Fauna of New Zealand

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Nepticulidae
(Insecta: Lepidoptera)

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Cover graphic. The insect depicted is *Stigmella hoheriae* Donner & Wilkinson.

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ABSTRACT

Twenty-eight species of Nepticulidae are here recognised in the New Zealand fauna, 14 of them new. All are placed in genus *Stigmella* Schrank, and all except *microtheriella* Stainton are considered to be endemic. Two new synonymies are proposed: *perissopa* Meyrick with *cypracma* (Meyrick); and *erechtitus* Watt with *ogygia* Meyrick. Species identification leans heavily upon characters of the genitalia, and this is reflected in the keys to adults, the descriptions, and the illustrations; for twenty-six species genitalia are figured for the first time. The leaf-mining habit of the larvae is discussed in some detail, and the diagnostic value of aspects of the host-plant / larva association – such as mine morphology and host-plant specificity – is explained and illustrated. There is evidence of mining in New Zealand leaf fossils of middle Miocene age. The history of study of New Zealand's nepticulid fauna is reviewed, and the background to the present study is described. Criteria for the recognition of all life stages are described, and advice is given on methods of collection, rearing, and preparation of specimens. Records of confirmed associations between *Stigmella* species and foodplants are catalogued in an appendix. Drawings of adult facies are given for fourteen species.

CHECKLIST OF TAXA

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It is difficult in a few lines to adequately thank our many friends in New Zealand for their help, welcome, and hospitality. First we thank John Dugdale (Entomology Division, DSIR, Auckland) for his invaluable help in the

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AUTHORSHIP

The authors are cited by initials where it is necessary to attribute responsibility for aspects of this work.

The project was initiated by CW, who planned and organised collecting trips throughout New Zealand, with considerable guidance from John Dugdale. CW examined all the New Zealand collections, including leaf fossils; sorted the Nepticulidae; selected those specimens requiring further study; and worked on all the material, mainly type specimens, at the British Museum (Natural History). CW also made contact with other New Zealand entomologists – most notably Brian Patrick – who assisted with collecting, and continued to do so for the duration of the project.

HD continued the project under supervision, making detailed examination of the selected museum specimens, together with those we had collected and reared. He wrote descriptions and keys, and chose specimens for dissection. HD also visited New Zealand, and collected widely. On his return he wrote a project report which was submitted as part of his special subject assessment for the degree of doctorandus (Drs) in the Vrije Universiteit. This was followed by a draft manuscript for publication.

Latterly, however, the manuscript has been extensively revised by CW; given new introductory sections; and finally brought up to publishing standard with the help of John Dugdale's detailed knowledge of New Zealand localities and 'Fauna' series layout.

INTRODUCTION

New Zealand Lepidoptera whose larvae mine leaves or green stems for all or part of their larval life are found in ten families: Nepticulidae, Gracillariidae, Roeslerstammiidae, Yponomeutidae, Lyonetidae, Elachistidae, Momphidae, Gelechiidae, Tortricidae, and Pterophoridae.

The Nepticulidae of New Zealand all have larvae that mine leaves, feeding on the epidermal or mesophyll layer. While there is no hard-and-fast diagnostic character distinguishing nepticulid mines from others, New Zealand nepticulid mines are usually relatively short (under 30 mm) and increase in width at a more or less even rate. Mines of some species are shown in Fig. 19–28.

The Nepticulidae as a whole are monotrysian microlepidoptera which as larvae tunnel or mine in leaves, petioles, stems, fruits, and bark of plants; some even cause the production of galls. The family is a member of the Glossata: Myoglossata, and is more advanced than the Eriocraniidae (Dacnonypha) in having, for example, intrinsic musculature in the haustellum. The Nepticulidae and Opostegidae are currently regarded as sister groups. Some

Australian Nepticulidae have a pectinifer in the male genitalia which is also typical of the Opostegidae (absent from New Zealand), and in both families the moths have an expanded antennal scape ('eye caps') and comparable ultrastructures on the antennal segments. The Australian nepticulid species deserve early attention, since they seem to demonstrate a wider diversity of structure than the Nepticulidae of other regions so far studied.

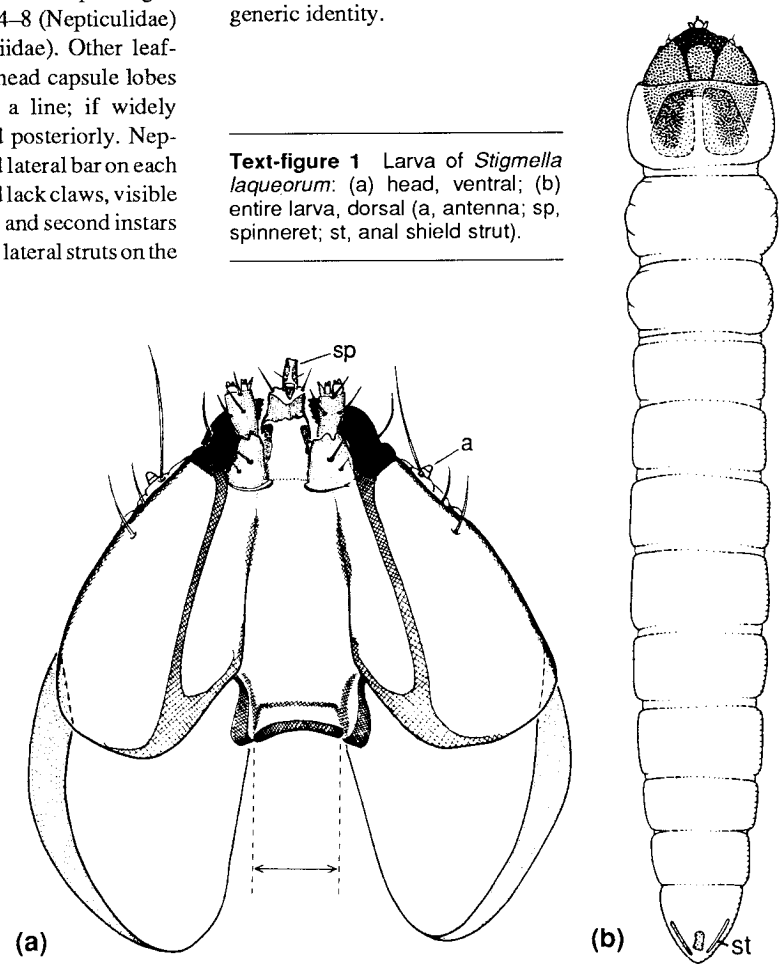
It should be noted that not only Lepidoptera mine leaves; larvae of some weevils (Coleoptera: Curculionidae) and some flies (Diptera: Cecidomyidae, Agromyzidae, Drosophilidae) are miners. Diptera larvae that mine have distinctive mouthparts, with pharyngeal hooks or a sub-cephalic plate, and no recognisable head capsule; weevil larvae lack a spinneret ('sp' in Text-fig. 1a).

Nepticulid larvae are immediately distinguishable in New Zealand by their head capsule structure (Text-fig. 1a), with a squat antenna, a more or less rectangular frons, and the left and right lobes widely separated and prolonged posteriorly: cf. Watt 1924, p. 677, fig. 4–8 (Nepticulidae) and p. 680, fig. 17 and 18 (Gracillariidae). Other leaf-mining lepidopterous larvae have the head capsule lobes touching, either at a point or along a line; if widely separated, the lobes are not prolonged posteriorly. Nepticulid larvae have a slender, sclerotised lateral bar on each side of the anal shield (Text-fig. 1b), and lack claws, visible forelegs, or crotchets. (The mining first and second instars of a New Zealand roeslerstammiid have lateral struts on the last abdominal segment, but these are irregular in shape, and the forelegs have claws.) A typical nepticulid larval head is shown in Text-fig. 1a, and a dorsal view of an entire larva in Text-fig. 1b.

We were shown a damaged larva in a linear mine, recovered from a herbarium specimen of the rare shrub *Teucridium* (Verbenaceae) from Awahuri Reserve, Feilding WI, collected 23 December 1961 by A.E. Esler (NZAC). While superficially resembling a nepticulid larva it lacks both a spinneret and the characteristic lateral rods on the anal segment. Subsequently B.H. Patrick (pers. comm.) has searched without success for mines on *Teucridium* at Trotter's Gorge DN. We give details of this record to draw attention to the presence of an unknown miner on North Island *Teucridium*.

Nepticulid larvae are often heavily parasitised by Hymenoptera belonging – in Europe at least – to the families Braconidae (Ichneumonoidea) and Eulophidae (Chalcidoidea) . These are usually solitary parasitoids attacking and later emerging from the larvae (e.g., *Chrysocaris*), though sometimes they emerge from the pupa (e.g., *Derostinus*); few are gregarious. They are not usually host-specific, but may search for hosts on particular kinds of plants. Parasites recognised in New Zealand belong to the family Eulophidae.

The different genera of Nepticulidae were originally recognised on adult characters, particularly wing venation. Since they are so minute (wingspan 5–18 mm), these moths require special handling techniques, including preparation and examination of genitalia. This comparatively recent approach to study of nepticulids has reinforced the original generic divisions. Even more recently, stereoscan studies have revealed valuable diagnostic characters whereby, for example, even a single segment of the antenna may signify generic identity.



Text-figure 1 Larva of *Stigmella laqueorum*: (a) head, ventral; (b) entire larva, dorsal (a, antenna; sp, spinneret; st, anal shield strut).

Externally the moths worldwide tend to fall into four basic wing patterns which, under the microscope at least, are overlain by scales with a variety of iridescent colours of differing intensity. Thus, it is common to find very similar wing patterns in species which are not closely related – even in different genera. To add to the complexities of morphological study, genital structures may also be similar in different species. Therefore, species recognition may require a combination of morphological characteristics together with features of the life cycle, and sometimes even biochemical analysis is necessary.

Collecting leaf-mining Lepidoptera in New Zealand differs in three fundamental ways from the Northern Hemisphere. (1) The preponderance of non-deciduous plants in the flora allows the presence of actively feeding larvae even above the winter snowline, and potentially permits increased size and voltinism. (2) The majority of New Zealand species are on Asteraceae [Compositae], a host family of only minor importance in the Holarctic region. (3) New Zealand is the only country known to have but one genus of Nepticulidae, viz *Stigmella*. Everywhere else that *Stigmella* is found the genus *Ectoedemia* also occurs, and usually other genera as well.

Stigmella is extremely widespread, as is *Ectoedemia*, and is associated with vascular plants on all continents. In the Holarctic region there is considerable similarity between the species of western Europe and those of North America.

The name *Stigmella* Schrank, 1802 is the senior subjective synonym of *Nepticula* Heyden, 1843. The valid name for the genus was long in dispute, but the position has been clarified by Wilkinson (1978), who gave detailed arguments based on the taxonomic history of the family and genus. The generic name has now been stabilised as *Stigmella* and the family name as Nepticulidae. The new combinations created by this situation have been formalised by Dugdale (1988).

Historical background

In Europe, leaf-mining microlepidoptera were known before the time of Linnaeus and his tenth edition of 'Systema Naturae'. For example, De Geer in 1752 thoroughly described the life cycle of the rose-feeding "Phalaene" leaf-miner and illustrated the major instars in some detail. Since then the number of described species has steadily increased; today some 470 are known in the western Palearctic region, with 245 synonyms. However, it is not unusual still to find new species in northern areas, and around the Mediterranean there are many new species awaiting a name and description.

In North America interest in leaf-miners began in the middle of the last century; there are now about 146 known species of Nepticulidae, but the real number is likely to be similar to that in Europe. In most countries studies did not begin until about 60 or 70 years ago, and this is the period when interest burgeoned in New Zealand.

The first New Zealand nepticulid was described by Francis Walker in 1864, but he did not recognise its affinities. He named the species *Tinea maoriella* from three specimens collected by Col. D. Bolton in Auckland AK. Its identity as a species of *Stigmella* has only recently been recognised.

Other early species were described by Edward Meyrick (1854–1938), who worked in New Zealand and Australia between 1879 and 1886 as a schoolmaster. During 1882 and 1883 he taught at Christchurch Cathedral Grammar School, but he left New Zealand in mid 1883 to take up a teaching position in Australia. He visited New Zealand on several occasions and collected new material, but he finally left for England in 1887 aged 33 years, and never travelled again. Three New Zealand species were described by Meyrick in England in 1889, but these were represented by unique holotypes collected as adults, and nothing was known about their host plants or life cycles. Meyrick described five further species between 1916 and 1924, again from one or two adult specimens collected by him or sent to him by G.V. Hudson (Hudson 1938). Meyrick's immense collection was presented to the British Museum (Natural History) in 1939.

One further species now occurring in New Zealand was described in the last century – Stainton's *microtheriella* (1854). This is unique in being the only introduced species, and was brought into New Zealand from Britain around 1850. It was described from British populations, and is also unusual in being parthenogenetic and pupating on the stem of its food plant (*Corylus avellana*). Both characteristics played a major role in its introduction to New Zealand. The story is an interesting one (see p. 29).

That famous New Zealand entomologist George Vernon Hudson (1867–1946) took an interest in all insects, and with regard to Lepidoptera was guided by Meyrick's advice. In 1892 he published what for a long time was the only general book on New Zealand insects, 'Manual of New Zealand Entomology'. After 24 years' work he finished 'The Butterflies and Moths of New Zealand' in 1928; this, together with its 1939 supplement, is still the most comprehensive work on New Zealand Lepidoptera. There are many Nepticulidae in his collection, which is now deposited in the National Museum of New Zealand in Wellington. During Meyrick's lifetime Hudson gave him much of his material to be described, but in 1939 Hudson himself described "*Nepticula sophorae*".

Morris Netterville Watt (1892–1973) was a specialist on New Zealand's leaf-mining insects. He was a medical

practitioner by profession, but as an amateur entomologist he amassed a substantial collection in his spare time. His detailed notes have been of great value to later authors. He described one nepticulid species in 1921 and another in 1924, and published eight papers on leaf-miners in 'Transactions of the New Zealand Institute' between 1914 and 1924. His collection too is now deposited in the National Museum in Wellington (Ordish 1974).

Another entomologist and naturalist who described New Zealand nepticulids was Alfred Philpott (1871–1931), a man of private means who lived in Invercargill SL during his early years. He compiled a checklist to the birds of Otago, and as an entomologist was primarily interested in Lepidoptera. From 1921 to 1929 he was curator of Lepidoptera at the Cawthron Institute in Nelson NN, and in 1930, after the Murchison earthquake of 1929, he moved to Auckland. He described "*Nepticula lucida*" in 1919 and "*Nepticula insignis*" in 1927. He is regarded as having contributed to modern interpretations of Lepidoptera structures.

The most recently described New Zealand nepticulid is *Stigmella laqueorum* (Dugdale, 1971). Many more specimens, often representing new species, have since been collected by John Dugdale (DSIR, Auckland) and Brian Patrick (Dunedin), who have also reared many species.

The present study

Nepticulidae have been the subject of intensive research at the Vrije Universiteit, Amsterdam, over the period 1978–1985. This family has held our attention not only because of the large number of hitherto unknown species, but also because of its intimate relationship – evolved over a very long time – with the host plants, and the interesting life cycles that are being elucidated. Groups within the family were studied using disciplines ranging from biochemistry to population biology, in order to discover something of the principles governing insect-plant relationships and evidence of co-evolution between the two. In connection with this work, systematic revisions of the nepticulid faunas of the western Palearctic, the Nearctic regions, South Africa, and Japan have already been completed (Wilkinson & Scoble 1979; Wilkinson & Newton 1981; Wilkinson 1981; Newton & Wilkinson 1982; Scoble 1983; Schoorl *et al.* 1985; Kemperman & Wilkinson 1986; Schoorl & Wilkinson 1986; also see Wilkinson 1987).

As a basis for our work on New Zealand's nepticulid fauna we have made collecting trips country-wide during July–September 1982 (CW), April–May 1984 (JHD), and May–June 1985 (CW). In addition we have borrowed material from the National Museum of New Zealand, Wellington; New Zealand Arthropod Collection, Entomology Division, DSIR, Auckland; and the British Museum (Natural History), London. Further specimens were borrowed from the private collection of B.H. Patrick, of Dunedin. The rest of the material comes from our own collecting, and will largely be deposited in the above collections. Some duplicate specimens will go to the Instituut voor Taxonomische Zoology, Amsterdam.

In the New Zealand fauna 28 species are here recognised; 14 of them are new, the other 14 are redescribed. Twenty-six species are illustrated with genitalia figures for the first time. All primary types have been examined, whether in New Zealand or at the British Museum (Natural History).

It has not been possible to work out a meaningful phylogeny, nor is it practicable to divide the species into species-groups, as has been done with those of Europe. The New Zealand species are very closely related, and – the adventive *microtheriella* excepted – all seemingly evolved from common stock. Thus they may conveniently be retained in a single group. Certainly there are outliers (*platina* n.sp., *progonopis*, and *hoheriae* n.sp., for example), and a numerical analysis would prove interesting, but with such a small fauna splitting into groups is neither warranted nor justified. *S. microtheriella* is a member of the *betulicola* species-group of Johannson, a European species-group (Nieukerken 1986, p. 8).

Fossil evidence

CW examined more than 2000 leaf fossils at the New Zealand Geological Survey (DSIR, Lower Hutt) and in the Geology Department of Victoria University, Wellington. A few clear and unmistakable leaf mines were found from the middle Miocene; these are shortly to be describedtogether with others, including two from North America found in deposits from the same period (CW, in preparation). Fossil leaves were found in the coal tips near Westport (NN–BR), but none had recognisable mines. It was also hoped to find mines in DSIR's material from Antarctica, but this was not to be.

CW has at present in his care the oldest known fossil leaf with distinct and irrefutable insect mines in it, which are exactly similar to those of *Stigmella* today. The fossil comes from Turonian Age (Upper Cretaceous) deposits in Kazakhstan, of about 110 million years ago. He has also collected wood from the Kellaways beds (140 mya) in England which contains tunnels resembling the borings of present-day beetle larvae, so undoubtedly the origins of such insect/plant relationships are much earlier than might be supposed.

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IDENTIFICATION

Non-specialists tend to come across adult microlepidoptera mainly when specimens are caught in light traps and sweep-nets. Because their wings and scales are so fragile the moths are usually by then worn and unidentifiable, at least on external features.

The most accurate way to identify adults, especially males, is by examination of the genitalia, which in the majority of species provide diagnostic characters. Preparation and interpretation of the genitalia are skilled techniques which, when mastered, can lead to successful identification using our key, based on the reproductive structures.

Collecting mined leaves with living larvae and rearing the caterpillars through to the adult stage is the simplest and surest route to identification, with the help of our guide to food plants, mine characters, and external features.

For identification to species the identity of the host plant is paramount; and the season of occurrence may be valuable supporting evidence.

Mines. It is not possible to give foolproof characters separating nepticulid mines from those of other groups. Usually they are serpentine, and sometimes they terminate in a blotch. Others may comprise only a blotch, either because the caterpillar eats round in a circle from the very beginning or because its subsequent feeding eliminates the serpentine track of earlier instars. There is usually a granular frass line which makes characteristic patterns along the mine. These patterns may vary according to species and instar. They can also be changed by weathering, particularly by rain. Some species do not defecate in the early stages, and others only intermittently. In such instances it is sometimes difficult to discriminate them from Agromyzidae (Diptera), but in the majority of nepticulid mines the frass line is diagnostic.

Other characters, or combinations of them, which may prove helpful include the length of the mine and other dimensions; the number of mines per leaf; and their position at different stages in all three planes of the leaf, since larvae tend not to mine indiscriminately throughout the thickness of the lamina.

In Britain, where species produce mines of two different lengths, CW (unpublished data) has been able to demonstrate that the shorter examples are collected in the open, e.g., on the edges of woodland and hedgerows, whereas the longer mines occur in more enclosed habitats, e.g., within woodland. The phenomenon can be further related to the surface area and thickness of the leaf. In woodland, leaves often have an increased surface area to maximise the surface presented to the sun during a limited period. As a result the leaf is usually thinner and induces the longer mine. Outside, where competition for light may be less and the leaf remains exposed to the sun for longer, the resulting mine is shorter. This in turn relates to the nutrient available within the leaf per unit length, i.e., more nutrient is available in the leaf with longer exposure to the sun, and hence the mine is shorter.

Eggs are minute, oval, and cemented to the surface of the leaf, often alongside a vein or at the leaf margin. At least in many European species the oviposition site is deliberately selected, and in some species is characteristic. Egg maps are therefore often very useful diagnostically. Recent tests suggest that some females are aware of differences in texture between the two epidermes, but in other species females can be misled into laying on the wrong side of the leaf simply by turning it over (CW). Stereoscan studies have shown the presence of a scale covering the egg which differs in texture and pattern between genera.

Larvae. On hatching, the larva eats directly into the leaf, without appearing on the outside. Not surprisingly, its legs are vestigial. The mouthparts are prognathous and mandibulate, although evidence suggests that some species subsist on the fluid content of the leaf rather than by ingesting solid particles. Larvae are usually green or yellow, but some may be pink or other shades according to which pigments are developed in the leaf. The body segments have a characteristic chaetotaxy. Orientation in the mine may be venter up or venter down, but is consistent within each species.

Cocoons are spun from dense, brown or yellow silk, the colour depending on the xanthophylls, carotenoids, and other pigments in the leaf. This can be confirmed by radioactive labelling applied to the host plant. They are broadly oval, flattened, and slightly wider anteriorly. Cocoons are usually made among debris or soil particles, or between decaying leaves on the ground. However, sometimes the larva does not reach the ground, but pupates on stems or in bark crevices, as has been observed in *S. microtheriella.*

Shortly before eclosion the pupa breaks through the anterior end of the cocoon. It is compressed in appearance, and has free appendages and flexible abdominal segmentation as far as segment 7.

Adults are very active, having the use of their wings soon after emergence, but usually they do not stray far from the parent plant. At rest the wings lie in a very shallow, inverted V, and meet in the middle of the back.

The number of generations per year is variable, often depending on climatic factors. In high latitudes there is usually only one, but in warmer climates there may be two

or three, and even four in some species on oak (*Quercus* spp.). Six weeks usually suffice to complete the life cycle in optimum conditions, but this extends to several months in species with only one generation per year.

METHODS AND CONVENTIONS

Collecting. In the field the larva is the easiest life stage to collect, by searching for its mine – usually in leaves, but also in fruits and bark. More useful information is gleaned from a reared moth than from one collected at light.

The larvae are collected by picking the leaves they mine, and if the leaves are very small a piece of stem is taken as well. The leaves are put into plastic bags, which are closed and labelled. Each sample should be kept in a separate bag to avoid confusion should the larva vacate the mine before being sorted for rearing. In older collections one may often see series of mixed species, resulting from the collector not keeping his samples separate. Different plants of the same species, or even different parts of the same plant, may house different species of miner, so whenever in doubt separate plastic bags should be used. It is useful to add some sphagnum moss to the bags to keep the leaves fresh and free from mould, especially if the specimens are likely to remain in the bags for some days.

As soon as possible after returning from the field the living larvae should be separated from those which are dead or parasitised. Healthy larvae are bright green or yellow, in contrast with their brown or black colour when dead. Parasitised specimens become decreasingly active and stop mining. As the percentage of parasitised specimens can be very high (50%), allowance should be made for this when collecting. Under the microscope the parasite can often be seen under the skin of the larval host. In our work, parasitised specimens are retained for study of the parasite and the living larvae are divided; some are deep-frozen for biochemical studies, but usually the majority are used for larval examination and rearing to adults.

Rearing. Rearing Nepticulidae normally provides an accurate means of identification which may be otherwise impossible unless the male genitalia are dissected out. Rearing further provides additional data regarding food plant, mine, immature stages, and which males and females belong together. Similarity of external appearance amongst species, as well as the ease with which scales are lost during flight, makes identification from wing markings much less reliable.

We try to keep reared larvae in the same conditions (e.g., of temperature, day length) as in the wild, thus aiming at the natural time of adult emergence, especially if breeding is hoped for. However, if we know nothing of the climatic tolerances and life cycles of our material, which is so often the case with new species brought from other hemispheres and continents, we divide the larval samples and try different regimes.

Leaves containing larvae are placed in glass jars with slightly damp earth and sphagnum moss to keep them fresh. When the larvae have left their mines and spun cocoons, the leaves are taken out to prevent mould from forming. If they are still in good condition they are then dried for the herbarium. Temperature is often an important factor. In summer broods, adults may emerge within a couple of weeks owing to warm temperatures. The pupal stage is lengthened by colder temperatures, and with overwintering pupae sometimes sub-zero temperatures are essential to initiate adult development (CW). Pupae can be 'forced' by reducing the period of time they are kept in the cold, whether outside or in the refrigerator, but normally 1 month is optimal; the temperature can then be gradually increased.

To rear cocoons in natural conditions they are enclosed in stainless steel tins with gauze lids at both ends. These are buried just below the surface of the soil in autumn and dug up again in spring. Black polythene sheeting is placed over each end of the container to make it totally dark inside. A 3 x 1 cm glass tube connected to a hole in the side of the tin provides the only light source. On emergence the adults make for the light inside the tube, where they can be easily removed. This reduces the risk of losing specimens, which if the lid had to be removed would certainly occur.

Preparation. It is important to set the moths as soon as possible after emergence, because they quickly lose their scales when flying. The moths should be anaesthetised but not killed before mounting; after death they stiffen too quickly, and cannot easily be relaxed. We enclose the moth in a small tube and anaesthetise it by dampening the cork with a little ethyl acetate.

The small size of nepticulid moths demands special mounting materials and techniques. The setting boards used by us are small wooden blocks approximately 10 x 3 x 2 cm with a central groove 0.8 mm or 1.0 mm wide filled with polystyrene and balsa strips glued on either side. The moth's body is pinned into the groove, by means of a minuten pin (size 0.10 mm, 0.15 mm, or 0.20 mm) placed through the thorax. The wings are spread by means of gentle blowing and fine needles. They are held in place with strips of transparent paper 5 mm wide and pinned with the same fine pins outside the edge of the wings.

The board is placed in a killing jar with ethyl acetate vapour until the pinned moth is dead. When removed from the jar, the moth is left on the board to dry and set for about 10 days at 30°C. It is then taken off the board, placed on a

Table 1 Monthly distribution of records of New Zealand *Stigmella* species; months are indicated numerically, from 1=January to12=December (parentheses denote reared specimens)

Species	Adults	Larvae	Species	Adults	Larvae
aigialeia	1,2,9,10	4,5,9	*laqueorum*	1,2,11,12	1,2
aliena	12		*lucida*	1,9–12	1–12
atrata	1,2,11,12	4,5,7–9	*microtheriella*	2	
cassiniae	1–4,10,(11)	5–11	*maoriella*	? no precise record	
childii	1		*ogygia*	(1),3–7,9–12	4–9,11,12
cypracma	2,9–11	5–10,12	*oriastra*	1,10–12	2–5
erysibodea	2,11		*palaga*	2	
fulva	1–3,8–12	3–5,7–12	*platina*	1,2	
hakekeae	1, 2,5–12	5–8,10	*progama*	1	
hamishella	12		*progonopis*	1,2	4–8
hoheriae	2,(7),9–12	2–8	*propalaea*	1	
ilsea	1,10,11	2–7,9	*sophorae*	2,8–12	5–8
insignis	3,10–12		*tricentra*	3,6,8–10	4–9
kaimanua	11,12	4–8	*watti*	2	5

strip of polyporus with a No. 3 pin, and labelled.

Genitalia preparations. For removing the abdomen we find it advisable to place the moth in a small box, the sides of which are higher than the pin. This prevents the abdomen from flicking away while it is being loosened. With a needle or fine forceps the tip is gently pushed downwards until the abdomen breaks off between the thorax and first abdominal segment. It is then placed in a small test tube with a little 10% potassium hydroxide solution. The tube is labelled with a number corresponding to that of the specimen – especially important if several slides are prepared at the same time.

A loose-fitting cap placed over the tube prevents loss of the specimen whilst allowing changes in pressure during heating. The tube is placed in a water bath and heated to 85°C for 25–50 minutes to disintegrate the internal membranous structures. The abdomen is then rinsed in distilled water. While still immersed, unwanted internal structures (e.g., gut, trachea) are cleaned away by drawing them out of the abdomen with hooked or straight minuten needles mounted in holders. The outer surface of the abdomen is cleaned of its scales to reveal abdominal structures which may be present.

A complete dissection of the male genitalia involves removal of the capsule from the abdomen and withdrawal of the aedeagus anteriorly from the capsule. However, a number of workers find this prolonged and exacting process unnecessary. For identification purposes, at least, the aedeagus can often be left *in situ*, and some workers feel that it is only necessary to evert the capsule from the surrounding abdominal membranes. In the female the membranes between segments 8 and 9 are carefully parted with forceps, and the bursa copulatrix and accessory sac are drawn out with the terminalia from the ensleeving abdomen, which can now be further cleaned. The bursa may also have to be emptied through a small cut.

There are several suitable stains. For males an aqueous solution of haemaluin is very good. Staining time varies according to the strength of the solution, but 3 minutes is usually sufficient. Females are often stained in Chlorazol Black E, which imparts colour to the preparation ranging from black through green and blue to yellow, depending on the degree of sclerotisation. Care must be taken not to overstain, or detail will be obliterated by too much black. Chlorazol can be used in aqueous solution, but more often it is dissolved in 70% ethanol. An aqueous stain is used after cleaning and before passing the genitalia through increasing concentrations of alcohol. In the case of Chlorazol in 70% ethanol staining is carried out when the 70% stage is reached in the alcohol series; the preparation is washed in 70% alcohol before and after staining.

After two washes in absolute alcohol the preparation is ready for mounting. Our mounting medium is Euparal, two separate drops of which are placed on the glass slide. The abdomen and genitalia are placed in them with fine forceps, ventral side up. The abdomen is normally placed to the right of the genitalia, and the aedeagus below the male capsule. The slide is left flat to start drying for 12 hours, after which time the genitalia and abdomen will stay in

place, so another drop of Euparal can be added and the coverslip placed on top. A good way to avoid catching air bubbles is to place the coverslip on the edge of the table and tilt the slide down on to it. The slide is now placed in the oven to dry.

Slide labels should carry essential information from the data label, together with the slide number, species name and/or number, sex, host plant, mounting medium, date, and name or initials of the preparator. Often two labels will be needed for each slide; the layout should therefore be standardised.

Conventions. Each species is described in terms of its external characters, genitalia, biology, life history, and distribution. For terminology used in the descriptions, see Fig. 1–4. Emphasis is placed on the genitalia because of their extremely useful distinguishing characters.

The genitalia were examined with a high-power Zeiss binocular microscope with phase and interference contrast, and were illustrated by means of a drawing tube attachment. The male genitalia are presented from the ventral aspect. The aedeagus is illustrated separately from the capsule. The scale line represents 0.1 mm unless otherwise indicated.

External features were described with the aid of a Zeiss binocular microscope with front illumination; this can be important to note in the case of iridescent colours. Colours of particular discriminatory value are those of the head tuft, scape, antenna, collar, and forewing.

The wing measurement represents length from point of attachment to tip.

In the key, external characters are given in italic type, to distinguish them at a glance from the many characters evident only in genitalia preparations.

Collection data are summarised for each species. The "VU coll. number" refers to the entry number in the collecting list of the Vrije Universiteit, Amsterdam, The Netherlands (VUAN), and the "VU genitalia slide number" to the number given to a genitalia slide prepared and catalogued there. However, VUAN is not the final repository of the material. The two capital letters appended to localities are area codes as proposed by Crosby *et al.* (1976).

The incidence by month of records of adults and larvae is summarised in Table 1.

Known host plants are recorded under each species, together with their general appearance and distribution according to Allan (1961), Poole & Adams (1980), and Wilson (1982). Host plants and their attendant nepticulids are also listed in an Appendix.

Supplementary records kindly provided by B. Patrick and checked against specimens by J.S. Dugdale are listed after the material examined by us.

Repository abbreviations (see Watt 1979)

BMNH British Museum (Natural History), London
BPNZ private collection of Mr Brian Patrick, Dunedin
ITZA Instituut voor Taxonomische Zoologie, Amsterdam
NMNZ National Museum of New Zealand, Wellington
NZAC New Zealand Arthropod Collection, Dept of Scientific and Industrial Research, Auckland

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KEY TO *STIGMELLA* SPECIES KNOWN FROM NEW ZEALAND

Males

1 *Forewing with a straight, silvery-white postmedial fascia* ... (p. 27) .. ***lucida***
—*Forewing without a straight fascia* ... **2**

2(1) *Forewing with scattered orange-yellow scales, especially on terminal half* ... (p. 27) .. ***laqueorum***
—*Forewing without orange-yellow scales* .. **3**

3(2) Transtilla without a ventral arm or with a minute ventral arm ... **4**
—Transtilla with a well developed ventral arm ... **7**

4(3) Gnathos with basal plate broad; aedeagus with large cornuti ... **5**
—Gnathos with basal plate slender; aedeagus with spines only ... **6**

5(4) *Antenna with less than 40 segments;* valvae shorter than ventral plate; uncus with medial excavation broad ... (p. 31) .. ***palaga***
—*Antenna with more than 45 segments;* valvae longer than ventral plate; uncus with medial excavation narrow ... (p. 33) .. ***progonopis***

6(4) *Forewing with anal half whitish for at least two-thirds of its length; antenna with less than 35 segments;* gnathos H-shaped; ductus ejaculatorius spinose ... (p. 17) .. ***aigialeia***
—*Forewing brown; antenna with more than 45 segments;* gnathos U-shaped; ductus ejaculatorius without spines ... (p. 24) .. ***hoheriae***

7(3) Aedeagus with a large, prominent cornutus (Fig. 84) ... **8**
—Aedeagus with spines but without large cornuti ... **11**

8(7) *Forewing buff with distinct, small, medial and terminal black spots* ... **9**
—*Forewing dark brown, with paler antemedial and medial areas that may vary in size* ... **10**

9(8) *Forewing 4–5 mm long;* aedeagus with many large cornuti ... (p. 21) .. ***fulva***
—*Forewing about 3 mm long;* aedeagus with only 1 large cornutus ... (p. 34) .. ***sophorae***

10(8) *Forewing brown with 2 antemedial white areas, one at costa and one at dorsum;* gnathos with medial processes blunt, valvae less than twice as long as ventral plate ... (p. 22) .. ***hakekeae***
—*Forewing speckled brown and buff;* gnathos with medial processes sharply pointed; valvae more than twice as long as ventral plate ... (p. 29) .. ***ogygia***

11(7) Ventral arm of transtilla basally broad and tapering, up to half as long as horizontal bar ... **12**
—Ventral arm of transtilla slender, rod-like, more than half as long as horizontal bar ... **16**

12(11) Aedeagus shorter than valve ... **13**
—Aedeagus longer than valve ... **14**

13(12) Gnathos with medial processes V-shaped; ventral plate with medial excavation very shallow ... (p. 19) .. ***childi***
—Gnathos with medial processes U-shaped; ventral plate with medial excavation deep ... (p. 20) .. ***cypracma***

14(12) Gnathos with 2 medial processes ... (p. 18) .. ***atrata***
—Gnathos with a single medial process, which may be cleft ... **15**

15(14) Gnathos with medial process broad; valvae near rectangular; uncus with small lobes ... (p. 32) .. ***platina***
—Gnathos with medial process bifurcate; valvae long, narrow; uncus with large lobes ... (p. 35) .. ***tricentra***

16(11) Lower part of ventral plate longer than upper part (measured medially) ... (p. 26) .. ***kaimanua***
—Lower part of ventral plate shorter than upper part ... **17**

17(16) *Forewing silvery white with 1, 2, or 3 very conspicuous black spots respectively medial, postmedial, and terminal in position* ... **18**
—*Forewing brown in various shades, sometimes with spots or paler areas* ... **19**

18(17) *Forewing longer than 4 mm;* gnathos with anterior and lateral arms clearly separated ... (p. 25) .. ***insignis***
—*Forewing shorter than 4 mm;* gnathos with anterior and lateral arms fused ... (p. 31) .. ***oriastra***

19(17) *Forewing grey-brown, lustrous, reflecting a dull silver;* gnathos with basal plate very broad (Fig. 53) ... (p. 21) .. ***erysibodea***
—*Forewing ground colour pale brown with darker patches, or with a postmedial V-shaped fascia* ... **20**

20(19) *Forewing pale brown with a dark brown medial spot and terminal quarter;* gnathos with lateral and anterior arms fused into a large, triangular process ... (p. 35) .. ***watti***
—Gnathos with lateral and anterior arms separate ... **21**

21(20) Upper part of ventral plate at least 4x longer than lower part medially ... **22**
—Upper part of ventral plate at most 3x longer than lower part medially ... **23**

22(21) Gnathos with medial processes V-shaped; basal plate arcuate ... (p. 17) .. ***aliena***
—Gnathos with medial processes V-shaped; basal plate straight ... (p. 23) .. ***hamishella***

23(21) Gnathos with anterior arm nearly as long as medial process; transtilla with lateral arm long, narrow; apical margin of ventral plate with a shallow invagination ... (p. 18) .. ***cassiniae***
—Gnathos with anterior arm about one-third as long as medial process; transtilla with lateral arm short; apical margin of ventral plate with no invagination ... (p. 25) .. ***ilsea***

Females

1 *Forewing with a straight, postmedial silvery-white fascia* ... **2**
—*Forewing without a straight fascia* ... **3**

2(1) *Forewing about 3 mm long;* bursa copulatrix without signa, but accessory sac clearly present ... (p. 27) ... ***lucida***
—*Forewing about 2 mm long;* bursa copulatrix with 2 unequal signa and no accessory sac ... (p. 29) .. ***microtheriella***

3(1) *Forewing anally white for at least two-thirds of length* ... **4**
—*Forewing white, brown, buff, or speckled* ... **5**

4(3) *Forewing 2–3 mm long;* apophyses anteriores and apophyses posteriores of about the same shape and length ... (p. 17) .. ***aigialeia***

—*Forewing 3–4 mm long;* apophyses anteriores shorter and more sclerotised than apophyses posteriores ... (p. 24) .. ***hoheriae***

5(3) Ductus spermathecus terminally without spines ... (p. 18) .. ***cassiniae***

—Ductus spermathecus terminally spinose ... **6**

6(5) *Forewing ground colour silvery-white, sometimes with yellow-orange scales* ... **7**

—*Forewing ground colour grey, buff, or brown* ... **9**

7(6) *Forewing with yellow-orange scales mostly on terminal half;* apophyses anteriores longer than apophyses posteriores ... (p. 27) .. ***laqueorum***

—*Forewing without yellow-orange scales;* apophyses anteriores as long as apophyses posteriores ... **8**

8(7) *Forewing with small, black, medial and terminal spots;* accessory sac with small, pectinate plates ... (p. 25) .. ***insignis***

—*Forewing with terminal quarter dark brown and with a small, black, medial spot;* accessory sac wrinkled, without pectinations ... (p. 31) .. ***oriastra***

9(6) *Forewing without conspicuous markings such as spots or clearly defined discolorous patches* ... **10**

—*Forewing with spots or discolorous areas* ... **11**

10(9) Bursa terminally without pectinations ... (p. 21) .. ***erysibodea***

—Bursa terminally with pectinations ... (p. 32) .. ***platina***

11(9) *Frontal tuft consisting of white scales only* ... **12**

—*Frontal tuft orange, cream, brown, or bicolorous* ... **14**

12(11) Apophyses almost as long as last segment; pectinations on bursa not decreasing laterally ... (p. 35) .. ***tricentra***

—Apophyses at most two-thirds as long as last segment; pectinations on bursa decreasing laterally ... **13**

13(12) *Forewing with a white, V-shaped, subterminal fascia;* anterior margin of last segment without processes ... (p. 23) .. ***hamishella***

—*Forewing fascia absent;* anterior margin of last segment with 2 small, lateral processes ... (p. 35) .. ***watti***

14(11) *Forewing ground colour buff, with 2 or 3 conspicuous, small, black spots only* ... **15**

—*Forewing ground colour pale brown to dark brown with paler areas, sometimes with spots or with terminal quarter darker* ... **16**

15(14) *Forewing 4–5 mm long;* apophyses anteriores strongly arcuate; accessory sac present ... (p. 21) .. ***fulva***

—*Forewing about 3 mm long;* apophyses anteriores weakly arcuate; accessory sac absent ... (p. 34) .. ***sophorae***

16(14) Total length of ductus bursae and bursa copulatrix less than 2.0x medial length of last segment ... **17**

—Total length of ductus bursae and bursa copulatrix more than 2.5x medial length of last segment ... **18**

17(16) Bursa copulatrix entirely covered with pectinations; accessory sac with small, pectinate plates ... (p. 19) .. ***childi***

—Pectinations on bursa decreasing terminally; accessory sac smooth ... (p. 20) .. ***cypracma***

18(16) *Forewing about 5 mm long;* bursa entirely covered with pectinations ... (p. 18) .. ***atrata***

—*Forewing less than 3.5 mm long;* bursa with laterally or terminally decreasing pectinations ... **19**

19(18) *Antenna with about 25 segments* ... **20**

—*Antenna with more than 35 segments* ... **21**

20(19) *Forewing about 2.5 mm long;* apophyses anteriores similar in shape and length to apophyses posteriores ... (p. 25) .. ***ilsea***

—*Forewing about 3.4 mm long;* apophyses anteriores more sclerotised than apophyses posteriores ... (p. 26) .. ***kaimanua***

21(19) *Forewing with 2 pale antemedial areas, one at dorsum and one at costa; no conspicuous spots present;* apophyses anteriores strongly arcuate, terminating in a small knob ... (p. 22) .. ***hakekeae***

—*Forewing with conspicuous spots;* apophyses anteriores terminating in a point ... (p. 29) .. ***ogygia***

DESCRIPTIONS

Superfamily NEPTICULOIDEA
Family NEPTICULIDAE

Nepticulidae Stainton, 1854a: 295; 1854b: 166.
Stigmellidae Hampson, 1918: 387.

Diagnosis. Head. Front of head and vertex tufted. Collar between head and thorax comprising 2 tufts of scales. Antenna filiform, its basal segment enlarged to form a scape. Palps extending beyond labrum, the maxillaries twice as long as the labials. Tongue very short.

Thorax. Dorsal surface usually concolorous with abdomen. Forewing 2–9 mm long, tapering to a point when denuded of scales, but rounded apically when scales present. Markings present as fasciae, patches, or spots, or wing unmarked. Retinaculum subcostal in male, mid-ventral and sub-basal in female. Fringe slightly shorter than width of wing. Hindwing lanceolate, generally pale brownish grey. Fringe up to 4x as long as width of wing. Frenulum comprising a single, strong spine in male, minute bristles in female; costal spines present in female. Retinaculum usually a series of heavily sclerotised, hooked scales on underside of subcostal vein, in female generally a series of long scales on lower surface of forewing, just in front of fold, but occasionally subcostal. Wing coupling in male by frenulum-retinaculum association, in female by association of costal spines and retinaculum. Jugum sometimes present in both male and female.

Venation reduced. Forewing: *Rs* with *R2+3* always fused throughout their length, *R4* and *R5* sometimes fused, otherwise represented by separate branches; *Cu* either separate from or coalescent with *M* for a part of its length; *M* sometimes fused with *Cu* for part of length, otherwise separate, but always fused at least in part with *Rs*, sometimes present as 1 branch, sometimes as 2 (*M1* and *M2*); *2A* prominent, situated behind fold. Hindwing: *Sc* fused with *R1*; *Rs* and *M* coalescent basally; *Rs* unbranched; *M* either as a single branch or present as *M1* and *M2*.

Legs. Foreleg lacking epiphysis and tibial spurs; middle leg with a pair of apical spurs on tibia; hind leg with a medial and an apical pair of tibial spurs, the most proximal of which vary in position according to genus (tibial spur formula 0-2-4).

Genitalia. Male. Lateral arms of vinculum either U-shaped or forming a complete ring. Tegumen sometimes extended into a pseuduncus, in which case true uncus membranous. Gnathos usually well sclerotised. Valvae often divided into a pointed style and a broad cuiller, joined by transtilla comprising a pair of lateral arms and a horizontal bar. Aedeagus large, sometimes twice as long as genital capsule; vesica with cornuti generally spine-like, often adorned with striate thickening. Female. Genital aperture single, situated on sternite 8; ovipositor not attenuated. Ductus bursae short, often with accessory sac sometimes adorned with denticles. Signum often paired, and scallop-like pectinations sometimes present on bursa copulatrix.

