The moths of Quail Island (Ōtamahua): a faunal comparison of an island under restoration with other sites on Banks Peninsula

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(Received 30 July 2010, revised and accepted 24 January 2011)

Abstract

The Lepidoptera (moths and butterflies) of Quail Island located in Lyttelton Harbour, Banks Ecological Region, Canterbury, New Zealand were surveyed between 2007 and 2009. Four other Banks Peninsula sites were also sampled. In total, 146 species of Lepidoptera were found on Quail Island, which is currently undergoing ecological restoration. This is relatively rich for a small island with limited habitat diversity, but not as rich as nearby Banks Peninsula sites. None of the known Banks Peninsula endemic moths were recorded on the island. Recommendations are made for additional plantings to encourage the establishment of greater numbers of moth species and particular moth species are suggested for reintroduction to the island.

Key words: Quail Island - Ōtamahua - Banks Peninsula - ecological restoration - moths - Lepidoptera - host plants - reintroductions.

Introduction

Quail Island is located in Lyttelton Harbour, Banks Ecological Region, Canterbury, New Zealand. The island is an 85 ha Recreation Reserve administered by the Department of Conservation and the Quail Island Ecological Restoration Trust.

At present, Quail Island is being ecologically restored through pest eradication (Bowie 2008; Bowie *et al.* 2010) and native planting (Norton *et al.* 2004). Inventories of plants (Burrows *et al.* 1999), invertebrates (Bowie *et al.* 2003) and lizards (Lukis 1999) have been completed, but with the planting of approximately 80,000 native trees and shrubs over the last twelve years the habitat has changed considerably. In the early stages of the restoration, Bowie *et al.* (2003) identified 54 species of Lepidoptera on Quail

Island, but since then additional species are expected to have established, in addition to species missed in that survey. Due to the inventories of Kaitorete Spit (Patrick 1994), Hinewai Reserve (Ward *et al.* 1999) and Kennedys Bush (Ward *et al.* 2007), the Lepidoptera of some parts of Banks Ecological Region are fairly well known. However, further surveys are required to cover the many habitats present in the Banks Ecological Region, which contains three ecological districts (Wilson 1992). The position of Quail Island as bordering the Port Hills and Mt Herbert districts makes it an ecologically interesting location to survey.

The aim of this research is to gain an understanding of the Lepidoptera species present on the island, and to compare this new data to the earlier survey by Bowie *et al.* (2003) and other recently surveyed Banks Peninsula sites. These comparisons would enable recommendations to be made on the future course of the island restoration in respect to Lepidoptera species and associated habitats. Comparisons of moth catches over time can also provide an indicator of restoration success (Lomov *et al.* 2006) which would be of great benefit to the greater Quail Island restoration picture.

Methods

Details of all collection sites, dates and distances from Quail Island are shown in Table 1. Moth collecting was undertaken on the island on four nights and two days. Light-trapping was carried out on 7 December 2009 at Walkers Beach, and again on 13 December 2009 just east of the island centre, adjacent to some of the older native plantings on the island. Other Banks Peninsula sites sampled as a comparison were Orton Bradley Park (Lyttelton Harbour), Ahuriri Scenic Reserve (Port Hills) Onawe Peninsula (Akaroa Harbour) and Hinewai Reserve (East of Akaroa) (see Table 1). A 160 W mercury vapour UV light trap was used for these collections. Daytime collections were also made on the same dates using a net. Dry collections of butterflies and moths were prepared and are stored in the Lincoln University Entomology Research Museum (LUNZ). Nomenclature used in this publication essentially follows that of Dugdale (1988) but also utilises some more recent updates (Nielsen *et al.* 1996; Kaila 1999; Hoare 2010). The host plant records stated in the appendix are those of Brian Patrick's (unpublished data), based on his experience in other parts of New Zealand including Canterbury. Where a moth species has a known association with a particular host plant rather than actually reared, then this is noted.

Results

Lepidoptera species recorded from Quail Island, Onawe Peninsula, Hinewai Reserve, Orton Bradley Park and Ahuriri Scenic Reserve are shown in the appendix. A total of 146 species of Lepidoptera are now recorded from Quail Island, of which 134 are native species and 12 are introduced. Localised New Zealand species found on Quail Island are shown in Table 2.

