LANDCARE RESEARCH
MANAAKI WHENUA

The Moths of Mt Te Aroha:

A Summary

Robert J.B. Hoare

Manaaki Whenua / Landcare Research, Private Bag 92170, Auckland

CMER
Centre for Mineral Environmental Research
New Zealand

Funding for this research was provided by the New Zealand Ministry for Business Innovation and Employment (MBIE)

Introduction

Diversity of native moths. Aotearoa/New Zealand has only 30–50 species of butterflies but probably over 2000 moth species. About 85% of these moths are endemic, occurring nowhere else in the world. While most moths are nocturnal, we also have many tiny moths that fly by day, and are not attracted to light at night; there are many that we know almost nothing about.

Food web. Moths and their caterpillars are extremely important food web components in almost every kind of habitat from the coast to the high alpine zone, and contribute to the health and richness of these ecosystems.

Caterpillars may feed on:

- Living plants – some caterpillar species are very fussy and will only eat one plant species (e.g. the silver fern looper moth); others caterpillar species (e.g. some owlet moths) eat lots of plant species
- Leaf litter and dead wood
- Fungi

Moths may feed on:

- Nectar from flowers and dew on leaves – they use a well-developed tongue, coiled under the head when not in use to suck this up
- Fat stored in their own bodies (they do not visit flowers)

Food for others:

- Birds, spiders and insects, including parasitic wasps and flies eat caterpillars and moths

PLATE 1. Slender Owlet (*Rhapsa scotosialis*) male visiting kohekohe flower in winter (photo by Olly Ball, taken at Maungakaramea near Whangarei).

Pollinators. When larger moths are collecting nectar, they also pollinate many different kinds of flowers (e.g. houhere/lacebark (*Hoheria*), white rata (*Metrosideros perforata*), koromiko (*Hebe*), and, in winter, kohekohe (*Dysoxylum*). Pollen is easily trapped on the fluffy moth bodies and then transferred to other flowers, thus fertilising them and ensuring the plants produce seed.

The richness of native plants in a habitat has a huge effect on the richness of the moth fauna. When plants are disturbed or reduced by humans, weeds or by introduced pests, native moth populations will also be adversely affected. Where disturbance is extensive, moth species quickly become rare or even disappear. This has flow on affects for native animals that feed on moths. Similarly, without the pollination services provided by moths, natural vegetation regeneration may not occur.

Importance of Mt Te Aroha for moths

Mt Te Aroha forms the northernmost known location for several endemic species of moths, which are more widespread and common in the cooler South Island and in the southern and central North Island. Examples are the large ghost moth *Dumbletonius characterifer* and the very small metallic-looking Astelia zig-zag miner, *Charixena iridoxa*. Species at the edge of their natural range may disappear with future climate warming.

Mt Te Aroha is important habitat for some rare species, e.g. the owlet moth '*Graphania' prionistis* is common whereas it is rare throughout the rest of New Zealand (we do not know the host-plant of this species' caterpillar so why it thrives here is a mystery).

Another elusive moth, the tiny, day-flying 'salt and pepper fungus moth' (*Eschatotypa halosparta*), was found in 2015 near the Tui Mine – only the second locality ever recorded in New Zealand.

PLATE 2. Salt and pepper fungus moth (*Eschatotypa halosparta*) (Photo by Birgit Rhode, Landcare Research).

Important host-plants for moths: possible ideas for further restoration of mine site

Toe-toe (*Austroderia* spp.): the host-plant of the native owlet moth *Dipaustica epiastra*, a medium-sized reddish brown moth that is widespread but not common throughout New Zealand; it has been found on Mt Te Aroha near the summit, and is probably also present at the Tui Mine site.

A second very distinctive moth whose caterpillar feeds at the bases of the toe-toe leaves is *Orocrambus angustipennis* Crambidae. The adult has a 50-mm wingspan.

Cutty grass (*Gahnia* spp.): Caterpillars of several species of sedge moths (family Glyphipterigidae), and some fungus moths (Tineidae), feed on the seeds or in the stems. It is also the host-plant of the magnificent and rare Forest Ringlet butterfly (*Dodonidia helmsii*).