Biology. Eggs. Laid on surface of foodplant, not usually inserted in tissue. Chorion translucent, but empty shell sometimes appearing black because of dark frass ejected into it by mining larva (Lindquist & Hamden 1970).

Mines. Linear, serpentine galleries or blotches in leaves, fruits, or bark of host plant.

Larvae. Prognathous, eating their way out of egg directly into host plant. By consuming parenchyma larvae make a tunnel or mine, characteristic in appearance for some species. Most species mine leaves; some mine petioles and bark; one feeds on fruits of *Acer*; another causes galls.

Cocoons. Flattened, oval, silken, and brown, white, or yellowish brown. Spun by mature larvae, which pupate within cocoon.

Voltinism. First generation emerging in spring. Two or three generations per year in most species, but varying with latitude and altitude.

Genus *Stigmella* Schrank

Stigmella Schrank, 1802: 169. Type species *Phalaena Tinea anomalella* Goze, 1783, p. 168 (=*Tinea rosella* Schrank, 1802, p. 139), by subsequent designation (Walsingham 1907, p. 1008).

Nepticula Heyden, 1843: 208. Type species *Tinea aurella* Fabricius, 1775, p. 666, by subsequent designation (Tutt 1899, p. 184). Synonymised by Walsingham (1907, p. 1008).

Stigmella "Heyden". Beirne, 1945, p. 197 (incorrect author given by Beirne; incorrectly synonymised with *Nepticula* Heyden by Borkowski 1972, p. 702).

Diagnosis. Head: antenna rather less than half as long as wings. Wings: venation as in Fig. 2; forewing with *R4* and *R5* fused to form *R4+5*, and *M* separate from *Cu*; hindwing with *Rs* and *M* each represented by a single branch fused for half length of wing to form a common trunk. Legs: hind leg with proximal pair of tibial spurs never below mid tibia.

Genitalia. Male: vinculum U-shaped; gnathos generally M-shaped, U-shaped, or comprising a pair of processes arising from a basal plate; aedeagus more variable in length than in width; vesica usually with spines and/or denticles forming cornuti; cathrema often with lateral pectinations. Female: ductus bursae with accessory sac sometime bearing denticles; bursa copulatrix with minute pectinations of variable density; signa sometimes present.

Stigmella aigialeia new species

Figures 29–31; Map 1

Male (description from holotype plus 3 paratypes). Head. Frontal tuft and collar cream; scape silvery-white; antenna dark grey, comprising 32 segments.

Thorax dark grey. Forewing about 2 mm long; frontal half brown-grey, iridescent, reflecting copper, with a black antemedial spot and a black subterminal spot; anal half white, lustrous, reflecting silver. Hindwing and fringe pale grey.

Abdomen dark grey.

Genitalia. Uncus very broad, bilobed. Gnathos: medial processes long, narrow; anterior arms one-third as long as medial processes; basal plate slender, slightly arcuate. Valvae reaching just beyond uncus, narrow, gradually tapering to a long terminal style; transtilla with lateral arm arcuate, half as long as valve, and horizontal bar consisting of 2 thick, triangular processes, medially separated. Vinculum with ventral plate one-quarter as long as valve, bilobed. Aedeagus as long as capsule; vesica beset with many small cornuti; ductus ejaculatorius spinose.

Female (from 4 paratypes). As for male.

Genitalia. Apophyses anteriores and apophyses posteriores long, slender, slightly arcuate. Ductus bursae short, heavily folded; accessory sac semi-globular, with many narrow folds; ductus spermathecus terminally covered with spines; bursa copulatrix relatively small, with numerous minute pectinations.

Type data. Holotype: male, AK, Huia Reserve, collected 29 September 1973, emerged 23 October 1973, "ex *Plagianthus divaricatus*", B.M. May (VU genitalia slide 2189; NZAC).

Paratypes (2 males, 4 females; NZAC). NORTH ISLAND. AK: 1 male, same data as HT but emerged 22 October 1973 (VU genitalia slide 2190); 2 females, same data as HT.

SOUTH ISLAND. SD: 2 females, Queen Charlotte Sound, Whatamongo Bay, 6 Feb 1976, *Plagianthus divaricatus*, J.S. Dugdale (VU genitalia slides 2187, 2197). SL: 1 male, Invercargill, Clifton, 26 Jan 1976, *Plagianthus divaricatus*, J.S. Dugdale (VU genitalia slide 2188).

Material examined. Type series only.

Mines were examined from Tahuna Torea Reserve AK, Havelock SD, and Hooper's Inlet DN.

Also recorded from Taieri Mouth DN and Fortrose SL.

Biology. Foodplant: *Plagianthus divaricatus*, a shrub up to about 2 m tall, coastal in salt marshes and sandy banks.

Mine: a small gallery gradually filling all space between leaf cuticles.

Larvae: recorded April, May, and September; about 3 mm long, pale yellow. Cocoons: made of brown silk on ground.

Adults: recorded January, February, September, and October.

Voltinism: probably 1 generation per year, perhaps 2.

Remarks. The colour of the forewing is similar to that of *S. hoheriae* females, but *S. aigialeia* is much smaller. The male genitalia differ in the shape of the gnathos and valvae. The female genitalia have shorter apophyses than in *S. hoheriae*. *S. aigialeia* and *S. hoheriae* share the host-plant family Malvaceae.

Stigmella aliena new species

Figures 32 and 33; Map 2

Male (description from holotype). Head. Frontal tuft, scape, and collar white; antenna brown, comprising about 34 segments.

Thorax white. Forewing about 3 mm long, white, reflecting gold and purple, with large patches of brown scales basally, medially, and terminally; a small, black, medial spot, and terminally some black scales; fringe silvery white. Hindwing and fringe silvery white.

Abdomen pale brown.

Genitalia. Uncus small, with a medial excavation and 2 small medial lobes. Gnathos: medial processes cone-shaped; lateral arms short, blunt; basal plate arcuate. Valvae small, narrowing towards a small style; transtilla with lateral arm short, ventral arm about as long as horizontal bar and slender, and horizontal bar not fused. Vinculum with ventral plate broad, medially excavated. Aedeagus almost as long as capsule; vesica with many spines.

Female. Not known.

Type data. Holotype: male, NN, Mt Arthur, 4000′ [1200 m], 25 December 1921, A. Philpott (VU genitalia slide 2266; NZAC).

Material examined. Holotype only.

Biology. Not known.

Remarks. *S. aliena* is most easily differentiated from the other *Stigmella* species described here by the shape of the gnathos. Although we have only a single specimen, comparison of the figures will show the marked differences in the genitalia which indicate that it represents a new species.

Stigmella atrata new species

Figures 5a,b, 19, and 34–36; Map 3

Male (description from holotype and 22 paratypes). Head. Frontal tuft yellowish brown; scape buff with some brown scales; collar brown-grey; antenna brown, comprising 37 segments.

Thorax grey-brown, lustrous, reflecting gold. Forewing about 4 mm long, grey-brown, iridescent, reflecting gold, with an indistinct dark medial spot; terminal quarter darker; terminal scales overlapping the brown-grey fringe. Hindwing brown-grey; fringe grey.

Abdomen brown-grey.

Genitalia. Uncus large, with a deep medial excavation and triangular lobes. Gnathos: medial processes slender, tapering terminally; lateral arms small, triangular; basal plate broader than median process. Valvae large, reaching beyond uncus, terminating in a finger-like style; cuiller large, with irregularly shaped lateral edge; transtilla broad, with lateral arm originating at cuiller as a heavily papillated rim; ventral arm small, and horizontal bar triangular, not fused. Vinculum with ventral plate broad, its lower part consisting of 2 large lobes. Aedeagus large; vesica with numerous cornuti of variable size; cathrema with many small pectinations.

Female (from 9 paratypes). As for male, but forewing with contrasting areas submedially and antemedially, these varying in size and colour from shining white and covering major part of wing to pale brown, obscure patches.

Genitalia. Anterior margin with a small, medial invagination. Apophyses anteriores arcuate, broad, tapering terminally; apophyses posteriores not reaching beyond apophyses anteriores, very broad basally but terminally narrowing considerably. Ductus bursae heavily folded; accessory sac wrinkled, small; ductus spermathecus with small spines terminally; bursa copulatrix covered with numerous small pectinations.

Type data. **Holotype**: male, "St. Is" SI, Golden Bay, emerged mid November 1959, "M.N. Watt Collection", "M2" (VU genitalia slide 2094; NMNZ).

Paratypes (20 males, 12 females; BMNH, NMNZ, NZAC, BPNZ, ITZA). NORTH ISLAND. TK: 1 male, 1 female, Pouakai Range, Ahukawakawa Swamp border, 11 Jan 1978 (VU genitalia slides 2296, 2224); 2 males, North Egmont, Holly Hut, 950 m, 26 Nov 1975 (VU genitalia slides 2173, 2176); 1 female, Pouakai Range, Pouakai Hut, 9 Jan 1978 (VU genitalia slide 2226); 2 males, Pouakai Range, 1220 m, 10 Jan 1978 (VU genitalia slides 2143, 2270); 1 female, Pouakai Range, 1220–1400 m (VU genitalia slide 2144). WN–WA: 2 males, Tararua Range (one labelled "Table Top"), 28 Jan 1926 (VU genitalia slides 2165, 2216) (Hudson breeding no. 964a, 964b).

SOUTH ISLAND. NC–WD: 2 males, Arthur's Pass, 20 Apr 1984 (VU coll. no. 84111). FD: 1 male, Homer Valley, Lyttle's Flat, 13 Feb 1982; 1 female, Homer Tunnel, Cleddau, 850 m, 31 Dec 1983 (VU genitalia slide 2249).

STEWART ISLAND: 2 males, "St. Is.", Golden Bay, emerged 14 Nov 1958; 4 males, "St. Is." emerged 5, 8, and 9 Nov 1951; 1 male, "St. Is.", 14 Nov 1958; 1 male, "St. Is.", emerged 1 Nov 1959 (VU genitalia slide 2093); 1 female, "St. Is.", emerged mid Nov 1959; 2 females, "St. Is.", emerged 2 and 8 Nov 1959; 1 male, "St. Is.", emerged 1 Nov 1959; 1 male, "St. Is.", emerged 3 Nov 1959; 1 female, "St. Is.", emerged 8 Nov 1959 (VU genitalia slide 2096); 1 female, "St. Is.", pupated 23 Nov1958, emerged Jan 1959 (VU genitalia slide 2087).

Material examined. Type series only.

Mines were examined from Mt Egmont TK, Havelock SD, Arthur's Pass NC–WD, Otira Valley WD, and Stewart Island SI.

Also recorded from Five Fingers Peninsula FD, Mihiwaka DN, Swampy Summit DN, and Three Sisters SL.

Biology. Foodplant: *Brachyglottis reinoldii*, a shrub or small tree up to 10 m in height. *B. benettii* (South Island) and *B. eleagnifolius* (North Island) are probably best regarded as varieties of *B. reinoldii* (Wilson 1982).

Mine: gives appearance of a chain of empty cells, as though larva eats contents and leaves walls more or less intact. Frass visible only in last part of gallery.

Larva: recorded April, May, July, and September; about 4 mm long, pale brown.

Cocoon: brown; spun among debris on ground.

Adult: recorded January, February, November, and December.

Voltinism: probably 1 generation per year.

Remarks. *S. atrata* resembles *S. ogygia*, *S. cypracma*, and *S. hakekeae* but is larger and the male is generally darker; the male genitalia differ in lacking a large cornutus on the aedeagus.

Stigmella cassiniae new species

Figures 37–39; Map 4

Male (description from holotype, 2 paratypes, and 6 nontype specimens). Head. Frontal tuft buff; scape and collar pale grey to whitish; antenna brown, lustrous, reflecting gold, comprising 29 segments.

Thorax grey. Forewing 2–3 mm long, golden brown, iridescent, reflecting gold and silver; fringe concolorous. Hindwing silvery grey, lustrous, reflecting silver; fringe silvery white.

Abdomen concolorous.

Genitalia. Uncus bilobed, the lobes one-third of total length. Gnathos: medial processes as long as uncus and anterior arms; lateral arms short, arising from anterior arms; basal plate as thick as medial process. Valvae reaching well beyond uncus; cuiller gradually tapering to the straight style; transtilla with lateral arm almost as long as valve; ventral arm narrow, not reaching beyond ventral plate, and horizontal bar not fused. Vinculum with ventral plate two-thirds as long as valve; caudal margin medially excavated, the lower part bilobed. Aedeagus about as long as capsule; vesica with many small cornuti, one of them somewhat larger; cathrema present, distinct.

Female (from 4 paratypes and 2 non-type specimens). As for male, but antenna comprising 22 segments.

Genitalia. Apophyses anteriores long, broad; apophyses posteriores arcuate, as long as apophyses anteriores but narrower. Ductus bursae long, strongly folded; accessory sac small, wrinkled; bursa copulatrix densely covered with scallop-like pectinations, these less concentrated distally.

Type data. **Holotype**: male, SL, Takitimu Range, Cheviot Face, 30 January 1976, "on *Cassinia vauvillersii*", J.S. Dugdale (VU genitalia slide 2088; NZAC).

Paratypes (2 males, 4 females; NMNZ, NZAC, ITZA). NORTH ISLAND. GB: 1 female, Whakaki Lagoon, 10 km E of Wairoa, 7 Apr 1976 (VU genitalia slide 2091). HB–GB: 1 female, Raupunga Mohaka hillside, 7 Apr 1976 (VU genitalia slide 2232). TK: 1 male, Pouakai Range, Pouakai Hump, 1200 m, 1 Dec 1975 (VU genitalia slide 2095).

SOUTH ISLAND. SL: 1 male, 1 female, McLennan Range, Tautuku Forest, 31 Jan 1976 (male, VU genitalia slide 2092; female, VU genitalia slide 2231); 1 female, Longwood Range, 700 m, summit swards, 1 February 1976 (VU genitalia slide 2089).

Material examined. Type-series, plus 39 non-type examples (6 males, 2 females, 31 unsexed; BMNH, NMNZ, NZAC, ITZA) as follows.

TO: 1 unsexed, Desert Road, 19 Feb 1979. TK: 1 unsexed, Pouakai Range, 1 Feb 1975; 3 unsexed, Dawson Falls, 20 Jul 1977; 6 unsexed, Kapuni Valley, 19 Feb 1977.

DN: 1 male, Swampy Summit, 2 Feb 1982; 1 female, Dunedin, 21 Sep 1982; 3 males, Swampy Summit, 27 Nov 1982; 2 males, Dunedin Gardens, 5 Aug 1983. SL: 5 unsexed, Takitimu Mtns, 30 Jan 1976; 2 unsexed, Tautuku Forest, 1976; 1 unsexed, Cheviot Face, 1976; 1 unsexed, Wisp Range [=Hill], 8 Oct 1983; 1 female, 11 unsexed, Bluff Hill, 26 Jan 1976.

Mines were examined from Mt Cargill DN, Bluff Hill SL, and Longwood Range SL.

Also recorded from Homer Tunnel FD, Maungatua DN, and Waipati Beach SL.

Biology. Foodplant: shrubs in the genus *Cassinia* up to 2–3 m tall. *C. leptophylla* occurs on the North and South islands in coastal to montane shrubland and grassland. *C. fulvida* is distributed throughout, southwards from latitude 38°S. *C. vauvillersii* is spread throughout the North and South islands on lowland to montane or lower subalpine shrubland, southwards from latitude 37°S.

Mine: circular in early stage, later occupying entire leaflet; larva then mines through stem to another nearby leaflet. Up to five leaflets may be consumed before larva matures.

Larva: recorded May, July, August, and October; 2–3 mm long, orange-brown.

Cocoon: spun amongst debris on ground.

Adult: recorded January, February, April, and October. Reared moths emerged August, September, and November.

Voltinism: probably 2 generations per year.

Remarks. *S. cassiniae* is easily distinguished from other species by its small size and the smooth, immaculate golden-brown coloration of the forewing. The female genitalia lack the spines on the ductus spermathecus present in the other New Zealand *Stigmella* species. Judging from the genitalia and the host plant, *S. cassiniae* is closely related to the other species that mine Asteraceae. The larva is unusual in being able to mine the petiole, and thus pass from one leaf to another. This is clearly an adaptation to the small size of the leaves.

Stigmella childi new species

Figures 40–42; Map 5

Male (description from holotype). Head. Frontal tuft and scape rusty brown; collar brown-grey; antenna brownish-grey, comprising 30 segments.

Thorax grey-brown. Forewing about 2 mm long, grey-brown, lustrous, reflecting gold; fringe grey. Hindwing and fringe pale grey.

Abdomen brown-grey.

Genitalia. Uncus broad, bilobed, with a large medial invagination. Gnathos: medial processes blunt, triangular; anterior arms half as long as medial processes; lateral arms short, blunt; basal plate broad, heavily sclerotised. Valvae

straight, reaching beyond uncus and terminating in a short, arcuate style; transtilla with lateral arm half as long as valve; ventral arm short, and horizontal bar not fused. Vinculum with ventral plate broad, half as long as valve, and with a shallow medial excavation; lateral arms broad. Aedeagus as long as valve; vesica with numerous spines; cathrema clearly visible.

Female (from 1 paratype). Head. Frontal tuft orange; scape and collar buff.

Thorax buff. Forewing buff, lustrous, reflecting silver, with a terminal dark grey area.

Abdomen buff.

Genitalia. Apophyses anteriores broad, suddenly curving and narrowing terminally to a point; apophyses posteriores arcuate, slender, as long as apophyses anteriores. Ductus bursae very short, wrinkled; accessory sac semiglobular, covered with small, pectinate plates; ductus spermathecus terminally spinose; bursa copulatrix very small, with many scallop-like pectinations.

Type data. Holotype: male, FD, Murchisons [=Murchison Mtns], Lake McKenzie, 1200 m, 10 January 1984, B.H. Patrick (VU genitalia slide 2261; NZAC).

Paratype: female, same data as holotype but 9 Jan 1984 (VU genitalia slide 2263; NZAC).

Material examined. Type specimens only.

Biology. Foodplant: *Celmisia haastii*, a stout, mat-forming subshrub forming a dense sward; South Island, in subalpine and alpine grassland/herbfield and rocky places, a characteristic 'snowpatch' community plant.

Remarks. The female of *S. childi* differs from *S. oriastra* in the buff colour of the forewing and the much smaller bursa copulatrix. The shape of the genitalia links this species to the other Asteraceae miners. It shares with *S. oriastra* and *S. insignis* the host-plant genus *Celmisia*.

Stigmella cypracma (Meyrick)

Figures 6, 20, and 43–45; Map 6

Meyrick, 1916: 419 (*Nepticula*). Hudson, 1928: 355 (*Nepticula*).

perissopa Meyrick, 1919: 354 (*Nepticula*). Hudson, 1928: 355 (*Nepticula*). **New synonymy**.

Male (description from lectotype *perissopa* and 6 non-type specimens). Head. Frontal tuft cream; scape buff; collar brown-grey; antenna brown, with about 40 segments.

Thorax brown-grey. Forewing about 4 mm long, broad, pale brown; apical third dark brown; an antemedial and a medial dark spot, and a large, blackish-brown terminal spot; ground colour varying from pale to dark brown, and spots not always conspicuous; fringe brown. Hindwing and fringe brown-grey, lustrous, reflecting gold and silver.

Abdomen brown.

Genitalia. Uncus bilobed; lobes each with a small, pointed process. Gnathos short, with narrow medial processes; lateral arms short, slightly triangular; basal plate broad. Valvae reaching beyond uncus, terminating in a small style; transtilla with lateral arm curved, ventral arm short, triangular, and horizontal bar not fused. Vinculum with ventral plate broad, approximately one-third as long as valve, deeply bilobed. Aedeagus half as long as capsule; vesica with many cornuti; cathrema packed with spines.

Female (from holotype and 12 non-type specimens). As for male, but forewing ground colour much paler.

Genitalia. Apophyses anteriores broad, pointed, curving inwards; apophyses posteriores very slender, as long as apophyses anteriores. Ductus bursae long, broad, slightly folded; ductus spermathecus terminally beset with spines; bursa copulatrix long, densely packed with minute pectinations, these decreasing terminally.

Type data. Holotype: female, WN, Wellington, "11.13" [13 November], "Nepticula cypracma Meyrick 3/5", "E. Meyrick det. in Meyrick Coll.", G.V.H[udson] (BMNH).

Lectotype *perissopa*: male, TK, Mt Egmont, 3000 ft [900 m], "2.18", "*Nepticula perissopa* Meyr. 2/2", "E. Meyrick det. in Meyrick Coll.", G.V.H. (BM genitalia slide no. 23233; BMNH).

Material examined. Holotype *cypracma*, lectotype *perissopa*, plus 18 non-type examples (6 males, 12 females; BMNH, NMNZ, NZAC, ITZA, BPNZ) as follows.

NORTH ISLAND. BP: 1 male, 4 females, Mt Ngongotaha, 25 Nov 1972 (VU genitalia slides 2167, 2210, 2211, 2212, 2168). WN: 1 male, 2 females, Wellington, 20 Nov 1919 (VU genitalia slides 2106, 2206, 2105); 1 male, Wellington, 8 Nov 1919 (VU genitalia slide 2169); 1 female, Wellington, 6 Oct 1919 (VU genitalia slide 2207); 1 male, Wellington, 6 Oct 1919; 3 females, Wellington, 6 Oct and 20 Nov 1919; 2 females, Karori, Bush Hill, 9 Dec 1917 (VU genitalia slide 2109, 2110); 1 male, Karori, Bush Hill, 4 Nov 1917 (VU genitalia slide 2209); 1 male, Wilton's Bush, 24 Feb 1975 (VU genitalia slide 2140).

Mines have been examined from Kerikeri ND, Mt Ngongotaha BP, Mt Egmont TK, Wanganui WI, Wellington WN, and Havelock SD.

Biology. Foodplant: *Brachyglottis repanda*, a shrub or tree up to 7 m tall occurring on both North and South islands in lower montane and lowland forests from North Cape ND to Banks Peninsula MC.

Mine: narrow, not following a particular pattern, but strongly sinuous, and tending to isolate within its coils areas of tissue which, when withered, can be recognised as brown patches in the leaf. Mine terminating in a blotch. Frass deposited in 1 or 2 rows in middle of gallery.

Larva: recorded May–October and December; about 4 mm long, pale green.

Cocoon: made of brown silk within the mine; cocoons with live pupae have been found in May, June, August, September, and December.

Adult: recorded February and September–November.

Voltinism: 2 generations per year.

Remarks. In *S. cypracma* the wings are broader and more evenly coloured than in *S. ogygia* and *S. hakekea*, and the male genitalia lack a prominent cornutus on the aedeagus. From the similar colour of the wings and identical genitalia and host plant we consider *perissopa* to be a junior synonym of *cypracma*. This possibility was first mentioned by Hudson (1928, p. 355). As with *S. tricentra*, the cocoon is contained in the mine, and the leaf remains on the plant. *S. cypracma* and *S. tricentra* are the only species in New Zealand known to pupate in the mine.

Stigmella erysibodea new species

Figures 7 and 46–48; Map 7

Male (description from holotype and 5 paratypes). Head. Frontal tuft white; scape brown; collar brown-grey; antenna brown, comprising 42 segments.

Thorax brown-grey. Forewing 3–4 mm long, slender, with fore and hind margins more or less parallel; brown-grey with irregularly scattered paler spots, lustrous, reflecting smooth silvery grey that seems to cover wing with a thin, transparent layer; fringe brown, short, thickly set. Hindwing and fringe grey.

Abdomen brown-grey.

Genitalia. Uncus broad, bilobed; lobes small. Gnathos: medial processes short, blunt; lateral arms as small elevations only; basal plate very broad, with medial excavations forming 2 anterior lobes. Valvae not reaching beyond uncus, narrow, ending in a long, curved style; transtilla with lateral arms broad, ventral arms as long as lateral arms, and horizontal bar narrow, not fused. Vinculum with ventral plate half as long as valve medially, bilobed. Aedeagus as long as valve; vesica with cornuti and spines; cathrema with lateral pectinations and many spines.

Female (from 1 paratype). As for male, but with about 30 antennal segments, and wing fringe longer.

Genitalia. Apophyses anteriores arcuate, with lateral margin hooked; apophyses posteriores as long as anteriores, narrow, slightly curved. Ductus bursae long, broad, with some folds; accessory sac consisting of a hemispherical process on ductus bursae; ductus spermathecus terminally covered with spines; bursa copulatrix large, covered with pectinations, these decreasing distally and caudally.

Type data. Holotype: male, FD, Hollyford Valley, Lyttle's Flat, 3 February 1976, "on *Olearia ilicifolia*", J.S. Dugdale (VU genitalia slide 2205; NZAC).

Paratypes (5 males, 1 female; NZAC). NORTH ISLAND. TO: 4 males, 1 female, Hauhungaroa Range, Waituhi Saddle, 2 Feb 1976 (males, VU genitalia slides 2229, 2230, 2268; female, VU genitalia slide 2228). TK: 1 male, Mt Egmont, Bell's Falls track, 840 m, 29 Nov 1975 (VU genitalia slide 2236).

Material examined. Type series, plus 2 non-type examples (unsexed) from type locality, 13 Feb 1982 (NZAC).

Biology. Not known; host probably *Olearia ilicifolia*.

Remarks. *S. erysibodea* is differentiated from *S. atrata* by its smaller size. The male genitalia differ from those of all other *Stigmella* species described here in the shape of the gnathos. We associate one female with the male series of S. *erysibodea* because of its similarity in appearance to two of the males and having the same collection data; this association is tentative until confirmed by rearing.

Stigmella fulva (Watt)

Figures 10, 24, and 56–58; Map 8

Watt, 1921: 215 (*Nepticula*). Hudson, 1928: 356 (*Nepticula*).

Male (description from 13 specimens). Head. Frontal tuft, scape, and collar buff; antenna pale brown, comprising 26 segments.

Thorax silvery white. Forewing 4–5 mm long, pale brown to buff in various shades, slightly lustrous, reflecting copper, with a small medial black spot and a small terminal black spot; fringe greyish white. Hindwing and fringe pale brown, iridescent, reflecting copper.

Abdomen brown.

Genitalia. Uncus bilobed, the lobes bluntly pointed. Gnathos: medial processes long, narrow; anterior arms blunt, short; lateral arm half as long as medial process but

broader; basal plate thick. Valvae not reaching beyond uncus, twice as long as ventral plate, with a small terminal style; transtilla with ventral arm reaching beyond capsule, and horizontal bar not fused. Vinculum with ventral plate slightly bilobed. Aedeagus: vesica with very large cornuti, one of them two-thirds as long as aedeagus; cathrema beset with spines and small cornuti.

Female (from 14 specimens). As for male, but somewhat larger.

Genitalia. Apophyses anteriores long, suddenly curving inwards, terminating in a sharp point; apophyses posteriores narrow, shorter than apophyses anteriores. Ductus bursae short, broad, slightly folded; accessory sac very small; ductus spermathecus with terminal spines; bursa copulatrix with many scallop-like pectinations for about half its length.

Type data. Twenty syntypes, DN, Dunedin, 1921 (NMNZ).

Material examined. Syntypes, plus 42 non-type examples (13 males, 14 females, 15 unsexed; BMNH, NMNZ, NZAC, BPNZ, ITZA) as follows.

SOUTH ISLAND. WD: 1 unsexed, Otira Bridge, 27 Jul 1982 (VU coll. no. 82290). OL: 1 female, Lake Hawea, 11 Aug 1982 (VU coll. no. 82331, VU genitalia slide 2160). FD: 2 females, Manapouri, Wilmot Pass, 26 Jan 1970 (VU genitalia slides 2085, 2233). DN: 2 males, Dunedin, Dec 1919 and Nov 1920 (VU genitalia slides 2060, 2061); 2 females, Dunedin, 2 Jan 1958 (VU genitalia slide 2121); 1 male, Dunedin, Oct 1958; 4 males, Dunedin, Dec 1920 (VU genitalia slide 2123); 2 males, Dunedin, end Sep and 10 Dec 1919; 3 females, Dunedin, 6 Dec 1930 (?) (VU genitalia slide 2118); 4 females, Dunedin, 2 Dec 1919 (VU genitalia slide 2117); 1 male, Signal Hill, 3 Aug 1982 (VU coll. no. 82250, VU genitalia slide 2159); 1 male, 1 female, Dunedin, 22 and 26 Sep 1982; 3 unsexed, Mt Cargill, 15 Jun 1982. SL: 1 unsexed, Blue Mountains (VU coll. no. 84142); 2 males, 1 female, 8 unsexed, Bluff Hill, 26 Jan 1976 (VU genitalia slides 2120, 2124, 2119); 2 unsexed, Bluff Hill, lower track, 9 Oct 1981.

Mines have been examined from Mt Egmont TK, Dunedin DN, Blue Mountains SL, Tautuku Forest SL, Invercargill SL, and Stewart Island SI.

Also recorded from Leith Saddle DN.

Biology. Foodplant: *Olearia* species such as *arborescens, ilicifolia, nitida,* and *macrodonta*; apparently most common on *O. arborescens*, a shrub or tree up to 4 m tall occurring in forests and shrubland, lowland to montane, southwards from latitude 38°S.

Mine: starting as a very narrow gallery in lower surface of leaf, but soon expanding into a blotch. Small starting point often included in blotch and only recognisable by purple discoloration in leaf around egg site. Mines often difficult to see, owing to position in lower mesophyll layer of leaf.

Larva: recorded in all months except January, February, and June; 4–5 mm long, pale yellow.

Cocoon: brown, spun in ground.

Adult: recorded January–March and August–December; reared specimens emerged May and July.

Voltinism: generations apparently continuous throughout the year.

Remarks. *S. fulva* is one of the largest New Zealand *Stigmella* species. The smooth, pale brown appearance prevents confusion. The male genitalia differ from those of *S. laqueorum* in the broader uncus, narrow medial processes on the gnathos, and large cornuti on the aedeagus. The mine differs from that of *S. hakekeae* in having a purple discoloration of the leaf in the region of the egg (as described by Watt 1921, p. 202).

Stigmella hakekeae new species

Figures 9, 22, and 52–54; Map 9

Male (description from holotype, 10 paratypes, and 15 non-type specimens). Head. Frontal tuft rusty white; scape white; collar cream, sometimes with brown scales; antenna grey, comprising 32 segments.

Thorax grey. Forewing about 3 mm long, speckled brown-grey, with 2 obscure white postmedial areas, one at dorsum, one at costa; fringe grey. Hindwing and fringe pale grey.

Abdomen grey.

Genitalia. Uncus bilobed, the lobes bluntly pointed. Gnathos: medial processes long; lateral arms broad, half as long as medial processes; basal plate narrow, excavated caudally. Valvae joined basally, twice as long as ventral plate (medially), terminating in a finger-like style; transtilla T-shaped, with horizontal bar not fused, and lateral arm extending as a heavily sclerotised ridge on inside of valve. Vinculum with broad lateral arms; ventral plate slightly bilobed. Aedeagus as long as valve, with many small spines on vesica and a large, prominent cornutus.

Female (from 16 paratypes and 10 non-type specimens). As for male.

Genitalia. Apophyses anteriores broad, curved, terminating in a knob; apophyses posteriores long, straight, narrow. Ductus bursae long, heavily folded, covered with

scallop-like pectinations; ductus accessorius with terminal spicules.

Type data. **Holotype**: male, DN, Dunedin, November 1920 (VU genitalia slide 2078; NMNZ).

Paratypes (10 males, 16 females; BMNH, NMNZ, NZAC, BPNZ, ITZA). NORTH ISLAND. TO: 1 male, 2 females, Waituhi Trig, 914 m, 17 and 18 Jul 1982; 1 female, Waituhi Summit, 914 m, 16 Jul 1982 (VU genitalia slide 2145).

SOUTH ISLAND. NC–WD: 2 males, Arthur's Pass, 915 m, 7 Feb 1982. MC: 1 female, Banks Peninsula, Sugar Loaf, 14 Sep 1982. DN: 2 males, Dunedin, 6 Dec 1920 (VU genitalia slides 2076, 2077); 1 female, Dunedin, 8 Oct 1958 (VU genitalia slide 2080); 1 male, Signal Hill, 3 Aug 1982 (VU coll. no. 82246 (VU genitalia slide 2081); 2 females, same data (VU coll. no. 82255, VU genitalia slide 2082); 1 male, Port Chalmers, 14 Sep 1982. SL: 1 male, Invercargill, 9 May 1984 (VU coll. no. 84113); 1 male, Bluff Hill, 260 m, 26 Jan 1976 (VU genitalia slide 2208); 4 females, same data (VU genitalia slides 2111, 2204, 2234, 2235); 1 female, Bluff Hill, 1 Oct 1980 (VU genitalia slide 2084); 1 female, Bluff Hill, 1 Aug 1980 (VU genitalia slide 2083); 3 females, Bluff Hill, 9 Sep, 2 Oct, and 4 Oct 1982.

SI: 1 male, Stewart Island [Oban area), mid Nov 1959 (VU genitalia slide 2079).

Material examined. Type series, plus 25 non-type examples (15 males, 10 females; NMNZ, NZAC) as follows.

DN: 9 males, 4 females, Dunedin, 6 Dec 1920; 4 males, 3 females, Dunedin, Oct 1920; 1 female, Dunedin, Nov 1920; 1 female, Dunedin, 10 Sep 1919. SL: 1 female, Tiwai Peninsula, 15 Dec 1982 (VU genitalia slide 2257); 1 male, Tiwai Peninsula, Nov 1983 (VU genitalia slide 2259); 1 male, Tiwai Peninsula, 5 Sep 1983 (VU genitalia slide 2258).

Mines were examined from Dunedin DN, Invercargill SL, and Stewart Island SI.

Also recorded from Piano Flat CO, Portobello DN, and Longwood Range SL.

Biology. Foodplant: *Olearia arborescens*, *O. ilicifolia*, *O. macrodonta*, *O. paniculata*, and *O. nummularifolia* – trees or shrubs up to 6 m tall occurring throughout New Zealand in forests and shrublands at various altitudes.

Mine: a tortuous gallery under upper epidermal layer, following rib to leaf margin, which it then follows. Frass deposited against roof of mine. A single leaf of *O. arborescens* may contain many mines, but on *O. macrodonta* rarely have more than 3 been found (Watt 1921).

Larva: recorded May–August and October; 3–4 mm long, greenish white.

Cocoon: made of brown silk, on ground.

Adult: recorded in every month except March and April.

Voltinism: 4 or 5 generations per year.

Remarks. *S. hakekeae* is similar to *S. ogygia* and *S. cypracma* in having a large cornutus in the aedeagus. Variation in colour and size of the dark brown irroration and white areas on the forewing cause individual differences in apparent ground colour ranging from pale grey to dark brown.

The mine differs from that of *S. fulva* in the lack of purple discoloration of the leaf in the region of the egg (cf. Watt 1921, p. 202).

The three specimens bred ex *Olearia nummularifolia* from Tiwai Point SL are similar to the others in the series, but much smaller; this may be due to the smaller leaf size of the host species.

Stigmella hamishella new species

Figures 10 and 55–57; Map 10

Male (description from holotype). Head. Frontal tuft white; scape white and grey; collar greyish white; antenna dark grey, comprising 36 segments.

Thorax grey. Forewing about 4 mm long; ground colour whitish grey, with basal, medial, and terminal dark grey areas and vague black spots medially and terminally; fringe grey. Hindwing and fringe grey.

Abdomen pale brown.

Genitalia. Uncus bilobed. Gnathos: medial processes slender; lateral arms triangular. Valvae not reaching beyond uncus, terminating in a large, heavily sclerotised style; transtilla with lateral arm heavy, broad, ventral arm long, broad, and horizontal bar fused. Vinculum with ventral plate two-thirds as long as valve; medial excavation shallow. Aedeagus as long as capsule; vesica beset with spines; cathrema with large lateral pectinations.

Female (from 2 paratypes). Generally larger than male; antenna comprising 32 segments; forewing paler, with spots more conspicuous.

Genitalia. Apophyses anteriores curving inwards, broad; apophyses posteriores pointed, as long as apophyses anteriores. Ductus bursae short, folded; accessory sac small, bulb-like; ductus spermathecus covered with spines terminally; bursa copulatrix small, with numerous pectinations.

Type data. **Holotype**: male, FD, Homer Tunnel, 900 m, 29 December 1983, B.H. Patrick (VU genitalia slide 2255; NZAC).

Paratypes: 2 females, same data as HT but one 31 Dec 1983 (VU genitalia slides 2254, 2256; NZAC).

Material examined. Type specimens only.

Biology. Foodplant: *Olearia moschata*, a shrub up to 4 m tall with a musky fragrance and leaves with woolly undersides; South Island southwards from latitude 43°S on montane to subalpine shrubland.

Mine: blotches, mainly on lower leaves.

Larva: not known.

Cocoon: not known.

Adult: recorded December.

Voltinism: not known.

Remarks. *S. hamishella* differs from *S. hakekeae* and *S. ogygia* in its paler forewing colour and lack of large cornuti on the aedeagus. Although there are only two females and one male, the differences in genitalia and general appearance indicate that *S. hamishella* is a discrete species.

Stigmella hoheriae new species

Figures 11, 23, and 59–61; Map 11

Male (description from holotype and 13 paratypes). Head. Frontal tuft and scape cream; collar brownish cream; antenna brown, comprising 45–52 segments.

Thorax brown. Forewing 3–4 mm long, brown, lustrous, reflecting gold, with a small spot at dorsum medially varying from clearly present to almost absent; fringe grey. Hindwing and fringe grey, lustrous, reflecting platinum.

Abdomen greyish brown.

Genitalia. Uncus bilobed. Gnathos: medial processes long, narrow, terminating in rounded knobs; lateral arms one-quarter as long as medial processes; basal plate very narrow. Valvae reaching beyond uncus, narrow, terminating in a long style; transtilla a broad structure without processes. Vinculum with ventral plate one-third as long as valve (measured medially), bilobed. Aedeagus two-thirds as long as capsule; vesica with many small cornuti; cathrema with numerous minute spines.

Female (from 10 paratypes). As for male, but forewing 4 mm long, brown, iridescent, reflecting purple, with anal half white for three-quarters of length.

Genitalia. Apophyses anteriores broad, curving inwards, with a hooked lateral margin; apophyses posteriores narrow, longer than apophyses anteriores. Ductus bursae short, folded; accessory sac small, wrinkled; ductus spermathecus terminally with small spines; bursa copulatrix densely pectinate.

Type data. **Holotype**: male, AK, Waitakere Range, Mt Don[ald] McLean, emerged 17 August 1976, "ex *Hoheria populnea*", J.S. Dugdale (VU genitalia slide 2178; NZAC).

Paratypes (13 males, 10 females; BMNH, NMNZ, NZAC, BPNZ, ITZA). NORTH ISLAND. AK: 2 females, 1 male, Waitakere Range, Mt Don[ald] McLean, emerged 17 Aug 1976 (1 female, VU genitalia slide 2177); 2 females, Auckland, Laingholm, 25 Feb 1980 (VU genitalia slide 2184) and 11 Oct 1980; 1 male, Huia, Mt Donald McLean, collected 12 Jul 1976, emerged 17 Aug 1976; 1 male, Destruction Gully, 2 Dec 1974, ex *Hoheria populnea*, B.M. May (VU genitalia slide 2185); 2 males, 1 female, Mill Bay, Huia Road, 29 Oct 1977, emerged 8–18 Nov 1977. RI: 1 female, Pemberton Memorial Reserve, 19 Aug 1982 (VU coll. no. 82363, VU genitalia slide 2182).

SOUTH ISLAND. MC: 1 male, Port Hills, 27 Jul 1983; 2 males, Banks Peninsula, Kennedy's Bush, 18 Feb 1982. MK: 1 male, Mt Cook, Hooker Valley, Stocking Stm, mines collected Apr 1977, emerged 20 Sep 1977; 1 female, 1 male, Hooker Valley, Stocking Stm, emerged 20 Sep 1977. FD: 2 males, Wilmot Pass, pupated 14 Mar 1959, emerged 16 Jul 1959 (VU genitalia slide 2179) and 29 Jul 1959 (VU genitalia slide 2180). DN: 1 female, Trotter's Gorge, 20 Jul 1983; 1 male, Trotter's Gorge, Sep 1983; 1 female, Dunedin, 10 Jun 1983; 1 female, Waipori Gorge, Berwick, 6 Aug 1982, emerged 27 Aug 1982 (VU coll. no. 82309, VU genitalia slide 2181).

Material examined. Type series, plus 11 non-type examples (unsexed; NZAC) as follows. AK: 3, Waitakere Range, 17 Aug 1976; 5, Mill Bay, emerged 8–18 Nov 1977. MK: 3, Hooker Valley, 20 Sep 1977.

Mines were examined from Huia AK, Pemberton Memorial Reserve RI, Arthur's Pass NC–WD, Woodhaugh Gardens DN, and Balclutha DN–SL.

Biology. Foodplant: *Hoheria* species such as *H. glabrata*, *H. populnea*, *H. sexstylosa*, and *H. angustifolia*; trees up to 10 m, occurring in shrubland and forests at various altitudes. The different species of host plant are highly heteroblastic and somewhat polymorphic, hence identification may cause some trouble (Allan 1961).

Mine: narrow, crossing over itself several times, but rarely passing larger leaf ribs; frass deposited in a straight, granular line medially in mine.

Larva: recorded February–August; 2–3 mm long, pale transparent green.

Cocoon: spun from dark brown silk (ex *Hoheria lyalli*, *H. glabrata*) or pale whitish silk (other *Hoheria* species) amongst debris at base of foodplant.

Adult: recorded February and July–December; reared October.

Voltinism: probably 2 generations per year.

Remarks. Males of *S. hoheriae* are generally smaller than those of *S. cypracma* and darker than *S. hakekeae*; they differ from *S. aigialeia* in the shape of the gnathos and valvae. Watt (1924) mentioned the possibility of a new species occurring on *Hoheria populnea* – he was possibly referring to this species. *S. hoheriae* shares the host-plant family Malvaceae with *S. aigialeia*.

Stigmella ilsea new species

Figures 12 and 61–63; Map 12

Male (description from holotype and 13 paratypes). Head. Frontal tuft pale brown with scattered white; scape pale brown; collar brown-grey; antenna brown-grey, comprising 25 segments.

Thorax brown-grey. Forewing: about 2 mm long, varying from very pale brown to dark brown, sometimes with a vague black medial spot; fringe pale grey. Hindwing grey, lustrous, reflecting platinum; fringe silvery grey.

Abdomen brown.

Genitalia. Uncus bilobed, with convex sides, each lobe terminally pointed. Gnathos: medial processes long, narrow; anterior arms short, triangular; lateral arms short, narrow, slightly arcuate. Valvae not reaching beyond uncus, terminating in a distinct style; transtilla with lateral arm very long, originating near style on inside of valve, ventral arm narrow, long, and horizontal bar narrow, fused. Vinculum with ventral plate two-thirds as long as valve, bilobed. Aedeagus shorter than capsule; vesica with a patch of spines and 2 areas with cornuti; cathrema beset with spines, bordered by 2 pectinate plates.

Female (from 25 paratypes). As for male.

Genitalia. Apophyses anteriores broad, inward-curving; apophyses posteriores tapering, as long as apophyses anteriores. Ductus bursae short, slightly folded; accessory sac a bulb on ductus bursae; bursa copulatrix large, with many small pectinations, these decreasing distally; ductus spermathecus narrow, terminally spinose.

Type data. Holotype: male, TO, Taringamotu State Forest, Whanganui Valley, Whenuakura flats, 792 m, 11 October 1979, J.S. Dugdale (VU genitalia slide 2194; NZAC).

Paratypes (14 males, 25 females; BMNH, NMNZ, NZAC, BPNZ, ITZA). NORTH ISLAND. TO: 1 male, 1 female, same data as holotype (VU genitalia slides 2202, 2203).

SOUTH ISLAND. DN: 1 male, Swampy summit, 640 m, 23 Aug 1982. SL: 1 female, Hokonui Hills, Dolamore Park, 27 Jan 1976 (VU genitalia slide 2193); 6 males, 9 females, Hokonui Hills, Bare Hill, 10 May 1984 (VU coll. no. 84138); 6 males, 14 females, Tautuku Forest, 6 May 1984 (VU coll. no. 84126).

