SUSTAINABLE LAND USE FOR THE DRY TUSSOCK GRASSLANDS IN THE SOUTH ISLAND

Office of the
PARLIAMENTARY COMMISSIONER FOR THE ENVIRONMENT
Te Kaitiaki Taiao a Te Whare Pāremata

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PREFACE

Pastoral production has been the principal source of income for the South Island high country communities for over 100 years, and has contributed many thousands of tonnes of fine wool towards New Zealand's export income. Understandably, there is a desire at local, regional and national levels to see this tradition sustained.

In the 1940s land degradation problems were greater than they are today. There was a widespread rabbit plague, tussock grassland was replaced by scabweed and bare ground, and farmers contemplated walking off their land. In the 1950s and 1960s rabbit grazing pressure was controlled through aerial drops of 1080 poisoned bait, on-the-ground follow-up by dedicated pest control workers and topdressing and oversowing to restore the lands. This effort was assisted by a substantial input of taxpayer funding.

In the 1980s the problem returned, although in a smaller area than before. Instead of widespread scabweed, there is hawkweed. The solutions of the 1950s are no longer affordable options, following cuts in taxpayer subsidy. Making rabbit control more affordable with myxomatosis could, given sufficient motivation and funding for land production, give a 'window of opportunity' in the 1990s to again rehabilitate the degraded lands.

However, unless the answers to "why has severe land degradation re-occurred?" and "why has the rabbit come back?" are understood by landholders and institutions, a 'window of opportunity' may be wasted.

Landholders have informed us that land development encouragement loans and catchment board subsidies in the 1970s were responsible for land improvements and increased stock numbers. Land improvements require continual maintenance and without that, and combined with the unsustainable practices such as burning tussock, more fertility has been lost from the land than has been restored. The 'health' of the land has declined and rabbits, hawkweed and bare ground are the result.

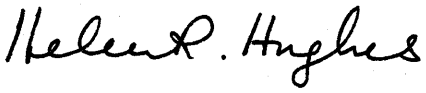
The reasons for the return of the rabbit are also known. Complacency by institutions and landholders alike over the success of aerial poisoning with 1080 and the failure to always follow up poison operations with other methods of control has resulted in selection of rabbit populations resistant to poisoning methods. The necessity to never rely on only one method of control is relevant irrespective of the primary method of control. There will always be pest control costs.

As well as rabbits the land is now invaded by hawkweeds for which effective control is still largely unknown.

The land remains under threat of continuing degradation even if pest control costs are reduced. Changes in land use away from traditional pastoralism are inevitable in some areas. The challenge for New Zealand is to prove that sustainable land use in the dry tussock grasslands of the South Island high country is possible.

This report is not saying anything new. It reinforces the messages my Office has received from many people, organisations and agencies.

Implementing land use change will require cooperation between the landholder, the rural community, and regional and central government. Where the Crown is also the land owner there is a clear responsibility to ensure the health of the land is restored and maintained, and to assist landholders to find their own solutions for land restoration.



Helen R Hughes
Parliamentary Commissioner for the Environment

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1.0 INTRODUCTION

1.1 Background to review

The Parliamentary Commissioner for the Environment has a policy of periodically reviewing the implementation of recommendations made to public authorities under the Environment Act 1986. It has been three years since the audit of the proposal to introduce myxomatosis as another means of rabbit control, and this report is a review of the implementation of the recommendations made in that audit.[1]

In response to the Commissioner's 1987 recommendations, a Rabbit and Land Management Task Force was established, reporting to the Minister of Agriculture in 1988.[2] Subsequent to that a Rabbit and Land Management Programme was established with central government, regional government, and landholder funding. This review addresses both the 1987 recommendations and the Programme itself.

This review was also undertaken in response to representations from the MP for Ashburton, members of the Canterbury Regional Council, and members of the public, describing negative environmental impacts from rabbit infestation and concerns about the economic sustainability of current control programmes, and calling for urgent reconsideration of the 1987 recommendations.

