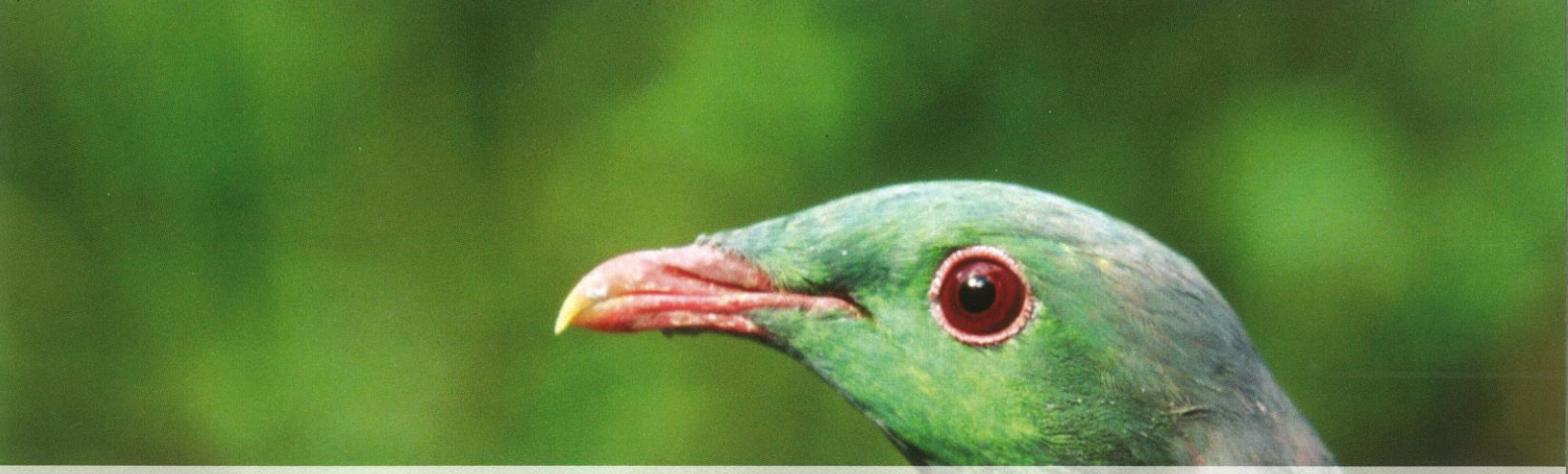

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by

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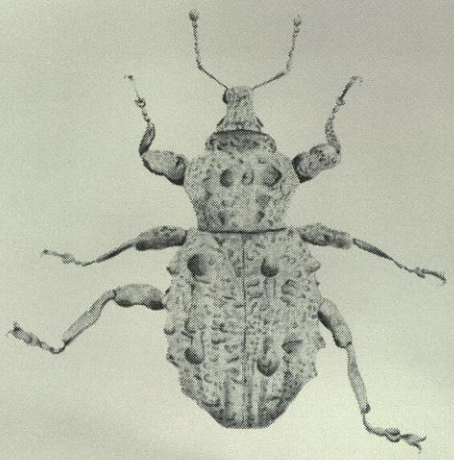

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Conservation and biology of the rediscovered nationally endangered Canterbury knobbled weevil, *Hadramphus tuberculatus*

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Abstract

Three areas near Burkes Pass Scenic Reserve were surveyed for the presence of *Hadramphus tuberculatus*, a recently rediscovered endangered weevil. The reserve itself was resurveyed to expand on a 2005/2006 survey. Non-lethal pitfall traps and mark and recapture methods were used. Six *H. tuberculatus* were caught in pitfall traps over 800 trap nights. Day and night searching of *Aciphylla aurea* was conducted. Four specimens were observed on *Aciphylla* flowers between 9 am and 1.30 pm within the reserve. No specimens were found outside of the reserve by either method. Other possible locations where *H. tuberculatus* may be found were identified and some visited. At most locations *Aciphylla* had already finished flowering, no *H. tuberculatus* were found. Presence of *H. tuberculatus* at other sites would be best determined by searching of *Aciphylla* flowers during the morning from late October onwards.

Introduction

Hadramphus tuberculatus belongs to a small genus of large, nocturnal flightless weevils (Craw 1999). The protected fauna list in the Seventh Schedule of the Wildlife Amendment Act 1980, included *Hadramphus tuberculatus* (Craw 1999) and it was identified as one of the highest priorities for conservation action in Canterbury by Pawson and Emberson (2000). The last specimen was collected in 1922 and *H. tuberculatus* was presumed extinct (Craw 1999), until a recent discovery of a specimen at Burkes Pass Scenic Reserve in 2004 by a Masters student (Young 2006). This rediscovery has been likened to the insect version of rediscovering the takahe by Dr Geoffrey Orbell in 1948.

Hadramphus tuberculatus is easily identified due to its large size (11.7-16.3 mm long and 6.5-8.3 mm wide), dark grey to brown colour and distinctive triangular or rounded tubercles on its sides and back (Craw 1999). Species of this genus tend to be closely associated with a specific plant, in *H. tuberculatus's* case its host plant was thought to be *Aciphylla glaucenscens* or *Aciphylla subflabellata* (Craw 1999). However, those found at Burkes Pass are on *Aciphylla aurea* (Johns 2006). *H. tuberculatus* is a lowland species (Craw 1999); specimens in collections and Holocene fossils indicate it was once common over the Canterbury plains, foothills and fringing ranges where *Aciphylla* species were widespread (Kuschel and Worthy 1996, Craw 1999). The distribution of *H. tuberculatus* from known specimens extended from Oxford in North Canterbury to Waimate in South Canterbury, with the western and eastern limits at Mt Oakden and Christchurch respectively (Craw 1999). It was referred to as the Banks Peninsula speargrass weevil by Sherley (1990). However, no known specimens were collected there (McGuinness 2001) and it was not found in a survey of Banks Peninsula arthropods (Johns 1986).

Hadramphus tuberculatus is one of many invertebrate species which have been unable to cope with radical changes since human settlement (Pawson and Emberson 2000). Although native birds, such as weka, takahe, laughing owl, kakapo and kiwi, are natural predators of large weevils, they are not a feasible cause of the decline in *H. tuberculatus* as this only occurred in recent times (Kuschel and Worthy 1996). Instead the range reduction of *H. tuberculatus* is likely to have resulted from two main factors: destruction and degradation of *Aciphylla* habitat and introduced animals. Native grasslands, once suitable habitat for H.

tuberculatus, were changed by burning and cultivation for agriculture. *Aciphylla*, the spiky, tenacious host plant of *H. tuberculatus*, is considered a weed by many farmers and was cleared by large-scale repetitive burning of grasslands (Kuschel and Worthy 1996). Browsing by introduced herbivorous animals, such as sheep, has reduced the size and extent of *Aciphylla* populations (Kuschel and Worthy 1996, Craw 1999). Introduced predators, such as mice, rats and hedgehogs, prey on weevils due to their large size, and have been instrumental in the decline in population size and geographical range of numerous large lowland weevil species in New Zealand (Kuschel and Worthy 1996, Craw 1999).

A number of studies are worth noting; Kuschel and Worthy (1996) studied Holocene fossil remains of large weevils which were found in caves, rock crevices and under ledges in Canterbury. These included *H. tuberculatus* remains, with a minimum total of 23 individuals found. These findings are noteworthy as they indicate historical distributions were significantly larger than present, and that *H. tuberculatus* was common in Canterbury prior to its discovery (Kuschel and Worthy 1996). Katrin Schöps (1998) studied *Hadramphus spinipennis* which is found on the Chatham Islands and also has a species of *Aciphylla* as its host plant. A comprehensive study was conducted on the population dynamics and behaviour of *H. spinipennis* in relation to its host plant *Aciphylla dieffenbachii*. This is useful as the behaviour and ecology of the two related species is likely to be similar. Laura Young (2006) provided an insight into masting and insect pollination of *Hadramphus tuberculatus'* host plant *Aciphylla aurea*.A survey of *Hadramphus tuberculatus* was conducted by Peter Johns during the summer of 2005-2006 at Burkes Pass Scenic Reserve (Johns 2006). Over 225 trap nights nine *H. tuberculatus* were caught, these specimens were released but not marked. Johns (2006) recommended ascertaining the presence of *H. tuberculatus* at other possible distant sites.

The aims of this study were to: (1) expand on the 2005-2006 survey conducted by Peter Johns at Burkes Pass by resurveying the area within Burkes Pass Scenic Reserve and survey areas near the reserve which have high concentrations of *Aciphylla aurea* to determine the presence of *Hadramphus tuberculatus* in these areas; (2) establish population size and viability; (3) gather any information on the behaviour and ecology of *H. tuberculatus*; and (4) identify other possible locations where *H. tuberculatus* may be found.

Methods

Study areas

Four study areas were identified, one within the Burkes Pass Scenic Reserve and three in close proximity to the reserve.

1. Burkes Pass Scenic Reserve (BP1)

The Burkes Pass Scenic Reserve is bordered by State Highway 8 (Figure 1) and is administered by the Department of Conservation. It is thought there have been no fires in recent times (Johns 2006). Vegetation within the reserve is dominantly *Aciphylla aurea*, *Discaria toumatou*, *Chionochloa* grass, exotic grasses and Russell lupins. In the central proportion of the reserve, where *A. aurea* is most abundant, a grid of 20 non-lethal pitfall traps was established. The traps were organised in four trap lines, at intervals of 50 m, perpendicular to the road. Traps within trap lines were spaced at 20 m intervals.

