

Adventive species of Lepidoptera recorded for the first time in New Zealand since 1988

Robert J.B. Hoare

Landcare Research, Private Bag 92170, Auckland, New Zealand. HoareR@landcare.cri.nz

Abstract

Information is provided about the 27 species of foreign Lepidoptera recorded from New Zealand for the first time after 1988. Most of these have become established in this country. Four species (*Heteroteucha dichroella* (Oecophoridae), *Cizara ardeniae* (Sphingidae), *Papilio xuthus* (Papilionidae) and *Chasmia* sp. (Noctuidae)) are only known in New Zealand from a single specimen, with no evidence of establishment. One established species (*Orgyia thyellina* (Lymantriidae)) has been deliberately eradicated. Eighteen species are believed to have arrived from Australia, although some of these (e.g. *Herpetogramma licarsisalis*) also occur elsewhere. Three species (*Orgyia thyellina*, *Artona martini* (Zygaenidae) and *Papilio xuthus*) are Asian in origin. Three species (*Agonopterix alstromeriana* (Depressariidae), *Coleophora striatipennella* (Coleophoridae) and *Scrobipalpa obsoletella* (Gelechiidae)) are European. One species (*Monochroa* sp. (Gelechiidae)) is probably Palearctic but has not yet been identified to species. The remaining two species (*Trichophyesis* sp. (Crambidae) and *Chasmia* sp.) have not been found in collections from outside New Zealand, but are likely to be Australian. A further two Australian species (*Barea codrella* (Oecophoridae) and *Teia anartoides* (Lymantriidae)), first recorded in New Zealand prior to 1988, are dealt with here. All 29 species are illustrated, and a brief diagnosis is provided for adults of species that resemble other New Zealand taxa. Notes are given on origin, date of first collection in New Zealand, known distribution in this country and life history where known.

Keywords: immigration, species establishment.

Introduction

Means of arrival of adventives

The migration of Lepidoptera from Australia to New Zealand is a familiar phenomenon. A particular study of the migratory patterns of butterflies and moths visiting New Zealand was made by the late K.J. Fox (summarized in Fox (1978)). Large migrations often follow a period of strong westerly or northwesterly winds, which may be associated with the northern edge of a depression approaching New

Zealand; a full discussion of weather conditions favourable to trans-Tasman insect dispersal is found in Tomlinson (1973). The true migrants could be said to be those butterflies and moths that build up large populations in eastern Australia, and regularly migrate within that country, for example the Australian Painted Lady (*Cynthia kershawi* McCoy), the Blue Moon (*Hypolimnas bolina nerina* (Fabricius)) and the bogong moth (*Agrotis infusa* (Boisduval)). Other species of Lepidoptera, not known to have migratory tendencies, undoubtedly arrive under the influence of the same weather conditions, and this would explain, for example, the two New Zealand records of the Australian satyrine *Melanitis leda bankia* (Fabricius) (Gibbs 1980). It is not just larger butterflies and moths that are able to survive the journey across the Tasman: a number of species of 'microlepidoptera' certainly owe their presence in this country to this form of dispersal. One example is the crambid *Achyra affinitalis* (Lederer), which was first recorded in New Zealand in October 1973 in association with a very large influx of Australian insects that included several other species of moth not formerly recorded here (Fox 1975, 1978). *A. affinitalis* is now widespread and well established in both North and South Islands (Dugdale 1988; unpublished records).

Of course, not all Australian moths that are recorded or have become established in New Zealand have flown here across the Tasman Sea. For some species, it can be hard to tell whether their appearance here is the result of transport on the prevailing winds, or of accidental importation. However, importation is clearly the only explanation for the occurrence of moths with flightless females, such as the Australian bag moth *Cebysa leucotelus* Walker (Psychidae), or the painted apple moth *Teia anartoides* Walker (Lymantriidae). Whilst Australia seems to be the only source of migrant Lepidoptera in New Zealand, importations may of course originate from elsewhere, and this is the case with the white-spotted tussock moth *Orgyia thyellina* Butler (Lymantriidae), which became temporarily established in Auckland in 1996 (see below) and with the bamboo moth *Artona martini* (Zygaenidae):

both species are from South-East Asia.

24 Whilst the influx of new species of Lepidoptera to New Zealand is in large part a natural phenomenon, there are some concerns from both economic and conservation points of view. The year 1999 saw the establishment of two species considered to be of pest status. *Herpetogramma licarsisalis* (Walker) (Crambidae) had been recorded in this country before (see below), but for the first time built up very large populations, which were responsible for conspicuous damage to some areas of dairy pasture in Northland (Hardwick *et al.* 2000). *Teia anartoides*, which had been recorded at Dunedin in 1983 (Harris 1988), became established in the wild in Auckland in 1999, raising worries about threats to horticulture and forestry should it spread. It is still present in west Auckland in 2001. As pointed out by Fox (1978), pests will always tend to be amongst the most successful colonists because such species typically have polyphagous larvae and the potential to build up large populations, both features that aid considerably towards establishment (but see under Host-plant associations below).

Polyphagous defoliating species such as *Teia anartoides* and other Lymantriidae may also pose a threat to natural ecosystems, but so far there is little documented evidence of adverse effects on native vegetation from adventive Lepidoptera. However, another cause for concern is competition, including genetic introgression of a local species or subspecies by a closely related Australian taxon. This has possibly happened in the case of the endemic New Zealand blue butterfly *Zizina oxleyi*, which is now

extinct in several areas of the country, having been replaced by the Australian *Z. labradus* (Gibbs 1980; Patrick & Dugdale 2000).

Host-plant associations

The larval biology of established adventive Lepidoptera in New Zealand is summarized in Table 1. 'Pre-1986' species are those first captured in New Zealand before 1986; 'post-1986' species are those for which there are no known pre-1986 New Zealand specimens. The following species treated in this paper fall into the 'pre-1986' category: *Coleophora striatipennella*, *Barea codrella*, *Monochroa* sp., *Teia anartoides*. The division of the data into these time-categories is admittedly somewhat arbitrary, especially as some species may have been established in this country well before they were first captured. However, a number of species appear to have first arrived in 1986, and there are some interesting indications of a shift in the kind of species becoming established since this date (see below).

Amongst all adventives, detritivores are the dominant group; this is not surprising as most of the included species may not be very particular as to the larval substrate, and detritus is an abundant and easily located resource. Nonetheless many of these species are probably relatively restricted in their climatic tolerance and are notably more abundant in cities, e.g. *Cebysa leucotelus* Walker (Psychidae). Oligophagous species with widespread hosts include many cosmopolitan crop pests such as *Phthorimaea operculella* (Zeller) (Gelechiidae, on Solanaceae) and *Plutella xylostella* (L.) (Plutellidae,

Table 1. Larval biology and origins of established adventive Lepidoptera in New Zealand.

'Polyphagous': species whose host-plants range across two or more unrelated plant families; oligophagous: species restricted to a single host family, but feeding on more than one genus within that family; monophagous: restricted to a single host genus. (See Appendix 1 for details of pre-1986 species).

LARVAL BIOLOGY	Pre-1986	Post-1986	Total spp.	ORIGINS	Pre-1986	Post-1986	Total spp.
Polyphagous	10	4	14	Australian	49	18	67
Oligophagous: monocots	2	3	5	European and cosmopolitan	37	2	39
Oligophagous: dicots, etc.	21	4	25	Asian trade	0	2	2
Monophagous	13	7	20	North American	1	0	1
Detritivores	32	4	36	Pacific trade	1	0	1
Stored products	9	0	9	South African	1	0	1
Unknown	3	0	3	Unknown	1	0	1
TOTAL	90	22	112	TOTAL	90	22	112

on Brassicaceae), for which human activities (planting of large monocultures of the hosts) create favourable conditions. The third best represented group consists of species restricted to Australian hosts, especially wattles (*Acacia* spp. and their relatives) and eucalypts (*Eucalyptus* and *Angophora* spp.). It is interesting that there appears to have been an increase in the rate of establishment of such species, with only eight recorded up to 1986, but eight more since then. Despite the attention given to polyphagous species such as *Teia anartoides* and *Orgyia thyellina*, true polyphages are only moderately well represented amongst established adventives. The two known monophagous species to have become established are *Agonopterix alstromeriana* (on *Conium maculatum*, an introduced host) and *Heliozela* cf. *catoptrias* (on *Kunzea ericooides*, a host naturally shared with Australia). The unidentified *Monochroa* sp. is also likely to be monophagous, in common with most of its congeners.

Species treated and Discussion

Dugdale (1988) provided a definitive annotated checklist of moths recorded in New Zealand up to 1988. In the current paper, I discuss the 27 adventive species that have been newly recorded here since then, along with one species (*Barea codrella*) that was mentioned by Dugdale (1988: 91, as 'undetermined species' of *Barea*), but has only recently been identified. I also discuss one species (*Teia anartoides*) that was recorded previously (Harris 1988; Dugdale 1988), but has only recently become established. Distribution within and outside New Zealand, brief details of the life history where known, and illustrations of the adults of all these species are provided, and their possible economic importance is noted. Where species resemble other taxa present in New Zealand, a short diagnosis is provided. This paper does not set out to provide a full diagnostic guide for the known early stages of adventive species, but some (especially the leafminers) can be very easily identified from their host-plants and larval workings, and these are described.

Species deliberately introduced for the purposes of biological control are not treated in this paper; nor are species intercepted in confinement (e.g. at airports) and not found at large. There are a few probably adventive species additional to those treated here whose status and identity are currently under investigation (e.g. an unidentified cosmopterigid known from a single specimen from Parnell,

Auckland).

The species discussed are listed below. When the specific identity of the New Zealand specimens assigned to a genus is still in doubt, I have used the abbreviation 'cf.' ('compare') where they may belong to the species named. Species that are known to be undescribed are marked 'sp. nov.' ('new species'); those that may be named but have not yet been identified are marked 'sp.'.

25

The classification and order of families and sub-families follows Kristensen (1999) except for the Gelechioidea, where Nielsen *et al.* (1996) are followed. Order within subfamilies is alphabetical by genus. Collection details of illustrated specimens are given in Appendix 2.

HELIOZELIDAE

1. *Heliozela* cf. *catoptrias* Meyrick

GRACILLARIIDAE

2. '*Acrocercops*' *laciniella* Meyrick

3. *Dialectica scalarrella* (Zeller)

LYONETIIDAE

4. *Stegommata sulfuratella* Meyrick

OECOPHORIDAE

Oecophorinae- *Wingia* group

5. *Heteroteucha dichroella* (Zeller)

Oecophorinae- *Barea* group

6. *Atalopsis* sp. nov.

7. *Barea codrella* (Felder & Roggenhofer)

8. *Leptocroca sanguinolenta* Meyrick

Stathmopodinae

9. *Stathmopoda cephalaea* Meyrick

COLEOPHORIDAE

10. *Coleophora striatipennella* Tengström

DEPRESSARIIDAE

11. *Agonopterix alstromeriana* (Clerck)

GELECHIIDAE

12. *Monochroa* sp.

13. *Scrobipalpa obsoletella* (Fischer von Röslerstamm)

LECITHOCERIDAE

14. *Sarisophora leucoscia* Turner

ZYGAENIDAE

15. *Artona martini* Efetov

TORTRICIDAE

Tortricinae

16. *Merophyas divulsana* (Walker)

Olethreutinae

17. *Holocola* sp. nov.

18. *Zomariana doxastiana* Meyrick

CARPOSINIDAE

19. *Coscinoptycha improbana* Meyrick

- CRAMBIDAE
Crambinae
20. *Culladia cuneiferellus* (Walker)
Cybalomiinae
21. *Trichophysetis* sp. nov.
Pyraustinae
26 22. *Glyphodes* cf. *onychinalis* (Guenée)
23. *Herpetogramma licarsisalis* (Walker)
PAPILIONIDAE
24. *Papilio xuthus* Linnaeus
SPHINGIDAE
25. *Cizara ardeniae* (Lewin)
NOCTUIDAE
26. *Chasmina* sp.
LYMANTRIIDAE
27. *Orgyia thyellina* Butler
28. *Teia anartoides* Walker
NOLIDAE
29. *Uraba lugens* Walker

Abbreviations for distribution within New Zealand follow Crosby *et al.* (1998). Specimens are deposited in the New Zealand Arthropod Collection (NZAC), Mt Albert, Auckland, unless otherwise stated. Abbreviations for other institutions are as follows:

- AMNZ Auckland War Memorial Museum,
Auckland, New Zealand
ANIC Australian National Insect Collection,
CSIRO, Canberra, Australia
BMNH British Museum (Natural History),
London, U.K.
LUNZ Lincoln University, Canterbury, New Zealand
OMNZ Otago Museum, Dunedin, New Zealand

**1. *Heliozela* cf. *catoptrias* Meyrick, 1897
(*Heliozelidae*) (Fig. 1)**

Country of origin and distribution. Australia. Described by Meyrick (1897) from three specimens from Sydney, New South Wales, collected between August and October. Not recognized with certainty since that date, as there has been no modern treatment of the Australian *Heliozelidae* (Nielsen 1996).

First New Zealand record. CL: Little Barrier Island (Hauturu), Te Maraeroa, 17 Sep 1994, R.C. Henderson (larvae / pupae on *Kunzea ericoides*), 26 specimens reared.

Additional New Zealand records. ND: Kerikeri Basin Recreation Reserve, Jun 2000, mines common on *Kunzea ericoides*, R. Hoare; AK: Huia, Kaitarakihi, Spragg Monument, Jun 1998, mines

abundant on *K. ericoides*, 5 moths emg. Aug, R. Hoare; same locality, mines Aug 1999, 1 emg. Dec, B. Patrick (OMNZ); Anawhata, Aug 1999, mines abundant on *K. ericoides*, 5 moths emg. Sep, R. Hoare; Omanawanui Track near Whatipu, adults common by day, 22 Oct 2000, R. Hoare & S. Fowler; Matuku Reserve, mines, 1 Jul 2001, R. Hoare, B. Patrick.

