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o Aotearoa

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Fauna of New Zealand
Ko te Aitanga Pepeke o Aotearoa

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Lithinini
(Insecta: Lepidoptera:
Geometridae: Ennominae)

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Whenua
P R E S S**

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POPULAR SUMMARY

HE WHAKARĀPOPOTOTANGA

Class **Insecta**Order **Lepidoptera**Family **Geometridae**Subfamily **Ennominae**Tribe **Lithinini**

 Illustration / Whakaahua: *Sestra flexata* (Walker).

Lithinini looper moths

The Lithinini are one of the most widespread tribes of ennomine looper moths, with representatives on every continent except Antarctica. These small, narrow-bodied moths are one of the few groups of herbivorous insects that exploit ferns as their primary food source.

This tribe is represented in New Zealand and its offshore islands by 3 endemic genera comprising 8 endemic species. These moths favour forest habitats although species associated with bracken fern (*Pteridium esculentum*) may sometimes occur in more disturbed areas along forest margins or in scrub. The adult moths visit flowers of various plants (e.g., native Myrtaceae including “White Rata” [*Metrosideros perforata* (J.R. & G. Forst.) A. Rich.]; cultivated Loganiaceae [*Buddleja davidii* Franchet]) to feed on nectar. The females deposit eggs on or near the ferns on which the larvae feed. Larvae feed singly on the vegetative portion of ferns, and crawl off the growing portion of the plant to pupate in leaf litter, just below the surface of the soil, or among dead fronds of the host.

These moths utilise a broad range of ferns as host plants. Recorded hosts include many different growth forms from low-growing members of the forest herb layer such as *Paesia* (Dennstaediaceae) to broadleaved ferns such as *Microsorium* (Polypodiaceae) and the towering tree ferns *Cyathea* (Cyatheaceae) and *Dicksonia* (Dicksoniaceae).

The larvae of Lithinini exhibit a characteristic defense mechanism when disturbed, dropping or actively jumping off the host plant and twisting/turning rapidly if the disturbance continues. Adults are attracted to lights, and like many other forest Geometridae, may also be collected by beating or sweeping vegetation in suitable habitats. The

Ngā pūrēhua whakakoromeke Lithinini

Ko ngāi Lithinini tētahi o ngā iwi pūrēhua whakakoromeke ennomine kua tino marara te noho ki te ao, inā rā, e kitea ana i ngā whenua rahi katoa, hāunga anō te Kōpakatanga ki te Tonga. He pūrēhua ririki, he whāiti anō te tinana. Ko ia tētahi o ngā rōpū pepeke kaiota ruarua ko ngā huruhuru whenua tā rātou tino kai.

I Aotearoa nei me ōna tini moutere, e 3 ngā puninga, e 8 ngā momo, ā, ko Aotearoa anake te wāhi o te ao e kitea ai ngā pūrēhua nei. Ko te ngahere te tino kāinga o te nuinga, engari arā ētahi momo ka piri taahi ki te rarauhe, ā, kai te noho ētahi o ēnei ki ngā wāhi kua rawekehia i ngā taitapa o te ngahere, i ngā mōheuheu anō. Toro ai ngā pūrēhua pakeke i ngā pua o ētahi tipu (i ngā Myrtaceae māori, tae atu ki te ‘rātā tea’ [*Metrosideros perforata* (J.R. & G. Forst.) A. Rich.], me te Loganiaceae [*Buddleja davidii* Franchet]) ki te kai ngongo māna. Ka tukuna e te uwaha ana hua ki runga, ki te taha rānei o ngā huruhuru whenua ka kāinga e ngā torongū. Kai takitahi ai ngā torongū i ngā wāhi māota o te huruhuru whenua, kātahi ka ngōki atu ki ngā rau popo kei raro tata iho i te oneone, ki ngā tētē mate rānei o te huruhuru whenua, ki reira whakangeti ai.

He huhua tonu ngā momo huruhuru whenua ka noho hei kāinga mō ngā pūrēhua nei, mai i ngā mea ka piri tonu ki te papa o te ngahere, pērā i te *Paesia* (Dennstaediaceae), tae atu ki ngā huruhuru whenua rau nui, pērā i te

(continued overleaf)

(haere tonu)

normal flight period begins at dusk and continues until the ambient temperature is too low for adults to fly. Most New Zealand Lithinini are bivoltine, and usually overwinter in the pupal stage.

New Zealand's lithinine moth fauna is endemic and surprisingly diverse for a relatively small country (the entire Palaearctic region at comparable latitudes has only 2 species in 2 genera). These moths are well adapted to life in temperate rainforest with high pteridophyte diversity and biomass, and New Zealand's forests represent one of the best examples of such an optimal lithinine environment.

Contributor **Jason D. Weintraub** is the Entomology Collection Manager at the Academy of Natural Sciences in Philadelphia, Pennsylvania. A native of Michigan, his current entomological pursuits include cataloging the primary type specimens of the Academy's extensive insect collection as well as research on the geometrid moth fauna of the Greater Antilles. His museum and field research on Lepidoptera have taken him to over 30 countries on 6 continents during the past three decades. A former Research Fellow at the Natural History Museum in London, he now resides in central Philadelphia with his wife Elizabeth and daughter Maia.



Contributor **Malcolm Scoble** undertook his MPhil (Council for National Academic Awards, U.K.) and PhD (Rhodes University, South Africa) studies on the taxonomy of the Nepticulidae, a family of predominantly leaf-mining Lepidoptera. His subsequent research on Lepi-

(continued overleaf)

Microsorium (Polypodiaceae), me ngā rākau tonu, pērā i te *Cyathea*, i te *Aslophila* (Cyatheaceae) me te *Dicksonia* (Dicksoniaceae).

Ko tā ngāi Lithinini hei ārai atu i te hoariri, he taka, he peke atu rānei i te huruhuru whenua, ā, ki te mōrearea tonu tana noho, kua takawhitiwhiti, kua takaoraora. Kumea ai ngā pakeke e te rama, ā, pērā i te maha atu o ngā Geometridae noho ngahere, ko ētahi atu tikanga pai hei kohikohi i ngā hanga nei, ko te papaki otaota, ko te 'hao' rānei ki te toiemi i runga ake i ngā otaota i ō rātou ripoinga. Hei te torengitanga o te rā ka tīmata te rere haere, pēnei tonu ā, heke ai te pāmahana o te hau takiwā ki tērā e kore ai e taea e ngā mea pakeke te rere tonu. Ko te nuinga o ngā Lithinini o Aotearoa, he whakaputa i ngā reanga e rua i ia tau, ā, he ngeti te āhua ka takurua ana.

Katoa ngā pūrēhua lithinine o Aotearoa kāore e kitea i tāwāhi, ka mutu, he matahuhua tonu ina whakaarohia he whenua iti noa tēnei (i te whānuitanga atu o te rohe Palaearctic kei tēnei ahopae e noho nei tātou, e 2 noa ngā momo, o ngā puninga e 2). Kua pai noa te urutau atu a ngā pūrēhua nei ki ngā ngahere ua kāore e tino makariri, e kaha nohoia ana e ngā momo huruhuru whenua huhua noa. Koirā kāore i kō mai, i kō atu i ngā ngahere o Aotearoa hei kāinga mō ngā pūrēhua lithinine.

Ko Michigan te ūkaipō o **Jason D. Weintraub**, tētahi o ngā kaituhi nei. Ko ia te Kaiwhakahaere o te Kohinga Pepeke i te Kura Pūtaiao Ao Tūroa i Philadelphia, Pennsylvania. Ko ngā kaupapa mātai pepeke e kawea ana e ia i tēnei wā, he whakarārangi i ngā tauria e mau ana ki a rātou ngā ingoa o ngā momo o te kohinga pepeke nui tonu o te Kura, me te rangahau i ngā pūrēhua geometrid o te Greater Antilles. Nā ana mahi rangahau i ngā Lepidoptera i roto i ngā whare taonga, i te ao tūroa anō, kua kawea ia ki ngā tōpito o te ao – ki ngā whenua 30 neke atu, i ngā whenua rahi e 6, i roto i te toru tekau tau kua mahue ake. He Paewai Rangahau ia i mua, i te Whare Taonga Ao Tūroa i Rānana. Heoi, kei Philadelphia rāua ko tana hoa rangatira, a Elizabeth e noho ana, me tā rāua tamāhine, a Maia.

Ko ngā kaupapa rangahau a tērā atu kaituhi, a **Malcolm Scoble**, mō tana MPhil (Kaunihera mō ngā Tohu Mātauranga o te Motu, U.K.) me tana PhD (Whare Wānanga o Rhodes, Āwherika ki te Tonga) ko te whakarōpūtanga o ngāi Nepticulidae, he whānau Lepidoptera he 'huke-rau' te nuinga. Mai i tērā wā, ko ngā

(haere tonu)

doptera has been mainly on the Geometridae, the enigmatic neotropical family Hedyllidae, and the typification of Linnaeus's butterflies. He was awarded a DSc (University of London) in 2001. He worked at the Transvaal Museum, Pretoria, South Africa, from 1975–1982 and the University Museum of Natural History, Oxford, U.K., from 1982–1985. Since 1985 he has been at the Natural History Museum, London, UK, where he is currently Associate Keeper of the Entomology Department.



Lepidoptera kua aro nuitia e ia, ko ngāi Geometridae, ko ngāi Hedyllidae – tērā whānau hunahuna o ngā whenua pārūrū o Amerika, ā, me te āta whiriwhiri anō ko tēhea tauira me whakahāngai ki tēhea ingoa o roto i ngā pūrēhua a Linnaeus. Whakawhiwhia ana ki ia tētahi DSc (e te Whare Wānanga o Rānana) i te tau 2001. E mahi ana ia i te Whare Taonga o Transvaal, i Pretoria, Āwherika ki te Tonga, mai i te tau 1975 ki te 1982, ā, i te Whare Taonga Ao Tūroa o te Whare Wānanga, i Oxford, i Ingarangi Nui Tonu, mai i te tau 1982 ki te 1985. Mai i tērā wā, kua noho ki te Whare Taonga Ao Tūroa, i Rānana. Ko tana tūranga i reira, ko tō te Kaitiaki Tuarua o te Tari Mātai Pepeke.

Translation by **H. Jacob**
Levin



Frontispiece. *Sestra* sp. (cf. *humeraria*) larva on *Paesia scaberula* (Dennstaedtiaceae), Waitakere Ranges, Auckland, February 1993, showing characteristic lithinine defensive behaviour. Note the mite attached to the 1st abdominal segment (photographs: J. D. Weintraub).

ABSTRACT

The New Zealand Lithinini are reviewed, with a general discussion of morphology and natural history. A key is provided to the eight species, representing three genera. The New Zealand fauna is wholly endemic, with affinities to Southern Hemisphere genera that occur in temperate Australia and Tasmania. *Sarisa* (monotypic), *Sestra* (two species), and *Ischalis* (five species) are treated in detail. *Ischalis dugdalei* n. sp. is described from the South Island. Comprehensive distribution data are provided for all taxa. Host plant association data and information on immature stages are reviewed for all New Zealand genera and summarised.

Keywords: Lepidoptera, Geometridae, Ennominae, taxonomy, classification, key, new species, distribution, ecology, biology, species endemism, fauna, fern-feeding larvae, peridophagy.

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CHECKLIST OF TAXA

Genus <i>Ischalis</i> Walker, 1863	11
<i>gallaria</i> (Walker, 1860)	13
<i>variabilis</i> (Warren, 1895)	14
<i>fortinata</i> (Guenée, 1868)	16
<i>dugdalei</i> new species	17
<i>nelsonaria</i> (Felder & Rogenhofer, 1875)	17
Genus <i>Sestra</i> Walker, 1863	19
<i>flexata</i> (Walker, 1862)	19
<i>humeralia</i> (Walker, 1861)	21
Genus <i>Sarisa</i> Fletcher, 1979	22
<i>muriferata</i> (Walker, 1863)	22

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editorial work and steering this paper through the press, and G. Hall and R. J. B. Hoare for assistance with the distribution maps. This research was supported by an Interdisciplinary Research Fellowship from the Natural History Museum, London, to John H. Lawton and Malcolm J. Scoble, and a travel bursary from the Centre for Population Biology, Imperial College at Silwood Park.

INTRODUCTION

The Lithinini are a diverse cosmopolitan tribe belonging to the geometrid subfamily Ennominae, and comprise 36 genera and 100–150 species. One of their most unusual characteristics is their predominant host association: the vast majority of species with described life histories have pteridophagous larvae. This fern-feeding habit has been documented for all genera indigenous to New Zealand. Specialist fern-feeders are quite rare among phytophagous insects, probably because few herbivores have succeeded in circumventing the array of phytochemical defences present in pteridophytes (Cooper-Driver 1985; Soeder 1985). Lithinini is the only major lineage within the Geometridae that is characterised by pteridophagy, and the phylogenetic diversity of their fern hosts (10 genera in 6 families for the New Zealand fauna alone) is indicative of either long association or extreme plasticity in coping with pteridophyte defensive chemistry.

The tribe as a whole is difficult to characterise on the basis of universally shared derived characters, but a number of important diagnostic features have been discovered. The male genitalia (Fig. 27–34) have a characteristic shape when mounted conventionally (venter uppermost) on a microscope slide. The valves usually curve upwards close to the uncus rather than splay out laterally; the transtilla is characteristically triangular, and many taxa have a pair of setose processes arising from the anellus; and the furca usually has an apical spine or cluster of setae. The slender-bodied adults usually have a discal spot and, on the ventral surface of the hindwing, a postmedial band or row of spots on the veins.

The larvae of taxa with described life histories (9 of 36 genera) all have supernumerary (≥ 6) SV setae on the 6th abdominal segment, as opposed to the 3 or 4 SV setae characteristic of most ennomine Geometridae. Larvae have a striking and very characteristic defensive response when disturbed: they drop or ‘jump’ from the host, spasmodically twisting and curling, and this generally results in a rapid descent through vegetation and dead fern fronds which protects them from predators. This defensive behaviour is particularly effective in species associated with ferns such as *Pteridium*, as dense mats of dead fronds accumulate below the ferns, and their growth habit (generally multiple

fronds and often vegetative propagation) makes it easy for larvae that have ‘dropped’ to climb back on to host plants. Larvae feed openly on the fronds of their host plants, and adults are often disturbed from resting places on or near host plants.

The three genera endemic to New Zealand have a larval character that may prove to be widespread in Lithinini, and provides a functional/morphological connection to the aforementioned defensive behaviour: seta L_1 on one or more of segments A_6 – 8 is extremely slender and sensitive to touch/vibration, apparently acting as a ‘trigger’ for the jumping and coiling/twisting response (J.S. Dugdale, *in litt.*).

Pupae of Lithinini have 3 pairs of modified setae anterior to the terminal pair of cremastral setae. The homologies of these 3 pairs of setae were interpreted by Dugdale (1961, fig. 7a) as SD_1 , L_1 , and D_1 , with the terminal pair as D_2 . This character was first proposed as diagnostic for the North American members of the tribe by Forbes (1948), and holds for all taxa with pupae described to date. It may, however, represent a shared primitive character within the Geometridae.

The Lithinini of the temperate New World were reviewed by Rindge (1986), Pitkin (2002), and those from Chile and Argentina are being studied by Parra (*in prep.*). Holloway (1987) discussed fern-feeding in the Afro-Indo-Australian lithinine genus *Idiodes* and provided an overview of potentially related fern-feeding ennomine genera. The tribe has been treated within the context of several faunistic works, e.g., Forbes 1948 (N.America) and McGuffin 1987 (Canada). The New Zealand fauna has been treated within major works that cover or include the family Geometridae (Meyrick 1884a, b, 1917; Hudson 1928, 1939).

MATERIALS AND METHODS

Preserved specimens of adult moths from a number of major entomological collections were studied. Male and female genitalia were prepared for dissection by immersion overnight in a 10% solution of potassium hydroxide (KOH), or occasionally by brief immersion in 10% KOH heated in a water bath. Cleared material was cleaned and rinsed in distilled water, then transferred via a series of increasingly concentrated aqueous ethanol dilutions up to 70% ethanol. In dissections of males, the aedeagus was removed by gently prising it free from the enclosing membrane. A small syringe was then used to evert the vesica; see Hardwick (1950) for a detailed description of dissection/mounting technique employed for Lepidoptera genitalia. Preparations were mounted in Euparal on microscope slides. Genitalia were examined and photographed under a binocular dissecting microscope.

Detailed data on collecting locality, date of capture,

and any ecological notes were transcribed from specimen labels and compiled in a computer database using the program Microsoft Excel© (version 2.2). Summaries of these data were organised for each species, including: (1) geographical distribution by region, using areas as described by Crosby *et al.* (1976, 1998); and (2) phenology, based on dates of capture for adults.

The collections consulted (with associated acronyms) are as follows:

- AMNH American Museum of Natural History, New York, U.S.A.
 AMNZ Auckland Institute and Museum, Auckland, New Zealand
 BMNH Natural History Museum, London, U.K. (formerly British Museum (Natural History))
 BPBM Bernice P. Bishop Museum, Honolulu, U.S.A.
 BPNZ Brian Patrick collection, Dunedin, New Zealand (now in Otago Museum, Dunedin)
 CMNH Carnegie Museum of Natural History, Pittsburgh, U.S.A.
 CMNZ Canterbury Museum, Christchurch, New Zealand
 FRNZ Forest Research, Rotorua, New Zealand
 MONZ Museum of New Zealand (formerly National Museum), Wellington, New Zealand
 NZAC New Zealand Arthropod Collection, Auckland, New Zealand
 OMNZ Otago Museum, Dunedin, New Zealand.

Additional records from LUNZ (Lincoln University, Canterbury) were added to the maps after completion of the main study.

KEY TO LITHININI KNOWN FROM NEW ZEALAND

- 1 Forewing apex *strongly* falcate (Fig. 25); termen not projecting; drepanoid in form
 (p. 22) ... *Sarisa muriferata*
 — Forewing not as above 2
 2(1) Frons vertical, lacking a conical tuft of scales (at most with a few porrect scales); male antennae simple
 (p. 19)... genus *Sestra* ... 3
 — Frons with a pronounced conical tuft of scales; forewing with 2 or more transverse lines; male antennae minutely pectinate (p. 11)... genus *Ischalis* .. 4
 3(2) Forewing with a distinct projection from the termen (Fig. 19) between veins M₂ and M₃
 (p. 19)... *Sestra flexata*

- Forewing termen lacking a distinct projection between veins M₂ and M₃ (p. 21)... *Sestra humeraria*
 4(2) Forewing with postmedial line straight or very slightly curved (not jagged or wavy), distinct 5
 — Forewing with postmedial line distinctly jagged or wavy, or indistinct 6
 5(4) Forewing termen with 2 more or less distinct projections between R₅ and CuA₁ (rarely reduced to a gently rounded termen with 2 indistinct rounded projections); transverse postmedial line usually doubled; most specimens with a double (rarely single) spot outside postmedial line near tornus
 (p. 13)... *Ischalis gallaria*
 — Forewing termen with a single projection between M₂ and M₃; postmedial line not doubled, but may be lined with grey-white scales; no spots near tornus .
 (p. 17)... *Ischalis nelsonaria*
 6(4) Ground colour of forewings uniform, with area between antemedial and postmedial lines not distinctly paler; the wings mottled with greyish brown, maculation indistinct ... (p. 17)... *Ischalis dugdalei*
 — Ground colour of forewings usually distinctly paler between antemedial and postmedial lines, not mottled (but may have blackish peppering), maculation distinct 7
 7(6) Forewing with 2 distinct transverse lines, the postmedial line wavy, with 2 more-or-less distinct projections, originating well before forewing apex, not marked with spots (p. 16)... *Ischalis fortinata*
 — Forewing with 2 or 3 variably distinct transverse lines, postmedial line sinuous but lacking distinct projections, originating near forewing apex and often marked along its length with a series of black spots (p. 14)... *Ischalis variabilis*

DESCRIPTIONS

Genus *Ischalis* Walker

- Ischalis* Walker, [1863] 1862: 1749. Dugdale 1988: 166.
 Type species *Ischalis thermochromata* Walker (a junior subjective synonym of *Selenia gallaria* Walker, 1860), by monotypy.
Polygonia Guenée, 1868: 41 (a junior homonym of *Polygonia* Hübnér, 1816 [1819]). Type species *Polygonia fortinata* Guenée, by monotypy.
Stratocleis Meyrick, 1883: 530. Synonymised by Poole (1970: 135). Type species *Selenia gallaria* Walker, by subsequent designation of Poole.