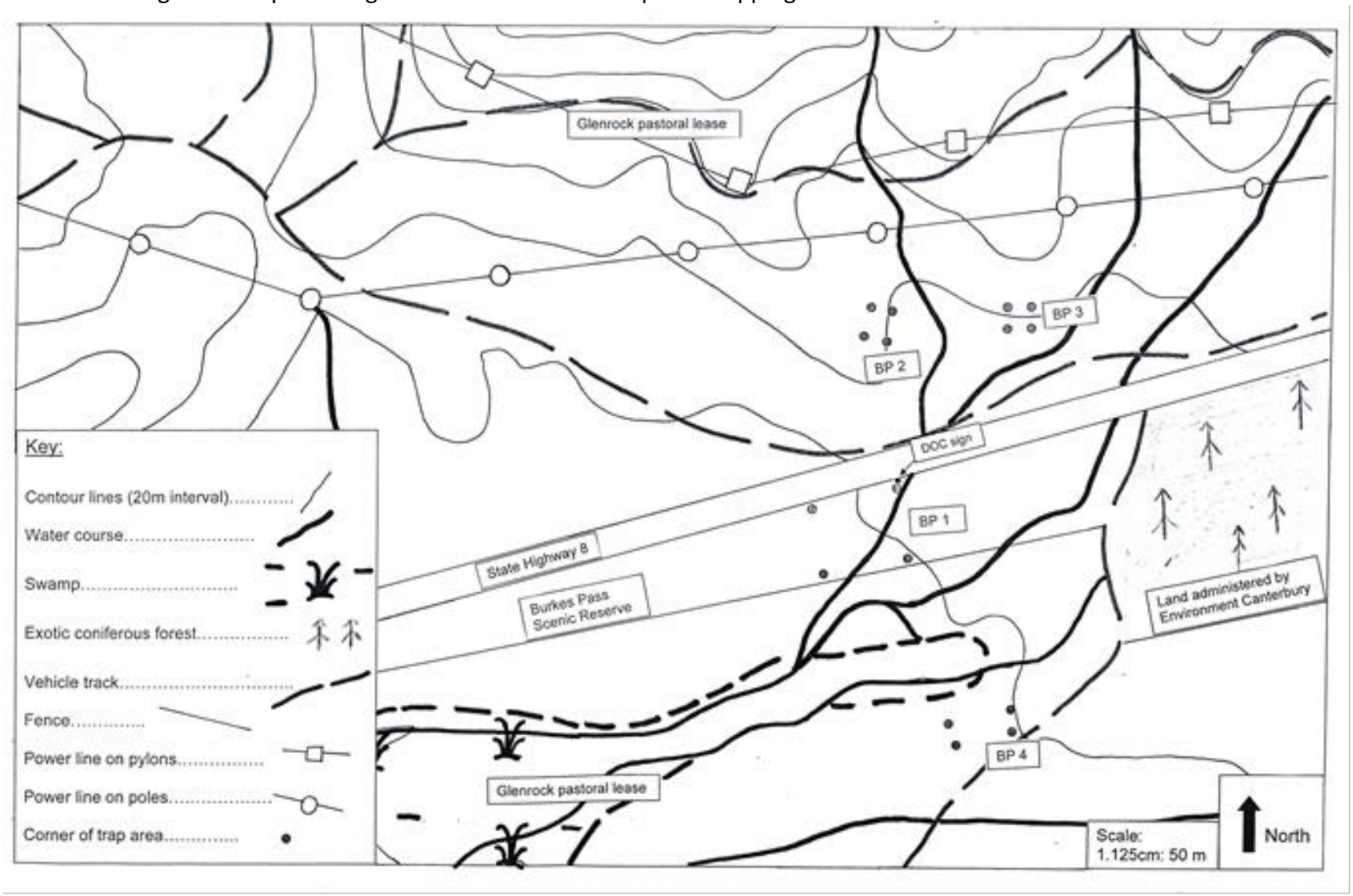
2. Pastoral Lease north of the highway (BP2 & BP3)

Two areas with high concentrations of *A. aurea* were identified on Glenrock pastoral lease, north of the highway (Figure 1). Both of these areas are grazed by sheep. Vegetation is dominated by exotic grasses with *D. toumatou*, *A. aurea* and *Chionochloa* grass. Due to the smaller size of the *Aciphylla* patches compared to the reserve, the traps were placed closer together. At each area four trap lines were spaced at 10 m intervals with traps spaced at 5 m intervals within each line, totally 20 traps at each area. Both of these areas were on hill sides, BP2 with a south-easterly aspect and BP3 with a southerly aspect.

3. Pastoral Lease behind the pine trees (BP4)

Another area of *A. aurea* was identified south of the reserve on Glenrock pastoral lease (Figure 1). Both sheep and cattle graze this area. The dominant vegetation is *D. toumatou* with exotic grasses, *A. aurea*, and *Chionochloa* grass. As the area of *A. aurea* is long and narrow, the 20 traps were placed in two trap lines 50 m apart. Traps within each trap line were spaced at 10 m intervals.

Figure 1: Map showing the locations of the four pitfall trapping areas at Burkes Pass.



Sampling methods

Non-lethal pitfall traps were constructed using 1.5 L soft drink bottles, these were washed and the tops were cut off and inverted to form funnels. Small holes were drilled in the bottom of each trap to ensure trap contents did not drown. A soil corer made holes of the correct diameter for the traps. Pitfall traps were left overnight and checked the following morning after they had been set. Skinks were released and other invertebrates recorded. Any *H. tuberculatus* caught were sexed, measured and marked using acrylic paint and then released back into the closest *Aciphylla* to the pitfall trap. Measurements were taken of length (excluding rostrum) and width at the widest point using callipers. Weevils were marked initially with white dots (Figure 2), weevils one to five, and then white numbers for weevils six to ten. Details of the weather were recorded during visits (Appendix 5) and a Hobo® data logger was left out within the reserve (row 1, trap C) during the experimental period to take hourly recordings of light levels, air temperature, soil temperature and relative humidity. Traps were inverted in the holes between visits. During the day visual checks were made for adult *H. tuberculatus* feeding on *Aciphylla* flower spikes. Visual checks were also conducted at night between 9 and 11 pm. On finding *H. tuberculatus*, wind speed and direction, temperature and relative humidity were recorded using an anemometer. Each weevil was observed before being sexed, measured, marked and released back onto the plant.

Within the reserve, composition sketches were made of the vegetation in a five metre radius around each trap (Appendix 2). These were used to construct percentages of *Aciphylla* cover. At all study sites it was noted if any *Aciphylla* were flowering in close proximity to each trap. Due to the small data set, no statistical tests were available. Results are descriptive only. Other possible locations where *H. tuberculatus* may be found were identified using historical records and high concentrations of *A. aurea, A. subflabellata* and *A. glaucenscens*.

Figure 2: *Hadramphus* number three after being marked with white acrylic dots. This weevil was seen on five separate occasions moving about on an *Aciphylla* flower spike.

Figure 3: *Hadramphus* number four with pollen and flower parts stuck to its mouthparts and one tarsus.

Figure 4: *Aciphylla aurea* flower spike at E 2316455, N 5676730. Three different *H. tuberculatus* were observed on this flower spike.

Results

Pitfall trap results

Hadramphus tuberculatus

Including all four of the study areas, over 800 trap nights, six *Hadramphus tuberculatus* were caught in pitfall traps. All specimens were caught in four traps within Burkes Pass Scenic Reserve (Table 1*)*. Only one weevil was caught at a time in a particular trap and no weevil was caught more than once. The *Aciphylla* plants surrounding successful pitfall traps were checked for signs of grazing, but nothing notable could be attributed to *Hadramphus* feeding damage. No flowering *Aciphylla* were within 5 m from any of the successful traps.

Table 1: *Hadramphus tuberculatus* caught in pitfall traps within Burkes Pass Scenic Reserve.

Trap (row and position)	Dates with specimen*	Specimen I.D number	Size	Sex
1b	15/12/06	6	17 X 6 mm	female
3b	17/01/07	7	15 X 8mm	female?
4a	17/01/07	9	14 X 7 mm	female?
4c	21/11/06	2	---	---
4c	17/01/07	8	17 X 6 mm	male
4c	23/01/07	10	11.5 X 6 mm	male

*date the pitfall trap was emptied

Other species

Predominant invertebrates found in pitfall traps were Opiliones, *Anoteropsis hilaris*, tipulid flies, collembolans, juvenile crickets (*Bobilla* sp.) and weta - both a new species of *Hemiandrus,* and *Weta thomsoni* which has not been previously found at this location. A full list of invertebrates can be found in the appendix (Appendix 1). Large numbers of skinks were caught on sunny days.

Vegetation composition

The vegetation composition in a 5 m radius around each trap within the reserve is shown in appendix 2. No statistical analysis can be preformed; but successful traps had greater than 1.9 m^2 of *Aciphylla aurea* (Table 2). *Aciphylla* plants were also in close proximity, less than 50 cm, to successful traps.

Table 2: Area of *Aciphylla aurea* within a 5 m radius of pitfall traps within the Burkes Pass Scenic Reserve, and the number of *Hadramphus tuberculatus* caught.

Trap	**Area of *Aciphylla aurea* around trap (m^2)**	**Number of *H. tuberculatus* caught**
1a	0.283	0
1b	1.979	1
1c	5.089	0
1d	2.121	0
1e	2.403	0
2a	2.969	0
2b	5.655	0
2c	3.110	0
2d	2.969	0
2e	0.141	0
3a	4.807	0
3b	2.545	1
3c	0.990	0
3d	1.979	0
3e	1.131	0
4a	2.403	1
4b	4.5243	0
4c	3.252	3
4d	2.686	0
4e	0.565	0

Hadramphus tuberculatus on *Aciphylla* flowers

Four *H. tuberculatus* were observed during day searching of *Aciphylla aurea* flower spikes within the reserve (Figure 4). Some of these weevils were seen on more than one occasion (Table 3). All were recorded on male flower spikes only, and they tended to be on the shady side of the flower spike. *H. tuberculatus* were only observed on fine days between 9 am and 1.30 pm (Table 3). The weevils appeared to be feeding on *Aciphylla* pollen and this was seen attached to mouth parts and tarsi (Figure 3). They appear to be clumsy movers, frequently falling off when moving about the flower spike. When disturbed they drop suddenly to the base of the plant. The lack of abundance means that statistical analysis of *H. tuberculatus* appearances can not be done. No *H. tuberculatus* were observed on *Aciphylla* flower spikes outside of the reserve

Table 3: *Hadramphus tuberculatus* observations on *Aciphylla aurea* flower spikes at Burkes Pass.

