

# Lepidoptera of gumland heaths — a threatened and rare ecosystem of northern New Zealand

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## ABSTRACT

The Lepidoptera fauna of gumland heaths, an ecosystem restricted to northern New Zealand, is reviewed. A total of 161 species (one including two subspecies) is recorded from the 14 sites surveyed; all are listed. Significant finds amongst endemic and adventive Lepidoptera are discussed. Two new endemic species were collected during the survey (*Paramorpha* new species 1 (Carposinidae) and '*Megacraspedus*' new species 1 (Gelechiidae)). Four species and one subspecies of adventive Lepidoptera are recorded here for the first time from mainland New Zealand, although the gumland records do not constitute the first or only records from this country: *Cosmopterix attenuatella* (Cosmopterigidae), *Lepidoscia protorna* (Psychidae), *Ephestiopsis oenobarella* (Pyrilidae: Phycitinae), *Pantylia sparsa* (Noctuidae: Catocalinae) and *Uresiphita polygonalis ornithopteralis* (Crambidae: Pyraustinae). Gumland sites are provisionally compared on the basis of Lepidoptera species richness and number of specialist species recorded, and Whakaruangangana, near Kaikohe, is so far considered the site of highest conservation significance.

**Keywords.** Gumland, Gumland heath, endemic, immigrant, adventive, Lepidoptera, rare ecosystem

## INTRODUCTION

The gumlands of northern New Zealand support heath, i.e., ecosystems dominated by sclerophyllous shrubs on highly infertile soils. Worldwide, heathlands are of high conservation value, supporting diverse and distinctive animal and plant communities, but are threatened by destruction and fragmentation (e.g., Taylor 1978; Gimingham 1981). European heathlands have been intensively studied over many years (e.g., Smith 1902; Maren *et al.* 2008), but southern hemisphere heathlands are beginning to come into focus as the subjects of research aimed at optimising habitat management, e.g., South African fynbos and Australian kwongan heaths (Richardson *et al.* 1996). The gumlands, wet heaths confined to the northern North Island of New Zealand, have remained poorly understood by comparison. The current study was part of a larger project aimed at determining the environmental controls and vegetation patterns of the remaining gumlands, as well as threats to their future conservation (Clarkson *et al.* 2010). The terms 'gumland' and 'gumland heath' are used interchangeably in this paper, as in Clarkson *et al.* (2010). Gumlands occur on flat to rolling areas with deposits of kauri gum, the subfossil resin of the coniferous tree kauri (*Agathis australis*; Araucariaceae) that once dominated forests on these sites. Naturally, gumlands form on highly infertile podzol

soils, resulting from leaching of *Agathis* litter. Other gumlands have undoubtedly been created and maintained by frequent fires since Polynesian settlement in about 1250 AD. Drainage is poor, frequently impeded by an iron pan. Ecologically similar wetland heaths outside the recent range of *Agathis* are often termed 'pakihi' in New Zealand (Johnson & Gerbeaux 2004). It is estimated that gumlands in the 1840s covered about 300,000 ha of Northland, Auckland and the Coromandel Peninsula (Molloy 1990).

Kauri gum, formerly used in the manufacture of varnishes, paints and linoleum, was the basis of an extensive and lucrative 'gum-digging' industry in the late 19<sup>th</sup> and early 20<sup>th</sup> centuries. About 1940 this industry came to an end and improved farming techniques allowed the conversion of large areas of gumland to agriculture (Esler & Rumball, 1975). Today only a few thousand hectares of gumlands remain, almost all in Northland.

## Flora of gumlands

The gumlands flora is poor, with a few dominant species, all of which occur in other habitats. These include *Leptospermum scoparium* (manuka), *Gleichenia dicarpa* (tangle-fern), and the sedges *Baumea teretifolia* and *Schoenus brevifolius* (Clarkson *et al.* 2010). The first three species are known hostplants of Lepidoptera, and it is likely that a search of *Schoenus brevifolius* would also result in the discovery of associated moth larvae (see below). Important but less abundant components of the vegetation include the ericaceous shrubs *Dracophyllum lessonianum* and *Epacris pauciflora*, and in places tussocks of the sedge *Lepidosperma filiforme* (mainly northern sites) or, particularly at one site (Lake Ohia South), the moss *Campylopus introflexus*. An Australian proteaceous shrub, *Hakea sericea*, is a common woody weed in gumlands. Despite the overall depauperate nature of the ecosystem, gumlands support a suite of at least 24 threatened plants (de Lange *et al.* 2009). However, the rarest finds amongst the Lepidoptera during this study were all associated with relatively common plants, as discussed below.

## Lepidoptera of heathlands and gumlands

Worldwide, heathlands are known to be important habitats for Lepidoptera, supporting distinctive and often threatened species assemblages. However, for most regions there are few or no detailed accounts treating heathland Lepidoptera. A notable exception is the paper by Wagner *et al.* (2003), who document 56 Lepidoptera species of conservation concern from a complex of shrubland habitats, including heathland, in southern New England and southeastern New York (U.S.A.). Wagner *et al.* (2003) regard shrublands as 'the most important natural communities

for rare and endangered Lepidoptera in both Connecticut and Massachusetts', and list heathlands as one of the three most important shrubland habitats for rare moths and butterflies in the region. Holloway (1979) discussed the Lepidoptera fauna of New Caledonia, and found that the 'maquis' (scrubby heathlands occurring on serpentine soils) supported a distinctive association of species, based on numerical analyses of light-trap samples. This association included several species of *Adeixis* Warren (Geometridae); the New Zealand representative of this genus was found to be a characteristic moth of gumland sites in the current study (see below). As with other types of heathland, the New Caledonian maquis is undoubtedly of high international importance for the conservation of Lepidoptera diversity.

There has been no previous published account of the Lepidoptera fauna of New Zealand's gumlands. Very little collecting of the group has been done in this habitat; the same applied until recently to the somewhat similar Lepidoptera fauna of the Waikato peatlands, now partially documented by Hoare *et al.* (2006) and by Watts and Hoare (2009). Before the collections made for this project, no specimens of Lepidoptera were present in NZAC from any of the gumland localities listed in Appendix 1, except the Ahipara Plateau, and no additional species from Ahipara are known from earlier collecting.

## MATERIALS AND METHODS

Sites at which Lepidoptera were sampled are listed, with latitude and longitude, and timing in Appendix 1. Adult Lepidoptera were collected by day with a net and by searching in low vegetation, particularly tussocks of *Lepidosperma filiforme*, where this plant was present. At night moths were attracted with a 125W mercury vapour bulb attached to a tripod, the tripod being placed in the middle of a white sheet spread on the ground. No general collection of larvae was made, but in November, flowering *Epacris pauciflora* was targeted for the larvae of *Pasiphila cf. humilis*; flowering twigs were shaken into a net and larvae retained with a portion of the host, and reared in plastic containers lined with soft tissue paper for pupation.