The terms of reference for this review, and the recommendations from the 1987 and 1988 reports, are presented in Appendices 2-4.

1.2 Review procedures

The review team visited the problem areas of Central Otago, the Mackenzie Basin and Inland Marlborough in the company of regional staff, councillors and landholders. Well-attended public meetings were held in Alexandra and Twizel.

Information was received and separate meetings were held with the National Advisory Committee and the MAF Technology managers of the Rabbit and Land Management Programme, the South Island High Country Committee of Federated Farmers, the Mackenzie Rabbit and Land Management Action Committee, the Central Otago Pest Management Committee, staff or representatives of the Central Otago, Canterbury, and Nelson/Marlborough Regional Councils, Ministry of Agriculture and Fisheries, Department of Survey and Lands Information (Office of Crown Lands), Landcorp, Ministry for the Environment, Department of Conservation, Ministry of Forestry, Mountain Lands Institute, and Treasury.

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1 Bamford and Hill,1985; APDC, 1987; PCE, 1987.

2 Rabbit and Land Management Task Force, 1988.

Meetings were also held in Auckland with representatives of environmental and animal rights groups concerned about 1080 use and the proposed introduction of myxomatosis (Greenpeace, Friends of the Earth, Royal Forest and Bird Protection Society, Toxin Action Group, Royal Society for the Prevention of Cruelty to Animals, Save Animals From Exploitation, NZ Conservancy Trust and the Biodynamics Farming and Gardening Association).

The Commissioner visited Australia and met Dr Tindall-Biscoe and colleagues in the Wildlife and Ecology Division of the Commonwealth Scientific and Industrial Research Organisation (CSIRO), and Mr H Moxam of the New South Wales Farmers Association. The review team also met Messrs Tony Jopp and Denis Fastier following their study tour of the Australian rabbit control situation on behalf of high country landholders in Central Otago and the Mackenzie.

Public submissions were not called for, as the 512 submissions received in 1987 on the proposal to introduce myxomatosis were considered relevant to the current review.

A substantial amount of documentation was received and reviewed by the team. Of particular value was the documentation on the Rabbit and Land Management Programme provided by the Regional Councils, the Programme managers in MAFTech, and other consultants contracted by MAFTech. In addition team members attended the Heiracium Workshop at Lincoln and reviewed the Report on Hawkweeds compiled for the Minister for the Environment by the Mountain Lands Institute.

A survey of agencies involved in relevant research was also conducted and the results analysed to ascertain where gaps existed. This material has been summarised and is available from the Commissioner's Office on request.

2.0 THE PROBLEM

2.1 Desertification: a declining land resource

> *"As long as tussock grassland is to be retained it must be remembered that, because its dominants are perennials with very long lives, it has many of the characteristics of a forest and few of those of a short rotation pasture. Like a forest, it is the product of a long slow development, and like a forest it is much easier to destroy than to rebuild."*
>
> Lucy Moore (1956)

The major environmental problem that confronts rural communities in Central Otago, Mackenzie Basin and parts of Inland Marlborough is not simply rabbits, nor hawkweed. It is the problem of seeking to sustain families and local communities at current levels, when the land resource base on which their pastoral economy is based is diminishing through increasingly severe degradation.

This is not a new problem. Degradation has been continuous, though cyclic in these areas for over 100 years. In large part it has resulted from unknowingly over-stressing the native tussock grassland ecosystems which evolved in the absence of frequent fire and intense grazing pressure.

The injurious aspect of land degradation is not so much erosion, but the reduction in soil organic matter, fertility, soil moisture, and soil structure. The soil becomes progressively unable to retain moisture or support plant growth. Eventually, a stage of desertification is reached and desert-like conditions prevail.