Discussion

The 146 Lepidoptera species recorded on Quail Island represent a somewhat diverse fauna for an island in the early stages of ecological restoration. By comparison, Hinewai Reserve (Ward *et al.* 1999) yielded 171 species, but that area's greater diversity of native plants and more mature composition of flora would provide a wider variety of habitats.

Table 1: Collection sites, dates and distances from Quail Island

Collection site	Latitude & Longitude	Collection date	Distance from Quail Island
Quail Island			
Information Centre	43° 37.722'S, 172° 41.814'E	3 December 2007, 4 February 2008	—
Walkers Beach	43° 37.861'S, 172° 41.200'E	7 December 2009	—
Central track	43° 37.685'S, 172° 41.632'E	13 December 2009	—
Banks Peninsula			
Magnificent Gully, Orton Bradley Park	43° 40.247'S, 172° 43.535'E	4 February 2010	5.07 km
Ahuriri Scenic Reserve	43° 39.987'S, 172° 37.447'E	2 December 2007	7.20 km
Onawe Peninsula	43° 46.129'S, 172° 55.643'E	31 January 2008	24.70 km
Hinewai Reserve	43° 48.678'S, 173° 1.706'E	9 January 2008, 21 February 2008	34.05 km

Other surveys, such as those of Kaitorete Spit (Patrick 1994) and Kennedys Bush (Ward *et al.* 2007) found fewer moth species than on Quail Island, with 130 and 67 respectively However, it should be noted that the collecting effort was not standardised between sites, therefore care must be taken not to over-analyse sites with a single night's collection, as was the case for Orton Bradley Park, Onawe Peninsula and Ahuriri Reserve (Table 1). The Quail Island Lepidoptera comprises species from a variety of habitats including forest, shrubland, grassland, rock faces and open areas. All of the Lepidoptera collected on the island are also found on either the surrounding Banks Peninsula or the Port Hills. None of the endemic Banks Peninsula moths (*Pseudocoremia modica*, *Pasiphila heighwayi* and *Paranotoreas* new species) have been collected on Quail Island, but expected that one or more of these species may establish over time as suitable habitats become available. The most interesting species collected was an undescribed *Eudonia* species. Its presence here is intriguing because it has previously only been found in a very small number of localities on the Otago Peninsula (Brian Patrick, pers. comm.). The discoveries of elegant geometrids *Helastia triphragma*, *Pasiphila magnimaculata*, *P. malachita*, *P. urticae,* and *Chloroclystis lichenodes* are also exciting as these species are seldom collected. Apart from P. *urticae* and *P. malachita*, they have never been successfully reared, although it is strongly suspected that *H. triphragma* utilizes the shrub *Helichrysum lanceolatum* as its larval host.

Of interest was the absence from Quail Island of *Cleora scriptaria* (Geometridae). This species is polyphagous on a variety of tree species and is known for the characteristic holes made by its larvae on kawakawa *Macropiper excelsum* leaves.

Table 2. Localised native moth species found on Quail Island, and their host or habitat

Species	Host/habitat
Eudonia new species	Rare undescribed coastal species. Feeds on moss on coastal rocks
Helastia triphragma	Associated with *Helichrysum lanceolatum*
Chloroclystis lichenodes	Forest species with unknown larval host
Kiwaia monophragma	Dryland species of open areas
Pasiphila magnimaculata	Unusual occurrence here; usually found in montane areas
Pasiphila malachita	Larvae on *Hebe*
Pasiphila urticae	Larvae on tree nettle *Urtica ferox*
Harmologa new species	Dryland leaf-roller on small-leaved *Melicytus* shrubs
Scoparia augastis	Southern coastal grassland species

Holes have been noticed on the leaves of Quail Island kawakawa, so *C. scriptaria* was expected to be collected. However, it has been suggested that the leaf damage may have been caused by larvae of the light brown apple moth, *Epiphyas postvittana*; a known herbivore of kawakawa (Hodge *et al.* 2000).

