

# Assessment of potential Chatham Island snipe habitat on Pitt Island

Colin M. Miskelly and Rowan M. Emberson

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Colin M. Miskelly<sup>1</sup> and Rowan M. Emberson<sup>2</sup>

<sup>1</sup> Wellington Conservancy, Department of Conservation, PO Box 5086, Wellington 6145, New Zealand. Email: [cmiskelly@doc.govt.nz](mailto:cmiskelly@doc.govt.nz)

<sup>2</sup> 14 Rockview Place, Mt Pleasant, Christchurch 8081, New Zealand

## ABSTRACT

After its 2006 meeting, the Chatham Island Snipe Recovery Group recommended that a habitat assessment of the predator-fenced portion of Ellen Elizabeth Preece Conservation Covenant (EEPCC) on Pitt Island be undertaken to determine its suitability for Chatham Island snipe (*Coenocorypha pusilla*). Fieldwork was carried out on 19–26 February 2007, both in EEPCC and in Woolshed Bush, Rangatira (South East Island), where snipe are abundant. Soil samples were collected from six matched microhabitats in EEPCC and in Woolshed Bush: beside rotting wood, beside petrel burrows, and beneath sedges, grass, herb mats and ferns. Invertebrates were hand-sorted from the soil samples and identified to species where possible, and the biomass of soil-dwelling invertebrates (wet weight) was measured for each sample. Total numbers of invertebrates were very similar for the two islands: 2465 for Pitt Island and 2284 for Rangatira. There was also no significant difference between the islands in overall biomass (14.8 g for Pitt Island and 9.7 g for Rangatira) or biomass in any of the six microhabitats, although one microhabitat (soil beside petrel burrows) did have a higher mean number of individuals on Pitt Island than on Rangatira ( $n = 121$  v. 26, respectively), due entirely to large numbers of tiny enchytraeid worms. It was found that there was abundant cover for snipe to nest, roost and forage in EEPCC. We conclude that EEPCC should provide excellent habitat for Chatham Island snipe. There are no threatened invertebrate species known to be present in EEPCC that would be at risk following snipe introduction.

Keywords: Chatham Islands, Chatham Island snipe, *Coenocorypha pusilla*, invertebrates, insects, conservation

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# 1. Introduction

The endemic Chatham Island snipe (*Coenocorypha pusilla*) is currently confined to islands of the Chatham Islands group that lack introduced mammals. They are abundant on Rangatira (South East) and Mangere Islands, and are known to be present on Tapuaenuku and Star Keys (Aikman & Miskelly 2004). At least two birds were present on Rabbit Island in February 2006 (J. Dowding & N. McNally in Miskelly, Bester et al. 2006), and there are occasional reports of birds being seen on Pitt Island (Higgins & Davies 1996), where they are assumed to rapidly succumb to predation by cats (*Felis catus*) and weka (*Gallirallus australis*). On Pitt Island, at least one snipe has been seen within the predator-exclusion fence at Ellen Elizabeth Preece Conservation Covenant (EEPCC or 'Caravan Bush') (on 14 July 2005; Mike Joy, Massey University, pers. comm. 2005).

The predator-exclusion fence around part of EEPCC was completed in 2001, and encloses about 36 ha of regenerating forest, shrubland and rank pasture. The primary reason for constructing the fence was to provide further habitat for black robin (*Petroica traversi*), though several other species (including snipe) were identified as potential beneficiaries of the fence. Mice (*Mus musculus*) are present within the fenced area, but the population was reduced to low numbers by poisoning during 2006/07 when this study was undertaken (Alison Davis and Kenny Dix, Department of Conservation (DOC), pers. comm. 2007; CMM, pers. obs.).

There has been no attempt to translocate snipe to EEPCC to date because the site was identified as the only potential release site for captive-reared Chatham Island snipe. The intention was to use Chatham Island snipe as a model for developing captive-rearing techniques to rescue the critically endangered Campbell Island snipe (*Coenocorypha* undescribed sp.). EEPCC was identified as the best site to monitor survival and establishment of captive-reared snipe following release. However, there is no longer any need to hold *Coenocorypha* snipe of any species in captivity, as Campbell Island snipe have recolonised rat-free Campbell Island/Motu Ihupuku of their own accord, and so do not require management intervention (Miskelly & Fraser 2006). Therefore, there is now no impediment to restoring Chatham Island snipe to EEPCC as long as the habitat is suitable, landowners and the Pitt Island community are supportive, and funding is available to meet the costs of the translocation.

Snipe feed almost exclusively by probing in soil, and apparently eat any and all invertebrate taxa present (Miskelly 1984, 1989; Higgins & Davies 1996). There is no information available on Chatham Island snipe dietary preferences, but Snares Island snipe (*Coenocorypha buegeli*) have been shown to consume (in decreasing order of percentage occurrence) earthworms, adult beetles, amphipods, beetle larvae and pupae, mites, spiders, fly larvae, weta, harvestmen, moth larvae, earwigs, and leeches (Miskelly 1984; Higgins & Davies 1996). Antipodes Island snipe (*C. aucklandica meinertzhagenae*) had a similar diet that also included isopods (Higgins & Davies 1996).

Previous work by one of the authors (RME) revealed a greater diversity and abundance of surface-dwelling invertebrates on Rangatira (no mammals present) compared to Pitt Island, as measured by pitfall traps, which was partially attributed to the presence of mice on Pitt Island (Dugdale & Emberson 1996; Emberson et al. 1996; Emberson 1998). However, these earlier studies did not assess the total diversity and abundance of soil-dwelling fauna on the two islands.

This report presents the findings of an assessment of the suitability of the habitat in EEPCC for snipe. Comparisons are made between habitat in EEPCC and that found in Woolshed Bush, Rangatira, where Chatham Island snipe are abundant. The assessment focuses primarily on the abundance and biomass of soil-dwelling invertebrates, but also to a lesser extent on vegetation structure. The potential impacts of the introduction of snipe on invertebrate populations in EEPCC were also assessed.

## 2. Methods

One of the authors (CMM) visited 36-ha EEPCC (Pitt Island) on 19–21 and 23–27 February 2007, and 20-ha Woolshed Bush (Rangatira) on 21–23 February 2007. Six matched microhabitats that could be (EEPCC) or are (Woolshed Bush) used for foraging by snipe were identified on each island:

1. Alongside rotting wood
2. Near the entrance to active petrel burrows
3. Around the base of *Carex* sp. or *Uncinia* sp. sedges
4. In soil under grass sward (of species of *Holcus*, *Dactylis* or *Bromus*)
5. In soil under herb mats (of species of *Dichondra*, *Parietaria* or *Hydrocotyle*)
6. Under the skirts of dead fronds of ferns of the genera *Polystichum* or *Dicksonia*

Three soil samples were collected from each microhabitat on each island (36 samples total). Each sample was 18 cm (a spade's width) × 18 cm × 5 cm deep (depth equivalent to the maximum length of a snipe's bill).

Samples were passed through a 5-mm sieve. All large invertebrates were picked out of the sample during sieving. The fines were then spread thinly on white sorting trays, and all invertebrates greater than 1 mm in size that were seen were collected into 70% ethanol. Exceptions were some amphipods (hoppers) that escaped, and tiny enchytraeid worms, of which some samples had very large numbers. In these cases, we counted the numbers of individuals that escaped or were not collected, and added these to the total. Most invertebrates were provisionally identified to family and life-stage level during collection. Each sample took 1–3 hours to process to this point, depending on soil moisture and the number of invertebrates present. One of the authors (RME) then identified the c. 4600 invertebrates collected to species level (where possible), and determined wet weights of the samples, which was used to estimate a soil sample's invertebrate biomass.