Hostplant. *Kunzea ericoides* (A. Rich.)
J. Thompson (Myrtaceae) (kanuka).

Life history. The larva mines a single leaf; the mine is at first linear, and later expands into a blotch which takes up most of the apical half of the leaf, or, in smaller leaves, most of the leaf. When full grown, it cuts an oval case from the mine and usually falls to the ground where it pupates in the case. Occasionally the case may remain attached to the old leaf-mine, or be spun to a twig or stem (where it can resemble a scale insect). The early mine often causes the leaf to turn reddish.

Economic importance. None.

Diagnosis. This is a tiny grey shining moth with a wingspan of 3 mm, and a small white tornal dot on the forewing. The only other moths of comparable size in New Zealand are *Nepiculidae*: *nepticulids* rest with their wings appressed flat to the substrate (they are held roof-wise in *Heliozela*), they have rough-scaled heads (smooth-scaled in *Heliozela*) and their wings are not shiny.

Remarks. The only other member of this superfamily (Incurvarioidea) recorded from New Zealand is an endemic undescribed species of *Cecidosidae* (previously assigned tentatively to *Prodoxidae*), the 'kamahi scribbler' (see Dugdale 1989). There are many species of *Incurvarioidea* in Australia, and it is possible that other species will eventually find their way to New Zealand. *Heliozela catoptrias* is one of Australia's smallest moths, and given its minute size and monophagous larval habits, it is perhaps remarkable that it should have arrived and become established here. It is now very abundant on the west Auckland coast, where some smaller kanuka bushes appear red because of the great density of mines; however, it has rarely been found more than a few hundred metres inland. Adults have been observed in sunshine visiting the flowers of *Corokia cotoneaster* Raoul.

The specific identity of the New Zealand taxon remains to be confirmed, and will require critical study of the genitalia and comparison with Meyrick's type series. Size and colour pattern correspond closely with Meyrick's description of *H. catoptrias*.

2. *'Acrocercops' laciniella* Meyrick, 1880 (Gracillariidae) (Fig. 2)

Country of origin and distribution. Australia: southern Queensland to Victoria, South Australia and Tasmania.

First New Zealand record. AK: Aviation Golf Course, mines on *Eucalyptus* sp., 6 Jan 1999, C. Scott.

Additional New Zealand records. AK: Meadowbank, Mt Albert, Glendowie and Devonport, Jan 1999 (leaf-mines; adults reared) (Withers 1999); Remuera, Cornwall Park, Auckland Zoo, Waikumete Cemetery, Mar-Apr 2000, leaf-mines; Glendene, Mt Wellington, Panmure, Avondale, Sep-Dec 2000, mines; Titirangi, 8 Jan 2001, R. Hoare, one at m.v. light; CL: Thames, 11 Feb 2001, larvae; BP: Mt Maunganui, 16 Jan 2001, larva; WO: Ngaruawahia, 2001, mines, T.M. Withers. (Most records from Forest Research database).

Hostplant. Mainly *Eucalyptus* spp. (Myrtaceae), especially *E. pilularis* Smith, but also (in Australia) *E. triantha* Link, *E. saligna* Smith, *E. nitens* (H. Deane & Maiden) Maiden (Tasmania), *E. regnans* F. Muell., *E. viminalis* Labill., *E. acmenoides* Schauer, *E. dives* Schauer, *E. bridgesiana* R.T. Baker, *E. stjohnnii* R.T. Baker, *E. macrorhyncha* F. Muell. ex Benth. Also recorded from *Angophora* spp. (Myrtaceae), including *A. costata* (Gaertner) Britten, *A. floribunda* (Smith) Sweet and *A. intermedia* DC. (Moore 1963; Withers 1999). In New Zealand recorded from *Eucalyptus bridgesiana*, *E. botryooides* Smith, *E. calophylla* Lindl., *E. dunnii* Maiden, *E. ficifolia* F. Muell., *E. leucoxydon* F. Muell., *E. macarthurii* H. Deane & Maiden, *E. nicholii* Maiden & Blakely, *E. nitens*, *E. pilularis*, *E. sideroxydon* A. Cunn. and *E. viminalis* (Forest Research database). Mines in juvenile leaves.

Life history. Described in detail by Moore (1963). The larva at first makes a narrow linear mine, but eventually forms a large irregular silvery white blotch on the upperside of a leaf. The leaf cuticle becomes stained with a variable amount of cream or brown discoloration due to the larval excrement (this excrement helps to distinguish the mines from the superficially similar blotches made by the leaf blister sawfly (*Phylacteophaga froggatti* Riek)). The excrement is almost liquid during the larva's first two, sap-feeding, instars, but after the moult to the third instar, which has chewing mouth-

parts, the excrement becomes more or less solid and is distributed in a narrow band around the edge of the mine. There may be several mines in a single leaf, and these may coalesce. The larva leaves the mine to pupate in an opaque pink to orange-brown cocoon amongst debris on the ground. The cocoon is decorated with up to eight small shiny globules of unknown function.

Economic importance. Can cause severe damage to eucalypt foliage, and may be of concern in plantations, although (at least in Australia) the trees seem to be able to recover even from a heavy infestation (Moore 1963).

Diagnosis. A very small narrow-winged moth with antennae as long as the forewings. Broadly similar in overall appearance to endemic New Zealand species of Gracillariidae, but the wing pattern, with the forewing dark, and a straight white subdorsal streak reaching nearly to the tornus, is diagnostic.

Remarks. This moth appears to be very well established and spreading in New Zealand.

3. *Dialectica scalariella* (Zeller, 1850) (Gracillariidae) (Fig. 3)

Country of origin and distribution. Southern Europe, Madeira, Canary Is., Asia Minor; Australia (deliberately introduced).

First New Zealand record. NN: Atawhai, larvae on *Echium candicans*, emg Feb-Mar 1997, J.S. Dugdale.

Additional New Zealand records. AK: Blockhouse Bay, ex *Echium* sp., Apr 1998, L. Clunie (more than 60 specimens); Mt Albert, ex *Echium pininana*, Dec 1998, T.K. Crosby (24 specimens); Glen Eden, Feb 1999, ex 'forget-me-not' (*Myosotis* sp.), R.C. Henderson; Bombay, 5 Jan 2000, B. Patrick (OMNZ); BR: St Arnaud (J. Dugdale); MB/SD: Cloudy Bay (J. Dugdale); MC: Ashton Beach, Kaitorete Spit, Ashburton River mouth, Rangitata Is., Nov-Dec 1999, mines on *Echium vulgare* and adults, B. Patrick (OMNZ).

Hostplant. Boraginaceae. In New Zealand recorded from *Echium* spp. including *E. candicans* L. f., *E. pininana* Webb & Berth. and *E. vulgare* L., *Anchusa* spp., *Borago* spp., *Myosotis* spp. and *Symphytum* spp., but not from *Myosotidium* (Chatham Island forget-me-not).

Life history. Described briefly by Wapshere & Kirk (1977). The opalescent eggs are attached to the under-surface of leaves of the host. They hatch in 4-

6 days, and the larva enters the leaf through the base of the chorion. The early instars in all Gracillariidae are sap-feeding and use their horizontally aligned mandibles to cut cell walls. It is not known at which instar the larvae of *Dialectica* develop the chewing mouthparts typical of most lepidopterous larvae.

According to Wapshere & Kirk (1977), the first three instars gradually enlarge the mine, forming a transparent lens-like blotch mine in which all tissue between the two epidermal layers (apart from vascular bundles) has been consumed: the epidermis eventually turns brown. Within the mine, the final instar larva constructs a white cocoon in two layers; the relatively large white inner cocoon distinguishes this species from the related Indo-Australian species *D. aemula* (Meyrick), in which the inner cocoon is attenuate and yellowish (Kumata & Horak 1997).

Economic importance. Introduced to Australia for biological control of the pasture weed *Echium plantagineum* ('Paterson's Curse'). In New Zealand the mines disfigure cultivated *Echium* spp. and relatives in gardens, and *E. vulgare* on waste ground, riverbeds and roadsides.

Diagnosis. The wing-pattern, with the white dorsal streak expanded apically into two or three subtriangular blotches, distinguishes this species from other gracillariids found in New Zealand. The Indo-Australian *D. aemula* is very similar, and is best distinguished on the basis of the cocoon (see above); it also differs in the female genitalia, which have the signa close to the proximal end of the corpus bursae, not near the middle as in *D. scariella* (Kumata & Horak 1997).

Remarks. This species is now very well established in New Zealand and can be expected to spread.

4. *Stegommata sulfuratella* Meyrick, 1880
(Lyonetiidae) Banksia leaf-miner (Fig 4)

Country of origin and distribution. Australia: southern Queensland to South Australia and Tasmania.

First New Zealand record. AK: Auckland Zoo, mines on *Banksia integrifolia* collected 13 Apr 1999 in the hippo cage by C. Scott (Forest Research database).

Additional New Zealand records. ND: Matapouri, 6 Jan 2000, mines. AK: Remuera Golf Course, Mt Albert, Glen Innes, Avondale, Titirangi, Karekare (N. Martin), Blockhouse Bay, Glendowie,

Waikowhai, Waiuku, 1999–2000; One Tree Hill, adults on rocks, 3 Jan 2000, B. Patrick (OMNZ); Snells Beach, Warkworth, 21 Jan 2000, B. Patrick (OMNZ); Mellons Bay, Howick, 2001, J. Dugdale; CL: Tairua, 12 Jan 2000, adults and mines very common, B. Patrick (OMNZ); TO: Whirinaki, 19 Jan 2000, mines; WO: Matamata, 5 Mar 2000, mines; TK: Pukekura Park, 30 Mar 2000, mines; WI: Wanganui, 15 Sep 2000, mines; WN: Waitare Beach, 25 Mar 2001, mines (Forest Research database unless otherwise indicated).

Hostplant. Mainly *Banksia integrifolia* L. f. (Proteaceae); also recorded from *B. serrata* Cav. and another unidentified *Banksia* sp.

Life history. The larva makes a large brownish blotch mine at the end of leaves of the host-plant, often on the young terminal growth, but occasionally on mature leaves. It leaves the mine to pupate in a flimsy cocoon suspended in a silken hammock from a leaf.

Economic importance. Potentially a minor horticultural pest where *Banksia* spp. are grown as ornamentals.

Diagnosis. A very small white moth with very narrow wings and antennae longer than the forewings; the first segment of the antenna is expanded to form an eye-cap. Superficially the moth appears unicolorous, although the forewings have faint yellowish and blackish transverse lines towards the apex, and a tiny black apical dot.

Remarks. *Stegommata* is a genus of three species endemic to Australia. *S. leptomitella* Meyrick is established on *Hakea salicifolia* (Vent.) Burt in Nelson gardens (Dugdale 1988).

5. *Heteroteucha dichroella* Zeller, 1877
(Oecophoridae) (Fig 5)

Country of origin and distribution. Australia: N.S.W., A.C.T., South Australia, Victoria, Tasmania.

First New Zealand record. HB: Havelock [North], Dec 1925, one specimen (AMNZ).

Additional New Zealand records. None.

Hostplant. *Eucalyptus* spp., including *E. bridgeana*, *E. tereticornis* Smith, *E. rubida* H. Deane & Maiden and *E. aggregata* H. Deane & Maiden.

Life history. Larvae feed communally in silk galleries spun amongst clusters of living green leaves of *Eucalyptus* (Common 1994).

Economic importance. Not a recognized pest.

Diagnosis. The colour of the forewings, yellowish

at the base to about 2/3 and purplish fuscous beyond, make this a very distinctive moth, unlikely to be confused with any other species currently known from New Zealand.

Remarks. Only a single specimen appears to have been collected in New Zealand; this was discovered amongst undetermined material in the Auckland War Memorial Museum collection. Although the specimen was captured in 1925, and there have been no further records, it is possible that the moth may be very locally established, and it should be sought in the Hawkes Bay area.

6. *Atalopsis* sp. nov. (Oecophoridae) (Fig. 6)

Country of origin and distribution. Australia: northern N.S.W. (see Remarks).

First New Zealand record. AK: Henderson, 4 Apr 1988, J.S. Dugdale.

Additional New Zealand records. AK: Henderson, Mar, Dec 1989, J. Dugdale (3 specimens); Titirangi 1998-2000, fairly common (R. Hoare).

Life history. Not known. Other Australian species of this genus have been reared in Queensland from leaf-litter that has accumulated in the fronds of *Livistona* palms (Common 2000).

Economic importance. None.

Diagnosis. A small yellowish oecophorid with the anterior half of the thorax and base of costa blackish, distinct tornal and costal dark spots and a small dark discal spot. This wing pattern distinguishes it from other yellow Oecophoridae (e.g. *Tingena* spp.) occurring in New Zealand.

Remarks. Possibly only three specimens of this undescribed species have been collected in Australia: these are from Wauchope and Whian Whian, northern N.S.W. (ANIC). *Atalopsis* Common is a recently described genus endemic to Australia with a number of undescribed species, most of which are restricted to Queensland (Common 2000).

7. *Barea codrella* (Felder & Rogenhofer, 1875) (Oecophoridae) (Fig. 7)

Country of origin and distribution. Australia: southern Queensland to Victoria, Tasmania and southern Western Australia.

First New Zealand record. HB: Haumoana, 20 Oct 1979, T.H. & J.M. Davies, one.

Additional New Zealand records. WI: Palmerston North, 12 Nov 1981, 25 Oct, 11 Nov

1989, 19 Oct 1990, J. Andrew, one on each date; AK: central Auckland, 30 Oct 1986, N. Hudson, one.

Life history. Larvae of most *Barea* species tunnel in dead rotten wood, especially that which is or has been in contact with the ground. *B. codrella* has been reared in Australia from larvae on dead *Eucalyptus* spp. and *Acacia* spp., from woody galls on *Exocarpos cupressiformis* Labill. (Santalaceae), and from a moist masonite building board (Common 2000). The early stages and biology of *B. codrella* were described by Moore (1959, as *B. banausa* (Meyrick)). Larvae are very similar to those of *B. consignatella* Walker (which also occurs in New Zealand), but are smaller and paler in colour.

