Management of frost flat communities under threat from mouse-ear hawkweed invasion

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Abstract

Formerly extensive on the Volcanic Plateau, frost flat heathland dominated by monoao (*Dracophyllum subulatum*) is now reduced to fragments. It is threatened by mouse-ear hawkweed (*Hieracium pilosella*) at the only major site where it is likely to survive indefinitely (Rangitaiki Conservation Area). In the past, fire has perpetuated monoao on frost flats, but in future it may accelerate the spread of hawkweed. This project aims to find ways of perpetuating monoao and minimising hawkweed spread, and of maintaining hawkweed-free samples of frost flat heathland. A randomised block trial was established at Rangitaiki C.A. in 1993 in 90-year-old monoao shrubland (burning, cutting, and control treatments) and in 30-year-old lichenfield (burning, herbicide, and control treatments). Two herbicides, 'Trimec' and 'Versatil', were tested. Vegetative cover was monitored by point intercept method before treatment and 20 months after treatment, and analysed by repeated measures ANOVA. In the shrubland, bare soil increased somewhat ($p<0.01$) after both burn treatments. Monoao decreased greatly ($p<0.01$) after all treatments. Woolly moss increased greatly ($p<0.01$) after all treatments. In the lichenfield, monoao decreased greatly in both burn treatments ($p<0.01$). Silver tussock increased somewhat ($p<0.01$) in the 'Versatil' herbicide treatment. Hawkweed increased substantially ($p<0.05$) after both burn treatments. No other changes in species cover were significant. Burning and cutting of mature frost flat heathland both largely eliminate existing monoao populations. Burning monoao communities with hawkweed already present leads to a substantial immediate increase in hawkweed abundance. Neither 'Trimec' nor 'Versatil' provide effective chemical control of it. Cutting mature frost flat heathland is not a means of reinvigorating monoao. Further experimental burns in mature heathland at a range of scales and involving a variety of fire intensities are necessary before prescriptions for operational burning can be formulated.

1. Introduction

In summer/autumn 1993 a randomised block trial involving combinations of cutting, burning, and herbicide treatments was set up by Landcare Research and Tongariro/Taupo Conservancy of the Department of Conservation in frost flat heathland at Rangitaiki Conservation Area. The trial was remeasured by Landcare Research twenty months later in spring 1994.

2. Background

Heathland dominated by monoao (*Dracophyllum subulatum*) formerly covered tens of thousands of hectares of the Volcanic Plateau on sites prone to cold air ponding ('frost flats') but has been much reduced in the last 70 years

by afforestation with exotic conifers, clearance for pasture, and invasion by aggressive adventive plants such as broom (*Cytisus scoparius*). Now only one substantial relic (Rangitaiki Conservation Area) and two smaller ones (Waimarama Conservation Stewardship Land and Otangimoana CSL) have reasonable prospects for long-term survival. Like most low open native plant communities it is susceptible to invasion by aggressive adventive species, especially mouse-ear hawkweed (*Hieracium pilosella*). This hawkweed was already locally common at the time of the first detailed survey of Rangitaiki in 1988, and is continuing to expand its range here (M.C.S., unpubl. data). In the past, occasional fires have perpetuated monoao dominance by initiating new populations, but fire also promotes the spread of hawkweed. This project aims at finding ways of perpetuating monoao while minimising hawkweed spread, and of maintaining some hawkweed-free samples of frost flat heathland.

3. Objectives

- To find ways of maintaining the shrub (monoao) component of frost flat communities in the absence of wildfires.
- To test the practicality and effectiveness of mechanical cutting and of burning monoao shrubland as a means of reinvigorating it, in order to prevent mouse-ear hawkweed from gaining a foothold.
- To test the practicality and effectiveness of chemical removal of mouse-ear hawkweed in monoao shrubland as a means of maintaining representative samples of frost flat vegetation in a natural hawkweed-free state.
- To work with and advise DoC Field Centre staff on the management of frost flat vegetation.

4. Methods

Forty 2 x 2 m plots were established in February 1993 in Rangitaiki Conservation Area using randomised block design in approx. 90-year-old monoao shrubland with no hawkweed present. Five treatments were carried out in early autumn (March) 1993:

(1) control;

(2) cut monoao at ground level and leave;

(3) cut monoao at ground level and remove;

(4) cut monoao at ground level and burn;

(5) add accelerant and burn.

An identical experiment was set up in approx. 30 year old lichenfield with a 30% cover of hawkweed. Five treatments were carried out in March 1993:

(1) control;

(2) cut monoao at ground level and burn;

(3) add accelerant and burn;

(4) herbicide -'Trimec' (ICI), applied by knapsack sprayer to the whole plot;

(5) herbicide -'Versatil' (Dow Elanco), applied by knapsack sprayer to the whole plot.

Vegetative cover (canopy layer *sensu* Atkinson 1990) was monitored by point intercept method at 96 points in each plot before treatment in February 1993 and again in November 1994, 20 months after treatment.