Reference samples of invertebrates collected during this study have been retained to allow identification of invertebrate fragments found in snipe faecal samples.

Vegetation structure was subjectively assessed (in terms of providing sufficient cover for nesting, roosting and foraging). CMM also surveyed EEPCC for the presence of snipe by walking slowly along tracks at dawn and dusk, stopping and playing taped calls of snipe at approximately 50-m intervals.

## 3. Results

### 3.1 SUITABILITY OF EEPCC FOR CHATHAM ISLAND SNIPE

No snipe were seen or heard in EEPCC. The vegetation in the covenant appeared ideal for snipe, with abundant potential nest sites (especially under the fronds of *Dicksonia* spp.), and good overhead cover to protect foraging birds from Australasian harriers (*Circus approximans*).

A total of 4749 invertebrates belonging to 111 recognisable taxonomic units (RTUs) or life stages were identified (Appendix 1). The actual number of species/life stages present was higher than this, as some RTUs were used for multiple species (e.g. some fly larvae).

The numbers of soil invertebrates found on the two islands were very similar (Table 1). Four of the six microhabitats showing slightly higher invertebrate numbers in EEPCC (Pitt Island) than in Woolshed Bush (Rangatira). However, this difference was only significant for one microhabitat (by petrel burrows) (Table 1), where it was entirely due to the large number of tiny enchytraeid worms found in the three samples collected beside petrel burrows on Pitt Island (mean of 108 enchytraeid worms per sample) (Appendix 1).

TABLE 1. NUMBER OF INVERTEBRATES COUNTED IN SOIL SAMPLES COLLECTED FROM ELLEN ELIZABETH PREECE CONSERVATION COVENANT (EEPCC, PITT ISLAND) AND WOOLSHED BUSH (RANGATIRA).

Three samples were collected from each of six microhabitats on each island. *P* = probability value from *t*-test comparison of individual totals.

MICROHABITAT	EEPCC			WOOLSHED BUSH			TOTAL	<i>t</i>	<i>P</i>
	MEAN	SD	TOTAL	MEAN	SD	TOTAL			
Beside log	73.0	25.9	219	100.7	12.3	302	521	-1.668	0.17
By petrel burrow	121.0	39.7	363	26.0	4.6	78	441	4.114	0.01
Sedge	146.0	81.2	438	96.0	31.4	288	726	0.995	0.38
Grass sward	196.0	107.2	588	332.0	175.8	996	1584	-1.144	0.32
Herb mat	205.3	48.1	616	161.3	147.6	484	1100	0.491	0.65
Under fern	80.3	24.2	241	45.3	22.0	136	377	1.854	0.14
Total			2465			2284	4749	0.282	0.78



The biomass of soil invertebrates found on the two islands was also similar, with five of the six microhabitats showing slightly higher invertebrate biomass in EEPCC than in Woolshed Bush (Table 2). None of the differences between microhabitats was significant, nor was there a significant difference in overall biomass between the two islands (Table 2).

TABLE 2. BIOMASS (g WET WEIGHT) OF SOIL INVERTEBRATES IN SOIL SAMPLES COLLECTED FROM ELLEN ELIZABETH PREECE CONSERVATION COVENANT (EEPCC, PITT ISLAND) AND WOOLSHED BUSH (RANGATIRA).

Three samples were collected from each of six microhabitats on each island.  $P$  = probability value from  $t$ -test comparison of individual totals.

MICROHABITAT	EEPCC			WOOLSHED BUSH			TOTAL	$t$	$P$
	MEAN	SD	TOTAL	MEAN	SD	TOTAL			
Beside log	1.36	0.96	4.08	0.48	0.51	1.43	5.51	1.405	0.23
By petrel burrow	0.19	0.05	0.57	0.34	0.13	1.02	1.59	-1.828	0.14
Sedge	1.10	0.31	3.29	0.67	0.49	2.01	5.30	1.282	0.27
Grass sward	1.00	0.46	3.00	0.86	0.59	2.59	5.59	0.315	0.77
Herb mat	0.75	0.36	2.24	0.59	0.18	1.76	4.00	0.689	0.53
Under fern	0.53	0.04	1.59	0.30	0.23	0.89	2.48	1.721	0.16
Total			14.77			9.70	24.47	1.744	0.09

### 3.2 SOIL-DWELLING INVERTEBRATES

Of the 111 RTUs/life stages identified among invertebrates in the soil samples, 73 were identifiable to a described species or tag name species. Of these, 21 species were found only in Pitt Island samples, 37 species were found only in Rangatira samples, and 15 species were found on both islands.

#### 3.2.1 Ellen Elizabeth Preece Conservation Covenant

The species found only on Pitt Island were the microsnailes *Paralaoma lateumbilicata* and *Cavellia buccinella* (both widespread throughout New Zealand), a spider in the genus *Tetragnatha*, the parasitid mite *Pergamasus* sp., a sminthurid springtail, an archaeognathan, a psocopteran, the adventive earwig *Forficula auricularia*, a lygaeid bug, a cicadellid bug, a cixiid bug, three carabid beetle species (*Mecyclothorax rotundicolle*, and the adventive species *Laemostenus complanatus* and *Haplanister crypticus*), the adventive staphylinid beetle *Atheta fungi*, the scarabaeid (grass grub) beetle *Odontria varicolorata*, the cerylonid beetle *Hypodacnella rubripes*, the coccinellid beetle *Veronicobius macrostictus*, the anthribid beetle *Cacephatus propinquus*, an unidentified stratiomyid fly and the neuropteran (lacewing) *Micromus tasmaniae*. All of these are common species within the Chatham Islands (see Emberson 1998 for the eight beetle species, and Appendix 2), and would not be threatened by predation by snipe within EEPCC.

At least two species of large-bodied beetle (*Mimopeus pascoei*—Tenebrionidae, and *Mecodema alternans*—Carabidae) are also known to be present in low numbers on Pitt Island, but were not detected in our samples.

### 3.2.2 Rangatira

The microsnail fauna of the Chatham Islands is poorly known (David Roscoe, DOC, pers. comm. 2007). Two of the four species found only in the Rangatira samples may represent new species (*Thalassobelix* n. sp. cf. *chathamensis* and *Charopa* n. sp. aff. *coma*), with the two others (*Mocella eta* and *Thalassobelix chathamensis*) being, respectively, a widespread New Zealand species and a widespread Chatham Islands endemic. It is likely that further surveys will show all species to have wider distributions on the Chatham Islands.

The Chatham Islands spider fauna has not been reviewed since the 1920s, but an update is underway (Phil Sirvid, Museum of New Zealand Te Papa Tongarewa, pers. comm. 2007). Of the six species found only in the Rangatira samples, one is a widespread New Zealand species not previously recorded from the Chatham Islands (*Poaka graminicola*), and the five others are all Chatham Islands endemics, four of which (*Laestrygones chathamensis*, *Laetesia chathamii*, *Waiporia chathamensis* and *Cambridgea annulata*) are listed as Range Restricted by the Department of Conservation (DOC) (Hitchmough et al. 2007). The remaining specimen was a female that has tentatively been identified as *Gasparia kaiangaroa*. This species was previously known only from a male specimen and is listed by DOC as Data Deficient (Hitchmough et al. 2007). Previously published records of *G. kaiangaroa*, *Laestrygones chathamensis* and *Laetesia chathamii* were from Chatham Island only, and so the presence of these species on Rangatira represents an expansion of their known ranges within the Chatham Islands.

