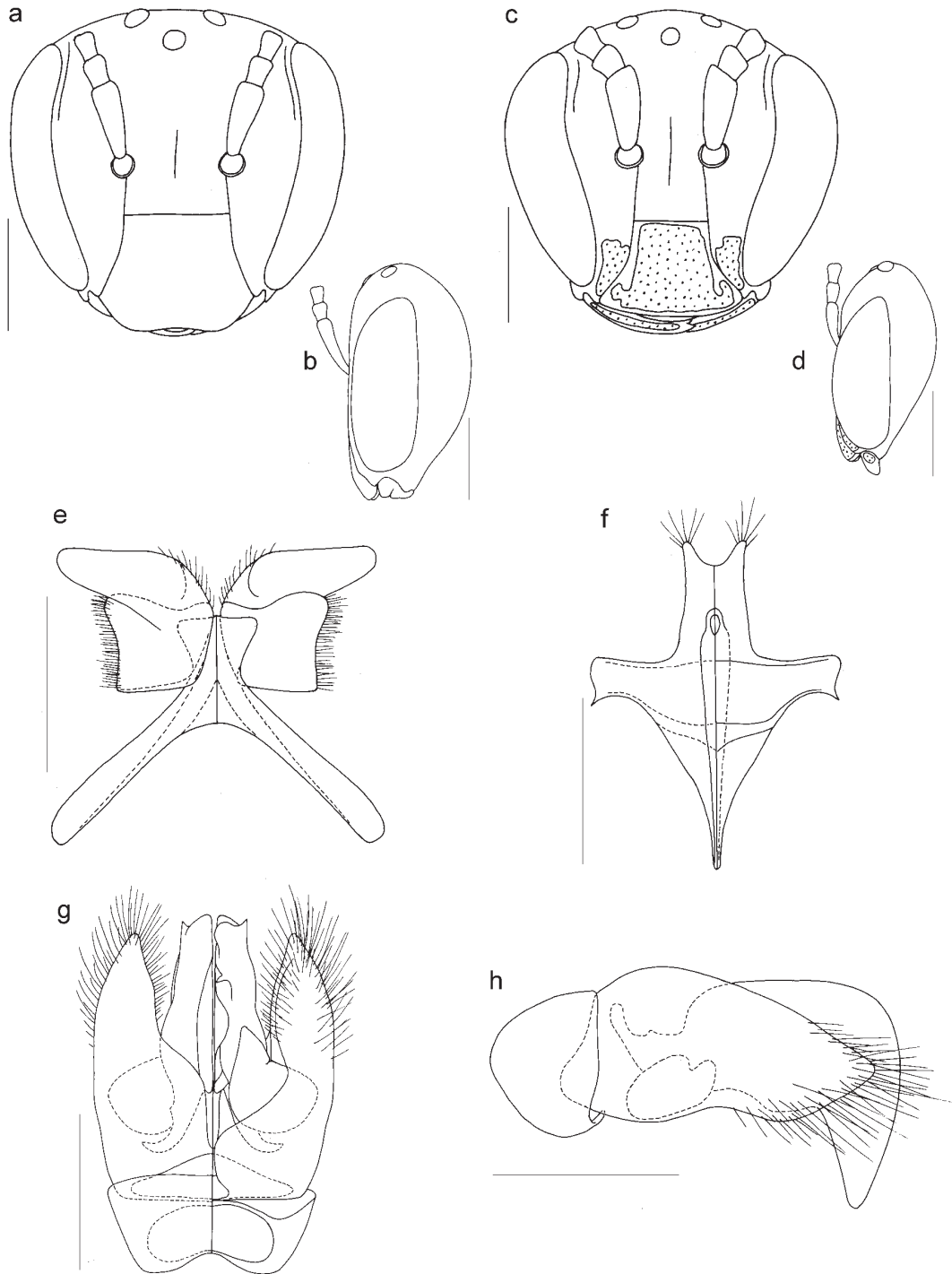
**Fig. 55** *Hylaeus agilis*. **a–b** female, head (stippled areas yellow), **a** frontal; **b** lateral. **c–h** male. **c** head, frontal (stippled areas yellow); **d** head, lateral (stippled areas yellow); **e** metasomal sternum 7, dorsal and ventral; **f** metasomal sternum 8, dorsal and ventral; **g** genital capsule, dorsal and ventral; **h** genital capsule, lateral. Scale bars = 1 mm; f = 0.5 mm.



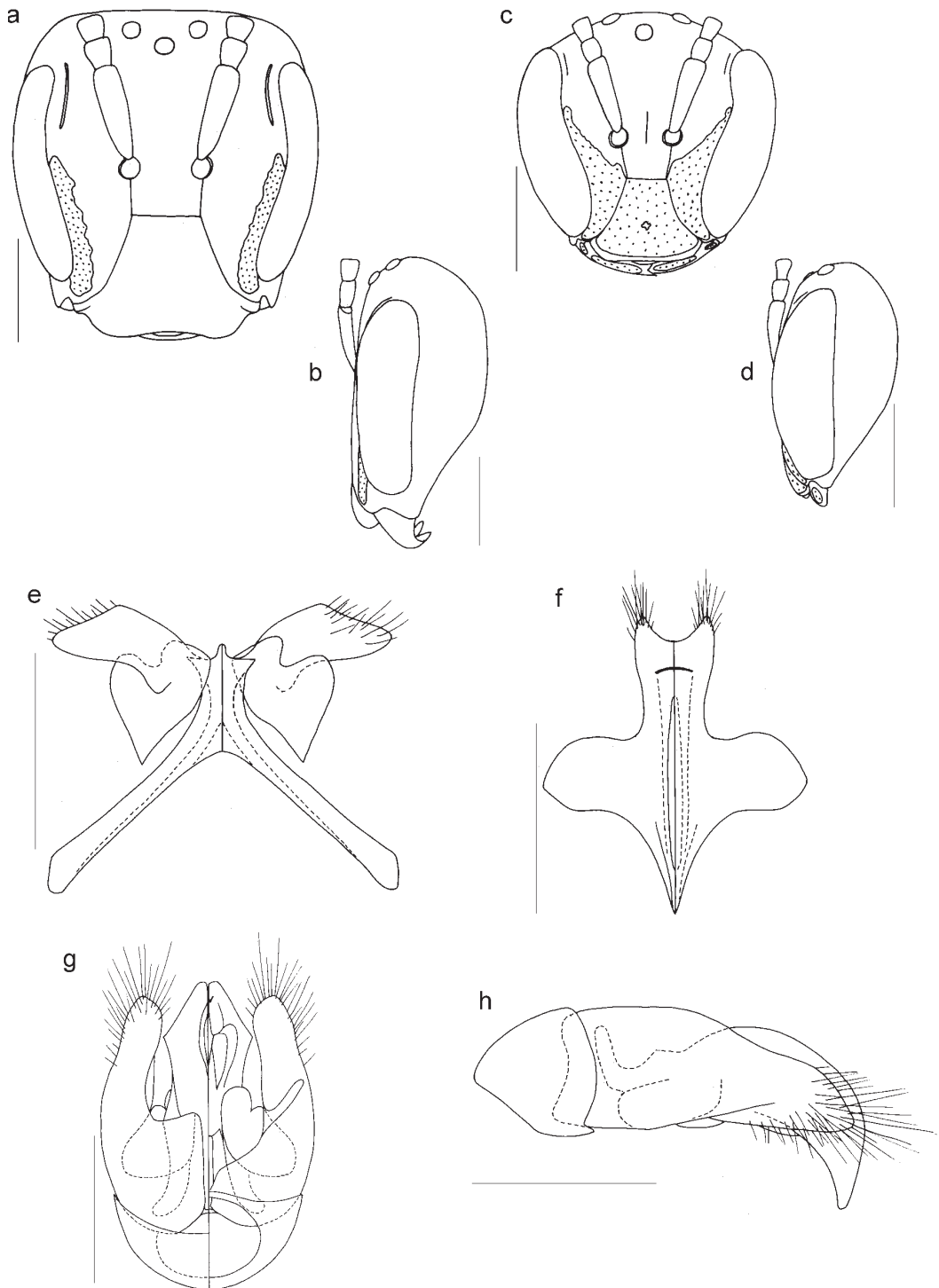
**Fig. 56** *Hylaeus asperithorax*. **a–b** female, head (stippled areas yellow), **a** frontal; **b** lateral. **c–h** male. **c** head, frontal (stippled areas yellow); **d** head, lateral (stippled areas yellow); **e** metasomal sternum 7, dorsal and ventral; **f** metasomal sternum 8, dorsal and ventral; **g** genital capsule, dorsal and ventral; **h** genital capsule, lateral. Scale bars a–d = 1 mm; e–h = 0.5 mm.



**Fig. 57** *Hylaeus capitosus*. **a–b** female, head (stippled areas yellow), **a** frontal; **b** lateral. **c–h** male. **c** head, frontal (stippled areas yellow); **d** head, lateral (stippled areas yellow); **e** metasomal sternum 7, dorsal and ventral; **f** metasomal sternum 8, dorsal and ventral; **g** genital capsule, dorsal and ventral; **h** genital capsule, lateral. Scale bars = 1 mm; **f** = 0.5 mm.

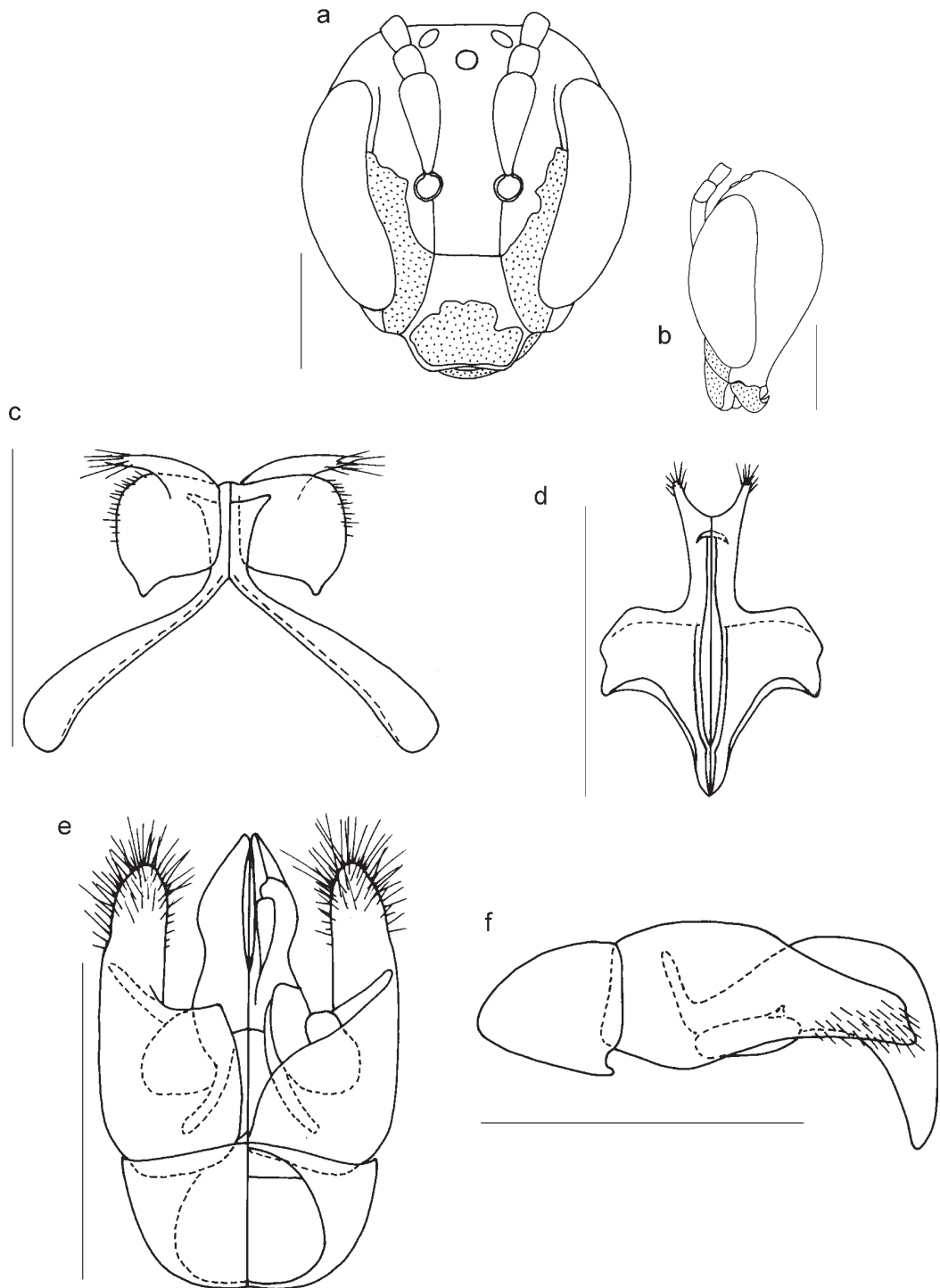


**Fig. 58** *Hylaeus kermadecensis*. **a–b** female, head, **a** frontal; **b** lateral. **c–h** male. **c** head, frontal (stippled areas yellow); **d** head, lateral (stippled areas yellow); **e** metasomal sternum 7, dorsal and ventral; **f** metasomal sternum 8, dorsal and ventral; **g** genital capsule, dorsal and ventral; **h** genital capsule, lateral. Scale bars **a–d** = 1 mm; **e–h** = 0.5 mm.

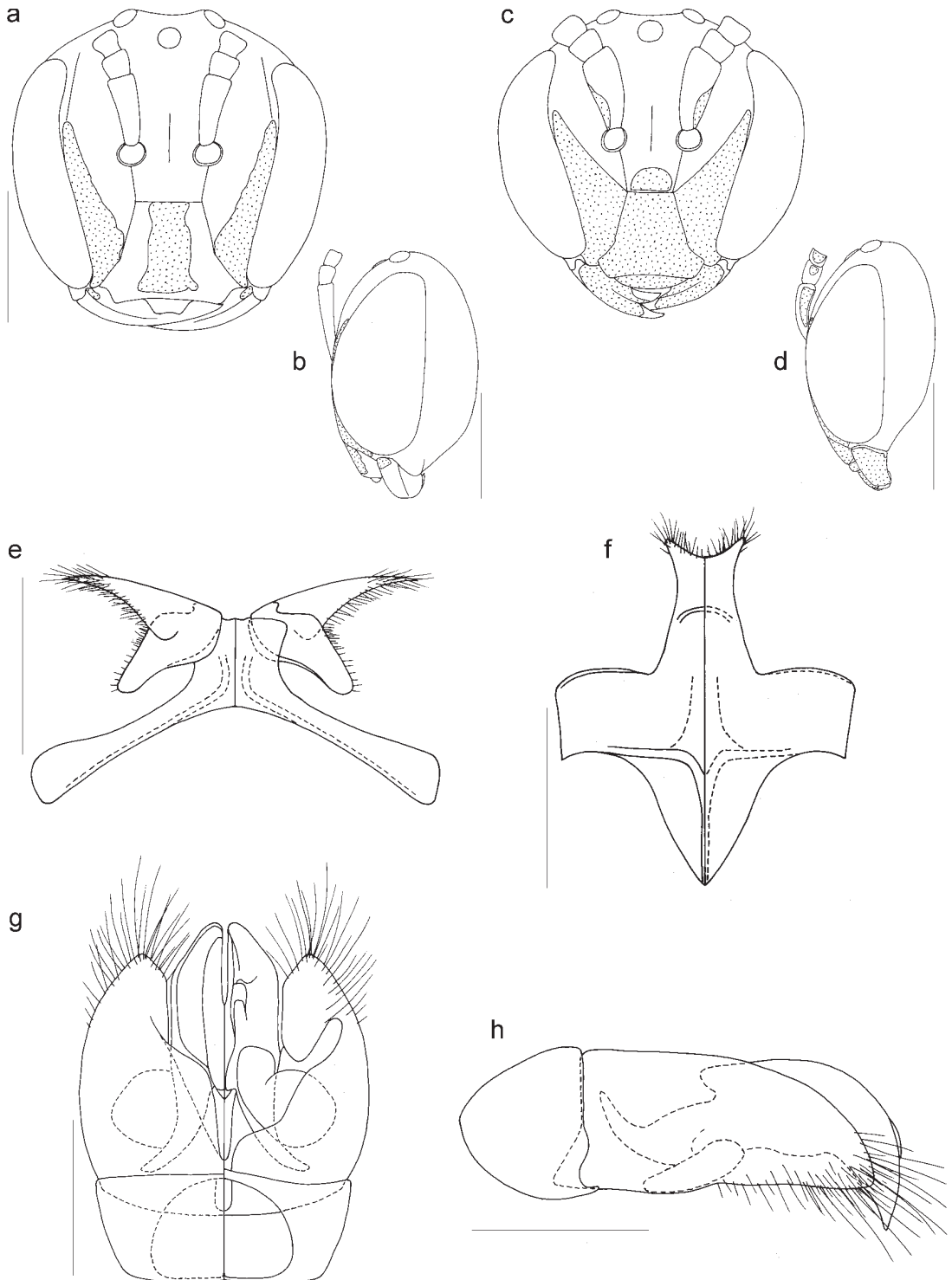


**Fig. 59** *Hylaeus matamoko*. **a–b** female, head (stippled areas yellow), **a** frontal; **b** lateral. **c–h** male. **c** head, frontal (stippled areas yellow); **d** head, lateral (stippled areas yellow); **e** metasomal sternum 7, dorsal and ventral; **f** metasomal sternum 8, dorsal and ventral; **g** genital capsule, dorsal and ventral; **h** genital capsule, lateral. Scale bars **a–d** = 1 mm; **e–h** = 0.5 mm.

