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Lincoln University Wildlife Management Report No. 51

Department of Ecology
Faculty of Agriculture and Life Sciences

New Zealand's specialist land-based university

Lincoln University
Te Whare Wānaka o Aoraki
CHRISTCHURCH•NEW ZEALAND

ISSN: 1177-6242 (Print)
ISSN: 1179-7738 (Digital)
ISBN: 978-0-86476-315-0 (Print)
ISBN: 978-0-86476-316-7 (Digital)

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Prepared for:
Environment Canterbury

February 2013

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Abstract

Burkes Pass Scenic Reserve, Mackenzie Basin, New Zealand is home to the only known population of the critically endangered Canterbury knobbled weevil, *Hadramphus tuberculatus*. Major threats to the weevil include introduced predators and habitat loss through weed invasion, herbivores and fire. This report investigates the stomach contents of predators trapped in a 185 hectare perimeter around the reserve. Trapping was conducted by Environment Canterbury from December 2010 to April 2011. The stomachs of hedgehogs, ferrets, feral cats and stoats were analysed and contents were recorded. Hedgehogs consumed the highest amount of invertebrates, present in 20%, and ferrets were the most abundant predator caught; however, no evidence of *H. tuberculatus* was found in any predator stomachs. We suggest predator trapping continue as part of future management of the reserve to protect not only the endangered weevil species but also other fauna including the recently identified and possibly rare invertebrates and the endemic skink found there.

Introduction

The Canterbury knobbled weevil, *Hadramphus tuberculatus* (Pascoe 1877) (Coleoptera: Curculionidae: Molytinae), is perhaps the rarest species in its genus, consisting of only one known population. Last sighted in the 1920s, it was presumed extinct by the late 1990s and listed as extinct on the IUCN red list. However, in 2004 it was rediscovered at Burkes Pass Scenic Reserve, Mackenzie County (Young et al. 2008). *Hadramphus tuberculatus* is the only species in the genus to be found in subalpine tussock grasslands rather than coastal habitats. Based on evidence from Holocene fossils and museum records, it was once distributed throughout the Canterbury Plains and surrounding hills despite now being confined to only one region (Kuschel and Worthy 1996).

Monitoring of the weevil population has occurred in 2006, 2007, 2009, 2010, and 2011 using non-lethal pitfall trapping (Johns 2006, Iles 2007, Fountain 2008, Fountain 2013). The results of monitoring consistently return low population numbers ranging from 6 to 45 individuals in a season. *Hadramphus tuberculatus* is considered threatened by habitat modification and

introduced predators. The conservation status of the weevil is critically endangered (Leschen et al. 2012).

The suite of introduced mammalian species in New Zealand is a well-known threat to biodiversity. A number of these introduced mammals occur within the Burkes Pass Scenic Reserve and the surrounding area. Of particular concern, in this context, are those introduced mammals that may negatively impact on the Canterbury knobbled weevil, either directly or indirectly. Hedgehogs (*Erinaceus europaeus*), rats (*Rattus* spp.), and mice (*Mus musculus*) are known to frequently consume invertebrates (Taylor and Thomas 1993, Moss and Sanders 2001, Ruscoe 2001, Towns and Broome 2003, Jones et al. 2005). These mammals also consume plant material (Moss and Sanders 2001, Ruscoe 2001, Towns and Broome 2003), with rats also readily predating upon birds (Brown et al. 2008). Another species in the *Hadramphus* genus, *H. stilbocarpae,* experienced marked declines in population size due to rats (Taylor and Thomas 1993, Towns 2009) indicating rats as a very likely predator of *H. tuberculatus*. Ferrets (*Mustela furo*), stoats (*Mustela ermine*), and cats (*Felis catus*) mainly prey on vertebrates such as birds, lagomorphs, and rodents (Langham 1990, Murphy and Dowding 1994, Smith et al. 1995). However, they are also recorded as consuming invertebrates, particularly insects such as weta (Langham 1990, Murphy and Dowding 1994, Smith et al. 1995).

Two lagomorphs species rabbits (*Oryctolagus cuniculus*) and hares (*Lepus europaeus*), and Bennett's wallaby (*Macropus rufogriseus rufogriseus*) are herbivorous (Norbury 2001, Sadleir and Warburton 2001), and while they are unlikely to actively seek out invertebrates as a food source, they could accidentally ingest them while consuming foliage. Potentially, these lagomorphs and wallabies can negatively influence the recruitment of appropriate host plants for invertebrates, particularly speargrass, *Aciphylla aurea*, host plant for the Canterbury knobbled weevil.

Low population levels and the interest created from the rediscovery of the weevil are the basis behind the predator trapping started by Environment Canterbury (ECan) in 2006-2007 as part of the Biodiversity Pest Programme. Weevil monitoring, weed control and trapping at Burkes Pass Scenic Reserve have a collaborative structure including the Department of Conversation (DOC), Lincoln University (LU), and ECan. The surveying for the weevil and survey equipment is handled by LU and DOC, weed control and predator trapping within the reserve since 2008 is handled by DOC. Predator control is conducted by ECan and LU does the predator stomach content analysis. Originally, ECan trapped within the reserve and 185 hectares of surrounding pastural land; however, starting in October 2008 DOC Twizel has begun intensive trapping within the reserve and ECan has continued to trap around the reserve.

