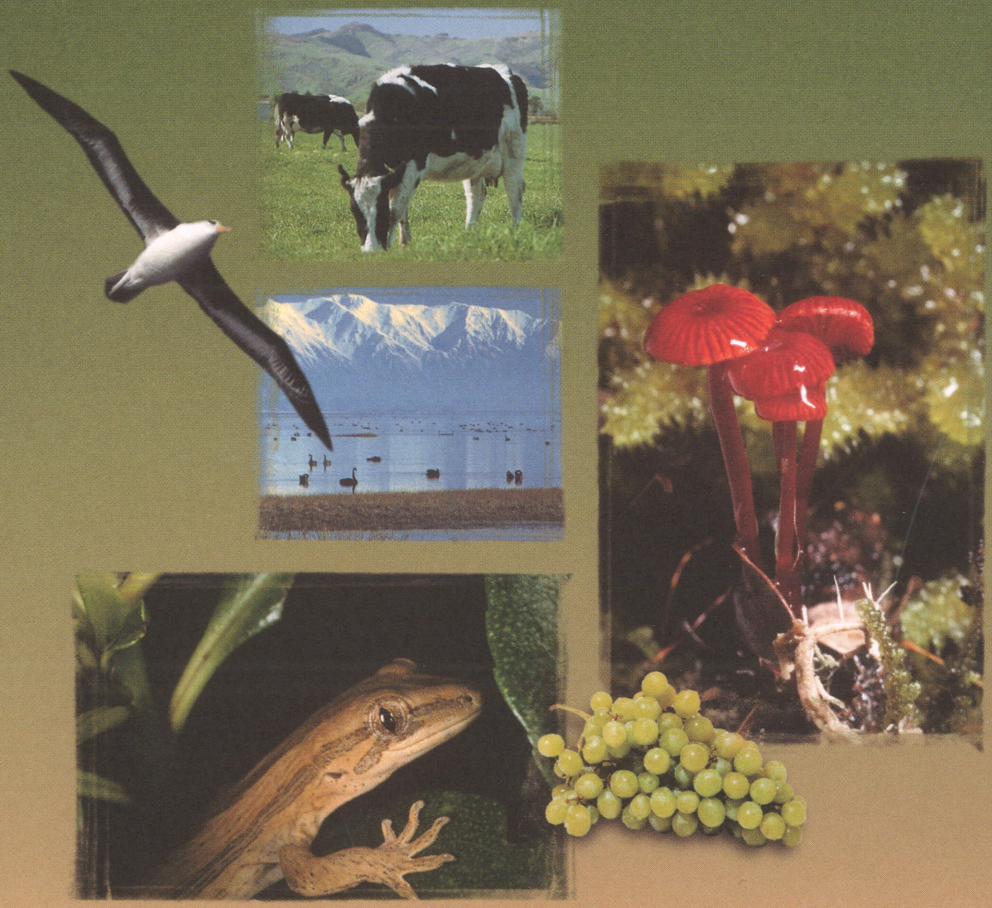
Lincoln University

Soil, Plant & Ecological Sciences Division



Restoration of Quail Island Invertebrates

Mike Bowie

Ecology and Entomology Group

SOIL, PLANT & ECOLOGICAL SCIENCES DIVISION

LINCOLN UNIVERSITY

Te Whare Wānaka O Aoraki

PO BOX 84, LINCOLN UNIVERSITY, CANTERBURY 8150, NEW ZEALAND

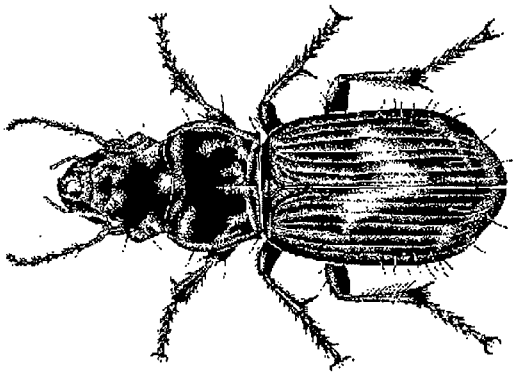
Wildlife Management Report No. 22

Lincoln University Wildlife Management Report No. 22

RESTORATION OF QUAIL ISLAND INVERTEBRATES

Mike Bowie

Ecology & Entomology Group
P.O. Box 84
Lincoln University



Prepared for:

Quail Island Restoration Trust & the Canterbury Conservancy,
Department of Conservation

November 2001

Summary

Project

To survey the current invertebrate fauna on Quail Island (including King Billy Island) and compare it with the fauna in similar habitat in close proximity such as Magnificent Valley in Orton Bradley Park. Name potential invertebrate candidates for reintroduction based on findings and outline habitat requirements.

Objective

- To provide Quail Island Restoration Trust with a framework on which to write the invertebrate section of the Quail Island Restoration Plan.