Material examined. Type series, plus 9 non-type examples (unsexed; NZAC, ITZA) as follows. TO: 4, Taringamotu State Forest, 11 Oct 1979. SL: 2, Dolamore Park, 27 Jan 1976; 3, Tautuku Forest, 6 May 1984.

Mines examined from Tautuku Forest and Bare Hill SL.

Also recorded from Alexandra CO, Paerau CO, Mt Benger CO, Kawarau Gorge CO, Great Moss Swamp CO, Chaslands SL, Hedgehope Hill SL, Ajax Swamp SL, Hinahina SL, and Rakeahua Valley SI.

Biology. Foodplant: *Olearia virgata, O. rugosa, O. odorata, O. laxiflora, O. lineata,* and *O. hectorii*; small, divaricating shrubs with small leaves. *O. virgata* is distributed throughout New Zealand in lowland shrubland and on boggy ground. The other species occur on the South Island only. It is sometimes difficult to identify these latter six species because they are linked by hybridism, and some are plastic, with several habitat forms (Allan 1961). All are deciduous, unlike other members of the genus.

Mine: starting as very narrow galleries, but full-grown larva occupies all space between cuticles, leaving nothing but a small, empty bladder.

Larva: recorded February–May, July, and September; 2–3 mm long, pale yellow.

Cocoon: pale brown, spun in detritus on ground.

Adult: recorded January, October, and November; reared specimens emerged July – September.

Voltinism: probably 1 generation per year.

Remarks. *S. ilsea* is distinguishable from *S. hakekeae, S. ogygia,* and *S. hoheriae* by its smaller size and lack of a large cornutus on the aedeagus. It resembles *S. hakekeae* and *S. ogygia* in the shape of the genitalia, and mines members of the same host-plant family (Asteraceae).

Stigmella insignis (Philpott)

Figures 64–66; Map 13

Philpott, 1927: 89 (*Nepticula*). Hudson, 1939: 469 (*Nepticula*).

Male (description from holotype, 1 paratype, and 2 non-type specimens). Head. Frontal tuft, scape, and collar white; antenna grey-brown, comprising about 35 segments, lustrous, reflecting purple and copper.

Thorax silvery white. Forewing about 3.5 mm long, silvery white with scattered yellow scales; a small, post-basal black spot sometimes extending caudally and anally, and a distal black spot varying from almost absent to covering terminal fifth of wing; fringe silvery grey. Hindwing silvery grey; fringe concolorous.

Abdomen silvery brown.

Genitalia. Uncus large, bilobed, the lobes rounded. Gnathos: medial processes long, broad; anterior arms half as long as medial processes; lateral arms short, triangular; basal plate broad, heavily sclerotised. Valvae reaching beyond uncus, tapering into a blunt, arcuate style; transtilla with lateral arm slender, ventral arm long, and horizontal bar as long as ventral arm, not fused. Vinculum with ventral plate almost as long as valve, deeply bilobed. Aedeagus as long as capsule; vesica beset with numerous spines; cathrema with lateral pectinations.

Female (from 1 paratype and 1 non-type specimen). As for male, but antenna comprising about 28 segments.

Genitalia. Apophyses anteriores basally broad, curving into a terminal point; apophyses posteriores as long as apophyses anteriores, straight, narrow. Ductus bursae short, wrinkled; accessory sac bulb-like, covered with small, pectinate plates around connection with ductus spermathecus, which is terminally spinose; bursa copulatrix covered with small pectinations, these diminishing terminally.

Type data. Holotype: male, NN, [Mt Arthur], Salisbury's Opening, 16 November 1925, "Nepticula insignis", "A. Philpott" (NZAC).

Paratypes: 1 male, same data as holotype (VU genitalia slide 1779); 1 female, Salisbury's Opening, 4000′ [1200 m], 28 Nov 1924 (NZAC).

Material examined. Type specimens, plus 8 non-type examples (2 males, 1 female, 5 unsexed; NZAC) as follows.

HB: 1 male, Kaweka Range, Oct 1963 (VU genitalia slide 2260).

NN: 1 male, 3 unsexed, Mt Richmond, 4300–5000 ft [1290–1500 m], 13 Mar 1969 (VU genitalia slide 2267); 1 female, Mt Arthur, 26 Dec 1921 (VU genitalia slide 2265); 2 unsexed, Mt Arthur, Dec 1921.

Biology. Foodplant: probably *Celmisia spectabilis*, a stout herb forming large patches, distributed throughout the North Island and northern half of the South Island in montane to subalpine grasslands.

Adult: recorded March, November, and December.

Larva, mine, cocoon, and voltinism not known.

Remarks. *S. insignis* differs from *S. oriastra* in its larger size, and from *S. laqueorum* in its lack of orange scales on the forewing. It differs from *S. childi* in the larger bursa copulatrix of the female. This species shares the host-plant genus *Celmisia* with *S. oriastra*, but has a more northern distribution. The Mt Richmond series was taken on rosettes of *C. spectabilis* (J.S. Dugdale, pers. comm.).

Stigmella kaimanua new species

Figures 67–69; Map 14

Male (description from holotype). Head. Frontal tuft pale brown; scape white; collar grey; antenna brown-grey, with about 30 segments.

Thorax brown. Forewing about 3 mm long, grey-brown in various shades, with 3 black spots - antemedial, medial, and apical; a blackish-brown area basally, near costa; fringe grey. Hindwing silvery grey; cilia concolorous.

Abdomen brown-grey.

Genitalia. Uncus broad, bilobed, the lobes very small. Gnathos: medial processes long, narrow, standing closely together; anterior arms broad, short; lateral arms short, triangular. Valvae very broad, with a large cuiller and a narrow, arcuate style reaching beyond uncus; transtilla with lateral arm broad, originating near style, ventral arm slender, not reaching beyond capsule, and horizontal bar narrow, not fused. Vinculum with ventral plate nearly as long as valve, bilobed. Aedeagus shorter than capsule; cathrema clearly visible; vesica with some large cornuti and many small spines.

Female (from 2 paratypes). As for male, but antenna comprising about 24 segments, and forewing generally larger and darker.

Genitalia. Apophyses anteriores broad, slightly arcuate; apophyses posteriores straight, slender, as long as apophyses anteriores. Ductus bursae short, folded; ductus spermathecus terminally spinose; accessory sac large, bulb-like, wrinkled; bursa copulatrix large, covered with small pectinations, these decreasing terminally.

Type data. Holotype: male, DN, Dunedin, Woodhaugh, 5 November 1982, B.H. Patrick (VU genitalia slide 2248; NZAC).

Paratypes: 2 females, same data as HT but one 25 Nov 1982 (VU genitalia slide 2246) and one 5 Nov 1982 (VU genitalia slide 2247) (NZAC).

Material examined. Type specimens only.

Mines were examined from Lake Hauroko FD, Woodhaugh Gardens DN, and Thomson's Bush, Invercargill SL.

Also recorded from Akatore Creek DN, Trotter's Gorge DN, Goodwood DN, Outram Glen DN, Croydon Bush SL, Glenburnie Bush SL, and Purakaunui Falls SL.

Biology. Foodplant: *Parsonsia heterophylla*, a branching, stem-twining liane up to 10 m or more long, distributed throughout New Zealand in lowland and lower montane forests, especially marginal. The leaves vary from broad-ovate in juvenile plants to linear on flowering plants.

Mine: linear, situated in either upper or lower mesophyll layer of leaf tissue, often near midrib; gallery continuing down stem for a short distance.

Larva: recorded April–August; 3–4 mm long, whitish yellow.

Cocoon: probably attached to detritus on the ground.

Adult: recorded November and December.

Voltinism: 1 generation per year.

Remarks. *S. kaimanua* is similar in appearance to *S. ogygia*, but less variable and somewhat larger. The spots on the forewing are more conspicuous.

M.N. Watt discovered mines of this species in 1958 in the "Upper Gardens" in Dunedin DN. He did not rear any moths, however, and there are no further records until it was rediscovered in 1982 by B.H. Patrick, Dunedin.

Stigmella laqueorum (Dugdale)

Figures 2, 13, and 70–72; Map 15 (inset)

Dugdale, 1971: 117 (*Nepticula*; as *laquaeorum*).

Male (description from holotype, 3 paratypes, and 1 non-type specimen). Head. Frontal tuft, scape, and collar white; antenna pale brown, comprising about 37 segments.

Thorax rusty white. Forewing 3–4 mm long, buff, with a black spot medially, sometimes extending caudally, and a black subterminal spot; apical half speckled with orange scales; fringe grey. The size of the black spots varies, as does the number of orange scales. Occasionally brown scales are present on collar, scape, and wing. Hindwing grey; fringe concolorous.

Abdomen yellowish-white.

Genitalia. Uncus deeply bilobed, the lobes not extending to lateral margin. Gnathos: medial processes broad, blunt; lateral arms short; anterior arms short, blunt; basal plate broad, wide. Valvae reaching beyond uncus; cuiller large; style triangular; transtilla with lateral arms long, curved, ventral arms long, narrow, and horizontal bar broad, not fused. Vinculum with ventral plate two-thirds as long as valve, bilobed. Aedeagus as long as capsule; vesica with numerous spines and cornuti; cathrema clearly visible.

Female (from 2 non-type specimens). As for male.

Genitalia. Apophyses anteriores long, slender, terminally curving inwards; apophyses posteriores shorter than apophyses anteriores. Ductus bursae short, folded; accessory sac small; ductus spermathecus terminally spinose; bursa copulatrix with scallop-like pectinations in a circular pattern, these decreasing distally.

Type data. Holotype: male, "Snares Island" [The Snares], South Ridge, 26 January 1976, "Olearia lyallii", "day flying", P.M. Johns (NZAC).

Paratypes: 3 males, same data as holotype (NZAC).

Material examined. Type specimens, plus 17 non-type examples (1 male, 2 females, 14 unsexed; NZAC) as follows.

The Snares: 1 female, 18 Dec 1972 (VU genitalia slide 2175); 1 male, 2 Feb 1971 (VU genitalia slide 2174); 4 unsexed, Jan 1971; 3 unsexed, "Snares Island", 1972, DSH[orning] jr; 3 unsexed, 26 Dec 1972; 3 unsexed, 13 Jan 1973; 1 female, 2 unsexed, 11 Jan 1975.

Biology. Foodplant: *Olearia lyallii*, a shrub or tree with large, tomentose leaves.

Mine: narrow, serpentine, rather scribble-like, close to upper epidermal layer, widening terminally; up to 20 mines per leaf; egg laid on leaf underside, amongst the thick tomentum.

Larva: present in all months (D.S. Horning jr, pers. comm.); up to 6 mm long, pale green.

Cocoon: made of pale brown or tan silk; attached to fallen large debris or trunk bases.

Adult: recorded from late November to February; diurnal, flying only in the morning.

Remarks. *S. laqueorum* is generally smaller and has more conspicuous wing markings than *S. fulva*. It differs also from *S. fulva* in the shape of the uncus and gnathos, and in the absence of large cornuti on the aedeagus. The female genitalia have longer apophyses and fewer pectinations than in *S. fulva*. It is similar to the other miners of Asteraceae in the shape of the genitalia.

Stigmella lucida (Philpott)

Figures 14, 24, and 73–75; Map 15

Philpott, 1919: 225 (*Nepticula*). Hudson, 1928: 355 (*Nepticula*).

Male (description from holotype and 36 non-type specimens). Head. Frontal tuft yellowish white; scape white; collar pale grey; antenna dark brown, 25-segmented.

Thorax pale grey. Forewing about 3 mm long, from basal to postmedial pale brown, iridescent, reflecting copper, postmedial a shining silvery-white fascia, and from subterminal to terminal dark brown; terminal scales overlapping the grey fringe. Hindwing pale grey, lustrous, reflecting silver; fringe concolorous, anally very long.

Abdomen dark grey.

Genitalia. Uncus deeply bilobed, the lobes triangular. Gnathos: medial processes large; lateral arms short; basal plate broad. Valvae small, terminating in a large style, not reaching beyond uncus; transtilla slender, with lateral arms basally broad, but narrowing considerably, and horizontal bar narrow, fused. Vinculum with ventral plate broad, its lower part consisting of 2 lobes only. Aedeagus almost twice as long as capsule; vesica with many cornuti, some very large; cathrema covered with spines.

Female (from 38 non-type specimens). As for male.

Genitalia. Anterior margin with 2 small, pointed processes; apophyses anteriores small, curving gently inwards; apophyses posteriores slender, longer than apophyses anteriores. Ductus bursae long, heavily folded; accessory sac large, wrinkled; bursa copulatrix relatively small, with many minute pectinations, these decreasing terminally.

Type data. **Holotype**: male, NN, Mt Arthur Tableland, 1919, A. Philpott (NZAC).

Material examined. Holotype, plus 91 non-type examples (36 males, 38 females, 17 unsexed; BMNH, NMNZ, NZAC, BPNZ, ITZA) as follows.

TO: 15 unsexed, Ruapehu, 2 Jan 1922.

NN: 1 female, Mt Arthur, 3 Feb 1982 (VU genitalia slide 2166). FD: 4 males, Milford Sound, 9 Aug 1982 (VU genitalia slides 2161, 2162); 2 unsexed, 20 Dec 1943. DN: 28 males, 33 females, Waitati, 1 Oct 1921 (VU genitalia slides: male 2059, 2148, 2133; female 2058, 2132, 2134, 2135); 2 males, Dunedin, 1 Oct 1921 (VU genitalia slide 2149); 1 male, 1 female, Dunedin, 26 Sep 1921 (female, VU genitalia slide 2150). SL: 1 male, Invercargill, 6 Sep 1980 (VU genitalia slide 2146); 1 female, Invercargill, 25 Sep 1980 (VU genitalia slide 2147); 2 females, Invercargill, 16 Oct and 7 Nov 1982.

Mines have been examined from Havelock SD, Lake Rotoiti NN, Carter Creek NN–BR, Lewis Pass MB–BR, Rahu Forest BR, Mt Cook MK, Lake Wanaka OL, Homer Tunnel FD, Dunedin DN, Kakanui DN, Purakaunui Falls SL, Catlins Estuary SL, and Invercargill SL.

Also recorded from Waipori Valley DN, Maungatua DN, and Mt Cargill DN.

Biology. Foodplant: *Nothofagus menziesii*, a tree up to 30 m tall with small, toothed thick leaves; southwards from Mt Te Aroha BP in lowland and montane forest, often forming a timberline, either dominant or co-dominant in a forest community.

Mine: starting close to midrib near stem as narrow galleries. At first only lower part of leaf tissue is eaten, but gradually, as mine becomes wider, it reaches both cuticular layers. Frass deposited in middle of mine, later filling all space.

Larva: recorded May–August, October, and November; about 3 mm long, pale green.

Cocoon: made of white to pale brown silk, and constructed amidst foliage and branches of foodplant.

Adult: recorded January and September–December.

Voltinism: 1 or 2 generations per year.

Remarks. The distinct white forewing fascia distinguishes *S. lucida* from all other endemic species. It differs from *S. microtheriella* in being larger, with the forewing fascia narrower in the middle (of even width in New Zealand specimens of *microtheriella*), and in lacking signa on the bursa copulatrix. Furthermore, males are unknown in *S. microtheriella*. *S. lucida* seems to have no close relationship with any other New Zealand *Stigmella* species described here. *Nothofagus menziesii* is the only southern beech species with a nepticulid miner.

Stigmella maoriella (Walker)

Figures 76 and 77; Map 16

Walker, 1864: 1008 (*Tinea*).

Male (description from type series). Head. Frontal tuft, scape, and collar white with an occasional brown scale; antenna silvery grey-brown.

Thorax grey-brown. Forewing about 3 mm long; ground colour brownish grey, speckled with brown scales, with a brown distal spot and a brown medial spot; fringe brown. Hindwing grey-brown; fringe concolorous.

Abdomen brownish grey.

Genitalia. Uncus bilobed. Gnathos: medial processes slender; lateral arms half as long as anterior arms; basal plate slender. Valvae reaching beyond uncus and terminating in a short, blunt style; transtilla with lateral arm straight and slender, ventral arm as long as lateral arm, and horizontal bar narrow, not fused. Vinculum with ventral plate broad, medially half as long as valve, bilobed. Aedeagus broad, about as long as capsule; vesica beset with patches of spines; cathrema clearly visible.

Female. Not known.

Type date. Lectotype: male, AK, Auckland, "54 4" [B.M. accession no.], "Tinea maoriella Wkr", "Cat. Lep. Het. BM 30 1008 (1854)", [Lt-Col. D.] Bolton (BM genitalia slide no. 21650; BMNH).

Paralectotypes: 2 males, same data as lectotype (BMNH).

Material examined. Type specimens only.

Biology. Not known.

Remarks. The absence of a very large cornutus on the aedeagus differentiates *maoriella* from *S. ogygia* and *S. hakekeae*. The adult is larger than that of *S. ilsea*. Although this species certainly is a *Stigmella*, we cannot be entirely sure about its position within the genus as represented in New Zealand. Only the type material (lectotype and two paralectotype males), collected prior to 1854, and in poor condition, are known. Their genitalia show a great resemblance to those of the Asteraceae miners, but there are marked differences in shape and size.

Stigmella microtheriella (Stainton)

Figure 78; Map 17

Stainton, 1854: 302; 1859: 435 (*Nepticula*). Herrich-Schäffer, 1855: 350; 1860: 52 (*Nepticula*). Frey, 1856: 386; 1857: 419–421 (*Nepticula*). Tutt, 1899: 275–277 (*Nepticula*). Petersen, 1930: 60 (*Nepticula*). Hering, 1957: 251, 335, 734 (*Stigmella*). Borkowski, 1969: 101 (*Stigmella*); 1975: 527 (*Nepticula*). Emmet, 1976: 260 (*Stigmella*). Schoorl & Wilkinson, 1986: 238 (*Stigmella*).

Male. Believed not to exist (parthenogenetic females).

Female (description from lectotype and 2 non-type specimens). Head. Frontal tuft yellowish white or buff; scape and collar white; antenna silvery grey, lustrous, reflecting silver, comprising about 17 segments.

Thorax brown-grey. Forewing 2–3 mm long; basal half pale brown-grey, with a submedial shining silvery fascia of even width; apical third dark brown-grey, iridescent, reflecting several shades of gold and silver; fringe brown-grey. Hindwing pale grey; fringe concolorous.

Abdomen brown-grey.

Genitalia. Apophyses anteriores broad, gently tapering; apophyses posteriores narrow, straight, reaching beyond apophyses anteriores. Ductus bursae short, slightly folded; bursa copulatrix large, with scallop-like pectinations and spines, bearing 2 unequal signa, one on either side of bursa medially, each consisting of a band of thorned pectinations.

Type data. Lectotype: female, Lewisham, England, 6 August 1853 (BM genitalia slide no. 21624; BMNH).

Material examined. Lectotype, plus 2 non-type females from NN, Maitai Valley, 28 Feb 1972 (VU genitalia slides 2190, 2191; NZAC).

Biology. Foodplant: *Corylus avellana*, a shrub or tree up to 6 m tall.

Mine: long, narrow galleries; frass deposited in middle of mine.

Larva: yellow.

Cocoon: pale brown, attached to stem of foodplant.

Adult: recorded February.

Voltinism: not known.

Remarks. The distinct, silvery fascia on the forewing separates *microtheriella* from all other New Zealand *Stigmella* species except *lucida*. It can be distinguished from *S. lucida* by its smaller size, the presence of signa on the bursa, the absence of males, and the evenly wide forewing fascia (narrowed medially in *S. lucida*).

Only parthenogenetic females are known.

The species owes its presence in New Zealand to two unusual though not unique characters amongst the Nepticulidae. Firstly the cocoon is spun on the stem of the foodplant, and can thus be transported on dormant twigs when the larva/cocoon remain inactive. Secondly the progeny are alway parthenogenetic females, thus there need be only one introduction. The localities for this species are Smith's Ford, Maitai Valley, Nelson and "Broadgreen" Stoke, Nelson. Smith's Ford is a small alluvial flat in the Maitai Valley farmed in the 1850s and 1860s by a Mr Smith, who brought out cuttings of hazel from Britain. Most probably *microtheriella* cocoons were already on the cuttings right from the start. It is likely that the Broadgreen hazel was infested in a similar fashion, i.e., it came with *microtheriella* cocoons already on it. These are the only localities where *microtheriella* has been found. The 1970 plantings of hazel elsewhere in Nelson, and old hazels around Rotorua, are all clear of leaf mines.

Stigmella ogygia (Meyrick)

Figures 15(a,b), 25, and 79–81; Map 18

Meyrick, 1889: 187 (*Nepticula*). Watt, 1921: 197 (*Nepticula*).

tricentra Meyrick in the sense of Watt, 1921: 212 (misidentification).

erechtitus Watt, 1924: 686 (*Nepticula*). Hudson, 1928: 356 (*Nepticula*). **New synonymy.**

Male (description from holotype and 29 non-type specimens). Head. Frontal tuft and collar yellowish brown; scape white; antenna dark grey, comprising 25–30 segments.

Thorax dark grey. Forewing about 3 mm long, brown-grey in various shades; scales pale at base, darker at margin; fringe pale grey. Hindwing pale grey; fringe particularly long, concolorous.

Abdomen grey.

Genitalia. Uncus large, bilobed, the lobes small. Gnathos: medial processes M-shaped, sharply pointed; anterior arms short, forming a triangle with short lateral arms; basal plate very broad. Valvae not reaching beyond uncus; cuiller gradually tapering into a small terminal style; a papillated ridge originating on lateral arm of transtilla and connecting valvae basally; transtilla with lateral arm short and straight, ventral arm narrow, and horizontal bar not fused, each part equalling length of ventral arm. Vinculum with ventral plate comprising 2 large lobes and a narrow medial connection, about one-quarter as long as valve. Aedeagus nearly as long as capsule; vesica with many small cornuti and a single large, prominent cornutus; cathrema clearly visible.

Female (56 specimens). As for male, but somewhat larger.

Genitalia. Apophyses anteriores narrow, curving inwards; apophyses posteriores thin, longer than apophyses anteriores. Ductus bursae short, folded; accessory sac small, wrinkled; ductus spermathecus packed with small cornuti terminally; bursa copulatrix with small pectinations, these decreasing laterally.

Type data. Holotype *ogygia*: male, DN, Dunedin, 6 January 1889, "Nepticula ogygia Meyr.", "E. Meyrick det. in Meyrick Coll." (BMNH).

Lectotype *erechtitus* (here designated from original syntypic series): male, DN, Dunedin, M.N. Watt, "22", "Nepticula erechtitus Watt", "E. Meyrick det. in Meyrick Coll." (BM genitalia slide no. 23234, BMNH).

Material examined. Type specimens, plus 145 non-type examples (29 males, 52 females, 64 unsexed; BMNH, NMNZ, NZAC, ITZA, BPNZ) as follows.

AK: 1 male, 1 female, Lynfield, 6 Sep 1975. BP: 1 female, Lake Rotoiti, 3 Jan 1975 (VU genitalia slide 2125). TK: 1 male, 1 female, 2 unsexed, Lake Rotokare, 24 Apr 1975. WN: 4 males, 2 females, Eastbourne, larvae collected 18 Jul 1982 (VU coll. no. 82234, VU genitalia slides 2066, 2113, 2114, 2122); 1 male, 3 females, 2 unsexed, Tararua Forest, larvae collected 17 Jul 1982 (VU coll. no. 82238, VU genitalia slide 2112).

BR: 1 male, Lewis Pass, emerged 10 Sep 1982 (VU coll. no. 82326, VU genitalia slide 2172). DN: 27 females, Dunedin, Jul, 14 Jul, 16 Jul, Oct, and Dec 1919 (VU genitalia slide 2127); 4 males, Dunedin, Oct 1919; 1 male, Dunedin, Jul 1910 (VU genitalia slide 2063); 1 male, 6 females, Dunedin, Dec 1920; 1 male, Dunedin, 24 Sep 1979; 1 female, Dunedin, 26 Sep 1979; 6 unsexed, Dunedin, 8 Jun and 9, 28, and 29 Aug 1982; 1 female, Dunedin, 3 Aug 1982 (VU coll. no. 82307, VU genitalia slide 2065); 1 female, Dunedin, 15 Aug 1982; 2 males, 3 females, Dunedin, 27 Aug 1982; 3 males, Dunedin, 30 Aug, 1 Sep, and 6 Sep 1982; 4 females, Dunedin, 8, 9, and 24 Sep and 8 Oct 1982; 4 males, Woodhaugh Gardens, Dunedin, larvae collected 3 Aug 1982 (VU coll. no. 82253, VU genitalia slide 2116); 1 male, 1 female, Anderson's Bay cliffs, larvae collected 5 Aug 1982 (VU coll. no. 82297, VU genitalia slide 2115); 3 unsexed, Otago Peninsula, 16 and 24 Jun 1983. SL: 1 male, Otatara, 20 Jul 1981; 43 unsexed, Bluff Hill, larvae collected 3 May 1984.

SI: 3 males, Stewart Island, 5 and 28 Jan and 5 Feb 1959 (VU genitalia slide 2129); 4 females, Stewart Island, 26 Jan, 5 Feb, and 15 May 1959 (VU genitalia slide 2128); 9 unsexed, Stewart Island, larvae collected 4 May 1984.

Mines were examined from Auckland AK, Dunedin DN, Invercargill SL, and Stewart Island SI.

Also recorded from Oamaru DN.

Biology. Foodplant: *Senecio biserratus*, and *S. minimus*, an annual to biennial herb that is divided into two varieties. *S. m. heterophylla* occurs throughout New Zealand in lowland to montane forest margins. *S. m. angustata* occurs on the South Island and Auckland Island on coastal strands, streamsides, and clearings.

Mine: narrow, serpentine, close to upper epidermal layer, widening terminally; frass deposited medially.

Larva: recorded April-September, November, and December; 3–4 mm long, pale green.

Cocoon: made of brown silk, against stem of foodplant.

Adult: recorded March, July, and September–December; reared specimens hatched January, April, May, and August.

Voltinism: generations probably continuous throughout the year.

Remarks. *S. ogygia* is similar to *S. cypracma* and *S. hakekeae* in external features, and they share the same host-plant family (Asteraceae). The male genitalia differ in the shape of the gnathos, which has sharply pointed medial processes in *S. ogygia*; in *S. cypracma* and *S. hakekeae* they are blunt. Also, *S. cypracma* lacks the large aedeagal cornutus that is present in *S. ogygia* and *S. hakekeae*. The female genitalia of *ogygia* differ in the extension of the pectinations on the bursa copulatrix.

Details of the life history of this species were first given by Watt (1921, p. 212), who thought, however, that he was dealing with Meyrick's *Nepticula tricentra*. Meyrick later pointed out Watt's mistake, but himself failed to recognise the material as his own species *N. ogygia*. Thus, in 1924 Watt described it as a new species, *N. erechtitus*. As the holotype of *S. ogygia* and the lectotype and other male syntypes of *erechtitus* are identical, we conclude that *erechtitus* is a junior synonym of *ogygia*.

Stigmella oriastra (Meyrick)

Figures 82–84; Map 19

Meyrick, 1917: 247 (*Nepticula*). Hudson, 1928: 356 (*Nepticula*).

Male (description from paralectotype and 6 non-type specimens). Head. Frontal tuft, scape, and collar white; antenna buff, comprising 28 segments.

Thorax white. Forewing about 3 mm long, white, with antemedial, medial, and apical small black spots; fringe concolorous. Hindwing silvery white, lustrous, reflecting silver.

Abdomen silvery white.

Genitalia. Uncus large, weakly bilobed. Gnathos: medial processes just reaching beyond uncus; lateral arms broad, short, forming a triangle with anterior arms; basal plate short, broad. Valvae reaching beyond uncus, terminating in a large, arcuate, finger-like style; transtilla with lateral arms straight and narrow, ventral arm long and broad, and horizontal bar separated into 2 pointed processes, one on each transtilla. Vinculum with upper margin of ventral plate slightly depressed medially, lower part one-quarter as wide as upper. Aedeagus as long as capsule, narrow; vesica with many small cornuti; cathrema heavily set with pectinations, and with lateral sclerities.

Female (from lectotype and 6 non-type specimens). As for male, but distal third of forewing blackish brown.

Genitalia. Apophyses anteriores long, gradually curving inwards; apophyses posteriores straight, narrow, as long as apophyses anteriores. Ductus bursae as long as bursa copulatrix, folded; accessory sac consisting of some folds only; ductus spermathecus densely packed with spines terminally; bursa copulatrix relatively small, covered with pectinations, these decreasing distally.

Type data. **Lectotype**: female, WD, Otira Gorge, 3000′ [900 m], January 1916, Stella Hudson, "Nepticula oriastra", "E. Meyrick det. in Meyrick Coll." (BM genitalia slide 23235, BMNH).

Paralectotype: male, same data as lectotype.

Material examined. Type specimens, plus 15 non-type examples (6 males, 6 females, 3 unsexed; BMNH, NMNZ, NZAC, BPNZ) as follows.

SOUTH ISLAND. WD: 1 male, 3 females, Otira, 4000′ [1200 m], 7 Jan 1916 (male, VU genitalia slide 2099; 1 female, VU genitalia slide 2100). CO: 1 male, Dansey's Pass, 2 Oct 1979 (VU genitalia slide 2098); 1 male, 2 unsexed, Dansey's Pass, 23 and 25 Oct and 1 Nov 1981. FD: 1 male, Mt Cleughearn, 13 Jan 1916 (VU genitalia slide 2103); 1 female, Manapouri, Jan 1970 (VU genitalia slide 2102). DN: 1 female, Anderson's Bay, 20 Nov 1922; 1 female, Dunedin, 18 Nov 1922 (VU genitalia slide 2097). SL: 2 males, 1 unsexed, Nugget Point, 25 Dec 1983 (VU genitalia slides 2262, 2264).

Also recorded from St Arnaud Range MB, Mt Hutt MC, Mt Burns FD, Eyre Mtns OL, Mt Tennyson CO, Old Man Range CO, Garvie Mtns CO, Mopanui DN, Blue Mtns SL, False Islet SL, Purakaunui Bay SL, and Mt Anglem SI.

Biology. Foodplant: *Celmisia* species (see Appendix), including *C. coriacea*, a robust, tufted herb found throughout the South Island on montane to subalpine grassland.

Mine: narrow galleries, initially in a circular pattern and later linear; frass deposited in middle of mine.

Larva: recorded February, April, and May; 3–4 mm long, pale yellow.

Cocoon: buff, spun among debris on ground.

Adult: recorded January and October–December.

Voltinism: probably 1 generation per year.

Remarks. The shining white appearance of *S. oriastra* prevents confusion with the other species described here. *S. oriastra* shares with *S. insignis* and *S. childi* the host-plant genus *Celmisia*.

Stigmella palaga new species

Figures 85 and 86; Map 20

Male (description from holotype). Head. Frontal tuft, scape, and collar white; antenna golden brown, comprising about 25 segments.

Thorax golden brown; forewing golden brown, lustrous, reflecting gold; fringe concolorous.

Abdomen golden brown.

Genitalia. Uncus very broad, with a large medial excavation; lateral lobes triangular. Gnathos extremely large; medial processes long, pointed; anterior arms small, triangular; basal plate broad, with a large, thin, flap-like basal process. Valvae rectangular, as long as ventral plate, terminating in a tiny style and basally joined by a long, slender bar; transtilla with lateral arm very slender, ventral arm

almost absent, and horizontal bar narrow, fused. Vinculum with ventral plate large, bilobed. Aedeagus as long as capsule; vesica with a patch of large, sharp cornuti; cathrema with lateral pectinations and many spines.

Female. Not known.

Type data. Holotype: male, SI, Stewart Island, Rakeahua Valley, flats and bush, 12 February 1988, J.S. Dugdale (VU genitalia slide 2142; NZAC).

Material examined. Holotype only.

Biology. Not known.

Remarks. *S. palaga* differs from all other *Stigmella* species described here by its lack of wing markings and its smooth, golden coloration. The male genitalia differ in the shape of the valvae, the uncus, and especially the gnathos, which is larger than the valvae and very peculiar in shape (see Fig. 85). Lack of knowledge about the female and biology creates difficulties in relating this species to others, but the differences cited are so marked that we are confident that the unique holotype represents a new species.

Stigmella platina new species

Figures 16 and 87–89; Map 21

Male (description from holotype and 1 paratype). Head. Frontal tuft and scape brownish white; collar white; antenna dark grey, comprising 30 segments.

Thorax silvery grey. Forewing about 3 mm long, silvery grey speckled with black, lustrous, reflecting platinum; fringe pale grey. Hindwing and fringe silvery grey.

Abdomen pale brown.

Genitalia. Uncus large, with a shallow medial invagination. Gnathos: medial process large, single, almost as broad as basal plate, clearly reaching beyond uncus; lateral arms short, triangular; basal plate broad, with a large medial excavation. Valvae not reaching beyond uncus, somewhat rectangular, terminating in a broad, blunt style; transtilla with lateral arm long, reaching beyond capsule, ventral arm long and narrow, and horizontal bar narrow, clearly fused. Vinculum: ventral plate with a deep medial invagination forming 2 triangular lateral lobes. Aedeagus narrow, as long as capsule; vesica with many terminal spines and some cornuti; cathrema with lateral pectinations and beset with spines.

Female (from 2 paratypes). As for male.

Genitalia. Apophyses anteriores broad at base, narrowing terminally; apophyses posteriores arcuate, narrow, the anterior margin with a small, pointed process. Ductus bursae short, heavily folded; accessory sac very small; ductus spermathecus terminally with numerous minute spines; bursa copulatrix very thin, covered with small pectinations.

Type data. Holotype: male, NC–WD, Arthur's Pass, 2700 ft [810 m], 25 January 1933, Hudson breeding number 862b, G.V. Hudson (VU genitalia slide 2163; NMNZ).

Paratypes: 1 male, 2 females, TK, Egmont, Kapuni Valley, 100 m, 20 Feb 1977, J.S. Dugdale (VU genitalia slides 2214, 2186, 2215; NMNZ).

Material examined. Type specimens only.

Biology. Host plant probably *Brachyglottis eleagnifolius*, as adults have been swept from this shrub.

Remarks. The shape of the medial process on the male gnathos and the small process on the anterior margin of the female genitalia differentiate *platina* from all other *Stigmella* species described here. The shape of the valvae and the transtilla may indicate a relationship with *S. palaga*, but for lack of knowledge about host plants and female structures in *S. palaga* no conclusions can be drawn.

Stigmella progama (Meyrick)

Figure 90; Map 22

Meyrick, 1924: 662 (*Nepticula*). Hudson, 1928: 356 (*Nepticula*).

Male. Not known.

Female (description from holotype and 1 non-type specimen). Head. Frontal tuft, collar, and scape white; antenna dark brown, comprising about 30 segments.

Thorax whitish grey. Forewing 2–3 mm long, yellowish white, with 2 dark brown areas, one submedial, one apical; some brown scales at costa sub-basally; fringe concolorous. Hindwing silvery grey.

Abdomen grey.

Genitalia. Aphophyses anteriores long, gradually curving inwards; apophyses posteriores straight, narrow. Ductus bursae folded; ductus spermathecus terminally spinose; bursa copulatrix about as long as last abdominal segments, covered with pectinations, these slightly decreasing terminally.

Type data. Holotype: female, OL, Bold Peak, Lake Wakatipu, 4000′ [1200 m], 5 January 1921, G.V. Hudson (BMNH) [abdomen missing].

Material examined. Holotype, plus 1 non-type female, same data as holotype (VU genitalia slide 2104).

Biology. Adult: recorded January (Hudson 1928, p. 365).

Remarks. *S. progama* differs from *S. oriastra* in having a submedial brown area on the forewing. The holotype abdomen is missing, but on antennal characters we consider the specimen to be a female. The genitalia are described from the only other specimen collected so far. We think it is the same species because of the very close resemblance in external characters and the same collecting site and date.

The genitalia associate *S. progama* with the Asteraceae miners, but the lack of males and the similarity of the female genitalia in this group make for difficulties in establishing relationships.

Stigmella progonopis (Meyrick)

Figures 91–93; Map 23

Meyrick, 1921: 336 (*Nepticula*). Hudson, 1928: 356 (*Nepticula*).

Male (description from holotype and 1 non-type specimen). Head. Frontal tuft buff; scape white and brown; collar brown-grey; antenna brown, comprising 49 segments.

Thorax brown-grey. Forewing about 3 mm long, brown-grey, iridescent, reflecting gold; fringe concolorous. Hindwing grey; fringe concolorous.

Abdomen brown-grey.

Genitalia. Uncus broad, with medial and lateral excavations. Gnathos large; medial processes very long, horn-like; lateral arms small, triangular; basal plate singularly broad. Valvae almost rectangular, with a broad style which is shorter than the terminally broad cuiller; transtilla with lateral arm long and slender, and horizontal bar very narrow and short, probably fused medially. Vinculum with ventral plate broad, its lower part consisting of 2 triangular lobes. Aedeagus as long as capsule; vesica with many heavily sclerotised cornuti; cathrema with lateral pectinations and many spines.

Female (from 3 specimens). As for male, but smaller.

Genitalia. Apophyses anteriores broad, terminally narrowing to a point; apophyses posteriores very slender, as long as apophyses anteriores. Ductus bursae long, heavily folded; accessory sac wrinkled; ductus spermathecus with minute spines terminally; bursa copulatrix small, with scattered pectinations.

Type data. Holotype: male, NN, Mt Arthur, 4000 ft [1200 m], January 1920, "Nepticula progonopis Meyrick", "E. Meyrick det. in Meyrick Coll.", G.V.H[udson] (BM genitalia slide no. 23231, BMNH).

Material examined. Holotype, plus 4 non-type examples (1 male, 3 females; BMNH, NZAC, BPNZ) as follows.

NN: 1 male, Mt Arthur, 3 Feb 1980 (VU genitalia slide 2164). SL: 3 females, Ajax Swamp, 25 Feb 1984 (VU genitalia slides 2271, 2272, 2273).

Also recorded from Mackinnon Pass FD, Five Fingers Peninsula FD, Maungatua DN, Mopanui DN, Swampy Summit DN, Horse Range DN, Blue Mtns SL, Hedgehope Hill SL, Bare Hill, Hokonui Hills SL, Mt Anglem SI, and Rakeahua Valley SI.

Biology. Foodplants: *Dracophyllum traversii*, a tree reaching 10 m, occurring on the South Island in montane to subalpine forest and shrubland; *D. longifolium*, a shrub reaching 3 m, distributed throughout New Zealand; *D. menziesii*; and *Gaultheria crassa*.

Mine: long, linear galleries originating near leaf-base. When the larva reaches the apex of the leaf it crosses a leaf-rib and eats its way back towards the egg site. Each mine is visible as a brown streak, and often there are several mines on one leaf.

Larva: recorded April–August; 3–4 mm , pale yellow.

Cocoon: consisting of brown silk, and spun between the tightly packed petioles of older leaves on the shoot.

Adult: recorded January, February.

Voltinism: 1 generation per year.

Remarks. The genitalia distinguish *S. progonopis* from all other species of *Stigmella* described here. The shape of valvae, uncus, and especially gnathos is diagnostic.

The females examined are much smaller than the males, and this may be related to the size of the leaves of the host plants. One male was reared on *D. traversii* with large leaves, and the three females were found on *D. longifolium*, which has small leaves. There is also a possibility that they are not the same species, and rearing is necessary to test these speculations. It is, however, very difficult to keep the leaves of *Dracophyllum* in good condition since they dry out soon after being collected.

Mined leaves were collected at Lake Hauroko and Secretary Island FD, but larvae failed to develop. Mined leaves have also been observed on *D. latifolium*, Waitakere Range AK (J.S. Dugdale, pers. comm).

Stigmella propalaea (Meyrick)

Map 24

Meyrick, 1889: 187 (*Nepticula*).

Male (description from holotype). Head. Frontal tuft, scape, and collar white; antenna pale brown.

Thorax pale brown. Forewing about 3 mm long; ground-colour cream, speckled with pale brown scales; fringe short, silvery white.

Abdomen missing.

Female. Not known.

Type data. Holotype: male (?), NC–WD, Arthur's Pass, 25 January 1883, "Nepticula propalaea, Meyr.", "E. Meyrick det. in Meyrick Coll." (BMNH).

Material examined. Holotype only.

Biology. Not known.

Remarks. Because of the poor condition of the unique holotype, no diagnostic characters of *propalaea* could be recognised.

Stigmella sophorae (Hudson)

Figures 17, 27, and 94–96; Map 25

Hudson, 1939: 469 (*Nepticula*).

Male (description from lectotype and 11 non-type specimens). Head. Frontal tuft, scape, and collar cream; antenna grey, lustrous, reflecting silver, comprising 19–23 segments.

Thorax creamish white. Forewing about 3 mm long, speckled white and brown, with 2 small black spots, one medial and one subterminal; each scale cream at base, pale brown at margin; fringe silvery white. Hindwing silvery grey; fringe long, concolorous.

Abdomen pale grey.

Genitalia. Uncus bilobed, small. Gnathos: medial processes broad, short, bluntly pointed; anterior arms triangular; basal plate short. Valvae reaching beyond uncus, terminating in a thick, curved style; cuiller near-rectangular; transtilla with lateral arm broad, ventral arm long, narrow, and horizontal bar not fused. Vinculum with ventral plate two-thirds as long as valve, the lower part half as long as the upper, bilobed. Aedeagus as long as capsule; vesica with some spines and a large cornutus; cathrema with many minute pectinations.

Female (from 13 specimens). As for male.

Genitalia. Apophyses anteriores very broad, sharply pointed; apophyses posteriores longer than apophyses anteriores, narrow. Ductus bursae short, slightly folded; ductus spermathecus strongly spiculate terminally; bursa copulatrix medially with many minute pectinations.

Type data. Lectotype: male, MC, Christchurch, 24 November 1926, "Kowhai ", "Hudson Coll." (NMNZ).

Material examined. Lectotype, plus 65 non-type examples (11 males, 13 females, 41 unsexed; BMNH, NMNZ, NZAC, BPNZ, ITZA) as follows.

AK: 1 male, 1 female, 5 unsexed, Huia, Nov 1974, emerged 9 Dec 1974 (VU genitalia slides 2155, 2156); 1 male, 2 females, Kaitarakihi Park, 10 Jul 1982, emerged 1–3 Aug 1982 (VU coll. no. 82230, VU genitalia slides 2157, 2158). WN: 4 unsexed, Stokes Valley, 10 Nov 1969.

MC: 1 male, 1 female, 2 unsexed, Christchurch, 14 and 24 Nov 1924 (VU genitalia slides 2151, 2153); 1 unsexed, Christchurch, 30 Jul 1982. OL: 1 male, Wakatipu, 31 Oct 1980 (VU genitalia slide 2052). DN: 1 female, Dunedin, 14 Oct 1958 (VU genitalia slide 2053); 1 male, Dunedin, 11 Nov 1958 (VU genitalia slide 2154); 2 unsexed, Dunedin, 22 and 28 Sep 1982; 1 female, 5 unsexed, Dunedin, 8–24 and 27 Sep 1983; 8 unsexed, Dunedin, emerged Oct and Nov 1985; 3 unsexed, Saddle Hill, 10 and 16 Oct 1982; 7 unsexed, Trotter's Gorge, 11–24 Sep 1983; 1 female, Otago Peninsula, 17 Sep 1983. SL: 1 female, Invercargill, 3 Nov 1980 (VU genitalia slide 2152); 6 males, 5 females, 4 unsexed, Invercargill, 26 Oct and 25 Nov 1980, 3 Nov 1981.

Mines were examined from Huia AK, Christchurch MC, Dunedin DN, Tautuku Forest SL, Nugget Point SL, and Invercargill SL.

Biology. Foodplant: *Sophora tetraptera* and *S. microphylla*, trees up to 12 m tall occurring mainly on well drained hillsides and along stream-sides, *tetraptera* on the North Island and *microphylla* throughout New Zealand.

Mine: starting in random loops and later filling all space between cuticles. One mine per leaflet, but adjacent leaflets often occupied. Frass green originally, but soon turning grey. Immature mines paler green than leaflet.

Larva: recorded April–August; 2–3 mm long, pale green.

Cocoon: pale brown, attached to stem of host plant.

Adult: recorded February, August–December.

Voltinism: 1 generation per year.

Remarks. *S. sophorae* is a very small nepticulid. It differs from *S. cassiniae* in its paler forewing colour, and in the shape of the gnathos and the large cornutus on the

aedeagus. Females lack the long, heavily folded ductus bursae and the accessory sac present in *S. cassiniae*.