Of the 18 beetle species found only in the Rangatira samples, six have not been recorded from Pitt Island: the rove beetles (staphylinids) *Pselaphaulax* sp. 1, *Leptusa* sp. 1, *Leptusa* sp. 2 and *Quedius antipodum*; the protected, flightless click beetle *Amychus candezei*; and the weevil *Crisius* n. sp. 1 (Emberson 1998). With the exception of *Pselaphaulax* sp. 1 (known from Chatham and Little Mangere Islands), these species may now be confined to the outlying smaller islands, with their high seabird populations and absence of rodents. We note also that while the large flightless darkling beetle *Mimopeus pascoei* has previously been recorded on Pitt Island (Emberson 1998), it is relatively scarce there, and we did not find any in the soil samples we collected in EEPCC. In contrast, it is abundant on Rangatira, and we found 3 adults, 21 larvae and 1 pupa in the samples from there. Similarly, the large flightless carabid *Mecodema alternans* has been recorded previously from Pitt Island (Emberson 1998); it is scarce there and relatively abundant on Rangatira. We did not collect it in EEPCC but collected three adults and two larvae from the Woolshed Bush samples.

## 4. Discussion

It was a surprise to find that there were similar numbers of invertebrates in the soil on Pitt Island and Rangatira, as previous observations and collecting within EEPCC and other forest remnants had indicated that densities of invertebrates on or above the soil surface on Pitt Island were much lower than on Rangatira (Dugdale & Emberson 1996; Emberson et al. 1996; Emberson 1998). These earlier observations, however, were largely based on the insect fauna, particularly the beetle fauna, and did not take into account the large numbers of enchytraeid worms and amphipods in litter samples from both islands.

Based on the habitats present, and the density and biomass of soil-dwelling invertebrates found, we have little doubt that EEPCC will provide excellent habitat for Chatham Island snipe. While some potential prey species may be absent or rare on Pitt Island, the density and variety of invertebrates present in the soil appears sufficient to allow a high-density snipe population to establish.

There have been three previous attempts to translocate *Coenocorypha* snipe. In 1964, the Wildlife Service attempted to rescue Stewart Island snipe (*C. tredalei*) when ship rats (*Rattus rattus*) invaded Big South Cape Island. The two birds captured both died in captivity before they could be moved to another island, and the taxon is now extinct (Miskelly & de Lange 2006). In November 1970, the Wildlife Service successfully translocated 23 Chatham Island snipe from Rangatira to Mangere Island (Bell 1974), and snipe are now abundant on Mangere. In April 2005, DOC translocated 30 Snares Island snipe to Putauhinu Island, a muttonbird island near Big South Cape Island (Charteris & Miskelly 2005). Anecdotal reports from muttonbirders indicate that the snipe are breeding and spreading over the island (Anon. 2007). A successful trial at holding Chatham Island snipe in captivity was undertaken on Rangatira in April–May 2001 (Miskelly & Barlow 2001), making us confident that birds could be moved with minimal risk to their health and wellbeing.

Of more concern is the ongoing presence of mice on Pitt Island, and the interaction between mice, snipe and invertebrates. *Coenocorypha* snipe currently co-exist with mice only on subantarctic Antipodes Island, where the presence of mice has been suggested as the cause of lower snipe densities compared to similar habitats on Adams Island (Auckland Islands) (Miskelly, Walker et al. 2006). Mice consume large quantities of invertebrates, especially caterpillars, spiders, beetles and weta (Ruscoe & Murphy 2005), and are considered the main cause of the rarity of large invertebrates on Pitt Island (Dugdale & Emberson 1996; Emberson et al. 1996; Emberson 1998). The combined predation by mice and snipe might jeopardise the ongoing survival of some invertebrate species that are struggling to survive in EEPCC, especially if mouse numbers are not controlled. This includes the beetles *Mimopeus pascoei* and *Mecodema alternans*, both of which are common on outlying rodent-free islands, including Rangatira, Mangere, Tapuaenuku and Star Keys.

Chatham Island snipe occur at densities of 10 or 11 birds per hectare in Woolshed Bush, Rangatira (Miskelly 1990; Miskelly & Barlow 2001). Our assessments of soil-dwelling invertebrate densities in February 2007 indicated that similar densities

could be reached within the 36 ha of EEPCC enclosed by a predator-exclusion fence. However, effective mouse control was being undertaken at the time, and ongoing mouse control may be necessary for snipe to persist at high densities within EEPCC. The relationship between mouse control/densities, invertebrate abundance and snipe abundance should be monitored as part of the ongoing adaptive management of the covenant.

## 5. Acknowledgements

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# Appendix 1

## SOIL-DWELLING INVERTEBRATES

Soil-dwelling invertebrates found in each of three samples in six different microhabitats in Ellen Elizabeth Preece Conservation Covenant (EEPC, Pitt Island) and Woolshed Bush (Rangatira). Further detail of sampling locations and habitats, and the invertebrates collected are held by C. Miskelly (unpubl. data).

MICROHABITAT	TAXON	EEPC				WOOLSHED BUSH			
		1	2	3	TOTAL	1	2	3	TOTAL
Beside log	Earthworm	4	1	1	6		1	23	24
	Enchytraeid	9	18	28	55		20	4	24
	Flatworm	1			1				0
	Amphipod: <i>Makaue burleyi</i>	22	37	38	97	80	60	65	205
	Isopod: <i>Styloniscus</i> sp.				0			1	1
	Centipede: <i>Maoriella ecdema</i>	2	9	1	12	4	2	6	12
	Millipede: <i>Cylindroiulus brittanicus</i>	2	7	10	19				0
	Spider:								
	Indeterminate				0	1			1
	Desidae: <i>Gasparia kaiangaroa?</i>				0	1			1
	Linyphiidae: <i>Haplitis rufocephalia</i>			2	2				0
	Harvestman: <i>Neonuncia opaca</i>			1	1				0
	Collembola:								
	Indeterminate			3	3				0
	Entomobryidae			1	1				0
	Hemipteran: Lygaeidae			1	1				0
	Coleoptera larva (indet.)	1			1				0
	Carabid: <i>Laemostenus complanatus</i>	1			1				0
	Carabid larva (indet.)		1		1			2	2
	Staphylinid: <i>Notolinus socius</i>				0			1	1
	Staphylinid larva (indet.)				0		5	2	7
	Scarabaeidae:								
	<i>Costelytra zealandica</i> larva		8	1	9			1	1
	<i>Odontria varicolorata</i> larva	1			1				0
	<i>Odontria varicolorata</i> pupa	1			1				0
	Elaterid larva:								
	Indeterminate				0		1	1	2
	<i>Amychus candezeti</i>				0			1	1
	Tenebrionid larva: <i>Mimopeus pascoei</i>				0	1			1
	Anthribid: <i>Dysnocryptus pilicornis</i>				0			1	1
	Curculionid larva (indet.)			3	3		2		2
	Curculionid pupa (indet.)			2	2		1		1
	Dipteran: Orthorrhapha (indet.)			1	1				0
Dipteran larva (indet.)			1	1		5	3	8	
Dipteran pupa (indet.)				0		1		1	
Tipulid larva (indet.)				0		5		5	
Tipulid larva (large)				0		1		1	
Total	44	81	94	219	87	104	111	302	
Biomass (g)	2.39	1.20	0.49	4.08	0.19	0.17	1.07	1.43	