Methods

- Invertebrates were collected on Quail Island using mainly pitfall trapping and malaise trapping over 12 months.
- Invertebrates were identified (where possible) and compared with other Banks Peninsula collections to assess what species are absent from Quail Island.
- New techniques (weta 'motels' and wooden discs for ground beetles) for releasing and monitoring invertebrates were assessed at Quail Island and at five other sites.

Results

- Many large invertebrates including tree weta are absent from Quail Island.
- Ground beetles (Carabidae) are poorly represented on Quail Island compared with other Banks Peninsula areas studied.
- Several invertebrates species found on Quail Island are endemic to Banks Peninsula including at least five spiders, one beetle, one snail, one cockroach and one ground weta species.
- Good populations of a rare aphid (*Aphis cotteri*) were found on *Muehlenbeckia complexa* on Quail Island.
- Tree weta and cave weta inhabited only weta motels at Orton Bradley Park.
- Three carabid species at Quail Island and another three species at other 'mainland' sites used wooden discs.

Recommendations

- Identify areas of *Muehlenbeckia complexa* to be set aside for the rare aphid (*Aphis cotteri*) populations to be maintained.
- Reintroduce native aphids once additional host species are planted.
- Reintroduce ground beetles, tree weta and other large invertebrate species when mammalian predators are eradicated or reduced to low numbers.
- Use weta motels and wooden discs to create habitat for weta and carabids respectively.
- Annually monitor invertebrate populations using pitfall trapping and/or other methods.

Aims for invertebrate restoration on Quail Island

- To restore the Quail Island invertebrate fauna to a state that resembles the fauna found in local Banks Peninsula forest remnants.

- To provide a safe sanctuary for locally extinct, threatened or endangered invertebrate species.

Introduction

The invertebrate fauna provides the greatest contribution to diversity in any terrestrial community. Invertebrates are crucial components of the ecology of most communities, including islands, and play roles in pollination, nutrient cycling and seed dispersal (Keesing & Wratten, 1998). Invertebrates also provide prey for insectivorous birds (including bellbirds) and lizards. Many Banks Peninsula insects have become extinct or endangered due to deforestation, farming practices and the introduction of predators (including hedgehogs, rats, mice, mustelids and cats) (Wells *et al.*, 1983). Because of its former isolation, Banks Peninsula has a very high proportion of endemic invertebrates. Many of the larger species are now threatened due to introduced predators, hence the importance of Quail Island as a refuge for such species. Due to its isolation by sea, Quail Island has been more adversely affected than other parts of Banks Peninsula because it has also suffered from local extinctions of larger flightless invertebrates such as tree weta and Carabidae (ground beetles).

Although Quail Island has potential as a refuge for threatened invertebrates susceptible to mammalian predators, it must be remembered that the proximity of the island to the mainland will make it vulnerable to mammal reinvasions and the island will require constant monitoring. Regardless of this, reduced predator densities in New Zealand 'mainland islands' (Ell, 2000) have shown many benefits to the native fauna (Innes, *et al.*, 1999). Quail Island will allow invertebrate species unique to Banks Peninsula and coastal Canterbury to be given a predator-free island habitat in a similar way that Somes Island and Tiritiri Matangi Island have for the Wellington and Auckland regions respectively.

The primary aim of species introductions is to restore the biodiversity values of Quail Island. They could also assist in the conservation of individual species and enable increased public awareness of conservation issues. Each introduction should follow the standard operating procedure for species' reintroductions, including writing a transfer proposal, gaining approvals, and clearly presenting methods and cost. These transfers should be used as trials for new techniques where existing techniques do not exist.

1. Species restoration – where a species that was or could have been present on Quail Island is being re-established. This is likely to be limited to species that were present in the Banks Peninsula Ecological Region (Wilson, 1992).

2. Species recovery – where Quail Island provides a safe refuge for a nationally or locally threatened species to assist species recovery. Nationally threatened species should be considered only if there are few other suitable sites.
3. Educational – where the species is being released for educational or advocacy purposes.
4. Scientific – where the release is a trial as part of a recovery programme or it contributes towards a monitoring programme.

In addition to restoring the diversity of invertebrate species that were once likely to have been present on Quail Island, transfer of some ecologically appropriate species with high conservation values could also be considered. Populations of these invertebrate species on Quail Island will gain a reproductive advantage with reduced densities or the absence of mammalian predators, compared with 'mainland' invertebrate populations in the presence of predators.

