FUTURE CHANGES IN NEW ZEALAND'S HILL COUNTRY PASTURE WEEDS

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ABSTRACT

This paper examines the current and possible future status of weed problems in hill country pastures in New Zealand. Factors like lower fertiliser inputs, stocking rates, rural depopulation and changing land use that have affected pastures and pasture management in recent years were assessed. The possible effects of climate change on pastures and weed invasions were also considered. In addition farmers, Regional Councils, chemical companies and other stakeholders were surveyed for their opinions on existing and increasingly important weed problems. Survey results indicated a resurgence of woody weeds in hill country, probably as a result of lower fertiliser input/stocking rates and changing livestock classes due to marginalisation of hill country farming. There were few indications of any new weed species appearing in hill country pastures. Suggestions were made for increasing surveillance efforts to assist in the early detection of newly emerging weeds in pastures.

Keywords: pasture weeds, hill country, climate change, survey, weed dynamics.

INTRODUCTION

While many changes have affected New Zealand's pastoral industries in the last 20 years, hill country areas have probably been most affected. Following the removal of agricultural subsidies in the 1980s, sheep numbers fell, less fertiliser was applied, rural populations declined, and land uses changed. Changing climates, due to the burning of fossil fuels, already affect and will continue to alter the nature of hill country pastures. All of these may have affected weeds growing in pastures, and no assessments had been made since those reported by Bascand and Jowett (1981, 1982).

About half the number of Biosecurity Officers are currently employed by Regional Councils than were employed before Regional Councils were established by the Resource Management Act 1991. These officers now deal with environmental weeds as well as weeds of agriculture. Government-sponsored advice to farmers is no longer available. Many plant species that are serious weeds overseas have not yet reached New Zealand, but increased international traffic and trade increases the risks of their reaching our shores. In New Zealand, about 25 000 plant species are grown in gardens but have not yet become naturalised (P. Williams, pers. comm.). Some of these have the propensity to become invasive in some environments, including pastures.

Detection of new weed species soon after naturalisation is important if they are to be stopped from becoming a serious menace. The report on which this paper is based (Rahman & Popay 2001) was commissioned by MAF Policy and attempted to answer the question of whether recent changes in hill country farming have affected weeds. In particular, we wanted to know if any weed species are becoming noticeably more prevalent in hill country.

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METHODS

Land management information

Information was collected on changes in stock numbers (MAF NZ 2000a; 2001), fertiliser application (data supplied by Meat and Wool Economic Service), herbicide use (Holland & Rahman 1999) and rural populations (Houghton et al. 1996) over the last 20 years. Predictions of climate change were gathered along with any reports on its possible effects on pastures and weeds (CLIMPACTS; IPPC 2002; MAF NZ 2000b).

Opinion survey

In early 2001, we surveyed farmers, Regional Council staff and chemical company representatives for their opinions on existing weeds and on any weeds that are increasing in importance in hill country pastures. The survey form can be seen as Appendix 3 in Rahman & Popay (2001). Fifty three survey forms were distributed to Regional Councils, Provincial Presidents of Federated Farmers, and agrichemical companies. Some of the recipients forwarded copies of the form to field staff or to the people most qualified to complete it. Respondents were asked to rank the most common woody weeds in hill country pastures in their areas and to nominate the three most serious in terms of time and money land-owners spent in controlling them. They were also asked to name the commonest, and the most serious, herbaceous weeds. Furthermore, they were asked to name any 'increasingly important' woody or herbaceous weeds. Respondents were also asked for any additional comments they might have; the answers are not discussed in this paper but are available in Rahman & Popay (2001).

RESULTS

Sheep numbers declined from about 70 million in the early 1980s to 44 million in June 2001 (Fig. 1), and are expected to fall to 40.9 million by June 2004 (MAF NZ 2000a). The expected fall is attributed to further land use conversions to deer and forestry, and shifts to cattle (MAF NZ 2000a). Cattle to sheep ratios have increased and will probably continue to do so (MAF NZ 2000a). Fertiliser application to sheep and beef farms declined dramatically after 1980 but has now returned to its former level (Fig. 2). The proportion of hill country to which fertiliser was applied fell from an average of 38% between 1975 and 1985 to 22% between 1985 and 1992, and then recovered to previous levels. Regression analysis showed that 93.6% of the variation in fertiliser application rate could be attributed to the proportion of hill country to which it was being applied.