Economic importance. The larvae of *Barea* species may occasionally attack constructional timbers, fencing posts, poles, etc. (Moore 1959), but are not usually of economic concern.

Diagnosis. This species is superficially very similar to two other *Barea* spp. that have become established in New Zealand, *B. confusella* (Walker), and an undescribed species related to *confusella*. It is distinguished from both of these by the labial palpi, which are uniformly blackish except for a pale patch on the inner surface of the second segment near the base, and (in fresh specimens) by the presence of a tuft of shining scales on the posterior margin of the thorax.

Remarks. This is the undetermined species of *Barea* mentioned by Dugdale (1988: 91). *Barea* is a very large Australian genus with 98 described species, mainly from wet sclerophyll forest and rainforest (Common 2000). Five species have become established in New Zealand, probably introduced with timber.

Barea codrella is a senior synonym of *B. banausa* (Meyrick, 1883).

8. *Leptocroca sanguinolenta* Meyrick, 1886 (Oecophoridae) (Fig. 8)

Country of origin and distribution. Australia: south-east Queensland, New South Wales, A.C.T. and Victoria.

First New Zealand record. AK: Albert Park, 23 Jun 1991, N. Hudson, one resting on wall.

Additional New Zealand records. AK: Albert Park, 2 Jul 1991, N. Hudson, one; Mt Albert, 24 Jun 1998, R. Hoare, one on wall.

Life history. The eggs are pink and hatch in 7-10 days. First instar larvae are pink with a brown

head capsule, and feed between webbed dead leaves of *Eucalyptus* spp. (Common 2000; however, these features do not distinguish them from other commoner oecophorid larvae such as *Tachystola acroxantha* (Meyrick)). They continue to feed up slowly over the summer months, and adults emerge from May to July (Common 2000).

Economic importance. None.

Diagnosis. The colour pattern is distinctive: the brownish forewing has a broad central longitudinal black streak bearing three small dorsal projections, and the area between the streak and the costa is darker brown than the dorsal half of the wing. The usual flight time of the moth (mid-winter) should also be an aid in determination.

Remarks. This is the type species of *Leptocroca*, and the only species assigned to the genus by Common (2000). New Zealand species assigned to this genus are wrongly placed and will eventually be removed to other genera. This species may be commoner and more widespread in New Zealand than records indicate; it has possibly been overlooked due to its mid-winter time of emergence.

9. *Stathmopoda cephalaea* Meyrick, 1897 (Oecophoridae) (Fig. 9)

Country of origin and distribution. Australia: southern Queensland to Tasmania.

First New Zealand record. AK: Titirangi, one at m.v. light, 11 Dec 1999, R.J.B. Hoare.

Additional New Zealand records. Same locality, one on 17 Dec 1999, one on 12 Feb 2000, one on 8 Jan 2001.

Life history. Larvae feed in *Uromycladium* rust galls on wattles (*Acacia* spp.) (Common 1990).

Economic importance. None.

Diagnosis. This species (especially the female) resembles the endemic *S. coracodes* Meyrick, but may be distinguished by its larger size and the distinct white streak along the fold from the base of the wing to 1/3 (the streak is absent in *S. coracodes*).

Remarks. This is the third Australian species associated with *Uromycladium* galls to be recorded in New Zealand. The other two are '*Acrocercops*' *eumetalla* (Meyrick) (Gracillariidae) and *Gauna aegusalis* (Walker) (Pylalidae). All four New Zealand specimens of *S. cephalaea* are females.

10. *Coleophora striatipennella* Tengström, 1848 (Coleophoridae) (Fig. 10)

Country of origin and distribution. Europe, including the United Kingdom.

First New Zealand record. NN: Opouri Valley, 6–8 Jan 1969, 2 males, R. J. B. Power.

Additional New Zealand records. MC: Cass, Mt Sugarloaf Fan, Nov 1988, light trap, E.G. White (LUNZ). MK: common and widespread in southern Mackenzie Basin from 1994 onwards (E.G. White, pers. comm.).

Hostplant. In the U.K., recorded from *Cerastium fontanum* Baumg., *Stellaria media* (L.) Cirillo and *S. graminea* L. (Caryophyllaceae). All of these plants are established and widespread throughout New Zealand.

Life history. Described in detail by Emmet *et al.* (1996). The egg is laid on a flower of the hostplant, and the larva starts feeding on the seeds inside a capsule. Once the first capsule is emptied, the larva constructs a silken case and continues feeding from this on other capsules, attaching the case to the outside of each in turn. The case is white at first but becomes ochreous later and is sprinkled with fragments of chewed husk and frass. When the larva is full-fed (late summer in the U.K.) its case is 6 mm long, greyish ochreous and tubular, with a trivalved anal opening (Emmet *et al.* 1996: plate 6, fig. 6). It overwinters in its case, pupating in the spring or early summer, and emerging throughout the summer months.

Economic importance. None.

Diagnosis. Similar superficially to *C. versurella* Zeller, which is also well established in New Zealand, but distinguished by the antennae which are ringed grey and white (pale and unicolorous in *C. versurella*).

Remarks. This species has been confused in New Zealand collections with *C. versurella*; its distinctness was first noted by E.G. White, and dissection of the male genitalia subsequently confirmed its identity. Given the ubiquity of its hosts, it is likely to be more widespread in this country than at present known.

11. *Agonopterix alstromeriana* (Clerck, 1759) (Depressariidae) Hemlock flat moth (Fig. 11)

Country of origin and distribution. Palearctic: widespread throughout Europe south to Morocco, and as far east as Siberia; adventive to western North America.

First New Zealand record. DN: Dunedin, 11 Mar 1986, B.H. Patrick (OMNZ).

Additional New Zealand records. Now very

widespread throughout New Zealand, and probably present in most areas (C. Winks pers. comm.). Specimens in NZAC are from AK (Mt Albert, 1991), WO (Te Kuiti, 1993), TK (New Plymouth, 1992), MC (West Melton, 1990) and CO (Clyde, 1991). Also recorded from WI, WN, SC and SL (B. Patrick, pers. comm. (OMNZ)) and KA (J. Dugdale).

Hostplant. *Conium maculatum* L. (Apiaceae; hemlock).

Life history. Described by Berenbaum & Passoa (1983). The eggs are laid singly on the undersides of hemlock leaves and hatch in about 6 days. The young larvae are yellowish with black head capsules; as they mature they become light green with darker green dorsal and dorsolateral lines, and yellowish green heads. Larvae feed in spinings on the leaves, flowers and seedheads for about a month before pupating in the soil. Early stages of infestation are signalled by many reflexed or spun-together leaflets (the shelters of the early instar larvae); heavy attack contorts the plants. Moths emerge in mid-summer, and remain alive through the autumn and winter.

Economic importance. A very useful bio-control agent for hemlock, although not deliberately introduced.

Diagnosis. The wing pattern, with the creamy base to the costa and the large dark costal patch which contains contrasting red-brown scales, is distinctive.

Remarks. This species was presumably accidentally imported to New Zealand. It overwinters as an adult, and does not reproduce until the spring. The adults are flattened and able to hide in small crevices, which coupled with their long life-span would aid their chances of being transported relatively long distances and surviving. The moth has also become widely established in the United States (Powell 1991), and this could be the origin of the New Zealand populations.

12. *Monochroa* sp. (Gelechiidae) (Fig 12)

Country of origin and distribution. The genus is Holarctic.

First New Zealand record. AK: Henderson, 8 Nov 1974, at light, J.S. Dugdale.

Additional New Zealand records. ND: Parau Sc Res, 15 Feb 2000, R. Hoare, G. Hall, R. Leschen, 2 at m.v. light; AK: Laingholm, Mar 1980, R. Kleinpaste, 2 at light; Titirangi, Jan 2000, R. Hoare, 1 at m.v. light; Clevedon, 24 Jan 2001, 1 at m.v. light, R. Hoare.

Hostplant and life history. Not known. Most species of *Monochroa* with a known biology have larvae which bore in stems or roots of herbaceous plants (Emmet 1988).

Economic importance. None.

Diagnosis. A small narrow-winged unicolorous brown gelechiid, with a very inconspicuous darker discal spot on the forewing at 3/4. It superficially resembles the endemic '*Athrips*' *zophochalca* Meyrick and the adventive *Biloba subsecivella* (Zeller). It differs from '*A.*' *zophochalca* in lacking white markings on the forewing, and in the mottled 2nd segment of the labial palp (pale and unicolorous in *zophochalca*). It may be easily distinguished from *B. subsecivella* as the latter species has a whitish head (dark brown in *Monochroa*).

Remarks. The specific identity of this taxon has not yet been established, but the generic placement is confirmed by the form of the male terminalia. The New Zealand specimens do not appear to be referable to any of the British species of *Monochroa* reviewed by Sokoloff & Bradford (1993).

13. *Scrobipalpa obsoletella* (Fischer von Röslerstamm, 1841) (Gelechiidae) (Fig 13)

Country of origin and distribution. Europe, North America.

First New Zealand record. CO: Alexandra, late Jan 1992, reared from *Atriplex*, J. Begg.

Additional New Zealand records. NN: Boulder Bank, reared from *Atriplex*, 26 Dec 1998, J.S. Dugdale; same locality, 22 Feb 1999, J. Dugdale & R. Hoare, 7 at m.v. light (6 in NZAC, 1 in BMNH).

Hostplant. *Atriplex* spp. and *Chenopodium* spp. (Chenopodiaceae).

Life history. The larva is described as yellowish green with a reddish mid-dorsal line, blackish pinacula and a brownish-ochreous head; it lives inside the stem of the host-plant, eating the pith (Meyrick 1928; Emmet 1988). Pupation is in the feeding place; when the larva is ready to pupate it bores through to the outside of the stem making a small hole.

Economic importance. None.

Diagnosis. Superficially resembles some species of the endemic genus *Kiwaia*. May be distinguished by the strongly mottled greyish forewings, which appear very uniform and lack patches of pale scales or distinct patterning. Also somewhat similar to

Phthorimaea operculella (Zeller), but smaller; *P. operculella* has the forewing ground colour more ochreous, not grey, usually with a row of 3 distinct dark spots along the fold; the hindwing cilia are tinged yellowish (whitish in *S. obsoletella*). The male of *P. operculella* can be very easily recognised by the enlarged 8th tergite covered in short specialized yellowish scales.

Remarks. Like *Leucoptera spartifoliella* (Hübner) and *Agonopterix alstromeriana*, this is a European species that has arrived in New Zealand by unknown agency. There is a specimen in NZAC from Haumoana HB, collected by T.H. and J.M. Davies on 10 January 1980, which on the basis of size and colour pattern probably belongs to this species. Unfortunately, it is missing its abdomen, and there must therefore be some doubt over its identity. However, it is clearly possible that *S. obsoletella* has been established in New Zealand for 20 years or more, and it may well occur in the North Island.

14. *Sarisophora leucoscia* Turner, 1919 (Lecithoceridae) (Fig. 14)

Country of origin and distribution. Australia: southern Queensland and northern N.S.W.

First New Zealand record. AK: Mangere, 12–13 Nov 1998, M. & M. Shaffer, 3 at motel light (1 specimen in NZAC, 2 in BMNH).

Additional New Zealand records. None.

Life history. Larvae feed on dead leaves of *Eucalyptus* and *Angophora* spp. (ANIC unpublished records: E.D. Edwards, pers. comm.).

Economic importance. None.

Diagnosis. Lecithocerids can generally be recognized by the combination of long antennae (as long as the forewing or longer) and scaled proboscis (a feature of the superfamily Gelechioidea), lack of abdominal spinules and relatively broad fore-wings (compared e.g. with Stathmopodinae). Differs from the other two species of Lecithoceridae recorded from New Zealand by the striate pattern of the forewing, and the yellowish abdomen upperside.

Remarks. Apparently not a common species in Australia (E.D. Edwards, pers. comm.). Not seen in New Zealand since the original three specimens were collected, but may well be established in South Auckland.

15. *Artona martini* Efetov, 1997 (Zygaenidae) Bamboo moth (Fig. 15)

Country of origin and distribution. South-east Asia: Japan; Taiwan; China; Vietnam.

First New Zealand record. ND: Hatea River, Whangarei, March 1996 (larvae).

Additional New Zealand records. Still present at the original locality and has spread within a 10km radius of Whangarei (Gill 2000).

Hostplant. Various species of bamboo: in New Zealand recorded on *Shibataea kumasasa* (Zoll.) Makino ex Nakai, *Pleioastus auricomus* (Mitford) D.C. McClint., *Phyllostachys nigra* (Lodd.) Munro, *Miscanthus sinensis* Andersson and *Bambusa multiplex* (Lour.) (Gill 2000); in its natural range also on *Phyllostachys makinoi* Hay. and *P. pubescens* Mazel ex Houz.

Life history. The life history was described by Yen *et al.* (1996) under the name *Artona funeralis* (Butler), and in New Zealand by Gill (2000). Eggs are attenuate and light yellow and deposited on the leaves or nodes of the host-plant. The young larva is yellowish, and becomes darker yellow as it grows. It bears numerous secondary setae on conspicuous verrucae and hence somewhat resembles an arctiid larva, although it is not as densely hairy as the larvae of the few native New Zealand arctiids. The larva damages the edges of leaves and makes windows in them. It pupates in a papery brown oval cocoon on a leaf surface. In its native range there are two to three generations a year.

Economic importance. May be very damaging to bamboo when populations build up. Potentially a horticultural pest, but could also be beneficial where bamboo has escaped from cultivation and is a weed.

Diagnosis. Unlikely to be confused with any other New Zealand moth; it is the only member of the superfamily to occur here. There are three other very similar species in south-east Asia (*Artona funeralis* (Butler), *A. uniformis* (Alberti) and *A. parilis* Efetov); in all these the proboscis is yellow (brown in *A. martini*).