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MICROHABITAT	TAXON	EEPCC				WOOLSHED BUSH				
		1	2	3	TOTAL	1	2	3	TOTAL	
By petrel burrow	Earthworm		1		1	4	9	7	20	
	Enchytraeid	155	75	95	325		11	2	13	
	Amphipod: <i>Makaawe burleyi</i>	1		3	4	7	2	5	14	
	Centipede:									
	<i>Maoriella ecdema</i>				0	1		3	4	
	<i>Henicops maculatus</i>				0		3		3	
	Millipede: <i>Dityloma</i> sp.				0			1	1	
	Spider: Linyphiidae: <i>Haplitis rufoccephalia</i>			2	2				0	
	Mite:									
	Indeterminate	3	2	2	7				0	
	Mesostigmata: Parasitidae: <i>Pergamasus</i> sp. 2		2	2	6				0	
	Prostigmata: protonymph				0			1	1	
	Collembola: Entomobryidae		1		1		1		1	
	Staphylinid:									
	Indeterminate				0	1			1	
	<i>Leptusa</i> sp. 1				0			1	1	
	Staphylinid larva (indet.)		1	2	3			5	5	
	Scarabaeid:									
	<i>Costelytra zealandica</i> larva			10	10		1		1	
	<i>Odontria varicolorata</i> larva	2			2				0	
	Elaterid larva (indet.)		2		2				0	
	Cerambycid: <i>Ptinostoma vicinus</i>				0	1			1	
	Dipteran larva (indet.)				0	2		1	3	
	Tipulid larva (indet.)				0			1	1	
	Tipulid larva (large)				0			1	1	
	Schizophora pupa				0			1	1	
	Lepidopteran (indet.)				0	1			1	
	Geometrid larva (indet.)				0	4			4	
	Lepidopteran pupa				0			1	1	
	Total		163	84	116	363	21	27	30	78
	Biomass (g)		0.22	0.13	0.22	0.57	0.24	0.29	0.49	1.02
	Sedge	Earthworm		2		2	3	1	3	7
Enchytraeid		1	16		17	63	2	11	76	
Flatworm				1	1				0	
Snail:										
<i>Paralaoma lateumbilicata</i>			1		1				0	
<i>Tbalassobelix chatbamensis</i>					0			1	1	
Amphipod: <i>Makaawe burleyi</i>		75	41	138	254	40	37	26	103	
Isopod: <i>Styloniscus</i> sp.		3	5	8	16	2	2	8	12	
Centipede:										
<i>Maoriella ecdema</i>		1		7	8	7	3	6	16	
<i>Henicops maculatus</i>				1	1			11	11	
Millipede:										
<i>Cylindroiulus brittanicus</i>		27	9	55	91				0	
<i>Icosidesmus variegatus</i>					0			1	1	
Spider:										
Indeterminate			1		1	2	2		4	
Desidae: <i>Laestrygones chatbamensis</i>					0		1		1	
Linyphiidae: <i>Haplitis rufoccephalia</i>				0			1	1		

Continued on next page

MICROHABITAT	TAXON	EEPCC				WOOLSHED BUSH			
		1	2	3	TOTAL	1	2	3	TOTAL
	Linyphiidae: <i>Laetesia chatbami</i>				0			1	1
	Linyphiidae: <i>Tenuipbantes tenuis</i>	1		2	3			2	2
	Lycosidae: <i>Anoteropsis ralphi?</i>				0		1		1
	Orsolobidae: <i>Waiporia chatbamensis</i>				0	1	1		2
	Stiphidiidae: <i>Cambridgea annulata</i>				0	1		1	2
	Tetragnathidae: <i>Tetragnatha</i> sp.	1			1				0
	Harvestman: <i>Neonuncia opaca</i>	3		1	4				0
	Mite (indet.)				0			1	1
	Collembola:								
	Indeterminate)	1			1	1	2	3	6
	Neanuridae				0		1		1
	Entomobryidae		1		1		2		2
	Sminthuridae			1	1				0
	Hemipteran:								
	Indeterminate	1			1				0
	Lygaeidae	2			2				0
	Cercopidae: <i>Philaenus spumarius</i>				0	1			1
	Cercopidae? nymph				0			1	1
	Carabid:								
	<i>Mecyclothorax rotundicollis</i>	1			1				0
	<i>Mecyclothorax</i> n. sp. 1	1	2	1	4				0
	<i>Allocinopus latitarsis</i>				0			5	5
	Carabid larva:								
	Indeterminate			1	1				0
	<i>Mecodema alternans</i> larva				0			1	1
	Staphylinid:								
	Indeterminate			1	1			1	1
	<i>Botromana vulcanica</i>			4	4				0
	<i>Leptusa</i> sp. 1				0		1		1
	<i>Leptusa</i> sp. 2				0		2	1	3
	Lucanid larva: <i>Geodorcus?</i>				0		1		1
	Scarabaeid: <i>Odontria varicolorata</i>	1			1				0
	Scarabaeid larva:								
	<i>Costelytra zealandica</i>				0	1			1
	<i>Odontria varicolorata</i>	1	1		2				0
	Elaterid larva: <i>Amychus candezei</i>				0			2	2
	Tenebrionid: <i>Mimopeus pascoei</i>				0			2	2
	Tenebrionid larva: <i>Mimopeus pascoei</i>				0		1		1
	Cerambycid: <i>Ptinusoma vicinus</i>				0			1	1
	Cerambycid larva (indet.)		1		1				0
	Anthribid: <i>Dysnocryptus pilicornis</i>				0			1	1
	Curculionid larva (indet.)			3	3				0
	Dipteran larva (indet.)			4	4	1			1
	Tipulid larva (indet.)			5	5				0
	Tipulid larva (large)				0		1		1
	Therevid larva (indet.)			3	3				0
	Ichneumonid (indet.)				0			6	6
	Ant: <i>Amblyopone saundersi</i>				0			2	2
	Lepidopteran larva (indet.)		1		1		1	1	2

