

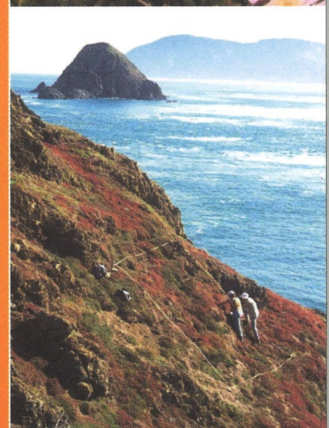
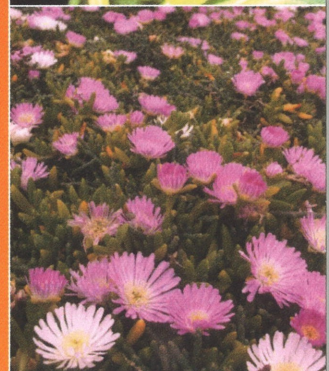
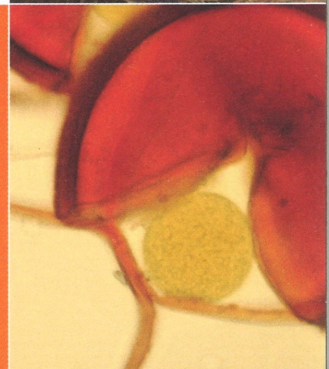
# Bio-Protection & Ecology Division

## MEASURING DIVERSITY AND ABUNDANCE OF INVERTEBRATES IN AHURIRI, COOPERS KNOB AND ORONGOMAI RESERVES IN THE PORT HILLS, CANTERBURY

Mike Bowie and Cor Vink



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**MEASURING DIVERSITY AND ABUNDANCE OF INVERTEBRATES  
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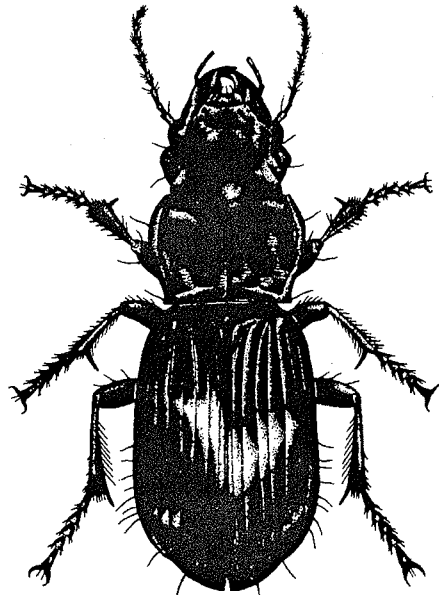
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## **Introduction**

The Port Hills Rangers (Greenspace Unit, Christchurch City Council) in conjunction with Environment Canterbury are ecologically restoring several reserves on the Port Hills of Canterbury. Vegetation, birds and invertebrates are being monitored to collect baseline information on presence and abundance of the taxa. This study, combined with the previous surveys (Bowie & Sirvid, 2004; Bowie & Sirvid, 2005), will provide baseline invertebrate data for comparisons in future years. It may also enable some effects of ecological restoration through pest management to be measured.

Motels (see Methods) were used to non-destructively sample cavity-dwelling species to provide a snapshot of forest diversity and health (Bowie *et al.* 2003; Bowie and Sirvid, 2004; Bowie and Sirvid, 2005; Bowie *et al.* 2006). Another non-destructive sampling method uses wooden discs as facsimiles for natural fallen logs to sample large soil-dwelling insects (Bowie and Frampton 2004; Bowie and Sirvid, 2004; Bowie and Sirvid, 2005). Pitfall trapping is a common method used by entomologists to sample invertebrates (Willet *et al.* 2001). It is an indiscriminate and destructive technique, but does usually collect a broad range of invertebrate taxa and is easily replicated or compared with other pitfall trap studies. Data from pitfall traps, rather than absolute density estimates are often used to measure populations of ground-dwelling invertebrates (Lang, 2000). The likely reason for this is that large numbers of individuals and species can be collected with little labour and expense (Topping and Sunderland, 1992). This work reports on the invertebrate abundance and diversity of three reserves on the Port Hills using these three sampling methods in an attempt to corroborate the use of the non-destructive methods. The two sites showing the highest diversities (Ahuriri and Coopers Knob) and lowest (Orongomai), over the previous two years (Bowie and Sirvid, 2004; Bowie and Sirvid, 2005) were selected for monitoring over the 2005-6 period. Only three sites were chosen due to the extra work needed to carry out the pitfall trapping and identifications. The Pitfall trap catches also provides more specimens to allow a Port Hills invertebrate checklist to be set in motion and a preliminary evaluation of a replication of the Butcher and Emberson (1981) survey carried out at Ahuriri Scenic Reserve. This report discusses results and suggests possible future research.

## **Methods**

### *Sites*

Motels were used at ten sites in the Port Hills Ecological District (Wilson, 1992) in Canterbury, New Zealand (43°37' S, 172°36' E). At each site a range of tree species were chosen to attach 20 motels. Table 1 gives the location of the sites and sampling dates for each site.

### *Motels*

Blocks of untreated pine wood 45 x 45 mm in cross-section and 150 mm long, were cut with a 60° 'roof' (see photo). A drill was used to cut a cavity (~30mm wide x 22mm deep x 70 mm long) and a 14mm diameter entrance hole. A glass microscope slide was used as a window and a wooden door slides open for viewing (see photo). A plastic 'roof' cut from white plastic was stapled to the top to reduce rain damage to the wood. Plastic-coated twist-tie wire was used to attach the motels to trees. Twenty motels were attached to trees predominantly around the perimeter of each 20 x 20 m vegetation plot.

### *Wooden discs*

Based on the specifications of Bowie and Frampton (2003), untreated pine discs (350-450 mm in diameter and 100-150 mm thick) were cut from a fallen tree by the Port Hills Ranger Service (CCC) and eight were placed on bare soil around the perimeter of 20 x 20 m vegetation plots at each site (see photo).

### *Pitfall traps*

Five 350 ml honey pots (6628NA, Stowers, Christchurch) were used as pitfall traps at each site and were placed about five metres away from corner discs of each plot, plus one in the middle of

the plot. Each trap was seated in a galvanised sleeve to maintain a good trap/soil interface surface and a galvanised iron roof was used to reduce rain and vegetative debris entering the traps and minimise the removal of trapped invertebrates by birds (see photo). A 95% solution of antifreeze was used as a preservative and 2% detergent (final concentration) was used in the pitfalls as a surfactant. Contents were collected after approximately one month (see Table 1) and kept in a fridge until sorted into 70% ethanol for further analysis.