The list of moths and butterflies collected on Quail Island (Appendix) reflect the composition of the island's flora, as many moth species are associated with a specific larval host plant or a particular community. Some special host plant relationships are present on the island: native brooms (*Carmichaelia*) support the two uncommon moths; *Muehlenbeckia* is utilised by many native moths; and *Dichondra*, *Solanum*, *Hoheria*, *Urtica,* and *Plagianthus* all act as host plants for uncommon Lepidoptera species found on the island. The number of moth species present indicates that Quail Island has a diverse flora with reasonably diverse ecological habitats, supporting rock-face, forest, shrubland and grassland Lepidoptera species. It is expected that more native moth species will be found on Quail Island with additional sampling, especially once under-storey plants are established and the island's habitat matures.

Several moth species collected on Quail Island during this latest survey have larvae that are specialist feeders on native plants that are not present on the island (Colin Burrows, pers. comm.). Conspicuous amongst these species are two large noctuids, *Meterana dotata* and *M. praesignis,* and the elegant geometrid *Tatosoma tipulata*; all of which have larvae that defoliate beech (*Nothofagus*). Additionally, the elegant geometrid *Pasiphila magnimaculata* was collected on the island, but its larval host *Gaultheria* is absent. It could be suggested that both of these host plants be introduced to the island to support the establishment of these Lepidoptera species; however, as beech is not considered a historic species on Quail Island, it is unlikely to be planted. Low numbers of other host plants, such as lawyer (*Rubus squarrosus* and *R. schmideliodes*) could be supplemented with additional plantings to accommodate moth populations; indeed, both of these host species are suggested as part of the revegetation plan to secure these moth species on Quail Island. *Plantago raoulii* is

a plant species absent from Quail Island but could be introduced in moist areas to assist establishment of *Hydriomena deltoidata* (currently present), but also to attract native moths such as the geometrid *Asaphodes abrogata*. As *Plantago raoulii* is susceptible to competition from exotic grasses, care must be taken to plant it in suitable locations (Colin Burrows, pers. comm.).

The absence of any mistletoe species on Quail Island restricts the presence of moth fauna that would normally be associated with them. The Lyttelton Harbour basin has three mistletoe species: *Ileostylus micranthus, Korthalsella lindsayi,* and *Tupeia antarctica* (Lucas *et al.* 2005). Establishing the two larger-leaved mistletoes, *T. antarctica* and *I. micranthus* (Baird 1997) on hosts such as small-leaved coprosmas and kowhai (de Lange *et al.* 1997) using hand-planting techniques (Ladley *et al.* 1997) should accelerate the restoration of these parasites and thus allow native moths such as geometrids *Declana griseata* and *Tatosoma agrionata* to colonise, and help secure the existing moth *Zelleria sphenota* (Patrick & Dugdale 1997).

Conclusions

Comparison of Lepidoptera species numbers collected on Quail Island from the first survey completed by Bowie *et al.* (2003) and the present survey shows an increase of more than 250%. Although the increase in species numbers may partly reflect a more concerted collection effort, another reason for the increase is likely to be the quantity and diversity of host shrub and tree species planted in the seven years since the last survey. Given time, canopy closure, accumulation of leaf litter and the future establishment of under-storey plant species, additional habitats will allow new Lepidoptera species to colonise the island. Other flying insects, such as Diptera and Hemiptera, and their parasites will also establish as restoration plantings mature. An increase in moth diversity, as well as that of other insects, will benefit insectivorous birds and lizards on the island. Apterous invertebrate species such as spiders may need to be reintroduced through translocations.

Although Quail Island is still at a very early stage in the ecological restoration process, Lepidoptera species diversity is impressive. There is undoubtedly potential for further increases, by both Lepidoptera reintroductions and also introduction of new host plants to encourage the immigration and establishment of other moth species. The recommendations below will provide guidance on how to maximise the Lepidoptera species present from the Banks Ecological region.