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MICROHABITAT	TAXON	EEPCC				WOOLSHED BUSH			
		1	2	3	TOTAL	1	2	3	TOTAL
Grass	Geometrid larva (indet.)				0	1			1
	Lepidopteran pupa				0			2	2
	Unident pupa			1	1				0
	Total	120	81	237	438	124	62	102	288
	Biomass (g)	1.39	1.13	0.77	3.29	0.27	0.53	1.21	2.01
	Earthworm	2	1		3	2	2		4
	Enchytraeid	67	185	40	292	290	110	65	465
	Flatworm		2	2	4				0
	Snail:								
	<i>Mocella eta</i>				0		1		1
	<i>Tbalassobelix chatbamensis</i>				0	1			1
	<i>Tbalassobelix</i> n. sp.				0	1			1
	<i>Climocella</i> n. sp. aff. <i>akarana</i>				0		1		1
	Amphipod: <i>Makawe burleyi</i>	92	57	19	168	158		84	242
	Isopod: <i>Styloniscus</i> sp.	5	2	1	8	7	8	38	53
	Centipede:								
	Indeterminate				0	3			3
	<i>Maoriella ecdema</i>		1		1	1			1
	<i>Henicops maculatus</i>				0	34	22	10	66
	Millipede:								
	Indeterminate				0			2	2
	<i>Cylindroiulus brittanicus</i>		10	13	23	7	13	3	23
	<i>Icosidesmus variegatus</i>				0	2	3		5
	<i>Ditylawa</i> sp.				0	2	1	2	5
	Spider:								
	Indeterminate		2		2		1	2	3
	Amaurobiidae: <i>Poaka graminicola</i>				0			7	7
	Linyphiidae: <i>Haplitis rufocephalia</i>	2	23	4	29	2	4	6	12
	Linyphiidae: <i>Laetesia chatbami</i>				0			4	4
	Linyphiidae: <i>Tenuiphantes tenuis</i>	1			1		3	2	5
	Lycosidae: <i>Anoteropsis ralphi?</i>	2			2		9	4	13
	Orsolobidae: <i>Watportia chatbamensis</i>				0	3	3		6
	Salticidae (indet.)				0	1			1
	Harvestman: <i>Neonuncia opaca</i>	8	10	11	29	1	3	10	14
	Pseudoscorpion				0			2	2
	Mite:								
	Mesostigmata: Parasitidae: <i>Pergamasus</i> sp.		2		2				0
Mesostigmata: Macrochelidae:									
<i>Gebolaspis</i> sp.				0			1	1	
Prostigmata				0	1		2	3	
Collembola: Entomobryidae				0	1	5	3	9	
Archaeognathan	1			1				0	
Earwig: <i>Forficula auricularia</i>		1		1				0	
Aphid				0	1			1	
Hemipteran:									
Lygaeidae			1	1				0	
Cicadellidae	1			1				0	
Cercopidae: <i>Philaenus spumarius</i>				0			1	1	
Cicada nymph			1	1		1		1	

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MICROHABITAT	TAXON	EEPCC				WOOLSHED BUSH			
		1	2	3	TOTAL	1	2	3	TOTAL
	Carabid:								
	<i>Mecodema alternans</i>				0			1	1
	<i>Mecyclothorax</i> n. sp. 1				0		3		3
	<i>Allocinopus latitarsis</i>				0	1			1
	<i>Haplanister crypticus</i>		1		1				0
	Carabid larva:								
	Indeterminate				0			1	1
	<i>Mecodema alternans</i> larva				0		1		1
	Staphylinid:								
	Indeterminate				0		1		1
	' <i>Stenomalius</i> ' n. sp. 1				0	2			2
	Pselaphinae, <i>Pselaphaulax</i> sp. 1				0		1		1
	Aleocharinae (indet.)				0			1	1
	<i>Atheta fungi</i>		1		1				0
	<i>Botromana vulcanica</i>				0	1			1
	<i>Notolinus socius</i>		2		2				0
	<i>Quedius antipodum</i>				0	1			1
	Staphylinid larva (indet.)		1		1	1			1
	Scarabaeid:								
	<i>Costelytra zealandica</i> larva	5	1		6				0
	<i>Saprosites sulcatissimus</i> larva				0			1	1
	Elaterid larva (indet.)				0		1		1
	Cerylonid: <i>Hypodacnella rubripes</i>	1	2		3				0
	Coccinellid: <i>Veronicobius macrostictus</i>	1			1				0
	Tenebrionid larva: <i>Mimopeus pascoei</i>				0	2		2	4
	Curculionid:								
	<i>Crisius</i> n. sp. 1				0			1	1
	<i>Patellitergum rectirostris</i>				0			1	1
	Dipteran larva (indet.)		1		1			1	1
	Dipteran pupa (indet.)			1	1				0
	Tipulid larva (indet.)				0	1		2	3
	Therevid larva (indet.)				0	1			1
	Stratiomyid larva (indet.)		1		1				0
	Diapriid wasp				0	1			1
	Ant: <i>Amblyopone saundersi</i>				0	2		9	11
	Neuropteran: <i>Micromus tasmaniae</i>		1		1				0
	Total	188	307	93	588	531	198	267	996
	Biomass (g)	1.26	1.27	0.47	3.00	1.16	0.18	1.25	2.59
Herb mat	Earthworm			5	5		5		5
	Enchytraeid	8	68	118	194	165	12	16	193
	Flatworm	1			1				0
	Snail:								
	<i>Paralaoma lateumbilicata</i>		57		57				0
	<i>Cavellia buccinella</i>		1		1				0
	Amphipod: <i>Makawea burleyi</i>	108	109	40	257	110	34	65	209
	Isopod: <i>Styloniscus</i> sp.	21	1	1	23	20	1	2	23
	Centipede:								
	Indeterminate		1		1				0
	<i>Maoriella ecdema</i>	1		1	2		1		1

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MICROHABITAT	TAXON	EEPCC				WOOLSHED BUSH			
		1	2	3	TOTAL	1	2	3	TOTAL
	<i>Henicops maculatus</i>				0	2	1	2	5
	Millipede:								
	<i>Cylindroiulus brittanicus</i>	3	1	1	5	1			1
	Non-juliform millipede (indet.)		1		1				0
	Spider:								
	Indeterminate				0			1	1
	Linyphiidae: <i>Haplisis rufoccephalia</i>	2	5	12	19	11			11
	Lycosidae: <i>Anoteropsis ralphi?</i>	1			1				0
	Harvestman: <i>Neonuncia opaca</i>	2			2				0
	Pseudoscorpion				0	2			2
	Mite:								
	Mesostigmata: Parasitidae: <i>Pergamasus</i> sp.			10	10				0
	Mesostigmata: Macrochelidae:								
	<i>Gebolaspis</i> sp.			1	1				0
	Mesostigmata: Rhodocaridae			1	1				0
	Cryptostigmata (family indet.)			1	1				0
	Collembola:								
	Neanuridae				0			1	1
	Entomobryidae			3	3			1	1
	Heteroptera nymph			1	1				0
	Coleoptera larva (indet.)		1		1				0
	Carabid:								
	<i>Mecodema alternans</i>				0		1	1	2
	<i>Allocinopus latitarsis</i>				0	1	1		2
	Staphylinid: <i>Leptusa</i> sp. 1				0	7	1		8
	Staphylinid larva (indet.)	1		5	6				0
	Scarabaeid: <i>Costelytra zealandica</i> larva	7	1	3	11	4	1		5
	Curculionid:								
	<i>Irenimus</i> sp.				0	1			1
	<i>Pactolotypus</i> n.sp				0	1			1
	Dipteran (indet.)				0			1	1
	Dipteran larva (indet.)				0		1		1
	Cyclorrhapha larva (family indet.)		4	1	5				0
	Nematocera larva (family indet.)			1	1				0
	Tipulid larva (indet.)		1	3	4	1			1
	Schizophora larva				0		1		1
	Stratiomyid pupa (indet.)		1		1				0
	Diapriid wasp				0	1		1	2
	Ant: <i>Amblyopone saundersi</i>				0	2			2
	Lepidopteran larva (indet.)				0	2	2		4
	Geometrid larva (indet.)	1			1				0
	Total	156	252	208	616	331	62	91	484
	Biomass (g)	1.12	0.72	0.40	2.24	0.78	0.43	0.55	1.76