Remarks. There is little doubt that this species was accidentally imported to New Zealand, possibly with Japanese motor vehicles (Gill 2000). In Taiwan, populations in bamboo plantations fluctuate markedly, outbreaks being interspersed with periods of rarity or apparent absence (Yen *et al.* 1996). The species is well established and can be abundant in Whangarei; it can be expected to spread (Gill 2000).

16. *Merophyas divulsana* (Walker, 1863) (Tortricidae) Lucerne leaf-roller (Fig. 16)

Country of origin and distribution. Australia: very widespread, including Tasmania.

First New Zealand record. CO: Cairnmuir Range, near Clyde, 20 Apr 1988, B.H. Patrick (OMNZ).

Additional New Zealand records. ND: Katui, nr Waipoua SF; AK: Motuora Is., Glorit, Piha, Parakai; BP: Otanga, Whangaparaoa Valley, Oruaiti Beach; GB: Te Araroa; WD: Paroa; CO: Kawarau Gorge, Conroys Rd, Earnsclough Rd, Cromwell (NZAC and OMNZ) (Patrick & Dugdale 1994). Also recorded from NN, MB (J. Dugdale, pers. comm.) and CL, WO, WA, SD (B. Patrick pers. comm.).

Hostplant. In Australia recorded from lucerne (*Medicago sativa* L.), clover (*Trifolium* spp.), sunflower (*Helianthus*), dandelion (*Taraxacum*), *Senecio dryadeus* Ewart, capeweed (*Arctotheca calendula* (L.) Levyns), *Bassia quinquecupis* (F. Muell.) F. Muell., garden mint (*Mentha*), lettuce (*Lactuca sativa* L.), carrot (*Daucus carota* L.), sweet pea (*Lathyrus odoratus* L.), *Chrysanthemum* spp., *Geranium* spp. and honeysuckle (*Lonicera*) (Common 1990). Has been found in association with *Lotus pedunculatus* Cav. in New Zealand (Patrick & Dugdale 1994) and also with other pasture and waste ground Fabaceae.

Life history. The larva feeds on the leaves from a spun shelter. It is bright green, with a pale brown head capsule; the spinules are evenly darkened (cf. *Epiphyas postvittana* (Walker), where they are darkened in three stripes), and the setal pinacula are conspicuously paler (J. Dugdale, pers. comm.).

Economic importance. A pest of lucerne in Australia: usually only a sporadic problem (Bishop 1984), but infestations in some coastal areas of N.S.W. can be continuous (Whittle *et al.* 1991).

Diagnosis. Similar to the endemic New Zealand species *M. leucaniana* (Walker). In *M. divulsana*, the ventral surface of the wings is dark grey, and the hindwing upperside is grey to dark grey. In *M. leucaniana*, the ventral surface of the wings is pale, and the hindwing upperside is whitish to very pale grey.

Remarks. *M. divulsana* appears to have spread rapidly throughout New Zealand since its original colonization in ca. 1987-8.

17. *Holocola* sp. nov. (Tortricidae) (Fig 17)

Country of origin and distribution. Australia. (See under Remarks).

First New Zealand record. NN: Nelson, Tahunanui Beach, Oct 1999, J.S. Dugdale.

Additional New Zealand records. NN:

Rabbit Is, 27 Oct 1999, J.S. Dugdale, 4 specimens by day. AK: Titirangi, 12 Feb 2000, R.J. B. Hoare, one at m.v. light; Avondale, 14 Dec 2000, larvae on *Acacia longifolia*, L. Renney (det. J.S. Dugdale).

Hostplant. *Acacia longifolia* (Andrews) Willd. (Mimosaceae).

Life history. Larvae feed in the elongating shoots, or tie phyllodes together and gouge out the enclosed tissues. The larva is pink-tinged posteriorly and the anal shield has a marginal dark mark on each side. It pupates in a thick, oblong frass-coated cocoon in the feeding place; the pupa lacks a cremaster, cf. *Zomariana* below (J.S. Dugdale pers. comm.).

Economic importance. Not a recognized pest.

Diagnosis. May be distinguished from related New Zealand species in the genera *Strepsicrates* and *Holocola* by the forewing pattern, in which the blackish dorsal blotch usually encloses an irregular-shaped area of dull orange scaling. Sometimes the dorsal blotch is more or less obsolete, in which case the shining white dot in the disc at 3 / 4 is a characteristic feature in both sexes. The male lacks an antennal notch, and has a very long and conspicuous costal fold which reaches to slightly beyond 1 / 2 the forewing length; the combination of these two characters is diagnostic.

Remarks. This is a undescribed species, represented in the ANIC. It is related to *H. triangulana* Meyrick, *H. phaeoscia* (Turner) and a number of other species associated with *Acacia*.

18. *Zomariana doxasticana* Meyrick, 1881 (Tortricidae) (Fig 18)

Country of origin and distribution. Australia: southern Queensland and N.S.W.

First New Zealand record. ND: Kaitaia, 30 Dec 1990, ex larva on *Acacia melanoxylon*, D. Steven, one specimen.

Additional New Zealand records. ND: Kaitaia (Northern Nurseries), larvae coll. Feb 1991, emg 18 Feb to 15 Mar 1991, D. Steven, M. Fitzwater, 3 specimens. NN: Tahunanui Beach, 1999, J. Dugdale.

Hostplant. *Acacia melanoxylon* R. Br. and *A. longifolia* (Mimosaceae).

Life history. Larvae tie phyllodes together with white silk. They closely resemble the larvae of *Epiphyas postvittana* in appearance and behaviour, except that the cuticle is evenly green (lacking the darker dorsal and subdorsal stripes of *E. postvittana*).

Pupation is in a white silk cocoon without incorporated frass, and the pupa has a pair of pits on the dorsum of abdominal segment 2 and a cremaster (J.S. Dugdale pers. comm.).

Economic importance. Not a recognized pest.

34

Diagnosis. A nearly unicolorous greyish olethreutine, with a more or less well indicated slightly oblique strigula from the forewing costa at 2, which may more or less join with an area of darker scaling at the tornus to form a very faint transverse fascia. Differs from *Cydia succedana* (L.) (gorse pod moth) and *C. pomonella* (D. & S.) (apple codlin moth) in lacking the metallic strigulae ('ocellus') in the tornal area of the forewing. The ground colour is also lighter and more pinkish grey than in most specimens of *C. pomonella*.

Remarks. This species has possibly invaded New Zealand twice independently, once in 1990–1991 (Northland), and once in 1999 (Nelson). I know of no records from the North Island since 1991, but it may still be established. Early stages were far less common than those of *Holocola* sp. nov. at Tahunanui Beach in 1999 (J.S. Dugdale pers. comm.). Areas of weed-growth *Acacia melanoxylon* in Westland have not been surveyed for *Z. doxasticana*.

19. *Coscinoptycha improbana* Meyrick, 1881
(Carposinidae) Australian guava moth
(Figs 19, 20)

Country of origin and distribution. Australia: Queensland to Victoria and Tasmania.

First New Zealand record. ND: Ahipara, July 1999, larvae in *Citrus reticulata* fruit, G. Messenger (adults reared by M. O'Donnell, MAF, Lincoln, emerged 15 Aug).

Additional New Zealand records. ND: Pukepoto, Kaitaia, Awanui, Mangonui, 1999–2000 (M. O'Donnell, pers. comm.).

Hostplant. In Australia recorded from *Cassine australis* (Vent.) Kuntze (Celastraceae); *Schizomeria ovata* D. Don (Cunoniaceae); *Citrus* spp. (Rutaceae); *Psidium* (guava) and *Feijoa sellowiana* O. Berg (both Myrtaceae). In New Zealand, has been found on *Citrus* spp., *Prunus* spp., *Psidium guajava* L., *Eriobotrya japonica* (Thunb.) Lindl. (loquat) and *Pyrus pyrifolia* Nakai (nashi pear) (M. O'Donnell, pers. comm.).

Life history. Larvae bore in the fruits.

Economic importance. Of concern as a potential pest of fruits such as citrus and feijoa, although not a major pest in Australia.

Diagnosis. Similar to some endemic carposinids of the genus *Heterocrossa*. The male can be distinguished from these by the raised tuft of silky white scales towards the base of the forewing. The female may be distinguished from similar pale species such as *H. philpotti* Dugdale and *H. gonosemana* (Meyrick) by the dark marking that runs across the forewing at about 1 / 3; this is almost vertical in *C. improbana*, but oblique to L-shaped in the *Heterocrossa* species.

Remarks. This is one of a number of Australian species first recorded in New Zealand in 1999 (cf. '*Acrocercops*' *laciniella*, *Stegommata sulfuratella*, *Stathmopoda cephalaea*, *Holocola* sp. nov., *Culladia cuneiferellus*, *Trichophysetis* sp. nov.), suggesting a major 'invasion' event at some point during the previous one or two seasons.

20. *Culladia cuneiferellus* (Walker, 1863)
(Crambidae) (Fig. 21)

Country of origin and distribution. Australia: northern Queensland to southern N.S.W.

First New Zealand record. ND: Tapotupotu Bay nr Cape Reinga, 4 May 1999, 4 specimens (R.J.B. Hoare).

Additional New Zealand records. ND: Bayllys Beach, 18–19 Jan 2000, 9 at light; Woolleys Beach, 21 Jan 2000, 1 in dunes; AK: Karioitahi Beach, 4 Jan 2000, 2 at light; Titirangi, 4 May 2001, 2 at lit window, R. Hoare; WO: Ngatutura Point, 5 Jan 2000, 1 at light (all B. Patrick (OMNZ) unless otherwise stated).

Hostplant. Grasses, especially *Cynodon dactylon* (L.) Pers. (couch or bermuda grass).

Life history. Not fully documented. Probably lives in silken tubes close to the ground and emerges at night to feed.

Economic importance. May be damaging to dairy pastures and lawns, and considered a minor pest in Australia (Common, 1990).

Diagnosis. Distinctive amongst the New Zealand Crambinae in its nearly unicolorous dull greyish brown forewing without longitudinal markings, but with two strongly elbowed darker cross-lines beyond 1 / 2.

Remarks. *C. cuneiferellus* appears so far to be restricted to coastal habitats in northern New Zealand. Gaskin's (1973) placement of the New Zealand endemic '*Argyria*' *strophaea* Meyrick in *Culladia* is extraordinary and erroneous. Despite his comments, *strophaea* bears no significant resemblance

either superficially or genitally to members of this genus and is probably not even a crambine (pers. obs.).

21. *Trichophysetis* sp. nov. (Crambidae) (Fig. 22)

Country of origin and distribution. Probably Australia: Queensland.

First New Zealand record. ND: Paihia, 21 Jan 1999, R.A.B. Leschen, R.J.B. Hoare, G. Hall, 1 specimen.

Additional New Zealand records. AK: Browns Bay, Jan 1999, 1 specimen, R.J. Revell; Titirangi, Oct 1999, 2 specimens; Dec 1999, 4 specimens; Oct-Dec 2000, 3 specimens, R. Hoare; Mt Albert, Mar 2001, ca. 40 males in 2 pheromone traps, G. Clare.

Hostplant. Probably *Jasminum* spp., possibly also *Ligustrum* spp.

Life history. Larvae of other species in the genus have been found feeding on the fruits.

Economic importance. If the larvae feed on *Jasminum*, as do those of *T. neophyla* Meyrick and a related undescribed species represented in ANIC (see below), it may be of interest for the biological control of these weeds. For the possible occurrence on *Ligustrum*, see under Remarks.

Diagnosis. A very distinctive moth; the pale ground-colour, white crescentic discal spot, and the four wavy dark lines traversing the hind-wing separate it from all other New Zealand pyraloids. Rests with the wings held roof-wise, and with the hindwings partly exposed. Closely resembles an undescribed Australian species (see Remarks), but lacks the distinct situation in the terminal line of the forewing which gives the wings of this second species a falcate appearance.

Remarks. *Trichophysetis* currently contains about 25 species from the Indo-Australian region and one from the Canary Islands, but has not been revised (Robinson *et al.* 1994; M. Shaffer pers. comm.). The genus is referred to the subfamily Cybalomiinae, which is otherwise absent from New Zealand. There are five Australian *Trichophysetis* species represented in ANIC, one of them undescribed. The current species does not appear to have been collected in Australia, but it closely resembles the undescribed species in ANIC, and is presumed to be Australian. *T. cretacea* (Butler) from Japan also appears to belong to the same species group. In Auckland, adults have been observed in areas with little or no *Jasminum*, but with plenty of *Ligustrum* (privet), another genus

of Oleaceae. The privet berries in these localities showed plentiful signs of lepidopterous feeding (frass and webbing). A collection of berries made in autumn 2000 yielded only *Epiphyas postvittana* (Walker) (Tortricidae), but it still seems likely that some of the damage to privet may be caused by the cybalomiine.

22. *Glyphodes* cf. *onychinalis* (Guenée, 1854) (Crambidae) (Fig. 23)

Country of origin and distribution. From India to northern Australia (chiefly Queensland and Northern Territory).

First New Zealand record. AK: Henderson, Nov 1986, J.S. Dugdale.

Additional New Zealand records. AK: Lynfield, 1991 (reared), B.A. Holloway & G. Kuschel; Mt Albert, 1989 (P.A. Maddison); Birkdale, Mar 1996, J. Walters; Titirangi, 1999, R. Hoare; Mt Roskill, B. Parkinson.

Hostplant. Swan-plant (*Gomphocarpus* spp.) and *Hoya bella* Hook. (Asclepiadaceae). The latter is an indoor plant: one specimen of *G. onychinalis* was reared from a larva found feeding on this plant in Mt Roskill, AK.

Life history. The larvae have been found in Auckland feeding on the flowers.

Economic importance. None.