Stigmella tricentra (Meyrick)

Figures 18, 28, and 97–99; Map 26

Meyrick, 1889: 187 (*Nepticula*).

Male (description from holotype and 3 non-type specimens). Head. Frontal tuft, scape, and collar white; antenna brown, comprising 36 segments.

Thorax brown. Forewing about 2.6 mm long, speckled brown on cream ground colour, with a small black medial spot and a subterminal black spot sometimes extending distally; fringe golden grey. Hindwing silvery grey, lustrous, reflecting platinum; fringe concolorous.

Abdomen grey.

Genitalia. Uncus very large, deeply bilobed. Gnathos: medial process broad, long, bifurcate; lateral arms long, narrow; basal plate consisting of lower part of medial process. Valvae narrow, terminating in a blunt style; transtilla with lateral arm long, narrow, ventral arm small, triangular, and horizontal bar narrow, separated medially. Vinculum: ventral plate with upper part broad, about one-third as long as valva, and lower part consisting of large lobes, deeply invaginated. Aedeagus as long as capsule; vesica with 2 patches of large cornuti; cathrema with many spines.

Female (from 4 non-type specimens). As for male, but antenna comprising less than 33 segments.

Genitalia. Apophyses anteriores long, broad; apophyses posteriores long, slender. Ductus bursae long, narrow, heavily folded; ductus spermathecus with numerous terminal spicules; bursa copulatrix small, covered with many minute pectinations, these decreasing caudally.

Type data. **Holotype**: male, MC, Christchurch [Lyttelton], 23 March 1882, "Nepticula tricentra Meyrick", "E. Meyrick det. in Meyrick Coll." (BM genitalia slide no. 23232, BMNH).

Material examined. Holotype, plus 7 non-type examples (3 males, 4 females; NZAC, ITZA, BPNZ) as follows.

AK: 1 male, Whatipu, Destruction Gully, larva collected 19 Sep 1974, emerged 18 Oct 1974 (VU genitalia slide 2139).

MC: 1 female, Port Hills, 4 Aug 1983 (VU genitalia slide 2251). DN: 1 female, Anderson's Bay, larva collected 5 Aug 1982 (VU coll. no. 82302, VU genitalia slide 2137); 1 female, Dunedin, Vauxhall Cliffs, 16 Jun 1982 (VU genitalia slide 2138); 1 female, Dunedin, Vauxhall, 22 Sep 1983 (VU genitalia slide 2252); 1 male, Akatore Creek, 10 Jul 1983 (VU genitalia slide 2250); 1 female, Akatore Creek, 12 Jul 1983. SL: 1 male, Nugget Point, 8 Oct 1983 (VU genitalia slide 2253).

Mines were examined from Vauxhall Cliffs DN and Nugget Point SL.

Also recorded from Portobello DN, Akatore Creek DN, and Waipori Valley DN.

Biology. Foodplant: *Helichrysum aggregatum*, a shrub up to 3 m tall with slender, flexuous branchlets; throughout the North and South islands, except the far south, in lowland shrublands and forest margins.

Mine: tightly coiled, the contortions so close together that the mine often forms a secondary blotch. Frass fills gallery, but original course recognisable because gallery walls remain.

Larva: recorded April–September; 3–4 mm long, pale yellow.

Cocoon: spun from brown silk, within the mine; recorded May, August, September.

Adult: recorded emerging through upper cuticle of leaf, March and October; adults reared from larvae collected in May, July, and August hatched June, August, and September respectively.

Voltinism: probably 2 generations per year are usual.

Remarks. Its small size and features of the male genitalia, especially the long valvae and the medial process on the gnathos, differentiate *S. tricentra* from all other *Stigmella* species described here. The location of the cocoon, as in *S. cypracma*, is unusual: it is contained in the mine, and the leaf remains on the plant during this stage.

Stigmella watti new species

Figures 100–102; Map 27

Male (description from holotype). Head. Frontal tuft white; scape and collar yellowish white; antenna silvery grey, comprising about 45 segments.

Thorax brown and buff. Forewing about 3.5 mm long, yellowish white, lustrous, reflecting silver; costa with a narrow, brown shoulder line for one-fifth of length; a brown postmedial spot extending terminally and towards costa; apical fifth speckled brown and grey; fringe grey, iridescent, reflecting gold. Hindwing grey, lustrous, reflecting gold; fringe concolorous.

Abdomen brown.

Genitalia. Uncus large, with a broad medial excavation. Gnathos: medial processes thorn-like; lateral arms broad,

triangular; anterior arms short, wide; basal plate broad. Valvae reaching just beyond uncus, about twice as long as ventral plate (measured medially); style small; transtilla with ventral arms long and narrow, and horizontal bar narrow, fused. Vinculum with ventral plate bilobed. Aedeagus a little longer than valvae; vesica with scattered spines and a patch of cornuti; cathrema with spicules and lateral pectinations.

Female (from 2 paratypes). As for male, but antenna comprising about 30 segments, general appearance much paler, and forewing with medial spot pale brown, smaller, not extended, an additional small postmedial brown spot at costa, and terminal fifth speckled pale brown and yellowish white.

Genitalia. Apophyses anteriores long, curved; apophyses posteriores narrow, shorter than apophyses anteriores. Ductus bursae folded; accessory sac small, bulb-like; ductus spermathecus terminally covered with spines; bursa copulatrix relatively small, pectinate medially.

Type data. Holotype: male, "St. Is." SI, Ocean Beach, 6 February 1960, "M 1", M.N. Watt (VU genitalia slide 2171).

Paratypes: 2 females, same data as holotype (VU genitalia slides 2141, 2170).

Material examined. Type specimens only.

Mines were examined from Ocean Beach (SI).

Also recorded from Five Fingers Peninsula FD, Longwood Range SL, Mt Anglem SI, Table Hill SI, Mt Allen SI, and Mt Rakeahua SI.

Biology. Foodplant: *Olearia colensoi* var. *grandis*, a shrub up to 3 m tall found in coastal scrub; perhaps also *O. oporina*.

Mine: narrow, linear galleries in upper surface of leaves. Larva mines from cell to cell, and gallery at first only 1 cell wide, hence margin somewhat irregular. Mine becomes packed with dry, granular frass. Mines apparently of 2 types, one 2–3x longer than the other (see Remarks).

Larva: recorded May; 3–4 mm long, pale green.

Cocoon: brown; attached to leaves and stem of host plant.

Adult: recorded February.

Voltinism: probably 1 generation per year.

Remarks. *S. watti* is differentiated from *S. atrata* by the number of antennal segments and the dark brown shoulder line, and from *S. laqueorum* by the shape of the transtilla, the larger uncus, and the smaller cornuti on the aedeagus. Females differ from those of *S. fulva* in their smaller size, the small process on sternite 8, less arcuate apophyses anteriores, and smaller bursa copulatrix. The shape of the valvae and the aedeagus places *watti* close to *laqueorum*.

Morris N. Watt was the first to discover mines of this species. He found them on *O. colensoi* along the shores of Ocean Beach, Stewart Island, in 1959.

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APPENDIX: FOODPLANTS OF *STIGMELLA* SPECIES IN NEW ZEALAND

(*supplementary records provided by B. Patrick)

A: *Stigmella* species with foodplants

aigialeia	*Plagianthus divaricatus* J.R. et G. Forster
aliena	not known
atrata	*Brachyglottis reinoldii* Endlicher
	B. bennettii Simpson et Thompson
	B. eleagnifolius Hooker
cassiniae	*Cassinia fulvida* Hooker
	C. leptophylla (Forster)
	C. vauvilliersii (Hombron et Jacquinot)
childi	*Celmisia haastii* Hooker
cypracma	*Brachyglottis repanda* J.R. et G. Forster
erysibodea	*Olearia ilicifolia* (?)
fulva	*Olearia arborescens* (Forster)
	O. ilicifolia Hooker
	O. macrodonta Baker
	O. nitida Hooker
hakekeae	*Olearia arborescens* (Forster)
	O. macrodonta Baker
	O. nummularifolia Hooker
	O. paniculata (J.R. et G. Forster)
hamishella	*Olearia moschata* Hooker
hoheriae	*Hoheria glabrata* Sprague et Summerhayes
	H. populnea A. Cunningham
	H. sexstylosa Colenso
	H. angustifolia Raoul
ilsea	**Olearia hectorii* Hooker f.
	O. laxiflora Kirk
	**O. lineata* Kirk
	O. odorata Petrie
	O. rugosa Simpson
	**Olearia* sp. aff. *odorata* Petrie
insignis	*Celmisia spectabilis* Hooker
kaimanua	*Parsonsia heterophylla* A. Cunningham
laqueorum	*Olearia lyallii* Hooker
lucida	*Nothofagus menziesii* (Hooker)
maoriella	not known
microtheriella	*Corylus avellana* Linnaeus
ogygia	**Senecio biserratus*
	S. minimus Poiret
oriastra	**Celmisia brevifolia* Cockayne
	C. coriacea (Forster)
	**C. densiflora* Hooker f.
	**C. discolor* Hooker f.
	**C. durietzii* Cockayne et Allan
	**C. lindsayi* Hooker f.
	**C. prorepens* Petrie
	**C. semicordata* Petrie

	**C. verbascifolia* Hooker f.
	**Celmisia* sp. cf. *graminifolia* Hooker f.
palaga	not known
platina	*Brachyglottis reinoldii* Endlicher
	B. bennettii Simpson et Thompson
	B. eleagnifolius Hooker
progama	not known
progonopis	*Dracophyllum longifolium* (J.R. et G. Forster)
	**D. menziesii*
	**D. traversii*
	**Gaultheria crassa* Allan
propalaea	not known
sophorae	*Sophora tetraptera* J. Miller
	S. microphylla Aiton
tricentra	*Helichrysum aggregatum* P.F. Yeo
watti	*Olearia colensoi* Hooker

B: Foodplant with *Stigmella* species

APOCYNACEAE	
Parsonsia heterophylla	*kōtimanua*
ASTERACEAE	
Brachyglottis bennettii	*atrata, platina*
B. eleagnifolius	*atrata, platina*
B. reinoldii	*atrata, platina*
B. repanda	*cypracma*
Cassinia fulvida	*cassiniae*
C. leptophylla	*cassiniae*
C. vauvilliersii	*cassiniae*
**Celmisia brevifolia*	*oriastra*
C. coriacea	*oriastra*
**C. densiflora*	*oriastra*
**C. discolor*	*oriastra*
**C. durietzii*	*oriastra*
C. haastii	*childi*
**C. lindsayi*	*oriastra*
**C. prorepens*	*oriastra*
**C. semicordata*	*oriastra*
C. spectabilis	*insignis*
**C. verbascifolia*	*oriastra*
Helichrysum aggregatum	*tricentra*
Olearia arborescens	*fulva, hakekeae*
O. colensoi	*watti*
**O. hectorii*	*ilsea*
O. ilicifolia	*fulva, erysibodea*(?)
O. laxiflora	*ilsea*
**O. lineata*	*ilsea*
O. lyallii	*laqueorum*
O. macrodonta	*fulva, hakekeae*
O. moschata	*hamishella*
O. nitida	*fulva*
O. nummularifolia	*hakekeae*
O. odorata	*ilsea*
O. paniculata	*hakekeae*
O. rugosa	*ilsea*
Senecio biserratus	*ogygia*
S. minimus	*ogygia*
BETULACEAE	
Corylus avellana	*microtheriella*
EPACRIDACEAE	
Dracophyllum longifolium	*progonopis*
**D. menziesii*	*progonopis*
**D. traversii*	*progonopis*
ERICACEAE	
**Gaultheria crassa*	*progonopis*
FABACEAE	
Sophora microphylla	*sophorae*
S. tetraptera	*sophorae*
FAGACEAE	
Nothofagus menziesii	*lucida*
MALVACEAE	
Hoheria angustifolia	*hoheriae*
H. glabrata	*hoheriae*
H. populnea	*hoheriae*
H. sexstylosa	*hoheriae*
Plagianthus divaricatus	*aigialeia*

ILLUSTRATIONS

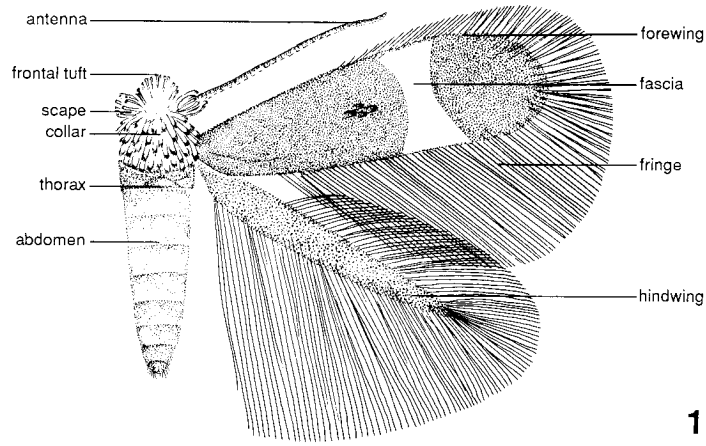
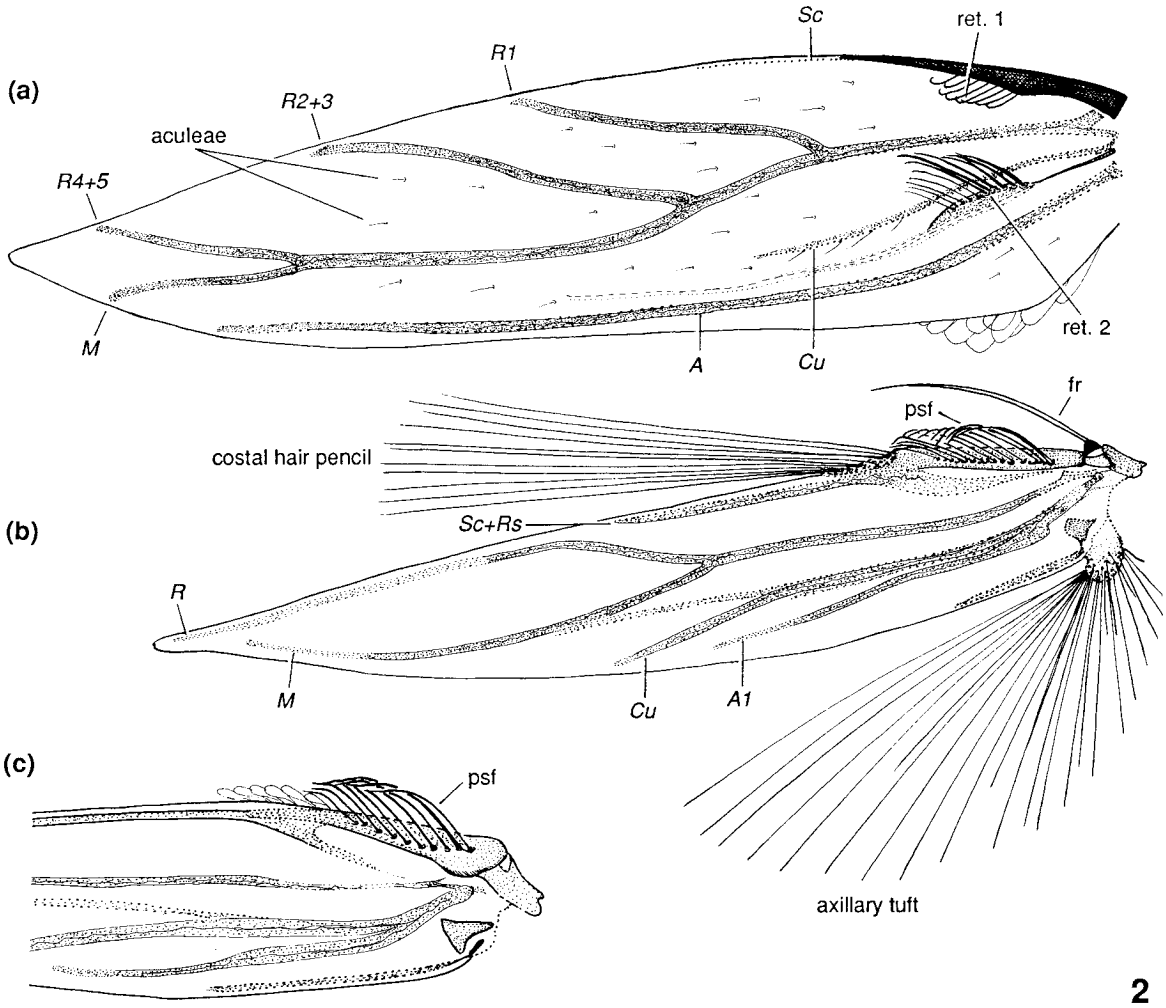


Figure 1 Terminology used in description of external features of Nepticulidae.

1

Figure 2 Wing morphology of a typical nepticulid (*Stigmella laqueorum*): (a) forewing, male; (b) hindwing, male; (c) hindwing, female, showing lack of frenulum. Key: fr, frenulum; psf, pseudofrenulum; ret.1, costal retinaculum; ret.2, subcubital retinaculum.



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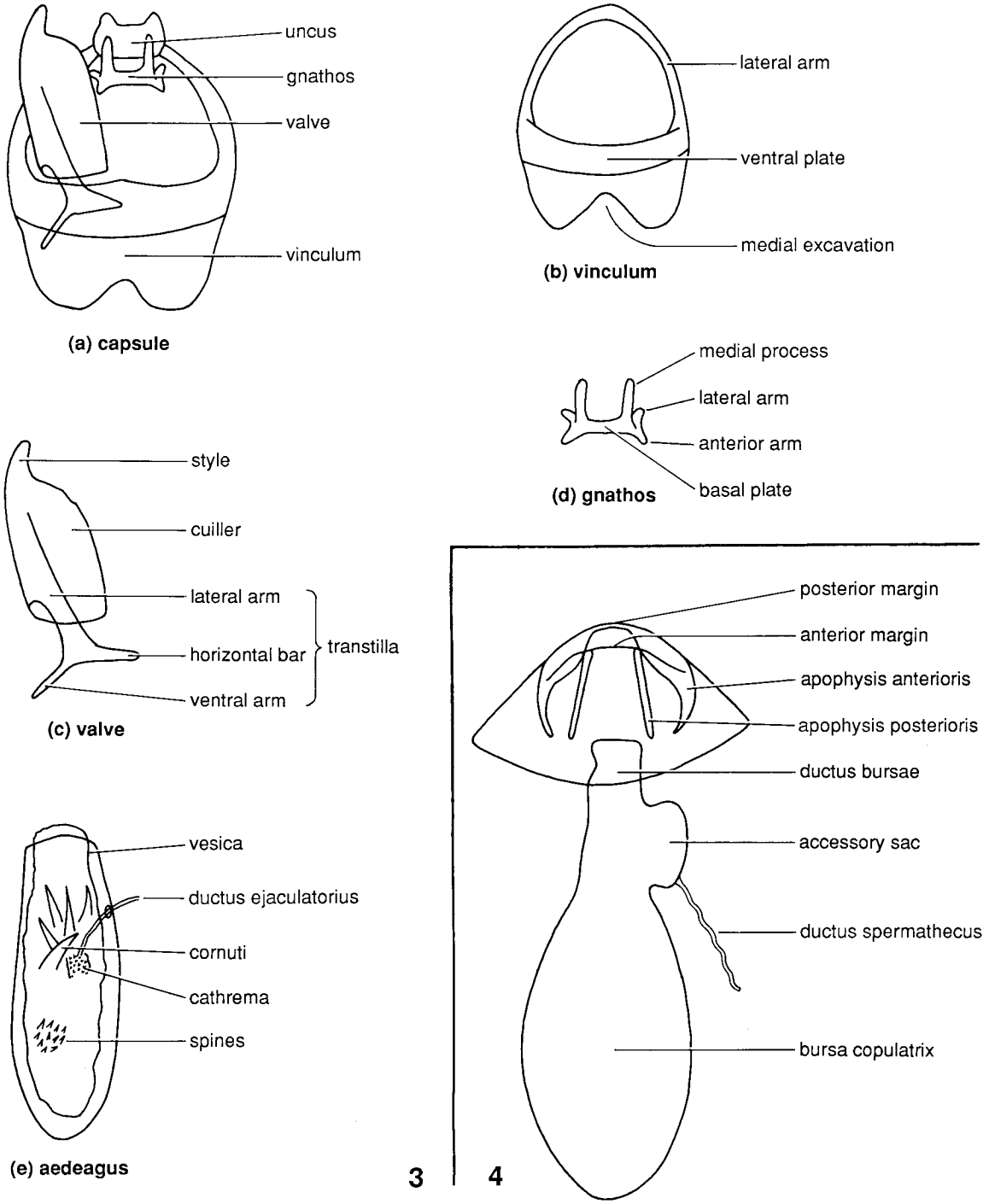
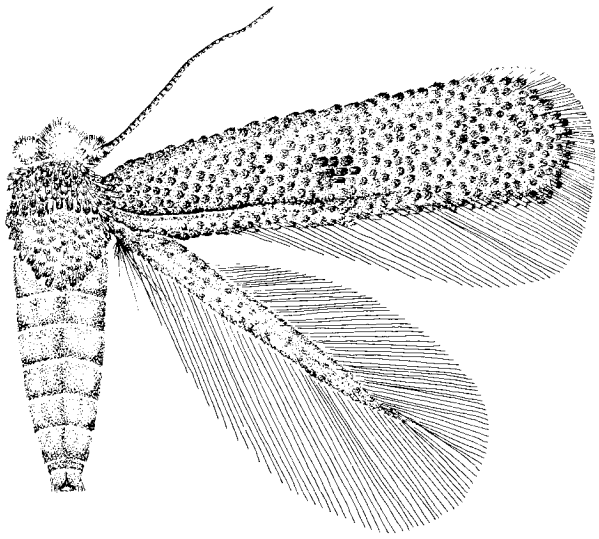
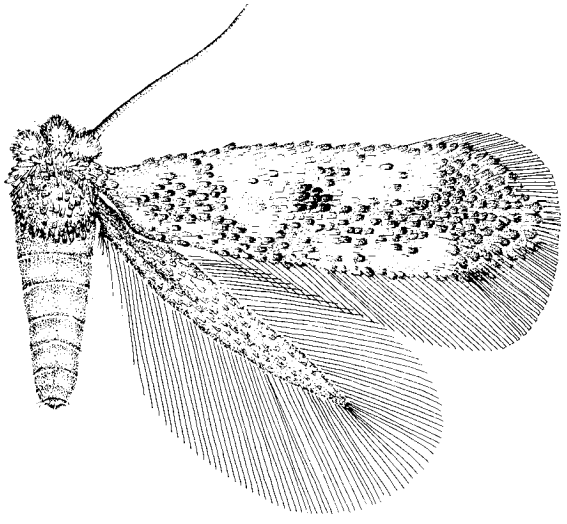


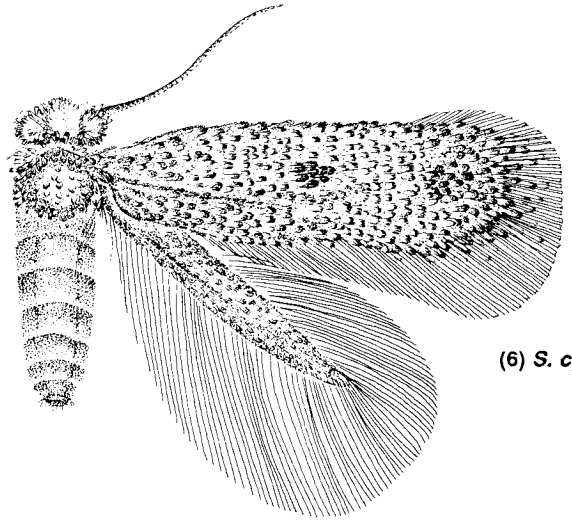
Figures 3 and 4 Terminology used in descriptions of genitalia of Nepticulidae: 3, male – (a) capsule, with structures in situ, (b–d) detail of vinculum, valve, and gnathos respectively, (e) aedeagus; 4, female.



(5a) ***S. atrata*, male**

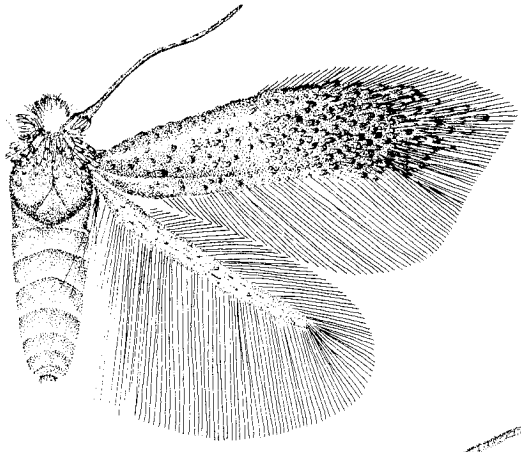


(5b) *S. atrata*, female

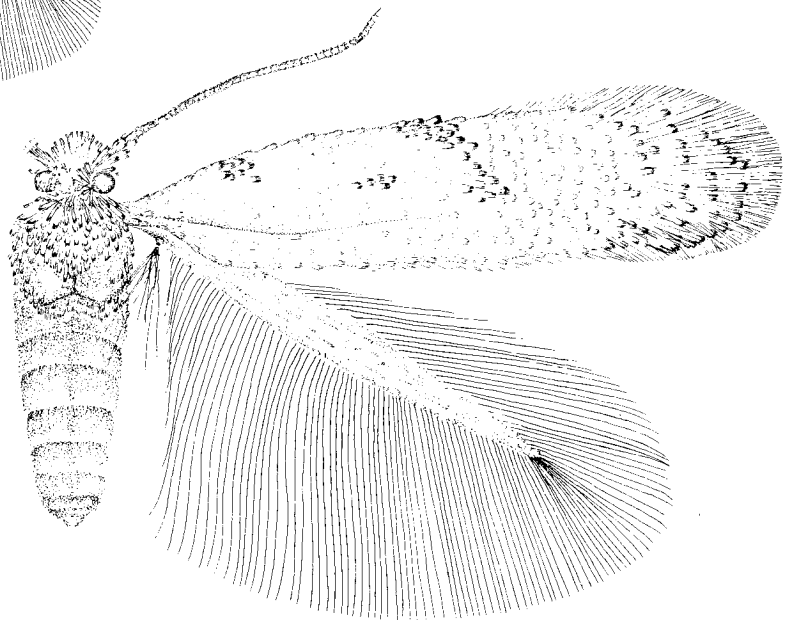


(6) *S. cypracma*

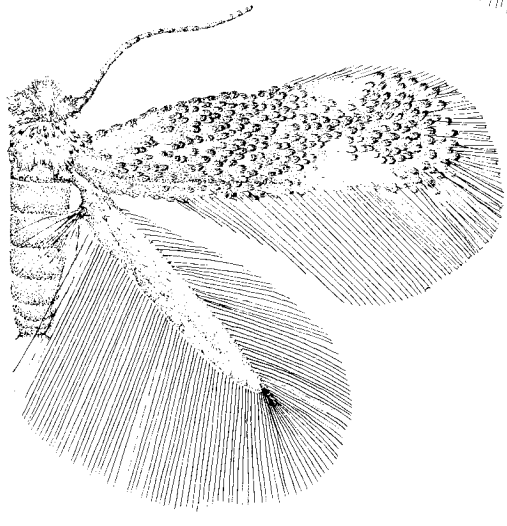
Figures 5–18 External features of some New Zealand species of *Stigmella*.



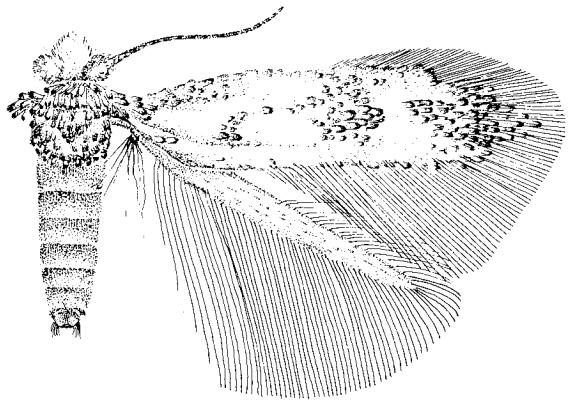
(7) ***S. erysibodea***



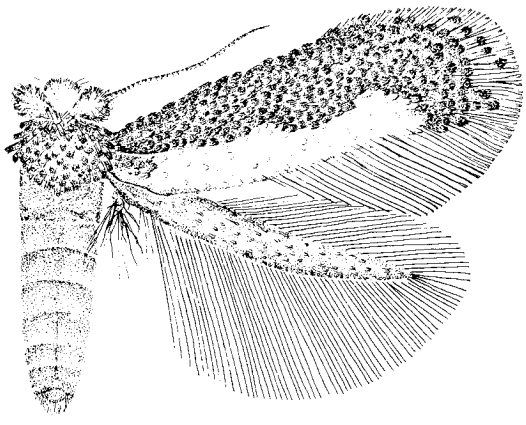
(8) ***S. fulva***



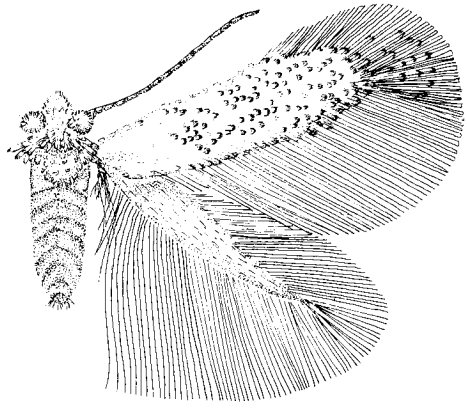
(9) ***S. hakekeae***



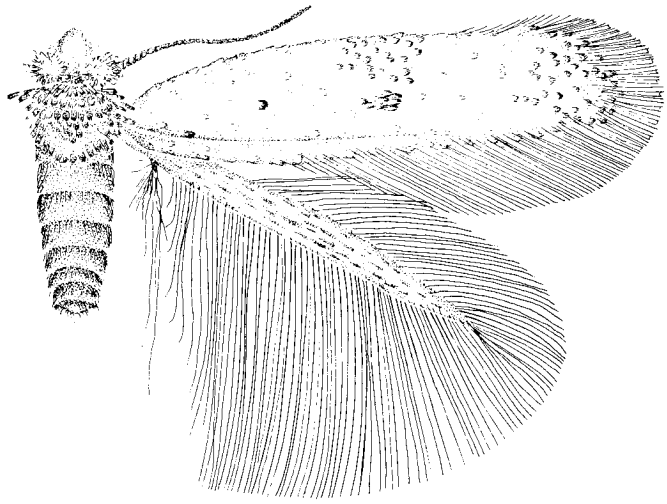
(10) ***S. hamishella***



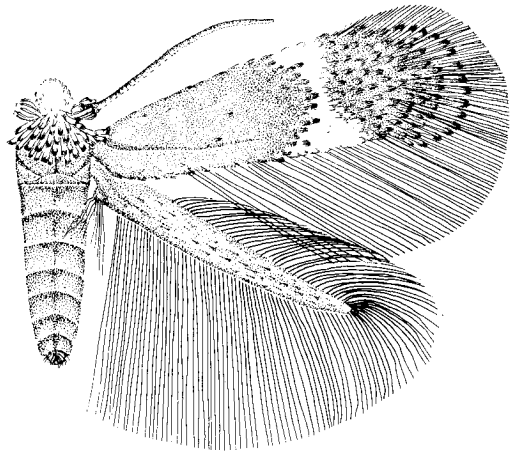
(11) ***S. hoheriae***



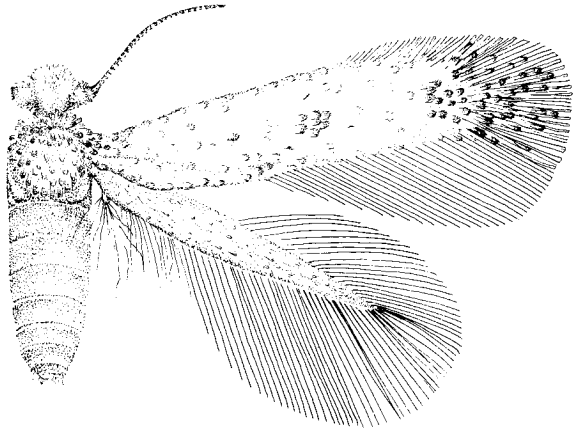
(12) ***S. ilsea***



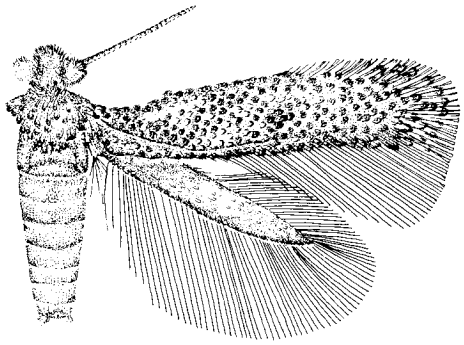
(13) ***S. laqueorum***



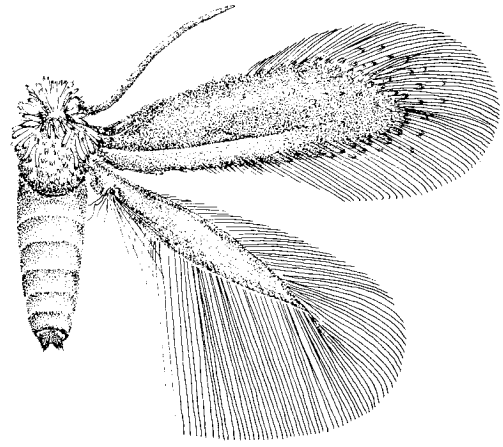
(14) ***S. lucida***



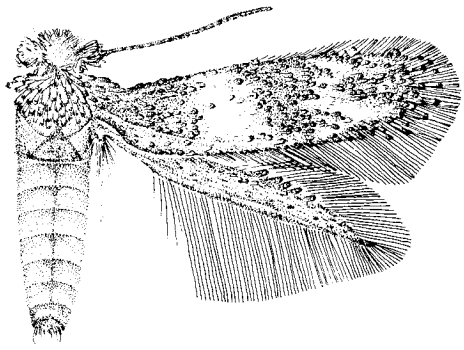
(15a) ***S. ogygia***, pale form



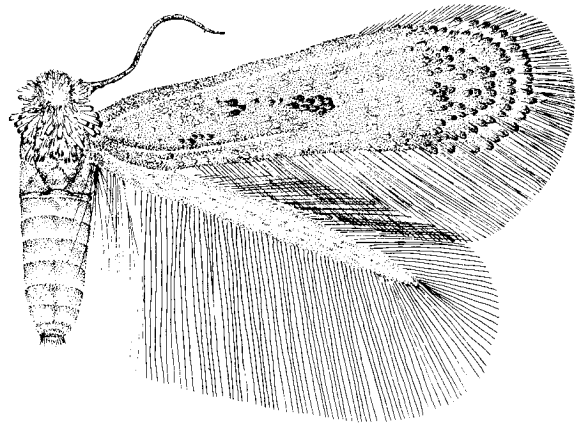
(15b) ***S. ogygia*** , dark form



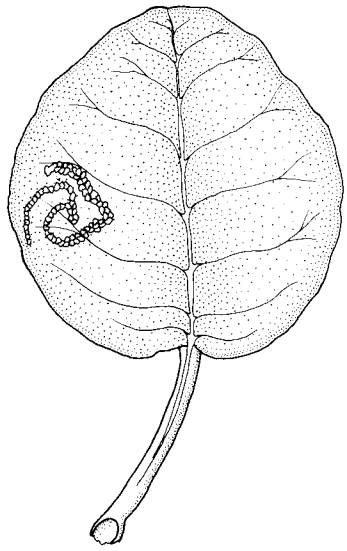
(16) ***S. platina***



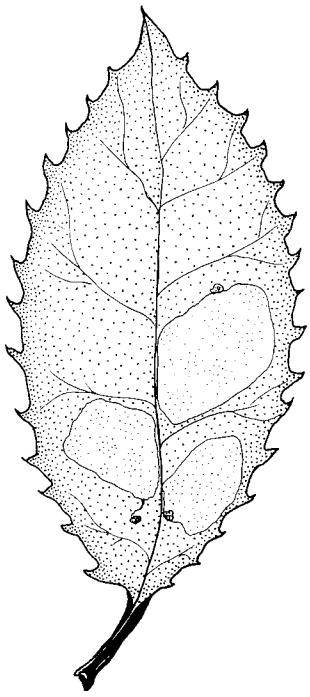
(17) ***S. sophorae***



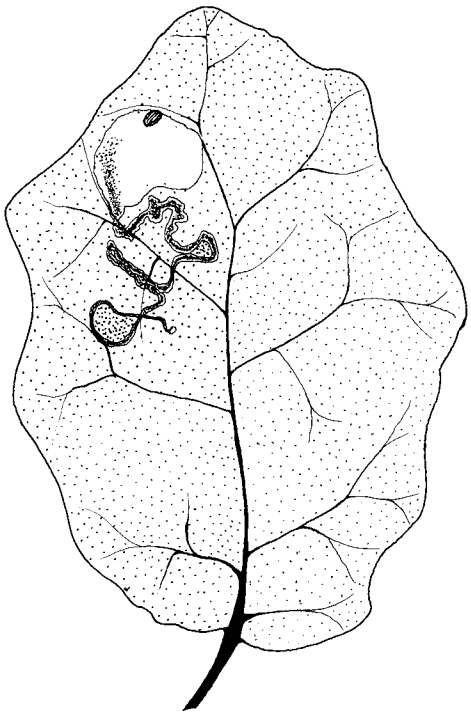
(18) ***S. tricentra***



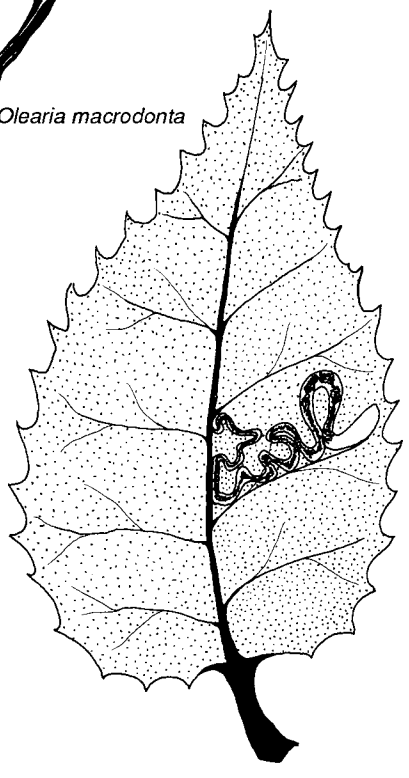
(19) ***S. atrata*** on *Brachyglottis bennettii*



(21) ***S. fulva*** on *Olearia macrodonta*

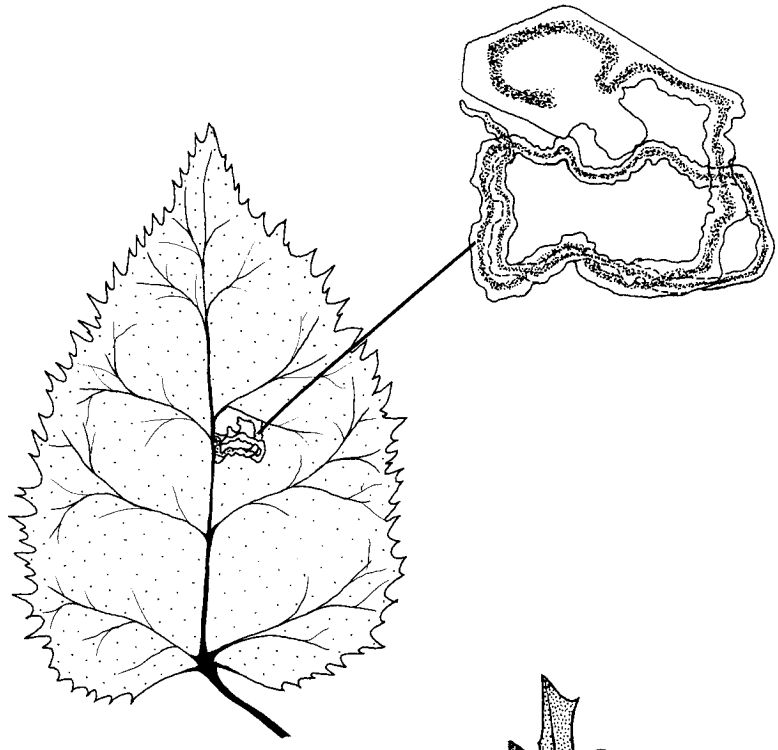


(20) ***S. cypracma*** on *Brachyglottis repanda*

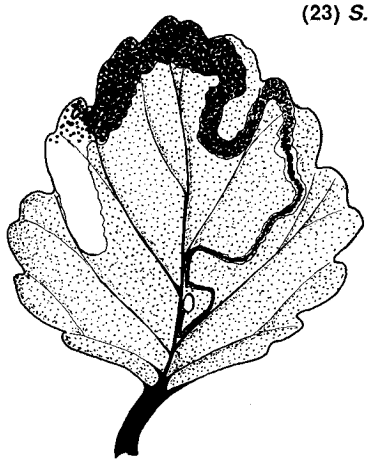


(22) ***S. hakekeae*** on *Olearia macrodonta*

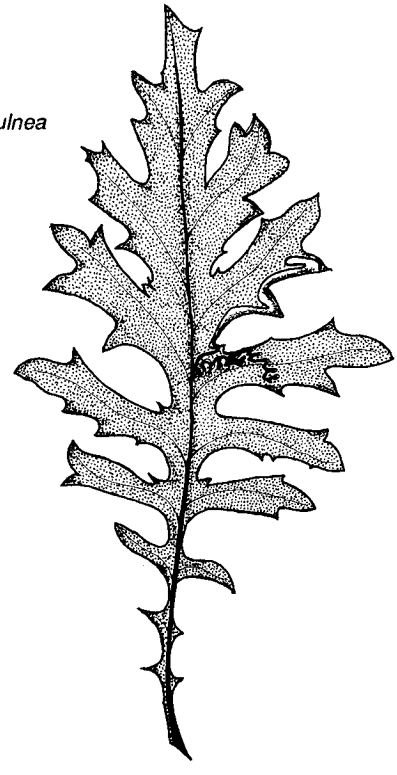
Figures 19–28 Mines of some New Zealand *Stigmella* species in host-plant leaves.