Gonophylla Meyrick, 1885: 589. Replacement name for *Phyllodoce* Meyrick, 1883: 530 (a junior homonym of *Phyllodoce* Ranzani, 1817). Synonymised with *Azelina* (*sensu* Meyrick, 1917) by Meyrick (1917: 269). Type species (of *Phyllodoce* Meyrick) *Gonodontis nelsonaria* Felder, Felder, & Rogenhofer, by monotypy.

Azelina in the sense of Meyrick, 1917: 269, not Guenée, [1858] 1857: 156. Synonymised by Poole (1970: 135). Hudson 1928: 148–150, pl. C fig. 63, 64 (venation), pl. 2 fig. 5, 6, 12, 13 (larvae), pl. 17 fig. 7, 8 (*fortinata*, ♂, ♀), 15–18 (*variabilis* ♂, ♀) pl. 18 fig. 1–6 (*gallaria* ♂, ♀). Dugdale 1961: 224, fig. 8e (1st-instar larva).

Diagnosis. Narrow-bodied lithinines showing considerable interspecific and intraspecific variation in wing pattern and colour. Forewing outer margin with a more or less pronounced angle at vein M₃. In 3 of the 5 species (*gallaria*, *fortinata*, and *dugdalei* n.sp.) the outer forewing margin is crenate. The forewing termen has a single projection between M₂ and M₃ in *variabilis* (Fig. 7–12) and *nelsonaria* (Fig. 17, 18).

Adults (Fig. 1–18) Eyes small, 0.5–0.7× width of frons. Frons contiguous with eyes in profile, bearing a pronounced ventral tuft of scales. Palpi long, >2× length of eyes; apical segment 0.4–0.5× length of segment 2 and 0.8× length of basal segment. Antennae simple (males minutely pectinate), with no pronounced sexual dimorphism. Thorax narrow. Foretibia with base of epiphysis arising at 1/2–2/3 its length. Males with hind tibiae modified to form a fold containing hair pencils. Forewing lacking an areole, with R₁ and R₂ arising independently from cell; radial system with a single accessory cell formed by fusion of R₂ and R₃.

Male genitalia (Fig. 27–31). Uncus narrow, elongate, strongly curved, appearing C-shaped in lateral view. Gnathos robust, with a small, sclerotised prong at apex. Valva without basal or apical projections, apex ranging from rounded to narrow, costal margin strong; setose band running along entire costal margin; transtillae of typical triangular lithinine type. Sacculus reduced, weakly sclerotised. Juxta plate-like, with prominent brush of setae on each side; processes present or absent. Aedeagus: posteriorly extended into a point on one side, but not in *nelsonaria*; vesica with several long, thread-like cornuti (e.g., Fig. 30b) or a single short, robust spine (*nelsonaria*).

Female genitalia (Fig. 35–39). Anal papillae slender, oblong. Ostium bursae: sterigma absent or present (*fortinata*). Ductus bursae longitudinally striate, narrowing to a small membranous constriction followed by split colliculum (colliculum absent from *dugdalei*); below (anterior to) colliculum, ductus curved or straight, sclerotised or membranous, wholly or partially with longitudinal striations, suddenly or hardly expanding into membranous corpus bursae; wall of globular sac with

(*gallaria*) or without (all other species) large thickening; signum usually present, sometimes minute, sometimes prominent.

Immature stages (Fig. 43A). First instar larva slender, with a red lateral stripe, abdominal setae D1, L1, L2 represented by groups of fine setae (Dugdale 1961: fig. 8e); later instars more generally covered by erect pilose setae and setulae (Fig. 43A), head capsule also with numerous erect setulae.

Hudson described and figured the larvae of all species known to him (1928: 148–149, pl. 2 fig. 5 (*I. variabilis* larva), 6 (*I. gallaria* larva), 12, 13 (*I. fortinata* mature, young larvae); 1939: 416, pl. 53 fig. 12 (*I. nelsonaria* larva)), and provided a rudimentary description of the egg of *gallaria* and *nelsonaria*. Dugdale (1961: 224, fig. 8e (*I. variabilis* 1st instar)) described and figured the pigmentation pattern of the 1st-instar larva, and described the chaetotaxy of *Ischalis* relative to other New Zealand lithinine genera. The 1st-instar larva has SV1 and SV2 on segments A1–5 arising from a common pinaculum, and setae D1, L1, and L2 represented by groups of setulae. The proleg of A6 has 20–40 setulae (Dugdale 1961).

Host plants include ferns in the families Cyatheaceae, Dryopteridaceae, Polypodiaceae, and Thelypteridaceae (see species accounts for specific host records).

Distribution. Endemic to New Zealand, and apparently restricted to the North, South, and immediate offshore islands. Four species (*fortinata* Guenée, *gallaria* Walker, *nelsonaria* Felder, Felder, & Rogenhofer, and *variabilis* Warren) have been recorded from both main islands, and the fifth (*dugdalei* n.sp.) is known only from mountains of the South Island.

Phenology. The main adult flight period for most *Ischalis* species is October–March, suggesting that these moths are bivoltine. The possible exception, *I. nelsonaria*, may be univoltine in parts of its range. The alpine *I. dugdalei* n.sp. is presumably univoltine, but only five specimens are known (dated 4 December to 5 February). Data on flight periods summarised by Hudson (1928) suggests the possibility of temporal resource partitioning, with *gallaria* flying earliest in the season and *nelsonaria* last, the remaining lowland species occupying intermediate positions in the seasonal progression. More data on the phenology of all four lowland species is required from localities where they are clearly sympatric.

Ecology / behaviour. Hudson (1928) noted that this genus occurs in dense forests, and that adults of several species feed at flowers, especially white rata (*Metrosideros* sp., Myrtaceae), in the evening. Escape behaviour is similar to that of *Sarisa* (see p. 23), adults ‘dropping’ to the ground and remaining motionless. The shape and colour of the wings contribute to an effective ‘dead leaf’ crypsis.

***Ischalis gallaria* (Walker)**

Fig. 1–6, 27, 35; Map 3

gallaria Walker, 1860: 185 (*Selenia*).

gallaria Gaskin, 1964: 306 (*Azelina*); incorrect subsequent spelling of *gallaria* Walker.

thermochromata Walker, [1863] 1862: 1750 (*Ischalis*). Synonymised by Prout (1927: 79).

palthidiata Felder & Rogenhofer, 1875: pl. cxxxii fig. 21 (*Euchlaena?*). Synonymised by Meyrick (1883: 530; 1884a: 105).

cinerea Felder & Rogenhofer, 1875: pl. cxxxii fig. 22 (*Euchlaena?*; as var. of *palthidata*). Synonymised by Prout (1927: 79).

venustula Salmon, 1956: 574–575 (as ssp. of *Azelina gallaria*). Synonymised by Dugdale (1988: 166).

Diagnosis. Showing extreme polymorphism that extends to wing shape as well as wing pattern. Wing shape variation largely in the degree of forewing and hindwing termen crenation. Individuals with forewing termen distinctly crenate bearing 2 projections between R_5 and CuA_1 (Fig. 5, 6). In some individuals, forewing termen more or less smooth in shape, with 2 indistinct rounded projections, and hindwing termen lacking crenation (Fig. 1). The only *Ischalis* species with a doubled transverse postmedial line, in some individuals fused to form a broader and often much darker transverse band. Majority of individuals examined with a double (rarely single) spot, or vestiges of such maculation, outside postmedial line near tornus of forewing. Some individuals with an additional spot or patch of dark scales near hindwing tornus. Ground colour varying from dark greyish brown to ochreous yellow, but basal portion of wings usually paler in ground colour than the portion distal to postmedian line.

Male genitalia (Fig. 27). Juxta lacking processes, but setal brushes present. Aedeagus: vesica with a relatively large spine-like cornutus and several narrower spine-like cornuti; lacking thread-like cornuti.

Female genitalia (Fig. 35). Ostium bursae: sterigma absent. Ductus bursae curved, striated throughout length, broadening suddenly into globose corpus bursae, which bears large, irregular thickening on one side; signum very small, star-shaped.

Immature stages. Described by Hudson (1928, p. 149) as follows:

Egg. “The egg is hemispherical, considerably flattened above, pale straw-colour, covered with numerous minute depressions.”

[First-instar] larva. “The young larva, which does not eat the [chorion] on emergence, is about [3.2 mm] in length, reddish ochreous with a very broad crimson line on each side; there are numerous large greenish-black [verrucae], each ... emitting several long black [setae].”

[Fifth-instar] larva. “The full-grown larva is about

[29 mm] in length, rather slender, cylindrical, with a strong hump on the back of segment 12 [*sic*; really A_8], abdominal segments 1–5 (A_{1-5}) length over twice diameter, A_{6-8} distinctly shorter; its colour varies from pale dull olive-green to dull blackish-red; there is usually an interrupted dorsal stripe, often containing fainter spots and frequently indistinct, except at the segmental divisions, as well as a series of more or less indefinite lateral stripes; the surface of the larva is much wrinkled and covered with very fine black [secondary setae]; there are also numerous minute brown and whitish-grey [spots] which make all the markings very indefinite; an irregular series of yellow tubercles is situated on the lateral line.”

Hudson (1928) noted that the young larvae show crupsis, resting “on the edges of the fern fronds” (along pinnae?), but mature larvae usually rest along the midrib. The larval host is recorded as “*Dryopteris pennigera*” (*Pneumatopteris pennigera*, Thelypteridaceae).

Pupation. “The pupa is enclosed in a light cocoon formed by fastening two of the side fronds together with silk, the insect passing the rest of the winter in this condition.”

Distribution (Map 3). Endemic to New Zealand. Widespread in the North and South Islands, and recorded from Stewart Island.

AK, BP, CL, HB, ND, RI, TK, TO, WI, WN / BR, DN, FD, KA, MC, NC, NN, OL, SD, SL, WD, SI.

Phenology. Recorded in every month of the year except July in the North Island, but main flight period September–April. Apparently bivoltine, but may breed continuously during mild winters.

Type data. Walker described *Selenia gallaria* on the basis of a single female collected by P. Earl. The type locality was restricted to Waikouaiti, by Dugdale (1988). The holotype female lacks antennae, and has the body flattened dorso-ventrally. The label data are, verbatim: “type” [printed circular label with red border] / “New Zeal[and]” [handwritten on circular white label]; 45 [-] 30 [handwritten accession number on reverse of circular white label] / “6. SELENIA GALLARIA.” [printed rectangular label with black lettering]; “albida.” [reverse of printed rectangular label], [BMNH. Examined.]

thermochromata: holotype male: “New Zealand”; “ISCHALIS THERMOCHROMATA”. [Wellington], Major Perry. [BMNH. Examined.]

palthidiata: holotype male: “347”; “Novara CXXXII f. 21 Euchlaena? pallidata N. Seeld. ♂ m.” [Nelson, T.R. Oxley]. [BMNH. Examined.]

cinerea: holotype male: “348”; “Novara CXXXII f. 22, Euchlaena? pallidata [*sic*] v.? cinerea N. Seeld ♂ m.” [Nelson, T.R. Oxley]. [BMNH. Examined.]

venustula: holotype male Little Barrier Island, J.T. Salmon; unique, designated by Salmon; "Type in the author's collection" (not found by Dugdale in NMNZ; not examined).

Material examined. Type specimens, plus 75 non-type examples (37 males, 38 females; BMNH, NZAC) from the following localities. **North I. ND.** Waipoua S[tate] F[orest], Oct, 1 ♀. **AK.** Whenuapai, Mar, Jun, 2♂ 3♀. Waitakere Ranges: Spragg's Bush, Nov, 1♂; Cutty Grass Track, Nov, 1♀. Titirangi, Mar, Apr, Dec, 2♂ 1♀. Auckland City, Massey, Feb, 1♂. Lynfield, Sep, 1♂. **BP. FRI** [Forest Research Institute, Rotorua], Feb, 1♀. **TK.** Pouakai Ra., Pouakai Hut, 1250 m, Jan, 1♀. Mt Egmont: Mangaoraka picnic area, 700 m, Mar, 1♀; Dawson Falls Rd, 2150 ft [645 m], Oct, 1♂; Whangamomona S[ad]d[e], 200 m, Oct, 1♀. **TO.** Waituhi S[tate] F[orest], [vic.] Moerangi, Saddle Rd, 670 m, Oct, 1♂. Waipakihī [R.♂], 1000 m, Dec, 1♂. **WN.** Porirua, Feb, Oct, 3♂ 2♀. Wellington: Jan, Feb, Dec, 3♂ 2♀; Karori, 1♀; Highbury, Sep, 1♂. Orongorongo Vly, A.E.D. [Animal Ecology Division, DSIR] Field Station, May, Sep, 1♂ 1♀. **South I. SD.** Pelorus B[ridge], Sep, Nov, 3♂. **NN.** Nelson, Apr, Dec, 1♀. Upper Maitai [R.], Jan, Feb, 1♂, 1♀. Dun Mtn, 1000 ft [300 m], [♂♂]. **BR. L.** Rotoiti, 610 m, Feb, 1♀. **WD.** Fox Glacier, Dec, 1♀. **FD.** [L.] Manapouri, Mica Burn, 800 ft [240 m], Jan, 2♀. Wairaurahiri [R.], Dec, 1♀. **NC.** Mt Grey, Feb, Dec, 1♂ 1♀. **SL.** West Plains, 2♂ 1♀. Bluff, Nov, 1♀. Longwoods [Longwood Ra.], Dec, 1♂.

Literature records. **North I. ND.** Kao (Hudson 1928: 149; *Azelina*); Whangarei (*ibid.*). **CL.** Little Barrier I., Feb (Salmon 1956: 574–575; *Azelina*, as ssp. nov.); Thames (Hudson 1928: 149; *Azelina*). **TK.** New Plymouth (Hudson 1939: 416; *Azelina*). **TO.** Mt Ruapehu (*ibid.*). **HB/WA.** Makatuku, Feb, Mar (Meyrick 1884a: 105–106; *Stratocleis*). **HB.** Puketiritiri (Hudson 1928: 149; *Azelina*). **GB.** Morere (Hudson 1939: 416; *Azelina*). **RI.** Ohakune, Jan (Hudson 1913: 60; *Gonophylla*; — 1928: 149; *Azelina*). **WI.** Palmerston North (Hudson, 1928: 149; *Azelina*). **South I. NN.** Mt Arthur (Hudson, 1939: 416; *Azelina*). **MC.** Christchurch, Feb, Mar (Hudson 1913: 60; *Gonophylla*; — 1928: 149; *Azelina*). **OL.** Makarora (*ibid.*). **DN.** Palmerston, Feb, Mar (Hudson 1913: 60; *Gonophylla*); Dunedin (Hudson 1928: 149; *Azelina*). **FD.** L. Manapouri (Hudson 1939: 416; *Azelina*); L. Te Anau (*ibid.*); Sandhill [Sand Hill] Point (*ibid.*). **SI.** Stewart I. (Hudson 1928: 149; *Azelina*).

Remarks. The genitalia of this species are most like *variabilis*, particularly in the sudden expansion of the ductus bursae into the corpus bursae in the female, and in the shape of the uncus and the spine-like rather than thread-like cornuti in the male.

Ischalis variabilis (Warren)

Fig. 7–12, 28, 36; Map 5
variabilis Warren, 1895: 153 (*Polygonia*).

ophiopa Meyrick, 1897: 387 (*Gonophylla*). Synonymised by Prout (1927: 79).

Diagnosis. Extremely variable in maculation. Forewing with 2 or 3 variably distinct transverse lines; antemedial line jagged, with 2 pointed projections; medial line (when present) very faint and wavy; postmedial line sinuous but lacking distinct projections, originating near forewing apex and often marked along its length with a series of black spots (the only *Ischalis* species with black spots on or replacing postmedial lines of forewings and hindwings). Females with maculation less distinct and postmedial line of forewing and hindwing continuous (usually lacking spots). Both sexes with 4 discal spots usually visible dorsally as well as ventrally.

Male genitalia (Fig. 28). Juxta lacking processes. Aedeagus: vesica with several spine-like cornuti; thread-like cornuti lacking.

Female genitalia (Fig. 36). Ostium bursae: sterigma absent. Ductus bursae divided into membranous, non-striate half and sclerotised, striate half; expanding suddenly into globose corpus bursae with large, disk-like, spined signum.

Immature stages. Described by Hudson (1928: 148) as follows:

Egg. "The eggs, which are usually deposited in January and February, are almost hemispherical, slightly ovate, flattened, pale bluish-green in colour, covered with numerous very slight hexagonal depressions. As the enclosed embryo develops, small irregular reddish-brown patches appear on the surface of the egg-shell."

[First-instar] larva. "The [neonate] larva ... is about [3.2 mm] in length; very pale ochreous-brown, with two wavy orange-red subdorsal lines, and numerous tufts of long black [setae]. The [chorion] is not eaten on emergence."

[Fifth-instar] larva. "The full-grown larva ... is about [32 mm] in length and of uniform thickness throughout; the general colour is pale rusty-brown with an obscure pale-brown dorsal line, stronger on the thorax and at the commencement of each segment; there are two similar obscure lateral lines; the head is yellow, speckled with dull-red, and the entire larva is thickly covered with dark-brown [spots] and clothed with many very fine pale-reddish [setae]; there are several obscure marks near the spiracular region, and a series of whitish tubercles on the sides of segments 5 to 12 [A₂–9] inclusive."

Pupation. "The pupa is enclosed in a curled fern leaf or hidden amongst [leaf litter] on the ground."

Hudson (1928) records *Cyathea* (Cyatheaceae) and *Dicksonia* (Dicksoniaceae) as larval hosts.

Distribution (Map 5). Endemic to New Zealand. Widespread in the North and South islands.

AK, BP, CL, GB, HB, ND, RI, TK, TO, WN / BR, DN, KA, MC, NN, SD, SL, WD.

Phenology. Recorded in every month of the year except June on the North Island; main flight period October–March. Apparently bivoltine, but may breed continuously during mild winters.

Type data. Warren described *Polygonia variabilis* on the basis of an indeterminate number of specimens of unknown sex in the collection of W. Rothschild. The specimen labelled by L.B. Prout “Type” in BMNH is here designated as lectotype (here designated, so as to assure the correct and consistent application of the name in the future). This specimen is one of 3 suspected male syntypes ex Felder Collection via Rothschild Collection. It lacks the right antenna and distal three-quarters of the left antenna. The label data are, verbatim: “type” [printed circular label with red border] / “FELDER COLLN.” [printed circular label] / “*Polygonia variabilis*; 1895 Warr.; type. L.B.P. sel.” [hand-written rectangular label].

ophiopa: holotype male: “Wellington New Zealand GVH [G.V. Hudson] [18]/93”; “Meyrick Coll. B.M. 1938-290”; “Tr. Ent. Soc. Lond. 1897 p. 387” [upper side of label]; “Gonophylla ophiopa Meyr. m type” [reverse of label]. The abdomen is missing from the specimen. [BMNH. Examined.]