The dry tussock grasslands (less than 1000 metres in altitude) of the South Island experience low rainfall with severe seasonal moisture deficits. In addition some areas lack important soil nutrients, while others show acidity and aluminium toxicity. However, the tussock grassland ecosystems evolved to utilise this environment, and over time contributed organic matter and nutrients to the soil.[3]

Tussocks are slow growing and years of repeated burning effectively reduced plant vigour.[4] In the unimproved grasslands, nothing was introduced to take the place of the tussock as it slowly declined and the inter-tussock sward opened through loss of small herbaceous species. In the improved tussock grasslands, pasture species were introduced

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[3] Some of the soils had developed under forest which had been burnt only within the last thousand years. (McKendry and O'Connor, 1990; P Espie, pers. comm.)

[4] Basher, Meurk and Tate, 1990, p.68.

which require regular maintenance topdressing and oversowing to be retained as useful pasture.

The loss of litter through burning also removed organic matter from the immediate environment. Some nutrients remained in the area in the form of ash, but some was lost via smoke. In addition, sheep grazing took up nutrients, particularly sulfur, to create wool, which was exported from the area. On unimproved lands, the effect of frequent burning, and many thousands of sheep over many decades, led to a net loss of nutrients.[5]

Topdressing can replace some soil nutrients but cannot directly replace the loss of organic matter. Organic matter provides water-holding capacity, and resistence to compaction and erosion. Unless organic matter is restored plant production will eventually decline regardless of how much synthetic fertiliser is used.

There have been periods of recovery, most notably in the 1950's and 1960's with topdressing, oversowing, and aerial drops of 1080 to control rabbits. In the 1950's, a dollar for dollar taxpayer subsidy was available to kill rabbits and the rabbit population was brought under control. Subsidisation of agriculture at the farm level began in the 1960's with tax incentives and subsidies for fertiliser. The 1970's brought the livestock incentive scheme, land development encouragement loans, catchment board conservation farm plan subsidies and supplementary minimum prices for stock. This subsidisation of agriculture in the marginal pastoral lands of the South Island high country contributed to farming practices which were difficult to maintain once subsidies were withdrawn. However, under user-pays, these subsidies were phased out, bringing the most marginal rabbit-prone pastoral lands into sharp focus.

Notable troughs in the land degradation cycle have occurred in the 1890's, 1940's and 1990's. This 50 year cycle of decline and recovery in the dry tussock grassland is illustrated in Figures 2.1 to 2.13.

2.2 Pastoral farming 'at the limits'

Managed ecosystems require continual maintenance. Where managed ecosystems exist at the limits of productive capacity, any deferral or default on maintenance can have disastrous consequences. The need for vigilance in ensuring the ecosystem remains healthy is illustrated in the state of lands showing marked or incipient signs of desertification as in parts of Central Otago, the Mackenzie Basin and Inland Marlborough, including loss of diversification of plant cover and dominance by hawkweeds. Maintenance of these lands, by preserving vegetation cover, returning nutrients to the soil and controlling weeds and pests, has not been consistent.

Following the 1950's successful control of rabbits through aerial poisoning using 1080, New Zealand appeared to become entirely complacent about pest control. Central

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5 To date this is empirical analysis: quantification awaits further research.

government scientific institutions no longer saw the need for research into alternative pest control methods. Public authorities with land management responsibilities were fragmented into single purpose authorities and no single organisation had the responsibility to consider the land as a whole. The fundamental processes andinteractions occurring between weather, soil, pests, weeds and pastoral management were not identified.

There is no doubt individual landholders were aware of these interactions. However they were not provided with either appropriate scientific information about land use alternatives or advice on how long-term management decisions could be made which would ensure the ecosystem was maintained and made sustainable.

The areas involved in the Rabbit and Land Management Programme are 'at the limits' of productive capacity. Long-term sustainable farming in the dry tussock grasslands requires sufficient land to run the stock plus a large 'buffer' to allow spelling of pasture and conservative management during years of drought and rabbit plague. However, many properties have a poor balance of 'winter' and 'summer' country, and insufficient 'buffer'.