Methods

Invertebrate survey

The invertebrate fauna of Quail Island was surveyed between November 1998 and January 2000. Six pitfall traps were placed in each of five habitats: exotic grassland, exotic pine and macrocarpa, recently planted natives, 20 yr old natives, and original native scrub and trees (totalling 30 traps). A malaise trap for flying insects was also used for 12 months. Other methods including pan traps, light traps and hand collecting were also used. Two forest remnants close to Quail Island, Magnificent Valley in Orton Bradley Park and Ahuriri Bush Scenic Reserve, were also assessed using pitfall traps to compare with the Quail Island invertebrate fauna. Because > 50% of New Zealand's insect species are beetles, most of the entomological effort went into the collection and identification of the beetle fauna. Taxa such as native snails, worms, spiders and insects have been investigated where possible.

Restoration techniques

Weta motels

Fifty weta motels (Fig.1) consisting of an untreated block of wood with a tunnel to provide a refuge for invertebrates (including weta and spiders) were used on Quail Island, Ahuriri Bush Scenic Reserve and Orton Bradley Park. Occupants of weta motels were recorded 3-monthly for one year.

Wooden discs

Thirty-two wooden discs 23-45 cm in diameter and 10-15 cm thick were cut from logs by chainsaw and left to dry for at least 20 weeks. Four tree species, three exotic tree species and one native species were used for discs on Quail Island: pine (*Pinus* sp.), macrocarpa (*Cupressus macrocarpa*), oak (*Quercus* sp.) and black beech *Nothofagus solandri* var. *solandri*. Invertebrates found under discs at other sites, including Orton Bradley Park and Ahuriri Bush Scenic Reserve, were compared with those found at Quail Island.

Results

Invertebrate survey

The total number of invertebrate species on Quail Island is thought to be over 500. Compared with Hinewai Reserve, Quail Island has a higher proportion of introduced spiders; 27% of the 51 Quail Island spider species are introduced to New Zealand, compared with only 9% of Hinewai spider species. This is most likely due to the highly modified landscape of Quail Island. Notable insect absences from Quail Island include stag beetles (Lucanidae), the Canterbury tree weta (Anostostomatidae), several ground beetles (Carabidae) and long-horn beetles (Cerambycidae) such as the kanuka long-horn. A comparison of carabid species collected from Banks Peninsula indicated that this beetle family is poorly represented on Quail Island (Table 1).

Species endemic to Banks Peninsula found on Quail Island include:

Spiders
Misgolas borealis (Banks Peninsula trap-door spider)
Maniho ngaitahu
Migas saxatilis
Stanwellia sp.
Pahora kaituna

Beetle
Mimopeus granulosus

Snail
Charopa pseudocoma

Cockroach
Celatoblatta sp. (new unnamed Banks Peninsula species)

Ground weta
Hemiandrus 'horomaka' (new unnamed Banks Peninsula species)

Populations of the native aphid *Aphis cotteri*, thought to be endangered and threatened with extinction in the short term (Pawson and Emberson, 2000), were found on *Muehlenbeckia complexa*. The three Quail Island populations of this aphid (see Fig. 2 for their location) represent the largest source to date (Marlon Stufkens, Crop & Food, Lincoln, pers. com.). Site A1 (see Fig. 2) had the highest population of this rare aphid on Quail Island.

Restoration techniques

Weta motels

Although no weta were found in the Quail Island or Ahuriri Bush motels, tree weta and cave weta were found in Orton Bradley motels. Spiders were the main occupants at all sites, however 'motel' occupation was considerably lower on Quail Island.

Wooden discs

Ground beetles (Carabidae) were found under wooden discs all sites. At least seven carabid species were found under discs, including three species under Quail Island discs. Other native invertebrates found under discs included slugs (absent from Quail Island), flatworms, snails, harvestman, millipedes, centipedes and spiders.

Discussion

The restoration of forest and scrub cover on Quail Island will likely induce re-colonisation by some flighted species, particularly native Diptera (flies) and Hymenoptera (wasps, bees and ants). However, some invertebrates, such as the larger flightless beetles (Kuschel, 1990) and tree weta, will not re-establish without human intervention. The lack of decaying native logs and litter associated with 'mature' forest means that Quail Island will also have lost the invertebrates associated with these micro-habitats such as the stag and longhorn beetles. The paucity of logs for invertebrates on Quail Island means that they will have to be sourced from somewhere close (like Orton Bradley Park or Ahuriri Bush Scenic Reserve) and/or use the existing pine and macrocarpa trees on the island. Sourcing native logs from off the island has the advantage of introducing the fungi, bacteria and small invertebrates that are part of the log habitat. However, logs will require careful screening to avoid the accidental introductions of undesirable species such as vespulid wasps (Miskelly, 1999). Recent work using wooden discs as carabid refuges on Quail Island and at Lincoln University shows good promise as a technique for release and monitoring. When trees on Quail Island are felled for management purposes, some of the logs should be cut into discs and kept for use as refuges in specific areas.

