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o Aotearoa

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**Ko te Aitanga Pepeke o Aotearoa**

**Number / Nama 73**

**Noctuinae**

**(Insecta: Lepidoptera: Noctuidae)**

**part 1: *Austramathes, Cosmodes, Proteuxoa, Physetica***

**by**

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**with colour photographs by B.E. Rhode**

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**Auckland, New Zealand**  
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## POPULAR SUMMARY

Class **Insecta**

Order **Lepidoptera**

Superfamily **Noctuoidea**

Family **Noctuidae**

### Owlet moths

The family Noctuidae is one of the largest moth families in the world with around 12,000 known species. Moths belonging to this group are sometimes known as ‘owlets’ because of their nocturnal habits and their camouflage wing patterns, which often feature eye-like markings. Most noctuids are relatively robust, medium-sized to large moths, with a strong fast flight; a number of them are well-known migrants that are able to travel large distances in the search for new breeding grounds. They feed actively from flowers of many kinds, and are known to be significant pollinators. Like most other moths, ‘owlets’ usually lay their eggs on living plants, and the caterpillars feed on the leaves, flowers or fruit or, in some species, inside the stem. Many owlet species have caterpillars that are able to utilise a wide range of plants as food, and some of these species have become serious pests of agriculture or horticulture. On the other hand, some species are restricted to specific habitats and foodplants and are very local or rare. The caterpillars and foodplants of many species are still unknown, especially in the tropics. New Zealand has a relatively small fauna of Noctuidae, with about 160 known species, but most of these (around 139 species) are endemic to the country, occurring nowhere else. The number of exotic species established or regularly migrating here is slowly increasing. Many originate from Australia: two of these, the distinctive green-spangled *Cosmodes elegans*, and the crimson-spotted *Proteuxoa sanguinipuncta* are discussed and illustrated here. The Noctuidae, though recognised as a very important moth family, have not been especially well studied in New Zealand, and around 10% of the known species have not even been scientifically named. Many others are poorly known, and much confusion exists over the identification of these moths, which can be extremely variable in their colours and wing patterns. This volume is the first part of a major review of the New Zealand noctuids, and treats 18 species in 4 genera; 3 species are described here as new to science. One of these new species, *Proteuxoa tetronycha*, is a very common moth that was previously overlooked due to confusion with the very similar *Proteuxoa comma*. It is now known for the first time that the true *Proteuxoa comma* is a local and rare species that may have declined in numbers due to environmental changes, and should probably be placed on the list of New Zealand’s threatened invertebrate species.

### Te Pēpepe Owlet

Ko te whānau Noctuidae tētahi o ngā whānau pēpepe nui katoa i te ao, kei tōna 12,000 nei ōna momo e mōhiotia ana. Ko ngā pēpepe o tēnei karangatanga ka kīia i ōna wā he 'owlet', nā tā rātou haere pō me ngā tauira kirihuna i ō rātou parirau, me te karu te rite o te nuinga. Ko te nuinga o ngā noctuid he ruarangi tonu, he āhua rahi ētahi, ko ētahi he rahi tonu, ka mutu he kaha, he tere te rere; ko ētahi momo he pēpepe heke, ka rere ki tawhiti tonu ki te kimi wāhi whakaputa uri. Ka kimi kai rātou i ngā momo putiputi maha tonu, ka mutu e mōhiotia ana tō rātou pai ki te kawae hae. Pērā i ētahi atu pēpepe 'owlet', ka whānauhia atu ā rātou hua ki te tipu ora, kia pai ai te kai a te anuhe i te rau, i te pua, i te hua rānei, ko ētahi atu momo ka whānauhia atu ngā hua ki roto rawa i te tā o te tipu. Ko ngā anuhe a ētahi momo owlet maha tonu e āhei ana ki te kai i ētahi momo tipu nui tonu, me te noho anō ki te whakararu i te ao ahuwheua, me te ao whakatipu kai. Tērā anō hoki ētahi momo e whāiti mai ana ki ētahi wāhi motuhake, ki ētahi tipu motuhake, ka mutu he momo kāore e whānui te kitea. Kāore e mōhiotia ana te āhua o te anuhe me ngā kai a ētahi momo o te pēpepe nei, ko ngā momo noho whenua pāroru ēnei. Kāore i maha ngā momo Noctuidae kei Aotearoa nei, kei tōna 160 pea e mōhiotia ana, engari ko te nuinga o ēnei (āhua 139 momo) nō Aotearoa taketake ake, arā kāore e kitea i whenua kē. Kei te piki haere te nui o ngā momo nō whenua kē kua rarau te noho ki konei, e heke mai ana rānei ki konei. He maha e heke mai ana i Ahitereiria: e rua o ēnei momo ko te momo kākāriki whakaira e kīia ana ko te *Cosmodes elegans*, me te momo whero whai kōtingotino, te *Proteuxoa sanguinipuncta* e kōrerohia ana, e whakaaturia ana i konei. Ahakoa te noho hira o te pēpepe Noctuidae i Aotearoa nei, kāore anō i āta

mātaitia, ka mutu kāore anō i tapaina tētahi 10% o ngā momo e mōhiotia ana ki tētahi ingoa pūtaiao. Ko ētahi momo kāore e tino mōhiotia ana, kāore hoki e taea ētahi momo te āta tohu i te tāupe o ngā tae me ngā tauira i ngā parirau. Ko tēnei tānga te wāhanga tuatahi o tētahi arotakenga o ngā noctuid o Aotearoa, e titiro ana ki ētahi momo 18 nō ētahi karangatanga e 4; e 3 ngā momo kua kōrerohia i konei e tauhou ana ki te ao pūtaiao. Ko tētahi o ngā momo nei ko te *Proteuxoa tetronycha*, he momo pēpepe e kitea whānuitia ana, he pēpepe kāore i tino arohia atu i te rite ōna ki te *Proteuxoa comma*. Kātahi tonu ka mōhiotia nō konei ake te *Proteuxoa comma*, ka mutu he momo kāore e whānui te kitea, kua itiiti haere i te huringa o te taiao. Me te aha, e tika ana pea kia noho mai ki te rārangi o ngā momo tuaiwi-kore o Aotearoa e rarururu ana.

Contributor **Robert Hoare** was born in Winchester in the south of England. He was educated at Eton, and then attended Oxford University where he completed a degree in Classics (Latin and Greek literature and philosophy). He followed this, logically enough, with a degree in Biological Sciences at Exeter University. An early interest in butterflies was fostered by his father Ian, who painstakingly reared many species through from egg to adult. The acquisition of a Robinson pattern mercury vapour moth trap at a formative point in life transformed him instantly into a mothman, after which he progressed inexorably towards the study of smaller and smaller moths, culminating in his PhD thesis on the Nepticulidae of Australia at the Australian National University in Canberra (nepticulids are the smallest moths of all). Since joining Landcare Research in 1998, Robert has concentrated his research efforts on slightly less tiny moths, especially those of the family Xyloryctidae, but retains a broad interest in all Lepidoptera, particularly leaf-miners and detritus-feeders. He is currently engaged in a major study of the New Zealand Noctuidae. From 2000 to 2010 he lectured annually on systematic entomology at the University of Auckland, and he often gives talks to primary school children about moths and other insects. In 2014, he produced a popular guide to New Zealand moths and butterflies through New Holland Publishers, with photographs of living moths by Olivier Ball. He aims to foster a wider interest in moths throughout New Zealand so that we can learn much more about these neglected creatures, so many of which are endemic to this country and perform a significant role in our unique ecosystems.



I whanau mai te kaituhi, a Robert Hoare i Winchester, ki te taha tonga o Ingarangi. I whai ia i te mātauranga i Eton, ka haere ki te Whare Wānanga o Oxford, ki te whakatutuki ana i tana tohu mātauranga Classics (ngā pukapuka kōrero a te Rātini me te Kariki, me te wānanga whakaaro). Nō muri ka whāia e ia tana tohu mātauranga Pūtaiao Koiora i te Whare Wānanga o Exeter. I tōna ohinga ka oho tana ngākau ki te pūrerehua, ka atawhaitia tēnei āhua e tana matua, a Ian, ko tāna nei mahi he āta whakatipu i ētahi momo pūrerehua maha tonu, mai i te hua, ā pūrerehua rawa. E ohi tonu ana ia ka whiwhi ia i tētahi tāwhiti whai rama tākohu konuoi nō te tauira a Robinson, whakakau ake ko te tangata pēpepe. Whai muri mai ka tahuri ia ki te mātai pēpepe iti, ka moroiti kē atu, ka moroiti kē atu ngā pēpepe i mātaihia e ia. Ko te hua o ēnei mahi ko tana Tohu Kairangi e pā ana ki te Nepticulidae o Ahitereira i te Australian National University i Kānapera (ko te nepticulid ngā pēpepe iti katoa). Mai i tana hononga mai ki Manaaki Whenua i te tau 1998, kua arotahi ngā mahi rangahau a Robert ki te pēpepe kāore i tino moroiti, me te aro nui ki te whānau Xyloryctidae, engari e ngākaunui tonu ana ia ki ngā Lepidoptera katoa, me te aro nui ki ēra momo he kai pūtautau rau te iro, me nga mea kai popo. I tēnei wā e mātai ana ia i ngā Noctuidae o Aotearoa. Mai i te 2000 ki te 2010 i kauhau ia tau a ia mō te mātai pepeke nahanaha i te Whare Wānanga o Tāmaki-makau-rau, ka mutu he rite tonu tana kōrero ki ngā tamariki kura tuatahi mō te pēpepe me ētahi atu pepeke. I te tau 2014 ka puta i a ia tana tānga mō ngā pēpepe me ngā pūrerehua o Aotearoa, i tāia nei e New Holland Publishers. Ko ngā whakaahua o ngā pēpepe ora nā Olivier ball. Ko tana whāinga ko te whakaoho i te ngākau tangata ki ngā pēpepe o Aotearoa, kia ako ai tātou mō ngā pepeke nei, ko te maha atu nō tēnei whenua taketake ake, ka mutu he wāhi nui kei a rātou ki te tiaki i ā tātou pūnaha hauropi.

Māori translation by Te Haumihiata Mason

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**ABSTRACT**

In this first part of a revision of the New Zealand Noctuidae *sensu lato*, several small genera unplaced to tribe are revised, i.e., *Austramathes* Hampson, 1906, *Cosmodes* Guenée, 1852, *Proteuxoa* Hampson, 1903 and *Physetica* Meyrick, 1887. An informal system of genus groups is erected for these unplaced genera as a first step towards clarifying their relationships and eventual tribal placement. The *Austramathes*, *Cosmodes* and *Proteuxoa* genus groups are each monotypic as here constituted; the *Physetica* genus group contains 6 other currently recognised genera in addition to *Physetica*. In total, 18 species are treated, including three new species; three new synonymies are proposed.

*Austramathes* is expanded to accommodate small species allied to *A. purpurea* (Butler) and previously incorrectly placed in the genera *Homohadena* Grote, 1873 and *Andesia* Hampson, 1906; as revised the genus contains five endemic species: *A. purpurea*, *A. fortis* (Butler) **n. comb.**, *A. squaliolus* **n. sp.**, *A. coelacantha* **n. sp.** and *A. pessota* (Meyrick) **n. comb.** *Cosmodes* is a monotypic genus containing only *C. elegans* (Donovan), an Australian species occurring regularly as a migrant in New Zealand and established at least temporarily in some localities. *Proteuxoa* contains the two endemic species *P. comma* (Walker) and *P. tetronycha* **n. sp.** and the recently established Australian adventive *P. sanguinipuncta* (Guenée); this is a chiefly Australian genus. The formerly monotypic genus *Physetica* (type species *Spaelotis caerulea* Guenée) is here expanded to include the following taxa in addition to the type species: *P. cucullina* (Guenée) **n. comb.**, *P. homoscia* (Meyrick) **n. comb.**, *P. longstaffi* (Howes) **n. comb.**, *P. funerea* (Philpott) **n. comb., sp. rev.**, *P. phricias* (Meyrick) **n. comb.**, *P. prionistis* (Meyrick) **n. comb.**, *P. sequens* (Howes) **n. comb.**, and *P. temperata* (Walker) **n. comb.** Three **new synonymies** are proposed in *Physetica*: *Aletia obsecrata* Meyrick and *A. probenota* Howes are both junior synonyms of *P. cucullina* and *Cucullia cellulata* Warren is a synonym of *P. phricias*. *Aletia parmata* Philpott is reinstated as a synonym of *Physetica cucullina*, and *P. funerea* is removed from synonymy with *parmata* and reinstated as a good species. No new *Physetica* species are described. The genus is endemic to New Zealand.

External features of adults of all species and genitalia of both sexes (where known) are fully described and illustrated. Immature stages, host-plants and life history are described briefly, where known, and distribution by New Zealand subregion is summarised and mapped.

*Austramathes purpurea* is a widespread lowland forest moth whose larvae feed on the common tree *Melicactus ramiflorus* (mahoe) (Violaceae). Other species of *Austramathes* for which the life history is known feed on shrubby Violaceae: *A. pessota* and *A. coelacantha* are local shrubland species, whilst *A. fortis* is a widespread forest and shrubland species; *A. squaliolus* replaces its close relative *A. fortis* in the forests of the Chatham Islands, to which it is endemic. *Cosmodes elegans* is a moth of rough herbage, e.g. in forest clearings, where its larvae feed chiefly on *Lobelia* spp.; in Australia, *Verbena* is another recorded host-plant. *Proteuxoa* species chiefly occur in open habitats; *P. tetronycha* is widespread and abundant throughout New Zealand; it was formerly confused with the much scarcer *P. comma* and is distinguished for the first time here. *Proteuxoa comma* is a local and probably declining moth of drier habitats; its conservation status is in urgent need of assessment now that it has been separated from *P. tetronycha*. *Proteuxoa sanguinipuncta* has become a common moth of grassland and forest edge habitats through much of the North Island since its establishment here in 2007, and it has been recently recorded from the north of the South Island. *Proteuxoa tetronycha* is probably more or less polyphagous on herbaceous plants; *P. comma* is likely to be more restricted in host choice, and a specialised oviposition site is suggested by its spinose ovipositor; *P. sanguinipuncta* has not been reared in New Zealand but is associated with grasses in Australia. Species of *Physetica* are largely inhabitants of native shrubland biotopes from the coastal to the alpine zone, occurring throughout New Zealand from North Cape ND (*P. longstaffi*) as far south as the Auckland Islands (*P. homoscia*). Known larval host-plants are in Asteraceae, Ericaceae and Rhamnaceae: *Ozothamnus* (*P. homoscia*, *P. temperata*), *Craspedia* (*P. longstaffi*), *Leucopogon* (*P. cucullina*, *P. sequens*), *Leptecophylla* (*P. sequens*) and *Discaria* (*P. phricias*). The life histories are in general poorly documented. All species of *Physetica* are more or less widespread and locally common, and none is currently recognised as being threatened.

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I would like to extend my warmest thanks to Birgit Rhode (NZAC) for the immense amount of time, care and energy she has put into the photography of adult noctuids, along with their heads, wing veins, abdomens and genitalia for this revision (and its forthcoming sequels). She has performed the time-consuming task of editing of these images for clarity and consistency with the greatest efficiency and to the highest quality. She also put together all the plates and the maps reproduced here, and databased the photographed specimens.

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## INTRODUCTION

### Family-level classification and diversity of Noctuoidea

The Noctuoidea represents a 'megadiverse' lineage of Lepidoptera, probably of relatively recent origin, easily defined by the presence of tympanal organs ('ears') on the metathorax (Kitching & Rawlins 1998). Over 40,000 species have been described worldwide (van Nieukerken *et al.* 2011), making this currently the largest known

radiation in the Lepidoptera, although it has been suggested that the far less well studied Gelechioidea may eventually challenge this position (e.g. Heikkilä *et al.* 2014).

The family Noctuidae in the traditional broad sense for a long time held the title of most diverse family of Lepidoptera, with over 35,000 described species (e.g., Kitching & Rawlins 1998). However, family classification within the Noctuoidea has been subject to increasing scrutiny in recent years (e.g. Fibiger & Lafontaine 2005, Lafontaine & Fibiger 2006, Zahiri *et al.* 2010). It has long been recognised that the forewing venation provides evidence for a basic division within Noctuoidea between ‘trifid’ and ‘quadrid’ groups. In ‘trifid’ groups (Oenosandridae, Notodontidae), vein M2 arises midway between M1 and M3, so that M3 clusters with CuA1 and CuA2, giving a three-branched appearance to the lower corner of the discal cell; in ‘quadrid’ groups (Arctiidae, Lymantriidae, Noctuidae, Nolidae and Pantheidae of Kitching & Rawlins 1998), M2 arises close to or stalked with M3, giving a four-branched appearance. Classification of the diverse quadrid Noctuoidea has been beset with controversy, due to the highly homoplastic nature of many or most adult characters (Kitching & Rawlins 1998), but recent phylogenetic studies including evidence from nuclear genes have offered hope of a more stable family-level taxonomy (Zahiri *et al.* 2010). These studies revealed that those noctuid subfamilies with a ‘quadrid’ hindwing venation (where M2 is a strong vein arising close to M3) form a monophyletic group together with the quadrid Arctiidae and Lymantriidae, to the exclusion of the trifid noctuid subfamilies (where M2 arises closer to M1 than M3 and may be reduced or absent) (Zahiri *et al.* 2010). This has led to the recognition of the quadrid lineages as a single family Erebidae, in which Arctiinae and Lymantriinae are subsumed as subfamilies alongside many subfamilies formerly assigned to Noctuidae (Zahiri *et al.* 2010, an arrangement prefigured by Fibiger & Lafontaine 2005). The remaining noctuoids with quadrid forewing venation are divided into three monophyletic families: Noctuidae (i.e. the trifid subfamilies), Nolidae, and Euteliidae (formerly a subfamily of Noctuidae). Pantheidae, treated as a family by Kitching and Rawlins (1998), is reduced to subfamily status within Noctuidae (Fibiger & Lafontaine 2005; Lafontaine & Schmidt 2010). Doidae, formerly included in Noctuoidea as one of the trifid families (Kitching & Rawlins 1998; Lafontaine & Schmidt 2010) has been provisionally moved to Drepanoidea (Regier *et al.* 2009; van Nieukerken *et al.* 2011).

One upshot of these changes is that Erebidae now ranks as the most diverse Lepidoptera family worldwide, with over 24,500 described species in 1,760 genera, just exceeding Geometridae (23,000 species: van Nieukerken *et al.* 2011); the new, narrower concept of Noctuidae is reduced to approximately 11,800 species in 1,089 genera (van Nieukerken *et al.*, *loc cit.*).

### New Zealand Noctuoidea diversity

Interestingly, the relative diversity of Erebidae and Noctuidae in New Zealand is the reverse of the global situation: only 33 species of Erebidae have occurred in New Zealand, of which 10 are either vagrants that have been reported once only, or adventives that have failed to establish or have been eradicated. A further 10 species are regular or irregular immigrants that are not thought to have permanent New Zealand populations, and six more are established adventive species (including the introduced biological control agent *Tyria jacobaeae* (Linnaeus), the Cinnabar Moth). This leaves a native New Zealand erebid fauna of only seven species, i.e. six endemic species plus the cosmopolitan *Schrankia costastrigalis* (Stephens). The only endemic genus in this family is *Metacrias* Meyrick; however, even this may prove to be congeneric with the Australian *Phaos* Walker (Edwards 1996a). The Noctuidae *sensu stricto*, on the other hand, contains approximately 160 species in New Zealand (including taxa newly described in this volume as well as still undescribed taxa), of which about 139 are endemic. The genus classification is still under review, but following revision, it is anticipated that there will be 5 or 6 endemic genera containing between them approximately 132 species.

### Historical notes: taxonomy of endemic Noctuidae

The earliest available name for an endemic New Zealand noctuid is *Dianthoecia pictula* (now *Meterana pictula*); this was the only new species of Lepidoptera named in the Rev. Richard Taylor’s book “Te Ika a Maui, or New Zealand and its inhabitants” (Taylor 1855: pl. 1, fig. 3). The name, which appears only in the caption to the plate and is not accompanied by any description, has usually been attributed to A. White (e.g., Butler 1877, Meyrick 1887, Dugdale 1988) as the artist, but White is not mentioned by Taylor and therefore the authorship must be attributed to the latter (ICZN Article 50.1.1; Nye 1975). A number of endemic noctuids were described by Francis

Walker of the Natural History Museum, London (BMNH) from specimens collected by the Rev. William Colenso (central North Island), Percy Earl (Waikouaiti DN), Lt.-Col. Daniel Bolton (Auckland) and the Rev. John F. Churton (Auckland and probably Wellington) (Walker 1856, 1857a, 1857b, 1858) and later from the collection of T.R. Oxley of Nelson (Walker 1865; see Dugdale (1988) for the mislabelling of Oxley's collection). R.W. Fereday of Canterbury sent specimens to Guenée, who named nine new species of Noctuidae from this collection (Guenée 1868), five of which are still recognised as valid. Five further noctuid species were added by Butler (1877) from specimens submitted from Canterbury by J.D. Enys: many of these specimens were in fact collected by Fereday (Fereday 1880). One of Butler's (1877) species, *Hadena debilis*, is now recognised as a synonym of *Graphania mutans* (Walker). Butler later worked on a collection sent by Capt. F. W. Hutton, director of the Otago Museum, Dunedin (Butler 1879): a number of species named or mentioned in this paper have Wairarapa as their locality and one of these (*Chersotis sericea* Butler, a synonym of *Agrotis admirationis* Guenée) has a label indicating that the collector was J.K. Lorimer. The Otago Museum still contains many old specimens labelled 'Wairarapa' and perhaps Lorimer was the collector of all of these. Butler also worked on material sent from William Skellon in Blenheim MB, many of whose specimens were severely damaged in transit (Butler 1880); these two papers added a further 11 noctuid species, six of which are currently accepted as valid. R.W. Fereday himself contributed very careful descriptions of three new species, all valid and currently in *Tmetolophota*: *T. sulcana* (Fereday 1880), *T. blenheimensis* and *T. purdii* (Fereday 1883); his training as a lawyer can perhaps be seen in his diffidence in assigning his species to named genera.

The first overview and revision of New Zealand Noctuidae was provided by Edward Meyrick (1887). Meyrick was dismissive of the work of his predecessors, and Walker, Guenée and Butler were probably all included when he wrote: "It is... not surprising that those writers who classify by superficial appearance have found themselves in a frightful state of confusion" (Meyrick 1887: 3). Meyrick at this time recognised two families in his 'Noctuina', i.e. Noctuidae and 'Plusiadae': in the Plusiadae he included five New Zealand species in five genera, four of which are now assigned to Erebiidae, the remaining one (*Chrysodeixis eriosoma* (Doubleday)) being a true plusiine noctuid in the current classification. Excluding these erebids, he treated 59 species in 13 genera; after visiting the BMNH, he modified his species-level classification somewhat, introducing two new names and several synonymies in a supplementary paper (Meyrick 1888). It is interesting to note that Meyrick (1887), like previous authors, did not recognise strong endemism at the genus level in the noctuid fauna, and assigned most species (42) to two genera, *Mamestra* Ochsenheimer and *Leucania* Ochsenheimer, which he regarded as cosmopolitan but particularly well represented in New Zealand. Nonetheless he erected two new monotypic endemic genera, *Physetica* and *Ichneutica*, and continued to recognise the endemic *Bityla* Walker (two species) and *Erana* Walker (monotypic, a preoccupied name later replaced by *Feredayia* Kirkaldy).

The next important contribution came from G.V. Hudson (1898), in the first of his three major volumes describing and illustrating the New Zealand Lepidoptera. Hudson added 10 new noctuid species in this book, all of which are still valid: spectacular species such as *Graphania maya* (Hudson) and *Meterana merope* (Hudson) were amongst them. During the following 14 years, further species were described by W.G. Howes of Dunedin (Howes 1906, 1908, 1911, 1912), Hudson (1909: the subantarctic species *Graphania erebia* and *G. pagaia*), Meyrick (1901, 1902, 1911), Alfred Philpott of Invercargill (1903, 1905, 1910) and G.F. Hampson of the BMNH (Hampson 1905, 1911).

Sir George Hampson's work on Noctuidae, contained in his 16-volume *Catalogue of the Lepidoptera Phalaenae in the British Museum* has been well described by Zimmerman (1958) as 'a monument of individual productivity and great perseverance'. But, as Zimmerman also trenchantly states, 'the usefulness of Hampson's work is diminished somewhat because of his idiosyncrasies, and had he only adopted a more fortunate course, all subsequent workers would have been spared much labor and confusion'. A detailed critique and *reductio ad absurdum* of Hampson's artificial system of noctuid classification and its consequences can be found in Meyrick (1912: 89–90). Hampson's first foray into New Zealand Noctuidae in volume 5 of his *Catalogue* (Hampson 1905) contains descriptions of four new species, only one of which (*Morrisonia chryserythra*, now in *Graphania*) remains valid, the others having been previously described by Meyrick and Hudson. However, he erected here two new genera, *Graphania* and *Tmetolophota*, with New Zealand type species (*Graphania disjungens* (Walker) and *Tmetolophota propria* (Walker)). In each genus, he placed a second species from outside New Zealand: the South African *Aspidifrontia atavistis* Hampson in *Graphania* and the Peruvian *T. polygona* Hampson in *Tmetolophota*.

His circumscriptions of each of these genera thus fell foul of Meyrick's (1912) expectation that 'a genus must be geographically consistent... its geographical distribution should not be incongruous'. And indeed, the inclusion of *atavistis* and *polygona* as congeners of *G. disjungens* and *T. propria* is certainly erroneous (although *atavistis* is still listed in *Graphania* by Vári et al. 2002). The names *Graphania* and *Tmetolophota* were soon sunk as synonyms of *Persectania* Hampson by Meyrick (1912) and were not revived again until Dugdale's (1971) far-reaching review of the subantarctic Lepidoptera fauna (see below). Most of the species recognised as belonging to *Mamestra* by Meyrick (1887) were transferred to *Morrisonia* Grote, a genus with a North American type species (*M. evicta* (Grote)). A further new endemic genus, *Austramathes*, was described by Hampson (1906) in the sixth volume of his Catalogue, to accommodate *Graphiphora purpurea* Butler; the genus was described as monotypic and has remained so. In a supplementary paper, Hampson (1911) named three striking new species, all valid, now *Graphania chlorodonta*, *G. oliveri* and *Meterana meyricki*; the last had been briefly described by Butler (1877) as the female of *pictula*, and by Meyrick (1887) also as *pictula* (both sexes) (the true *pictula* being Meyrick's *rhodopleura*).

Meyrick's second overview of New Zealand Noctuoidea (as 'Caradrinina': Meyrick 1912) was a genus-level revision, in which he described no new species. At this stage, he recognised four families (Arctiidae [*sic*], Hypsiidae, Caradrinidae and Plusiidae), 29 genera and 102 species. Of these, his Arctiidae, Hypsiidae and most of his Plusiidae are now subsumed in Erebiidae, and only his Caradrinidae and the two species of Plusiidae referred to *Plusia* (now *Chrysodeixis eriosoma* and *Ctenoplusia albostrigata* (Bremer & Grey)) are noctuids in the current definition, giving a total of 21 genera and 90 species in this family. One new monotypic endemic genus, *Dipaustica*, was described for *Leucania epiastra* Meyrick. The species he had previously included in *Mamestra* (Meyrick 1887) and which Hampson (1905) had placed in *Morrisonia* were now transferred to *Melanchra* Hübner, again a genus with a Eurasian type species (*Melanchra persicariae* (Linnaeus)). Endemic noctuid genera recognised by Meyrick (1912) were *Austramathes*, *Bityla*, *Dipaustica*, *Erana*, *Ichneutica*, *Physetica*: it is again striking that apart from *Ichneutica* (2 species) and *Bityla* (3 species), all were monotypic.

There followed a period of intense activity in the study of New Zealand Lepidoptera, with Meyrick, Hudson and Philpott between them describing numerous new species in many papers from 1913 onwards through the 1920's. The proportion of new Noctuidae described in these publications is relatively small, as the majority of the commoner and more accessible species recognisable without dissection had by now been named. The proportion of names later recognised as synonyms also increases: of the 11 noctuid species named by Philpott between 1924 and his death in 1930, only 4 remained valid following publication of Dugdale's (1988) catalogue of New Zealand Lepidoptera (and only two of these are regarded as valid by the current author). A single noctuid species, *Melanchra* (currently *Graphania*) *olivea* was described by Morris Watt (Watt 1916). Hudson's second illustrated book on New Zealand butterflies and moths (Hudson 1928) is a great landmark of this period, providing a succinct summary of the knowledge of Noctuidae to that date, and illustrating all species of which Hudson had seen specimens. No new noctuid species were described here; Hudson recognised 30 genera and 136 species of New Zealand Noctuidae, of which 20 genera and 123 species are currently regarded as noctuids, the rest being Erebiidae.

Few new Noctuidae were added during the 1930's. Meyrick (1931, 1934) described four further species before his death in 1938. However, from 1941 onwards, W.G. Howes began taking an especial interest in the Lepidoptera of the Homer region in Fiordland and in three papers, named four new noctuid species from this area and one from Southland (Howes 1943, 1945, 1946). Three of these five species are regarded by the current author as valid. J.T. Salmon, who accompanied Howes in the field on the later Homer expeditions, added three noctuid species and one subspecies in two further papers (Salmon 1946, 1956), but only one of these, *Ichneutica notata* Salmon, is a valid species; the subspecies *obscura* that Salmon named for specimens of *Agrotis admirationis* Guenée (as *Euxoa admirationis*) from Milford Sound is a variety that occurs widely throughout the range of this species and deserves no separate taxonomic status (Dugdale 1988).

Since 1956, only two new species of endemic Noctuidae have been described, and a single replacement name proposed (*Graphania lindsayi* Dugdale 1988 for *Melanchra olivea* of Hudson 1928 *nec* Watt 1916). Dr Kenneth Fox of Taranaki had a long-term interest in Noctuidae, and built up a substantial and important collection, now housed in MONZ; he described the striking *Graphania brunneosa*, a species surprisingly overlooked by earlier entomologists (Fox 1970a). The discovery by Brian Patrick of a remarkable and rare endemic species of Heliethinae, *Australothis volatilis*, in Central Otago was documented by Matthews and Patrick (1998). The most

significant publications of this period for noctuid systematics were the treatment of subantarctic Lepidoptera by Dugdale (1971) and his annotated catalogue of New Zealand Lepidoptera (Dugdale 1988). In the first of these major contributions, Dugdale (1971) substantially rearranged the genus-level classification of New Zealand Noctuidae as a whole: he dismantled Meyrick's (1912) concepts of *Melanchra*, *Persectania* and *Leucania*, resurrecting Hampson's genera *Graphania* and *Tmetolophota* to contain many of the displaced species, as well as defining an 'Erana group', whose species (apart from *Feredayia graminosa* (Walker)) he later explicitly reassigned to Butler's (1877) genus *Meterana* (Dugdale 1988). Though indicating that assignment of endemic New Zealand species to *Aletia* was invalid and biogeographically misleading, he did not tackle the problem of their correct placement, except for moving *Aletia nullifera* (Walker) to *Graphania*. His later catalogue (Dugdale 1988) introduced a large number of new synonymies (24), of which one (the sinking of '*Aletia*' *parmata* Philpott as a junior synonym of '*A.*' *cucullina* (Guenée)) has subsequently been reversed (White 2002: 305), though it is reinstated here. (A further synonymy listed as new by Dugdale, that of *Meterana rhodopleura* with *M. pictula*, should really be attributed to Hampson (1911: 421)). Dugdale recognised 45 genera and 162 named species of Noctuidae, of which 28 genera and 143 species are here regarded as true noctuids: the species he listed in subfamilies Catocalinae, Chloephorinae, Hypeninae and Hypenodinae now belong in Erebidae, and Nolinae has regained full family status as Nolidae.

In his important but eccentric book on New Zealand tussock grassland moths, White (2002) treated 73 species currently regarded as Noctuidae (including three unnamed species). It was White's careful study of antennae that allowed him to appreciate the subtle differences between male '*Aletia*' *cucullina* and '*A.*' *funerea* and justify the recognition of two species confused under the name *cucullina* (although he misidentified the second species as *parmata*). No other taxonomic changes were made in Noctuidae in this book, but White's analysis of diagnostic characters for very similar taxa has proved invaluable in the course of the current revision, though not all his conclusions are supported here.

### Historical notes: life histories and immature stages of endemic Noctuidae

The elucidation of life histories and description of early stages of New Zealand Noctuidae lagged well behind their taxonomic description. Amongst the 19<sup>th</sup> century collectors, Fereday appears to have been most active in observing early stages and rearing material. In an early paper (Fereday 1872) he mentioned having reared *Graphania nullifera* (as *Alysia specifica* Guenée) from hearts of *Aciphylla squarrosa*. In another paper on insect pests in New Zealand, he briefly described the larvae and pupae of *Persectania aversa* (Walker) (as *Chloantha composita* Guenée) and of *Helicoverpa armigera*, and noted their habits and depredations (Fereday 1873). There are a few reared Noctuidae amongst his collection in the Canterbury Museum.

Philpott took some early interest in rearing, as indicated in his paper on the Lepidoptera of Southland (Philpott 1901), but later seems to have concentrated almost exclusively on the pursuit of the adult stage. Meyrick took surprisingly little interest in life histories and even removed labels with rearing data from specimens supplied to him, preferring to keep the information in a separate handwritten register (Clarke 1955: 7–8).

An early proponent of study of the early stages of Lepidoptera in New Zealand was the Englishman Ambrose Quail. He arrived in the country circa 1897 (Quail 1900) but by the time of his death in 1905 had already left and was living in Queensland (Anon. 1905). Described by G.V. Hudson as an 'entomological microscopist' (Anon. 1905), he gave extremely detailed descriptions of the immature stages of several Lepidoptera, accompanied by fine drawings. He described the egg, larva and pupa of *Graphania mutans* in his second paper on the 'Embryology of New Zealand Lepidoptera' (Quail 1902).

In a remarkable and unique paper, Watt (1914) described and figured the eggs of a number of New Zealand Lepidoptera, including 8 species of Noctuidae *sensu stricto*. His descriptions are finely detailed and, a century on, have never been matched. The noctuid species treated are *Graphania lignana*, *G. mutans*, *G. insignis*, *Meterana dotata*, *Bityla defigurata*, *Chrysodeixis eriosoma* (as *Plusia chalcites*), *Persectania aversa* (as *Melanchra composita*) and *Diarsia intermixta* (as *Orthosia immunis*). Watt described three different 'varieties' of the egg of *Graphania mutans*, and one of these is probably *G. averilla* (see Gaskin 1966a), but further work is needed to follow up on Watt's important observations.

Of the early collectors, it was G.V. Hudson who dedicated the greatest amount of time and effort to the rearing and description of early stages. In his first major book on Lepidoptera (Hudson 1898) he briefly described the

larvae and gave host-plant information for 11 native noctuid species: *Agrotis ipsilon*, *Chrysodeixis eriosoma*, *Feredayia graminosa*, *Graphania insignis*, *G. mutans*, *G. nullifera*, *G. plena*, *Helicoverpa armigera*, *Meterana ochthistis* (as *Melanchra vitiosa*, a misidentification), *Persectania aversa* (as *Melanchra composita*) and *Proteuxoa comma*. (This list excludes *Mythimna separata* (Walker), which was misidentified at the time as its western sister-species *Leucania unipuncta* Haworth, hence Hudson's larval description from an American publication is not of the correct species.) In his second book (Hudson 1928) he added larval descriptions for another 12 species (an asterisk\* indicates an illustration on his plate I): '*Aletia*' *virescens*\*, *Austramathes purpurea*\*, *Dipaustica epiastrea*\*, *Graphania paracausta*, *G. ustistriga*\*, *Meterana merope*, *M. pictula*\*, *Physetica homoscia*\*, *Tmetolophota purdii*, *T. semivittata*, *T. steropastis*\*, *T. sulcana*. Most of these he had reared himself (though the descriptions for *M. merope* and *T. purdii* were based on Howes (1914) and that for *G. paracausta* was communicated to him by Philpott). In his supplementary volume (Hudson 1939), the larvae of 12 further noctuid species are described, mostly in the genus *Meterana*: '*Aletia*' *sistens* (as *temenaula*), *Bityla defigurata*, *Graphania infensa*, *G. omoplaca*, *Meterana alcyone*, *M. coctilis* (status under investigation: probably a junior synonym of *M. praesignis*), *M. coelena*, *M. diatmeta*, *M. pascoi* (as *saeva*), *M. stipata*, *M. vitiosa* and *Tmetolophota blenheimensis* (this last description derived from Chappell (1930): see below).

In two short papers published shortly after Hudson's *magnum opus* (Hudson 1928), A.V. Chappell gave detailed descriptions of the eggs and larvae of *Tmetolophota purdii* (Chappell 1929) and of the mature larva of *Bityla defigurata* (Chappell 1930), and briefer descriptions of the eggs and larvae of *Graphania infensa* and *Tmetolophota blenheimensis* (Chappell 1930). His descriptions of the larvae and host-plants of *B. defigurata* and *G. infensa* do not correspond closely with the later ones of Hudson (1939), who presumably reared these two species independently; Hudson only refers to Chappell when describing the life history of *T. blenheimensis*.

Gaskin (1966a) provided a useful summary of known host-plants of New Zealand Noctuidae (*sensu lato*), treating 51 species, of which 48 are currently recognised as Noctuidae *sensu stricto*. This paper contains several original observations by Gaskin, e.g. he was the first to report the rearing of the common grass-feeding *Tmetolophota atristriga*. No larvae are described, but descriptions by other authors are fully referenced. Dugdale (1971) in his paper on subantarctic Lepidoptera was the first author to provide detailed modern descriptions of New Zealand noctuid larvae, including chaetotaxy. He described and figured the larvae of *Physetica homoscia* (as *Graphania homoscia*), *Graphania pagaia* (as *G. insignis pagaia*), *G. erebia* (as *G. mutans erebia*) and *G. ustistriga*. In recent years, John Dugdale and Brian Patrick have been responsible for rearing and elucidating the life histories of a number of noctuid species never reared by the earlier collectors. A significant publication for noctuid larvae of species treated in the current volume is Patrick (1994), where host-plants are given for *Austramathes fortis*, *A. pessota*, *Physetica homoscia*, *P. longstaffi* and *P. phricias*; the larva of *homoscia* is also figured in colour. Further useful host-plant information, especially for the genus *Meterana*, as well as colour photographs of selected larvae, can be found in the popular publications by Neville Peat and Brian Patrick (Peat & Patrick 1999, 2001, 2002). By far the most comprehensive treatment of New Zealand noctuid larvae is that by Bejakovich and Dugdale ([1998]), who provided a well-illustrated key to the most frequently encountered species in field surveys and border control; this publication includes those erbid genera formerly recognised as Noctuidae. Morphological characters are treated in detail, larvae of several species are figured in colour (as are the adults) and brief details of host-plants and ecology are given.

### Scope of this treatment

The current treatment is intended as the first part of a revision of New Zealand Noctuinae *sensu lato* (i.e. in the sense of Poole (1995): see subfamily diagnosis below). It brings together for convenience all the smaller noctuid genera (fewer than 15 New Zealand species) that have not confidently been assigned to tribes. The genera treated here certainly do not form a monophyletic group, and *Physetica* (the only 'hairy-eyed' genus covered) is undoubtedly closely related to the large genera *Graphania* and *Meterana*, based on the conformation of the male and female genitalia. *Graphania* and *Meterana* along with *Physetica* belong to a large complex endemic radiation of uncertain affinity (see Remarks under the *Physetica* genus group diagnosis below). Generic boundaries in this radiation (beyond *Physetica*) are under review and the other small genera recognised by Dugdale (1988), i.e. *Dipaustica*, *Feredayia* and *Ichneutica*, are likely to be amalgamated with other larger genera, so they are not included in this volume. *Persectania* (with one endemic New Zealand species, *P. aversa* (Walker)) is confidently

associated with *Mythimna* and *Leucania* in Leucaniini based on a study of the genitalia, and especially on the presence of an intercalary sclerite between the bases of the sacculi in the male (cf. Hacker *et al.* 2002).

## METHODS AND CONVENTIONS

### Morphology

Terminology for wing pattern follows Heath (1983: fig. 5a) except that transverse elements of the wing markings are termed 'lines' rather than 'fasciae'. Terminology for male and female genitalia follows Fibiger (1997, especially figs 59–61), except that the term 'phallus' has been substituted for 'aedeagus' as recommended by Kristensen (2003). The term 'paratergal sclerite' (cf. Kitching & Rawlins 1999) has been substituted for 'pleurite' of some authors (e.g., Fibiger & Lafontaine 2005) to describe the sclerite between the tegumen and vinculum in the male genitalia. In the female, each ovipositor lobe usually takes roughly the form of a right-angled triangle, with the hypotenuse running along the ventral surface of segment 9 (i.e. the upper side in standard slide preparations); in this case, the lobes are said to be 'ventrally directed'. In one species (*Physetica homoscia*), the conformation of segment 9 is reversed (Fig. 164), so that the 'hypotenuse' is on the dorsal surface; the lobes in this species are said to be 'dorsally directed'.

### Collection and Dissection

Most noctuid moths collected during the course of this study were killed in fumes of ammonia, pinned on standard no. 3 entomological pins and set on balsa wood setting boards using a 'setting bristle' to brace the wing-bases as the wings were brought forward (cf. Worthington-Stuart 1951), and tracing paper to hold the wings in place. (The balsa was glued to a layer of plastazote to provide sufficient depth to take the pins and most boards used for noctuids have a 9 mm-wide groove.) Moths were left on the boards for three weeks before removal.

Genitalia dissection followed the techniques described by Fibiger (1997: 14–17), with the following modifications: the abdomen was transferred straight to 70% ethanol after maceration in KOH; scales were removed with a fine paintbrush, and the whole abdomen and genitalia of both sexes were stained after cleaning by (initially) very brief immersion (ca 10 seconds) in a 0.5% solution of Chlorazol Black E in 70% ethanol (with further staining as needed). The abdomen was opened up along one side by gentle pulling with two pairs of forceps. In earlier dissections, following standard practice for Noctuidae, the bulbus ejaculatorius was removed along with the portion of the ductus ejaculatorius lying outside the phallobase in order to facilitate the insertion of the syringe for vesica inflation. However, in later preparations, I found it possible to retain the bulbus ejaculatorius, where necessary making a slight tear with forceps at the point of entry into the phallobase for insertion of the syringe; the basal portion of the ductus ejaculatorius was removed as before. The bulbus ejaculatorius is not used as a taxonomic character in this work, so is not illustrated. Again, in earlier preparations, the female genitalia were inflated as described by Fibiger (1997: 16–17), without removal of the spermatophores. However, I have found this technique unsatisfactory, since the reduced signa of some species are easily obscured by the partially macerated spermatophores in the corpus bursae. Therefore in later preparations, any spermatophores were removed through a small slit in the dorsal membrane of the corpus bursae made by pulling with forceps, and the interior of the corpus and appendix bursae cleaned as far as possible without greatly enlarging the slit. This technique usually precludes inflation, but I believe it offers better results for most groups of New Zealand Noctuidae, especially for slides to be photographed.

Wing venation preparations followed the methods described by Common (1990).

### Repository of specimens and label data

The following acronyms are used for collections where specimens are held:

AMNZ: Auckland Museum, Auckland, New Zealand

BMNH: British Museum (Natural History), London, England

CMNZ: Canterbury Museum, Christchurch, New Zealand

LUNZ: Entomology Research Museum, Lincoln University, New Zealand

MONZ: Museum of New Zealand, Wellington, New Zealand

NZAC: New Zealand Arthropod Collection, Landcare Research, Auckland, New Zealand

OMNZ: Otago Museum, Dunedin, New Zealand

SMNZ: Southland Museum, Invercargill, New Zealand [M.O. Pasco collection: specimens salvaged from this collection are now all in NZAC, but some are lost].

Data for primary types are quoted (where possible) exactly, from the top label down, the data on separate labels being segregated by slashes [/]. For some primary types, it has not been possible to examine or re-examine labels during the course of this revision (e.g. material in the G.V. Hudson collection in MONZ); in these cases the data are quoted from the museum notebooks of J.S. Dugdale in NZAC and annotated '[per JSD]'. This applies especially to material in the BMNH; I examined almost all relevant specimens and genitalia slides during two brief visits in 2009 and 2012, but had insufficient time to transcribe or photograph the labels on all primary types. I have relied on J.S. Dugdale's notebooks (from his visit to BMNH in 1980) for transcriptions of these labels; it is likely that some minor inaccuracies result from my interpretation of these notes, but it is improbable that these will affect future recognition of the affected specimens as types. If locality data for primary types is derived from literature (e.g. for lost specimens, or BMNH specimens with labels not fully transcribed by myself or J.S. Dugdale) these are enclosed in square brackets. Paratype label data are given as far as possible in standard format.

Two-letter codes for collecting localities within New Zealand follow Crosby *et al.* (1998).

### Species concept and order

The species concept adopted here is a morphological one, i.e. I have treated as separate species only those entities showing constant and easily definable morphological differences at least in one sex, with particular weight being given to genitalic characters (cf. Hoare 2005, 2010). Morphological separation is taken to be indicative of reproductive isolation, as per the Biological Species Concept. Some groups of New Zealand Noctuidae are taxonomically problematic, and there are signs of very recent or incipient speciation, leading to confusing complexes of species. In this volume, the species pair *Physetica cucullina* and *P. funerea* show variation in size, wing pattern and genitalia that has led to the former recognition of two additional species (*obsecrata* and *probenota*); however, only the male antennae seem to offer 'easily definable differences', indicating that only two morphological species are involved. A different species concept, and/or the addition of molecular evidence may well lead to a different conclusion, and further work is desirable.

Species are treated alphabetically by species name within genera, except that the type species of the genus (where present in New Zealand) is given first, and species groups and complexes believed to be closely related are also generally kept together; in the case of *Physetica sequens*, to aid identification by comparison in the colour plates, it is placed next to species that it resembles superficially in size and wing shape (*P. phricias* and *P. prionistis*) rather than to its likely closest relatives (*P. cucullina* and *P. funerea*).

### Plant names

Scientific names of plants follow the New Zealand Plant Conservation Network website (<http://www.nzpcn.org.nz>).

## SYSTEMATICS

### Subfamily NOCTUINAE

**Diagnosis.** The definition of Noctuidae adopted here follows the expanded concept of Poole (1995), who gives the following characters as supporting monophyly of the subfamily: longitudinal (as opposed to transverse) orientation of the clasper along the valva; tendency of the cucullus of the valva to be well differentiated from the sacculus; step-like ('double') formation of the tegumen, with distinct 'shoulders' (the peniculi); larval subspiracular line (when present) running along long axis of the anal prolegs, as opposed to into or ventral to the anal shield. All of these Poole regards as somewhat unreliable and subject to reversal within the group; the occurrence of these characters in New Zealand noctuid taxa is commented on, where known, in the individual descriptions of genera given below.

**Remarks.** The enlarged definition of Noctuidae adopted here includes the former subfamily Hadeninae and many taxa formerly attributed to Acronictinae. The traditional Noctuidae (e.g., of Kitching & Rawlins 1999) is reduced in rank to a tribe Noctuini with Noctuidae and Agrotina (formerly tribes) as subtribes. Because of the great diversity of taxa included here, and the apparent morphological plasticity, with characters frequently lost and regained during the course of evolution, it is not possible to list a succinct and reliable set of characters supporting the monophyly of the expanded Noctuidae, and there are no unambiguous synapomorphies.

No key to New Zealand noctuid genera is offered here, because the circumscription of some genera not treated in this volume is undergoing major revision.

**Tribal placement of New Zealand noctuid genera.** Placement of New Zealand Noctuidae in named tribes is deferred to a later stage, once the genus- and species-level taxonomy has been revised. Though some attempt has been made to investigate possible tribal affinities of the taxa included here, and I discussed possible placements with Michael Fibiger when we examined dissected specimens together in 2009, no distinct conclusions have been drawn. The issue is complicated by the northern hemisphere focus of the available literature, the homoplastic nature of many morphological characters in Noctuidae, and the plasticity of morphology even within genera in New Zealand (see, e.g., *Austramathes* below). However, in order to take the first step towards a tribal classification, I here assign the treated genera to informal ‘genus groups’. Though three of the four genus groups adopted in this volume are monogeneric and might thus be regarded as redundant, they are intended as indicating a probable separate tribal placement (in a New Zealand context) for the included genera. The fourth genus group contains *Physetica* and all other ‘hairy-eyed’ endemic genera previously assigned to Hadeninae in New Zealand (e.g., by Dugdale 1988). The character states tentatively considered to be of significance at a taxonomic level higher than genus are given in the diagnoses of the genus groups; these diagnoses are therefore not strictly comparative in nature, i.e. they do not necessarily list the same set of characters for each genus group. However, all such characters are repeated in the genus descriptions below, which are fully comparative.

#### ***Austramathes* genus group**

**Diagnosis.** Eyes without surface hairs, with long ‘lashes’ arising from posterior margin and curving over eye. Male genitalia: tegumen very short and broad, strongly ‘stepped’. Dorsal membrane of manica with well-developed field of papillae. Subbasal sclerite of vesica with dense patch or narrow strip of spinules. Vesica short, without distinct diverticula. Female genitalia: ductus bursae short, weakly rugose, with an extensive band of scobinations taking up much of length to junction with corpus + appendix bursae; appendix bursae not differentiated or present as corrugated ‘bump’ that is weakly differentiated from corpus bursae; signum absent.

**Included genera.** *Austramathes* only.

**Remarks.** The former inclusion of the species here assigned to *Austramathes* in Cuculliinae (e.g., Hudson 1928, as ‘subfamily Poliades’; Dugdale 1988) followed from Hampson’s (1906) definition of this subfamily (i.e., trifine noctuids with lashed eyes, eyes not hairy and tibial spines absent), but this assemblage is polyphyletic (Poole 1995; Kitching & Rawlins 1999). The concept of Cuculliinae has now been narrowed to include only *Cucullia* and closely related genera (Poole 1995). Placement of *Austramathes* in the expanded Noctuidae is based on the capped tegumen (character 12 of Poole (1995)) and the modified twisted paratergal sclerite (his character 14).

Some genitalic characters of *Austramathes* suggest a possible association with the tribe Xylenini in the sense of Lafontaine and Schmidt (2010) (equivalent to subfamily Xyleninae of Fibiger & Lafontaine 2005), i.e. the short vesica in the male phallus, the short well sclerotised ductus bursae of the female and the reduced or undifferentiated appendix bursae (cf. Fibiger & Lafontaine 2005: 42). Likewise, the lashed eyes and the use of woody host-plants by the larvae are both accorded significance in recognising members of subtribe Xylenina (as tribe Xylenini) by Fibiger and Lafontaine (2005: 48). I have difficulty in interpreting their male genitalia character defining this subtribe (digitus very large and forming a sclerotised area along the costa of the valva) with respect to *Austramathes*, since the sclerotisation in this genus does not seem to be as extensive as in the taxa illustrated by Fibiger and Hacker (2007). Moreover, *Austramathes* does not share most of the other characters listed in the diagnosis of Xylenini (as Xyleninae) by Fibiger and Lafontaine (2005), e.g. well-differentiated, expanded cucullus, dorsal surface of sacculus irregular towards base, vesica with a few basal cornuti and elongate patch of spines in apical half. Therefore, for the time being I leave the tribal placement unresolved.

### Genus *Austramathes* Hampson, 1906

Figs 1–11, 61–63, 78, 82–101, 189–191

*Austramathes* Hampson, 1906. *Catalogue of the Lepidoptera Phalaenae in the British Museum*. Vol. 6: 492. Type species: *Graphiphora purpurea* Butler, 1879, by original designation.