Recommendations

In an effort to gain more knowledge of the Lepidoptera species present on Quail Island, we recommend ongoing Lepidoptera collection, particularly over a range of seasons including late summer, autumn and spring. Island collection sites should also be extended and could include a grassland site and a different coastal locality on the island. It is important not only to collect throughout the year, but also to utilise different collection techniques (such as Malaise trapping or sweep netting) in order to detect moth species that are difficult to find using normal light-trapping methods. This will highlight the Lepidoptera species-richness of the island. Ongoing surveys will also help us see the development of Lepidoptera species on the island, and to therefore judge the success of the revegetation plan to attract native moths and butterflies.

While we acknowledge that it is dif-

ficult to translocate moth species, we believe that by establishing an appropriate habitat of host plants, certain target moth species will self-establish. Possible Lepidoptera introductions include *Dasyuris partheniata*, an elegant, orange, day-flying geometrid that could flourish on Quail Island if sufficient host plants of *Aciphylla subflabellata* were planted adjacent to the small population already present. Another geometrid, *Pseudocoremia modica* could also be introduced as its larval host plant, Banks Peninsula endemic *Hebe strictissima* is already present on the island. As the female of *P. modica* is flightless, this species would have to be actively introduced as it will not disperse naturally to the island.

The following native plants could be considered for introduction or supplementary planting to support native moth species identified from the general area:

- Additional plantings of *Aciphylla subflabellata* for the diurnal geometrid moth *Dasyuris partheniata* (present on the Port Hills and eastern Banks Peninsula).
- Additional *Carmichaelia australis* to encourage native moths and to secure existing species *Pseudocoremia melinata*, *Samana acutata* and *Anisoplaca ptyoptera*.
- Additional plantings of *Helichrysum lanceolatum* to attract additional native moths such as the tiny day-flying *Asterivora chatuidea*, and also to secure the existing moth species *Helastia triphragma*.
- Additional plantings of *Urtica ferox* (tree nettle) to secure existing moth species *Pasiphila urticae*, *Pseudocoremia pergrata* and *Udea marmarina*, and to attract additional species including larger numbers of red admiral butterflies *Vanessa gonerilla*.
- Additional plantings of *Corokia cotoneaster* to attract native moths such as the geometrid *Horisme suppressaria* particular to this attractive shrub.
- Additional plantings of *Clematis afoliata* to attract native moths that utilise this liane, as well as to secure the existing species *Asaphodes chlamydota* and *Deana hybreasalis*.
- Continued plantings of *Pittosporum* and *Hoheria* to further secure the existing native moth species *Declana niveata*, *Epiphryne undosata*, *Xyridacma ustaria*, *Lysiphragma howesii* and *Anisoplaca achyrota*.
- Increased plantings of *Rubus squarrosus* and *R. schmideliodes* (already present, but rare) to secure the existing moth species *Meterana diatmeta* and *Elvia glaucata*.
- The herb *Plantago raoulii* to attract native moths such as the geometrid *Asaphodes abrogata*. Planting of this species will also help to secure the existing moth species *Hydriomena deltoidata* and *Scopula rubraria*.
- Low shrubs of *Gaultheria antipoda* to allow existing geometrid *Pasiphila magnimaculata* to establish.
- Additional plantings of hound's tongue fern *Microsorum pustulatum* to secure the existing moth species *Sarisa muriferata*.
- Introduction of local larger-leaved mistletoes *Tupeia antarctica* and *Ileostylus micranthus* to allow establishment of native moths such as geometrids *Declana griseata* and *Tatosoma agrionata*, and to secure the existing moth species *Zelleria sphenota*.

At this point in time it is difficult to know what effect the vegetation restoration to date has had on the Lepidoptera fauna of Quail Island, as the Lepidoptera surveys have not been standardised or thorough. However, if standardised, future detailed Lepidoptera surveys could help reveal the effects of restoration on this dynamic ecological system, and identify whether larvae or larval damage

occur on particular host plants.

This survey has shown that a comparatively rich Lepidoptera fauna is present on Quail Island. If additional surveys are carried out at other times of the year to provide a more comprehensive seasonal representation, an even more interesting Lepidoptera fauna is likely to be documented.