Banks Peninsula has several invertebrates that are threatened or endangered including species such as *Mecodema howitti* (Carabidae) (Anderson, 2001). If invertebrate introductions to Quail Island are successful and the habitat requirements are met, endangered species such as *M. howitti* may thrive and provide a valuable population in the absence of mammalian predators on the island. Quail Island could have up to seven more native carabid species (to make a total of 11) when suitable vegetation has been restored on the island. Carabid and other species identified as possible candidates for introduction or reintroduction are given with their preferred habitat (Table 2).

Other species missing from Quail Island are tree weta. There are two species of tree weta on Banks Peninsula, the Banks Peninsula tree weta, *Hemideina ricta*, which is restricted to the eastern portion of Banks Peninsula, and the Canterbury tree weta, *H. femorata*, which is more wide spread (Townsend *et al.*, 1997). As the two species are thought to hybridise, only one species should be introduced to the island. The tree species currently being planted at Quail Island will eventually provide good tree weta habitat. On Banks Peninsula, 95% of the *H. femorata* and 34% of *H. ricta* were found on kanuka (*Kunzea ericoides*) (Townsend *et al.*, 1997), which is one of the main tree species (~14% of restored plant species) on Quail Island.

Due to the paucity of mature native trees and associated roost sites for invertebrates, in particular tree weta, artificial weta roosts (Trewick and Morgan-Richards, 2000) can be used. Artificial weta roosts (weta motels) will provide a way of monitoring success of releases, can be used as a bioindicator of ecosystem "health" and to monitor the impact of mammalian predators and poisoning programmes (Spurr and Drew, 1999) on Quail Island (see Appendix).

Aphis cotteri may be a host of parasitic wasps (*Aphidius* sp.) introduced to New Zealand in 1977-78 as a biocontrol agent for aphid pest species (Carver, 2000) and, as a consequence, may threaten remaining populations of this rare aphid. The presence of this aphid species on Quail Island offers an excellent opportunity to conserve this species through plantings and management of *M. complexa.* Other native aphid species absent from Quail Island could be introduced once sufficient host plants are established e.g. *Neophyllaphis totarae* on totara (*Podocarpus totara*), *Paradoxaphid plagianthi* on *Plagianthus regius* and *Aphis healyi* on *Carmichaelia* sp.

Each proposed species transfer should be weighed against the above goals and against the limitations of size and in habitat on Quail Island. The island is 85 hectares, imposing restrictions on the potential numbers of species, especially birds with large territories. The habitat requirements of the species proposed for transfer should be carefully considered. It should also be remembered that Quail Island would always face the threat of a potential rodent, hedgehog or mustelid reinvasion. It is therefore important that other 'safer' islands are considered as alternatives for endangered species.

Two sites close to Quail Island, Magnificent Gully in Orton Bradley Park and Ahuriri Bush Scenic Reserve provide good habitats to source various beetles (particularly carabids) and *H. femorata*, which are absent on Quail Island (Bowie, unpublished; Butcher and Emberson, 1981; Gorton, unpublished).

Recommendations

- Protect identified areas of *Muehlenbeckia complexa* (Fig. 2) so that the rare aphid (*Aphis cotteri*) populations can be maintained and enhanced.

- Plant host species *Podocarpus totara*, *Plagianthus regius*, *Carmichaelia* sp. so that the native aphids *Neophyllaphis totarae*, *Paradoxaphid plagianthi* and *Aphis healyi* can be introduced.

- Reintroduce ground beetles (Carabidae), tree weta and other species (Table 2) to Quail Island as soon as mammalian predators are eradicated or reduced to low numbers.

- Use weta motels, wooden discs and logs to provide habitat for invertebrates during introductions and to allow non-destructive monitoring (Table 2).

- Annually monitor the invertebrate fauna using pitfall trapping and/or other methods to document population changes.

Table 1: Native ground beetle (carabids) species collected from Banks Peninsula

	Quail Island Bowie (in prep.)	**Magnificent Gully, Orton Bradley Park** Bowie (in prep.)	**Five sites on B.P. (May-Sept)** Gorton (in prep.)	**Ahuriri Bush Scenic Reserve** Butcher & Emberson, 1981	**Hinewai Reserve** Ward *et al.*, 1999	**Banks Peninsula survey** Johns, 1986
Totals	**4**	**6**	**7**	**11**	**13**	**31**
Banks Peninsula endemics	**0**	**2**	**4**	**7**	**7**	**10**

Table 2: Possible invertebrate candidates, habitat and date for reintroduction to Quail Island

