

TECHNICAL REPORT Investigations and Monitoring Group

Indigenous insect fauna and vegetation of Rakaia Island

Report No. R14/60

ISBN 978-1-927299-84-2 (print)

978-1-927299-86-6 (web)

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June 2014





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Executive summary

The northern end of Rakaia Island, a large in-river island of the Rakaia River, still supports relatively intact and extensive examples of formerly widespread Canterbury Plains floodplain and riverbed habitats. It is managed as a river protection reserve and conservation area by Canterbury Regional Council, having been retired from grazing since 1985. This report describes the insect fauna associated with indigenous and semi-indigenous forest, shrubland-grassland and riverbed vegetation of north Rakaia Island.

A total of 119 insect species of which 112 (94%) are indigenous were recorded from the area during survey and sampling in 2012-13. North Rakaia Island is of very high ecological significance for its remnant indigenous vegetation and flora (including four nationally threatened plant species), its insect communities, and insect-plant relationships. This survey, which focused on Lepidoptera, found many of the common and characteristic moths and butterflies that would have been abundant across the Canterbury Plains before European settlement. Three rare/threatened species and several new species of indigenous moth were also found. Because of its size and range of habitats, Rakaia Island is important for the conservation and protection of indigenous vegetation and insect fauna of the Canterbury Plains. The island also presents opportunities for restoration or enhancement of dry plains ecosystems.

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1 General introduction

This report describes the insect fauna associated with indigenous and semi-indigenous forest, shrubland-grassland and riverbed habitats at the northern end of Rakaia Island. Rakaia Island, also known as Great Island, is a large in-river island of the Rakaia River, Mid-Canterbury southeast of the township of Rakaia. The island, which almost stretches from the State Highway One bridge at Rakaia to the sea, is approximately 19 km long by 4 km at its widest point, but fluctuates in size depending on flooding events and the ever-changing river channels. While the central portion of the island is freehold title, most of the island is River Protection Reserve managed by the Canterbury Regional Council. The Council reserve lands at Rakaia Island include long-term lease and short-term grazing licence areas that, together with the adjoining freehold, have been developed as an irrigated dairy farm; and undeveloped land at the island's northern end that has been retired from grazing since 1985 and is managed as a conservation area.

Dry kānuka woodlands were formerly extensive across the Canterbury Plains on higher, older alluvial terraces, sometimes with an accumulation of loess. Soils on these surfaces are relatively high in carbon and nitrogen, but lower in bases. Native shrublands and grasslands were on the younger, raw stony soils of stabilised riverbeds and floodplains or low terraces. These soils have low carbon and nitrogen, are high in bases, and have a very low water-holding capacity. The active braided riverbeds were naturally sparsely vegetated with low herbs, cushion and turf forming plant species (Meurk, 2008). Tancred (1856) described the natural vegetation of the Canterbury Plains prior to large changes that were to come. He made special note of the abundance of speargrass (*Aciphylla* sp.), cabbage tree (*Cordyline australis*), kānuka (*Kunzea ericoides*), matagouri (*Discaria toumatou*) and grasses that dominated the plains at that time. Interestingly an anise, probably *Gingidia montana* was also noted as being abundant.

Few natural plant communities now remain on the alluvial and recent soils that characterise the Canterbury Plains. The floodplains have mostly been developed for agriculture and plantation forestry, while even the undeveloped areas – generally the margins and beds of the braided rivers – are largely covered in adventive tree, shrub and herbaceous plant species. However, at the undeveloped northern end of Rakaia Island there are some relatively large remnants of native riparian and flood plain vegetation (Figure 1-1). The native vegetation of North Rakaia Island was first documented in 1971 by Dr Brian Molloy, and remains much as it was described then: kānuka and kōwhai (*Sophora microphylla*) dominant forest and treeland on Selwyn-Waimakariri soils. Upstream of the main forest area, the island narrows to a tall natural dune system with scattered stands or individuals of kānuka, kōwhai and cabbage tree, and then spreads out into a large stony floodplain now abandoned by the Rakaia River. These younger Selwyn soils support examples of native braided riverbed vegetation dominated by low-growing thickets and scattered shrubs of matagouri (Molloy, 1971). A special feature of this floodplain site was the presence of a small population of the plains olearia shrub daisy *Olearia adenocarpa*, first recognised as a new species by Heenan and Molloy (2004) and immediately assigned the conservation threat status of Nationally Critical. The very small wild population of about a dozen plants has now been protected by fencing from wild mammal browse, and augmented in 2010 and 2011 by the establishment of 179 locally sourced nursery-grown plants in three fenced planting sites.

The active riverbed adjoining Rakaia Island also supports native cushionfield and herbfield in places, although these are generally of small extent and scattered distribution within the riverbed, where introduced shrubs and herbs now dominate the vegetation cover.

The ecological significance of relatively large and intact remnant indigenous habitats such as north Rakaia Island in the context of the highly modified Canterbury Plains landscape is well understood (Meurk 2008; Appendix 2). However, the invertebrate fauna of these areas has been less studied. Macfarlane *et al.* (1999) documented the invertebrates at a semi-natural site on Chattertons Road, west of Christchurch; Ecroyd and Brockerhoff (2005) described a threatened carabid ground beetle *Holcaspis brevicula* from the Eyrewell Forest plantation north of the Waimakariri River – its only known habitat. Patrick (2012a) studied the butterflies and moths of Kaitorete Spit, which also supports relatively substantial areas of natural vegetation; and on the Templeton Golf Course (2012b), a small remnant community of indigenous insects and plants southwest of Christchurch. The beetles (Coleoptera) of Rakaia Island have been surveyed as part of a wider study that encompassed 27 sites of the Selwyn District (Emberson *et al.*, 2011). They found 29 beetle species at two Rakaia Island

sample sites: one in the north Rakaia Island kānuka forest; the second a fenced area of kānuka-kowhai treeland within the Rakaia Island dairy farm. The Rakaia Island records of Emberson *et al.* (2011) are included in Appendix 4. The authors recommended further study of the Island's invertebrate fauna.

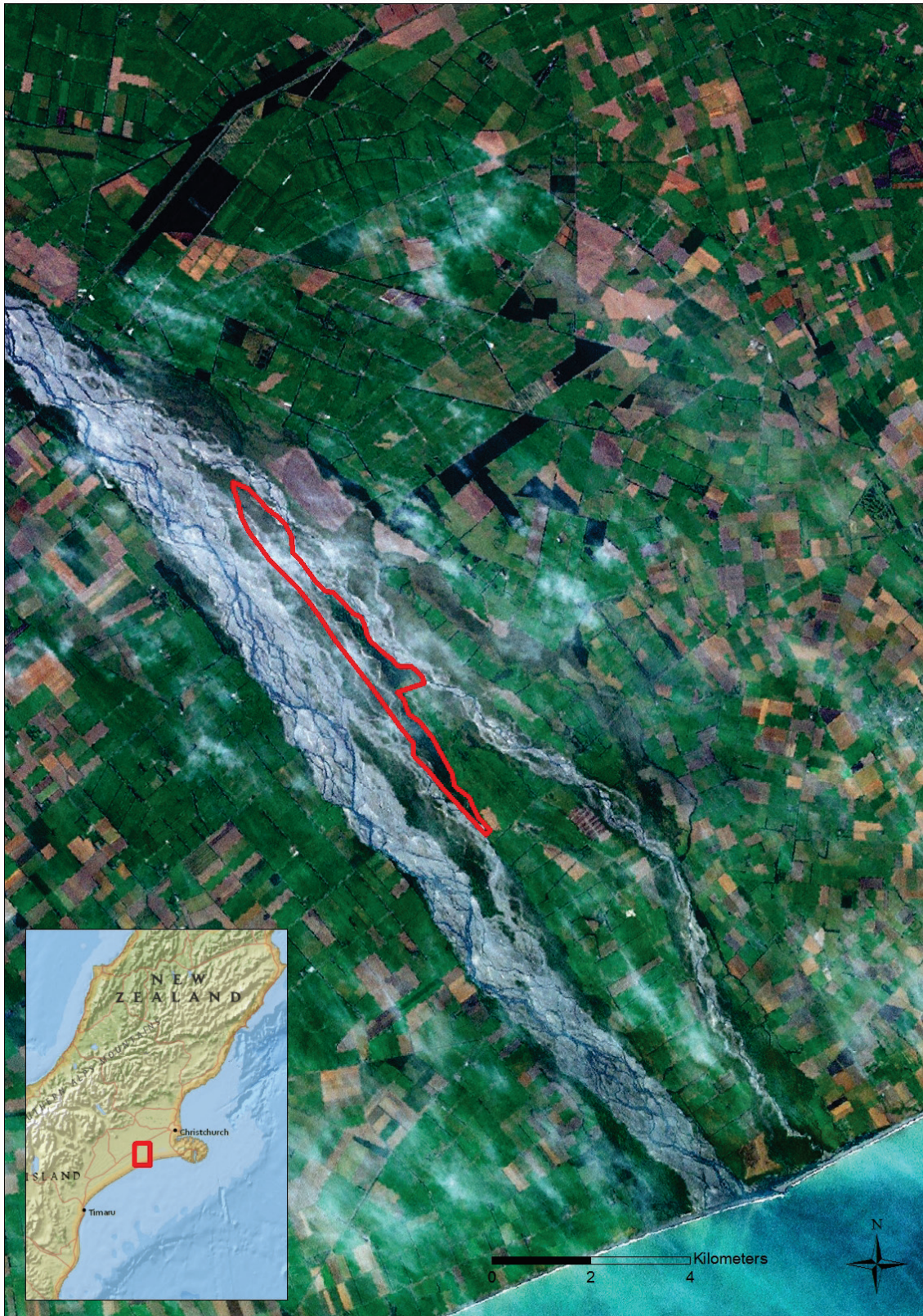


Figure 1-1: Rakaia Island location map with the northern island study area outlined

2 Indigenous vegetation and flora of northern Rakaia Island

The vegetation and flora of three adjacent habitats at the northern end of Rakaia Island, where indigenous plants are structurally or compositionally dominant, is described in more detail below: kānuka-kōwhai forest and treeland; dry shrubland and grassland; riverbed sparsely vegetated with cushion and turf species (Figure 2-1). The descriptions are based on site visits by the authors and members of Canterbury Botanical Society in 2012-13. Species recorded during these surveys and in the earlier records of Molloy (1971) and Molloy and Heenan (2004) are listed in Appendix 3.