Farming 'at the limits' must always be conservative if it is to be sustainable in the long term. As the Australian dryland farming experience has shown, a sustainable level is farming for the worst conditions, and letting the country recover during the good years.[6] This concept is also used in New Zealand's drought-prone areas where landholders are encouraged to manage for the dry years rather than taking higher returns from the land between droughts.[7] Unfortunately, however, short-term economic pressures and the fact that some properties have a poor balance of land types can force pastoral landholders to maximise their production in any one year. This may be despite their wishes to manage the land more conservatively to benefit present and future generations.[8]

Climate, rabbits and hawkweed are only part of the equation that makes high country farming a risky business. As in other farming areas, economic pressures are significant (e.g. commodity prices, debt loading, interest rates, cost of inputs). Unlike other areas, however, the environment is not so forgiving, and there is much less margin for error.

Withdrawal of Wool Board price supports will exacerbate this financial constraint. Less farm income will be available for land diversification, maintenance of improvements or land management changes. If land maintenance is deferred, then degradation of the land ecosystem will continue still further.

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6 B. Foran et al., 1990.

7 Caird, 1989.

8 MAF, 1990; Kerry Turner, NZ Rural Trust, pers. comm.

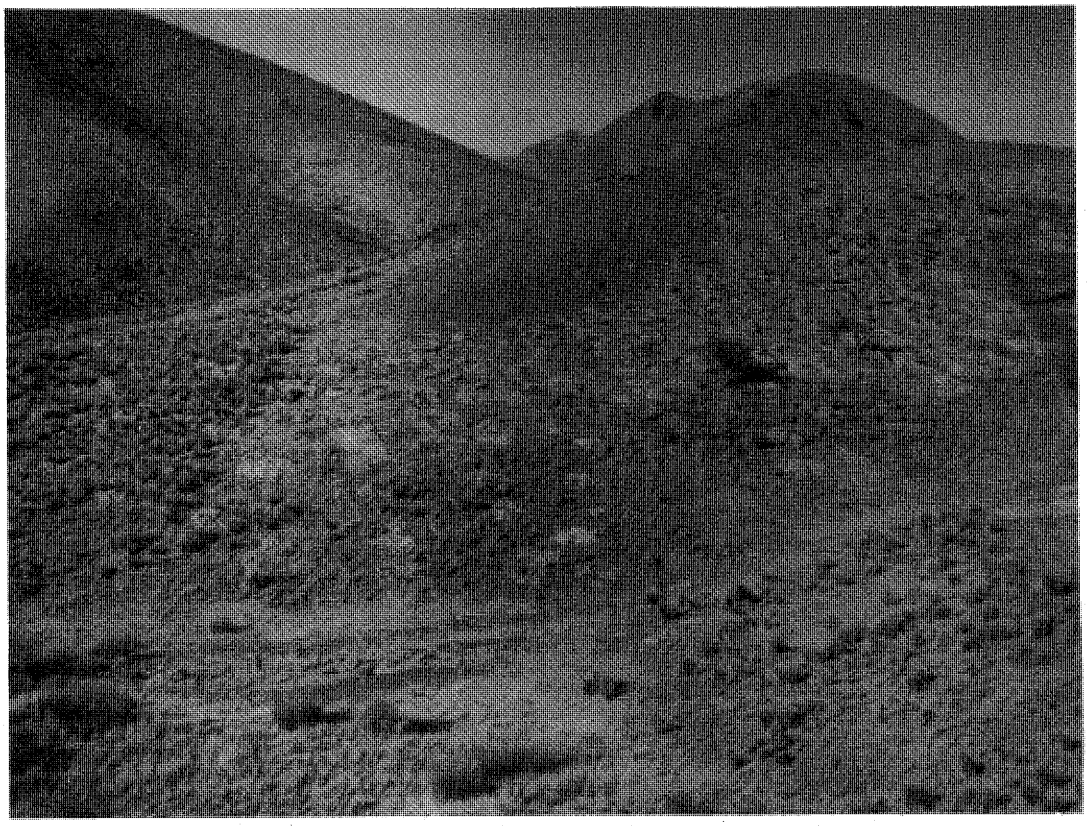


Photo credit: H S Gibbs, DSIR

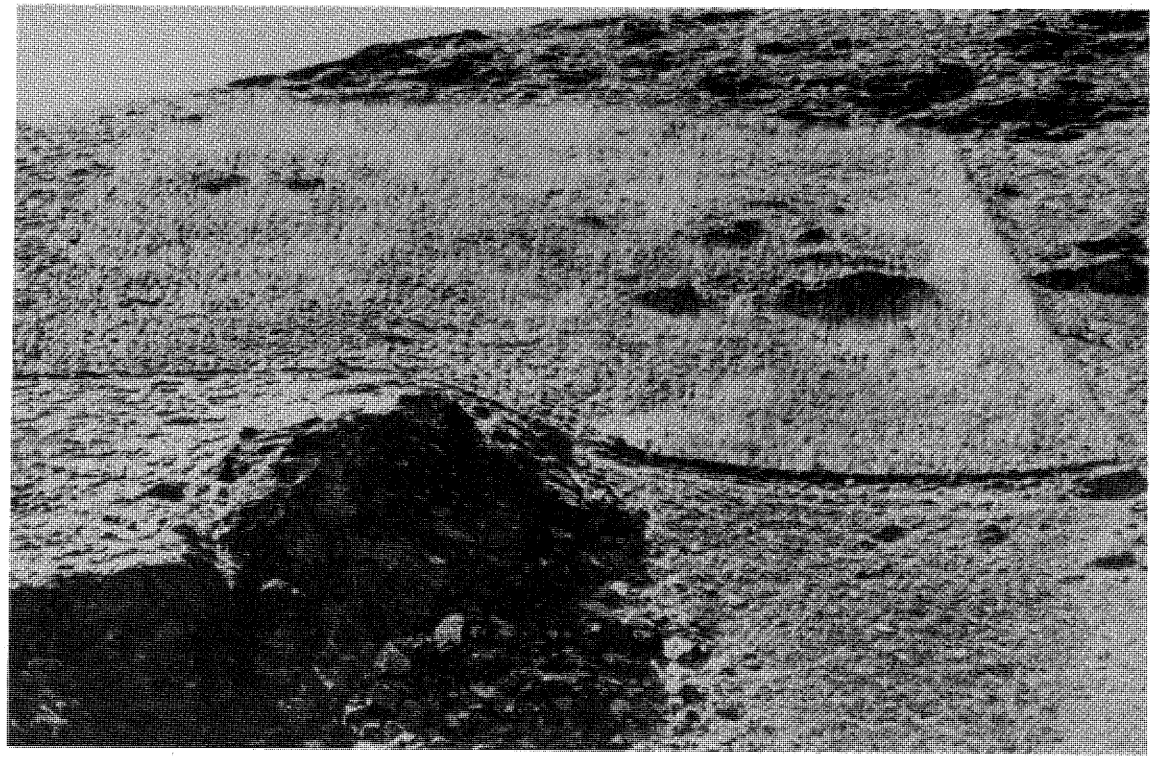
Molesworth Station, 1962: scabweed infestation (light coloured patches) on dry sunny face, surrounded by depleted tussock.

Photo credit: Dana Peterson

Molesworth Sation, 1991: Hawkweed infestation (light patches centre and left). Vegetation in moist depressions is predominantly sweet brier.