Diagnosis. A delicately marked crambid moth with long antennae, and rather intricate white markings on a grey-brown background. The wings are somewhat glossy or pearly in appearance.

Remarks. This moth is often found indoors, presumably attracted to light. *Gomphocarpus* (swan-plant) is a South African plant genus commonly grown in gardens to attract oviposition by Monarch butterflies (*Danaus plexippus* L.). It is assumed that the natural host of *G. onychinalis* is another member (or members) of the Asclepiadaceae.

Specimens under the name *Glyphodes onychinalis* in the ANIC differ from New Zealand specimens in having more conspicuous yellow markings along the forewing costa, and a greater area of white ground-colour, especially on the hindwings. The differences may indicate that our species is not the true *onychinalis*.

23. *Herpetogramma licarsialis* (Walker, 1859) (Crambidae) Grass webworm, Sod webworm (Fig. 24)

Country of origin and distribution. Very widespread. South Palaearctic, Ethiopian, Oriental and Australian regions, including Rapa I. in the Pacific. Established in southern Europe (Spain, Portugal and Canary Is.) since 1997, and recently recorded as a migrant in Britain for the first time (Goater & Knill-Jones 1999).

First New Zealand record. AK: Henderson, 1–4 May 1986, J.S. Dugdale, C.J. Green, 4 specimens at light (first record of landfall in New Zealand: an earlier record is from the Sedco oil-rig, 40km west of Taranaki coast, 16 Jan 1970 (Fox 1970)).

Additional New Zealand records. AK: Mt Albert, 9 May 1989, P.A. Maddison. In 1999 recorded from:- TH: Great Island, Tasman Stream; ND: Cape Reinga; Herekino Forest (Kaitaia Walkway); Kaitaia; Ahipara; Houhora; Waipapakauri; AK: Titirangi; NN: Pigeon Saddle; Oparara Gorge.

Hostplant. Grasses (Poaceae), including kikuyu (*Pennisetum clandestinum* Chiov.) and bermuda grass (*Cynodon* spp.), as well as rice (*Oryza*), maize (*Zea*) and millets (*Sorghum* spp.).

Life history. Described in detail by Tashiro (1976). Eggs are flattish and laid in small groups on the host-plant. They hatch in 3–5 days. The larva lives in a silk-lined tube spun amongst rolled leaves of the host-plant and emerges at night to feed on the foliage and culms. Within the tube, like most crambid and pyralid larvae, it can move equally easily forwards and backwards. When full-grown, the larva is about 20 mm long, light brown to light green in colour and somewhat translucent, with rings of conspicuous dark brown pinacula; the head is light brown with darker markings, and the prothoracic plate a paler brown. Pupates in a loosely woven cocoon, incorporating frass and plant debris, at ground level, and emerges under favourable conditions in about a week.

Economic importance. A serious grass pest in certain parts of the tropics, especially Hawaii, and caused substantial damage to pastures in parts of northern Northland during 1999.

Diagnosis. A relatively large, broad-winged dull brown crambid with a pair of inconspicuous wavy cross-lines on the forewing; the first discal spot is dot-like and the second discal comma-shaped. The male has a tuft of hair-scales towards the base of the forewing costa which is diagnostic. The only species likely to be confused with *H. licarsialis* in New Zealand is the endemic *Proternia philocapna*

Meyrick: *P. philocapna* is a smaller moth with the postmedian line much more strongly toothed than in *H. licarsialis*: it also has the discal spots rounded.

Remarks. Although first captured on the New Zealand mainland in 1986, this species was not noted again until 1999, apart from a single 1989 record. In 1999, it built up very large populations in some areas of Northland and was also recorded as far south as Auckland in the North Island and in north-west Nelson. Populations declined over the winter of 1999 in Northland (Hardwick *et al.* 2000), and although the moth is likely to have been temporarily established in the Auckland and north-west Nelson districts during the summer of 1999, these populations probably died out completely over the winter. In 2000, the species was only recorded from northern Northland (J.J. Dymock pers. comm.).

24. *Papilio xuthus* Linnaeus, 1767 (Papilionidae) Japanese swallowtail (Fig. 25)

Country of origin and distribution. Korea, Taiwan, Burma, northern and central China, eastern Russia and Japan.

First New Zealand record. Kaikorai Valley Dunedin DN, 7 Mar 1996, C. Patrick (OMNZ).

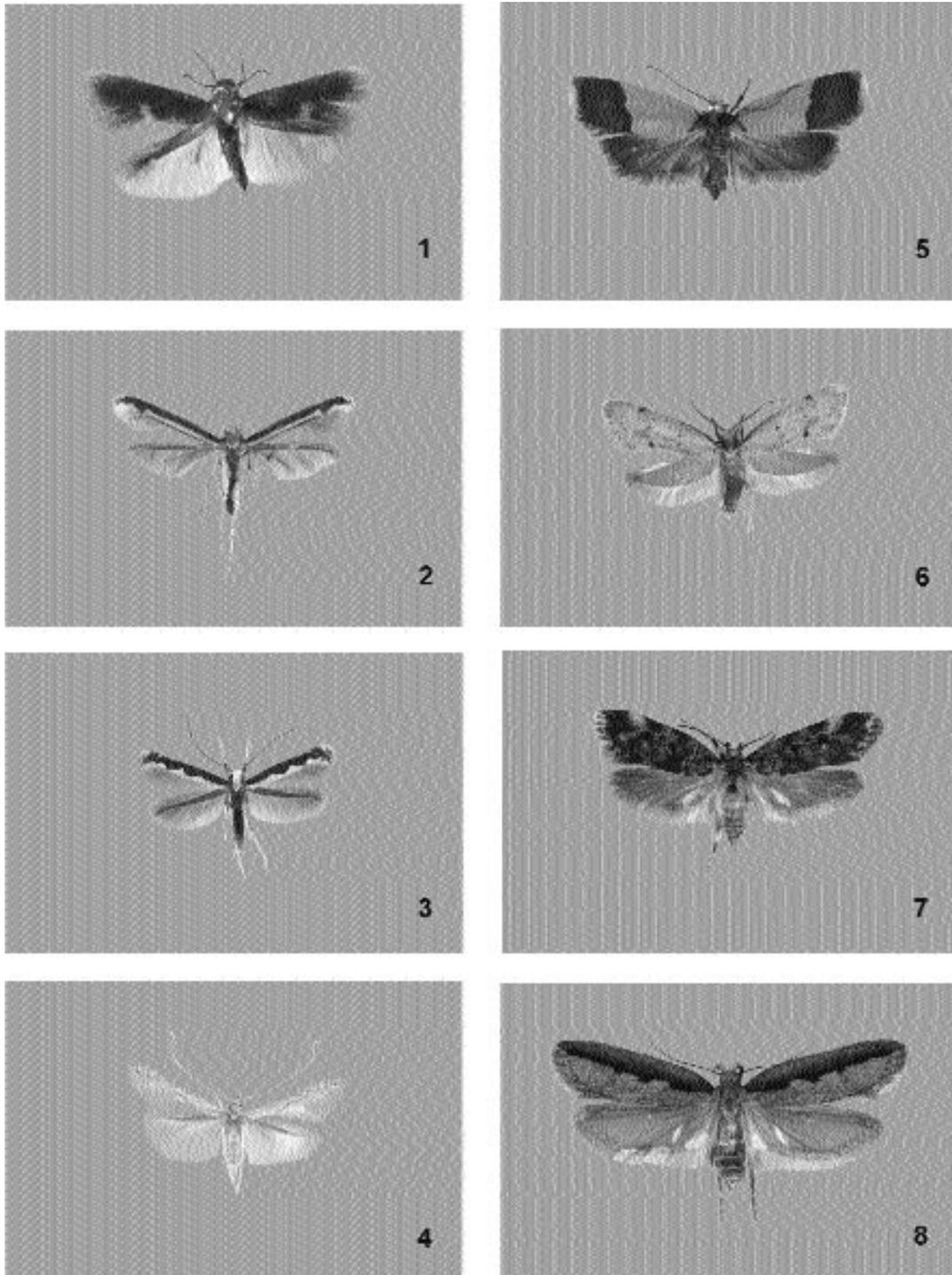
Additional New Zealand records. None.

Hostplant. Rutaceae, including *Poncirus trifoliata* Rafin., *Phellodendron amurense* Rupr., *Zanthoxylum ailanthoides* Sieb. & Zucc., *Z. nitidum* (Roxb.) DC., *Citrus* spp. and *Evodia rutaecarpa* Hook. f. & Thoms. (Chou 1994).

Life history. The larva is described as bright green, with a grey white-marked transverse band on the metathorax and on abdominal segments 2 and 9; a similar oblique band over abdominal segments 4 and 5, and large white spots above the prolegs. It can be found from June to November. The chrysalis is green or brown, with the anterior abdominal segments swollen and carinate laterally, head processes strongly developed, and an obtuse somewhat thorn-like process on the thorax (Jordan 1908). The life history has been illustrated in colour by Harry (1994). The main flight period of the adult is July and August, but some specimens emerge as early as May; these early specimens tend to be smaller.

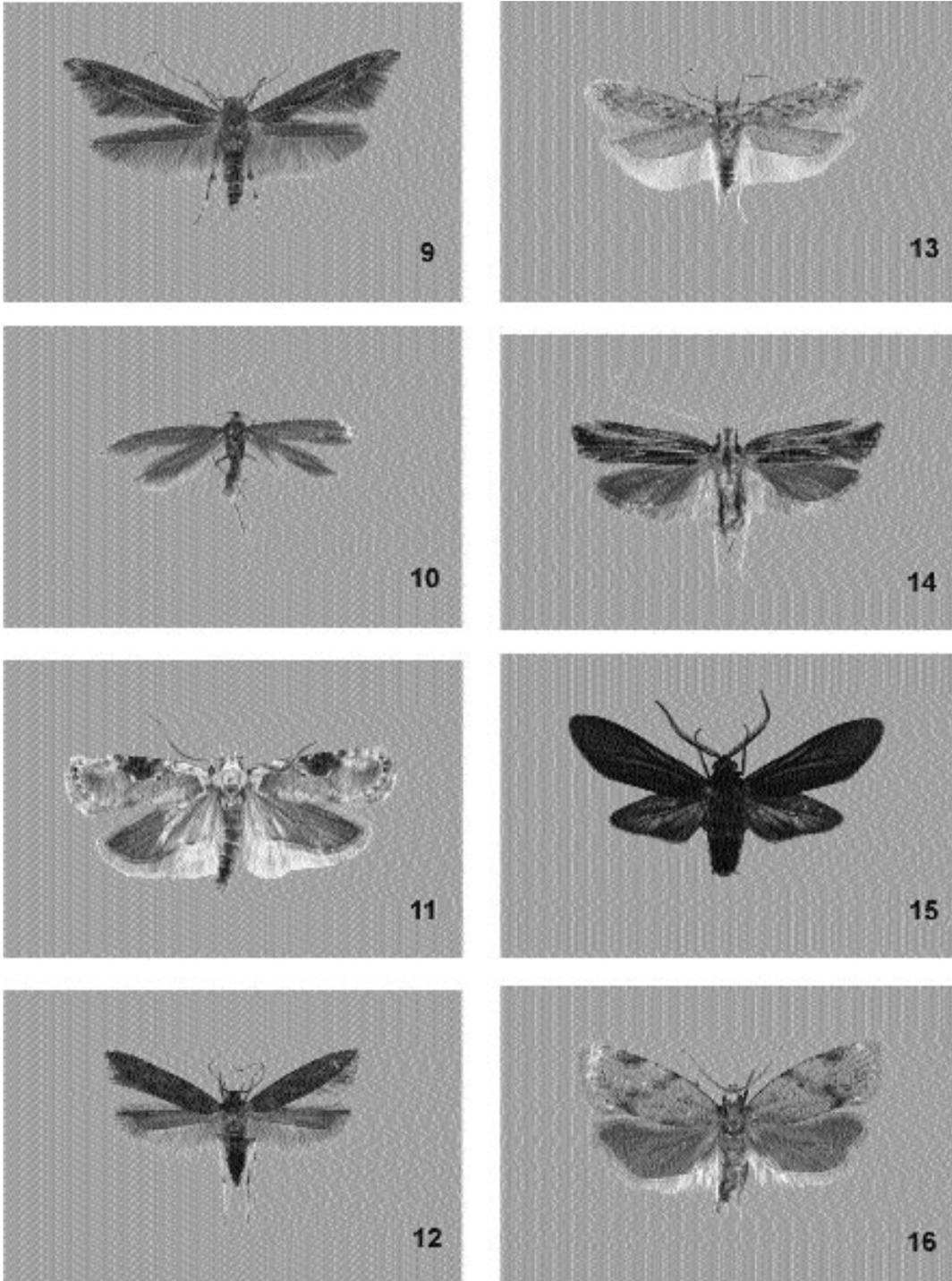
Economic importance. Not considered a pest in its native range.