***Hadramphus tuberculatus* ID number**	**Date**	**Time**	**Location**	**Ambient air temperature (°C)**	**Average wind speed and direction (km/hr)**	**Wind chill (°C)**	**Relative humidity (%)**	**Notes**
1	21/11/06	10.30 am	E 2316455 N 5676730	21.6	5 E	X	52.5	Moving between clumps of flowers on the spike and appeared to be feeding on flowers.
1	14/12/06	11.23 am	E 2316455 N 5676730	14.5	8.7 NE	12.3	64.5	Feeding on the freshest flowers at flower spike base on shady side of plant. Not handled but seemed to have been disturbed, perhaps by peoples' shadows. Dropped off to base of plant.
3	6/12/06	11.05 am	E 2316455 N 5676730	21.8	2.1 E	21.0	66	Feeding on flowers.
3	7/12/06	9.00 am	E 2316455 N 5676730	19	10 NW	18.8	34.5	At base of plant moving slowly on the leaves, fell to base of plant whilst trying to reach leaf blade.
3	7/12/06	10.40 am	E 2316455 N 5676730	18.9	10.4 NW	18.6	28.3	Still visible, moved around and up plant onto flowers. At 10.50 am at base of plant, not visible 12 pm.
3	14/12/06	1.15 pm	E 2316455 N 5676730	15.0	8.6 NE	13.9	61	Feeding on freshest flowers at base of the flower spike (shaded side) then walked down to base of plant. Flower spike old with few 'fresh' flowers at the base. Disappeared from view at base of plant 1.30 pm.
3	15/12/06	12.10 pm	E 2316455 N 5676730	16.5	13.5NE	15.2	69.2	Disappeared at from view at 1.14 pm.
4	7/12/06	9.30 am	E 2316468 N 5676653	21.0	11.3 NW	19.2	26.7	Feeding on open flowers at base of flower spike on shaded side. Appeared to be feeding on pollen. Had pollen/flower parts stuck to mouthparts and one tarsus. When released it headed back down the flower spike. Rechecked at 10.50 am, not visible.
5	14/12/06	11.46 am	E 2316484 N 5676725	14.4	13.0 NE	12.7	65.7	Right hand flower spike of two flower spikes. Walked up leaves next to flower spike near base, then down the sharp bracts onto fresh flowers. Appeared to be feeding on the pollen 11.46 am.

Sex ratio

Through examination of *H. tuberculatus* specimens in the Canterbury museum (Johns, pers. comm. 2006), use of Schöps (1998), and examination of *Hadramphus spinipennis* specimens in the Lincoln University collection, it was determined that the sexing of *H. tuberculatus* is similar to that of *H. spinipennis* using external morphological features. Males have a concave dip in the end of the last sternite with two tufts of long bristles on either side; in contrast the last sternite of females is rounded and has two tufts of shorter bristles. However, without dissection this method of sexing cannot be absolute. An estimate of the sex ratio can be given as 5 males to 3 females (Table 4). This estimate is rough as initial specimens were not sexed due to a lack of information on sexing *H. tuberculatus*, it is harder to give a positive identification of females and some difficulties were experienced in the field. Females tended to be wider than males (Table 4).

Table 4: *Hadramphus tuberculatus* size and sex

***H. tuberculatus* Identification number**	**Length (excluding rostrum)**	**Width (widest point)**	**Sex**
1	X	X	male?
2	X	X	male?
3	11 mm*	X	?
4	15 mm	7 mm	?
5	11 mm	6 mm	male
6	17 mm	8 mm	female
7	15 mm	8 mm	female?
8	17 mm	6 mm	male
9	14 mm	7 mm	female?
10	11.5 mm	6 mm	male

* Size estimated from pictures

Population size estimate

H. tuberculatus numbers provided by this study are too low to give a meaningful estimate of population size.

Location of specimens within the reserve

H. tuberculatus specimens, trapped and on flower spikes, were scattered around the study area in the reserve (Figure 1). They were trapped in the outer most rows, one and four, and also in the third row in the front half of the reserve. Visual observations on flower spikes were mostly towards the front of the reserve near the road and on the eastern side of the trapping area. However, few male flowers were flowering near row four where most specimens were trapped.

Other locations

Potential future searching sites for *H. tuberculatus* are listed in Appendix 3. Some locations were searched for *H. tuberculatus*: Banks Peninsula (Mt Evans, Mt Sinclair, and Ellangowan), Hakataramea Pass, MacKenzie Pass and Mt Oakden. Most sites had finished flowering at the time of visitation and no *Hadramphus* were found at any location. However, this does not mean that *H. tuberculatus* are not present. Feeding damage on *Aciphylla* leaves was observed at all locations, but nothing was obviously caused by *H. tuberculatus*. Lepidopteran larvae feeding damage was prominent causing significant damage to central leaf rosettes and fresh flower stalks, often with large holes (1 cm diameter) and decay. Damage caused by another large speargrass weevil, *Lyperobius*, was prominent at Hakateramea Pass. *Lyperobius* cause notching of leave edges and white sap is evident on *Aciphylla* leaves.

Discussion

Johns (2006) caught nine specimens in pitfall traps compared to our six. There may be several reasons for this difference. Firstly, it could be a numerical phenomenon: more traps equals more weevils caught. Johns (2006) had more trap nights within the reserve, 225 trap nights compared to 200 in this study. Secondly, it could be a time phenomenon: the longer

traps remain open the more chance of weevils being caught. Johns (2006) conducted trapping over two consecutive nights, so traps were left open for longer periods of time, including during the day. The majority of trapping during this study was conducted over one night only, and not for a full twenty-four hours. Over night trapping was conducted on the information that members of the *Hadramphus* genus are nocturnal (Craw 1999). However, appearances of *H. tuberculatus* on flower spikes were only noted during the day, although night searching was conducted. This indicates that *H. tuberculatus* may not be nocturnal; as weevil movement also occurs during the day. Finally, it could be due to the trap period in relation to weevil movement. This study trapped from the end of November through to the end of January with mostly one trap night per week, with a three week gap over Christmas (all trap dates are in Appendix 5). At the start of the trapping period *Aciphylla* within the reserve were flowering. In contrast Peter started trapping when all *Aciphylla* had ceased flowering (Johns, pers. comm. 2006) in mid December through to the start of February. After flowering had ceased weevils caught in pitfall traps increased, it may be that weevil movement between *Aciphylla* plants increases after flowering. It should be noted however that Peter Johns did not mark captured *H. tuberculatus*, so the same weevil may have been caught more than once.

H. tuberculatus was only found within Burkes Pass Scenic Reserve. This is most likely due to the history of the area. The reserve has been free from grazing by sheep and cattle and it is thought there have been no fires within the reserve since at least 1950 (Johns 2006). In contrast, the surrounding Glenrock pastoral lease has a history of grazing by both cattle and sheep combined with fire used to clear *Aciphylla*. Grazing and fire significantly reduce *Aciphylla* habitat with major consequences for flightless weevils (Kuschel and Worthy 1996).

Lifecycle and behaviour

As *Hadramphus spinipennis* and *Hadramphus tuberculatus* belong to the same genus and share *Aciphylla* as their host plant their biology is likely to be similar. The life cycle of *H. tuberculatus* is expected to be comparable to that of *H. spinipennis*. Female *H. spinipennis* oviposit eggs singly in the soil. The eggs develop into larvae which live in the soil and feed on *Aciphylla* roots. It is thought they have approximately five larval instars before pupating into

the adult form. From September to April/May mating of adults and subsequent oviposition occur (Schöps 1998).

Schöps (1998) observed that significantly more *H. spinipennis* were found on male plants than on female plants, with female weevils occurring more often than males on flowers. This is similar to Young's (2006) findings that on average male inflorescences received a much greater number of insect visitors. In this study *H. tuberculatus* was only found on male plants. It is thought that male inflorescences produce both nectar and pollen whereas females only produce nectar; thereby males offer more of a reward to insect pollinators (Young 2006). There was no evidence of a sex bias for *H. tuberculatus* found on male *Aciphylla* flowers (2 males and two unknown) due to a lack of data. A bias towards females would be expected as pollen is amino acid rich; amino acids are required for oogenesis (Schöps 1998).

Threats to the population

Threats to the population at Burkes Pass include predators and habitat modification by invasive species. During this study trapping was conducted by Target Pest on behalf on Environment Canterbury (ECAN). Trapping was conducted in the reserve and on the land surrounding the reserve. Hedgehogs were the main predator caught by Target Pest, along with one ferret. Hedgehogs are insectivorous and pose a major risk to *H. tuberculatus*. Trapping was also conducted for mice and rats, neither were caught. Skink and mouse predation experiments conducted by Schöps indicated that mice ate *Hadramphus spinipennis* whereas skinks did not (Emberson pers. comm. 2006). As *H. spinipennis* and *H. tuberculatus* are a similar size it is unlikely that skinks predate on *H. tuberculatus*. Invasive species are changing the habitat at Burkes Pass. Invasive Russell lupins are spreading through the reserve, especially near the state highway, down the two stream banks and at the eastern end of the reserve where there is a farm track (Figure 1). These lupins need to be eradicated to prevent further spread and stop them from excluding *H. tuberculatus'* host plant *Aciphylla.* Wilding pines are also a problem, entering the reserve from the ECAN forestry block and from the shelter belt which runs along the south side of the reserve (Figure 1).