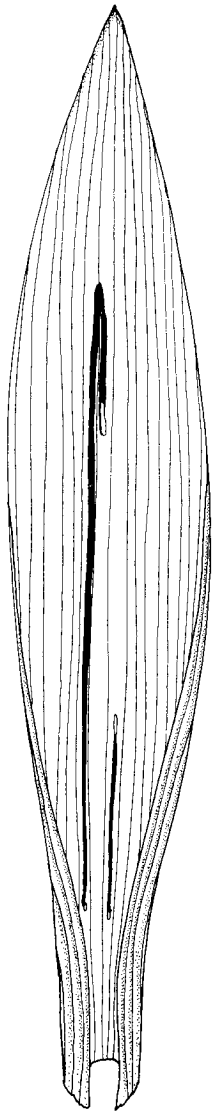
(23) ***S. hoheriae*** on *Hoheria populnea*



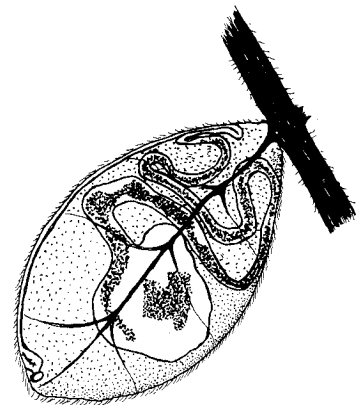
(24) ***S. lucida*** on *Nothofagus menziesii*



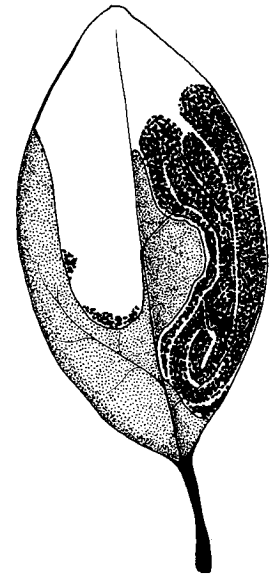
(25) ***S. ogygia*** on *Senecio minimus*



(26) *S. progonopis* on *Dracophyllum traversii*

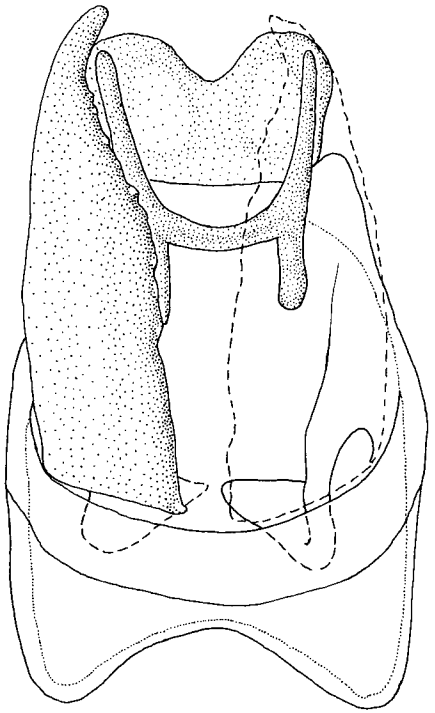


(27) *S. sophorae* on *Sophora microphylla*

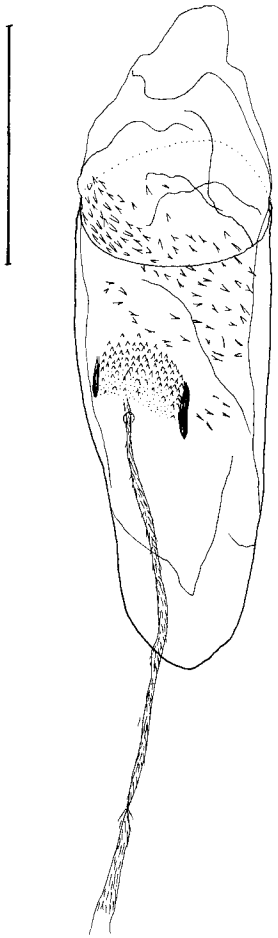


(28) *S. tricentra* on *Helichrysum aggregatum*

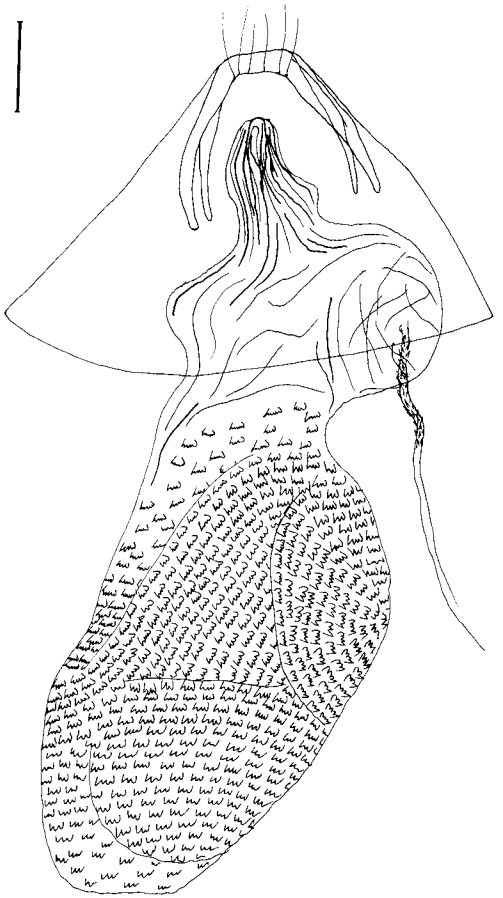
Figures 29–102 Genitalia of New Zealand *Stigmella* species.