Reference for map / release site (Fig. 3)	Species	Family	Common name	Banks Peninsula Endemic	Habitat required invertebrate species	Source population for reintroduction	Aproximate date for species reintroduction[1]
1	*Megadromus australasiae*	Carabidae	Ground beetle	Yes	Some scrub cover, logs / wooden discs	Orton Bradley / Ahuriri Reserve	2002-3
2	*Holcaspis intermittans*	Carabidae	Ground beetle	No	Bush cover, logs / wooden discs	Orton Bradley	2002-6
3	*Holcaspis suteri*	Carabidae	Ground beetle	Yes	Bush cover, logs / wooden discs	Orton Bradley / Ahuriri Reserve	2003-6
4	*Mecadema oregoide*	Carabidae	Ground beetle	Yes	Bush cover, logs / wooden discs	Ahuriri Reserve	2003-6
5	*Ochrocydus huttoni*	Cerambycidae	Longhorn beetle	No	Kanuka & manuka mainly	Orton Bradley	2003-6
6	*Hemideina femorata* or (*H. ricta*)	Anostostomatidae	Tree weta	No / (Yes)	Canopy for dispersal, roosting sites / 'weta motels', leaf litter for oviposition	Orton Bradley / (Hinewai)	2004-7
7	*Omedes* sp.	Tenebrionidae	Darkling Beetles	No	Ice plant on cliff edges	Motunau Island	2004-9
8	*Mimopeus* sp.	Tenebrionidae	Darkling Beetles	Yes	Shingle & *Muehlenbeckia*	Kaitorete Spit	2005-10
9	*Mecodema howitti*	Carabidae	Ground beetle	Yes	Bush cover, logs / wooden discs	Eastern BP reserves	2006-12
10	*Pseudaneitea maculata*	Athoracophoridae	Native slug	No	Bush cover, logs / wooden discs	Orton Bradley	2008-12

[1] Dates and order are indicative only and are dependant on species priorities and the time taken for appropriate habitat to be sufficiently 'developed'.

Acknowledgements

I thank John Marris, Rowen Emberson and Cor Vink (Lincoln University), Peter Johns (Canterbury University), Karin Mahlfeld (Te Papa), Gary Barker (Landcare Research), Marlon Stufkens and Trish Fraser (Crop & Food) for their help in invertebrate identification. I also thank the Community Trust and Lincoln University Fund for Excellence for financing this research. I also thank Eric Scott (Lincoln University) for his editorial input.

References

Anderson, S.J. 2001. Distribution, habitat associations, and activity patterns of two endemic Banks Peninsula carabid beetles, *Mecodema howitti* and *Megadromus australasiae.* Unpublished M.Appl.Sc. thesis, Lincoln University.

Butcher, M.R. and Emberson, R.M. 1981. Aspects of the biology of carabid beetles of Ahuriri Bush Scenic Reserve, Banks Peninsula. *Mauri Ora 9*: 59-70.

Carver, M. 2000. A new indigenous species of *Aphis* Linnaeus (Hemiptera: Aphididae) on *Muehlenbeckia* (Polygonaceae) in New Zealand. *New Zealand Entomologist 22*: 3-7.

Ell, G. 2000. Fighting them in the beeches. *Forest & Bird 298*: 30-33.

Innes, J., Hay, R., Flux, I., Bradfield, P., Speed, H. and Jansen, P. 1999. Successful recovery of North island kokako *Callaeas cinerea wilsoni* populations, by adaptive management. *Biological Conservation 87*: 201-214.

Johns, P.M. 1986. Arthropods of Banks Peninsula Reserves. Report to the Commissioner of Crown Lands, Christchurch. 114pp.

Keesing, V.F. and Wratten, S.D. 1998. Indigenous invertebrate components in ecological restoration in agricultural landscapes. *New Zealand Journal of Ecology 22*: 99-104.

Kuschel, G. 1990. Beetles in a suburban environment: a New Zealand case study. DSIR Plant Protection report No. 3. 118pp.

Lukis, K. 1999. Survey of the lizard fauna of Quail Island, Lyttelton Harbour, Canterbury. Report produced for the Quail Island Restoration Trust. 16pp.

Miskelly, C. 1999. Mana Island Ecological Restoration Plan. Department of Conservation. 140pp.

Pawson, S.M. and Emberson, R.M. 2000. The conservation status of invertebrates in Canterbury. *Conservation Advisory Science Notes 320.* Department of Conservation, Wellington, New Zealand, 66pp.

Spurr, E.B. and Drew, K.W. 1999. Invertebrates feeding on baits used for vertebrate pest control in New Zealand. *New Zealand Journal of Ecology 23*: 167-173.

Townsend, J.A.; Brown, B.; Stringer, I.A.N. and Potter, M.A. 1997. Distribution, habitat and Conservation status of *Hemideina ricta* and *H. femorata* on Banks Peninsula, New Zealand. *New Zealand Journal of Ecology 21*: 43-49.

Trewick, S.A. and Morgan-Richards, M. 2000. Artificial weta roosts: A technique for ecological study and population monitoring of the tree weta (*Hemideina)* and other invertebrates. *New Zealand Journal of Ecology 24(2)*: 201-208.