Percentage cover data for major species before and after treatment were analysed by repeated measures ANOVA, to determine the effects of treatment on the structure and composition of the native plant communities and on rates of mouse-ear hawkweed invasion.

5. Results

5.1 SHRUBLAND

Repeated measures ANOVA indicated significant changes attributable to treatment effects in the cover of bare soil, monoao, and woolly moss (*Racomitrium lanuginosum*) (Figure 1). Bare soil increased significantly ($p<0.01$) after both burn treatments, from nil up to approx. 7%. Monoao decreased significantly ($p<0.01$) after all treatments except the control, from 50-70% down to 4 (cutting treatments) and completely absent (burn treatments). Woolly moss increased significantly ($p<0.01$) after all treatments, from 7-12% up to 35-48%. No other changes in species cover were significant. No invasion by mouse-ear hawkweed occurred, but no seed source is nearby.

5.2 LICHENFIELD

Repeated measures ANOVA indicated significant changes attributable to treatment effects in the cover of monoao, silver tussock *(Poa cita)*, and mouse-ear hawkweed (Figure 2). Monoao decreased significantly ($p<0.01$) in both burn

treatments, from 20-24% to less than 1%. Silver tussock increased significantly ($p<0.01$) in the 'Versatil' herbicide treatment, from 2% to 9%. Mouse-ear hawkweed increased significantly ($p<0.05$) after both burn treatments, from 25-31 % up to 48%. No other changes in species cover were significant.

6. Discussion

The small-scale controlled burns in this experiment were effectively 'crown fires', removing only the monoao canopy and leaving much of the ground layer vegetation unaffected. Most natural fires in frost flat heathland appear to be much more intense, eliminating most of the ground layer as well and creating large areas of bare soil. Twelve months after a natural fire ignited by a lightening strike at Rangitaiki in February 1994, bare soil constituted up to half of the ground area (M.C.S., unpubl. data), compared with less than 7% in this experiment, and virtually none of the pre-existing vegetation remained alive. Thus the burns in this experiment were much less intense than most natural ones.

The reduction in monoao in both burn treatments in shrubland and lichenfield is directly due to fire; the species is highly flammable and promotes fire (Smale 1990). The small increase in bare soil results from the combustion of flammable monoao leaf litter on the soil surface beneath mature plants, and from combustion of other flammable species such as *Pimelea prostrata*. The decrease in monoao in the cutting treatments in shrubland results from its inability to coppice after removal of the existing crown; plants are killed when their crowns are removed entirely.

Large increases in woolly moss cover after all but one shrubland treatment (cutting and leaving) do not result from any measurable growth of existing plants. Woolly moss invades the ground beneath aging monoao plants as their branches collapse outwards and their crowns thin (M.C.S., pers. obs.). The increases in cover merely reflect exposure of the moss carpet after removal of the monoao canopy above, and a consequent increase in its importance as a canopy species.

Substantial increases in mouse-ear hawkweed in both burn treatments in lichenfield reflect rapid colonisation by this species of ground bared by burning, through both expansion of existing plants (vegetative spread by runners) and establishment of new ones (sexual spread from seed). The relative importance of each mode of spread in this experiment is unknown.

In terms of the objectives of the experiment, the small increase in bare ground after low-intensity burning of shrubland should enhance opportunities for the establishment of a new cohort of monoao, albeit to a limited extent, but only so long as mouse-ear hawkweed remains absent from the site. Unlike hawkweed, monoao is a slow invader of bare ground; re-invasion of large tracts of heathland burnt in previous fires at Rangitaiki has occurred over many decades, with seedlings still establishing on an area burnt over 20 years ago.

Further monitoring is needed to document the re-establishment of monoao in burnt plots. In contrast to burning, cutting has not increased the area of bare ground available for monoao establishment.

Effective chemical control of mouse-ear hawkweed has not been demonstrated with either 'Trimec' or 'Versatil', the latter having a significant deleterious effect on monoao.

Many aspects of the reproductive biology of major frost flat species such as monoao, important to their management, remain to be investigated.

7. Conclusions

(1) Burning should not be used in monoao communities with hawkweed present, because it leads to substantial increases in hawkweed cover.

(2) Cutting mature frost flat heathland is not a means of re-invigorating the shrub component of frost flat communities.

(3) The trial should continue to be monitored to assess longer-term results.

(4) Should the Department of Conservation adopt controlled burning as a management tool for frost flat heathland, further controlled burning experiments in mature heathland at a range of scales and involving a variety of fire intensities are necessary before effective prescriptions for operational burning can be formulated.

(5) Other herbicides with known activity against hawkweeds should be tested in frost flat heathland infested with mouse-ear hawkweed

(6) Research on the reproductive biology of major species of frost flats is needed to facilitate effective management of these ecosystems.

8. Acknowledgements

Taupo Field Centre of the Department of Conservation under Mr Ralph Turner carried out the treatments. Dr Harry Keys (Tongariro/Taupo Conservancy of DoC) liaised over the trial. Bridget Blackwell and Matthew Vandy assisted with data collection. Drs Bruce Burns and Ian Payton and an unknown referee made helpful comments on the report.