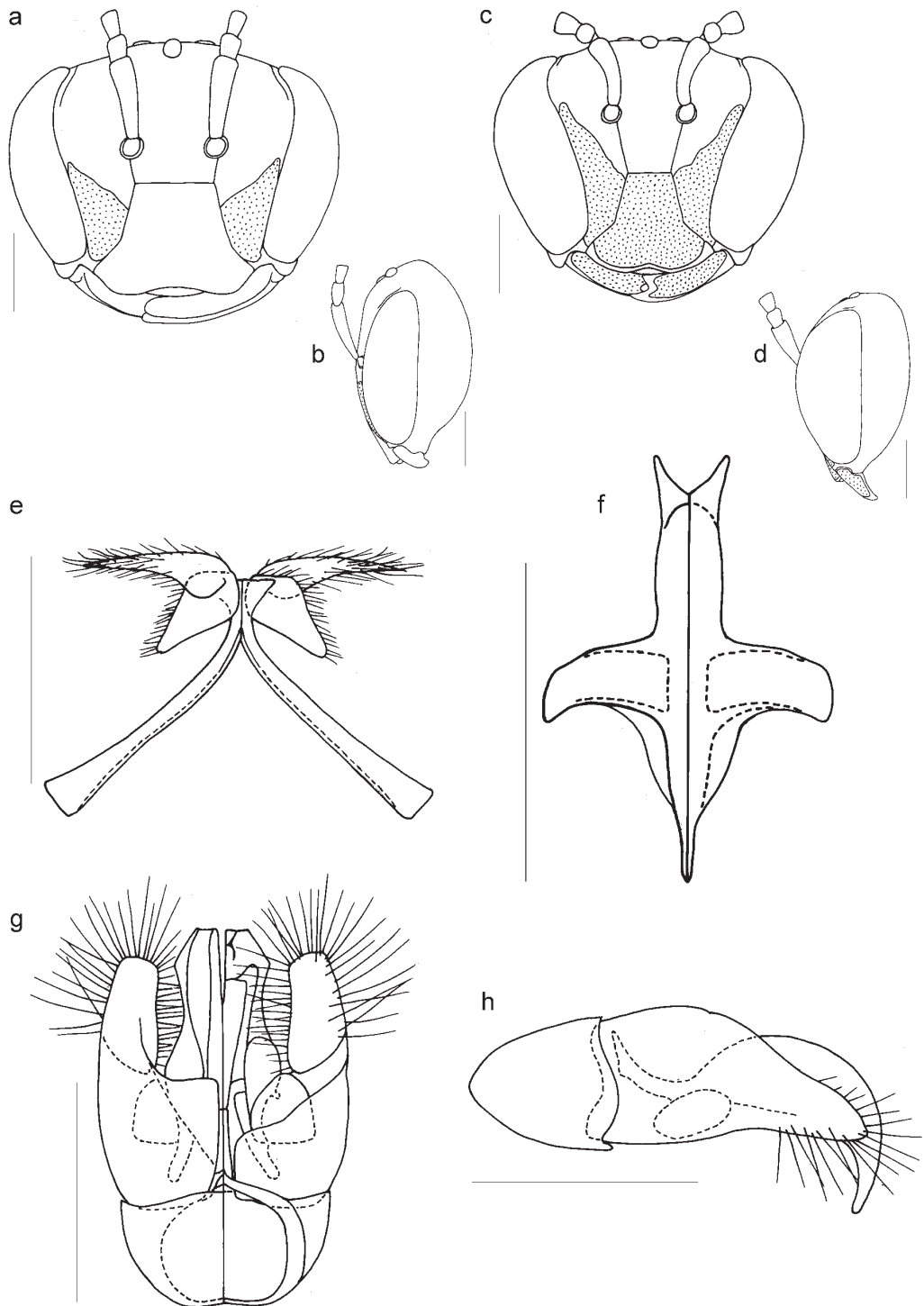




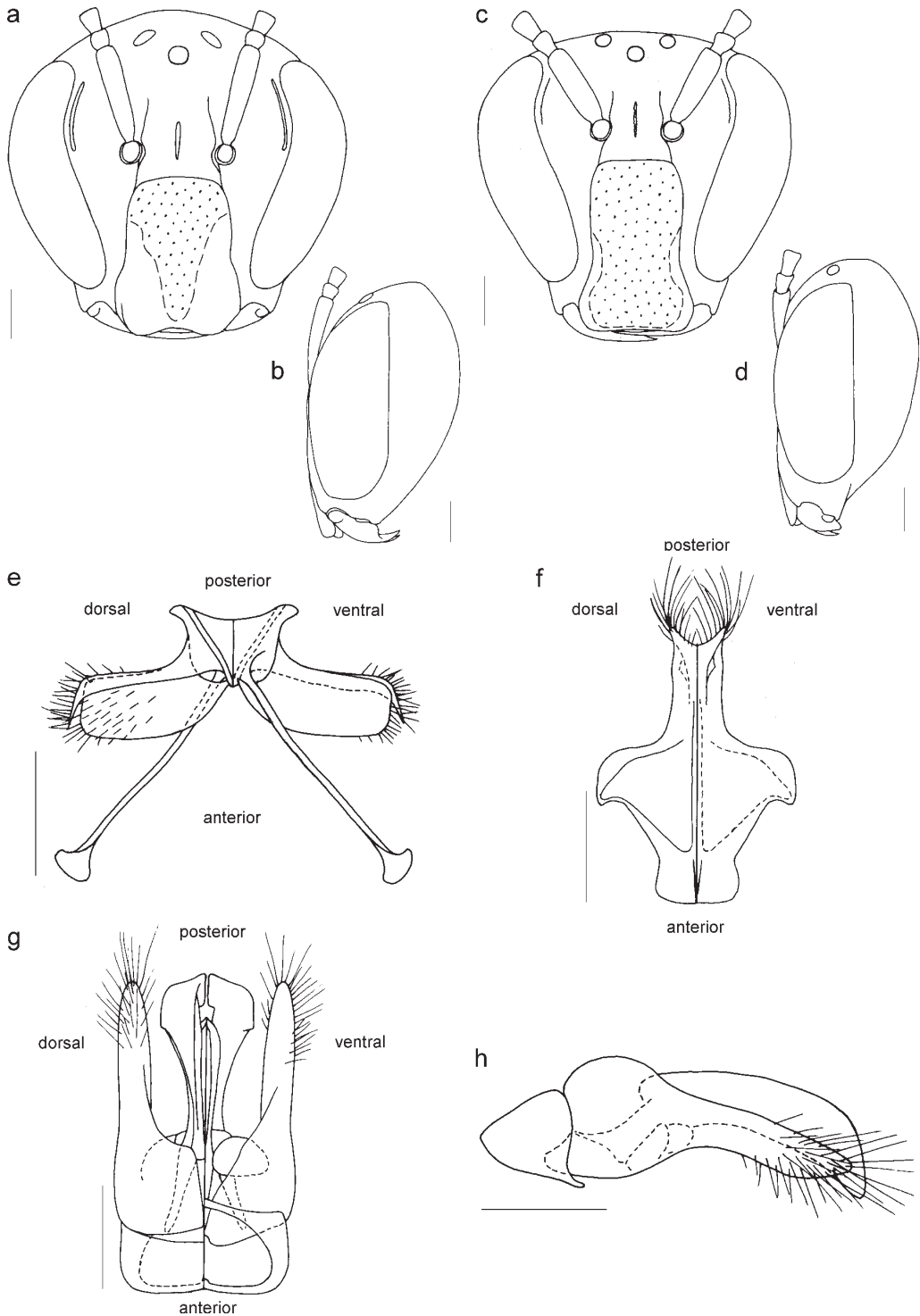
**Fig. 60** *Hylaeus murihiku*. **a–f** male. **a** head, frontal (stippled areas yellow); **b** head, lateral (stippled areas yellow); **c** metasomal sternum 7, dorsal and ventral; **d** metasomal sternum 8, dorsal and ventral; **e** genital capsule, dorsal and ventral; **f** genital capsule, lateral. Scale bars = 1 mm.



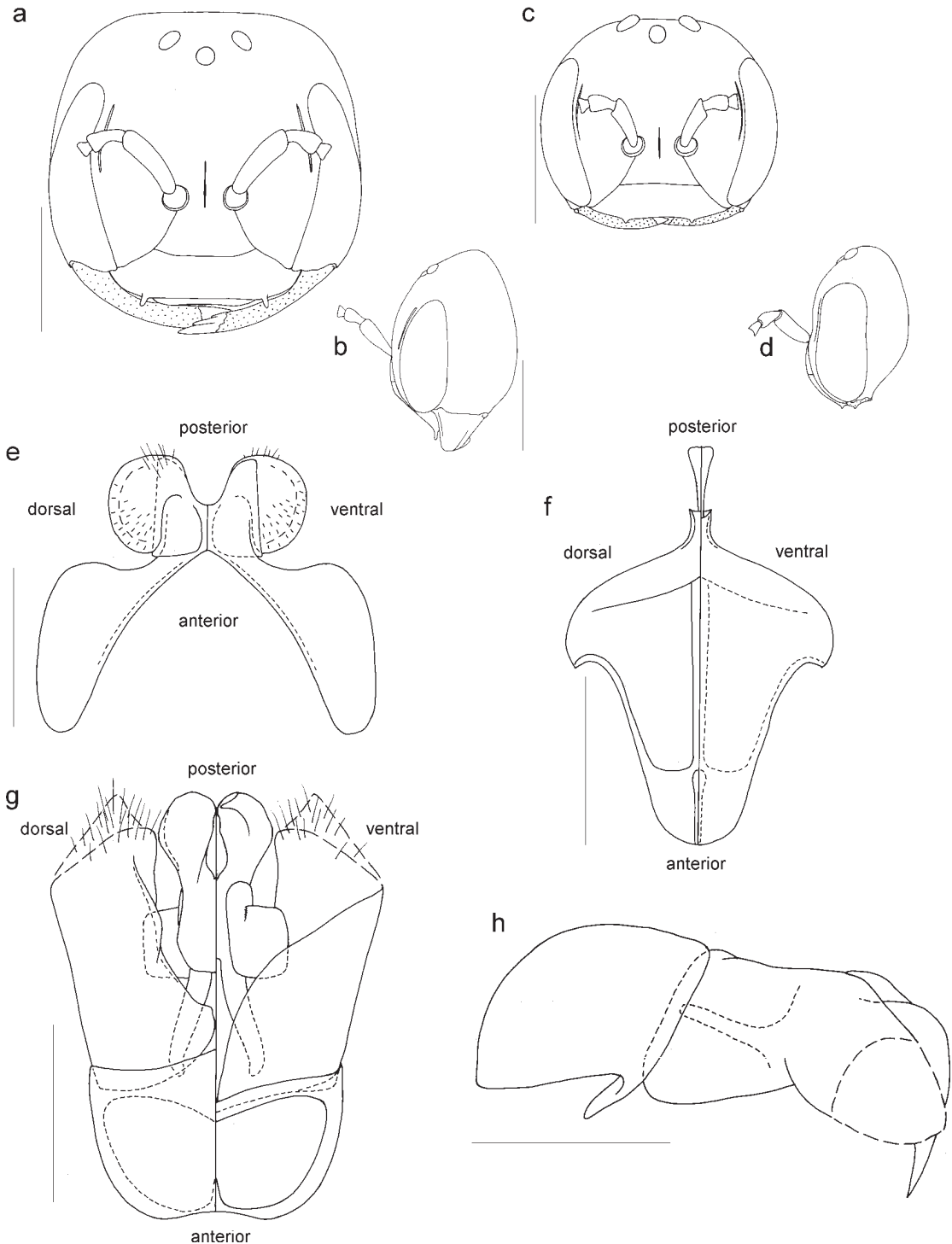
**Fig. 61** *Hylaeus perhumilis*. **a–b** female, head (stippled areas pale yellow), **a** frontal; **b** lateral. **c–h** male. **c** head, frontal (stippled areas pale yellow); **d** head, lateral (stippled areas pale yellow); **e** metasomal sternum 7, dorsal and ventral; **f** metasomal sternum 8, dorsal and ventral; **g** genital capsule, dorsal and ventral; **h** genital capsule, lateral. Scale bars **a–d** = 1 mm; **e–h** = 0.5 mm.



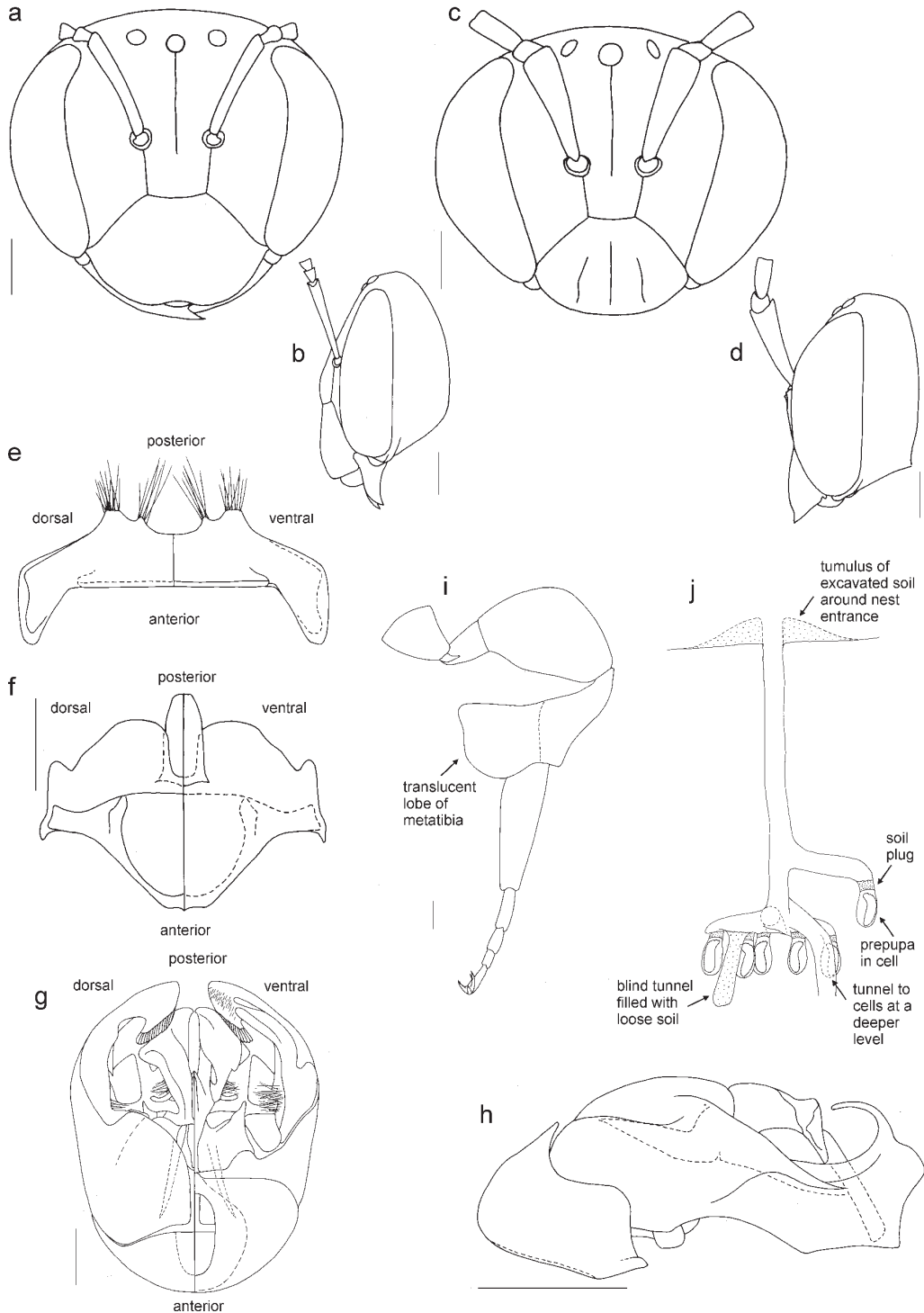
**Fig. 62** *Hylaeus relegatus*. **a–b** female, head (stippled areas yellow), **a** frontal; **b** head, lateral. **c–h** male. **c** head, frontal (stippled areas yellow); **d** head, lateral (stippled areas yellow); **e** metasomal sternum 7, dorsal and ventral; **f** metasomal sternum 8, dorsal and ventral; **g** genital capsule, dorsal and ventral; **h** genital capsule, lateral. Scale bars = 1 mm.