Ward, J. B., Macfarlane, R.P., Quinn, P.J., Morris, S.J., Hitchings, T.R., Green, E.H., Early, J.W., Emberson, R.M., Fenwick, G.D., Henderson, I.M., Henderson, R., Johns, P.M., Lariviere, M-C., Marris, J.W.M., Matile, L., McLellan, I.D., Patrick, B.H., Smithers, C., Stufkens, M.A.W., Vink, C.J. and Wilson, H.D. 1999. Insects and other arthropods of Hinewai Reserve, Banks Peninsula, New Zealand. *Records of the Canterbury Museum 13*: 97-121.

Wells, S.M., Pyle, R.M. and Collins, N.M. 1983. *The IUCN invertebrate red data book.* IUC Conservation Monitoring Centre. Gland, Switzerland. 632pp.

Wilson, H.D. 1992. Banks Ecological region: Port Hills, Herbert and Akaroa Ecological Districts. Protected Natural Areas Programme Survey Report No, 21. Department of Conservation, Canterbury Conservancy. 342pp.

Figure 1: Picture of weta motels used in this study.

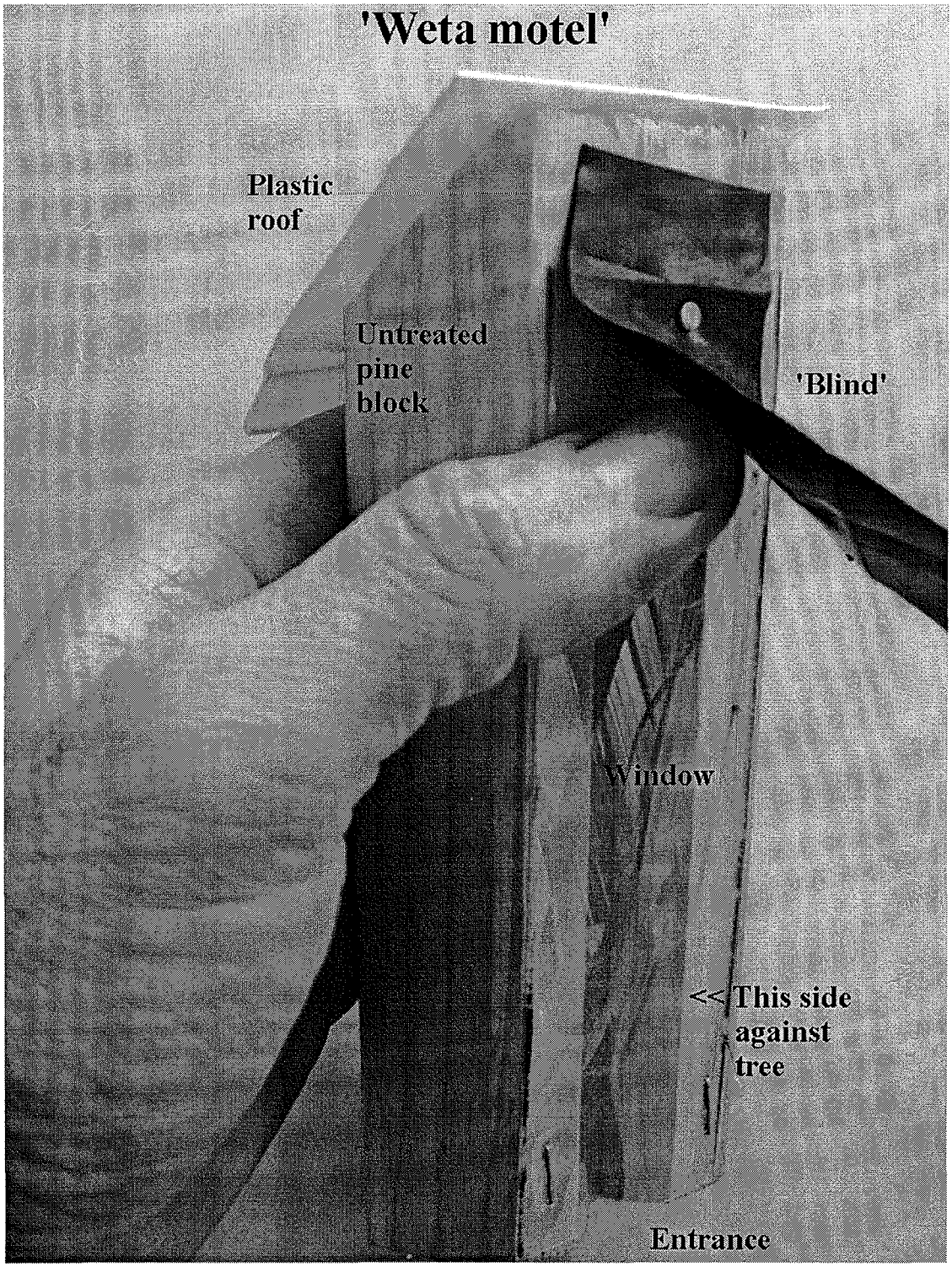


Figure 2: The three sites on Quail Island where the native aphid *Aphis cotteri* has been found on *Muehlenbeckia complexa* in 2000.