**The following abbreviations are used for specimen repositories mentioned in the text:**

**BMNH:** British Museum (Natural History), London, UK  
**NZAC:** New Zealand Arthropod Collection, Landcare Research, Auckland, New Zealand

Pinned material from this survey is deposited in the NZAC. The usage of the terms 'cf.' ('compare') and 'sp. nr.' (species near) follows Leschen *et al.* (2009). Undescribed endemic species have not been illustrated here, pending future description; voucher specimens are stored in NZAC under the designations given in this paper.

Authorities for Lepidoptera species names are listed in Appendix 1. Authorities for plant names mentioned in the text are given in Appendix 2.

## RESULTS

A total of 161 species of Lepidoptera were recorded (one, *Uresiphita polygonalis* (Crambidae) represented by two subspecies). The predominant families were Noctuidae (33 species), Crambidae (31 species) and Geometridae (31 species), followed by Oecophoridae

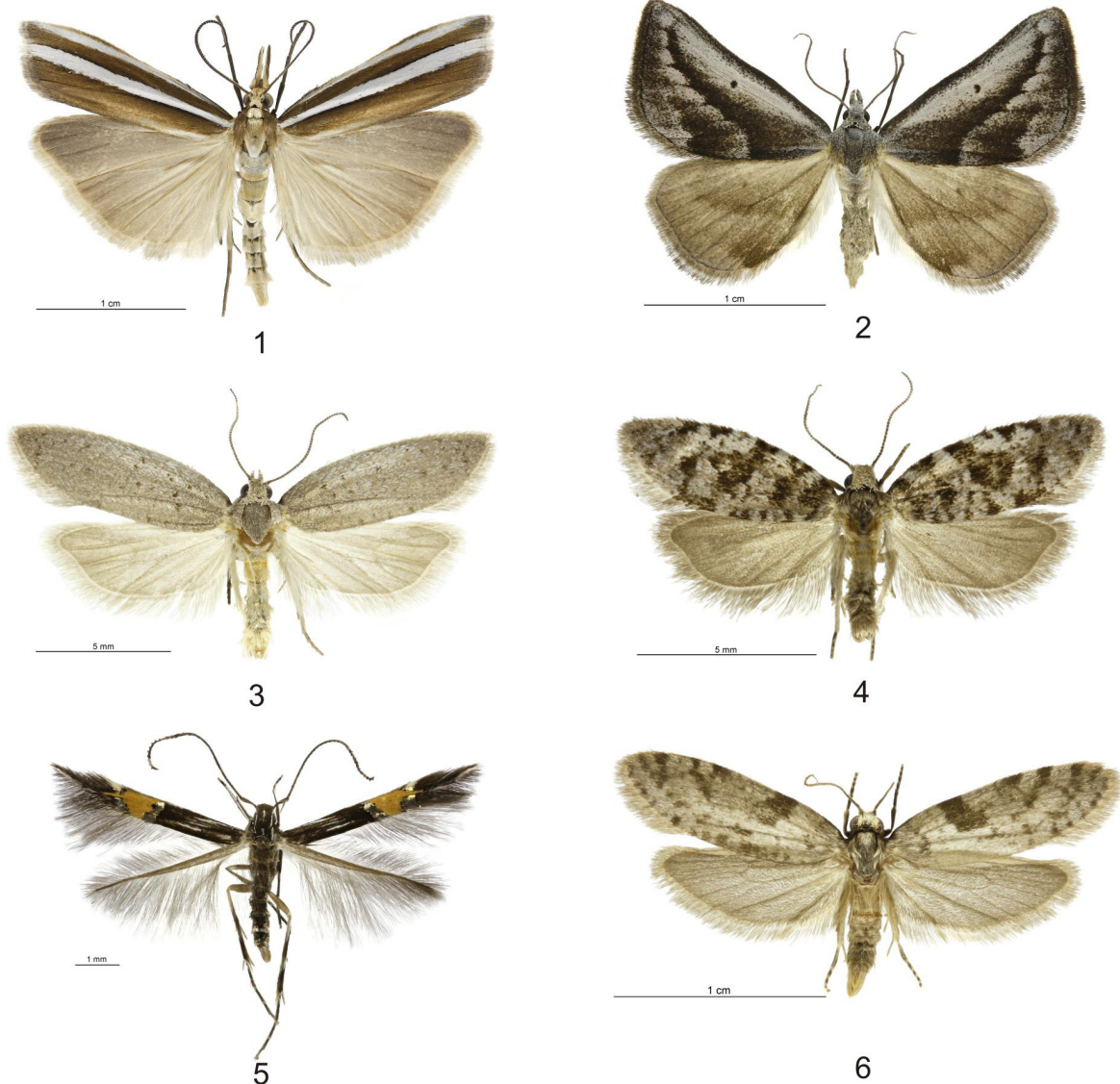
(16 species) and Tortricidae (15 species). Two new endemic species were collected during the survey; four species and one subspecies of adventive Lepidoptera are recorded here for the first time from mainland New Zealand, although the gumlands collections are not the first New Zealand records. A complete list of all species recorded, with localities, is given in Appendix 1.

## DISCUSSION

### Composition of the Lepidoptera fauna

The five most diverse families of Lepidoptera recorded in the gumlands survey (Noctuidae, Crambidae, Geometridae, Oecophoridae, Tortricidae) are the five most diverse families in New Zealand. However, their proportional representation in the gumlands is disharmonious, since Geometridae and Oecophoridae are the two largest families in the Lepidoptera fauna as a whole (Dugdale 1988). The low representation of Oecophoridae, whose larvae are chiefly detritivores (Hoare 2005), probably reflects the low quantity and diversity of leaf-litter in the habitat, and the lack of the perched litter microhabitat, which is known to be an important oviposition site in forest ecosystems (J.S. Dugdale, pers. comm.). Particularly notable is the almost complete lack of species associated with dead wood and fungi (*Izatha* Walker and *Gymnobathra* Meyrick species), with only *I. peroneanella*, one of the commonest species, being recorded in small numbers. Dead *Kunzea* and *Leptospermum* are known to be suitable substrates for *Izatha* larvae (Hoare 2010), so the scarcity of these moths may reflect nutrient status of the hosts, or lack of suitable wood-rotting fungi. The apparent predominance of Noctuidae over Geometridae in the gumlands is likely to be misleading, since the robust noctuids are able to fly long distances and many of the species recorded are certainly or probably wanderers from other habitats, e.g., *Feredayia graminosa* and *Austramathes purpurea*, which are forest species with larvae feeding on *Meliccytus* (Hudson 1928) and *Agrotis innominata*, a coastal species associated with dune grasses and low-growing dicots (Patrick & Green 1991). Others, e.g., *Agrotis munda*, *Anomis involuta*, *Helicoverpa armigera*, *Leucania stenographa*, are known migrants (Dugdale 1988). Patterns within the endemic Noctuidae are much as expected from the vegetation: genera whose species are monophagous or oligophagous on trees and shrubs (e.g., *Meterana*) are almost absent; those with larvae polyphagous on low-growing plants (*Graphania*) or larvae on monocotyledons (*Tmetolophota*) are relatively well represented. In the Geometridae, groups that are relatively diverse in forest ecosystems in northern New Zealand but poorly represented in gumlands are tree- and shrub-feeding (*Pseudocoremia*) or fern-feeding (Lithiniini, represented only by *Sestra flexata*). Amongst the Tortricidae, the apparent absence of *Ctenopseustis*, *Planotortrix* and *Pyrgotis*, all of which contain species common in forest, suburban gardens and orchards, is notable. Again, larvae are principally associated with ferns, podocarps, or broad-leaved trees and shrubs.