#### *Sampling sites*

Only three sites were sampled as the more labour-intensive pitfall traps were used as an additional method. See site details in Table 1 below:

**Table 1: Port Hills sites with locations, sampling details and site characteristics**

Sites	Location	Motel attachment dates	Disc and motel sample dates	Pitfall trap sampling duration	Slope and Altitude	Aspect and Forest type
Ahuriri Scenic Reserve	E2479700 N5726750	31 October 2003	14 December 2005	14 December 2005 – 11 January 2006	15° 450 m	South facing Podocarp/hardwood
Coopers Knob Reserve	E2479590 N5727256	10 November 2003	14 December 2005	14 December 2005 – 11 January 2006	35° 480 m	South facing 2 <sup>nd</sup> growth mixed hardwood
Orongomai Reserve	E2479674 N5730004	13 November 2003	14 December 2005	14 December 2005 – 11 January 2006	25° 460 m	South East facing Podocarp/hardwood

An additional sampling of the discs (to that shown in Table 1) was carried out on 11 January 2006 (when the pitfall traps were collected), but because the earlier December sampling was closer to previous years monitoring (Bowie and Sirvid, 2004; Bowie and Sirvid, 2005), it was used for subsequent analysis.

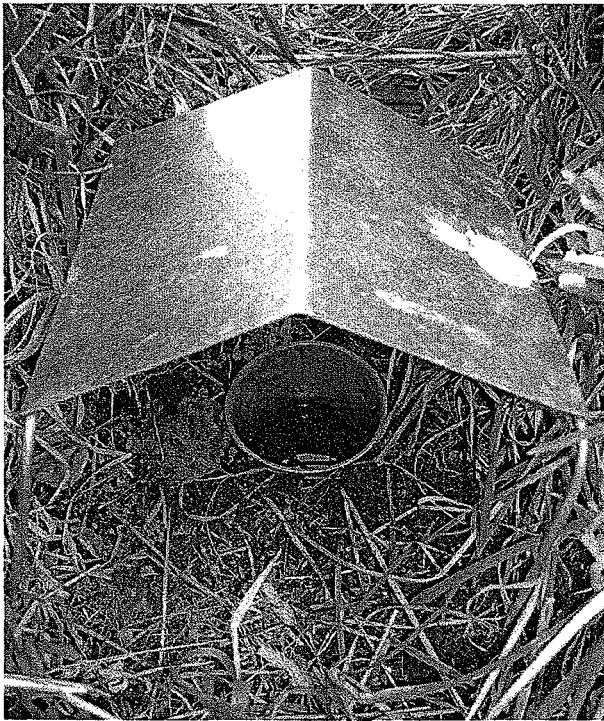
#### *Invertebrate identifications*

Occupants were identified in motels or under discs to the best of our ability but in some cases specimens were collected and preserved in 70% ethanol for more thorough identification in the laboratory.

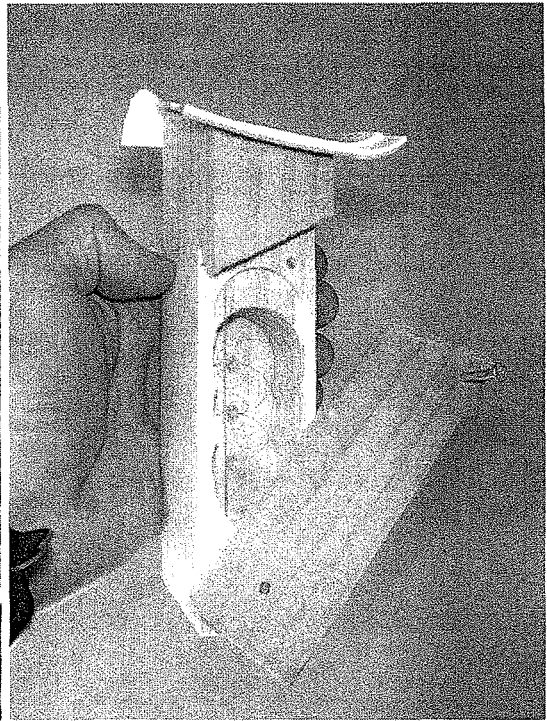
#### *Analysis*

Only beetles were identified from the pitfall traps as beetles are the largest and most diverse group of animals on earth (Klimaszewski and Watt, 1997). There are more than 5000 native New Zealand beetle species (Klimaszewski and Watt, 1997) and many more still await discovery. Beetles ecological roles include carnivores, herbivores, fungivores, and scavengers.

Species diversity was calculated using only ground beetles (Coleoptera: Carabidae) found under the wooden discs. Invertebrate diversity was calculated by combining carabids under discs and spiders (Araneae) found in motels. Pitfall beetles were also used to compare the relative diversities of the three reserves. The Shannon-Wiener index of diversity (Krebs, 1989) calculated for each reserve using log base 10 (rather than natural log). This index incorporates species richness and numbers of each species to give a measure of heterogeneity or evenness of species in populations at each site. Carabid diversity was calculated from both pitfall trap and wooden disc data and compared.



**Pitfall Trap design used in this study**



**Motel used to monitor arboreal invertebrates**



**Wooden discs used to sample ground-dwelling invertebrates e.g. carabids**

## Results

### *Occupancy*

Live occupancy in the motels was lowest at Orongomai with 79% and both Ahuriri and Coopers Knob were 95%. Overall, *Neoramia janus* was the most common spider found in motels and contributed to 67% of all spiders, while the black tunnel-web spider, *Porrhothele antipodiana* was the second most common species with 5% (Appendix 1).

### *Diversity*

At least 36 species of beetles were found in total of which 35 were collected from pitfall trap and 22 of which were found in Coopers Knob, the most diverse site sampled. (Appendix 2). Seven carabid species and six or seven spider species were found from the three sites on the Port Hills. The number of carabid species was less than last year, with four and five species from Ahuriri and Coopers Knob respectively. Only a single species of carabid was found at Orongomai, the same as the previous two years (Figure 1). The carabid and spider diversity was the lowest in the three years we have monitored for all three sites, with Orongomai showing the poorest diversity (Figure 2). When all beetles collected in pitfall traps are assessed, Coopers Knob is the most diverse, followed by Ahuriri, and Orongomai the poorest once again (Figure 3).

### *Abundance*

Overall 140 beetles were caught in pitfall traps and Coopers Knob pitfall traps collected more beetles than the other two sites combined. Carabids were the most abundant beetle family collected from pitfall traps (Appendix 2).

### *Checklist of significant carabid species*

Seven carabid species collected from the Port Hill reserves over the last six years were Banks Peninsula endemics (*Dicrochile attratus*, *Holcaspis suteri*, *Mecodema oregoides*, *Selenochilus piceus*, "*Osmaseus*" *pantomelas* and *Zabronothus striatulus*) (Table 4). One specimen of "*Osmaseus*" *pantomelas* has been found at Coopers Knob under a disc in 2004. A singleton was also under a disc in at Ahuriri Scenic Reserve 12 October 2001. Another single specimen was *Lecanomerus latimanus* and was collected from Kennedys Bush 1 under a wooden disc on 14 October 2004.