Material examined. Type specimens, plus 87 non-type examples (63 males, 24 females; BMNH, NZAC) from the following localities. **North I.** ND. Omahuta S[tate] F[orest], Kauri Reserve, Jul, 1♂. AK. Titirangi, Jan, Mar, Apr, Oct–Dec, 9♂ 3♀. Waitakere [Ra.]: Aug, 1♂; 1000 ft [300 m], Nov, 1♂; Cutty Grass Track, Nov, 1♂ 1♀; Kauri Knoll, 280 m, Feb, 1♂; Spragg’s Bush, Oct, Nov, 4♂ 1♀. Swanson: Jan, 1♂; Birdwood Rd, Aug, Sep, Nov, 3♂. Whenuapai, May, Jun, Oct, 2♂ 1♀. CL. Little Barrier I., main track to Hauturu Mtn, 198 m, Feb, 1♂. Kauaeranga S[tate] F[orest], Oct, 1♂. BP. Mt Te Aroha, Tui Mine (Norpac), 1000 ft [300 m], Oct, 2♂. Mt Ngongotaha, 757 m, Feb, 1♂. TK. Mt Messenger, 1000 ft [300 m], Jan, Oct, 2♂ 1♀. Mt Egmont, Dawson Falls Rd, 2150 ft [645 m], Oct, 1♂ 2♀. TO. Taupo: Jan, 1♂; P. & T. Bush, Feb, 1♂. GB. Urewera N[atational] P[ark], nr Waikaremoana at Aniwanui Falls, 700 m, Nov, 2♂. HB. [vic.] Puketitiri, Little Bush, Mar, Apr, Oct, 7♂ 2♀. WN. Upper Ohau R., Tararua Rd, Dec, 2♂. Well[ing]ton, 1♂ 1♀; Karori, Jan (1♀), 2♂ 3♀. Orongorongo Vly, DSIR Station, Nov, 2♂. **South I.** SD. Opouri Vly, Dec, 1♂ 1♀; Opouri, Nov, 5♀. Pelorus B[ridge], Nov, 9♂. NN. Whanganui Inlet, Mangarakau, Mar, 1♀. Denniston Hill, 500 ft [150 m], Oct, 1♀. Riwaka, Nov, 1♂. Dun Mtn, Feb, 1♂. DN.

Waitati, P. Line, Nov, 1♂. SL. Hokonui S[tate] F[orest], Bare Hill, 700–750 m, Mar, 1♂.

Literature records. **North I.** AK. Waitakere, Jan (Clarke 1920: 38, *A. ophiopa*). BP. Puhī Puhī [Puhīpuhī] (Hudson 1939: 416, *A. variabilis*). TO. Raurimu, Jan (*ibid.*). RI. Ohakune, Jan (Hudson 1913: 60, *G. ophiopa*). **South I.** NN. Motueka (Hudson 1928: 148, *A. variabilis*); Buller R. (*ibid.*). KA. Kaikoura, Puhī Puhī District, Dec, Jan (Lindsay 1930: 352, *A. variabilis*).

Ischalis fortinata (Guenée)

Fig. 13, 14, 29, 37, Map 2

fortinata Guenée, 1868: 41 (*Polygonia*).

zizac Felder & Rogenhofer 1875: pl. cxxvi fig. 4 (*Caustaloma?*). Synonymised by Meyrick (1883: 531; 1884a: 106).

Diagnosis. Forewing and hindwing with termen distinctly crenate. Forewing with 2 transverse lines, the antemedial line jagged with 2 pointed projections, the postmedial line wavy with 2 projections. Ground colour of wings varying from pale straw-yellow to brown; section of fore and hind wings bordered by antemedial and postmedial lines paler. Forewing with a dark costal patch midway between antemedial and postmedial lines. Ventral surface with discal spots visible on both wings; dorsal surface with only a forewing discal spot sometimes visible.

Male genitalia (Fig. 29). Juxta with pair of large, posterior processes similar to those of *dugdalei*, but differing slightly in shape, each ending posteriorly in a prominent spine. Aedeagus: vesica with several thread-like cornuti; spine-like cornuti lacking.

Female genitalia (Fig. 37). Ostium bursae: sterigma in form of a large, strongly sclerotised, cleft plate. Ductus bursae slightly curved, sclerotised and striate, widening suddenly into membranous, globose corpus bursae with minute signum.

Immature stages. Described by Hudson (1928, p. 149) as follows:

[Second-instar] larva. “The young larva, immediately after first moult, is about [3.2 mm] in length, dull ochreous with a conspicuous blackish dorsal line and three or four fine, bright red, lateral lines, another blackish line being situated below the spiracles; the head is pale ochreous [speckled] with black, and the entire larva is clothed with rather long black [setae].”

[Fifth-instar] larva. “The full-grown larva is from [29–32 mm] in length, rather elongate, slightly thickened posteriorly, pale brownish ochreous, sometimes slightly tinged with green and speckled with reddish-brown, especially towards the extremities; there is a very broad

brownish band on the back edged with [black]; this band is very faintly indicated on segments 2, 3 and 4 [T₂₋₃, A₁], and its edges marked by blackish [spots] only on segments 10, 11 and 12 [A₇₋₉]; segment 12 [*sic*; Ag, Fig. 43A] is humped, with a strong oblique lateral stripe; there are conspicuous slightly oblique black markings on the sides of segments 6, 7, 8 and 9 [A₃₋₆] and a black and whitish lateral line on segments 2, 3, and 4 [T₂₋₃, A₁]; the whole larva is densely covered with very fine blackish [secondary setae].”

Hudson (1913, 1928) records the larval host as *Aspidium aculeatum* (= *Polystichum vestitum*, Dryopteridaceae).

Pupation. “The pupa is enclosed in a light cocoon, constructed of the brown hairy scales of the fern. It is usually affixed to the underside of one of the fronds.”

Distribution (Map 2). Endemic to New Zealand. Widespread on the North and South islands, and recorded from Big South Cape Island.

AK, HB, RI, TK, TO, WN / BR, CO, DN, FD, KA, MC, MK, NC, NN, OL, SD, SL, WD, SI.

Phenology. Adults have been recorded on the wing from September to April, with a single mid-winter record (July) from Wellington. Apparently bivoltine.

Type data. Guenée described *Polygonia fortinata* on the basis of an unspecified number of males collected by R. W. Fereday in Canterbury. There are two specimens in the BMNH. The type locality of the specimen referred to by Dugdale (1988: 166) as the holotype was restricted by him to “?Akaroa, Banks Peninsula.” It is here designated as LECTOTYPE (here designated, so as to assure the correct and consistent application of the name in the future), and bears four labels as follows: “Ex Typicalibus Specimenibus” [red bordered rectangular printed label with red lettering] / “Ex Musaeo Ach. Guenée” [black bordered rectangular printed label with black lettering] / “Ex Oberthür Coll.; Brit. Mus. 1927-3.” [rectangular printed label with black lettering] / “*Fortinata*; *Gn. N^{lle}. Zd.*” [upperside of label]; “Cebrenus Cr. 178 Scorin[?]” [reverse of label] [handwritten rectangular label]. [BMNH. Examined.] Paralectotype ♂, abdomen missing, bearing three labels: “Ex Typicalibus Specimenibus” [red bordered rectangular printed label with red lettering] / “Ex Musaeo Ach. Guenée” [black bordered rectangular printed label with black lettering] / “Ex Oberthür Coll.; Brit. Mus. 1927-3.” [rectangular printed label with black lettering]. The red BMNH holotype label has been replaced with a lectotype label. [BMNH. Examined.]

ziczac: holotype male: “362”; “Novara CXXXII, f.4. Caustoloma?, ziczac m. ♂ Neuseeld”. [upperside of label]; “gen. *Polygonia* Guenée ent. m. Mag. V.41, 1068” [reverse of label]. [Nelson, T.R. Oxley]. The specimen lacks the

head and abdomen and the right hindwing is glued to the thorax. [BMNH. Examined.]

Material examined. Type specimens, plus 128 non-type examples (82 males, 47 females; BMNH, NZAC) from the following localities. **North I. AK.** Titirangi, Dec, 1 ♀. **TK.** Mt Egmont: Dawson Falls, 2700 ft [823 m], Oct, 3 ♂; North Egmont, Holly Hut, 914 m, Nov, 1 ♂. **TO.** Taringamotu S[tate] F[orest], Whanganui, Whenuakura Flats, Oct, 1 ♂ 1 ♀. Oruanui Strm, Dec, 1 ♂. [Mt] Opepe, Feb, 1 ♂. Waipakihi [R. ♂], 1000 m, Dec, 1 ♀. **HB.** [vic.] Puketitiri, Ball’s Clearing, Nov, 2 ♂ 1 ♀. **RI.** Taihape, Dec, 1 ♀. **WN.** Tararua Range, Dundas Hut, 1250 m, Feb, Nov, Dec, 3 ♂ 1 ♀. Wainuomata, 1 ♂. Wellington, Highbury, Jul, Dec, 2 ♀. **South I. SD.** Stephens I., Jan, 1 ♂. Opouri, Nov, 1 ♂. Pelorus B[ridge], Nov, 2 ♀. **NN.** Takaka, Feb, 1 ♂. Mt Donett [Domett], 1250 m, Dec, 1 ♂. Flora R. [Stm], Mar, Nov, 1 ♂ 3 ♀. Nelson, Sep–Dec, 8 ♂ 7 ♀. **BR.** L. Rotoroa, i. [Jan] 1 ♂ 1 ♀; [vic.] Reefton, Tawhai S[tate] Forest], Big River Rd, Jan, 1 ♂. Capleston, Mar, Apr, 1 ♂ 1 ♀. **KA.** Puhi-Puhi Scenic Reserve, nr Kaikoura, Jan, 1 ♀. Hapuku R., “behind Kai Koura”, Dec, 1 ♂. **NC.** Arthur’s Pass, 3000–3100 ft [900–930 m], Jan, Dec, 7 ♂ 1 ♀. Ashley Gorge, Jan, Dec, 3 ♂. **MC.** McLennan’s Bush, Dec, 1 ♀. Banks Peninsula, Sugar Loaf [Sugarloaf Hill, E of Dyers Pass], Nov, 2 ♂. **MK.** Governor’s Bush, Hooker V[ly], 728 [?ft, 220 m], Mar, 1 ♂. Mt Cook: Feb, 1 ♀; Hermitage, 2700 ft [810 m], Nov, 1 ♂. **OL.** Queenstown, Jan, Dec, 2 ♂. Dart Hut, 950 m, Feb, 2 ♀. Kingston, Mar, 1 ♂. **DN.** D[un]e[din, Flagstaff, Oct, Dec, 2 ♂. **FD.** Upper Pyke R., Simonin Ck, Jan, 2 ♀. [L.] Manapouri: Wilmot Pass, 300 m, Jan, 1 ♂, 2000–2100 ft [600–630 m], Jan, 1 ♂ 5 ♀; West Arm, 700 ft [210 m], Jan, 1 ♂. Green Lake, 2000 ft [600 m], Nov, 5 ♂. Mt Cleughearn, 3250 ft [975 m], Jan, 2 ♂ 3 ♀. Wairaurahiri R. [pres. vic. “hut” nr mouth], Dec, 1 ♂ 1 ♀. **SL.** West Plains, [no date], 2 ♂. Tisbury, Jan, Oct, Dec, 4 ♂ 1 ♀. Bluff, Nov, 1 ♂ 1 ♀. **SI.** Long I. [Big South Cape I.]: NE Long I., 400 ft [120 m; on 1 ♂ only], Nov, 8 ♂ 3 ♀; Pu Wai [Puwai] Bay, Feb, 1 ♂.

Literature records. North I. TO. Erua, 2600 ft [780 m], Jan (Clarke 1920: 38; *Azelina*); Waimarino [now National Park], 2600 ft [780 m], Jan (*ibid.*). **RI.** Ohakune, Jan (Hudson 1913: 60; *Gonophylla*). **South I. NN.** Nelson, Jan, Feb, (Meyrick 1884a: 106–107; *Azelina*). **MC.** Mt Hutt, Jan, Feb (*ibid.*); Akaroa, Jan, Feb (*ibid.*). **CO.** Danseys Pass, <500 m, Nov (Patrick 1982: 334). **FD.** Homer [vic. Tunnel / Saddle] (Howes 1946: 141; *Azelina*). **SL.** Owaka, Mar, Oct, Nov (Patrick & Archibald 1988: 72). West Plains, Feb, Mar, Sep (Philpott 1901: 178). Ota[ta]ra, Feb, Mar, Sep (*ibid.*).

Remarks. The genitalia show close similarities to those of *dugdalei*, notably in the shape of the components in the male (particularly the juxta), and in the well sclerotised strigima of the female.

***Ischalis dugdalei* new species**

Fig. 15, 16, 30, 38; Map 1

Description. Male and female. Length of forewing 16–18 mm. Grey with a pale brown tint; black marginal spots between veins at termen; weak median/postmedian line across each wing; dark brown to black speckling. Forewing weakly crenulated between apex and halfway point of termen. Hindwing termen with very slight protrusion. Eyes small, 0.5–0.7× width of frons. Frons with a pronounced ventral tuft of scales. Palpi approximately equal in length to eye diameter. Antennae of both sexes simple. Foretibia with base of epiphysis arising at approximately 1/2–2/3 its length. Male hind tibiae modified into a fold containing hair pencils.

Male genitalia (Fig. 30). Uncus narrow, elongate, curved dorsoventrally into a shallow ‘C’, slightly narrower just posterior to the broadened base than near apex. Gnathos robust, with a sclerotised tooth at apex. Valva broadly rounded, with a strong costal margin, lacking basal or apical projections; dorsal (costal) margin of valva with a setose band, the setae becoming denser towards posterior end. Transtilla triangular. Sacculus reduced, weakly sclerotised. Juxta with pair of prominent, irregular, spined processes posteriorly, similar to those of *fortinata* but differing slightly in shape. Aedeagus (Fig. 35b) over 7× as long as wide, with base slightly broadened; vesica with several thread-like cornuti; lacking spine-like cornuti.

Female genitalia (Fig. 38). Ostium bursae: sterigma in form of broad, sclerotised lamella antevaginalis, entire, not cleft. Ductus bursae with conspicuous antrum; colliculum absent; below antrum curved, fairly membranous, moderately striate, broadening slightly and gradually into corpus bursae. Corpus bursae: membranous; signum absent.

Immature stages unknown. J.S. Dugdale (pers. comm.) collected adults in the vicinity of the subalpine/alpine fern *Polystichum cystostegia* (Dryopteridaceae), and this is suspected to be the larval host.

Distribution (Map 1). Endemic to New Zealand, and apparently restricted to the South Island. Collected at a few widely separated localities. *Ischalis dugdalei* is the only New Zealand lithinine known to occur in subalpine and alpine habitats.

– / BR, NN, MB, MC.

Phenology. Collected in December and February. Additional material is needed to determine voltinism with certainty, but an alpine species such as *I. dugdalei* would probably be univoltine at a given location.

Type data. Holotype male (in FRNZ): “56.1 : 5536, Cascade C[ree]k, Angelus Basin 5200’–5700’, Nelson Prov., 5.2 [February]. [19]64 JSD [J.S. Dugdale]”; “Forest Research Institute Rotorua, New Zealand.”; [Genitalia] Slide

no. MJS. 244. Paratypes: 1 male (FRNZ; most of abdomen missing): “56.1 : 3716 Island Lake 4500’, Cobb area, Nelson Prov., coll. At dusk, 4.12.62”; “Forest Research Institute Rotorua, New Zealand”; 1 male, “NEW ZEALAND MB. ST ARNAUD RA. 21–24 Dec 1986, 1500 m [handwritten], B.H. PATRICK”; [Genitalia] Slide no. MJS. 242; 1 female, “NEW ZEALAND, [MC] Craigieburn Ra[nge]., 1500 m, 24 Jan. 1992, B.H. Patrick.”; 1 female, unspread, labelled as previous specimen except “22 Jan. 1992; [Genitalia] Slide no. MJS. 243”.

Material examined. Type specimens only. This new species is described from 3 male and 2 female specimens. One of the males lacks a substantial part of its abdomen. We are very grateful to J.S. Dugdale and B.H. Patrick for drawing our attention to this material.

Remarks. This poorly known species may prove to be more widespread when comprehensive collections of alpine Geometridae are obtained from many of the poorly explored ranges of the South Island. *I. dugdalei* is probably a Pleistocene relict, isolated in mountain ranges after a climatic change that may have restricted suitable habitat for ancestral *Ischalis* to higher elevations. More detailed studies of ecology and behaviour are needed for this remarkable species. It is the only truly alpine lithinine in New Zealand and perhaps the world (other montane Lithinini have not been recorded above the treeline).

This species has a prominent sterigma (lamella antevaginalis) and the posterior section of the corpus bursae broadens gradually rather than suddenly into the anterior section. In these features the species resembles *fortinata*, and both species have thread-like cornuti on the vesica in the male.

***Ischalis nelsonaria* (Felder & Rogenhofer)**

Fig. 17, 18, 31, 39, Map 4

nelsonaria Felder & Rogenhofer: 1875, pl. cxxiii fig. 3 (*Gonodontis*).

felix Butler, 1877: 389 (*Gonodontis*). Synonymised by Hudson (1898: 90; 1928: 150).

Diagnosis. Forewing termen with a single projection between M₂ and M₃; apex projecting, but not distinctly falcate. Males with forewing ground colour reddish brown; postmedial line transverse, often lined with greyish white scales, and forewing marked with greyish white outside postmedial line. Females with forewing ground colour a paler orange-brown speckled with darker reddish brown. Antemedial line jagged, with 3 projections visible in females, obscured in males; posterior margin of 3rd projection of this line (when present) corresponding to basal portion of forewing inner margin.

Male genitalia (Fig. 31). Valva: apex more pointed than rounded. Juxta bearing pair of short, medial prongs and pair of long furcate, and more widely separated, arms. Aedeagus: lacking prominent extension of wall; vesica with single, short, robust cornutus; lacking both spine-like cornuti and thread-like cornuti.

Female genitalia (Fig. 39). Ostium bursae: sterigma absent. Corpus bursae: posterior section broader than in other species and membranous with few striations; broadening gradually into weakly expanded anterior sac; signum small, but distinct, crescentic.

Immature stages. First instar larva slender, with dorsal and lateral red stripes, chaetotaxy normal (Dugdale 1961: fig. 8c); later instars with seta L₁ on A₆, A₇, A₈ setuliform, and set in a ring-sclerite, as are prothoracic setae L₂ and pro-, meso-, and metathoracic setae SD₂ (Fig. 43B); segments A_{1–5} length about twice diameter, A_{6–8} distinctly shorter.

Described by Hudson (1939, p. 416) as follows.

Egg. “The egg is oval, flatten[e]d at one end; pale sea green, covered with numerous very slight hexagonal depressions. The eggs are deposited loosely in two[s] and threes and are not fixed down. In many cases, on each side of the long axis of the egg, there is a very large oval depression. As development progresses the egg becomes yellowish, with numerous irregular orange-brown markings.”