It is doubtful if any species of Lepidoptera are restricted to the gumlands, although two species recorded during this survey have apparently never been collected elsewhere (see below). The fauna has much in common with that of the Waikato peatlands, another



**Figures 1-6.** Adults of gumlands Lepidoptera: (1), *Orocrambus siriellus* (Crambidae); (2), *Adeixis griseata* (Geometridae); (3), *Ericodesma argentosa* (Tortricidae); (4), *Ericodesma scruposa* (Tortricidae); (5), *Cosmopterix attenuatella* (Cosmopterigidae); (6), *Lepidoscia protorna* (Psychidae).

ecosystem poorly surveyed for Lepidoptera, and shares many of the same plants. Many of the same faunal elements are likely to be found in South Island pakihi habitats, but again this fauna is not well known. Based on this survey, and on a few visits to Torehape and Kopuatai in the Waikato peatlands (Watts & Hoare 2009), the following moth species are especially characteristic of both gumlands and peatlands: *Scoparia* species 1 (hostplant unknown, probably a moss), *Orocrambus siriellus* (Fig. 1; hostplant unknown, likely to be *Schoenus brevifolius* or another

common sedge), *Adeixis griseata* (Fig. 2; host plant unknown, possibly as for *O. siriellus*), *Chalastra* species near *pellurgata* (hostplant probably *Gleichenia*), *Ericodesma argentosa* (Fig. 3; hostplants fine-leaved *Dracophyllum* species) and *E. scruposa* (Fig. 4; hostplant *Gleichenia*).

The mossfield at Lake Ohia (south) was remarkable for the comparative abundance of two species, *Eudonia steropaea* and an undescribed *Kiwaia* (*Kiwaia* species 1). Species of *Kiwaia* are usually associated with open habitats, with most restricted

to the montane zone, and others to coastal shingle. The genus is poorly represented and seldom collected in the lowlands of the North Island. The Lake Ohia species was associated with the dominant moss, *Campylopus introflexus*, and this was confirmed as the hostplant when two specimens were reared from the moss. The moth was also present at Maitahi, where the light-sheet was set up in a bare area with *Campylopus*. Other *Kiwaia* species (e.g., *K. jeanae*) are known to be associated with *Raoulia* mats. The concomitant abundance of *Eudonia steropa*, which is widespread but rarely seen in such large numbers, suggests that its larvae too feed on *Campylopus*.

## Notable Lepidoptera records

### 1. Endemic species

The two most notable finds during the course of this survey were undescribed and previously unknown species of Gelechiidae and Carposinidae, tentatively assigned to the genera *Megacraspedus* (*sensu lato*) and *Paramorpha* Meyrick respectively. Species assigned to *Megacraspedus* Zeller in New Zealand and Australia probably do not correctly belong in this northern hemisphere genus (Dugdale 1988); larvae feed on seedheads of Poaceae, Cyperaceae and Restionaceae. One described (*M. calamogonus*) and two undescribed species have previously been recognized in collections. This fourth species was found by parting the tussocks of *Lepidosperma filiforme*, the presumed host, on humid days, the moths flying between or settling on the culms. It was only observed on the Karikari Peninsula, at Carrington Estate and Lake Ohia (east).

A single specimen of the new carposinid came to mercury vapour light at Whakaruangana, near Kaikohe. It is tentatively assigned to *Paramorpha*, rather than *Heterocrossa* Meyrick, based on the wing maculation and lack of scale-tufts on the forewing; dissection will be required to confirm this placement. It is larger than *P. marginata*, the only New Zealand species hitherto assigned to *Paramorpha*, and lacks the yellow costal forewing margin of that species. *Paramorpha* species are associated with *Leucopogon* (Epacridaceae) in Australia (Common 1990), and *P. marginata* has been beaten from, and reared from litter beneath *Leucopogon fasciculatus*. If this new species is restricted to gumlands (and similar habitats), its host may possibly be *Epacris pauciflora* or *Dracophyllum lessonianum*.

'*Batrachedra*' species nr *eustola* belongs to an undescribed genus of Batrachedridae related to *Houdinia* Hoare, Dugdale & Watts (Hoare *et al.* 2006). A single specimen was found low in a *Lepidosperma filiforme* tussock at Lake Ohia (east); known hosts for this genus in New Zealand are *Machaerina sinclairii* and *Baumea teretifolia*, the latter of which is present at the site. The genus requires revision and it is not known whether specimens from each host represent separate species, or whether the Lake Ohia specimen is conspecific with any previously collected.

The undescribed *Clepsicosma* species 1 (Crambidae) collected at Whakaruangana and Ngawha is known from very few specimens. Its congener *C. iridia* Meyrick is associated with the large sedges *Gahnia xanthocarpa* and *G. setifolia*, though its life history is unknown. In addition to the two gumland sites, the unnamed species has been found in a few coastal localities in

Northland and west Auckland, so if it is monophagous its host must be common to both habitats.

*Elachista melanura* (Elachistidae) has not been recognized in New Zealand since its original description by Meyrick (1889) (Dugdale 1988). However, a number of specimens belonging to the same species group as *melanura* are present in NZAC, and probably represent a complex of undescribed and very similar species (L. Kaila, pers. comm.); at least two species were collected in the gumlands survey, and another has been found at a pakihī site near Okarito in the South Island. Australian species of this group have larvae mining in Cyperaceae (L. Kaila, pers. comm.).