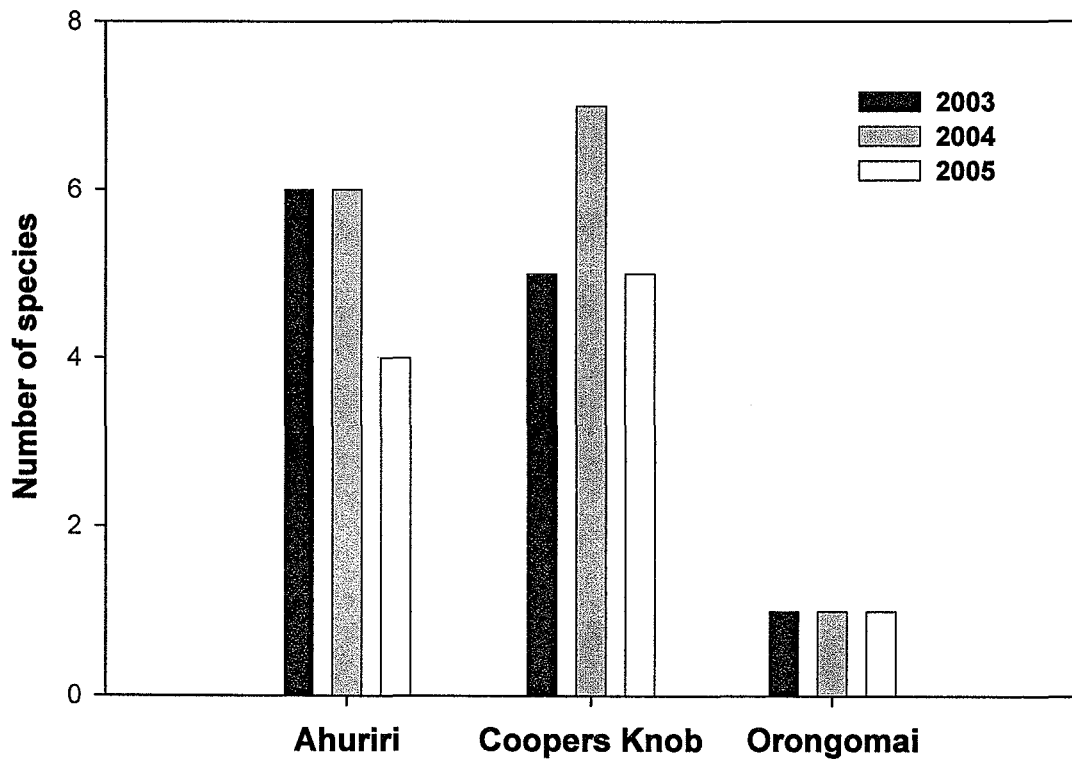
### *Other beetle species*

A "*Quedius*" sp. of Staphylinidae was found at Ahuriri under a wooden disc on 31 September 2003.

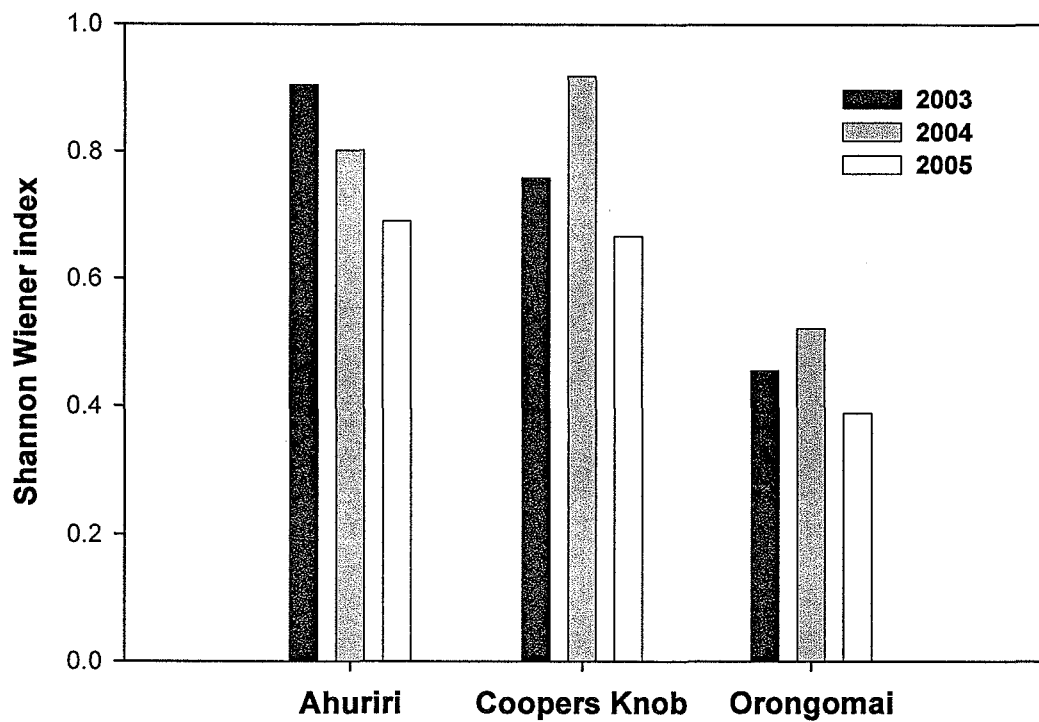
### *Comparison of collecting methods*

Pitfall traps collected considerably larger numbers of carabids over the four week period than wooden discs at the two sampling times (Table 3). Considerably larger numbers of beetles were caught in pitfalls than under wooden discs. The mean number of beetles was 5.8 for the discs compared to 46.7 for pitfall traps. However, if you compare the mean number of species using the two methods there is little difference. Eight wooden discs had an average 2.7 carabids per site, while five pitfalls caught 4.0 carabids per site. Pitfall traps closely mirrored the carabid diversity of the wooden disc data collected in December 2005 for Ahuriri and Coopers Knob, however diversity of carabids caught in pitfall traps at Orongomai was considerably higher than that found under discs ((Figure 4). The number of species found at Ahuriri and Coopers Knob was four and five respectively, regardless of which of the two methods (wooden discs and pitfall traps) used. At Orongomai discs only collected a single species compared with three collected from pitfall traps (Figure 5).