[Fifth-instar] larva. “The length of the full-grown larva is about [38 mm]; it is elongate, slender, cylindrical, with the head and thoracic segments slightly flattened; general colour dorsally dull greyish-brown, finely striped transversely with lighter and darker; ventrally dull pinkish-brown also [spotted] and striped with lighter and darker; top of head blackish-brown; a distinct white-edged dorsal band from antennae to segment 5 [A₂] and a darker ventral stripe in thoracic region; two distinct black spots on back of segment 5 [A₂], also on sides of segments 9 and 10 [A_{6,7}] and at base of ventral proleg; segments 11, 12, and 13 [A_{8–10}] very short, other abdominal segments elongate; a distinct pinkish-white lateral ridge on segments 5 to 10 [A_{2–7}] inclusive; there are numerous small warts and very short [setae]. ... The larva is of sluggish habit resting fully extended in a stick-like position.”

Hudson (1939) records the larval host as ‘*Polypodium diversifolium*’ (*Microsorium pustulatum*, Polypodiaceae).

Distribution (Map 4). Endemic to New Zealand. Wide-spread in the North and South Islands.

AK, CL, HB, ND, TK, TO, WI, WN / BR, DN, FD, MB(?), NC, NN, SD, WD, SL.

Phenology. This species has a shorter flight period than its congeners, with the earliest records in October and none beyond March. There do not appear to be any late autumn

or winter records, but this may be an artifact due to the relative rarity of this taxon in collections. The data reviewed suggest that *nelsonaria* may be univoltine in at least part of its range, and generally flies later in the season than sympatric congeners at a given locality.

Type data. Felder & Rogenhofer (1875, pl. 128: 3) figured the holotype female of *Gonodontis nelsonaria*, listing the type locality as “Nova Seelandia.” Dugdale (1988) indicated the sex of the holotype as male, but the specimen (BMNH; examined) is a female with a male abdomen glued on. Dugdale (1988) cited T.R. Oxley as the collector, and restricted the type locality to Nelson. The label data are, verbatim: “Holotype” [printed circular label with red border] / “34” [handwritten rectangular label in black ink] / “*Novara CXXXIII ; f.3. Gonodontis? ; Nelsonaria ; Neusel. ♀. n.*” [handwritten rectangular label in purple ink].

felix: HT male: “N. Zeel. 77-34”; “*Gonodontis felix* Butler”; “body is f, abd. is m! JSD [J.S. Dugdale] 1981” [Castle Hill Station], J.D. Enys. [BMNH. Examined.]

Material examined. Type specimens, plus 34 non-type examples (20 males, 14 females; BMNH, NZAC) from the following localities. **North I. ND.** S. Pandora, Te Pahi Coastal P[ark], Feb, 1♂. **AK.** Titirangi, Feb, 3♂. Waitakere Range, Kauri Knoll, 280 m, Feb, 1♂. **CL.** Tapu–Coroglen Rd, 396 m, Oct, 1♂. **TK.** Mt Messenger, 1000 ft [300 m], Oct, 1♂. North Egmont, Holly Hut, 950 m, Nov, 1♂. Whitecliffs, S of Tongaporutu, Dec, 1♀. **TO.** Taupo, Feb, Mar, 2♂; Feb, 1♂. Waituhi S[tate] F[orest], [vic.] Moerangi, Saddle Rd, 792 m, Oct, 2♂. Kaimanawa North, Forest Park, Feb, 1♀. **HB.** Puketitiri, Little Bush, Jan, Nov, 1♂ 2♀. **WN.** Wellington: 2♀; Karori, Bush Hill, Feb, 1♂. **South I. SD.** Opouri Vly, Dec, 1♂. **NN.** Dun Mtn, 3000 ft [900 m; female], Jan, Feb, 1♂ 1♀. [vic.] Westport, [nr] Waimangaroa, Stoney Ck [Stm], Mar, 1♂. **WD.** Jackson Bay, Feb, 1♀. **NC.** Arthur’s Pass, Jan, 1♂ 5♀. Jacks Hut [Bealey Vly], Jan, 1♀. **FD.** Wairaurahiri [R.], Dec, 1♂.

Literature records. **North I. ND.** Whangarei (Hudson 1939: 416; *Azelina*). **CL.** Thames (Hudson 1928: 150; *Azelina*). **HB.** Puketitiri (*ibid.*). **TK.** Mt Egmont (Hudson 1928: 150; *Azelina*). **TO.** Wairakei, Jan (Clarke 1920: 38; *Azelina*). Waimarino, Jan (*ibid.*). **South I. NN.** Nelson (Meyrick 1884a: 104, *Phyllodoce*; Hudson 1928: 150, *Azelina*). **NC.** Bealey R. (Hudson 1928: 150, *Azelina*). **DN.** Dunedin (Meyrick 1884a: 104, *Phyllodoce*; Hudson 1928: 150, *Azelina*). **FD.** [L.] Manapouri (Hudson 1939: 416, *Azelina*); [L.] Te Anau (*ibid.*); Knife and Steel [Harbour] (*ibid.*); Sandhill [Sand Hill] Point (Hudson 1928: 150, *Azelina*). **SL.** Catlins (Patrick, pers.comm).

Remarks. The genitalia of *I. nelsonaria* are distinctly different from those of the other species of *Ischalis*. The juxta bears a pair of projections, which differ strongly from

those observed in *dugdalei* and *fortinata*, the valvae are pointed, and the cornutus is robust, unlike the series of slender spines in the other species. The bursa copulatrix is a long and relatively broad membranous sac, with the ductus hardly expanding into the corpus.

Genus *Sestra* Walker

Sestra Walker, [1863] 1862: 1750. Hudson, 1928: 146, frontispiece, fig. 20 (egg), pl. C fig. 53 (venation), pl. 17 fig. 28, 29 (*humeraria* ♂ ♀), fig. 30–33 (*flexata* ♂ ♀). Dugdale, 1961: 229, fig. 9d (♂ genitalia); —1988: 169. Type species *Sestra fusioplagiata* Walker (a junior subjective synonym of *Cidaria flexata* Walker, 1862), by monotypy.

Amastris Meyrick, 1883: 530 (a junior homonym of *Amastris* Stål, 1860). Type species *Amastris encausta* Meyrick, by monotypy.

Diagnosis. Narrow-bodied moths with unicolorous hindwings; forewing margin with a rounded angle at M₃. Distinguished from other New Zealand endemic lithinines by the smooth-scaled frons (no trace of a tuft or ‘cone’ of scales ventrally).

Adults (Fig. 19–24). Eyes large, 0.9–1.2× width of frons. Length of palpi > length of eye. Frons smooth-scaled, lacking a cone or tuft of scales ventrally. Thorax narrow, smooth-scaled; patagial scales extending to 1st abdominal segment. Hind tibiae in male elongate and modified, with a fold extending entire length enclosing a hair pencil, in female unmodified. Abdomen slender; males with a setal comb on sternite 3. Wings broad. Forewing with a single areole; veins R₁ and R₂ sharing a common stalk; radial system with a single accessory cell formed by fusion of R₁ and R₂.

Male genitalia (Fig. 32, 33). Uncus slender, rounded at apex, but not distinctly spatulate. Gnathos V-shaped, with a cluster of spines at apex. Valvae narrow, rounded apically, lacking projections, and with a setose band on outer 2/3 of costal margin. Juxta with a pair of prominent, long, straight, flattened projections; brush of setae on each side where juxta meets base of valva.

Female genitalia (Fig. 40, 41). Anal papillae oblong, slender. Ostium bursae: sterigma absent. Bursa copulatrix: ductus bursae with short antrum and split colliculum; lateral expansion lacking; below (anterior to) colliculum, slender, sclerotised, and longitudinally striate; expanded suddenly or more gradually into membranous, oblong corpus bursae with a small, single-grooved signum.

Immature stages (Fig. 43B). All previously published accounts refer to the type species *flexata*. Hudson first described and figured the immatures (1892: 87, erroneously identified as *Sestra humeraria*; pl. XI fig. 5 (adult), 5a (larva); 1928: 146, frontispiece, fig. 20 (egg), pl. 2 fig. 8

(larva)). Dugdale (1961: 224, fig. 6a, 7c) described and figured the pigmentation pattern of the 1st-instar larva and the pupal cremaster, and described the chaetotaxy of *Sestra* relative to other New Zealand lithinine genera. The 1st-instar larva has a longitudinal red band running between seta L₁ and SV₁ on the thoracic segments; 2nd-instar to final-instar larvae have 2 or 3 subprimary setae on the A₆ proleg. The bifid pupal cremaster is subtended by 3 pairs of modified setae with curled apices.

Larval hosts include ferns in the families Pteridaceae and Dennstaedtiaceae (see species accounts for specific host records).

Distribution. Endemic to New Zealand, where both species occur in the North and South Islands. Recorded from the Chatham Islands (*flexata* only), but not from the subantarctic islands.

Ecology / behaviour. Adults have functional mouthparts and presumably visit flowers, but there are no literature records of nectar sources. These moths occur in forest and scrub habitats where, like many lithinines, they are often quite local, appearing common only in the immediate vicinity of their host plants (Hudson 1928). Larvae of both species show the characteristic lithinine ‘coil and drop’ defensive response when disturbed.

Sestra flexata (Walker)

Fig. 19, 22, 32, 40; Map 7

flexata Walker, 1862: 1421 (*Cidaria*).

fusioplagiata Walker, [1863] 1862: 1751 (*Sestra*). Listed as a junior synonym by Meyrick (1917: 268)

encausta Meyrick, 1883: 530 (*Amastris*). Listed as a junior synonym by Meyrick (1917: 268).

Diagnosis. Readily distinguished from *S. humeraria* by a distinct projection from the forewing termen between veins M₂ and M₃. Ground colour of forewing greyish brown, with a dorsal series of 3 dark brown costal patches; medial patch frequently extended into a transverse band across forewing; postmedial patch often extending posteriorly as a series of small spots. Hindwing either a uniform straw-yellow with a dusting of darker scales near anal margin, or with a postdiscal transverse band of greyish-brown spots forming a continuation of forewing postmedial spots (when present). In a small number of individuals a second faint discal band on dorsal hindwing forming a continuation of forewing medial band (when present).

Male genitalia. (Fig. 32). See generic description. Larger than those of *humeraria*, otherwise indistinguishable.

Female genitalia (Fig. 40). Bursa copulatrix: ductus bursae with short antrum; membranous and relatively broad anterior to colliculum, then taking the form of a long, narrow,

heavily striate, well curved duct before expanding suddenly into membranous corpus bursae with small signum.

Immature stages. Described by Hudson (1928: 146) as follows.

Egg. “The egg, which is laid on its side, is cylindrical, considerably larger at the micropylar end, pale ochreous yellow, covered with numerous rows of small hexagonal depressions.”

[Fifth-instar] larva. “The larva ... is about [32 mm] in length when full-grown, very attenuated towards the head, and much thickened posteriorly, with a large hump on the back of segment 12 [sic; A₈]; the head is small, brown, with two pale stripes; the body dull ochreous, faintly tinged with green; there is a very broad dull brown dorsal line, more or less distinctly edged with [black]; a broad pale sub-dorsal line, streaked with brown near the middle, and a broad indistinct lateral line, irregularly edged with [black] below; segments 9 to 12 [A₆₋₉] inclusive have two rows of more or less distinct pale coloured [chalazae] each of which emits a short black [seta]; the underside of the larva is pale yellowish, speckled with brown, and segments 6 to 10 [A₃₋₇] inclusive have two central black marks.”

Hudson (1928) recorded *Histiopteris incisa* (Dennstaedtiaceae) and *Pteris macilenta* (Pteridaceae) as larval hosts, and noted the characteristic lithinine defensive response. Bracken (*Pteridium esculentum*, Dennstaedtiaceae) was recorded as a larval host by Winterbourn (1987) on the Port Hills near Christchurch.

Pupation. “The pupa is buried in the earth about [50 mm] below the surface, and, in the case of autumnal larvae, the insect remains in this state during the winter months.”

Distribution (Map 7). Endemic to New Zealand and surrounding islands. Widespread in the North and South Islands, and recorded from the Chatham Islands.

AK, CL, HB, ND, TK, TO, WN, WO(?) / BR, CO, FD, MB, MC, MK, NC, NN, OL, SD, SL, WD, SI / CH.

Phenology. Adults have been recorded from September to early April (Hudson 1928), suggesting that this species is normally bivoltine. A single late record (20–21 May, Orongorongo Valley WN) indicates that mild weather in autumn may afford the opportunity for a partial third brood.

Type data. Walker described *Cidaria flexata* on the basis of a single male collected by Col. D. Bolton. The type locality, originally cited as ‘New Zealand’ (Walker 1862) was restricted to Auckland by Dugdale (1988). The holotype male (BMNH) has a damaged left hindwing, and a fragment of the right forewing apex is missing. The label data are, verbatim: “Type” [printed circular label with red border] / “New Zealand” [handwritten on circular blue-grey label] / “93. CIDARIA FLEXATA” [printed rectangular

label]; “*striga obliqua apicalis*” [printed reverse side of rectangular label].

fusipecta: holotype male: “SESTRA FUSIPLAGIATA.”; “New Zealand” [upper side of label]; 54. [reverse of label]. [Auckland], D. Bolton. The abdomen is missing from the specimen. [BMNH. Examined.]

encausta: lectotype male designated by Dugdale (1988: 170), “Otira Gorge, New Zealand, 1,500 ft., 24/1/[18]83 / Lectotype ♂ *Amastris encausta* Meyrick, J.S. Dugdale 1981” (BMNH).

Material examined. Type specimens, plus 118 non-type examples (79 males, 39 females; BMNH, BPBM, NZAC) from the following localities. **North I. ND.** Spirits Bay, Waipuna Stm, Nov, 1♂. Waipoua S[tate] F[orest], Oct, 2♀. **AK.** Whenuapai, Mar, 1♀. Titirangi, Dec, 4♂. Waitak[ere Range]s: Nov, 1♂; Spragg’s Bush, Oct, 1♂. Papakura, Jan, 1♀. Hunua, Dec, 1♂ 1♀. **CL.** Great Barrier [I.], S side of Whangaparapara Harbour, Nov, 1♀. Kauaeranga R., Jan, 1♂. **WO(?)**. Waiho [= Waihou?], Jan, 1♀. **TK.** Mt Messenger, 1000 ft [300 m], Oct, 1♂ 1♀. Mt Egmont, Dawson Falls, 2700 ft, Oct, 1♂ 1♀. **TO.** Taupo: Mar, Nov, 1♂ 2♀; “P & T Bush,” Jan, Feb, Dec, 5♂; “Kaas” Potato Patch,” Dec, 1♀; Hatipi R., Jan, 3♂; Aritaliaia [Aratiaia] Rapids, Feb, 1♂; “Lake Shou” [lake shore], Jan, 1♀. Waituhi S[tate] F[orest], [vic.] Moerangi, Saddle Rd, 792 m, Oct, 1♂. N[ational] Park, Jan, 3♂. **HB.** Hastings, 1♀. **WN.** Mangahao, Jan, 1♂. Linden, Nov, 1♀. Orongorongo Vly, A.E.D. [Animal Ecology Division] Field Station, 122–152 m, May, Sep, 1♂ 1♀. **South I. NN.** Nelson, Jan, Oct, 1♂ 1♀. Aniseed V[ly], Dec, 1♀. Dun Mtn, 2000 ft [600 m], Jan, Nov, 4♂ 2♀. Belgrove, Dec, 1♂. **BR.** [L.] Rotoroa: Dec, 4♂; Jan, 1♂ 1♀. Tawhai S[tate] F[orest], [vic.] Reefton, Big River Rd, Jan, 1♀. **WD.** Mt Misery, Ecology Div[ision] Stn, 550 m, Jan, 1♀. Otira Gorge, 1500 ft [450 m], Jan, 1♂. **MC.** Christchurch, 1♂. Mt Grey, Dec, 1♂. Craigieburn [Ra.]: end of Camp S[tate] F[orest] Rd, Dec, 1♂; Thermistor Hut, Jan, 1♀. **MK.** Mt Cook, Dec, 1♂. **OL.** Rout-burn [Route Burn], Dec, 2♂. **FD.** [L.] Manapouri: West Arm, 700 ft [210 m], Jan, 7♂ 7♀; Grebe R., Jan, 6♂; Mica Burn, 800 ft [240 m], Jan, 2♀. Darran Mtns, Tutoko Bench, 1020 m, Jan, 1♀. **SI.** Long I. [Big South Cape I.], SW [of] Stewart I. / NE Long I., 2♂ “at hut,” 3♂ “in bush,” Nov, 6♂. **SL.** Longwoods [Longwood Ra.], Dec, 1♂. Wyndham, Dec, 1♂ 1♀. West Plains, 5♂ 3♀. Tisbury [Tisbury], Nov, 1♂.

Literature records. **North I. ND.** Parau Hill, ±3 mi [les; 5 km] E of Whangarei P.O., Nov, Dec (Patterson 1930: 557). **TO.** Waimarino, 2600 ft [780 m], Jan (Clarke 1920: 38). **HB/WA.** Makatuku, Jan–Mar (Meyrick 1884a: 105). **HB.** “vic. Hastings and Napier” (Davies 1973: 213). **South I. SD.** Arapawa I., Jan–Mar, Oct (Gaskin & Cawthorn

1964: 4). **MC.** Port Hills, Summit Rd [larvae] (Winterbourn 1987: 101). Mt Hutt, Jan–Mar (Meyrick 1884a: 105). **CO.** Otago, Danseys Pass, <500 m, Oct–Dec (Patrick 1982: 334). **SI.** Stewart I. (Hudson 1928: 146).

Sestra humeraria (Walker)

Fig. 23, 24, 33, 41; Map 8

humeraria Walker, 1861: 940 (*Macaria* ?).

obtusaria Walker, 1861: 985 (*Lozogramma*). Synonymised by Meyrick (1884b: 235).

obtruncata Walker, 1862: 1421 (*Cidaria* ?). Synonymised by Prout (1912: 54).

punctilineana Walker, 1866: 1780 (*Teras*). Synonymised by Prout (1912: 54), as *punctilinearia*.

Diagnosis. Readily distinguished from *S. flexata* by the forewing termen lacking a distinct projection between veins M₂ and M₃. Ground colour of forewings orange-red and that of hindwings straw-yellow, as in *flexata*. Forewing maculation variable, sometimes similar to that of *flexata* with a series of 3 darker costal patches, and occasionally with distinct antemedial and postmedial transverse bands, the latter often represented by a series of spots.

Male genitalia (Fig. 33). Smaller than those of *flexata*, otherwise indistinguishable.

Female genitalia (Fig. 41). Bursa copulatrix: ductus bursae with antrum prominent; striate below (anterior to) colliculum, but less strongly so than in *flexata*; narrow, then expanding to terminate in membranous corpus bursae with small signum.

Immature stages. Larvae of a *Sestra* species tentatively identified by J.S. Dugdale as *S. humeraria* were collected feeding on *Paesia scaberula* (Dennstaedtiaceae) in the Waitakere Range west of Auckland during February 1993. The ground colour of the 3rd- or 4th-instar larva is reddish brown, with lateral grey-black bands edged in white. The prolegs on A₆ have a prominent white basal patch extending laterally. There are 2 rows of white dorsal chalazae bearing short black setae. One of the larvae collected harboured a mite, attached dorsolaterally to the 1st abdominal segment (**frontispiece**). The larvae showed characteristic lithinine defensive behaviour, dropping from the host and twisting/turning rapidly when disturbed. Additional larval material identified by Dugdale as *S. humeraria* has been collected on *Paesia* at Te Matarae, Chatham Island (NZAC).

Distribution (Map 8). Endemic to New Zealand. Widespread in the North and South Islands, and recorded from Chatham Island.

AK, ND, RI, TK, TO, WN / BR, FD, MC, NN, OL, SD, SL, WD / CH.