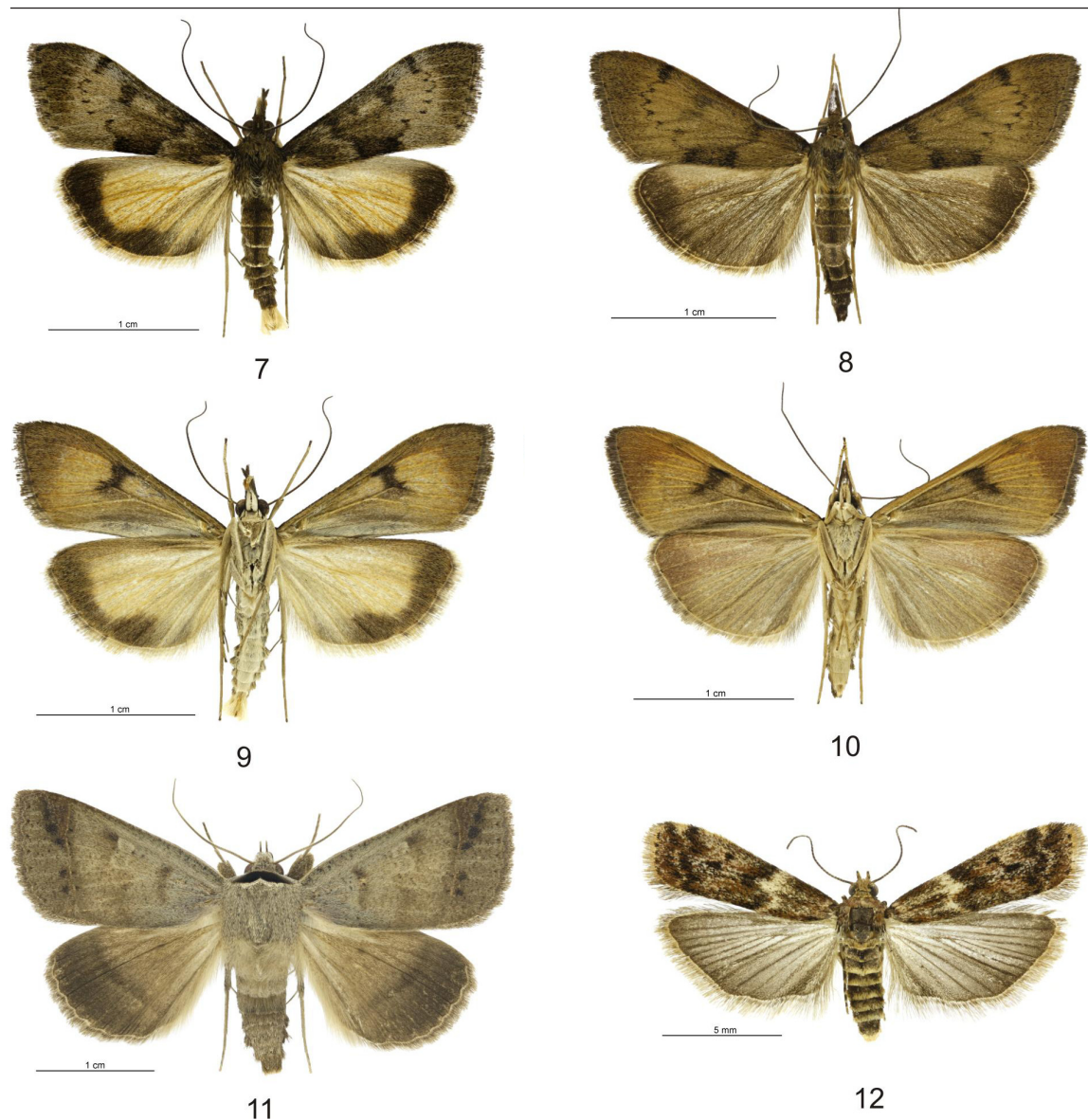
*Scoparia* species 1 (Crambidae) is probably an unnamed species, commonly encountered in gumlands and peatlands; similar specimens from other poorly drained habitats (sometimes under *ejuncida* in collections) may belong to the same species. Its assignment to *Scoparia* rather than *Eudonia* needs confirmation, and is based on its similarity to *S. ejuncida*, from which it differs in lacking a convex frons (cf. White 2002: 248).

*Chalastra* sp. nr *pellurgata* (Geometridae) is a recently discovered taxon, differing from true *pellurgata* in details of coloration and wing-shape. It has only been found in gumland and peatland habitats in Northland and the Waikato (Watts & Hoare 2009), and at a single west Auckland site; the hostplant is probably *Gleichenia* (common at all the known localities) since *C. pellurgata* has larvae oligophagous on ferns.

*Pasiphila* cf. *humilis* (Geometridae) was reared during this survey from larvae shaken from flowers of *Epacris pauciflora*. The same species has also been reared from *Dracophyllum* by J.S. Dugdale (specimen in NZAC), and is not restricted to gumland sites. True *P. humilis* appear to lack the pinkish markings of these reared specimens but are otherwise similar; two species may be involved.

*Bactra optanias* (Tortricidae) has not been recognized with certainty since Meyrick (1911) described it from near Hamilton; an Australian species described under the same name is unlikely to be conspecific (cf. Dugdale 1988; Horak 2006). The genus is a difficult one, with superficially very similar species. Specimens of a *Bactra* species resembling the type of *optanias* were common in a very restricted strip of vegetation at Whakaruangana near the roadside; they occurred by day only amongst young plants of *Baumea teretifolia* on the disturbed edge of the gumland, and were absent from mature stands of *Baumea* further into the habitat. *Bactra* species have larvae boring in stems of Cyperaceae, Juncaceae and Poaceae (Horak 2006) and *Baumea* is the probable host of *B. cf. optanias*. A single specimen of the same species was collected in a grassy clearing on the edge of Trounson Kauri Park, Northland in February 2006 (specimen in NZAC). Since the moth is only known with certainty from these two sites, and appears to be associated with a marginal and probably ephemeral microhabitat, it may be of conservation concern.

A single specimen of *Graphania homoscia* (Noctuidae) was taken at Rangiputa. This cannot be regarded as a gumland species, since the larva feeds on *Ozothamnus* (e.g., Hudson 1928); the specimen was probably a wanderer from the nearby coast. The record is highlighted here as it represents by far the northernmost



Figures 7-12. Adults of gumlands Lepidoptera: (7), *Uresiphita polygonalis ornithopteralis*, upperside (Crambidae); (8), *U. p. maoralis*, upperside (Crambidae); (9), *U. p. ornithopteralis*, underside; (10), *U. p. maoralis*, underside; (11), *Pantylia sparsa* (Noctuidae); (12), *Ephestiopsis oenobarella* (Pyralidae).

known locality for the species, which has apparently not previously been collected north of Tongariro National Park.

## 2. Immigrant and adventive species

Four species and one subspecies of Lepidoptera, not previously listed as occurring in mainland New Zealand, were recorded in the gumlands survey. These are illustrated in Figures 5, 6, 7, 9, 11 and 12. All of these species had been collected in New Zealand prior to their discovery in the gumlands, but none except *Lepidoscia protorna* and *Uresiphita polygonalis ornithopteralis*

had been noted prior to the last review of the adventive Lepidoptera fauna (Hoare 2001); the latter subspecies was omitted from that review in error. Brief notes on their occurrence and status in New Zealand are given below.