(29) male capsule

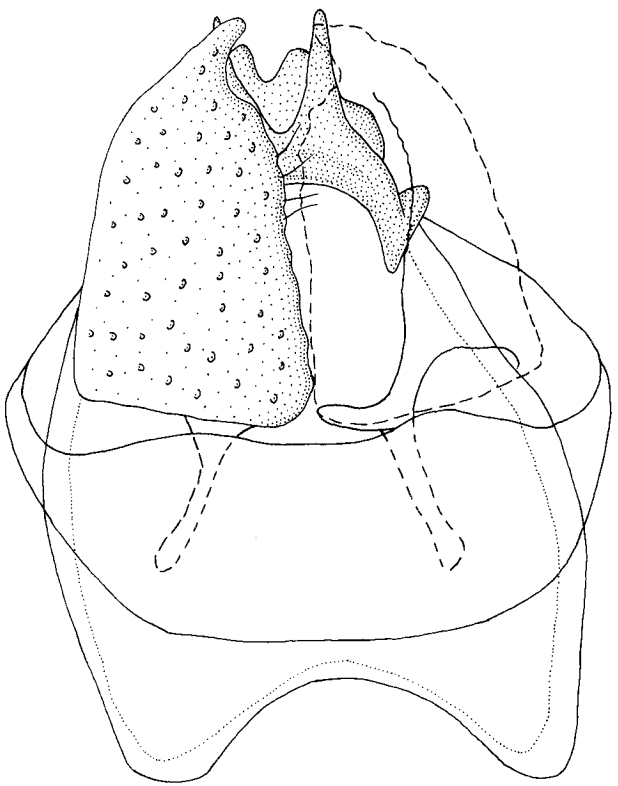


(30) aedeagus

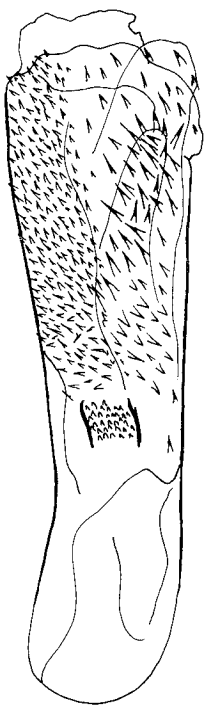


(31) female

29–31 *S. aigialeia*

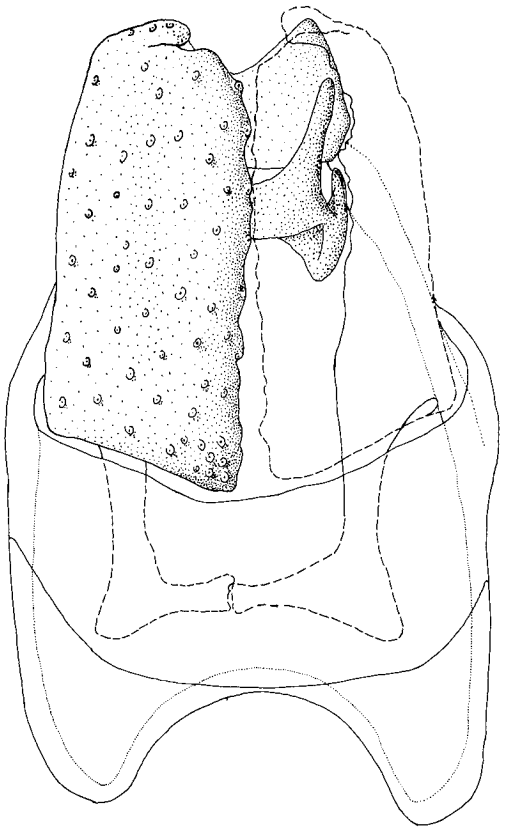


(32) male capsule

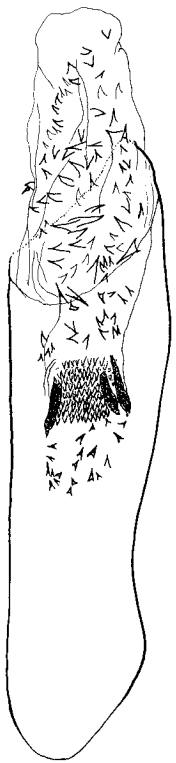


(33) aedeagus

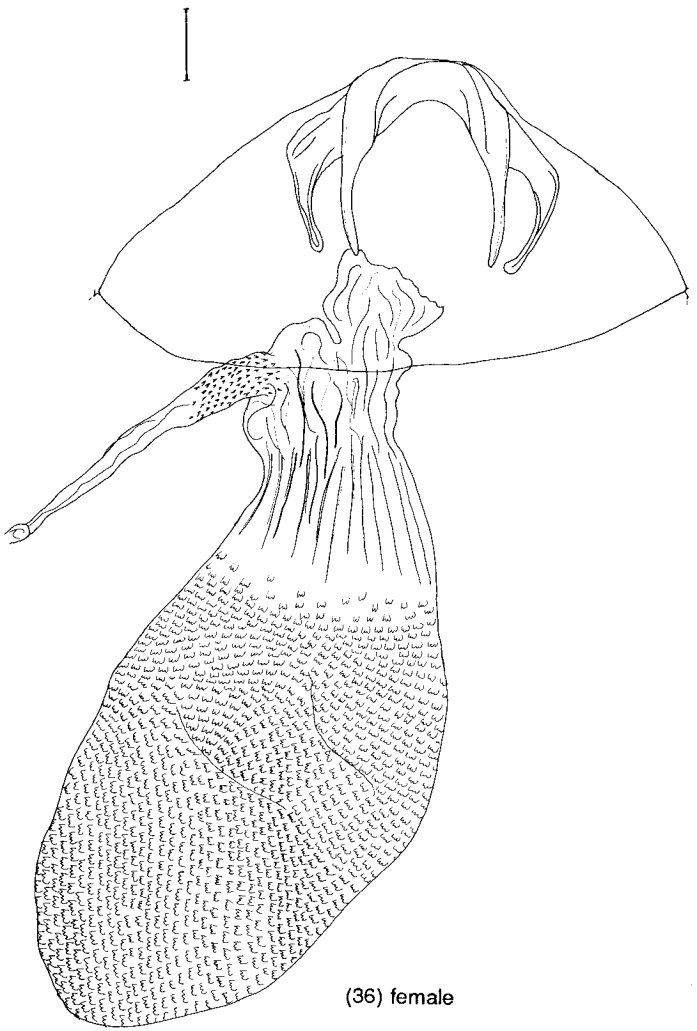
32, 33 *S. aliena*



(34) male capsule

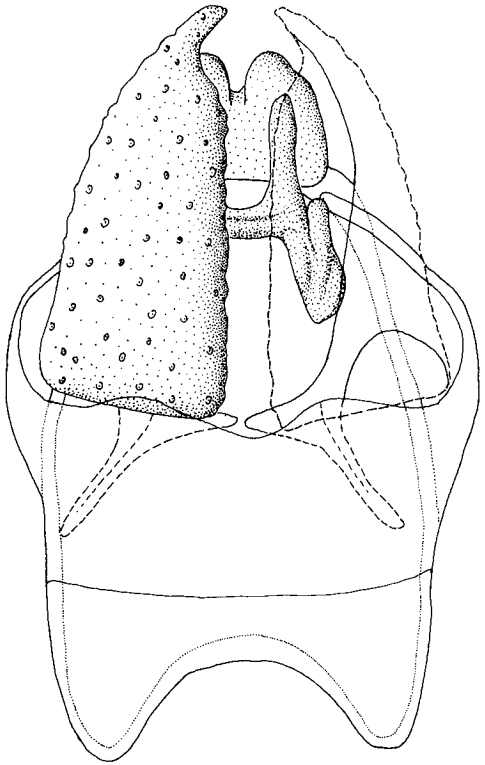


(35) aedeagus

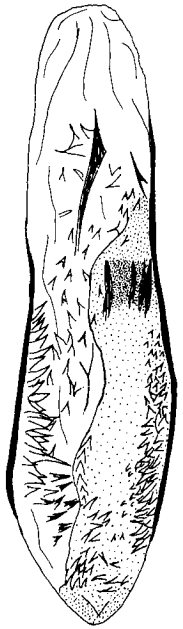


(36) female

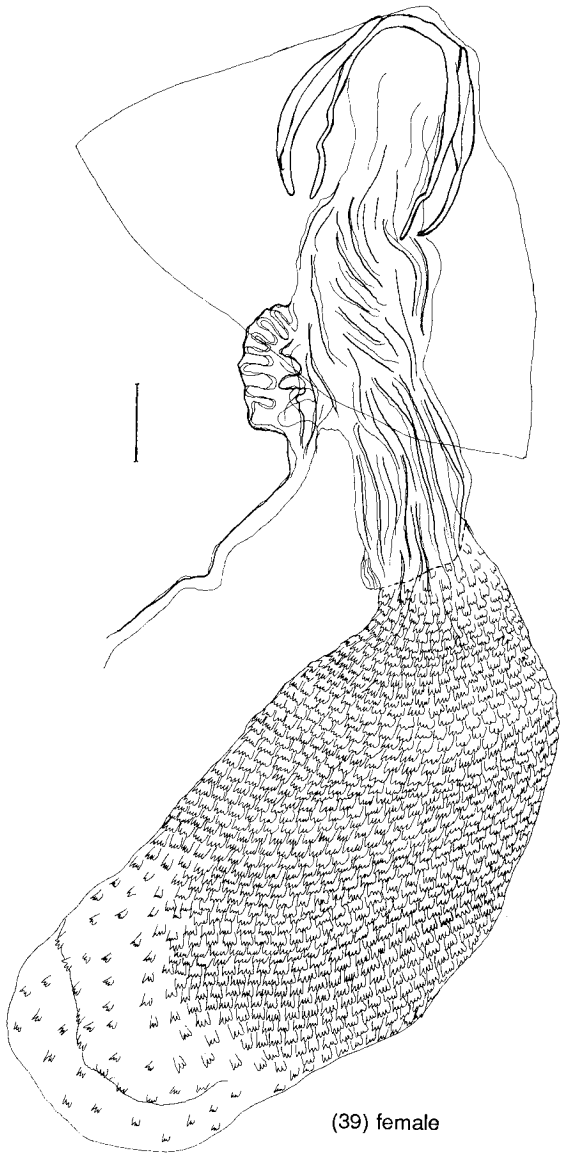
34–36 *S. atrata*



(37) male capsule

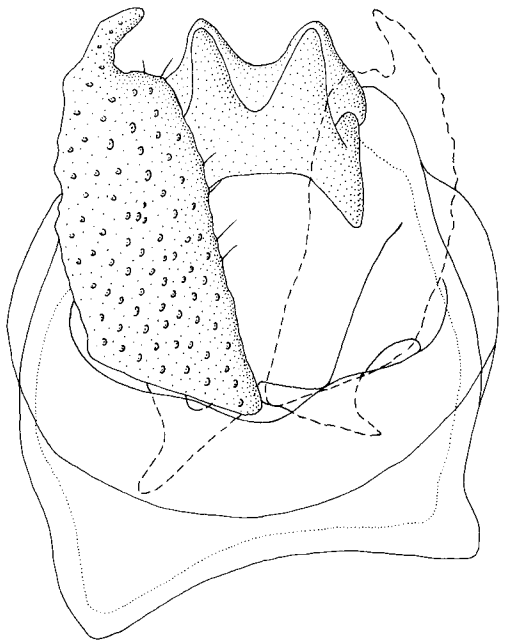


(38) aedeagus



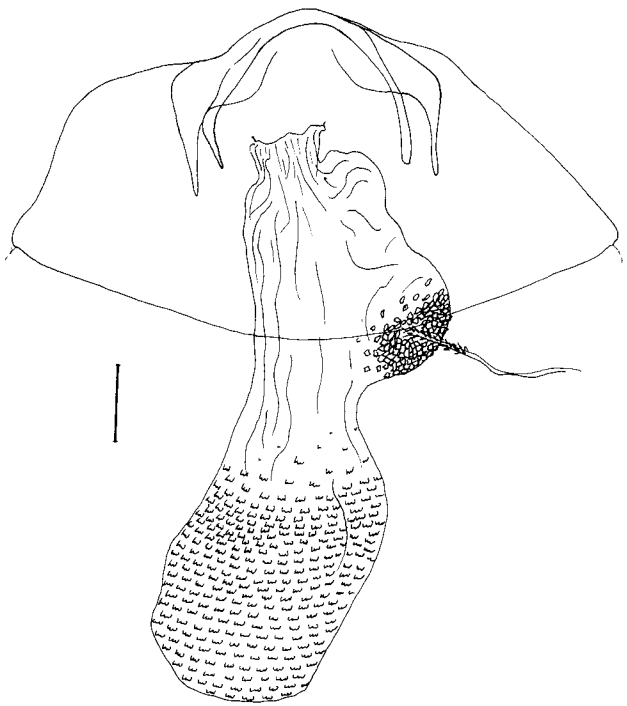
(39) female

37–39 *S. cassiniae*



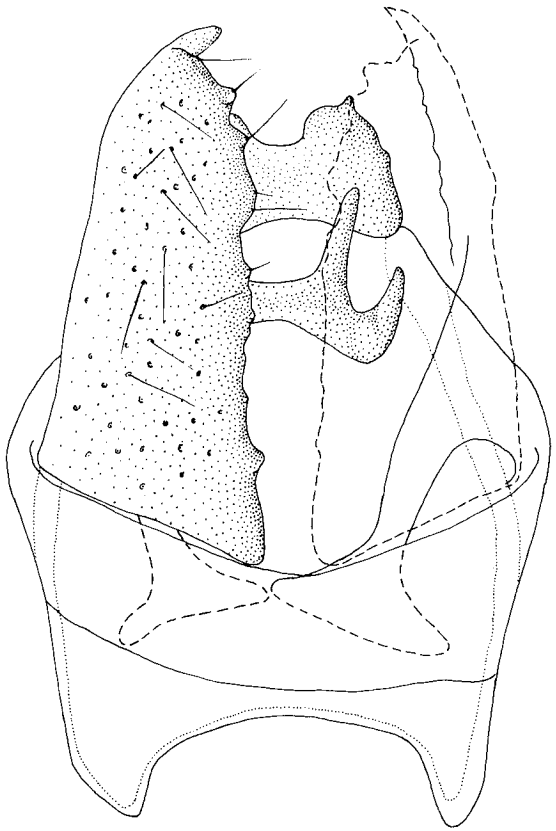
(40) male capsule

(41) aedeagus

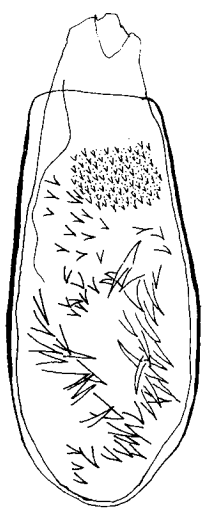


(42) female

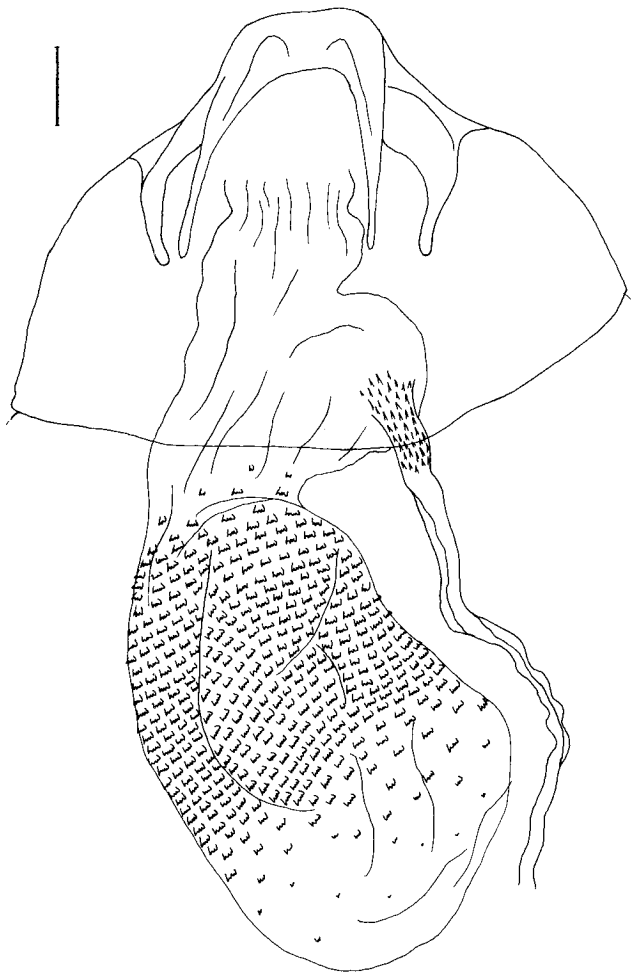
40–42 *S. childi*



(43) male capsule

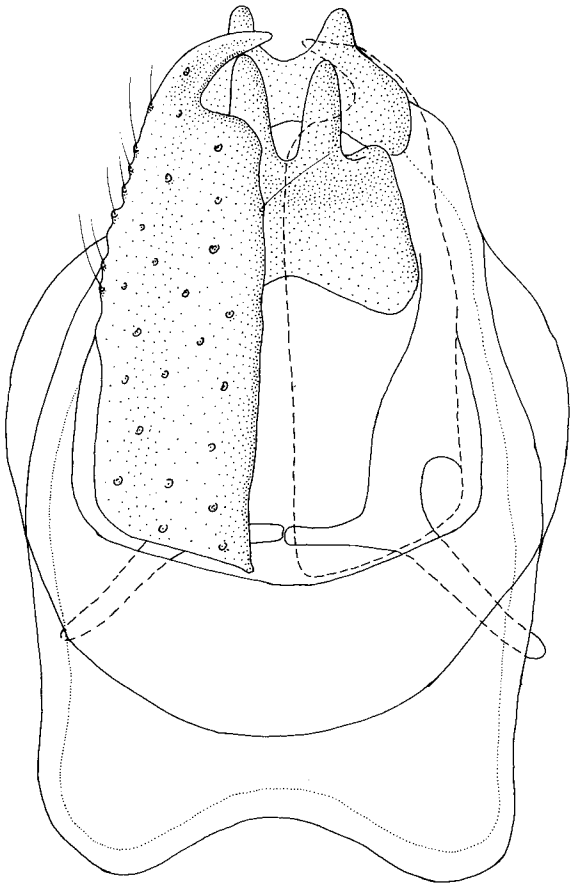


(44) aedeagus

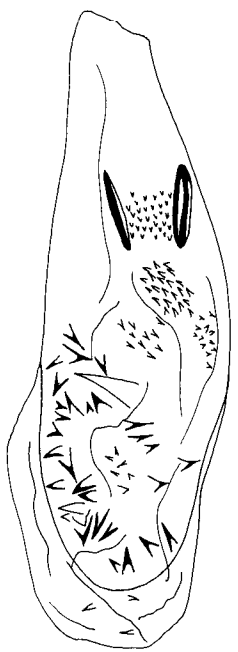


(45) female

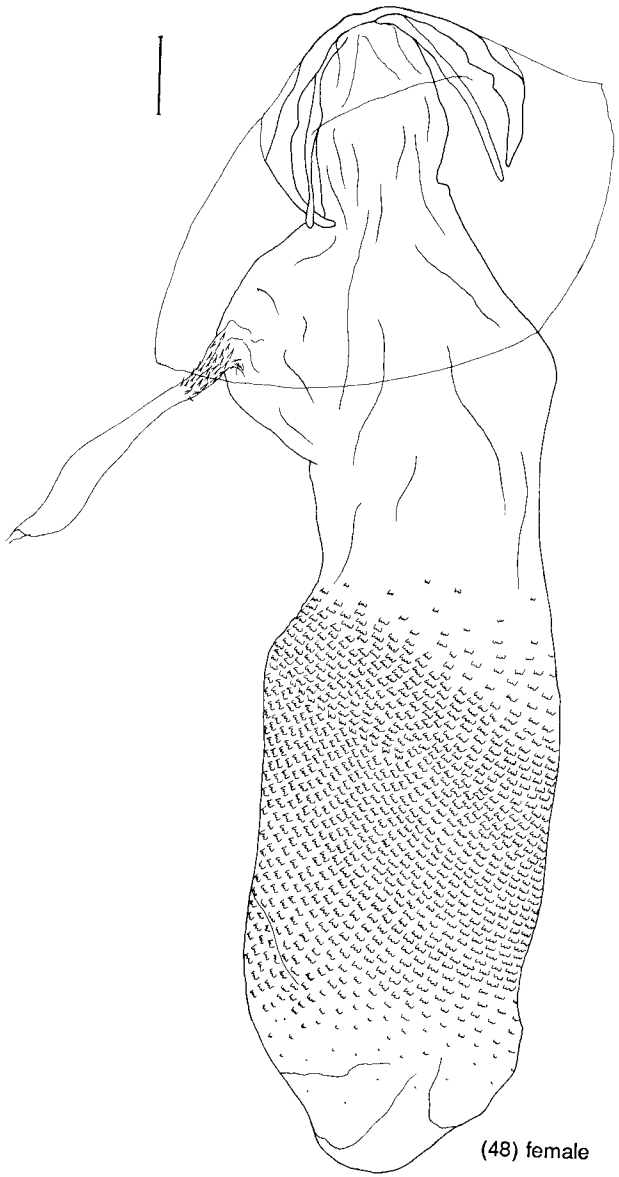
43–45 *S. cypracma*



(46) male capsule

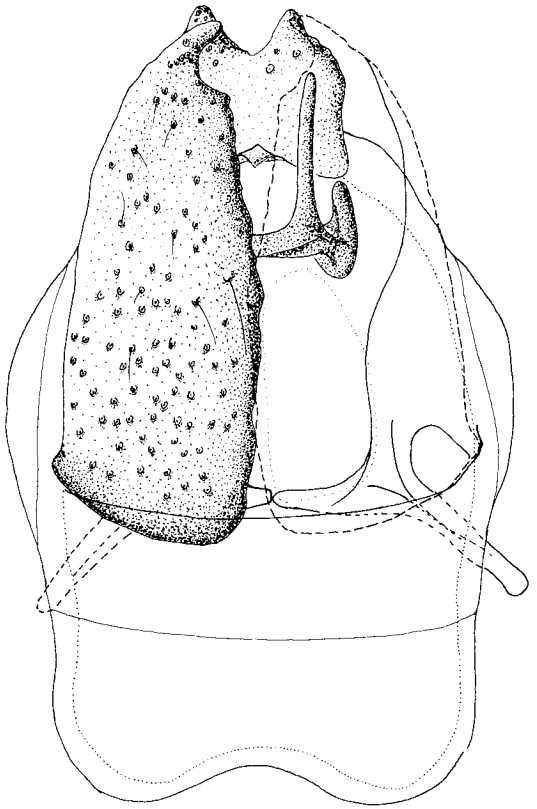


(47) aedeagus



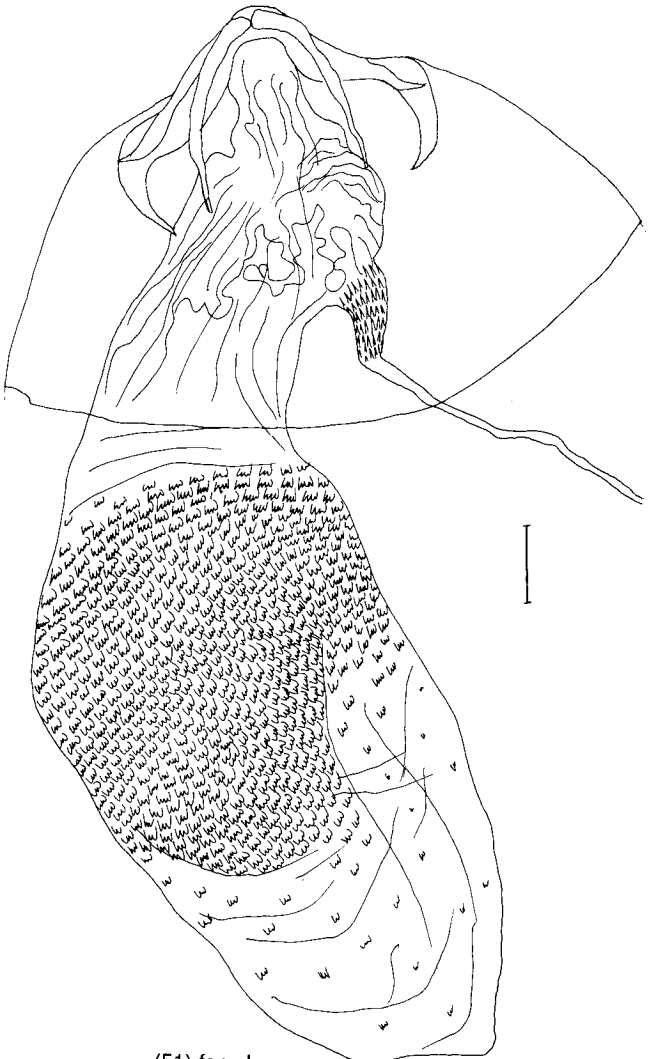
(48) female

46–48 *S. erysibodea*



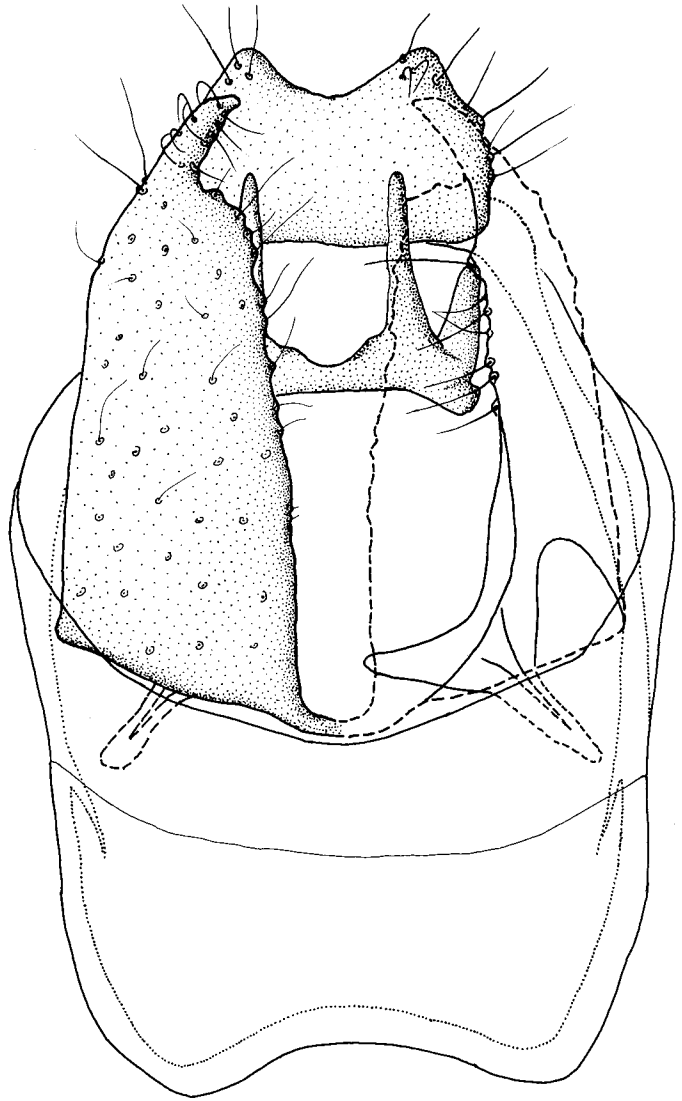
(49) male capsule

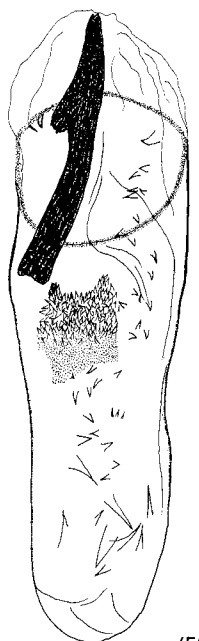
(50) aedeagus

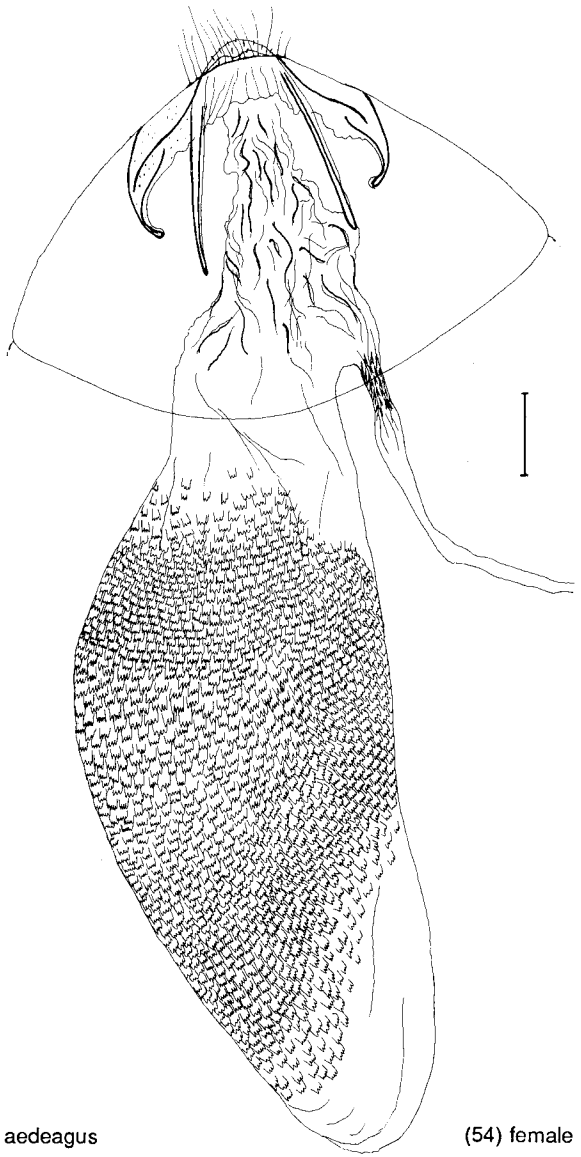


(51) female

49–51 *S. fulva*





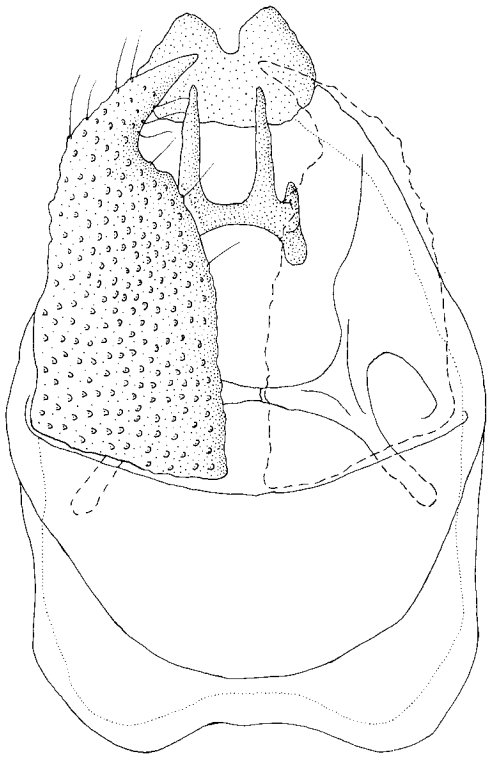


52–54 *S. hakekeae*

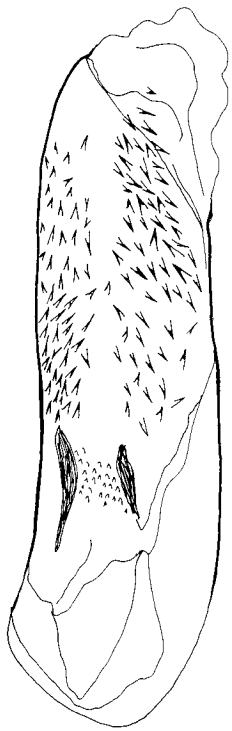
(52) male capsule

(53) aedeagus

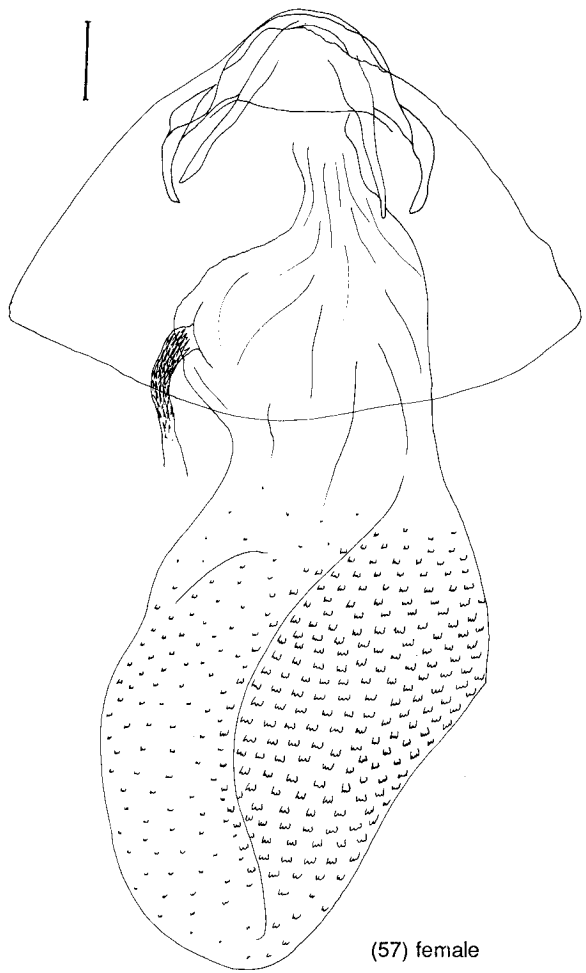
(54) female



(55) male capsule

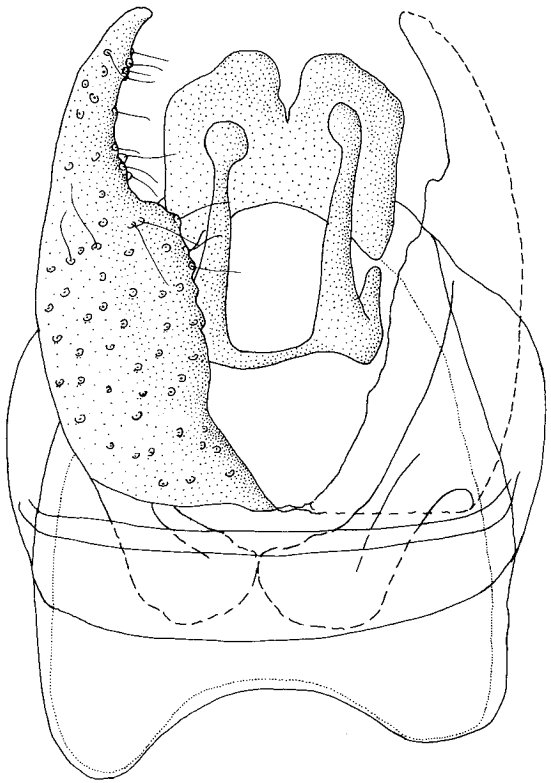


(56) aedeagus

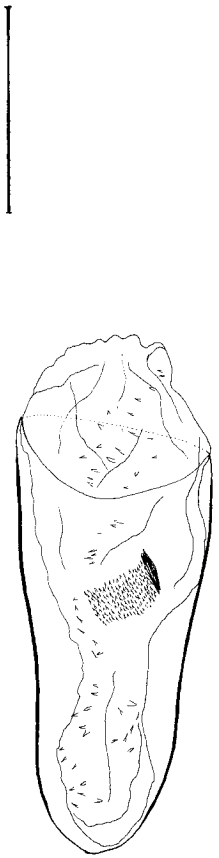


(57) female

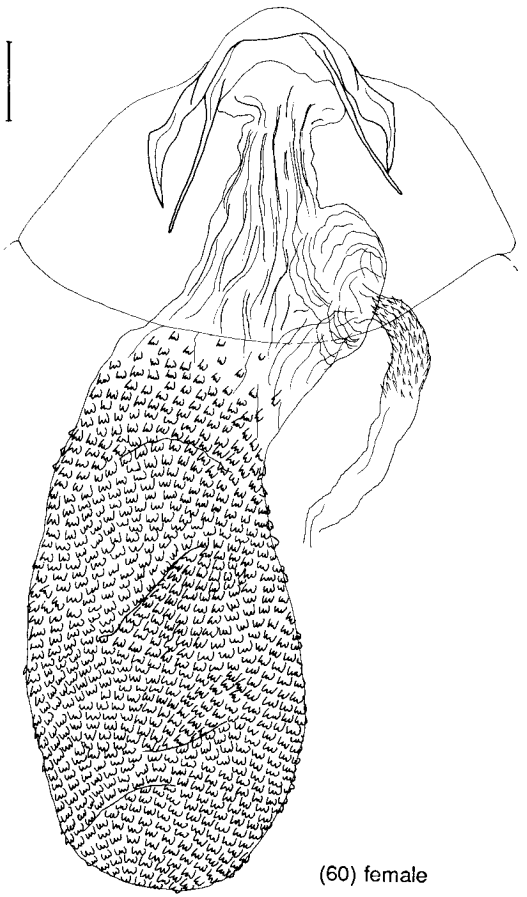
55–57 *S. hamishella*



(58) male capsule

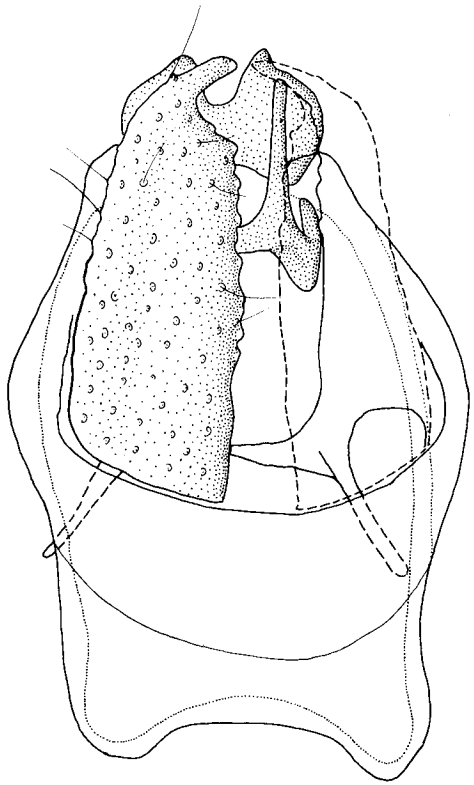


(59) aedeagus



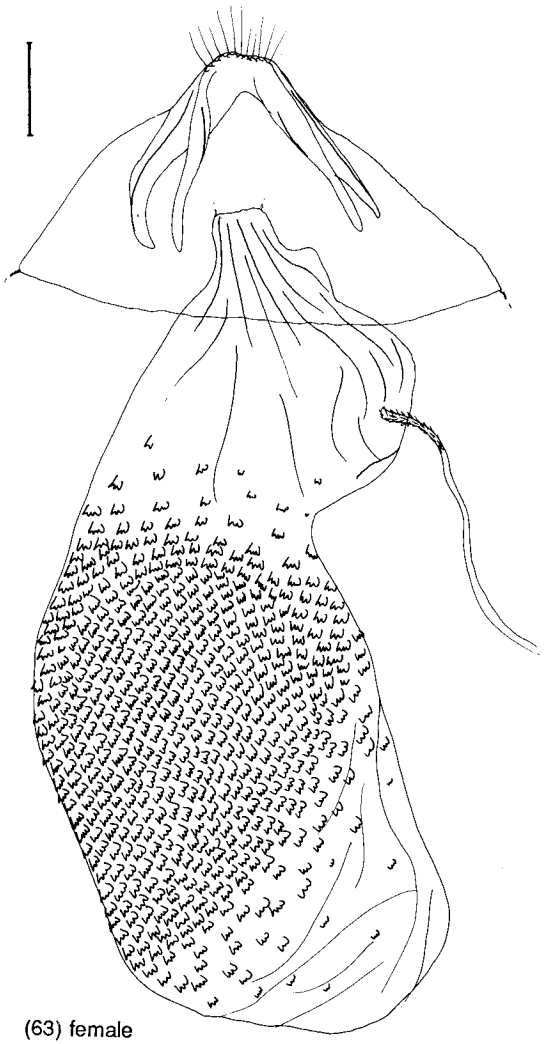
(60) female

58–60 *S. hoheriae*



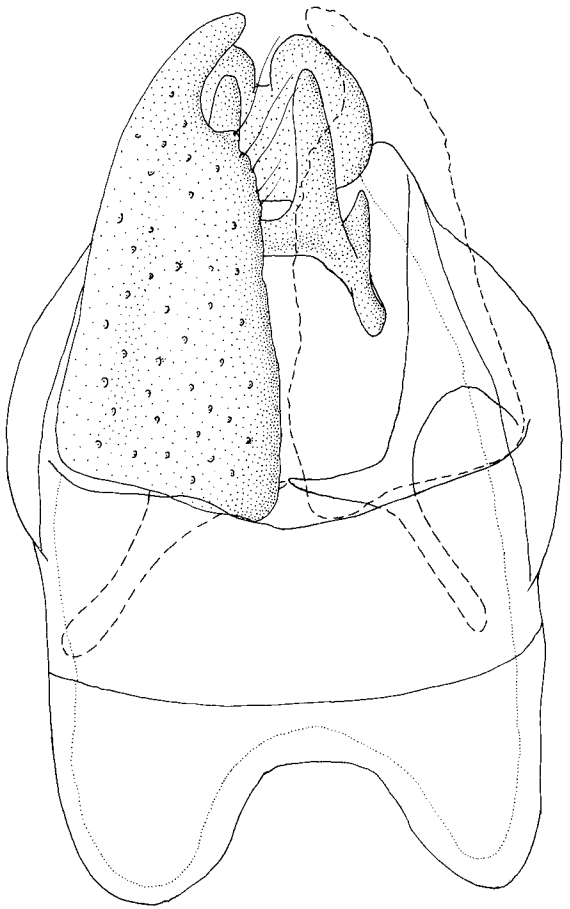
(61) male capsule

(62) aedeagus

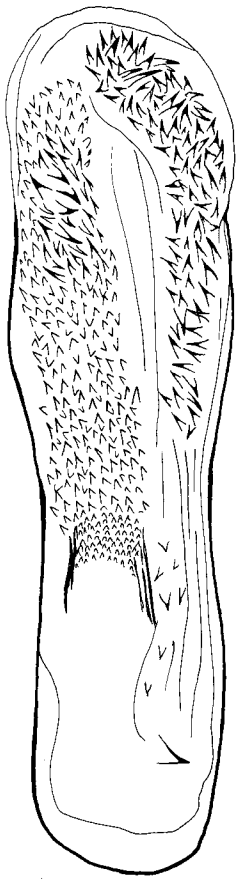


(63) female

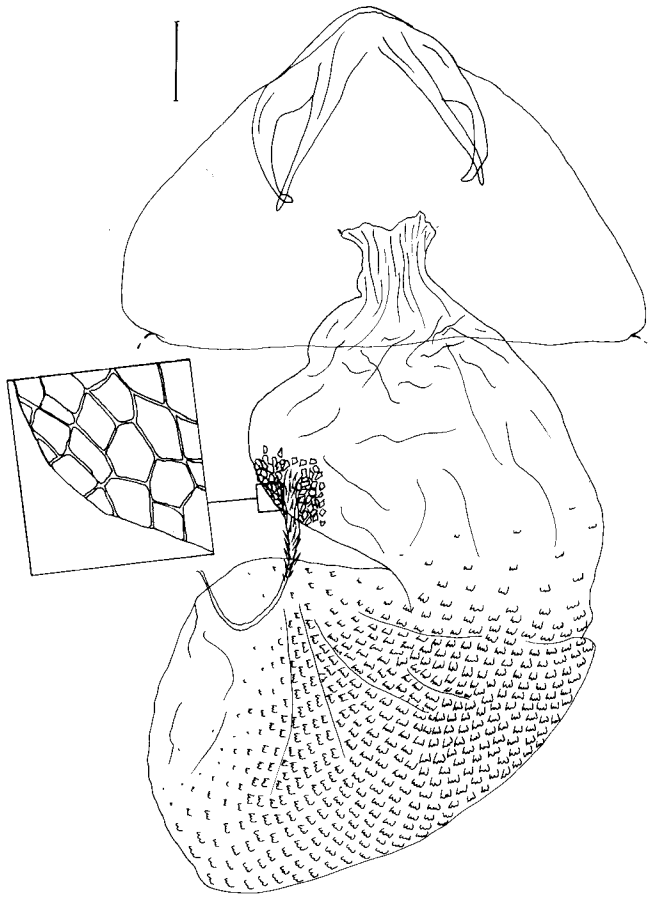
61–63 *S. ilsea*



(64) male genitalia

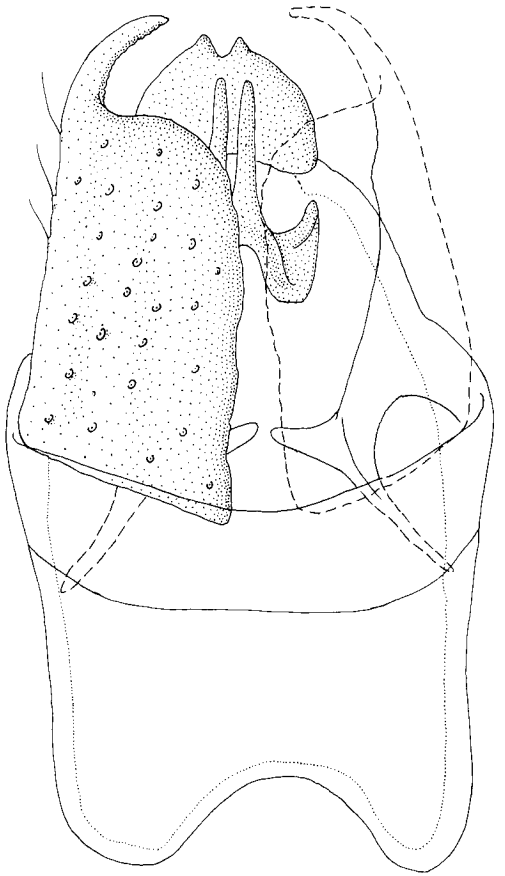


(65) aedeagus

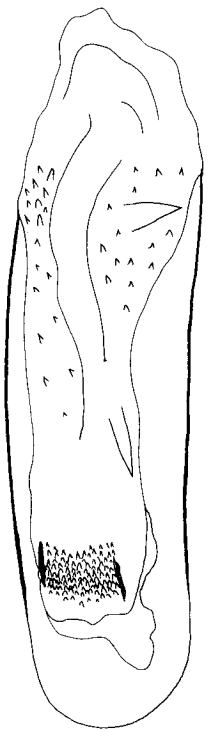


(66) female

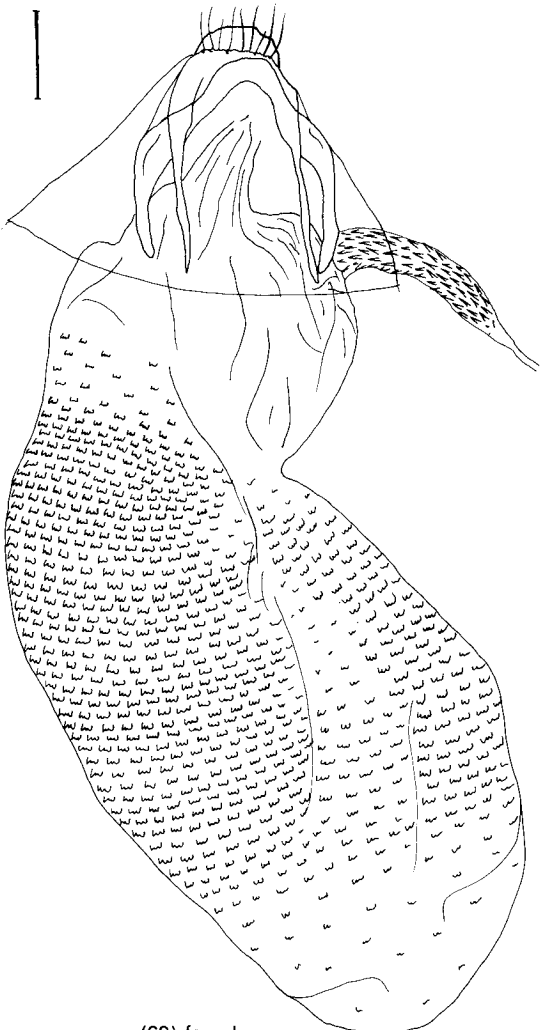
64–66 *S. insignis*



(67) male capsule

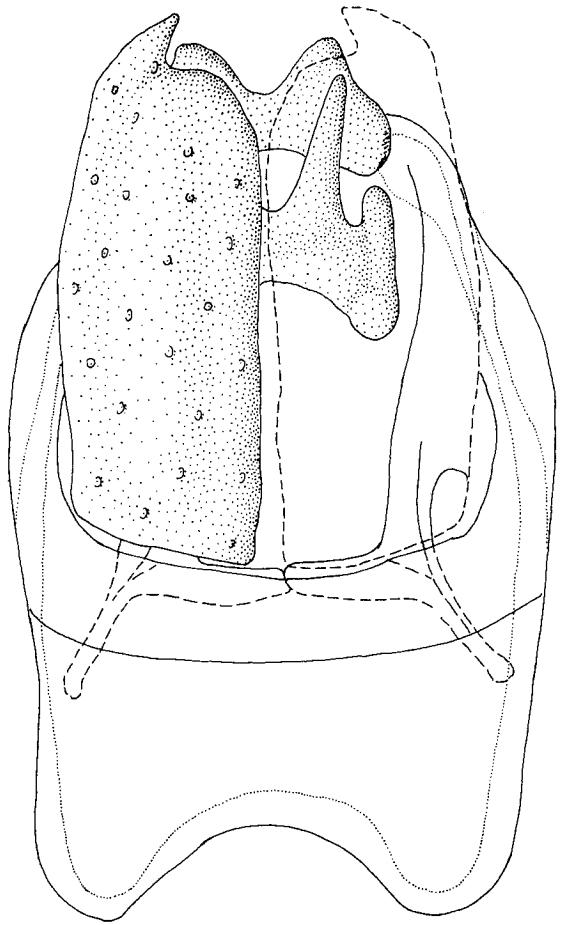


(68) aedeagus



(69) female

67–69 *S. kaimanua*

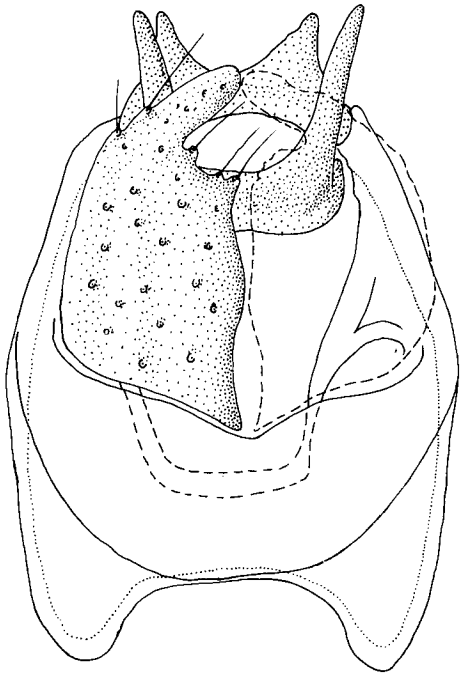


(70) male capsule

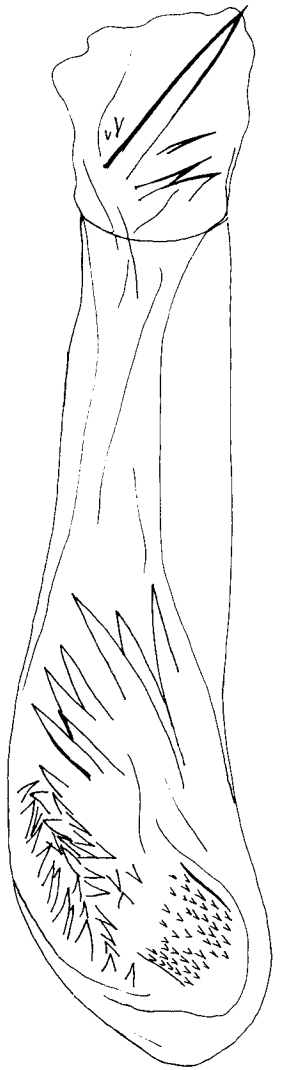
(71) aedeagus

(72) female

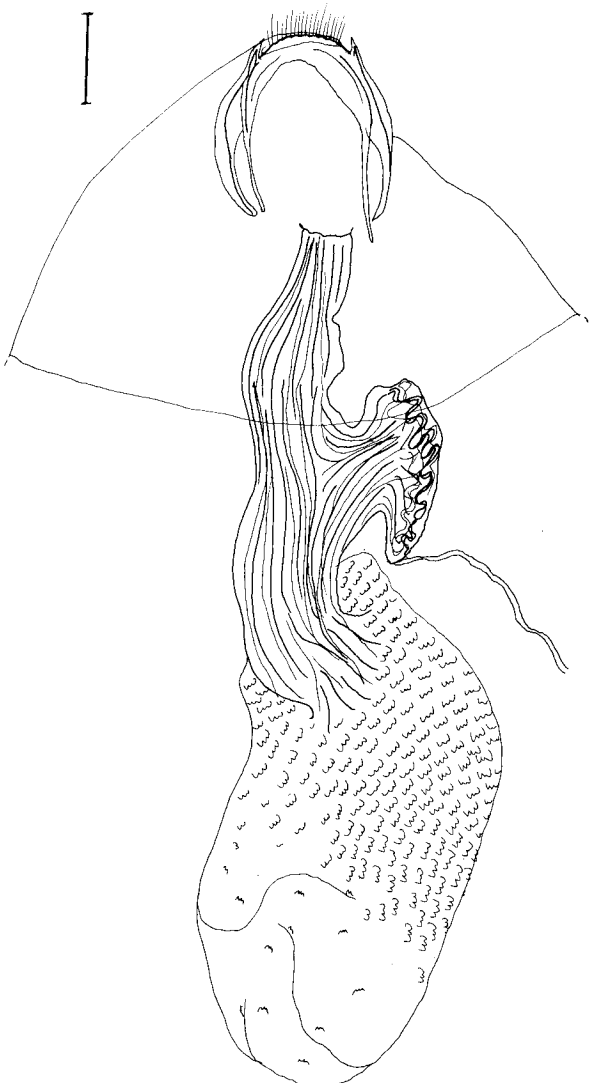
70–72 *S. laqueorum*



(73) male capsule

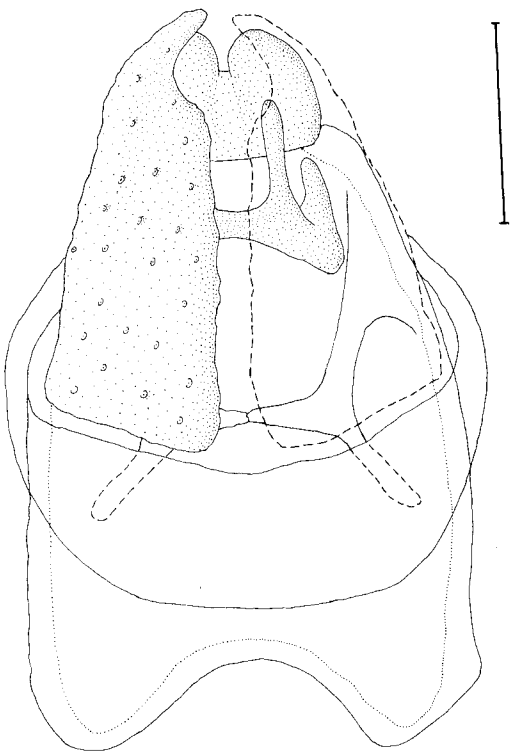


(74) aedeagus

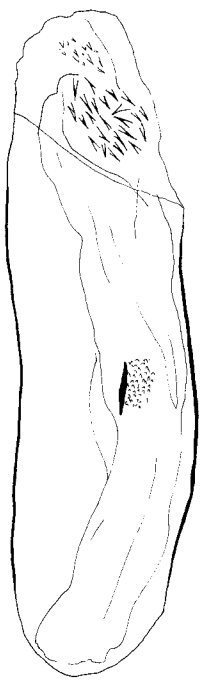


(75) female

73–75 *S. lucida*

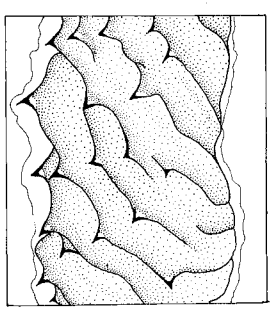