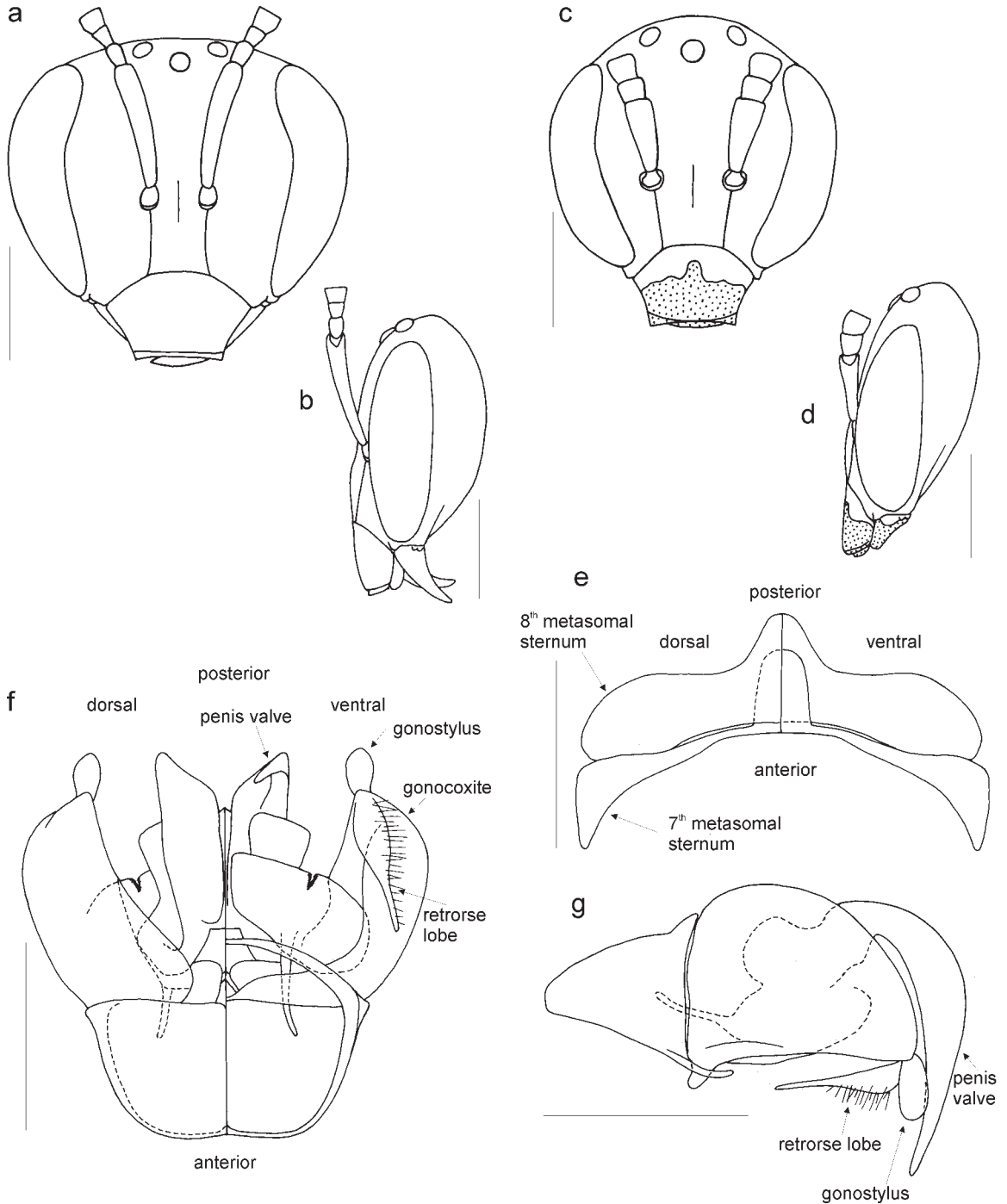
**Fig. 63** *Hyleoides concinna*. **a–b** female, **a** head, frontal (stippled area orange); **b** head, lateral. **c–h** male. **c** head, frontal (stippled area yellow); **d** head, lateral; **e** metasomal sternum 7, dorsal and ventral; **f** metasomal sternum 8, dorsal and ventral; **g** genital capsule, dorsal and ventral; **h** genital capsule, lateral. Scale bars = 1 mm.



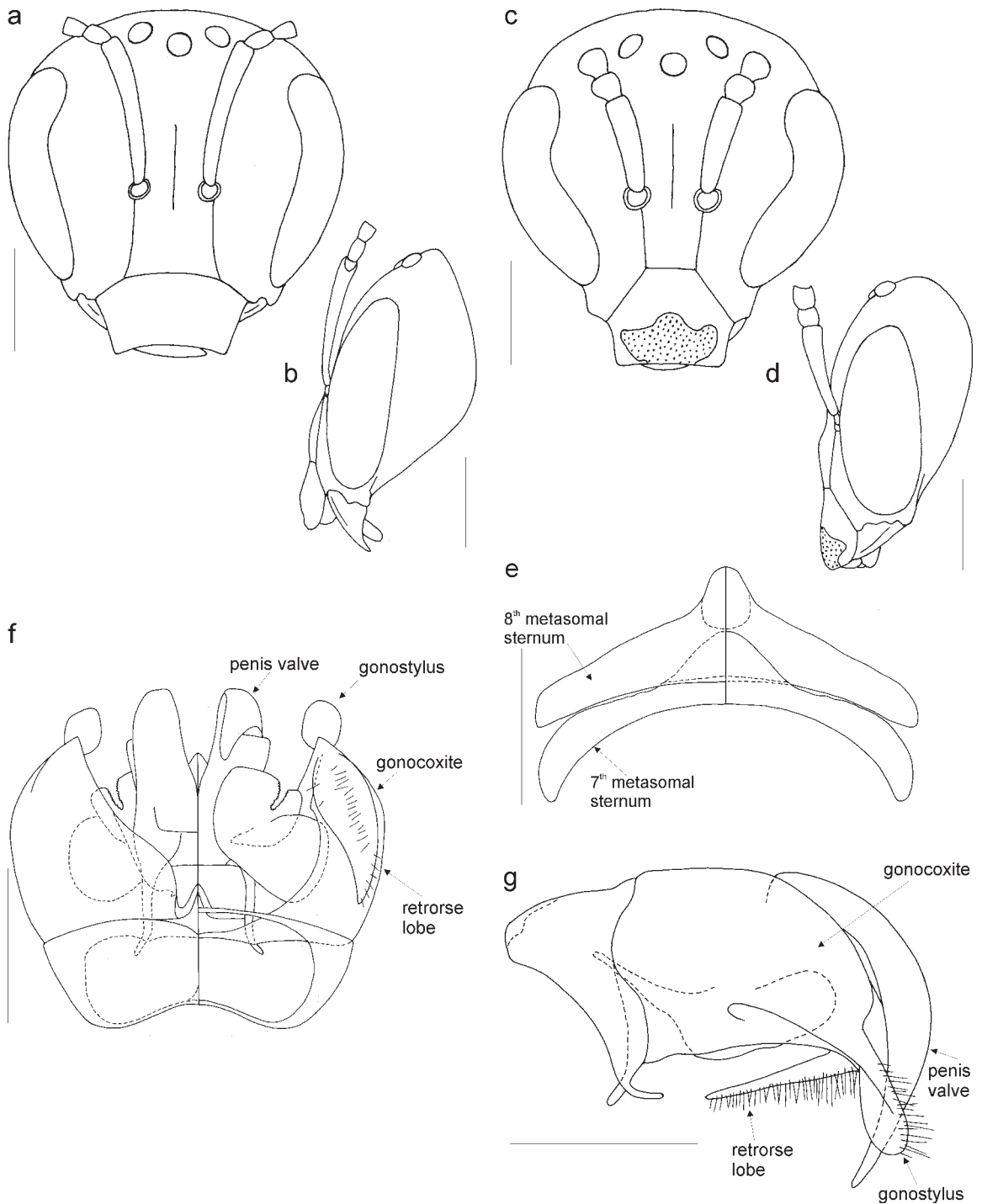
**Fig. 64** *Euryglossina proctotrypoides*. **a–b** female, **a** head, frontal (stippled areas yellow); **b** head, lateral. **c–h** male. **c** head, frontal (stippled areas yellow); **d** head, lateral (stippled areas yellow); **e** metasomal sternum 7, dorsal and ventral; **f** metasomal sternum 8, dorsal and ventral; **g** genital capsule, dorsal and ventral; **h** genital capsule, lateral. Scale bars **a–d** = 1 mm; **e–h** = 0.5 mm.



**Fig. 65** *Nomia melanderi*. **a–b** female, **a** head, frontal; **b** head, lateral. **c–i** male. **c** head, frontal; **d** head, lateral; **e** metasomal sternum 7, dorsal and ventral; **f** metasomal sternum 8, dorsal and ventral; **g** genital capsule, dorsal and ventral; **h** genital capsule, lateral; **i** hind leg with translucent area of metatibia. **j** nest, lateral. Scale bars = 1 mm.

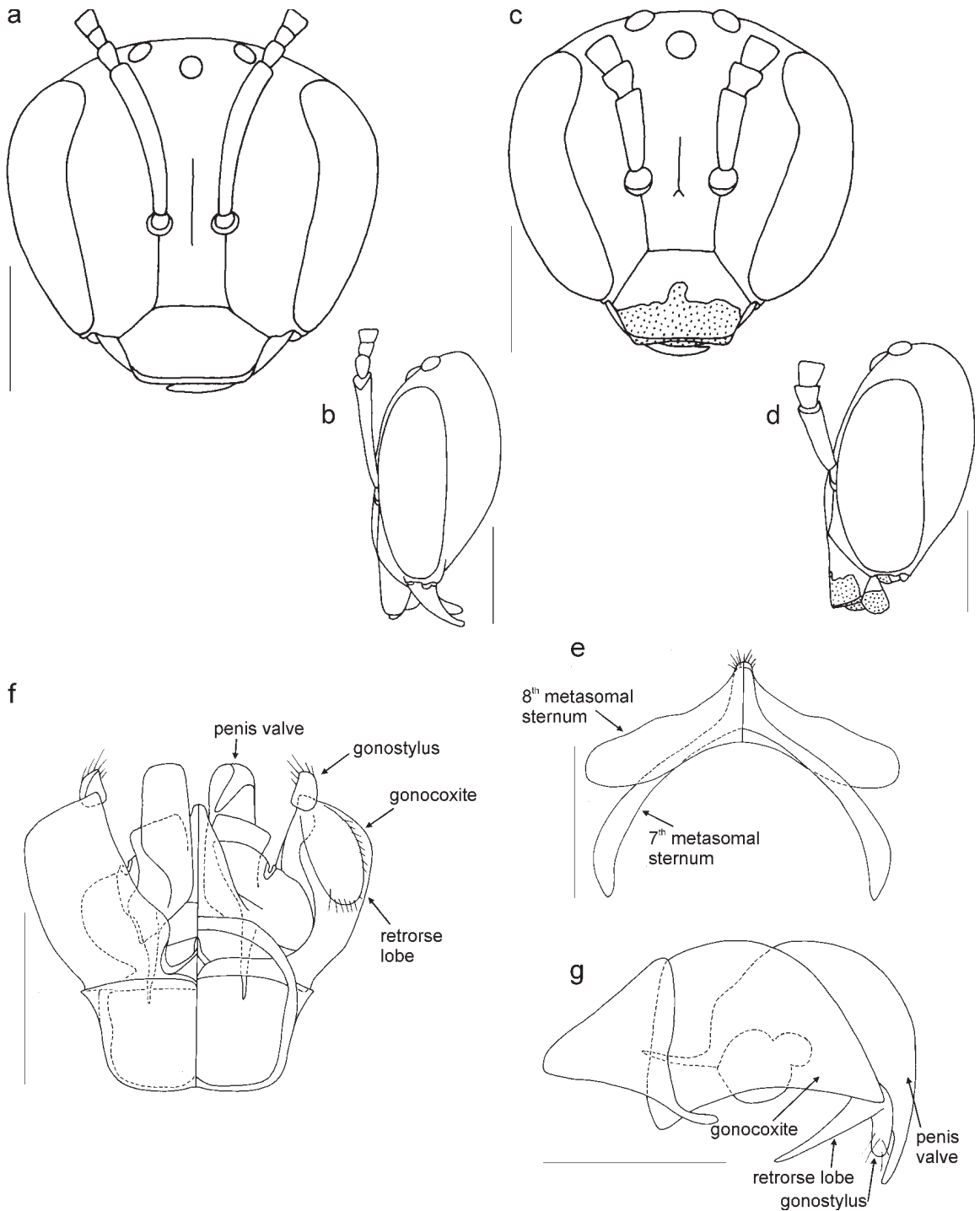


**Fig. 66.** *Lasioglossum matoroa*. **a–b** female, **a** head, frontal; **b** head, lateral. **c–g** male, **c** head, frontal (stippled areas yellow); **d** head, lateral (stippled areas yellow); **e** metasomal sterna 7 and 8, dorsal and ventral; **f** genital capsule, dorsal and ventral; **g** genital capsule, lateral. Scale bars **a–d** = 1 mm, **e–g** = 0.5 mm.

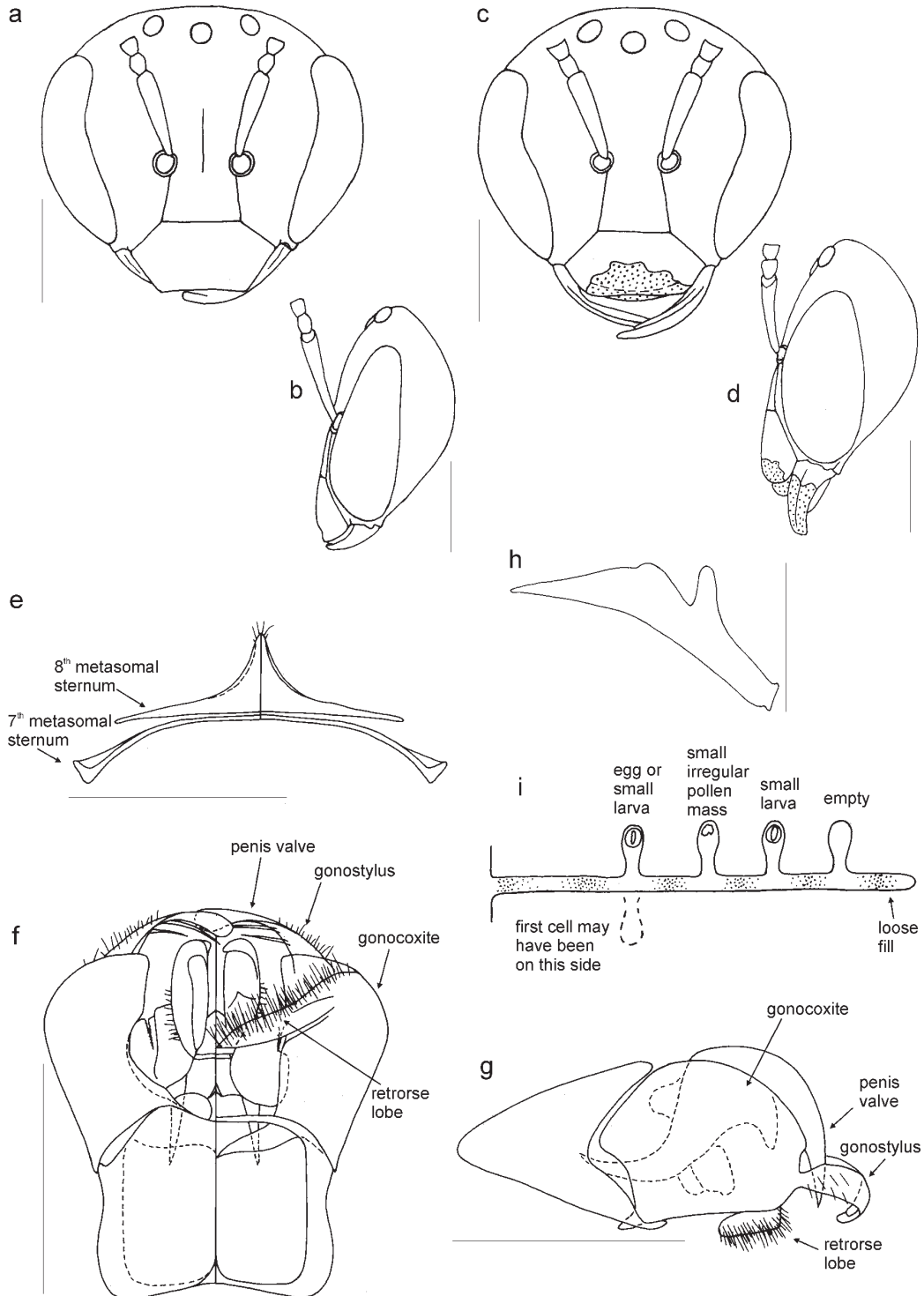


**Fig. 67.** *Lasioglossum maunga*. **a–b** female, **a** head, frontal; **b** head, lateral. **c–g** male, **c** head, frontal (stippled areas yellow); **d** head, lateral (stippled areas yellow); **e** metasomal sterna 7 and 8, dorsal and ventral; **f** genital capsule, dorsal and ventral; **g** genital capsule, lateral. Scale bars a–d = 1 mm, e–g = 0.5 mm.