Acknowledgements

We thank the Quail Island Ecological Restoration Trust and the island workers for assistance with this survey. Thanks also to the Department of Conservation for their support of research on the island. We thank Sonja Akkerman for her assistance moth collecting at Orton Bradley Park. Thanks to Colin Burrows for sharing his vision for the island with us, his ongoing support and constructive comments about the manuscript, particularly his botanical suggestions. We thank Dr Robert Hoare and Eric Edwards for reviewing the paper and greatly improving it. Thanks also to Candice Barclay for her useful suggestions to improving the manuscript.

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Appendix. Lepidoptera caught on Quail Island and other Banks Peninsula sites between 2007 and 2009 (Bowie *et al.* 2003), and their associated host plants and habitats, where known. Species introduced* or endemic[e] to New Zealand.

Family & species	Quail Island 2007-2009	Quail Island 2003	Ahuriri Scenic Reserve	Onawe Peninsula	Hinewai Reserve	Orton Bradley Park	Host plant or Habitat
Hepialidae							
Wiseana cervinata[e]			x				Subterranean in grassland
Wiseana copularis[e]	x		x		x	x	
Wiseana umbraculata[e]	x		x				
Psychidae							
Liothula omnivora[e]		x					Polyphagous on trees and shrubs
Tineidae							
Archyala terranea[e]	x						Adults have been reared from detritus and feathers, but no host confirmed
Lysiphragma howesi[e]						x	*Hoheria* on bark
*Monopis ethelella**	x						Wool
*Nemapogon granella**	x						Cosmopolitan domestic species
Tinea mochlota[e]						x	Dead wood
Plutellidae							
Plutella antiphona[e]						x	Crucifers
Yponomeutidae							
Zelleria sphenota[e]					x		Mistletoes; larvae mine leaves then feed on young leaves and buds
Glyphipterigidae							
Glyphipterix oxymachaera[e]	x						*Poa cita*
Glyphipterix triselena[e]						x	Coastal grassland
Gelechiidae							
Anisoplaca achyrota[e]					x	x	*Hoheria* fruit
Anisoplaca acrodactyla[e]	x						*Plagianthus* fruit
Anisoplaca ptyoptera[e]	x						*Carmichaelia*
Kiwaia monophragma[e]	x						Open areas and shrubland
*Symmetrischema tangolias**	x						*Solanum* stems
Unidentified Gelechiidae[e]		x					Unknown
Oecophoridae							
*Barea exarcha**	x						Dead wood
Gymnobathra parca[e]	x						Leaf litter

Family & species	Quail Island 2007-2009	Quail Island 2003	Ahuriri Scenic Reserve	Onawe Peninsula	Hinewai Reserve	Orton Bradley Park	Host plant or Habitat
Oecophoridae cont.							
Gymnobathra tholodella[e]					x		Leaf litter
Izatha huttonii[e]	x		x				Dead wood
Izatha katadiktya[e]	x						Dead wood
Izatha convulsella[e]	x						Lichen on rocks and bark
Leptocroca scholaea[e]	x	?	x			x	Dying roots and leaves
Phaeosaces coarctatella[e]	x						Larvae found in dead wood; presumably feed on lichen
Phaeosaces apocrypta[e]	x		x				Lichen on wood
Stathmopoda horticola[e]	x	x			x		Polyphagous
Stathmopoda plumbiflua[e]						x	Polyphagous
Tingena chloradelpha[e]	x						Leaf litter
Tingena melinella[e]	x						Leaf litter
Tingena species 1[e]	x				x		Leaf litter
Tingena species 2[e]	x						Leaf litter
Trachypepla anastrella[e]	x						Leaf litter
Trachypepla euryleucota[e]	x						Detritus in bird nests
Elachistidae							
Elachista ochroleuca[e]	x						Leaf miner on grasses
Elachista ombrodoca[e]	x						Leaf miner on grasses
Choreutidae							
*Tebenna micalis**	x						Thistles
Carposinidae							
Heterocrossa gonosemana[e]					x		*Griselinia* fruit
Tortricidae							
Apoctena flavescens[e]			x		x	x	Polyphagous
Capua semiferana[e]	x	x			x		Detritus
*Capua intractana**	x	x					Detritus
Crocidosema plebejana	x	x					Malvaceae
Ctenopseustis obliquana[e]	x				x	x	Polyphagous
*Cydia succedana**					x	x	Gorse
Epichorista siriana[e]						x	Grasses
New genus and species[e]						x	Larvae in webbed tunnels in short sward leaf litter