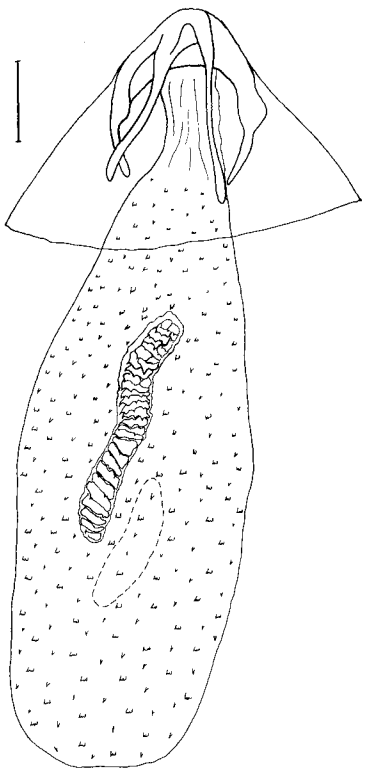
(76) male capsule



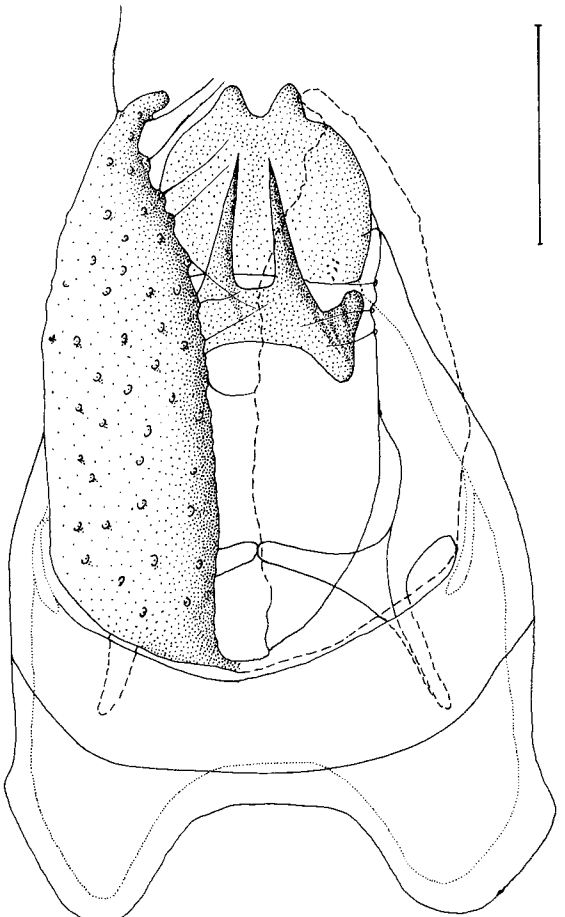
(77) aedeagus

76,77 *S. maoriella*

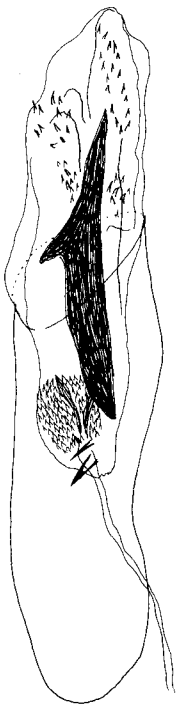




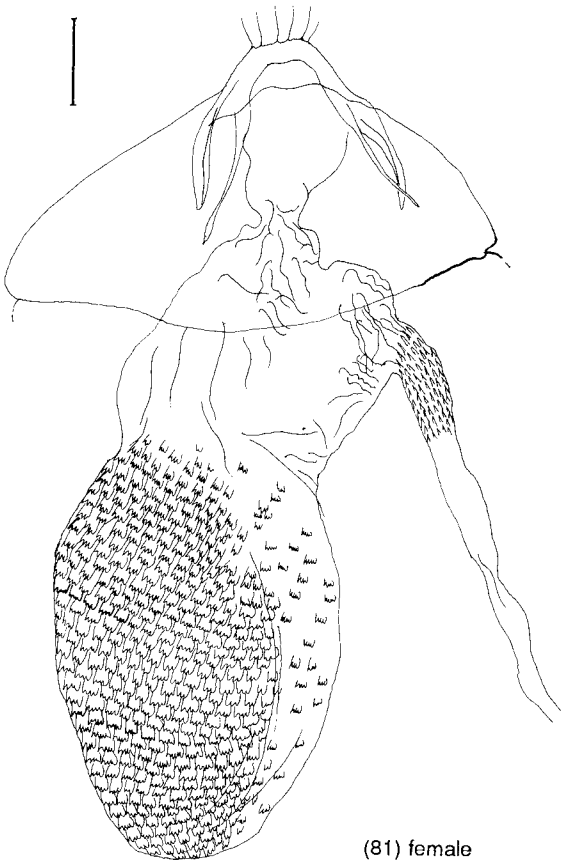
78 *S. microtheriella*, female



(79) male capsule

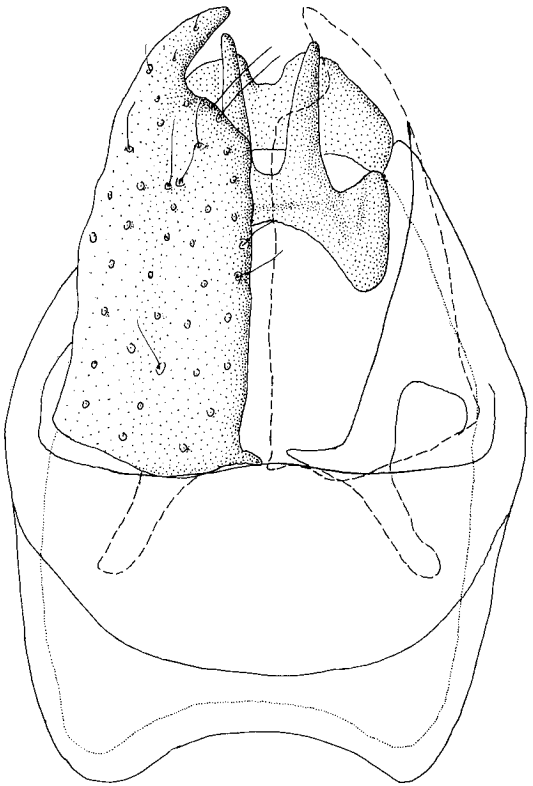


(80) aedeagus

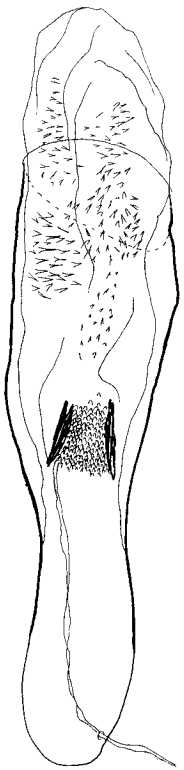


(81) female

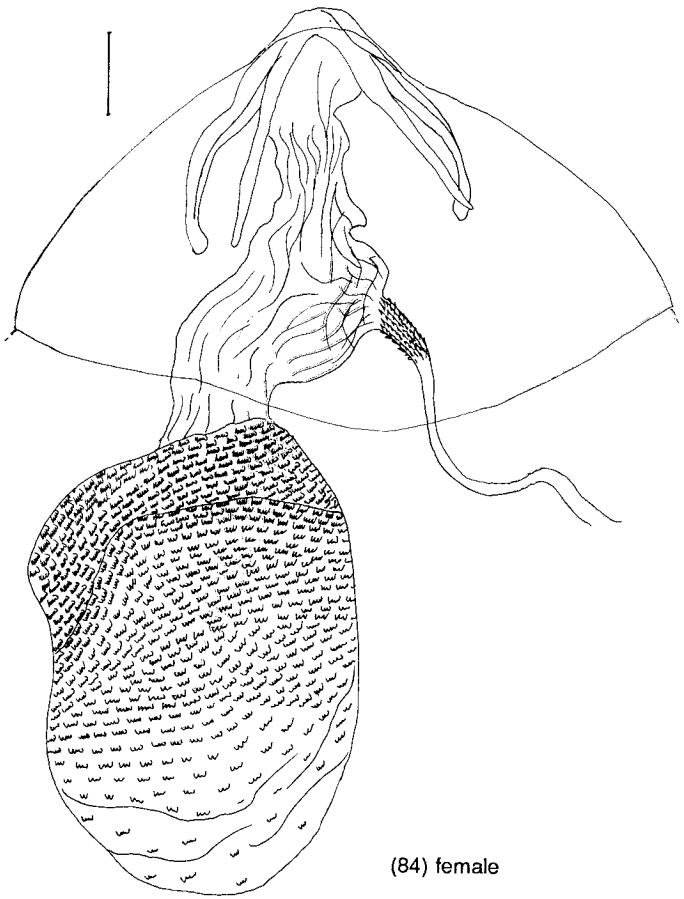
79–81 *S. ogygia*



(82) male capsule

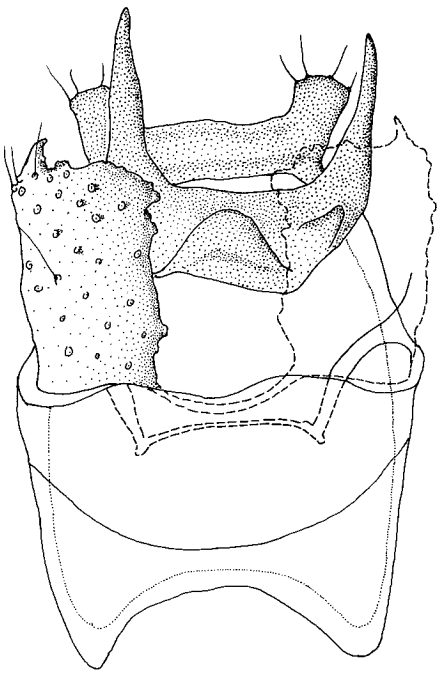


(83) aedeagus



(84) female

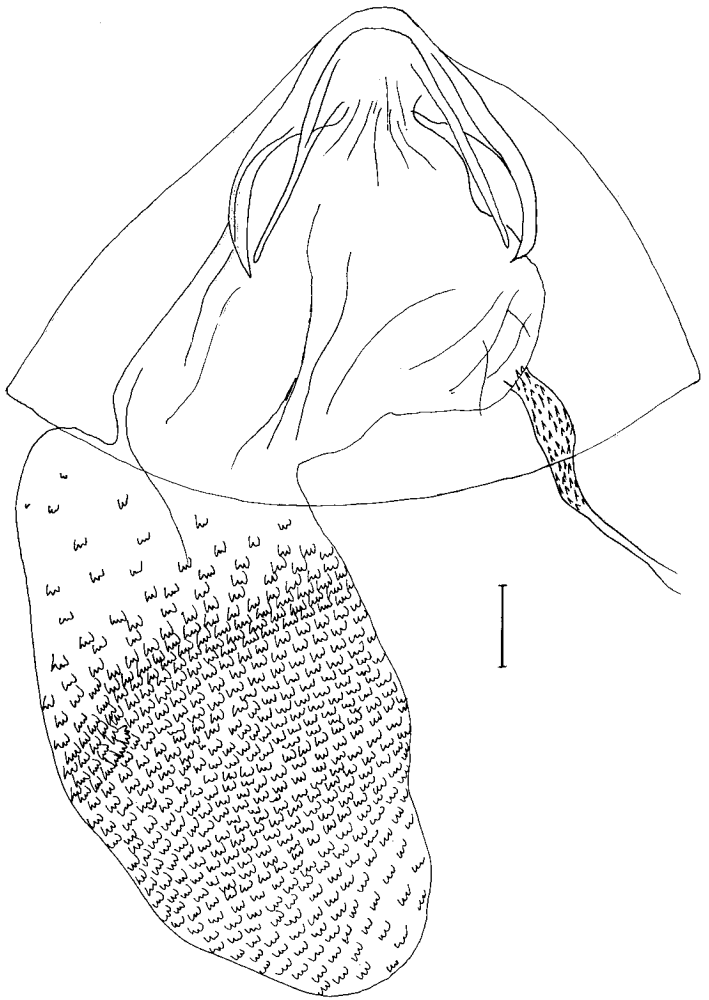
82–84 *S. oriastra*



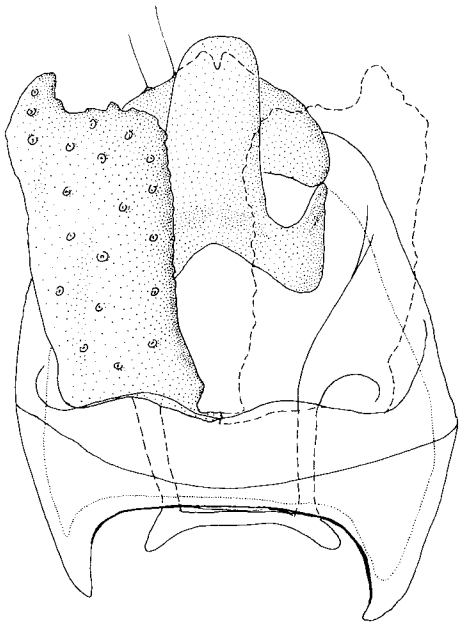
(85) male capsule

(86) aedeagus

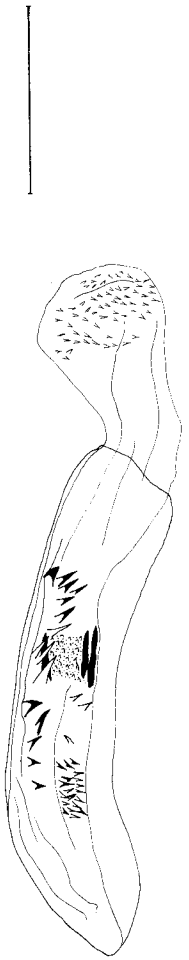
85, 86 *S. palaga*



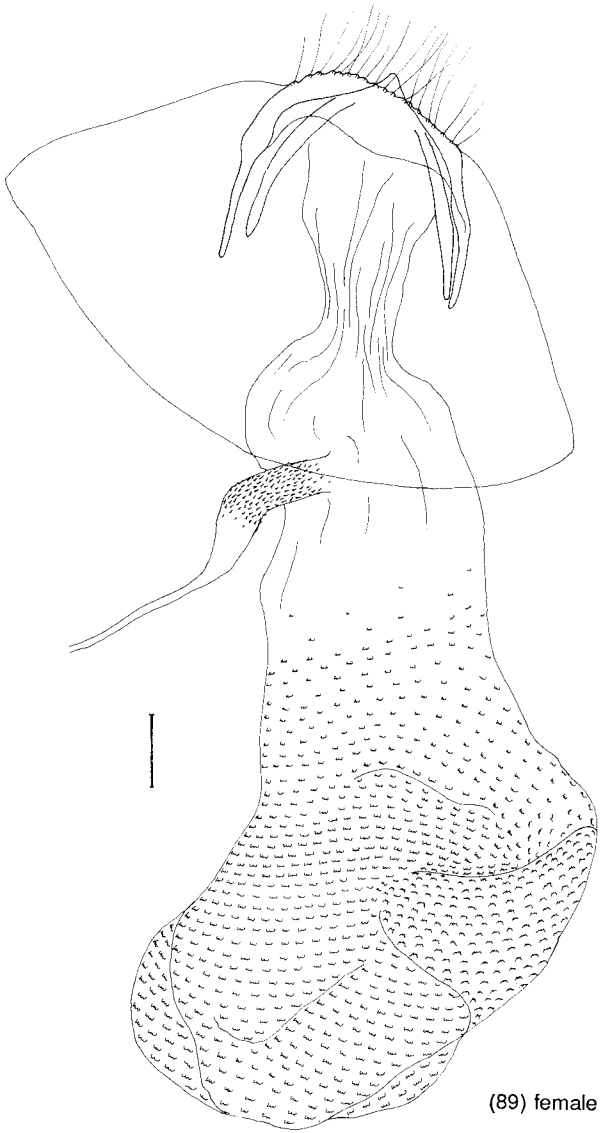
90 *S. progama*, female



(87) male capsule

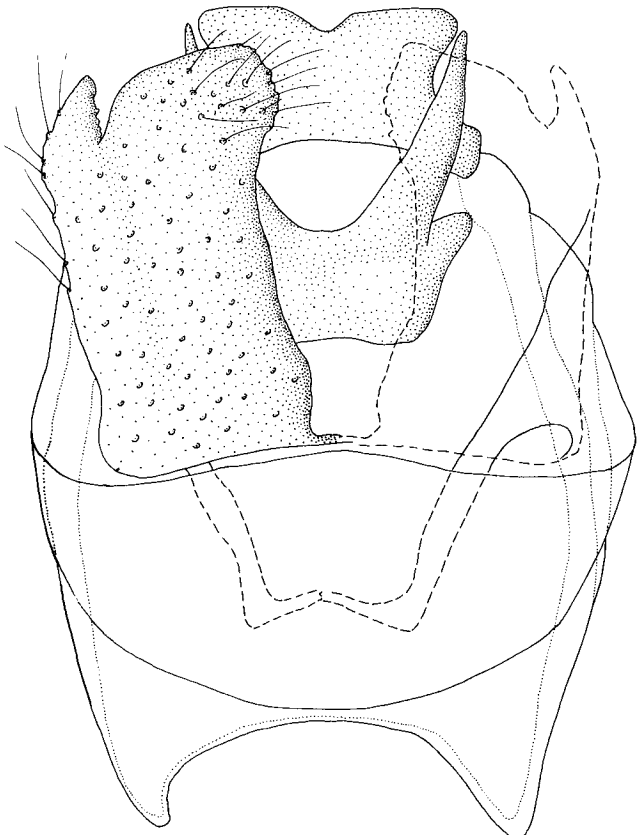


(88) aedeagus



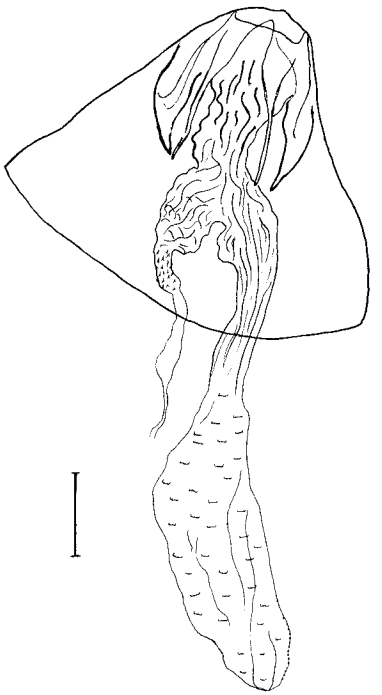
(89) female

87–89 *S. platina*



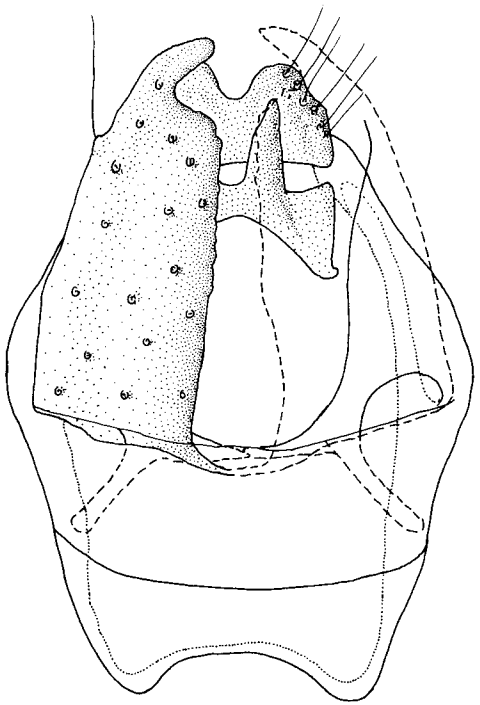
(91) male capsule

(92) aedeagus

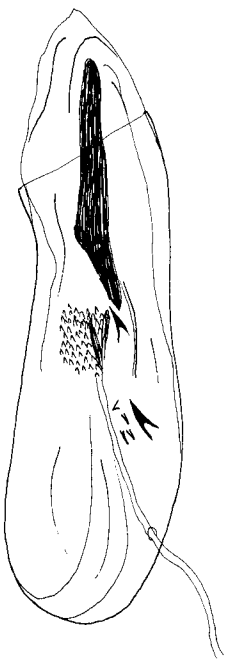


(93) female

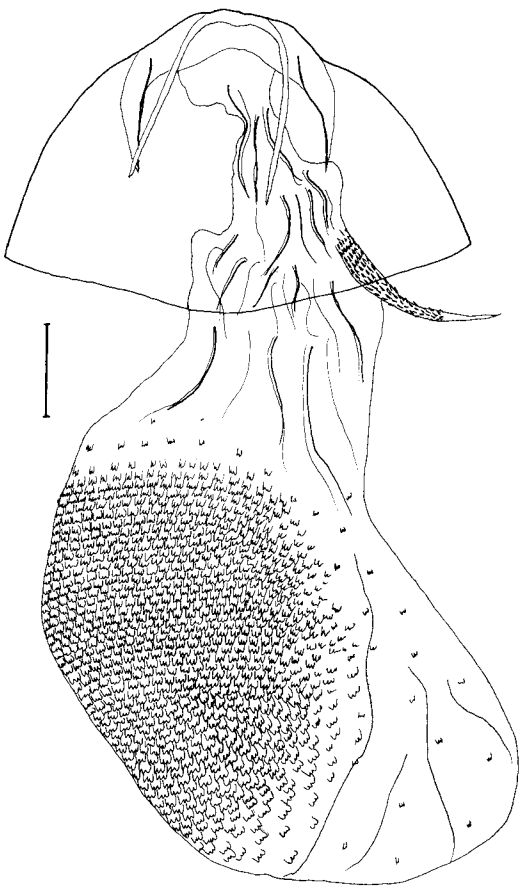
91–93 *S. progonopis*



(94) male capsule

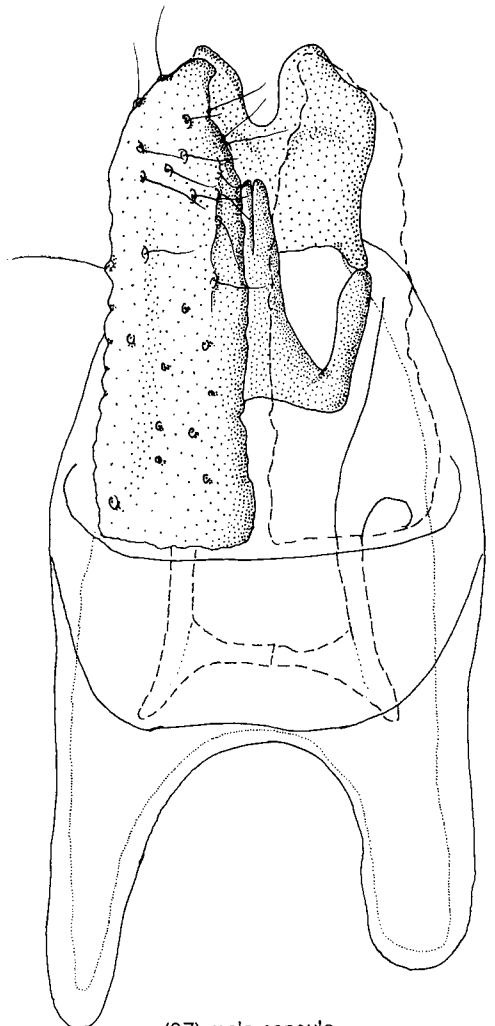


(95) aedeagus

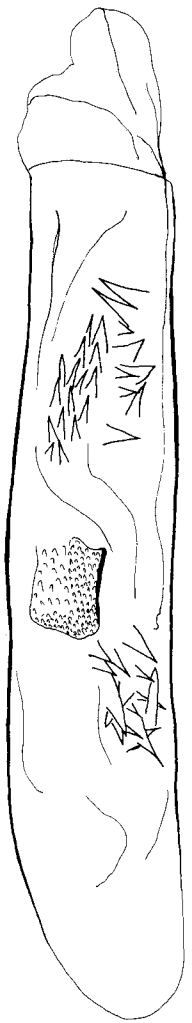


(96) female

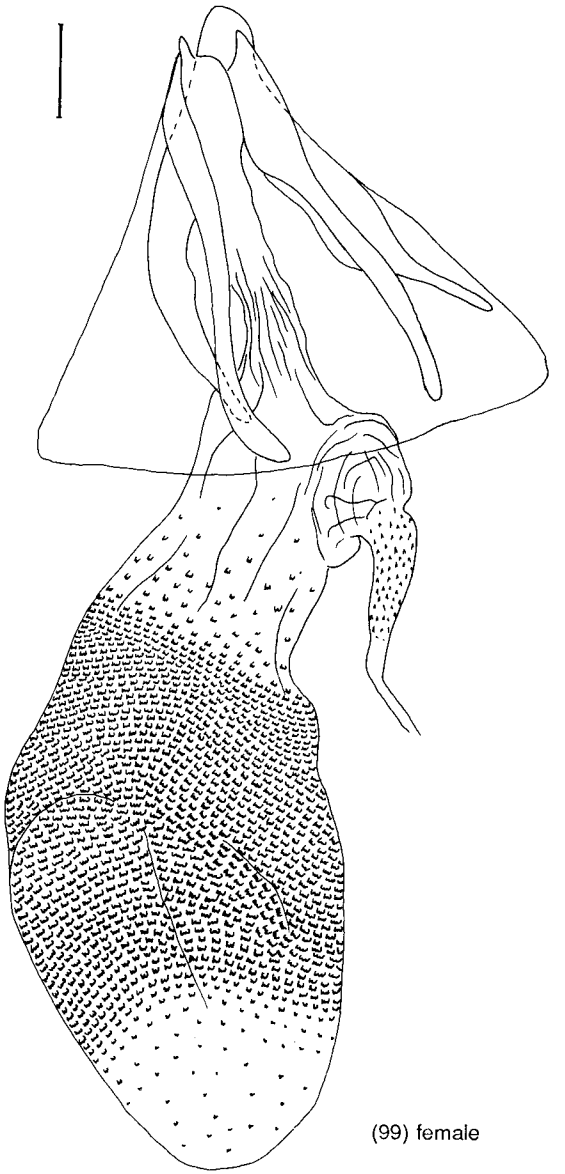
94–96 *S. sophorae*



(97) male capsule

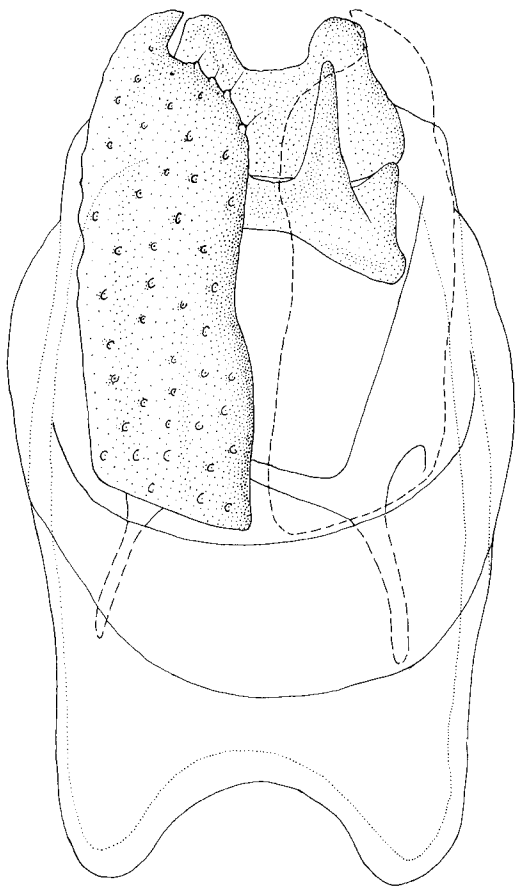


(98) aedeagus

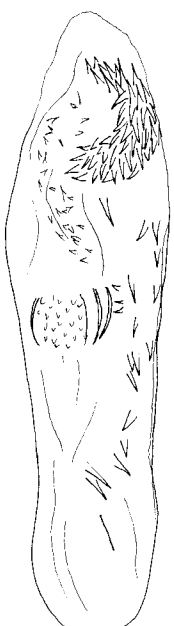


(99) female

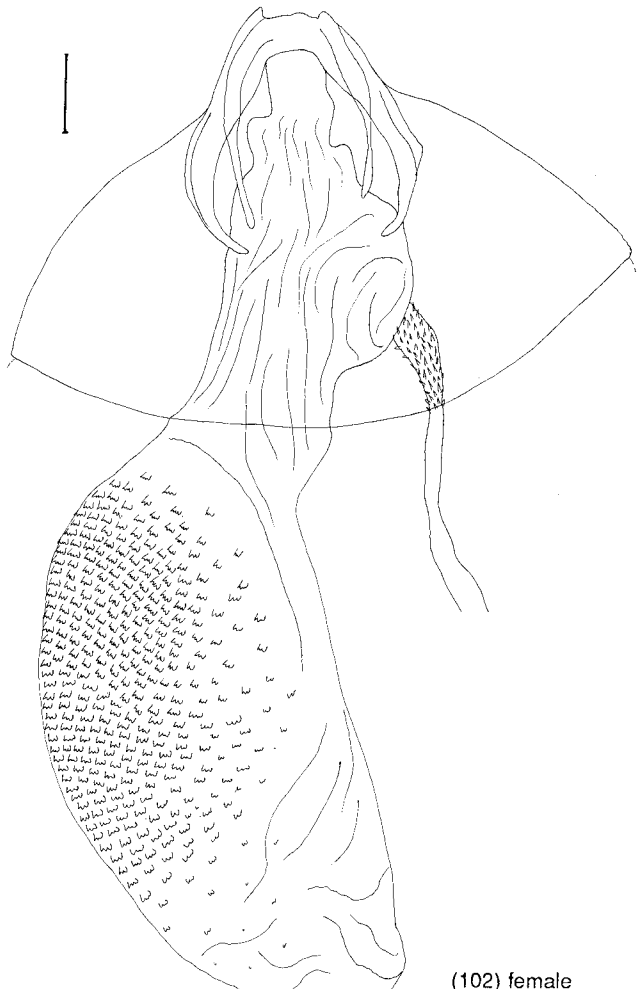
97–99 *S. tricentra*



(100) male capsule

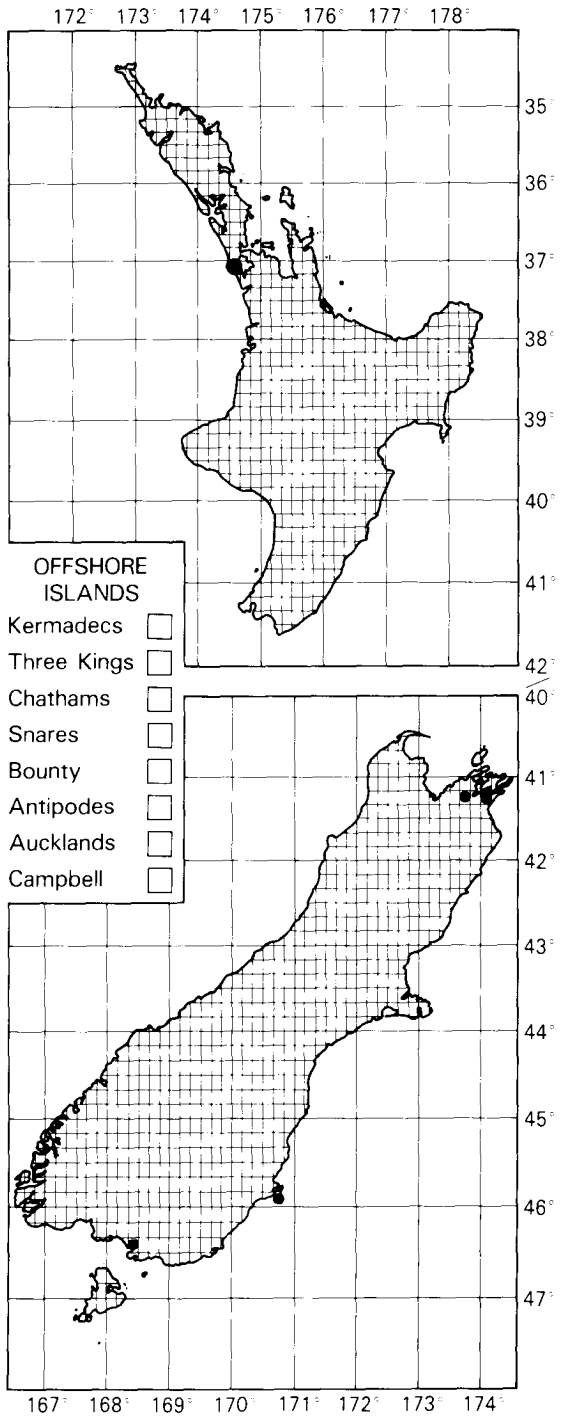


(101) aedeagus

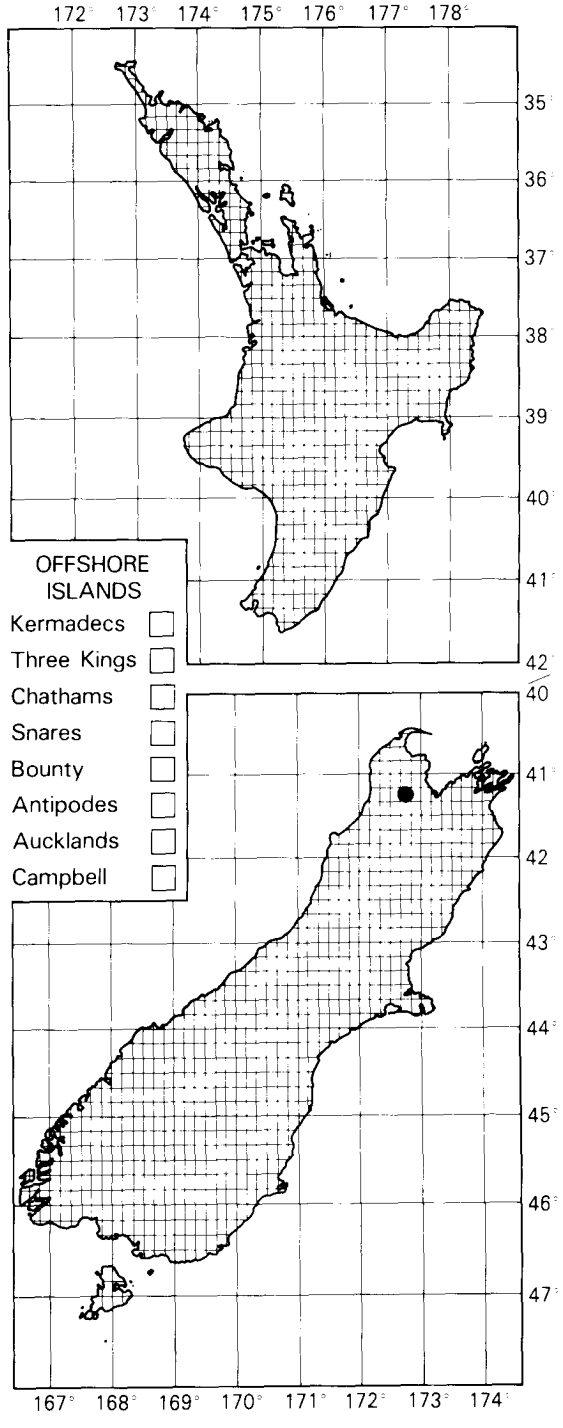


(102) female

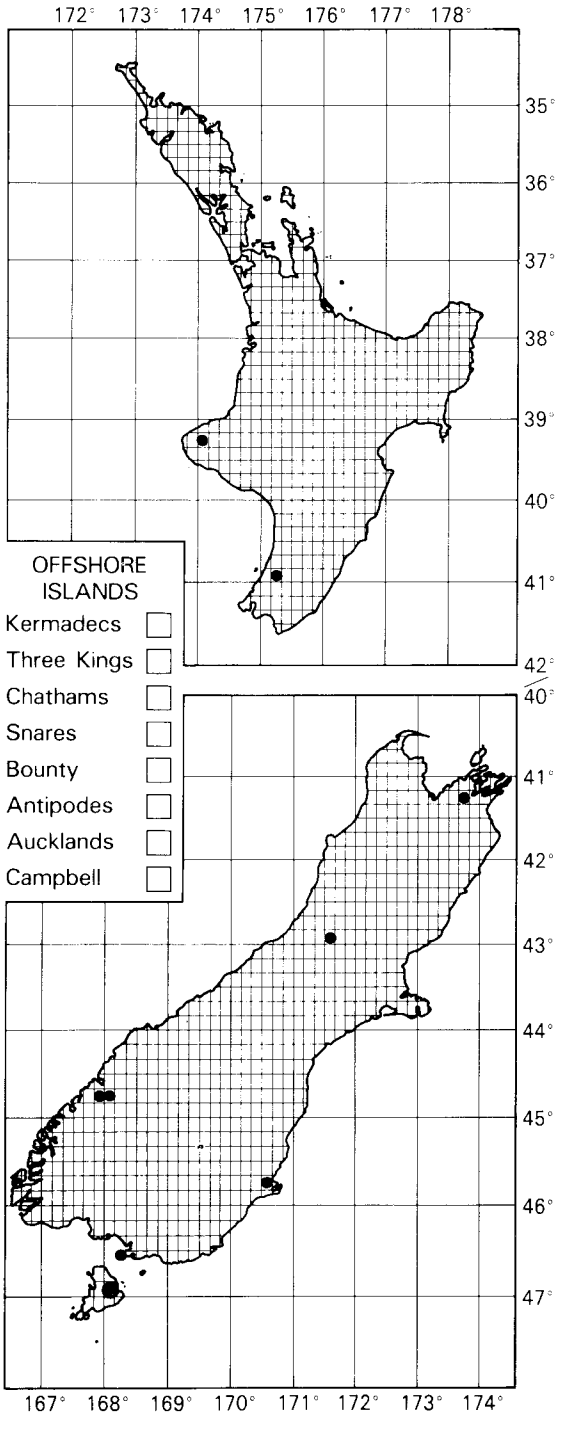
100–102 *S. watti*



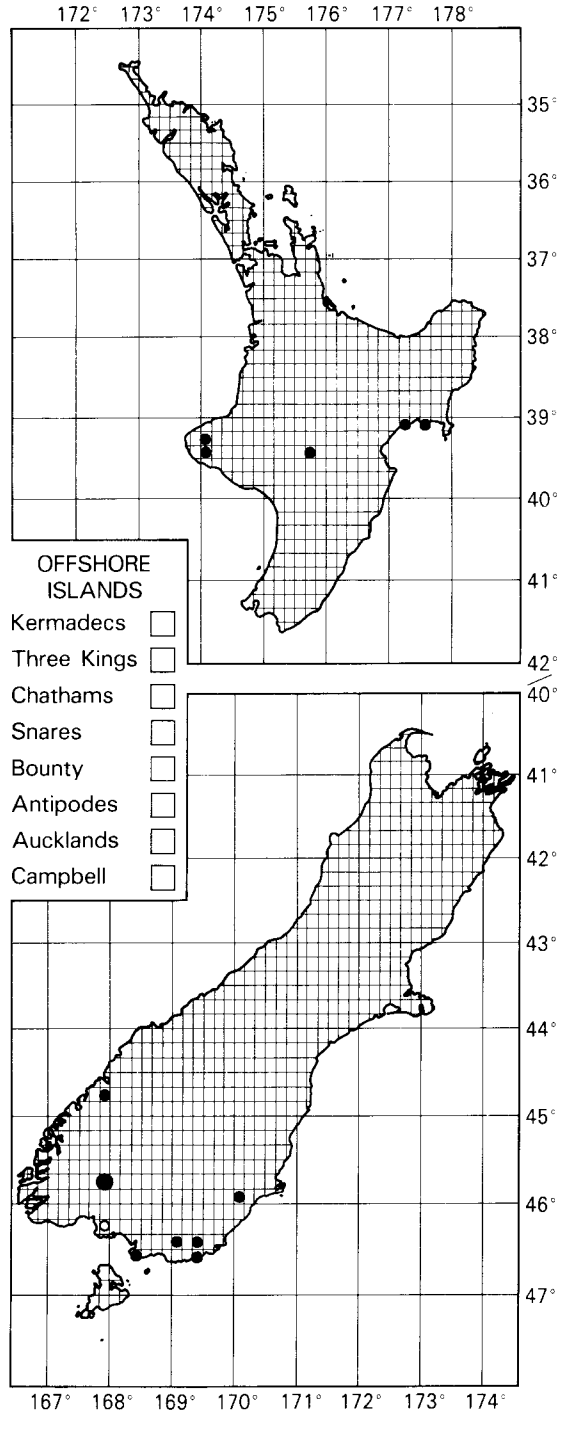
• **Map 1:** ***Stigmella aigialeia*** •



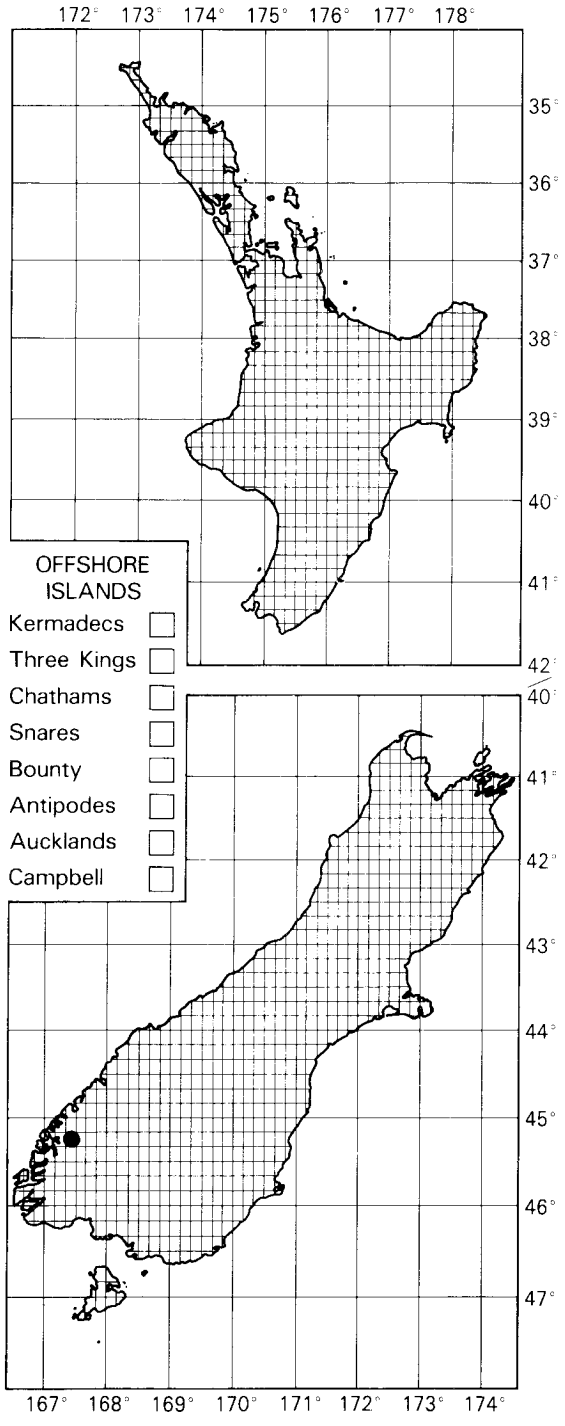
• **Map 2:** ***Stigmella aliena*** •



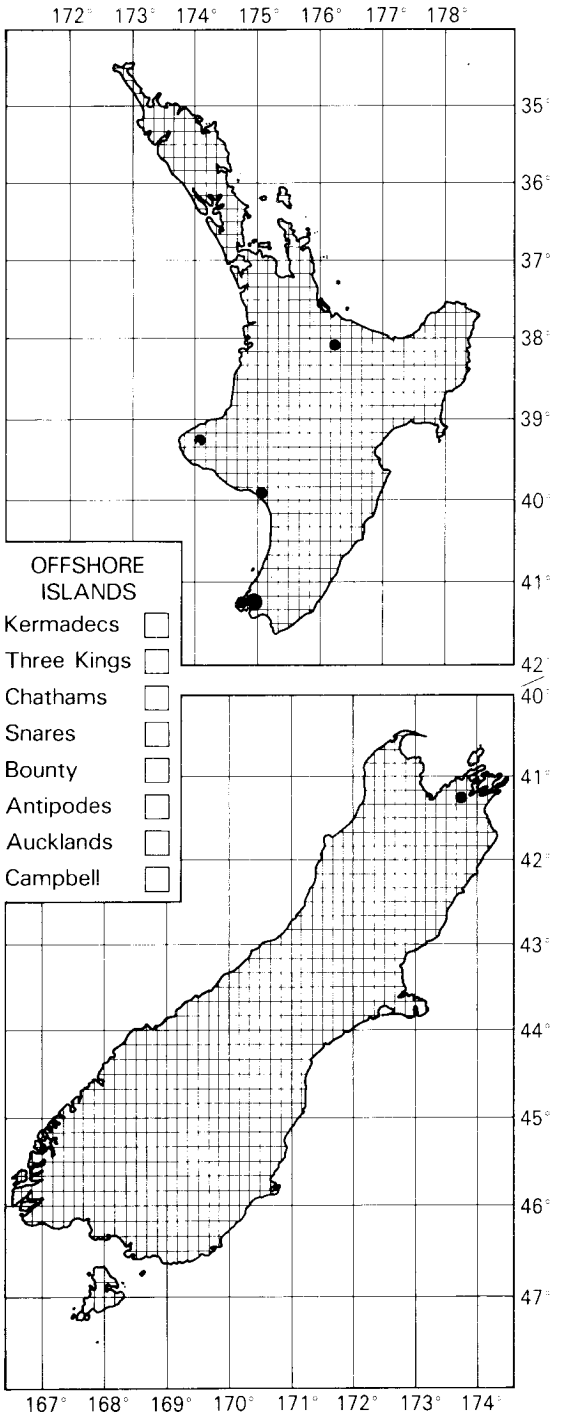
• **Map 3:** ***Stigmella atrata*** •



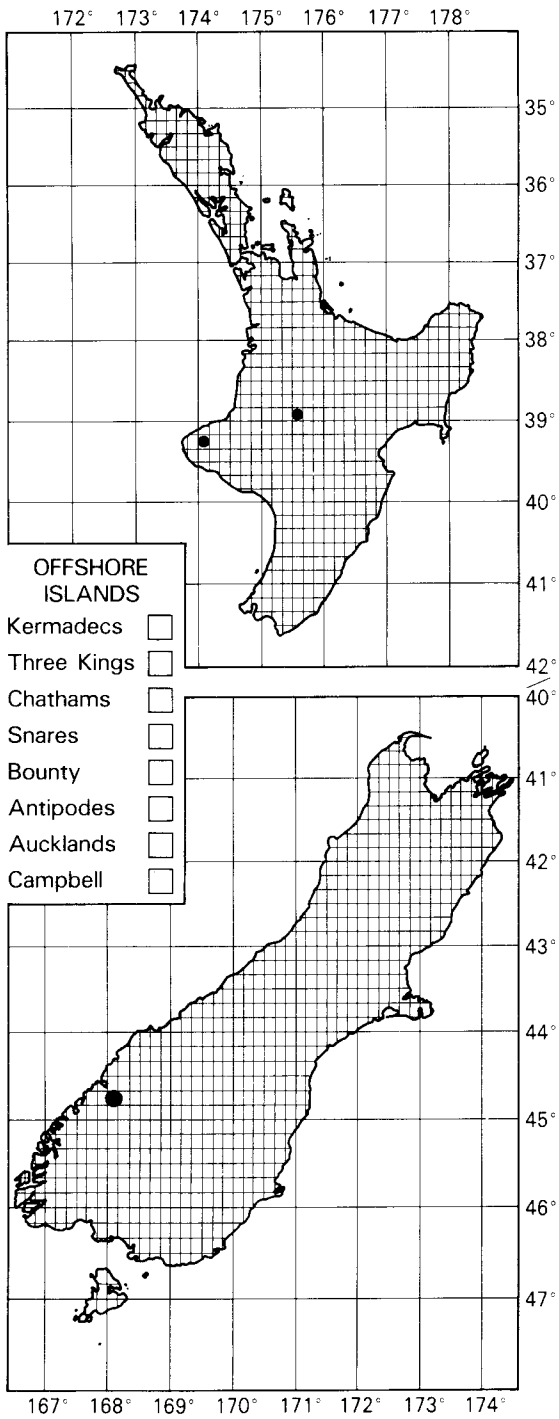
• **Map 4:** ***Stigmella cassiniae*** •



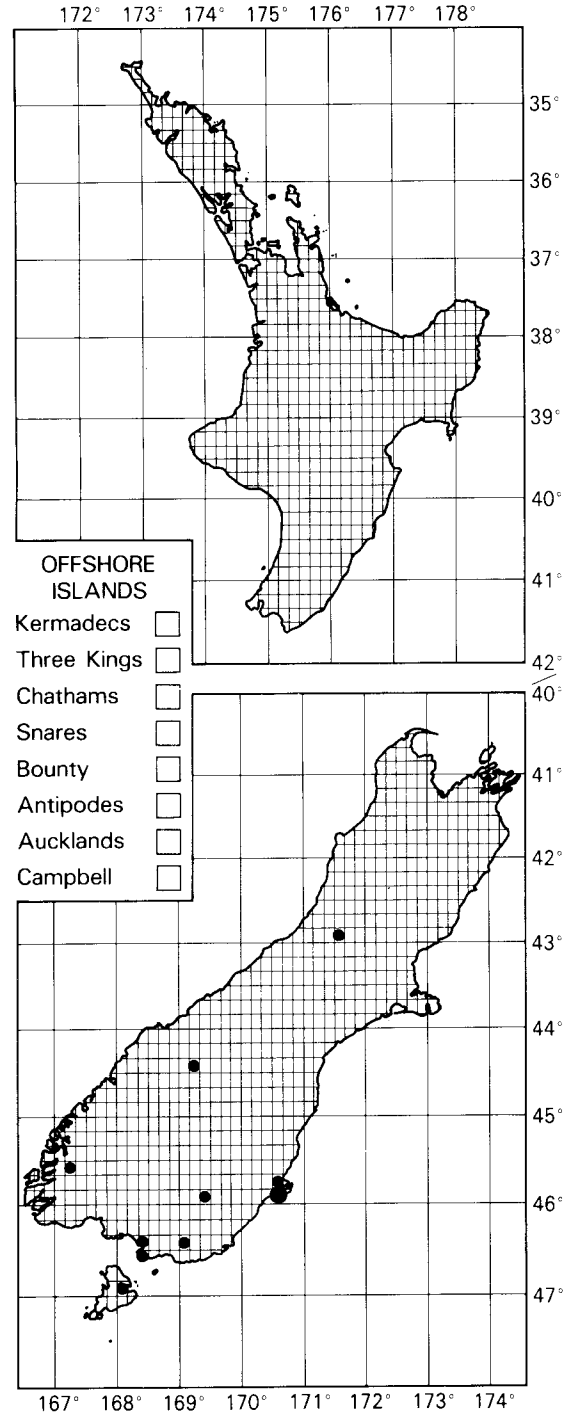
• **Map 5:** ***Stigmella childi*** •



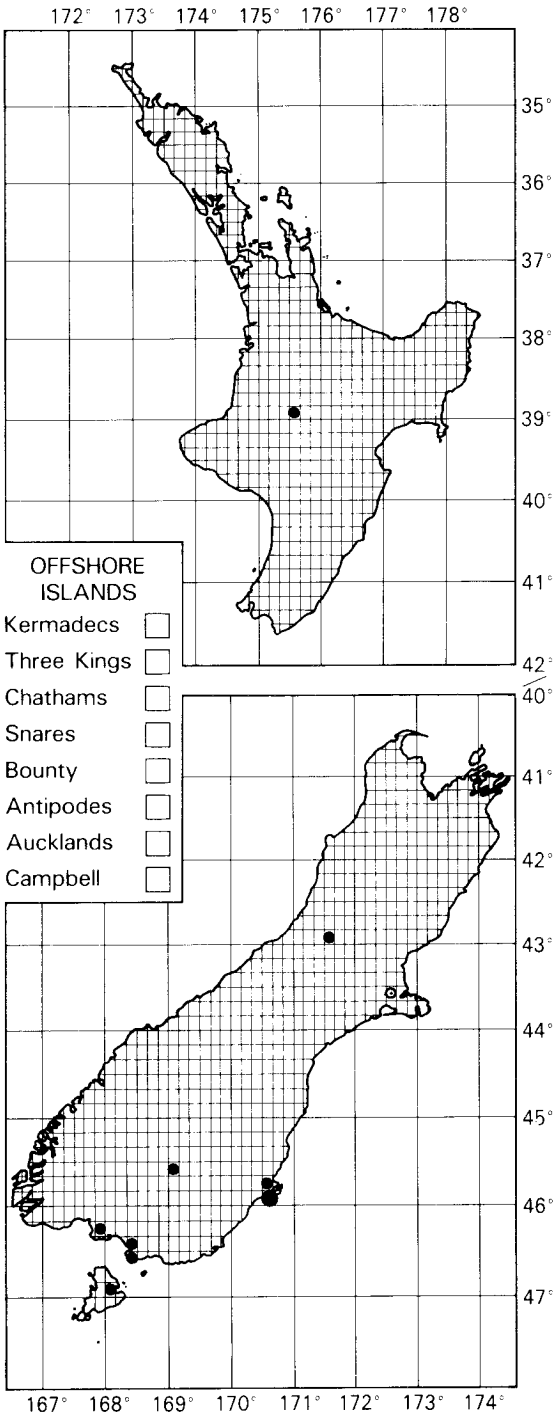
• **Map 6:** ***Stigmella cypracma*** •



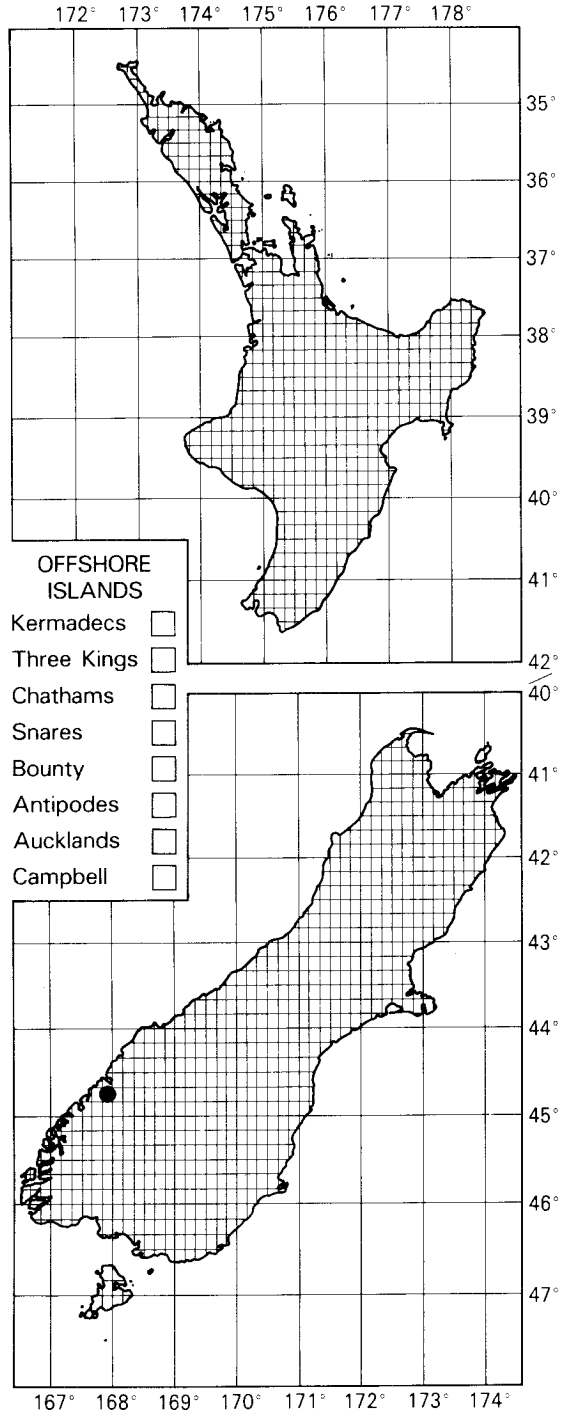
• **Map 7:** ***Stigmella erysibodea*** •



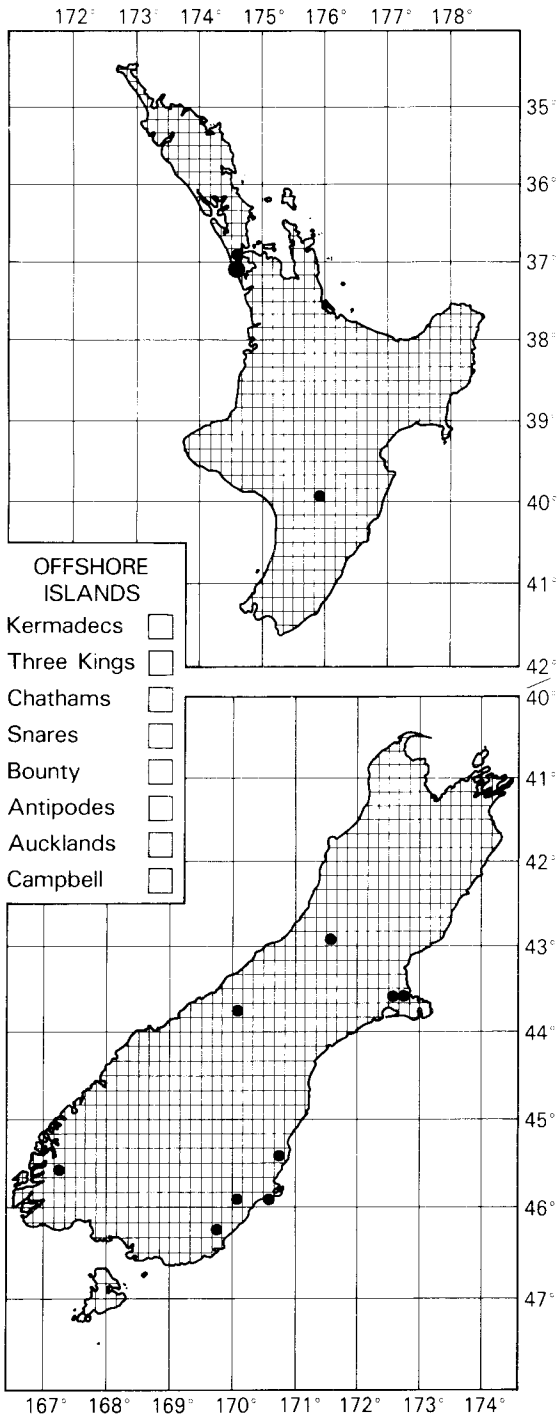
• **Map 8:** ***Stigmella fulva*** •



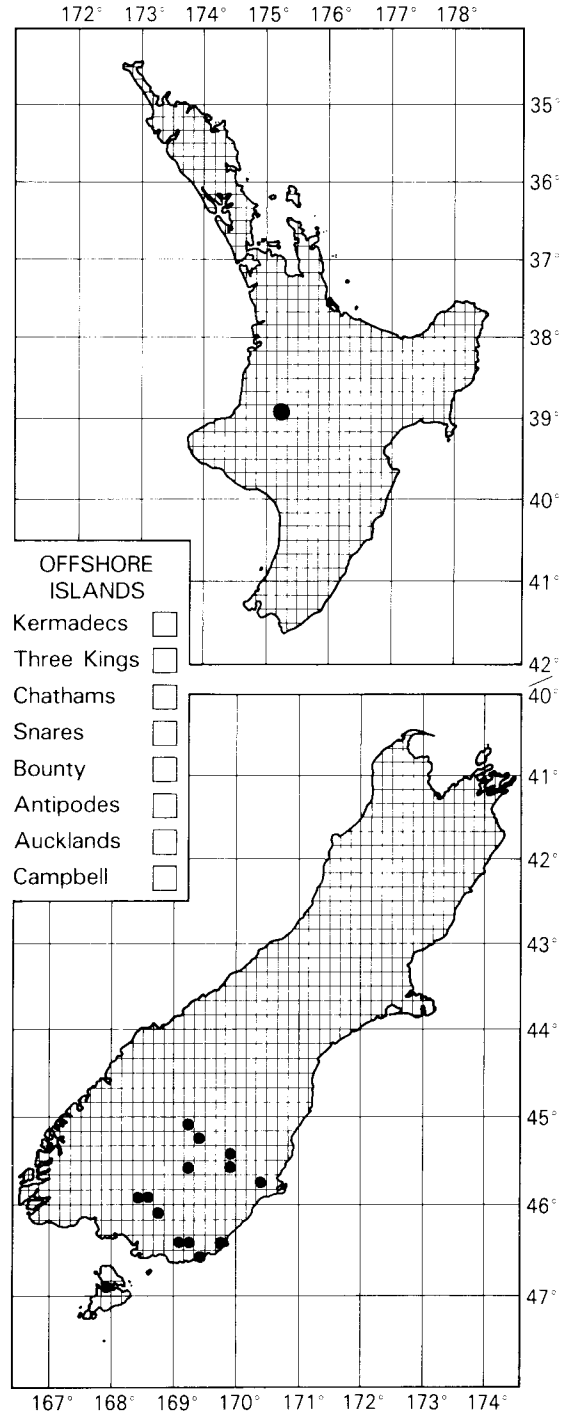
• **Map 9:** ***Stigmella hakekeae*** •



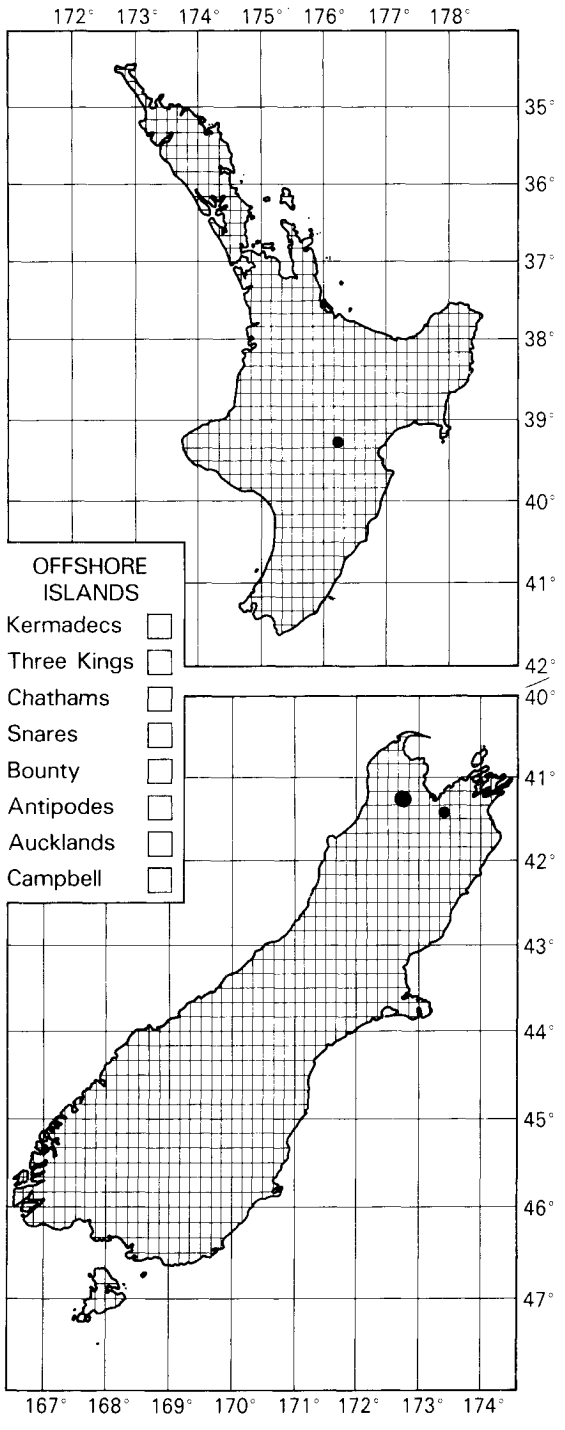
• **Map 10:** ***Stigmella hamishella*** •



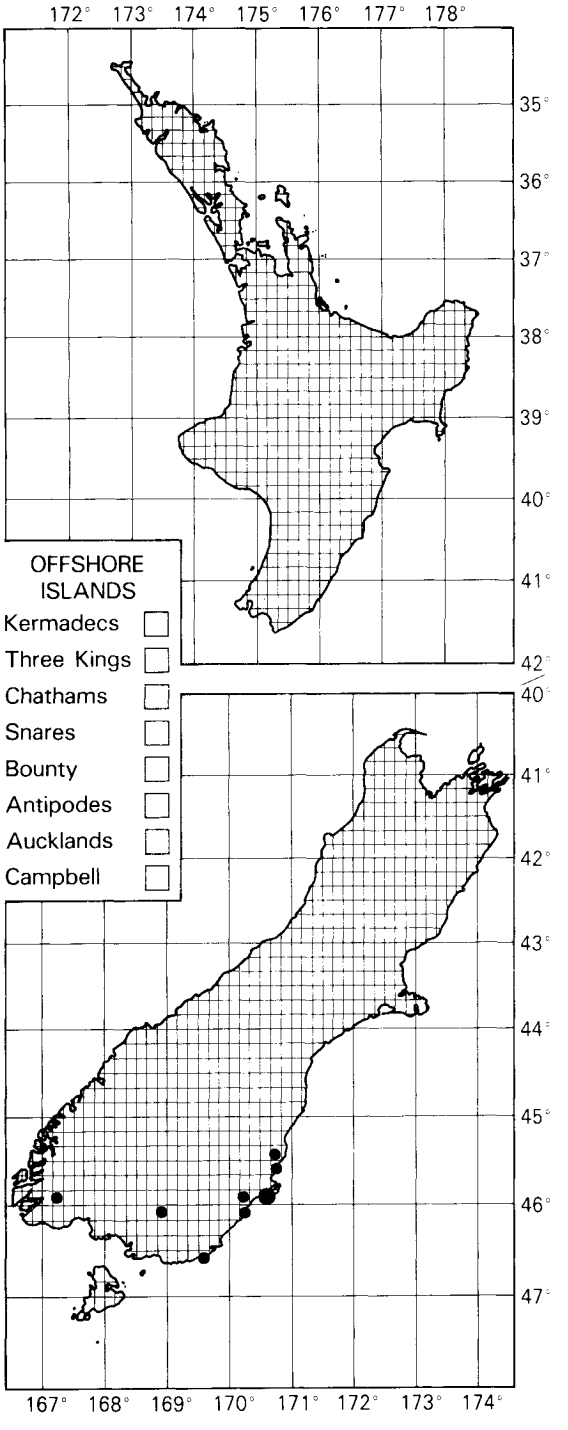
• **Map 11:** ***Stigmella hoheriae*** •



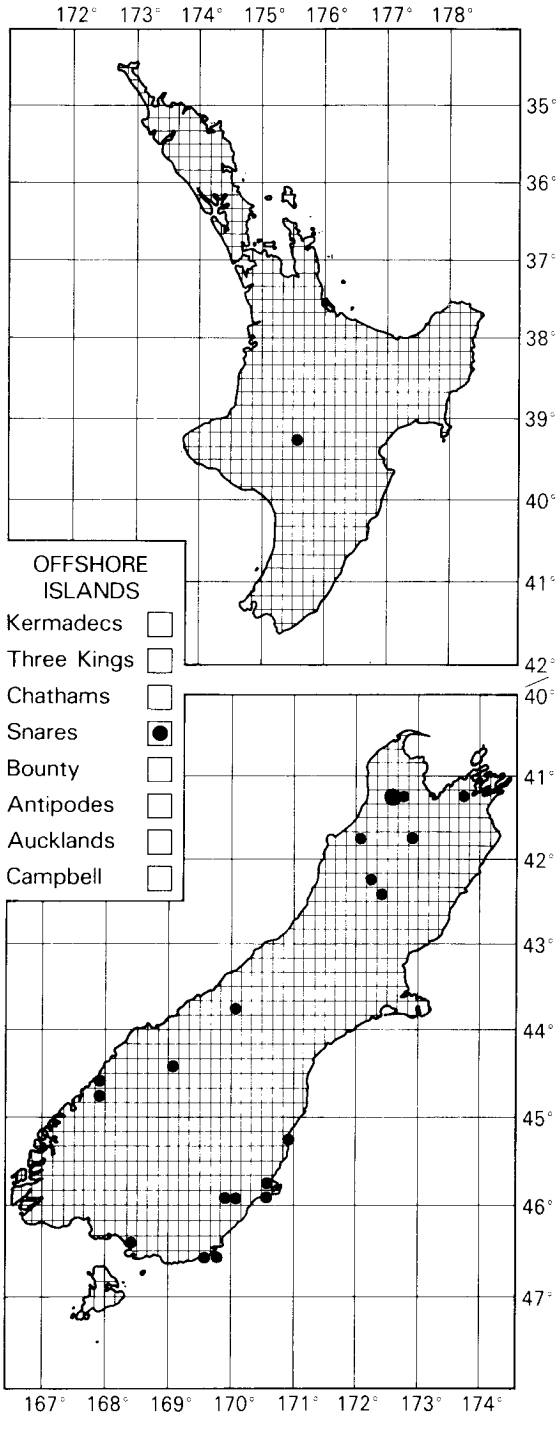
• **Map 12:** ***Stigmella ilsea*** •



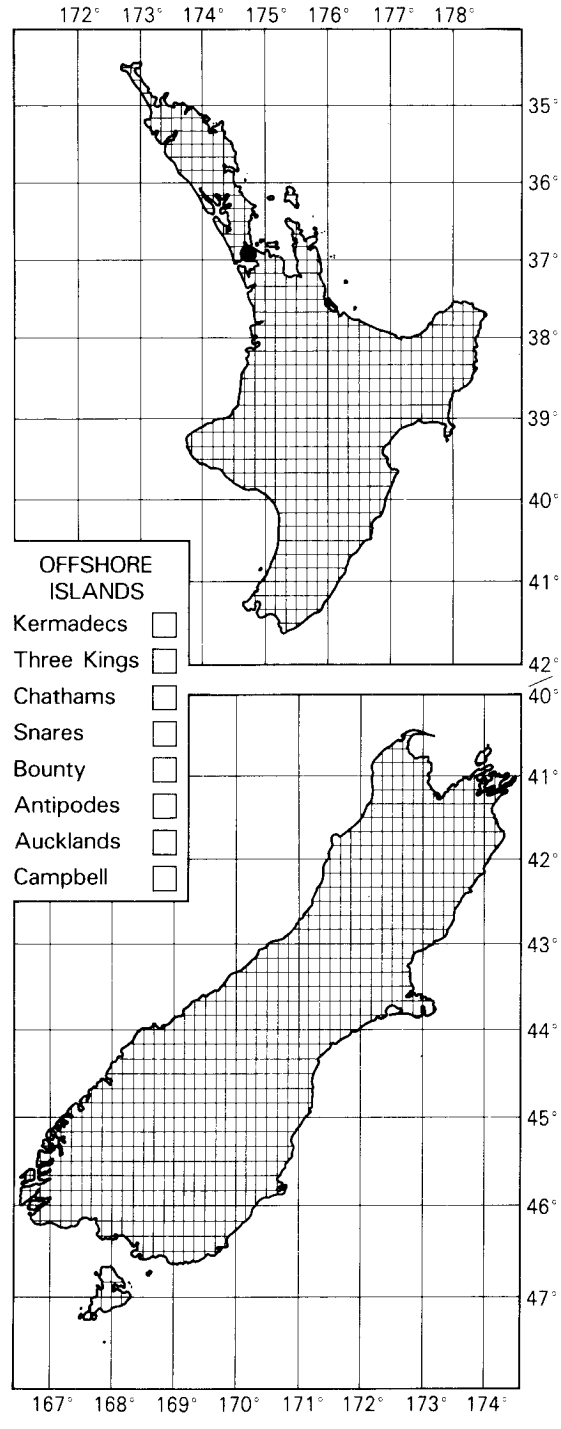
• **Map 13:** ***Stigmella insignis*** •