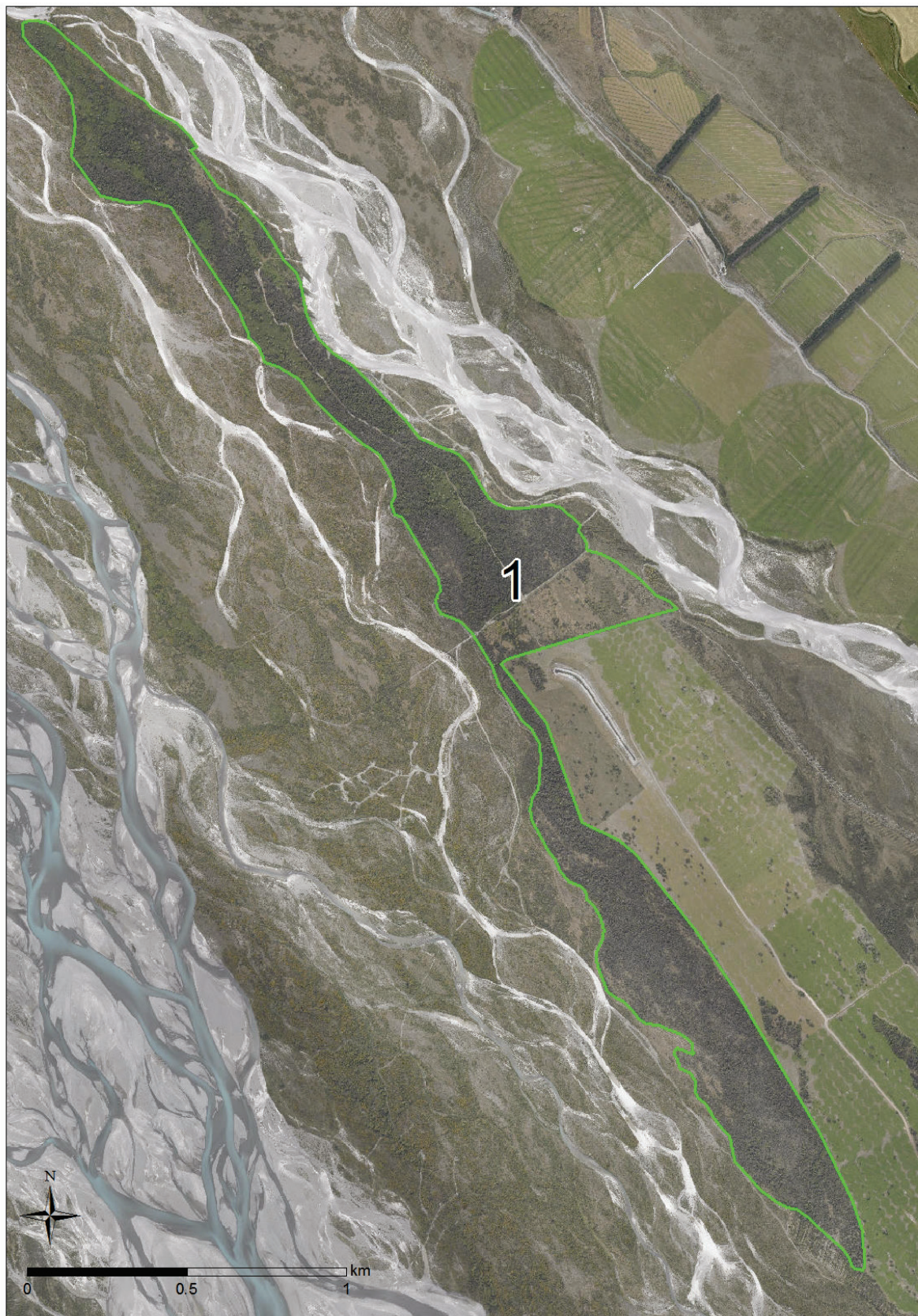


Figure 2-1a: Location of described indigenous forest and treeland (1) habitats at north end of Rakaia Island



Figure 2-2b: Location of described indigenous shrubland-grassland (2) and riverbed (3) habitats at north end of Rakaia Island

2.1 Kānuka-kōwhai forest and treeland

This is the area described as 'riparian woodland' by Molloy (1971). Here, the island is elevated 1-2 m above the river bed. Soils were mapped as Waimakariri stony sandy loam and shallow sandy loam matrix by Kear *et al.* (1967), now described as 'Recent Orthic' according to the New Zealand soil classification (Webb, 2008).

Kānuka and kōwhai trees of variable height (up to 10 m but mostly 6-8 m tall) form the canopy of what is, at c. 105 ha, probably the largest area of native forest and treeland left in the Canterbury Plains ecological region (Figure 2-1a). Kānuka dominates the canopy in denser forest areas, with kōwhai generally more abundant on the forest margins and open treeland. Canopy associates are kohuhu or black matipo (*Pittosporum tenuifolium*) and cabbage tree (*Cordyline australis*), with lianes of *Muehlenbeckia australis* and native jasmine (*Parsonsia heterophylla*) common (Figure 2-2). Smaller 2-4 tall kohuhu form a dense sub-canopy in places, with scattered juvenile kowhai, cabbage tree and some exotic broom also present in this tier. Forest and treeland groundcover is dominated by blackberry or exotic grasses such as cocksfoot (*Dactylis glomerata*); invasive male fern (*Dryopteris felix-mas*) is also common.

Other native species of note present on the forest margins and/or understorey include (in approximate order of abundance) harakeke (*Phormium tenax*), *Coprosma propinqua*, korokio (*Corokia cotoneaster*), trip-me-up sedge *Carex testaceae*, tutu (*Coriaria arborea*), weeping matipo (*Myrsine divaricata*) and the nationally-threatened shrub *Teucrium parvifolium* (only one individual recorded so far but others are likely to be present).

Several patches of bracken (*Pteridium esculentum*) fernland occur within the mapped forest-treeland area. Scattered flax, cabbage tree and kowhai emerge from the bracken. Occasional thousand-leaved fern (*Hypolepis millefolium*) and exotic broom shrubs are also present in the bracken fernland.



Figure 2-3: Kānuka forest, north Rakaia Island. *Muehlenbeckia australis* vines are also visible in the c. 10 m high kānuka canopy

2.2 Shrubland and grassland

This northern extremity of Rakaia Island is a lower terrace than the main island, elevated for the most part only 0.5-1 m above the riverbed. The core of this habitat (Figure 2-1b) is an approximately 15 ha area where matagouri forms a low (0.5-1.5 m), open shrub canopy (Figure 2-3). Occasional taller kōwhai and kānuka shrubs (up to 3 m) are also present while gorse shrubs are scattered throughout the area. The very small wild population of about a dozen plants of *Olearia adenocarpa* (five unbrowsed and remainder browsed but recovering following fencing) has been augmented over the last three years by the establishment of 130 nursery-grown plants in two rabbit-fenced planting sites (a third fenced *Olearia* planting site is located at the southern end of the kānuka- kōwhai treeland). A single native broom (*Carmichaelia australis*) also grows here.

Dry grass-herb-mossfield vegetation forms the matagouri shrubland ground cover. Native mosses (mostly *Racomitrium* spp. and *Polytrichum juniperinum*) and lichens make up over 50% of the overall cover. Grasses, while prominent above the associated low-statured herbs and non-vascular plants, together form less than 50% overall cover. On these stony recent soils, grasses are mostly clumped or tussock-forming, with swards present only in patches of suitable microhabitat (e.g. *Anthosachne scabra* on old channel margins). Australian needle grass (*Austrostipa nodosa*), danthonias (*Rytidosperma* spp.) and blue wheat grass (*A. scabra*), sweet vernal (*Anthoxanthum odoratum*) and Chewing's fescue (*Festuca rubra* ssp. *commutata*) are the most common grasses here, although some native *Rytidosperma clavatum* is also present. Common associated herbs are native patotora (*Leucopogon fraseri*), *Oxalis exilis*, *Meuhlenbeckia axillaris* and fuzzweed (*Vittadinia australis*) as well as exotic sheep's sorrel (*Rumex acetosella*), catsear (*Hypochoeris radicata*), clovers (*Trifolium dubium*, *T. repens*, *T. arvense*) and Australian sheeps bur (*Acaena agnipila*).

Other native herbaceous species present at low abundance here are the native cushion *Scleranthus uniflorus*, native mat daisy *Raoulia australis*, *Pseudognaphalium luteoalbum* and fireweed (*Senecio quadridentatus*). Two other nationally threatened plant species, fan-leaved mat daisy (*Raoulia monroi*) and leafless muehlenbeckia (*Muehlenbeckia ephedroides*), both 'Declining', are also present.