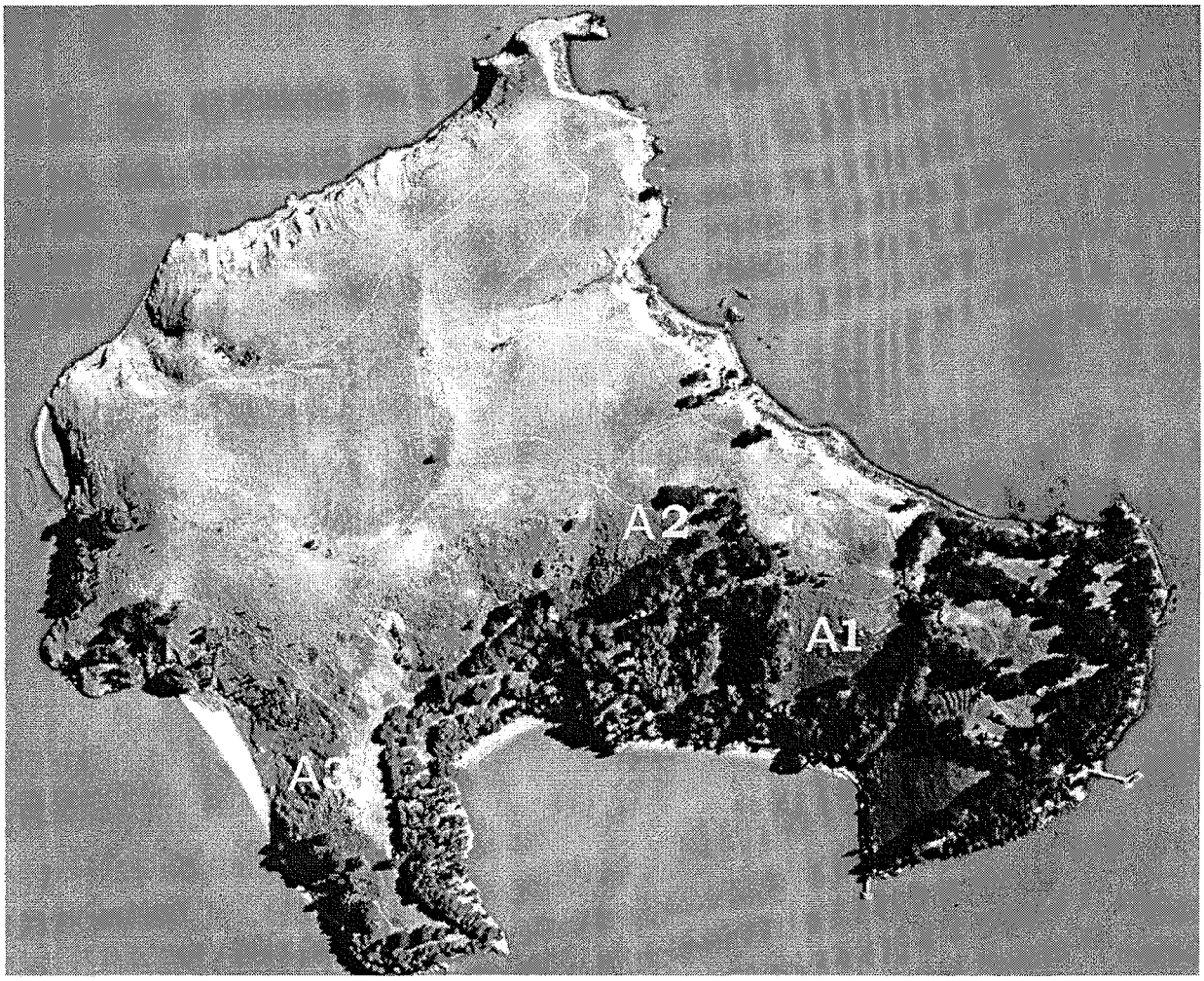
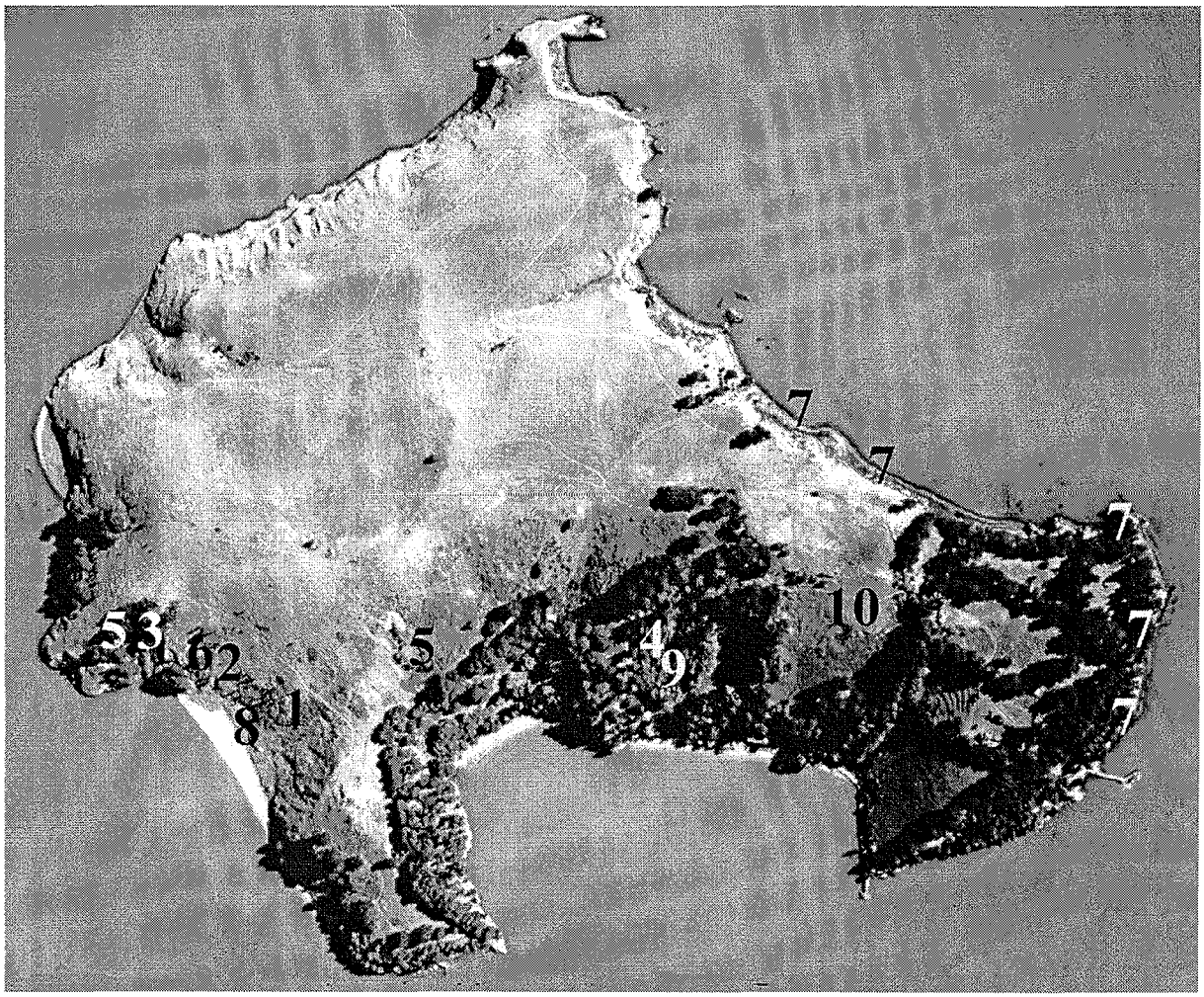