*Cosmopterix attenuatella* (Cosmopterigidae; Fig. 5) has been recorded in the New Zealand region only from the Kermadec Islands (Dugdale 1988: 235). A specimen was taken at Whakaruangangana gumland, and two others have been collected in the far north at Te Pahi, where the species may be established.

*Lepidoscia protorna* (Fig. 6) is an Australian psychid, established in New Zealand since about 1979, when a specimen was collected in Mt Eden, Auckland. It now occurs commonly at light in Auckland and Northland in late summer (January to March); both sexes are fully winged. The larval case is more or less square in cross section, up to ca 2 cm in length, and consists of short sections of small plant stems attached in a shallow spiral; this has attracted the vernacular name 'big log cabin'. The larva feeds low down amongst decaying plant material. The species has previously been referred to in the New Zealand literature as an undescribed species in a genus near *Alytopistis* (Dugdale 1988: 69); the identity given here is based on comparison of New Zealand specimens with Meyrick's types in the BMNH. *Lepidoscia* is currently something of a dumping ground for Australian Psychidae previously referred to other genera; the generic placement of *protorna* is likely to change once this group is revised.

*Uresiphita polygonalis ornithopteralis* (Figs 7, 9) is the Australian subspecies of this widespread species; it is sometimes treated as a full species (cf. Common 1990). It can usually be distinguished from the endemic New Zealand subspecies *U. p. maorialis* (Figs 8, 10) by the presence of a strong blackish terminal band on the underside of the hindwing; often but not always, *U. p. maorialis* has the hindwing upperside dull brownish (yellow in *ornithopteralis* and some *maorialis*). Two specimens of *ornithopteralis* were collected at Rangiputa; there are others in NZAC from Waitangi and Kerikeri, Bay of Islands, the earliest of which was collected as long ago as 1949 by K.P. Lamb. A series reared by J.S. Dugdale and S. Muggleston from *Ulex europaeus* at Kerikeri Inlet includes one specimen that is apparently typical *maorialis*, and one with the dull brownish hindwings typical of *maorialis*, but the hindwing underside markings of *ornithopteralis*; the rest are typical *ornithopteralis*. This suggests possible hybridisation, and the taxonomy and genetics of *U. polygonalis* in Australasia require further study. At Rangiputa, the moths occurred amongst other Australian adventives (*Anarsia dryinopa*, '*Acrocercops*' *alysidota*, *Dasypodia cymatodes*) associated with *Acacia*, which was an abundant weed in parts of the site; Common (1990) gives *Acacia* as an occasional host of *U. p. ornithopteralis*.

*Pantylia sparsa* (Fig. 11) is a noctuid currently assigned to Catocalinae; it is widespread in Australia from Queensland to Victoria and in southwestern and central Australia, and also occurs in New Caledonia and on Norfolk Island (Common 1990). Hostplants recorded by Common are *Dillwynia* and *Medicago sativa* (lucerne) (both Fabaceae) and *Exocarpos* (Santalaceae); of these only *Medicago* is present in New Zealand, but larvae are certainly polyphagous. The moth is now commonly recorded at light from the far north of Northland at least as far south as Auckland. It is not considered to be a pest species.

*Ephesiopsis oenobarella* (Fig. 12) is a phycitine pyralid widespread in Australia from southern Queensland to southern Western Australia. Its life history is not known. In New Zealand it occurs in small numbers at light in modified habitats, and has been found in Auckland and Northland.

## Significant gumland sites for Lepidoptera

Since Lepidoptera collecting was not fully quantitative, and the sites were visited only briefly, the assessments that follow must be considered provisional. Sites are considered significant based on two criteria: overall diversity of recorded Lepidoptera, and presence of scarce specialised species (i.e., those discussed above under 'Endemic species', but excluding the widespread *Adeixis griseata*, *Orocrambus siriellus* and *Scoparia* species 1). On the basis of both criteria, the most important site surveyed was Whakaruangangana. This site boasted the greatest number of recorded species (69), and an impressive list of 7 specialists: *Bactra* cf. *optanias*, *Clepticosma* species 1, *Elachista* species 2, *Ericodesma argentosa*, *E. scruposa*, *Paramorpha* species 1, *Pasiphila* cf. *humilis*. Two of these (*Bactra* cf. *optanias* and *Paramorpha* sp. 1) were found only here. Second in diversity was Maitahi, with 63 species, but only 2 of the scarcer specialised taxa, i.e., *Kiwaia* species 1 and *Ericodesma argentosa*. At Rangiputa, 55 species were recorded, with none of the scarce specialists. Ngawha Springs, with 45 species overall, had 2 specialists: it was the only site where *Chalastra* species nr *pellurgata* was found, and the only site apart from Whakaruangangana with *Clepticosma* species 1. Spirit's Bay Road had 39 species and one specialist, *Elachista* species 1, which was not found elsewhere. Lake Ohia (south) appeared to be a depauperate site with only 29 species recorded, but it was the most important site for *Kiwaia* species 1, which was common there. Ahipara, with a mere 24 species and no specialists, was disappointing. However, weather conditions for light-trapping were cool, and the visit was early in the season (November). This is a highly important site, with the largest remaining area of gumland, and botanically very significant (Clarkson *et al.* 2010). The Lepidoptera fauna is likely to be far more diverse than this survey revealed.

The remaining sites were visited only by day and few species were recorded. Lake Ohia (east) on the Karikari Peninsula stands out, as 4 specialists occurred here: '*Megacraspedus*' species 1, '*Batrachedra*' species near *eustola* (only here), *Ericodesma argentosa* and *E. scruposa*. Both Pairatahi Road and Kaimaumau had larvae of *Pasiphila* cf. *humilis*, and Carrington Estate was the only site apart from Lake Ohia (east) with '*Megacraspedus*' species 1

In summary, Whakaruangangana is provisionally considered to have the highest importance of the sites surveyed for gumland Lepidoptera. The area is on private land, but the landowner is aware of its significance, and was supportive of the survey. It is hoped that longer-term protection can be secured for this site. Ngawha Springs and Lake Ohia (east) stand out for the presence of rare specialised taxa, and should also be considered of high conservation status. Further survey work at Ahipara is desirable.