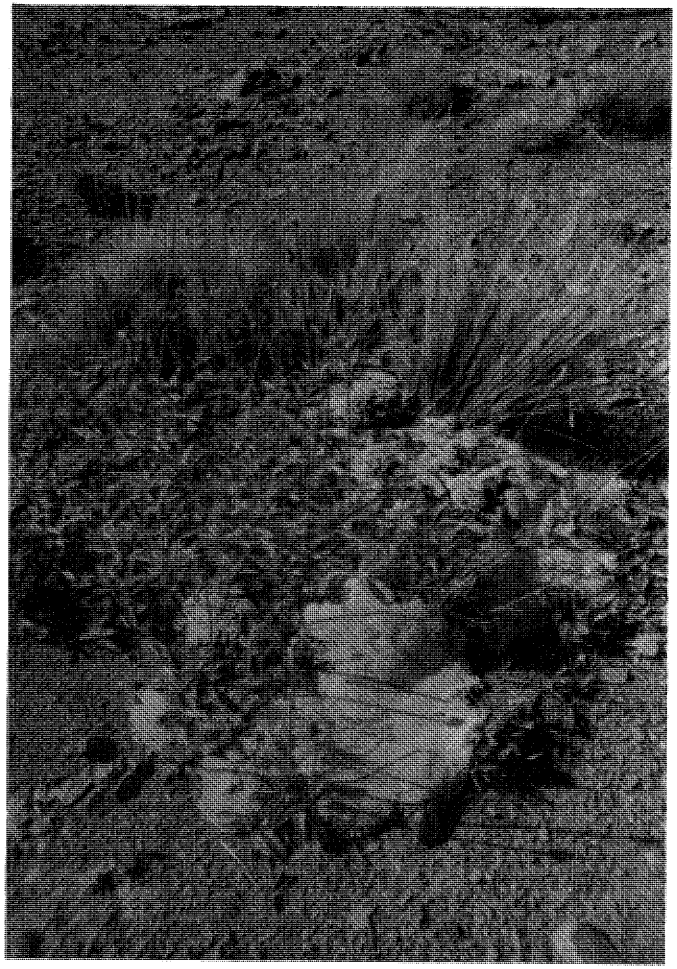
Figure 2.1: Land degradation in Inland Marlborough, 1962 and 1991.

Photo credit: Alexander Turnbull Library, Wellington



Natural recovery of extremely degraded lands after excluding rabbit and livestock grazing pressure, Central Otago, 1952. Outside the fence is dominant scabweed vegetation and bare ground. Agricultural Department experiment plot.

Photo credit: Dana Peterson



Old scabweed surrounded by bare ground, being colonised by tussock seedlings (slow growing) and hawkweed (faster growing). Molesworth Station, 1991.

Figure 2.2: Vegetation change in Central Otago 1952 and Inland Marlborough 1991.

Photo credit: DSIR Land Resources

Improvements with topdressing and oversowing near Tarras, ca. 1960's. Foreground: unimproved dry tussock grassland; background; tussock replaced with cocksfoot and lucerne. Improved lands require input to establish and maintain cover.