Phenology. *S. humeraria* has a shorter flight period than *S. flexata*, adults having been recorded from September to January, with two anomalous autumn records (4 March, 30 April). This species is probably univoltine, with an occasional partial second brood.

Type data. Walker described *Macaria? humeraria* on the basis of a single female collected by A. Sinclair. The holotype female has apparently been lost or mislabelled, and Dugdale (*in litt.*, 1988) has noted that the specimen labelled “Type” in BMNH cannot be the holotype female as the accession number [“54-4”] indicates that it was collected by Bolton. Dugdale (*in litt.*) has hypothesised that the holotype of *humeraria* may have been confused or mixed in with specimens subsequently designated as syntypes of *obtruncata* by Walker. Five of the six *obtruncata* syntypes (all males) are deposited in BMNH, suggesting that if the *humeraria* holotype were mixed with the *obtruncata* type series, it is the missing sixth paratype (Dugdale, *in litt.*). Alternatively, if Walker misdetermined the sex of one of the six *obtruncata* syntypes, the male Bolton specimen erroneously labelled “type” of *humeraria* may be the missing *obtruncata* syntype. As there are no female specimens bearing the Sinclair accession number [45-61], the holotype of *humeraria* is presumed lost. No neotype will be designated here, as the identity of this species is not in doubt.

obtusaria: holotype male: “New Zealand” [upperside of label]; “45 61” [reverse of label]; “LOZOGRAMMA OBTUSARIA”. [Auckland], A. Sinclair. [BMNH. Examined.]

obtruncata: lectotype male designated by Dugdale (1988: 170), [Auckland], “New Zeal. 54.4” / “-92 Cidaria? Obtruncata” / “Type” (BMNH).

punctilineana: holotype male: “TERAS PUNCTILINEANA”; “New Zeal” [upperside of label]; “54.4”. [reverse of label]. [Auckland], D. Bolton. [BMNH. Examined.]

Material examined. Type specimens, plus 100 non-type examples (67 males, 33 females; BMNH, NZAC) from the following localities. **North I. ND.** Waipoua S[tate] F[orest], Kawerua Beach, Oct, 1 ♀. **AK.** Whenuapai, Apr, 1 ♂. Titirangi, Dec, 1 ♀. Waitakere [Ra.], Dreamland, Mar, 1 ♂. **TK.** Mt Egmont: Dawson Falls, 2700 ft [810 m], Oct, 4 ♂; N. Egmont, Holly Hut, 914 m, Nov, 4 ♂; N. Egmont, Pukeiti Rd, 1100 ft [330 m], 1 ♂. Paiaka [Hill], Jan, Nov, 2 ♂ 2 ♀. **TO.** Taupo, Jan, Nov, Dec, 3 ♀. Palmer’s Bush, Dec, 1 ♂. Waituhi S[tate] F[orest], [vic.] Moerangi, Saddle Rd, 792 m, Oct, 1 ♂. Taringamotu S[tate] F[orest], Whanganui V[al]ley, Whenuakura Flats, 792 m, Oct, 1 ♂. Ohakune Mtn Rd, picnic area, 700 m, Nov, 1 ♂. **WN.** Light trap, Ballance Res[erve], Man[awatu] Gorge, Nov, 2 ♂. Wellington: Karori, Bush Hill, Oct, Nov, 1 ♀; Linden, Sep, Nov, 2 ♂; Highbury,

Sep, 1♂. Orongorongo Vly, A.E.D. [Animal Ecology Division] Field Station, [122–152 m], Sep, 2♂ 2♀. **South I. SD.** Tennyson Inlet, Oct, 1♂. Opouri, Nov, 6♂ 5♀; Opouri Vly, Dec, 4♂ 2♀. Pelorus B[ridge], Sep, Nov, 4♂ 3♀; Pelorus R., Oct, 2♀. **NN.** Nelson, Oct, Nov, 1m 3♀. Aniseed Vly, Dec, 1♂. Dun Mtn, 2000 ft [600 m], Nov, Dec, 7♂. Belgrove, Dec, 3♂ 1♀. **BR.** [L.] Rotoroa: Nov, 2♀; Dec, 1♂. Boatmans Vly, Caplestone, Nov, 1♂. **FD.** [L.] Manapouri, Mica Burn, 800 ft [240 m], Jan, 1♀. **OL.** Queenstown, Oct, Dec, 4♂ 1♀. **SL.** Gore, Sep, 2♂. Orepuke, Oct, 1♂. West Plains, Nov, 2♀. Tisbury, Sep, Oct, Nov, 4♂ 1♀. **Offshore islands.** **Chatham Is** Chatham I., Te Matararae, Nov, larvae.

Literature records. **North I. ND.** Kaeo (Clarke 1920: 38). **AK.** Auckland (Hudson 1928: 146); Kauri Gully [Birkenhead], Jan (Clarke 1920: 38). **RI.** Ohakune, Jan (Hudson 1913: 60). **WN.** Wellington (Hudson 1928: 146). **South I. WD.** Otira (Hudson 1928: 146). **OL.** Routeburn Hut [vic. Routeburn Falls], Jan (Hudson 1907: 203); Kinloch (Hudson 1928: 146); L. Wakatipu (*ibid.*). **SL.** Invercargill (*ibid.*). **FD.** Homer [vic. Homer Tunnel / Saddle] (Howes 1946: 141); Marion PWD Camp (*ibid.*).

Genus *Sarisa* Fletcher

Gargaphia Walker, 1863 [1862]: 1634 (junior homonym of *Gargaphia* Stål, 1862). Hudson 1928: 147–148, pl. 2 fig. 7 (larva), pl. 17 fig. 34, 35 (♂), 27, 36 (♀). Dugdale 1971: 91–93, fig. 40 (♀ genitalia), 41 (♂ genitalia), 42 (larva). Type species *Gargaphia muriferata* Walker, by monotypy.

Gargaphania Clarke, 1920: 38 (incorrect subsequent spelling of *Gargaphia* Walker).

Sarisa Fletcher in I.W.B. Nye (ed.), 1979: 185 (replacement name for *Gargaphia* Walker). Type species: *Gargaphia muriferata* Walker, by original monotypy.

Diagnosis. This monotypic genus is readily distinguished from the other New Zealand lithinine genera *Ischalis* and *Sestra* by the distinctive falcate forewing apex (hence the placement of the taxon in *Drepanodes* Guenée by Meyrick 1884a). The scaling on the ventral portion of the frons forms a distinct tuft, whereas in *Sestra* this tuft is vestigial. The male genitalia are unique among the Lithinini in that the normal paired processes of the juxta are modified to form three pairs of heavily sclerotised sinuate spines with hooked tips. The apex of the uncus is spatulate, and the juxta bears a pair of stout, horn-like processes, each with a highly distinctive group of three, sinuous spines. In the female genitalia there is a large, distinctive sclerotised lateral sac on the ductus bursae (Dugdale 1971: 91). Late instar larva (Fig. 43C) slender (segments A_{1–5} length about twice diameter); seta L₁ setulose, on a ring sclerite on segment Ag only.

Sarisa muriferata (Walker)

Fig. 25, 26, 34, 42; Map 6

muriferata Walker, 1863: 1635 (*Gargaphia*).

ephyraria Walker, 1863: 1761 (*Panagra*). Synonymised by Meyrick (1883: 531; 1884a: 107). Hudson (1898, p. 91; 1928: 147; as synonym of *muriferata* Walker).

cookaria Felder & Rogenhofer, 1875: pl. cxxiii fig. 26 (*Zanclapteryx*?). Synonymised by Meyrick (1883: 531; 1884a: 107). Hudson (1898: 91; 1928: 147, as synonym of *muriferata* Walker).

haastaria Felder & Rogenhofer, 1875: pl. cxxiii fig. 32 (*Zanclapteryx*?). Synonymised by Meyrick (1883: 531; 1884a: 107). Hudson (1898: 91; 1928: 147, as synonym of *muriferata* Walker).

neoselena Meyrick, 1909: 70 (*Drepanodes*). Synonymised by Dugdale (1971: 91).

The following descriptions are based in part on Dugdale, 1971: 90–93.

Description. Adults (Fig. 25, 26). Eyes large, 1.1–1.2× width of frons. Palpi subsacceding, longer than eye; apical segment 0.3–0.5× length of 2nd segment and almost hidden by its apical scales. Frons with scaling on ventral portion forming a tuft. Antenna of male unipectinate, slightly thickened, evenly and shortly setulose. Thorax narrow, smooth-scaled, with patagial scales extending to 1st abdominal segment. Hind tibiae in male elongate and modified, with a fold extending entire length enclosing a hair pencil, in female unmodified. Wings: colour variable; pale purplish brown; line traversing wings from near apex of forewing to mid point of anal edge of hindwing; line sometimes indistinct; basal part of wings in a few specimens much darker than proximal part; area from base of wings to line dark in *neoselena* holotype, sharply demarcated from pale section of wing distal to line; spot on forewing conspicuous or minute, on hindwing minute; submedial line present on forewing, sometimes very weak. Forewing (Fig. 25): apex falcate; areole single; vein R₁ and R₂ sharing common stalk; radial system with a single accessory cell formed by fusion of R₂ and R₃; vein R₄ extending to costal margin, R₅ to termen; discal cell with crossveins M₁–M₂, M₁–M₂ bearing pairs of unscaled patches between branches of M. Hindwing with a similar spot on discal crossvein at position of obsolete M₂. Abdomen slender, projecting well beyond posterior margin of hindwing in males but not in females; males with a setal comb on sternite 3.

Male genitalia (Fig. 34). Uncus slender, broadening into spatulate apex. Valva ovate, with expanded costa. Juxta bifid, with pair of curved, stout processes; 3 long, sinuate, spines arise laterally from each apex and close to valva. Aedeagus: acute apically; vesica bilobed, with cornutus at apex of each lobe.

Female genitalia (Fig. 42). Ostium bursae: sterigma absent. Bursa copulatrix: ductus bursae membranous

posteriorly, lacking sclerotised antrum; colliculum split, leading to section with longitudinal striations; expanded just below colliculum into a large, membranous lateral sac; rest of ductus/corpus bursae membranous, tubular, with ductus expanding imperceptibly into slightly broadened corpus with a small, carinate, signum.

Immature stages. Hudson (1928: 147, pl. 2 fig. 7) described and figured the mature larva, which is reddish brown with an interrupted black dorsal line containing five oblong yellowish-brown spots. Dugdale (1961: 227) diagnosed the 1st-instar chaetotaxy as follows: “SV₁ and SV₂ on segments A₁–5 widely separated; no setal members replaced by setulose groups.” Dugdale (1971: 92–93, fig. 42) described and illustrated a larva of unspecified instar collected on Auckland Island as follows: “All setae single; seta L₁ excessively fine on 8th abdominal segment only; 6th abdominal segment proleg with 3 or more subprimary setae” (Fig. 43C).

Larval hosts include two fern genera in unrelated families: “*Polypodium diversifolium*” / “Phymatodes” (= *Microsorium pustulatum*, Polypodiaceae) (Hudson 1928, Dugdale 1971) and the tree fern *Dicksonia fibrosa* (Dugdale 1971). The latter record, based on field-collected larvae from Auckland Island, requires confirmation. This species passes the winter in the pupal stage (Hudson 1928), but there is no published description of the pupa.

Distribution (Map 6). Endemic to New Zealand and surrounding islands. Widespread in the North and South Islands, and recorded from Stewart I., Big South Cape I., Chatham Is, and the Auckland Is (both Auckland I. and Adams I.).

AK, BP, HB, ND, RI, TK, TO, WN, WO / DN, FD, KA, MB, MC, NN, OL, SL, SI / CH, AU.

Phenology. Apparently bivoltine in the North and South Islands, with adults recorded September–March. At the southern limit of its range (Auckland Is, approx. 51°S) it is probably univoltine, flying during January and February, but records are limited.

Ecology / behaviour. Adults have functional mouthparts, and are commonly attracted to nectar sources. Evasive behaviour consists of ‘dropping’ when disturbed or attacked and falling to the ground, with the wings held motionless. The shape and colouring of the wings contribute to a most effective “dead leaf” crypsis (Hudson 1928).

Type data. Walker described *Gargaphia muriferata* on the basis of a single female collected by T. R. Oxley at or near Nelson, New Zealand. The holotype female (BMNH) lacks an abdomen. The original description listed “Auckland, New Zealand. From Mr. Oxley’s Collection” as the source of this specimen. The type locality was subsequently restricted to Nelson by Dugdale (1988) on the basis of his-

torical data regarding the source of Oxley’s collections.

The label data are, verbatim: “Type” [printed circular label with red border] / “Auckland; N. Zeal” [handwritten on circular blue-grey label] / “GARGAPHIA MURIFERATA.” [printed rectangular label].

ephyraria: holotype female: “Auckland N. Zeal” [upper side of label]; “60 73” [reverse of label]; “Panagra ephyraria”. Abdomen is glued to the specimen. [Nelson], T.R. Oxley. [BMNH. Examined.]

cookaria: holotype male: “Novara CXXIII f. 26 Zanclopteryx? Cookiaria [sic] n. Neu Seeld”. [Nelson], T.R. Oxley. Terminal 2/3 of abdomen glued on. [BMNH. Examined.]

haastaria: holotype male: “Austral.”; “Novara CXXIII f. 32. Zanclopteryx? Haastaria n. Neuseeld. ♂”. [Nelson], T.R. Oxley. [BMNH. Examined.]

neoselena: holotype female: Carnley Harbour; “Auckland I. New Zealand GVH. 08”; “Meyrick Coll. B.M. 1938-290”; “neoselena Meyr.”; “subantarct. Is of New Zealand, 1, p. 70”, [upperside of label]; “Drepanides neoselata Meyr. ♀ type” [reverse of label]; “Drepanodes neoselena Meyr. Paratype [sic] ♀ det. D.S. Fletcher, 1975”. The holotype bears, incorrectly, a circular, yellow-bordered BMNH Paratype label, see Dugdale (1988: 169, under *haastaris* [sic]). A holotype label has been added. The abdomen is missing from the specimen. [BMNH. Examined.]

Material examined. Type specimens, plus 130 non-type examples (88 males, 43 females; BMNH, CMNH, NZAC) from the following localities. **North I. ND.** Omahuta S[tate] F[orest], Kauri Sactuary, Oct, 2♂. Mangamuka Gorge, Oct, 2♀. Poor Knights Is: Aorangi [I.], Crater Bay, Nov, 1♂; Aorangi [I.], Puweto Vly, 150–200 m, Nov, 1♂. **AK.** Auckland, Oct, 1♂. Waitakere Range: Aug, 1♀; Nov, 1♂; Kauri Knoll, 280 m, Feb, 1♂; Spragg’s Bush, Oct, Nov, 2♂. Titirangi, Jan, Feb, Dec, 5♂ 1♀. Laingholm, Jan–Mar, 3♂ 2♀. **WO.** Pio Pio, Jan, 1♂. **BP.** Mt Te Aroha, Tui Mine (Norpac), 1000 ft [300 m], Oct, 1♂ 1♀. Mt Ngongotaha, 757 m, Feb, 1♂. **TK.** Hillsboro’ [Hurworth House], Dec, 1♂. Mt Egmont [Taranaki]: Dawson Falls, 2700 ft [810 m], Oct, 2♂; Dawson Falls Rd, 2150 ft [645 m], Oct, 2♀. Waitaanga Plateau, 500 m, Dec, 1♀. **TO.** Taupo: Jan, Feb, Dec, 3♂ 1♀; “P & T Bush”, Dec, 1♂. Waituhi S[tate] F[orest], Saddle Rd, [vic.] Moerangi, 670 m, Oct, 1♂. **HB.** [vic.] Puketitiri, Little Bush, Jan, Oct, 6♂ 1♀. **WN.** Levin, Jan, 1♀; Kaituna, Nov, 1♂; [vic.] Wellington: Oct–Dec, 3♂ 4♀; Highbury, Nov, 1♂; Wilton Bush, Oct, 1♀. Orongorongo Vly: F[ield] S[tation], Sep, 1♀; A.E.D. [Animal Ecology Division] Field Station, 122–152 m, May, Nov, 3♂ 2♀. **South I. SD.** Pelorus B[ridge], Nov, 1♀. **NN.** Nelson, Jan, Feb, Oct, Nov, 4♂ 4♀. Dun Mtn [2000 ft? = 600 m; illegible on 1 specimen], Feb, Oct, Nov, 5♂ 1♀.

DN. Dunedin: Aug, Nov, 2♂ 2♀; Aug, 1♂; Leith, Sep, 1♂. "Otago" [vic. Otago Harbour / Peninsula?], [no date], 2♂. **KA.** Puhī Puhī Res[erve], Dec, 1♂. **OL.** Queenstown, Jan, Sep–Nov, 12♂ 3♀. **FD.** Secretary I., Gut Hut, Jan, 1♂. **SL.** West Plains, [no date], 1♀. Tisbury, Oct, Nov, 6♂. Kapuka, Oct, 1♀. Greenhills, Nov, 1♂ (NZAC). **Offshore islands.** **Chatham Is.** Chatham I.: Awatotara C[ree]k, Tableland F[or]est, Feb, 1♀; [vic.] Waitangi, 2 m[ile] Bush, Feb, 2♂; Waitangi, Feb, 1♂; Te Matarea, Dec, 1♂; Mangone Creek, Nov, 1♂. **Auckland Is.** Auckland I., [Carnley Harbour], Camp Cove, Feb, 1♂ 5♀ [on 1♀ ex BMNH].

Literature records. **North I.** **ND.** Paranui Hill, ±3 miles [5 km] E of Whangarei P.O. (Patterson 1930: 557, *Gargaphia*). **AK.** Waitakere, Jan (Clarke 1920: 38, *Gargaphania* [sic]). **BP.** Rotorua (Dugdale 1971: 93). **TK.** "Taranaki" [no specific locality], Feb, Mar (Meyrick 1884a: 107). **HB.** Napier / Wairoa Rd, White Pine Bush (Davies 1973: 213). **RI.** Ohakune, Jan (Hudson 1913: 60, *Drepanodes*; Clarke 1920: 38, *Gargaphania* [sic]). **WN.** Gollan's Valley, Feb, 1♀ (Hudson 1950: 94, *Gargaphia*). **South I.** **MC.** Christchurch, Feb, Mar (Meyrick 1884a: 107). **DN.** Dunedin, Feb, Mar (Meyrick 1884a: 107). **SL.** Invercargill (Dugdale, 1971: 93). **SI.** Stewart I., 2♂ (Dugdale 1971: 93). Big South Cape I., Feb, Nov (*ibid.*). **Offshore islands.** **Auckland Is.** Auckland I., Ranui Cove, Jan, 4 larvae (Dugdale 1971: 93, fig. 42). Adams I., Magnetic Cove, Feb, 1 larva (Dugdale 1971: 93, fig. 42).

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ILLUSTRATIONS



1

10 mm



2

10 mm



3

10 mm



4

10 mm



5

10 mm



6

10 mm

Fig. 1–6 *Ischalis gallaria* (Walker). (1–3) male, dorsal; (1) “New Zealand” / “60d [ref. to Hudson locality]” (BMNH); (2) “New Zealand” (BMNH); (3) “New Zeal[an]d.; Tararua Mts.” (BMNH); (4) male, ventral; same data as fig. 3. (5–6) female; (5) dorsal; “Wellington, N.Z.” (CMNH); (6) ventral; same data as fig. 5.