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MICROHABITAT	TAXON	EEPCC				WOOLSHED BUSH			
		1	2	3	TOTAL	1	2	3	TOTAL
Fern	Enchytraeid	10	2	4	16	3	19		22
	Snail:								
	<i>Climocella</i> n. sp. aff. <i>akarana</i>			1	1	6			6
	<i>Charopa</i> n. sp. aff. <i>coma</i>				0	1	1		2
	Amphipod: <i>Makaue burleyi</i>	20	48	47	115	31	17	5	53
	Isopod: <i>Styloniscus</i> sp.	1		5	6	4	3		7
	Centipede:								
	<i>Maoriella ecdema</i>				0	1	4	1	6
	<i>Henicops maculatus</i>				0	6	6		12
	Millipede: <i>Cylindroiulus brittanicus</i>	10	5	12	27				0
	Spider:								
	Indeterminate		1	1	2	1			1
	Agelenidae: <i>Mabura</i> sp. nov.			16	16		1		1
	Linyphiidae: <i>Haplisis rufoccephalia</i>			1	1				0
	Linyphiidae (indet. juvenile)	2			2				0
	Orsolobidae: <i>Waiporia chatbamensis</i>				0		1		1
	Salticidae (indet.)			1	1				0
	Harvestman: <i>Neonuncia opaca</i>	9	2	8	19			1	1
	Collembola:								
	Neanuridae			1	1				0
	Entomobryidae	2			2				0
	Psocoptera (family indet.)	1			1				0
	Hemipteran:								
	Indeterminate				0	1			1
	Cixiidae nymph	12	2	9	23				0
	Cicada nymph	1			1				0
	Rhaphidophoridae juvenile (indet.)				0		1		1
	Carabid:								
	<i>Mecyclothorax rotundicolle</i>			1	1				0
	<i>Allocinopus latitarsis</i>				0		1		1
	Staphylinid: Aleocharinae (indet.)		3		3				0
	Scarabaeid: <i>Costelytra zealandica</i> larva	2			2				0
	Mycetophagidae: ' <i>Triphyllus</i> ' sp. 1				0		1		1
Tenebrionid:									
<i>Mimopeus pascoei</i>				0			1	1	
<i>Mimopeus pascoei</i> (larva)				0	1	3	11	15	
<i>Mimopeus pascoei</i> (pupa)				0			1	1	
Anthribid: <i>Cacephatus propinquus</i>			1	1				0	
Dipteran larva (indet.)				0	1			1	
Diapriid wasp				0	1			1	
Ant: <i>Amblyopone saundersi</i>				0		1		1	
Total		70	63	108	241	57	59	20	136
Biomass (g)		0.56	0.48	0.55	1.59	0.13	0.20	0.56	0.89

# Appendix 2

## NOTES ON INVERTEBRATES RECOVERED FROM THE SOIL SAMPLES

The following invertebrates were found in soil samples from Ellen Elizabeth Preece Conservation Covenant (EEPC, Pitt Island) and Woolshed Bush (Rangatira).

### **Platyhelminthes: Turbellaria**

The terrestrial flatworms of the Chatham Islands are poorly known, but are commonly found under logs and in damp places. They require special preservation techniques if they are to be identified.

### **Annelida: Oligochaeta**

Very little is known about the earthworms and enchytraeid (pot) worms of the Chatham Islands. Many of the earthworms were juveniles or only represented by pieces, making them almost impossible to identify. The species of earthworms on Pitt Island were probably different from those on Rangatira, reflecting the different soil type and pH.

### **Mollusca: Gastropoda**

Of the seven species in these samples, three are common on mainland New Zealand, one was previously described as a Chatham Islands endemic, and three are apparently new from this survey.

#### **Punctidae**

*Paralaoma lateumbilicata* (Suter, 1890). There are several undescribed species of small punctid known with the typical wide umbilicus that gave *lateumbilicata* its name. *Paralaoma lateumbilicata* varies little over its range (North and South Islands, Stewart Island/Rakiura, Hen and Chickens Islands, and Hauturu/Little Barrier Island, according to the literature). A random sample taken from the 58 *Paralaoma* snails found in EEPCC samples was compared with some taken from Pataua North, near Whangarei, and all proved to have shell characters within the range of that population. The species is common in disturbed bush, and appears to be xerophilic.

#### **Charopidae**

*Cavellia buccinella* (Reeve, 1852). The fragment noted (from under the herb *Parietaria debilis*, EEPCC) is almost certainly *C. buccinella*, the only *Cavellia* species recorded from the Chatham Islands by Powell, as well as (commonly) from the North and South Islands.

*Charopa* n. sp. aff. *coma*. The two specimens both came from under the fern *Polystichum vestitum* in Woolshed Bush. One was considerably eroded, but the other (which was photographed; Mahlfeld in press) is clearly different from all populations of *Charopa coma* (Gray, 1843) and *Charopa pseudocoma* Suter, 1894, having much closer coarse riblets. This specimen appears to be a related new species, previously unknown and therefore restricted (so far) to Rangatira.

*Climocella* n. sp. aff. *akarana*. Compared with specimens of *Climocella akarana* Goulstone, 1996 (which it superficially resembles), the eight specimens collected had a much larger protoconch, and so appear to be members of an undescribed new species of *Climocella*, known only from these samples. One was collected from EEPCC (under the tree fern *Dicksonia fibrosa*), and seven from Rangatira (six from under *Polystichum vestitum*, and one from under cocksfoot grass *Dactylis glomerata*).

*Mocella eta* (Pfeiffer, 1853). This species is common and widespread from Cape Reinga to North Otago. The specimen from Rangatira (under *Dactylis glomerata*) is typical of the species.

*Thalassobelix chathamensis* (Suter, 1909). Recorded previously only from Chatham Island, and apparently endemic. The two animals collected on Rangatira have not been critically compared with type material, but they match the species description.

*Thalassobelix* sp. (*chathamensis?* freak). Compared with *T. chathamensis*, this is larger in size, but with a substantially smaller, more tightly coiled protoconch. It almost certainly will be a new species, but better specimens would help to decide this. A single specimen was found under adventive grass species (Yorkshire fog *Holcus lanatus*, cocksfoot *Dactylis glomerata* and prairie grass *Bromus willdenowii*) on Rangatira.

### **Arthropoda: Crustaceae: Amphipoda**

The terrestrial amphipods belong to the family Talitridae and were revised by Duncan (1994). There is only one species known from the Chatham Islands, *Makawe hurleyi* (Duncan). It is common everywhere on all the main islands of the Chatham Islands group and is also found in the eastern and southern parts of the South Island.

### **Arthropoda: Crustaceae: Isopoda**

There was only one species of isopod in the samples, belonging to the genus *Styloniscus* (family Styloniscidae). It keys out to *S. thomsoni*, but this could well be a complex of species.

### **Arthropoda: Chilopoda**

Two species of centipedes were found: *Maoriella ecdema*, which is endemic but widespread on the Chatham Islands, and is elongate with short legs; and *Henicops maculatus*, which is probably introduced from mainland New Zealand and is relatively shorter and broader, with longer legs. All centipedes are predatory.

### **Arthropoda: Diplopoda**

Three species of millipedes were represented in the samples. One is a common European species, *Cylindroiulus brittanicus*, which is more or less round in cross section. The other two are more flattened with longer legs and were identified only from Rangatira: *Icodesmus variegatus*, which may be introduced from Canterbury, is quite dark all over; and *Ditylowa* sp., which is paler with a dark dorsal stripe. The latter species may be undescribed. None of these species are thought to be vulnerable. Millipedes usually feed on dead plant material and can be important decomposers.