Surrounding the core area of matagouri shrubland is another shrubland and grassland habitat dominated by exotic plant species, but still with a substantial native component. Exotic gorse and broom shrubs to 2.5 m tall and grasses form the canopy on elevated dune ridges with lupin (*Lupinus arboreus*) and the odd sweet briar (*Rosa rubiginosa*) shrub also present. Scattered kōwhai and kānuka trees are emergent over the gorse and broom, with smaller shrubs of both species and matagouri present amongst the gorse and broom. Exotic grasses cocksfoot and chewings fescue (*Festuca rubra* ssp. *commutata*) are the main ground cover under the gorse and broom, but native holy grass (*Hierochloa redolens*), silver tussock (*Poa cita*), and fireweed (*Senecio quadridentatus*) are also present. Under several of the taller kānuka trees in this area, patches of native dichondra (*Dichondra repens*) and *Crassula colligata* are found.

Between the gorse-broom patches is exotic grassland dominated by sweet vernal and danthonia species. Native patotora and mosses are still common in the ground cover however.

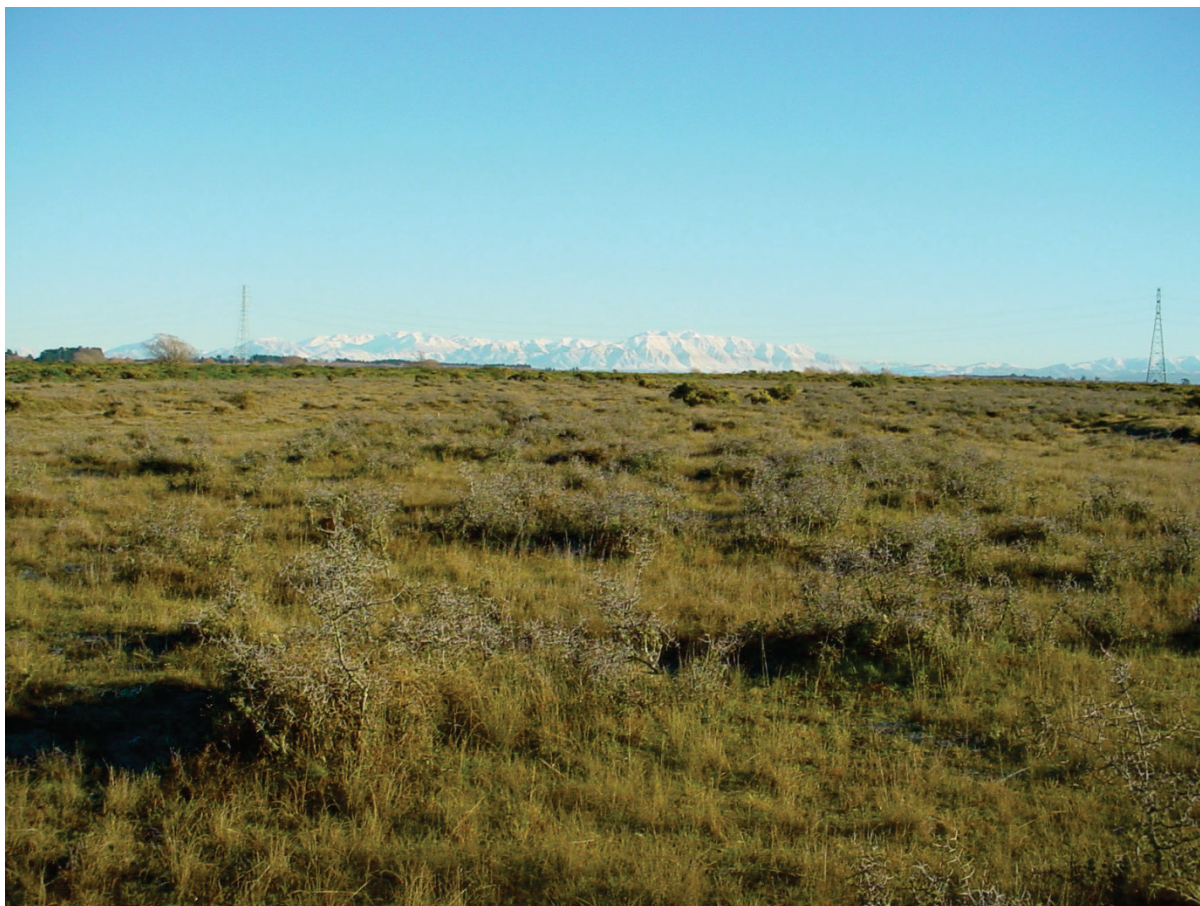


Figure 2-4: Native low matagouri shrubland at the core of the ‘shrubland and grassland’ habitat

2.3 Riverbed

The riverbed sample site is a side braid of the Rakaia River that experiences regular flooding (Figure 2-1). Bare stones and silt occupied almost half the area at time of survey. Scattered gorse shrubs are present – most low and rabbit-browsed. Native cushion or mat-forming plants are the main vegetation cover: mat daisy, fan-leaved mat daisy and creeping pohuehue with exotic stonecrop (*Sedum acre*) also common (Figure 2-4). Other native species present are *Raoulia hookeri* and mosses; with introduced narrow-leaved plantain, sorrel and danthonia also present. Higher islands within the riverbed are largely covered in exotic gorse-broom-lupin shrubland. These were not sampled for invertebrates.

Similar native or semi-native cushion/mat herbfield communities are scattered throughout the lower Rakaia Riverbed, but generally form small and isolated patches, amongst the far more extensive exotic shrubland and grassland vegetation. The riverbed sample site described here, covering several hectares, is one of the larger more-or-less contiguous examples of this plant community on the lower Rakaia River.



Figure 2-5: Sparsely-vegetated riverbed habitat. Native mat daisies *Raoulia australis* and *R. hookeri* are visible in the foreground together with creeping pohuehue *Muehlenbeckia axillaris* and adventive stonecrop (*Sedum acre*)

3 Indigenous insect fauna of northern Rakaia Island

3.1 Introduction

The insect fauna, particularly the moths, of Rakaia Island are historically as well as ecologically important. Richard Fereday (1820-1899), one of New Zealand's first lepidopterists, collected near Rakaia Island while living at his brother's Oakleigh (Oakley) Farm from 1862 to 1864 (Johns, 1993). Richard Fereday's collection is housed in the Canterbury Museum, but he also sent specimens to Europe where many new species were identified and named, making Oakley Farm the type locality for these species (Table 3-1). Substantial changes to the natural habitats where he collected have taken place since the early 1860s, so Rakaia Island is now the nearest natural or semi-natural area comparable to the Oakley Farm type location.

Rakaia Island has a population of the Canterbury Plains endemic daisy shrub *Olearia adenocarpa* (Heenan & Molloy, 2004). The group of *Olearia* spp. shrub daisies is well known to support specialist insects including moths, many of which are nationally rare (Patrick, 2000), but the moth fauna associated with *Olearia adenocarpa* had not previously been sampled.

3.2 Methods

Existing entomological literature for the area was reviewed.

Sampling methods were focused on Lepidoptera and included:

- Light trapping for nocturnal flying species
- Hand searching for diurnal species
- Sweeping with a net for cryptic species in the vegetation, and for larvae
- Rearing larvae on the hosts they are found on.

Six expeditions to Rakaia Island were made over the 2012-2013 period. These included several overnight trips so the nocturnal insect fauna could be sampled: 8-9 May 2012; 23-24 October 2012; 5 December 2012; 2-3 February 2013; 8-10 March 2013; 7 May 2013.

Insect material was mostly curated, stored and identified by BP using existing collections. Some material was examined by Dr Robert Hoare, Landcare Research, Auckland and is stored there. The Fereday Collection at Canterbury Museum was examined by Dr Cor Vink.

3.3 Results and discussion

In total, 119 insects of which 112 (94%) are indigenous species were recorded from the northern parts of Rakaia Island in this study. Of these, 108 were butterflies and moths from 25 families of the order Lepidoptera. The preponderance of Lepidoptera species collected was an artefact of the sampling methods used, but also a reflection of the size and importance of this large insect order in New Zealand. This is a substantial number considering the limited indigenous vascular flora present, and probably reflects the relative naturalness of these plant communities, and the abundance of associated lichens and mosses. Insect specimens from five other orders were also collected; all are listed in Appendix 4.

Lepidopterist Richard W. Fereday

Richard W Fereday (1820-1899) was the first resident lepidopterist to collect butterflies and moths on the Canterbury Plains. When he first arrived in Canterbury in 1862, he lived with his brother, on his brother's farm at Oakley (Oakleigh) Station, just northeast of Rakaia Island and close to Southbridge (Johns, 1993). The Fereday legacy is celebrated in Feredays Road and Fereday Island, which are close to and north of Rakaia Island. Oakleigh Farm is still present on Feredays Road.