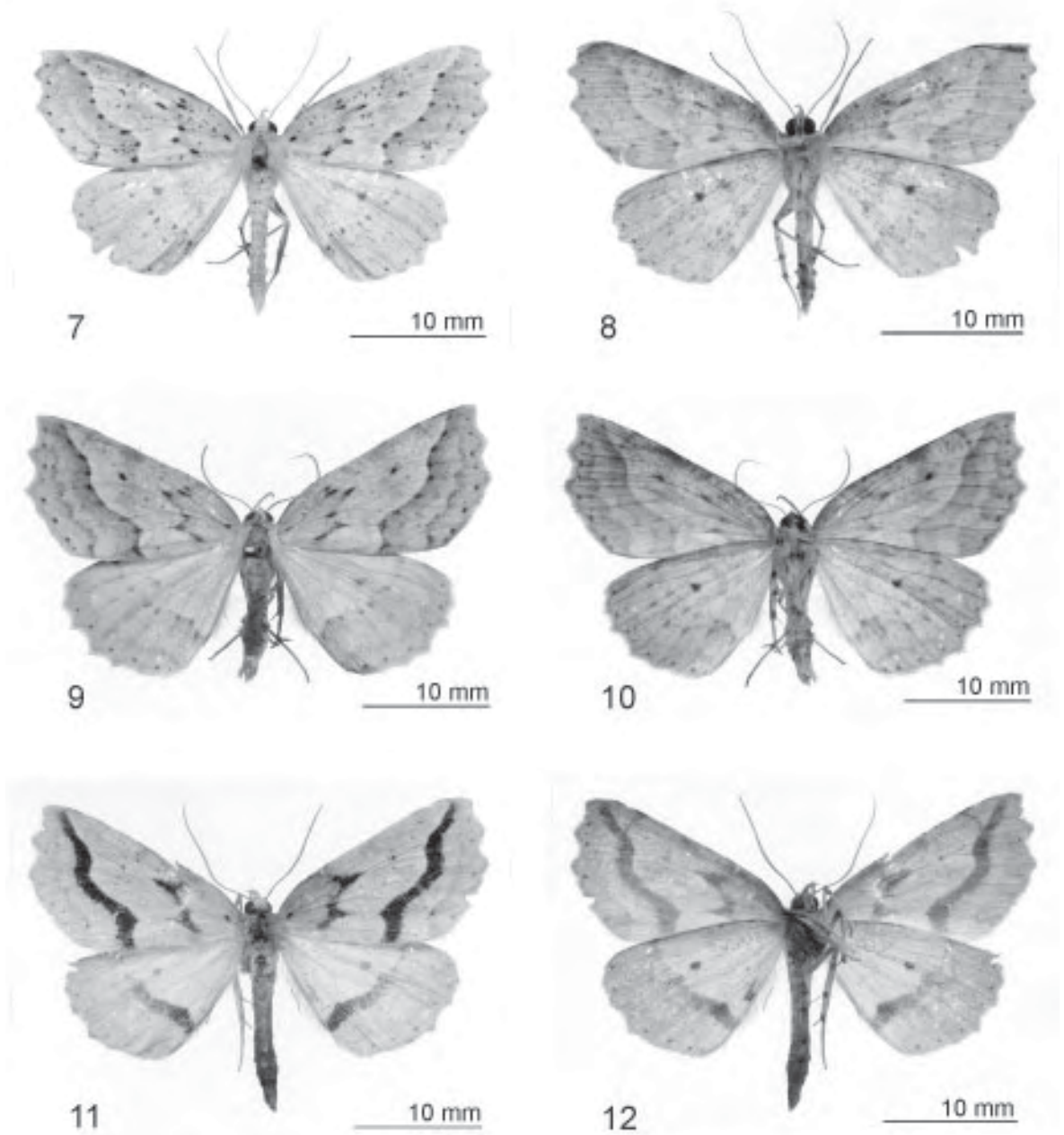


Fig. 7–12 Male *Ischalis variabilis* (Warren). (7) dorsal; “Wellington, N.Z.” (CMNH); (8) ventral; same data as fig. 7; (9) dorsal; “New Zealand: Ohakune” / “1922-23” / “[*leg.*] T.R. Harris” (BMNH); (10) ventral; same data as fig. 9; (11) dorsal; “Nouv. Zelande” (BMNH); (12) ventral; same data as fig. 11.

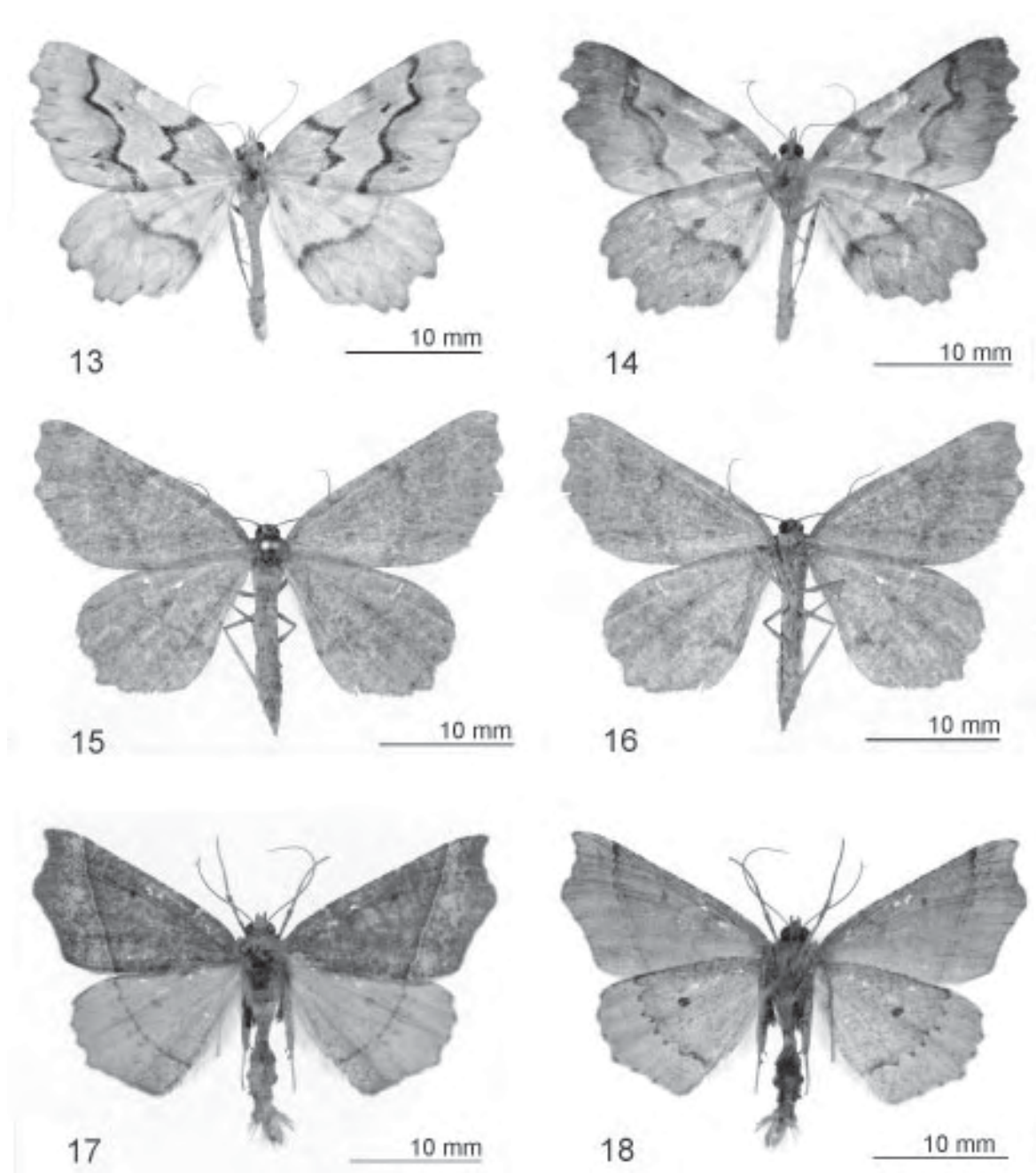


Fig. 13–14 Male *Ischalis fortinata* (Guenée). (13) dorsal; [New Zealand]: “Flagstaff” [xii.1914] (BMNH); (14) ventral; same data as fig.13. **(15–16)** Male *Ischalis dugdalei* new species. (15) dorsal; “Nelson Prov.; Cascade Ck., Angelus Basin 5200’–5700’; 5.2.64; [leg.] J.S.D[ugdale].” (FRNZ) [holotype]; (16) ventral; same data as fig. 25. **(17–18)** Male *Ischalis nelsonaria* (Felder, Felder & Rogenhofer). (17) dorsal; “Nouv. Zelande” (BMNH); (18) ventral; same data as fig. 17.

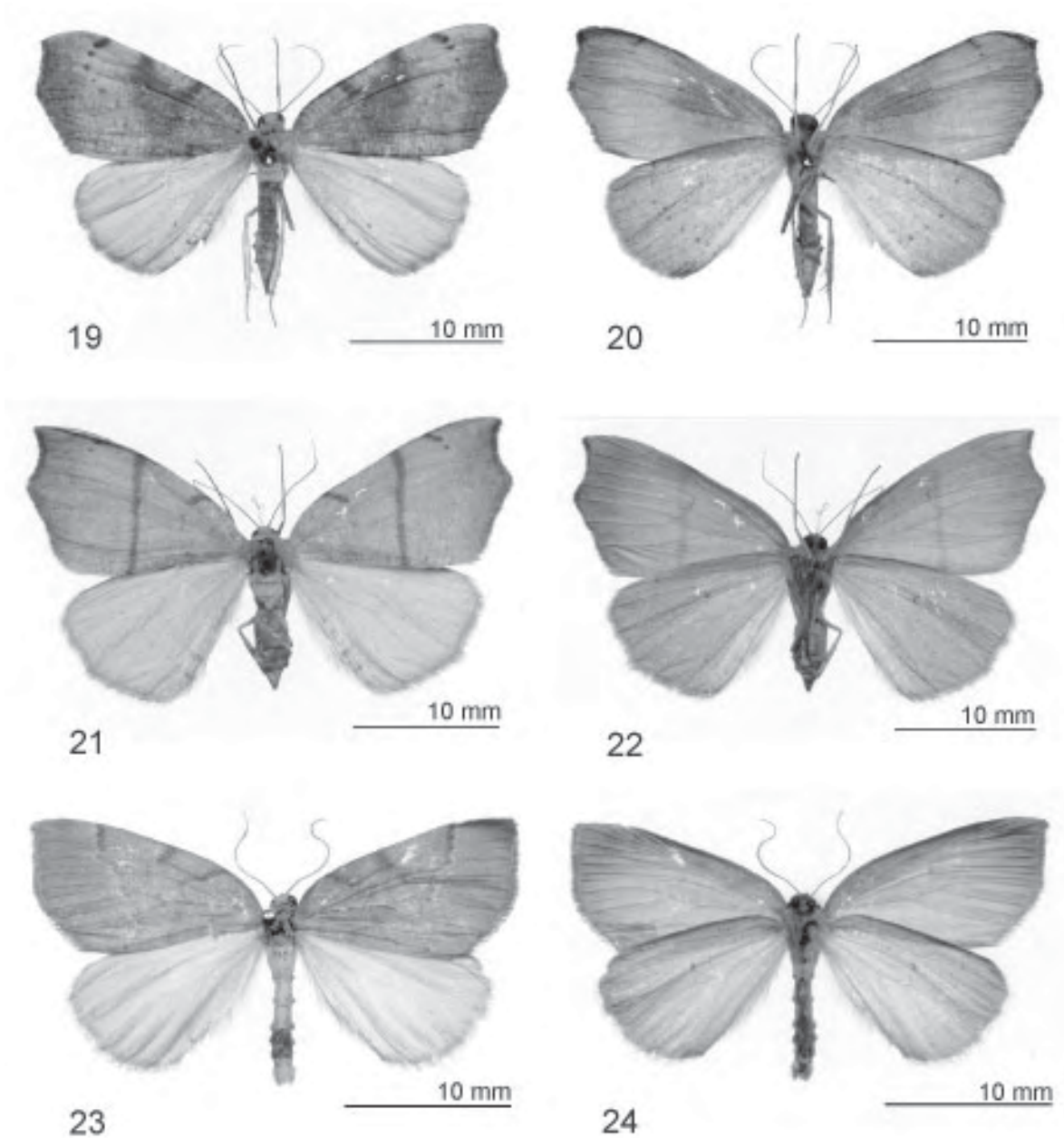


Fig. 19–22 *Sestra flexata* (Walker). (19) male, dorsal; “New Zealand” (CMNH); (20) male, ventral; same data as fig.19; (21) female, dorsal; “New Zealand” (CMNH); (22) ventral; same data as fig. 21. **(23–24)** Male *Sestra humeraria* (Walker). (23) dorsal; “New Zealand” / “[*leg.*] Hudson” / “26j [ref. to Hudson locality]” (BMNH); (24) ventral; same data as fig. 23.

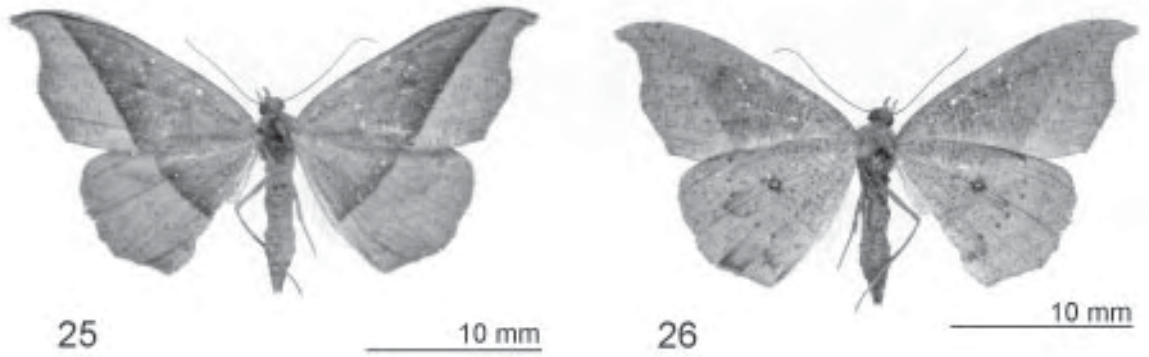


Fig. 25–26 Female *Sarisa muriferata* (Walker). (25) dorsal; “Nouv. Zelande” (BMNH); (26) ventral; same data as fig.25.

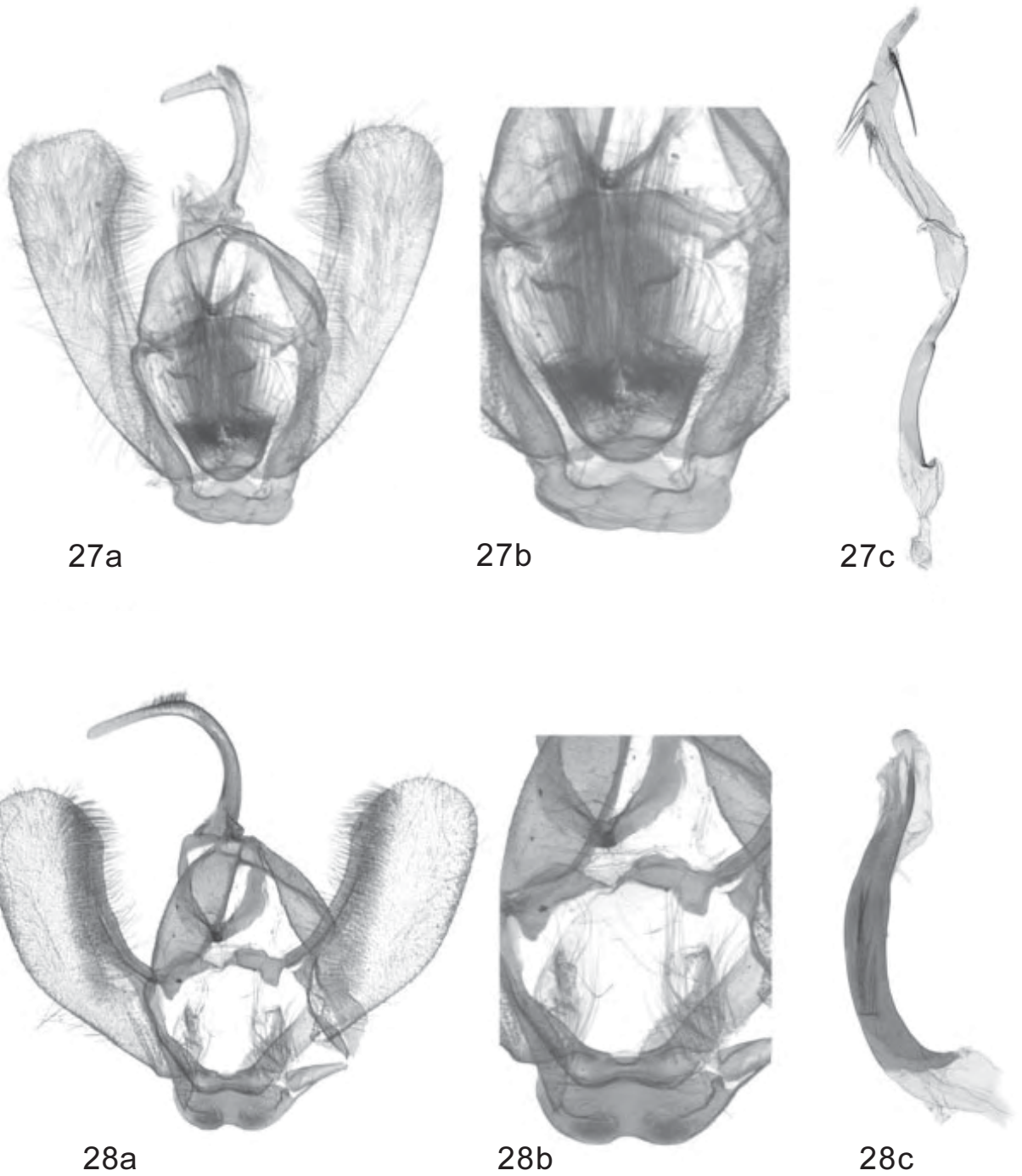
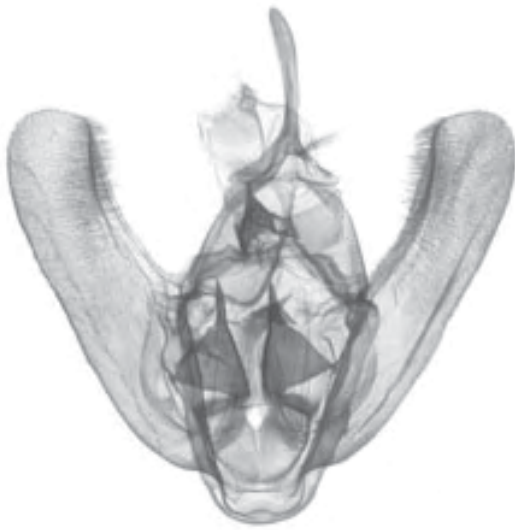
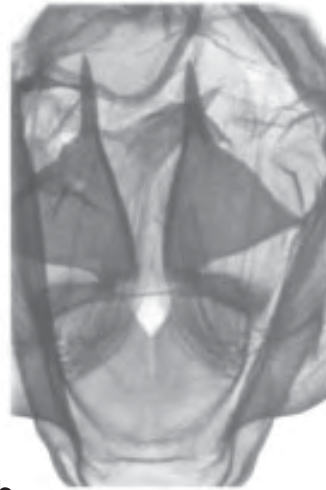


Fig. 27–28 Male genitalia. (27a–c) *Ischalis gallaria*; (28a–c) *Ischalis variabilis*.