**Diagnosis.** As for *Austramathes* genus group, above.

**Description.** *Adult* (Figs 1–11). Small, compact noctuids (wingspan 24–32 mm), except *purpurea*, which is usually larger, medium-sized (29–41 mm). Head (Figs 61–63): Labial palpi weakly to strongly upcurved, erect-scaled beneath; segment 3 ca 0.6–0.75x length of segment 2. Eyes without surface hairs; a row of long dark hair-like scales ('lashes') along posterior margin of eye and curving over eye. Antennae basally cylindrical, strongly antero-posteriorly flattened beyond ca flagellomere 10 in male to give subtriangular cross-section, and weakly serrate (serrations hardly visible except in slide preparations) from this point to near apex; barely flattened in female, with dense appressed ciliations beneath in both sexes; male with anterior and posterior tufts of longer ciliations ca 0.8x to 1x depth of flagellum in ventral view. Thorax: prothorax with narrow lamellate scales, sometimes some hair-like scales; mesothorax with variable admixture of hair-like scales and narrow lamellate scales with scalloped tips; lamellate scales concentrated in the scale-tufts; mesothorax with anterior scale-tuft (except in *fortis* and *squaliolus*), and posterior (mesoscutellar) scale-tuft (all species). Wing venation (Fig. 78): forewing with R3 and R4 stalked, separate from just under half length; hindwing cross-vein at end of cell with smooth curve inwards towards wing-base (not angled), cross-vein displaced basad in *A. purpurea*, well before junctions of Rs+M1 and M3+CuA1, arising from junctions of those veins in other species. Male frenulum with 1, female frenulum with 3 bristles. Wing pattern: forewings brownish to purplish brown, reniform and orbicular stigmata paler and with black scaling between (*purpurea*, *coelacantha*, *pessota*), or not paler, no black scaling between (*fortis*, *squaliolus*); claviform absent; crosslines rather indistinct, less so in *fortis* and *squaliolus*. Legs: Tibiae without spines; inner tibial spurs ca 2x as long as outer spurs; each tarsus with three rows of spines. Abdomen smooth-scaled, without distinct scale-tufts. S2 apodemes in both sexes either long, apically recurved (*purpurea*, *coelacantha*), or shorter, more evenly curved (other species).

Male abdomen and genitalia (Figs 82–96): abdominal base with fully developed brushes, pockets and levers, except in *purpurea* where these are absent. Uncus narrow to moderately robust, strongly curved, sparsely clothed in suberect scales in apical ½ above and beneath. Tegumen very short and broad, strongly 'stepped'. Paratergal sclerite moderately long, strongly sinuous, apically with striate surface. Dorsal membrane of manica with well-developed field of papillae. Juxta broadly diamond-shaped to octagonal (caudal margin broadly indented in *coelacantha* to form U-shape), with variable caudal extension. Valva narrow and elongate, corona absent (*purpurea*) or present (other species); cucullus not differentiated; sacculus without membranous flange; clasper present (finger-like) or absent. Saccus U-shaped to V-shaped. Phallus: short, cylindrical, not bulbous basally. Subbasal sclerite of vesica with dense patch or narrow strip of spinules. Vesica short, without distinct diverticula. Everted vesica at right angles to phallobase, cornuti present as dense crest (*pessota*), reduced (*coelacantha*), or absent (other species).

Female abdomen and genitalia (Figs 97–101): S7 shallowly emarginate caudally. Terminal segments barely extensible. Ovipositor lobes rather short, broad (more elongate in *pessota*), with scattered long setae basally, dense shorter setae subapically and very fine short spine-like setae apically. Ostium broad; antrum cup-shaped, not curved in cross-section, without lateral grooves, sclerotised in band dorsally and ventrally. Ductus bursae short, weakly rugose, with an extensive band of fine to coarse scobinations taking up much of length to junction with corpus + appendix bursae. Appendix bursae not differentiated (*purpurea*) or present as corrugated 'bump' that is weakly differentiated from corpus bursae (other species). Corpus bursae rounded (*purpurea*) to elongate-ovate (*coelacantha*, *pessota*) or elongate and curved (*fortis*, *squaliolus*), signa absent.

*Larva* (Figs 189, 190). (Structural characters from preserved specimens of *A. purpurea*, *A. fortis* and *A. squaliolus* only.) Coloration cryptic (*fortis*) or with distinct (probably aposematic) colour pattern (*purpurea* and perhaps *squaliolus*). Cuticle not spinulose. T1 with SV group bisetose; T2 and T3 with SV unisetose. Crochets uniordinal. SD1 pinaculum on T2–T3 small, unmodified, seta long, hairlike; prominent pinaculum posterodorsad of spiracle on each of A1–7, above L1 and extending anteriorly to surround SD1, in *purpurea*; no such pinaculum in *fortis* or *squaliolus*. D1 setae on A1 raised on prominent bulbous pinacula in *fortis*, somewhat raised in

*squaliolus* (see below under that species), not raised in *purpurea*. A8 unmodified in *purpurea*, modified in *fortis* and *squaliolus*, where D2 setae raised on prominent bulbous pinacula. Seta SD1 on A9 short, hair-like.

**Pupa.** (From material of *A. squaliolus* only). Abdominal segments 5–7 each with anterior band of round depressions dorsally, a few depressions on A4; apex of A10 strongly longitudinally rugose, only 1 or 2 transverse rugae; cremaster of 4 apical curled setae (one longer inner pair, one shorter outer pair), 2 subapical dorsal curled setae, and 2 lateral curled setae; apices of setae not scobinate.

**Biology.** Larvae on endemic trees or shrubs of the family Violaceae (*Melicytus* spp.). Pupation in a silken cocoon amongst moss on the ground (at least in *purpurea*: Hudson 1928).

**Distribution.** New Zealand (endemic).

**Remarks.** The genus *Austramathes* is expanded here to include endemic species previously placed incorrectly in the genera *Homohadena* Grote, 1873 (a synonym of *Sympistis* Hübner, 1823 (Troubridge 2008)) and *Andesia* Hampson, 1906. The species *fortis* + *squaliolus* are closely related and very similar sister taxa, and *pessota* + *coelacantha* are probably also sisters (see under *pessota*), but overall the genus is heterogeneous in a number of features as detailed in the description above (e.g. size, wing pattern, presence or absence of clasper on male valva, presence or absence of corona, form of vesica, shape of corpus bursae). Monophyly of the genus as defined is supported by the following characters: the larval hostplant choice (woody Violaceae (*Melicytus* spp.) for all four species that have been reared), the form of the tegumen in the male genitalia (very short, broad and transverse basally, with a marked ‘step’ to the narrower portion supporting the uncus), and the form of the female genitalia (very short, scobinate ductus bursae leading to membranous corpus bursae without signa). The presence of a prominent field of papillae in the dorsal membrane of the manica is a further character of interest, but may be plesiomorphic; other Noctuidae examined have the manica dorsally roughened and appearing granular in slide preparations, but without prominent papillae.

#### Key to *Austramathes* species adults

Additional less reliable characters are placed in parentheses.

- |   |  |                   |
|---|--|-------------------|
| 1 | Forewing with distinct black hook-shaped mark from base of costa; reniform and orbicular stigmata not joined by black scaling (stigmata well separated).....               | 2                 |
| — | Forewing without black hook-shaped mark from base of costa; reniform and orbicular stigmata joined by black scaling (stigmata confluent, adjacent or well separated) ..... | 3                 |
| 2 | Chatham Islands species (usually with series of distinct black spots on abdomen underside)..... (p. 24)...   | <i>squaliolus</i> |
| — | Species from remainder of New Zealand (usually lacking distinct black spots on abdomen underside).....   |                   |
|   | .....(p. 22)...  | <i>fortis</i>     |
| 3 | Forewing pale grey-brown; reniform and orbicular stigmata closely adjacent but not confluent; stigmata concolorous with forewing ground colour .....                       | (p. 25)...        |
| — | Forewing dark brown or deep purplish brown; reniform stigmata confluent or well separated; stigmata with at least some white scaling, paler than ground colour.....        | 4                 |
| 4 | Reniform and orbicular stigmata confluent; forewing without subdorsal black dash near base .... (p. 20)....  | <i>purpurea</i>   |
| — | Reniform and orbicular stigmata well separated; forewing with distinct black subdorsal dash near base .....  |                   |
|   | ..... (p. 27)...   | <i>pessota</i>    |

#### ***Austramathes purpurea* (Butler, 1879)**

Figs 1–3, 61, 78, 82–84, 97, 189

*Graphiphora purpurea* Butler, 1879. *Cistula Entomologica* 2: 490.

*Xanthia ceramodes* Meyrick, 1887. *Transactions and proceedings of the New Zealand Institute* 19: 31. Synonymised by Meyrick (1888: 46).

**Diagnosis.** *Austramathes purpurea* is a distinctive species amongst the New Zealand Noctuidae; it could possibly be confused with large specimens of *A. pessota*, but that species lacks the strong purplish tinge to the forewing, has the orbicular and reniform stigmata separate, not confluent, the cream reniform stigma much more distinct than in *purpurea*, and a distinct subdorsal black dash at the forewing base. Within *Austramathes* as redefined here, *A. purpurea* stands apart morphologically in the relatively larger size of the adults, the loss of the

corona in the male valva, and the loss of the appendix bursae and globose shape of the corpus bursae in the female genitalia.

**Description.** Adult (Figs 1–3). Wingspan: 29–37 mm (male); 29–41 mm (female). Head (Fig. 61) deep purplish brown, with variable suffusion of ochreous-tipped scales; in some specimens, underside of labial palpi segment 2 and whole of segment 3 ochreous. Labial palpi strongly upcurved; segment 3 long, ca 0.75x length of segment 2. Antennae with ciliations in male up to ca 1x depth of flagellum. Prothorax deep purplish brown, margined with ochreous-tipped scales distally; scales lamellate, strap-like, with scalloped tips. Mesothorax deep purplish brown, scales of anterior and posterior scale-crests tipped ochreous, and tegulae with scattered ochreous-tipped scales; scales mostly hair-like to very narrow-lamellate on tegulae, narrow-lamellate in large anterior scale-crest, with 3- or 4-pointed broad scalloped tips, similar in posterior scale-crest but with 2- or 3-pointed tips. Forewing deep reddish brown, with glossy overlay of deep purplish either concentrated in basal half of wing and extending along veins distally, or covering most of wing; a sparse scattering of white scales; basal subdorsal streak absent; basal hook-shaped mark from costa absent; costa without distinct dark marks; antemedian and postmedian lines irregular, indistinctly picked out in white scales, but postmedian often rather distinct towards costa above reniform; stigmata outlined in pale brownish-tipped scales; orbicular stigma elongate, oblique, confluent with reniform to form broad V or U, a small triangle of black scaling between stigmata; subterminal line indistinct, represented by small white specks on veins; fringe unicolorous deep reddish brown, slightly paler than forewing. Hindwing dark brown, slightly paler basally, with usually distinct elongate discal spot before  $\frac{1}{2}$  and variably distinct median line; fringe brown, slightly paler basally. Underside: forewing ochreous strongly suffused purplish brown except towards base and dorsum, distinct dark upright reniform stigma adjacent to indistinct dark postmedian line; dark subtriangular spots on termen between veins; fringe purplish brown; hindwing ochreous, suffused purplish brown, with very distinct blackish antemedian dot in disc and distinct dark postmedian line; subtriangular spots on termen between veins, fringe purplish brown. Abdomen with erect hair-scales of T1–3 whitish ochreous, remaining segments ochreous mixed with pinkish brown, above and below. Male abdominal base (Fig. 84) without brushes, levers or pockets; S2 apodemes elongate and apically recurved in both sexes. Male genitalia (Fig. 83): uncus robust, curved, with dorsoventrally flattened, diamond-shaped apex, minutely hooked apically; basal portion of tegumen extremely short; manica dorsally with large field of very short papillae; juxta shovelhead-shaped, with very short distal extension; valva with base of sacculus mesally rounded (not notched); sacculus ending in short, low prominence, without discrete clasper or ampulla; valva narrowed at mid-length, expanding to rhomboid apex, corona absent. Phallus (Fig. 82): caecum penis without keel; subbasal sclerite of vesica oval, with uneven rows of small spines, 6–8 spines across at broadest point; vesica rather short, with distinctly bulbous base, tapering to cylindrical portion; cornuti absent, but minute scobinations present in a patch dorsally. Female genitalia (Fig. 97): ovipositor lobes short, squarish, not oblique; segment 8 with scattered medium-length setae in apical half; ostium as described for genus, lamella antevaginalis crescent-shaped, rather well sclerotised; antrum membranous, weakly rugose; ductus bursae very short, not rugose, with fine tooth-like scobinations throughout, opening directly into posterior end of corpus; corpus bursae globular; appendix bursae not differentiated (ductus seminalis arising from distal portion of corpus bursae on left side in ventral view).

**Type material.** *Graphiphora purpurea*: Holotype: Male, ‘Type [round red-ringed label] / N. Zealand Otago Hutton 79-19 / Otago 79-19 [label upperside] Graphiphora purpurea Butler Type [label underside]’ (BMNH) (examined, not dissected).

*Xanthia ceramodes*: Lectotype: Male, ‘1873-4 [last figure near illegible, interpreted by Dugdale (1988) as ‘15’] from Enys North Island / Fereday Collection. / 31 / LECTO HOLOTYPE Xanthia ceramodes Meyrick teste Dugdale’, designated by J.S. Dugdale (Dugdale 1988: 198) (CMNZ) (examined, not dissected).

**Note:** Meyrick (1887) described *Xanthia ceramodes* from two male specimens, one from the ‘North Island’ (the lectotype) and one from Dunedin. The paralectotype from Dunedin has not been located either in BMNH or in CMNZ and may be lost. The top label on the lectotype is interpreted in the CMNZ database as reading ‘1873-4’ (i.e. 1873–1874), and this reading is followed here.

**Distribution.** Widespread throughout the North and South Islands, certainly under-recorded. Not yet known from Stewart Island.

ND, AK, CL, WO, TK, TO, GB, HB, WN / NN, BR, WD, NC, MC, SC, DN, FD, SL.

**Biology.** The larva (Fig. 189) usually feeds on the native tree *Melicactus ramiflorus* (mahoe, Violaceae), but has also been recorded on *M. lanceolatus* (reared specimens from Southland in OMNZ). The full-grown larva is described by Hudson (1928: 49) as follows: ‘about [32 mm] long, moderately stout and of uniform thickness. The head is ochreous, with a black stripe on each side; the back of the larva is dark greyish-green, and the under-surface pale greenish ochreous; there is a rather large, shining black mark above each spiracle; the dorsal, subdorsal and lateral lines are orange-yellow and very conspicuous, the two upper lines being very much broken; there are several minute black warts [pinacula] below the spiracles, and a series of very small black marks on the orange dorsal line.’ From the photograph of the larva in Fig. 189, it can be seen that there is a tendency for the orange lines to grade into a brighter yellow anteriorly, especially on the prothorax, and that there are white and pale pink areas in the lateral line behind the abdominal spiracles. Pupation is in a strong silken cocoon amongst moss (Hudson 1928; Gaskin 1966b).

**Flight period.** March to January, but with most records from March to September.

**Remarks.** Hudson (1928) regarded this as an uncommon moth and listed only two localities, Wellington and Dunedin, adding only two more (Puketitiri HB and Takitimu Mountains SL) in his Supplement (Hudson 1939). It is now known to be a very widespread species throughout the main islands of New Zealand, and can be fairly common (cf. Gaskin 1966b), but as an adult it is much less abundant at light than *Feredayia graminosa* (Walker), the other noctuid whose larvae feed on *Melicactus ramiflorus*. Larvae, however, can apparently be commoner than those of *F. graminosa* (N. Martin, pers. comm.), and light-trapping is most likely a rather inefficient technique of sampling this species. Adults of *Austramathes purpurea* occur chiefly during the late autumn, winter and early spring (March to September), which may also partially account for its relative paucity in collections. However, the moth has been recorded in the summer as late as December and January.

#### ***Austramathes fortis* (Butler, 1880) new combination**

Figs 4, 5, 62, 85–87, 98, 190, 191

*Toxocampa fortis* Butler, 1880. *Cistula Entomologica* 2: 549–550.

*Miselia iota* Hudson, 1903. *Transactions and proceedings of the New Zealand Institute* 35: 243. Synonymised by Meyrick (1912: 95).

**Diagnosis.** *Austramathes fortis* is a very distinctive small noctuid, and cannot be confused with any other on the mainland of New Zealand: the black curved mark from the costa at the base of the wing (which led Hudson to name the species *iota* after the Greek letter ‘i’) is on its own diagnostic. This species probably cannot be reliably distinguished from the newly described Chatham Islands endemic *A. squaliolus* on external characters; male genitalic differences are as follows: manica with small field of papillae; distal extension of juxta parallel-sided; clasper not bent at base, directed towards costa; subbasal sclerite of vesica a very elongate narrow strip with 2–3 uneven rows of backward-pointing spines. The venter of the abdomen in *A. fortis* usually lacks distinct black spots centrally on segments 4–7 (these are present in *squaliolus*); however, this character is not completely reliable as the spots are present in some *fortis*.

**Description.** Adult (Figs 4, 5). Wingspan: 26–28.5 mm (male); 24–29 mm (female). Head (Fig. 62) dark purplish brown, tips and bases of scales pale ochreous giving mottled appearance; labial palpi ochreous variably suffused dark brown, blackish on exterior surface, weakly upcurved; segment 3 short, ca 0.6x length of segment 2. Antennae with ciliations in male ca 0.75x depth of flagellum. Prothorax dark brown, mottled ochreous (tips of scales); a distinct black double crescent medially; scales hairlike to very narrow-lamellate, 2-pointed. Mesothorax dark brown; anterior scale-crest absent; scales mostly hairlike, but a scattering of lamellate scales with broad scalloped tips on tegulae, some of these ochreous-tipped and some black-tipped; posterior scale-crest small, scales very narrow-lamellate, 2-pointed, dark brown, tipped ochreous to mid-brown. Forewing brown; basal subdorsal black streak absent; basal hook-shaped black mark in costal ½ of wing present; costa with more or less distinct dark dashes at position of antemedian and postmedian lines and less distinct dash or cloudy mark between; antemedian line rather indistinct, irregular, zigzag towards dorsum, concolorous with ground-colour but picked out by variably distinct distal dark edging; postmedian more distinct, pale, weakly scalloped in medial portion, dark-edged basally and often demarcated distally by broad dark brown fascia between here and subterminal line; orbicular stigma round, outlined in yellowish scales, and sometimes with suffusion of blackish scales inside; reniform distinct, coloration as for orbicular, well separated from orbicular and no black scaling between them; an irregular dark brown median line runs just basad of reniform; subterminal line distinct, sinuous, pale brown, sometimes with

some yellowish scales; termen with variable greyish suffusion, broader towards apex; indistinct small black dots on termen between veins; a blackish scalloped line beyond at base of fringe; fringe mottled ochreous and dark brown. Hindwing: blackish (fading to blackish brown in older specimens), hardly paler basally; a distinct antemedian black dash in disc; median line very indistinct; fringe brownish with blackish subbasal line. Underside: forewing brown, paler ochreous towards dorsum, suffused blackish in disc and between postmedian and subterminal lines; a dark spot on costa in position of median line; reniform present as dark spot; postmedian line moderately distinct, especially towards costa; dark dots on termen very indistinct; fringe mottled ochreous and darker brown; hindwing ochreous speckled blackish, with very distinct blackish antemedian spot in disc and dark postmedian line, blackish dots on termen joining into line around tornus; fringe mottled ochreous and darker brown. Abdomen with erect hair-scales of T1–3 whitish ochreous to greyish ochreous, remaining segments dorsally ochreous strongly mixed with blackish and silvery grey, above and below; laterally with long brown hairlike scales with pale tips, ventrally mottled pale ochreous and brown, sometimes with, usually without distinct black spots centrally on S4–7. Male abdominal base (Fig. 87) with brushes, levers and pockets; S2 apodemes rather short, evenly curved. Male genitalia (Fig. 86): uncus moderately slender, curved, not apically flattened, minutely hooked apically; basal portion of tegumen fairly short; manica dorsally with rather small field of short to moderate papillae; juxta irregularly octagonal, with moderate parallel-sided distal extension; valva with base of sacculus mesally weakly to strongly notched; sacculus ending in short, digitate clasper, clasper not bent at base, directed towards costa, and tip close to or overlapping costa; valva narrow, with sinuous costa, expanding slightly to rounded apex, apex with corona of ca 15–26 elements. Phallus (Fig. 85): caecum penis with sclerotised keel; subbasal sclerite of vesica a very elongate narrow strip, with ca 2–3 uneven rows of small backward-pointing spines; vesica short, with weakly bulbous base, tapering to cylindrical portion; cornuti absent, but distal portion of vesica covered in minute inconspicuous scobinations throughout. Female genitalia (Fig. 98): ovipositor lobes short, squarish, somewhat oblique (ventrally directed); segment 8 with scattered short to medium-length setae in apical half; ostium as described for genus, lamella antevaginalis crescent-shaped, rather weakly sclerotised; antrum membranous, weakly rugose; ductus bursae fairly short, rugose, with rather coarse plate-like scobinations throughout; ductus opening at an angle into posterior end of corpus; corpus bursae very elongate, crescentic; appendix bursae differentiated as finely scobinate ‘bump’ at posterior end of corpus, from which ductus seminalis arises; fine scobinations continuing part way along corpus bursae.

**Type material.** *Toxocampa fortis*: Holotype: Male, ‘Type [round red-ringed label] / N. Zealand. Marlborough Province Skellon 80-57 / N. Zeal. 80-57 [label upperside] *Toxocampa fortis* Butler type [label underside]’ (BMNH) (examined, not dissected).

*Miselia iota*: Holotype: Male, [Karori, Wellington, 9 Jan 1898, G.V. Hudson] [per JSD] (MONZ) (not examined, but photograph seen and identity not in doubt).

**Distribution.** Widespread from the Three Kings Islands to Southland, mainly in the east of both main islands. Not known from Stewart Island.

TH / ND, AK, CL, TK, TO, WA, WN / SD, NN, MB, NC, MC, SC, MK, OL, CO, DN, FD, SL.

**Biology.** Rearing records are few: hosts in shrubland localities are small-leaved *Melicytus* spp., such as *M. crassifolius*, *M. diversifolius* and *M. alpinus* (Barratt & Patrick 1987; Patrick 1994; reared specimens in OMNZ). In northern mainland forest localities, the host is *Melicytus macrophyllus* (specimens in NZAC, reared from larvae by N.A. Martin). It has been reared from the Noises Islands, AK, from *Melicytus novae-zelandiae* (specimens in NZAC). Two colour forms of the larva are shown in Figs 190, 191; the following description was drawn up from a single, probably penultimate instar larva from Orewa AK, collected on *M. macrophyllus*. Head marbled whitish and pale ochreous brown, mouthparts slightly darker brown. Thorax and abdomen pale green, finely flecked yellow, with pinacula ringed black, setae black, legs and prolegs pale green; a fine, broken yellow dorsal line, surrounded by irregular dark marbling, the marbling most prominent on A1–3 and A8; T1 with irregular dark marbling along front margin, anterior to each setal group; abdomen with larger irregular yellow blotches behind L3 especially prominent on A2–4; irregular dark marbling laterally between spiracle and proleg on A3–6 and below spiracle on A7; D1 setae on A1 raised on bulbous black pinacula; D1 setae on A2 on smaller bulbous pinacula; A8 strongly humped, with D1 setae on bulbous black pinacula (pinacula yellow laterally) and D2 setae on very prominent posteriorly-directed bulbous pinacula (pinacula marbled black and yellow); other D setae (except on A10) with pinacula slightly raised but not bulbous. This larva corresponds with the form shown in Fig. 191;

another form is dark greyish, as shown in Fig. 190, with the yellow lines showing up more clearly against this ground colour. It is likely that in the wild the latter form predominates in later instars, at which stage most noctuid larvae rest under bark or at the base of the host-plant by day rather than exposed on leaves. The pupa has been found in a cocoon of silk and plant debris at the base of the host-plant stem; the pupal stage lasts from 25 to 45 days (based on 3 South Island rearings) (B.H. Patrick, pers. comm.).

**Flight period.** July to March.

**Remarks.** As remarked by Hudson (1928), *Austramathes fortis* appears to be usually uncommon on the mainland of New Zealand, but it can be common in coastal localities and on eastern offshore islands (e.g., Poor Knights Islands ND and Noises Islands AK), and in montane to high alpine areas of the South Island (e.g. Central Otago: Barratt & Patrick 1987). It occurs from sea level to 1840 m. In higher rainfall areas it seems scarce: Fox (1970b) had only two records from Mt Taranaki, despite intensive collecting there, and there are rather few records from the well-recorded Waitakere Ranges in west Auckland. Like its very close relative *A. squaliolus* from the Chathams (see below), *fortis* is strongly crepuscular in habits and thus may often be overlooked by light-trapping: it has frequently been recorded actively flying from late afternoon onwards until dusk in the South Island (B.H. Patrick, pers. comm.). However it occasionally occurs in numbers at light (45 individuals in a night in OL in October 2009; B. H. Patrick. pers. comm.).

### ***Austramathes squaliolus* new species**

Figs 6, 7, 88–90, 99

**Diagnosis.** Amongst Chatham Island noctuids, this species is extremely distinctive; as with *A. fortis* on the mainland, the black curved mark from the base of the forewing costa is on its own diagnostic. The most reliable diagnostic differences from *A. fortis* are in the male genitalia, as follows: manica with more extensive field of papillae dorsally; distal extension of juxta with sides converging, not parallel; clasper bent at base and directed along axis of valva; vesica with subbasal sclerite broad, with suberect spines arranged in ca 4 irregular rows. The venter of the abdomen usually has very distinct central dark spots on segments 4–7; these are rarely present in *fortis*.

**Description.** Adult (Figs 6, 7). Wingspan: 25–31 mm (male); 28–31 mm (female). Very similar in almost all characters to *A. fortis*; only characters that separate the two are given here. (Note that all external characters are somewhat variable, comparative and unreliable, and the male genitalia offer the clearest diagnostic features.) On average, a larger species than *A. fortis*. Forewing with basal hook-shaped mark from costa often (not invariably) slightly elongated into disc, so that longitudinal element is longer than transverse element (longitudinal element apparently always shorter in *fortis*). Hindwing often (not invariably) with fringe yellowish brown, contrasting with upperside of wing more strongly than in *fortis* where fringe brownish; sometimes (especially in specimens from Rangatira (South East) Island) with very distinct dark dashes along termen, and with terminal area of hindwing pallid, especially towards tornus; underside of hindwing on all islands with termen broadly pallid and dark dashes distinct (termen at most very narrowly pallid in *fortis* and dashes small and indistinct). Underside of abdomen usually with very distinct black spots centrally on S4–7; these spots usually absent or indistinct in *fortis*. Male abdominal base (Fig. 90) with brushes, levers and pockets. Male genitalia (Fig. 89): as described for *fortis*, but manica dorsally with more extensive field of short to moderate papillae; juxta with shorter distal extension with sides converging, valva tending to be rather broader than in *fortis*; clasper bent at base and directed along axis of valva, not closely approaching costa at apex; corona with ca 13–28 elements. Phallus (Fig. 88): subbasal sclerite of vesica elongate, much broader than in *fortis*, with suberect spines arranged in ca 4 irregular longitudinal rows. Female genitalia (Fig. 99) not distinguished from those of *fortis*.

**Type material.** Holotype: Male, 'CHATHAM IS, NZ Rangatira Id 7–11 Dec 1984 G.W. Gibbs / ex larvae on *Myrsine chathamica* / NZAC slide Noct. 270 genitalia ♂' (NZAC). Paratypes: 9 males, 2 females, as follows: 2 males, Rangatira Is. CH, 7–11 Dec 1984, G.W. Gibbs; 7 males, Rangatira Is. CH, 1–14 Dec 1987, J.S. Dugdale (1 with NZAC genitalia slide Noct. 273); 1 female, Chatham Is. CH, Te Matarae, Ia. 3 Nov. 1991, reared *Hymenanchera* [= *Melicytus*], coll. off *Muehlenbeckia*, J.S. Dugdale (NZAC slide Noct. 302); 1 female, Chatham Is. CH, Kaingaroa, evening, 30 Dec 2004, R.J.B. Hoare (all NZAC). **Note.** The reference to *Myrsine chathamica* on the holotype label is presumed to be a slip for *Melicytus chathamicus*.

**Distribution.** Chatham Islands only, where recorded so far from Chatham, Pitt, Little Mangere and Rangatira (South East) Islands.

- / - / CH.

**Biology.** Larvae feed on the endemic Chatham Island mahoe, *Melicactus chathamicus* (Dugdale & Emberson 2008, as *Homohadena fortis*; reared specimens in NZAC). No description is available of the larva in life, but Dugdale and Emberson (*loc. cit.*) record the larvae as ‘brightly coloured and distasteful to birds, unless they can strip out the gut’. Preserved specimens in NZAC (synoptic larval collection) are faded and retain elements of pattern but not of colour; they appear to have much more extensive dark dorsal marbling than the larva of *A. fortis*, and the bulbous pinacula of the D setae on A1 and A8 are apparently less prominent than in *fortis*, becoming quite inconspicuous in the final instar. J.S. Dugdale (pers. comm.) recalls the larvae in life as being darker dorsally than the dark form of *fortis*, but with similarly contrasting yellow markings laterally. Fresh observations of the larvae of *A. squaliolus* to confirm the degree and constancy of the larval differences would be of great interest.

**Flight period.** Recorded in November and December; sampling has been limited at other times of year.

**Etymology.** The name *squaliolus* (a noun in apposition) comes from the Latin, meaning ‘little shark’. It refers to the multiple rows of spines in the subbasal sclerite of the vesica, which distinguish the species from *A. fortis*, and are likened to the multiple rows of teeth of a shark. There is also a reference to the moth’s home on the Chatham Islands, where fossil sharks’ teeth are commonly found in some localities.

**Remarks.** *Austramathes squaliolus* has previously been lumped with the very similar *A. fortis*. In erecting this as a new species, I have placed particular weight on the diagnostic characters of the male genitalia, i.e. the longitudinal orientation of the clasper in *squaliolus*, the more extensive papillate field on the manica, the converging sides of the distal extension of the juxta, and the broader subbasal sclerite of the vesica with its suberect teeth arranged in several rows. However, one male in NZAC from Rangatira (South East) Island, here referred to *squaliolus* based on size, wing markings, locality, and form of the clasper, has a subbasal sclerite very similar to that of *fortis*. This is tentatively considered an aberrant reversion to the ancestral condition. Larval differences between *A. squaliolus* and *A. fortis*, as detailed above, are also considered significant. To confirm the proposed species status of this taxon, further detailed studies of larval morphology and ecology and of genetic markers are desirable.

This is a common species on the Chatham Islands. Adult moths have been seen flying at dusk near their hostplant at Kaingaroa on Chatham Island (pers. obs.).

#### ***Austramathes coelacantha* new species**

Figs 8, 9, 91–93, 100

**Diagnosis.** *Austramathes coelacantha* can easily be distinguished from the other members of the genus by the greyish ground-colour, lack of hook-shaped mark from the base of the forewing costa, the large, closely approximated orbicular and reniform stigmata, and the black thorn-like mark from the costa between these.

**Description.** Adult (Figs 8, 9). Wingspan: 24–27 mm (male); 28–30 mm (female). Head and thorax appearing grey brown, finely mottled (the individual scales mostly yellowish brown at base, dark brown subapically and apically white); labial palpi concolorous but with some dark-scaling exteriorly; scales of head and thorax mostly very narrow-lamellate with 3- to 5-pointed tips. Labial palpi barely upcurved; segment 3 short, ca 0.5–0.6x length of segment 2. Antennae with ciliations in male ca 0.4x depth of flagellum. Thorax grey-brown, tips of scales whitish; prothorax with weakly marked blackish double crescent; mesothorax with very prominent anterior and posterior scale-crests (in fresh specimens), concolorous with rest of thorax; tegulae with sparse scattering of blackish-tipped scales. Forewings grey-brown; basal hook-shaped black mark in costal ½ of wing absent, but narrow dark wavy margin to subbasal line present in costal half of wing; basal subdorsal black streak present as a weak elongate U- to V-shaped mark (much less distinct than in *pessota*); costa with 1 or 2 distinct dark dashes at position of antemedian line and 2 distinct dashes above space between orbicular and reniform stigmata and more or less contiguous with dark mark between these; wavy antemedian line more or less distinctly picked out by dark scaling along both sides; postmedian line indistinct, finely scalloped; reniform and orbicular stigmata grey-brown as ground-colour, with black scaling between forming dark V-shaped mark; stigmata separate but nearly contiguous; orbicular large, oblique; reniform slightly larger; subterminal line very indistinct, represented by a series of very inconspicuous cream spots, sometimes some weak dark brown clouding around these, and always a

more or less distinct dark brown dash or triangle on costa before apex; terminal area of ground-colour; ca. 8 black dots along termen; fringe concolorous with forewing but scales inconspicuously tipped whitish. Hindwing dark greyish, with very indistinct antemedian discal dot; median line very faint or absent; fringe pale brownish, scales tipped whitish. Underside: forewing dark grey-brown, paler ochreous greyish along costa and termen; postmedian line of forewing represented by dash on costa, reniform stigma by indistinct dark spot; termen with ca 8 blackish dots; hindwing whitish brown, speckled darker, with subbasal black dash, strongly marked discal spot before ½; distinct dark line, weakly scalloped, at ½; termen with series of black dots. Abdomen with hair-scales of T1–3 greyish ochreous; rest of abdomen dull grey-brown, speckled blackish, paler and lacking blackish speckling beneath. Male abdominal base (Fig. 93) with brushes, levers and pockets; S2 apodemes rather long and more or less evenly curved in both sexes. Male genitalia (Fig. 92): uncus moderately slender, distinctly narrower from 2/3 length, not apically flattened, without hook at tip; basal portion of tegumen fairly short; manica dorsally with rather large field of moderately long papillae; juxta a very broad ‘U’ with tongue-shaped distal extension between arms of ‘U’; valva with base of sacculus mesally with large U-shaped invagination; sacculus without clasper; valva narrow, rather strongly curved, with weakly sinuous costa, barely expanding to apex; corona with ca 14–17 elements. Phallus (Fig. 91) with sclerotised portion bent and more or less swollen apically; caecum penis with very weakly sclerotised keel; subbasal sclerite of vesica a very broad oval patch of evenly spaced backward-pointing spinules >10 spinules wide at broadest point; vesica very short, tapering, with elongate patch of very reduced cornuti dorsally. Female genitalia (Fig. 100): ovipositor lobes rather large, squarish, strongly oblique (ventrally directed); segment 8 with scattered short to medium-length setae in apical half; ostium broad; lamella antevaginalis well-sclerotised, crescent-shaped; antrum rugose, funnel-shaped; ductus bursae short, narrow, with small granular scobinations anteriorly, opening more or less directly into posterior end of corpus + appendix bursae; corpus bursae round to oval; appendix bursae present as small lobe, poorly differentiated from posterior end of corpus, scobinations continuous with those of ductus.

**Type material.** Holotype: Male, ‘NEW ZEALAND MB Upper Clarence Vy [Valley] Mitchells Cutting 2 February 2012 Troy Watson 840m / UV trap in beech forest beside small stream 2km S of Mitchells Cutting 1593405E 5300062N’ (NZAC). Paratypes: 6 males, 2 females, as follows: 1 male, same data as Holotype (NZAC); 1 male, Boyle R. BR, to light 5 Feb 2014 M. Bowie (NZAC); 1 female, Lees Valley Rd. MC, Ashley R., Billy Stm, 10 Mar 2012, B.M. Lyford (NZAC); 1 male, 1 female, Tasman Valley MK 800m, 17 Feb 2001, B. and H. Patrick (OMNZ; specimen nos. IV42546, 42547, 42550; female genitalia on slide IV42550); 1 male, Cass MC 620m, 1–2 Feb 1997, B. Patrick, J. Ward (OMNZ; specimen no. IV42549; genitalia on slide IV42549); 1 male, Wairau Valley Branch R. MB, 1 Jan 1996, B. Patrick, J. Ward (OMNZ; specimen no. IV42548); 1 male, Tarndale MB, Upper Oldham Stm 1220m, 11 Jan 2012, UV trap in beech forest, Troy Watson (NZAC).

**Distribution.** Restricted to the central and eastern South Island, just extending into easternmost part of Buller district.

- / BR, MB, NC, MC, MK.

**Biology.** Unknown. Larva presumed to feed on shrubby *Melicytus* spp., in common with the other smaller members of the genus.

**Flight period.** January to March.

**Etymology.** The name *coelacantha* (a noun in apposition) derives from the Greek *koilos* (hollow) and *akantha* (thorn) and refers to the thorn-like black mark that starts on the forewing costa, with its point between the reniform and orbicular stigmata; the mark appears ‘hollow’ as it is interrupted by the paler ground-colour.

**Remarks.** This species is rare in collections, and was overlooked by the earlier New Zealand collectors: the first specimen was apparently taken in 1963 by E.G. White at Ribbonwood Fan, Cass, MC. However, it remained unrecognized as a separate species for a further 50 years, until specimens were noticed in OMNZ rather late in the course of the current revision, and after the author had already seen misidentified specimens in MONZ but failed to realise their significance. It is interesting that *coelacantha* was mixed (in more than one collection) in series of both *A. fortis* and *A. pessota*, neither of which it closely resembles in colour or wing pattern; the assumption that this small group of Noctuidae was well known in New Zealand seems to have been powerful!

This species appears to be local or very local, and is confined to inland shrubland localities and subalpine beech forest in the central and eastern South Island. It can be relatively common where found, e.g. at Cass MC (B.H. Patrick, pers. comm.), and a recent record of 17 specimens to light in a single night at Upper Glenrae River in

North Canterbury (B.H. Patrick, pers. comm.) is an encouraging sign that populations may be locally strong. At the latter locality, *A. coelacantha* occurred alongside both *A. fortis* and *A. pessota*. All specimens of *coelacantha* in collections were taken at light (usually UV light), and there are no records of crepuscular activity. Further investigation of its life history, ecology and conservation status should now be a priority.

***Austramathes pessota* (Meyrick, 1887) new combination**

Figs 10, 11, 63, 94–96, 101

*Miselia pessota* Meyrick, 1887. *Transactions and proceedings of the New Zealand Institute* 19: 29.

**Diagnosis.** *Austramathes pessota* is a small, distinctly marked species. It differs from *A. purpurea* in lacking a strong purplish tinge to the forewing, in having the orbicular and reniform stigmata separate, not confluent, with the cream reniform stigma much more distinct than in *purpurea*, and a distinct subdorsal black dash at the forewing base. The forewing ground colour is much darker than in *A. coelacantha* and the small, pale, well separated stigmata further separate *pessota* from that species. This is the only species in the genus with well-developed cornuti on the male vesica.

**Description.** Adult (Figs 10, 11). Wingspan: 25–28 mm (male); 28–32 mm (female). Head (Fig. 63) dark purplish brown, tips of scales whitish; labial palpi purplish brown, mixed whitish above and below, weakly upcurved; segment 3 very short, ca 0.3–0.4x length of segment 2. Antennae with ciliations in male ca 0.75x depth of flagellum. Prothorax purplish brown to pinkish brown, darker anteriorly, tips of scales whitish; a distinct black double crescent medially; scales very narrow-lamellate, 2- to 3-pointed. Mesothorax with strong scale-crest anteriorly, scales pinkish brown tipped paler; tegulae mostly with dark purplish brown hairlike to very narrow lamellate scales, an admixture of paler pinkish brown scales centrally, some of these white-tipped, paler scales with broader lamellate tips, 4- to 5-pointed; posterior scale-crest pinkish brown to purplish brown, scales tipped white, hairlike to narrow lamellate, up to 4-pointed. Forewing purplish brown; basal subdorsal black streak present, distinct (enclosing oblique line of white scales); basal hook-shaped mark in costal ½ of wing absent, but indistinct subbasal fascia in this position present, reaching from costa ½ way across wing; costa with more or less distinct dark dashes at position of antemedian and postmedian lines and less distinct dash or cloudy mark between; antemedian and postmedian lines usually moderately distinct (lower part of antemedian may form definite dark V-mark beyond apex of subbasal dark streak); antemedian wavy, postmedian scalloped, each picked out by paler scaling on both sides; orbicular stigma very small, round, or oblong and oblique, pale-edged; reniform distinct, pale-edged and more or less infilled with pale scales; stigmata well separated, joined by block of black scaling; subterminal line extremely indistinct, sometimes a series of weak blackish marks along termen between veins; fringe mottled pale to dark brown. Hindwing: dark brownish, not paler basally; very weak antemedian spot in disc; median line obsolete; fringe brownish with faint darker median line. Underside: forewing grey-brown with costa paler, ochreous, postmedian line very distinct on costa, otherwise indistinct; dark dots along termen moderately distinct, otherwise no distinct markings, fringe dark brown tipped whitish; hindwing pale ochreous variably suffused darker brown, distinct brown antemedian spot in disc and postmedian line, dark brown line around termen; fringe mottled brownish. Abdomen with suberect hair-scales of basal segments whitish; rest of abdomen brownish, mottled whitish dorsally, paler ventrally, sometimes with black midventral spots as in *A. squaliolus*. Male abdominal base (Fig. 96) with brushes, levers and pockets. Male genitalia (Fig. 95): uncus moderately robust, curved, apically flattened and barely hooked; basal portion of tegumen very short; manica dorsally with dense field of moderately long papillae; juxta roughly hexagonal with rounded corners; valva with base of sacculus strongly notched; clasper reduced to minute ‘bump’; valva narrow, with sinuous costa; corona with ca 17–20 elements. Phallus (Fig. 94): caecum penis lacking keel; subbasal sclerite of vesica a long moderately narrow strip of dense very small spinules; vesica short, with weakly bulbous base, tapering only slightly beyond; cornuti present in single dense band, apical cornuti progressively shorter, and band bordered on each side by fine spinules. Female genitalia (Fig. 101): ovipositor lobes rather elongate, rounded, ventrally directed; segment 8 with scattered rather short setae in apical half; ostium as described for genus; lamella antevaginalis weakly sclerotised; ductus bursae rather short, finely scobinate, opening obliquely into posterior end of corpus; corpus bursae elongate, elliptical; appendix bursae present as distinct strongly rugose and internally sclerotised bump, lacking scobinations.

**Type material.** Lectotype: Female, ‘Dec. 1873 Riccarton Bush / 75 / Fereday Collection’, designated by J.S. Dugdale (Dugdale 1988: 198) (CMNZ) (examined, not dissected). Paralectotype (see below): male, ‘Dunedin’ (but see below), Feb 1873, R.W. Fereday (CMNZ), (examined, not dissected).

**Note.** Meyrick (1887: 29) described *Miselia pessota* from two specimens, both of which he considered to be male, and gave ‘Christchurch, in December’ as the only locality and date; most of the species described in the paper were from the collection of R.W. Fereday (Meyrick 1887: 1). There are no relevant specimens in BMNH, but there are two specimens in CMNZ collected by Fereday, a male labelled ‘Dunedin Feb’y 1873’ and a female labelled ‘Riccarton Bush Dec 1873’, as noted by Dugdale (1988: 198). Dugdale designated the female as lectotype, on the assumption that Meyrick mistook the sex of the specimen. He reasons as follows (Dugdale, *loc. cit.*): “While I could have inferred that Meyrick’s citing of both sex and locality was mistaken, I saw no need, as the ♀ would have been seen by him, in Fereday’s collection, in 1880.” This is confusing, since neither specimen disagrees with the description in both sex *and* locality; designating the male as lectotype would have implied only that Meyrick’s citing of locality was mistaken. Indeed, when the current author examined the specimens in CMNZ in March 2015, it was the male from Dunedin (CMNZ database no. 2007.222.229) that bore the lectotype label as follows: ‘~~H~~LECTOTYPE ♂ *Miselia pessota* Meyrick teste Dugdale’; the female was labelled as paralectotype. Clearly Dugdale changed his mind about the appropriate lectotype after labelling the male, and I assume that in the above-quoted passage the phrase ‘both sex and locality’ is a *lapsus calami* for ‘both *date* and locality’; i.e., the justification for designating the female as lectotype is that this involves only a single apparent error by Meyrick (in sex) rather than two for the male (in locality and date). Anyway the published designation is valid, and the labelling of the specimens has now been changed accordingly (C. Vink, pers. comm.).

No further specimens of *A. pessota* have been collected in the greater Dunedin area (DN) despite the presence of much apparently suitable habitat with shrubby *Melicytus*, and intensive collecting in the region by Brian Patrick (and others before him) over many years, and it is strongly suspected that the male paralectotype is mislabelled (B.H. Patrick, pers. comm.). In this case, perhaps Meyrick was in fact correct about its date and locality; it may have been unlabelled when he saw it in Fereday’s collection, or perhaps it had a temporary label, and Fereday later replaced this with the incorrect label.

**Distribution.** Northland, southern North Island and South Island (chiefly eastern). Apparently absent from Dunedin and Southland districts (see Note above for discussion of Fereday’s ‘Dunedin’ specimen), but present in Fiordland.

ND, WI, WN / SD, MB, NC, MC, MK, OL, CO, FD.

**Biology.** There are few rearing records. Larvae feed on small-leaved *Melicytus* spp., including *M. alpinus* (reared by B. Patrick from Old Man Range CO, Feb. 1983; Patrick 1994). At the Northland site, *M. micranthus* is the likely host. The larva has apparently never been described or photographed.

**Flight period.** December to April.

**Remarks.** This is a local or very local and rather infrequently collected coastal to subalpine shrubland moth. It has been recorded flying at dusk (B.H. Patrick, pers. comm.), and also comes to light. It has never been found at Riccarton Bush, the type locality, since the original collection by Fereday; however, it has recently been collected elsewhere in MC, e.g. on the coast at Birdling’s Flat and Kaitorete Spit and inland at Mt Hutt and Lake Lyndon Road (B.H. Patrick, B.M. Lyford pers. comm.), so Fereday’s specimen could have been a wanderer. A single female (in NZAC) was collected in February 2017 in Northland, in swamp forest on the Hikurangi flood plain near Whangarei, greatly extending the known range of the moth.

The presence of well-developed cornuti on the male vesica is a plesiomorphic feature that separates it from its congeners. However, a possible sister-species relationship with *A. coelacantha* (which has reduced cornuti) is suggested by the form of the male valva, which in both species has a strongly reduced clasper and a distinct basal invagination of the sacculus.

#### **Cosmodes genus group**

**Diagnosis.** Eyes without surface hairs; without ‘lashes’. Forewing termen with projections just below middle (end of vein CuA1) and at tornus (end of A vein). Male abdominal base without brushes, levers or pockets. Paratergal sclerite short, not twisted. Valva: sacculus basally with dense spinules along dorsal margin; clasper present as forked sclerotised extension of sacculus; cucullus not differentiated; corona present, with normal and modified

elements (see genus description). Vesica without distinct diverticula; short, with spinulose transverse patch and two large apical tooth-like cornuti. Female genitalia: antrum cup-shaped; ductus bursae narrow, short, longitudinally rugose; appendix bursae a small round pouch with strongly sclerotised and scobinate inner wall; corpus bursae very elongate; signum absent.

**Included genera.** *Cosmodes* only.

**Remarks.** The genus *Cosmodes* is monotypic and peculiar with no apparent close relatives. It has traditionally been placed within the broad definition of Amphipyridae (e.g., Common 1990; Edwards 1996, where Amphipyridae and Acronictidae are treated together). However, it shares none of the characters listed as autapomorphies of the restricted definition of Amphipyridae by Fibiger & Hacker (2007: 22). The presence of a corona on the valva together with the spinulose area on the sacculus indicate that *Cosmodes* belongs amongst the 'higher' Noctuidae, i.e. the Noctuinae in the sense of Poole (1995) and of Lafontaine and Schmidt (2010) (cf. Fibiger & Lafontaine 2005). Tribal placement remains very doubtful, but there are possible similarities in the conformation of the male genitalia to *Spodoptera* Guenée (Prodeniini), particularly in the complex sacculus and the very broad-based cornuti of the vesica. I have not placed great weight on these as the homologies of the valval structures need to be assessed more critically. The larva of *Cosmodes* is highly modified (especially in its reduced clavate setae and unisetose prothoracic L group) and lacks obvious synapomorphies with *Spodoptera* or any other noctuid genus of which I am aware.

#### Genus *Cosmodes* Guenée, 1852

Figs 12–14, 64, 79, 102–105

*Cosmodes* Guenée, 1852. *Spécies général des Lépidoptères*, vol. 6. *Noctuérites* 2: 289. Type species: *Phalaena elegans* Donovan, 1805, by original monotypy.

**Diagnosis.** As for genus group above.

**Description.** *Adult* (Figs 12–14). Head (Fig. 64): Labial palpi upcurved, with short semi-erect scales beneath; segment 3 very short, ca 0.25x length of segment 2. Eyes without surface hairs; without 'lashes'. Antennae short, ca 2/3 length of forewing, filiform, becoming dentate beneath in apical ½ in male, densely and finely ciliate beneath in male, ciliations up to ca 0.5x depth of flagellum; ciliations in female up to 0.3x depth of flagellum. Thorax: prothorax with posterior scale-tuft; mesothorax with posterior (mesoscutellar) scale-tuft. Wing venation (Fig. 79): forewing with R3 and R4 stalked, separate from just under half length; hindwing cross-vein at end of cell angled inwards towards wing-base, running from before junction of Rs+M1 to base of M3 very near junction with CuA1. Forewing termen with projections just below middle (end of vein CuA1) and at tornus (end of A vein). Legs: Tibiae without spines. Abdomen with weak scale-tufts dorsally on segments 1–2, and a strong tuft on segment 3.

Male abdomen and genitalia (Figs 102–104): abdominal base (Fig. 104) without brushes, levers or pockets. Genital capsule (Fig. 103): uncus moderately robust with claw-like tip, clothed in suberect scales in apical ½ above and beneath. Paratergal sclerite short, not twisted. Valva: sacculus basally with dense spinules along dorsal margin; clasper present as forked sclerotised extension of sacculus, dorsal branch much the longer and extending beyond costa of valva; ampulla absent (unless dorsal branch of clasper is interpreted as displaced ampulla); cucullus not differentiated; corona present, consisting of 5–6 normal elements towards valva apex; below these a sclerotised prominence surmounted by a sixth more robust seta pointing inward toward valval base; a further small tooth-like sclerite perpendicular to valva below this (these last two may be highly modified corona elements); saccus U-shaped. Phallus (Fig. 102): short, cylindrical; vesica without distinct diverticula; everted vesica in same orientation as phallobase, short, with spinulose transverse patch (perhaps representing the distally displaced subbasal sclerite) and two large apical tooth-like cornuti with broad bases.

Female abdomen and genitalia (Fig. 105): S7 with indistinct V-shaped indentation caudally. Terminal segments not strongly extensible. Ovipositor lobes broad, squarish, not oblique, with setae mostly short to medium-length, a few longer setae dorsally. Segment 8 with a few minute setae posteriorly only, mesoventral margins of S8 produced into short, blunt, spinulose processes. Ostium broad; antrum cup-shaped, not curved in cross-section, without lateral grooves, sclerotised in band dorsally and ventrally. Ductus bursae narrow, short, longitudinally rugose; appendix bursae a small round pouch with strongly sclerotised and scobinate inner wall; corpus bursae very elongate, finely and evenly scobinate; signa absent.

**Larva.** Coloration cryptic. Cuticle not spinulose. T1 with L group unisetose; SV group bisetose; T2 and T3 with SV unisetose. Crochets biordinal. Pinacula all small and inconspicuous, unmodified; SD1 pinaculum on T2 and T3 small, circular, more conspicuous than other pinacula except L1 and SD1 on T1; seta minute. D, SD and L setae in final instar (including SD1 on A9) all tending to be very short and weakly clavate.

**Pupa.** Thorax dorsally with numerous irregular pits on all segments. Abominal segments 1–7 each with a pair of sclerotised (but barely raised) ridges and associated furrows dorsally. Abdominal segments without depressions except for a group of small pits around each spiracle on A2–7. A10 not rugose; cremaster a pair of stout setae, not curled but weakly curved outwards.

**Distribution and Biology.** See below under species description.

**Remarks.** See above under genus group diagnosis.

### ***Cosmodes elegans* (Donovan, 1805)**

Figs 12–14, 64, 79, 102–105

*Phalaena elegans* Donovan, 1805. *An epitome of the natural history of the insects of New Holland, New Zealand, New Guinea, Otaheite and other islands in the Indian, Southern and Pacific Oceans &c.*: pl. 36, fig. 5 (text overleaf).

**Diagnosis.** The unusual forewing shape and striking wing pattern of *C. elegans* preclude confusion with any other moth (see Figs 12–14).