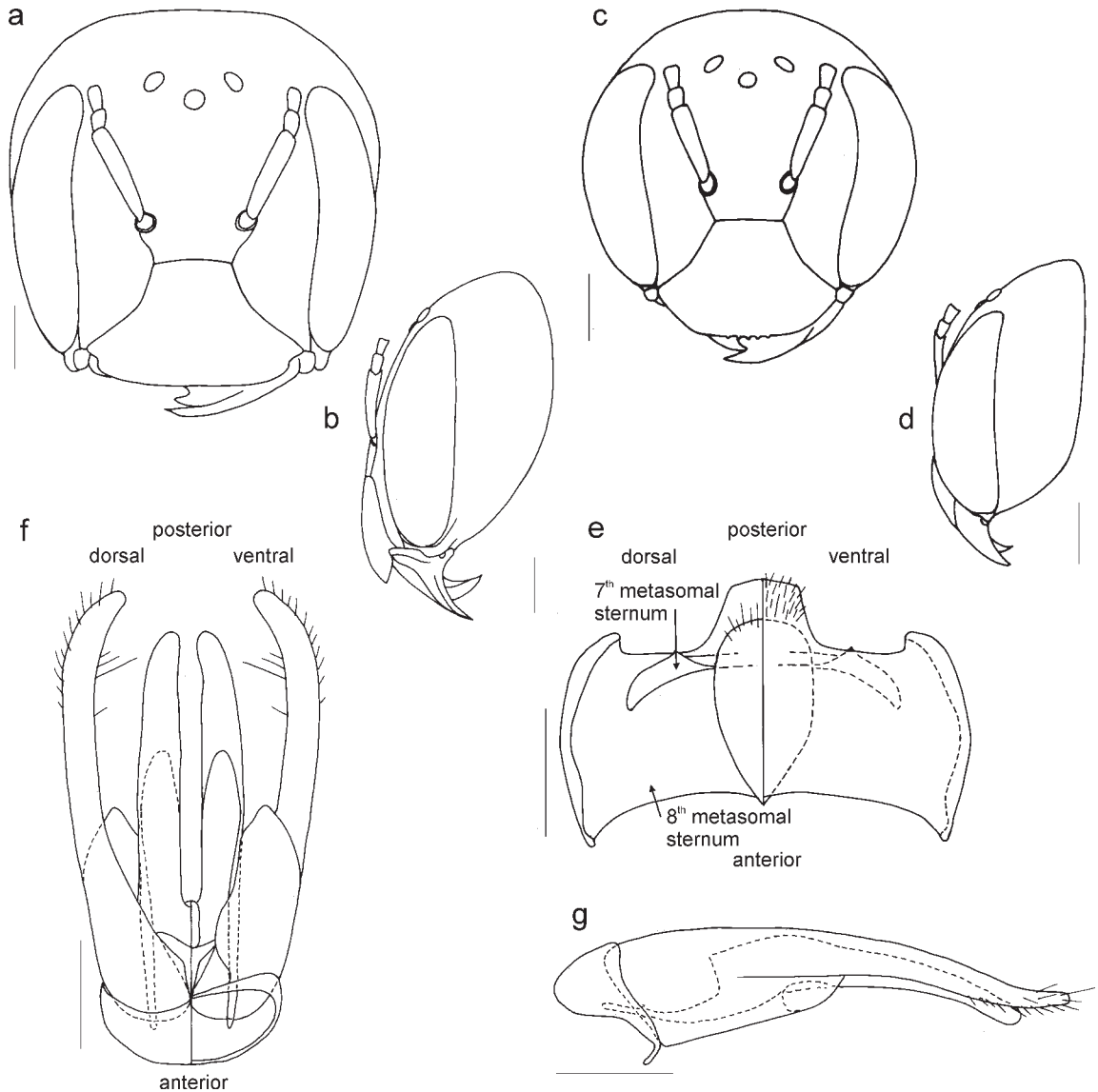




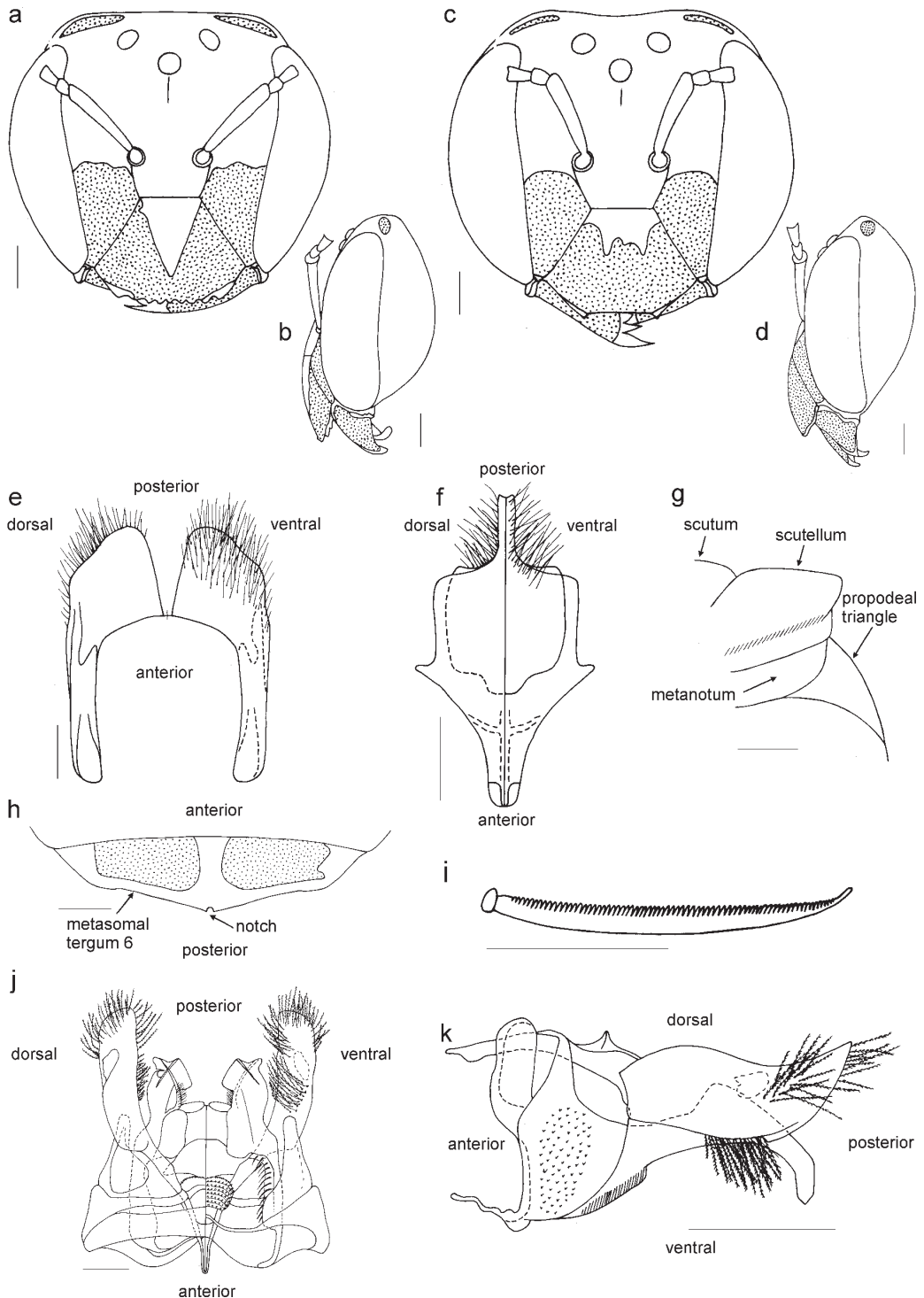
**Fig. 68.** *Lasioglossum sordidum*. **a–b** female, **a** head, frontal; **b** head, lateral. **c–g** male, **c** head, frontal (stippled areas yellow); **d** head, lateral (stippled areas yellow); **e** metasomal sterna 7 and 8, dorsal and ventral; **f** genital capsule, dorsal and ventral; **g** genital capsule, lateral. Scale bars a–d = 1 mm, e–g = 0.5 mm.



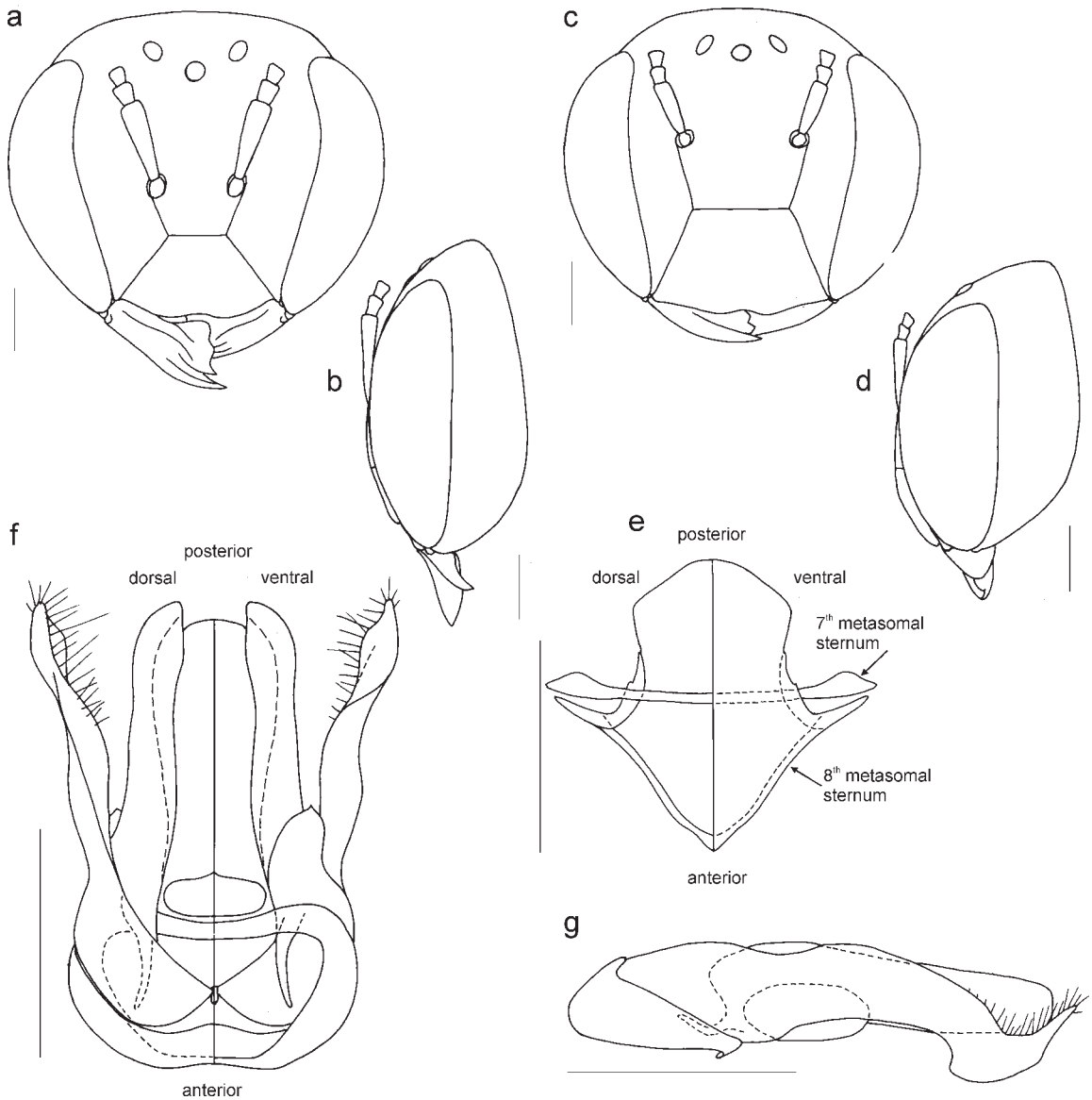
**Fig. 69.** *Lasioglossum cognatum*. **a–b, h** female, **a** head, frontal; **b** head, lateral; **h** inner metatibial spur. **c–g** male, **c** head, frontal (stippled areas yellow); **d** head, lateral (stippled areas yellow); **e** metasomal sterna 7 and 8, dorsal and ventral; **f** genital capsule, dorsal and ventral; **g** genital capsule, lateral. **i** nest, dorsal view (stippled areas loose fill). Scale bars = 1 mm, f = 0.5 mm.



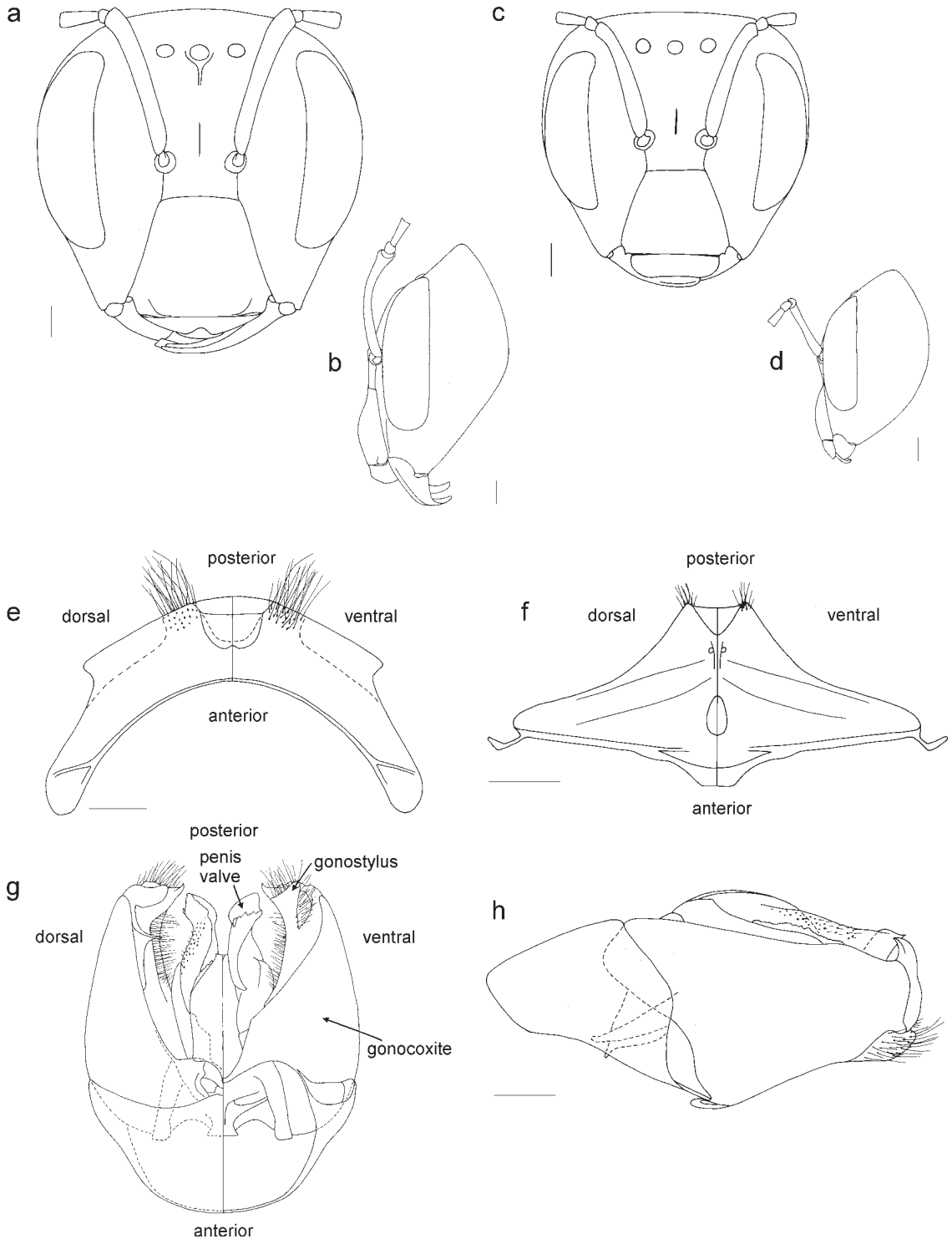
**Fig. 70.** *Osmia coerulescens*. **a–b** female, **a** head, frontal; **b** head, lateral. **c–g** male, **c** head, frontal; **d** head, lateral; **e** metasomal sterna 7 and 8, dorsal and ventral; **f** genital capsule, dorsal and ventral; **g** genital capsule, lateral. Scale bars = 1 mm.



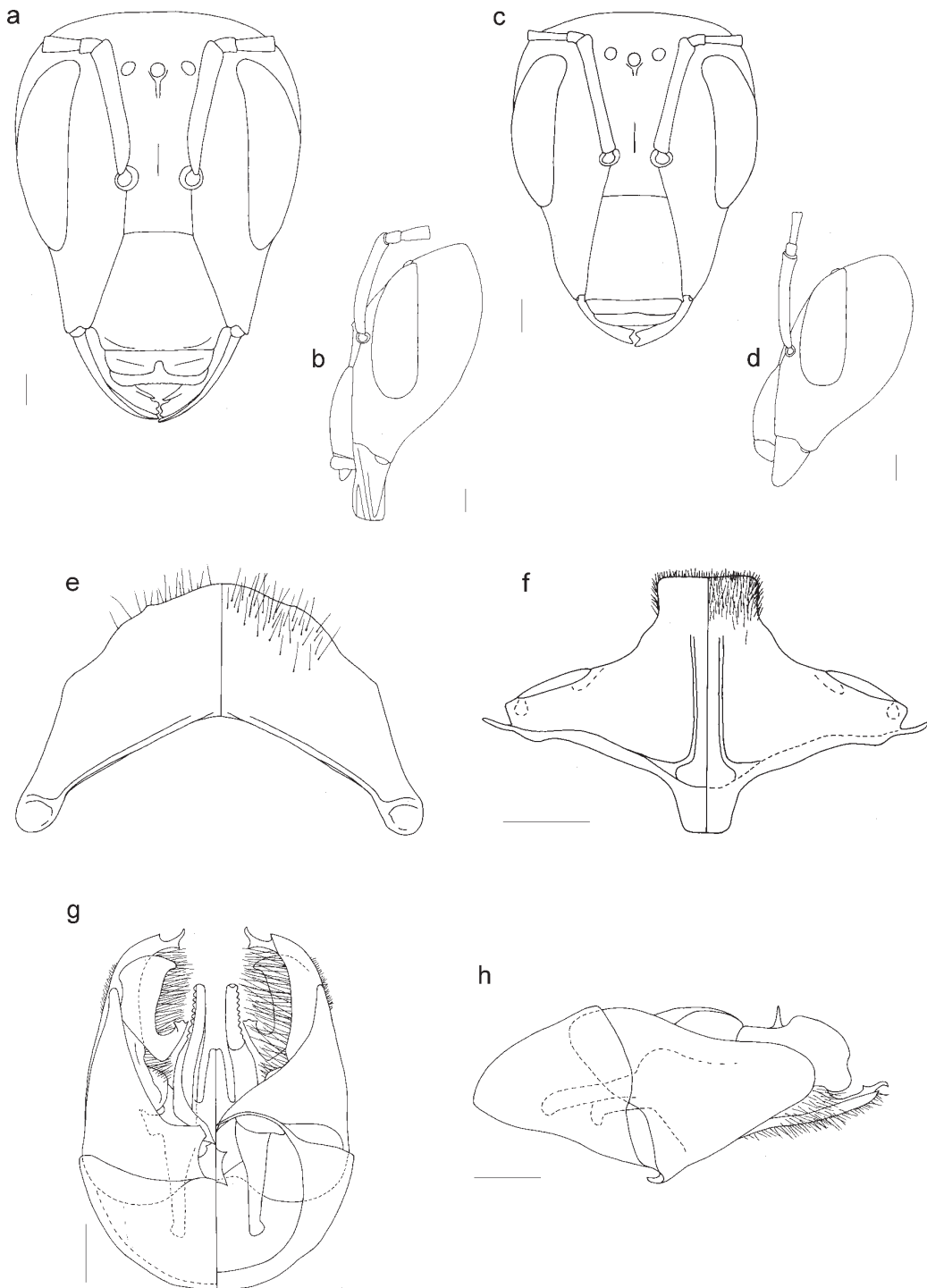
**Fig. 71.** *Anthidium manicatum*. **a–b, g–i** female, **a** head, frontal (stippled areas yellow); **b** head, lateral (stippled areas yellow); **g** lateral aspect of posterior of mesosoma; **h** dorsal view of metasomal tergum 6 (stippled areas yellow); **i** inner hind tibial spur. **c–f** male, **c** head, frontal (stippled areas yellow); **d** head, lateral (stippled areas yellow); **e** metasomal sternum 7, dorsal and ventral; **f** metasomal sternum 8, dorsal and ventral; **j** genital capsule, dorsal and ventral; **k** genital capsule, lateral. Scale bars **a–d** = 1 mm, **e–g** = 0.5 mm.