Application of herbicides commonly used for brush weed control has declined over the past 10 years, partly as a result of lower farm profitability (Holland & Rahman

FIGURE 1: Trends in New Zealand stock numbers, 1980-2001 (MAF NZ 2001).

1999). Rabbit haemorrhagic disease killed many rabbits in some parts of the country, and this may have led to an increase in woody weeds (NZPA 2001).

The rural downturn accelerated the long-term drift of populations from country to town. Between 1986 and 1991 populations in New Zealand rural areas declined by 5% nationally and by 10% in Southland, where the decrease was primarily in sheep farming (Houghton et al. 1996).

Mean temperatures have risen by up to 0.1°C per decade over the past century. The past decade has seen the highest mean annual temperatures ever recorded (IPCC 2002). Future climate change patterns for New Zealand are based on modifying various general circulation model (GCM) simulations. Climate models for the Australia-New Zealand region predict average temperatures to rise between 0.7°C and 3.1°C over the next 100 years (CLIMACTS 2000). NIWA's preferred GCM model (CLIMACTS 2000) suggests increased westerly winds, bringing more rain to the south and west and a greater chance of droughts in the north and east. Climate change will also be associated with a much greater incidence of adverse events like droughts, storms and floods. Fewer frosts will occur, with the greatest reduction in the South Island of over 10 fewer frost days by 2050 and 20 fewer days by 2100, approximately halving the number of frosts in that part of the country.

FIGURE 2: Fertiliser application to New Zealand hill country. The data are means over North Island hill country (including “hard” hill country) and South Island hill country (Meat and Wool Economic Service 2001).

Carbon dioxide concentration in the atmosphere is now about 30% higher than it was 200 years ago, and could nearly double today's level by the year 2035 (Morgan et al. 2001). Apart from its effects on temperature and rainfall, increasing levels of carbon dioxide directly affect plant growth, especially the interactions between different components of pastures. According to the overview of Campbell et al. (2000), a doubling of CO₂ will lead to a 17% increase in grassland production and a 10% rise in legume content of pastures. In FACE (Free Air Carbon dioxide Enrichment) field experiments at Flock House in the Rangitikei, the most responsive pasture species were broad-leaved herbaceous species, such as clovers and weeds. Elevated CO₂ increased seed production of several species, including weeds, and also enhanced seedling emergence and survival for some species. (Edwards et al. 2001).

Opinion survey

Fifty three replies were received from the survey, with responses well distributed across the country (Table 1).

TABLE 1: Number of replies received from each area.

Region	Replies	Region	Replies	Region	Replies
Nth Auckland	4	Wanganui/Manawatu	4	North Canterbury	3
Auckland	2	Hawkes Bay	4	Central Canterbury	4
Waikato	4	Wairarapa	2	South Canterbury	4
BOP/ Gisborne	5	Taranaki	3	Otago/Southland	4
Volcanic Plateau	3	Nelson/Blenheim	6	West Coast	1

Respondents ranked the commonest, and the most serious woody weeds to be those shown in Table 2.

TABLE 2: The number of respondents out of 53 listing each species as a common or serious woody weed species.