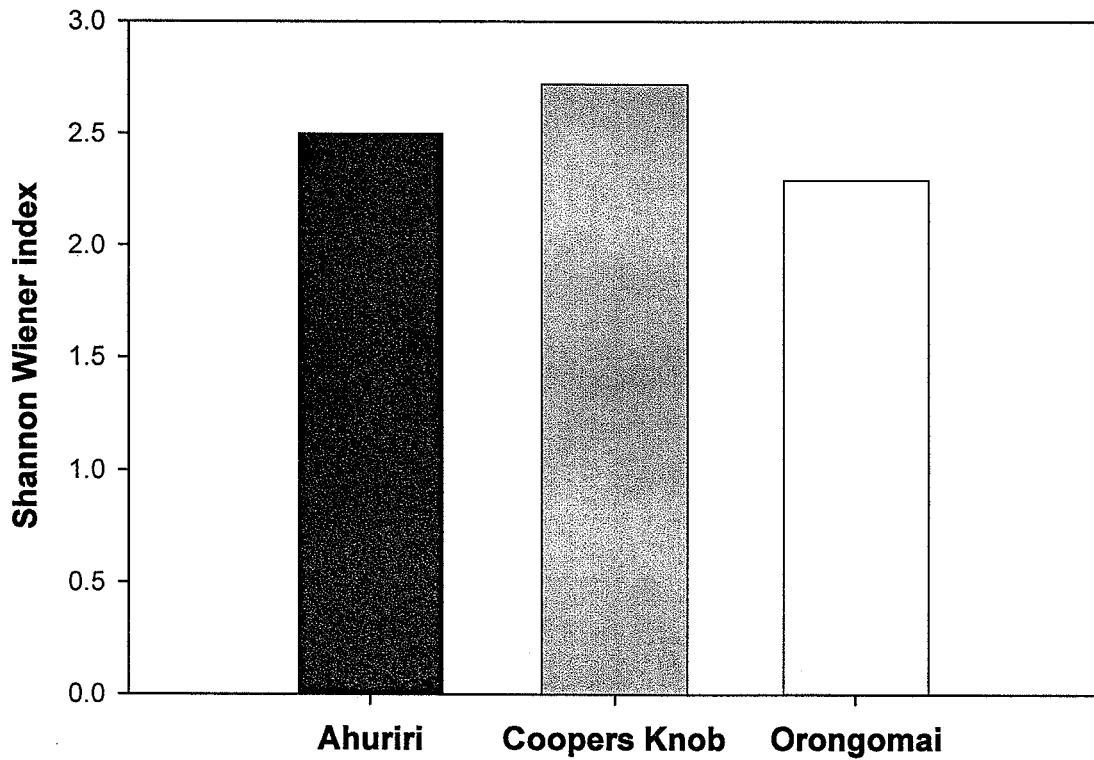
**Figure 1: Carabid species diversity under discs at three Port Hills reserves**



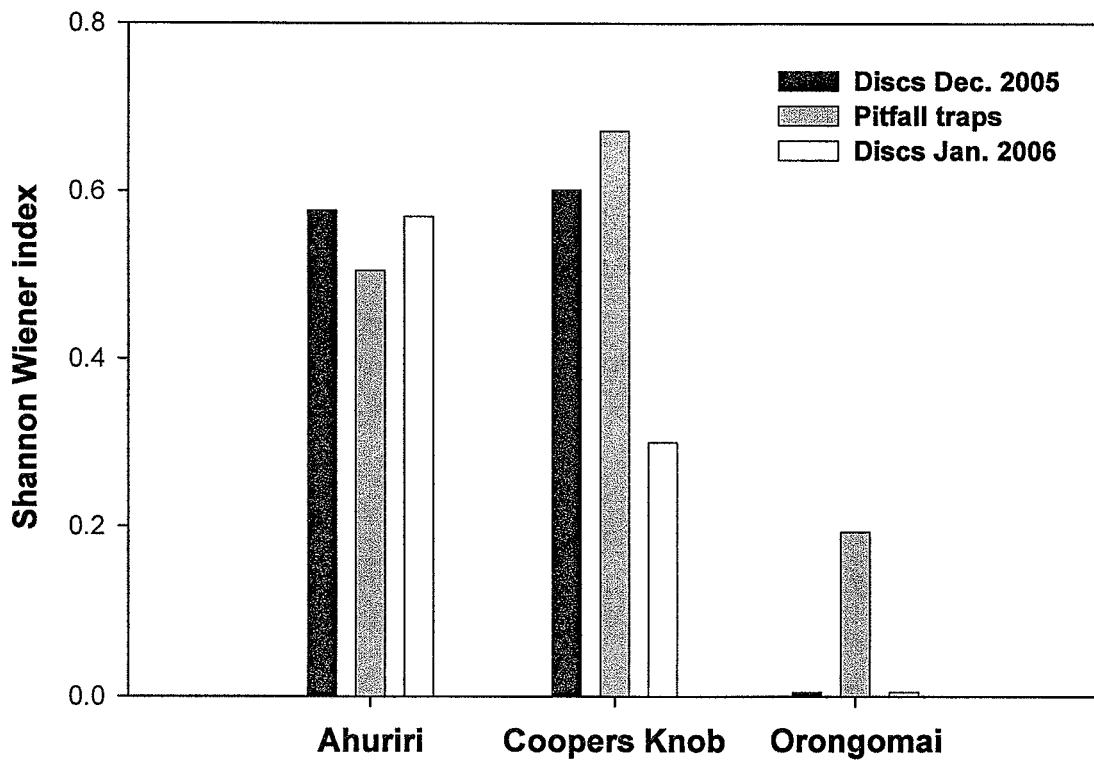
**Figure 2: Invertebrate diversity at three Port Hills reserves from 2003-5 using carabids under discs and spiders in motels**