### **Arthropoda: Arachnida: Acari**

Several species of mites were present in the samples. They were mostly larger species of Mesostigmata belonging to the families Parasitidae (*Pergamasus* sp.) and Macrochelidae (*Gebolaspis* sp.), and on one occasion Rhodocaridae. However, occasional Cryptostigmata and Prostigmata were also present. The macrochelids, and possibly the parasitids, are common introduced European species. The sampling technique was not suitable for sampling even large mites, so the data grossly under-represent mites in the material collected.

### **Arthropoda: Arachnida: Araneae**

At least 12 spider species were present in the samples, with 11 found on Rangatira and 6 on Pitt Island. Families represented in the material are listed alphabetically.

#### **Agelenidae**

*Mabura* sp. nov. Found in fern samples on both islands, with 16 specimens from Pitt Island, and one from Rangatira. Apparently, this is a previously unknown species, and almost certainly endemic to the Chatham Islands.

#### **Amaurobiidae**

*Poaka graminicola* Forster & Wilton, 1973. A widespread if infrequently collected New Zealand species. This is likely to be a new record for the Chatham Islands (seven specimens from Rangatira).

#### **Desidae**

*Gasparia kaiangaroa?* Forster, 1970. One female found in a sample from Rangatira. This species was previously known only from the holotype male specimen collected at Kaiangaroa on Chatham Island. The identification is tentative because the specimen was in poor condition.

*Laestrygones chathamensis* Forster, 1970. Chatham Islands endemic and previously known only from Chatham Island. We found only one specimen, among the Rangatira samples.

#### **Linyphiidae**

*Haplisis rufoccephalia* (Urquhart, 1888). Chatham Islands endemic. As most specimens found were juveniles, there is a chance that some of them may be the closely related *H. tegulata* (another Chatham Islands endemic). A total of 77 specimens was found on both islands (1 male, 7 females and 69 juveniles). This species appears to be common and widespread throughout the Chatham Islands.

*Laetesia chatbami* Millidge, 1988. Chatham Islands endemic. Although previously known only from the holotype female from Chatham Island, it has since been collected from several other localities there (Phil Sirvid, Museum of New Zealand Te Papa Tongarewa, pers. comm. 2007). This is the first time this species has been collected from Rangatira, where we found five specimens.

*Tenuiphantes tenuis* (Blackwall, 1852). An adventive species that is widespread throughout New Zealand, including the Chatham Islands. This is one of the few exotic spider species readily encountered in native New Zealand ecosystems (Phil Sirvid, Museum of New Zealand Te Papa Tongarewa, pers. comm. 2007). A total of 11 specimens was found on both islands.

### **Lycosidae**

*Anoteropsis ralphi?* (Simon, 1905). All 17 specimens found (on both islands) were juveniles. Their colour pattern differs from the known Chatham Islands lycosids, but it most closely resembles that of *A. ralphi*. *Anoteropsis ralphi* has not been recorded from Rangatira before, but has been collected from most other islands in the Chatham Islands, including The Pyramid and Star Keys. It appears to be a very common species throughout the Chatham Islands.

### **Orsolobidae**

*Waiporia chathamensis* Forster & Platnick, 1985. A Chatham Islands endemic, this species has previously been recorded from both Chatham Island and Rangatira, where we found nine specimens.

### **Salticidae**

Three adults from Rangatira are likely to belong to an undescribed species. One juvenile jumping spider (not identified to species) was found in a Pitt Island sample. As this family has had little taxonomic study, it is difficult to evaluate the range and abundance of the Chatham Islands salticid fauna. Despite this, salticids are commonly encountered in the Chatham Islands.

### **Stiphidiidae**

*Cambridgea annulata* Dalmas, 1917. A Chatham Islands endemic, which appears to be quite common in both modified and native habitats. We found five specimens in Rangatira samples.

### **Tetragnathidae**

*Tetragnatha* sp. One juvenile (not identified to species) was found in a Pitt Island sample. Tetragnathids are quite commonly encountered in open country in the Chatham Islands, and are often found when the collecting technique of beating low shrubs and long grasses is used.

### **Arthropoda: Arachnida: Opiliones**

The single species of harvestman in the material collected was *Neonuncia opaca* (Roewer). It is widespread and common on the Chatham Islands, and is thought to be an endemic.

### **Arthropoda: Arachnida: Pseudoscorpionida**

False scorpions are commonly encountered in litter samples and are also found under rocks and in birds' nests. The New Zealand fauna is not well known, though a number of species have been described. All pseudoscorpions are predatory.

### **Arthropoda: Collembola**

Several species of springtails were present, most belonging to the family Entomobryidae. Springtails are very unlikely to be vulnerable to snipe predation and will have been grossly under-represented in the collections because of the sampling technique used. Most species are thought to feed on fungal hyphae and other micro-organisms.



### **Arthropoda: Insecta: Archaeognatha: Meinertellidae**

Archaeognatha are the most primitive living insects. Only two or three species are known from New Zealand. They are believed to feed on algae and lichens, though some may be predatory or scavengers on dead insects. The Chatham Islands species have not been studied.

### **Arthropoda: Insecta: Orthoptera: Rhaphidophoridae**

One very young, juvenile cave weta was found; small juveniles cannot be reliably identified.

### **Arthropoda: Insecta: Dermaptera**

*Forficula auricularia* L. 1758. The introduced European earwig, common on Chatham and Pitt Islands.

### **Arthropoda: Insecta: Hemiptera**

Families represented in the material are listed alphabetically.

#### **Cercopidae**

*Pbilaenus spumarius* (L. 1758). The introduced meadow spittlebug. Adults and nymphs are sap feeders on herbaceous plants.

#### **Cicadidae**

Nymphs of Cicadidae are currently unidentifiable, but all species are believed to be root feeders. The only species known to be present is the Chatham endemic *Kikibia longula*.

#### **Cixiidae**

Nymphs of Cixiidae are unidentifiable. Adults of several species are commonly found in leaf litter and may be root feeders.

#### **Lygaeidae**

This is a large family of plant-feeding bugs. Several species are known from the Chatham Islands.

### **Arthropoda: Insecta: Psocoptera**

A single unidentified psocopteran, or bark louse, was present in one of the samples. Psocopterans are often found in leaf litter and probably feed on fungi.

### **Arthropoda: Insecta: Coleoptera**

Details of all the beetle species known from the Chatham Islands are given by Emberson (1998, 2002). Families represented in the material are listed alphabetically.

#### **Anthribidae**

*Cacephatus propinquus* (Broun, 1911). A common, endemic species widely distributed on the larger islands of the Chatham Islands group, often associated with dead branches.

*Dysnocryptus pilicornis* (Broun, 1911). Another very common endemic species.

## **Carabidae**

*Allocinopus latitarsis* Broun, 1911. The most ubiquitous ground beetle in the Chatham Islands, it is found on nearly every island that supports woody vegetation. *Allocinopus latitarsis* most often occurs in forested habitats, but can also be found in more open situations and gardens. It is usually collected under rocks and logs, on tree trunks at night, and around petrel burrows.

*Haplanister crypticus* Moore, 1996. An introduced species of unknown provenance, common in New Zealand.

*Mecodema alternans* Castelnau, 1867. A large ground beetle, which also occurs in coastal South Otago. It is found on most of the small islands that support woody vegetation, and occasionally on Pitt Island. Nowhere is it very common. Both adults and larvae were collected, but only from Rangatira. They are top predators in the soil fauna.

*Mecyclothorax rotundicollis* (White, 1846). A common and widespread New Zealand species also found in eastern Australia.

*Mecyclothorax* n. sp. 1. An undescribed species, endemic to the Chatham Islands and not closely related to other New Zealand or Australian species of *Mecyclothorax*. It is widespread, but not common, in damp forest habitats.