Family & species	Quail Island 2007-2009	Quail Island 2003	Ahuriri Scenic Reserve	Onawe Peninsula	Hinewai Reserve	Orton Bradley Park	Host plant or Habitat
Tortricidae cont.							
*Epiphyas postvittana**	x	x					Polyphagous
Harmologa amplexana[e]	x				x		Polyphagous
Harmologa new species[e]	x						Small-leaved *Melicytus*
Harmologa oblongana[e]	x					x	Polyphagous on shrubs
Harmologa scoliastis[e]	x				x		*Muehlenbeckia*
Leucotenes coprosmae[e]					x		*Coprosma*
Merophyas leucaniana[e]	x						Grasses and herbs
Planotortrix excessana[e]	x	x	x		x		Polyphagous
Strepsicrates ejectana	x						Kanuka (*Kunzea*)
*Strepsicrates macropetana**		x					*Eucalyptus*
Strepsicrates zopherana	x						Kanuka (*Kunzea*)
Pterophoridae							
Pterophorus innotatalis[e]	x	x					Larvae mine & later defoliate *Dichondra*
Pterophorus monospilalis[e]			x		x		*Schefflera* & *Pseudopanax*
Lycaenidae							
Lycaena salustius[e]	x	x				x	*Muehlenbeckia*
Zizina oxleyi[e]	x	x				x	Prostrate *Carmichaelia* flowers & clover
Nymphalidae							
Vanessa gonerilla[e]	x	x				x	Nettles (*Urtica*)
Vanessa itea		x					Nettles (*Urtica*)
Danaus plexippus		x					Swan plant
Pieridae							
*Pieris rapae**	x	x					Crucifers
Thyrididae							
Morova subfasciata[e]					x		*Muehlenbeckia* galls
Pyralidae							
Patagonioides farinaria	x					x	*Senecio*
*Gauna aegusalis**	x						*Acacia* galls
Crambidae							
Deana hybreasalis[e]		x	x			x	*Clematis*
Eudonia aspidota[e]						x	Mosses

Family & species	Quail Island 2007-2009	Quail Island 2003	Ahuriri Scenic Reserve	Onawe Peninsula	Hinewai Reserve	Orton Bradley Park	Host plant or Habitat
Crambidae cont.							
Eudonia chlamydota[e]					x		Forest & shrubland
Eudonia cymatias[e]						x	Rocky areas
Eudonia dinodes[e]			x			x	Mosses
Eudonia diphtheralis[e]	x						Sod web-worm
Eudonia exilis[e]	x						Open grassland
Eudonia feredayi[e]						x	Open areas
Eudonia minualis[e]		x					Mosses
Eudonia new species[e]	x						Moss on coastal rocks
Eudonia periphanes[e]							Forest
Eudonia philerga[e]	x	x				x	Moss on wood
Eudonia rakaiensis[e]					x		Open and shrubland areas
Eudonia sabulosella[e]	x	x			x	x	Sod web-worm
Eudonia submarginalis[e]	x	x			x	x	Sod web-worm
Gadira acerella[e]	x					x	Moss on rocks
Glaucocharis elaina[e]	x						Moss on rocks
Glaucocharis chrysochyta[e]	x						Forest
Glaucocharis interrupta[e]						x	Forest
Orocrambus cyclopicus[e]	x	x					Grass bases
Orocrambus flexuosellus[e]	x		x		x		Grass bases
Orocrambus ramosellus[e]	x	x			x	x	Grass bases
Orocrambus vittellus[e]						x	Grass bases
Orocrambus vulgaris[e]	x	x			x		Grass bases
Sceliodes cordalis	x						*Solanum* berries
Scoparia augastis[e]	x						Coastal grassland
Scoparia chalicodes[e]	x						Open areas
Scoparia minusculalis[e]			x		x		Moss
Scoparia new species[e] (formally '*minualis*')	x						Forest
Scoparia phalerias[e]						x	Forest
Udea flavidalis[e]	x	x			x	x	Polyphagous on herbs
Udea marmarina[e]	x				x		*Urtica*
Uresiphita maorialis[e]	x	x					Kowhai (*Sophora*)
Geometridae							
Asaphodes aegrota[e]	x				x		Herbs
Asaphodes chlamydota[e]	x		x			x	*Clematis*
Austrocidaria anguligera[e]	x		x				*Coprosma*