**Figure 3: Beetle diversity at three Port Hills reserves collected from pitfall traps in Dec. 2005 and Jan. 2006**

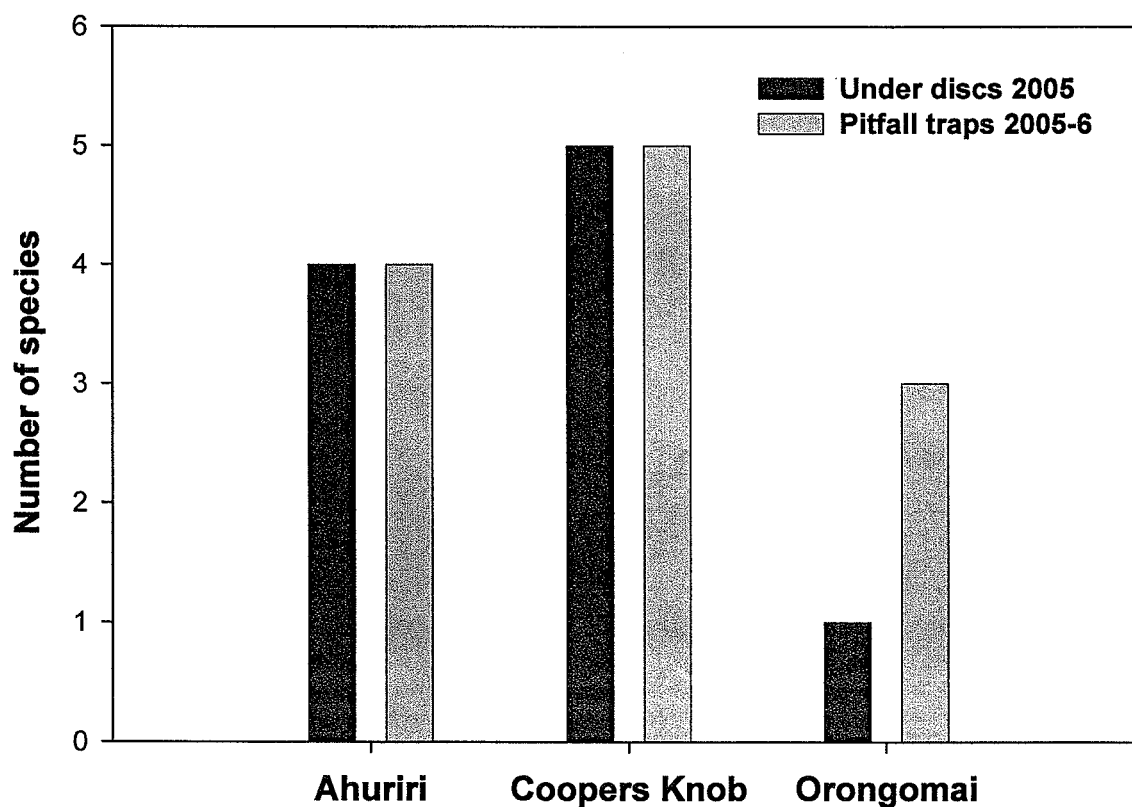


**Figure 4: Comparison of Carabid diversity at three Port Hills reserves using discs and pitfall traps**





**Figure 5: Numbers of carabid species found under discs compared to pitfall traps at three Port Hills sites**



**Table 3: Comparison of carabid numbers caught using wooden discs and pitfall traps at three Port Hills sites**

Site	Discs Dec 2005	Pitfall traps Jan 2006	Discs Jan 2006	Totals
<b>Ahuriri</b>	6	13	8	<b>27</b>
<b>Coopers Knob</b>	8	41	6	<b>55</b>
<b>Orongomai</b>	2	17	1	<b>20</b>
<b>Totals</b>	<b>16</b>	<b>71</b>	<b>17</b>	<b>102</b>

## Discussion

### *Carabids*

A specimen of “*Argutor*” (“*Omaseus*”) *pantomelas* found under a wooden disc at Coopers Knob in 2004 is the most interesting finding in the last three years of monitoring. It is the only *A. pantomelas* collected in 18 years, and the first known specimen collected from Coopers Knob. The last published reference to the collection of this species was by Johns (1986) when only a few specimens were collected at Ahuriri. In and around Armstrong Reserve is the only other location where this species has been found (Johns, 1986). Butcher and Emberson (1981) collected seven *A. pantomelas* specimens using pitfall traps at Ahuriri, more than double that previously known.

*Lecanomerus latimanus* is another species identified from Kennedys Bush 1 under a wooden disc on 14 October 2004. This appears to be a new record for this species on the Port Hills/Banks Peninsula as Johns (1986) found *Lecanomerus marginatus* Sharp, a more widespread species. *L. latimanus* is only known from Central Otago and Dunedin ecological districts (Larochelle and Lariviere, 2001). “*Argutor*” *pantomelas*, *Lecanomerus latimanus* and *Selenochilus piceus* are three rare specimens which have been found using wooden disc monitoring, yet have not been collected in pitfall traps. This corroborates the suggestion made by Bowie and Frampton (2004) that the wooden disc technique may be useful for monitoring rare species.

One rare carabid species not found during our monitoring but a single specimen was found by Butcher and Emberson (1981) at Ahuriri is an *Agonum* species which is thought to prefer damp habitats (Butcher and Emberson, 1981), which is supported by its presence in Hinewai Reserve (Ward et al. 1999). A specimen (12 mm) in the Lincoln University Entomological Museum was collected under stones on the Kennedys Bush Rd on the 10<sup>th</sup> of January 1973.

Another species not found during our monitoring or that of Butcher and Emberson (1981) was a *Pelodiaetus* sp. Johns (1986) records this pale, eyeless, minute (1.5 mm long) beetle as being found near Ahuriri Scenic Reserve in 1976. Two further specimens were collected by Johns (1986) from leaf litter samples on Mitchell’s Track in Sugarloaf Reserve. This very small carabid could easily have been overlooked under discs in the poor dappled light at the litter level.

The slightly later sampling time of December 2005 compared to 2004 and 2003 may be why diversity and numbers were down as Bowie and Frampton (2004) showed a seasonal influence on wooden disc colonisation. In addition, the weather preceding sampling could have several negative influences on the reproduction of beetles including carabids. Alternatively, a mild winter in 2005 followed by a good spring may have led to higher mouse numbers and therefore higher predation of carabids.

### *Spiders*

*Periegops suteri* has been found at a number of locations on Banks Peninsula including some Port hills reserves (Vink, 2006). *Periegops suteri* is found in mature forests with a deep leaf litter layer and well-drained soil. This species was not found in these surveys but could potentially appear under wooden discs if they were left for long enough as it is typically found under rocks and logs that are snugly fitted next to the soil (Vink, 2006).

All of the other spiders found are typical of the spider fauna of Banks Peninsula (e.g. Bowie et al. 2006).

### *Wooden discs vs pitfall traps*

The high percentage of exposed rock (30%) at the Orongomai site (Grove, 2005) may ‘compete’ with wooden discs as suitable refuges for some carabid species. This may mean that larger species, such as *Holcaspis suteri*, are more easily monitored or detected using pitfall traps at such sites. This and previous studies (Bowie and Sirvid, 2004; Bowie and Sirvid, 2005) appear to

corroborate this as *Holcaspis suteri* has not been collected under wooden discs previously at Orongomai, whereas 15 specimens were collected from five pitfall traps (see Appendix 2).

Table 2: Comparison of two carabid monitoring techniques

	<b>Pitfall traps</b>	<b>Wooden discs</b>
Advantages	Easy and convenient	Non-destructive method
	Cheap	Selective
	Standard ecological method	Standard area measured = density
	Collects wide range of taxa	Non-destructive method
	Can be used indefinitely	Snapshot in time
Disadvantages	Indiscriminant collector	Discs deteriorate over time
	Bias towards larger species	Wooden discs can differ
	Thick vege can reduce catches	Collects fewer taxa than pitfalls
	Measures degree of activity	Creates habitat, may alter density

There may be a need to use additional collection methods e.g. litter, Malaise trapping and pitfall trapping for species that are not picked up with wooden discs alone.

The discs are picking up the differences between the abundance and diversity of most carabids at the sites and are more closely related to population density than pitfall traps as they give a snapshot of fauna under a certain area of disc. By comparison, pitfall traps are a very rough measure of relative abundance as they rely on activity of carabids causing them to inadvertently fall into the cup of the trap. Depending on the duration of the trapping period, large numbers of invertebrates can be caught, particularly in the hotter summer months. Regardless of their disadvantages, Lang (2000) found carabids to be the only ground-dwelling invertebrate predators where pitfall traps catches were significantly correlated to density in two arable habitats.

#### *Motels*

Motels have given a measure of arboreal spider diversity at sites, but the poor species diversity and the low cohabitation rate (Bowie and Sirvid, 2005), leaves little potential for strong differences between sites to be displayed. Most spiders are hard to identify to species level without a microscope, making this method more time consuming than the wooden disc method.



## Summary

- Ahuriri and Coopers Knob were found to be considerably more diverse in terms of carabids, spiders and beetles than at Orongomai.
- Carabid and spider diversity was lower in 2005 than both 2004 and 2003 for all three sites. This may be due to the slightly later sampling time compared to the two previous surveys; mild winter weather (low mortality meaning more predacious mice); or some other climatic influence.
- Diversity of carabids caught in pitfall traps and under wooden discs gave similar trends between the sites.
- Numbers of carabids caught in pitfall traps was significantly more than under wooden discs.
- Both wooden discs and pitfall traps have their advantages and disadvantages, but both are more useful than motels.