Diagnosis. Impossible to confuse with any



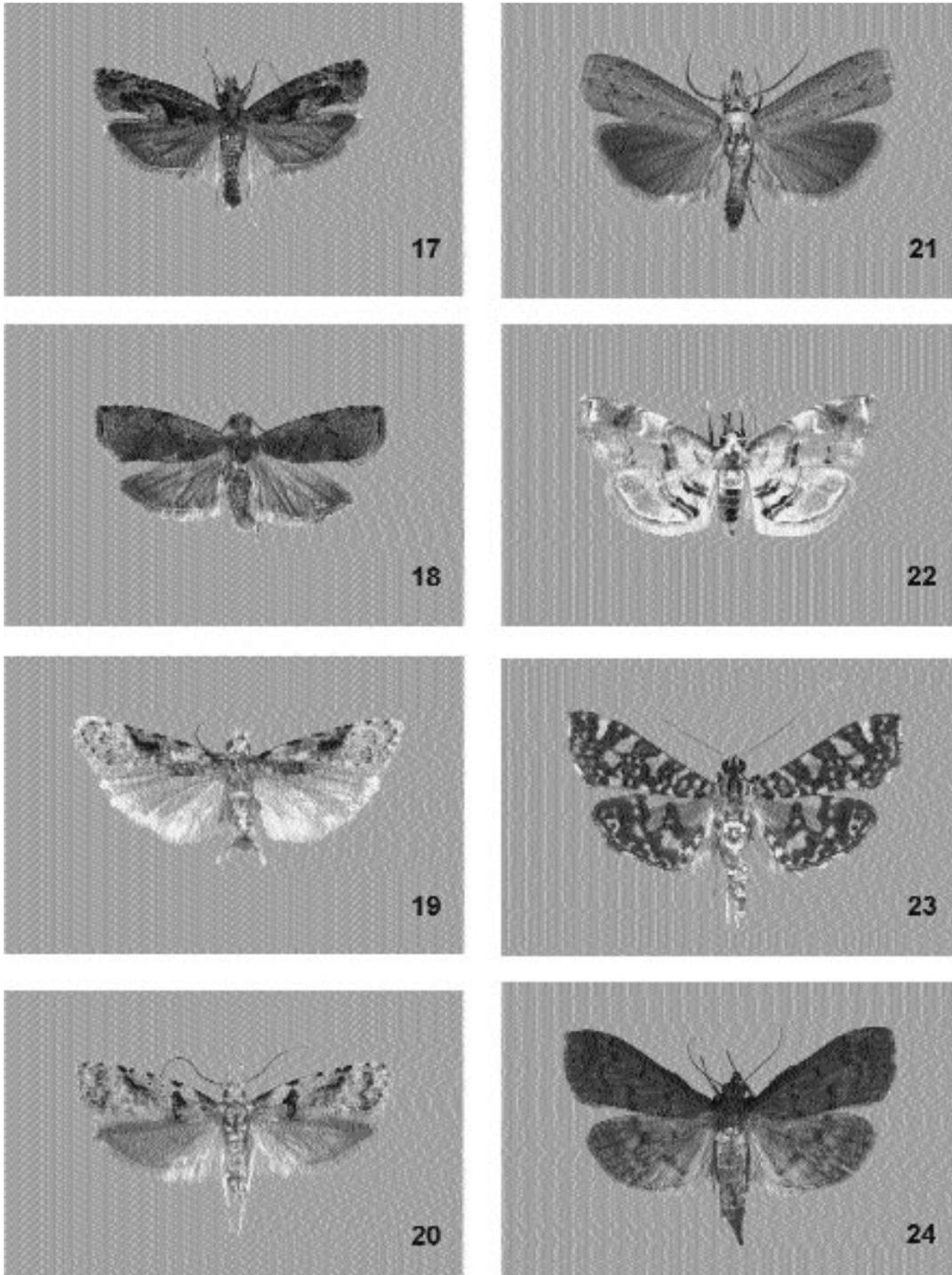
Figs 1-8. Heliozelidae, Gracillariidae, Lyonetiidae, Oecophoridae (wingspan in parentheses).

- 1,** *Heliozela catoptrias*™ (3 mm); **2,** *'Acrocercops' laciniella* ♀ (7.5 mm); **3,** *Dialectica scalariella*™ (8 mm); **4,** *Stegommata sulfuratella* ♀ (9 mm); **5,** *Heteroteucha dichroella*™ (22 mm); **6,** *Atalopsis* sp. nov. ♀ (10.5 mm); **7,** *Barea codrella*™ (21 mm); **8,** *Leptocroca sanguinolenta*™ (27 mm)
-



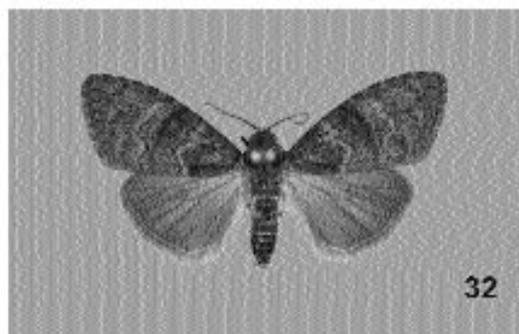
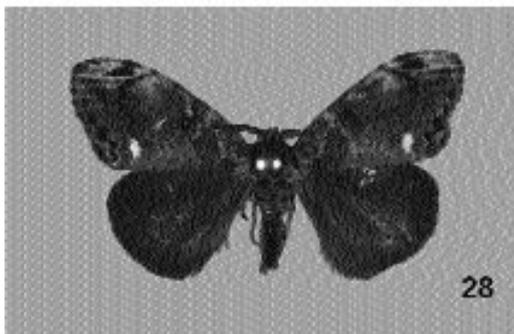
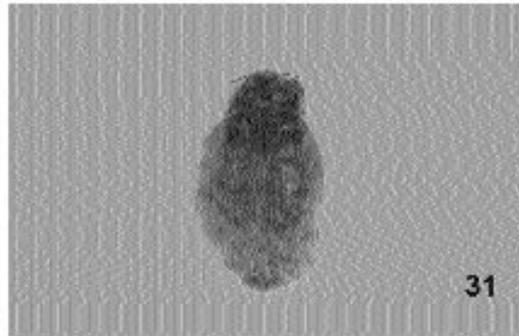
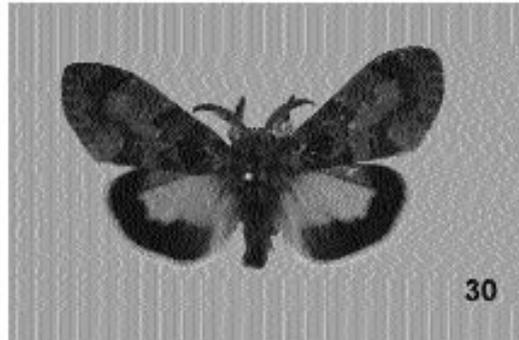
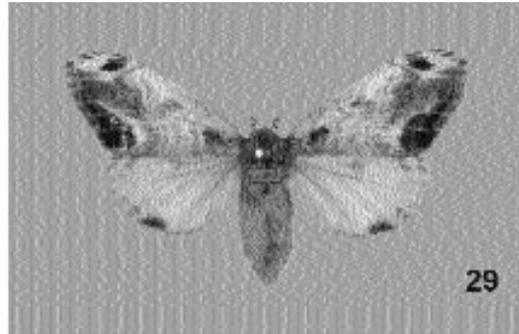
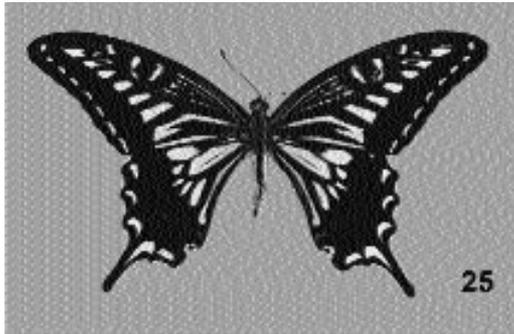
Figs 9-16. Oecophoridae, Coleophoridae, Depressariidae, Gelechiidae, Lecithoceridae, Zygaenidae, Tortricidae (wingspan in parentheses).

9, *Stathmopoda cephalaea* [™] (18 mm); **10,** *Coleophora striatipennella* ♀ (12 mm); **11,** *Agonopterix alstromeriana* ♀ (18.5 mm); **12,** *Monochroa* sp. ♀ (11 mm); **13,** *Scrobipalpa obsoletella* ♀ (12 mm); **14,** *Sarisophora leucoscia* [™] (17 mm); **15,** *Artona martini* ♀ (20 mm). **(16)** *Merophyas divulsana* ♀ (15 mm).



Figs 17-24. Tortricidae, Carposinidae, Crambidae (wingspan in parentheses).

17, *Holocola* sp. nov. ♀ (12 mm); **18,** *Zomariana doxasticana* ♀ (15.5 mm); **19,** *Coscinoptycha improbana* ♀ (17.5 mm); **20,** *C. improbana* TM (17.5 mm); **21,** *Culladia cuneiferellus* ♀ (16.5 mm); **22,** *Trichophysetis* sp. ♀ (14 mm); **23,** *Glyphodes onychinalis* TM (19.5 mm); **24,** *Herpetogramma licarsisalis* ♀ (26 mm).



Figs 25-32. Papilionidae, Sphingidae, Noctuidae, Lymantriidae, Nolidae (wingspan in parentheses).

25, *Papilio xuthus* ♀ (90 mm); **26,** *Cizara ardeniae* ♀ (56 mm); **27,** *Chasmina* sp. ♀ (39 mm); **28,** *Orgyia thyellina* ♀ (31.5 mm); **29,** *O. thyellina* ♂ (35 mm); **30,** *Teia anartoides* ♀ (23 mm); **31,** *T. anartoides* ♂ (length 16 mm); **32,** *Uraba lugens* ♀ (24 mm).

native New Zealand butterfly; similar to the Palearctic *P. machaon* Linnaeus, from which it differs in the more restricted area of the yellow ground-colour, and in having 3 longitudinal black streaks in the discal cell of the forewing (2 in *P. machaon*).

Remarks. The only specimen recorded in New Zealand was found freshly emerged in a used vehicle yard (Patrick 1996). The yard had received a shipment of Japanese vehicles within the previous three weeks and the butterfly had undoubtedly been imported as a pupa on one of these. The species is very common in Japan. *P. xuthus* is an established adventive in Hawaii, where it was first recorded in 1971 (Ehrlich 1976).

25. *Cizara ardeniae* (Lewin, 1805) (Sphingidae)
(Fig. 26)

Country of origin and distribution. Australia: Cairns, Queensland south to coastal southern N.S.W.

First New Zealand record. CO: Naseby, Feb 1982, one captured by Ms L. McPhee (Harris 1990) (OMNZ).

Additional New Zealand records. None.

Hostplant. Rubiaceae, including *Morinda jasminoides* A. Cunn., *Myrmecodia beccarii* Hook. f. (ant plant) and *Coprosma* spp., including the New Zealand species *C. repens* A. Rich. and *C. lucida* J.R. & G. Forst., introduced to Australia as garden plants (Moulds 1984; Common 1990). Records from plants other than Rubiaceae are almost certainly erroneous: the record from *Cissus* (Vitaceae) is based on the vague reference in Froggatt (1907) to 'native vine' as a host, and the records from *Embothrium* and *Grevillea* (both Proteaceae) are based on Lewin (1805). Without further evidence, these records should be discounted.

Life history. The larva is described as brown, finely dotted with white, with a light subdorsal stripe, the anterior segments below the stripe deep blackish brown, and the posterior horn large and rough (Seitz, 1928-9). It feeds on the foliage of the host-plants, but no detailed account of the life history has been published.

Economic importance. None.

Diagnosis. Very distinctive and unlikely to be confused with the few other sphingids that occur in New Zealand.

Remarks. The Australian hosts are unlikely to be

imported to New Zealand, and the specimen from Naseby was probably a migrant. Given the larval records from New Zealand species of *Coprosma*, it is possible that this moth could eventually become established here in favourable situations.

26. *Chasmina* sp. (Noctuidae) (Fig. 27)

Country of origin and distribution. The genus is widespread in the Oriental and Australian regions and has 4 species in Australia.

First New Zealand record. AK: Auckland, Mt Albert, 1 in light trap, 5 Jan 1986, D.J. Allan.

Additional New Zealand records. None.

Hostplant. Not known. The Australian *C. pulchra* has been reared from *Brachychiton populneus* (Schott) R. Br. (Sterculiaceae) (Common 1990).

Life history. Not known.

Economic importance. None.

Diagnosis. Amongst New Zealand moths, unmistakable: an all-white noctuid with a greenish tinge to the forewings.

Remarks. This species is unusual amongst the genus in having a short third segment of the labial palp and lacking spots on the fore-tibia. Comparison with the Australian and New Guinean *Chasmina* material in ANIC and with Pacific Islands material in NZAC has yielded no matching specimens. Similarly, there appear to be no conspecific specimens in BMNH (I. Kitching pers. comm.). Thus the identity and origin of the New Zealand specimen remains an enigma. It is possible that it represents an undescribed Australian taxon that has not yet been collected in its country of origin (cf. Remarks under *Trichophysetis* sp. nov. above).

27. *Orgyia thyellina* Butler, 1881 (Lymantriidae)
White-spotted Tussock Moth (Figs 28, 29)

Country of origin and distribution. South-east Asia: Japan, Korea, Taiwan and China.

First New Zealand record. AK: widespread in eastern suburbs by April 1996, when it was first detected.

Additional New Zealand records. None.

Hostplant. In its native range, mainly Rosaceae, including mulberry (*Morus* sp.), pear (*Pyrus* spp.), cherry (*Prunus avium* L.), plum (*Prunus domestica* L.) and apple (*Malus* spp.). In New Zealand also recorded on rose (*Rosa* spp.), peach (*Prunus persica* (L.) Batsch), willow (*Salix* spp.), birch (*Betula* spp.), oak

(*Quercus* spp.), ash-leaved maple (*Acer negundo* L.), *Wisteria*, coral pea (*Kennedia*), kakabeak (*Clianthus puniceus* (G. Don) Sol. ex Lindl.) and grapefruit (*Citrus x paradisi* Macfad.).

Life history. The life history was described by Sato (1977). In its native range, *O. thyellina* has two to three generations per year. The females of the final generation before winter are brachypterous and flightless; they lay eggs that overwinter and hatch in the spring. Females from the other generation(s) are fully winged and capable of flight. The larva is a typical tussock caterpillar, blackish and strongly setose, with a red line along each side, and four tufts of pale hairs along the back. The male larva has five instars; that of the female has six.

Economic importance. Not considered a major pest in its native range, although occasional outbreaks may occur. As with other Lymantriidae, its polyphagous larvae and high reproductive rate make it of concern as a potential pest in New Zealand.