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Geometridae cont.							
Austrocidaria callichlora[e]					x		*Coprosma*
Austrocidaria gobiata[e]	x		x	x	x	x	*Coprosma*
Austrocidaria similata[e]	x		x	x	x	x	*Coprosma*
Anachloris subochraria[e]							*Epilobium*
*Chloroclystis filata**	x	x	x		x	x	Flowers, especially *Senecio*
Chloroclystis inductata[e]	x		x		x		Flowers
Chloroclystis lichenodes[e]	x						Forest
Chloroclystis testulata	x		x				Flowers
Cleora scriptaria[e]			x	x	x		Polyphagous on trees
Declana egregia[e]			x		x		*Pseudopanax*
Declana floccosa[e]	x	x	x	x	x	x	Polyphagous on trees and shrubs
Declana junctilinea[e]	x		x		x	x	Polyphagous on shrubs
Declana leptomera[e]	x	x	x	x	x	x	Polyphagous on shrubs
Declana niveata[e]	x		x		x		*Hoheria angustifolia*
Elvia glaucata[e]	x		x	x	x	x	*Rubus*
Epicyme rubropunctaria[e]		x				x	*Haloragis erecta*
Epiphryne undosata[e]	x		x		x	x	*Hoheria*
Epiphryne verriculata[e]	x	x					*Cordyline*
Epyaxa lucidata[e]	x	x				x	Herbs and lianes
Epyaxa rosearia[e]	x	x	x	x		x	Herbs
Epyaxa venipunctata[e]	x						Herbs
Gellonia dejectaria[e]	x		x	x	x		Polyphagous on trees and lianes
Gellonia pannularia[e]					x	x	Shrubland
Helastia cinerearia[e]	x	x		x		x	Lichens on rocks
Helastia corcularia[e]	x		x			x	Mosses & herbs
Helastia triphragma[e]	x					x	Associated with *Helichrysum lanceolatum*
Homodotis megaspilata[e]	x	x	x	x	x	x	Herbs
Hydriomena deltoidata[e]	x	x	x	x	x	x	*Plantago*
Hydriomena purpurifera[e]					x		*Epilobium* in damp sites
Ischalis fortinata[e]			x	x	x		*Polystichum*
Orthoclydon praefectata[e]	x				x		Flax (*Phormium*)

Family & species	Quail Island 2007-2009	Quail Island 2003	Ahuriri Scenic Reserve	Onawe	Hinewai Reserve	Orton Bradley Park	Host plant or Habitat
Geometridae cont.							
Pasiphila aristias[e]						x	Forest
Pasiphila bilineolata[e]	x			x	x		Hebe flowers and foliage
Pasiphila magnimaculata[e]	x						Associated with *Gaultheria*
Pasiphila malachita[e]	x		x		x		*Hebe*
Pasiphila muscosata[e]			x		x		*Muehlenbeckia*
Pasiphila new species[e]	x						Shrubland
Pasiphila urticae[e]	x		x		x		*Urtica ferox*
Poecilasthena schistaria[e]	x		x	x	x	x	Kanuka (*Kunzea*)
Poecilasthena subpurpureata[e]	x						Shrubland
Pseudocoremia fascialata[e]	x						*Pseudowinteria*
Pseudocoremia fenerata[e]			x				Podocarps including rimu
Pseudocoremia indistincta[e]	x				x		*Muehlenbeckia*
Pseudocoremia leucelaea[e]	x	x	x				Polyphagous on native and exotic podocarps
Pseudocoremia lupinata[e]				x	x		Kanuka (*Kunzea*)
Pseudocoremia melinata[e]	x		x				*Carmichaelia*
Pseudocoremia pergrata[e]			x		x		*Urtica ferox*
Pseudocoremia productata[e]			x	x	x		Polyphagous on trees
Pseudocoremia rudisata ampla[e]	x		x				*Olearia*
Pseudocoremia suavis[e]	x		x	x	x		Polyphagous on trees
Samana acutata[e]				x		x	*Carmichaelia*
Sarisa muriferata[e]	x		x				Hound's tongue fern
Scopula rubraria[e]	x	x	x	x			*Plantago*
Sestra flexata[e]	x		x		x		Ferns
Sestra humeraria[e]			x				Ferns
Tatosoma tipulata[e]			x				*Nothofagus*
Xanthorhoe semifissata[e]	x	x	x				*Cardamine* and exotic crucifers
Xyridacma alectoraria[e]	x		x			x	*Pseudopanax*
Xyridacma ustaria[e]	x	x	x				*Pittosporum*
Xyridacma veronicae[e]					x		*Hebe*