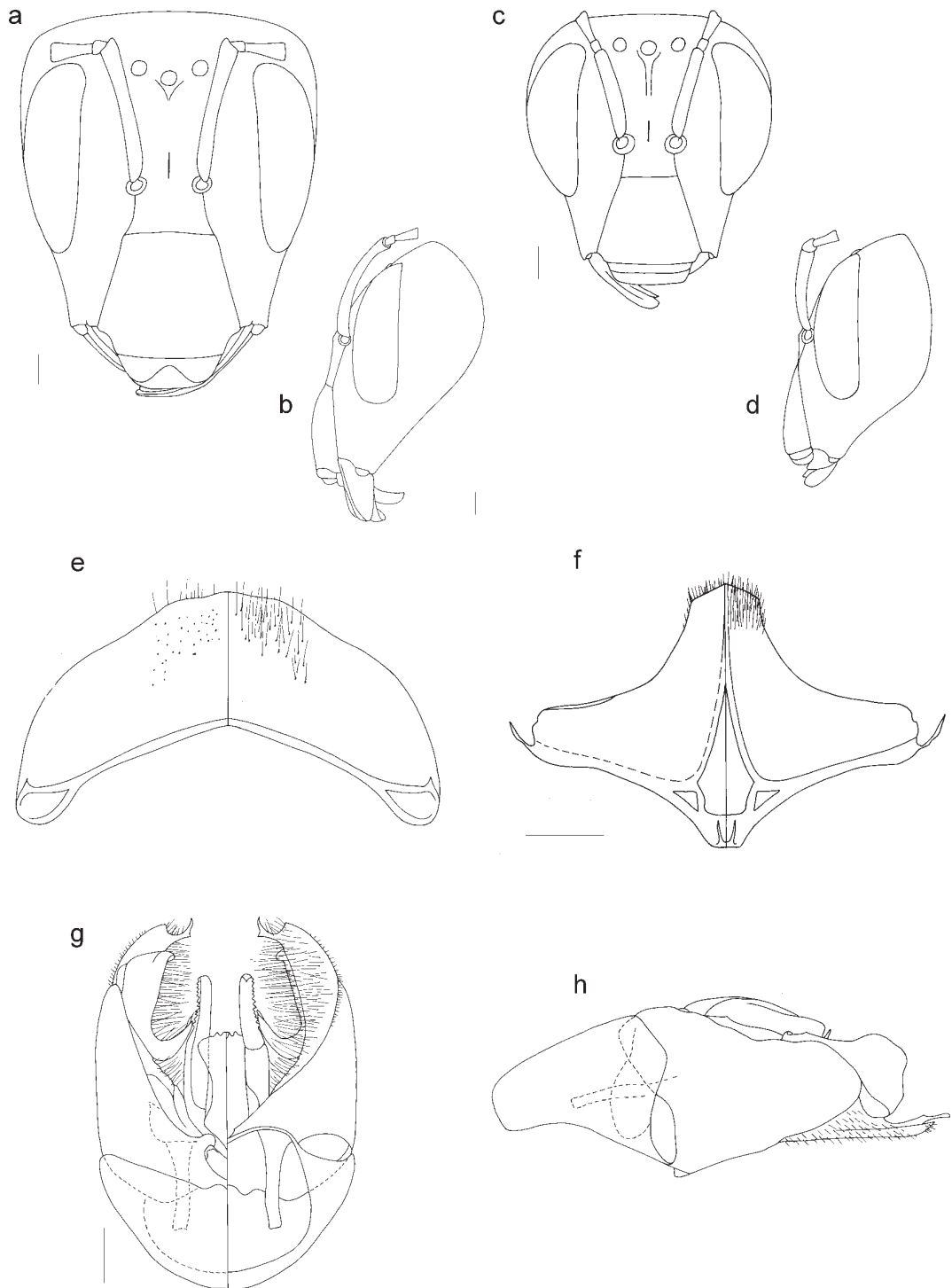
**Fig. 72.** *Megachile rotundata*. **a–b** female, **a** head, frontal; **b** head, lateral. **c–g** male, **c** head, frontal; **d** head, lateral; **e** metasomal sterna 7 and 8, dorsal and ventral; **f** genital capsule, dorsal and ventral; **g** genital capsule, lateral. Scale bars a–d = 1 mm, f–g = 0.5 mm.



**Fig. 73.** *Bombus terrestris*. **a–b** female, **a** head, frontal; **b** head, lateral. **c–h** male, **c** head, frontal; **d** head, lateral; **e** metasomal sternum 7, dorsal and ventral; **f** metasomal sternum 8, dorsal and ventral; **g** genital capsule, dorsal and ventral; **h** genital capsule, lateral. Scale bars = 1 mm.

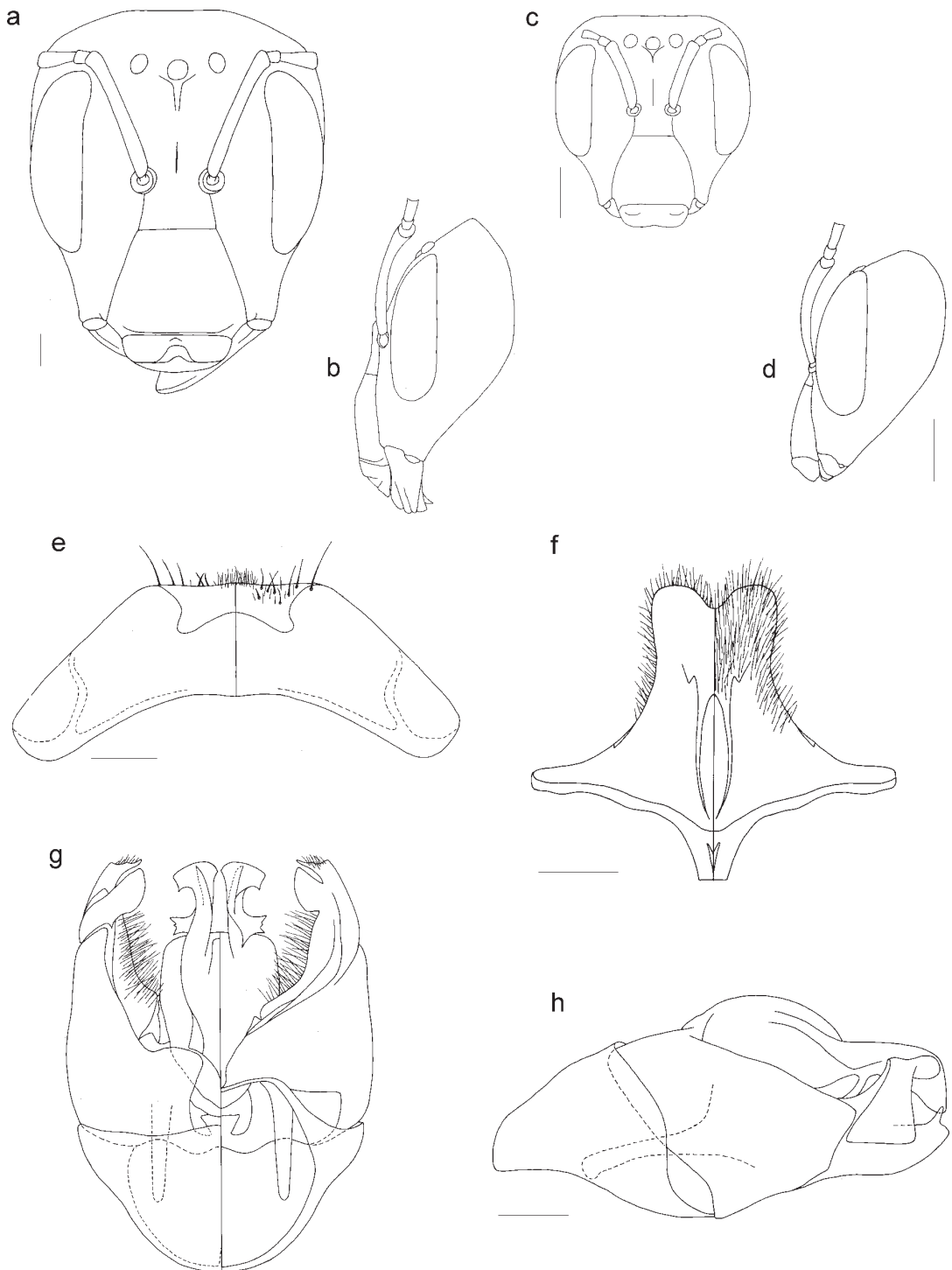


**Fig. 74.** *Bombus hortorum*. **a–b** female, **a** head, frontal; **b** head, lateral. **c–h** male, **c** head, frontal; **d** head, lateral; **e** metasomal sternum 7, dorsal and ventral; **f** metasomal sternum 8, dorsal and ventral; **g** genital capsule, dorsal and ventral; **h** genital capsule, lateral. Scale bars = 1 mm.

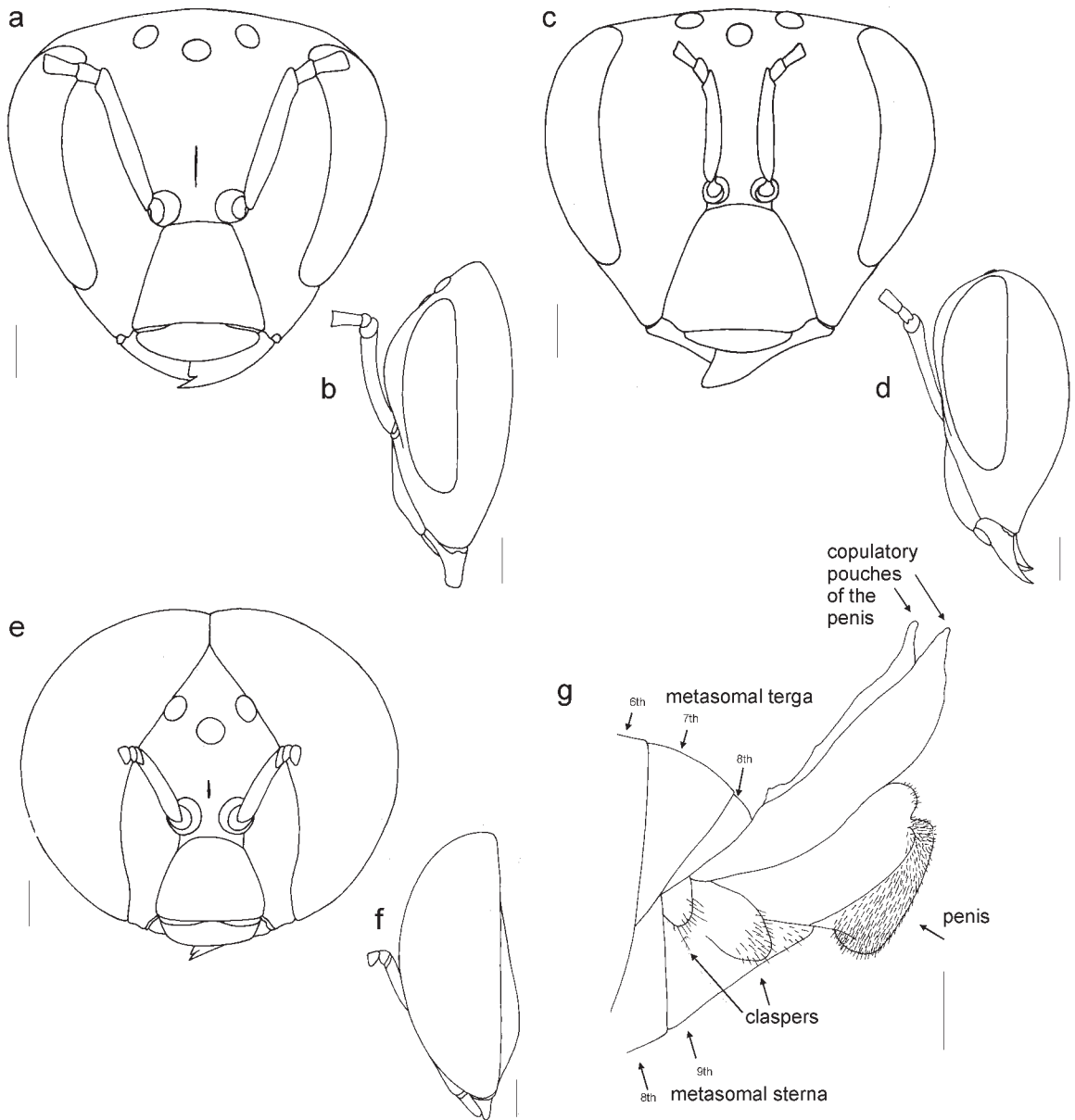


**Fig. 75.** *Bombus ruderatus*. **a–b** female, **a** head, frontal; **b** head, lateral. **c–h** male, **c** head, frontal; **d** head, lateral; **e** metasomal sternum 7, dorsal and ventral; **f** metasomal sternum 8, dorsal and ventral; **g** genital capsule, dorsal and ventral; **h** genital capsule, lateral. Scale bars = 1 mm.

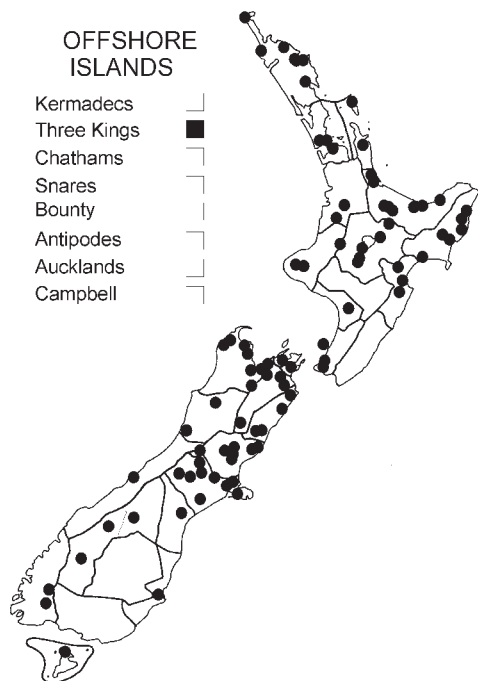
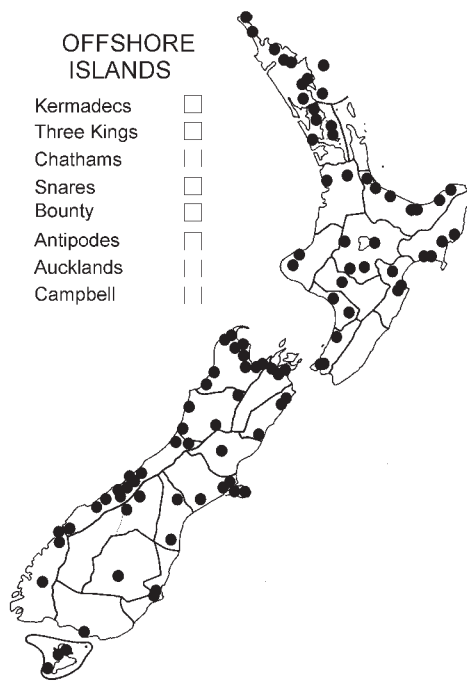
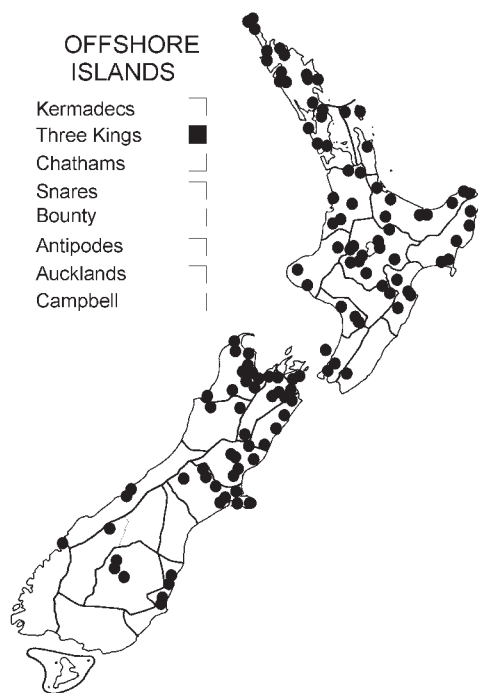
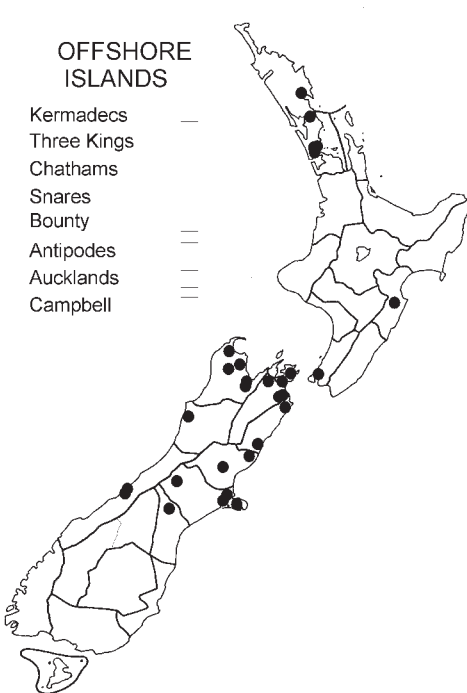


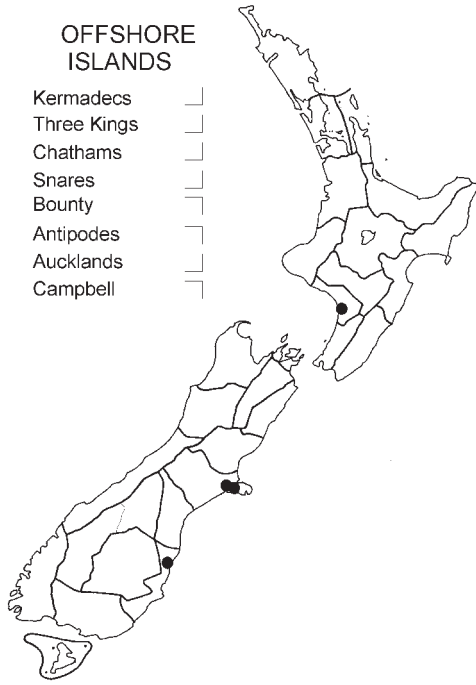


**Fig. 76.** *Bombus subterraneus*. **a–b** female, **a** head, frontal; **b** head, lateral. **c–h** male, **c** head, frontal; **d** head, lateral; **e** metasomal sternum 7, dorsal and ventral; **f** metasomal sternum 8, dorsal and ventral; **g** genital capsule, dorsal and ventral; **h** genital capsule, lateral. Scale bars = 1 mm.