A number of unidentified carabid larvae, representing several species, were also collected.

## **Cerambycidae**

*Ptinusoma vicinus* (Broun, 1911). A small, litter-inhabiting longhorn beetle, found only on the smaller islands, where it is not uncommon. It was originally described from Pitt Island, but has not been collected from there in recent times.

## **Cerylonidae**

*Hypodacnella rubripes* (Reitter, 1880). One of the commonest species of beetles on the Chatham Islands, mostly found in forested habitats.

## **Cerylonidae or Erotylidae**

This small larva looks superficially very like some known erotylid larvae. It would be amazing if it were an erotylid, as the family is known on the Chatham Islands only from two adult specimens belonging to the recently described endemic *Cryptodacne rangiauria* Skelly & Leschen from Pitt Island. More probably, it could be the undescribed larva of *Hypodacnella rubripes*.

## **Coccinellidae**

*Veronicobius macrostictus* (Broun, 1911). This small, endemic ladybird is very common everywhere, usually on vegetation, but also in leaf litter.

## **Curculionidae**

*Cristus* n.sp. 1 (LUNZ Chathams). An uncommon, apparently undescribed species, found in leaf litter from coastal scrub on Rangatira and Star Keys.

*Irenimus* sp. Several apparently undescribed species of *Irenimus* occur on the Chatham Islands. They are commonly found in leaf litter, but also under rocks on the smaller islands of the group.

*Pactolotypus* n. sp. A common and widespread, undescribed, endemic species, usually found in leaf litter or by beating coastal vegetation and dead branches. Similar species are known from southern New Zealand and some subantarctic islands.

*Patellitergum rectirostris* Lyal, 1993. *Patellitergum* Lyal is a Chatham Islands endemic genus without known close relatives. This species is usually associated with woody vegetation, but has also been collected in pitfall and malaise traps. RME has seen material only from Pitt Island and Rangatira, but the species probably occurs on all the main islands.

### **Elateridae**

*Amychus candezei* Pascoe, 1876 (larvae only). The Chatham Islands flightless click beetle, a legally protected species, is rated as Range Restricted by Hitchmough et al. (2007). It is not uncommon on the smaller islands, and survives in low numbers on Chatham Island. It has not been found on Pitt Island in recent times. Larvae have been found in soil and rotten logs; adults are most often seen on tree trunks at night, but can also be found under logs and rocks.

A number of unidentified elaterid larvae, representing several species in addition to *Amychus candezei*, were also collected.

### **Lucanidae**

Possible young larva of *Geodorcus capito* (Deyrolle). Unlike most other lucanid larvae, larvae of *Geodorcus* are usually found free-living in soil with a high humus content, or in peat. They are believed to feed on humus rather than dead wood. Small lucanid larvae are difficult to identify, and the New Zealand species have not been described.

### **Mycetophagidae**

'*Triphyllus*' sp. 1 (LUNZ Chathams). These small beetles are usually found associated with fungal fruiting bodies and plant material infested with fungi. The species is common on the main islands.

### **Scarabaeidae**

*Costelytra zealandica* (White, 1846) (larvae only). The New Zealand grass grub. It is common everywhere.

*Odontria varicolorata* Given, 1952 (mostly larvae). Widespread on all the larger islands; possibly introduced from Canterbury.

*Saprosites sulcatissimus* (Broun, 1910). A common, leaf litter detritivore, also found in petrel burrows; it is known from all the main islands.

### **Staphylinidae**

Aleocharinae indet. The subfamily Aleocharinae is extremely large in New Zealand, but there are no keys to genera or species, making some species very hard or virtually impossible to identify.

*Atheta fungi* (Gravenhorst, 1806). An introduced European species. It is common on Pitt Island.

*Botromana vulcanica* (Broun, 1894). A native species. It is very common everywhere, and widespread in New Zealand.

*Leptusa* sp. 1 (LUNZ Chathams). A moderately common, litter-inhabiting species, found on the smaller islands. It is possibly endemic to the Chatham Islands, but the group needs much systematic work.

*Leptusa* sp. 2 (LUNZ Chathams). A smaller species. It was known previously only from Star Keys, where a single specimen was found under a rock in coastal scrub. It is recorded here from Rangatira for the first time, where three specimens were found under *Carex chatthamica*.

*Notolinus socius* (Fauvel, 1877). An introduced European species. It is common throughout the Chatham Islands.

*Pselaphaulax* sp. 1 (LUNZ Chathams). An undescribed endemic species, previously collected in small numbers from leaf litter on Chatham and Little Mangere Islands. It is recorded here from Rangatira for the first time.

*Quedius antipodum* Sharp, 1886. A relatively common large rove beetle on Rangatira and Mangere Islands, often associated with petrel burrows, but also under logs and on the ground at night.

'*Stenomalius*' n. sp. 1 (LUNZ Chathams). An undescribed species. It belongs to a well-known, but undescribed genus. The species is relatively common and has been collected on all the accessible small islands. It is usually found in leaf litter, under dead birds or in bird nest litter, but has also been collected by beating dead branches.

A number of unidentified staphylinid larvae, representing several species, were also collected.

### **Tenebrionidae**

*Mimopeus pascoei* (Bates, 1873). The common darkling beetle of the southern islands of the Chatham Islands group. It is often found under rocks and logs or on the ground and tree trunks at night. The larvae are detritivores and pupate in dry leaf litter and other organic debris.

### **Arthropoda: Insecta: Diptera**

Families represented in the material by larvae are listed alphabetically. A considerable number of unidentified dipteran larvae, representing several different families and major dipteran lineages, were also collected.

### **Stratiomyidae**

Stratiomyid larvae are very characteristic, with permanently exerted heads. They are often found in the soil or in wet or boggy places. Some species are root feeders, others are probably detritivores.

### **Therevidae**

Therevid larvae are very elongate, vermiform and almost featureless. They are predatory and all New Zealand species are soil inhabiting.

### **Tipulidae**

Tipulid larvae are commonly found in soil. They are usually root feeders, but some species also feed on decaying plant material.

## **Arthropoda: Insecta: Neuroptera**

### **Hemerobiidae**

*Micromus tasmaniae* (Walker, 1860). The Tasmanian lacewing. Both adults and larvae prey on soft-bodied insects, such as aphids. The species is widespread in Australia and New Zealand, including the Chatham Islands.

## **Arthropoda: Insecta: Lepidoptera**

### **Geometridae**

Most geometrid larvae, or looper caterpillars, feed on live plant material, but often descend to the soil to pupate. There are many species and no keys are available for New Zealand larvae.

## **Arthropoda: Insecta: Hymenoptera**

Families represented in the material are listed alphabetically.

### **Diapriidae**

Diapriids are small parasitic wasps that have fly larvae as hosts. The species present in several samples was wingless and ant-like. It possibly represents an undescribed endemic species. The systematics of the New Zealand fauna is still poorly known, though a number of species have been described.

### **Formicidae**

*Amblyopone saundersi* Forel, 1892. A common ant species, widely distributed on the Chatham Islands. It lives in small nests with relatively few individuals.

### **Ichneumonidae**

Many ichneumonids are larval- or larval-pupal parasitoids of Lepidoptera; the five specimens found in one sample may have recently hatched from their host(s). They are not a usual component of the soil fauna. The systematics of the New Zealand fauna, except for a few species of economic importance, is poorly known.

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