Koromiko (*Hebe stricta*) and other *Hebe* species: Quite a few species of moths have caterpillars that feed on various species of *Hebe*. Examples are the hebe plume moth *Amblyptilia falcatalis*, hebe pug moth *Pasiphila lunata*, the triangle moth *Mnesictena daiclesalis*, and the looper *Xyridacma veronicae*. The flowers of *Hebe* are also attractive to moths, butterflies, beetles, and other native insects by day and night.

Kiekie (*Freycinetia*): Several small fungus moths family Tineidae are associated specifically with kiekie; the caterpillars feed either on the dead stems or dead leaf material. Kiekie also provides excellent shelter for the adult moths. For forest above 300 m altitude, abundant kiekie seems to be a good indicator of excellent moth habitat.

Five-finger (*Pseudopanax arboreus*) and other *Pseudopanax* species: This is the host plant for two large species of looper moths, both recorded on Mt Te Aroha. One species is the North Island Zebra Moth *Declana atronivea*, whose caterpillar resembles a lichen-covered twig. The second less-common species is *Xyridacma alectoraria*, a broad-winged moth that resembles a dead leaf. Possums browsing on *Pseudopanax* may be one reason for the decline of this moth, which was considered common 100 years ago. *Pseudopanax* species are also important hosts for tiny leaf-mining moths of the family Gracillariidae.

Monitoring moths

▶ **Attracting moths at night with a bright light.** Most recording by scientists is done by placing a generator-powered bright 125W mercury vapour light bulb over a white sheet to attract moths. While this approach is highly efficient, weather conditions often make light-trapping difficult. And just because a species does not turn up on a particular night, that does not mean it is not present.

▶ **Searching for feeding sign.** An alternative is to search for the feeding signs left behind by the caterpillars, the easiest way to record many of the smaller elusive species. Feeding signs often persist on plants for many weeks or even months.

Fern spore moths: Some of the easiest feeding signs to spot are on fern spores on the undersides of fern fronds. Caterpillars tie together the spores with silk and shelter underneath. Many ferns are environmentally sensitive, and may be slow to recolonise disturbed sites. If ferns and their associated moths are present, that is likely to indicate healthy habitat.

Calicotis crucifera spore-feeding on *Pyrrosia elaeagnifolia*, leatherleaf

Thylacosceles radians spore-feeding on *Microsorum pustulatum*

Batrachedra species A spore-feeding on *Asplenium flaccidum*

PLATE 3. Plant signs (spore-feeding) left by the caterpillars of micro-moths on their host-plants: some examples (photos by Nicholas Martin, Plant and Food Research).

Leaf-mining moths: Some tiny moths lay their eggs on the surface of leaves, and the caterpillar then bores into the tissue of the leaf, eating its way along through the inner leaf cells and leaving a characteristic track or blotch. The adult moths are rarely seen but since the caterpillars of each species make a particular mine pattern, the leaf-mining signs can be used to identify them.

Leaf-mining moths include the pygmy moths, (Nepticulidae), some of which are the smallest moths in the world with wingspans of no more than 3 mm. New Zealand has about 40 species of pygmy moth; they have not been studied on Mt Te Aroha but certainly several species are very likely to be present.

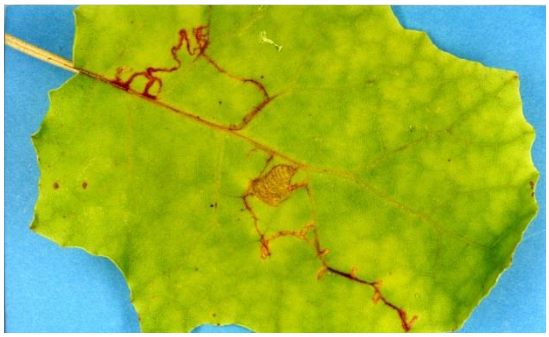
Another very unusual leaf-miner is the leather-leaf star-miner *Philocryptica polypodii*. The characteristic radiating mines made by the larva in a frond of leatherleaf fern (*Pyrrosia elaeagnifolia*) can sometimes be found in the sunnier parts of the forest where this fern tends to live. The adult moths are almost invisible on the wing ensuring they are very rarely seen, so the mine is the best way to record this species.