**Description.** Adult (Figs 12–14). Wingspan: 26–32 mm (male) 28–36 mm (female). Head and prothorax mixed white, pale ochreous to pinkish ochreous, or purplish brown in fresh dark specimens; labial palpi and antennae as described for genus. Prothorax indistinctly banded with darker scales, and with medial dark scale-crest posteriorly; all thoracic scales lamellate, with shallowly scalloped tips. Mesothorax mostly concolorous with paler areas of prothorax (whitish ochreous to pinkish ochreous), but with darker scaling on tegulae medially (forming oblique band) and posteriorly, and tips of scales of posterior scale-crest also darkened. Forewing pinkish ochreous to deep purplish brown, darker distally; crosslines absent except for silvery white line at 5/6 wing length (possibly a distally displaced postmedian line), distinct only in disc and towards tornus, where strongly inward-oblique; also a deep brown to black scalloped line along termen, usually indistinct but occasionally edged white basally; a conspicuous pattern of four lime-green blotches, edged silvery-white, as follows: crescentic blotch from wing base to just before ½ wing length, curving towards dorsum; enlarged elongate orbicular stigma nearly contiguous with distal apex of crescent; enlarged subtriangular reniform stigma; and truncate triangular blotch between reniform and tornus with apex on vein CuP; fringe concolorous with wing, but mottled blackish. Hindwing: basally translucent white, distally suffused pinkish brown, colour concentrated along veins, or with overlay of blackish scales in darkest specimens; no spots or crosslines; fringe white with pinkish brown basal suffusion. Underside: forewing suffused pinkish to purplish brown except towards dorsum where whitish; fringe somewhat darker, with conspicuous pale basal line; hindwing white to brownish white, exterior suffusion as for upperside except usually less distinct; darkest specimens show a median spot and faint postmedian line (only distinct near costa); fringe whitish with median darker line. Abdomen very pale whitish ochreous dorsally and ventrally, in some specimens more or less strongly suffused with blackish grey; T1–2 with median area of blackish scales; T3 with distinct purplish brown scale-crest. Male and female genitalia: as described for genus.

**Type material.** Not located. Donovan (1805) says ‘This pretty undescribed species is found in the vicinity of New South Wales.’ Upton (1984) discusses the history and whereabouts of material described by Donovan with relation to *Papilio antinous* Donovan, the holotype of which was discovered in the Macleay Museum, Sydney.

**Distribution.** Scattered records almost throughout the main islands of New Zealand, except the far south; also one record from the Chathams (Pitt Island: Lindsay 1930).

ND, AK, TK, TO, GB, HB, WI, WA, WN / SD, NN, BR, KA, MC / CH

**Biology.** Larvae in Australia feed on *Verbena* (Verbenaceae), *Wahlenbergia* and *Lobelia* (Campanulaceae) (Holloway 1977; Common 1990); in New Zealand reported by E.S. Gourlay on ‘the common herbaceous verbena’ (Gaskin 1966b). In his paper on noctuid host-plants, Gaskin (1966a) gives *Lathyrus odoratus* (sweet pea, Fabaceae) as an additional host based on his own observations, though this is not mentioned in his popular book (Gaskin 1966b). The larva is stout, bright green, with a yellowish or green head (head colour perhaps changes to green in later instars), a pale lateral line, and dark clouding around the spiracles (based on photographs by W.

Moore in Herbison-Evans & Crossley (2015)). Pupation is in a cocoon amongst the foliage of the host-plant (Herbison-Evans & Crossley 2015).

**Flight period.** Recorded throughout the year, but with most records from February to April.

**Remarks.** This species is an Australian endemic, appearing yearly in New Zealand as a trans-Tasman immigrant or vagrant, and establishing temporary colonies in summer (Fox 1973; Dugdale 1988). Sometimes it may be found in the same locality in successive seasons, suggesting longer-term establishment (B.H. Patrick, pers. comm.). It usually occurs in small numbers, although Fox (1973) observed that it could be abundant in some years.

#### ***Proteuxoa* genus group**

**Diagnosis.** Eyes without surface hairs; without ‘lashes’. Male abdominal base with well-developed brushes and levers; pockets absent. Tegumen cordate, not distinctly ‘stepped’. Dorsal membrane of manica without field of papillae. Subbasal sclerite of vesica not differentiated from base of cornutal strip. Everted vesica with very long cylindrical basal portion, expanding into more bulbous apex, basally spinulose, with many smaller cornuti along cylindrical portion and a few larger cornuti subapically and apically. Ductus bursae very narrow, longitudinally pleated / rugose in anterior portion, membranous posteriorly; appendix bursae strongly sclerotised, scobinate, pleated in basal portion and weakly S-shaped; signa absent.

**Included genera.** *Proteuxoa* only.

**Remarks.** The diagnosis above is based on study only of the *Proteuxoa* species present in New Zealand plus two Australian endemics (see under *P. tetronycha*) and may require revision once a fuller range of Australian species is examined. No detailed examination of other Australian genera assigned (alongside *Proteuxoa*) to Acronictinae / Amphipyridae by Edwards (1996b) was undertaken for this revision. Therefore, while *Proteuxoa* stands out morphologically from other New Zealand noctuid genera, and is placed in its own genus group here, it may have Australian relatives. *Proteuxoa* is tentatively assigned to Noctuidae here based on the weakly (but definitely) differentiated cucullus of the male valva (character 11 of Poole (1995)) and the apically twisted paratergal sclerite (his character 14, in part). At present, the tribal affinities of this genus remain obscure.

#### **Genus *Proteuxoa* Hampson, 1903**

Figs 15–24, 65, 80, 106–120

*Proteuxoa* Hampson, 1903. *Catalogue of the Lepidoptera Phalaenae in the British Museum. Vol. 4:* 649. Type species: *Agrotis amaurodes* Lower, 1902, by original designation.

*Nitocris* Guenée, 1868. *Entomologist's Monthly Magazine* 5: 4. Type species: *Mamestra comma* Walker, 1856, by subsequent designation by Hampson (1909: 383). Unavailable; preoccupied by *Nitocris* Rafinesque, 1815 (Hymenoptera).

*Peripyra* Hampson, 1908. *Catalogue of the Lepidoptera Phalaenae in the British Museum. Vol. 7:* vii, 25. Type species: *Amphipyra sanguinipuncta* Guenée, 1852, by original designation. Synonymised by Edwards (1996b: 327).

*Rictonis* Nye, 1975. *The Generic Names of Moths of the World Vol. 1 Noctuoidea (part): Noctuidae, Agaristidae, and Nolidae:* 433. Objective replacement name for *Nitocris* Guenée. Synonymised by Edwards (1996b: 327).

**Diagnosis.** As for genus group above.

**Description (in New Zealand context).** *Adult* (Figs 15–24). Medium-sized noctuids (wingspan 29–44 mm). Head (Fig. 65): Labial palpi weakly upcurved, with short semi-erect scales beneath; segment 3 short, ca 0.3x length of segment 2. Eyes without surface hairs; without ‘lashes’. Antennae filiform, cylindrical, densely and finely ciliate beneath in male, ciliations ca 0.5–0.7x depth of flagellum; ciliations in female ca 0.2–0.3x depth of flagellum. Thorax: prothorax and mesothorax either with rather broad-tipped 3- to 5-pointed lamellate scales (*comma*, *tetronycha*), or with very narrow, almost hairlike 1-pointed scales (*sanguinipuncta*); mesothorax without distinct scale-tufts. Wing venation (Fig. 80): forewing with R3 and R4 stalked, separate from just under half length (most specimens of all three species) to well under 1/2 length from cell (some specimens of *tetronycha*); hindwing cross-vein at end of cell angled inwards towards wing-base, running from junction of Rs+M1 junction with CuA1. Wing pattern: forewings grey brown, mid-brown or blackish brown; reniform and orbicular stigmata either black, subequal, ringed with crimson scales (*sanguinipuncta*), or white to cream with orbicular reduced to small round dot and reniform with darker scaling interiorly (other species); antemedian and postmedian lines rather distinct and whitish (*sanguinipuncta*) or indistinct (other species). Legs: Tibiae without spines; inner tibial spurs ca 2x as long

as outer spurs; each tarsus with three rows of spines. Abdomen smooth-scaled, without scale-tufts. S2 apodemes in both sexes short and nearly straight.

Male abdomen and genitalia (Figs 106–114): abdominal base (Figs 108, 111, 114) with well-developed brushes and levers; pockets absent. Uncus moderately robust with weakly hooked tip, clothed in suberect scales in apical ½ above, bare beneath. Tegumen cordate, not distinctly ‘stepped’. Paratergal sclerite short, broad, apically twisted. Dorsal membrane of manica without field of papillae. Juxta a small, rather weakly sclerotised broadly V-shaped plate (*comma*, *tetryncha*) or octagonal plate with caudal notch (*sanguinipuncta*). Valva narrow, elongate; corona present; cucullus weakly differentiated (by slight constriction of valva below apex); sacculus without membranous flange; clasper large, sickle-like. Saccus U-shaped. Phallus: moderately long, cylindrical, basally bulbous. Subbasal sclerite of vesica not differentiated from base of cornutal strip. Vesica without distinct diverticula. Everted vesica evenly curved from phallobase, with very long cylindrical basal portion, expanding into more bulbous apex, basally spinulose, with many smaller cornuti along cylindrical portion and a few larger cornuti subapically and apically.

Female abdomen and genitalia (Figs 115–120): S7 not indented caudally. Terminal segments rather strongly extensible (*comma*, *tetryncha*) or barely extensible (*sanguinipuncta*). Ovipositor lobes squarish (*sanguinipuncta*) to elongate, cone-like (*comma*, *tetryncha*); ovipositor with mixed long and short setae; spinose setae present in *comma*. Ostium taking up ca 2/3 width of segment 8, cup-shaped and elongate (*comma*, *tetryncha*) or very shallow (*sanguinipuncta*). Antrum rather weakly sclerotised in band dorsally and ventrally; not curved in cross-section, without lateral grooves (cf. *Physetica*). Ductus bursae very narrow, longitudinally pleated / rugose in anterior portion, membranous posteriorly; corpus + appendix bursae pear-shaped; corpus membranous, tapering without strong differentiation into strongly sclerotised, scobinate appendix bursae, pleated in basal portion and weakly S-shaped; signa absent.

*Larva.* Coloration cryptic. Cuticle finely spinulose. T1 with L group bisetose (L2 hairlike and often hard to observe), SV group bisetose; T2 and T3 with SV unisetose. Crochets uniordinal. Pinacula small and inconspicuous, unmodified, except SD1 pinaculum on T2 and T3 an expanded hollow with ventral pit, seta hairlike. Seta SD1 on A9 long, hair-like.

*Pupa* (from preserved exuviae of *P. tetryncha* only). Thorax not pitted. Abdominal segments 1–4 without dorsal ridges or furrows; segments 5–7 each with row of large depressions dorsally (bordered by 2–3 rows of much smaller depressions anteriorly) in region where segments telescope. A10 not rugose; cremaster a pair of stout setae weakly curved ventrad but not curled.

**Distribution.** The genus is chiefly Australian, but two of the three New Zealand species are apparently endemic; the third is a recently established immigrant.

**Biology.** Larvae are probably more or less polyphagous on herbaceous plants, including grasses; a record of *P. comma* s.l. on *Pinus radiata* seedlings after a forest fire is given by White (2002).

**Remarks.** With the new synonymies established by Edwards (1996b), this genus now contains 77 described Australian species. Only *Proteuxoa comma* is recorded from New Zealand in the older literature (usually as *Ariathisa comma* or *Rictonis comma*). It is here shown that two very similar species have been confused under this specific name, the smaller of which is described as *P. tetryncha* n. sp. below. Since 2007 the very distinctive Australian species *P. sanguinipuncta* has been established in the North Island, where it is now widespread and sometimes very common. It has recently spread to the South Island.

Note that there is a *lapsus calami* in Gaskin’s (1966b) discussion of ‘*Ariathisa comma*’ (i.e. the aggregate of *P. comma* and *P. tetryncha*): he states that the male is darker than the female and that the female has the cross-lines more distinct; the dimorphism is the other way round in both species.

#### Key to *Proteuxoa* species adults

Additional less reliable characters are placed in parentheses.

- |   |  |                       |
|---|--|-----------------------|
| 1 | Wingspan over 38 mm; forewing with crimson spots; reniform stigma black; male with dense fluffy scaling on underside of foretibia.....(p. 36)... | <i>sanguinipuncta</i> |
| — | Wingspan under 38 mm; forewing without crimson spots; reniform stigma cream to pale brown; male without fluffy scaling on foretibia.....         | 2                     |

- 2 Male genitalia: vesica with 2 large claw-like cornuti; female ovipositor with spine-like setae (wingspan usually 33 mm or more; prothoracic collar usually not contrastingly pale; subterminal forewing line usually distinct, blackish in costal half of wing) ..... (p. 33)... *comma*
- Male genitalia: vesica with 4 large claw-like cornuti; female ovipositor without spine-like setae (wingspan 33 mm or less; prothoracic collar usually contrastingly pale; subterminal forewing line usually indistinct, not blackish) ..... (p. 35)... *tetronycha*

***Proteuxoa comma* (Walker, 1856)**

Figs 15, 16, 106–108, 115, 116

*Mamestra comma* Walker, 1856. *List of the specimens of lepidopterous insects in the collection of the British Museum*. IX: 239.

*Graphiphora* [as *Graphiphoga*] *implexa* Walker, 1857. *List of the specimens of lepidopterous insects in the collection of the British Museum*. X: 405. Synonymised by Meyrick (1887: 30).

*Hadena plusiata* Walker, 1865. *List of the specimens of lepidopterous insects in the collection of the British Museum*. XXXIII: 742. Synonymised by Meyrick (1887: 30).

*Nitocris bicomma* Guenée, 1868. *Entomologist's Monthly Magazine* 5: 4–5, as replacement name for *comma* Walker. Synonymised by Meyrick (1887: 30).

**Diagnosis.** Very similar to the newly described *P. tetronycha*; see below under that species for diagnostic differences.

**Description.** Adult (Figs 15, 16). Wingspan 32–37 mm (male), 33–37 mm (female). Head in male dark grey-brown, in female grey-brown to blackish brown, darkest in frontal band between eyes, whitish on lower frons in both sexes (white area may be concealed by labial palpi); labial palpi whitish ochreous variably mottled blackish brown, base of segment 2 extensively blackish brown. Antennae in male with ciliations ca 0.5–0.6x depth of flagellum. Prothorax dull ochreous to grey-brown or dark brown, scales tipped paler giving paler grey (or sometimes greyish or brownish white) colour posteriorly and with more or less indistinct blackish crescent medially; contrast with darker mesothoracic colour rather weak. Mesothorax including tegulae grey-brown in male, darker brown in female, especially on tegulae; posterior scale-crest with paler whitish-tipped scales; most thoracic scales lamellate, with shallowly scalloped 4- or 5-pointed tips. Male foretibia without dense scale-brush beneath. Forewing grey brown (male) or dark brown (female); crosslines blackish, moderately distinct in male, indistinct in female: antemedian line irregular, more or less zigzag; postmedian line irregularly scalloped; claviform stigma V-shaped, joined to dorsum by dark line; orbicular reduced to small or tiny white dark-edged dot; reniform distinct, weakly to strongly C-shaped, with cream margin that is broader distally, margin tending to be suffused yellow-ochreous towards costa especially in male, reniform with darker scaling interiorly; a cloud of blackish scaling just basad of reniform forms part of zigzag median line; a second narrow line extending parallel to this to dorsum from reniform; subterminal line rather distinct, inwardly oblique, near straight, blackish; black scaling along veins in discal area just basad of subterminal line usually rather distinct in male, forming 3–4 streaks; indistinct or absent in female; terminal area beyond line pale grey-brown in male, grey-brown in female, paler than rest of wing in both sexes; weak black dashes along termen between veins; fringe mottled grey-brown and pale to deep ochreous brown, some scales tipped whitish. Hindwing: pale brownish, hardly paler basally, with fairly distinct antemedian dash in disc; termen sometimes with faintly darker line; fringe cream basally, then white beyond pale brown subbasal line. Underside: forewing grey-brown, costa paler in middle and terminal area also paler; reniform stigma present as dark dash and costal part of postmedian line more or less distinct, fringe pale grey-brown with tips of scales white; hindwing pale greyish ochreous, mottled grey-brown, most strongly towards apex, with distinct discal spot and variably distinct postmedian line; fringe whitish. Abdomen whitish ochreous variably mottled brown dorsally and ventrally, usually more densely mottled in female. Male genitalia (Fig. 107): Uncus strongly and evenly curved, tapering to weakly hooked tip. Juxta a broad weakly sclerotised roughly V-shaped transverse plate. Valva very slender, curved; apex slightly above highest point of curve of uncus in slide preparations; clasper robust, spinulose on costal surface, broadened distally, in bird's-head shape; corona with 26–34 elements. Phallus (Fig. 106) as described for genus; vesica with 2 very large claw-like cornuti towards apex of bulbous part, 3–5 broad-based cornuti in centre of bulbous part (apical 3 of these usually, but not always, with truncate tips); bulbous part and beyond with mixture of fine spinules and scobinations; cylindrical portion of vesica with numerous smaller basally curved cornuti, cornuti progressively smaller towards base of vesica, where gradually reduce to sinuous band of minute spinules. Female genitalia (Figs 115, 116): ovipositor lobes (Fig. 116) with short straight spine-like

setae apically, and a few long hair-like setae basally; apophyses posteriores very long, reaching distinctly anterior to base of apophyses anteriores in slide preparations; segment 8 elongate, with scattered long and short straight spine-like setae, concentrated along lateral margins of sterigma, surface including sterigma and lamella postvaginalis finely and densely scobinate (scobinations coarser on lamella postvaginalis); membranous posterior portion of ductus bursae about 1/3 ductus length; otherwise as described for genus.

**Type material.** *Mamestra comma*: Holotype: Female, 'Type [round green-ringed label] / N. Zealand Churton 51-136 / 40. MAMESTRA COMMA' (BMNH) (examined, not dissected).

*Graphiphora implexa*: Lectotype: Female, 'Type [round green-ringed label] / N. Zealand W. Colenso 53-19 / 42. GRAPHIPHORA COMMA', designated by J.S. Dugdale (Dugdale 1988: 196) (BMNH) (examined, not dissected). Paralectotypes: see below.

*Hadena plusiata*: Lectotype: Male, 'Type [round green-ringed label] / N. Zealand Auckland Oxley 60-73 / HADENA PLUSIATA', designated by J.S. Dugdale (Dugdale 1988: 196) (BMNH) (examined, not dissected). Paralectotype: see below.

**Note.** The interpretation of the names *comma*, *implexa* and *plusiata* is based on the size and external appearance of the primary type specimens examined in the BMNH (see diagnostic characters separating the species from *P. tetronycha* below); wingspans of all three types are 35–36 mm. Therefore, all three names are considered to refer to the same species, the larger and less widespread of the two confused under the name *comma* in New Zealand collections.

Dugdale (1988: 196) gives 'Auckland' as the type locality of *Mamestra comma*, based on the Rev. J.F. Churton's residence there as colonial chaplain from 1841 to 1853, i.e. most of his life in New Zealand. Since the true *Proteuxoa comma* is unknown north of TO in the North Island, I consider that the correct type locality is probably Wellington, where Churton first arrived in New Zealand in 1840 (cf. Dugdale 1988: 10). (Possible corroboration for Churton having collected in Wellington comes from the holotype of *Feredayia graminosa* (Walker), a Churton specimen that has a Wellington locality label; admittedly, the label was not written by Churton and the locality is not specified by Walker (1857b: 605), but there seems no *prima facie* reason to reject it.) However, it is also possible that *P. comma* occurred in Auckland in the mid 19<sup>th</sup> century, since its current range is similar to that of two other endemic moth species associated with native grasslands, *Orocrambus enchophorus* (Meyrick) (Crambidae) and *Agrotis admirationis* Guenée (Noctuidae); these both had colonies in the Auckland district until the 1950's (specimens in NZAC), but there is only one recent AK record of *O. enchophorus* and none of *A. admirationis*.

The type locality of *Graphiphora implexa* is very likely Hawkes Bay HB or Taupo TO as surmised by Dugdale (1988) from W. Colenso's long association with those regions; although *P. comma* is not recorded here from HB, this is an under-collected region and it is very likely to occur or have occurred there.

The type locality of *Hadena plusiata* is undoubtedly Nelson: Dugdale (1988: 10, 17) explains how the collection sent by T.R. Oxley to Walker was mislabelled as originating from Auckland. (Note that the page number of the description of *plusiata* is misprinted in Dugdale (1988: 196) as 472: it should be 742; also the page number for the synonymy by Meyrick (1887) is 30, not 80).

Dugdale (1988: 196) is taken to have designated the lectotypes of *Graphiphora implexa* and *Hadena plusiata*, as I am unaware of any previous published designation, although the labelling of the specimens respectively as 'Holotype' and 'Type' predates his catalogue. The description of *G. implexa* mentions three specimens (all female) and that of *H. plusiata* two specimens (male); the paralectotypes in each case have not been located in BMNH, and are almost certainly not labelled as such; but they were not specifically searched for and may be present.

In the BMNH, there are three specimens (2 male, 1 female) of *P. comma* labelled as syntypes of *Nitocris bicomma* Guenée. No type material or locality is mentioned in the original description of *bicomma* (Guenée, 1868: 4–5). *Nitocris bicomma* is interpreted as a replacement name for *comma* (Dugdale 1988) based on the following statement by Guenée (*loc. cit.*): "I think this species is the *comma* of Mr Walker; but, as that name cannot be retained, it being already employed for a European *Leucania*, I have modified it in the least possible manner." Clearly the implied combination *Nitocris comma* is not a homonym of *Leucania comma* (Linnaeus, 1761), so the replacement name was unnecessary. By current nomenclatural rules for replacement names (ICZN Article 72.7), the type material of *bicomma* is automatically identical to the type material of *comma*, of which it is an objective synonym, and these three specimens therefore have no type status.

**Distribution.** North Island south of the Taupo line, widespread in the South Island; chiefly eastern. The record from MB is based only on a Skellon specimen in BMNH labelled ‘Marlborough’. Also present on the Chathams, where *P. tetronycha* has not been recorded.

TO, WN / NN, MB, NC, MC, MK, OL, CO, DN, SL / CH

**Biology.** The spinose setae on the ovipositor of *comma* (absent in *tetronycha*) indicate a specialised oviposition site, and the biology of this species is in need of further study. With few exceptions, rearing records and larvae have not been separated from those of *P. tetronycha*. There are specimens of true *P. comma* reared from cabbage (*Brassica oleracea*) from Taupo by J.S. Armstrong in NZAC, and one reared from ‘herbs’ in the Brian Patrick private collection in Christchurch (see Remarks below). The following description of the larva from Hudson (1928: 77) may be applicable to either (or both) species: “dark brown, tinged with pink; the subdorsal region is paler, there is a series of diagonal blackish stripes on each segment, and the anterior portions of the larva are much darker than the rest of the body”. Hudson’s figures of adult ‘*Ariathisa comma*’ (Hudson 1928: figs 19, 20) appear to show the true *comma*, based on the presence of a strong dark subterminal line, but I have not been able to check the Hudson collection in MONZ for reared specimens to establish the true identity of the larval description.

The larva figured as *Proteuxoa comma* by Bejakovich and Dugdale ([1998]: fig. 77) could be *comma*, but is more likely to be the much commoner *tetronycha*; however, the adults figured by these authors (*loc. cit.*: figs 170, 171) are true *P. comma*. Pupation (probably in both species) is in the soil (Hudson 1928).

**Flight period.** December to April.

**Remarks.** The discovery of an abundant undescribed species (named below as *P. tetronycha*) confused with *P. comma* in collections means that a reassessment of the conservation status of the true *comma* is now urgently needed. Clearly, it is a much rarer moth than previously believed, and it is apparently restricted to the drier eastern areas of the North and South Islands, south of the Taupo line, though it also occurs on the Chathams (where *P. tetronycha* is so far unknown). There is evidence suggestive of a historical decline; of the 31 specimens of *P. comma* in NZAC, only two date from after 1959: a male from Roaring Meg CO collected by J.S. Dugdale in 1984 and the illustrated female from Kaingaroa, Chatham Is., collected by the author in 2005 (Fig. 16). In the extensive Brian Patrick collection in Christchurch, there are only three specimens, all female, two collected at light at Conroy’s Road CO on 31 Dec 2001, and one reared from a larva on herbs from Christchurch MC on 20 Feb 2012 (identification of all three confirmed by examination of ovipositor).

### ***Proteuxoa tetronycha* new species**

Figs 17–22, 65, 80, 109–111, 117, 118

**Diagnosis.** *Proteuxoa tetronycha* is difficult to separate from *P. comma* on colour characters, but the more contrasting (pale) prothoracic collar and browner (less grey) forewing ground colour of *tetronycha* are helpful pointers; the subterminal forewing line is usually not as strongly marked with dark scaling as in *comma*. Size is also a helpful guide: known specimens with wingspans above 33 mm are all *comma*; those with wingspans less than 32 mm are *tetronycha*. When the two species are seen side by side, *Proteuxoa comma* has a narrower-winged appearance than *tetronycha*, which looks more compact or ‘stubby’. For specimens with intermediate wingspans from the range of *comma* (central and southern North Island and eastern South Island), dissection is the most certain means of identification, although the ovipositor can sometimes be examined for presence (*comma*) or absence (*tetronycha*) of spinose setae without dissection if it is extruded in the specimen, or if some scales are removed from the abdominal apex. The two species are easier to separate provisionally if seen in series.

**Description.** Adult (Figs 17–22). Wingspan 29–33 mm (both sexes, cf. *comma*). Very similar to *Proteuxoa comma*, q.v.; only the distinguishing characters are given in this description. Prothorax usually with rather distinct blackish medial crescent; apex of prothoracic collar usually appearing whitish and contrasting rather strongly with mesothorax. Thorax and forewing ground colour usually a warmer mid-brown in the male than in *comma*, though grey-brown specimens also occur; female forewing occasionally also mid-brown, but more usually blackish brown as in *comma*; reniform weakly to strongly C-shaped, colour as in *comma*; dark line running from reniform to dorsum between median and postmedian in male often absent (present in male *comma*); subterminal line usually less distinct than in *comma* and lacking blackish scaling; black scaling along veins in discal area just basad of subterminal line usually indistinct or absent in male, occasionally distinct, forming 3–4 streaks; very indistinct or absent in female. Male genitalia (Fig. 110): Valva apex level with or below highest point of curve of uncus in slide

preparations; corona with 14–21 elements. Phallus (Fig. 109): vesica with 4 large claw-like cornuti altogether: 3 in bulbous part, and a fourth beyond these where vesica tapers; no truncate cornuti, numerous smaller cornuti progressively reducing in size towards base as in *comma*. Female genitalia (Figs 117, 118): ovipositor lobes (Fig. 118) with long hair-like setae, without spine-like setae; apophyses posteriores moderately long, reaching level with base of apophyses anteriores in slide preparations; segment 8 elongate, but less so than in *comma*, without spine-like setae, but with scattered hair-like setae, concentrated along lateral margins of sterigma; ostium less elongate than in *comma*; appendix bursae longer, narrower and more sinuous than in *comma*.

**Type material.** Holotype: Female, ‘Taupo, N.Z. 19-1-34 light J.S. Armstrong / NZAC slide Noct. 430 genitalia ♀ / NZ Arthropod Collection NZAC04023982 [database label with barcode]’ (NZAC). Paratypes: 5 males, 2 females, as follows: 1 female, Parengarenga Harbour, ND, Paua, m.v. light 13 Oct 2008, R.J.B. Hoare (Fig. 22); 1 male, Onehunga AK, 12 Feb 1936 [A.J. Hipwell] (genitalia on NZAC slide Noct. 424); 1 male, Little Bush, Puketitiri HB, 25 Oct 1980 T.H. & J.M. Davies (Fig. 20); 1 male, Waitaanga Plateau TK, N.G. Tucker Res., to light, 14 Dec 1981, J.S. Dugdale & K.J. Fox (genitalia on NZAC slide Noct. 2); 1 female, Cromwell Gorge CO, Roaring Meg, 12 Dec 1984, J.S. Dugdale (genitalia on NZAC slide Noct. 429); 1 male, West Plains SL, [no date], [A. Philpott] (genitalia on NZAC slide Noct. 426); 1 male, Otatara SL, 185 Grant Rd, m.v. trap, 3-4 Dec 2011, R.J.B. Hoare & A.W. Emmerson (genitalia on NZAC slide Noct. 425) (all paratypes in NZAC).

**Note.** A female is chosen as holotype for this species because of the clear differences in the ovipositor (often visible without dissection) as compared to *comma*.

**Distribution.** Widespread throughout New Zealand.

ND, AK, BP, TK, TO, RI, WA, WN / SD, NN, BR, MB, NC, MC, OL, CO, DN, FD, SL / SI

**Biology.** Presumed to be polyphagous on herbaceous plants but rearing records and larvae have by and large not been separated from those of true *P. comma* (q.v.). One specimen in NZAC is labelled as having been reared from piripiri (i.e. *Acaena* sp., Rosaceae), and another adult (preserved in ethanol in the synoptic larval collection with pupal and larval exuviae) was reared from a larva on *Poa cita* (Poaceae) by C. de Sassi.

**Flight period.** September to March.

**Etymology.** The name *tetronycha* (a feminine adjective) derives from the Greek *tetra* (four) and *onyx* (claw) and refers to the four large claw-like cornuti in the male vesica that distinguish this species from *P. comma*.

**Remarks.** *Proteuxoa tetronycha* is a common species throughout the North and South Islands of New Zealand, where it is far more widespread than *P. comma*; however, only *comma* is known so far from the Chathams. Though *tetronycha* is believed to be endemic to New Zealand, it is likely to be rather recently derived from an Australian immigrant. It appears to be very closely related to an apparently unnamed Tasmanian *Proteuxoa* species in ANIC, although the latter has a prothoracic collar that contrasts less with the mesothorax, and a paler hindwing base in the male. In the male genitalia, the Tasmanian species has a narrower, more truncate tip to the valva, with the spines of the corona reaching at least half way across the width (less than half way in *tetronycha*), and the vesica is distinctly shorter, with the claw-like cornuti less widely spaced. There is a fifth smaller claw-like cornutus in the Tasmanian species. *Proteuxoa hydraecioides* (Guenée) is also close to *tetronycha*, but the valva of *hydraecioides* is again narrower and less curved, the clasper is more strongly curved and the tegumen is more strongly tapered and pyriform. A possible sister-species relationship with *P. hydraecioides* is suggested by preliminary phylogenetic results from the COI mitochondrial gene (R. Hitchcock, pers. comm.), but *P. comma* has not been sequenced, so a divergence within New Zealand following a single immigration event cannot yet be ruled out.

### ***Proteuxoa sanguinipuncta* (Guenée, 1852)**

Figs 23, 24, 112–114, 119, 120

*Amphipyra sanguinipuncta* Guenée, 1852. *Spécies général des Lépidoptères*, vol. 6. *Noctuérites* 2: 412, pl. 18, fig. 2.

*Mamestra trilineata* Walker, 1865. *List of the specimens of lepidopterous insects in the collection of the British Museum*. XXXIII: 669–670.

**Diagnosis.** *Proteuxoa sanguinipuncta* is a very distinctive noctuid, unlikely to be confused with any other species in New Zealand; the small crimson spots on the forewing on their own easily diagnose the species. The dense fluffy scaling of the male foretibia is also a conspicuous diagnostic feature in fresh specimens.

**Description.** (From New Zealand specimens only). Adult (Figs 23, 24). Wingspan 39–43 mm (male); 44 mm (female). Head black, frons creamy white, labial palpi creamy white except exterior and interior surfaces of

segments 1 and 2 black to near apex of segment 2; also white scales around base of antenna. Antennae in male with ciliations very short, ca 0.25x depth of flagellum. Prothorax anteriorly whitish, posteriorly reddish brown, with broken black crescent between the two colours; mesothorax reddish brown with black-brown longitudinal central stripe, some black-brown scaling posteriorly on tegulae and dense black posterior scale-tuft; some scales especially in centre of mesothorax white-tipped; most thoracic scales very narrow-lamellate, with minutely notched (two-pointed) tips. Male foretibia with massive dense ventral brush of hair-scales, scales blackish with grey to whitish bases in distal portion of tibia, scales entirely reddish brown in basal and exterior portions of tibia; female foretibia unmodified. Forewing deep leaden grey; a crimson subcostal spot at wing base; crosslines white, distinct: a subbasal line from costa reaching to CuP, where interrupted by crimson spot; crimson spot in disc between subbasal and antemedian lines; black-edged antemedian line nearly straight to just above dorsum, where kinks sharply outwards; postmedian line rather smoothly curved, not or very weakly scalloped, edged basally by series of small black triangular dashes that increase in size towards dorsum, crimson scales at distal end of each dash that may overlie postmedian; claviform stigma an elongate black triangle, with crimson scales basally that may overlie antemedian; orbicular small, round, black, edged crimson basally and distally; reniform slightly larger, roughly square, black, edged with three patches of crimson scales basally, costally and dorsally; subterminal line represented by row of 7–8 small pale crimson spots on veins, subtended basally by series of long black triangular dashes with their apices near postmedian line, some further weak pale crimson scaling at basal end of each of these dashes; a series of black spots on veins on termen, each including a tiny pale crimson spot basally; spot at tornus and associated crimson scaling more elongate; fringe leaden beyond narrow pale basal line. Hindwing dark greyish, distinctly paler (brownish white) basally, with indistinct antemedian discal spot and very indistinct median line; fringe basally yellowish, then white beyond dark subbasal line, except at apex where fringe lead-grey. Underside: forewing blackish grey, whitish ochreous towards dorsum, with reniform represented by small black spot and postmedian line moderately distinct; small black spots along termen and fringe greyish beyond pale basal line; hindwing basally yellow-ochreous (speckled black towards costa), distally blackish, with distinct discal spot and moderately distinct median line; fringe as for upperside. Abdomen basally ochreous-white, increasingly suffused blackish distally and laterally in both sexes; bright yellowish ochreous scaling on valvae in male; abdomen ventrally blackish with variably distinct central ochreous line.

Male genitalia (Fig. 113): Uncus strongly curved near base, tip distinctly hooked. Juxta a small octagonal plate, with caudal notch. Valva very slender, slightly curved; apex well above highest point of curve of uncus in slide preparations; clasper weakly and evenly curved, barely broadened distally, rather suddenly tapered just before apex, minutely setulose on costal surface; corona with ca 13–14 long elements that tend to be directed away from valva surface. Phallus (Fig. 120) as described for genus; everted vesica forming complete loop; basally with long narrow zigzag sclerotised strip (perhaps the modified subbasal sclerite) and from half way along this to start of first vesica bend, a broad band of tiny spinulose scobinations; beyond this, on outer surface of first bend ca 20 small cornuti increasing in size distally, with last 4 large, forming group, then 3 larger broad-based cornuti well-spaced around bend, and 5 rather smaller spine-like cornuti distally, a band of tiny round to scallop-shaped scobinations extending along outer surface of vesica between cornuti from group of 4 to apex; cornuti all spine-like, not claw-like or truncate.

Female genitalia (Figs 119, 120): ovipositor lobes (Fig. 120) truncate, squarish, with long and short hair-like setae throughout, no spine-like setae; apophyses posteriores long, reaching to about base of apophyses anteriores in slide preparations; segment 8 transverse, short, with scattered long and medium-length hair-like setae, concentrated along caudal margin, surface including sterigma and lamella postvaginalis very finely and densely spinulose; ostium very shallow, not cup-shaped; membranous posterior portion of ductus bursae short, about 1/4 ductus length; corpus bursae globose; appendix bursae moderately broad, sinuous, rugose.

**Type material.** *Amphipyra sanguinipuncta*: Holotype: Male, 'Museum Paris Tasmanie J. Verreaux 1846 / Genitalia male, P. Viette prep. No. 2939 / 46' (E.D. Edwards, pers. comm., from notes by E.S. Nielsen, who photographed the specimen) (MHNH) (not examined, but photograph seen).

*Mamestra trilineata*: *Mamestra trilineata* was described from two Tasmanian specimens, one 'presented by Dr Milligan' and one 'from Mr A.J. Smith's collection' (Walker, 1865: 670). The Milligan syntype is labelled 'Type / Tasmania Hobart Milligan 60-115 / Mamestra trilineata' (E.D. Edwards, Y.N. Su, pers. comm.) (BMNH)

(not examined, but photograph seen). No lectotype is selected here as there is no ambiguity over the identity of this moth, and the synonymy with *sanguinipuncta* is not challenged.

**Distribution.** An Australian species now widespread in the North Island and northern South Island.

ND, AK, WO, TO, GB, HB, WN / NN.

**Biology.** In Australia, larvae feed on various unspecified grasses (Poaceae) (Common 1990; Herbison-Evans & Crossley 2015). The larva is brown, with a pair of broad longitudinal blackish stripes either side of the dorsal midline (darker towards the front of each segment), and an oblique white line interrupting this stripe on each side of A7; paler brown sublaterally (from photograph by M. Crossley and description by Herbison-Evans & Crossley (2015)). The species has not yet been reared in New Zealand.

**Flight period.** February to early April.

**Remarks.** This is a widespread moth throughout Australia, where larvae can be a minor pasture pest (Common 1990). The first New Zealand record was of two males captured at mercury vapour light at Blowhard Bush HB on the 20th February 2007; further specimens were taken at Lake Waikaremoana GB on the 22nd February and at Waipapa Scenic Reserve TO on the 23rd, most likely indicating that the species was already established in New Zealand. In subsequent years the species has become increasingly common and widespread, the male coming freely to light traps in February and March. The first South Island record was a specimen collected on 26 Feb 2015 in sand dunes north of Karamea NN (B.H. Patrick, pers. comm.) and in 2016 larvae were common in northern South Island pastures (R. Powlesland, pers. comm.). Very few females have been found so far in New Zealand.

The remarkable dense fluffy scaling of the underside of the foretibiae of the male moth (see Fig. 23) does not appear to have been noted in the literature, though it is a conspicuous feature in life, and in specimens set with the forelegs spread. The scales are present only in fresh specimens and appear to be very easily abraded. Based especially on the wing pattern and genitalia of both sexes (lack of claw-like cornuti in the male vesica, female with short segment 8, and short membranous portion of the ductus bursae), this species does not appear to be particularly closely related to the New Zealand endemics *P. comma* and *P. tetronycha*, though undoubtedly congeneric.

#### ***Physetica* genus group**

**Diagnosis.** Eyes with dense rather long surface hairs, without curved ‘lashes’. Dorsal membrane of manica finely spinulose or scobinate, without papillae. Male genitalia: vesica with prominent single continuous strip or ‘crest’ of rather uniform cornuti (cornuti reduced in some species, strip interrupted in one species-group). Female genitalia: dorsal ‘roof’ of antrum curved ventrad, and lateral margins of antrum and posterior part of ductus curved dorsad (i.e. C-shaped in cross-section) and forming sclerotised lateral grooves; a dorsal desclerotised area at posterior end of each groove; appendix bursae usually large and well differentiated (less so in *Physetica*).

**Included genera.** *Physetica*; *Dipaustica*; *Feredayia*; *Graphania*; *Ichneutica*; *Meterana*; *Tmetolophota*. Species retained in *Aletia* sensu Meyrick by Dugdale (1988), and not reassigned to *Physetica* in this volume, also belong here, but will all be reassigned to the other named genera when revised.

**Remarks.** The group of 7 currently recognised genera included here is under revision, following which it is anticipated that only 3 to 4 generic names will be recognised as valid. The diagnosis given above is necessarily based on few characters since this genus group contains the major diversity of New Zealand Noctuidae, and morphology, especially of the male valva, is highly variable across this lineage. Apart from the hairy eyes, the most constant characters across the group appear to be the conformation of cornuti on the male vesica and the modifications to the female antrum.

Hairy-eyed triline noctuids were traditionally referred to the Hadeninae of Hampson (1905), and this is the placement for this group of genera adopted by Dugdale (1988). The history of the circumscription of Hadeninae is well summarised by Kitching and Rawlins (1999: 383–384); most members of the *Physetica* group share all characters used by these authors to define this subfamily, i.e. triline noctuids with a filiform SD1 seta on larval segment A9, larval spinneret more than twice as long as wide, and male genitalia with the harpe [clasper of this work] near the middle of the valva (though larvae of *Meterana* species I have examined have a much shorter larval spinneret). However, because these characters are regarded as plesiomorphic and Hadeninae as thus defined is probably paraphyletic (Kitching & Rawlins, *loc. cit.*), this subfamily is divided into its constituent (putatively

monophyletic) tribes in more recent classifications (e.g., Lafontaine & Schmidt 2010), and these are assigned to the inclusive definition of Noctuidae.

Since tribal classification of the hairy-eyed Noctuidae relies heavily on larval characters (Fibiger & Lafontaine, *loc. cit.*), further detailed studies of larvae of New Zealand species are required before their tribal placement can be resolved. Hacker *et al.* (2002: 159) suggest a possible association of *Graphania* with Leucaniini (as Mythimnini), without detailing supporting characters; they also illustrate the male genitalia of *Graphania rubescens* (Butler) on p. 267 (as *rubescens*). The larvae of species of the *Physetica* genus group that I have examined lack the mouthpart modifications used to define Leucaniini by Fibiger and Lafontaine (2005: 50), which is perhaps to be expected as these are considered to be adaptations for monocot-feeding, a behaviour that occurs only sporadically through the *Physetica* group.

### Genus *Physetica* Meyrick, 1887

Figs 25–60, 66–77, 81, 121–188

*Physetica* Meyrick, 1887. *Transactions and proceedings of the New Zealand Institute* 19: 5. Type species: *Spaelotis caerulea* Guenée, 1868, by original designation and monotypy.

**Diagnosis.** Thorax entirely clothed in hairlike to very narrow lamellate scales. Tegumen of moderate length, smoothly arched, without distinct ‘step’. Valva complex: sacculus extended apically into free lobe; cucullus strongly differentiated, spatulate or bird’s-head-shaped; corona well developed; a separate robust spine at dorsal apex of cucullus present, more or less separated from corona on elongate ‘stalk’. Phallus: subbasal sclerite of vesica absent; vesica bulbous, moderately short, with basal and lateral diverticula. Female genitalia: ductus bursae sclerotised, not distinctly scobinate; appendix bursae not well differentiated from corpus bursae, extended into a lobe where ductus seminalis arises; corpus bursae more or less globose, without signa. Pupal cremaster with only 2 curled setae.

**Description.** *Adult* (Figs 25–60). Head (Figs 66–77): Labial palpi moderately sinuous, with segments 1–2 weakly upcurved and segment 3 weakly angled down, segments 1–2 with short erect scales beneath (including few to many dark hair-like scales); segment 3 short to very long (ca 0.3–0.9x length of segment 2), narrow (except in *P. caerulea*), and either unmodified (e.g., *P. homoscia*) or tending to be club-shaped (with swollen tip) (e.g., *P. longstaffi*, *P. phricias*), or entirely bulbous (male *P. caerulea*); if clavate or bulbous, with vom Rath’s organ enlarged and more or less visible without descaling as ‘hole’ at apex of palp. Eyes with dense rather long surface hairs; without ‘lashes’ (but with bordering hair-scales that do not curve over eye). Antennae filiform, cylindrical (except in males of *P. homoscia* and *P. prionistis*, where subpectinate), ciliations minute and appressed (all females and some males) to distinct, up to 0.7x depth of flagellum (some males, e.g., *P. cucullina*, *P. homoscia*, *P. prionistis*). Thorax: entirely clothed in hairlike to very narrow lamellate scales; narrow lamellate scales 2-pointed, with very deep indentation between points; mesothorax with moderate anterior scale-crest except in *P. caerulea*, *P. homoscia* and *P. temperata*; scale-crest present but indistinct in *P. cucullina*, *P. funerea*; posterior mesothoracic scale-crest absent. Wing venation: (Fig. 81): forewing with R3 and R4 stalked, separate from well under to just under half length; hindwing cross-vein at end of cell curved inwards towards wing-base, not strongly angled, running from junction of Rs+M1 to base of M3 very near junction with CuA1. Male frenulum with 1, female frenulum with 3 bristles. Wing pattern: forewings brown or grey to bluish grey (*P. caerulea*), usually with marbled or striate appearance, stigmata usually rather indistinct, but reniform may be outlined and/or underlined in black; claviform absent; crosslines indistinct except in darker specimens of *P. cucullina* and *P. funerea*. Legs: tibiae without spines; inner tibial spurs ca 2x as long as outer spurs; each tarsus with 3 rows of spines. Abdomen with small to moderate scale-tuft on T1; in some species, also with scale-tufts on T2 and T3.

Male abdomen and genitalia (Figs 121–159): abdominal base with well-developed brushes, levers and pockets, except in *P. cucullina*, *P. funerea* and *P. sequens*, where absent. S2 apodemes rather short and curved. Uncus somewhat flattened and strap-like, with blunt apex (except in *P. caerulea* and *P. temperata*, where more robust, cylindrical, with hooked apex); with dense semi-erect scales throughout most of length dorsally and near apex ventrally. Subscaphium moderately sclerotised and smooth (most species) to rather well sclerotised and spinulose (*P. caerulea*, *P. temperata*). Tegumen of moderate length, smoothly arched, without distinct ‘step’. Paratergal sclerite moderately long, sinuous, apex not striate. Dorsal membrane of manica finely spinulose or scobinate, without papillae. Juxta inverted shield-shaped. Valva elongate, complex; sacculus extended apically into

free lobe; clasper well developed, usually elongate, curved, with or without spinules on dorsal surface; ampulla very small to well developed; cucullus strongly differentiated, spatulate or bird's-head-shaped; corona well developed; sometimes a subapical field of spinose setae adjacent to corona; a separate robust spine at dorsal apex of cucullus present, more or less separated from corona on elongate 'stalk'. Phallus: phallobase moderately short; subbasal sclerite of vesica absent; vesica bulbous, moderately short, with basal and lateral diverticula of varying development; cornuti short to long, in a single dense band. Everted vesica either at right angles to phallobase or recurring back toward phallobase.

Female abdomen and genitalia (Figs 160–188): S7 more or less distinctly indented caudally. Terminal segments barely extensible. Ovipositor lobes moderately short to moderately elongate, either with scattered long setae throughout and dense short setae apically (most species), or with rather evenly spaced short to very short hairlike setae (*P. temperata*) or spine-like setae (*P. caerulea*) throughout. Ostium moderately broad, tapering only slightly to antrum and ductus bursae. Antrum a well-sclerotised funnel, smooth to finely spinulose; dorsal 'roof' of antrum curved ventrad, and lateral margins of antrum and posterior part of ductus curved dorsad (i.e. C-shaped in cross-section) and forming sclerotised lateral grooves (except in inflated slide preparations); dorsal desclerotised area at posterior end of each groove without distinct raised ridge. Ductus bursae short or moderately short, sclerotised, not distinctly scobinate. Appendix bursae not well differentiated from corpus bursae, interpreted here as the rugose lateral / distal portion of the corpus, extended into a lobe where ductus seminalis arises; corpus bursae itself more or less globose, smooth to very finely spinulose, without signa.

*Larva*. (From preserved specimens of *P. homoscia* and *P. phricias* only). Coloration cryptic. Cuticle not spinulose. T1 with L group bisetose (L2 hairlike and often hard to observe), SV group bisetose; T2 and T3 with SV unisetose. Crochets uniordinal. Pinacula all small and inconspicuous, unmodified, except SD1 pinaculum on T2 and T3 oblong, with hairlike seta dorsally. Seta SD1 on A9 short, hairlike.

*Pupa*. (From preserved specimens of *P. homoscia*, *P. cucullina*, *P. sequens* and *P. prionistis*). Thorax not pitted. Abdominal segments 1–3 without dorsal ridges or furrows; segments 4–7 each with anterior band of round depressions, deeper dorsally (depressions smaller and fewer on A4) in region where segments telescope; apex of A10 strongly longitudinally and transversely rugose, cremaster of two robust curled setae with scobinate apices.

**Biology.** The life histories and host-plants of *Physetica* are in general rather poorly documented, but known species appear to be oligophagous on shrubs or, in one case, herbs. Larvae of three species are known to feed on Asteraceae (*P. homoscia* and *P. temperata* on *Ozothamnus* and *P. longstaffi* on *Craspedia*); two species have been reared from Ericaceae (*P. cucullina* on *Leucopogon fraseri* and *P. sequens* on *Leucopogon fasciculatus* and *Leptecophylla juniperina*) and one species on Rhamnaceae (*P. phricias* on *Discaria*). The biology of *P. longstaffi* is not fully understood (see under this species below), and *Dracophyllum* (Ericaceae) is a further possible host. The larvae and host-plants of *P. caerulea*, *P. prionistis* and *P. funerea* are unknown.

**Distribution.** Throughout New Zealand, but only *P. prionistis* is known from the Chathams, and only *P. homoscia* from the subantarctic (Auckland Islands). *Physetica cucullina*, *P. funerea* and *P. phricias* are only known from the South Island.

**Remarks.** *Physetica*, formerly monotypic, is here expanded to include nine species. The eight additional species were formerly placed in *Aletia* s.l. (*cucullina*, *funerea*, *longstaffi*, *temperata*) or *Graphania* (*homoscia*, *phricias*, *prionistis*, *sequens*). The chief characters defining this new concept of *Physetica* are: the form of the vesica in the male genitalia (more or less bulbous, with distinct diverticula); the projecting apex of the male sacculus; and the lack of strong differentiation between the appendix bursae and corpus bursae in the female genitalia. In all species except *P. homoscia*, the third segment of the labial palp is distinctly modified: either elongate and more or less club-like, or entirely bulbous, and has an enlarged vom Rath's organ, usually discernible as a 'hole' amongst the scales at the tip of the palp. A pupal character that may be useful in distinguishing the genus is the presence of only two curled setae in the cremaster: there are 4 or 6 in other 'hairy-eyed' New Zealand Noctuidae examined (i.e. the former Hadeninae); in the other genera with 2 cremastral setae treated here (*Cosmodes*, *Proteuxoa*) the setae are gently curved but not apically curled. Based on characters of the foretarsus, the male abdomen and male and female genitalia, two possible monophyletic subgroupings may be recognised within the genus: *Physetica caerulea* + *P. temperata* share an enlarged outer row of spines on the basal segment of the foretarsus, a spinulose subscaphium, expanded cucullus, and modified ovipositor with short setae, and *P.*

*cucullina* + *P. funerea* + *P. sequens* share loss of the secondary sexual modifications of the male abdominal base and have indistinguishable or very similar male and female genitalia.

#### Key to *Physetica* species adults

*Physetica* species differ in rather subtle characters, often sex-specific, and it is very difficult to create an adequate key. Consultation of the colour plates (Figs 25–60), and especially of the close-ups of heads (Figs 66–77) for antennal and labial palp characters is highly recommended. Additional less constant or reliable characters are given in parentheses.

- 1 Basal segment of foretarsus with outer row of spines distinctly more robust than inner row; usually 6 or fewer spines in outer row ..... 2
- Basal segment of foretarsus with outer and inner rows of spines of approximately equal size; 7 or more spines in outer row ..... 3
- 2 Forewing veins unmarked; forewing fringe unicolorous; underside usually more or less extensively yellowish buff; male labial palp segment 3 swollen and blunt (larger species, wingspan 32–45 mm) ..... (p. 41)...*caerulea*
- Forewing veins at least partially black (more or less overlain with white scales); forewing fringe at least weakly chequered; male labial palp segment 3 narrow, cylindrical (smaller species, wingspan 30–35 mm) ..... (p. 44)...*temperata*
- 3 Thorax with distinct whitish longitudinal central stripe; forewing grey with strong admixture of ochreous scaling and dorsum extensively darkened ..... (p. 52)...*prionistis*
- Thorax without distinct central whitish stripe; forewing, if grey, without strong admixture of ochreous scaling; dorsum at most with very fine dark line..... 4
- 4 Forewing dull brownish, mottled white on veins; labial palp segment 3 very short (both sexes); male antenna subpectinate with ciliations up to ca 0.5x depth of flagellum.....(p. 43)...*homoscia*
- Forewing grey; labial palp segment 3 at least moderately elongate, and male antennae either with appressed ciliations or if with longer ciliations then filiform, not subpectinate ..... 5
- 5 Forewing with orbicular stigma rather distinct, rather large, oblique (i.e. angled outwards from costa), closely approaching reniform stigma (forewing usually with distinct basal black streak edged white above) ..... (p. 49)...*longstaffi*
- Forewing with orbicular stigma either indistinct, or rather small, round, not angled away from costa and not closely approaching reniform (forewing with or without basal black streak)..... 6
- 6 Forewing base with at least a trace of a longitudinal black streak (more or less parallel to costa), bordered white above (forewing termen usually very weakly concave below apex so that wing tends to appear sharply pointed)... 7
- Forewing base without black streak, but usually with dark-edged white M-shaped subbasal line (lower part of this line at an angle to costa) (forewing termen not concave, wing not appearing sharply pointed)..... 8
- 7 Dark subterminal forewing line interrupted below apex by pale ground colour; male with labial palp segment 3 barely over 0.5x eye diameter; fresh specimens with small antemedian thoracic scale-crest; (reniform stigma usually underlined with black scales, underlining usually extending beyond reniform distally; forewing appearing more marbled with stronger dark scaling; dorsum without dark line) ..... (p. 54)...*sequens*
- Dark subterminal forewing line not interrupted below apex; male with labial palp segment 3 nearly equal to eye diameter; fresh specimens with large antemedian thoracic scale-crest; (reniform stigma not underlined with black scales, or underlining not extending distad of stigma; forewing appearing relatively smooth and plain, not marbled; dorsum often with narrow dark line)..... (p. 51)...*phricias*
- 8 Male antenna with distinct erect ciliations beneath, 0.3–0.5x flagellum depth ..... (p. 46)... *cucullina*
- Male antenna with minute appressed ciliations only ..... (p. 48)... *funerea*

#### *Physetica caerulea* (Guenée, 1868)

Figs 25–31, 66, 67, 81, 121–123, 160–162

*Spaelotis caerulea* Guenée, 1868. *Entomologist's Monthly Magazine* 5: 38.