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Noctuidae							
Agrotis ipsilon aneituma	x	x					Polyphagous on herbs
Aletia inconstans[e]	x				x		Open areas near forest or shrubland
Aletia moderata[e]	x				x		Herbs including *Raoulia*
Austramathes purpurea[e]						x	*Melicytus ramiflorus*
Bityla defigurata[e]	x		x	x	x	x	*Muehlenbeckia*
Chrysodeixis eriosoma	x						Polyphagous on flowers and herbs
Diarsia intermixta	x						Herbs including nettles
Ectopatria aspera				x	x		Salt meadow *Sarcocornia*
Euxoa admirationis[e]	x						Herbs in open areas
Feredayia graminosa[e]	x		x	x	x	x	*Melicytus ramiflorus*
Graphania disjungens[e]	x				x		Grasses in open areas
Graphania infensa[e]	x		x				Sedges
Graphania insignis[e]	x		x	x	x		Native and exotic herbs
Graphania lignana[e]	x	x					Native and exotic grasses
Graphania mollis[e]	x		x	x	x		Mainly forest areas
Graphania morosa[e]	x	x		x		x	Native and exotic grasses
Graphania mutans[e]	x		x	x	x		Native and exotic herbs
Graphania nullifera[e]	x						*Aciphylla*
Graphania omoplaca[e]	x		x		x	x	Native and exotic grasses
Graphania phricias[e]	x	x	x			x	*Discaria toumatou*
Graphania plena[e]	x		x	x	x		Native and exotic herbs
Graphania ustistriga[e]	x	x	x	x	x		Polyphagous on herbs, lianes and shrubs
Meterana decorata[e]	x		x	x		x	Kowhai (*Sophora*)
Meterana diatmeta[e]	x		x				Rubus

Family & species	Quail Island 2007-2009	Quail Island 2003	Ahuriri Scenic Reserve	Onawe Peninsula	Hinewai Reserve	Orton Bradley Park	Host plant or Habitat
Noctuidae cont.							
Meterana dotata[e]			x				*Nothofagus*
Meterana levis[e]	x		x		x		*Plagianthus*
Meterana ochthistis[e]	x		x		x		Shrubs and lianes
Meterana praesignis[e]			x				*Nothofagus*
Meterana stipata[e]	x		x		x	x	*Muehlenbeckia*
Persectania aversa[e]	x	x		x	x	x	Polyphagous on grasses
Proteuxoa comma[e]	x	x	x	x	x	x	Polyphagous on grasses and herbs
Rhapsa scotosialise	x						Leaf litter
Tmetolophota arotis[e]	x						Wetlands
Tmetolophota atristriga[e]	x		x	x	x	x	Grasses
Tmetolophota propria[e]	x	x		x	x		Grasses
Tmetolophota steropastis[e]	x	x			x		Flax (*Phormium*)
Tmetolophota unica[e]	x						*Poa*
Arctiidae							
Nyctemera annulata[e]		x					*Senecio*
TOTAL	**146**	**54**	**73**	**34**	**83**	**66**	