Species	Commonest woody weeds ¹		Most serious woody weeds ²
	Listed among 'common' weeds by	Listed in top 5 most common weeds by	Listed in top 3 most serious weeds by
gorse (<i>Ulex europaeus</i>)	53	48	49
blackberry (<i>Rubus fruticosus</i>)	42	35 (more in NI)	28 (more in NI)
broom (<i>Cytisus scoparius</i>)	35	29 (more in SI)	24 (more in SI)
manuka/kanuka (<i>Leptospermum scoparium</i> /Kunzea <i>ericoides</i>)	35	31	16 (more in NI)
barberry (<i>Berberis glaucocarpa</i>)	25	19	7
bracken (<i>Pteridium esculentum</i>)	25	21	3 (only SI)
sweet brier (<i>Rosa rubiginosa</i>)	20	11 (more in SI)	2 (only SI)
tutu (<i>Coriaria</i> spp.)	19	10	2 (only SI)
matagouri (<i>Discaria toumatou</i>)	17	14 (most in SI)	6 (only SI)
hawthorn (<i>Crataegus monogyna</i>)	17	6	3 (only SI)

¹Also often mentioned (ranked in order of mention as common by most respondents) were pampas (*Cortaderia* spp.), privet (*Ligustrum* spp.), Himalayan honeysuckle (*Leycesteria formosa*), tauhinu (*Cassinia leptophylla*), boxthorn (*Lycium ferocissimum*) and woolly nightshade (*Solanum mauritianum*).

²Other species named among the most serious were boneseed (*Chrysanthemoides monilifera*), burdock (*Arctium* spp.), mingimingi (several native spp.), nassella tussock (*Nassella trichotoma*), pampas, ring fern (*Paesia scarebula*), Spanish heath (*Erica lusitanica*), wilding pines (various spp.) and woolly nightshade.

The herbaceous weeds considered the commonest, and the most serious are shown in Table 3.

TABLE 3: The number of respondents out of 53 listing each species as a common or serious herbaceous weed species.

Species	Commonest herbaceous weeds ¹		Most serious herbaceous weeds ²
	Listed among 'common' weeds by	Listed in top 5 most common weeds by	Listed in top 3 most serious weeds by
thistles ³	49	48	41
ragwort (<i>Senecio jacobaea</i>)	38	36	30
barley grass (<i>Critetion</i> spp.)	12	7 (more in SI)	7
hawkweeds (<i>Hieracium</i> spp.)	11	8 (only SI)	4
pennyroyal (<i>Mentha pulegium</i>)	10	8 (only NI)	2 (only NI)

¹Also commonly mentioned (ranked in order of mention by most respondents) were horehound (*Marrubium vulgare*) (only SI), rushes (*Juncus* spp.) (only NI), buttercups (*Ranunculus* spp.), hemlock (*Conium maculatum*), docks (*Rumex* spp.), nassella tussock (mostly SI), ratstail (*Sporobolus africanus*), ring fern (mostly NI) and woolly mullein (*Verbascum thapsus*).

²Other species named among the most serious were alligator weed (*Alternanthera philoxeroides*), burdock, buttercups, Chilean needle grass (*Nassella neesiana*), fireweeds (various spp.), hawkweeds (only SI), horehound (only SI), lupins (*Lupinus* spp.), nettle (*Urtica* spp.), parsley dropwort (*Oenanthe pimpinelloides*) (Northland), pennyroyal, ratstail, ring fern, rushes, summer grass (*Digitaria* spp.), tutu and wild ginger (*Hedychium* spp.).

³Where thistles were listed by species, Californian thistles (*Cirsium arvense*) were mentioned as common by 26 respondents, nodding (*Carduus nutans*) by 18, Scotch (*Cirsium vulgare*) by 17, winged (*Carduus tenuiflorus*) by 12, variegated (*Silybum marianum*) by 7, marsh (*Cirsium palustre*) by 2 and plumeless (*Carduus acanthoides*) by 2.

Weeds commonly thought to be of 'increasing importance' are shown in Table 4.

TABLE 4: The number of respondents out of 53 listing each species as of 'increasing importance'.

Woody weeds of increasing importance		Herbaceous weeds of increasing importance	
Species	Listed by	Species	Listed by
gorse	12	thistles ¹	10
broom	8	hawkweeds	6
native species ²	7	ragwort	4
blackberry	6	pennyroyal	3
barberry	4	nassella tussock	2
hawthorn	3	parsley dropwort (Northland)	2
sweet brier	2	foxglove (<i>Digitalis purpurea</i>)	2
inkweed (<i>Phytolacca octandra</i>)	2	horehound	2
elderberry (<i>Sambucus nigra</i>)	1	nettles	2

¹Californian, marsh, nodding, Scotch and variegated thistles.