*Physetica hudsoni* Howes, 1906. *Transactions and proceedings of the New Zealand Institute* 38: 510. Synonymised by Hudson (1928: 59).

**Diagnosis.** *Physetica caerulea* is a variable, but usually easily recognised species, the strong bluish tint of most specimens and the modified bulbous apical labial palp segment of the male distinguishing it from other noctuids of similar size. The extensively buff coloration of the underside (present in most specimens) is also diagnostic. Within the genus *Physetica*, the only other species with an enlarged outer row of spines on the

foretarsus is *P. temperata*, which is easily distinguished on the basis of its black-marked forewing veins and chequered forewing fringe. Occasionally *P. caerulea* has been confused with '*Aletia*' *nobilis* Howes, another nearly unicolorous bluish species: although *nobilis* is on average a much larger moth (wingspan 42–55 mm), there is some overlap. The male of *nobilis* is distinguished from that of *caerulea* by its very short, unmodified third labial palp segment, and by the long ciliations on the underside of the antenna (ca 1x flagellum depth) (ciliations minute in *caerulea*). Female *nobilis* are almost invariably much larger than *caerulea* and the very short inconspicuous third labial palp segment differs strongly from the porrect, clubbed segment in *caerulea*. Both sexes of *nobilis* have conspicuous whitish hair-scales emanating from the tegulae and overlying the entire forewing base; in *caerulea*, there is at most a tuft of yellowish scales overlying the dorsal half of the forewing base.

**Description.** Adult (Figs 25–31). Wingspan 32.5–41 mm (male); 33.5–45 mm (female). Labial palpus segment 3 swollen and blunt-ended in male (Fig. 66), narrower and clubbed in female (Fig. 67). Male antennae filiform, with ciliations minute and suberect. Head and thorax bluish grey, sprinkled pale buff and/or white, with scales hairlike. Foretarsus with outer row of spines distinctly larger and more robust than inner and central rows; 5–6 spines in outer row (rarely 7). Forewing variable in colour, usually deep bluish grey, but sometimes whitish grey or bluish black (Tongariro National Park), markings usually indistinct, but occasionally in paler specimens distinct; basal streak absent; antemedian line irregular, whitish to pale greyish, edged dark distally; postmedian line strongly scalloped, whitish to greyish, edged dark basally; claviform stigma absent; orbicular stigma small, round, outlined whitish to grey; reniform narrow, colour as for orbicular; area between antemedian and postmedian lines often somewhat darkened in indistinct fascia running from costa to dorsum between orbicular and reniform; subterminal line very indistinct, whitish to grey, but sometimes in pale specimens strongly edged darker basally and therefore distinct; terminal area concolorous with rest of wing; series of dark marks along termen absent; fringe dark grey to bluish black with narrow basal whitish line. Hindwing grey to blackish, sometimes with extensive basal buff area and occasionally termen also buff; fringe white to yellowish with dark median line. Underside entirely buff, or buff with exterior areas of all wings suffused blackish, or (darkest females from Tongariro National Park) entire underside suffused blackish, except for pale hair-scales in forewing disc. Abdomen whitish to yellowish ochreous, more or less extensively mottled black. Male abdominal base (Fig. 123) with brushes, pockets and levers. Male genitalia (Fig. 122): uncus pointed, hooked; subscaphium microspinulose; valva with costa nearly straight, cucullus stem short, cucullus very large with corona of ca. 40–55 elements; field of spinose setae confined to costal half of cucullus; clasper very long, narrow, curved; ampulla very short, thumb-like. Phallus (Fig. 121): vesica truncate-oblong, with short stubby pair of basal (dorsal) diverticula, and asymmetrically bilobed lateral diverticulum at mid-length on right; cornuti short, in narrow cluster beyond mid-length. Female S7 as in Fig. 162. Female genitalia (Figs 160, 161): ovipositor lobes (Fig. 161) ventrally directed, diamond-shaped, not strongly melanised, fairly evenly covered with well-spaced short rigid spinose setae, some medium-length spinose setae usually scattered amongst these; segment 8 moderately long; posterior half of T8 with scattered very irregularly spaced spinose setae, slightly longer than those of ovipositor; ostium smooth, without spinules, but with minute scobinations on dorsal desclerotised ridges; lateral pockets long; ductus bursae rather short, not sinuous, sclerotised, centrally with band of weaker sclerotisation, not rugose where meets corpus + appendix bursae; corpus + appendix bursae rounded-cordate, strongly rugose, with short, broad papilla subtending ductus seminalis inception.

**Type material.** *Spaelotis caerulea*: Holotype: Male, 'Ex Oberthur Coll. Brit. Mus. 1927-3 / Ex Musaeo Ach. Guenée / 23. Spæl. cœrulea Gn. Ent. mont. mag. 1868 p. N<sup>le</sup> Zelande' [per JSD] (BMNH) (examined, not dissected).

*Physetica hudsoni*: Holotype: Male, [Tuturau SL, R. Gibb], (repository unknown, not examined, lost (Dugdale 1988: 209)).

**Distribution.** Central and southern North Island, and throughout the South Island, also Stewart Island.

TO, HB, RI, WN / NN, BR, WD, MB, NC, MC, SC, MK, OL, CO, DN, FD, SL / SI

**Biology.** Unknown.

**Flight period.** Late August to April.

**Remarks.** This is a species of open habitats such as coastal dunes and tussock grasslands (White 2002), occurring mainly from sea level to 900 m, but with a record from 1385 m on the Hawkdun Range CO (B.H. Patrick, pers. comm.). In the inland black sand volcanic dunes of the Rangipo Desert TO a very dark bluish black form occurs (Figs 30, 31); similar specimens are also known from the eastern Ruahine Range RI. Brownish or

greenish brown forms are also known from some localities, such as the Kaweka Range HB and the Manuherikia River valley CO.

Several shared characters indicate a close relationship between this species and *P. temperata*: the shape of the valva and the spinulose subscaphium in the male genitalia; the spinose setae on the ovipositor in the female, and the enlarged outer row of spines on the basal segment of the foretarsus. *Physetica temperata* has larvae feeding on *Ozothamnus*, but this cannot be the host-plant of *P. caerulea*, as *caerulea* is very common at Kaitorete Spit, where *Ozothamnus* is absent (B.H. Patrick, pers. comm.). The modified spinose setae of the ovipositor and segment 8 in the female indicate a specialised oviposition site; *P. temperata* has similarly arranged but less robust ovipositor setae. A tomentose plant is a likely candidate (J.S. Dugdale, pers. comm.).

***Physetica homoscia* (Meyrick, 1887) new combination**

Figs 32, 33, 68, 124–126, 163–165

*Mamestra homoscia* Meyrick, 1887. *Transactions and proceedings of the New Zealand Institute* 19: 21–22.

*Hyssia sminthistis* Hampson, 1905. *Catalogue of the Lepidoptera Phalaenae in the British Museum*. Vol. 5: 280, pl. 86, fig. 17.

Synonymised by Meyrick (1912: 102).

**Diagnosis.** This species is characterised within the genus by its plain brownish forewing with indistinct markings and white mottling on the blackish veins; the white distal dot in the lower corner of the reniform stigma is usually distinct though small in all but very worn specimens. Worn specimens could be confused with '*Aletia*' *moderata* (Walker), but that species has the antennae serrate beneath in the male, has no white speckling on the forewing veins or in the reniform stigma, and has a conspicuously pallid hindwing fringe. See below for distinctions from *P. temperata*.

**Description.** Adult (Figs 32, 33). Wingspan 29.5–43 mm (male); 35–46 mm (female). Labial palpus (Fig. 68) segment 3 rather short, porrect and cylindrical, not swollen subapically, in both sexes. Male antennae subpectinate, with long ciliations up to ca 0.5x depth of flagellum. Head and thorax greyish brown evenly sprinkled blackish; prothorax and tegulae unmarked; scales very narrow lamellate. Foretarsus with outer row of spines roughly of same size as inner row; 7 or more spines in outer row. Forewing dull greyish brown with veins marked black and mottled white; basal streak and subbasal fascia absent; antemedian and postmedian lines usually very indistinct, occasionally moderately distinct, when wavy, paler than ground-colour and edged dark; claviform stigma absent; orbicular stigma indistinct, round, pale-edged, sometimes indistinctly outlined black; reniform squarish, variably outlined black and with pale ochreous inner lining including one or two white dots distally, not distinctly underlined black; area between antemedian and postmedian lines sometimes weakly darkened in fascia running anterior to reniform; subterminal line present, broken, pale ochreous, with some dark brown shading basad; terminal area concolorous with rest of wing; series of dark subtriangular to crescentic marks along termen present; fringe brown beyond pale basal line. Hindwing plain brown, unmarked; fringe brown beyond white basal line. Underside mottled grey-brown and whitish, hair-scales in forewing disc yellowish; hindwing with discal spot distinct but postmedian line faint or absent. Abdomen with small dorsal scale-tufts on segments 1–3 (more distinct in male) dark brown, tipped white; rest of abdomen mixed silver-grey and pale ochreous, with whitish to grey hair-scales basally. Male abdominal base (Fig. 126) with brushes, levers and pockets. Male genitalia (Fig. 125): uncus pointed, not hooked; subscaphium not spinulose; valva with costa barely convex; cucullus stem moderately short and broad; cucullus moderately large and subtriangular, with corona of ca. 50–60 elements and narrow field of spinose setae confined to costal half; clasper short, nearly straight, beak-like, not serrulate; ampulla short and very broad, not papillate. Phallus (Fig. 124): vesica with short basal diverticulum, and single, very small lateral diverticulum; cornuti long, in narrow band beyond mid-length, basalmost cornuti rather thin and flexible. Female S7 as in Fig. 165. Female genitalia (Figs 163, 164): ovipositor lobes (Fig. 164) dorsally directed, short, subrectangular, evenly covered with well-spaced long setae and with numerous short setae clustered apically; segment 8 moderately long; some short to medium-length setae laterally, and posterior margin (T8) dorsally with short fine setae in narrow band; ostium densely and finely spinulose, spinules larger sublaterally; lateral pockets short; ductus bursae with very short sclerotised portion, not dorsoventrally sinuous, rest of 'ductus' crenulately rugose (or this section could be interpreted as part of the appendix bursae taking the tubular shape and function of the anterior portion of the ductus); corpus + appendix bursae round / cordate, with long papilla subtending ductus seminalis inception.

**Type material.** *Mamestra homoscia*: Holotype: Male, 'Type [round red-ringed label] / Wellington New Zealand GVH /85 / homoscia Meyr. / Mamestra homoscia Meyr. 1/5 E. Meyrick det. in Meyrick Coll.' [per JSD] (BMNH) (examined, not dissected).

*Hyssia sminthistis*: Holotype: Male, 'Type [round red-ringed label] / N. Zealand Mathew 87-50 921 / Hyssia sminthistis Hampson type / genitalia slide 353' [per JSD] (BMNH) (examined, including genitalia slide).

**Distribution.** Throughout New Zealand from North Cape to the Auckland Islands, but apparently somewhat patchy in occurrence.

ND, AK, BP, TO, HB, WA, WN / SD, NN, MB, KA, NC, MC, SC, MK, OL, CO, DN, FD, SL / AU

**Biology.** Larvae feed on the coastal shrub *Ozothamnus leptophyllus* and on the subalpine *O. vauvilliersii* (Asteraceae) (Dugdale 1971). The late instar larval coloration is described as follows by Dugdale (1971: 121): "Body colour pattern in black and yellowish or greenish brown, variegated. Dorsal area longitudinally, darkly marbled, seta D1 on a small, and D2 on a large white patch, the D2 patch connected with a prominent pallid subdorsal line; zone between this and spiracle longitudinally marbled; spiracle on a dark patch, subspiracular line broadest behind, narrowest just in front of spiracle; subventral and ventral zones pallid, obscurely marbled; ventral line obscure to prominent." The head capsule is described as having a similar pattern to that of *Graphania ustistriga* (Walker) but with the frontal zone paler basally. The larva is illustrated in a photograph by Patrick (1994: fig. 27).

**Flight period.** Recorded in every month of the year except July and August, and often found in autumn and early winter, from April to June.

**Remarks.** *Physetica homoscia* is a very widespread but local species, occurring from sea level to the alpine zone (up to at least 1750 m a.s.l.). It has probably been overlooked over much of the North Island, due to patchy collecting on coastal dunes where its host-plant occurs. There is only a single known record from the Auckland district (AK) (a specimen reared from *Ozothamnus leptophyllus* at Bethells Beach, 11 Jan 2014 by B.H. Patrick (pers. comm.)) and only one specimen from the Nelson district (NN) (reared, Denniston Plateau, 21 Apr 2012 (B.H. Patrick, pers. comm.)). Dugdale (1971) indicated some doubt over whether the species was resident on the Auckland Islands, from where only one adult and no larvae were known at the time. His subsequent collection of larvae and adults in February 1973 from Auckland Island and Enderby Island (specimens in NZAC) confirms the species' resident status in the subantarctic.

A remarkable feature of this species is the dorsally directed ovipositor of the female (Figs 163, 164); i.e. abdominal segment 9 appears to have been rotated 180 degrees relative to other species of noctuid. The significance of this adaptation is unknown, and it would be interesting to observe oviposition behaviour.

#### ***Physetica temperata* (Walker, 1858) new combination**

Figs 34–36, 69, 127–130, 166–168

*Bryophila temperata* Walker, 1858. *List of the specimens of lepidopterous insects in the collection of the British Museum*. XV: 1648–1649.

*Xylina inceptura* Walker, 1858. *List of the specimens of lepidopterous insects in the collection of the British Museum*. XV: 1736–1737. Synonymised by Meyrick (1887: 27).

*Xylina deceptura* Walker, 1858. *List of the specimens of lepidopterous insects in the collection of the British Museum*. XV: 1737. Synonymised by Meyrick (1887: 27).

*Aletia accurata* Philpott, 1917. *Transactions and proceedings of the New Zealand Institute* 49: 239. Synonymised by Dugdale (1988: 201).

*Aletia eucrossa* Meyrick, 1927. *Transactions and proceedings of the New Zealand Institute* 58: 313. Synonymised by Dugdale (1988: 201).

**Diagnosis.** Though this species is rather indistinctly marked, neither sex closely resembles any other noctuid occurring in the same localities. *Physetica homoscia*, which could possibly be confused with male *temperata*, is usually a much larger moth, with the third segment of the labial palp very short (elongate in *temperata*) and the male antenna weakly bipectinate and strongly ciliate beneath (appressed ciliations only and no pectinations in male *temperata*). Distinctions from *P. caerulea* (the only other species with an enlarged outer row of foretarsal spines) are given under that species.

**Description.** Adult (Figs 34–36). Wingspan 30–32 mm (male); 32–35 mm (female). Labial palpus segment 3 (Fig. 69) rather short, porrect and cylindrical, not or barely swollen subapically in both sexes. Male antennae filiform, with fine appressed pubescence. Head and thorax brownish grey more or less distinctly sprinkled white in

male, strongly mixed white in female to appear whitish grey; prothorax unmarked; tegulae sometimes each with traces of black mesally and laterally in female; scales narrow lamellate. Foretarsus with outer row of spines distinctly larger and more robust than inner and central rows; 5–6 spines in outer row. Forewing brownish grey with variable admixture of white, usually more extensively white in female, and veins marked black and mottled white; basal streak absent; subbasal fascia distinct in middle of wing as curved white mark, black-edged basally; antemedian line very indistinct; postmedian line absent in male, very indistinct and whitish in female, with transverse series of white dots on veins beyond in both sexes; claviform stigma absent; orbicular stigma indistinct, round, white, sometimes outlined black; reniform squarish, variably outlined black and with white inner lining, not distinctly underlined black; area between antemedian and postmedian lines sometimes patchily darkened; subterminal line absent, but usually a series of interneural brown to blackish clouds or dashes roughly in this position; terminal area concolorous with rest of wing; series of dark subtriangular marks along termen present, small; fringe dark grey, strongly chequered white. Hindwing greyish brown (darker in male), with faint postmedian line and veins blackish; fringe plain greyish brown in male; white beyond brown subbasal line in female. Underside whitish brown in male, whitish grey in female, darkest in disc of forewing; hindwing with discal spot and postmedian line moderately distinct. Abdomen with indistinct dorsal scale-tuft on segment 1 brown to dark grey, tipped or sprinkled white (or all white in female, where usually very indistinct); rest of abdomen pale brownish ochreous in male, more or less mottled blackish and with yellowish hair-scales associated with tegumen and valvae (when everted); whitish, mottled grey, to uniform silvery grey in female; both sexes with brownish to grey hair-scales basally. Male abdominal base (Fig. 130) with brushes, pockets and levers. Male genitalia (Fig. 129): uncus pointed, hooked; subscaphium microspinulose; valva with costa barely convex; cucullus stem short and broad; cucullus very large and oval, with corona of ca. 35–38 elements; field of spinose setae absent; clasper moderately long, narrow, smoothly curved, not serrulate; ampulla minute, thumb-like, not papillate. Phallus (Figs 127, 128): vesica with very large basal diverticulum, and large conical lateral diverticulum at mid-length on right; cornuti very short, in small subtriangular cluster beyond mid-length. Female S7 as in Fig. 168. Female genitalia (Figs 166, 167): ovipositor lobes (Fig. 167) ventrally directed, moderately long, rather well melanised, diamond-shaped, evenly covered with short spinose setae many of which are less rigid than those of *caerulea* and have hair-like flexible tips, these more flexible setae very dense and numerous apically; segment 8 moderately long, with scattered short to medium-length rather spine-like setae in posterior half throughout, densest along caudal margin; ostium smooth, without spinules, but with minute scobinations on dorsal desclerotised ridges; lateral pockets rather long; ductus bursae moderately short, sclerotised, somewhat dorsoventrally sinuous, without rugae at junction with corpus + appendix bursae; corpus + appendix bursae ovate, moderately rugose, with short, broad papilla subtending ductus seminalis inception.

**Type material.** *Bryophila temperata*: Holotype: Female, 'Type [round green-ringed label] / N. Zealand Churton 51-136 / *Bryophila temperata* / Agrotidae genitalia slide 340' [per JSD] (BMNH) (examined, including genitalia slide).

*Xylina inceptura*: Holotype: Male, 'Type [round green-ringed label] / N. Zealand Churton 51-136 / *Xylina inceptura*' [per JSD] (BMNH) (examined, not dissected).

*Xylina deceptura*: Holotype: Female, 'Type [round green-ringed label] / N. Zealand Churton 51-136 / *Xylina deceptura*' [per JSD] (BMNH) (examined, not dissected).

*Aletia accurata*: Holotype: Male, [Titahi Bay WN, M.O. Pasco] (formerly SMNZ, not examined, lost (Dugdale 1988: 201)).

*Aletia eucrossa*: Holotype: Female, '1101a / Waiuku N.Z. summer 1925-26 P. Shepherd' [per JSD] (MONZ, not examined).

**Distribution.** North Island and northernmost South Island; coastal.

ND, AK, WO, BP, GB, HB, TK, WN / NN.

**Biology.** The life history has not been documented and no reared specimens have been seen in collections, however, larvae identified as belonging to this species by J.S. Dugdale have been beaten from the shrub *Ozothamnus leptophyllus* on the coast. A brief description of larvae found in sand at the base of *Ozothamnus leptophyllus* and almost certainly of *temperata* has been provided by B.H. Patrick (pers. comm.): grey dorsally, with a broad white lateral band; mature larva reddish on grey with three dorsal lines; ventrally grey with white lateral band. The larvae were noted as being 'stiff and tough' and fed on the young buds of the host-plant.

Preserved larvae under this name in NZAC are not in their final instar, but broadly appear to match the description of *P. homoscia* in body pattern. Further elucidation of the life history is desirable.

**Flight period.** September to March.

**Remarks.** *Physetica temperata* shows a tendency towards sexual dimorphism in colour, the male often being strongly brownish-tinged, whilst the female is silvery grey; however, some males are almost indistinguishable in coloration from females. This is presumed to be a fairly common and widespread species throughout the North Island and northern South Island, wherever dunes are intact enough to support the host-plant, but it is remarkably poorly represented in collections, perhaps through lack of night collecting in coastal situations. Females seem to be more frequently collected than males (e.g., 5 males and 17 females in NZAC). An unsexed female in NZAC labelled as having been captured during the grasslands survey at Gore SL in 1967 is here considered mislabelled as no other specimens from south of Nelson and no other inland localities are known; the type of pin and style of pinning (near the rear of the thorax) are identical to those of a male *P. homoscia* from the Orongorongo Valley WN collected in May 1969 (and formerly misidentified as *temperata*), and this is considered to be the likely locality.

***Physetica cucullina* (Guenée, 1868) new combination**

Figs 37–40, 70, 72, 131–136, 169–171

*Xylocampa cucullina* Guenée, 1868. *Entomologist's Monthly Magazine* 5: 40.

*Aletia obsecrata* Meyrick, 1914. *Transactions and proceedings of the New Zealand Institute* 46: 101. **New synonymy.**

*Aletia parmata* Philpott, 1926. *Transactions and proceedings of the New Zealand Institute* 56: 387. **Reinstated synonymy.**

*Aletia probenota* Howes, 1945. *Transactions of the Royal Society of New Zealand* 76: 65, pl. 7 fig. 1. **New synonymy.**

**Diagnosis.** Extremely similar to *P. funerea*, but male antenna with distinct erect ciliations beneath, 0.25–0.5x depth of flagellum. For differences from *P. sequens*, see under that species, below.

**Description.** Adult (Figs 37–40). Wingspan 29–37 mm (male); 29–36 mm (female). Labial palpus segment 3 (Fig. 70) elongate, porrect and cylindrical in both sexes, barely swollen subapically. Male antennae filiform, with ciliations distinct, 0.25–0.5x depth of flagellum (Fig. 72). Head and thorax variably mixed blackish and white; tegulae usually each with mesal blackish line; scales hairlike to narrow lamellate. Foretarsus with outer row of spines roughly of same size as inner row; 7 or more spines in outer row. Forewing variable in colour, blackish grey to silvery grey or whitish grey, markings variably distinct and whitish grey; basal streak absent; subbasal fascia and antemedian line regular, rather weakly scalloped, edged dark distally; postmedian line distinctly scalloped, edged dark basally; claviform stigma absent or present as an indistinct dark streak; orbicular stigma small to moderate, round, outlined blackish; reniform moderate, colour as for orbicular; area between antemedian and postmedian lines often somewhat darkened in indistinct fascia running from costa to dorsum between orbicular and reniform; subterminal line very indistinct, but usually in pale specimens irregularly edged darker basally; terminal area concolorous with rest of wing or paler; series of dark subtriangular marks along termen present; fringe pale grey to blackish grey more or less clearly chequered white. Hindwing dark greyish brown, unmarked; fringe brownish white to dark median line, pure white beyond. Underside grey, paler on hindwing where discal spot and postmedian line distinct. Abdomen silvery grey, variably mixed pale ochreous, and with whitish hair-scales basally. Male abdominal base (Fig. 133) without brushes, levers or pockets. Male genitalia (Figs 132, 135, 136): uncus bluntly rounded, hooked; subscaphium smooth; valva with strong V-shaped convexity in costa at base of cucullus stem, cucullus stem moderately short, cucullus rather small, with corona of ca. 20–25 elements; field of spinose setae absent; clasper long, blade-like, angled, serrulate on dorsal edge; ampulla very short, thumb-like. Phallus (Figs 131, 134): vesica truncate-oblong, with single rounded basal diverticulum, and pair of short lateral diverticula at ¼ and mid-length on right; cornuti moderately long, in elliptical cluster beyond mid-length. Female S7 as in Fig. 171. Female genitalia (Figs 169, 170): ovipositor lobes (Fig. 170) ventrally directed, of moderate length, weakly sclerotised, more or less oblong, evenly covered with well-spaced long setae and with numerous short setae clustered apically; segment 8 short; with scattered medium-length to long setae laterally and in narrow band along caudal margin dorsally; ostium very finely and evenly spinulose / scobinate; lateral pockets rather long; ductus bursae moderately short, sclerotised except for membranous lateral patches at mid-length, somewhat dorsoventrally sinuous, with very small area of rugosity at junction with corpus + appendix bursae; corpus + appendix bursae round / cordate, weakly rugose, with short rather narrow papilla subtending ductus seminalis inception.

**Type material.** *Xylocampa cucullina*: Holotype: Male, 'Type [round red-ringed label] / *Xylocampa cucullina* Gn Ent mont. magaz. p. N<sup>le</sup> Zélande M. Knaggs / Ex Oberthür coll. Brit. Mus. 1927-3' [per JSD] (BMNH) (examined, not dissected).

*Aletia obsecrata*: Holotype: Female, 'Type [round red-ringed label] / Ben Lomond New Zealand AP 25.11.12 / obsecrata Meyr. / *Aletia obsecrata* Meyr. 1/1 E. Meyrick det. in Meyrick Coll. Holotype ♀ [per JSD] (BMNH) (examined, not dissected).

*Aletia parmata*: Holotype: Female, [Mt Grey NC, 24 Feb 1924, S. Lindsay] (CMNZ) (examined by B.H. Patrick and photograph seen).

*Aletia probenota*: Holotype: Male, 'Homer 23.12.43 / G. HOWES COLLECTION / ALETIA PROBENOTA TYPE G. HOWES' (MONZ) (examined, not dissected).

**Notes on synonymy.** (1) *Aletia parmata*. Dugdale (1988) synonymised *parmata* with *cucullina*, but this synonymy was reversed by White (2002), who reinstated *parmata* as a good species and a senior synonym of *funerea* Philpott. I regard White as correct in distinguishing two species based on male antennal ciliations (distinct and erect in *cucullina* (Fig. 72) and minute and appressed in the second species (Fig. 73)), but incorrect in his identification of the second species as *parmata*. He apparently based his taxonomic decision on an examination of the holotype of *parmata* in CMNZ, citing differences in 'forewing' (presumably pattern of forewing) and expected differences in male antennal ciliations from the holotype of *cucullina* in BMNH (which he had not examined, but of which he had seen a photograph) (White 2002: 301). As stated below (see under *P. funerea*), forewing pattern appears to be of little use in separating species in this complex; only male antennal ciliations represent a useful morphological character. The antennae of the holotype of *cucullina* in the BMNH correspond with White's concept of *cucullina*, as he predicted (J.S. Dugdale, BMNH notes; pers. obs.). White presumed that the holotype of *Aletia parmata* (from Mt Grey, NC) was a male (as stated by Dugdale (1988: 199)), but in fact, as correctly noted in the original description by Philpott (1926), it is a female (B.H. Patrick, pers. comm.). Therefore, unfortunately, the antennal characters are unhelpful for identifying this specimen. However, all male specimens I have examined from the eastern South Island (Jack's Pass MB to Tiwai Point SL), including all specimens from Canterbury, have distinct erect antennal ciliations and are therefore referable to *P. cucullina*. Furthermore, Philpott (1926: 387) in his description of *parmata* mentions a male in poor condition from a higher elevation on Mt Grey (the type locality) whose antennae 'are clothed beneath with extremely short ciliations, about ¼'. This is presumed to be the specimen in CMNZ (subsequently identified as *Aletia obsecrata*) collected by Lindsay on Mt Grey on 12 Nov 1923 (CMNZ database no. 2007.222.495); this is undoubtedly a male of *P. cucullina* in the concept adopted here (B.H. Patrick, pers. comm.). I therefore reinstate *parmata* as a synonym of *cucullina*. The oldest name for the species with appressed antennal ciliations is thus *funerea* Philpott, removed from synonymy with *parmata* (see below).

(2) *Aletia obsecrata*. The name *Aletia obsecrata* has been generally applied to small, often strongly variegated specimens (otherwise resembling *cucullina*) from higher altitudes in CO and OL (Figs 38, 39). Meyrick (1914) described *obsecrata* from a single female and offered no explicit comparison with similar species, but stated that it was 'at once recognisable by the unusually dark colouring'; the holotype is in fact an exceptionally dark specimen and most specimens under this name in collections are much paler. Philpott (1926) likewise distinguished *cucullina* (his *Aletia parmata*) from *obsecrata* on the base of the former's 'lighter colouring'. Hudson (1928: 58) compared *obsecrata* with *longstaffi* and with *Graphania lithias*, but not with *cucullina* (his *Aletia parmata*) or *funerea* (his *A. cucullina*). White (2002) was the first author to attempt a more critical diagnosis of *obsecrata* that would separate it explicitly from *cucullina*. He gives two distinguishing characters of *obsecrata*: forewing shorter than in *cucullina*, and antenna ventrally blackish or blackish red-brown, as opposed to reddish brown in *cucullina*. A male in NZAC from St Arnaud BR has a wingspan towards the higher end of the range for *cucullina* / *obsecrata* (34 mm) but has ventrally blackish brown antennae, indicating that White's characters do not always align. I know of no other case worldwide where two noctuid species are separated on antennal integument colour alone, and moreover, antennal colour varies from red-brown to blackish brown in *P. funerea* (*parmata* in the sense of White 2002). Therefore I do not consider that these characters offer sufficient evidence for continuing to separate *cucullina* and *obsecrata*. There does appear to be some variation between populations in the length of the ciliations of the male antennae, which vary between ca 0.25x and 0.5x the depth of flagellum, with alpine populations (specimens usually assigned to *obsecrata* and *probenota*) tending to show slightly longer ciliations; however, the variation appears to be more or less continuous and again not useful for separating species. Likewise, there is a

range of subtle variation in the shape of the valva and cucullus in the male genitalia of *cucullina* (see Figs 132, 135, 136) that suggests the possibility of a species complex or incipient speciation, but none of the differences noted appear to align consistently with other morphological characters or with geographically defined populations. Given the lack of satisfactory criteria for separation, I synonymise *obsecrata* with *cucullina* here.

(3) *Aletia probenota*. White (2002) did not treat '*Aletia*' *probenota*, which is the name that has been applied to dark specimens, otherwise similar to *P. cucullina*, from Fiordland (Fig. 40). Howes (1945: 65) in his description of *probenota* stated that the species was 'closely allied to *Aletia parmata*, but the distinctive black and white colouring makes it easily recognisable'. He noted (*loc. cit.*) a difference in the antennae communicated to him by S. Lindsay, stating that those of "*parmata*" are circular [in cross-section] and with only scattered scales on the upperside, whereas those of *probenota* are hemispherical (flattened on the underside) and densely scaled on the convex upperside. The other antennal difference noted by Howes (antennae with 'short stiff cilia' beneath in *probenota*, finely pubescent only in "*parmata*") is the one used here to distinguish males of *cucullina* from those of *funerea*; it does not differentiate *probenota* from *cucullina*. The issue of what Lindsay's and Howes' concepts of "*parmata*" included is somewhat complex (hence the inverted commas throughout this discussion), but not of central importance. After careful examination of these characters, I am unable to find consistent differences in antennal shape or upperside scaling within this complex that could justify recognition of *probenota* as a separate taxon. In all specimens of *cucullina* and *funerea* examined, the antenna is somewhat flattened beneath towards the base and more cylindrical distally. Given the variability of wing pattern in both *cucullina* and *funerea*, and the absence of other distinguishing characters of dark Fiordland forms externally or in genitalia, I synonymise *probenota* with *cucullina*.

**Distribution.** Widespread in the South Island, but not known from the Nelson district proper, though present in the St Arnaud Range on the border with MB and BR.

- / BR, MB, KA, NC, MC, SC, MK, OL, CO, DN, FD, SL / SI

**Biology.** The life history is poorly known; apparently the only rearing records are of two specimens (preserved in ethanol in the synoptic larval collection in NZAC) from Kakapo Brook NC reared in 2009 by C. de Sassi from larvae on the low prickly shrub *Leucopogon fraseri* (Ericaceae). No description of the larva is available.

**Flight period.** October to March.

**Remarks.** This species and the next have been the source of great confusion in the literature and collections, and more work is needed. While the distinct erect ciliations of the male antennae appear to be diagnostic of *cucullina*, no other constant characters have been found either in wing pattern or male or female genitalia that allow *cucullina* and *funerea* to be confidently distinguished. The wing pattern characters given by White (2002) (antemedian and postmedian forewing lines obscure in *funerea* [his *parmata*], usually distinct in *cucullina*) are variable and unreliable, as he indeed implies. Very large specimens from Fiordland (wingspan over 37 mm) seem to be invariably *P. funerea*; other than this, size does not seem a good guide.

*Physetica cucullina* as here defined is a locally common to very common shrubland species, widespread in the subalpine and alpine zone of the South Island but occurring down to sea level in the south (e.g. at Tiwai Point SL). It comes freely to light. There are few records from Stewart Island (Mason Bay, 5 and 9 Dec 1988, and Smoky Beach dunes, 14 Jan 2000: B.H. Patrick, pers. comm.), but it is almost certain to be resident there.

### ***Physetica funerea* (Philpott, 1927) new combination, reinstated species**

Figs 41–44, 71, 73, 137–143, 172–174

*Aletia funerea* Philpott, 1927. *Transactions and proceedings of the New Zealand Institute* 57: 703–704. Synonymised with *cucullina* by Hudson (1928: 58); synonymy transferred by implication to *parmata* by White (2002: 301).

**Diagnosis.** Extremely similar to *P. cucullina*, but male antenna with indistinct appressed ciliations only. For differences from *P. sequens*, see under that species, below.

**Description.** Adult (Figs 41–44). Wingspan 32–41 mm (male); 38–40 mm (female). Male antennae filiform, minutely pubescent only, i.e. ciliations very short and near-appressed (Figs 71, 73). Other characters and variation, including male and female genitalia, as described for *cucullina* above, except largest specimens with greater wingspan than the largest known *cucullina*; no other diagnostic characters known. Male abdominal base (Fig. 139); male genitalia (Figs 138, 141, 143); phallus (Figs 137, 140, 142). Female S7 (Fig. 174); female genitalia (Fig. 172); ovipositor (Fig. 173).

**Type material.** *Aletia funerea*: Holotype: Female, 'Mt Arthur Td 1.-1-25. 4500' A. Philpott / *Aletia funerea* Philp. Holotype. ♀. / HOLOTYPE ♀ *Aletia funerea* Philpott, 1927' (NZAC) (examined, not dissected).

**Note.** As with the holotype of *Aletia parmata*, the holotype of *funerea* is stated to be a male by Dugdale (1988: 199), but is in fact a female, as noted in the original description by Philpott (1927). Therefore antennal characters are unhelpful in deciding the application of this name; however, the type locality is again significant: only the species with the appressed ciliations in the male is known from the Nelson district, so the name *funerea* is applied to this species here (as in White 2002). For removal from synonymy with *parmata*, see under *cucullina* above.

**Distribution.** Western and central South Island.

- / NN, BR, WD, MK, FD

**Biology.** Unknown.

**Flight period.** October to February.

**Remarks.** *Physetica funerea* has in general a more northerly and westerly distribution than *P. cucullina*, and appears to be absent from the eastern South Island. It seems to be restricted to subalpine and alpine shrubland, where it is locally common. Only a few females have been examined during the course of this revision, all from Tutoko Bench, Darran Mts, Fiordland, a population of very large dark specimens; undoubtedly other populations will have females with wingspans less than 38 mm. This locality is also the only one so far confirmed that has both *funerea* and *cucullina*.

White's (2002: 305) record of *Aletia parmata* from 'inland Canterbury' is presumed to be based only on the holotype of *parmata*, which as shown above, is a specimen of *P. cucullina*; I have seen no specimens of *P. funerea* collected by him (or anyone else) from Canterbury. Otherwise, all his records of *parmata* are referable to *P. funerea*.

#### ***Physetica longstaffi* (Howes, 1911) new combination**

Figs 45–47, 74, 144–146, 175–177

*Morrisonia longstaffii* Howes, 1911. *Transactions and proceedings of the New Zealand Institute* 43: 128.

*Morrisonia longstaffi* Howes; Longstaff, 1912 (*Transactions and proceedings of the New Zealand Institute* 44: 112) and subsequent authors. Incorrect subsequent spelling to be maintained (see below).

**Diagnosis.** *Physetica longstaffi* could be confused with *P. sequens* and possibly *P. phricias*, but usually differs from both in its enlarged, oblique orbicular stigma, which closely approaches the reniform. The male of *P. longstaffi* can also be quite easily distinguished from *P. sequens* by its very elongate clubbed third labial palp segment; this segment is much shorter and not clubbed in *sequens*. *Physetica longstaffi* also usually has the white-edge black basal forewing streak and the reniform stigma better defined than in *phricias* or *sequens*. The female of *longstaffi* (Figs 46, 47) is generally a darker, more distinctly marked moth than *sequens*, with more contrasting stigmata and crosslines, and differs from the pallid *phricias* even more strongly in this respect. The male genitalia of *longstaffi* are particularly distinctive in the very long dorsolateral diverticulum of the vesica and the two different size-classes of cornuti. It is not clear whether this dorsolateral diverticulum is homologous with one of the two lateral diverticula of other species such as *cucullina*; *longstaffi* is the only species where a diverticulum of the vesica bears cornuti.

**Description.** Adult (Figs 45–47). Wingspan 30–36 mm (male); 33–37 mm (female). Labial palpus segment 3 (Fig. 74) very elongate, porrect and cylindrical, distinctly swollen subapically in male; shorter and barely swollen in female. Male antennae filiform, with fine appressed pubescence. Head and thorax mixed dark grey and white; prothorax with black bar, edged white above; tegulae each with mesal blackish line; scales hairlike to narrow lamellate. Foretarsus with outer row of spines roughly of same size as inner row; 7 or more spines in outer row. Forewing variable in colour, blackish grey to silvery grey or whitish grey, usually darker in female, markings whitish or silvery grey and black, veins marked in black and sprinkled white; basal streak present, short, sometimes indistinct in male; subbasal fascia and antemedian line usually rather indistinct in male, in female distinct, regular, rather weakly scalloped, edged dark basally and distally; postmedian line usually indistinct in both sexes, weakly scalloped, in female edged dark basally and distally; claviform stigma absent in male, present in female as small dark 'U'; orbicular stigma small to moderate, oblique, oval, outlined blackish; reniform moderate, colour as for orbicular, but rather strongly underlined black; area between antemedian and postmedian lines sometimes somewhat darkened in indistinct fascia running from costa to dorsum between orbicular and reniform; subterminal

line more or less indistinct, but usually in pale specimens irregularly edged darker basally; terminal area concolorous with rest of wing but usually with dark cloud in region of veins M1 and M2; series of dark subtriangular to crescentic marks along termen present; fringe pale grey to blackish grey more or less clearly chequered white. Hindwing dark greyish brown, unmarked; fringe brownish white to dark median line, pure white beyond. Underside grey, paler on hindwing where discal spot distinct and postmedian line more or less distinct. Abdomen with distinct dorsal scale-tuft on segment 1 and less distinct tuft on 2 pale to dark grey, tipped or sprinkled white; rest of abdomen silvery grey, mixed whitish grey to pale ochreous, and with whitish to grey hair-scales basally. Male abdominal base (Fig. 146) with brushes, levers and pockets. Male genitalia (Fig. 145): uncus bluntly rounded, hooked; subscaphium smooth; valva with shallow V-shaped convexity in costa at base of cucullus stem, cucullus stem relatively short and stout, cucullus large, with corona of ca. 45 elements; field of spinose setae present in costal ½ of cucullus; clasper long, blade-like, barely curved, not serrulate; ampulla very short, thumb-like, papillate. Phallus (Fig. 144): vesica without basal diverticulum, with long finger-like lateral diverticulum, and with longer dorsolateral diverticulum; dorsolateral diverticulum with broadly conical base directed dorsad, from which arises the curved cylindrical portion directed ventrad; a small group of large cornuti subapically continuous with a group of distinctly smaller cornuti that continue in narrow band onto basal (dorsally directed) portion of dorsolateral diverticulum. Female S7 as in Fig. 177. Female genitalia (Figs 175, 176): ovipositor lobes (Fig. 176) ventrally directed, of moderate length, weakly sclerotised, more or less oblong (subtriangular in ventral view), evenly covered with well-spaced long setae and with numerous short setae clustered apically; segment 8 short, with numerous medium-length to long setae in posterior ½ ventrolaterally. laterally and dorsally; ostium very finely and evenly spinulose / scobinate in rearmost dorsal portion where dorsal wall is distinctly invaginated between membranous and sclerotised areas of segment 8; lateral pockets rather short; ductus bursae (as here interpreted) very short, sclerotised, weakly dorsoventrally sinuous, opening anteriorly into expanded, longitudinally rugose portion here interpreted as the appendix bursae; appendix bursae with short oblong papilla subtending ductus seminalis inception; corpus bursae round.

**Type material.** Lectotype: Male, [Ben Lomond OL 10 Mar 1910, W.G. Howes, G.B. Longstaff], designated by J.S. Dugdale (Dugdale 1988: 200) (BMNH) (examined, not dissected). Paralectotype: sex not recorded, same data as Lectotype, but 17 Mar 1910 (BMNH).

**Note.** Howes (1911) in the original description mentions a specimen collected in Dunedin on 28 Mar 1907 and ‘a good series [taken] when collecting with Dr. Longstaff at Queenstown and Paradise, Lake Wakatipu district, in second week of March, 1910’. Apart from the lectotype and paralectotype in the BMNH mentioned above, the whereabouts of the remaining specimens of the original type series has not been investigated for this revision.

**Note on nomenclature.** The spelling of the species name given in the original description by Howes (1911) is *longstaffii*. This was changed to *longstaffi* by Longstaff (1912: 112) and the latter spelling has been used in all subsequent publications I have traced (except Howes 1912: 205), including the major reference works by Hudson (1928) and Dugdale (1988). According to ICZN Articles 33.3 and 33.4 *longstaffi* is an incorrect subsequent spelling of the name; however, because it is in prevailing usage and is attributed to the publication of the original spelling, it is to be preserved and treated as a correct original spelling (Article 33.3.1).

**Distribution.** Throughout the two main islands of New Zealand from Northland to Southland.

ND, AK, TO, HB, RI / NN, BR, MB, KA, NC, MC, SC, MK, OL, CO, DN, FD, SL

**Biology.** The biology of this species is not fully understood. Larvae have been found on narrow-leaved *Dracophyllum* (Ericaceae) but in captivity they were reared through on herbs such as plantain and chickweed (B.H. Patrick, pers. comm.; cf. Patrick 1994). Larvae have also been found in the wild on *Craspedia* (Asteraceae) and reared through (B.H. Patrick, pers. comm., specimens in OMNZ). Larvae believed to be of this species were found resting by day on *Dracophyllum subulatum* at Rangitaiki TO; they were offered but failed to feed on *Dracophyllum sinclairii* in captivity and died. Perhaps the difficulty of keeping *Dracophyllum* foliage in suitable condition once picked accounts for the failure to rear the species on this plant (cf. Donner & Wilkinson 1989: 33); the association of related species (*P. cucullina* and *P. sequens*) with Ericaceae suggests that *Dracophyllum* is a likely host. Alternatively, if *Dracophyllum* is not a host-plant, then possibly the larval habit of resting on this shrub is a defensive behaviour against parasitoids that track larvae using frass and plant volatiles released by feeding. No description of the larva is available and no preserved larvae have been seen.

**Flight period.** February to May, but recorded in December from North Cape ND.

**Remarks.** *Physetica longstaffi* is a widespread but local species of open habitats, particularly *Dracophyllum*-rich shrublands, from sea level (e.g. at Seaward Moss SL) to the low alpine zone. It appears to be very local and rare in the north of the North Island, and was not found during surveys of the remaining gumlands (Hoare 2011) though occurring fairly commonly at North Cape ND. There is a single record from the Waitakere Ranges AK, where a female was taken at light in a clearing amongst tall kauri forest in 2006; otherwise the moth is unknown from the Auckland district.

***Physetica phricias* (Meyrick, 1888) new combination**

Figs 48–50, 75, 147–151, 178–180

*Mamestra temperata* in the sense of Meyrick, 1887 (*Transactions and proceedings of the New Zealand Institute* 19: 27–28),  *nec* Walker, 1858 (*List of the specimens of lepidopterous insects in the collection of the British Museum*. XV: 1648–1649).

*Mamestra phricias* Meyrick, 1888. *Transactions and proceedings of the New Zealand Institute* 20: 46.

*Cucullia cellulata* Warren, 1911. *Novitates Zoologicae* 18: 140. **New synonymy.**

**Diagnosis.** *Physetica phricias* is most likely to be confused with some forms of the variable *P. sequens*; the larger reniform of *sequens*, which tends to be more strongly extended towards the costa, is a useful identification feature, though somewhat variable. The male of *phricias* has a longer 3rd labial palp segment (nearly as long as the diameter of the eye) than that of *sequens* (barely over 0.5x the eye diameter) (cf. White 2002). The forewing of *P. phricias* has a ‘smoother’ less marbled appearance than that of *sequens*, due to the less distinct cross-lines, and the area of pallid scaling beyond the reniform is enclosed by the (very faint) subterminal line in *phricias*, whereas the pallid scales tend to interrupt the subterminal line towards the apex in *sequens*. *Physetica phricias* occasionally has the reniform stigma underlined in black, as it often is in *sequens*, but the underlining never extends as a streak beyond the stigma; in *sequens* it usually does. *Physetica sequens* lacks the thin black line along the forewing dorsum that is usually present in *phricias*. A further possible diagnostic feature of *sequens* is the presence of distinct blackish subtriangular marks between the veins on the termen; these marks are usually very faint or absent in *phricias*, and in the few specimens where they are more distinct, they tend to take the form of dashes. *Physetica phricias* differs from *P. cucullina* and *P. funerea* in the same characters as does *P. sequens* (q.v.).

**Description.** Adult (Figs 48–50). Wingspan 33–39.5 mm (male); 33–41 mm (female). Labial palpus segment 3 (Fig. 75) very elongate, porrect and cylindrical, distinctly swollen subapically in male; shorter and barely swollen in female. Male antennae filiform, with fine appressed pubescence. Head and thorax mixed dark grey and white; prothorax with more or less distinct black bar, edged white above; tegulae sometimes each with mesal blackish line and traces of exterior black line; scales hairlike to narrow lamellate. Foretarsus with outer row of spines roughly of same size as inner row; 7 or more spines in outer row. Forewing silvery grey or whitish grey, veins marked in black with a few white scales; dorsum often narrowly but distinctly edged black; basal streak hardly discernible, short and very fine; subbasal fascia and antemedian line indistinct, toothed, only discernible from dark distal edging; postmedian line very indistinct; claviform stigma absent; orbicular stigma indistinct, round to slightly oblique, outlined white; reniform squarish, patchily outlined black and with white inner lining, not distinctly underlined black, but usually black-flecked interiorly near dorsal edge; area between antemedian and postmedian lines not darkened; subterminal line indicated by dark grey basal edging; a more or less distinct pallid patch between reniform and subterminal line; terminal area concolorous with rest of wing; series of dark crescentic to dash-like marks along termen present; fringe grey, indistinctly chequered white. Hindwing dark greyish brown, unmarked; fringe greyish with dark median line. Underside grey, paler on hindwing where discal spot absent to occasionally distinct and postmedian line absent or very indistinct. Abdomen with distinct dorsal scale-tuft on segment 1 dark grey, tipped or sprinkled white (no tuft on 2); rest of abdomen silvery grey, mixed whitish grey to pale ochreous, and with whitish to grey hair-scales basally. Male abdominal base (Fig. 149) with brushes, levers and pockets. Male genitalia (Fig. 148, 151): uncus bluntly rounded, not hooked; subscaphium smooth; valva with indistinct convexity in costa at base of cucullus stem; cucullus stem very long; cucullus large, with corona of ca. 45–52 elements; field of spinose setae present in costal ½ of cucullus (a few additional spinose setae sometimes present near dorsal apical spine of cucullus (Fig. 151)); clasper long, blade-like, smoothly curved, not serrulate; ampulla very short, thumb-like, not papillate. Phallus (Figs 147, 150): vesica with short basal diverticulum, and pair of short dorsal / subdorsal diverticula at 1/3 length on right, smaller one conical, larger one subcylindrical; cornuti moderately long, in elliptical cluster beyond mid-length. Female S7 as in Fig. 180. Female genitalia (Figs 178, 179): ovipositor lobes

(Fig. 179) ventrally directed, of moderate length, weakly sclerotised, more or less oblong (more or less subtriangular in ventral view), evenly covered with well-spaced long setae and with numerous short setae clustered apically; segment 8 short, with scattered medium-length to long setae laterally and more numerous mostly long setae in narrow band along caudal margin dorsally; ostium very finely and evenly spinulose / scobinate; lateral pockets rather long; ductus bursae with very short sclerotised portion, not dorsoventrally sinuous, otherwise broadening into and not well differentiated from rugose appendix bursae; a large rounded sclerotised plate along broad invagination between crenulately rugose papilla of appendix (on left in ventral view) and fused ductus / appendix section (on right); papilla subtending ductus seminalis incurved; corpus bursae elongate, oblong, rather strongly rugose.

**Type material.** *Mamestra phricias*: Lectotype: Male, 'Lectotype [round yellow-ringed label] / Christchurch New Zealand RWF 7/2/65 / phricias Meyr. / Mamestra phricias Meyrick 5/1 E. Meyrick det. in Meyrick Coll. Lectotype ♂' [per JSD] designated by J.S. Dugdale (Dugdale 1988: 205; labelling as lectotype predates that publication) (BMNH) (examined, not dissected).

**Note.** Meyrick initially misidentified this species as Walker's *Bryophila temperata*, and his description appears under the name *Mamestra temperata* in his first revision of 'Noctuina' (Meyrick 1887: 27–28). Having visited the BMNH, he realised his error and introduced the name *Mamestra phricias* Meyrick (Meyrick 1888: 46). The original description (under *M. temperata*) mentions six specimens from Christchurch and Lake Coleridge; one paralectotype from Christchurch has been located in BMNH (J.S. Dugdale, BMNH notebook).

*Cucullia cellulata*: Holotype: Male (see below), 'Spiti / Felder Coll. / Cucullia cellulata Warr. type ♂ [written as inverted ♀ symbol] Warr. / Spiti — err. loc. Hadeninae = Morrisonia phricias Meyr. fr. N. Zealand / Cucullia cellulata Warren ♂ [written as inverted ♀ symbol] / Rothschild Bequest BM 1939+1' [per JSD] (BMNH) (examined, not dissected).

**Note on synonymy.** Dugdale (1988: 205) mentions the specimen of *phricias* in the BMNH labelled as the type of *Cucullia cellulata* Warren, but states 'I cannot trace publication of Warren's epithet', casting doubt on its availability. The name is available, having been published by Warren (1911) in a paper in *Novitates Zoologicae* entitled 'Descriptions of some new *Noctuidae* in the Tring Museum'. The erroneous locality 'Spiti' is high in the Himalayas, in the Indian state of Himachal Pradesh. As indicated on one of the labels, the specimen has long been recognised as mislabelled, and its identity as a specimen of *Physetica phricias* has also long been realised. I formalise the synonymy here, though it is possible that either Dugdale (1988) or another source could be regarded as having made the synonymy by implication earlier. Though Dugdale (1988: 205) says that the specimen is a female, his BMNH notebook gives the sex as male, and this accords with the labels (the inverted ♀ sign presumably indicating ♂) and with the original description.

**Distribution.** Widespread in the South Island. See below for status of North Island records.

- / SD, NN, MB, KA, NC, MC, SC, MK, OL, CO, DN, FD, SL

**Biology.** Larvae have been found and reared on matagouri (*Discaria toumatou*) by B.H. Patrick (Patrick 1994), and there are preserved larvae beaten from *Discaria* in NZAC (but no associated reared adults). The significance of this host association was doubted by White (2002), who found the adult moth far more abundant at light in localities above 850 m a.s.l. where there was little or no matagouri. Perhaps there is another host-plant; alternatively the flight behaviour and dispersal of adults may not give a good indication of breeding sites. Further investigation is desirable. The larva is briefly described as follows (B.H. Patrick, pers. comm.): up to 33 mm long, grey with a pinkish tinge dorsally, a black and white dashed subdorsal line (darker posteriorly) and a broad dull white lateral band.