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## APPENDIX 1

### List of Lepidoptera recorded in gumland heaths, 2007-2008.

In the list, localities are given in brief form for each species. Full details of these localities and their associated collecting dates are as follows (all localities are in Northland):

**Ahipara:** Ahipara Plateau, 8 Feb 2008 (m.v. light); 35 12.2S 173 08.4E

**Aratoro:** Aratoro Stream Bush, 5 Feb 2008 (by day); 35 16.7S 173 46.7E

**Carrington Estate:** (Taupiroa Range), Karikari Peninsula, 6 Nov 2007 (by day); 34 52S 173 23E

**Kaimaumau:** Kaimaumau, Lake Road (east end), 5 Nov 2007 (by day); 34 54S 173 15E

**Lake Ohia (east):** Lake Ohia (east), 7 Nov 2007 (by day); 34 58.8S 173 22.4E

**Lake Ohia (south):** Lake Ohia (south), 6 Nov 2007 (by day and m.v. light); 34 57.8S 173 22.6E

**Maitahi:** Maitahi Scientific Reserve, 7 Feb 2008 (by day and m.v. light); 35 51.8S 173 44.6E

**Ngawha Springs:** Ngawha Springs, 5 Feb 2008 (m.v. light); 35 25S 173 52E

**Pungaere:** Upper Pungaere Road, 1 Feb 2008 (by day); 35 11S 173 49.7E

**Pairatahi:** Pairatahi Road, 4 Nov 2007 (by day); 35 01.8S 173 17.7E

**Rakautao:** Rakautao Bush, 2 Feb 2008 (by day); 35 25S 173 50E

**Rangiputa:** Rangiputa Reserve, 3 Nov 2007 (m.v. light); 34 52.9S 173 18.1E

**Spirit's Bay Rd:** Spirit's Bay Road, 1 Nov 2007 (by day and m.v. light); 34 29.1S 172 52.4E

**Whakaruangangana:** Whakaruangangana, 3 Feb 2008 (by day and m.v. light); 35 26.5S 173 45.6E

## An asterisk indicates a species discussed further in the text.

### Batrachedridae (3)

*Batrachedra psithyra* Meyrick, 1889 Rangiputa

*Batrachedra* cf. *tristicta* Meyrick, 1901 (*tristictica* Dugdale, 1988: 84, misspell.) Ngawha Springs

\*\**Batrachedra*' sp. nr *eustola* Meyrick, 1897 Lake Ohia (east)

### Bedelliidae (1)

*Bedellia psaminella* Meyrick, 1889 Whakaruangangana

### Blastodacnidae (1)

*Microcolona limodes* Meyrick, 1897 Ngawha Springs

### Carposinidae (2)

*Heterocrossa* cf. *contactella* (Walker, 1866) Ahipara, Whakaruangangana

*Paramorpha* sp. 1 Whakaruangangana

### Choreutidae (1)

*Tebenna micalis* (Mann, 1857) Maitahi, Whakaruangangana

### Copromorphidae (1)

*Isonomeutis amauropa* Meyrick, 1888 Aratoro

### Cosmopterigidae (2)

\**Cosmopterix attenuatella* (Walker, 1864) Whakaruangangana

*Limnaecia phragmitella* Stainton, 1851 Whakaruangangana

### Crambidae (31)

*Clepsicosma iridia* Meyrick, 1888 Aratoro, Rakautao

\**Clepsicosma* sp. 1 Ngawha Springs, Whakaruangangana

*Culladia cuneiferellus* (Walker, 1863) Whakaruangangana

*Eudonia bisinualis* (Hudson, 1928) Ahipara, Lake Ohia

(south), Maitahi, Ngawha Springs, Rangiputa, Spirit's Bay Rd, Whakaruangangana

*Eudonia colpota* (Meyrick, 1888) Maitahi, Ngawha Springs, Whakaruangangana

*Eudonia dinodes* (Meyrick, 1884) Maitahi, Ngawha Springs

*Eudonia leptalea* (Meyrick, 1884) (*leptalea* Dugdale, 1988: 158, misspell.) Maitahi, Rangiputa

*Eudonia minualis* (Walker, 1866) Lake Ohia (south), Ngawha Springs, Rangiputa, Spirit's Bay Rd

*Eudonia* cf. *luminatrix* (Meyrick, 1909) Ahipara, Rangiputa, Spirit's Bay Rd

*Eudonia* cf. *octophora* (Meyrick, 1884) Whakaruangangana

*Eudonia philerga* (Meyrick, 1884) Maitahi, Ngawha Springs, Whakaruangangana

*Eudonia rakaiensis* (Knaggs, 1867) (*rakaiaensis* Dugdale, 1988: 158, misspell.) Ngawha Springs

\**Eudonia steropaea* (Meyrick, 1884) Ahipara, Lake Ohia

(south), Maitahi, Ngawha Springs, Spirit's Bay Rd

*Eudonia submarginalis* (Walker, 1863) Lake Ohia (south),

Maitahi, Ngawha Springs, Rangiputa, Whakaruangangana

*Glaucocharis auriscriptella* (Walker, 1864) Ngawha Springs

*Glaucocharis selenaea* (Meyrick, 1885) Rakautao

*Hygraula nitens* (Butler, 1880) Maitahi, Rangiputa,

Whakaruangangana

*Musotima nitidalis* (Walker, 1866) Maitahi

*Orocrambus apicellus* (Zeller, 1863) Ahipara, Maitahi, Ngawha Springs, Rangiputa, Whakaruangangana

*Orocrambus flexuosellus* (Doubleday, 1843) Lake Ohia (south),

Maitahi, Ngawha Springs, Rangiputa, Whakaruangangana

*Orocrambus ramosellus* (Doubleday, 1843) Pungaere

\**Orocrambus siriellus* (Meyrick, 1882) Maitahi, Ngawha

Springs, Pungaere, Whakaruangangana

*Orocrambus vittellus* (Doubleday, 1843) Aratoro, Rangiputa

*Protornia philocapna* Meyrick, 1884 Maitahi

*Scoparia animosa* Meyrick, 1914 Maitahi

*Scoparia chalicodes* Meyrick, 1884 Lake Ohia (south), Rangiputa

*Scoparia diphtheralis* Walker, 1866 Ngawha Springs,

Whakaruangangana

*Scoparia* sp. nr *minuscularis* Walker 1866 Ngawha Springs,

Rangiputa, Spirit's Bay Rd, Whakaruangangana

\**Scoparia* sp. 1 Ahipara, Maitahi, Spirit's Bay Rd,

Whakaruangangana

*Scoparia ustimacula* Felder & Rogenhofer, 1875 Ngawha

Springs, Spirit's Bay Rd

*Uresiphita polygonalis maorialis* (Felder & Rogenhofer, 1875)

Maitahi, Ngawha Springs, Whakaruangangana

\**Uresiphita polygonalis ornithopterialis* (Guenée, 1854)

Rangiputa

### Elachistidae (4)



*Elachista archaenoma* (Meyrick, 1889) Ngawha Springs  
 \**Elachista* cf. *gerasmia* Meyrick, 1889 Lake Ohia (south),  
 Ngawha Springs, Whakaruangangana  
 \**Elachista* sp. 1 nr *melanura* Meyrick, 1889 Spirit's Bay Rd  
 \**Elachista* sp. 2 nr *melanura* Carrington Estate,  
 Whakaruangangana [N.B. Specimens from these two sites may  
 represent two separate species]