Searching for the signs on plants left behind by leaf-miners and spore-feeders adds an extra dimension to assessing restoration success on a site like the Tui Mine. Re-establishment of the native plants is the first step in the process of restoration. Once the feeding signs made by these

native caterpillars are seen on their host-plants, it means another positive step towards full restoration.

PLATE 5. Plant signs (leaf-mines) left by the caterpillars of micro-moths on their host-plants: some examples (photos by Nicholas Martin, Plant and Food Research).

'Acrocercops' zorionella leaf-mine on *Coprosma* sp.



Stigmella cypracma leaf-mine on rangiora (*Brachyglottis repanda*)

Philocryptica polypodii leaf-mine on *Pyrrosia* frond

Moss-feeding moths on Mt Te Aroha

There are many species of moths in New Zealand whose caterpillars feed on mosses. Almost all these moths are small 'micro-moths' (Crambidae). The caterpillars live concealed in the moss and are quite difficult to find. Most species of moss-feeding moths probably have a number of moss hosts but some rarer species may only feed on a single genus or species of moss. One possible example of the latter is the rare species *Glaucocharis stella*, *which* occurs near the summit of Mt Te Aroha. *Glaucocharis* species often fly actively by day and are quite conspicuous. When disturbed, they will fly for a short distance then hide on the underside of trackside vegetation, often fern fronds.

Plate 6 shows the adults of 8 species of 'moss moth' that have been found on Mt Te Aroha.

Glaucocharis holanthes

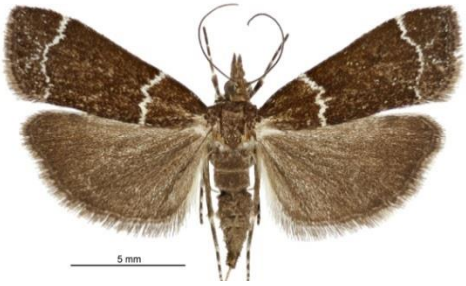
Glaucocharis leucoxantha

Glaucocharis pyrsophanes

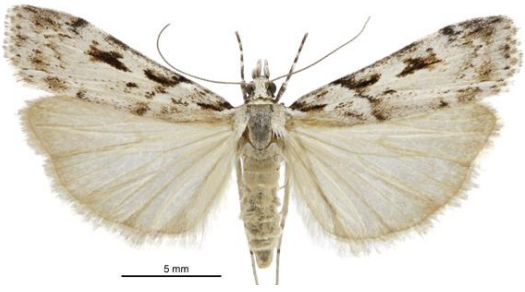
Glaucocharis stella

Eudonia aspidota

Eudonia colpota



Eudonia leucogramma



Scoparia astragalota

PLATE 6. Moths of Mt Te Aroha whose caterpillars certainly or probably feed on mosses (photos by Birgit Rhode, Landcare Research).

Moths of possible conservation or cultural significance from Mt Te Aroha

See plates 7 and 8 for illustrations of some especially significant larger moths of Mt Te Aroha (photos by Birgit Rhode, Landcare Research).

PLATE 7

Aenetus virescens Puriri Moth. Largest moth in New Zealand. Larvae in trunks of many native and introduced trees, including houhere, pūriri, putaputaweta. Very common in native forest throughout the North Island. Favoured prey of ruru.

Aoraia enysii. Northern Aoraia, emerging only from March onwards near the summit. Mt Te Aroha is the northernmost locality of this moth, which belongs to a genus mainly associated with South Island mountains and cool forest habitats.