Diagnosis. Superficially only likely to be confused with *Teia anartoides* (Painted apple moth), the only other tussock moth to have been recorded in New Zealand. *O. thyellina* can be distinguished by the pale tufts on the back of the larva (greyish to brownish in *T. anartoides*), by the presence of noticeable wings even in the brachypterous form of the female (*T. anartoides* females are completely wingless), and by the larger males, which have all-dark hindwings (orange bordered with black in *T. anartoides*).

Remarks. The moth was certainly accidentally imported to New Zealand, probably up to a year before it was first detected here. An eradication campaign in spring 1996, involving aerial spraying of *Bacillus thuringiensis* var. *kurstaki* over the infested area of Auckland, appears to have been successful, and no further records of the moth have been made.

28. *Teia anartoides* Walker, 1855 (Lymantriidae) Painted Apple Moth (Figs 30, 31)

Country of origin and distribution. Australia: southern Queensland to Victoria, South Australia, Tasmania.

First New Zealand record. DN: Dunedin, 10 Jun 1983, cocoons and eggs, moths reared (Harris 1988). AK: Glendene, 5 May 1999, C. Scott, male flying by day.

Additional New Zealand records. AK: Glendene, larvae and pupae common, mainly on *Paraserianthes lophantha*, 6 May 1999, moths reared.

Still established and widespread in west Auckland, summer 2001; a second population in Mt Wellington appears to have a less firm foothold.

Hostplant. Polyphagous. In Australia native hosts include *Acacia* spp. (Mimosaceae), *Hardenbergia*, *Indigophora* and *Sesbania* (Fabaceae), *Eucalyptus* (Myrtaceae), and *Duboisia* (Solanaceae); introduced hosts include *Malus* (apple), *Pyrus* (pear), *Rosa* (rose), *Prunus* spp., *Cotoneaster* (Rosaceae), *Lupinus* (lupin) (Fabaceae), *Paraserianthes* (Mimosaceae), *Lantana* (Verbenaceae), *Salix* (willow) (Salicaceae) *Cupressus* (Cupressaceae) and *Pinus radiata* D. Don (Pinaceae) (Common 1990). In New Zealand, recorded hosts include the introduced *Paraserianthes lophantha* (Willd.) I. Nielsen, *Acacia longifolia*, *A. mearnsii* De Wild., *Acacia dealbata* A. Cunn., *Prunus* spp., *Salix*, *Geranium*, *Platanus acerifolia* Willd., *Schinus molle* Hort. ex Engl. (Anacardiaceae), *Lotus* sp., *Cytisus multiflorus* (Aiton) Sweet (Fabaceae) and the endemic *Sophora microphylla* Ait. (kowhai) (Fabaceae) and *Plagianthus regius* Hochr. (Malvaceae).

Life history. The eggs are greyish and laid in a mass on the cocoon of the female. The larva was described in detail by Riotte (1979): it resembles that of *Orgyia thyellina* except that the tufts on abdominal segments 1–4 are greyish or brownish rather than whitish. Female larvae and pupae are considerably larger than those of males. The larva feeds on the leaves of the host, and the cocoon is formed on the host, adjacent vegetation, walls of houses, etc.

Economic importance. Although the favoured host-plants are acacias and their relatives (Mimosaceae), this species is considered a pest of economic concern because of the wide range of other hosts that the polyphagous larva will sometimes attack. The natural rate of spread is relatively slow, as the chief means of dispersal is by crawling first instar larvae (Harris 1988), but accidental transport by human agency can of course make a considerable difference.

Diagnosis. The differences between this species and *Orgyia thyellina* have been treated under that species (q.v.). The only other moth that might be confused with the male of *T. anartoides* is *Cebysa leucotelus* Walker (Psychidae), another Australian adventive with dark forewings and orange and black hindwings. As in *Teia*, the male of *C. leucotelus* flies rapidly in sunshine. *C. leucotelus* can be easily distinguished by its smaller size (wingspan 16 mm against 22 mm for *T. anartoides*) and the presence of orange spots along the forewing costa (no orange on the forewing of *T. anartoides*).

Remarks. The Dunedin introduction in 1983 did not lead to establishment of a population of this moth. The current Auckland populations are being closely monitored by MAF with a view to eradication.

29. *Uraba lugens* Walker, 1863 (Nolidae)
(Fig. 32)

Country of origin and distribution. Australia: northern Queensland (Cooktown to Atherton tableland), southern Queensland to Victoria, Tasmania, South Australia and south-western Western Australia.

First New Zealand record. BP: Mt Maunganui Golf Course, 13 Jun 1997, leaves of *Eucalyptus nitens* skeletonized, and small piece of shed larval skin recovered, J. Bain.

Additional New Zealand records. Further records of eggs, larvae and larval damage from Mt Maunganui up to 14 Jan 2001; larvae last found on 10 Oct 2000.

Hostplant. Myrtaceae, chiefly *Eucalyptus* spp. (Common 1990); in New Zealand recorded from *Eucalyptus cinerea* Benth., *E. crenulata* Blakely & Beuzev., *E. ficifolia* F. Muell., *E. globulus* Labill., *E. macarthurii*, *E. macrocarpa* Hook., *E. maidenii* F. Muell., *E. nicholii* Maiden & Blakely, *E. nitens*, *E. saligna* and *Lophostemon confertus* (R. Br.) P.G. Wilson & J.T. Waterhouse.

Life history. Larvae feed gregariously on the leaves of the host, skeletonizing them. The hairy larva is characteristic in that the cast head-capsules of earlier instars remain attached to the thorax in a vertical column (Common 1990: fig. 54.8), and are later often incorporated in the cocoon. The setae arising from the dorsal tubercles on the last two thoracic segments and on the abdomen of the larva are poisonous and contain histamine; contact with the skin produces a sharp stinging sensation followed by a persistent itchy rash (Common 1990).

Economic importance. In Australia, can occasionally cause considerable damage to *Eucalyptus* by defoliation (Common 1990), but not a major pest.

Diagnosis. The larva is easily diagnosed by its long setae, and the stacked head-capsules on the thorax. The adult has not been taken at large in New Zealand, but the typical noline forewing shape (short, broad and subtriangular) together with the dark coloration, and the two irregular transverse lines, should distinguish it from any other New Zealand taxon.

Remarks. Despite spraying of the Mt Maunganui infestation, a small population of *U. lugens* may possibly persist there.

Acknowledgements

Many people have assisted greatly with this manuscript by providing unpublished records including details of host-plants and life-histories of the taxa treated. I am particularly grateful to the following for their generous help in this respect: Toni Withers (Forest Research), Maurice O'Donnell (MAF), Brian Patrick (Otago Museum) and John Dugdale (Landcare Research). Several of the species could not have been identified without the help of specialists outside New Zealand, and I am very grateful to Michael Shaffer and Klaus Sattler (British Museum) and Ted Edwards (CSIRO Entomology, Canberra) for their contributions in this respect. I would also like to thank Ian Kitching and Martin Honey (British Museum) for their attempt to identify the mysterious *Chasmina* sp. The following provided additional information that has been of great value in putting together the manuscript: Graeme Clare and John Charles (Hort Research), Chris Winks (Landcare Research) and Jenny Dymock. Martin Heffer (Hort Research) very kindly photographed the specimens illustrated. I would also like to acknowledge the important contribution of the collectors who have made first records of species for New Zealand, especially Chris Scott (Forest Research), John Dugdale and Brian Patrick. Likewise, Graeme White's careful observations led to the discovery of *Coleophora striatipennella* in his and other New Zealand collections. John Dugdale and Brian Patrick made many useful comments on an earlier draft of this manuscript, and Richard Leschen and Jo Berry on a later draft. This study was funded under FRST contract no. CO9X0002.

References

- Berenbaum M, Passoa S. 1983.** Notes on the biology of *Agonopterix alstroemeriana* (Clerck), with descriptions of the immature stages (Oecophoridae). *Journal of the Lepidopterists' Society* 37 (1): 38–45.
- Bishop AL. 1984.** *Heliothis* spp. and *Merophyas divulsana* (Walker) in the seasonal damage of lucerne in the Hunter Valley, New South Wales. *General Applied Entomology* 16: 36–44.
- Chou I. 1994.** *Monographia Rhopalocerorum Sinensium*. Henan Science & Technology Press, Zhengzhou, Henan, China. 854 pp.
- Common IFB. 1990.** *Moths of Australia*. Melbourne University Press. 535 pp., 32 pl.
- Common IFB. 1994.** *Oecophorine Genera of Australia I. The Wingia group (Lepidoptera: Oecophoridae)*.

- Monographs on Australian Lepidoptera 3, CSIRO Publishing, Collingwood, Victoria, Australia. 390 pp.
- Common IFB. 2000.** *Oecophorine Genera of Australia III. The Barea Group and Unplaced Genera (Lepidoptera: Oecophoridae)*. Monographs on Australian Lepidoptera 8, CSIRO Publishing, Collingwood, Victoria, Australia. 453 pp.
- Crosby TK, Dugdale JS, Watt JC. 1998.** Area codes for recording specimen localities in the New Zealand subregion. *New Zealand Journal of Zoology* 25: 175–183.
- Dugdale JS. 1988.** Lepidoptera- annotated catalogue, and keys to family-group taxa. *Fauna of New Zealand* 14. 262 pp.
- Dugdale JS. 1989.** A preliminary note on Incurvarioidea in New Zealand. *New Zealand Journal of Zoology* 16: 277–281.
- Ehrlich PR. 1976.** *Papilio xuthus* (Papilionidae) in Hawaii. *Journal of the Lepidopterists' Society* 30(2): 149–150.
- Emmet AM. 1988.** *A field guide to the smaller British Lepidoptera*. British Entomological and Natural History Society, London. 288 pp.
- Emmet AM, Langmaid JR, Bland KP, Corley MFV, Razowski J. 1996.** Coleophoridae. Pp. 126–338 In: *The Moths and Butterflies of Great Britain and Ireland*. Volume 3. (ed AM Emmet). Harley Books, Colchester, Essex, U.K. 452 pp., 17 pl.
- Fox KJ. 1970.** More records of migrant Lepidoptera in Taranaki and the South Island. *New Zealand Entomologist* 4 (4): 63–66.
- Fox KJ. 1975.** Migrant Lepidoptera in New Zealand. *New Zealand Entomologist* 6 (1): 66–69.
- Fox KJ. 1978.** The transoceanic migration of Lepidoptera to New Zealand – a history and hypothesis on colonisation. *New Zealand Entomologist* 6 (4): 368–380.
- Froggatt WW. 1907.** *Australian Insects*. William Brooks & Co., Sydney. 449 pp.
- Gaskin DE. 1973.** Revision of New Zealand Chilonini (Lepidoptera: Pyralidae) and redescription of some Australian species. *New Zealand Journal of Science* 16: 435–463.
- Gibbs GW. 1980.** *New Zealand Butterflies: Identification and Natural History*. Collins, Auckland, Sydney, London. 207 pp.
- Gill GSC. 2000.** A first record of *Artona (Balataea) martini* (Lepidoptera: Zygaenidae) for New Zealand. *New Zealand Entomologist* 23: 33–35.
- Goater B, Knill-Jones SA. 1999.** *Herpetogramma licarsisalis* (Walker, 1859) (Lepidoptera: Pyralidae), the Grass Webworm, new to Britain. *Entomologist's Gazette* 50 (2): 71–74.
- Hardwick S, Baltus JG, Willoughby BE. 2000.** Seasonal distribution of *Herpetogramma licarsisalis* (Walker) (Lepidoptera: Pyralidae) in northern Northland. *New Zealand Entomologist* 23: 77–83.
- Harris AC. 1988.** A first record of the painted apple moth *Teia anartoides* (Lepidoptera: Lymantriidae) intercepted in New Zealand. *New Zealand Entomologist* 11: 68–70.
- Harris AC. 1990.** A specimen of *Cizara ardeniae* (Lepidoptera: Sphingidae) captured at Naseby, Central Otago. *New Zealand Entomologist* 13: 38–39.
- Harry JL. 1994.** *Papilio xuthus* in Hawaii: a photo life history (Lepidoptera: Papilionidae). *Tropical Lepidoptera* 5(1): 6–7.
- Jordan K. 1908–09.** Papilionidae, swallowtails. In: *The Macrolepidoptera of the World*. 9. *The Indo-Australian Rhopalocera*. (ed A Seitz), pp. 11–109, pls 1–49. Alfred Kernen Verlag, Stuttgart. 2 vols, viii + 1197 pp., 177 pls.
- Kristensen NP. (ed) 1999.** *Lepidoptera, moths and butterflies Vol 1: Evolution, Systematics and Biogeography*. Handbuch der Zoologie Vol. IV Part 35. 490 pp.
- Kumata T, Horak M. 1997.** The native *Dialectica aemula* (Meyrick) and the introduced *Dialectica scariella* (Zeller) (Lepidoptera: Gracillariidae) in Australia: characterisation of two closely related species on Boraginaceae. *Australian Journal of Entomology* 36 (1): 25–35.
- Lewin JW. 1805.** *Prodromus Entomology. Natural History of Lepidopterous Insects of New South Wales*. T. Bensley, London. 18 pls and text (letterpress).
- Meyrick E. 1897.** Descriptions of Australian Microlepidoptera. XVII. Elachistidae. *Proceedings of the Linnaean Society of New South Wales* 22: 297–435.
- Meyrick E. 1928.** *A Revised Handbook of British Lepidoptera*. London. 914 pp.
- Moore KM. 1959.** Observations on some Australian forest insects. 3. The biology and larval taxonomy of some Lepidoptera attacking trees and timber. *Australian Zoologist* 12 (4): 337–350, pls 41–43.
- Moore KM. 1963.** Observations on Australian forest insects. 11. Two species of lepidopterous leaf-miners attacking *Eucalyptus pilularis* Smith. *Australian Zoologist* 13: 46–53.
- Moulds MS. 1984.** Larval food plants of Hawk Moths (Lepidoptera: Sphingidae) affecting garden ornamentals in Australia. *General Applied Entomology* 16: 57–64.
- Nielsen ES. 1996.** Heliozelidae. In: *Checklist of the Lepidoptera of Australia*. Monographs on Australian Lepidoptera 4, (eds ES Nielsen, ED Edwards & V Rangsi). p 29. CSIRO Publishing, Collingwood, Victoria, Australia. 529 pp + CD-Rom.
- Nielsen ES, Edwards ED, Rangsi V. (eds) 1996.** *Checklist of the Lepidoptera of Australia*. Monographs on Australian Lepidoptera 4, CSIRO Publishing,