### Gelechiidae (5)

*Anarsia dryinopa* Lower, 1897 Rangiputa  
*Aristotelia paradessa* (Meyrick, 1885) Ngawha Springs  
*Helcystogramma* sp. nr *phryganitis* (Meyrick, 1911)  
 Whakaruangangana  
 \**Kiwaia* sp. 1 Lake Ohia (south), Maitahi  
 \*\**Megacraspedus* sp. 1 Carrington Estate, Lake Ohia (east)

### Geometridae (31)

\**Adeixis griseata* (Hudson, 1903) Ahipara, Kaimaumuau,  
 Pairatahi, Rangiputa, Spirit's Bay Rd, Whakaruangangana  
*Austrocidaria anguligera* (Butler, 1879) Maitahi  
*Austrocidaria gobiata* (Felder & Rogenhofer, 1875) Rangiputa  
*Austrocidaria similata* (Walker, 1862) Whakaruangangana  
 \**Chalastra* sp. nr *pellurgata* Walker, 1862 Ngawha Springs  
*Chloroclystis filata* (Guenée, 1857) Ahipara, Rangiputa, Spirit's  
 Bay Rd  
*Chloroclystis inductata* (Walker, 1862) Ahipara, Maitahi,  
 Spirit's Bay Rd, Whakaruangangana  
*Declana floccosa* Walker, 1858 Lake Ohia (south),  
 Maitahi, Ngawha Springs, Rangiputa, Spirit's Bay Rd,  
 Whakaruangangana  
*Declana junctilinea* (Walker, 1865) Ahipara, Lake Ohia  
 (south), Ngawha Springs, Rangiputa, Spirit's Bay Rd,  
 Whakaruangangana  
*Declana leptomera* (Walker, 1858) Ahipara, Maitahi, Ngawha  
 Springs, Rangiputa, Spirit's Bay Rd  
*Epicyme rubropunctaria* (Doubleday, 1843) Whakaruangangana  
*Epiphryne undosata* (Felder & Rogenhofer, 1875) Spirit's Bay Rd  
*Epiphryne verriculata* (Felder & Rogenhofer, 1875) Rangiputa,  
 Spirit's Bay Rd  
*Epyaxa lucidata* (Walker, 1862) Lake Ohia (south), Maitahi,  
 Rangiputa  
*Epyaxa rosearia* (Doubleday, 1843) Lake Ohia (south),  
 Maitahi, Rangiputa, Whakaruangangana  
*Epyaxa venipunctata* (Walker, 1863) Rangiputa  
*Gellonia pannularia* (Guenée, 1868) Whakaruangangana  
*Helastia semisignata* (Walker, 1862) Rangiputa  
*Homodotis megaspilata* (Walker, 1862) Ngawha Springs,  
 Rangiputa  
*Microdes quadristrigata* Walker, 1862 Rangiputa  
 \**Pasiphila* cf. *humilis* (Philpott, 1917) Kaimaumuau, Pairatahi,  
 Whakaruangangana  
*Pasiphila lunata* (Philpott, 1912) Maitahi  
*Pasiphila testulata* (Guenée, 1857) Spirit's Bay Rd,  
 Whakaruangangana  
*Phrissogonus laticostatus* (Walker, 1862) Maitahi,  
 Whakaruangangana  
*Poecilasthena pulchraria* (Doubleday, 1843) Ahipara,

Maitahi, Ngawha Springs, Rangiputa, Spirit's Bay Rd,  
 Whakaruangangana  
*Poecilasthena schistaria* (Walker, 1861) Ahipara, Lake Ohia  
 (south), Rangiputa  
*Poecilasthena subpurpureata* (Walker, 1863) Lake Ohia  
 (south), Spirit's Bay Rd  
*Pseudocoremia fenerata* (Felder & Rogenhofer, 1875) Ngawha  
 Springs.  
*Pseudocoremia suavis* Butler, 1879 Lake Ohia (south), Maitahi,  
 Rangiputa, Spirit's Bay Rd  
*Sestra flexata* (Walker, 1862) Ngawha Springs, Rangiputa  
*Tatosoma transitaria* (Walker, 1862) Ahipara

### Gracillariidae (2)

'*Acrocercops*' *alysidota* (Meyrick, 1880) Rangiputa  
*Macarostola miniella* (Felder & Rogenhofer, 1875) Ngawha  
 Springs, Whakaruangangana

### Hepialidae (3)

*Aenetus virescens* (Doubleday, 1843) Maitahi, Ngawha Springs,  
 Whakaruangangana  
*Dumbletonius unimaculatus* (Salmon, 1948) Maitahi  
*Wiseana signata* (Walker, 1856) Maitahi, Whakaruangangana

### Lycaenidae (1)

*Zizina otis labradus* (Godart, 1824) Maitahi

### Noctuidae (33)

*Agrotis ipsilon* (Hufnagel, 1766) Maitahi, Rangiputa,  
 Whakaruangangana  
*Agrotis innominata* Hudson, 1898 Ahipara, Lake Ohia (south)  
*Agrotis munda* Walker, 1857 Maitahi  
 \**Anomis involuta* (Walker, 1858) Rangiputa  
*Athetis tenuis* (Butler, 1886) Rangiputa  
*Austramathes purpurea* (Butler, 1879) Spirit's Bay Rd  
*Bityla defigurata* (Walker, 1865) Maitahi, Whakaruangangana.  
*Chrysodeixis eriosoma* (Doubleday, 1843) Maitahi  
*Cosmodes elegans* (Donovan, 1805) Maitahi  
*Dasypodia cymatodes* Guenée, 1852 Rangiputa  
*Feredayia graminosa* (Walker, 1857) Maitahi, Ngawha Springs  
 Rangiputa, Spirit's Bay Rd, Whakaruangangana  
*Graphania homoscia* (Meyrick, 1887) Rangiputa  
*Graphania insignis* (Walker, 1865) Maitahi, Ngawha Springs,  
 Spirit's Bay Rd, Whakaruangangana  
*Graphania lignana* (Walker, 1857) Ahipara, Maitahi, Ngawha  
 Springs, Rangiputa, Spirit's Bay Rd, Whakaruangangana  
*Graphania mutans* (Walker, 1857) Ahipara, Maitahi, Ngawha  
 Springs, Rangiputa, Spirit's Bay Rd, Whakaruangangana  
*Graphania sequens* (Howes, 1912) Ahipara, Maitahi, Ngawha  
 Springs, Rangiputa, Whakaruangangana  
*Graphania* sp. (*insignis* group) Ahipara, Lake Ohia (south),  
 Maitahi, Ngawha Springs, Spirit's Bay Rd, Whakaruangangana  
*Graphania ustistriga* (Walker, 1857) Maitahi, Ngawha Springs,  
 Rangiputa, Spirit's Bay Rd, Whakaruangangana  
*Helicoverpa armigera* (Hübner, 1805) Maitahi  
*Leucania stenographa* Lower, 1900 Maitahi, Rangiputa