Recommendations

It is recommended that a further survey is conducted from approximately late October 2007 through to January 2008 at Burkes Pass. Pitfall traps ought to be left open for a full twenty-four hours and ideally over two consecutive nights. In addition to trapping, searches of *Aciphylla* flowers should be conducted, in particular male flowers when they are at their freshest, however female flowers should not be ignored. Both day and night searches should be conducted to determine whether *H. tuberculatus* is indeed not nocturnal. Searching should be concentrated in the morning and early afternoon to find maximum numbers. It would be useful to either observe or video, using several cameras, *H. tuberculatus* specimens to determine behaviour. Mark and recapture methods are recommended for specimens caught by both methods.

Other possible locations (Appendix 3) should be searched during *Aciphylla* flowering. Because there are such low numbers of *H. tuberculatus* it is unlikely that grazing damage is likely to be as apparent as that associated with high numbers of *H. spinipennis* (Emberson et al. 1996). Therefore, searching should focus on *Aciphylla* flower spikes in particular searching male flowers during the morning. This method is a relatively easy method of finding *H. tuberculatus* compared to pitfall trapping. Possible areas should be prioritized according to time of flowering. *Aciphylla* flowering is not consistent due to proximate causes of masting, such as weather and resources (Young 2006). Young (2006) identified *A. aurea* flowering to begin from early to mid December at montane altitudes, however *Aciphylla* flowering at Burkes Pass was well under way by late November. Flowering seems to depend on altitude with *Aciphylla* at higher altitudes flowering later. As *H. tuberculatus* is thought to be a lowland species and share the same host plant as *Lyperobius* it is likely that an altitudinal portioning of niches occurs, with *Lyperobius* found at higher altitudes and *Hadramphus* found at lower altitudes. It would be ideal to have several groups searching different areas at the same time as *Aciphylla* flowering is short-lived. Priority should be given to areas which have experienced little habitat modification and areas near Burkes Pass, in particular Mackenzie Pass, Hakateramea Pass and the Hunter Hills.

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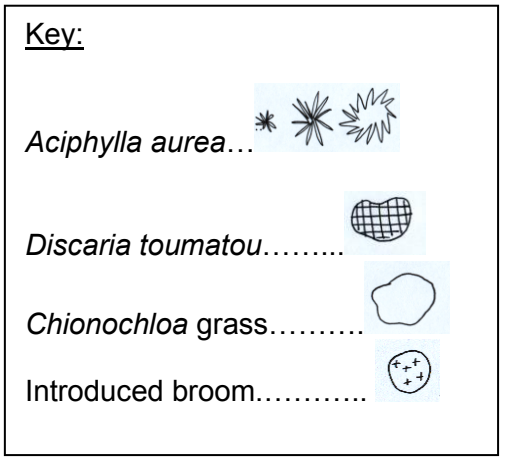
APPENDICES

1. INVERTEBRATE SPECIES COLLECTED FROM BURKES PASS

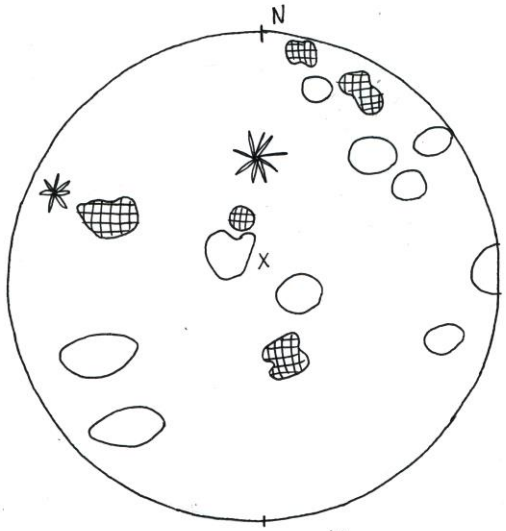
Order	Family	Genera/species	Notes
Orthoptera	Anostostomatidae	*Hemiandrus* n. sp.	New species
		Hemideina maori	
	Rhaphidophoridae	*Weta thomsoni*	First time found at this location
	Acrididae	*Phaulacridium marginale*	
		Sigaus sp.	
	Tettigoniidae	*Conocephalus* sp.	
	Gryllidae	*Bobilla* sp.	Many juveniles were found
Hemiptera	Lygaeidae	*Rhypodes* sp.	
	Nabidae	*Nabis* sp.	
Homoptera	Deltacephalinidae	unknown	
Coleoptera	Scarabaeidae	*Prodontria* sp.	
		Odontria sp.	
		Costelytra zealandica	
		Pyronota festiva	
	Carabidae	*Oregus aereus*	
		Holcaspis angustula	
		Mecodema sculpturatum or *bri*	
		Mecodema auralis?	
		Megadromus n. sp.	
	Curculionidae	*Hadramphus tuberculatus*	
		Many unidentified species	
	Chrysomelidae	unknown	
	Ulodidae	unknown	
	Elateridae	*Conoderus exsul*	
	Staphylinidae	*Stenomalium* n. sp.	
	Anthicidae	unknown	
	Melyridae	*Dasytes* sp.	
	Oedemeridae	unknown	
Diptera	Tachinidae	unknown	
	Tipulidae	*Leptotarsus* cf. *mesocerus*	
		Ostrotipula? sp.	
	Nematoceridae	unknown	
	Asilidae	*Neoitamus melanopogon*	
	Tachinidae	unknown	several species
	Bibionidae	unknown	
	Stratiomyidae	unknown	
	Syrphidae	unknown	
	Tephritidae	unknown	
	Ephydridae	unknown	
	Calliphoridae	unknown	
	Muscidae	unknown	several species

	Sapromyzidae	*Poecilohetaerella bilineata*	common
Hymenoptera	Formicidae	*Monomorium antarticum*	
		Monomorium smithi	
	Pompilidae	*Priocnemis* sp.	
	Halictidae	*Lasioglossum sordidum*	
	Apidae	*Bombus terrestris*	
Blattodea	Blattidae	*Celatoblatta* sp.	
Lepidoptera	Hepialidae	unknown	
	Crambidae	*Orocrambus* sp.	
	Pyralidae	unknown	
Chilopoda			
Diplopoda	Dalodesmidae	unknown	
Actinedida	Acari	unknown	red spider mite
Opiliones	Laniatores	*Nuncia* sp.	
		Hendea?	
	Palpatores	*Megalopsalis* sp.	
Araneae	Lycosidae	*Anoteropsis hilaris*	
		Allotrochsina schausilandi?	
	Tetragnathidae	unknown	
	Clubionidae	unknown	
	Agelenidae	*Neoramia* sp.	
	Salticidae	unknown	
	Mygalomorphidae	*Aparoa* sp?	
	Pisuaridae	*Dolomedes minor*	

2. THE VEGETATION COMPOSITION IN A 5 M RADIUS AROUND EACH PITFALL TRAP WITHIN BURKES PASS SCENIC RESERVE



Scale: The radius of each circle is equal to 5 m.



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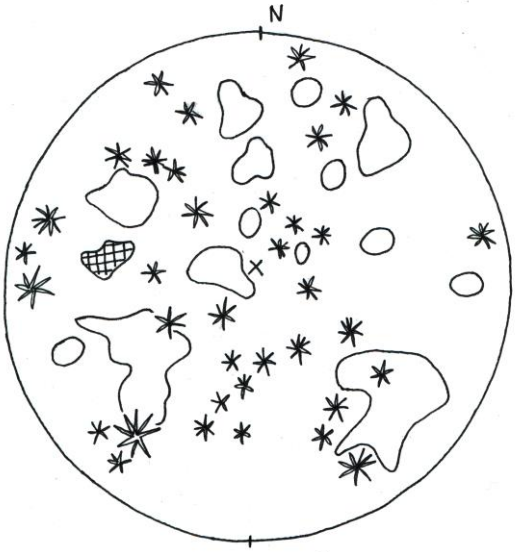

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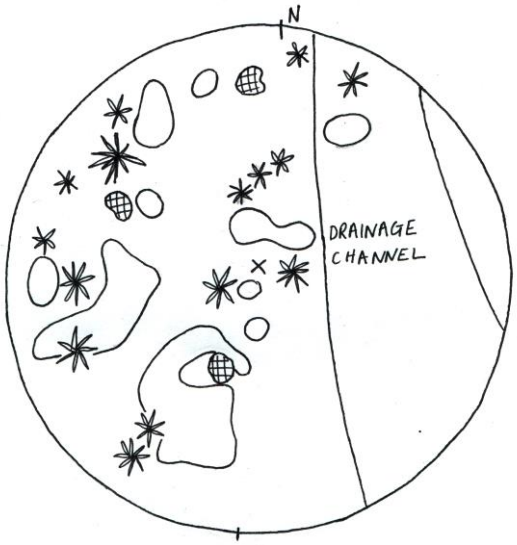

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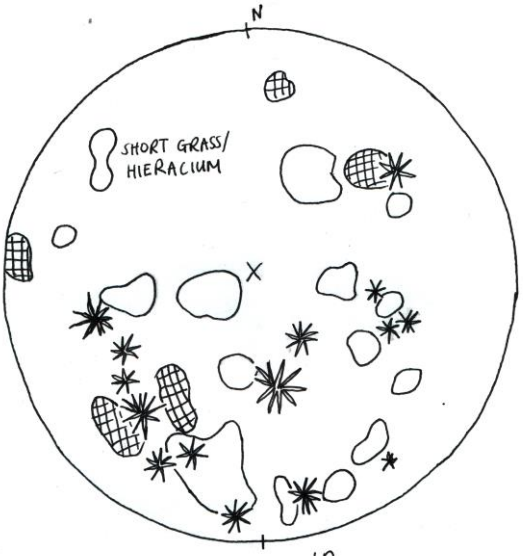