- Collingwood, Victoria, Australia. 529 pp + CD-Rom.
- Patrick BH. 1996.** Japanese Swallowtail in New Zealand. *The Weta* 18 (1): 3–4.
- Patrick BH, Dugdale JS. 1994.** Australian lucerne leafroller, *Merophyas divulsana* (Lepidoptera: Tortricidae) in New Zealand. *New Zealand Journal of Zoology* 21 (3): 305–308.
- Patrick BH, Dugdale JS. 2000.** *Conservation Status of the New Zealand Lepidoptera*. Science for Conservation 136. Department of Conservation, Wellington, New Zealand.
- Powell JA. 1991.** Rapid colonization of the western United States by the Palaearctic moth *Agonopterix alstroemeriana* (Oecophoridae). *Journal of the Lepidopterists' Society* 45 (3): 234–236.
- Riotte JCE. 1979.** Australian and Papuan tussock moths of the *Orgyia* complex (Lepidoptera: Lymantriidae). *Pacific Insects* 20 (2-3): 293–311.
- Robinson GS, Tuck KR, Shaffer M. 1994.** *A Field Guide to the Smaller Moths of South-East Asia*. The Natural History Museum, London. 309 pp., 32 pls.
- Sato T. 1977.** Life history and diapause of the white spotted tussock moth *Orgyia thyellina* Butler (Lepidoptera: Lymantriidae). *Japanese Journal of Applied Entomology* 21(1): 6–14.
- Seitz A. 1928-29.** Family Sphingidae. In: *The Macrolepidoptera of the World*. 10. *Bombyces and Sphinges of the Indo-Australian Region*. (ed A Seitz). Pp. 523–576. Alfred Kern Verlag, Stuttgart. 2 vols, 909 pp, 100 pls.
- Sokoloff PA, Bradford ES. 1993.** The British species of *Monochroa*, *Chrysoesthia*, *Ptocheuusa* and *Sitotroga* (Lepidoptera: Gelechiidae). *British Journal of Entomology and Natural History* 6(2): 37–44.
- Tashiro H. 1976.** Biology of the grass webworm, *Herpetogramma licarsisalis* (Lepidoptera: Pyraustidae) in Hawaii. *Annals of the Entomological Society of America* 69: 797–803.
- Tomlinson AI. 1973.** Meteorological aspects of trans-Tasman insect dispersal. *New Zealand Entomologist* 5 (3-4): 253–268.
- Wapshere AS, Kirk AA. 1977.** The biology and host specificity of the Echium leaf-miner *Dialectica scariella* (Zeller) (Lepidoptera: Gracillariidae). *Bulletin of Entomological Research* 67: 627–633.
- Whittle CP, Bellas TE, Bishop AL. 1991.** Sex pheromone of lucerne leafroller, *Merophyas divulsana* (Walker) (Lepidoptera: Tortricidae): evidence for two distinct populations. *Journal of Chemical Ecology* 17: 1883–1895.
- Withers T. 1999.** *Information Sheet on New Eucalyptus Leafminer*. Forest Research. 1 p.

Yen S-H, Jean J-L, Yang P-S. 1996. On two *Artona* species from Taiwan (Lepidoptera: Zygaenidae, Procrudinae). *Entomologist's Gazette* 47: 99–108.

Note added in proof

The *Monochroa* sp. treated above has been provisionally determined as *M. leptocrossa* (Meyrick, 1926), a species from eastern Russia and Japan. I am very grateful to Dr Klaus Sattler for this determination. 45

Appendix 1. Established adventive species of Lepidoptera recorded in New Zealand up to 1988

Each species name is followed by two letter codes: the first of these indicates host-range of the larva, the second the presumed immediate area of origin of the species in New Zealand (which may or may not correspond with its natural range).

Larval host codes are as follows:

- 46 D, detritivorous; M, monophagous; O, oligophagous (dicots, conifers, algae); O(m), oligophagous (monocots); P, polyphagous; S, stored products (including beehives); U, unknown.

Geographical origin codes are as follows:

- A, Australian; As, Asian; E, European or cosmopolitan; N, North American; P, Pacific; S, South African; U, unknown.

If the immediate origin in New Zealand is presumed to be other than the native range of the species, the code is enclosed in brackets.

The use of these categories, especially those for host range, is inevitably to some extent subjective, and in some instances partly conjectural. This list represents the views of the author, and should be considered open to revision in the light of new data.

Nepticulidae (1)	<i>Brachmia</i> sp. nr <i>phryganitis</i> U A	<i>Lampides boeticus</i> O (A)
<i>Stigmella microtheriella</i> M E	<i>Chrysoesthia drurella</i> O E	<i>Zizina labradus</i> O A
Tineidae (13)	<i>Phthorimaea operculella</i> O E	Nymphalidae (1)
<i>Monopis argillacea</i> D A	<i>Sitotroga cerealella</i> S E	<i>Danaus plexippus</i> O N
<i>M. crocicapitella</i> D E	<i>Symmetrischema tangolias</i> O (A)	Pieridae (1)
<i>Nemapogon granella</i> D E	Blastobasidae (1)	<i>Pieris rapae rapae</i> O (P)
<i>Niditinea fuscella</i> D E	<i>Blastobasis tarda</i> D A	Saturniidae (1)
<i>Opogona comptella</i> D A	Symmocidae (1)	<i>Opodiphthera eucalypti</i> M A
<i>O. omoscopia</i> D (A)	<i>Oegoconia caradjai</i> D E	Pyralidae (10)
<i>Lindera tessellatella</i> D E	Coleophoridae (3)	<i>Achroia grisella</i> S E
<i>Tinea dubiella</i> D E	<i>Coleophora mayrella</i> M E	<i>Galleria mellonella</i> S E
<i>T. pallescens</i> D E	<i>C. frischella</i> M E	<i>Ephestia cautella</i> S E
<i>T. pellionella</i> D E	<i>C. versurella</i> O E	<i>E. elutella</i> S E
‘T.’ sp. D A	Lecithoceridae (1)	<i>E. kuehniella</i> S E
<i>Tineola bisselliella</i> D E	<i>Lecithocera micromela</i> D A	<i>Morosaphycita oculiferella</i> O A
<i>Trichophaga tapetzella</i> D E	Oecophoridae (8)	<i>Plodia interpunctella</i> S E
Psychidae (4)	<i>Barea confusella</i> D A	<i>Aglossa caprealis</i> S E
<i>Cebysa leucotelus</i> D A	<i>B. sp. nr confusella</i> D A	<i>Gauna aegusalis</i> D A
Genus A sp. 1 (‘Big log cabin’) D A	<i>B. consignatella</i> D A	<i>Pyralis farinalis</i> S E
Genus A sp. 2 (‘Thatched cottage’) D A	<i>B. exarcha</i> D A	Crambidae (3)
Genus B sp. 1 (‘Little log cabin’) O U	<i>Endrosia sarcitrella</i> D E	<i>Bleszynskia malacelloides</i> O(m) A
Gracillariidae (5)	<i>Hofmannophila pseudospretella</i> D E	<i>Spoladea recurvalis</i> P A
<i>Acrocercops alysidota</i> M A	<i>Tachystola acroxantha</i> D A	<i>Achyra affinalis</i> P A
<i>A. eumetalla</i> D A	<i>Sphyrelata amotella</i> D A	Geometridae (3)
<i>Caloptilia azaleella</i> M E	Sesiidae (1)	‘ <i>Chloroclystis</i> ’ <i>filata</i> P A
<i>Porphyrosela hardenbergiella</i> M A	<i>Synanthedon tipuliformis</i> M E	<i>Phrissogonus laticostatus</i> P A
<i>Phyllonorycter messaniella</i> O E	Tortricidae (7)	<i>Nyctemera amica</i> O A
Yponomeutidae (1)	<i>Cydia pomonella</i> P E	Noctuidae (8)
<i>Prays nephelomima</i> O A	<i>Grapholita molesta</i> O E	<i>Spodoptera litura</i> P A
Plutellidae (1)	<i>Strepsicrates infensa</i> M A	<i>Phalaenoides glycinae</i> P A
<i>Plutella xylostella</i> O E	<i>S. macropetana</i> M A	<i>Artigisa melanephele</i> D A
Lyonetiidae (2)	<i>Epiphyas postvittana</i> P A	<i>Dasypodia cymatodes</i> O A
<i>Leucoptera spartifoliella</i> M E	<i>Sperchia intractana</i> D A	<i>D. selenophora</i> O A
<i>Stegommata leptomitella</i> M A	<i>Acleris comariana</i> O E	<i>Leucania stenographa</i> (= <i>Mythimna loreyimima</i>) O(m) A
Gelechiidae (7)	Pterophoridae (1)	<i>Ctenoplusia albostrata</i> O A
<i>Anarsia trichodeta</i> O A	<i>Lantanophaga pusillidactyla</i> M (A)	<i>Thysanoplusia orichalcea</i> P A
<i>Biloba subsecivella</i> U S	Lycaenidae (2)	

Appendix 2. Collection details of figured specimens.

All specimens are held in NZAC unless otherwise stated.

-
- Heliozela catoptrias*.
AK: Anawhata, larva Jun 1999, *Kunzea ericoides*, emg. 26 July 1999, R.J.B. Hoare.
- '*Acrocercops*' *laciniella*.
Australia: N.S.W., 10 miles W. of Moruya, emg. 27 Sep 1948, I.F.B. Common. From leaf-mine on *Eucalyptus* sp. (ANIC).
- Dialectica scalariella*.
AK: Mt Albert, larva Nov 1998, leaf-mine on *Echium pininana*, emg. 8 Dec 1998, T.K. Crosby.
- Stegommata sulfuratella*.
AK: Auckland Zoo, larva May 1999, mining leaf of *Banksia integrifolia*, emg. 12 May 1999, C. Scott.
- Heteroteucha dichroella*.
Australia: Vic., Gisborne, 3 Nov 1916, G. Lyell.
- Atalopsis* sp. nov.
AK: Titirangi, lit window, 3 Nov 1998, R.J.B. Hoare.
- Barea codrella*.
HB: Haumoana, 20 Oct 1979, T.H. & J.M. Davies.
- Leptocroca sanguinolenta*.
Australia: Qld, Toowoomba, Middle Ridge, 660 m, 2 July 1982, I.F.B. Common.
- Stathmopoda cephalaea*.
AK: Titirangi, m.v. light, 12 Feb 2000, R.J.B. Hoare.
- Coleophora striatipennella*.
MK: Ben Ohau Range, 730 m, light trap, 20 Dec 1995, E.G. White. (LUNZ).
- Agonopterix alstromeriana*.
WO: roadside between Benneydale and Te Kuiti [ex la. on?] *Conium*, 9 Dec 1993, C. Winks.
- Monochroa* sp.
AK: Titirangi, m.v. light, 22 Jan 2000, R.J.B. Hoare.
- Scrobipalpa obsoletella*.
NN: Nelson, Boulder bank, m.v. light, 22 Feb 1999, R.J.B. Hoare, J.S. Dugdale.
- Sarisophora leucoscia*.
AK: Mangere, Coronation Rd, lit window, 12 Nov 1998, M. & M. Shaffer.
- Artona martini*.
ND: Whangarei, Kamo, la. 21 Feb 1999 on bamboo *Shibataea kumasasa*, emg. 21 Oct 1999. G.S. Gill.
- Merophyas divulsana*.
AK: Titirangi, m.v. trap, 28 May 1999, R.J.B. Hoare.
- Holocola* sp. nov.
AK: Titirangi, m.v. light, 12 Feb 2000, R.J.B. Hoare.
- Zomariana doxasticana*.
ND: Kaitaia, [pupa] 12 Feb 1991, *Acacia melanoxylon*, emg. 18 Feb 1991, D. Steven.
- Coscinoptycha improbana*.
♂ Australia: N.S.W., Church Point, 14 Sep 1966, I.F.B. Common (ANIC). ♀ Australia: N.S.W., Macquarie Pass, 1200ft, 9 Oct 1969, I.F.B. Common (ANIC).
- Culladia cuneiferellus*.
ND: Tapotupotu Bay, by day, 4 May 1999, R. J.B. Hoare, R.A.B. Leschen.
- Trichophysetis* sp. nov.
AK: Titirangi, m.v. light, 17 Dec 1999, R.J.B. Hoare.
- Glyphodes* cf. *onychinalis*.
AK: Titirangi, indoors, 10 Mar 1999, R.J.B. Hoare.
- Herpetogramma licarsisalis*.
ND: Tapotupotu Bay, by day, 4 May 1999, R. J.B. Hoare, R.A.B. Leschen.
- Papilio xuthus*.
No data.
- Cizara ardeniae*.
Australia: Blackbutt, 29 Oct [19]14. P. Leaf collection.
- Chasmina* sp.
AK: Mt Albert, 5 Jan 1986, D.J. Allan.
- Orgyia thyellina*.
♂ 'Reared Forest Research, emg. 15 Jun 1998'. ♀ 'Reared Forest Research, emg. 21 May 1998'.
- Teia anartoides*.
♂ AK: Glendene, cocoon 6 May 1999, emg. 15 May 2000, R.J.B. Hoare. ♀ AK: Glendene, la. 6 May 1999 *Paraserianthes lophantha*, emg. 10 Jun 1999, R.J.B. Hoare.
- Uraba lugens*.
Australia: South Australia, Minnipa, 23 Oct 1958, I.F.B. Common (ANIC).
-