*Meterana stipata* (Walker, 1865) Whakaruangangana  
*Mythimna separata* (Walker, 1865) Maitahi  
 \**Pantylia sparsa* Guenée, 1852 Maitahi, Rangiputa, Spirit's Bay Rd, Whakaruangangana  
*Proteuxoa comma* (Walker, 1856) Lake Ohia (south), Maitahi, Ngawha Springs, Rangiputa, Spirit's Bay Rd, Whakaruangangana  
*Rhapha scotosialis* Walker, 1866 Ngawha Springs, Rangiputa, Spirit's Bay Rd, Whakaruangangana  
*Schrankia costaestrigalis* (Stephens, 1834) Maitahi, Whakaruangangana  
*Spodoptera litura* (Fabricius, 1775) Maitahi  
*Thysanoplusia orichalcea* (Fabricius, 1775) Maitahi  
*Tmetolophota arotis* (Meyrick, 1887) Maitahi, Rangiputa  
*Tmetolophota atristriga* (Walker, 1865) Whakaruangangana  
*Tmetolophota micrastra* (Meyrick, 1897) Ahipara, Spirit's Bay Rd  
*Tmetolophota semivittata* (Walker, 1865) Maitahi  
*Tmetolophota steropastis* (Meyrick, 1887) Lake Ohia (south), Maitahi, Rangiputa, Spirit's Bay Rd, Whakaruangangana

### Oecophoridae (16)

*Endrosis sarcitrella* (Linnaeus, 1758) Lake Ohia (south)  
*Gymnobathra tholodella* Meyrick, 1883 Ngawha Springs, Spirit's Bay Rd, Whakaruangangana  
*Hierodoris illita* (Felder & Rogenhofer, 1875) Aratoro  
*Izatha peroneanella* (Walker, 1864) Ahipara, Ngawha Springs  
*Thamnosara sublittella* (Walker, 1864) Spirit's Bay Rd  
*Tingena actinias* (Meyrick, 1901) Ahipara  
*Tingena ancogramma* (Meyrick, 1919) Kaimaumau, Lake Ohia (east), Lake Ohia (south)  
*Tingena armigerella* (Walker, 1864) Lake Ohia (south)  
*Tingena clarkei* (Philpott, 1928) Lake Ohia (south)  
*Tingena* cf. *epimylia* (Meyrick, 1883) Kaimaumau  
*Tingena* cf. *grata* (Philpott, 1927) Spirit's Bay Rd  
*Tingena hemimochla* (Meyrick, 1883) Lake Ohia (south), Pairatahi  
*Tingena* cf. *innotella* (Walker, 1864) Lake Ohia (south), Spirit's Bay Rd  
*Tingena* sp. nr *pallidula* (Philpott, 1924) Kaimaumau  
*Tingena* cf. *plagiata* (Walker, 1863) Ahipara  
*Trachypepla hieropis* Meyrick, 1892 Spirit's Bay Rd

### Pieridae (1)

*Pieris rapae* (Linnaeus, 1758) Maitahi

### Psychidae (1)

\**Lepidoscia protorna* (Meyrick, 1893) Maitahi, Ngawha Springs, Whakaruangangana

### Pyralidae (3)

\**Ephestiopsis oenobarella* (Meyrick, 1879) Rangiputa  
*Morosaphycita oculiferella* (Meyrick, 1879) Maitahi  
*Patagoniodes farinaria* (Turner, 1904) Maitahi, Whakaruangangana

### Stathmopodidae (2)

*Stathmopoda coracodes* Meyrick, 1923 Rangiputa  
*Stathmopoda horticola* Dugdale, 1988 Whakaruangangana

### Tineidae (2)

*Monopis ethelella* (Newman, 1856) Whakaruangangana  
*Opogona omoscopia* (Meyrick, 1893) Lake Ohia (south), Ngawha Springs, Rangiputa, Spirit's Bay Rd, Whakaruangangana

### Tortricidae (15)

*Apoctena conditana* (Walker, 1863) Whakaruangangana  
*Bactra noteraula* Walsingham, 1907 Whakaruangangana  
 \**Bactra* cf. *optanias* Mayrick, 1911 Whakaruangangana  
*Capua intractana* (Walker, 1869) Lake Ohia (south), Maitahi, Whakaruangangana  
 'Capua' *semiferana* (Walker, 1863) Ahipara, Maitahi, Ngawha Springs, Rangiputa, Spirit's Bay Rd, Whakaruangangana  
 'Cnephasia' *jactatana* (Walker, 1863) Rangiputa  
*Cryptasasma querula* (Meyrick, 1912) Maitahi, Ngawha Springs  
*Cydia succedana* (Denis & Schiffermueller, 1776) Carrington Estate, Lake Ohia (south), Whakaruangangana  
*Epiphyas postvittana* (Walker, 1863) Maitahi, Whakaruangangana  
 \**Ericodesma argentosa* (Philpott, 1924) Lake Ohia (east), Maitahi, Whakaruangangana  
 \**Ericodesma scruposa* (Philpott, 1924) Lake Ohia (east), Whakaruangangana  
*Holocola zopherana* Meyrick, 1881 Ahipara, Lake Ohia (south), Rangiputa, Spirit's Bay Rd, Whakaruangangana  
*Merophyas divulsana* (Walker, 1863) Lake Ohia (south), Maitahi, Rangiputa  
*Strepsicrates ejectana* (Walker, 1863) Lake Ohia (south)  
*Strepsicrates infensa* (Meyrick, 1911) Rangiputa

**TOTAL = 161 species**

## APPENDIX 2

### Authorities for plant species names listed in the text

*Agathis australis* (D. Don) Lindl. ex Loudon (1829)  
*Baumea teretifolia* (R. Br.) Palla (1902)  
*Campylopus introflexus* (Hedw.) Brid. (1819)  
*Dracophyllum lessonianum* A. Rich.  
*Epacris pauciflora* A. Rich. (1832)  
*Gahnia setifolia* (A. Rich.) Hook. f. (1853)  
*Gahnia xanthocarpa* (Hook. f.) Hook. f. (1863)  
*Gleichenia dicarpa* R. Br. (1810)  
*Hakea sericea* Schrad. & J.C. Wendl. (1796)  
*Kunzea ericoides* (A. Rich.) Joy Thomps. (1983)  
*Lepidosperma filiforme* Labill. (1805)  
*Leptospermum scoparium* J.R. Forst. & G. Forst. (1776)  
*Leucopogon fasciculatus* (G. Forst.) A. Rich. (1832)  
*Machaerina sinclairii* (Hook. f.) T. Koyama (1956)  
*Medicago sativa* L.  
*Schoenus brevifolius* R. Br. (1810)