9. References

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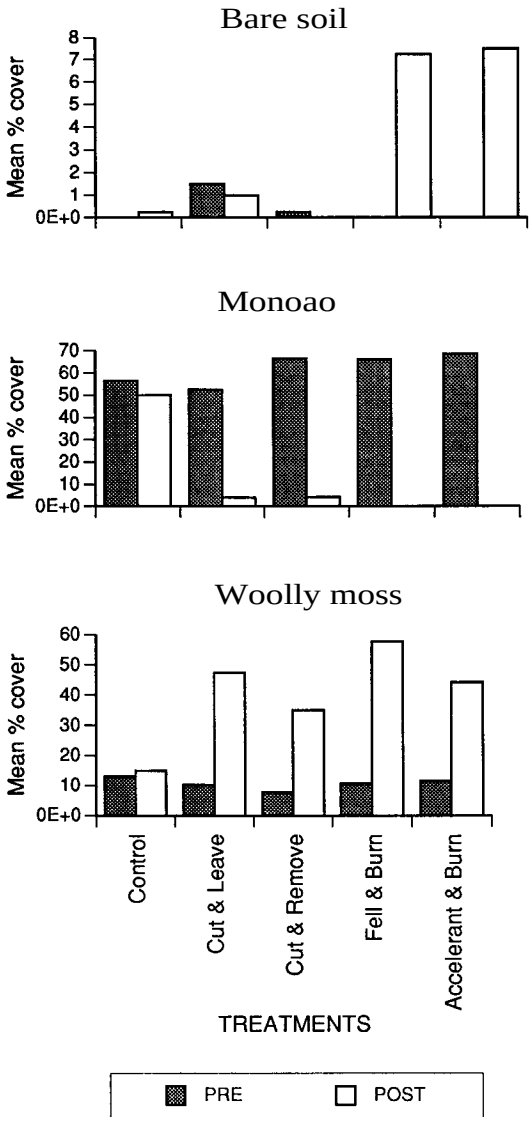

Figure 1: Significant changes in mean percentage cover of major species before and after treatment in cutting/burning trial in 90-year-old frost flat heathland (shrubland) at Rangitaiki.

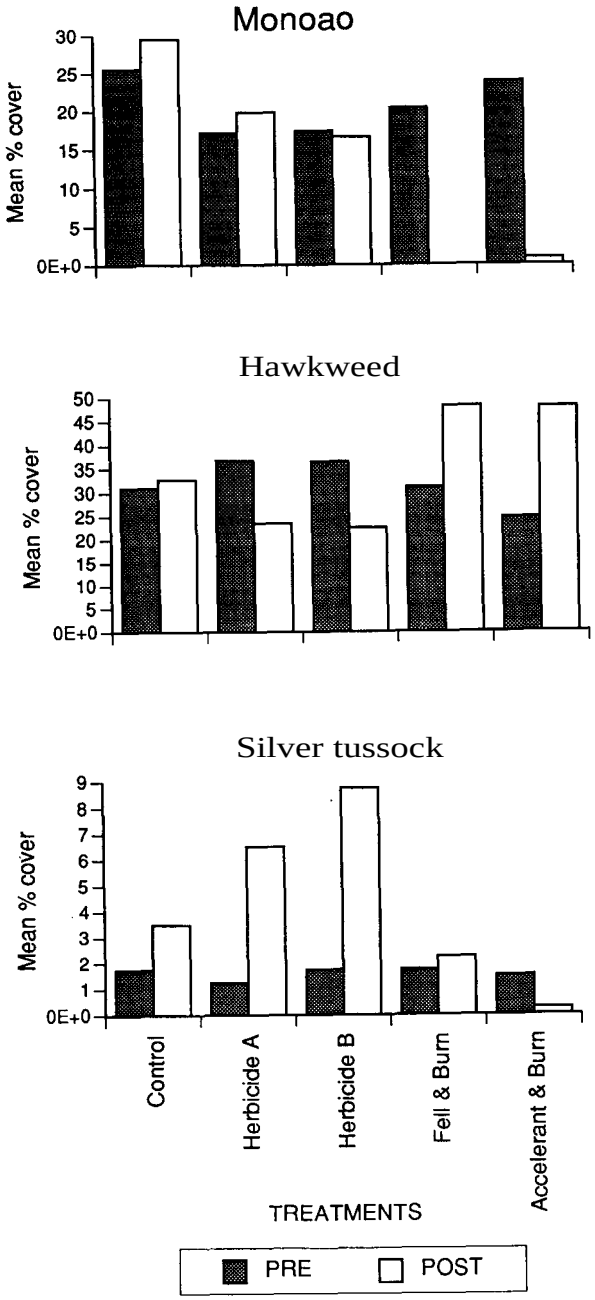

Figure 2: Significant changes in mean percentage cover of major species before and after treatment in herbiciding/burning trial in 30-year-old frost flat heathland (lichenfield) at Rangitaiki.