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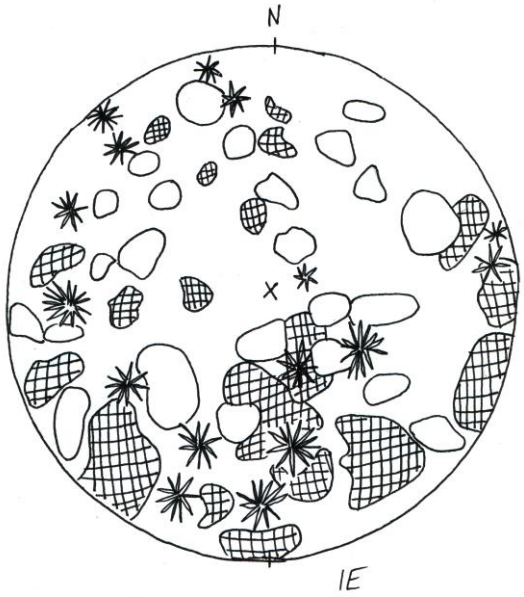
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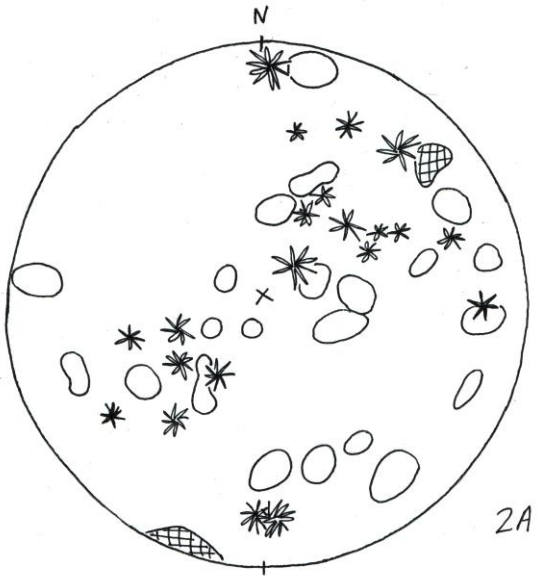
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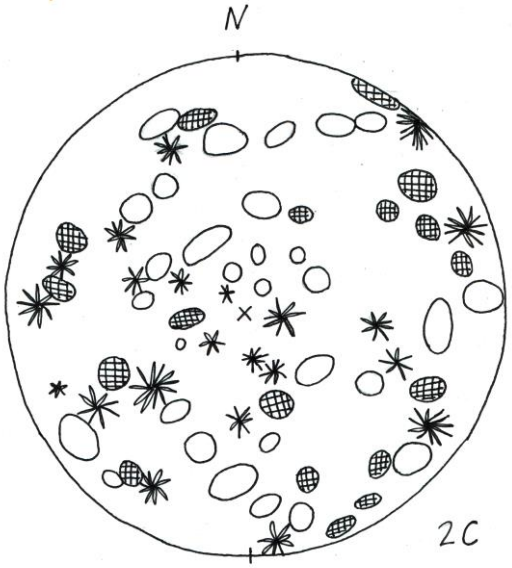
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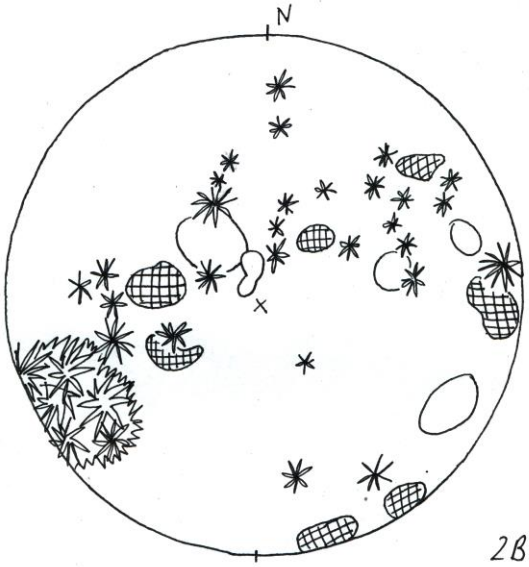

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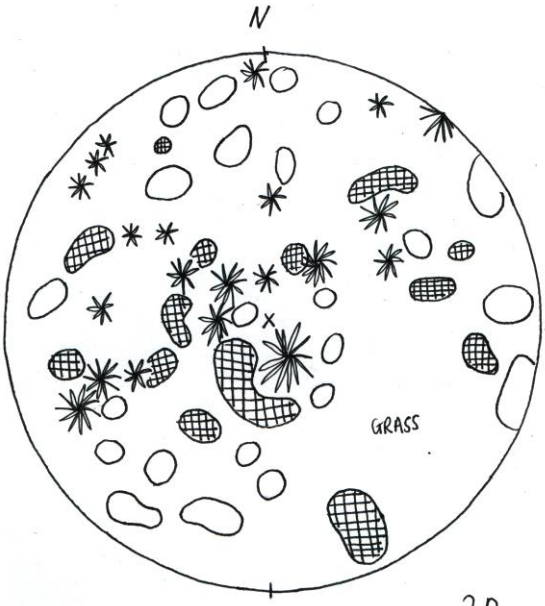

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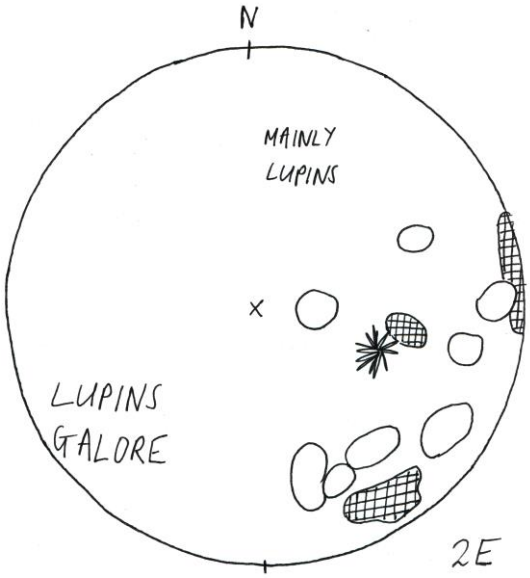

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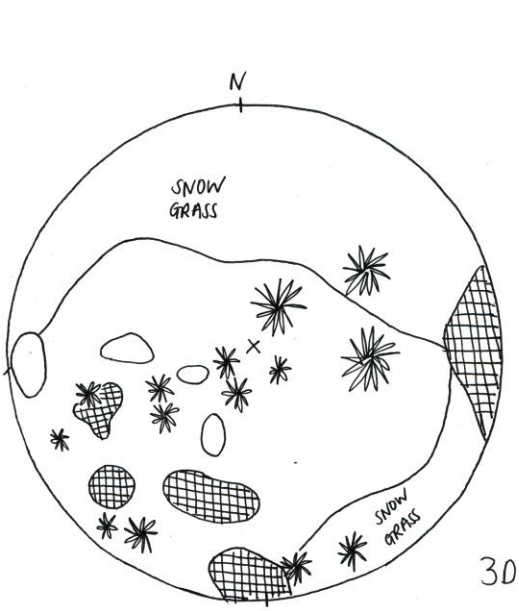

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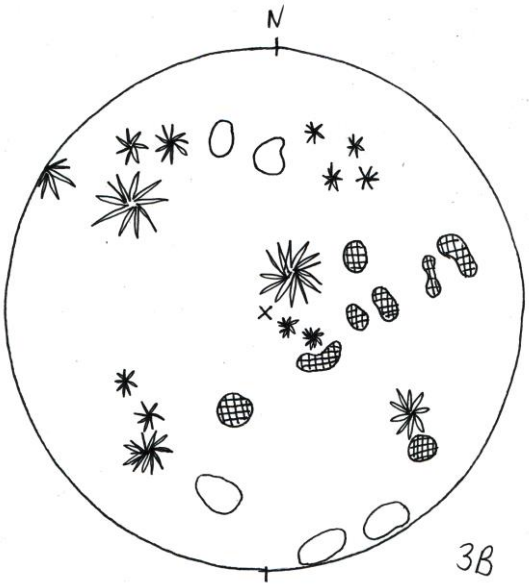

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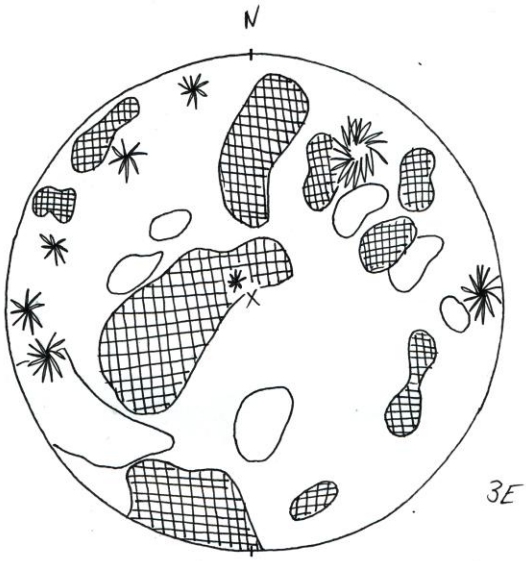

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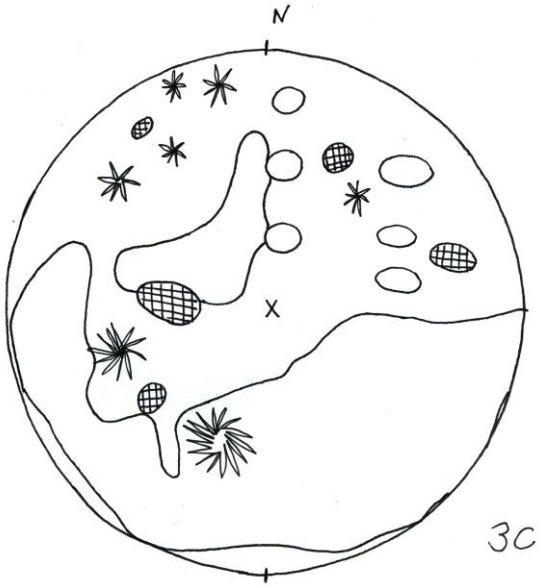