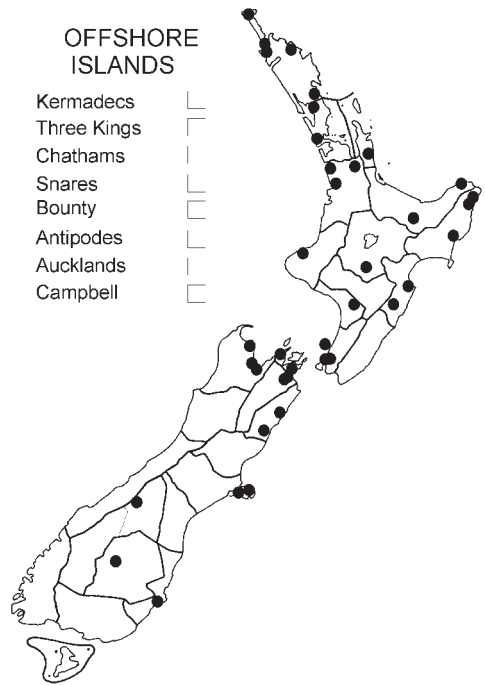


**Fig. 77.** *Apis mellifera*. **a–b** queen, **a** head, frontal; **b** head, lateral. **c–d** worker, **c** head, frontal; **d** head, lateral. **e–g** male, **e** head, frontal; **f** head, lateral; **g** apex of abdomen, copulatory apparatus exerted, lateral. Scale bars = 1 mm.

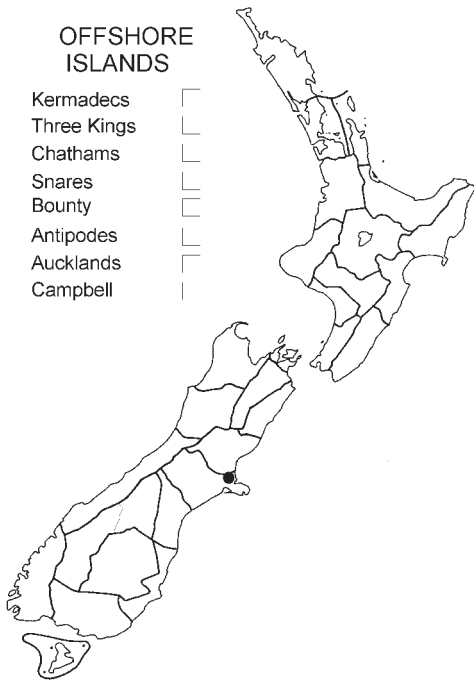
Map 1 Collection localities, *Leioproctus (L.) boltoni*Map 2 Collection localities, *Leioproctus (L.) huakiwi*Map 3 Collection localities, *Leioproctus (L.) imitatus*Map 4 Collection localities, *Leioproctus (L.) kanapuu*



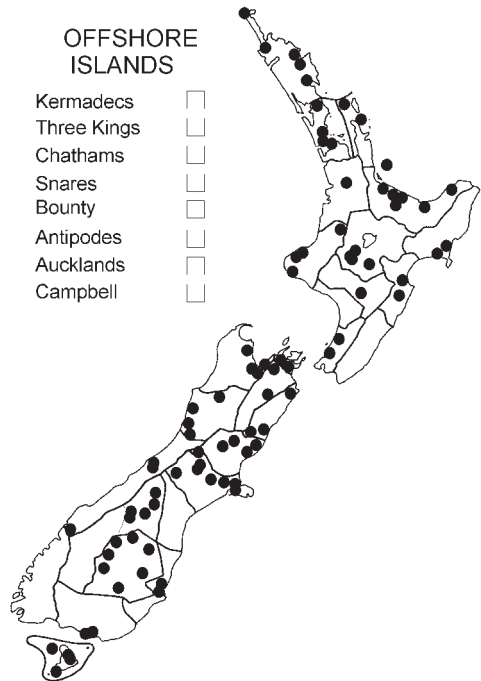
Map 5 Collection localities, *Leioproctus (L.) keehua*



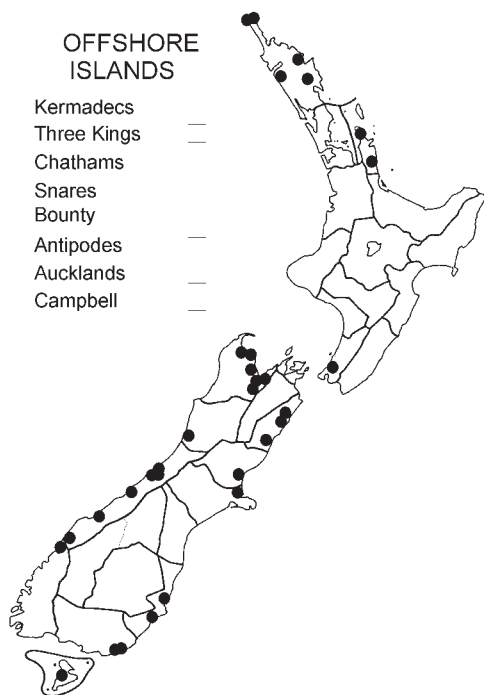
Map 6 Collection localities, *Leioproctus (L.) metallicus*



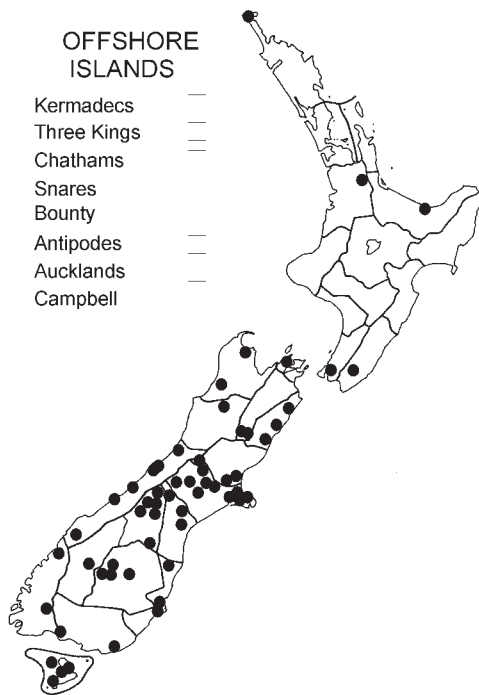
Map 7 Collection localities, *Leioproctus (L.) otautahi*



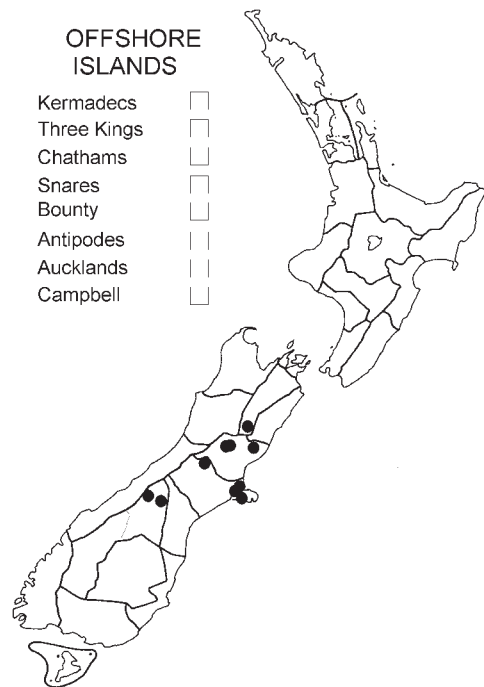
Map 8 Collection localities, *Leioproctus (L.) pango*



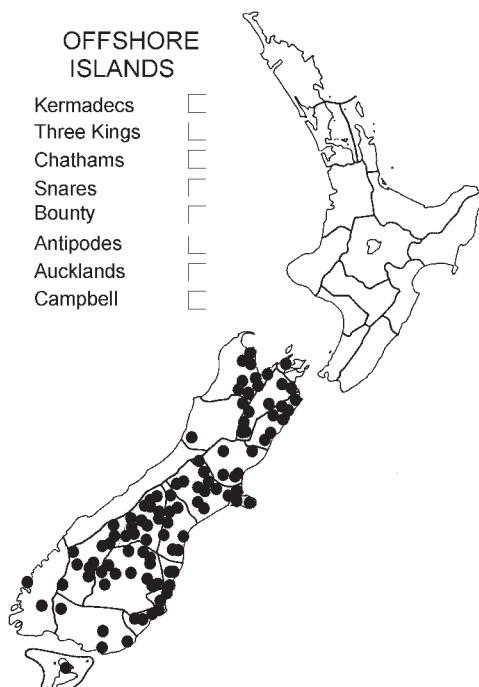
**Map 9** Collection localities, *Leioproctus (L.) purpureus*



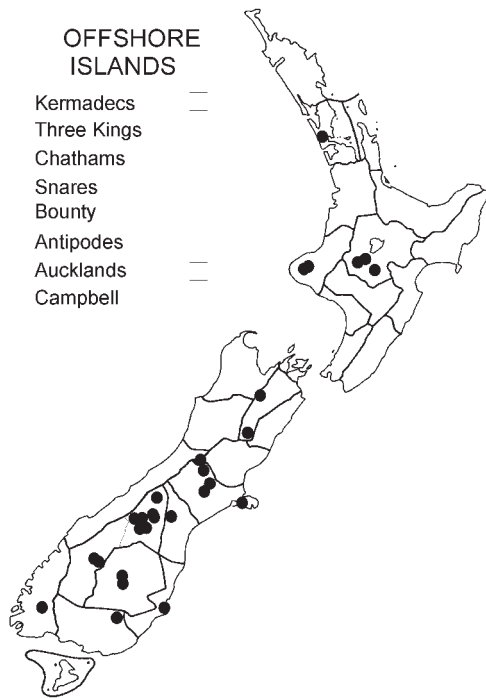
**Map 10** Collection localities, *Leioproctus (L.) vestitus*



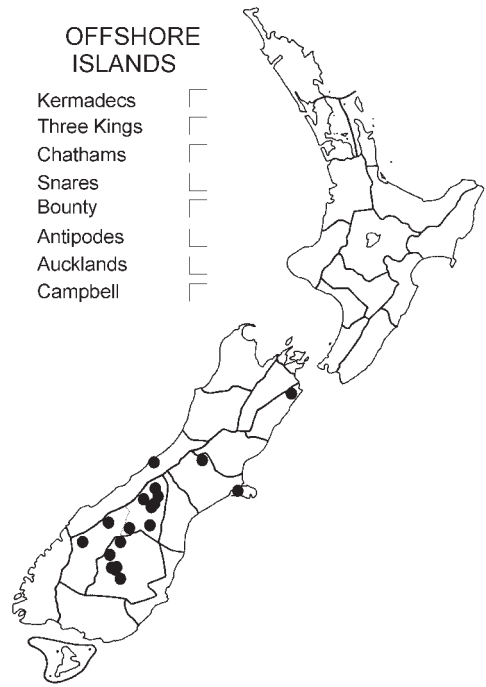
**Map 11** Collection localities, *Leioproctus (L.) waipounamu*



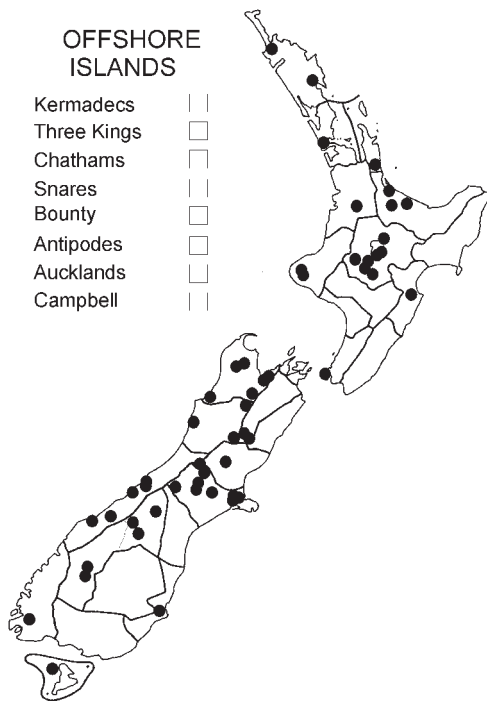
**Map 12** Collection localities, *Leioproctus (N.) fulvescens*



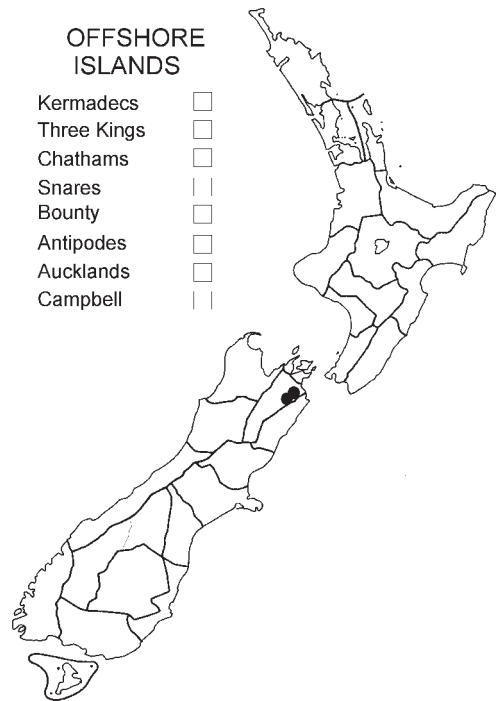
**Map 13** Collection localities, *Leioproctus (N.) hudsoni*



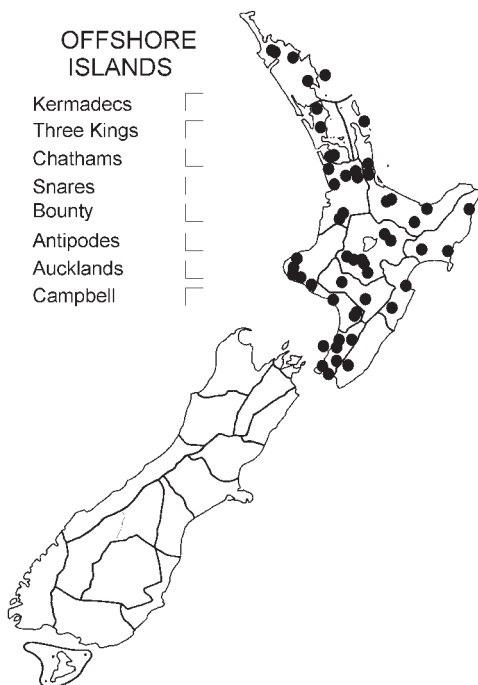
**Map 14** Collection localities, *Leioproctus (N.) maritimus*



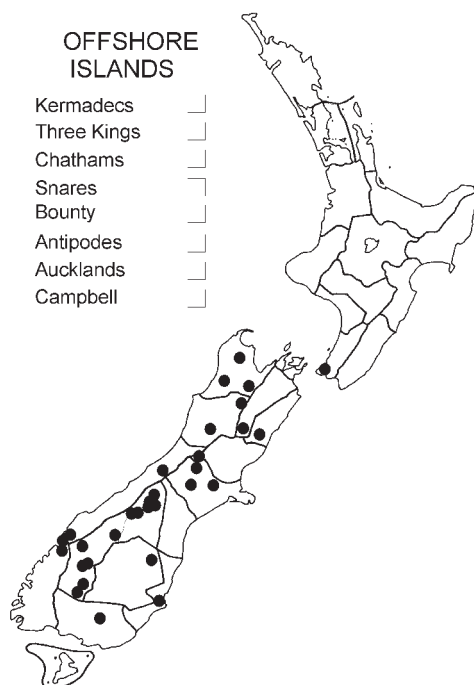
**Map 15** Collection localities, *Leioproctus (N.) monticola*



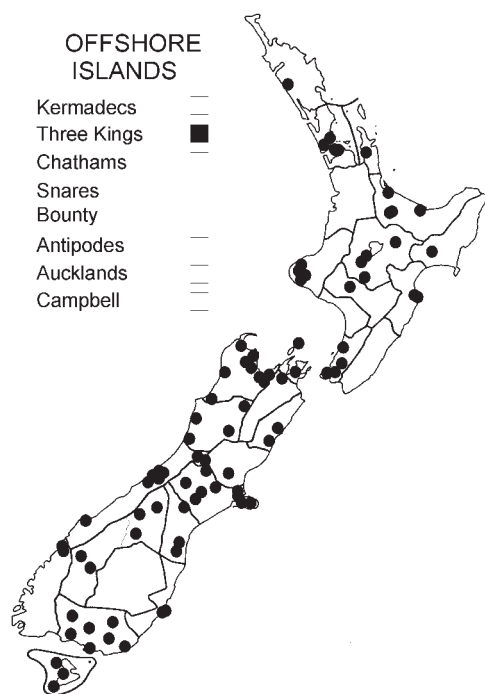
**Map 16** Collection localities, *Leioproctus (N.) nunui*