This report documents the results of stomach analysis of predators trapped by ECan for the 2010-2011 trapping season. We provide information on food sources for the predators and

offer future management suggestions to help reduce the impact of introduced predators not only on *H. tuberculatus* but the other valuable biodiversity within Burkes Pass Scenic Reserve.

Methods

Site information: Burkes Pass Scenic Reserve and surrounding area

Burkes Pass Scenic Reserve is a small (12.4 hectare) tussock grassland reserve in the Mackenzie Basin, South Island (Department of Conservation 2000), and home to the only known population of *H. tuberculatus*. At ~700 m altitude, the reserve is situated directly alongside the main road to Lake Tekapo (SH 78) and surrounded by farms on all sides but one, which is a small introduced pine plantation. The reserve is a mix of *Chionochloa rigida* (tall tussock), and *Festuca novae-zelandiae* (short tussock) grassland with *Discaria toumatou* (matagouri), as well as *Aciphylla aurea*. The Reserve has an extensive history of burning and livestock grazing (McEwen 1987), however, in the last 20 years the reserve has only one fire record that occurred in 2005 and was ignited by a spark from a passing bus. Although extensive trapping for introduced predators occurs inside and outside the Reserve, and spraying for introduced weeds within the reserve, the reserve is still heavily grazed by introduced rabbits and wallabies and has several introduced plant species, including lupins, broom and wilding pines (Department of Conservation 2000).

Glenrock and Holbrook Station surround the Reserve; both areas are grazed by livestock. A small extension of the population of weevils is known to be found at Holbrook Station, discovered by Fountain (2013) in 2009. Holbrook Station has been under tenure review and is anticipated to become DOC land in 2013. The small pine plantation to the east of the Reserve is managed by the Mackenzie District Council.

Trapping

Predator trapping occurred 13 December 2010 to 1 April 2011. Livestock was not grazed in the trapping area while trapping was conducted. Ninety traps and approximately 250 rodent bait stations were used. Hedgehogs, feral cats, ferrets, stoats, and weasel were targeted by traps baited with fresh rabbit meat running in a pulsed campaign over a total of 18 nights. Rats and mice were targeted by Ditrac rodent baits. Trapping was done by independent contractor, Excell Pest Control Ltd.

Stomach analysis

Frozen stomachs were dissected and contents analysed. If the intestines contained material, they were also analysed. Trap number, predator species and stomach contents were recorded. Any invertebrate pieces found were kept and stored in 100% ethanol.

Results

A total of 158 individuals were caught and their stomachs dissected. Of those caught, hedgehogs accounted for 37% of all predators, ferrets 53%, cats 7%, and stoats 3% (Table 1).

Table 1. Total number of each predator caught during the 2010-11 trapping season.

Predator	No. caught
Ferret	84
Hedgehog	58
Cat	11
Stoat	5
Total	158

The traps that caught the highest percentage of hedgehogs were the Fenn and DOC traps, while Timms and Holden traps worked best for ferrets (Table 2). Sentinel traps caught the highest percentage of cats, while no traps appeared effective for stoats, possibly due to low stoat numbers (Table 2).

Table 2. The number of trap captures by trap type and percentage of each predator caught by trap type.

Trap type	No. of trap captures	% Hedgehog	% Ferret	% Stoat	% Cat
Fenn	81	63	33	4	0
DOC	42	55	33	5	7
Timms	19	16	58	0	26
Holden	9	22	78	0	0
Sentinel	6	33	17	0	50

Hedgehogs had the highest percentage of individuals with invertebrate bits in their stomachs (20%) (Figure1). Cats had the second highest percentage (9%), while only 1% of ferrets had invertebrate bits (Figure 1). No stoats contained invertebrate bits. Hedgehogs had identifiable parts of earthworm, grasshoppers, weta, carabids and the manuka chafer beetle resulting in the most diverse amount of invertebrates consumed. Skinks were predated by all predator species; however, cats ate the most skinks ranging from 1 to 18 skinks eaten by one individual. Ferrets

consumed the lowest amount of invertebrates with most consuming some type of rodent indicated by the fur in the stomach and some bits able to be identified as mouse.