Fereday collected moths mainly by "sugaring", a method by which a sweet solution is spread on tree trunks and other suitable surfaces at dusk, and regularly checked for feeding moths during the night. In this way, Fereday collected many moths in the vicinity of the Rakaia farm and then sent this material to various colleagues such as George V Hudson in Wellington who was preparing an illustrated book on New Zealand moths – a New Zealand first. The book appeared in 1898 (Hudson 1898), but unfortunately Fereday died the following year. Up to then he was a lawyer living in Christchurch, and had published a number of papers describing novel butterflies and new moths. Much of his Lepidoptera collection is in the Canterbury Museum, but many types of new species he discovered are stored in the European institutions where he sent them to be described. Hudson acknowledged Fereday's help with his 1898 book with the following: "next, to Mr R.W. Fereday, who very kindly allowed me to figure many species of whom he alone possesses specimens, in itself an invaluable assistance". The following moth species were recorded in this book as coming from Richard Fereday Rakaia collections (Oakleigh Station); their presence or absence in the recent survey is also noted:

Geometridae

Dasyuris partheniata – type locality Christchurch – not found in present survey but widespread on Banks Peninsula still

Noctuidae

Agrotis ceropachoides - Type locality Rakaia – an enigmatic species that was rediscovered at Kaitorete Spit (Patrick, 2013)

Agrotis admirationis – still present

Aletia virescens – not found in present survey

Aletia moderata – still present

Aletia cucullina – not found in present survey

Andesia pessota – not found in present survey

Graphania disjungens – still present (noted by Fereday as getting scarcer at Rakaia during his stay there)

Graphania nullifera – not found in present survey

Graphania omoplaca – still present

Graphania prionistis – not found in present survey

Heliothis armigera – still present

Proteuxoa comma – still present

Physetica caerulea – still present

Tmetolophota arotis – still present

Tmetolophota unica – still present

Psychidae

Orophora unicolor - (Fereday named a synonym *O. toumatou* in 1878 from Rakaia Riverbed) – not found in present survey

Nymphalidae

Argyrophenga antipodum (tussock butterfly) – Fereday reports this species as common in tussocklands and riverbeds of Canterbury Plains – none recorded in this survey, although one was found on Kaitorete Spit in March 2013.

These moths and butterfly help to paint a picture of the vegetation in the early days of European settlement on the Canterbury Plains. This is a valuable historical list of moths from Oakleigh Station near Southbridge, many of which are now gone. For those for which the host plant is known e.g. *Graphania nullifera* (*Aciphylla*), *Dasyuris partheniata* (*Aciphylla*), and *Andesia pessota* (*Melicytus alpinus*), it gives an insight into the original vegetation of the area. Both these plants are species of grassland and shrubland habitats.

Moths at their type locality

Fereday sent many specimens of new moths and other insects to colleagues in Paris or London for formal description. Three important papers by Knaggs (1867), Guenée (1868) and Bates (1867) are based on Fereday material, and because most of the insects came from Oakleigh Station, near Rakaia Island, this is the Type Locality. Additionally, because the farmland of the station is now highly modified with very few indigenous plants and no natural communities, Rakaia Island assumes high importance as the closest area of natural plant communities that would likely have been similar to the original localities where Fereday collected in the early 1860s onwards.

Table 3-1 lists moths discovered by the early Canterbury entomologists John Enys, Richard Fereday and Stuart Lindsay that now have Christchurch or places nearby including “Rakaia” as their type locality. This list is informative regarding not only the moths that were once present but also the plants and plant communities that were once present across the Canterbury Plains. To this list can be added the large casemoth *Orophora unicolor* as one of its synonyms was named from the Rakaia riverbed (*O. toumatou*) by Richard Fereday in 1878. This species is now not found on the Canterbury Plains but is widespread in the montane and alpine areas of New Zealand south to Stewart Island.

Many of the species described from Fereday material from Oakleigh Station were found during this survey. The small crambids *Eudonia feredayi*, *Scoparia exilis* and *S. rakaiensis* are reasonably numerous on open areas of Rakaia Island, whereas other species found by Fereday in the “Christchurch” area after he left Oakleigh Station are also found on Rakaia Island such as the plume moth *Stenoptilia celidota*. The noctuids *Agrotis admirationis* and *Physetica caerulea*, both described from the Canterbury Plains, are still reasonably common in areas of natural vegetation such as Rakaia Island and Kaitorete Spit (Patrick, 1994).

Table 3-1: List of the moths discovered by early entomologists on the Canterbury Plains which have their type locality at or close to Christchurch including Rakaia (Oakleigh Station)

Species	Author & date	Type locality	Host-plant
<i>Dasyuris partheniata</i>	Guenée, 1868	Christchurch	<i>Aciphylla</i> species
<i>Asaphodes stinaria</i>	Guenée, 1868	Christchurch	<i>Ranunculus</i> species
<i>Gellonia pannularia</i>	Guenée, 1868	Christchurch	polyphagous woody
<i>Helastia corcularia</i>	Guenée, 1868	Christchurch	mosses, herbs
<i>Xanthorhoe bulbulata</i>	Guenée, 1868	Christchurch	unknown – herb?
<i>Samana acutata</i>	Butler, 1877	Christchurch	<i>Carmichaelia</i> species
<i>Theoxena scissaria</i>	Guenée, 1868	Christchurch	unknown
<i>Eudonia ejuncida</i>	Knaggs, 1867	Rakaia*	mosses
<i>Eudonia feredayi</i>	Knaggs, 1867	Rakaia*	mosses
<i>Scoparia exilis</i>	Knaggs, 1867	Rakaia*	mosses
<i>Scoparia rakaiensis</i>	Knaggs, 1867	Rakaia*	mosses
<i>Kiwaia pumila</i>	Philpott, 1928	Yaldhurst	unknown
<i>Leptocroca lindsayi</i>	Philpott, 1930	Yaldhurst	unknown
<i>Eurythecta robusta</i>	Butler, 1877	Canterbury Plains	polyphagous herbs
<i>Stenoptilia celidota</i>	Meyrick, 1885	Christchurch	<i>Vittadinia australis</i>
<i>Physetica caerulea</i>	Guenée, 1868	Canterbury Plains	unknown
<i>Agrotis admirationis</i>	Guenée, 1868	Canterbury Plains	polyphagous herbs
<i>Agrotis ceropachoides</i>	Guenée, 1868	Rakaia*	polyphagous herbs
<i>Aletia sistens</i>	Guenée, 1868	Rakaia*	grasses
<i>Aletia cucullina</i>	Guenée, 1868	Rakaia*	unknown

*More correctly Oakleigh Station, north Rakaia River mouth, near Southbridge

Characteristic insects of Rakaia Island

Forest

The kānuka dominated forest supported the most indigenous insects on Rakaia Island with 83 moth species (77% of total). The most important hostplants for the specialist butterflies and moths are *Muehlenbeckia australis* (7) followed by kānuka (4) and kōwhai (3). Many of the moth species found feed on leaf litter (eg. *Tingena plagiata*), grasses (eg. *Cosmiotes ombrodoca*) or are polyphagous on a range of common shrubs or lianes (eg. *Harmoloba oblongana*). The generally species-poor flora of the kānuka woodland accounts for the paucity of specialist lepidoptera.

Moths that utilise kānuka foliage as their larval hostplant include the moderately large geometrid *Pseudocoremia lupinata*, smaller pale *Poecilasthena schistaria* and leaf rollers *Planotortrix notophaea* and *Holocola zopherana*. Whereas the large casemoth *Orophora unicolor* has become locally extinct the other large New Zealand casemoth *Liothula omnivora* is still common and polyphagous on a range of trees and shrubs on the island. Noteworthy among the seven butterflies and moths that feed on *Muehlenbeckia* on the island is the attractive day-flying moth *Morova subfasciata*, with larvae feeding within swellings of the stems on this vine.

Large, old kōwhai trees support three specialist moths including a seed feeder *Stathmopoda aposema*, and two moths with larvae on the foliage - *Meterana decorata* and the kowhai moth *Uresiphita maoralis*. Another geometrid *Pseudocoremia ochrea* may be present but was not seen. Several non-specialist moths feed on kowhai in addition to other species and include *Chloroclystis inductata* and *Stathmopoda plumbiflua*.

The rare and threatened gracillariid leaf-mining moth *Caloptilia* sp. (a new undescribed species) was reared from mines on its larval hostplant *Teucrium parvifolium* from a single shrub discovered under

the kānuka canopy. This is a significant record for Rakaia Island for both plant and moth. This is the only known remaining plant of this species on the Canterbury Plains, and points to a more diverse flora and therefore fauna in the past for the island. Although the characteristic mines of this moth had been known for 45 years, the tiny adult of this species was first seen in 2013. It was found by BP in Christchurch just a few months prior to this Rakaia Island discovery.

Grassland and shrubland

The grassland-shrubland of the northern end of Rakaia Island is dominated by exotic grasses and locally by exotic gorse, but some extensive areas of matagouri shrubland are also present which support indigenous insects such as praying mantis, several chafer beetles as well as a variety of butterflies and moths. In all 48 butterflies and moths were found to be living in this habitat. Among the moths the small plume moth *Stenoptilia celidota* with larvae on *Vittadinia australis*, the grey-coloured noctuid *Graphania phricias* with larvae on matagouri and grass moth *Orocrambus abditus* are of particular interest. Seven species of grass moth in the genus *Orocrambus* breed in these predominately exotic grasslands, highlighting how well this endemic genus of moths has adapted to exotic grasslands nationwide to become some of our most ubiquitous moths (Patrick, 2012).

The small plain plume moth *Pterophorus innotatalis* lives in the grassland and edge of the kānuka forest where its tiny larvae leaf mine the herb *Dichondra repens* there.

Riverbed

Stony river terraces and flood channels adjacent to Rakaia Island host just 15 butterfly and moth species. Most characteristic of this habitat is the undescribed boulder copper butterfly which has one of its strongholds here. The brightly coloured *Lycaena* sp. (a new undescribed species) was once common across the Canterbury Plains but now finds itself reduced to isolated populations at Kaitorete Spit (Patrick, 2012), old riverbeds west of Christchurch (Patrick, In Press) and Rakaia Island. Elsewhere it is now rare. Its colourful larvae feed on mats of *Muehlenbeckia axillaris* that dot the Rakaia riverbed.