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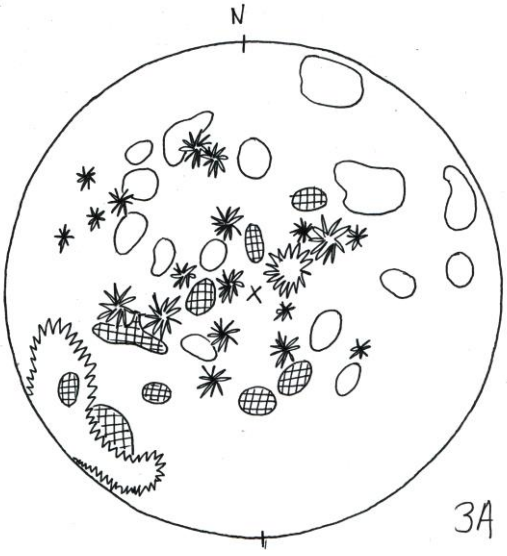

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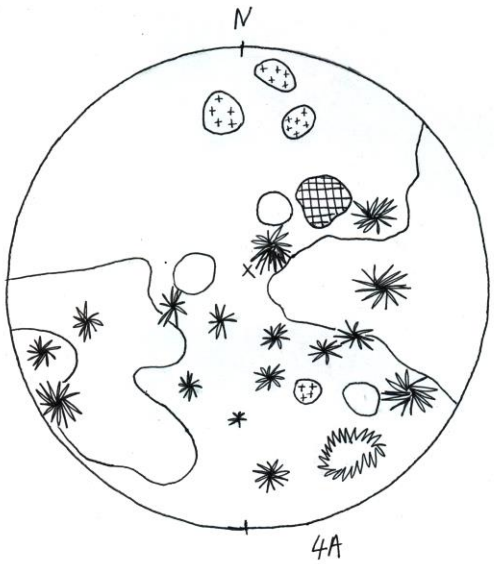

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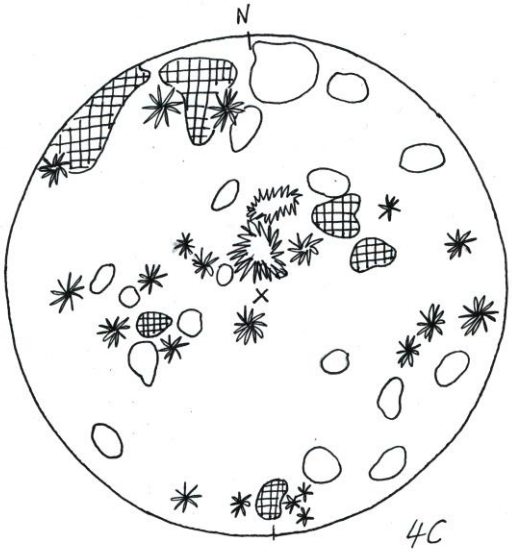

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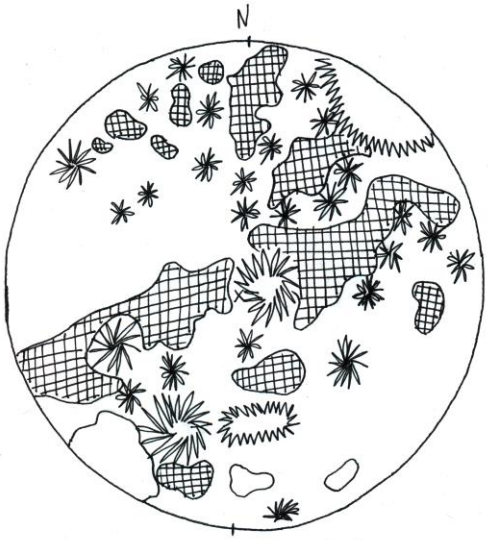

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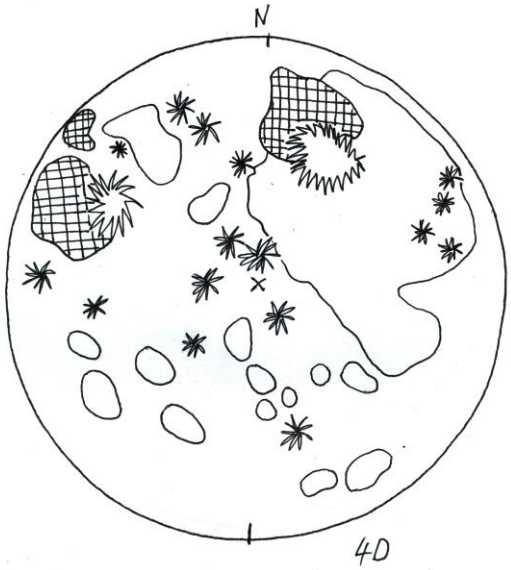

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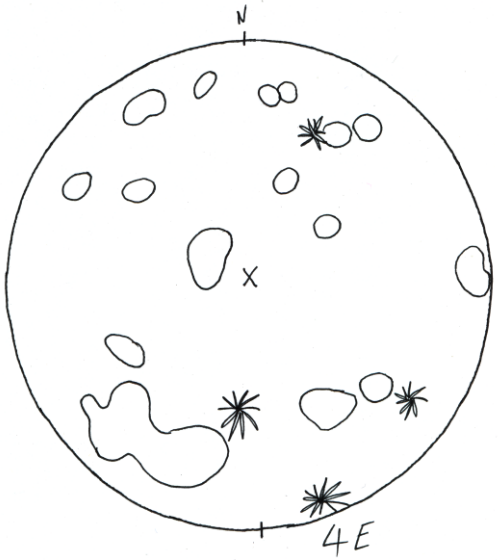


4E

3. SUGGESTED SITES FOR FURTHER INVESTIGATION

3.1 Banks Peninsula

Note: No specimens are recorded to have been collected from Banks Peninsula (Craw 1999), although there is some mention in the literature to *Hadramphus tuberculatus* historically being found there (Sherley 1990).

- Mt Sinclair Scenic Reserve

Coordinates: E 2498910, N 5721360
Altitude: 700-841 m
Description: Largest patch of flowering *A. aurea* on NE slopes of Mt Sinclair, other plants scattered (Approx. 30 flowering 12/12/6006).
Notes: Visited 12/12/2006, approximately less than 5 % of plants flowering. In 1980 Rowan Emberson pulled up a recently dead *Aciphylla*, the root had a tunnel over 1 cm in diameter chewed in it; it was proposed that this might have been caused by a *H. tuberculatus* larva (Scott and Emberson 1986). However, during our visit Lepidoptera larvae were observed to be causing a similar type of damage in the flower spikes of *A. aurea* and to the central rosettes.

- Mt Fitzgerald Scenic Reserve

Coordinates: E 2492185, N 5729214
Altitude: 826 m
Description: *Aciphylla subflabellata*
Notes: Recommended by Miles Giller, QEII Trust.

- Mt Evans

Coordinates: E 2492360, N 5729300
Altitude: 703 m
Description:
Notes: Warren Chinn visited 14/12/06.

- Cass Peak

Coordinates: E 2479675, N 5730110
Altitude: 545 m
Description: Sporadic *Aciphylla subflabellata*
Notes: Warren Chinn visited 14/12/06.

- Ellangowan Reserve

Coordinates: E 2512655, N 5712330
Altitude: 500 – 650 m
Description: Sporadic *A. aurea*
Notes: Visited 27/12/2006

3.2 Near Burkes Pass

- Mackenzie Pass/ Manahuna

Coordinates: E 2319080, N 5665730
Altitude: 600-800 m
Description: 12 km south of Burkes Pass and of a similar altitude. There are several areas with high concentrations of *A. aurea,* notably:

1. E232 0459 N566 5478, >20-50 plants, elevation: 622m.
2. E2320165 N566 5513. Over 100 plants, elevation 676m. More *A. aurea* flowering than at Burkes Pass (all recently finished flowering flower spikes). *A. scott-thompsoni* on true left hand side of stream opposite, 5 male flower spikes close together, very fresh flowers but few insects.
3. E 2318550, N 5665480. Just over Mackenzie Pass on the Mackenzie Basin side. On true left hand side of Mackenzie River there are high numbers of *A. aurea* which can be seen from the road. There is also *A. aurea* on the opposite side of the valley.

Notes: Visited 18/12/2006 by Warren Chinn and Jenie Iles.

- Albury

Coordinates:
Altitude:
Description: Historic location of *H. tuberculatus*, Holocene fossil remains were found by Kuschel and Worthy (1996) at: Albury Park, Tengawai River, North Canterbury; Gordons Valley and Braeburn, Glenlea and Craigmore Stations in South Canterbury.
Notes: Visited by Warren Chinn. Lots of *Aciphylla*.

- Hakataramea Pass

Coordinates: E 2316220, N 5652290
Altitude: up to 947 m
Description: 25 km south of Burkes Pass. Large patches of *Aciphylla aurea* and *Aciphylla scott-thompsoni* on both sides of the road on both sides of the pass. These locations may be too high an altitude for *H. tuberculatus*, with *Lyperobius huttoni* found on *A. aurea* plants (E 2316479, N 5651849).
The following sites are worth visiting (descriptions are from travelling southeast from Mackenzie Basin):

- E 2315344, N 5655114: approximately 200 *A. aurea* plants alongside stream on right hand side of the road.
- E 2315833, N 5653663: large number of *A. aurea* along hill slopes continuing up the left hand side of the road.
- E 2316310, N 5652670: large patch of *A. scott-thompsoni* (flowering) and some *A. aurea* on hillside.
- E 2316290, N 5652215: *A. aurea* on left hand side of road.
- E2316479, N 5651849: *A. aurea* on both sides of the road surrounding the streams
- E2316777, N 5651239: lots of *A. aurea* and *A. scott-thompsoni* on both sides of the road.