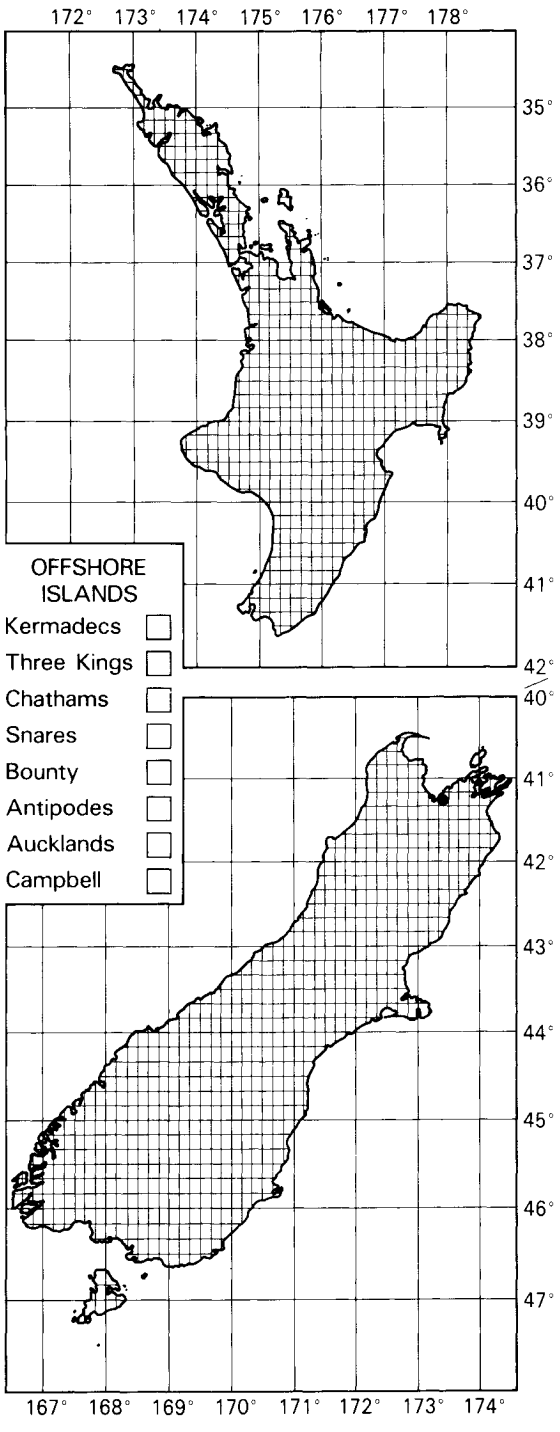
• **Map 14:** ***Stigmella kaimanua*** •



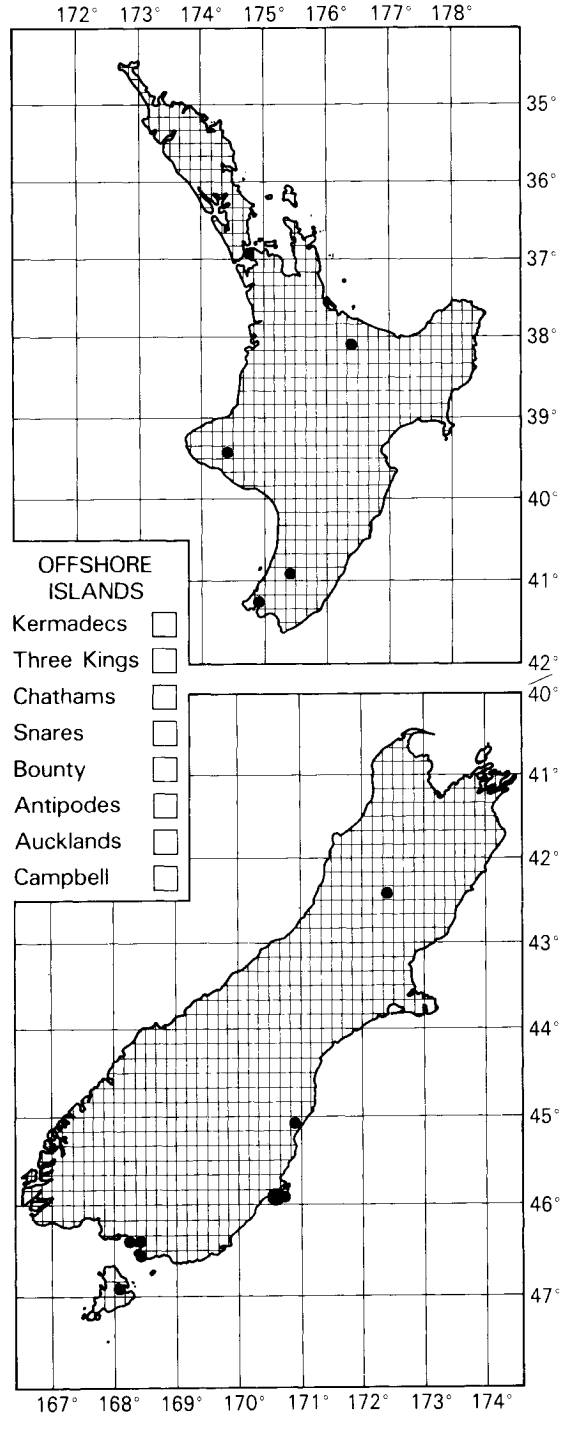
• **Map 15:** ***Stigmella laqueorum*** (Snares), ***S. lucida*** •



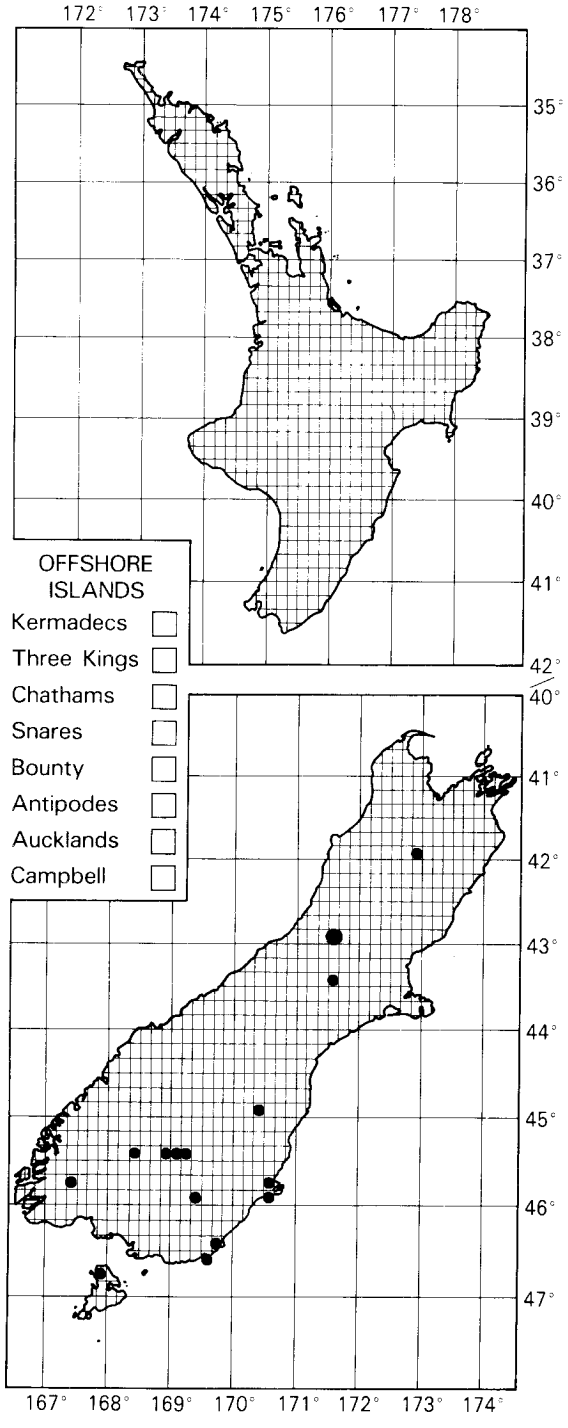
• **Map 16:** ***Stigmella maoriella*** •



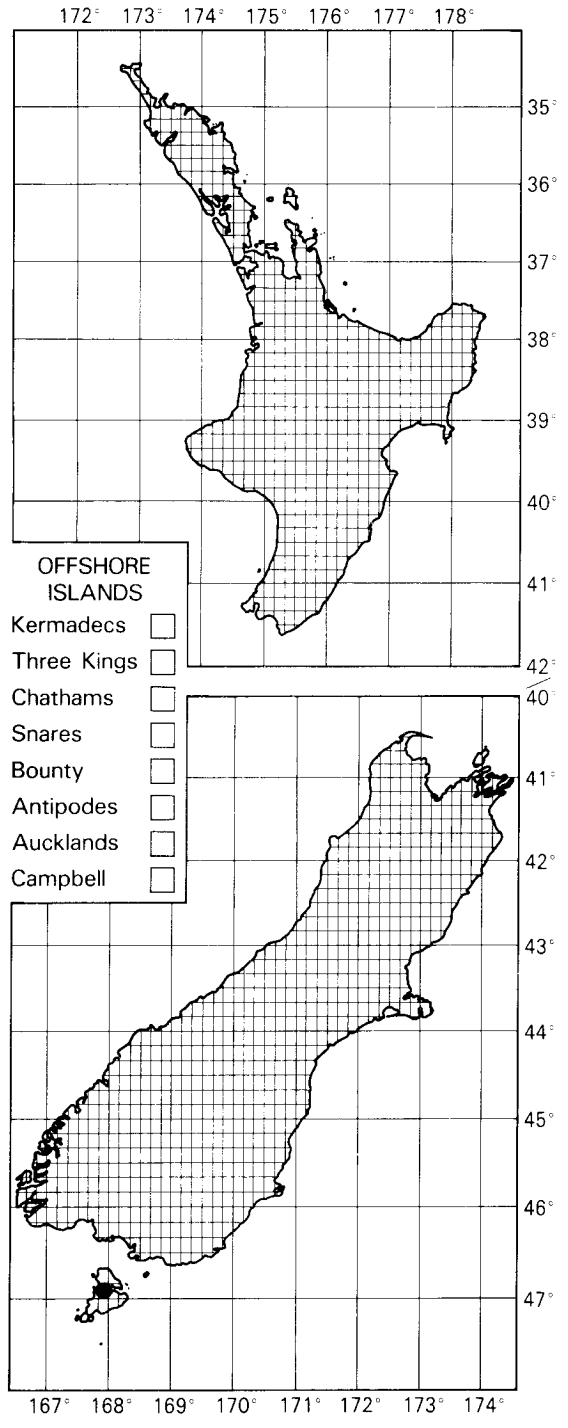
• **Map 17:** ***Stigmella microtheriella*** •



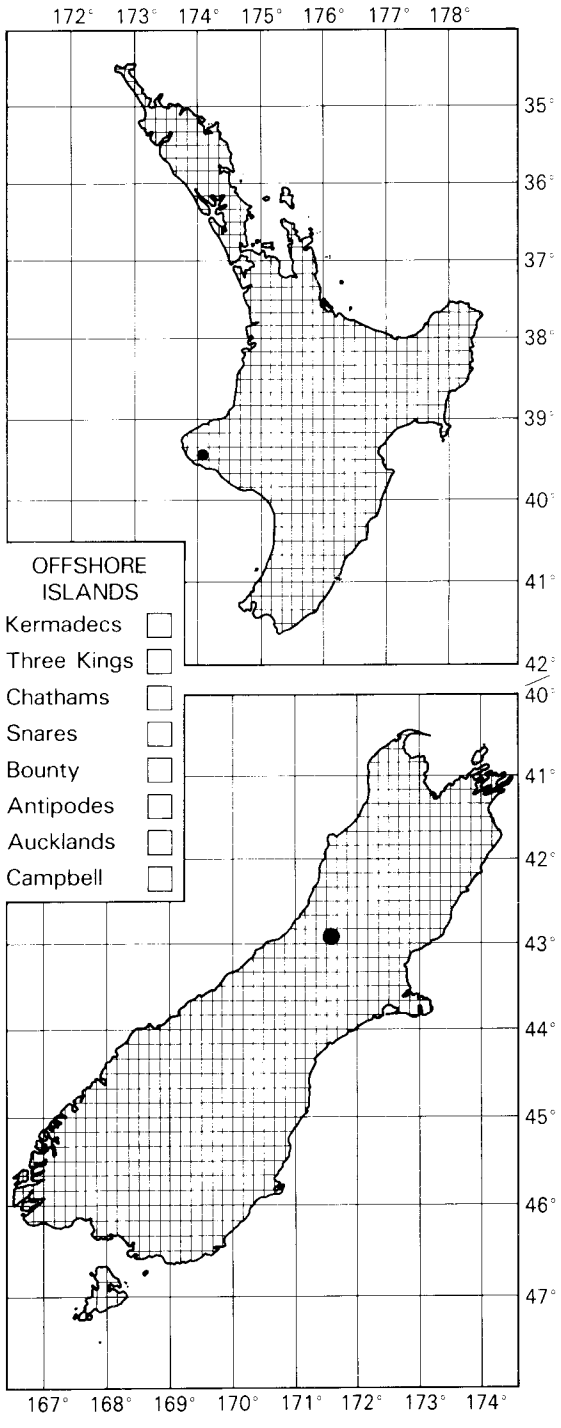
• **Map 18:** ***Stigmella ogygia*** •



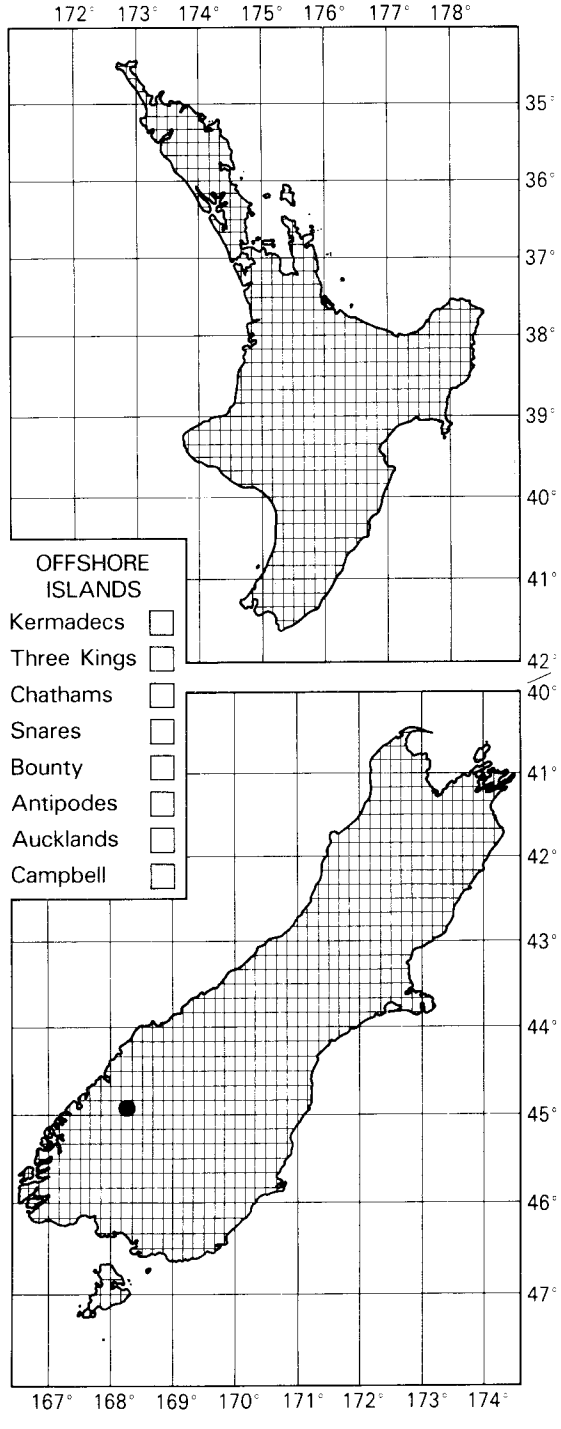
• **Map 19:** ***Stigmella oriastra*** •



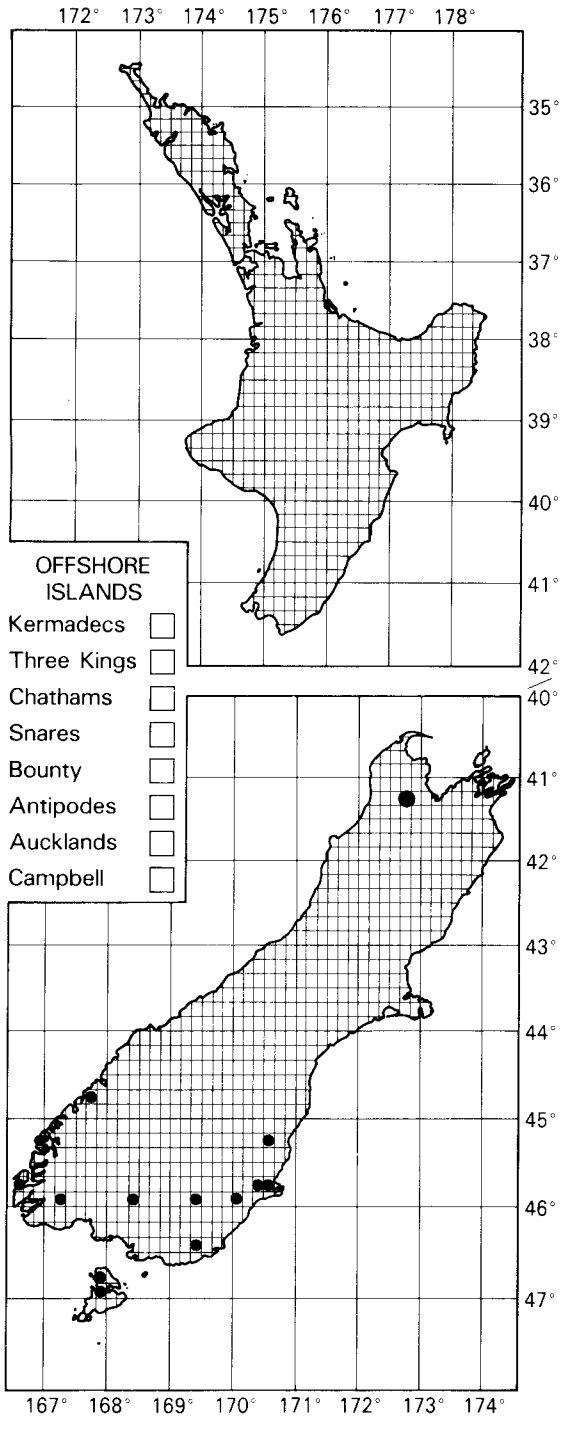
• **Map 20:** ***Stigmella palaga*** •



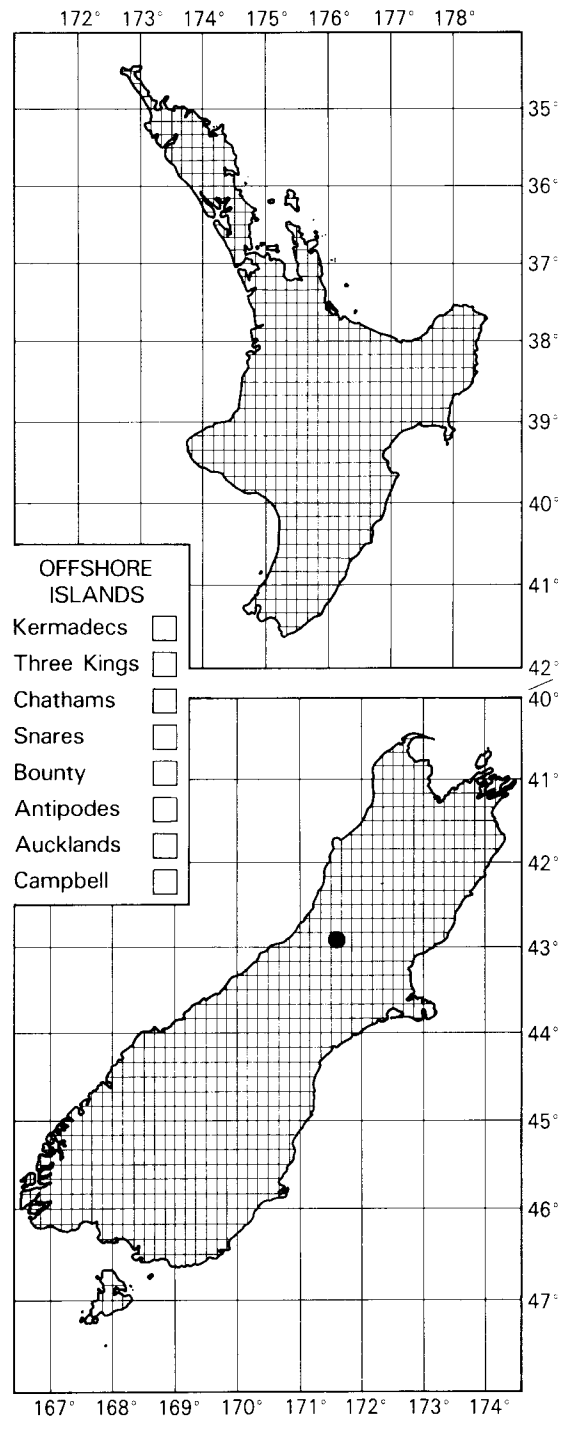
• **Map 21:** ***Stigmella platina*** •



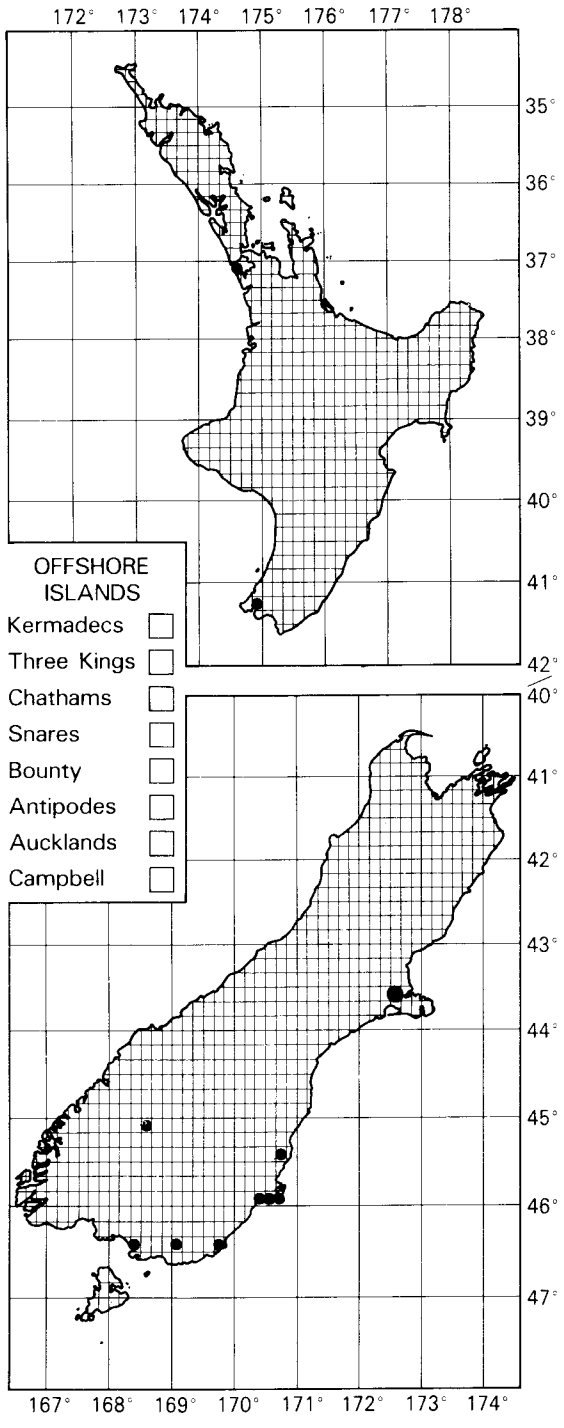
• **Map 22:** ***Stigmella progama*** •



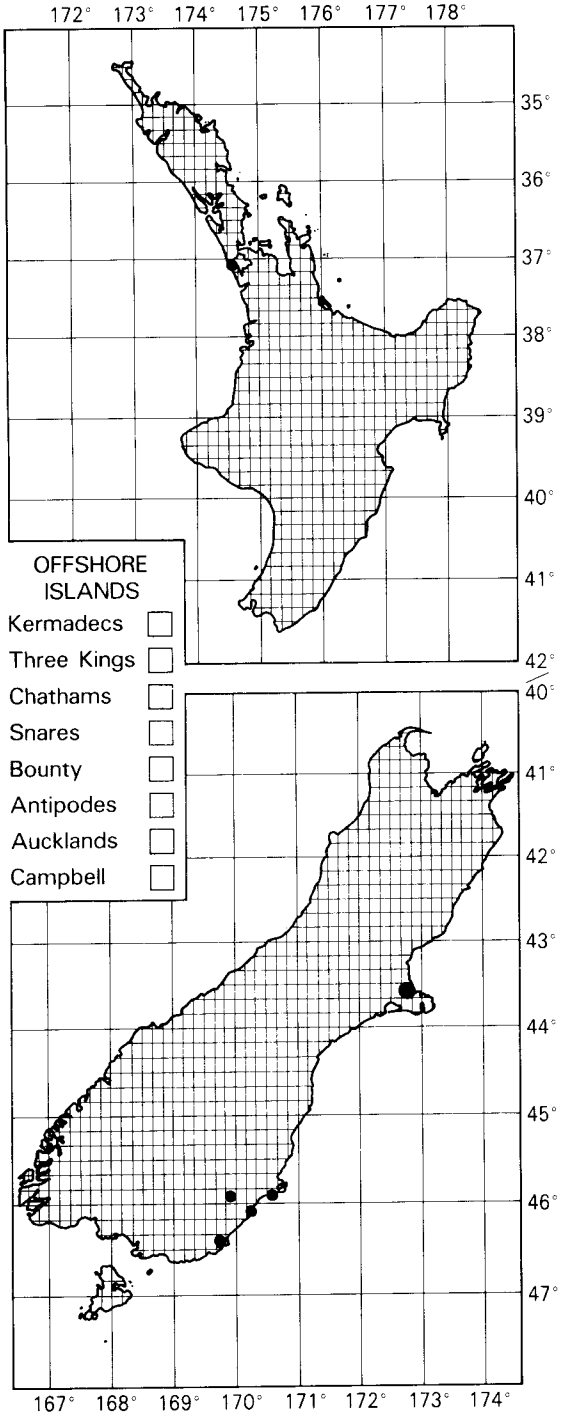
• **Map 23:** ***Stigmella progonopis*** •



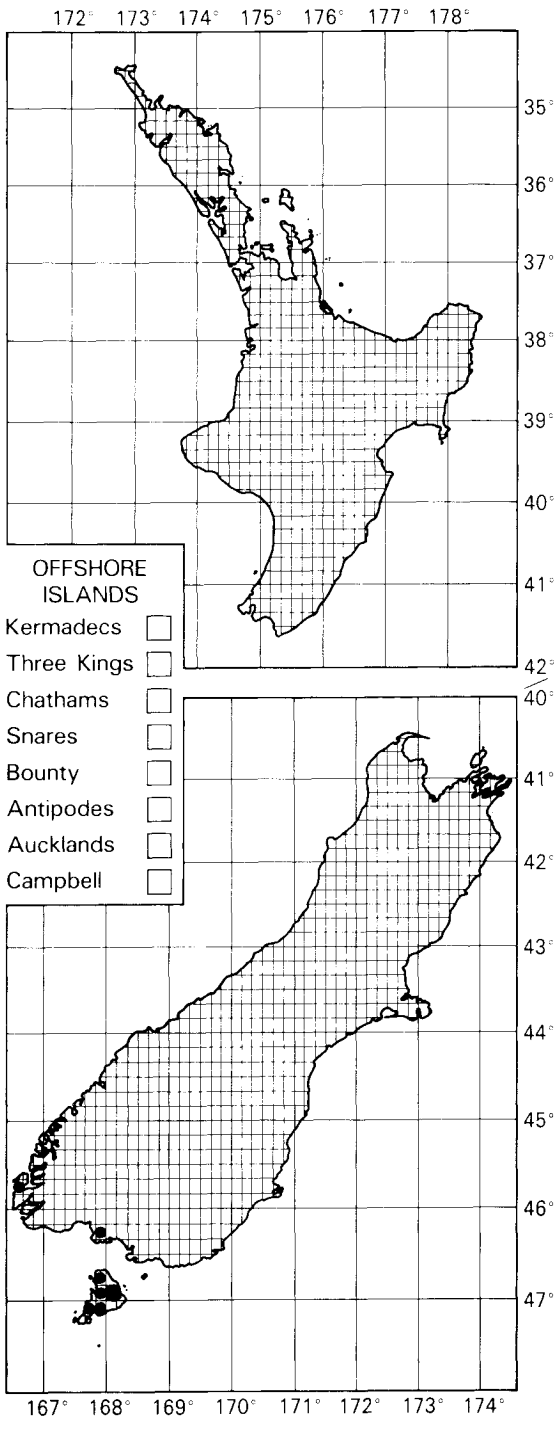
• **Map 24:** ***Stigmella propalaea*** •



• **Map 25:** ***Stigmella sophorae*** •



• **Map 26:** ***Stigmella tricentra*** •

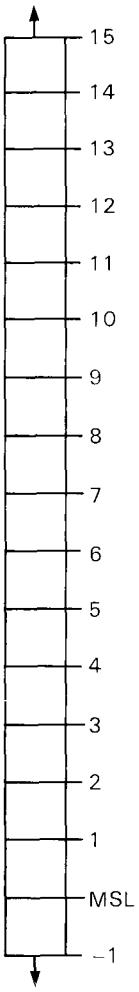


• **Map 27: *Stigmella watti*** •

TAXONOMIC INDEX

Since most of the names indexed are species of the one genus *Stigmella* (or its precursor *Nepticula*), only exceptions are named in full. Page numbers in bold type indicate the start of descriptions; italic type denotes pages on which illustrations occur. Key to suffixes: d, distribution map; g, genitalia; k, key; m, leaf mine.

TAXON :



ALTITUDINAL DISTRIBUTION

(MSL, mean sea level) The range of altitude for each scale division may be set according to need, but should be in metric units.

OFFSHORE ISLANDS

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

This base-map is used in the *Fauna of N.Z.* for recording the distribution of collection localities. The small grid divisions are 10 minutes of arc by latitude and longitude.

DISTRIBUTION IN TIME

Suggested subdivisions: (A, adult; E, egg; J, juvenile; L,larva; P, pupa)

or

Fauna of New Zealand

Number 16

Nepticulidae
(Insecta: Lepidoptera)

Hans Donner &
Christopher Wilkinson

Fauna of New Zealand

This series of refereed occasional publications has been established with two major objectives: to encourage those with expert knowledge of elements in the New Zealand fauna to publish concise yet comprehensive accounts; and to provide a means of identification accessible to the non-specialist. It will deal with non-marine invertebrates only, since the vertebrates are well documented, and marine forms are covered by the series 'Marine Fauna of New Zealand'.

Contributors should discuss their intentions with an appropriate member of the Fauna Advisory Group or with the Series Editor before commencing work (for names and addresses, see page ii). All necessary guidance will be given.

Persons wishing to receive issues of the 'Fauna' should address inquiries to the Publications Officer, DSIR Publishing, P.O. Box 9741, Wellington, New Zealand, who will maintain standing orders in three categories, as follows. 'A' – an invoice will be sent for each number, as soon after publication as possible. 'B' – essentially as for 'A', but invoices will be sent only for those numbers in a nominated field of interest (e.g., beetles only, mites only). 'C' – updated catalogues and order forms will be sent from time to time. Orders should be accompanied by full payment; rates quoted are surface mail, New Zealand (GST included) and overseas. All overseas orders are charged at the US$ rate.

CHECKLIST OF TAXA

INTRODUCTION

KEY TO TAXA

DESCRIPTIONS

HOST RECORDS

ILLUSTRATIONS

IN PRINT

No. 1 Terebrantia (Insecta: Thysanoptera), by Laurence A. Mound & Annette K. Walker. ISBN 0–477–06687–9. Published 23 December 1982. 120 p. Price NZ$29.95 (overseas US$29.95).

No. 2 Osoriinae (Insecta: Coleoptera: Staphylinidae), by H. Pauline McColl. ISBN 0–477–06688–7. Published 23 December 1982. Second impression May 1983. 96 p. Price NZ$18.60 (overseas US$18.60).

No. 3 Anthribidae (Insecta: Coleoptera), by B. A. Holloway. ISBN 0–477–06703–4. Published 23 December 1982. Second impression February 1985. 272 p. Price NZ$41.00 (overseas US$41.00).

No. 4 Eriophyoidea except Eriophyinae (Arachnida: Acari), by D. C. M. Manson. ISBN 0–477–06745–X. Published 12 November 1984. 144 p. Price NZ$29.95 (overseas US$29.95).

No. 5 Eriophyinae (Arachnida: Acari: Eriophyoidea), by D. C. M. Manson. ISBN 0–477–06746–8. Published 14 November 1984. 128 p. Price NZ$29.95 (overseas US$29.95).

No. 6 Hydraenidae (Insecta: Coleoptera), by R. G. Ordish. ISBN 0–477–06747–6. Published 12 November 1984. 64 p. Price NZ$18.60 (overseas US$18.60).

No. 7 Cryptostigmata (Arachnida: Acari) – a concise review, by M. Luxton. ISBN 0–477–06762–X. Published 8 December 1985. 112 p. Price NZ$29.95 (overseas US$29.95).

No. 8 Calliphoridae (Insecta: Diptera), by James P. Dear. ISBN 0–477–06764–6. Published 24 February 1986. 88 p. Price NZ$18.60 (overseas US$18.60).

No. 9 Protura (Insecta), by S. L. Tuxen. ISBN 0–477–06765–4. Published 24 February 1986. 52 p. Price NZ$18.60 (overseas US$18.60).

No. 10 Tubulifera (Insecta: Thysanoptera), by Laurence A. Mound & Annette K. Walker. ISBN 0–477–06784–0. Published 22 September 1986. 144 p. Price NZ$34.65 (overseas US$34.65).

No. 11 Pseudococcidae (Insecta: Hemiptera), by J. M. Cox. ISBN 0–477–06791–3. Published 7 April 1987. 232 p. Price NZ$49.95 (overseas US$49.95).

No. 12 Pompilidae (Insecta: Hymenoptera), by A. C. Harris. ISBN 0–477–02501–3. Published 13 November 1987. 160 p. Price NZ$39.95 (overseas US$39.95).

No. 13 Encyrtidae (Insecta: Hymenoptera), by J. S. Noyes. ISBN 0–477–02517–X. Published 9 May 1988. 192 p. Price NZ$44.95 (overseas US$44.95).

No. 14 Lepidoptera – annotated catalogue, and keys to family-group taxa, by J. S. Dugdale. ISBN 0–477–02518–8. Published 23 September 1988. 264 p. Price NZ$49.95 (overseas US$49.95).

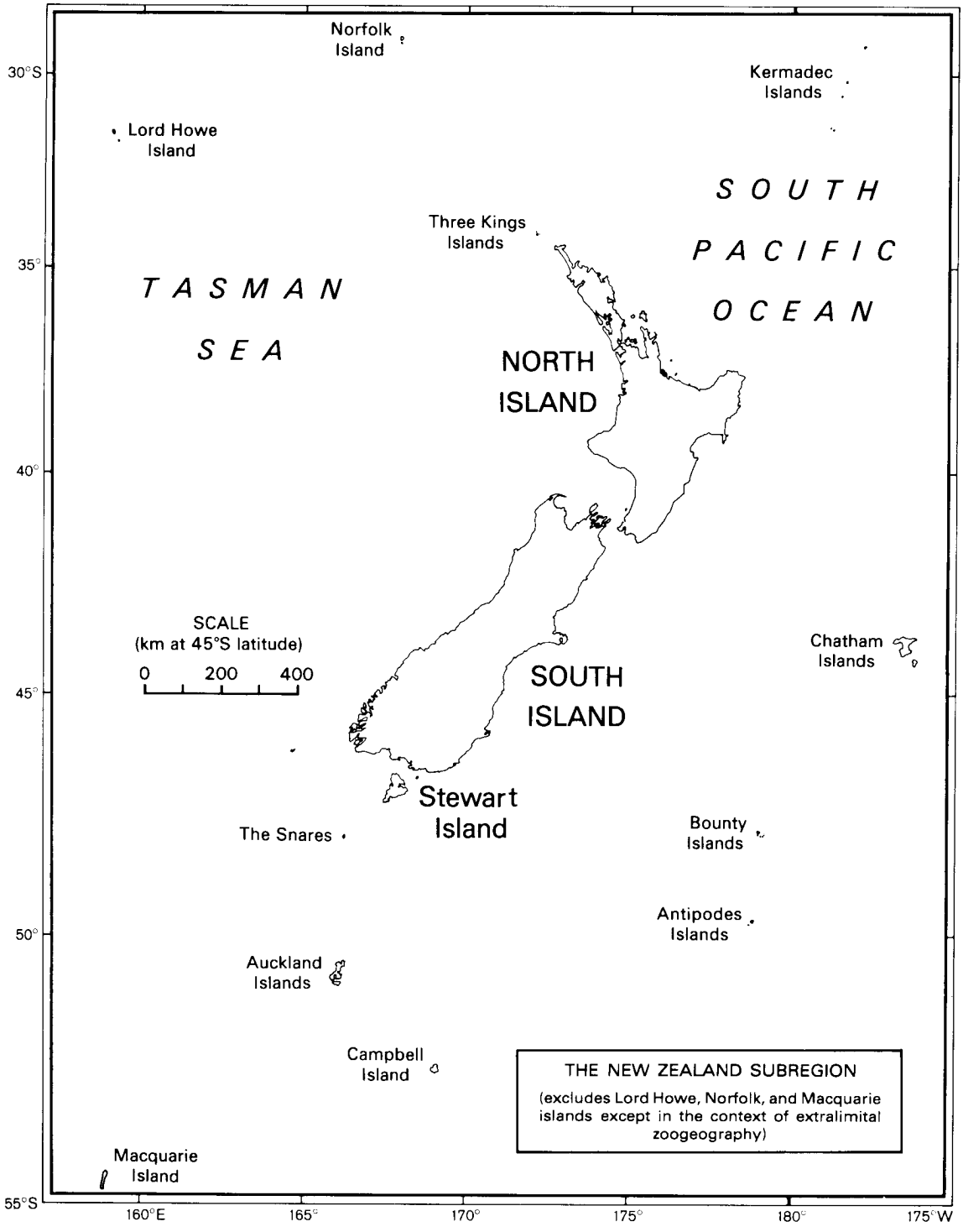
No. 15 Ambositrinae (Insecta: Hymenoptera: Diapriidae), by I. D. Naumann. ISBN 0–477–02535–8. 168 p. Publication date and price to be announced.

No. 16 Nepticulidae (Insecta: Lepidoptera), by Hans Donner & Christopher Wilkinson. ISBN 0–477–02538–2. 92 p. Publication date and price to be announced.

IN PREPARATION (and scheduled for early publication)

Chalcidoidea (part), by J. S. Noyes & E. W. Valentine. Mantodea, by G. W. Ramsay.

DEPARTMENT OF SCIENTIFIC AND INDUSTRIAL RESEARCH, WELLINGTON, NEW ZEALAND


Norfolk Island
Kermadec Islands
Lord Howe Island
SOUTH PACIFIC OCEAN
Three Kings Islands
TASMAN SEA
NORTH ISLAND
SCALE
(km at 45°S latitude)
0 200 400
SOUTH ISLAND
Chatham Islands
Stewart Island
The Snares
Bounty Islands
Antipodes Islands
Auckland Islands
Campbell Island
Macquarie Island
30°S
35°
40°
45°
50°
55°S
160°E
165°
170°
175°
180°
175°W
THE NEW ZEALAND SUBREGION
(excludes Lord Howe, Norfolk, and Macquarie islands except in the context of extralimital zoogeography)

North Island

AK – Auckland

BP – Bay of Plenty

CL – Coromandel

GB – Gisborne

HB – Hawkes Bay

ND – Northland

RI – Rangitikei

TK – Taranaki

TO – Taupo

WA – Wairarapa

WI – Wanganui

WN – Wellington

WO – Waikato

South Island

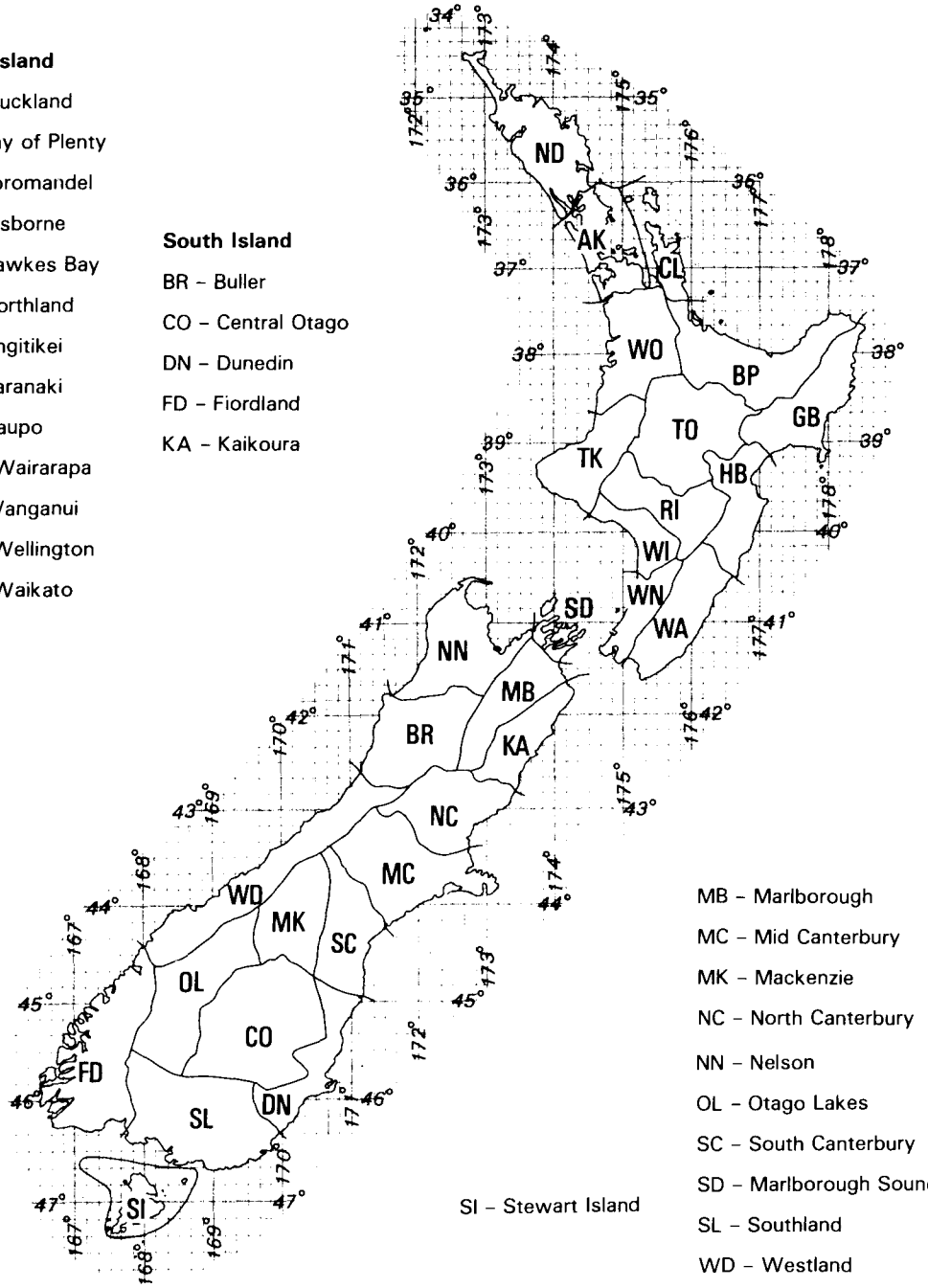
BR – Buller

CO – Central Otago

DN – Dunedin

FD – Fiordland

KA – Kaikoura



MB – Marlborough

MC – Mid Canterbury

MK – Mackenzie

NC – North Canterbury

NN – Nelson

OL – Otago Lakes

SC – South Canterbury

SD – Marlborough Sounds

SL – Southland

SI – Stewart Island

WD – Westland

Area codes and boundaries proposed by Crosby *et al.* (1976) for use with specimen locality data

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Fauna of New Zealand, ISSN 0111-5383; 16
ISBN 0-477-02538-2

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