This diurnal species is joined by a small colourful moth that is also active by day. The geometrid *Arctesthes catapyrrha* is quite common in the Rakaia riverbed of Rakaia Island where its larvae feed on a range of cushionplants and herbs. It is joined by other characteristic riverbed species such as the blue-grey *Kiwaia lithodes* and *Eudonia cataxesta*, and striped grass moth *Orocrambus callirrhous*.

In spring, on the most stable of these river terraces emerges a rare and threatened moth species *Kiwaia* new species. As a specialist of such habitats the adults do not fly, but instead jump amazingly fast with their strong legs and use their short wings for balance. The tiny black and white adults are locally common amongst cushion plants and bare sandy areas. Also known from Kaitorete Spit, one site west of Christchurch and a few sites in the Mackenzie Basin, the Rakaia Island population is very important for its relatively large size. The “plains jumper” moth is listed as Nationally Vulnerable in the Department of Conservation’s list of threatened species (Stringer *et al.*, 2012).

Threatened and rare species

Several moth species found during this survey on Rakaia Island are nationally rare or threatened with extinction (Stringer *et al.* 2012).

- The tiny undescribed leaf-mining gracillariid moth in the genus *Caloptilia* (Gracillariidae); one shrub of the larval host plant *Teucrium parvifolium* was found during this survey within the kānuka forest on Rakaia Island. It was found to harbour many leaf mines of this moth species that had hitherto never been seen as an adult until January 2013 when the author found it in Christchurch. Prior to that it was only known from leaf mines in the host from a number of localities from the central North Island southwards to Banks Peninsula. On 8 June 2013 an adult emerged from a pupa on the host from Rakaia Island. This species is listed as Nationally Vulnerable. Its emergence in winter is of interest too and possibly points to a mild climate in this habitat
- A possible new species of moth was discovered on Rakaia Island on 10th March 2013. The distinctive *Graphania* new species (Noctuidae) appears to have not been found elsewhere to date. Three males and two females were attracted to light, and appear to exhibit two varieties within the species.

- The tiny plume moth *Stenoptilia celidota* (Pterophoridae), whose larvae feed on the diminutive shrub *Vittadinia australis*, appears to be extinct at its type locality of Christchurch as it has not been found in recent surveys west of Christchurch where some semi-natural areas remain (B. Patrick unpublished data., 2013). The species is rare on Kaitorete Spit and there are no other current Canterbury Plains localities for the species.
- A tiny gelechiid *Kiwaia* “plains jumper” (Gelechiidae) is only known from a few localities in Canterbury where it inhabits open river terraces and duneland cushion vegetation. Among the three Canterbury localities for the species are Kaitorete Spit, Chattertons Road – west of Christchurch (Macfarlane *et al.*, 1999) and Tekapo Scientific Reserve. Both male and female are short-winged and flightless, but possess long and strong legs that mean it can jump and run quite quickly. On Rakaia Island, it was found to be locally common in three areas of riverbed *Raoulia* cushionfield during October and November. The tiny but distinctive adults appear to be associated with *Raoulia australis* cushions, but their life history and exact foodplant is unknown. The species is listed as Nationally Vulnerable by Stringer *et al.* (2012).
- The normally coastal noctuid *Ectopatria aspera* was trapped in the forest edge near the river on Rakaia Island. The larvae are known to feed on *Sarcocornia quinqueflora* in saltmarsh vegetation. It probably dispersed from the river mouth where this type of community exists. It is a rarely seen species with few records in the South Island.

Additionally, although not found on Rakaia Island during this survey, another of Fereday’s “Rakaia” moths, the noctuid *Agrotis ceropachoides*, was recently rediscovered at nearby Kaitorete Spit. Fereday had probably originally recorded this species from the coastal margin of Oakleigh Farm; it may well still be present on the coastal sections of Rakaia Island on the edge of the river mouth lagoon.

A. ceropachoides (Noctuidae) had been listed by the Department of Conservation as a Data Deficient species, because it had not been recorded for over 140 years. It is likely that questions with this species taxonomy had made it difficult to recognise in the field and therefore rank its conservation status. When rediscovered on Kaitorete Spit on 4th July 2012 it was soon apparent that it was actually common in this coastal habitat. The taxonomic problem with this species was two-fold. First, the holotype, and specimen illustrated by Hudson (1898) were extreme varieties of the species that constitute less than 10% of the population. The most typical varieties of the species were put under *Agrotis innominata* in most collections. Secondly, the species mainly emerges as adults in the period July to September, so this winter to very early spring emergence pattern has led to it being rarely collected. Patrick (2013) recommended that this species be removed from the list of Data Deficient species as it is common on Kaitorete Spit from June to September, with other populations present in coastal sand dunes north as far as the Kaikoura region.

Moth on shrub daisy Olearia adenocarpa

The rare and Nationally Threatened (Nationally Critical) plains shrub daisy *Olearia adenocarpa* has a small population on Rakaia Island. The plant is a Canterbury Plains endemic. Recently this population has been augmented by the planting, in two fenced enclosure plots, of 130 additional individuals close to the existing *Olearia* shrubs. The group of small-leaved, deciduous, divaricating tree daisies to which this species belongs has been the subject of an entomological study by the author (Patrick, 2000). This earlier study described a species-rich moth fauna that as larvae are specialist feeders on this group of shrubs and small trees.

It was thought unlikely that any of these moths would have survived on the few remaining shrubs of *O. adenocarpa* on Rakaia Island to then re-colonise the freshly planted shrubs of *O. adenocarpa*. Surprisingly one indigenous moth has, although it is not a specialist on the group of small-leaved *Olearia* species. In February and March 2013, many larvae of the geometrid *Zermizinga indocilisaria* were found feeding on the foliage of the planted *O. adenocarpa*. This is interesting as the female of this speckled grey moth species is short-winged and flightless, so how the females have found their way through a dense grassland sward to lay eggs on the shrubs is a puzzle. The larvae of *Z. indocilisaria* also feed on matagouri, so have survived on the island when the population of *O. adenocarpa* has declined. Maybe it is the larvae that can transport themselves to fresh hosts with the use of silk ‘balloons’? Or perhaps the male carries the female to distant shrubs during mating? In any case, they have moved somehow and are now well established on the new *Olearia adenocarpa* plantings. Other small-leaved *Olearia* moths may join it here from further away such as the strong-flying *Meterana exquisita* and *M. grandiosa*.

Fereday reported *Zermizinga indocilisaria* as common around Christchurch in the early days of the European settlement as “males on bare ground amongst *Leptospermum* and females on stems”.

4 General discussion

4.1 Conservation

North Rakaia Island is of high conservation value for its indigenous vegetation and flora, indigenous insect fauna, insect-plant relationships and insect communities. Its remote in-river island location gives some security to the biota. Adjoining undeveloped or semi-natural areas provide additional habitat for indigenous species, as well as ecological connections between the more natural habitats and some protection or buffering from external threats. However, as a riverbed island, it is vulnerable to flooding and erosion. Although natural processes, these are a threat to the remnant native habitats of north Rakaia Island. This is because the combination of land development and spread of introduced plant species mean there are now few opportunities for native communities to naturally occupy new or reworked floodplain and riverbed habitats. Over the last eight years, river engineering works have been carried out to protect the main kānuka forest area; investigation of options to protect the lower-lying matagouri shrubland site is now underway.

Rakaia Island is one of only two sites where the critically endangered shrub *Olearia adenocarpa* occurs. *O. adenocarpa* at Rakaia Island is threatened by wild animal browse (rabbits, hares, deer) and competition from introduced plants. Three declining plant species (*Teucrium parvifolium*, *Muehlenbeckia ephedroides*, *Raoulia monroi*) also occur at Rakaia Island. The presence of *Olearia adenocarpa* in particular, and the other threatened plant species, means the island is an important site for conservation of indigenous dry floodplain and riverbed flora.

The north Rakaia Island survey found many of the common and characteristic moths and butterflies that would have been widespread and typical of the Canterbury Plains before European settlement (eg. *Eudonia cataxesta*, *Arctesthes catapyrrha*, and *Lycaena* new species – boulder copper complex). In addition, the survey uncovered rare (eg. *Stenoptilia celidota*), threatened (*Kiwaia* new species and *Caloptilia* new species), and novel species (eg. *Graphania* new species) of indigenous moths. Rakaia Island is a highly significant site for conservation of the indigenous moth fauna of the Canterbury Plains.

4.2 Restoration

Rakaia Island presents many possibilities for restoration of natural dry lowland plains ecosystems, and for populations of indigenous plants and insects that have mostly disappeared from the Canterbury Plains since European settlement began in the 1850s. Again in terms of its size, remoteness and range of habitats, Rakaia Island is an ideal refuge. Woody species (shrubs and trees) were more common across the eastern South Island before the arrival of humans. While Rakaia Island has retained more native woody cover than most other natural or semi-natural dry Canterbury Plains remnants, species diversity is still low, and restoration plantings to increase species diversity of forest-treeland and dry shrubland habitats would be of value.

For restoration plantings, the closest seed source or closest genetic population should be used. It is important that any associated invertebrate introductions be carefully planned or staged so as not to disrupt restoration plantings (e.g. introduction of the large noctuid moth *Graphania nullifera* would decimate any modest-sized *Aciphylla* species restoration efforts).

For example, the knobbed weevil (*Hadramphus tuberculatus*) is a Canterbury Plains and adjacent hill country endemic (Craw, 1999). It was reasonably common and widespread across the plains up to the late 1800s, but numbers diminished dramatically since then and it was thought extinct until re-discovered at Burkes Pass in 2004 (Young *et al.*, 2008). If a population of speargrass (*Aciphylla* sp) was established at north Rakaia Island, knobbed weevil could be introduced here.