**Flight period.** September to May, but also recorded in July.

**Remarks.** *Physetica phricias* is a locally common shrubland species throughout the South Island occurring from sea level to at least 1850 m (B.H. Patrick, pers. comm.). Though Hudson (1928) and White (2002) indicate that the moth occurs in the central and southern North Island, I have seen no specimens in any collection to confirm this.

#### ***Physetica prionistis* (Meyrick, 1887) new combination**

Figs 51–53, 76, 152–154, 181–185

*Mamestra prionistis* Meyrick, 1887. *Transactions and proceedings of the New Zealand Institute* 19: 27.

**Diagnosis.** *Physetica prionistis* can be readily recognised on external characters by its white central thoracic stripe and the dark shading along the dorsum of the forewing (which is more extensive than the dark ‘pencil-line’ sometimes present in *P. phricias*).

**Description.** Adult (Figs 51–53). Wingspan 37–45 mm (male); 39–43 mm (female). Labial palpus segment 3 (Fig. 76) short, porrect and cylindrical, barely swollen subapically in both sexes. Male antennae subpectinate, with distinct ciliations up to ca 0.75x depth of flagellum. Head and thorax mixed grey, mauve, brown and white, and sometimes black; head with white central line edged brown laterally; prothorax with brown bar, edged white above; mesothorax with central white line; tegulae usually with some brownish scaling anteriorly and mauve or blackish scaling posteriorly; scales hairlike to very narrow lamellate. Foretarsus with outer row of spines roughly of same size as inner row; 7 or more spines in outer row. Forewing mixed whitish grey to dark grey and pale to mid ochreous; dorsum from 1/5 to tornus broadly suffused grey to blackish, darker than rest of wing; veins lined black distally beyond disc; basal streak absent or indistinct; subbasal fascia and antemedian line very indistinct, irregular, pale, dark-edged basally and distally; postmedian line very indistinct; claviform stigma absent; orbicular stigma an indistinct pale cloud; reniform squarish to weakly S-shaped, patchily outlined black distally, with white to pale ochreous inner lining, indistinct basally, not or barely underlined black; area between antemedian and postmedian lines not darkened; course of subterminal line vaguely indicated by series of blackish or brown wedge-shaped marks; terminal area concolorous with rest of wing; series of dark subtriangular marks along termen present; fringe mottled brown, blackish and white. Hindwing dark greyish brown, unmarked; fringe yellowish white to dark median line, white beyond. Underside grey, paler on hindwing where discal spot absent to occasionally distinct and postmedian line absent. Abdomen with distinct dorsal scale-tufts on segments 1–3 brownish, tipped white; rest of abdomen mixed grey and ochreous, and with whitish to grey hair-scales basally. Male abdominal base (Fig. 154) with brushes, levers and pockets. Male genitalia (Fig. 153): uncus bluntly rounded, hooked; subscaphium smooth; valva with indistinct convexity in costa at base of cucullus stem; cucullus stem long; cucullus large, with corona of ca. 40–45 elements; sparse scattered field of spinose setae present throughout width of cucullus; clasper long, boomerang-like, smoothly curved, not serrulate, very weakly expanded apically; ampulla short, thumb-like, not papillate. Phallus (Fig. 152): vesica with moderately long tapering basal diverticulum, strongly twisted portion beyond this has two very short diverticula; a further ventral ‘bump’ subapically below cornuti; cornuti moderately long, in long narrow even strip on distal 2/3 of vesica. Female S7 as in Fig. 183. Female genitalia (Figs 181, 182, 184, 185): ovipositor lobes (Figs 182, 185) ventrally directed, of moderate length, weakly sclerotised, more or less oblong (more or less subtriangular in ventral view), evenly covered with well-spaced long setae and with numerous short setae clustered apically; segment 8 moderately short, with band of numerous medium-length to long setae laterally and dorsally in caudal ½ of segment, band narrows strongly mid-dorsally; ostium finely and evenly spinulose / scobinate in rather narrow posterior band; lateral pockets rather short; ductus bursae sclerotised except for lateral membranous patches at about mid-length, somewhat dorsoventrally sinuous, expanding anteriorly; junction with appendix + corpus bursae strongly modified as follows: central part of ventral wall of ductus forms ventral lip of strongly sclerotised, dorsally open funnel, left side of which (in ventral view) is smoothly sclerotised and fused with corpus bursae, right side is crenulately rugose and fused for most of its length with appendix bursae, but extends to corpus anteriorly; appendix bursae enlarged, C-shaped, wrapping around ductus / corpus junction so that a large section overlaps the anterior part of the ductus anteroventrally and the ductus seminalis emerges posterodorsally from a short rounded papilla; corpus bursae ovate, barely rugose.

**Type material.** Lectotype: Male, ‘Rakaia New Zealand RWF 2/76 / prionistis Meyr. / Mamestra prionistis Meyr. 3/1 E. Meyrick det. in Meyrick Coll. / Lectotype’ [per JSD], designated by J.S. Dugdale (Dugdale 1988: 205; labelling as lectotype predates that publication) (BMNH) (examined, not dissected).

**Note.** Meyrick (1887) described this species from three specimens from Rakaia; the paralectotypes have not been located in BMNH (J.S. Dugdale, BMNH notebooks). There are no Fereday specimens in CMNZ.

**Distribution.** Locally widespread throughout the North and South Islands, and also known from the Chathams.

ND, AK, BP, TO, HB, WN / NN, WD, MC, SC, MK, OL, CO, DN, FD, SL / CH

**Biology.** Unknown.

**Flight period.** Recorded throughout the year.

**Remarks.** This is a local species of open forest and shrubland, rarely seen in numbers, and appears especially scarce in the northern North Island. It occurs from sea level to at least 1850 m in the alpine zone (B.H. Patrick, pers. comm.). There are only two known records from Northland (a specimen from Mangamuka in NZAC, and one photographed at Maungakaramea near Whangarei by O. Ball) and two from the Auckland district (one collected by D. Milligan, who lived at Leigh, but the locality is given only as ‘Auckland’, and one from Anawhata Hut, Waitakere Ranges, collected by D.J. Allan in 1966). It is common, however, near the summit of Mt Te Aroha BP in clearings in silver beech forest, and Hudson (1928: 75) indicated that it occurred commonly in the Wellington district, but varied strongly in abundance from year to year.

***Physetica sequens* (Howes, 1912) new combination**

Figs 54–60, 77, 155–159, 186–188

*Morrisonia sequens* Howes, 1912. *Transactions and proceedings of the New Zealand Institute* 44: 204–205.

*Melanchra distracta* Meyrick, 1924. *Transactions and proceedings of the New Zealand Institute* 55: 202. Synonymised by Dugdale (1988: 205).

**Diagnosis.** Differences between *Physetica sequens* and *P. phricias* are as described under *phricias*, above. The male of *P. sequens* can be distinguished from that of *cucullina* by the lack of distinct erect ciliations on the underside of the antenna. Specimens of *sequens* with a prominently underlined reniform stigma are also relatively easy to distinguish from *cucullina* and *funerea*. However, other specimens can be more problematic. Externally, perhaps the most reliable character is the black basal forewing streak of *sequens*, which, though often indistinct, can usually be picked out in the centre of the wing by the whitish scaling above. The white scales represent the lower ‘stroke’ of the M-shaped subbasal line, and this ‘stroke’ along with the black streak are more or less parallel with the costa. In *P. funerea* and *P. cucullina*, the black streak is absent and the lower white stroke of the subbasal line is usually at an angle to the costa, not parallel with it (compare Figs 37–44 with Figs 54–60). As noted in the key above, *P. sequens* and *P. phricias* tend to have the forewing termen very slightly concave below the apex, with the wing appearing sharply pointed; the termen is more smoothly rounded in *P. funerea* and *P. cucullina*. This character is subtle and should not be relied upon on its own. The genitalia of *P. sequens* are extremely similar to those of *P. funerea* and *P. cucullina* in both sexes; the most reliable separation features seem to be the number of elements in the corona on the male valva (over 30 in *sequens*, fewer than 30 in *cucullina* and *funerea*) and the number of lateral diverticula in the everted male vesica (one in *sequens*, as opposed to two in *funerea* and *cucullina*).

**Description.** Adult (Figs 54–60). Wingspan 31–42 mm (male); 32.5–44 mm (female). Labial palpus segment 3 (Fig. 77) very elongate, porrect and cylindrical, barely swollen subapically in male; narrower and not swollen in female. Male antennae filiform, with fine appressed pubescence. Head and thorax mixed dark grey to mauvish grey and white; prothorax with indistinct black bar, edged white above; tegulae sometimes each with mesal blackish line and traces of exterior black line; scales hairlike to very narrow lamellate. Foretarsus with outer row of spines roughly of same size as inner row; 7 or more spines in outer row. Forewing silvery grey or whitish grey; basal streak short and very fine; subbasal fascia and antemedian line absent to indistinct, toothed, antemedian edged dark basally and distally; postmedian line absent to indistinct, weakly scalloped, edged dark basally and distally; claviform stigma absent; orbicular stigma indistinct, round to oval, outlined or underlined black and with inner lining or infill of white; reniform large, more or less S-shaped, patchily outlined black and with white inner lining, often distinctly underlined black, the underlining often continuous with that of orbicular; area between antemedian and postmedian lines not darkened; subterminal line indicated by variable series of blackish wedge-shaped marks basad; often a whitish cloud between reniform and subterminal line; terminal area concolorous with rest of wing, but veins often lined black in this area; series of dark subtriangular marks along termen present; fringe grey, with white basal line. Hindwing dark brown, unmarked; fringe greyish brown beyond white basal line. Underside grey, paler on hindwing where discal spot distinct and postmedian line more or less distinct. Abdomen with distinct dorsal scale-tuft on segment 1 dark grey, tipped or sprinkled white (no tuft on 2); rest of abdomen silvery grey, mixed pale ochreous, and with brownish white to grey hair-scales basally. Male abdominal base (Fig. 157) without brushes, levers or pockets. Male genitalia (Figs 156, 159): uncus bluntly rounded, hooked; subscaphium smooth; valva with distinct convexity in costa at base of cucullus stem, often produced into minute spur; cucullus stem long; cucullus moderately large, with corona of ca. 31–40 elements; field of spinose setae absent; clasper long, blade-like, smoothly curved, serrulate on dorsal margin; ampulla very short, thumb-like, not papillate. Phallus

(Figs 155, 158): vesica with very short basal diverticulum, and single short lateral diverticulum at 1/2 length on right; cornuti moderately long, in subtriangular cluster beyond mid-length, basal and apical cornuti shorter and flexible. Female S7 as in Fig. 188. Female genitalia (Figs 186, 187): ovipositor lobes (Fig. 187) subtriangular, evenly covered with well-spaced long setae and with numerous short setae clustered apically; segment 8 rather short, compact; posterior margin only of T8 with fine (not spine-like) setae, dorsal ones extremely long; ostium densely and finely spinulose; lateral pockets moderately long; ductus bursae of moderate length, dorsoventrally sinuous, sclerotised for full length, a few short rugae at junction with corpus + appendix bursae; corpus + appendix bursae oval / cordate, with short papilla subtending ductus seminalis inception.

**Type material.** *Morrisonia sequens*: Lectotype: Male (here designated), 'Syntype / New Zealand Whakarewarewa 15.II.1910 G.H. Howes 1911-407 336 / Agrotidae genitalia slide No. 341' (BMNH) (examined, including genitalia slide). Paralectotypes: 1 male, 1 female, same data as lectotype, female with genitalia slide no. 342 (BMNH).

**Note.** The collector of the type series was G.B. Longstaff according to Howes (1912), and Howes' initials were W.G. not 'G.H.' as given on the syntype labels. 'G.H. Howes' is also mentioned as collecting the cranefly *Cerzodia paradisea* with G.B. Longstaff at Paradise, Otago, in 1910 by Edwards (1923: 328). Howes was known as 'George', so a possible explanation is that Longstaff recorded his collecting companion's initials as G.W. instead of W.G. and the 'W' was subsequently mistranscribed as an 'H', the error persisting on the labels and in associated literature.

*Melanchra distracta*: Holotype: Female, 'Type [round, red-ringed label] / Mt Ruapehu New Zealand GVH 4000' 1.22 / *distracta* Meyr. / *Melanchra distracta* Meyr. 1/1 E. Meyrick det. in Meyrick Coll. / Holotype ♀ (BMNH) (examined, not dissected).

**Distribution.** Throughout the two main islands of New Zealand.

ND, AK, CL, WO, BP, TK, TO, HB, WA / NN, BR, MB, NC, MC, SC, MK, OL, CO, DN, FD

**Biology.** No details of the life history have been available until now; however, three specimens from the Nelson district recently donated to NZAC by L. Peralta were reared from larvae on *Leucopogon fasciculatus* (2) and *Leptecophylla juniperina* (1) (both Ericaceae) (specimens preserved in ethanol in synoptic larval collection, along with pupal and last instar larval exuviae). A prepupal larva found in herbfield at Arthur's Pass and reared through to adult was briefly described as being dull green with brown and grey dorsal markings (B.H. Patrick, pers.comm.); no other description of the larva is available.

**Flight period.** September to March.

**Remarks.** Although *P. sequens* resembles *P. prionistis* and *P. phricias* in size and wing shape, and has been placed next to these species here for comparative purposes, it is probably more closely related to *P. cucullina* and *P. funerea*, based on the loss of secondary sexual characters of the male abdominal base and the very similar male and female genitalia.

This is a very locally common moth associated chiefly with open shrubby native habitats, such as subalpine shrublands, peatlands and *Dracophyllum*-dominated frost flats. It occurs from sea level to at least 1600 m in the alpine zone. It is common, e.g., in the remaining Northland gumlands (Hoare 2011), and in the inland volcanic dunes of the Rangipo Desert TO, but appears to be rather scarce and local in the South Island (B.H. Patrick, pers.comm.).

At the start of this revision, some larger specimens of *Physetica sequens* with the reniform stigma less prominently underlined had been separated in NZAC as a potential new species. This form is especially common in the region of Tongariro National Park, the type locality of *distracta* Meyrick, a name that probably refers to the same entity. I have been unable to find any consistent characters either externally or in the genitalia to support such a separation, and *P. sequens* is retained here as a single variable species, with *distracta* as a synonym.

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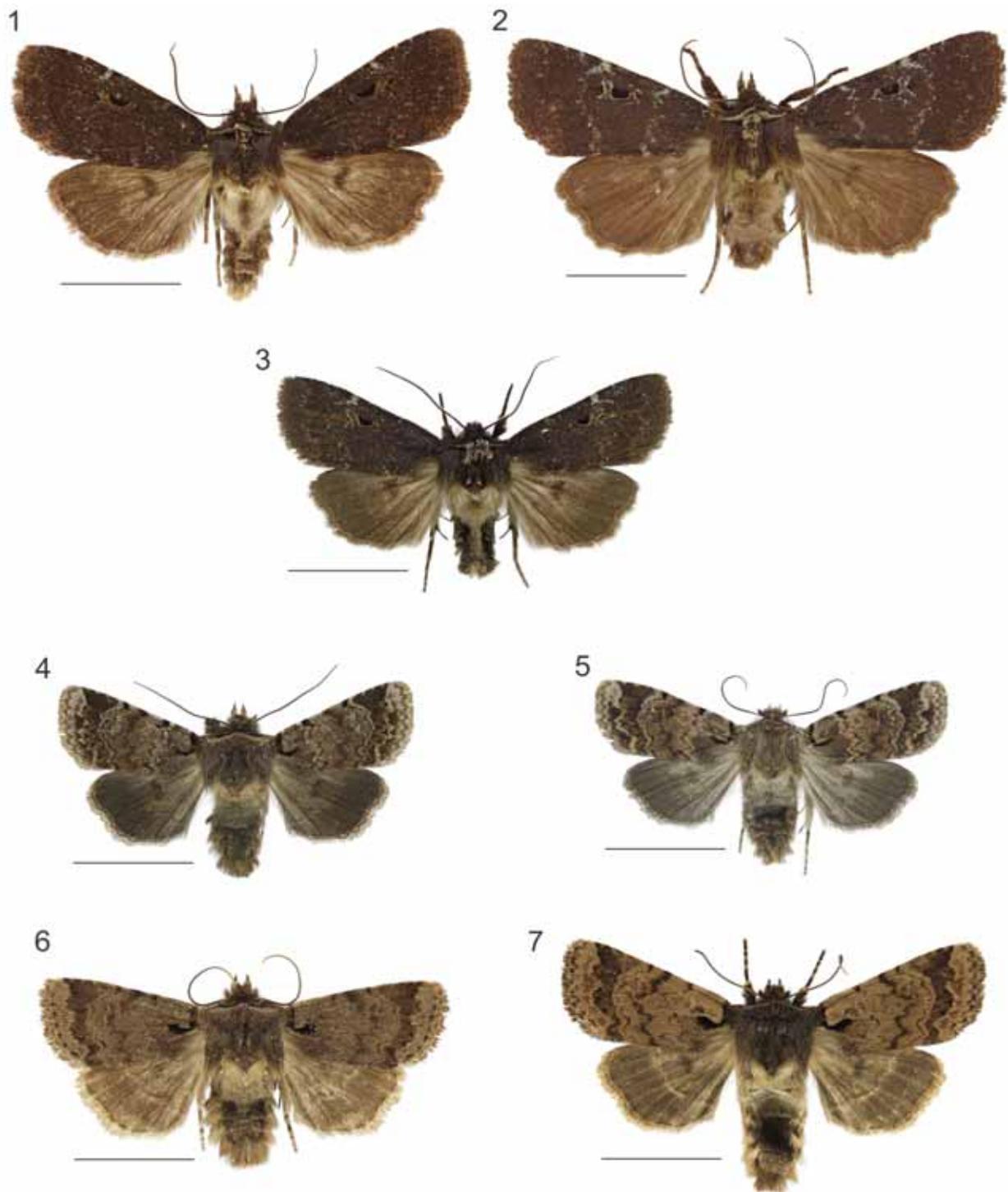
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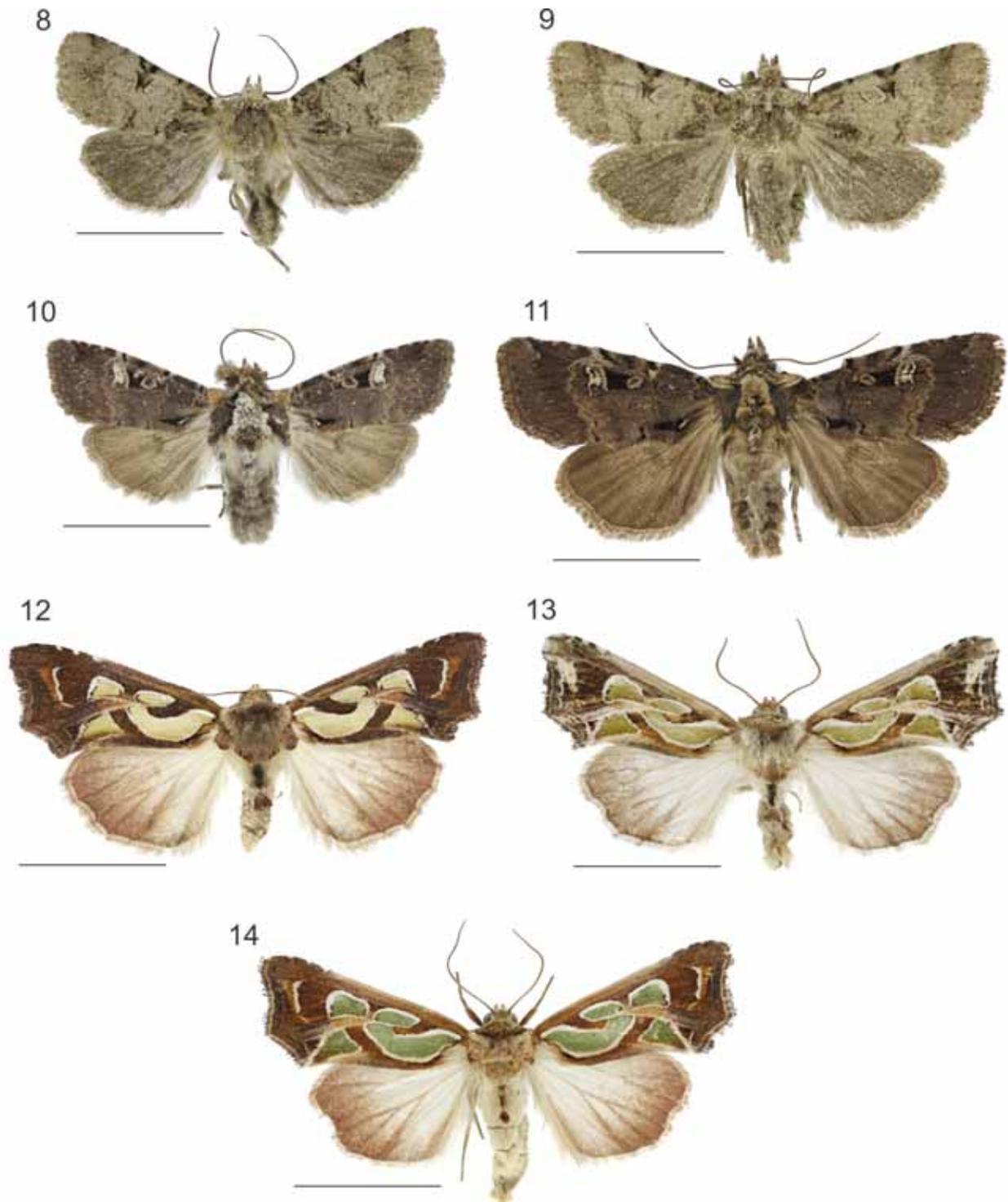
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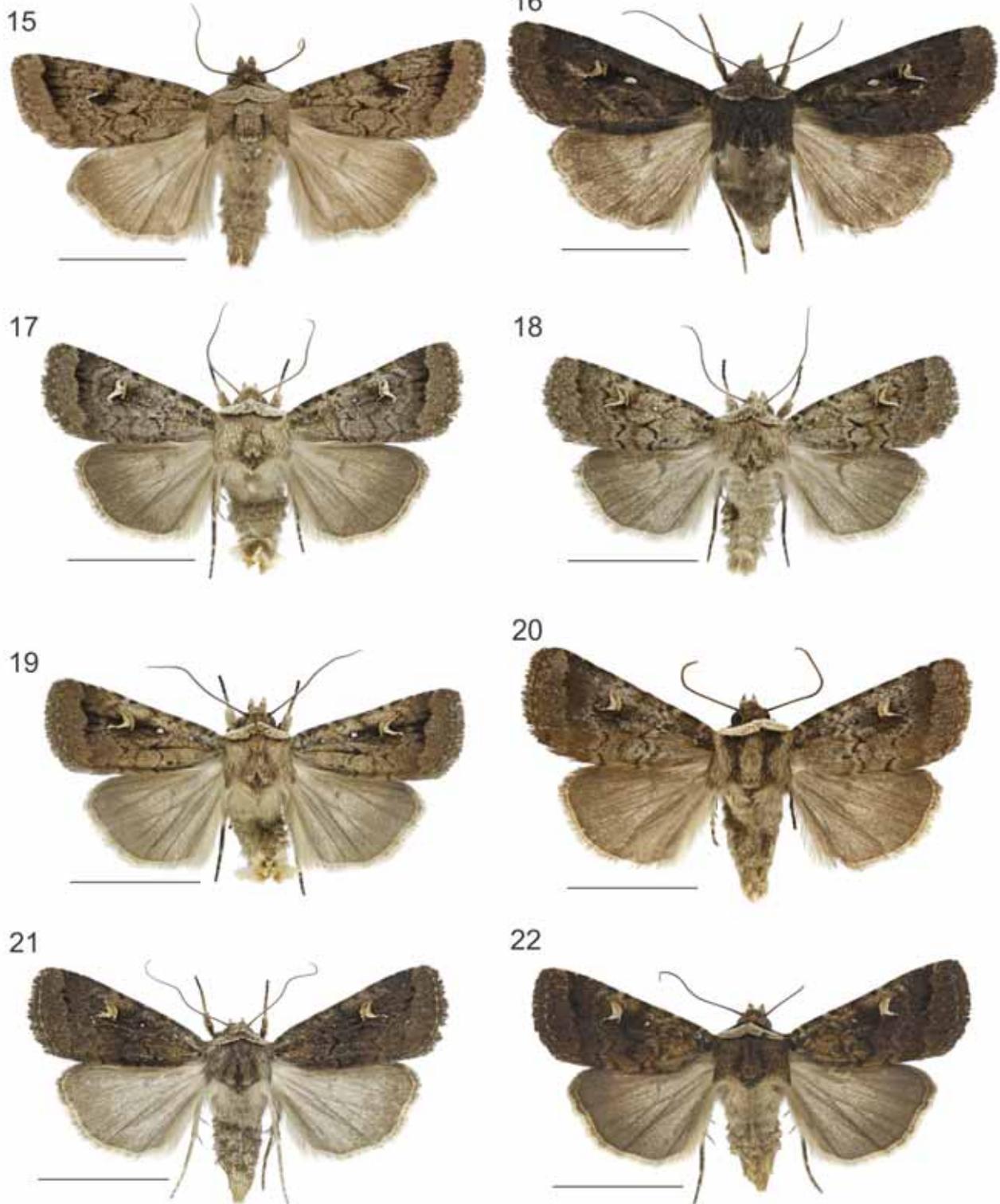
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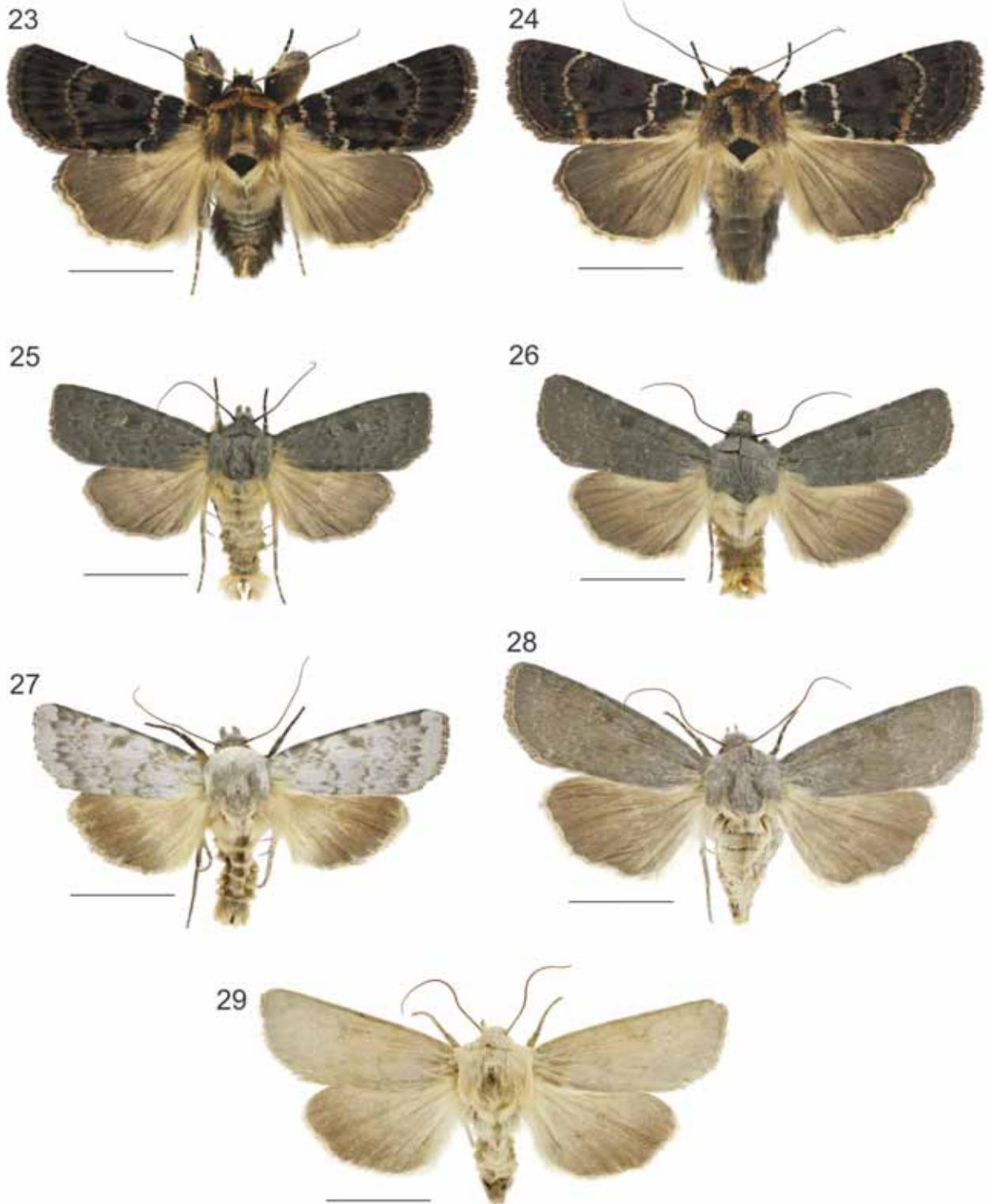
**Figs 1–60:** Adults, dorsal habitus. Automontage photographs by B.E. Rhode, scale bars 10 mm. Specimens in NZAC unless otherwise indicated. (1–3) *Austramathes purpurea*: 1 male, Little Bush HB, 25 Oct 1980; 2 male (?), Woodhaugh DN, 17 Sep 1914, MONZ; 3 male, Redvale, Albany AK, 6–7 May 2014; (4, 5) *A. fortis*: 4 male, Orewa AK, ex la. on *Melicytus macrophyllus* em. 7–8 Jan 2013; 5 female, same data; (6, 7) *A. squaliolus*: 6 paratype male, Rangatira Is. CH, 1–14 Dec 1987; 7 paratype female, Kaingaroa, Chatham Is. CH, 30 Dec 2004.



(8, 9) *Austramathes coelacantha*: 8 paratype male, Boyle R. BR, 5 Feb 2014; 9 paratype female, Lees V. MC 10 Mar 2012; (10, 11) *A. pessota*: 10 male, Porter's Pass MC, 23 Feb 1912 (MONZ); 11 female, Tempest Spur FD, ex pupa in *Poa* sward, 31 Jan 1975; (12–14) *Cosmodes elegans*: 12 female, Titirangi AK, 11 May 1986; 13 male, L. Rotoiti BR, 4 Dec 2005; 14 female, Pakaraka ND, 1 Feb 2008.

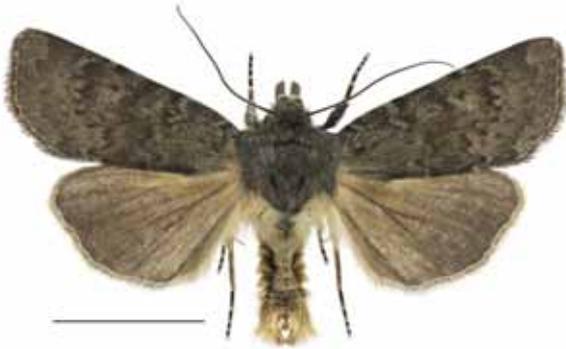


(15, 16) *Proteuxoa comma*: 15 male, Balmoral NC, 24 Jan 1956 (FRNZ); 16 female, Kaingaroa, Chatham Is. CH, 3 Jan 2005; (17–22) *P. tetronycha*: 17, 18 males, Otatara SL, 3–4 Dec 2011; 19 male, Destruction Gully, Waitakere Ra. AK, 12 Oct 2012; 20 male, Little Bush HB, 25 Oct 1980; 21 female, Kakamatua Inlet, Waitakere Ra. AK, 19 Nov 2012; 22 female, Parengarenga Harbour ND, 13 Oct 2008.

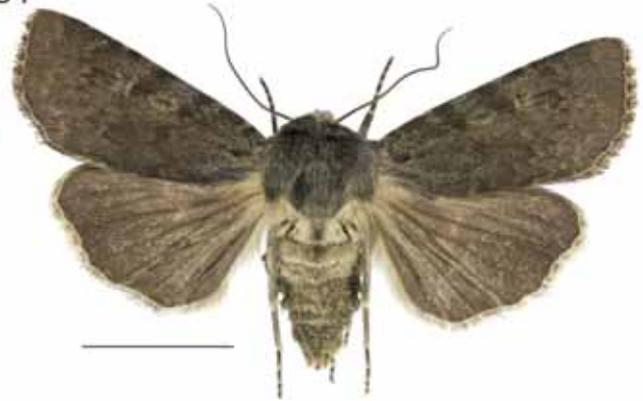


(23, 24) *Proteuxoa sanguinipuncta*: 23 male, Blowhard Bush HB, 20 Feb 2007; 24 female, Old Maori Tk, L. Waikaremoana GB, 22 Feb 2007; (25–29) *Physetica caerulea*: 25 male, Canavan's Knob, Franz Josef WD, 28 Jan 2009; 26 male, Kaitorete Spit MC, 29 Jan 2005; 27 male, Vanguard Peak OL, 21 Dec 1908, AMNZ; 28 female, Vanguard Peak OL, 21 Dec 1908; 29 female, Waipori DN, 1 Dec 1908, AMNZ.

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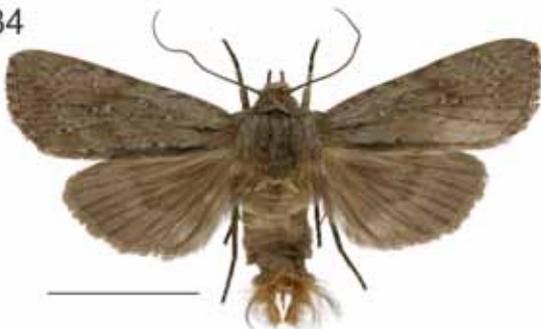
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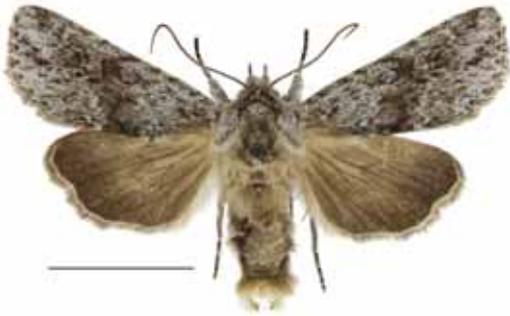


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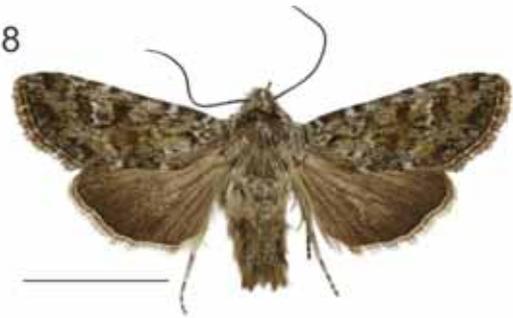


(30, 31) *Phyetica caerulea*, dark volcanic dune form: 30 male Rangipo Desert TO, 8 Dec 2009; 31 female, same data; (32, 33) *P. homoscia*: 32 male, Kilbirnie WN, 13 Jan 1954; 33 female, Rangiputa Res., Karikari Pen. ND, 3 Nov 2007; (34–36) *P. temperata*: 34 male, Woodhill Forest AK 9 Dec 2004; 35 female, same data; 36 female, old shearers' quarters, Te Paki ND, 2 Nov 2007.

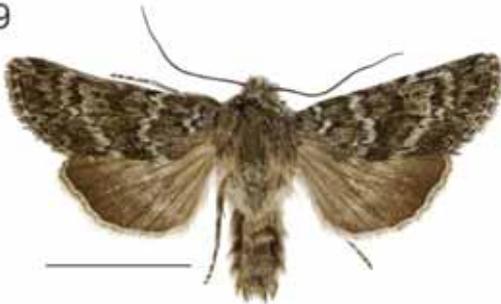
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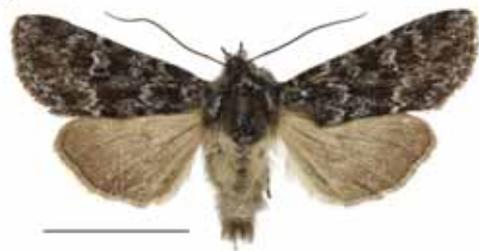
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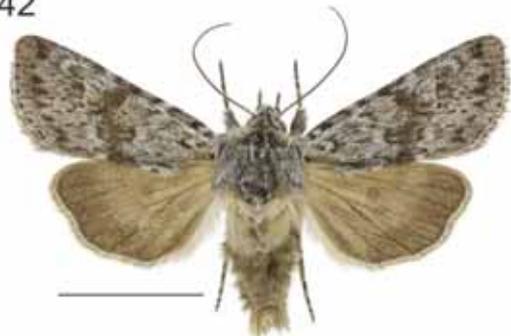
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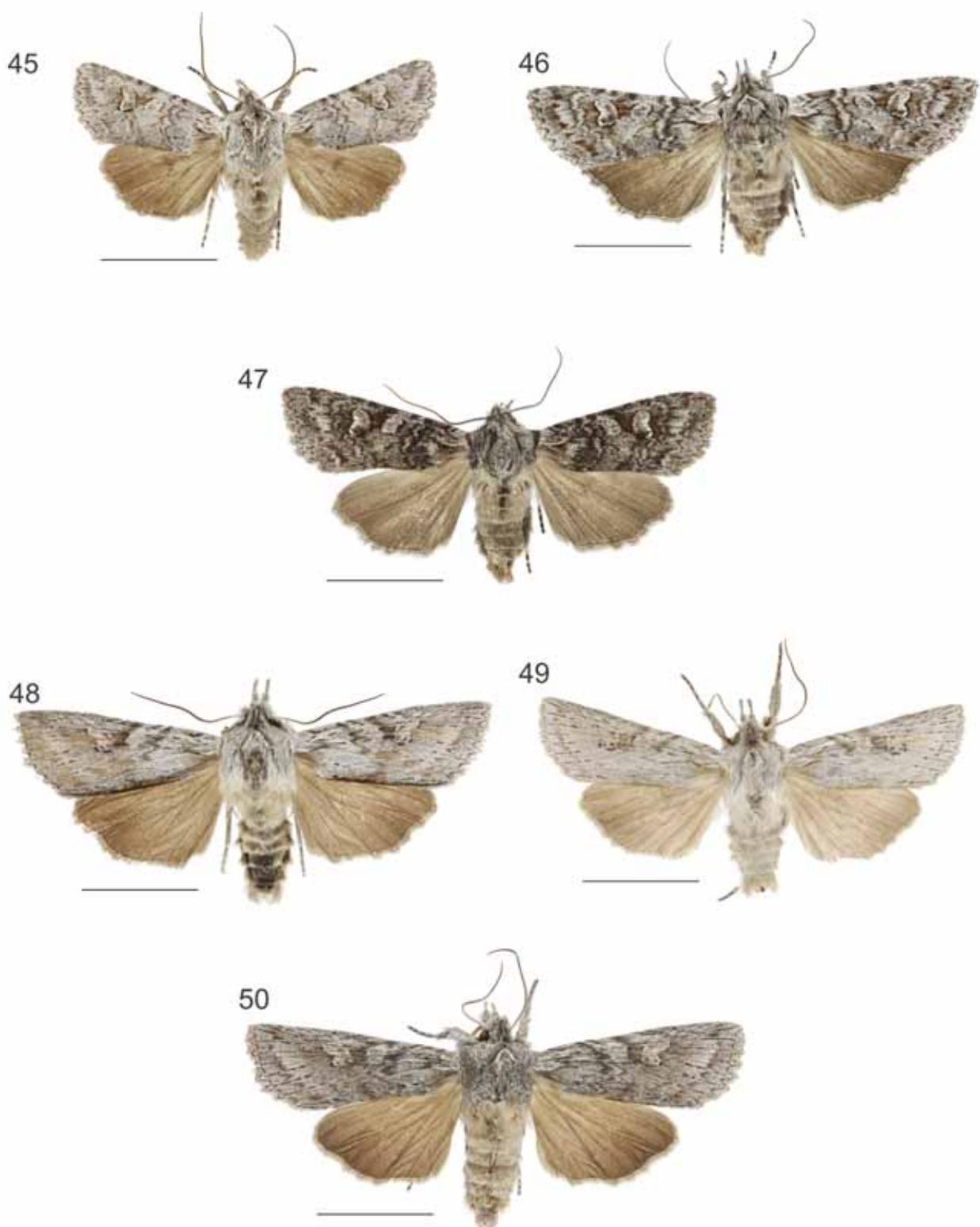
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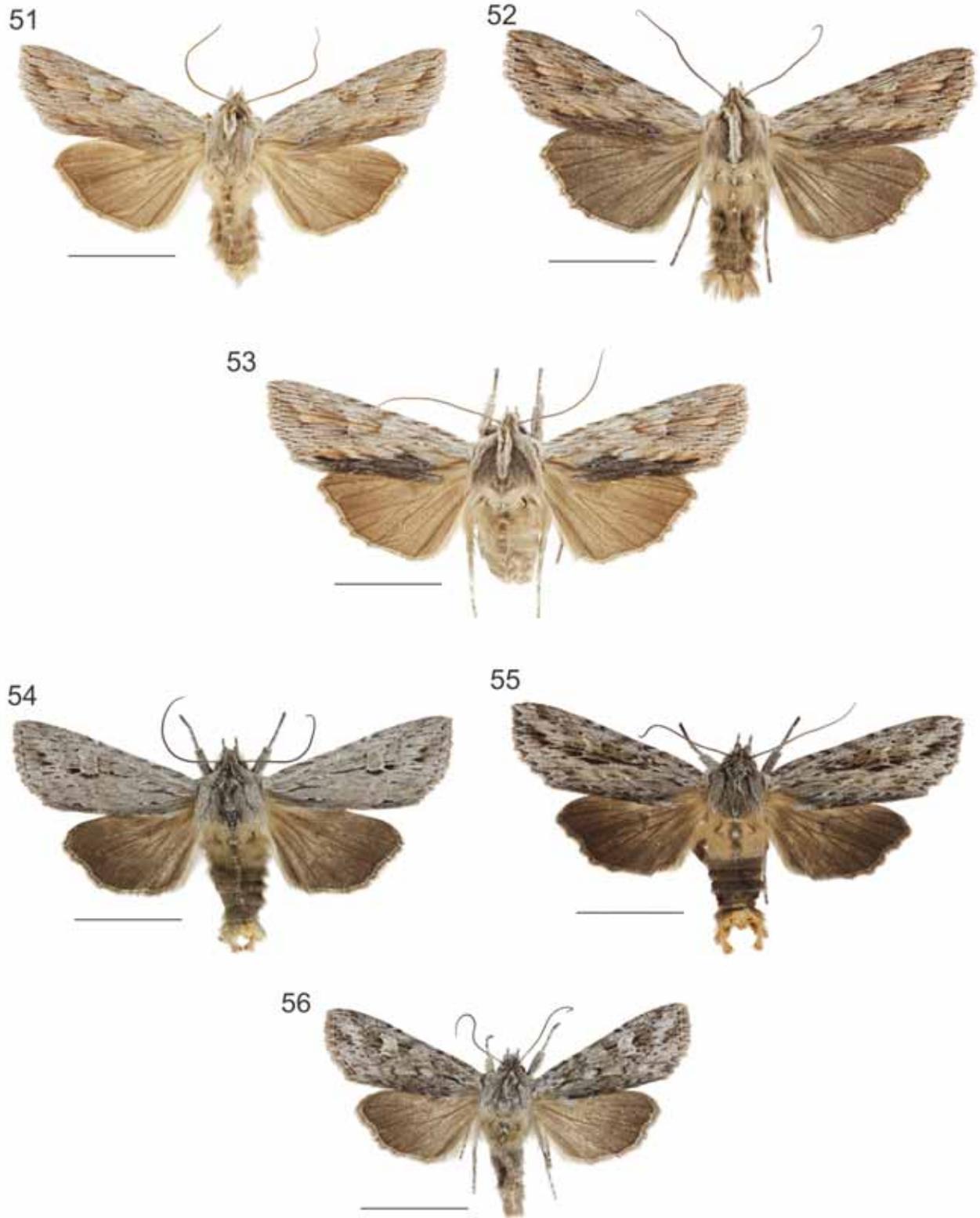
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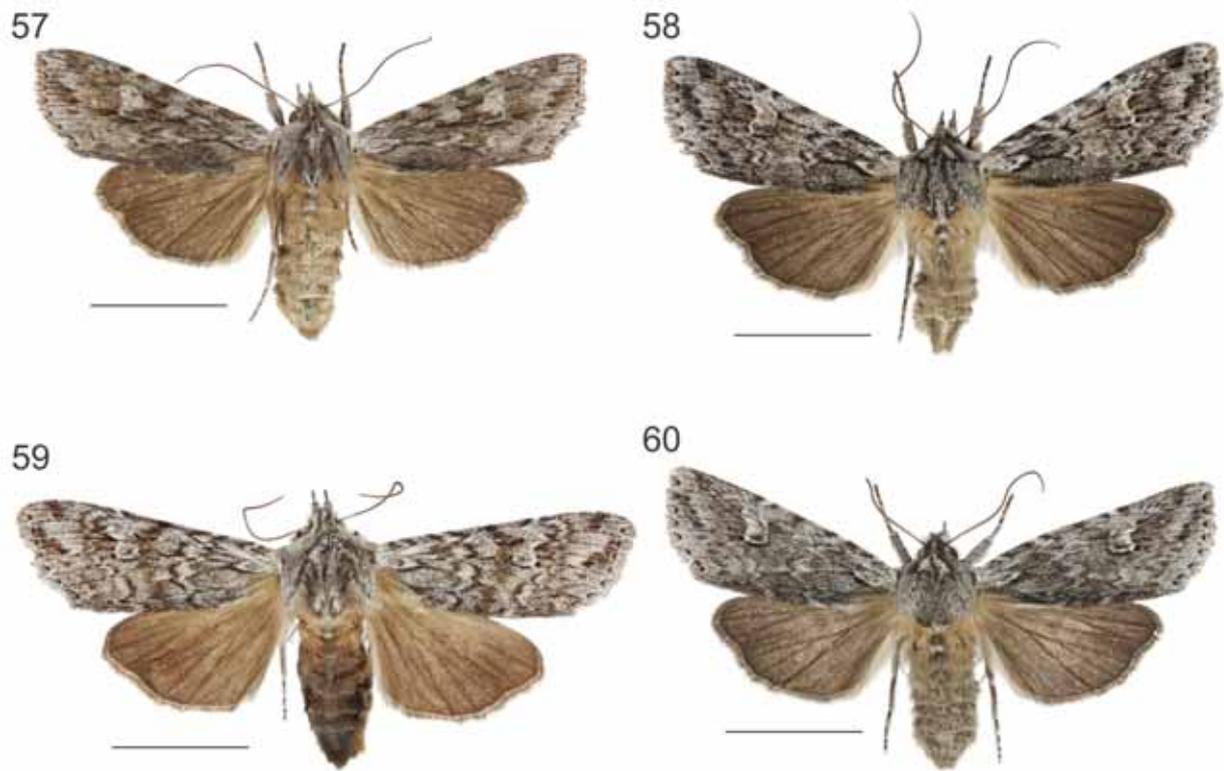
(37–40) *Physetica cucullina*: 37 male, Tiwai Point SL, 4 Dec 2011; 38, 39 males, Moke Lake OL 4 Dec 1963; 40 male (?), Homer Forks FD, 21 Jan 1946, MONZ; (41–44) *P. funerea*: 41 male, Mt Arthur NN, 10 Dec 1928; 42 male, Flora carpark, Mt Arthur NN, 27 Nov 2007; 43 male, Tutoko Bench FD, 9–15 Jan 1977; 44 female, Tutoko V. FD, 15 Jan 1977.



(45–47) *Physetica longstaffi*: 45 male, Flagstaff DN, 14 Mar 1915; 46, 47 females, Tapanui no. 2, Blue Mts SL, 15 Mar 1986; (48–50) *P. phricias*: 48 male, Craigieburn Ra. MC, 30 Mar 1985; 49 male, Kiwi Bush MC, 17 Feb 1924; 50 female, Skippers Saddle OL, 2 Apr 1989.



(51–53) *Phytetica prionistis*: 51 male, Queenstown 14 May(?) 1912; 52 male, Mt Te Aroha BP, 27–28 Jan 2010; 53 Tisbury SL 20 Apr 1912; (54–56) *P. sequens*: 54 male, Mt Cook Village MK, 9 Jan 2006; 55 male, Ahipara Plateau ND, 8 Nov 2007; 56 female, Rangipo Desert TO, 8 Dec 2009.



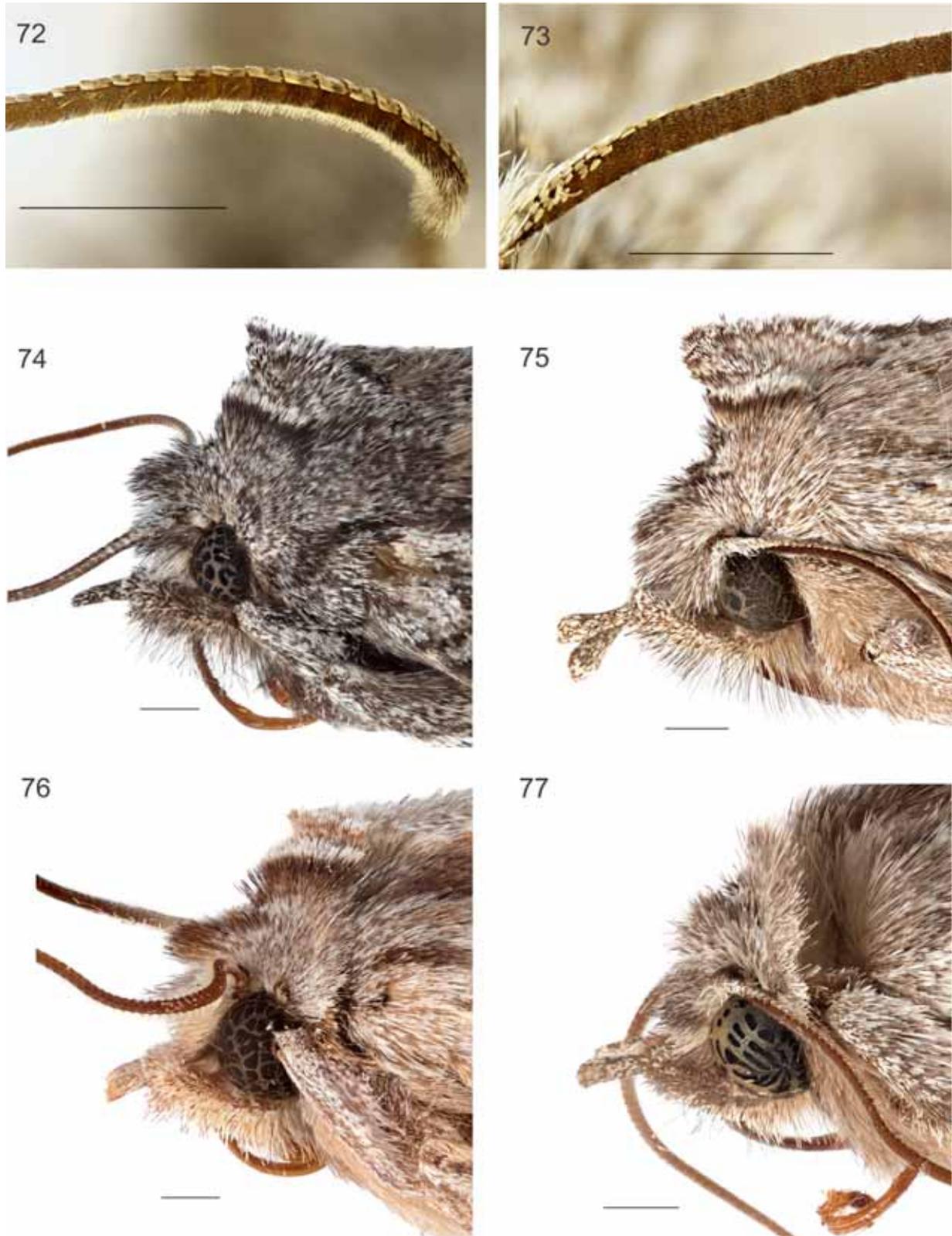
**Figs 57–60:** *Physetica sequens*: 57 female, Puketi Forest ND, 5 Feb 2006; 58 female, Rangipo Desert TO 8 Dec 2007; 59 female, Waipakihi TO, 9 Dec 1985; 60 female, Rangipo Desert TO, 8 Dec 2009.