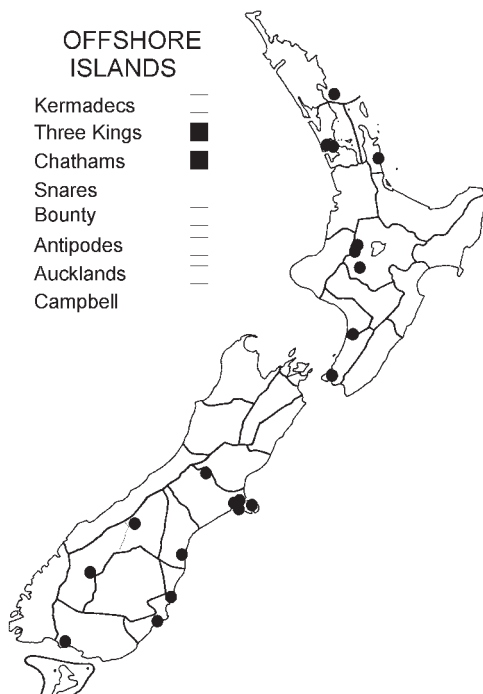
Map 17 Collection localities, *Leioproctus (N.) paahaumaa*



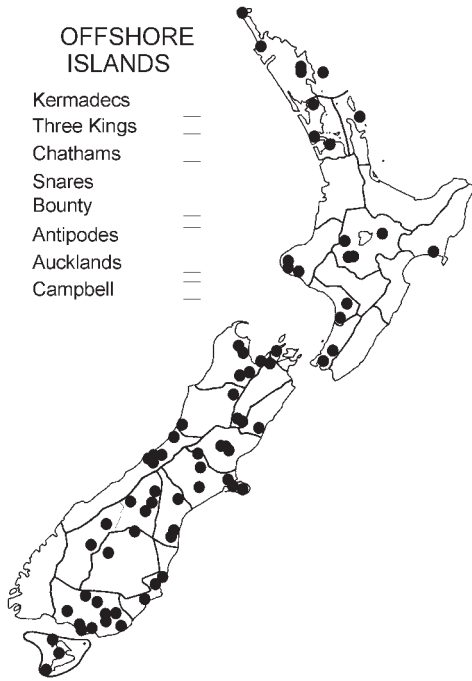
Map 18 Collection localities, *Leioproctus (N.) pekanui*



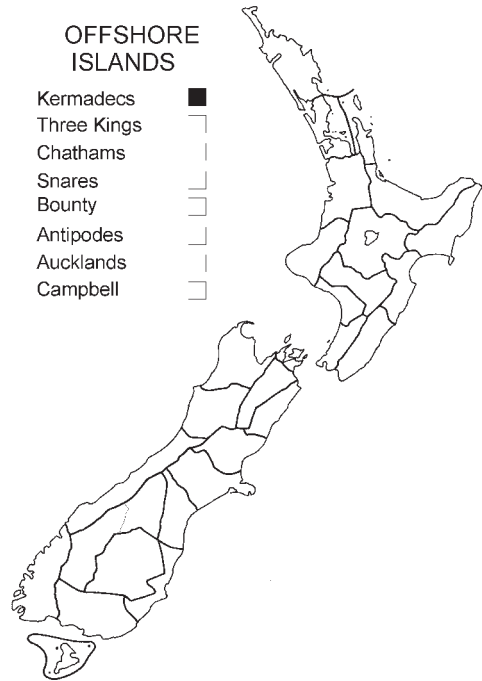
Map 19 Collection localities, *Hylaeus (P.) agilis*



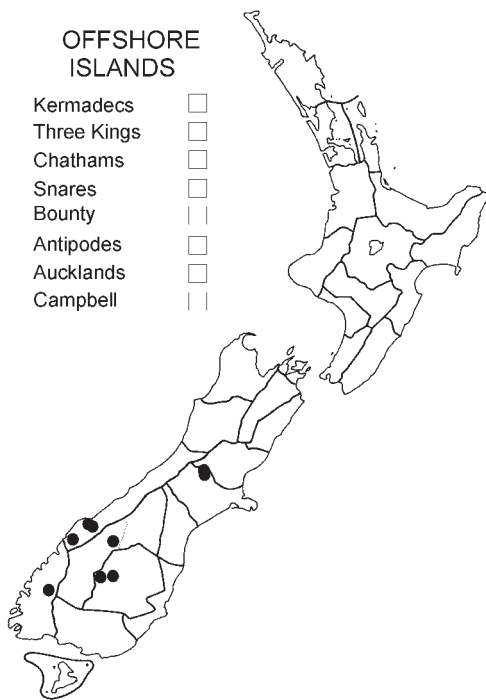
Map 20 Collection localities, *Hylaeus (P.) asperithorax*



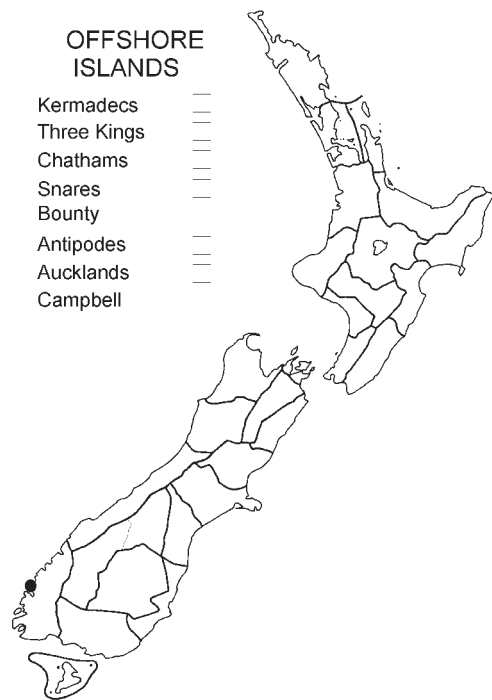
**Map 21** Collection localities, *Hylaeus (P.) capitosus*



**Map 22** Collection localities, *Hylaeus (P.) kermadecensis*

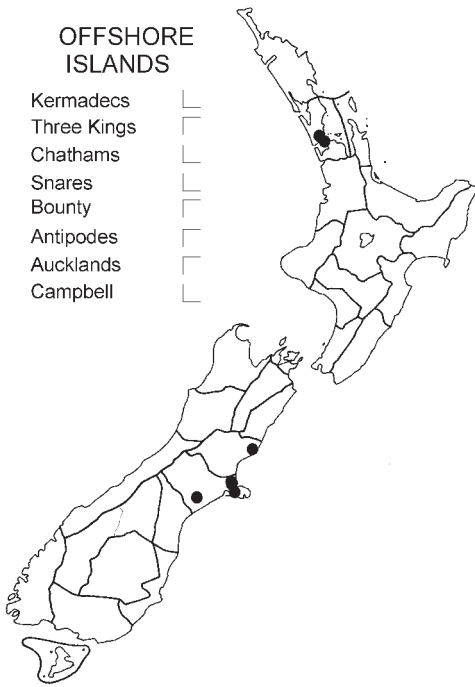


**Map 23** Collection localities, *Hylaeus (P.) matamoko*

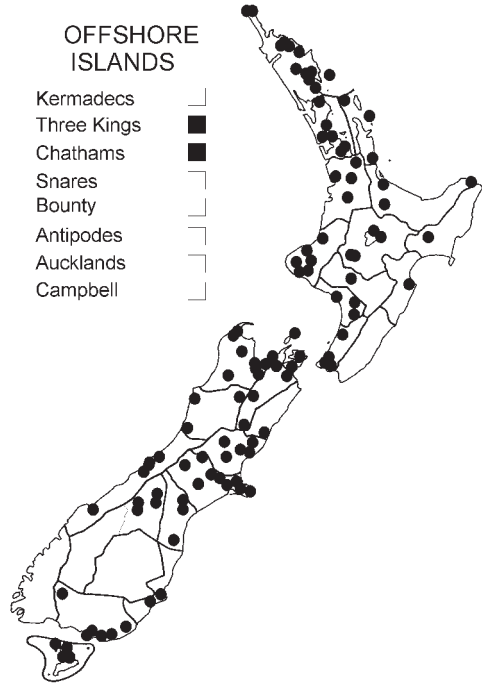


**Map 24** Collection localities, *Hylaeus (P.) murihiku*

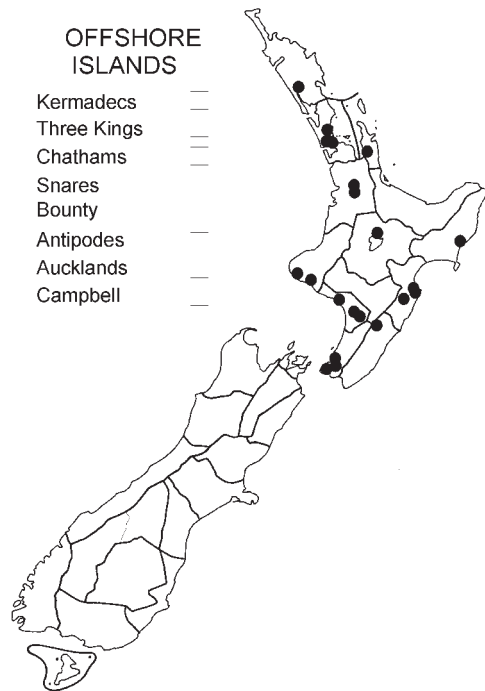




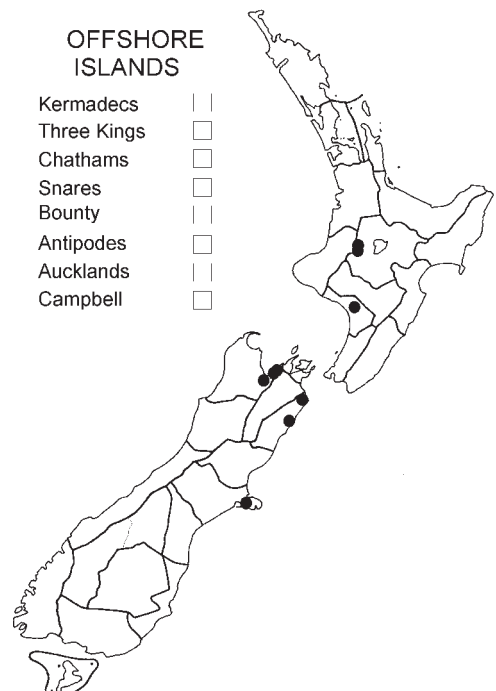
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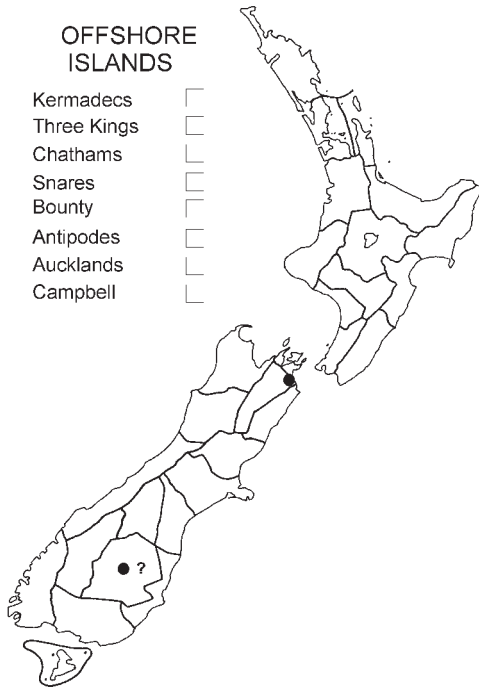
Map 26 Collection localities, *Hylaeus (P.) relegatus*



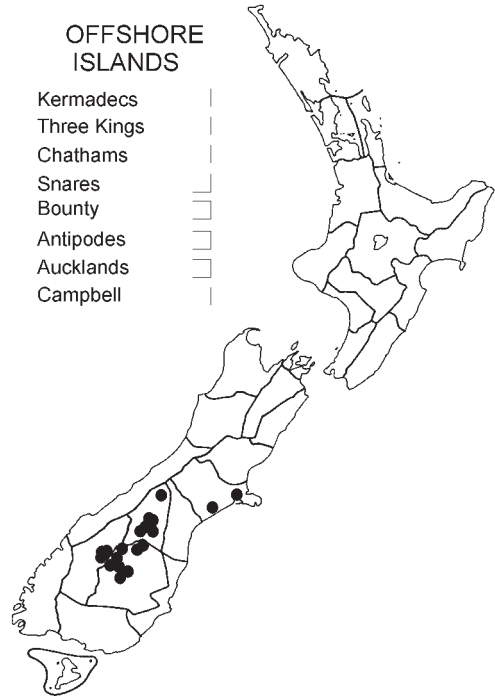
Map 27 Collection localities, *Hyleoides concinna*



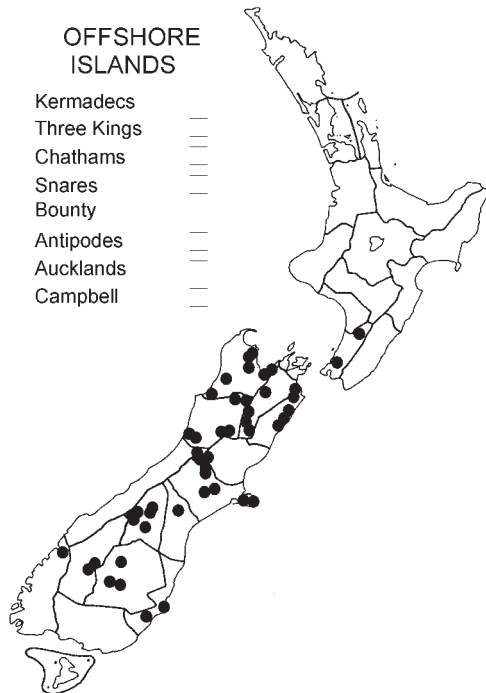
Map 28 Collection localities, *Euryglossina proctotrypoides*



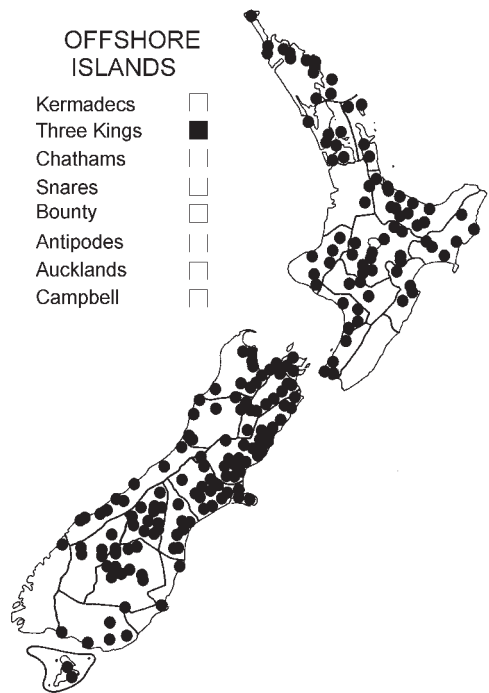
Map 29 Collection localities, *Nomia (A.) melanderi melanderi*