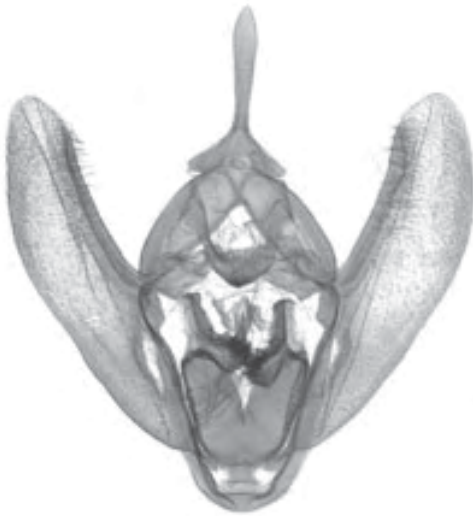
29a



29b



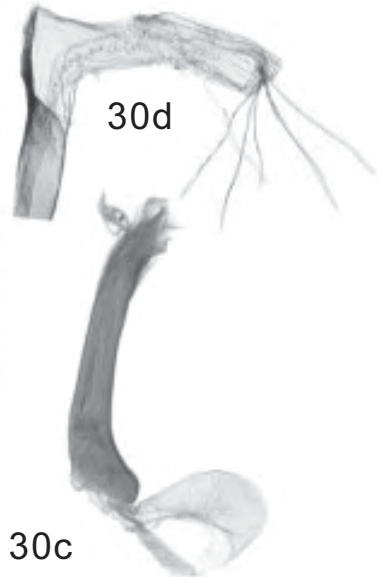
29c



30a



30b



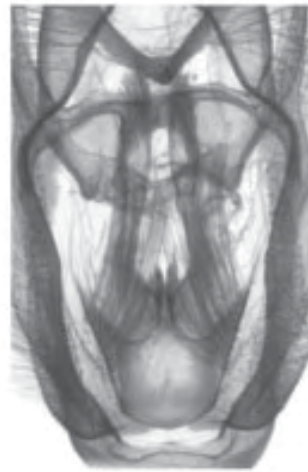
30d

30c

Fig. 29–30 Male genitalia. (29a–c) *Ischalis fortinata*; (30a–c) *Ischalis dugdalei*.



31a



31b



31c



32a

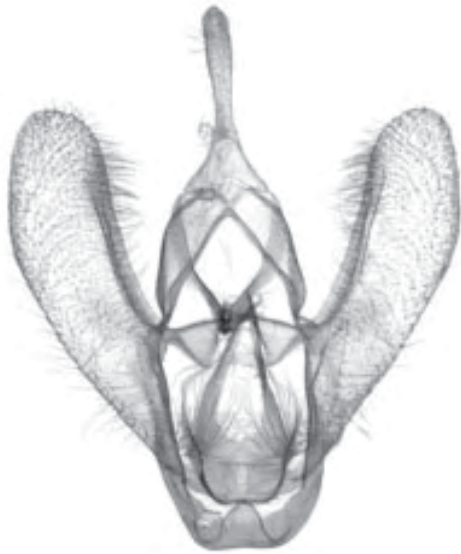


32b



32c

Fig. 31–32 Male genitalia. (31a–c) *Ischalis nelsonaria*; (32a–c) *Sestra flexata*.



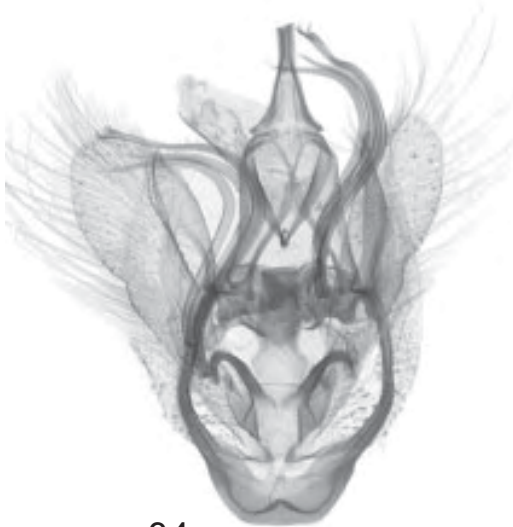
33a



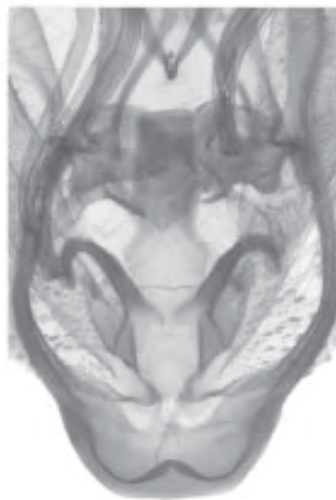
33b



33c



34a



34b



34c

Fig. 33–34 Male genitalia. (33a–c) *Sestra humeraria*; (34a–c) *Sarisa muriferata*.

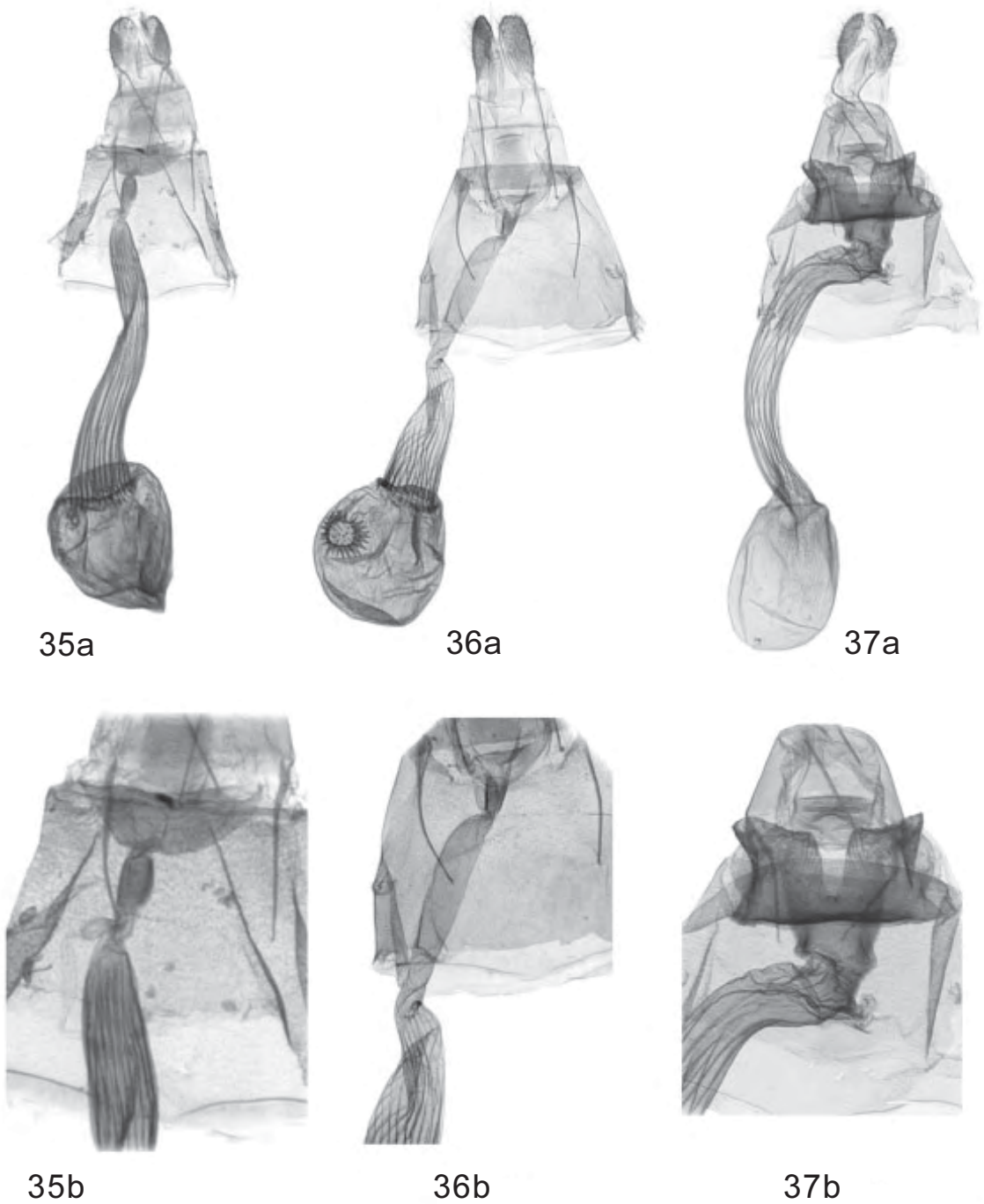
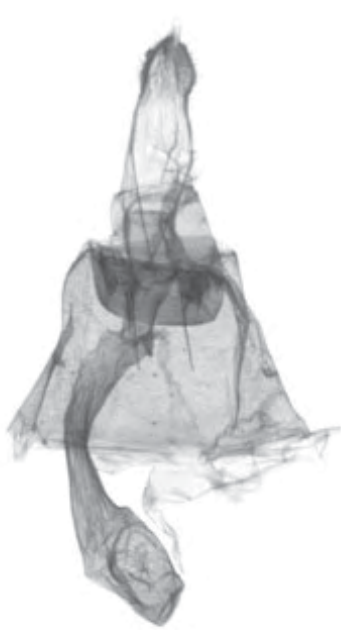


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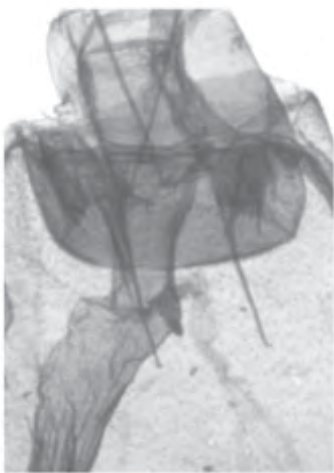
38a



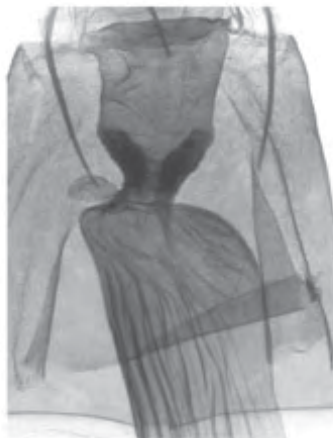
39a



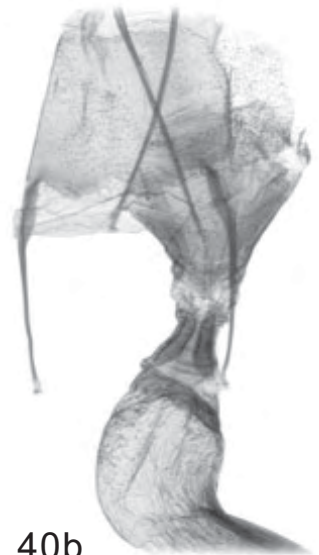
40a



38b



39b



40b

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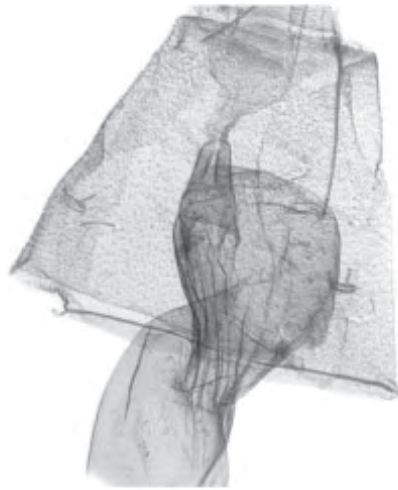
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42a

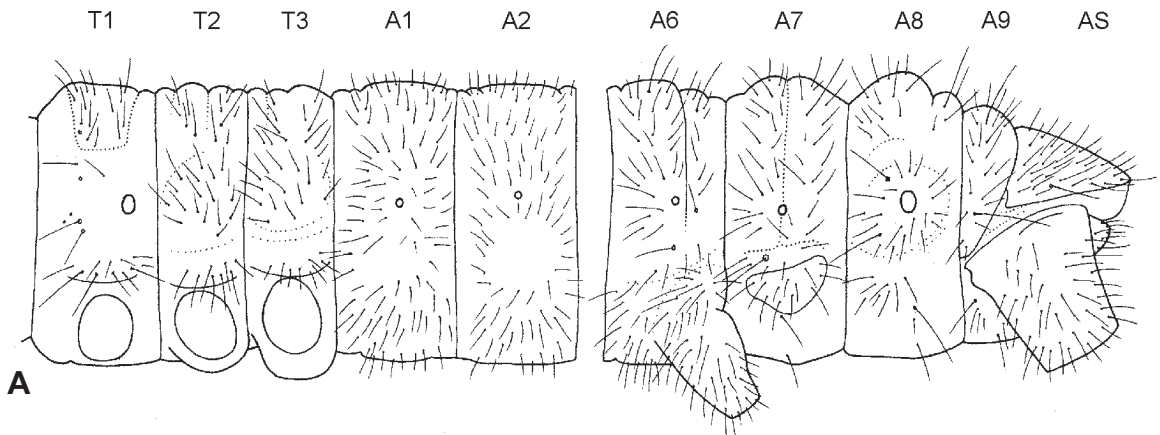


41b

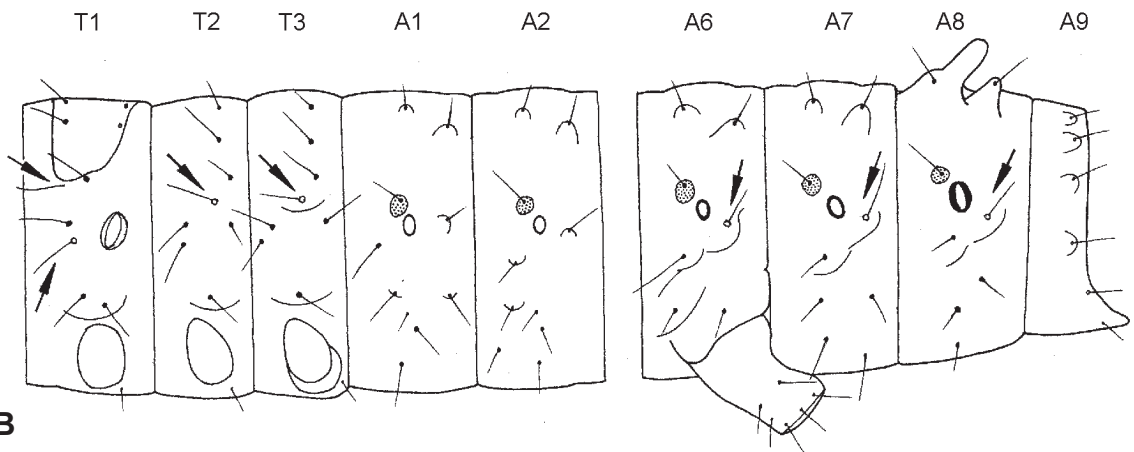


42b

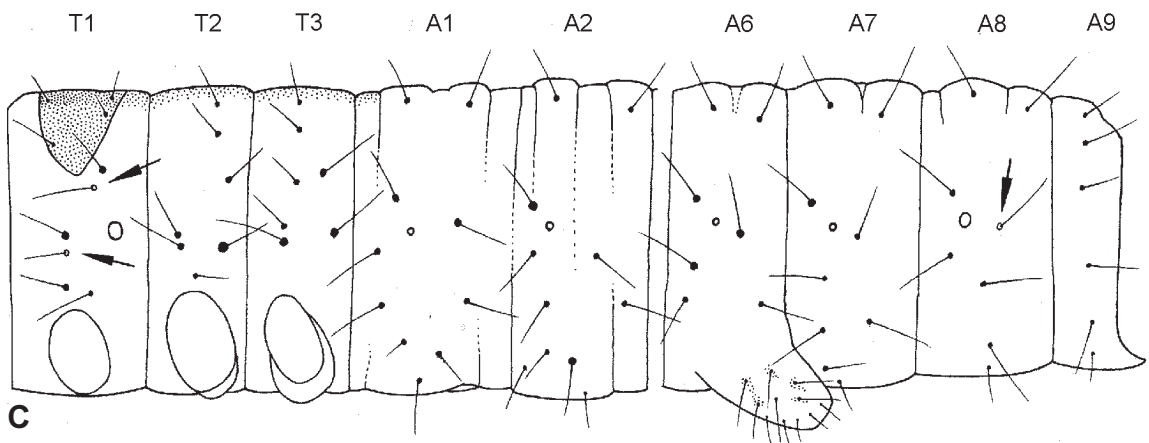
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A