²Coprosma (*Coprosma* spp.), manuka, matagouri, muehlenbeckia (*Muehlenbeckia* spp.), rata (*Metrosideros* spp.), tutu and wineberry (*Aristotelia serata*).

Very few 'new' weed species were reported by any of the respondents. Some of the weeds reported are normally regarded as weeds of conservation areas, and may be becoming more common in bush margins impinging on pasture. Some of those named, like cotoneaster (*Cotoneaster* spp.) and tutsan (*Hypericum androsaem*), are already recognised as problems in some areas, and may be spreading further.

DISCUSSION

Lower sheep numbers, higher cattle to sheep ratios, lower fertiliser inputs (now reversed), less herbicide inputs and greater diversity of land use, accompanied by lower rural populations would have meant hill country pastures have become less vigorous, less intensively grazed and therefore more susceptible to weed invasion. This view is supported by the increases in both native and adventive woody species in hill country pastures perceived by the survey respondents.

The trends in declining sheep populations are predicted to continue (MAF NZ 2000a). Fertiliser and herbicide use will fluctuate with the fortunes of farming. Lower sheep numbers, reduced fertiliser use and the smaller rabbit population may jointly have led to the increases in woody weeds identified by survey respondents; a trend that will be irreversible without a considerable input of capital. Reduced profitability of hill country farming may have caused farmers to abandon or at least neglect pastoral land, especially on steeper country where woody weeds were already encroaching.

Higher rainfall in the south and west, resulting from climate change, will make grazing control of pastures harder, and will probably lead to further increases in woody weeds. Increasing temperatures will see the continued southward march of sub-tropical grasses and other warm-zone species. Conditions will become more amenable for warm-zone plants currently grown in gardens and not yet naturalised, and possibly for newly-introduced invasive species.

Many weeds, especially annuals or biennials like thistles increase in area and numbers after a series of dry summers and decline after wetter seasons. Some weeds, and Californian thistle is a good example, have been regularly cited in reports as 'increasing' for over 100 years, and are still seen as 'of increasing importance'. Increasing incidence of droughts in the future, especially in the north and east of the country, are likely to further exacerbate such fluctuations in the populations of annual or biennial weeds.

Very few 'new' emerging weed problems were mentioned by respondents. This may be because no new weeds are appearing as problems in hill country pastures, because they were not reported by respondents, or because they are not being noticed. Reductions in the rural population and lower numbers of Biosecurity Officers means there are fewer people in the countryside likely to recognise and take action on newly emerging weeds. Fewer farm workers means less time can be devoted to grubbing or spot spraying isolated patches of weeds.

Previous surveys of weeds in New Zealand, like that of Bascand & Jowett (1981, 1982) tended to concentrate on scrub weeds in the South Island. Bascand & Jowett (1981, 1982) listed the most widespread weeds (in order) as bracken, matagouri, gorse, kanuka/manuka, broom, sweet briar, tutu, blackberry. These same species still feature as the commonest and most important weeds.

Improved border security is important for stopping new potential weeds entering the country. Regional councils, responsible for most weed control once weeds are present, are doing a good job, but fewer biosecurity officers and fewer people on farms make early detection of new and spreading weeds difficult. Farmers, contractors, and the general public should be encouraged to provide information to Regional Councils. A weed awareness campaign should be introduced to help educate the public to the problems that weeds can cause. An enhanced and better-publicised identification service, education on the dangers of some weed species, and advice on eradication would help. Improved co-operation is needed between the agencies involved in weed control – Department of

Conservation (DoC), Ministry of Agriculture and Forestry (MAF) and Regional Councils. Better national co-ordination between Regional Councils would help in tracking of and advising on weed control. Research work should be better co-ordinated between the funding and delivery agencies concerned.

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