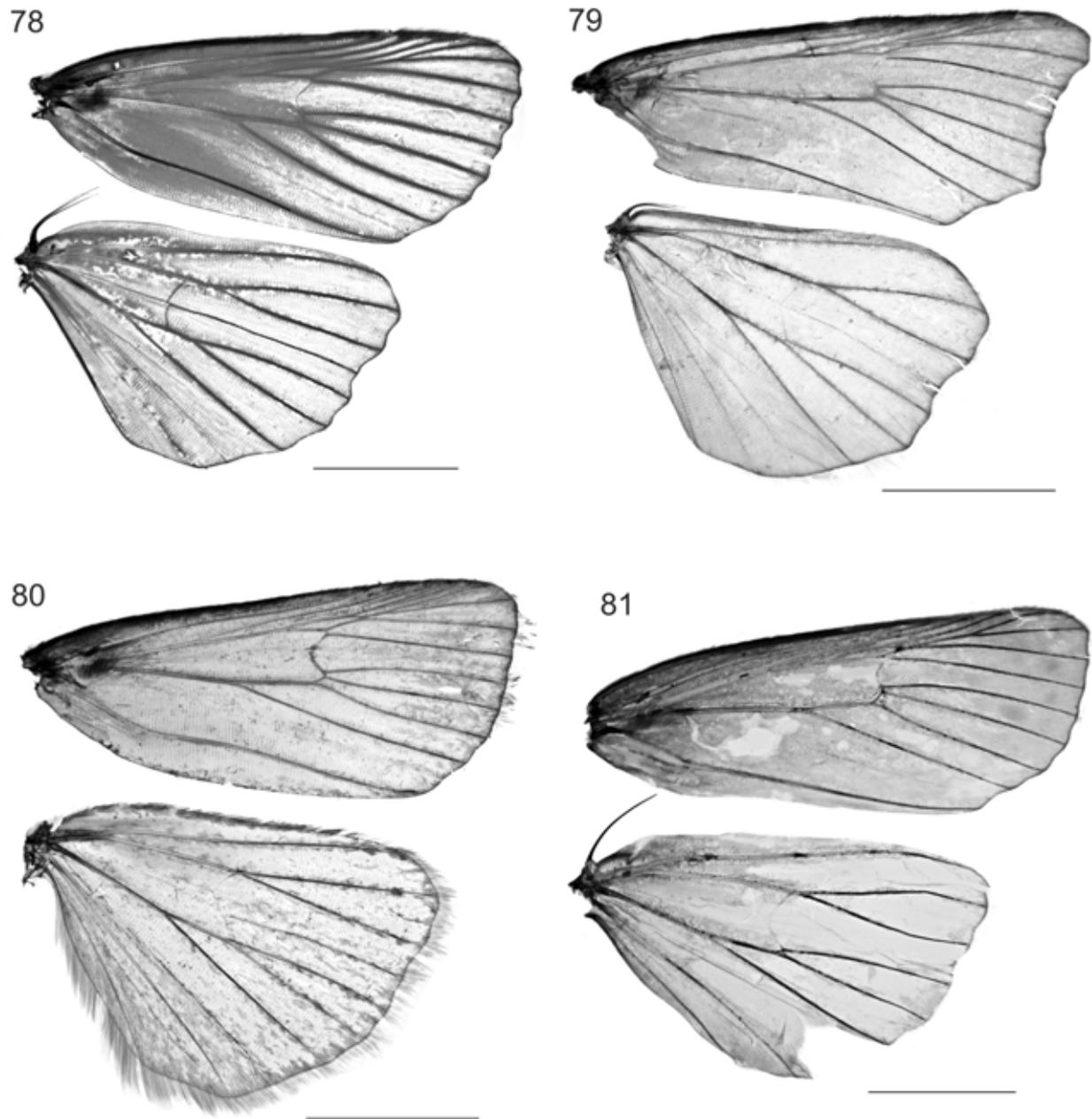
**Figs 61-71:** Adult heads, lateral view (automontage photographs by B.E. Rhode, scale bars 1 mm): 61 *Austramathes purpurea* female; 62 *A. fortis* male; 63 *A. pessota* male; 64 *Cosmodes elegans* male; 65 *Proteuxoa tetronycha* female.



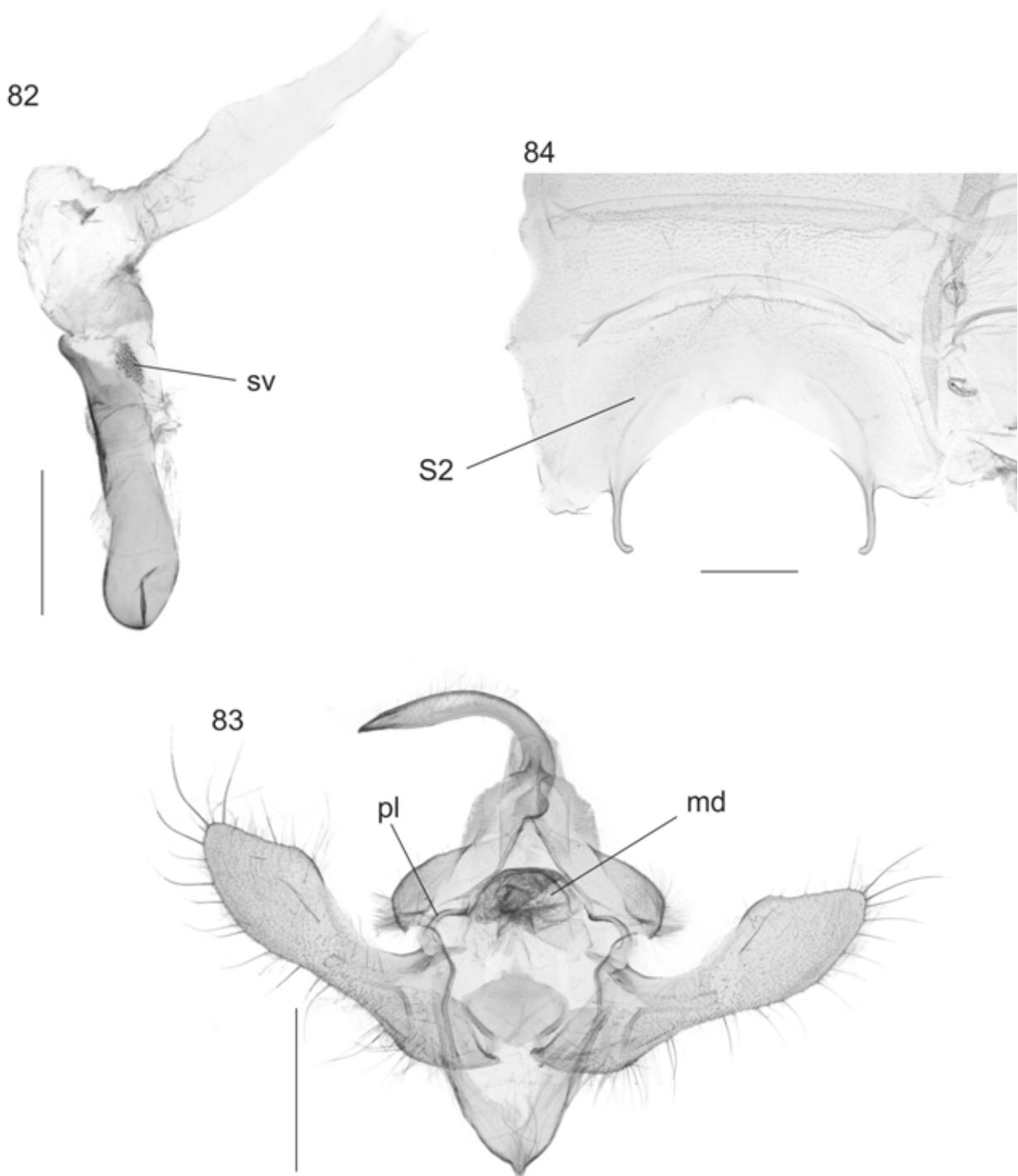
66 *Physetica caerulea* male; 67 *P. caerulea* female; 68 *P. homoscia* female; 69 *P. temperata* female; 70 *P. cucullina* male; 71 *P. funerea* male.



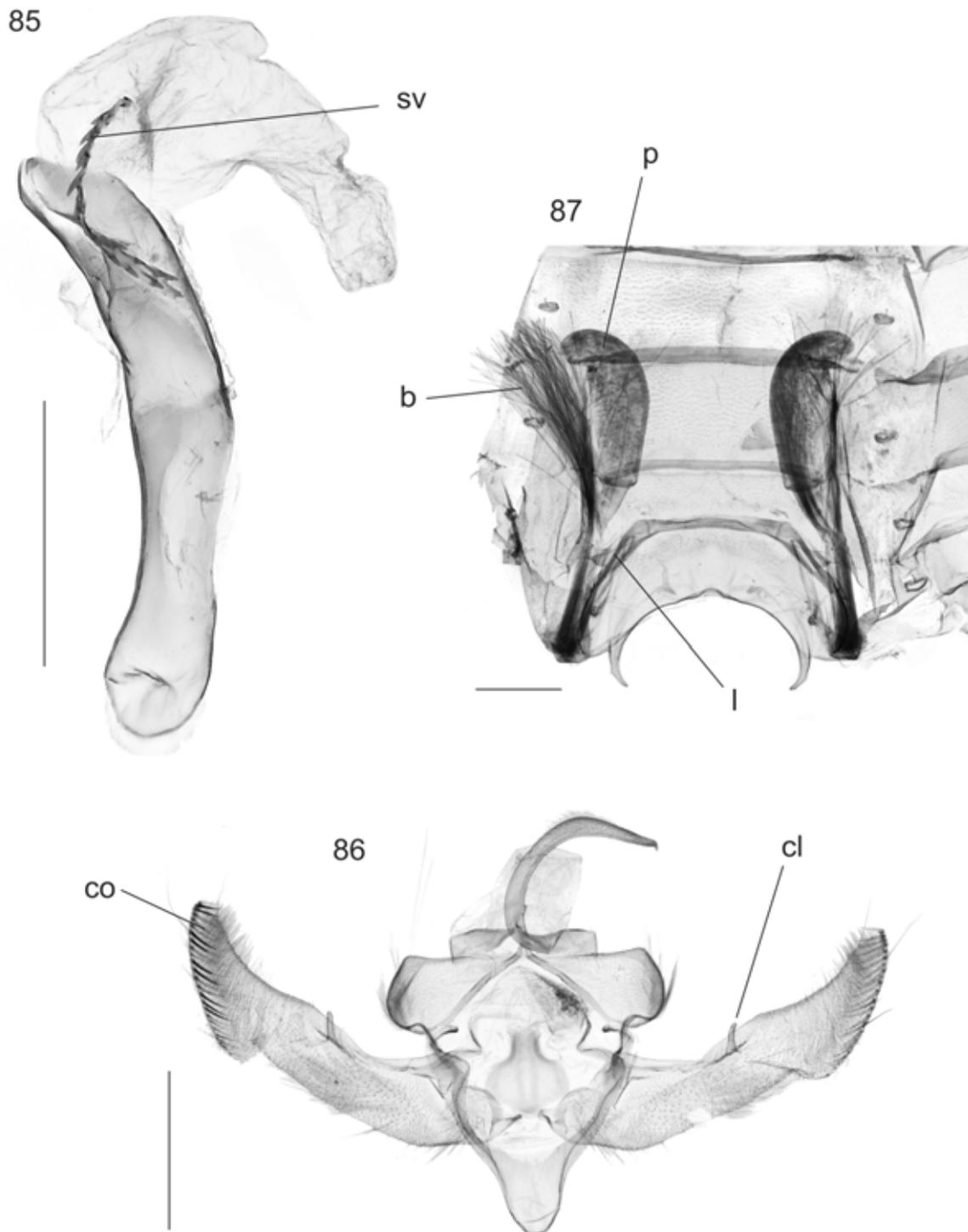
**Figs 72–77:** Adult antennae (frontal view), heads (lateral view) (scale bars 1 mm), *Physetica*: (72, 73) antennae: 72 *P. cucullina* male; 73 *P. funerea* male; (74–77) heads: 74 *P. longstaffi* female; 75 *P. phricias* male; 76 *P. prionistis* male; 77. *P. sequens* male.



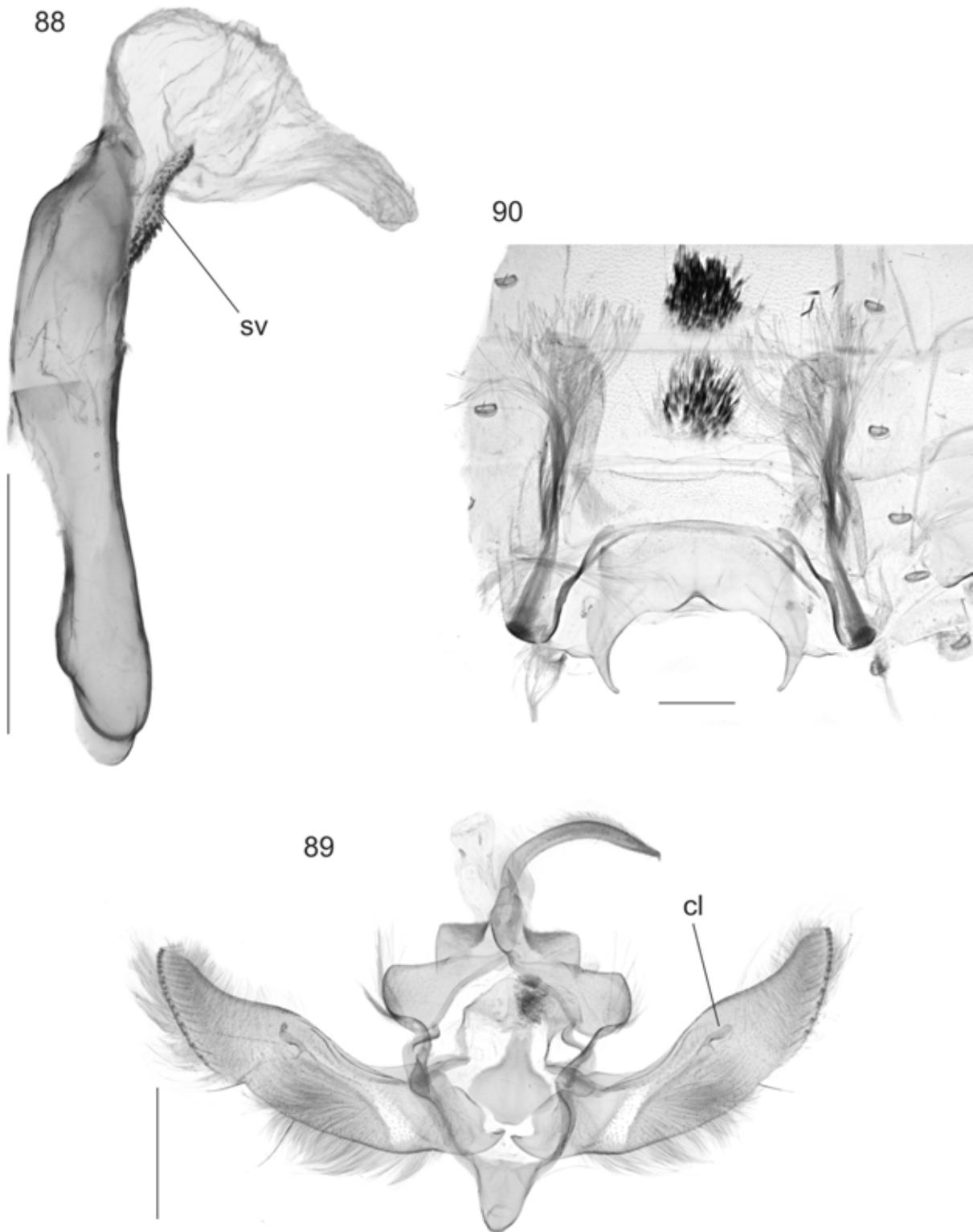
**Figs 78–81:** Wing venation (automontage photographs by B.E. Rhode, scale bars 5 mm): 78 *Austramathes purpurea* female; 79 *Cosmodes elegans* female; 80 *Proteuxoa tetronycha* male; 81 *Physetica caerulea* male.



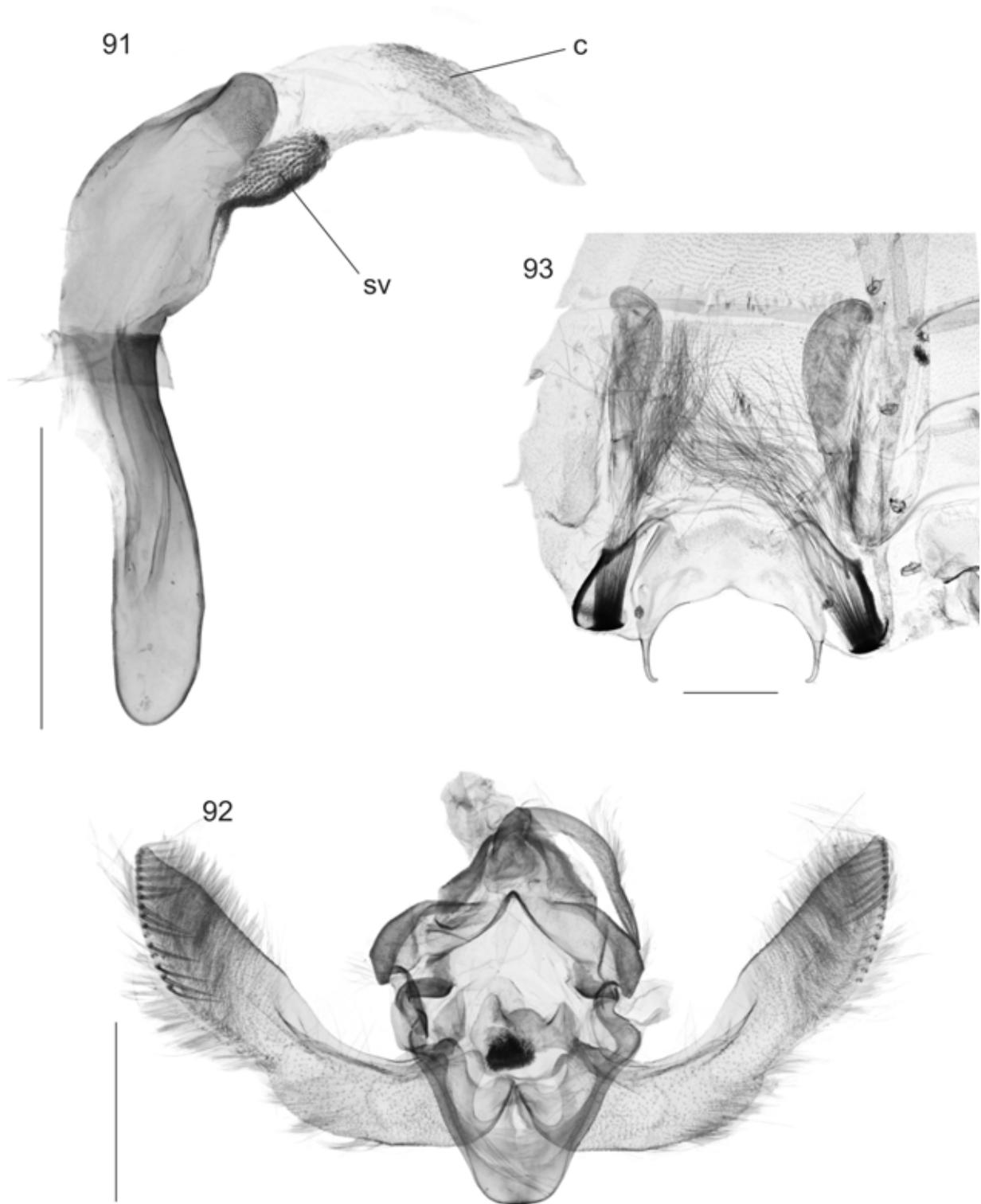
**Figs 82–188:** Male and female abdominal structures and genitalia (automontage photographs by B.E. Rhode, scale bars 1 mm). (82–84) Male abdomen and genitalia, *Austramathes purpurea*: 82 phallus; 83. genital capsule; 84 abdominal base. (md, dorsal papillate field of manica; pl, paratergal sclerite; sv, subbasal sclerite of vesica.)



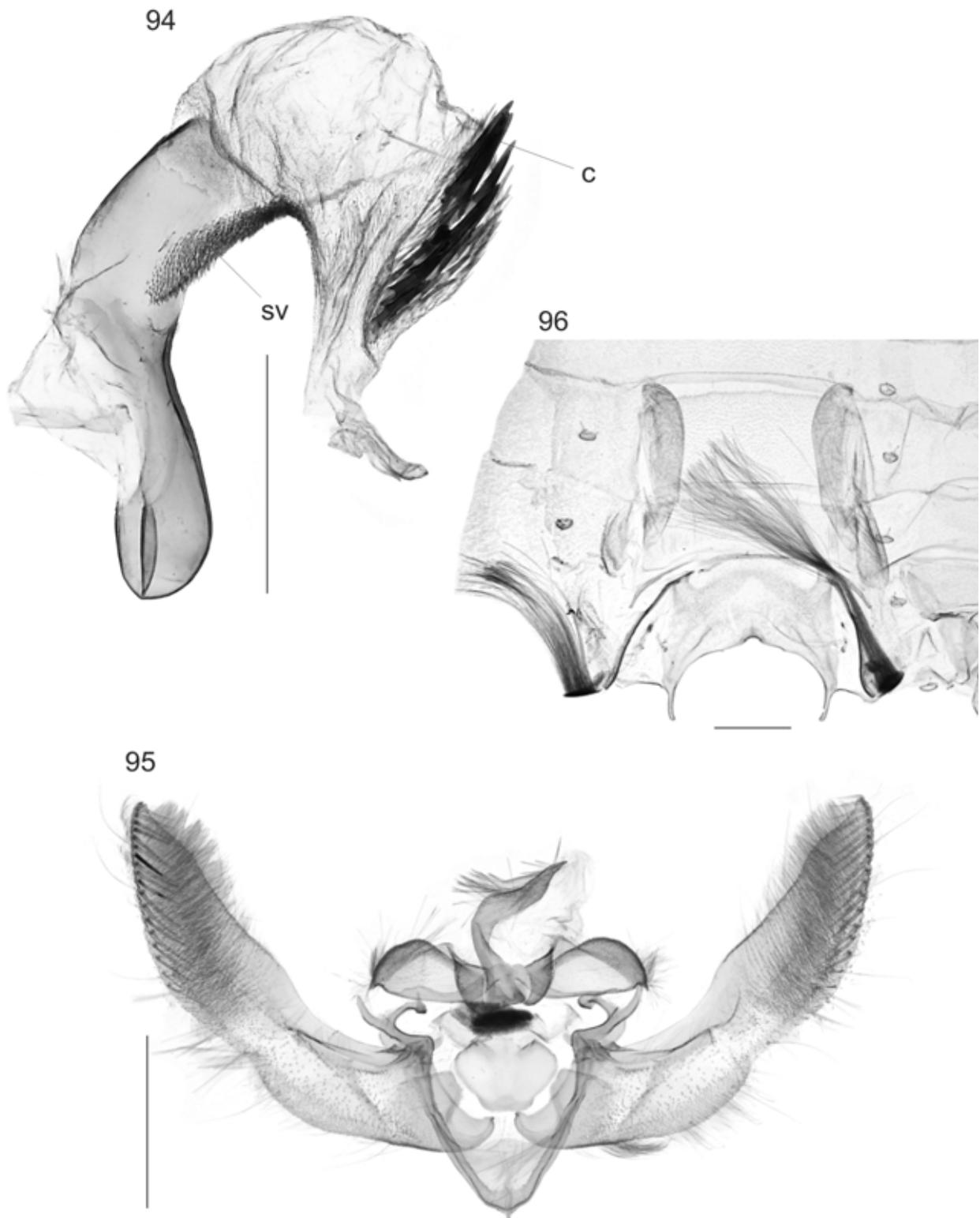
(85–87) Male abdomen and genitalia, *Austramathes fortis*: 85. phallus; 86. genital capsule; 87 abdominal base. (b, brush; cl, clasper; co, corona; l, lever; p, pocket; sv, subbasal sclerite of vesica.)



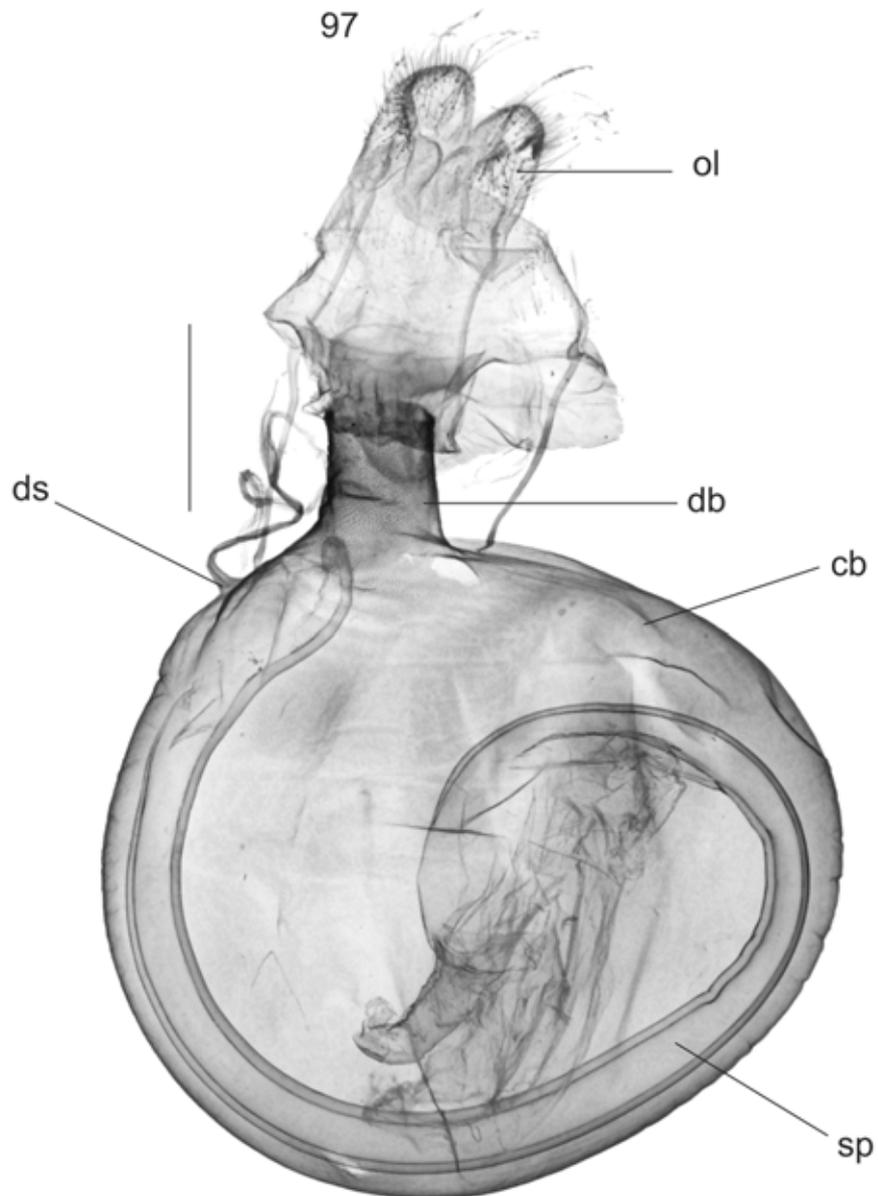
(88–90) Male abdomen and genitalia, *Austramathes squaliolus*: 88 phallus; 89 genital capsule; 90 abdominal base. (cl, clasper; sv, subbasal sclerite of vesica.)



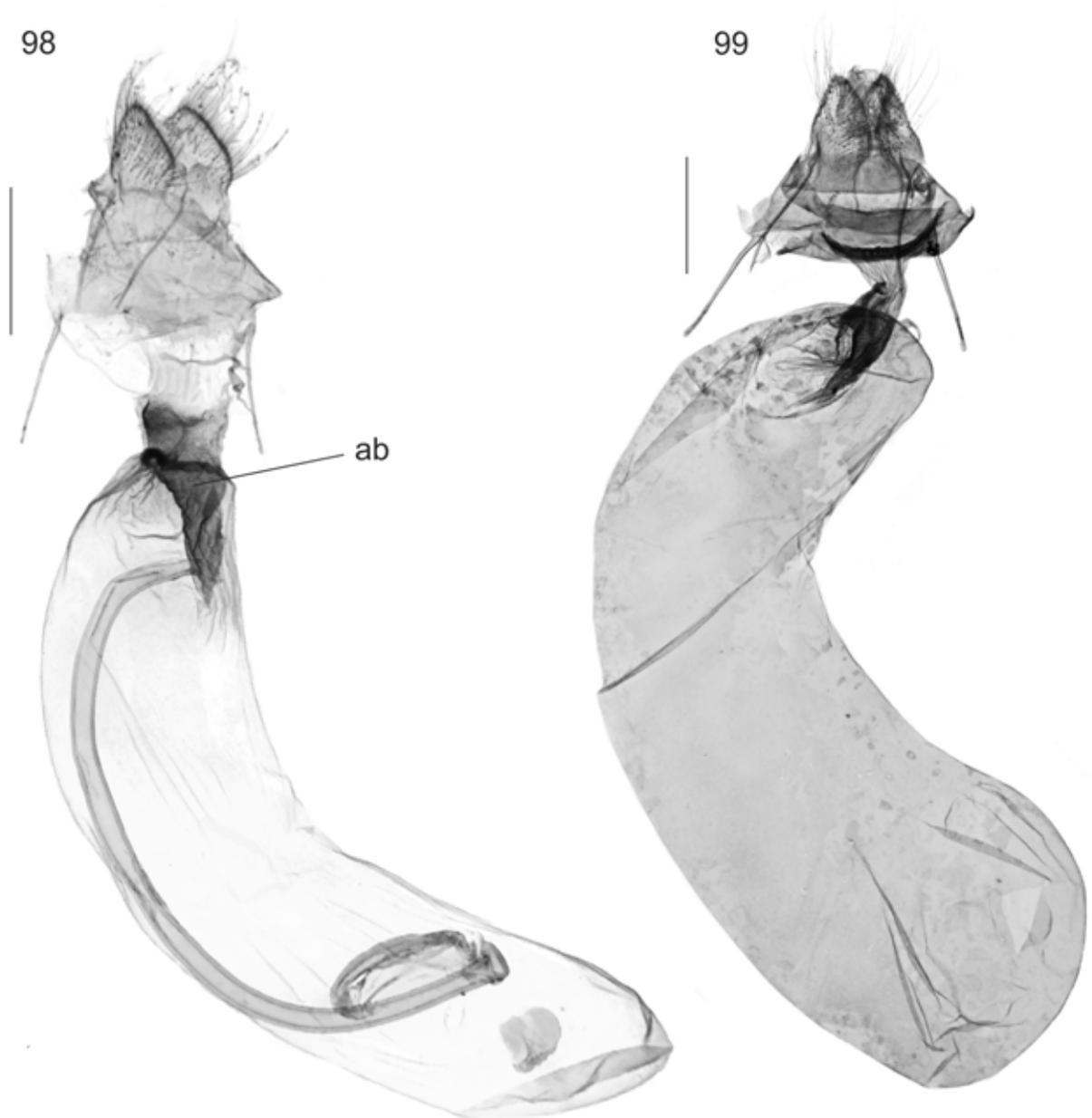
(91–93) Male abdomen and genitalia, *Austramathes coelacantha*: 91 phallus; 92 genital capsule; 93 abdominal base. (c, reduced cornuti; sv, subbasal sclerite of vesica.)



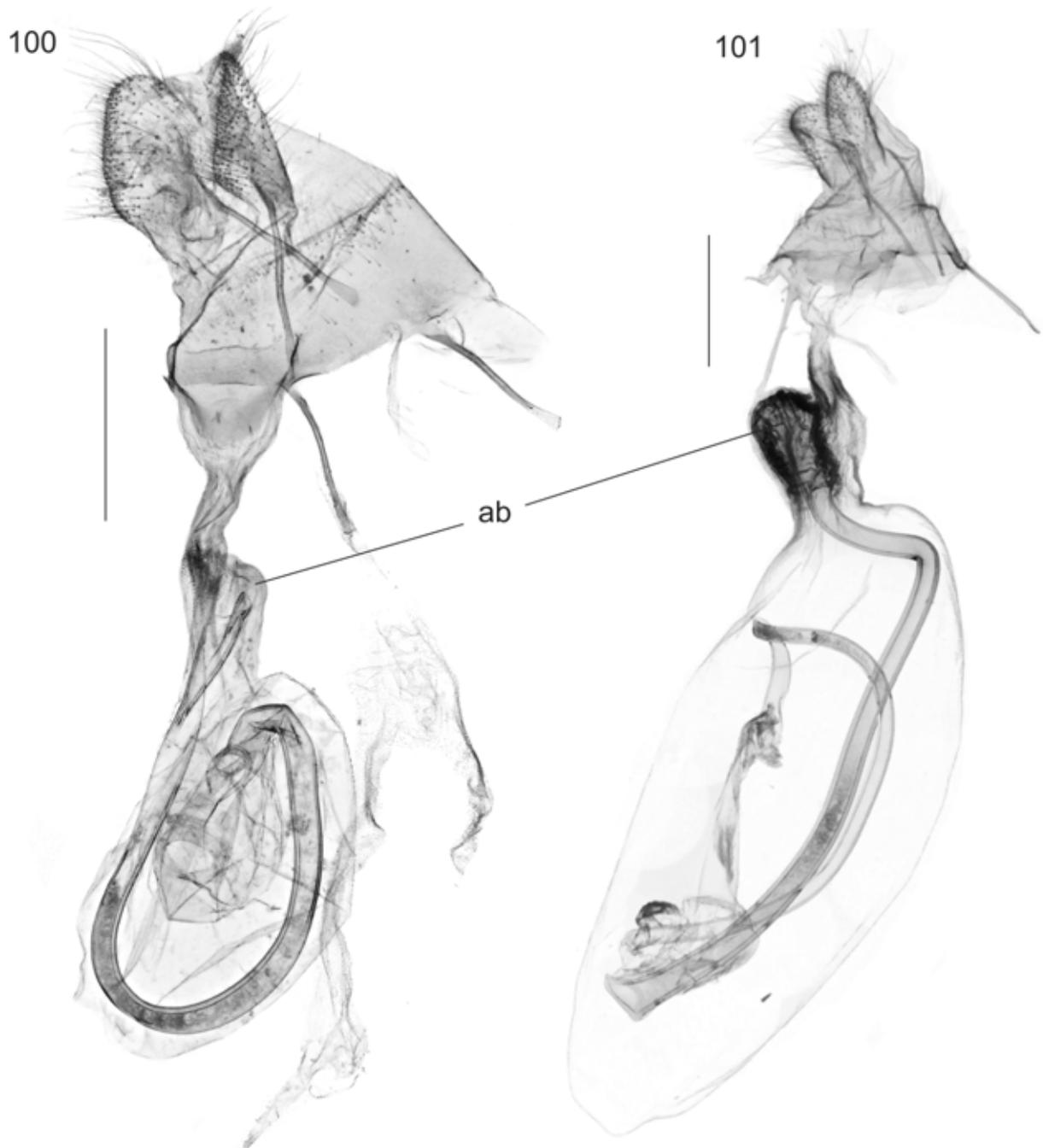
(94–96) Male abdomen and genitalia, *Austramathes pessota*: 94 phallus; 95 genital capsule; 96 abdominal base. (c, cornuti; sv, subbasal sclerite of vesica.)



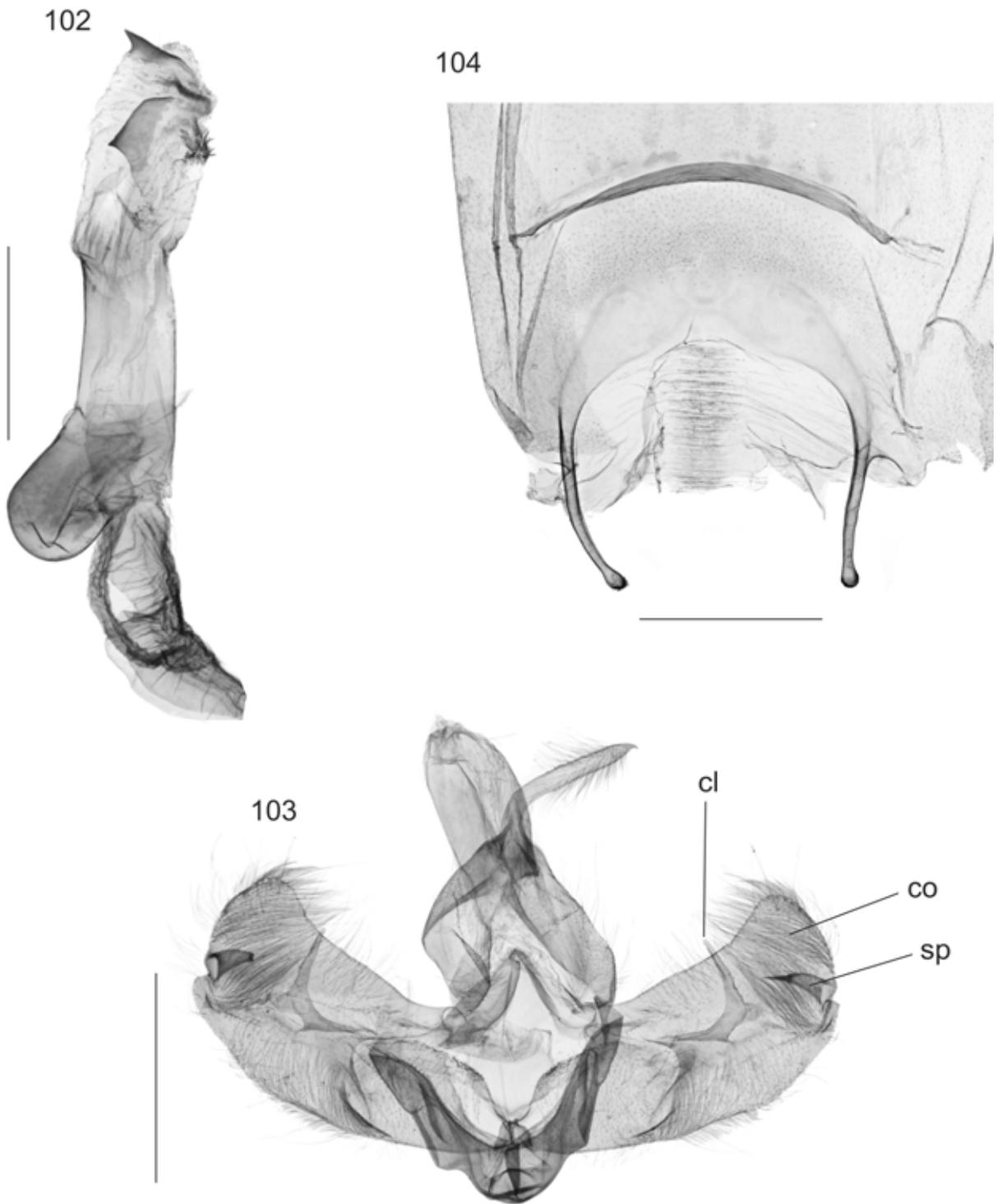
97 Female genitalia, *Austramathes purpurea*. (cb, corpus bursae; db, ductus bursae; ds; ductus seminalis inception; ol. ovipositor lobe; sp, spermatophore.)



(98, 99) Female genitalia, *Austramathes* spp.: 98 *A. fortis*; 99 *A. squaliolus*. (ab, appendix bursae.)



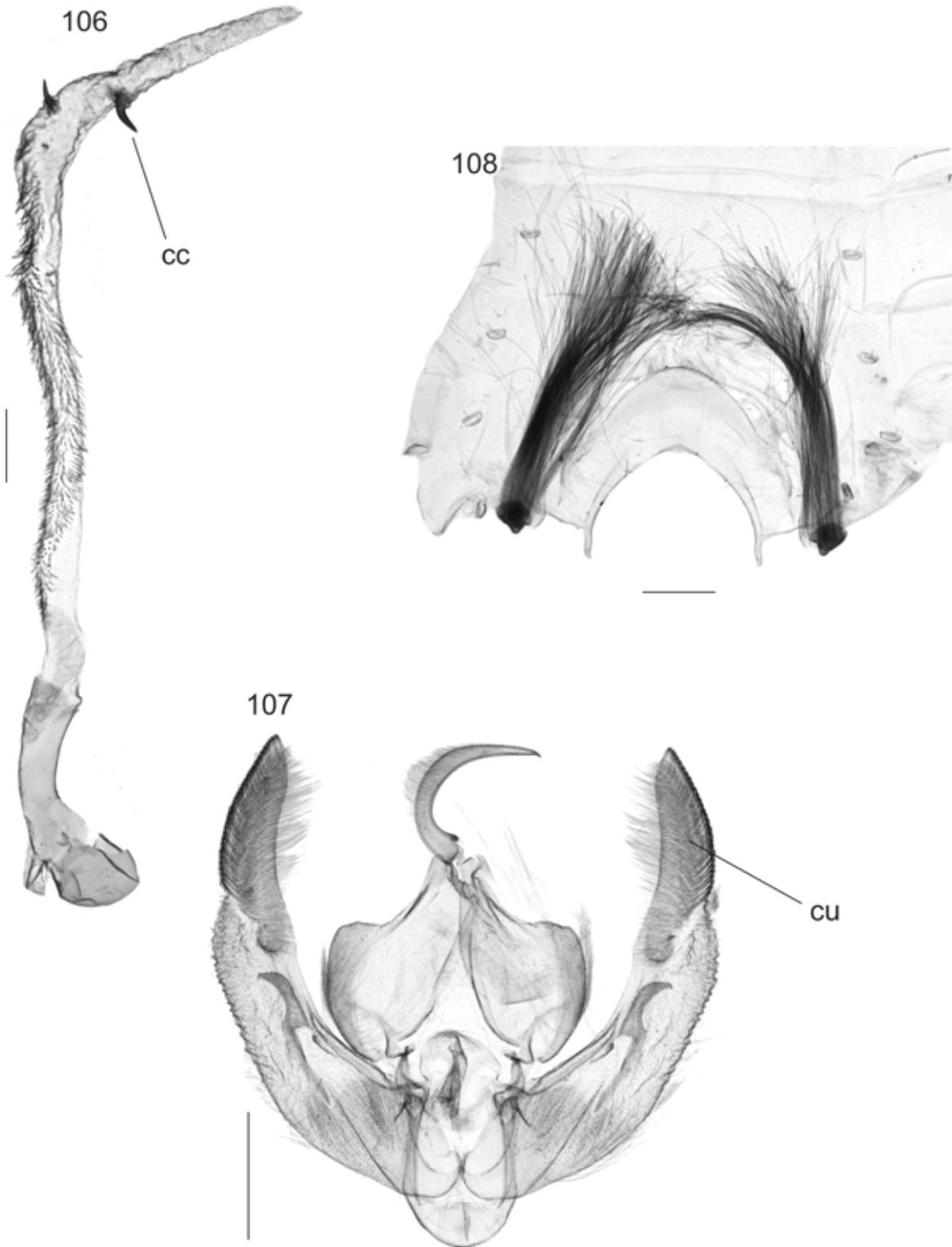
(100, 101) Female genitalia, *Austramathes* spp.: 100 *A. coelacantha*; 101 *A. pessota*. (ab, appendix bursae.)



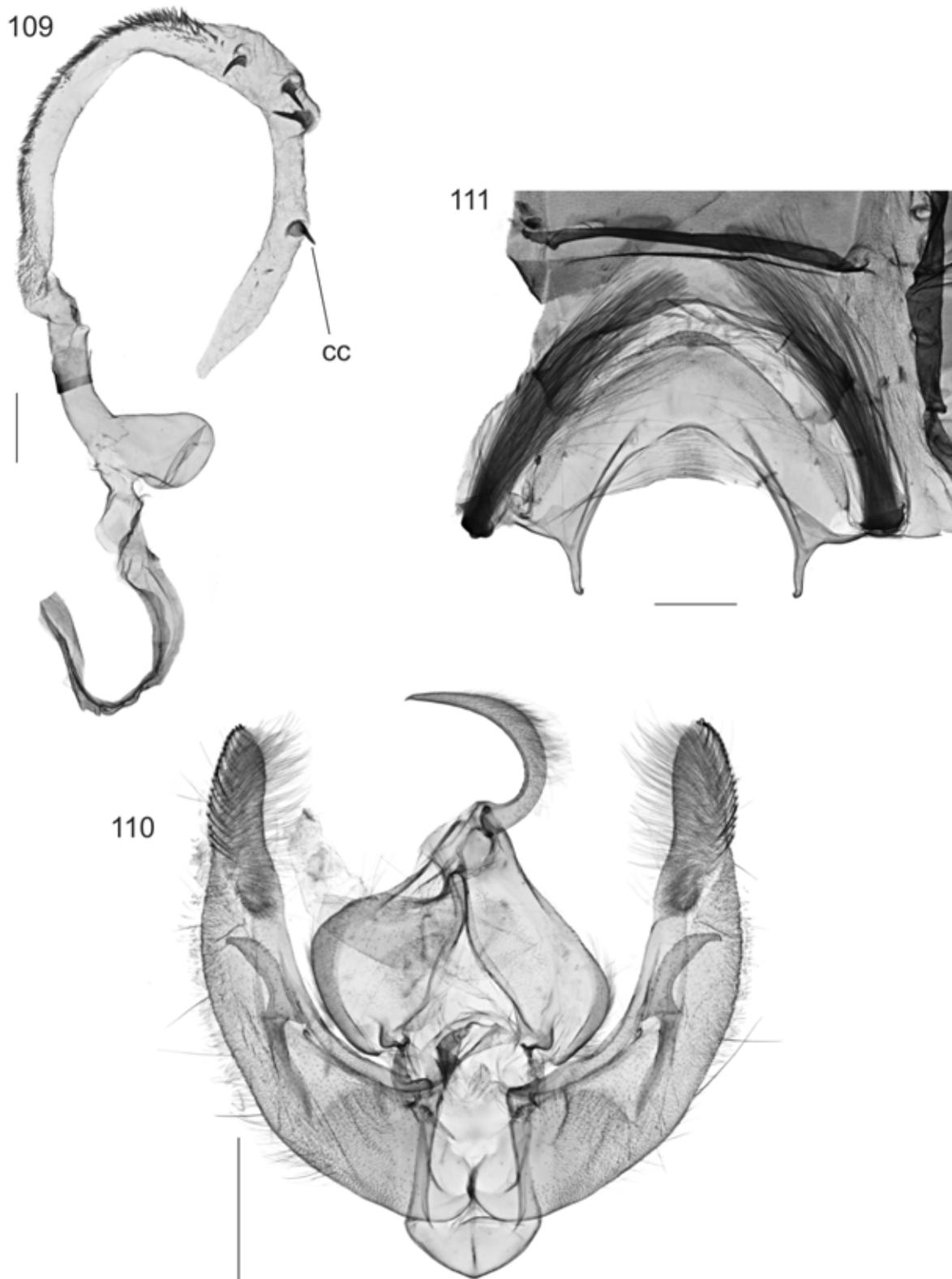
(102–104) Male abdomen and genitalia, *Cosmodes elegans*: 102 phallus; 103 genital capsule; 104 abdominal base. (cl, clasper; co, corona; sp, seta-bearing prominence.)



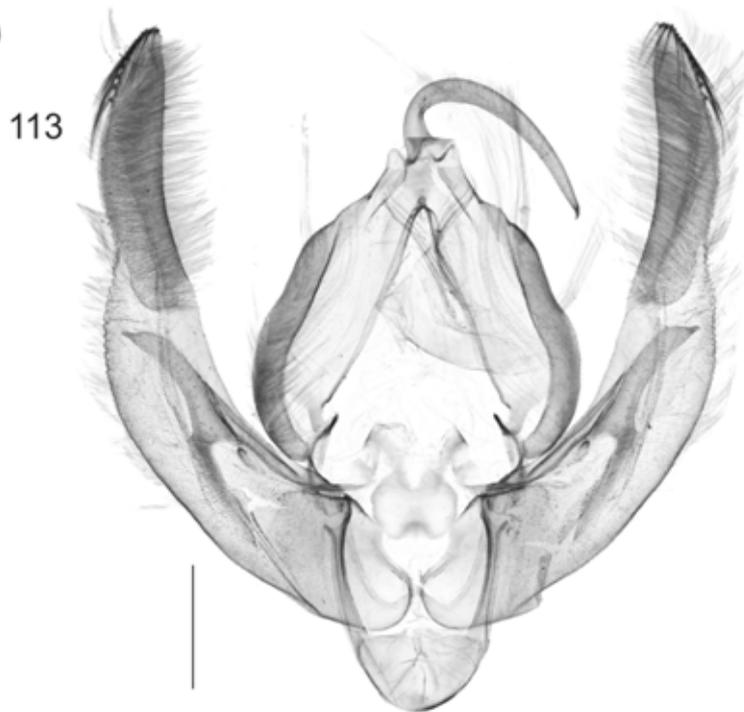
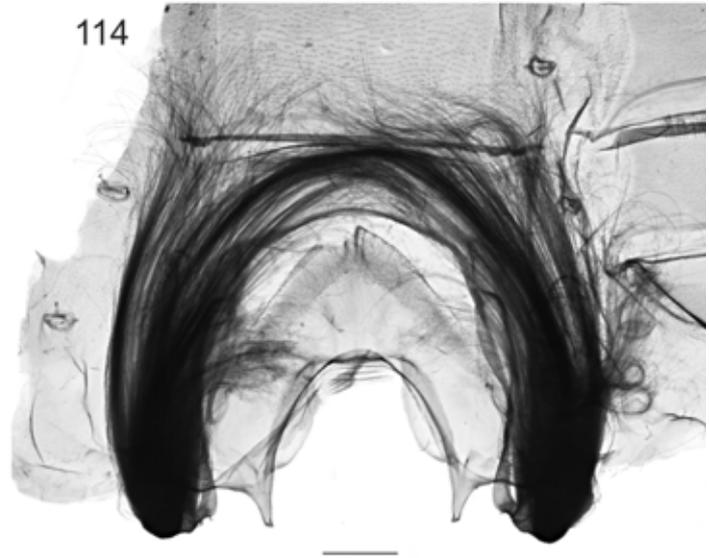
105 Female genitalia, *Cosmodes elegans*. (ds, ductus seminalis.)



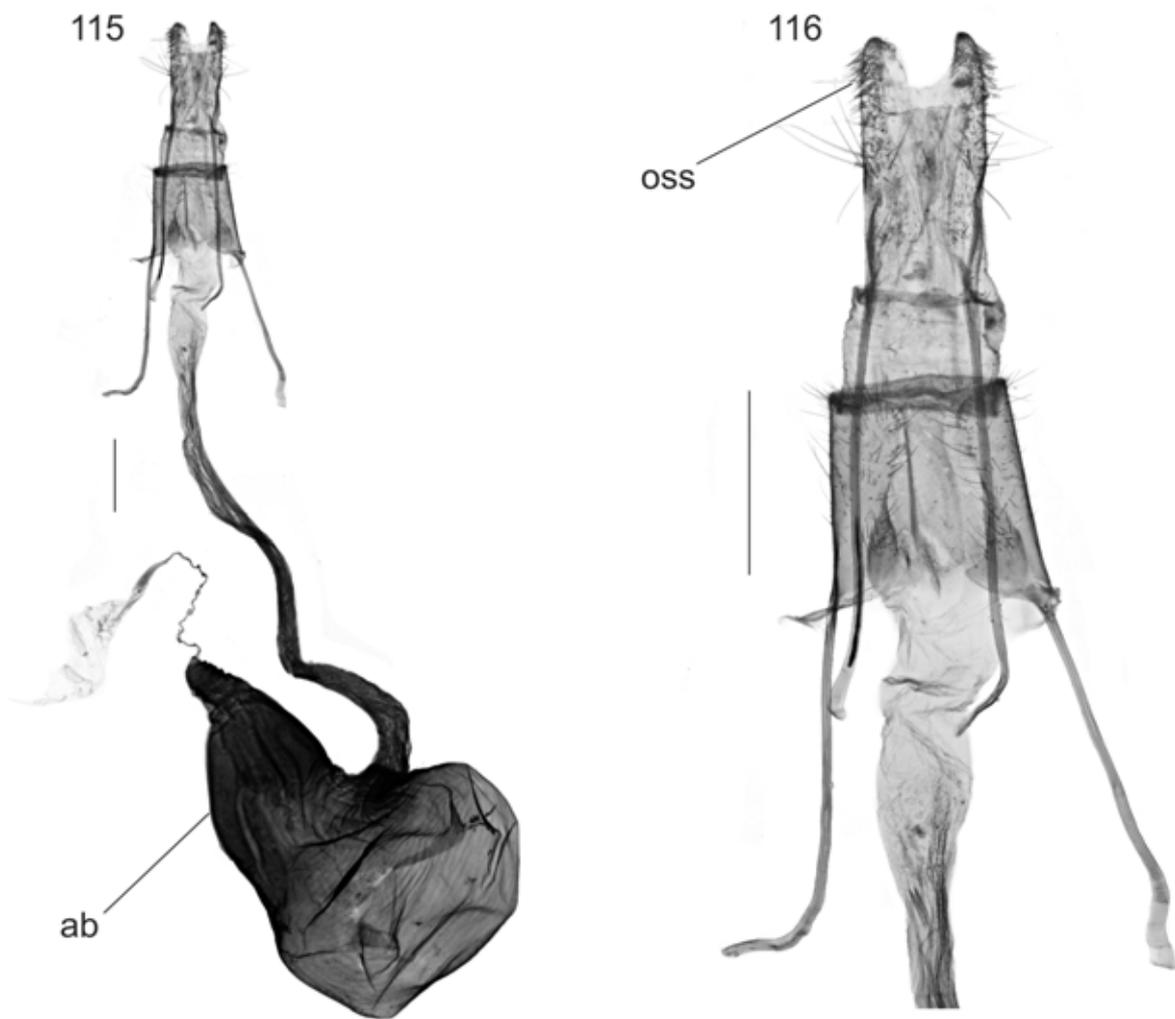
(106–108) Male abdomen and genitalia, *Proteuxoa comma*: 106 phallus; 107 genital capsule; 108 abdominal base. (cc, claw-like cornutus; cu, cucullus of valva.)