Notes: Visited 01/02/07 by Jenie and Hilary Iles, although some *A. scott-thompsoni* was flowering at this time, flowering of *A. aurea* was well finished.

- Grampian Station

Coordinates: E 2307250, N 5657680
Altitude: 600 – 1921 m
Description:
20 km SW of Burkes Pass, Grampian Range (up to 1921 m) which are at the northern end of the Kirkliston Range, pastoral lease.
Notes: Noted by Myles Mackintosh and Hannah Buckley as having high *Aciphylla aurea* concentrations during a vegetation survey (Myles Mackintosh pers. comm. 2006). Also recommended by Laura Young (pers. comm.).

- Dalgety Station

Coordinates: E 2323100, N 5667420
Altitude: 520 – 1752 m
Description: Dalgety Range, 11 km south of Burkes Pass, pastoral lease.
Notes: Recommended by Laura Young (pers. comm.).

3.3 The Hunter Hills, near Waimate

Specimens have been collected from this area historically. Three sites along the Hunter Hills have been identified by Graeme Guilford (wallaby inspector) and Brent Glentworth from ECAN, Timaru (Glentworth pers. comm. 2006) as having high *Aciphylla* concentrations.

- Mt Cecil

Coordinates: E 2344630, N 5624360
Altitude: 700 – 900 m
Description: 1 km NW of Mt Cecil, on north side of fence line. Sizeable area of *Aciphylla*.
Notes: For access contact Scott Emerson, ph 6129989, Backline Rd, RD2.

- Mt Blyth (NE of)

Coordinates: E 2340540, N 5625290
Altitude: 540- 750 m
Description: 500 m NE of Mt Blyth.
Notes: For access contact Tim Morrow, Blue Cliffs Station manager

- Mt Blyth (NW of)

Coordinates: E 2339710, N 5627280
Altitude: 500 – 800 m
Description: 3 km NW of Mt Blyth, NE of peak 954 m, a sizeable patch of *Aciphylla*.
Notes: For access contact Tim Morrow Blue Cliffs Station manager

- Mt Studholme

Coordinates: E 2344280, N 5616390
Altitude: 1080 m
Description:

Notes: Dave Anderson from Raupapuka Area Office, DOC recommended Mount Studholme as having suitable densities of *Aciphylla* (Anderson pers. comm. 2007).

- Mt Nimrod and Matata Reserve

Coordinates: E 2335010, N 5638920
Altitude: 400-1525 m
Description:
Notes: Recommended by Kennedy Lange from Raupapuka Area Office, DOC (Lange pers. comm. 2007).

3.4 Mid Canterbury:

- Mt Oakden

Historically a *H. tuberculatus* specimen was collected from Mt Oakden (Craw 1999). The farmer at Mt Oakden Station identified two areas of *Aciphylla* on Mt Oakden. A third area was noted on the north side Algidus Road before Mt Oakden Station.

Coordinates: Mt Oakden northern patch: E 2382629, N 5773929; Mt Oakden southern patch: E 2383700, N 5769050; Algidus Road: E 238655, N 576352.
Altitude: Mt Oakden northern patch: 800 m, Mt Oakden Southern Patch (estimate): 800 m, Algidus Road: 600 m (approx.)
Description: The northern patch on Mt Oakden (1-2 acres) is grazed for three months a year over winter by sheep, and pigs have been digging up *Aciphylla*. Alongside Algidus Road there is a sizeable patch of *Aciphylla*, according to Mt Oakden Station this has been present for over 50 years, and is increasing in size. At the time of visitation male flowers had finished flowering and females had set seed.
Notes: For access contact Mt Oakden Station. Algidus Road and the northern patch on Mt Oakden were visited on 12/01/2006.

- Peak Hill Conservation Area

Coordinates: E 2387690, N 5764470
Altitude: 500 – 1240 m
Description: Occasional *Aciphylla aurea* on north-facing midslopes (approx. 950 m) and some on the eastern end of Peak Hill (approx. 950 m) slopes (LINZ 2003).
Notes: DOC land since 2003.

- Mt Hutt/ Blackford

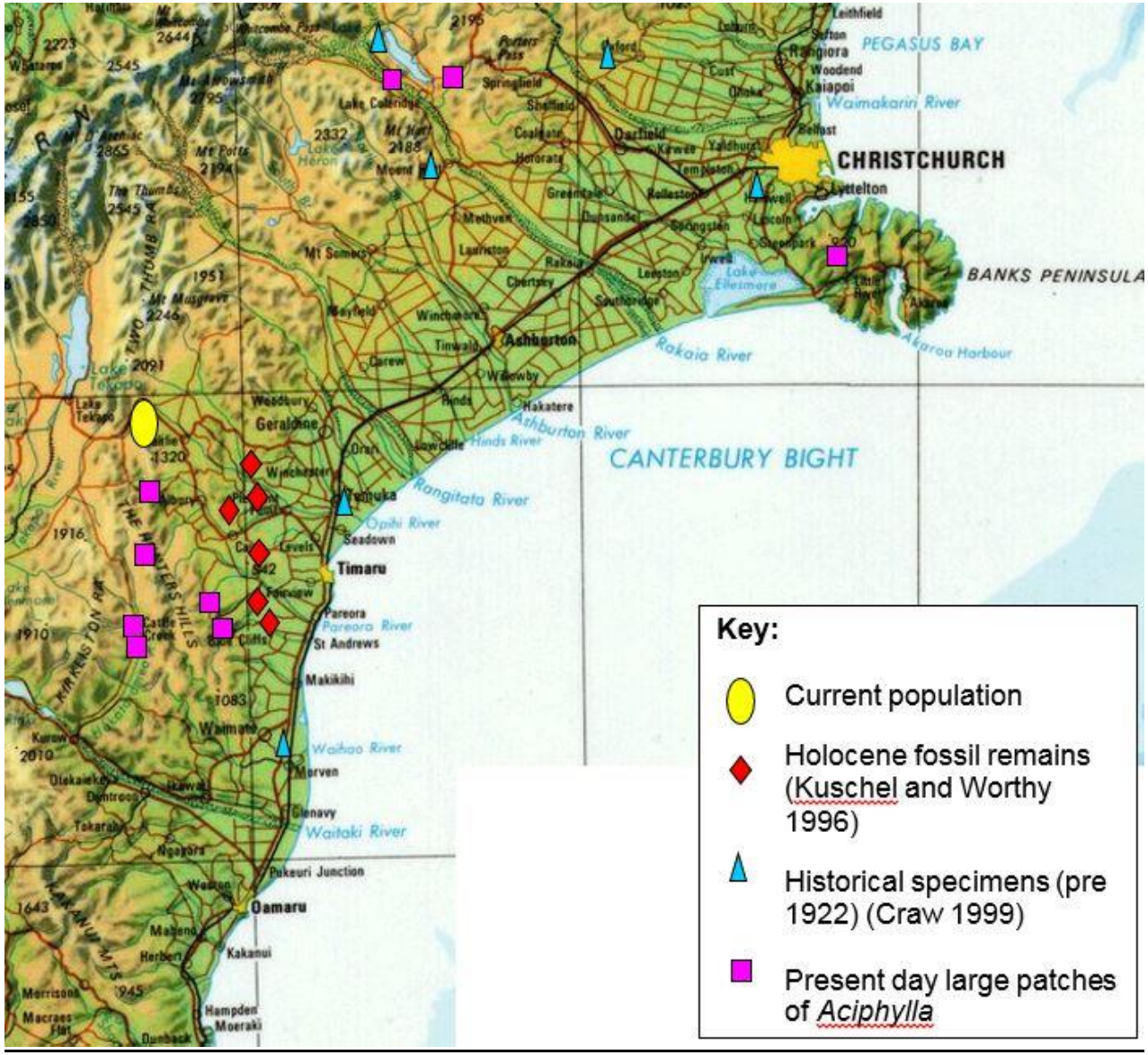
Coordinates: E 2390770, N 5747410
Altitude: up to 2185 m
Description:
Notes: A specimen was collected from Blackford, near Mt Hutt. Also recommended by Kennedy Lange from Raupapuka Area Office, DOC (Lange pers. comm. 2007).

3.5 North Canterbury:

- Oxford

Coordinates: E 2444140, N 5767670
Altitude: 240 m
Description: A historic collection location (Craw 1999).
Notes: Oxford is a populated place, it might be better to try some of the surrounding foothills.

4. MAP SHOWING PRESENT, PAST AND POSSIBLE LOCATIONS OF *HADRAMPHUS TUBERCULATUS* IN CANTERBURY



5. WEATHER CONDITIONS DURING TRAPPING PERIODS

20-21/11/06

20th
Warm, sunny very light easterly wind with little cloud cover during the day. Increasing wind and cloud cover from 5 pm. Night visit from 9 -11 pm, ambient air temp 11.9 °C and wind chill 8.2 °C.

21st
Fine warm day, light easterly wind.

30/11/06- 01/12/06

30th
During the day it was very cold with rain, sleet and snow. Weather at 5 pm: light westerly wind, ambient air temp 5.7 °C, wind chill 4.3 °C, average wind speed 3.2 km/hr, relative humidity (RH) 46 %.
The site was visited between 9-10 pm, weather at 10pm: wind (average) 3.6km/hr westerly, ambient air temperature 2.8 °C, wind chill 1.45 °C, RH 79 %. Flower spikes were inspected at BP1 for *Hadramphus*, none found but little weevils were out feeding.

01/12
Weather at 9.40 am at BP 1: Wind 7.8 km/hr north westerly, ambient air temperature 4 °C, wind chill 0.2 °C, RH 100%. Snowing but not settling.

6/12/06 – 7/12/06

6th
A high pressure system with initially easterly wind with high cloud, changed to north westerly with decreasing cloud cover.