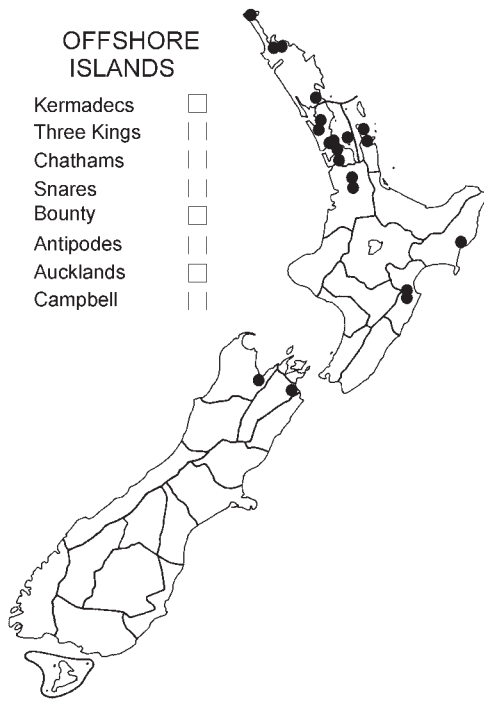
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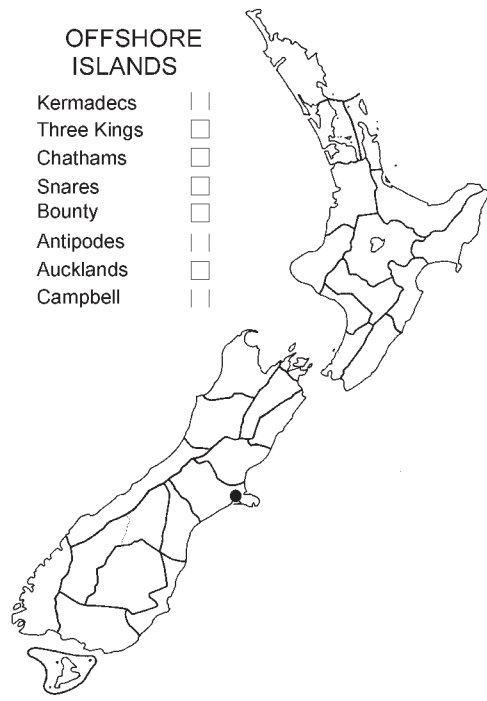
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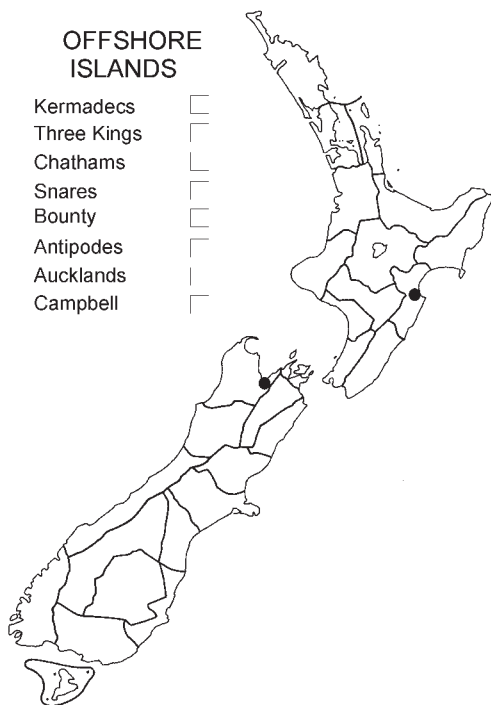
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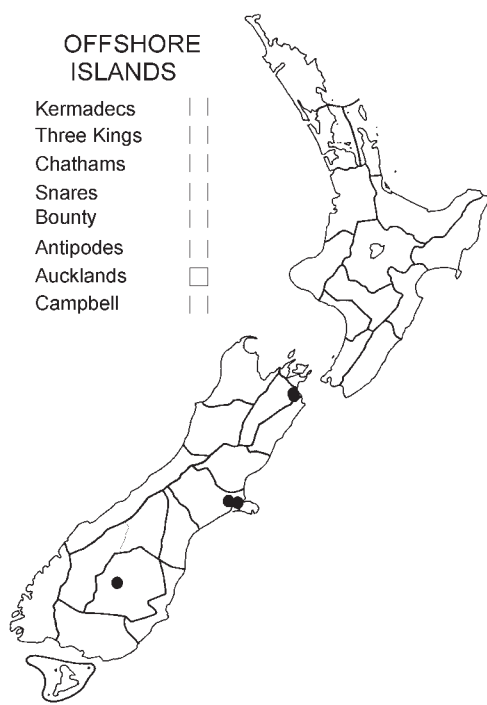
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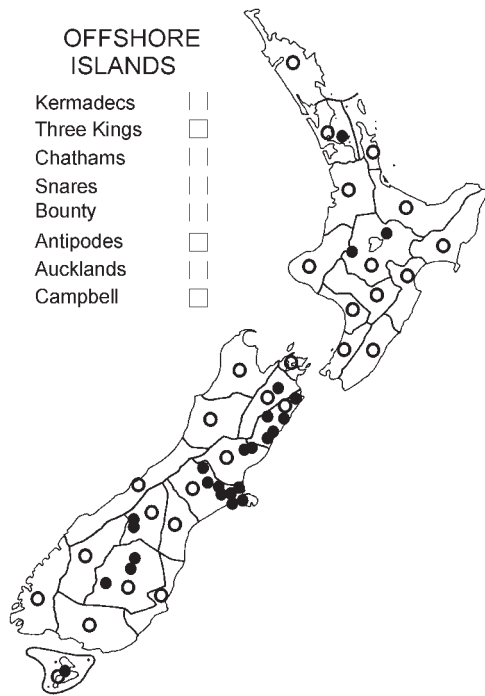
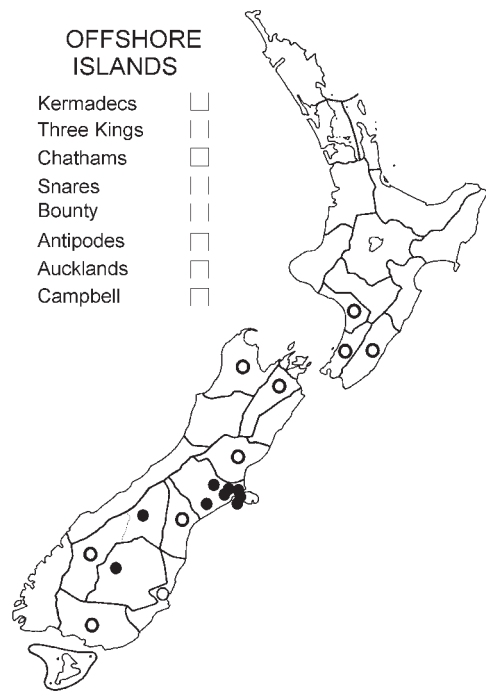
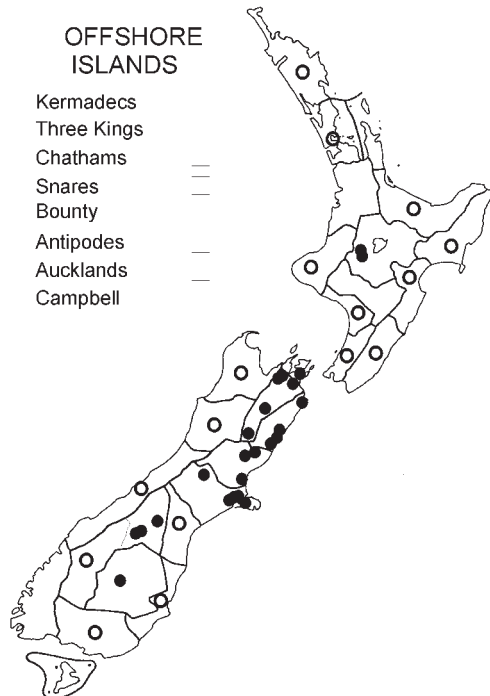
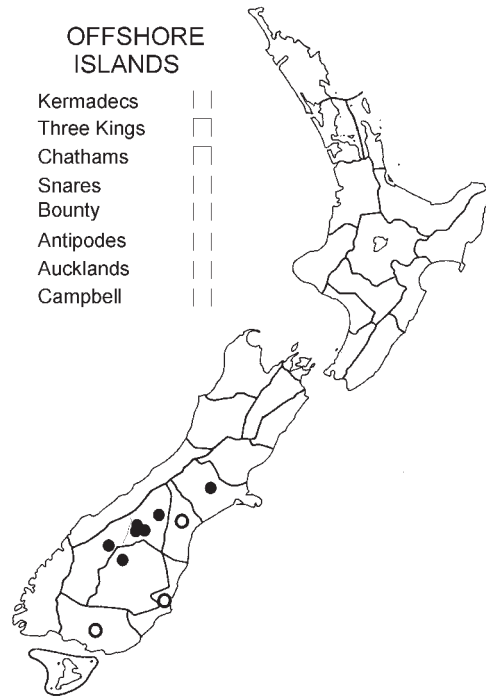
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Open circles are records of Macfarlane & Gurr (1995).

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This index covers the nominal taxa mentioned in the text, regardless of their current status in taxonomy. In the case of synonyms, the combinations of generic and specific names are those originally published by authors, and may differ from combinations implicit in current usage. Taxa in **bold** are those included in the checklist. Page numbers in **bold** indicate main entries: because of the numerous use of many names only the main entries are given. The letter "p" after a page indicates **photographs**, the letters "tp" indicate **type photographs**, the letter "f" indicates **figures**, the letter "k" indicates a **key**, and the letter "m" indicates a **distribution map**. Plant names are not included as they can be readily located by referring to Appendices 4 and 5 and **Biology and Remarks**.

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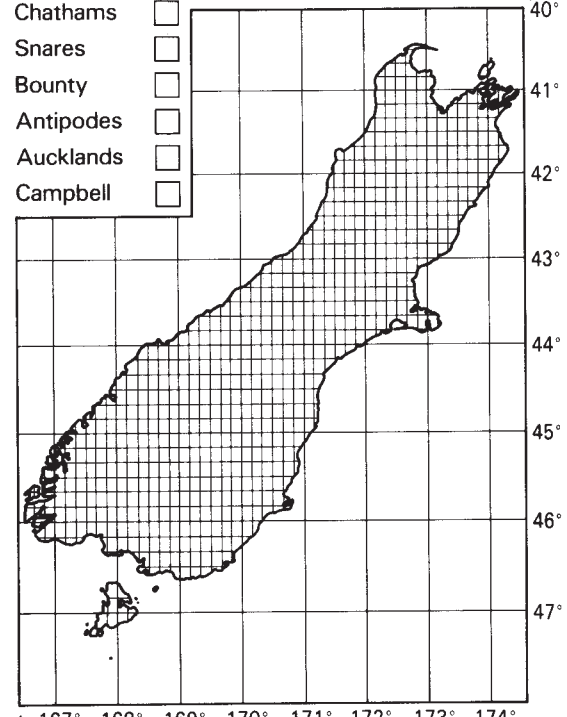
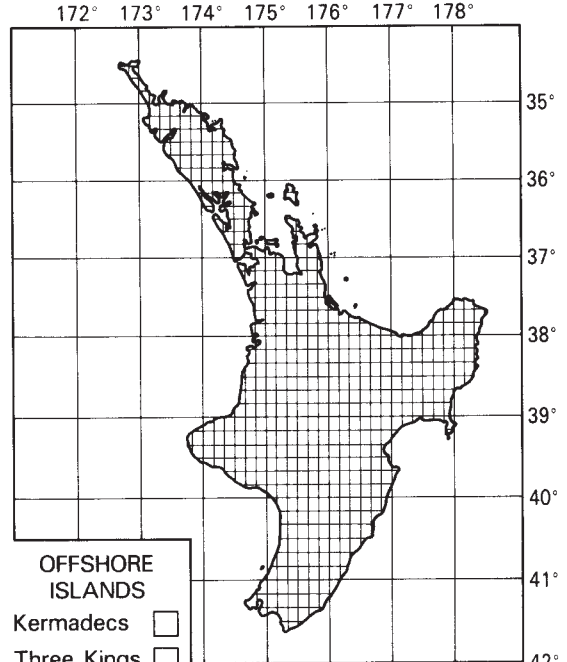
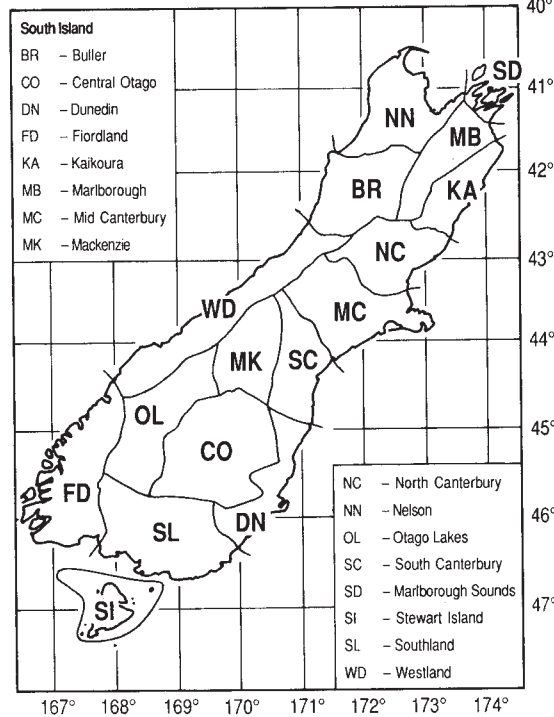
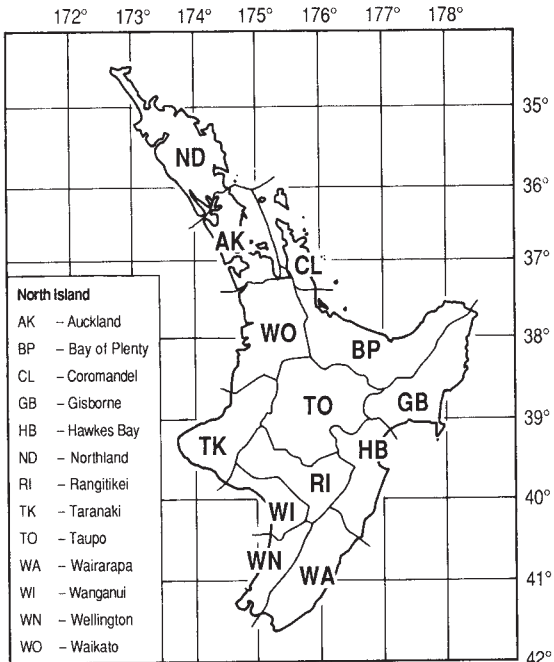
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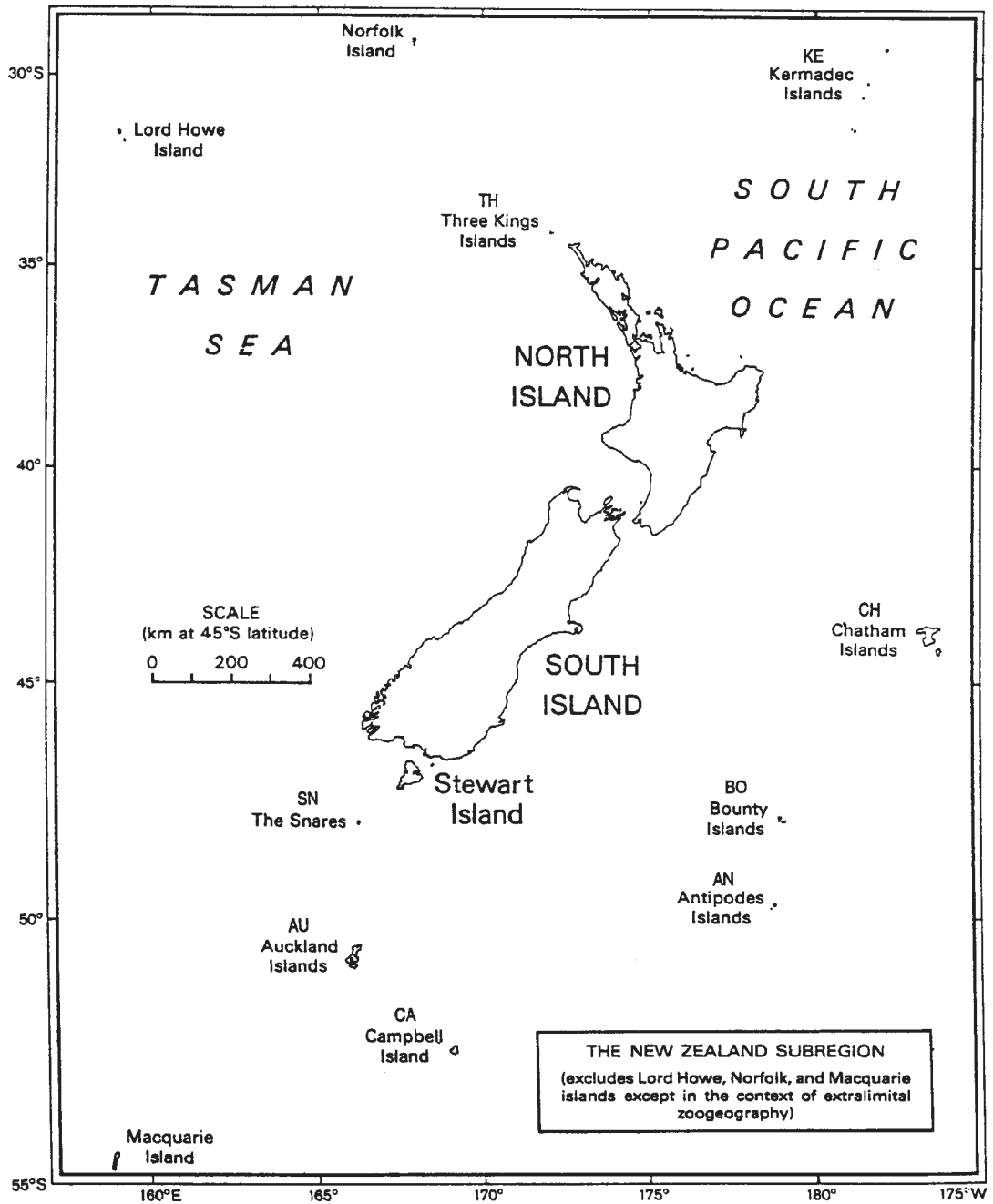


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*Fauna of N.Z.* deals with non-marine invertebrates only, since the vertebrates are well documented, and marine forms are covered by the series *Marine Fauna of N.Z.*

**Contributions** are invited from any person with the requisite specialist skills and resources. Material from the N.Z. Arthropod Collection is available for study.

Contributors should discuss their intentions with a member of the Invertebrate Systematics Advisory Group or with the Series Editor before commencing work; all necessary guidance will be given.

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## NGĀ PĀNUI

Kua whakatūria tēnei huinga pukapuka hei whakahauhau i ngā tohunga whai mātauranga kia whakaputa i ngā kōrero poto, engari he whaikiko tonu, e pā ana ki ngā aitanga pepeke o Aotearoa. He tōtika tonu te āhua o ngā tuhituhi, engari ko te tino whāinga, kia mārāma te marea ki ngā tohu tautuhi o ia ngārara, o ia ngārara, me te roanga atu o ngā kōrero mō tēnā, mō tēnā.

He titiro whāiti tā tēnei pukapuka ki ngā mea noho whenua, kāore he tuarā; i pēnei ai i te mea kei te mōhio whānuitia ngā mea whai tuarā, ā, ko ngā mea noho moana, koirā te tino kaupapa o te huinga pukapuka *Marine Fauna of N.Z.*

Ka āhei te tangata ki te **whakauru tuhituhinga** mehemea kei a ia ngā tohungatanga me ngā rauemi e tutuki pai ai tana mahi. Heoi anō, e wātea ana te Kohinga Angawaho o Aotearoa hei āta tiroiro mā te tangata mehemea he āwhina kei reira.

Me whāki te kaituhi i ōna whakaaro ki tētahi o te Kāhui Ārahi Whakarōpūtanga Tuarā-Kore, ki te ġ tita rānei i mua i te tīmatanga, ā, mā rātou a ia e ārahi mō te wāhi ki tana tuhinga.

Ko te hunga pīrangi **hoko pukapuka**, me tuhi ki *Fauna of N.Z.*, Manaaki Whenua Press, Manaaki Whenua, Pouaka Poutāpeta 40, Lincoln 8152, Aotearoa.

E rua ngā tūmomo kaihoko: “A” – kaihoko tūmau, ka tukua ia pukapuka, ia pukapuka, me te nama, i muri tonu i te tānga; “B” – ka tukua ngā pānuī whakatairanga me ngā puka tonu i ōna wā anō.

Te utu (tirohia “Titles in print”, whārangi 293). Ko te kōpaki me te pane kuini kei roto i te utu. Me utu te hunga e noho ana i Aotearoa me Ahitereiria ki ngā tāra o Aotearoa. Ko ētahi atu me utu te moni kua tohua, ki ngā tāra Merikana, ki te nui o te moni rānei e rite ana.

E toe ana he pukapuka o ngā putanga katoa o mua. Mehemea e hiahia ana koe ki te katoa o ngā pukapuka, ki ētahi rānei, tonoa mai kia whakaheke te utu. Tekau ōrau te heke iho o te utu ki ngā toa hoko pukapuka.