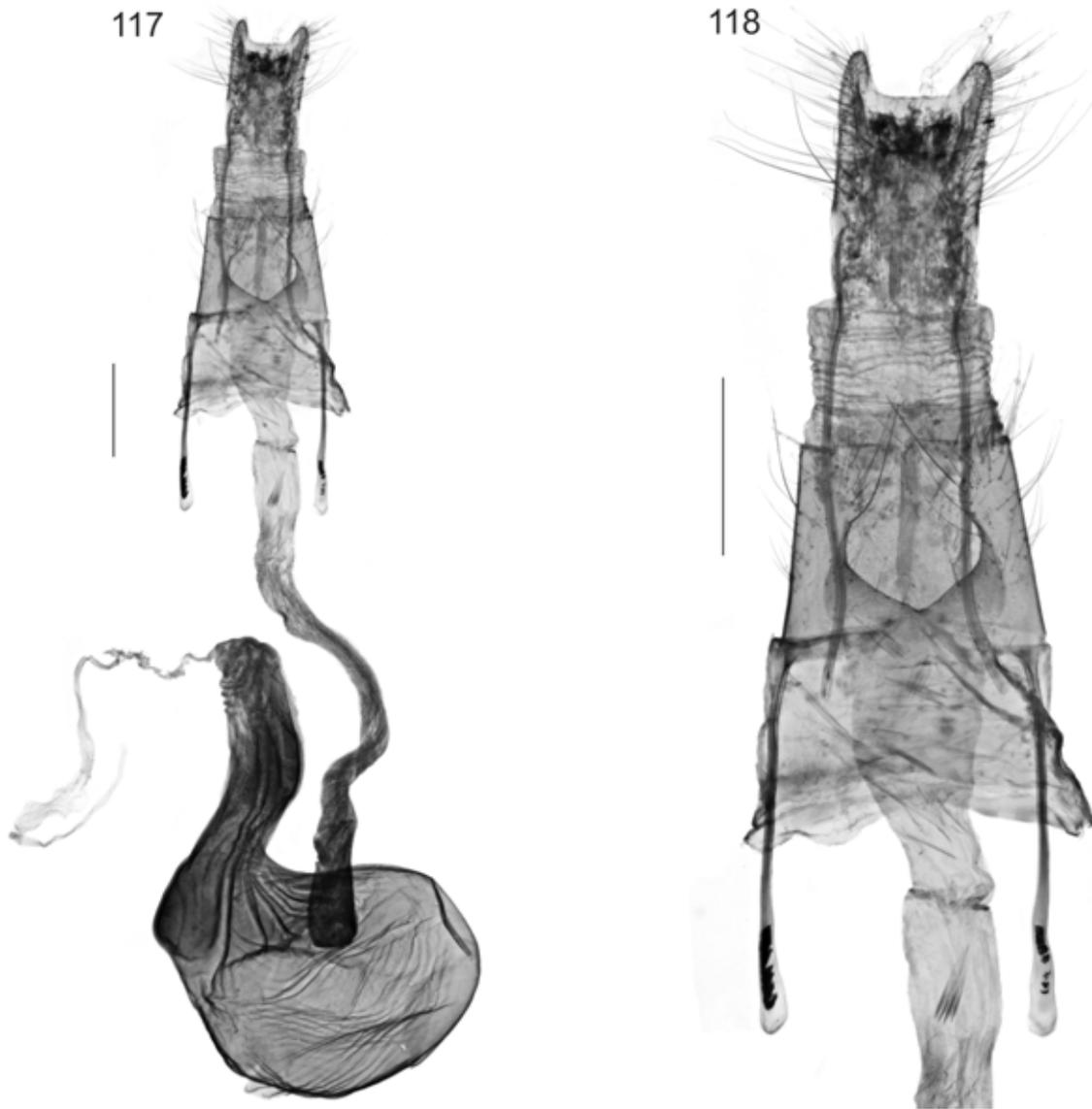
(109–111) Male abdomen and genitalia, *Proteuxoa tetronycha*: 109 phallus; 110 genital capsule; 111 abdominal base. (cc, claw-like cornutus.)



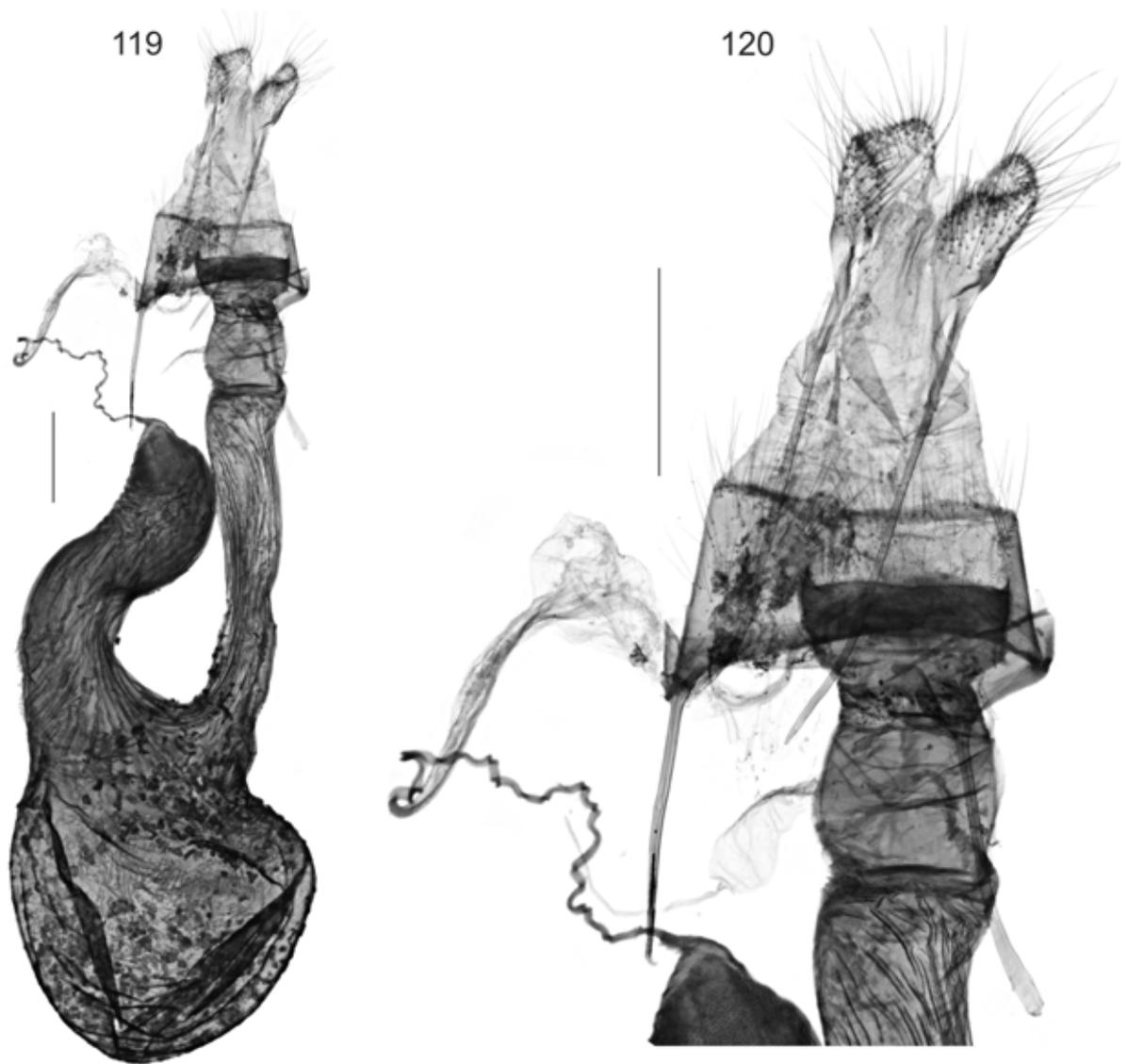
(112–114) Male abdomen and genitalia, *Proteuxoa sanguinipuncta*: 112 phallus; 113 genital capsule; 114 abdominal base.



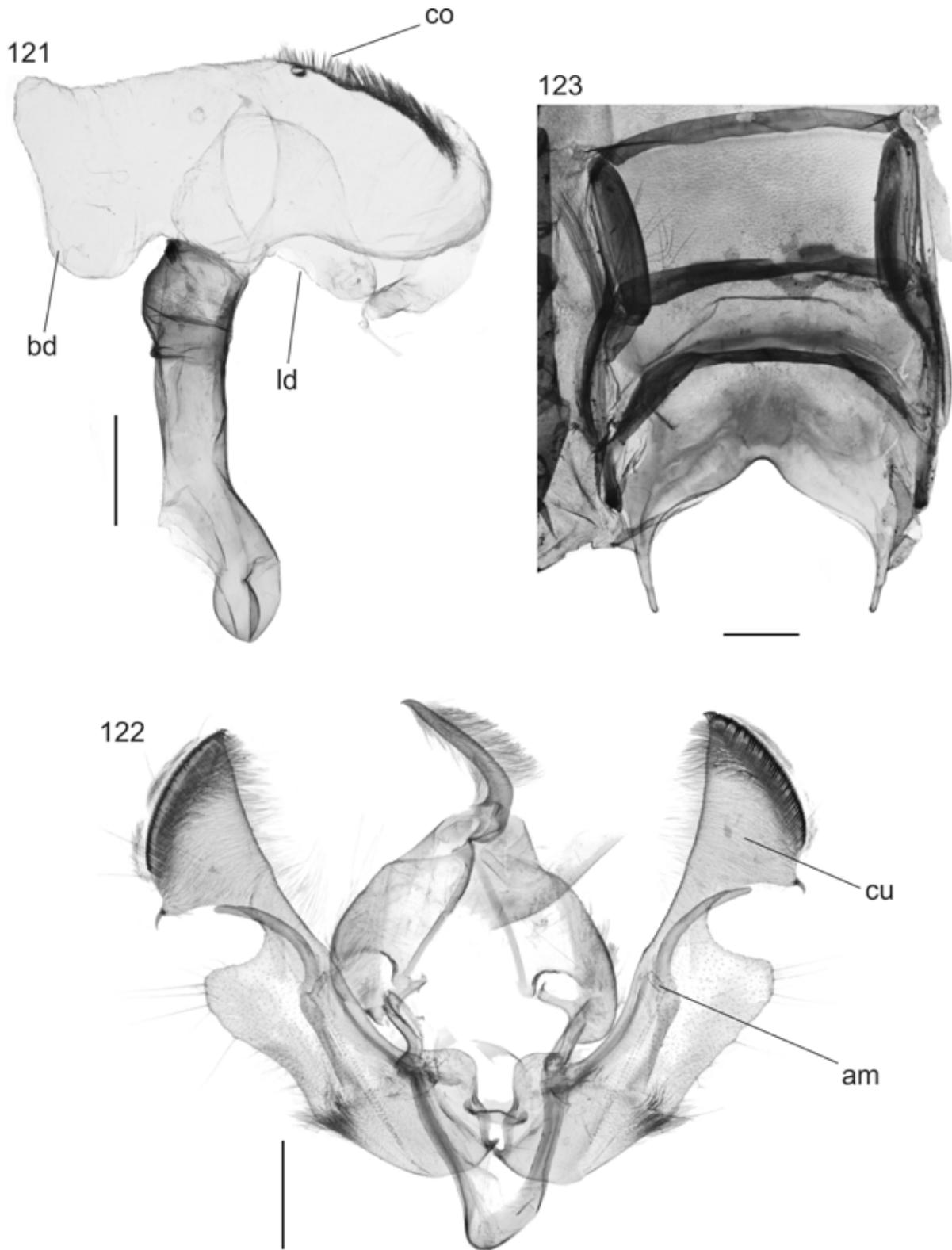
(115, 116) Female genitalia, *Proteuxoa comma*: 115 whole genitalia; 116 ovipositor. (ab, appendix bursae; oss, spinose setae of ovipositor.)



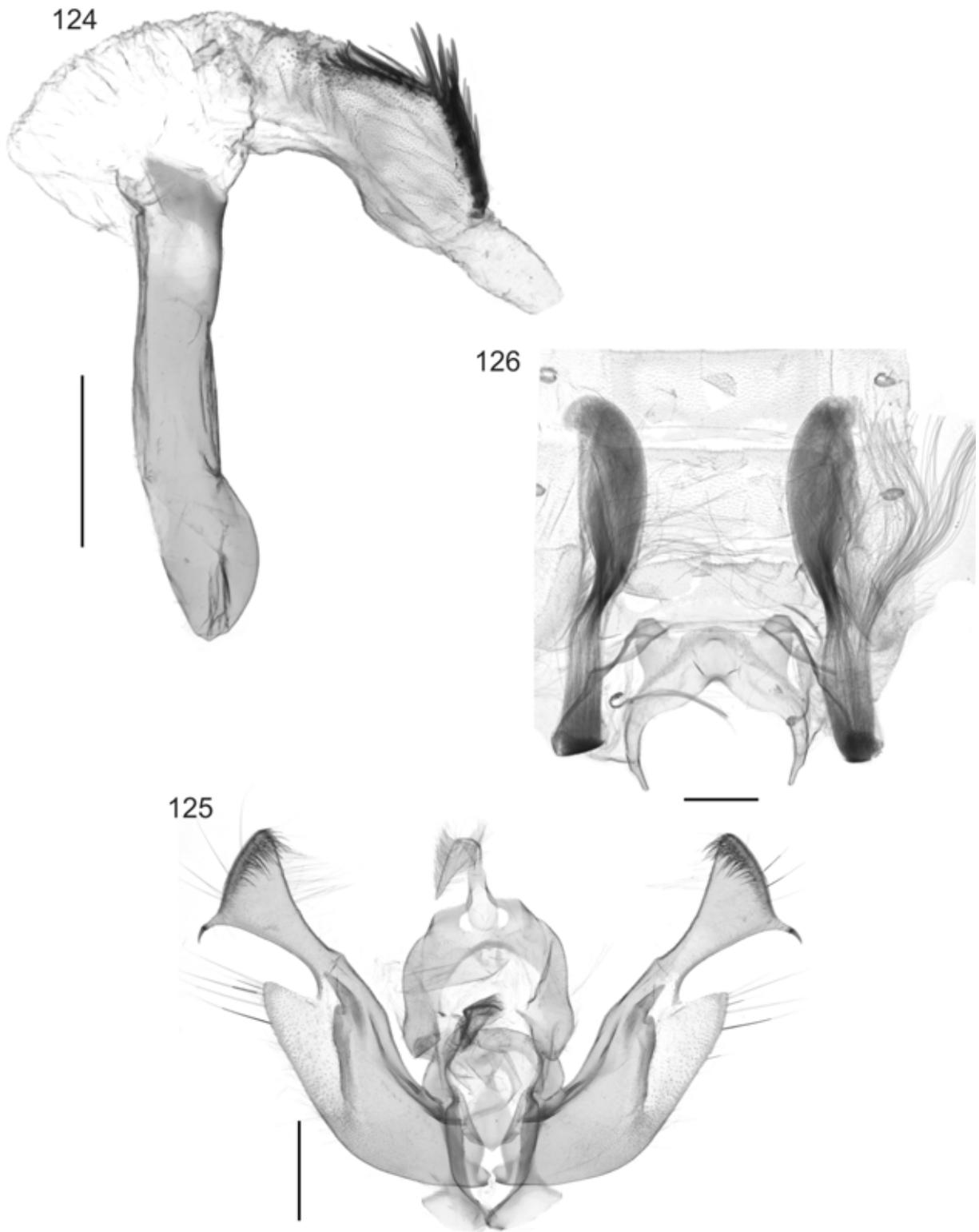
(117, 118) Female genitalia, *Proteuxoa tetronycha*: 117 whole genitalia; 118 ovipositor.



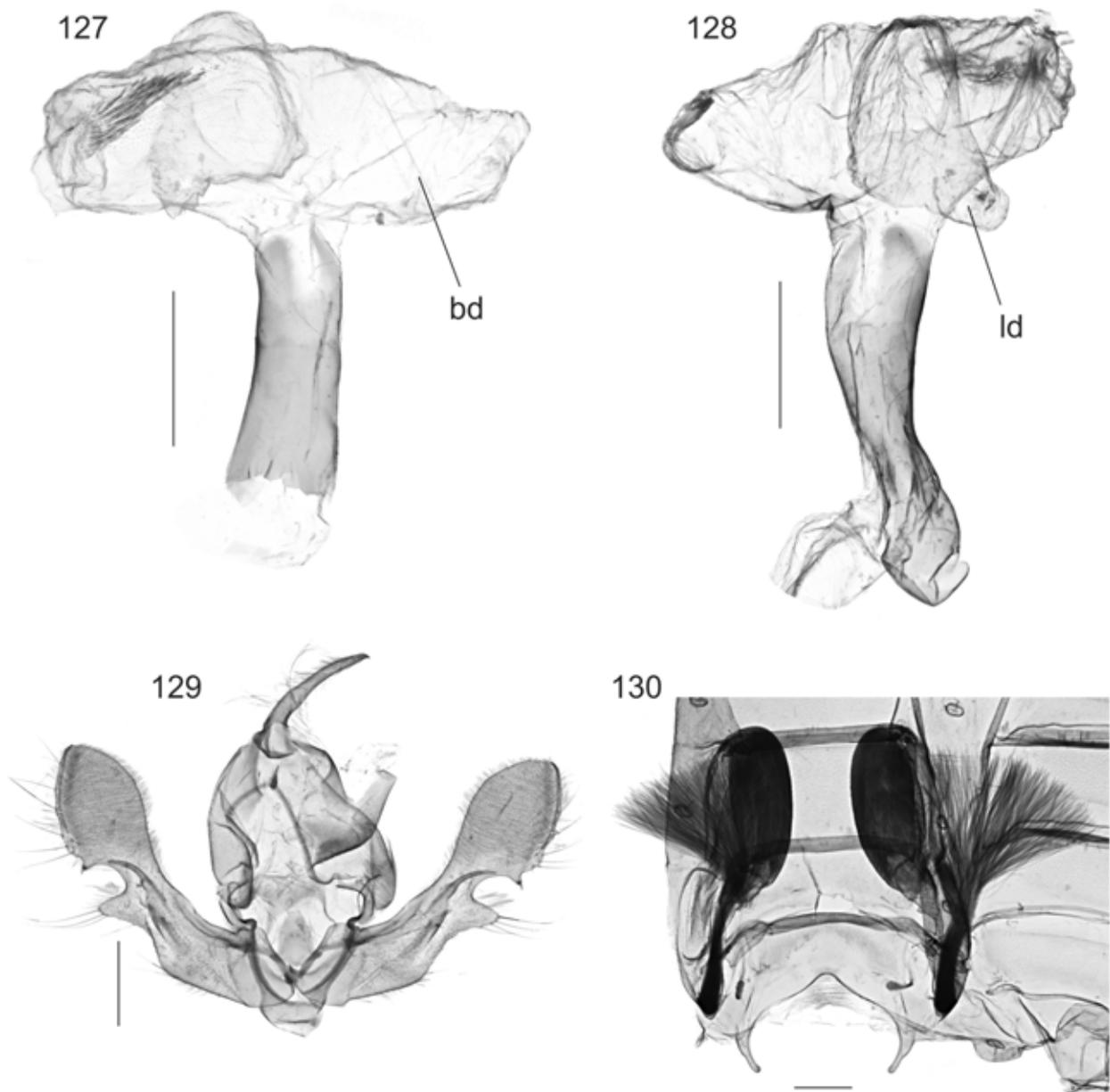
(119, 120) Female genitalia, *Proteuxoa sanguinipuncta*: 119 whole genitalia; 120 ovipositor.



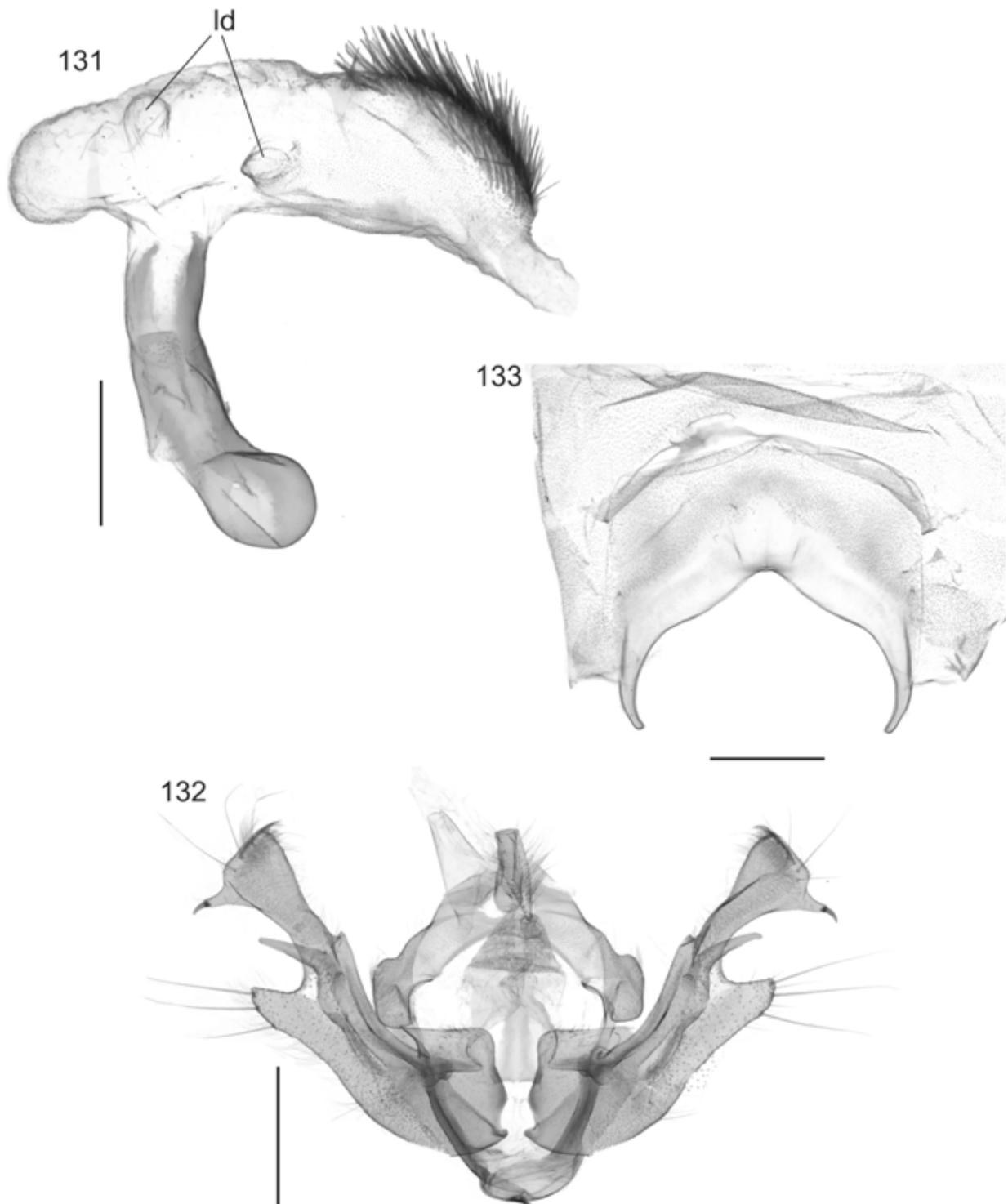
(121–123) male genitalia, *Phyetica caerulea*: 121 phallus; 122 genital capsule; 123 abdominal base. (am, ampulla; bd, basal diverticulum of vesica; cu, cucullus; ld, lateral diverticulum of vesica.)



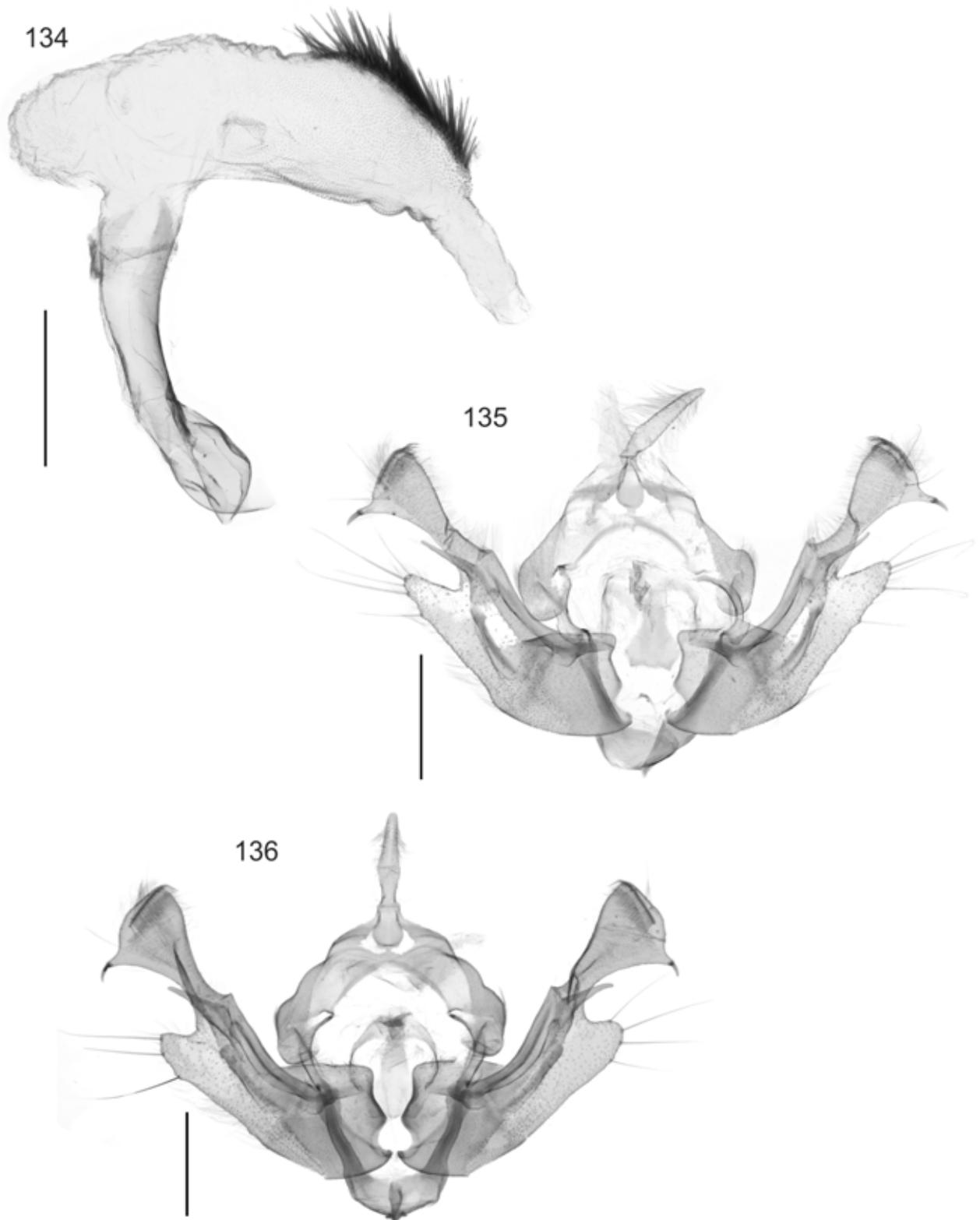
(124–126) Male abdomen and genitalia, *Phyetica homoscia*: 124 phallus; 125 genital capsule; 126 abdominal base.



(127–130) Male abdomen and genitalia, *Phyetica temperata*: 127 phallus (left lateral view); 128 phallus (right lateral view); 129 genital capsule; 130 abdominal base. (bd, basal diverticulum of vesica; ld, lateral diverticulum of vesica.)



(131–133) Male abdomen and genitalia, *Physetica cucullina*: 131 phallus; 132 genital capsule; 133 abdominal base. (ld, lateral diverticula of vesica.)



(134–136) Male abdomen and genitalia, *Physetica cucullina*: 134 phallus (2); 135 genital capsule (2); 136 genital capsule (3).

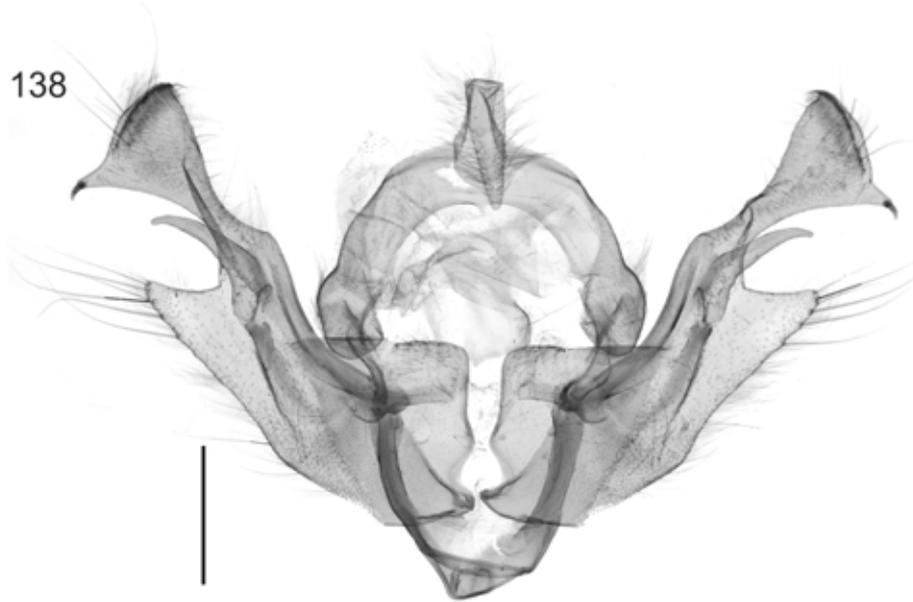
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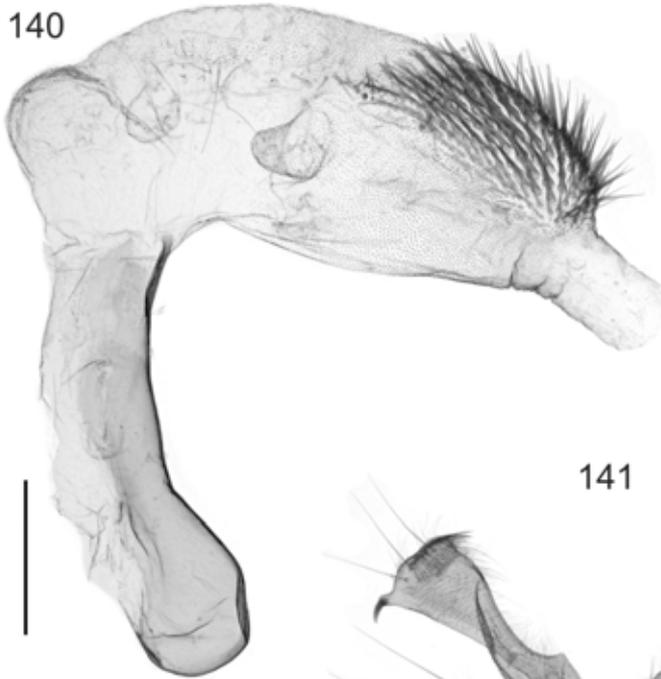
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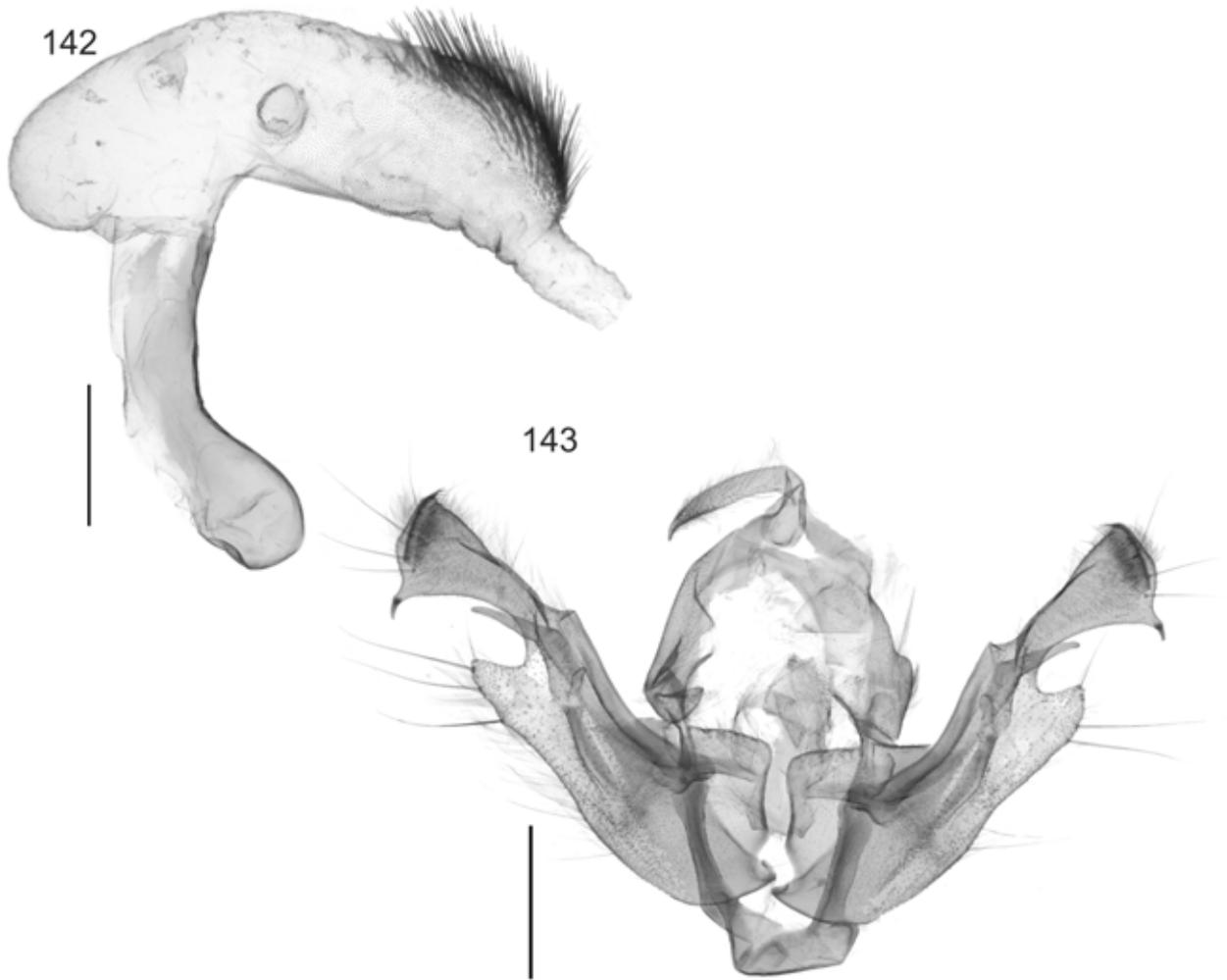
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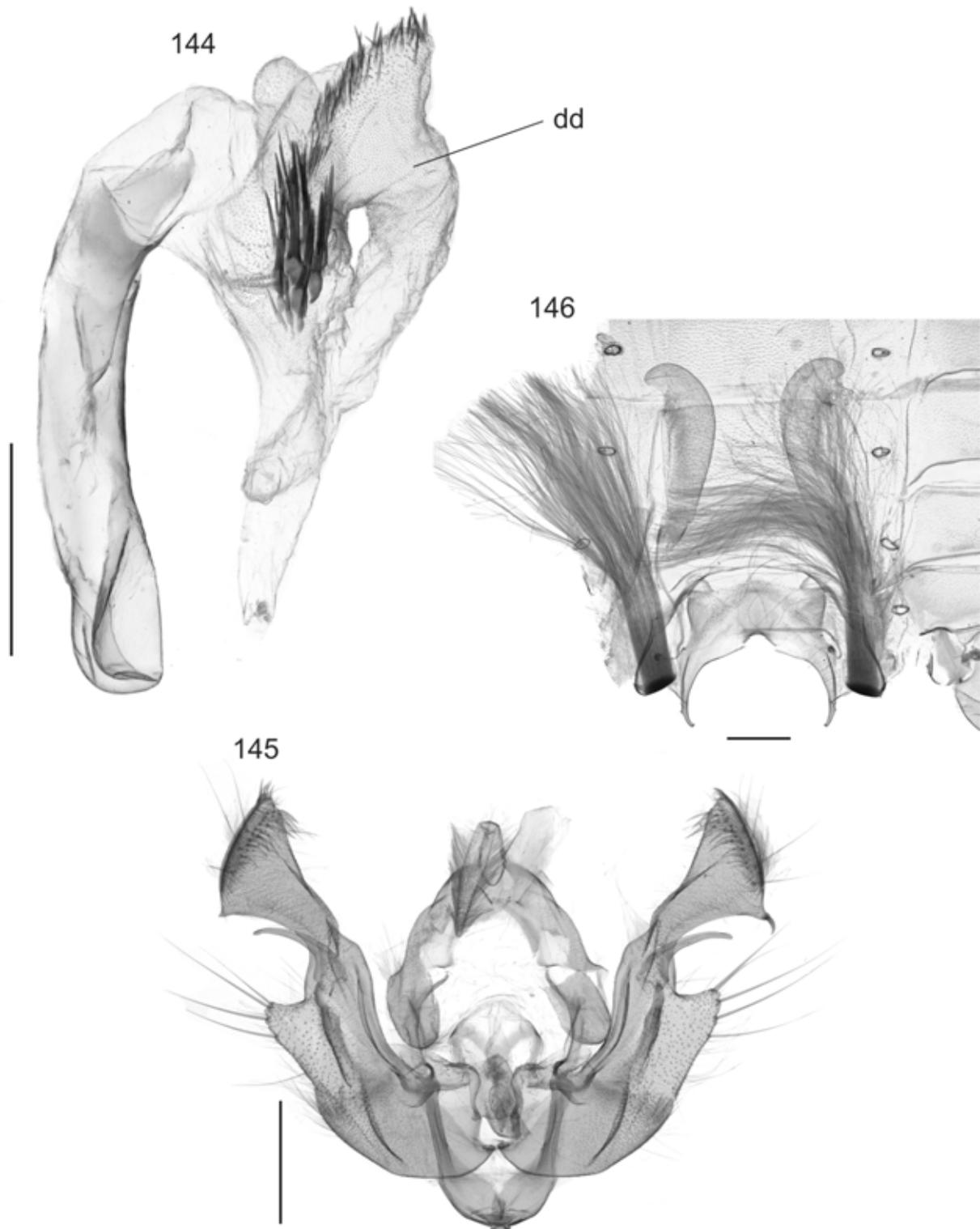
(137–139) Male abdomen and genitalia, *Phyetica funerea*: 137 phallus; 138 genital capsule; 139 abdominal base.



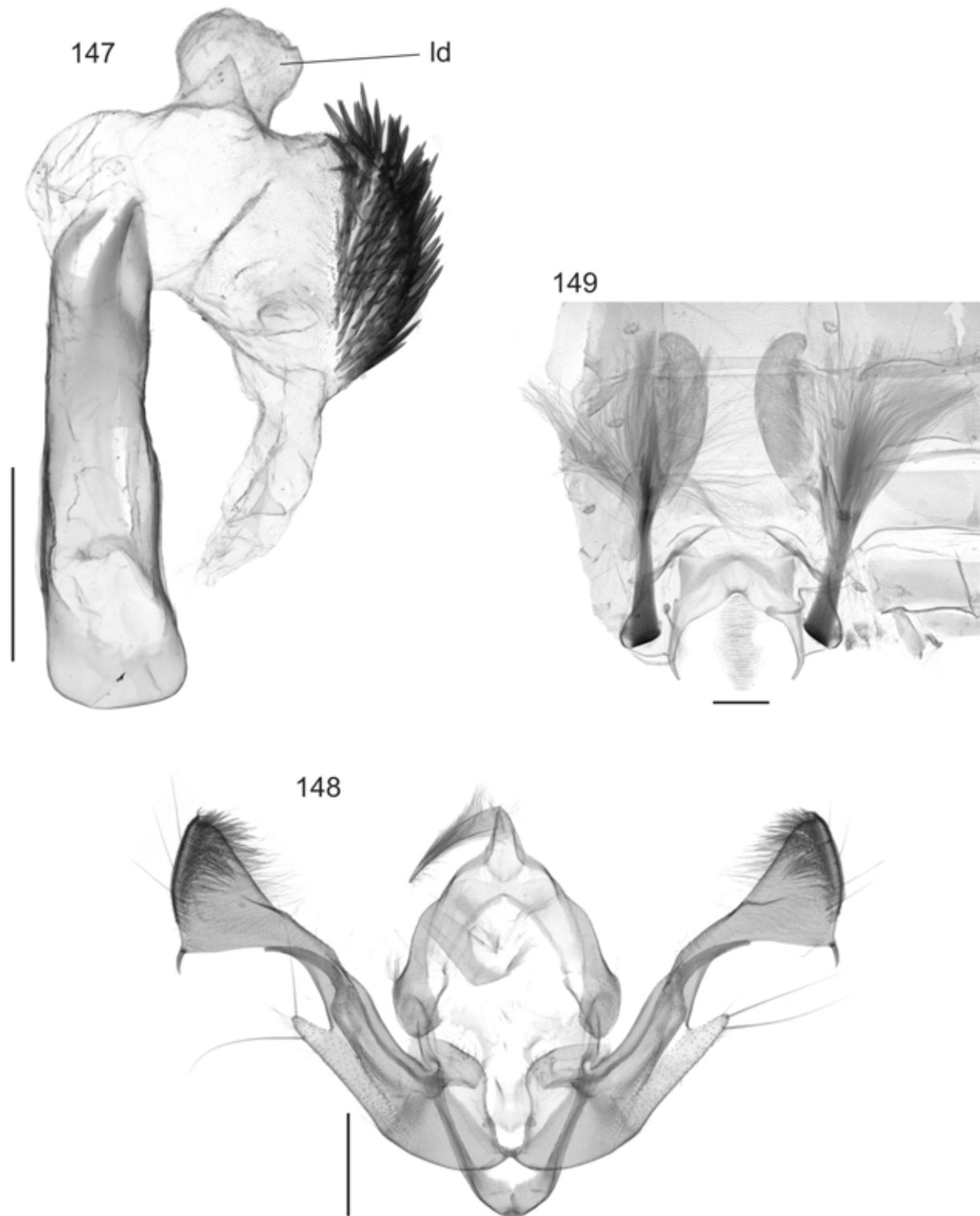
(140, 141) Male abdomen and genitalia, *Phyetica funerea*: 140 phallus (2); 141 genital capsule (2).



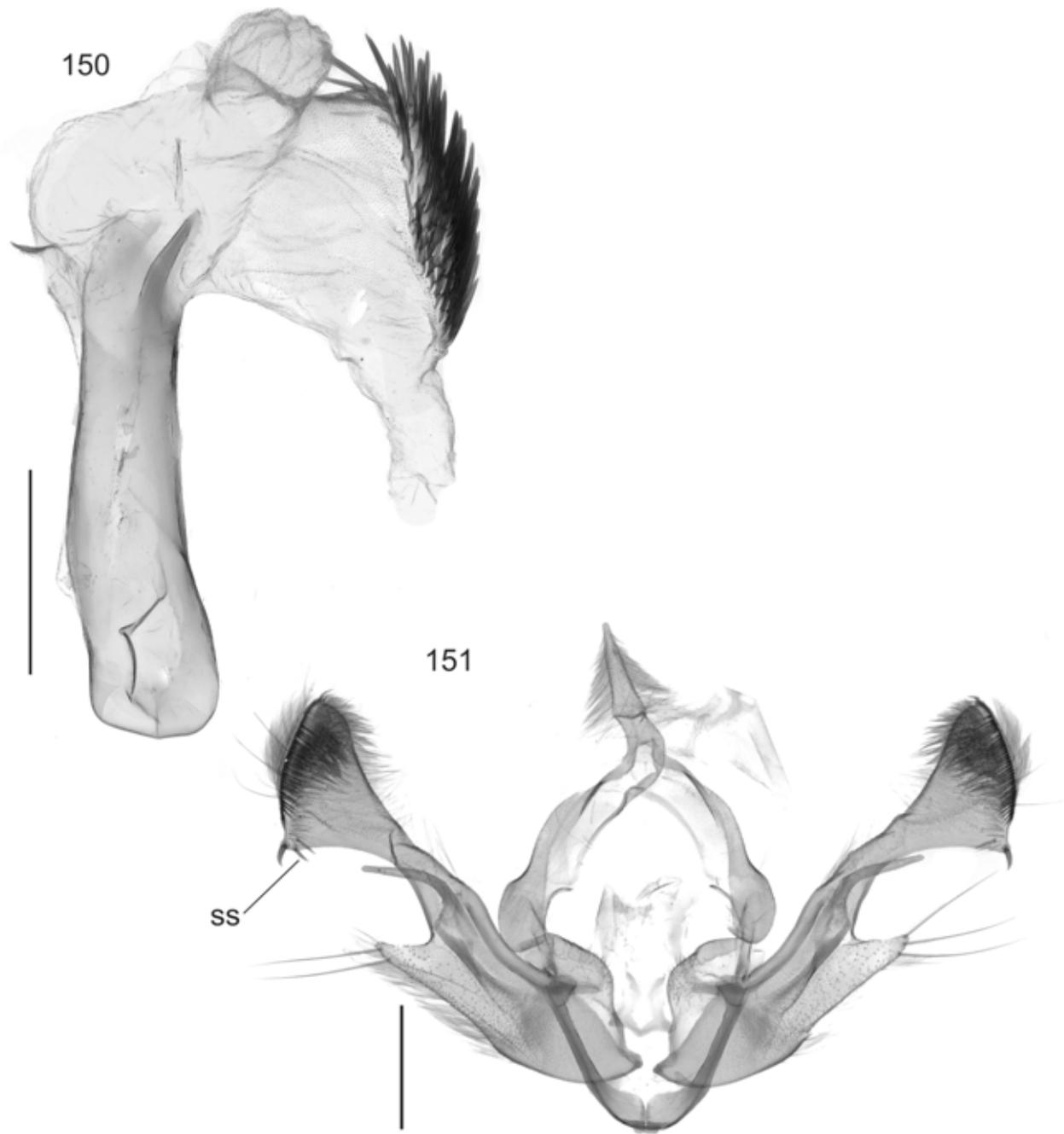
(142, 143) Male abdomen and genitalia, *Phyetica funerea*: 142 phallus (3); 143 genital capsule (3).



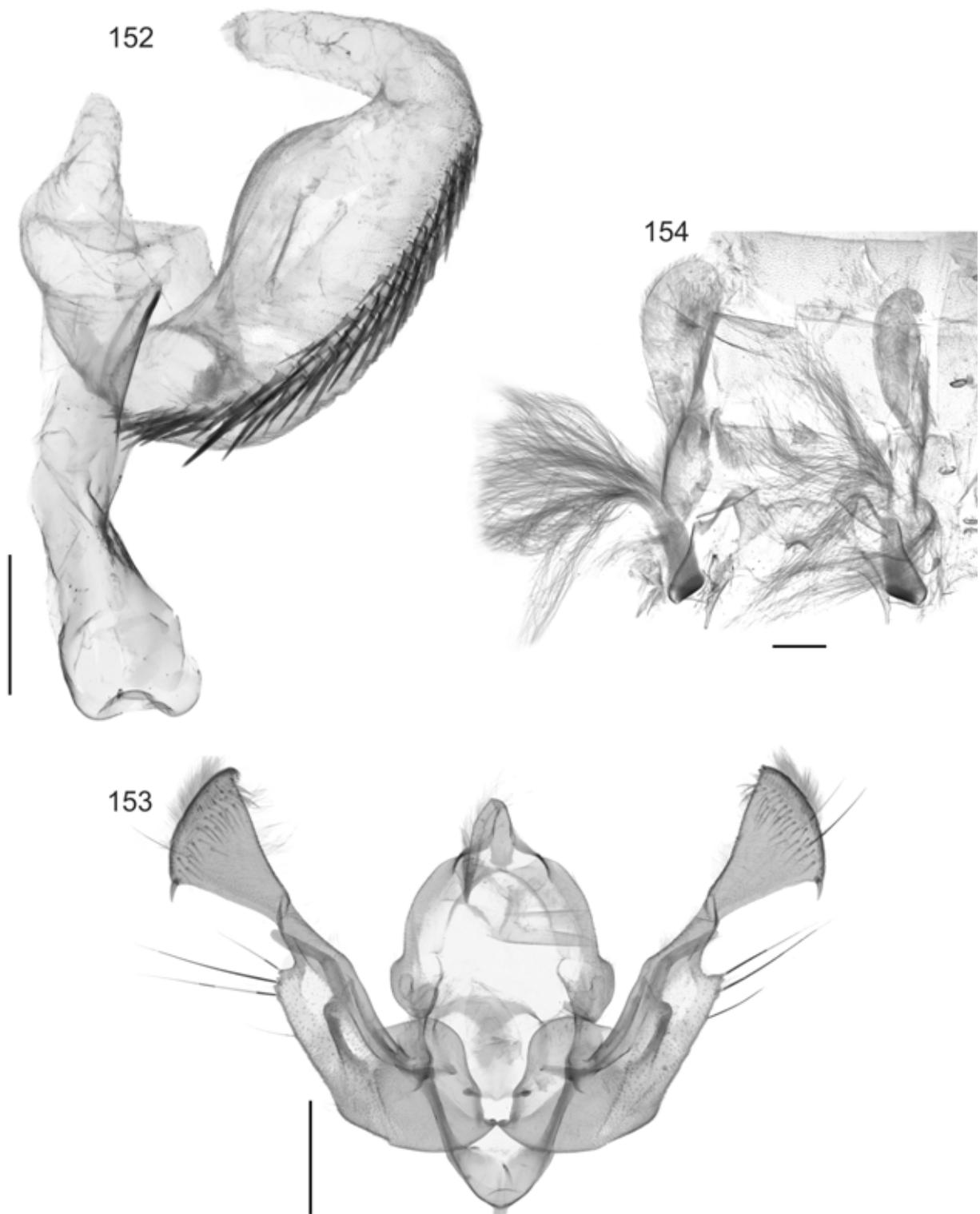
(144–146) Male abdomen and genitalia, *Phyetica longstaffi*: 144 phallus; 145 genital capsule; 146 abdominal base. (ld, lateral diverticulum of vesica.)



(147–149) Male abdomen and genitalia, *Physetica phricias*: 147 phallus; 148 genital capsule; 149 abdominal base. (ld, lateral diverticulum of vesica.)