Figure 3: Proposed release sites for invertebrate species listed in Table 2 (the numbers refer to the insects named in the table).



Appendix

Survey and monitoring strategy

Objectives

- To monitor the response of invertebrates to the removal of mammalian pests.
- To monitor the success of transfers / reintroductions.
- To conduct species inventory surveys for species recovery needs.

Monitoring methods

To monitor invertebrates before and after the removal of rodents, hedgehogs and mustelids

Thirty pitfall traps will be set over a one-month period between December and January each year. The invertebrate catches can then be compared with baseline data collected during 1999-2000. Approximately 100 'weta motels' will also be attached to trees to allow long-term monitoring of weta and spider populations. The wooden disc technique is useful for monitoring native ground beetles (carabids), flatworms, snails, spiders and other relatively large invertebrates (Bowie, in preparation).

To ensure the success of transfers / reintroductions

It is important that the success of all transfers is monitored. The specifics of monitoring will vary enormously between species. One possible method for carabid beetles is the use of wooden discs (mentioned above) laid out in the release area. It is important that an appropriate form of monitoring is incorporated in to every transfer proposal. This monitoring should be considered as part of the overall cost of the transfer.

To conduct species inventory surveys for species recovery needs

Bird, invertebrate and lizard surveys (Lukis, 1999) have already been undertaken and will continue annually on Quail Island. It is planned that the bird and invertebrate checklists will be updated with any new species encountered.