## Recommendations

- A repeat of the Butcher and Emberson (1981) methodology would give an excellent comparison of carabid diversity and abundance at Ahuriri. This would give the best indication of how the Port Hills invertebrates 'shape up' since the survey 30 years ago.
- Use some additional sampling methods to try to pick up some of the harder to find species e.g. litter sample extraction for *Pelodiaetus* sp., hand searching for *Periegops suteri* under logs, *Agonum* sp. in damper areas, Malaise trapping for Staphylinidae and other smaller beetle species. This would contribute towards a Port Hills checklist of invertebrates. By knowing what rare and endangered species are present or absent will help to make future management decisions on their ecological restoration.
- Continue monitoring of invertebrates using existing methodology using motels and discs in 2008. This would allow time for any changes from predator control to show up in monitoring.

## Acknowledgements

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Table 4: Checklist of arthropod species found at ten reserves on the Port Hills in 2003-5 surveys

ORDER / Family	Common name	Species and locations found
<b>AMPHIPODA</b>	<b>Litter hoppers</b>	
Taltriciidae		? <i>Makawe hurleyi</i> (Duncan) <sup>AH,CK,CP,KB1,KB2,OR,OT1,OT2,SL1,SL2</sup>
<b>ANNELIDA</b>	<b>Earthworms</b>	
<b>TUBELLARIA</b>	<b>Flatworms</b>	
Geoplanidae		? ' <i>Newzealandia</i> ' sp. <sup>CK,CP,KB1,KB2,OR,OT1,SL1,SL2</sup>
<b>CHILOPODA</b>	<b>Centipedes</b>	
Henicopidae?		Unidentified species 1 <sup>AH,CK,CP,KB1,KB2,OT1,OT2,SL1,SL2</sup>
<b>COLLEMBOLA</b>	<b>Springtails</b>	
<b>Tomoceridae</b>		Unidentified species 1 <sup>AH,CK,CP,KB1,KB2,OR,OT1,OT2,SL1,SL2</sup>
<b>DIPLOPODA</b>	<b>Millipedes</b>	
Dalodesmidae		<i>Icosidesmus</i> sp.
<b>MOLLUSCA</b>	<b>Molluscs</b>	
Athoracophoridae	<b>Native slug</b>	? <i>Pseudaneitea</i> sp. <sup>AH,CK,KB1,KB2,SL2</sup>
Charopidae	<b>Native snail</b>	<i>Charopa pseudocoma</i> Suter. <sup>KB1,CP,CK,OR,OT2,SL1,OT2</sup> <i>Flammulina crebriflammis</i> (Pfeiffer) <sup>KB2</sup> <i>Flammulina perdata</i> (Hutton) <sup>OT2,SL1</sup> <i>Flammulina zebra</i> (Le Guillou) <sup>CK,CP,KB2,OT2,SL2</sup>
<b>OPILIONES</b>	<b>Harvestman</b>	
Triaenonychidae		? <i>Nuncia</i> sp. <sup>CK,KB1,KB2,OR,OT2,SL1,SL2</sup>
<b>TUBELLARIA</b>	<b>Flatworms</b>	
Geoplanidae		? ' <i>Newzealandia</i> ' sp. <sup>CP,CK,KB1,KB2,OR,OT1,SL1,SL2</sup>
<b>ARANEAE</b>	<b>Spiders</b>	
Araneidae		<i>Zealaranea crassa?</i> (Walckenaer) <sup>SL2</sup>
Agelenidae		<i>Neoramia janus</i> (Bryant) <sup>AH,CK,CP,KB1,KB2,OR</sup> <i>Neoramia setosa</i> (Bryant) <sup>AH,CK,CP,KB2,OR,OT1,OT2,SL1,SL2</sup> <i>Maniho ngaitahu</i> Forster and Wilton <sup>*SL1</sup> <i>Nuisiana arboris</i> (Marples) <sup>AH,CK,KB1,KB2,OT1,OT2,SL1,SL2</sup> <i>Porrhothele antipodiana</i> (Walckenaer) <sup>AH,CP,CK,OR,OT1</sup> <i>Misgolas ?borealis</i> (Forster) <sup>CP,OR,OT1,SL2</sup> Undescribed sp. <sup>SL1</sup>
Amphinectidae		<i>Cambridgea peelensis</i> Blest and Vink <sup>CP,OT2</sup>
Desidae		<i>Cambridgea quadromaculata</i> Blest and Taylor <sup>AH,CK,KB2,OR</sup>
Hexathelidae	<b>Tunnel web spiders</b>	<i>Theridion zantholabio</i> Urq. <sup>AH,CK,CP,KB1,KB2,OR,OT1,OT2,SL1,SL2</sup>
Idiopidae	<b>Trap door spider</b>	<i>Achaearanea veruculata</i> (Urquhart) <sup>KB2,OT1,SL1</sup>
Malkaridae		<i>Uliodon</i> sp. <sup>AH,KB1,OT2,SL1,SL2</sup>
Stiphidiidae	<b>Sheet web spiders</b>	
Theridiidae	<b>Cobweb spiders</b>	
Zoropsidae		
<b>COLEOPTERA</b>	<b>Beetles</b>	
Carabidae	<b>Ground beetles</b>	<i>Dicrochile atratus</i> (Blanchard) <sup>*KB1,OT2</sup> <i>Holcaspis angustula</i> (Chaudoir) <sup>AH,CK,OR,KB1</sup> <i>Holcaspis elongella</i> (White) <sup>AH,CK,OR,KB1,KB2,OT1,OT2</sup> <i>Holcaspis intermittans</i> (Chaudoir) <sup>AH,CK,CP,KB2,OT1,OT2</sup> <i>Holcaspis suteri</i> Broun <sup>*AH,CK,OR,CP,KB2,OT1,OT2</sup> <i>Lecanomerus latimanus</i> Bates <sup>KB1</sup> <i>Mecodema oregoides</i> (Broun) <sup>*AH,CK,CP,KB2,OT1</sup> <i>Megadromus antarcticus</i> (Chaudoir) <sup>AH,OR,KB2</sup> <i>Oopterus laevicollis</i> Bates <sup>*CK,KB1,SL1,SL2</sup> ' <i>Osmaseus</i> ' <i>pantomelas</i> Blanchard <sup>*CK</sup> <i>Selenochilus piceus</i> (Blanchard) <sup>*AH</sup> <i>Zabronothus striatulus</i> Broun <sup>*AH,CK,OT2,SL1,SL2</sup>
Cerambycidae	<b>Longhorn beetles</b>	<i>Coptomma sulcatum</i> (Fabricus) <sup>OR</sup>
Cerylonidae		? <i>Philothermus</i> sp. 1 <sup>AH,CK</sup> <i>Nodulosoma</i> sp. 1 <sup>CK</sup> <i>Nodulosoma</i> sp. 2 <sup>AH</sup> ? <i>Clambus</i> sp. <sup>CK</sup> <i>Ryzobius</i> sp. ? <i>Veronicobius</i> sp.
Clambidae		<i>Enicmus</i> sp. <sup>OR</sup>
Coccinellidae		Unidentified species 1 <sup>CK,OR</sup> Unidentified species 2 <sup>CK,OR</sup> Unidentified species 1 <sup>CK,OR</sup>
Corticariidae		<i>Pentarthrum</i> sp. <sup>OR</sup>
Corylophidae		Unidentified species 1 Unidentified species 2 Unidentified species 3 Unidentified species 4
Cryptophagidae	<b>Weevils</b>	
Curculionidae		