It is odd that one of the most ubiquitous and important plants for indigenous insects and lizards remaining on the Canterbury Plains, foothills and Banks Peninsula, the vine *Muehlenbeckia complexa*, appears to be absent from Rakaia Island. This plant forms large areas of tangled and dense stems and foliage which provide valuable habitat for indigenous fauna. Its introduction here would add a great deal in terms of habitat and food for insects, with flow-on benefits for native insects, lizards and birds. Some *M. complexa* is present on nearby Fereday Island.

Restoration planting of dryland habitats like Rakaia Island is not simple: most plantings are highly palatable and will need to be protected from browsing animals. In addition, for plantings to survive and grow, control of exotic grasses is essential to reduce competition for scarce soil moisture and prevent smothering. Protection from browse and control of exotic grasses has shown another unexpected benefit at the Rakaia Island *Olearia* restoration planting sites: the only known example of natural regeneration and growth of *O. adenocarpa* seedlings recorded in recent times.

Some indigenous plants that could be considered for re-introduction to suitable sites on the island or enhancement of existing populations are listed below. These plants are hosts for a range of indigenous invertebrates typical of the Canterbury Plains in pre-European times:

- Speargrass *Aciphylla subflabellata* for both the knobbed weevil *Hadramphus tuberculatus* and colourful day-flying geometrid moth *Dasyuris partheniata*. Eventually the large noctuid moth *Graphania nullifera* could be considered for re-introduction once the hostplant is very well established over large areas
- The liane/ shrub *Muehlenbeckia complexa* is one of the most important indigenous plants for insects on Kaitorete Spit (Patrick, 1994)
- The rare shrub *Teucrium parvifolium* to secure the rare leaf-mining moth *Caloptilia* new species
- The native broom *Carmichaelia australis* supports many specialist insects including moths and weevils
- Porcupine shrub *Melicytus alpinus*, because it supports so many indigenous insects and was present in Fereday's time, is another good candidate for re-introduction to the island's grassland-shrubland community
- *Muehlenbeckia astonii* and *M. complexa* would be excellent additions to the local flora. *M. ephedroides* is present in the shrubland-grassland habitat, but further enhancement plantings of this species would also be valuable.
- The daisy shrub *Helichrysum lanceolatum* is excellent for indigenous insects
- Several local species in the liane genera *Clematis* and *Rubus*

All of these shrubs *Carmichaelia australis*, *Melicytus alpinus*, *Muehlenbeckia astonii* and *Helichrysum lanceolatum* are common on Kaitorete Spit, as is the sprawling *Muehlenbeckia ephedroides*. Most of these species, as well as *Aciphylla subflabellata*, also occur on other Regional Council reserve lands at McLeans Island, a dry floodplain habitat similar to Rakaia Island on the south side of the Waimakariri River. Therefore both a seed source for plantings and possible invertebrate herbivores are relatively close at hand. Some of the insect herbivores may be able to colonise any plantings naturally.

5 Acknowledgments

We thank Robert Hoare (Landcare Research) and Cor Vink (Canterbury Museum) for help with insect identification. Observations from Canterbury Botanical Society members during their field trip added greatly to the plant species records for Rakaia Island. The success of the *Olearia adenocarpa* restoration planting at this site is due to Stephen Brailsford. Bruce Gabites (Environment Canterbury), Debra Wotton (Moa's Ark Research) and Mike Bowie (Lincoln University) reviewed drafts of this report.

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Appendix 1 – Plates



Plate 1: *Orocrambus xanthogrammus* is a specialist moth on riverbed *Raoulia australis*



Plate 2: *Kiwaia lithodes* on *Raoulia australis* in its riverbed habitat



Plate 3: *Eudonia cataxesta* is a riverbed species where its larvae feed on moss



Plate 4: The cabbage tree moth *Epiphryne verriculata* is present in forest on Rakaia Island



Plate 5: Kānuka foliage is browsed by the larvae of *Poecilasthena schistaria*



Plate 6: Kowhai foliage is browsed by the caterpillars of the noctuid moth *Meterana decorata*



Plate 7: The short-winged flightless female of *Zermizinga indocilisaria*. Its larvae were found on *Olearia adenocarpa* within the shrubland enclosures



Plate 8: Male *Z. indocilisaria* are winged geometrid moths that fly by night in the grasslands and shrublands

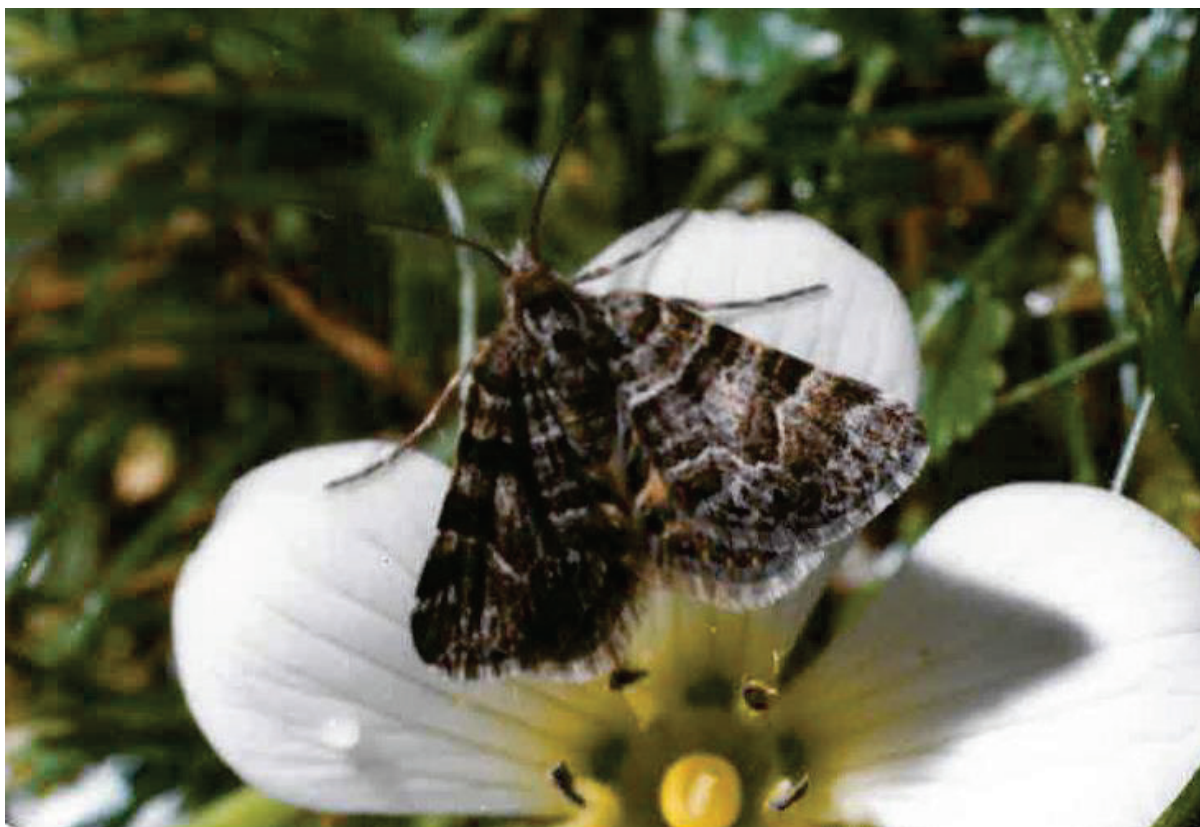


Plate 9: The small diurnal geometrid *Arctesthes catapyrrha* is found in the riverbed community

Appendix 2 – Ecological significance of north Rakaia Island

The North Rakaia Island study area is assessed against ecological significance criteria and guidelines developed for the Canterbury Regional Policy Statement (Wildlands, 2013)

Criteria	Rank	Notes
Representativeness	High	Best, largest representative example of kānuka -kowhai forest and treeland remaining in Low Plains Ecological District; good condition and relatively large representative examples of floodplain matagouri shrubland and native riverbed vegetation/habitats. All supporting representative associated insect fauna.
Rarity / Distinctiveness	High	Contains indigenous vegetation that has been reduced to less than 10% of its former extent in this land environment. Supports four nationally threatened plant species: <i>Olearia adenocarpa</i> (Nationally Critical); <i>Teucrium parviflorum</i> , <i>Muehlenbeckia ephedroides</i> , <i>Raoulia monroi</i> (all At Risk – Declining). Supports two nationally threatened moth species: <i>Caloptilia</i> n.sp. and <i>Kiwaiia</i> 'plains jumper' (both Nationally Vulnerable). Large number of other indigenous plants and invertebrates species present that are now rare in the wider ecological district.
Diversity and pattern	Moderate	North Rakaia Island contains an intact ecological sequence of high floodplain, low floodplain and riverbed habitats. However, relatively low diversity of indigenous plant and bird species within these habitats, particularly the kānuka forest and dry shrubland, compared to similar sites elsewhere.
Ecological Context	High	Island in braided riverbed that provides refugia for a suite of indigenous plants and insects.

North Rakaia Island is assigned an overall ecological significance ranking of **High**.

Appendix 3 – Plant species list

Vascular plant taxa and common mosses and lichens found at Rakaia Island invertebrate survey sites. * naturalised taxa; m, many; s, some; f, few; -, not recorded. Species list compiled following field visits by Canterbury Botanical Society members, Steven Brailsford, and authors over 2012-13, together with earlier published records from Molloy (1971) and Heenan and Molloy (2004).