7th
North westerly wind, sunny with a few high clouds.

14/12/06-15/12/06

14th
High pressure system. North easterly winds clear in morning increasing cloud cover in the afternoon.
Most flower spike have finished flowering with dead male flower spikes having collapsed and female flower spikes seeding. Approximately 30 old flower spikes, with 4 with pollen still remaining.
Target Pest trappers were out, placed traps on Monday and taking back in on Friday, caught 6 hedgehogs and sited one stoat.
The site was visited between 9.30 and 11.15 pm. Weather at 10.20 pm: easterly wind 4.2 km/hr, 7.5 °C ambient air temperature, wind chill 4.6 °C, RH 69.4 %.

Approximately 40 flower spikes were checked for *Hadramphus*, nothing found. The *Aciphylla* with *Hadramphus* observed on them were visually checked at 9.30 pm and again at 11.15 pm.

15th
Sunny, few high clouds, light north easterly winds.

18/12/2006 – 19/12/2006

18th
Cumulus nimbus clouds, local westerly winds turning southerly.

19th
North westerly wind, cool temperature. High cloud.

16-18/01/07

16th
Fine day, very light easterly wind increased towards evening. High cloud cover during the day which increased towards nightfall.

17th
Easterly wind, on edge of rain cloud receiving intermittent light rain. Cool temperature.

18th
Sunny, warm with local westerly wind.

22-23/01/07

22nd
Fine day with strong north westerly wind.

23rd
South easterly winds, clear in the early morning with increasing cloud cover towards noon.

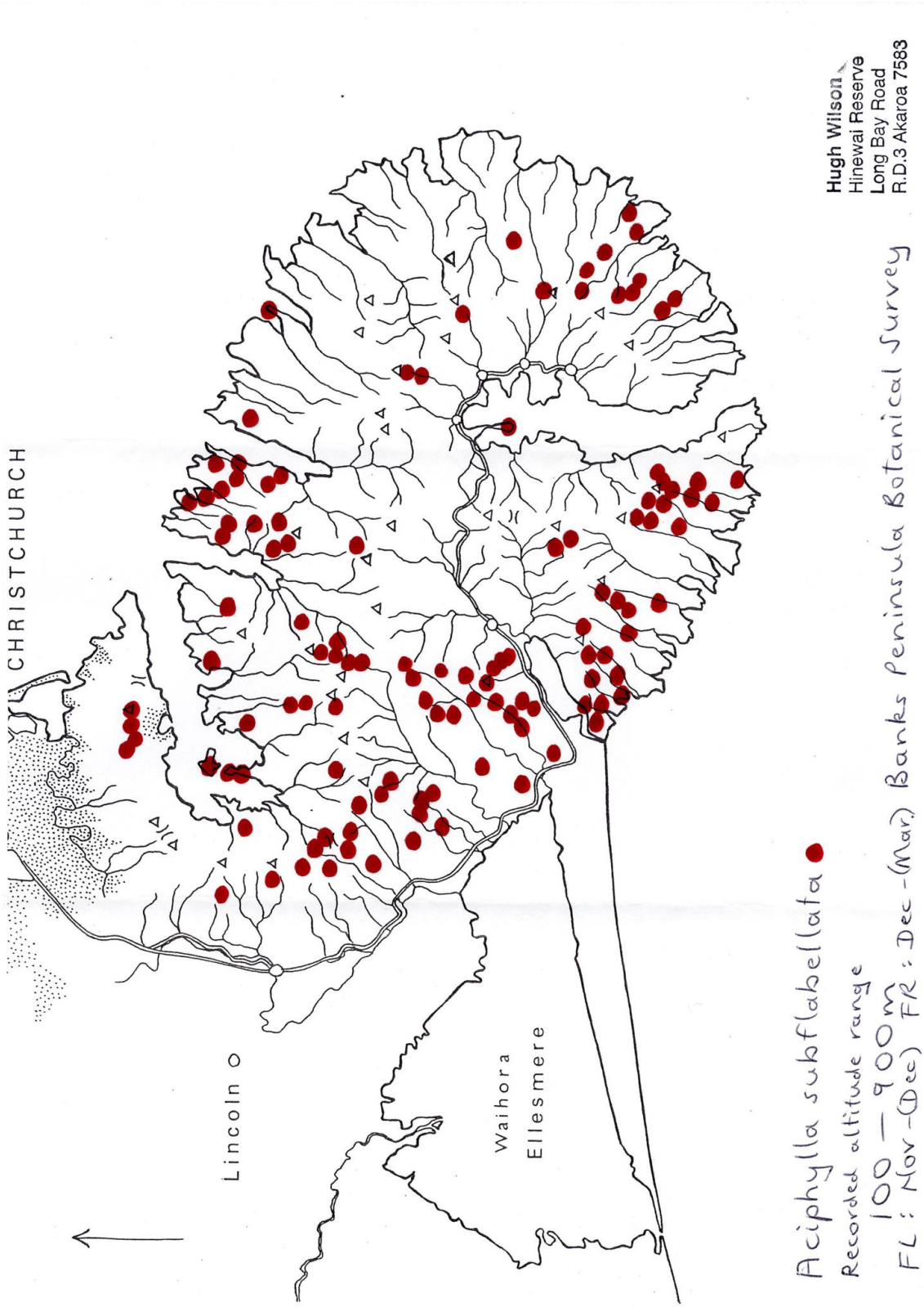
31/01/07 - 02/02/07

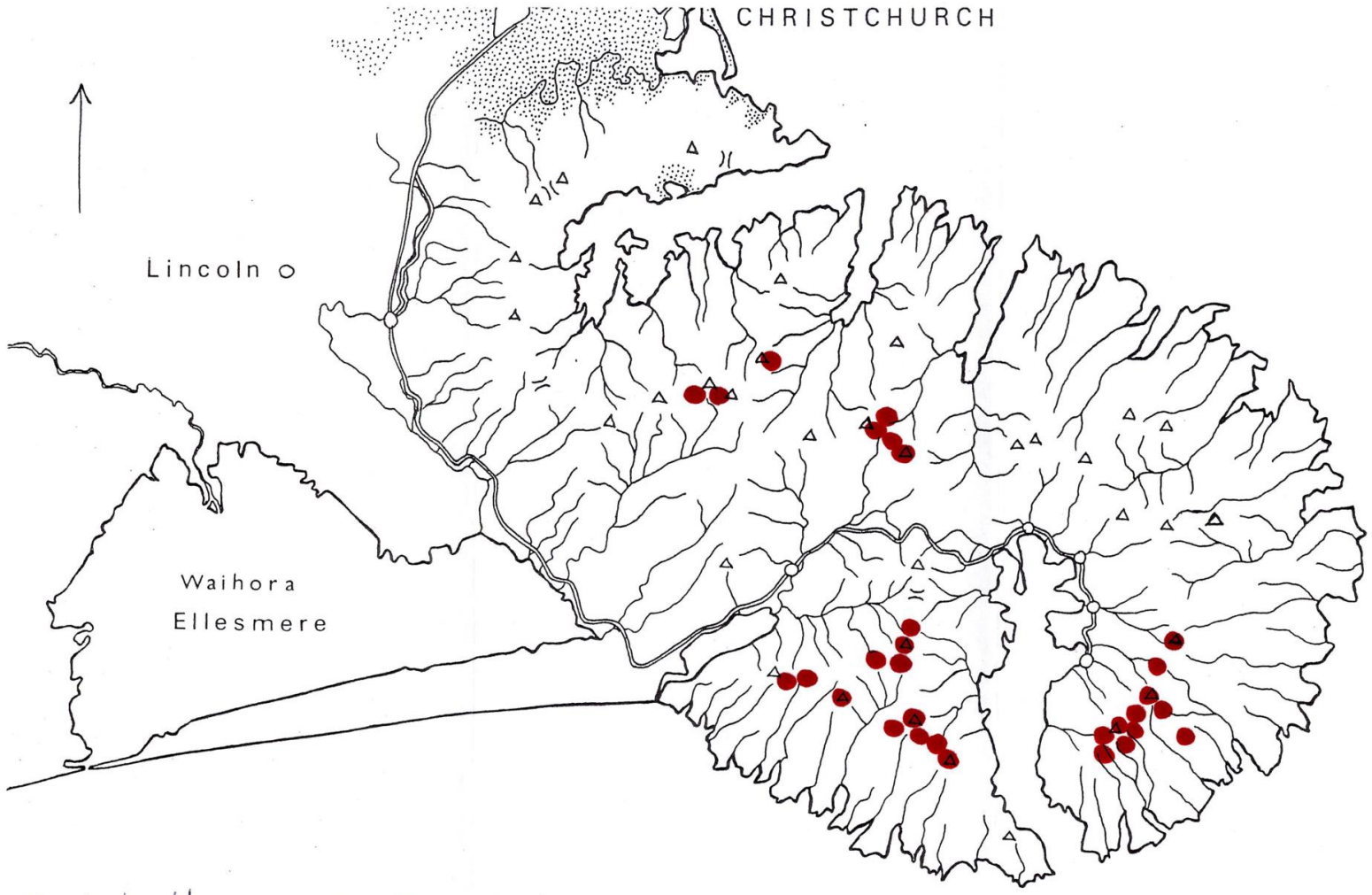
31st
High cloud, easterly wind, heavy rain on nightfall.

1st
Warm day with clear skies and a strong north westerly wind.

2nd
Easterly wind, clear skies over the pass.

6. BANKS PENINSULA MAPS FROM HUGH WILSON SHOWING AREAS OF *ACIPHYLLA SUBFLABELLATA* AND *AUREA*





Aciphylla aurea ●

Recorded altitude range
550 – 845 m
FL.(Nov)-Dec. FR. Jan - Feb.

Banks Peninsula Botanical Survey

Hugh Wilson
Hinewai Reserve
Long Bay Road
R.D.3 Akaroa 7583