Histeridae	<b>Pill beetles</b>	? <i>Parepierus</i> sp. <sup>CP</sup>
Lathridiidae	<b>Mildew beetles</b>	<i>Aridius nodifera</i> (Westwood) <sup>AH,OR</sup> <i>Bicava</i> sp. <sup>AH,CK,OR</sup> <i>Lithostigmus</i> sp. <sup>CK</sup> <i>Metophthalmas</i> sp. <sup>OR</sup> <i>Paralissotes reticulatus</i> (Westwood) <sup>AH,CP,KB2</sup> <i>Hylobia ?plagiata</i> Broun <sup>CK</sup> Unidentified species 1 <sup>AH</sup> <i>Platypidia</i> sp. <sup>CK</sup> <i>Artystona wakefieldi</i> Bates <sup>OT1,SL1,OR,SL1,SL2</sup> <i>Zealandelium zealandicum</i> (Bates) <sup>CP</sup> Unidentified (larvae) <sup>AH,KB2,SL1</sup> Unidentified Pselaphinae <sup>AH,OR</sup> "Quedius" sp. <sup>AH</sup> Unidentified species 1 Unidentified species 2 Unidentified species 3 Unidentified species 4 <i>Pristoderus bakewelli</i> (Pascoe) <sup>CK,OR,OT1,SL2,AH,CP,KB1,KB2,OT2</sup>
Lucanidae	<b>Reticulate stag beetle</b>	
Melandryidae	<b>Hairy fungus beetles</b>	
Mycetophagidae	<b>Fruit beetles, sap beetles</b>	
Nitidulidae	<b>Darkling beetles</b>	
Tenebrionidae		
Scarabaeidae	<b>Grass grub</b>	
Staphylinidae	<b>Rove beetles</b>	
Zophoridae		
<b>DIPTERA</b>	<b>Flies</b>	Unidentified species
<b>HYMENOPTERA</b>	<b>Wasps, ants and termites</b>	
	<b>Ants</b>	Unidentified species
<b>LEPIDOPTERA</b>	<b>Moths and butterflies</b>	Unidentified species
<b>ORTHOPTERA</b>	<b>Weta, grasshoppers, etc</b>	
Anostostomatidae	<b>Canterbury tree weta</b>	<i>Hemideina femorata</i> (Hutton) <sup>OT1,SL2</sup>
Raphidophoridae	<b>Cave weta</b>	<i>Isoplectron calcaratum</i> Hutton <sup>OT2,SL1,SL2</sup>

\* Banks Peninsula endemic

AH = Ahuriri  
OR = Orongomai  
CK = Cooper's Knob  
OT = Otahuna  
SL = Sugarloaf  
CP = Cass Peak  
KB = Kennedys Bush

**Appendix 1: Species and numbers of spiders and large invertebrates collected in motels and pitfall traps from three Port Hills sites**

Species	MOTELS DEC 2005		
	AH	CK	OR
<b>Spiders</b>			
<i>Neoramia janus</i>	11	12	10
<i>Theridion zantholabio</i>	2		1
<i>Porrhothele antipodiana</i>	1	7	1
<i>Cambridgea quadromaculata</i>	1	1	
Unidentified spider sp.	1		1
<b>Beetles</b>			
<i>Artystona wakefieldi</i>			
Coccinellidae			
<i>Coptomma sulcatum</i>			
Curculionidae			
Staphylinidae			
<b>Miscellaneous</b>			
Native slug	3	6	6
Earwig			
Lepidoptera larvae			1
Cockroach			
<i>Flammulina perdata</i>			

**Key to reserves:**

**AH = Ahuriri**

**CK = Cooper's Knob**

**OR = Orongomai**



**Appendix 2: Species and number of invertebrates collected from wooden discs and Pitfall traps from three Port Hills sites**

Beetle taxa	DISCS DEC 2005				PITFALLS JAN 2006				DISCS JAN 2006		
	AH	CK	OR		AH	CK	OR		AH	CK	OR
<b>Carabidae</b>											
<i>Holcaspis angustula</i>	1	1				11			2	3	
<i>Holcaspis elongella</i>					2	5	1				
<i>Holcaspis intermittans</i>		1			3	8					
<i>Holcaspis suteri</i>	2	1			7	12	15		1		
<i>Mecodema oregoides</i>	2	4				5			3	3	
<i>Megadromus antarcticus</i>	1				1		1		2		
<i>Zabronothus striatulus</i>		1	2								1
<b>Cerambycidae</b>											
<i>Nodulosoma</i> sp. 1						2					
<i>Nodulosoma</i> sp. 2					1						
<b>Cerylonidae</b>											
? <i>Philothermus</i> sp.					1	2					
<b>Clambidae</b>											
? <i>Clambus</i> sp.						2					
<b>Corticariidae</b>											
<i>Aridius nodifera</i>					1		2				
<i>Bicava</i> sp.					1	1	3				
<i>Enicmus</i> sp.							1				
<i>Lithostigmus</i> sp.						1					
<i>Metophtalmas</i> sp.							1				
<b>Corylophidae</b>											
Species 1						1	1				
Species 2						3	5				
<b>Cryptophagidae</b>											
Species 1						5	2				
<b>Curculionidae</b>											
<i>Pentarthrum</i> sp.							1				
Curculionidae species 1	2					2	2				
Curculionidae species 2						2	2				
Curculionidae species 3						2					
Curculionidae species 4					1	1					
<b>Lucanidae</b>											
<i>Paralissotes reticulatus</i>	1										
<b>Melandryidae</b>											
<i>Hylobia</i> ? <i>plagiata</i>						1					
<b>Mycetophagidae</b>											
Species 1					1						
<b>Nitidulidae</b>											
<i>Platypidia</i> sp.						1					
<b>Scarabiidae</b>											
Species 1	1										
<b>Scydmaenidae</b>											
Species 1						1	3				
<b>Staphylinidae</b>					2						
Pselaphinae species 1					1		1				
Species 1							1				
Species 2					1	3					
Species 3					1						
<b>Zopheridae</b>											
<i>Pristoderus bakewelli</i>						1					
<i>Tarphiomimus</i> sp.					1						
Species 1					1						