Plant taxa	Habitat		
	1 Forest	2 Grassland and shrubland	3 Riverbed cushionfield
Trees, shrubs, vines			
<i>Calystegia turgoriorum</i>	f	-	-
<i>Carmichaelia australis</i>	-	f	-
<i>Clematis marata</i>	f	-	-
<i>Coprosma propinqua</i>	f	-	-
<i>Coprosma propinqua</i> x	f		
<i>Cordyline australis</i>	m	-	-
<i>Coriaria arborea</i>	f	-	-
<i>Corokia cotoneaster</i>	f	-	-
* <i>Cytisus scoparius</i>	s	f	s
<i>Discaria toumatou</i>	f	m	-
<i>Kunzea ericoides</i>	m	f	-
<i>Leucopogon fraseri</i>	-	s	-
* <i>Lupinus arboreus</i>	-	f	s
<i>Muehlenbeckia australis</i>	m	f	-
<i>Muehlenbeckia axillaris</i>	-	s	s
<i>Muehlenbeckia ephedroides</i>	-	f	-
<i>Muehlenbeckia ephedroides</i> x <i>axillaris</i>	-	f	-
<i>Myrsine divaricata</i>	f	-	-
<i>Olearia adenocarpa</i>	-	f	-
<i>Parsonsia capsularis</i>	s	-	-
<i>Pittosporum tenuifolium</i>	m	-	-
* <i>Sambucus nigra</i>	f	-	-
* <i>Solanum chenopodioides</i>	f	f	-
<i>Sophora microphylla</i>	s	f	-
* <i>Rosa rubiginosa</i>	f	f	-
* <i>Rubus fruticosus</i> agg	m	-	-
<i>Teucrium parviflorum</i>	f	-	-
* <i>Ulex europaeus</i>	f	s	s
Monocot herbs			
* <i>Aira caryophyllea</i>	-	s	-
* <i>Agrostis capillaris</i>	f	f	-
* <i>Anthosachne scabra</i>	-	s	-
<i>Anthosachne solandri</i>	-	f	-
* <i>Anthoxanthum odoratum</i>	f	m	-
* <i>Austrostipa nodosa</i>	-	m	-
* <i>Bromus hordeaceus</i>	f	f	-
<i>Carex breviculmis</i>		f	
<i>Carex dipsacea</i>	f		
<i>Carex flagellifera</i>	f	-	-
* <i>Dactylis glomerata</i>	m	s	-
* <i>Juncus effusus</i>	f		
<i>Juncus pallidus</i>	s		
<i>Hierochloa redolens</i>	-	f	-
* <i>Festuca rubra</i>	s	s	-

Indigenous insect fauna and vegetation of Rakaia Island

Plant taxa	Habitat		
	1 Forest	2 Grassland and shrubland	3 Riverbed cushionfield
<i>Microlaena stipoides</i>	s		
<i>Microtis unifolia</i>	-	s	-
* <i>Nasella trichotoma</i>	-	f	-
<i>Phormium tenax</i>	s		
<i>Poa cita</i>	-	f	-
<i>Prasophyllum colensoi</i>		s	
* <i>Rytidosperma caespitosum</i>	-	m	f
<i>Rytidosperma clavatum</i>	-	s	f
<i>Rytidosperma maculatum</i>	-	s	-
<i>Rytidosperma unarede</i>	-	f	-
<i>Thelimytra longifolia</i>		f	
* <i>Vulpia bromoides</i>	-	f	-
Dicot herbs			
* <i>Acaena agnipila</i> var. <i>aequispina</i>	f	f	-
<i>Acaena novae-zelandiae</i>	f	f	
* <i>Anagallis arvensis</i>	-	-	f
<i>Cardamine corymbosa</i> agg.	f		
* <i>Carduus nutans</i>	f	f	-
* <i>Cerastium fontanum</i> subsp. <i>vulgare</i>	f	f	-
* <i>Conium maculatum</i>	m	-	-
<i>Crassula colligata</i> subsp. <i>colligata</i>	-	f	-
* <i>C. glomeratum</i>	-	f	-
<i>C. sieberiana</i>	-	f	-
* <i>Crepis capillaris</i>	f	f	-
<i>Dichondra repens</i>	-	s	-
* <i>Digitalis purpurea</i>	f		
* <i>Echium vulgare</i>	-	-	f
* <i>Erodium cicutarium</i>	-	f	-
* <i>Euphorbia peplus</i>	f	-	-
* <i>Hypochoeris radicata</i>	f	m	-
* <i>Leucanthemum vulgare</i>	-	f	f
* <i>Marrubium vulgare</i>	-	f	-
* <i>Moenchia erecta</i>	-	f	-
* <i>Oenothera stricta</i>	-	f	-
* <i>Orobanche minor</i>		f	
<i>Oxalis exilis</i>	-	s	-
* <i>Plantago lanceolata</i>	-	f	f
<i>Pseudognaphalium luteoalbum</i>	-	f	-
<i>Raoulia australis</i>	-	f	s
<i>R. hookeri</i>	-	-	f
<i>R. monroi</i>	-	f	s
* <i>Reseda luteola</i>	-	-	f
* <i>Rumex acetosella</i>	-	m	f
* <i>Sedum acre</i>	-	s	s
<i>Scleranthus uniflorus</i>	-	f	s
<i>Senecio glomeratus</i>	f	-	-
<i>Senecio quadridentatus</i>	f	f	-
<i>S. minimus</i>	f		
* <i>Trifolium arvense</i>	f	s	-
* <i>T. dubium</i>	-	f	-
* <i>T. repens</i>	f	f	-
* <i>T. subterraneum</i>	f	f	-

Indigenous insect fauna and vegetation of Rakaia Island

Plant taxa	Habitat		
	1 Forest	2 Grassland and shrubland	3 Riverbed cushionfield
<i>*Verbascum thapsus</i>	-	f	f
<i>*Verbascum virgatum</i>	-	f	-
<i>*Vicia sativa</i>	f	f	-
<i>Vittadinia australis</i>	-	f	f
Ferns			
<i>Asplenium flabellifolium</i>	f	-	-
<i>Asplenium trichomanes</i>	-	f	-
<i>Cheilanthes humilis</i>	-	f	-
<i>*Dryopteris felix-mas</i>	s	-	-
<i>Hypolepis ambiguum</i>	f	-	-
<i>Pellaea rotundifolia</i>	f	-	-
<i>Polystichum neozelandicum</i>	f	-	-
<i>Pteridium esculentum</i>	m	-	-
Mosses			
<i>Campylopus clavatus</i>		f	
<i>Hypnum cupressiforme</i>		f	
<i>Polytrichum juniperinum</i>		s	f
<i>Racomitrium curiosissimum</i>		m	f
<i>R. pruinatum</i>		s	f
<i>Triquetrella papillata</i>		f	
Lichens			
<i>Rhizocarpon geographicum</i>		f	
<i>Xanthoparmelia tasmanica</i>		f	

Appendix 4 – Insect species list

Compiled by Brian Patrick, June 2013. Includes records for North Rakaia Island from Emberson *et al.* (2011).

Order/ Family/ Species	Forest	Grassland and shrubland	Riverbed cushionfield	Biology/ Ecology/ Notes
Lepidoptera				
Hepialidae				
<i>Wiseana copularis</i>		X		subterranean larvae on grasses
<i>Wiseana cervinata</i>	X			subterranean larvae on grasses
<i>Wiseana umbraculata</i>		X		subterranean larvae on grasses
Tineidae				
<i>Monopis ethelella</i>	X			larvae in sheep's wool
<i>Monopis crocicapitella</i>	X			
<i>Opogona comptella</i>	X	X		larvae in dead wood
Psychidae				
<i>Liothula omnivora</i>	X	X		large case larvae - polyphagous larvae on shrubs/ trees
Elachistidae				
<i>Cosmiotes ombrodoca</i>	X	X		larvae mine grasses
Gracillariidae				
<i>Caloptilia</i> new species	X			larvae mine <i>Teucrium parvifolium</i> ; rare species
Glyphipterigidae				
<i>Glyphipterix alychoessa</i>	X	X		larvae in grass stems
Plutellidae				
<i>Plutella antiphona</i>	X			larvae on Brassicaceae
<i>Plutella xylostella</i>	X			larvae on Brassicaceae
Gelechiidae				
<i>Anisoplaca ptyoptera</i>	X			larvae in <i>Carmichaelia</i> and gorse stems
<i>Kiwaia lithodes</i>			X	<i>Raoulia australis</i> cushionfield
<i>Kiwaia</i> "plains jumper"			X	Threatened species - open river terrace
<i>Symmetricha plaeisosoma</i>	X			<i>Solanum</i> stems