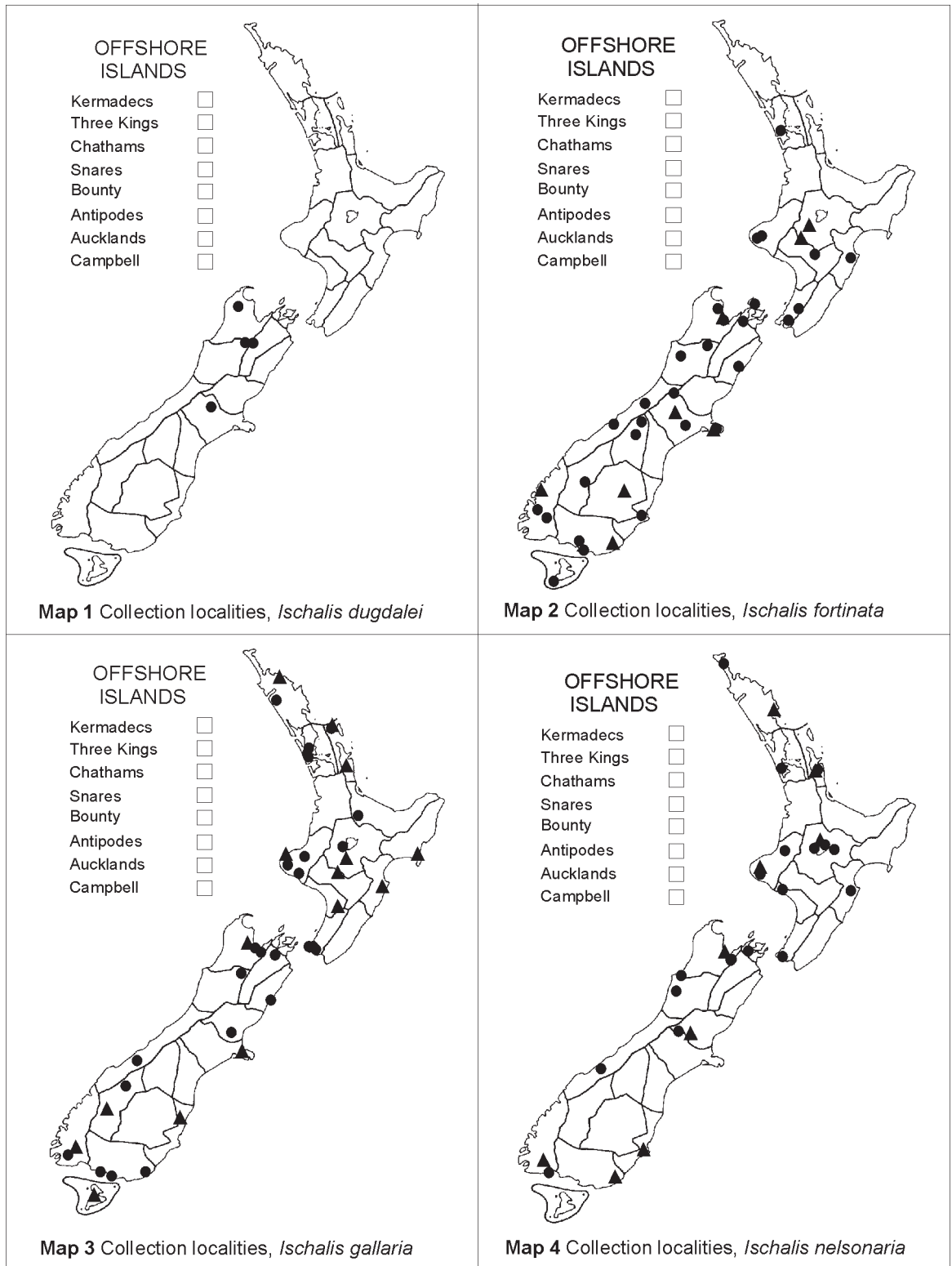


B

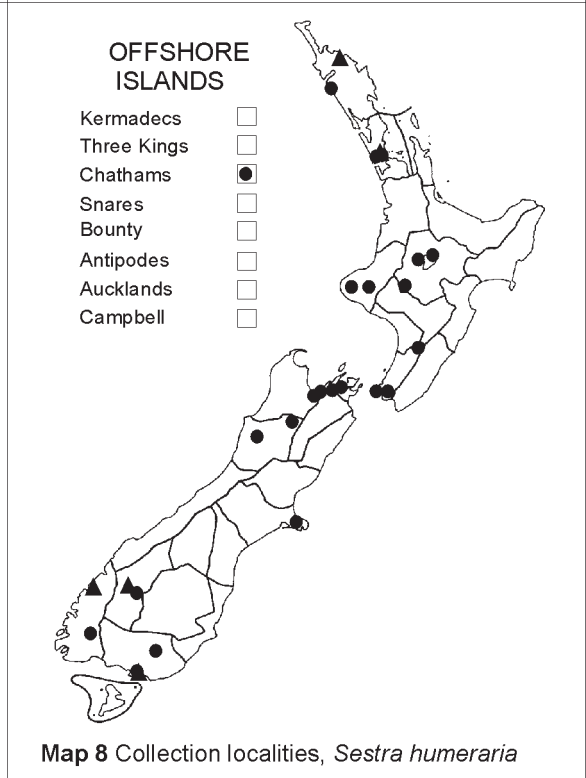
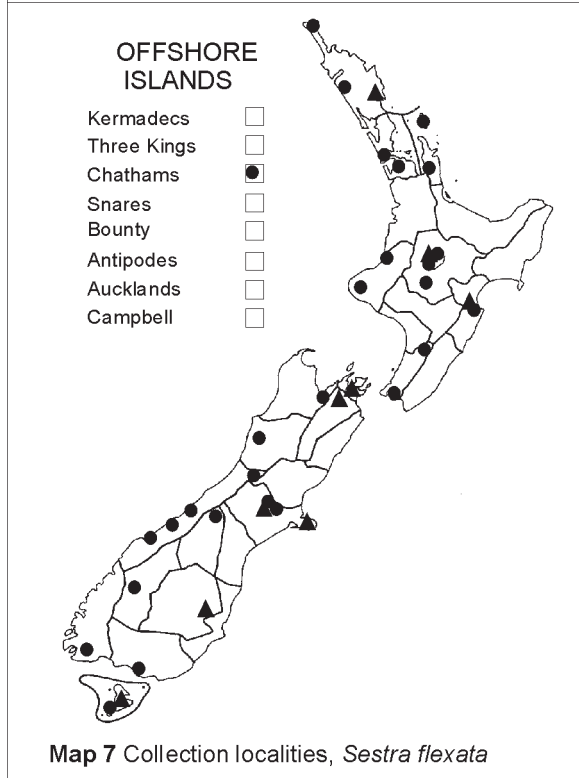
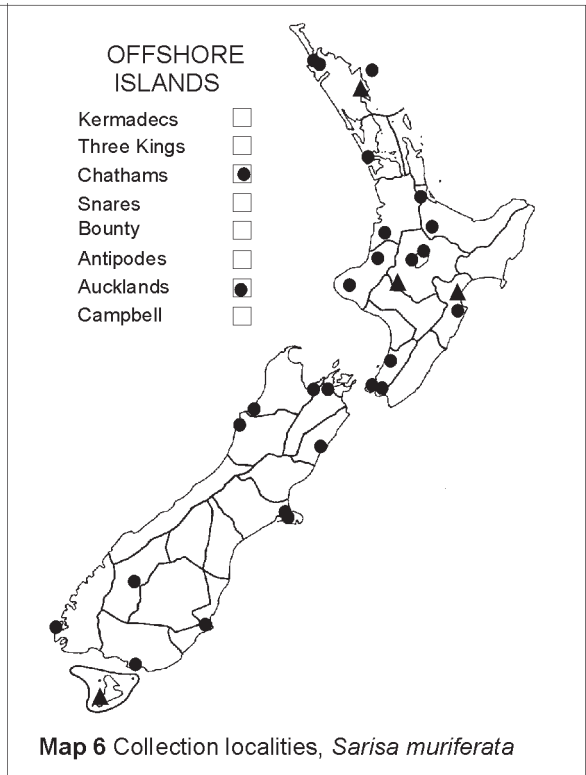
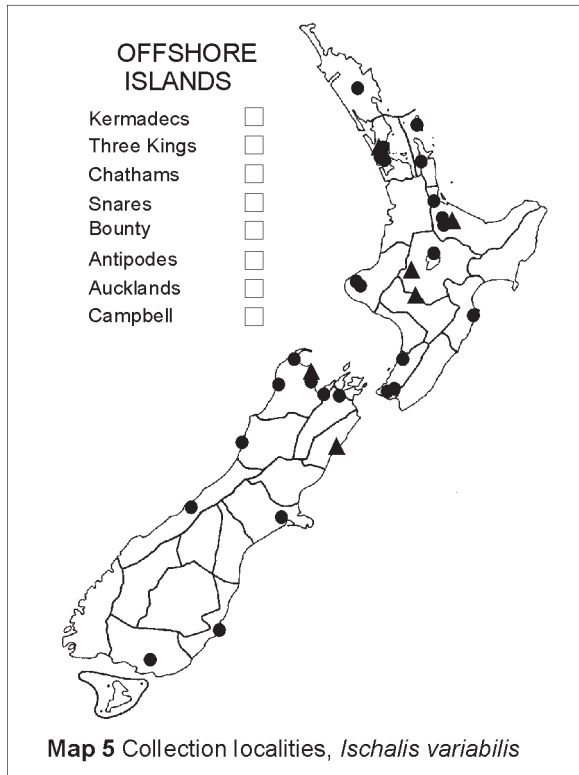


C

Fig. 43 Schematic diagrams of larval chaetotaxy (generically diagnostic characters indicated by arrows). (A) *Ischalis*; (B) *Sestra*; (C) *Sarisa*. Thoracic seta VI is shown only for *Sestra*.



Circles = specimen records, triangles = literature records



Circles = specimen records, triangles = literature records

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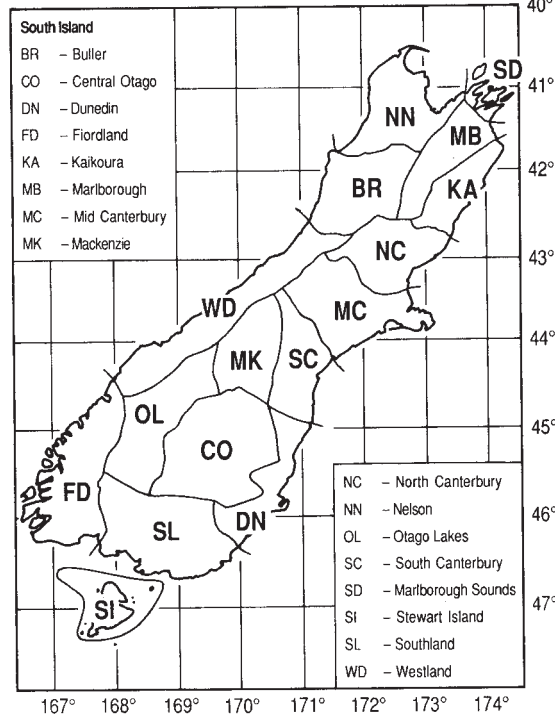
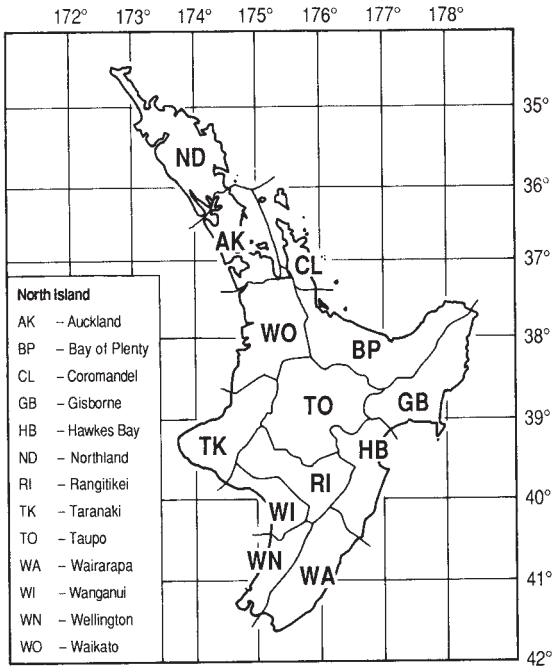
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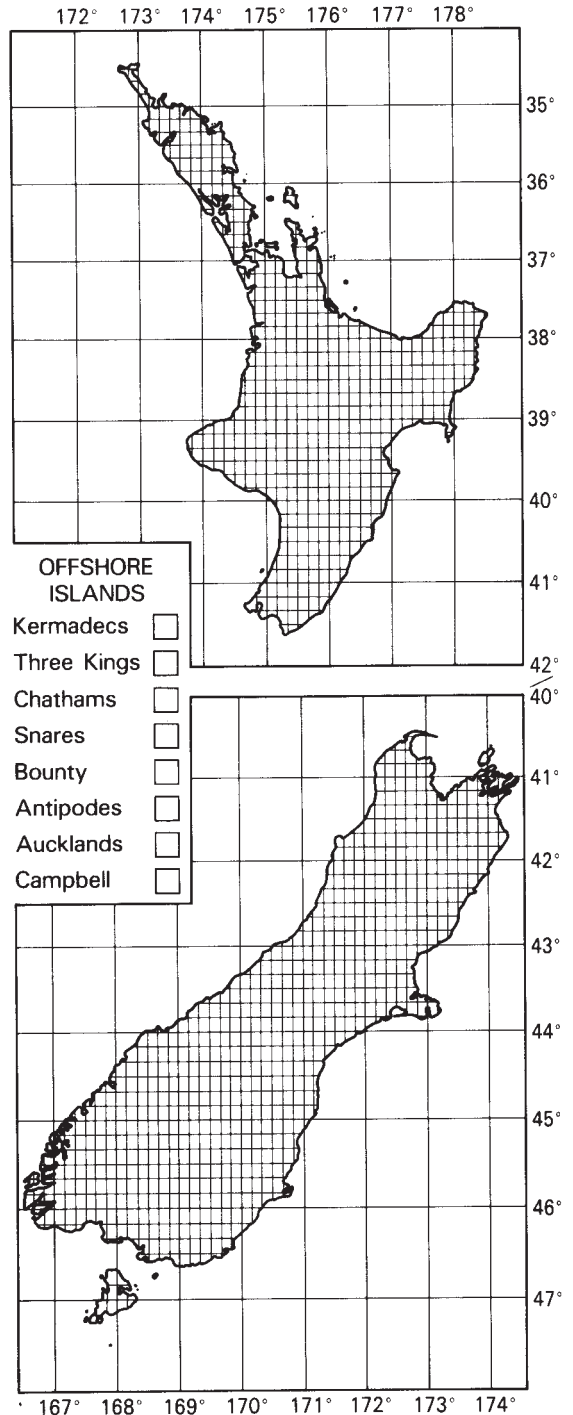
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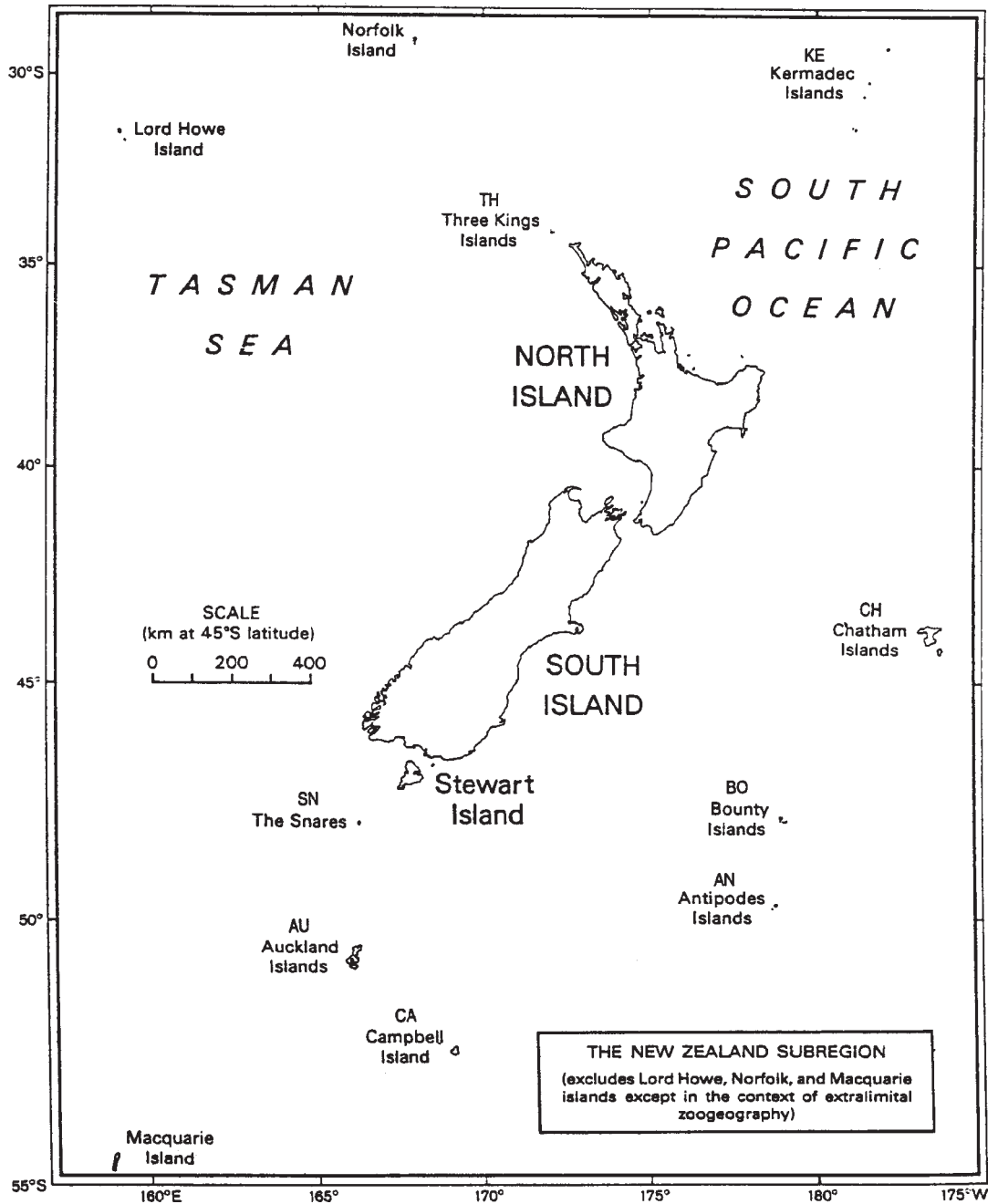
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Area codes and boundaries used to categorise specimen locality data (after Crosby *et al.* 1998)



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



The New Zealand subregion with area codes (from Crosby *et al.* 1998).

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- Annotated catalogue, and keys to family-group taxa (*J. S. Dugdale, FNZ 14, 1988*)
 Geometridae: Ennominae: Lithinini (*Jason D. Weintraub & Malcolm J. Scoble, FNZ 49, 2004*)
 Hepialidae (*J.S. Dugdale, FNZ 30, 1994*)
 Nepticulidae (*Hans Donner & Christopher Wilkinson, FNZ 16, 1989*)

- Mantodea**, with a review of aspects of functional morphology and biology (*G.W. Ramsay, FNZ 19, 1990*)

Plecoptera

- Antarctoperlinae (*I.D. McLellan, FNZ 27, 1993*)
 Notonemouridae (*I.D. McLellan, FNZ 22, 1991*)

- Protura** (*S.L. Tuxen, FNZ 9, 1986*)

Thysanoptera

- Terebrantia (*Laurence A. Mound & Annette K. Walker, FNZ 1, 1982*)
 Tubulifera (*Laurence A. Mound & Annette K. Walker, FNZ 10, 1986*)

Arachnida

Acari

- Cryptostigmata – a concise review (*M. Luxton, FNZ 7, 1985*)
 Eriophyoidea except Eriophyinae (*D.C.M. Manson, FNZ 4, 1984*)
 Eriophyinae (*D.C.M. Manson, FNZ 5, 1984*)

Araneae

- Lycosidae (*C. J. Vink, FNZ 44, 2002*)

Crustacea

Amphipoda

- Talitridae (*K.W. Duncan, FNZ 31, 1994*)

Mollusca

Gastropoda

- Naturalised terrestrial Stylommatophora (*G.M. Barker, FNZ 38, 1999*)

NOTICES

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NGĀ PĀNUI

Kua whakatūria tēnei huinga pukapuka hei whakahauhau i ngā tohunga whai mātauranga kia whakaputa i ngā kōrero poto, engari he whaikiko tonu, e pā ana ki ngā aitanga pepeke o Aotearoa. He tōtika tonu te āhua o ngā tuhituhi, engari ko te tino whāinga, kia mārāma te marea ki ngā tohu tautuhi o ia ngārara, o ia ngārara, me te roanga atu o ngā kōrero mō tēnā, mō tēnā.

He titiro whāiti tā tēnei pukapuka ki ngā mea noho whenua, kāore he tuarā; i pēnei ai i te mea kei te mōhio whānuitia ngā mea whai tuarā, ā, ko ngā mea noho moana, koirā te tino kaupapa o te huinga pukapuka *Marine Fauna of N.Z.*

Ka āhei te tangata ki te **whakauru tuhituhinga** mehemea kei a ia ngā tohungatanga me ngā rauemi e tutuki pai ai tana mahi. Heoi anō, e wātea ana te Kohinga Angawaho o Aotearoa hei āta 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 ġtita rānei i mua i te timatanga, ā, mā rātou a ia e ārahi mō te wāhi ki tana tuhinga.

Ko te hunga pīrangī **hoko pukapuka**, me tuhi ki *Fauna of N.Z.*, Manaaki Whenua Press, Manaaki Whenua, Pouaka Poutāpeta 40, Lincoln 8152, Aotearoa.

E rua ngā tūmomo kaihoko: “A” – kaihoko tūmau, ka tukua ia pukapuka, ia pukapuka, me te nama, i muri tonu i te tānga; “B” – ka tukua ngā pānuī whakatairanga me ngā puka tonu i ōna wā anō.

Te utu (tirohia “Titles in print”, whārangi 106). Ko te kōpaki me te pane kuini kei roto i te utu. Me utu te hunga e noho ana i Aotearoa me Ahitereiria ki ngā tāra o Aotearoa. Ko ētahi atu me utu te moni kua tohua, ki ngā tāra Merikana, ki te nui o te moni rānei e rite ana.

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