<b>Miscellaneous</b>									
Native slug									
Native Snail	2	1							
<i>Charopa pseudocoma</i>									
<i>Flammulina crebriflammis</i>									
<i>Flammulina perditia</i>									
<i>Flammulina zebra</i>									
Chilopoda (centipede)	2								
Diplopoda (millipede)	6	10	6						
Amphipoda (Taltriciidae)		1							
Native opiliones	3								
Tubellaria (flatworms)	2	2	2						
Annelida (earthworms)	12	1	1						
Hemiptera						1			
Dipteran larva	1	5	4						
Bumble bee					1				
<b>Spiders</b>									
Malkaridae undescribed sp.									
<i>Maniho ngaitahu</i>									
<i>Misgolas</i> sp. (Trapdoor)									
<i>Porrhothele antipodiana</i>	3	1	1						
Theridiidae									
<i>Uliodon</i> sp. (Zoropsidae)									
Unidentified spiders		2	1						

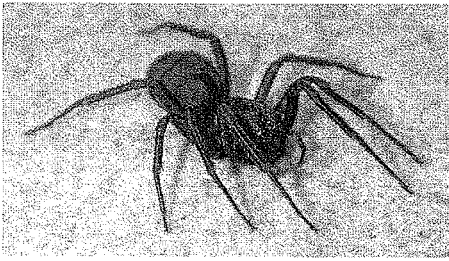
**Key to reserves:**

**AH = Ahuriri**

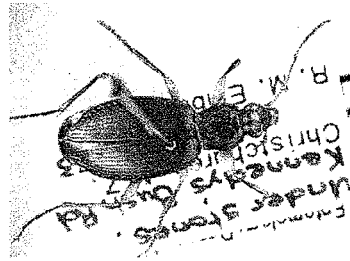
**OR = Orongomai**

**CK = Cooper's Knob**

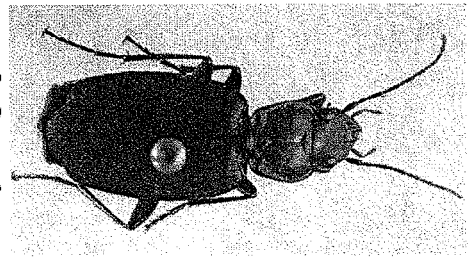
**Appendix 3: Identification guide to significant invertebrates of the Port Hills reserves**



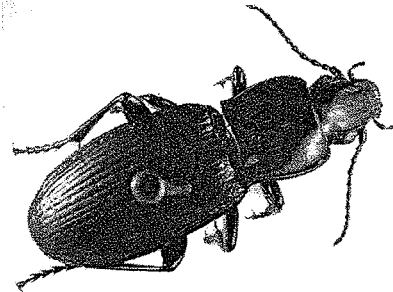
*Periegops suteri* (8 mm)



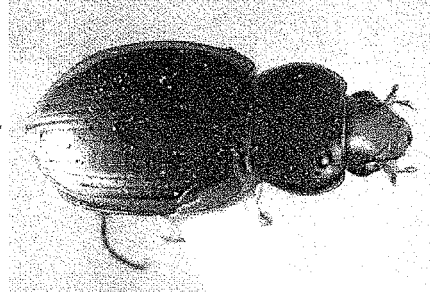
*Agonum* sp. (11 mm)



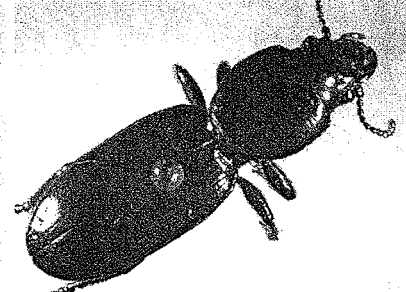
*Dicrochile atratus* (12 mm)



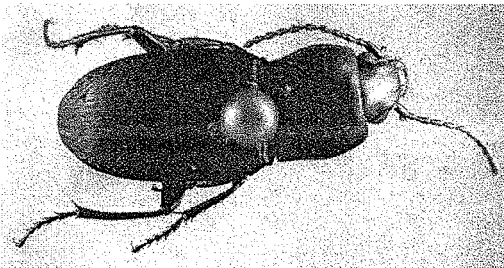
*Holcaspis suteri* (15 mm)



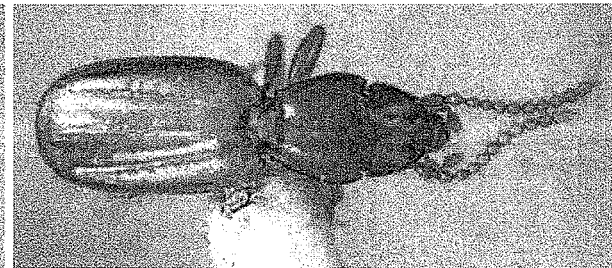
*Lecanomerus latimanus* (6 mm)



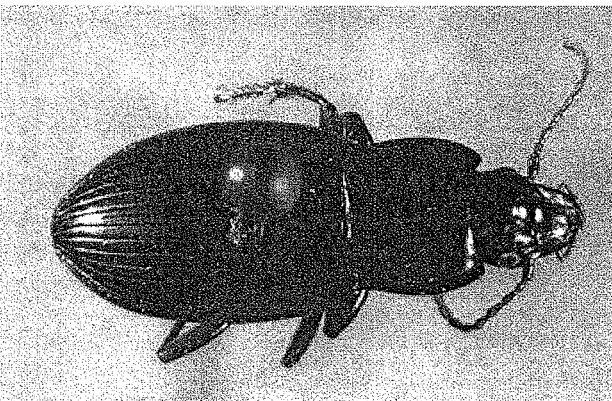
*Mecodema oregoide* (17 mm)



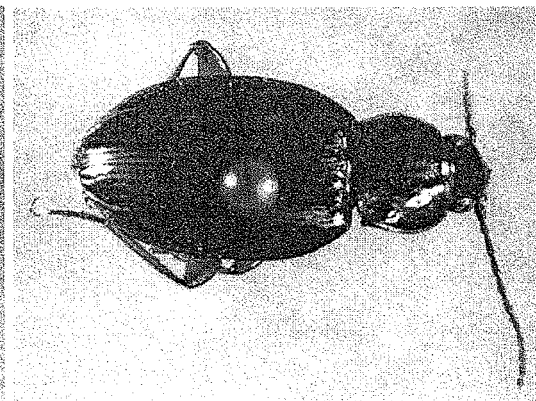
*Oopterus laevicollis* (6 mm)



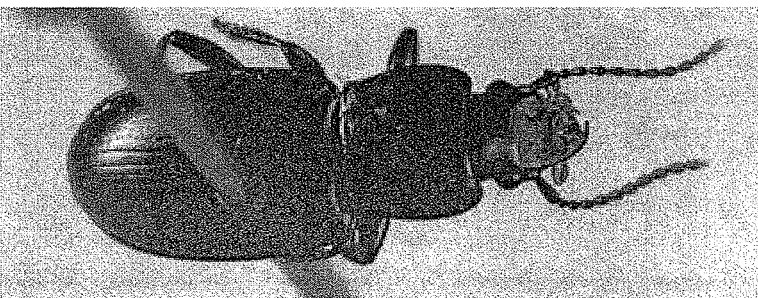
*Pelodiaetus* sp. (1.5 mm)



*Zabronothus striatulus* (8 mm)



"Argutor" ("Osmaseus") *pantomelus* (8 mm)



*Selenochilus piceus* (6 mm)