Indigenous insect fauna and vegetation of Rakaia Island

Order/ Family/ Species	Forest	Grassland and shrubland	Riverbed cushionfield	Biology/ Ecology/ Notes
Stathmopodidae				
<i>Stathmopoda aposema</i>	X			kowhai seeds
<i>Stathmopoda horticola</i>	X			tree trunks on dead wood
<i>Stathmopoda plumbiflua</i>	X			dead wood
Oecophoridae				
<i>Leptocroca scholaea</i>	X			
<i>Tingena</i> sp.	X			larvae on leaf litter
<i>Tingena griseata</i>	X			larvae on leaf litter
<i>Tingena plagiarella</i>	X			larvae on leaf litter
Depressariidae				
<i>Agonopterix umbellana</i>	X			Introduced biocontrol of gorse
Tortricidae				
<i>Capua semifera</i>	X	X	X	leaf litter
<i>Capua intractana</i>	X	X		leaf litter
<i>Ctenopseustis obliquana</i>	X			polyphagous on shrubs/ trees
<i>Cydia succedana</i>	X	X	X	introduced biocontrol of gorse
<i>Epiphyas postvittana</i>	X	X		polyphagous on herbs/ grasses
<i>Merophyas divulsana</i>		X		herbaceous Fabaceae - self introduced moth - Australia
<i>Harmologa amplexana</i>	X			polyphagous on lianes/ shrubs
<i>Harmologa oblongana</i>	X			polyphagous on lianes/ shrubs
<i>Harmologa scoliastes</i>	X			polyphagous on lianes/ shrubs
<i>Planotortrix excessana</i>	X			polyphagous on lianes/ shrubs
<i>Planotortrix notophaea</i>	X			larvae on kānuka
<i>Holocola zopherana</i>	X			larvae on kānuka
Pteropteridae				
<i>Pterophorus innotatalis</i>	X	X		larvae mine <i>Dichondra repens</i>
<i>Stenoptilia celidota</i>	X	X		larvae on <i>Vittadinia australis</i> flowers; rare species Type locality "Christchurch"
Pyralidae				
<i>Crocidiphora cinigerella</i>		X	X	open dry areas
<i>Patagonoides farinaria</i>	X			larvae in <i>Senecio</i> stems

Indigenous insect fauna and vegetation of Rakaia Island

Order/ Family/ Species	Forest	Grassland and shrubland	Riverbed cushionfield	Biology/ Ecology/ Notes
Momphidae				
<i>Zapyrastra calliphanes</i>	X			mine <i>Muehlenbeckia australis</i>
Thyrididae				
<i>Morova subfasciata</i>	X			swellings on <i>Muehlenbeckia australis</i> stems
Lycaenidae				
<i>Lycaena</i> nsp 1 (boldenarum group)		X	X	larvae on <i>Muehlenbeckia axillaris</i>
<i>Lycaena</i> nsp 2 (common copper group)	X			larvae on <i>Muehlenbeckia australis</i>
Nymphalidae				
<i>Vanessa gonerilla</i>	X			larvae on nettles
Pieridae				
<i>Pieris rapae</i>				introduced species - larvae on Brassicaceae
Crambidae				
<i>Achyra affinalis</i>		X		increasingly common Australian species of grasslands
<i>Eudonia cataxesta</i>	X		X	open riverbed and terraces on mosses
<i>Eudonia feredayi</i>		X		Type Locality Rakaia
<i>Eudonia leptalea</i>	X	X	X	sod webworm
<i>Eudonia rakaiensis</i>		X		Type Locality Rakaia
<i>Eudonia sabulosella</i>		X		sod webworm
<i>Eudonia submarginalis</i>		X		sod webworm
<i>Gadira acerella</i>	X			moss
<i>Hygraula nitens</i>	X		X	aquatic larvae on aquatic herbs
<i>Orocrambus abditus</i>		X		larvae in sock base of grasses
<i>Orocrambus callirrhous</i>			X	larvae in sock base of grasses
<i>Orocrambus cyclopicus</i>		X		larvae in sock base of grasses
<i>Orocrambus flexuosellus</i>	X	X		larvae in sock base of grasses
<i>Orocrambus lewisi</i>		X		larvae in sock base of grasses
<i>Orocrambus ramosellus</i>	X	X		larvae in sock base of grasses
<i>Orocrambus vittellus</i>	X	X		larvae in sock base of grasses
<i>Orocrambus vulgaris</i>	X	X		larvae in sock base of grasses
<i>Scoparia chalicodes</i>	X	X		open areas of moss?

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Order/ Family/ Species	Forest	Grassland and shrubland	Riverbed cushionfield	Biology/ Ecology/ Notes
<i>Scoparia exilis</i>		X		Type Locality Rakaia
<i>Udea flavidalis</i>	X	X		polyphagous larvae on herbs and lianes
<i>Uresiphita maoralis</i>	X			kowhai moth - larvae on kowhai and lupin
Geometridae				
<i>Arctesthes catapyrrha</i>			X	river terrace herbs
<i>Chloroclystis filata</i>	X	X		larvae on flowers - self introduced from Australia
<i>Chloroclystis inductata</i>	X			larvae on flowers esp. kowhai
<i>Chloroclystis sphragitis</i>	X			larvae on <i>Muehlenbeckia</i> flowers
<i>Declana floccosa</i>	X			polyphagous on trees/ shrubs
<i>Declana leptomera</i>	X			polyphagous on trees/ shrubs
<i>Epyaxa rosearia</i>	X	X		larvae on herbs
<i>Epiphyrme verriculata</i>	X			larvae on cabbage tree foliage
<i>Helastia cinerearia</i>	X			larvae on mosses on rocks
<i>Helastia corcularia</i>	X	X		larvae on mosses and herbs
<i>Homodotis megaspilata</i>	X			larvae on leaf litter
" <i>Hydriomena</i> " <i>deltoidata</i>	X	X		larvae on plantains
<i>Poecilasthena schistaria</i>	X			larvae on kānuka
<i>Phrissogonus testulatus</i>		X		larvae on flowers
<i>Pseudocoremia lupinata</i>	X			larvae on kānuka
<i>Zermizinga indociliaria</i>		X		larvae on <i>Olearia adenocarpa</i> - flightless female
Noctuidae				
<i>Agrotis ipsilon</i>	X			larvae polyphagous
<i>Aletia moderata</i>		X	X	larvae on <i>Raoulia</i>
<i>Bityla defigurata</i>	X			larvae on <i>Muehlenbeckia</i>
<i>Ectopatria aspera</i>			X	uncommon species - larvae on <i>Sarcocornia</i>
<i>Euxoa admirationis</i>	X		X	larvae polyphagous on herbs
<i>Graphania disjungens</i>	X	X		larvae on grasses
<i>Graphania lignana</i>	X	X		larvae on grasses
<i>Graphania mutans</i>	X			larvae on herbs
<i>Graphania morosa</i>	X			larvae on grasses
<i>Graphania phricias</i>		X		larvae on matagouri
<i>Graphania plena</i>	X			larvae on herbs
<i>Graphania scutata</i>	X	X		polyphagous larvae on lianes and shrubs

Indigenous insect fauna and vegetation of Rakaia Island

Order/ Family/ Species	Forest	Grassland and shrubland	Riverbed cushionfield	Biology/ Ecology/ Notes
<i>Graphania ustistriga</i>	X			aboreal polyphagous larvae on shrubs and lianes
<i>Graphania new species</i>	X			five adults in March of this new species discovered here
<i>Meterana alcyone</i>	X			larvae on <i>Muehlenbeckia</i>
<i>Meterana decorata</i>	X			larvae on kowhai
<i>Meterana stipata</i>	X			larvae on <i>Muehlenbeckia</i>
<i>Meterana ochthistis</i>	X			polyphagous on trees and lianes
<i>Physetica caerulea</i>		X	X	larvae on low herbs
<i>Proteuxoa comma</i>	X	X		larvae on grasses and herbs
<i>Persectania aversa</i>	X	X		larvae on grasses
<i>Tmetolophota atristriga</i>	X	X		larvae on grasses
<i>Tmetolophota propria</i>	X	X		larvae on grasses
Erebidae				
<i>Nyctemera annulata</i>	X	X		larvae on <i>Senecio</i>
<i>Rhaphsa scotoscialis</i>	X			larvae on dead leaves
Orthoptera				weta, grasshoppers, katydids and crickets
Gryllidae				
<i>Pteronemobius bigelowi</i>		X		grassland cricket
Acrididae				
<i>Phaulacridium marginale</i>		X	X	small flightless grasshopper
Tettigoniidae				
<i>Conocephalus bilineatus</i>		X		grassland katydid is common
Rhaphidophoridae				
cave weta	X			cave weta in forest
Coleoptera				beetles
Scarabaeidae				
<i>Odontria striata</i>	X	X		winged chafer
<i>Odontria varicolorata</i>	X			winged chafer
<i>Costelytra zealandica</i>	X	X		small winged chafer
<i>Pyronota festiva</i>		X	X	green chafer
<i>Saprosites communis</i>	X			

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Order/ Family/ Species	Forest	Grassland and shrubland	Riverbed cushionfield	Biology/ Ecology/ Notes
Carabidae				
<i>Dicrochile thoracica</i>	X			
<i>Metaglymma moniliferum</i>	X			
Staphylinidae				
Aleocharinae 8-10 species indet.	X			
Dermeestidae				
<i>Trogoderma</i> sp.	X			
Melyridae				
<i>Dasytes</i> sp.	X			
Cryptophagidae				
<i>Paratomaria</i> sp.	X			
Corylophidae				
<i>Seridocerus</i> sp.	X			
Latridiidae				
<i>Corticara hirtalis</i>	X			
<i>Lithostygnus serripennis</i>	X			
Tenebrionidae				
<i>Zeadelium zealandicum</i>	X			
Cerambycidae				
<i>Ptinostoma ptinoides</i>	X			
Chrysomelidae				
<i>Eucolaspis puncticollis</i>	X			
Curculionidae				
<i>Catoptes</i> sp.	X			
Mantodea				mantids
<i>Orthodera novaezealandiae</i>	X	X		native praying mantis

Indigenous insect fauna and vegetation of Rakaia Island

Order/ Family/ Species	Forest	Grassland and shrubland	Riverbed cushionfield	Biology/ Ecology/ Notes
Neuroptera				lacewings
Hemerobiidae				
<i>Micromus tasmaniae</i>	X	X		Australian lacewing is predator
Hemiptera				
Lygaeidae				
<i>Nysius huttoni</i>		X	X	small bug

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