Dumbletonius characterifer. Beech Forest Ghost Moth, common near the summit of Mt Te Aroha; possibly the northernmost locality for the moth. The caterpillar lives in subterranean tunnels in leaf-litter, and falls prey to the vegetable caterpillar fungus, *Cordyceps robertsii*.

Declana atronivea. North Island Zebra Moth (or North Island Lichen Moth), fairly common in the North Island forest wherever its host-plant, five-finger, occurs.

Tatosoma apicipallida. A little known looper moth that occurs near the summit; its northernmost locality. The caterpillar's host-plant is unknown.

Tatosoma fasciata. Another looper moth, confined to the summit forest; perhaps the northernmost locality. The caterpillars feed on silver beech (*Lophozonia menziesii*).

Xyridacma alectoraria. Five-finger looper, rarely seen.

PLATE 8

Graphania brunneosa. Widespread in high rainfall localities; Mt Te Aroha is probably its northernmost locality, possibly the northernmost. The host-plant of the caterpillar is unknown.

Graphania chlorodonta. Green-toothed Owlet whose caterpillar feeds on the fork-ferns (*Tmesipteris* species) often found growing from the trunks of tree-ferns.

'Graphania' prionistis. This owlet moth is quite rare but on Mt Te Aroha, it seems to be rather common, at least near the summit. Its host-plant is unknown and the caterpillars have never been seen.

Meterana merope. Patē Owlet, widespread but not common. Caterpillars feed on patē (*Schefflera digitata*).

Tmetolophota purdii. Orange Astelia Wainscot, widespread but not often seen. The caterpillars make notches in leaves of kōwharawhara (tank-lilies, *Astelia*), and this damage may be more easily seen than the moth.

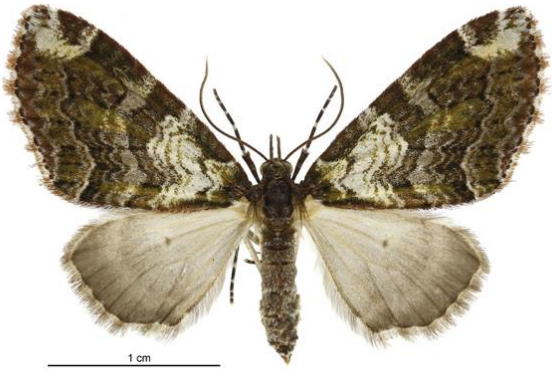
PLATE 7

Aenetus virescens

Aoraia enysii

Dumbletonius characterifer

Declana atronivea



Tatosoma apicipallida

Tatosoma fasciata

PLATE 8

Xyridacma alectoraria

Graphania brunneosa

G. chlorodonta

'G.' prionistis

Meterana merope

Tmetolophota purdii

Conclusions and Recommendations

Mt Te Aroha is a very special place for our native moths, especially as the northernmost location in the country for a number of species that require the cool moist forest conditions present at the summit. More work is needed to discover the full diversity even of the larger moths – 92 species of larger moths have been recorded from Tui Mine site and Mt Te Aroha summit, and we expect a further 50 to 60 species could be present. Including the numerous micro-moth species and butterflies, over 500 species may inhabit the area.

The rehabilitation areas are more open and weedy and have more non-native and cosmopolitan (unspecialised) moth species. The native forest areas have more moth species as their larvae feed on moss, leaf litter, ferns, native trees and shrubs or dead wood. While moths from the forest willingly fly across open areas such as the Tui Mine site, they are unlikely to breed there until the sites are restored. Specific host-plants could be monitored for typical signs of moth caterpillars (e.g. fern-spore feeders and leaf-miners) moving in from the adjacent forest.

We do not know the effect on moth behaviour of the bright lights at the summit; it is likely that their normal behaviour is strongly disrupted by the lights and as a result many moths and other insects attracted to the light are probably far more vulnerable to predators such as birds.

Given the knowledge we have already, and given its special nature as the highest peak in the area, Mt Te Aroha has the potential to be a significant place for long-term recording of moths, and somewhere where we can keep an eye on their numbers and look for any signs of decline as a result of climate change or other disruption.