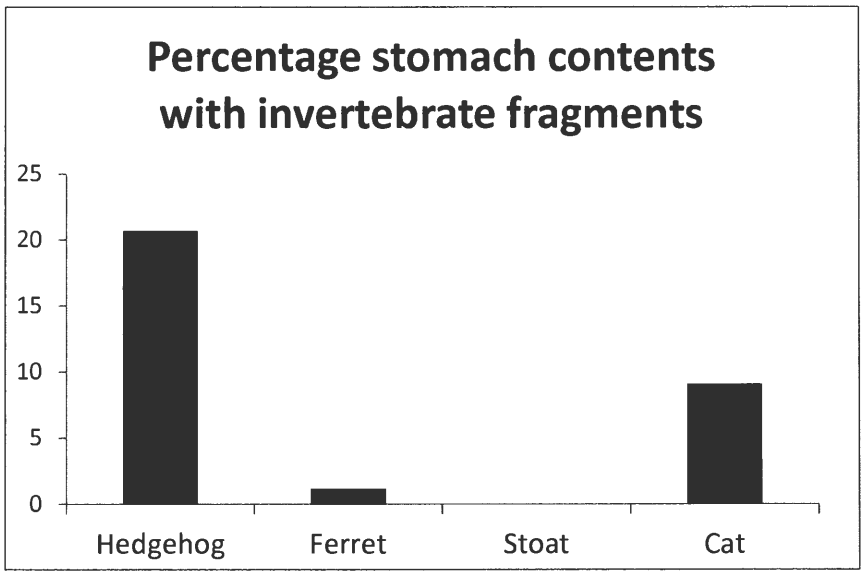

Figure 1. Four predators trapped adjacent to Burkes Pass Scenic Reserve and the percentage that contained invertebrate fragments in their stomach contents.

Discussion

Trapping is effective at targeting hedgehogs, cats, mustelids, and rodents whereas poisoning can target wallabies, rodents and rabbits. Shooting and hunting dogs may also be effective to kill those predators found at Burkes Pass Reserve; however, in regards to cost-effectiveness and ease, trapping and poisoning still seem the best options. The Fenn and DOC traps were the most effective at capturing hedgehogs, the mammal most likely to pose a threat to the Canterbury knobbled weevil of the animals provided for stomach content analysis in this report. Since Fenn traps are being phased out due humaneness issues, we recommend they be replaced with DOC traps which are just as effective in capturing targeted species. Sentinel traps should continue to be used and possibly be bolstered with additional numbers for catching feral cats.

The selection of Ditrac rodent baits is to be commended, due to the much shorter half-life of this toxin and relatively low risk to non-target organisms compared to other anticoagulants (Fisher et al. 2004, Fisher et al. 2007); however, other compounds are worth consideration such

as those based on cholecalciferol which have further reduced non-target effects (Eason et al. 2000).

As outlined already, rats can be an important invertebrate predator, linked to the decline of *H. stilbocarpae*; therefore, having rat stomachs for future analysis is pertinent. Obtaining rat stomachs may require, for a short time period, more regular checking of the traps when rats are known to be abundant to ensure their collection before they become too decomposed.

For *H. tuberculatus*, the availability of *A. aurea* is crucial to its survival. Although introduced carnivorous predators are controlled within and around the reserve, a substantial problem with wallabies, rabbits and hares feeding on the *Aciphylla* may threaten this weevil's long-term survival. During monitoring of the population from 2009-2011, significant feeding damage on the *A. aurea* population has been documented, intensive tracts of land have been dug up, high rabbit numbers have been seen, and also wallabies have been spotted (Fountain, pers. obs.). If high numbers of herbivorous mammals continues, the *A. aurea* population may no longer be able to sustain current numbers of *H. tuberculatus* in the future. An intensive eradication programme needs to be created to focus on rabbits, hares, and wallabies. This would also be beneficial for reducing disturbance to planned restoration plantings of *Aciphylla* within the reserve.

The current predator trapping regime should continue to not only protect the future of the *H. tuberculatus* but to also protect other endemic species and possibly unidentified, data deficient species. In 2010, Rowland (2010) collected other invertebrates found in the Reserve and in the surrounding area. Two new species were identified by Peter Johns, *Prodontria* sp. and *Holcaspis* sp., and several other invertebrates still remain to be identified. As new species, no information such as their geographic range or abundance is known so preventing these species from being consumed would allow time for this information to be gathered. A range of invertebrate parts were identifiable as grasshopper, weta, carabid, cicada, manuka chafer beetle and earthworms indicating most large invertebrates are at risk of predation. Additionally, endemic skinks are being consumed at high numbers, particularly by feral cats, with one cat stomach containing 18 skinks. A continued predator trapping programme would help protect all endemic species from predation.

Although this report failed to find proof of the Canterbury knobbled weevils in the gut contents of predators, absence of evidence is not evidence of absence. Given the low population numbers of the endangered weevil and that its host-plant is hard to access for most predators, finding identifiable weevil parts is probably unlikely. However, we believe the precautionary principle should be applied, with trapping and poisoning of potential predators continuing to help protect the weevil from predation pressure and potentially extinction.

Specific Management Recommendations

- Continue predator trapping within and around Burkes Pass Scenic Reserve.
- Phase out Fenn traps and replace with DOC 250 traps.
- If possible, obtain rat stomachs for content analysis.
- Wallaby, hare, and rabbit control within and around the Reserve.

Acknowledgements

We would like to thank Environment Canterbury for provided the funding for this project, in particular Phil Cochrane, but also Brent Glentworth arranging the trapping and stomachs for dissection.

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