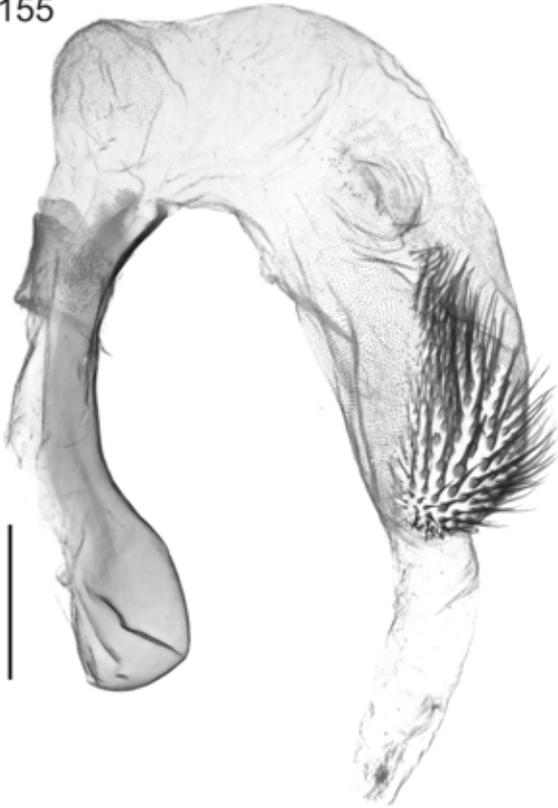


(150, 151) Male abdomen and genitalia, *Physetica phricias*: 150 phallus (2); 151 genital capsule (2). (ss, extra spinose setae on cucullus, cf. Fig. 148.)



(152–154) Male abdomen and genitalia, *Physetica prionistis*: 152 phallus; 153 genital capsule; 154 abdominal base.

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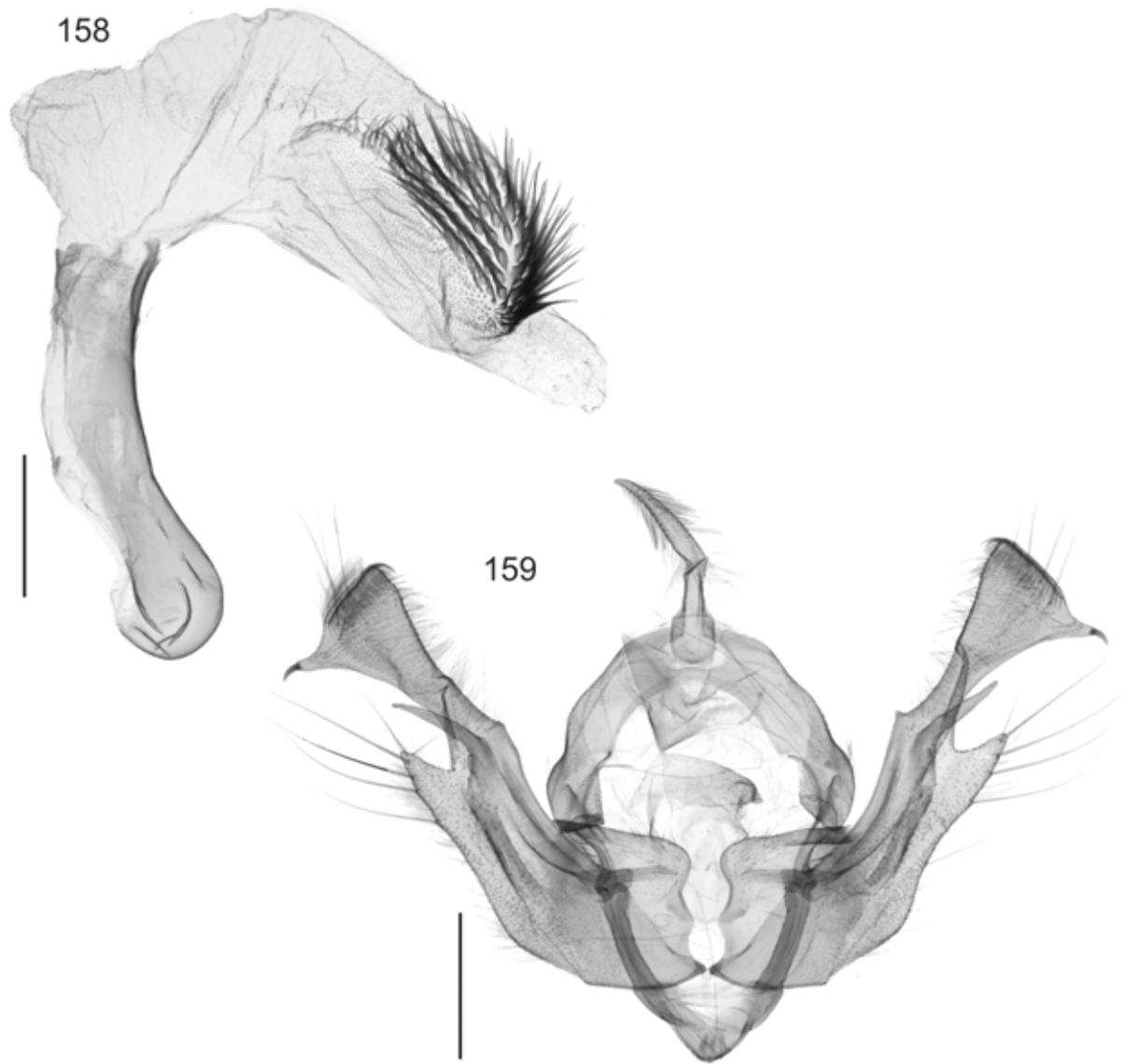
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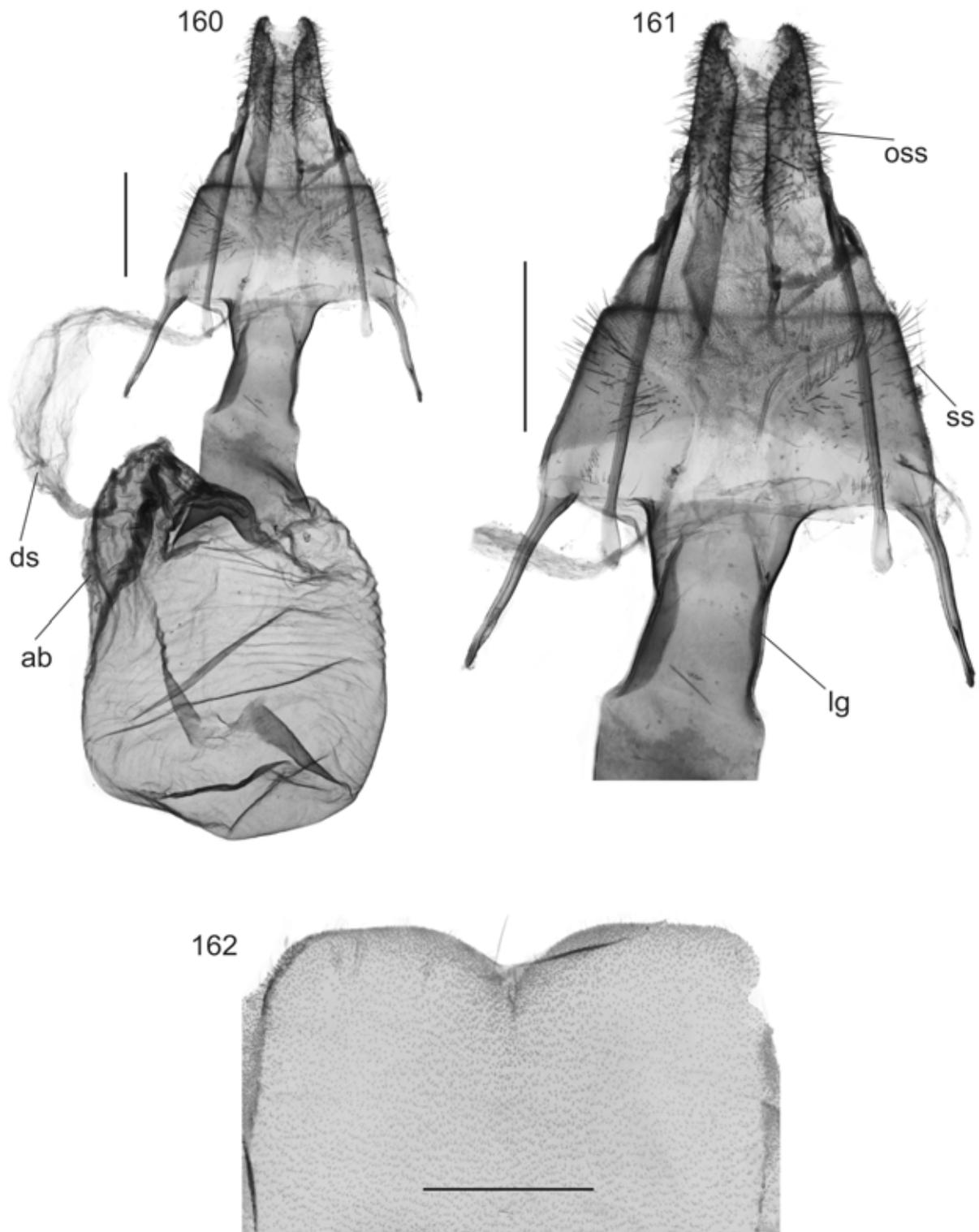
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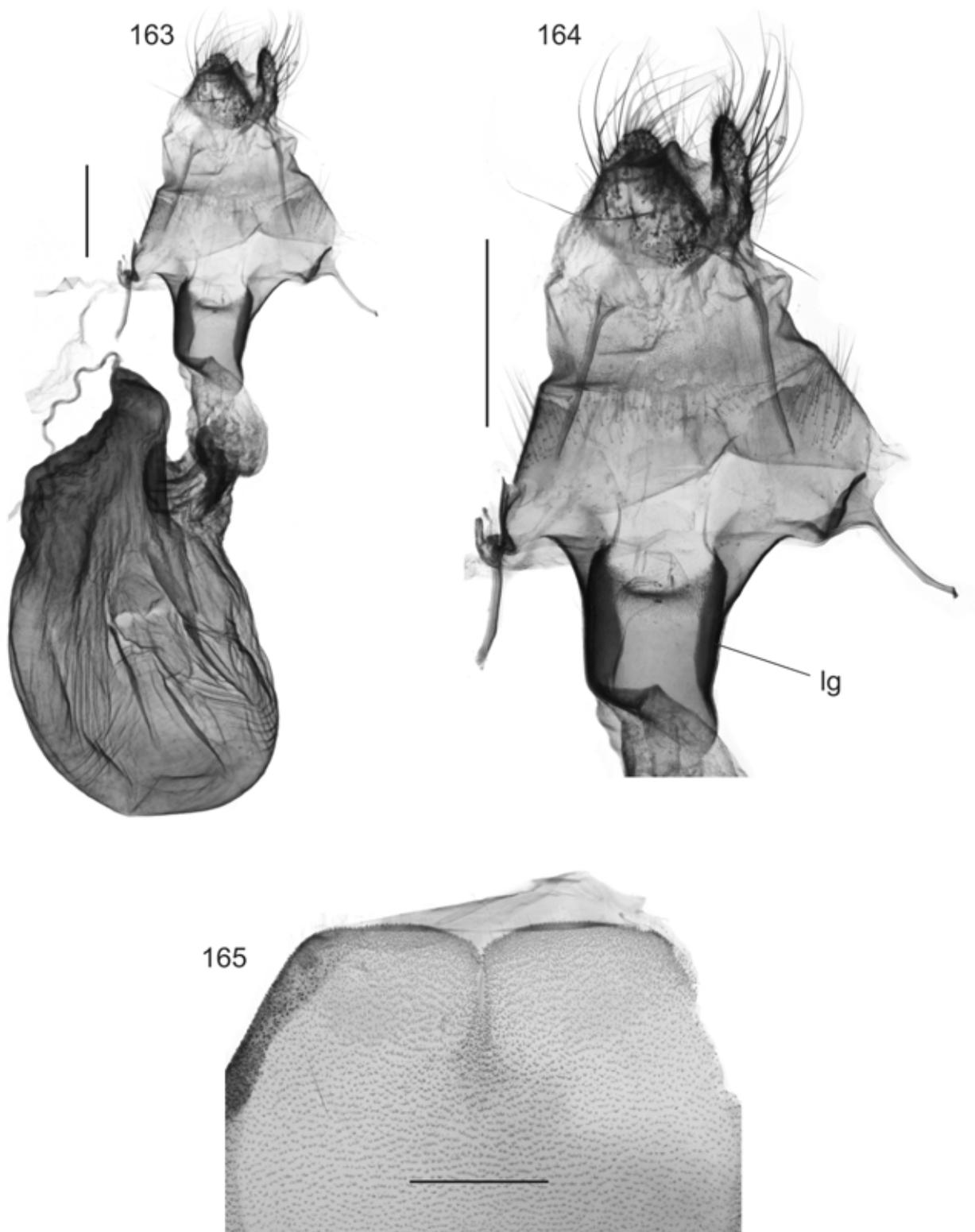
(155–157) Male abdomen and genitalia, *Physetica sequens*: 155 phallus; 156 genital capsule; 157 abdominal base.



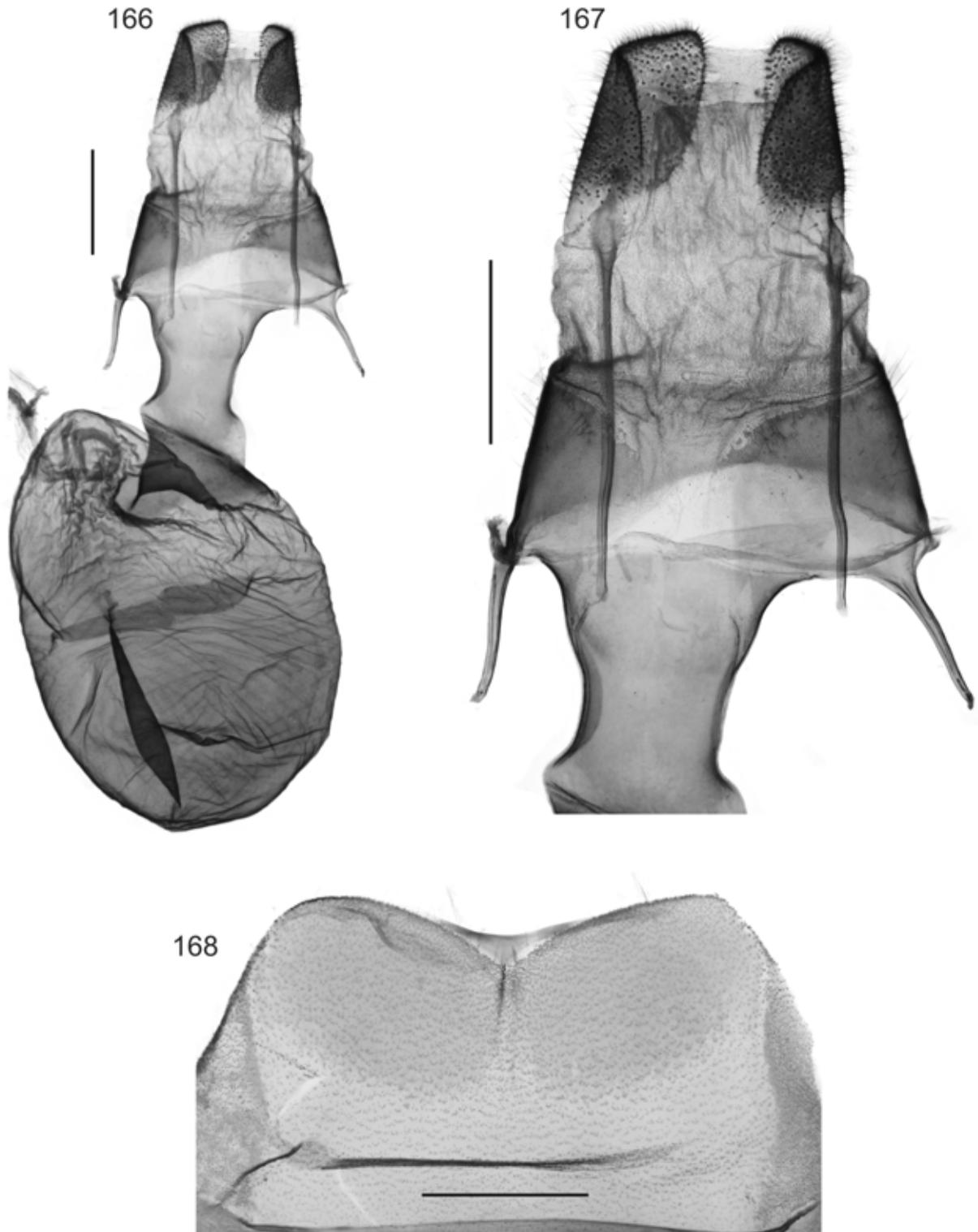
(158, 159) Male abdomen and genitalia, *Phyetica sequens*: 158 phallus (2); 159 genital capsule (2).



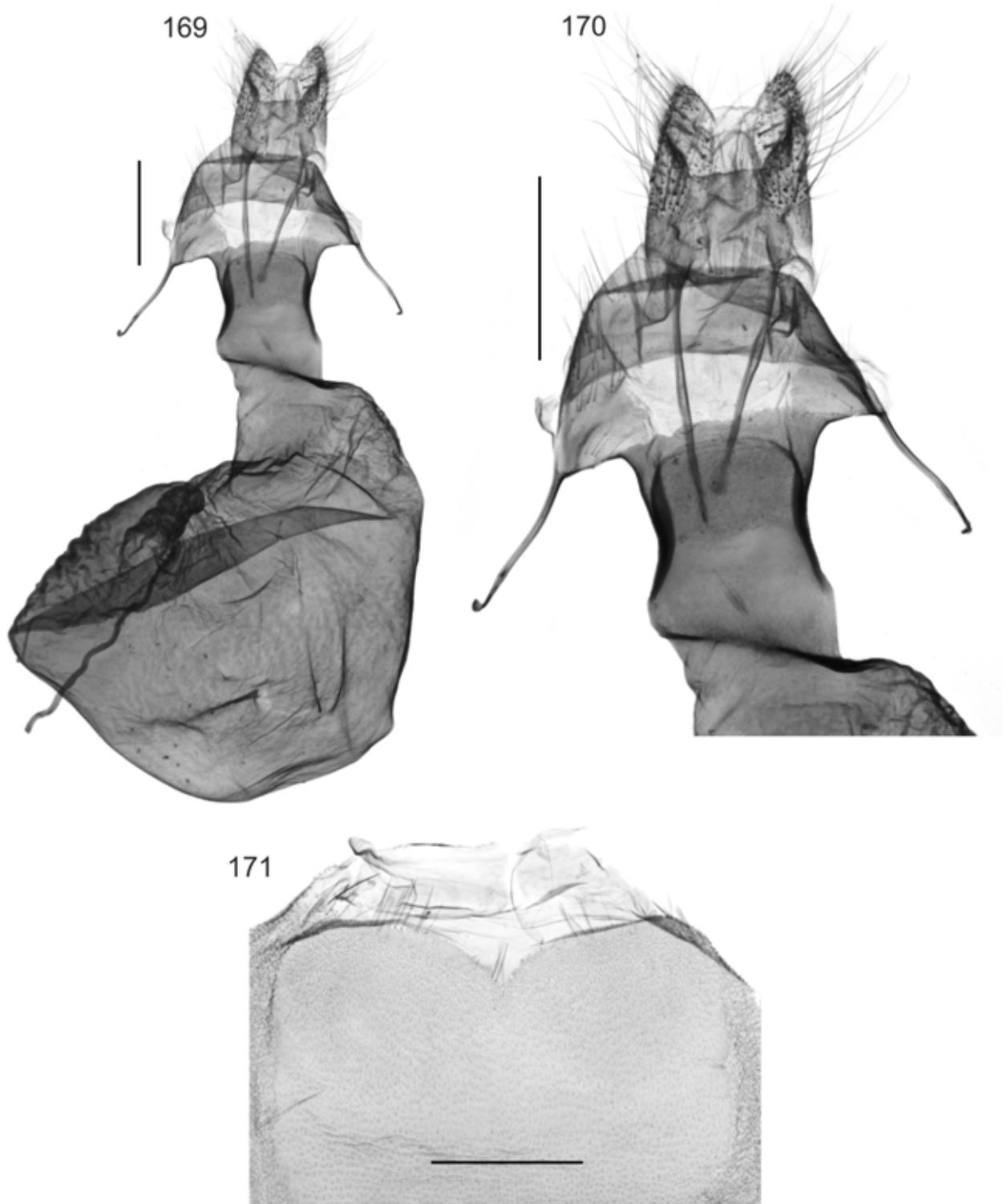
(160–162) Female genitalia, *Phyetica caerulea*: 160 whole genitalia; 161 ovipositor; 162 abdominal sternite 7. (ab, appendix bursae; ds, ductus seminalis; lg, lateral sclerotised grooves formed by dorsal curvature of antrum / ductus bursae; oss, spinose setae of ovipositor; ss, spinose setae of segment 8.)



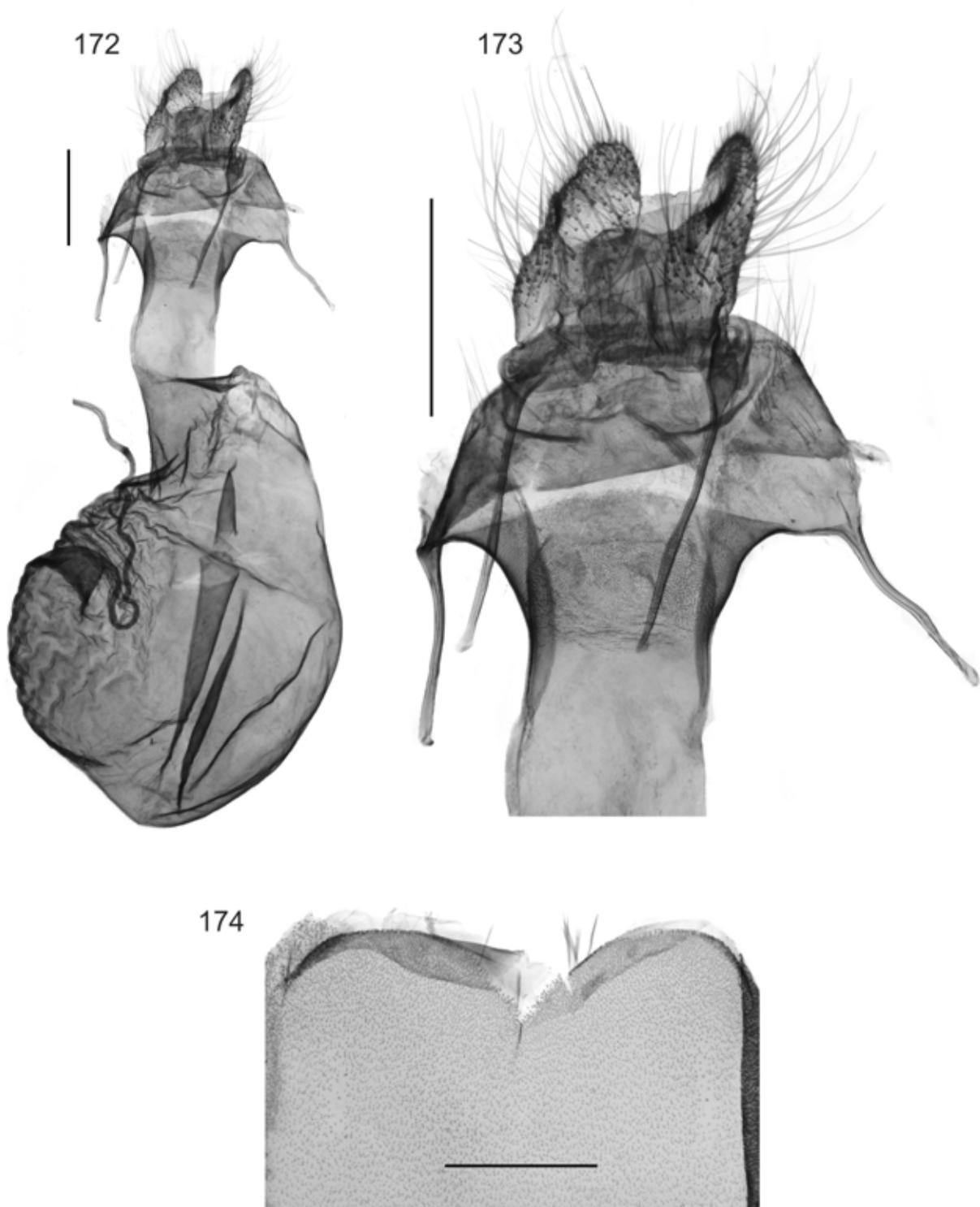
(163–165) Female genitalia, *Physetica homoscia*: 163 whole genitalia; 164 ovipositor; 165 abdominal sternite 7. (lg, lateral sclerotised grooves of antrum / ductus bursae.)



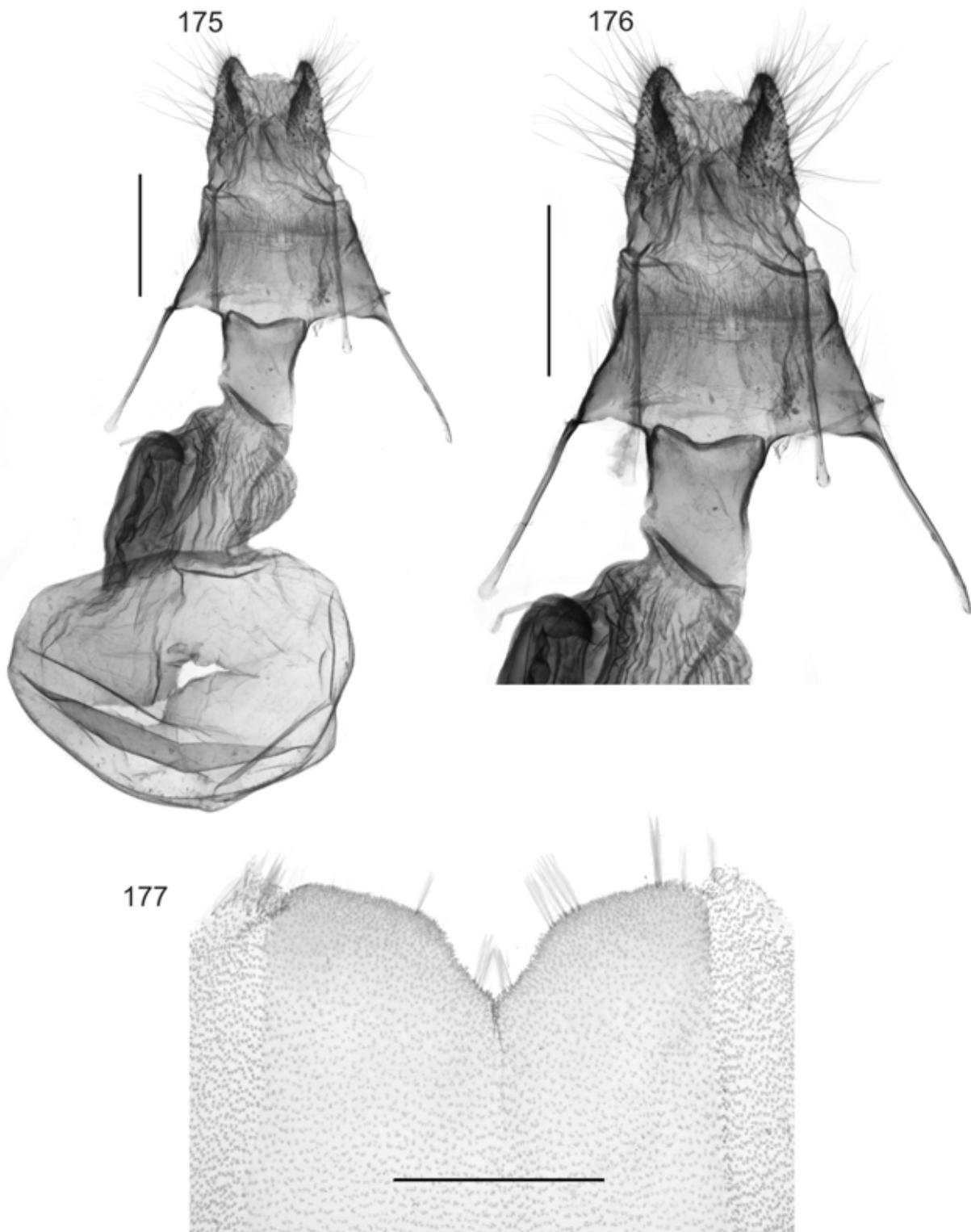
(166–168) Female genitalia, *Phyetica temperata*: 166 whole genitalia; 167 ovipositor; 168 abdominal sternite 7.



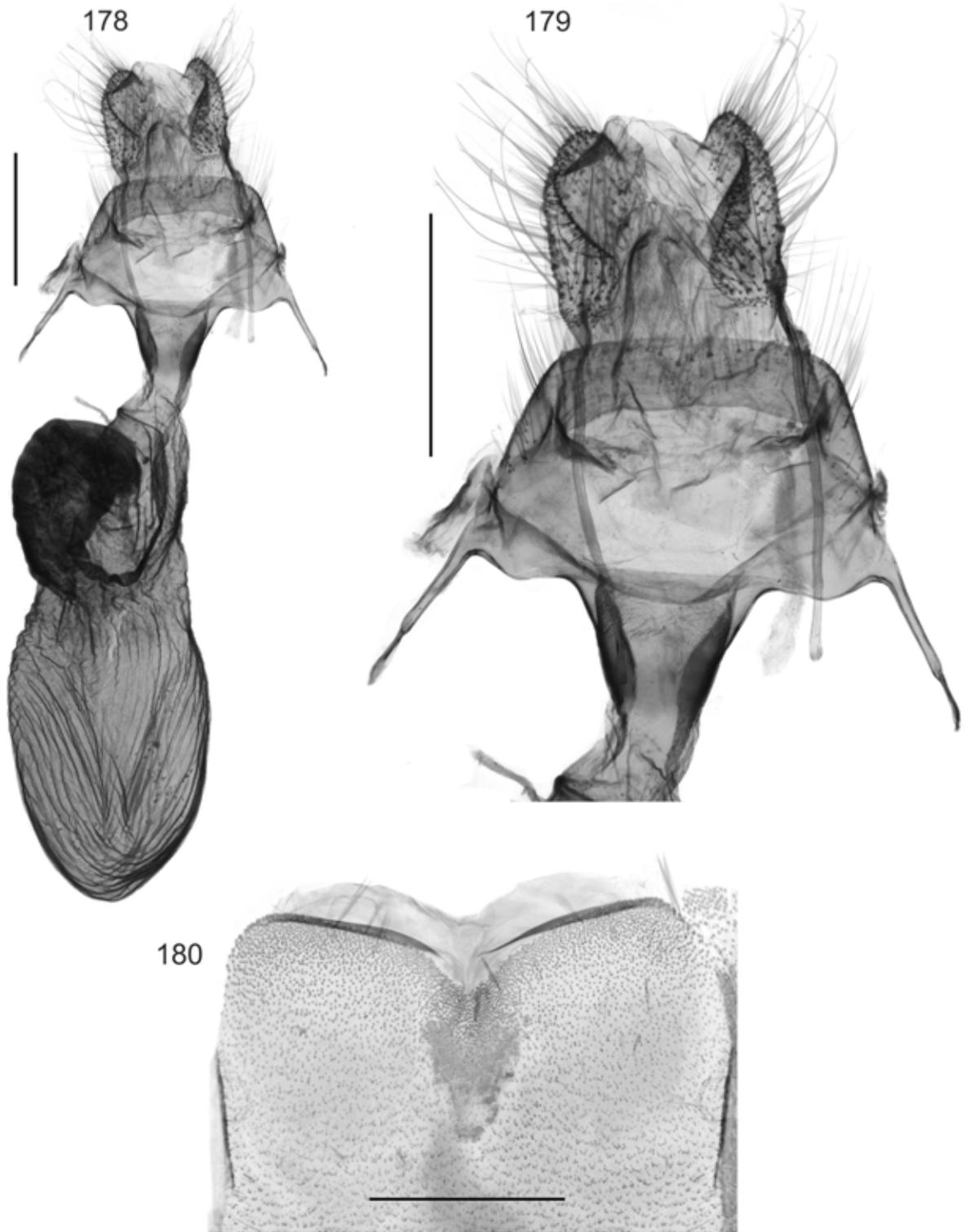
(169–171) Female genitalia, *Physetica cucullina*: 169 whole genitalia; 170 ovipositor; 171 abdominal sternite 7.



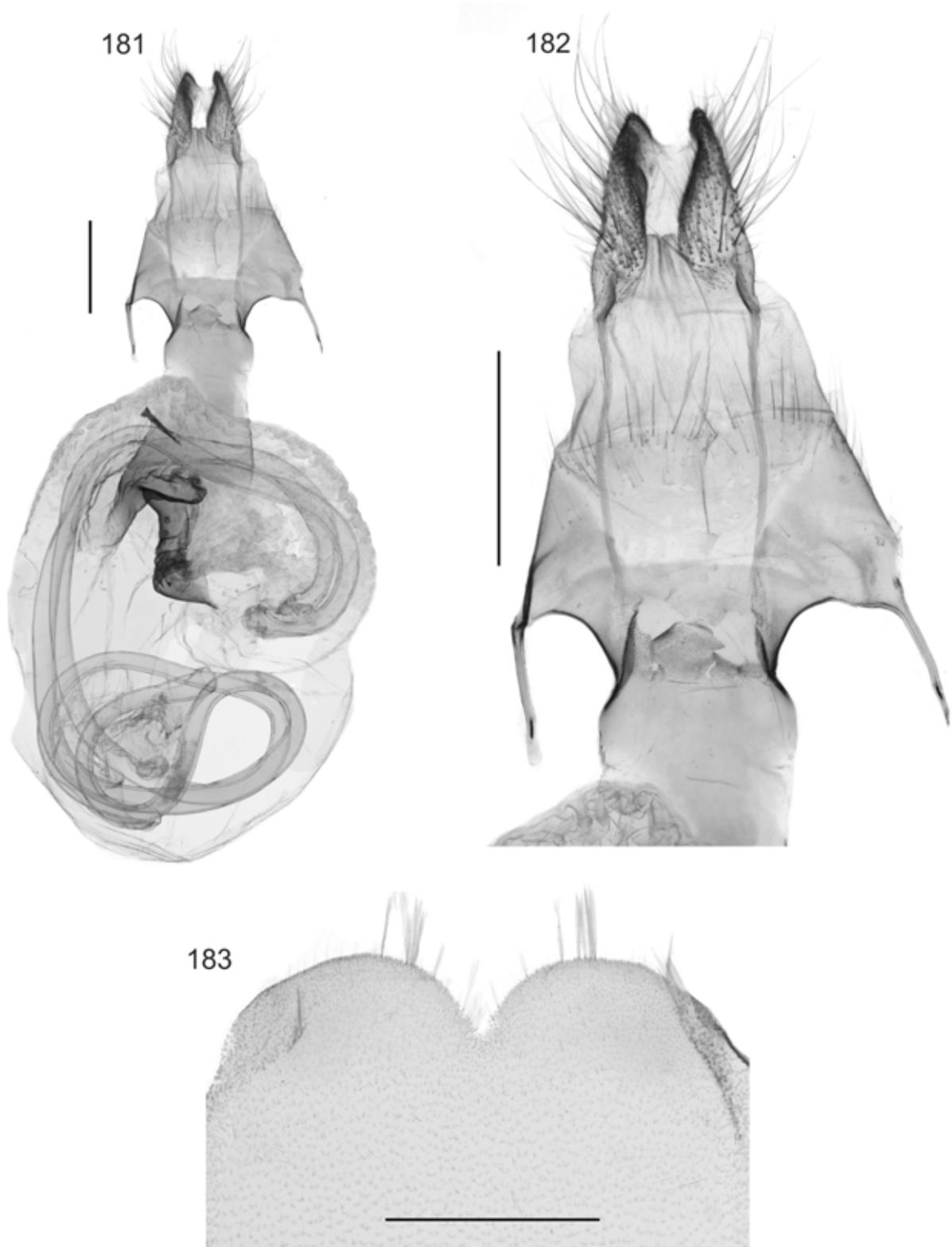
(172–174) Female genitalia, *Phytetica funerea*: 172 whole genitalia; 173 ovipositor; 174 abdominal sternite 7.



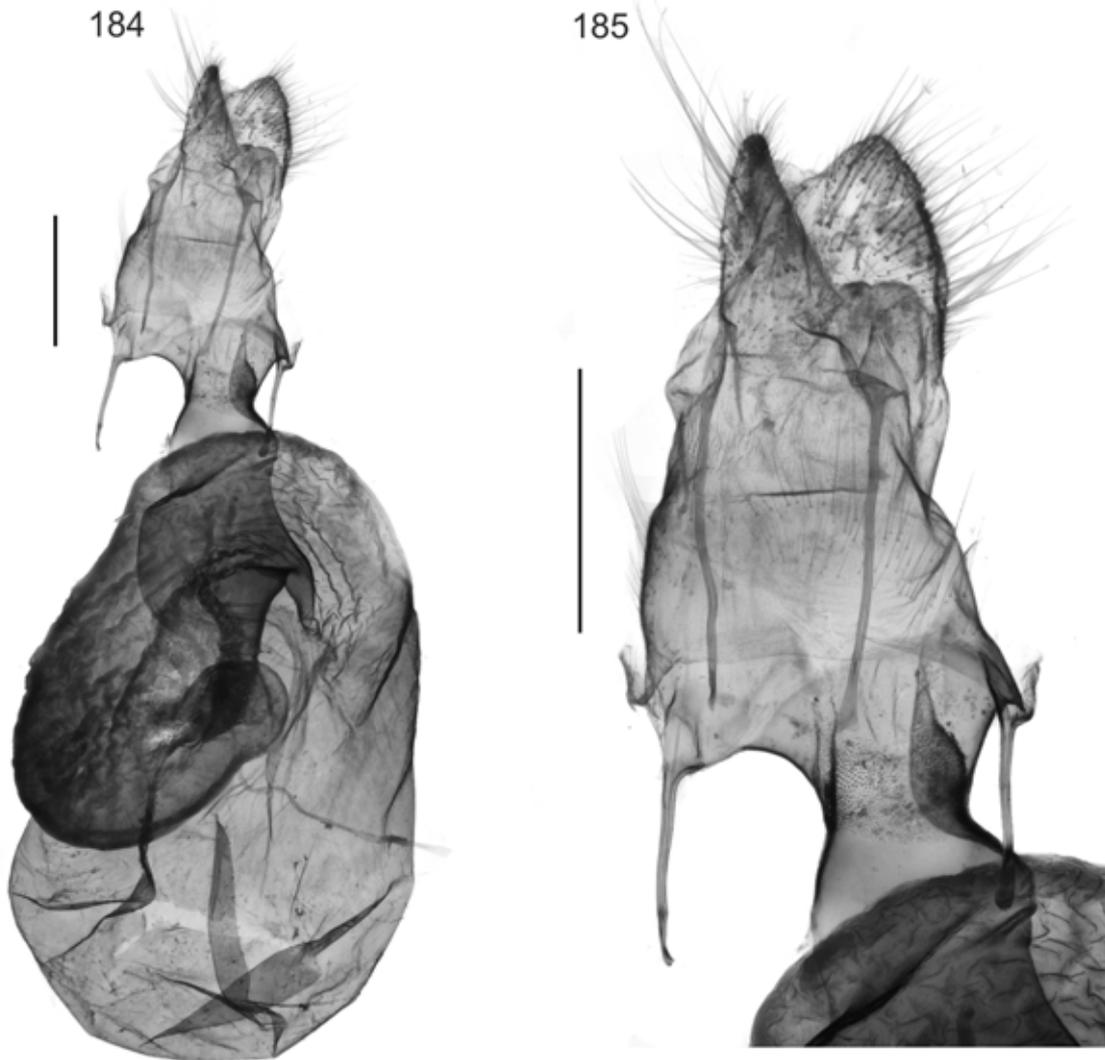
(175–177) Female genitalia, *Physetica longstaffi*: 175 whole genitalia; 176 ovipositor; 177 abdominal sternite 7.



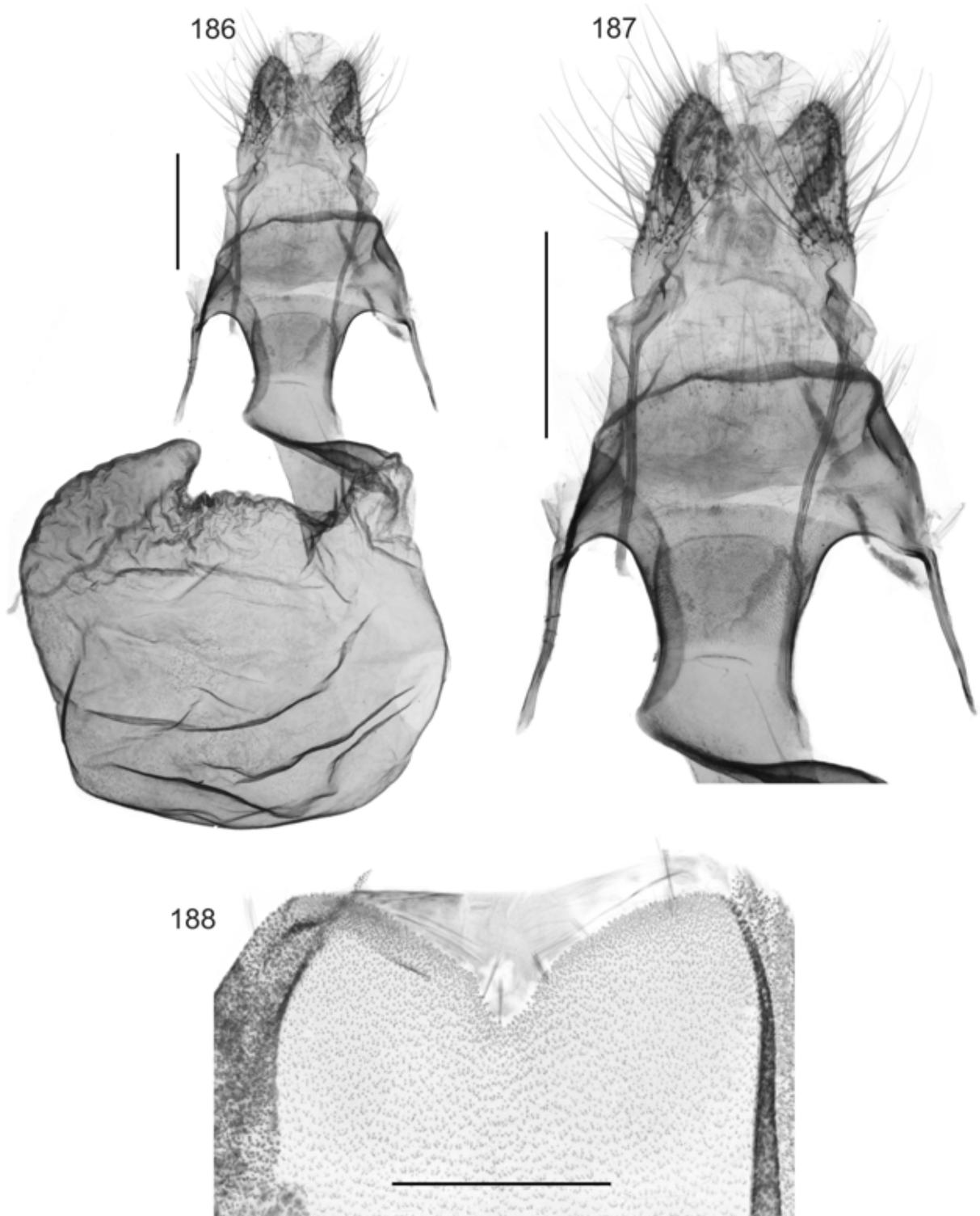
(178–180) Female genitalia, *Phyetica phricias*: 178 whole genitalia; 179 ovipositor; 180 abdominal sternite 7.



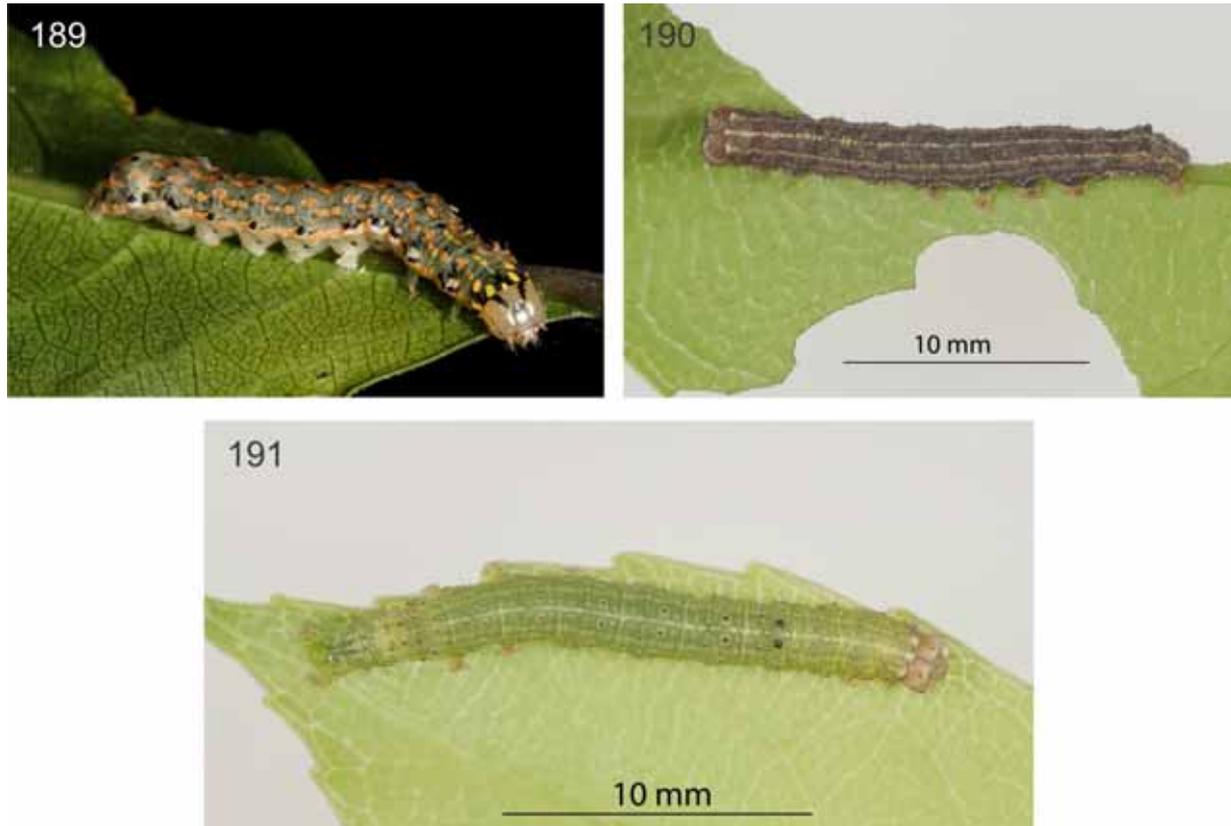
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(184, 185) Female genitalia (dorsal view), *Physetica prionistis*: 184 whole genitalia (2); 185 ovipositor (2).



(186, 187) Female genitalia, *Physetica sequens*: 186 whole genitalia; 187 ovipositor; 188 abdominal sternite 7.



**Figs 189–191:** Larvae (late instar): 189 *Austramathes purpurea* on *Melicytus ramiflorus* (photo by O. Ball); 190, 191 *Austramathes fortis* on *Melicytus macrophyllus* (photos by D. Snaith): (190) grey form; (191) green form.





### Taxonomic index

This index covers the nominal invertebrate taxa mentioned in the text, regardless of their current status in taxonomy. Taxa in **bold** are those included in the checklist. Page numbers in **bold** indicate main entries. Page numbers in *italics* indicate figures. The letter ‘**p**’ after a page indicates **habitus photographs** of adults or larvae, the letter ‘**k**’ indicates a **key**, and the letter ‘**m**’ indicates a **distribution map**.

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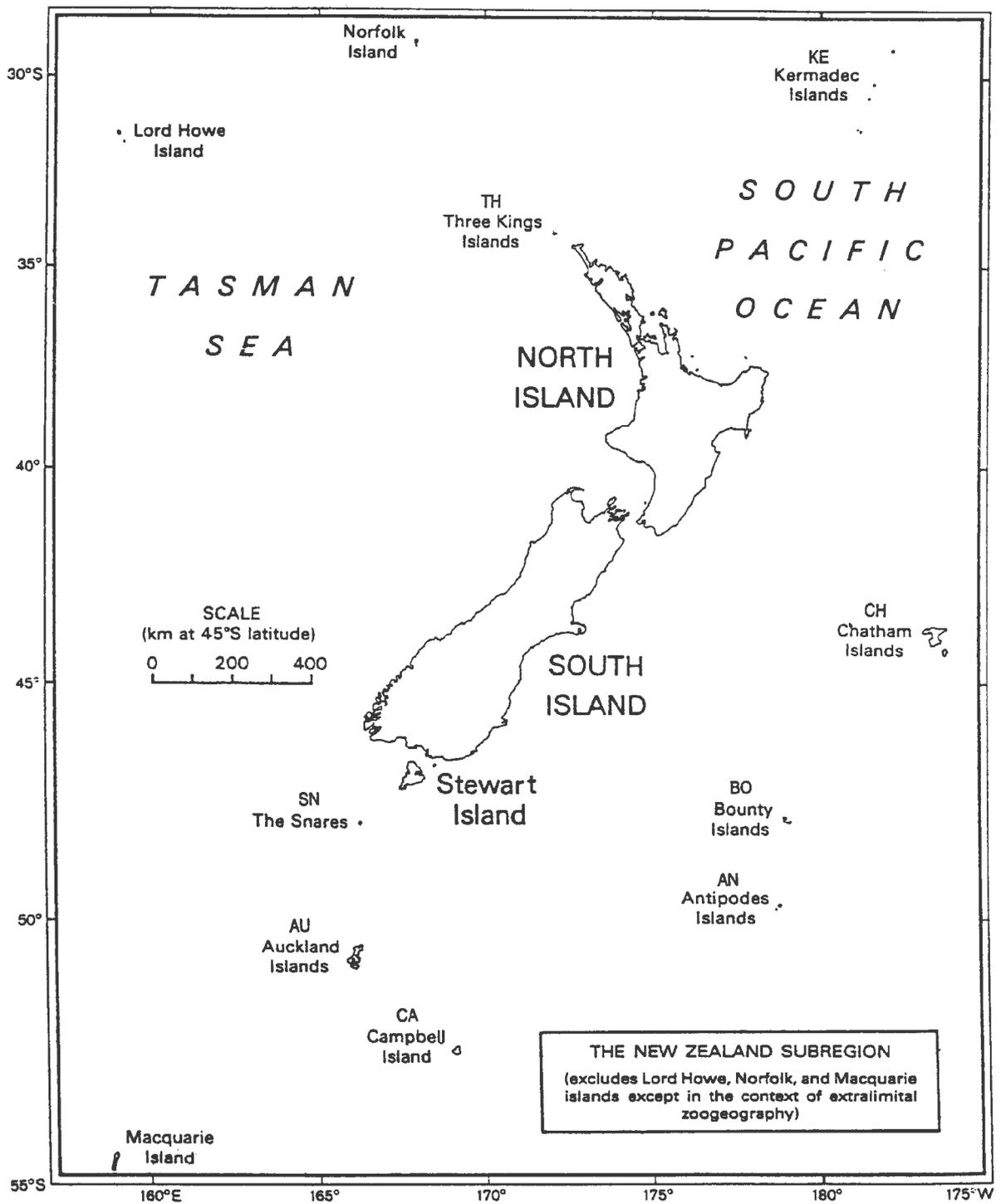
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**Tylenchida**: Criconematina (*W. M. Wouts*, FNZ 55, 2006)

## NOTICES

This series of refereed publications has been established to encourage those with expert knowledge to publish concise yet comprehensive accounts of elements in the New Zealand fauna. The series is professional in its conception and presentation, yet every effort is made to provide resources for identification and information that are accessible to the non-specialist.

*Fauna of N.Z.* deals with non-marine invertebrates only, since the vertebrates are well documented, and marine forms are covered by the series *NIWA Biodiversity Memoirs*.

**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 Editorial Board or with the Series Editor before commencing work; all necessary guidance will be given.

## 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 mārama 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 *NIWA Biodiversity Memoirs*.

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 tiro tiro 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 Ētita rānei i mua i te tīmatanga, ā, mā rātou a ia e ārahi mō te wāhi ki tana tuhinga.