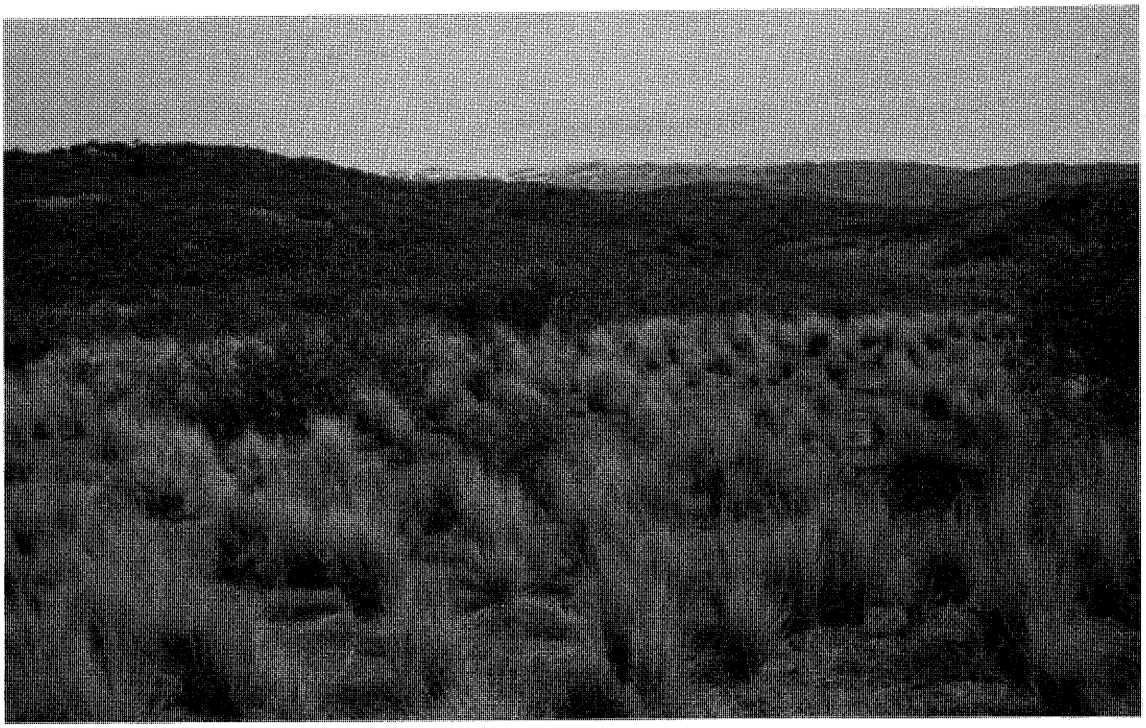


Photo credit: Dana Peterson

Good vegetative recovery after a burn in the 1960's, in 'scrub belt' near Fruitlands, adjacent to Earnscleugh Station. Native matagouri scrub (dark vegetation, background) causes stock and rabbit management problems, but provides good ground cover and restores nitrogen to the soil.

Figure 2.3: Good vegetative cover, Central Otago, 1960's and 1990's.

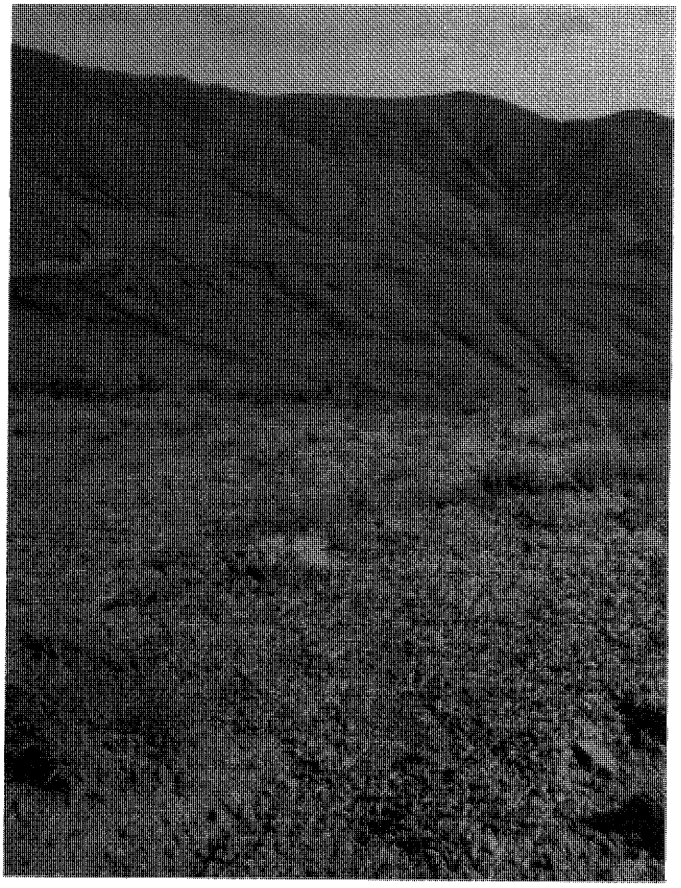


Photo credit: Dana Peterson

Molesworth Station, Inland Marlborough. Background hills also hawkweed dominant.

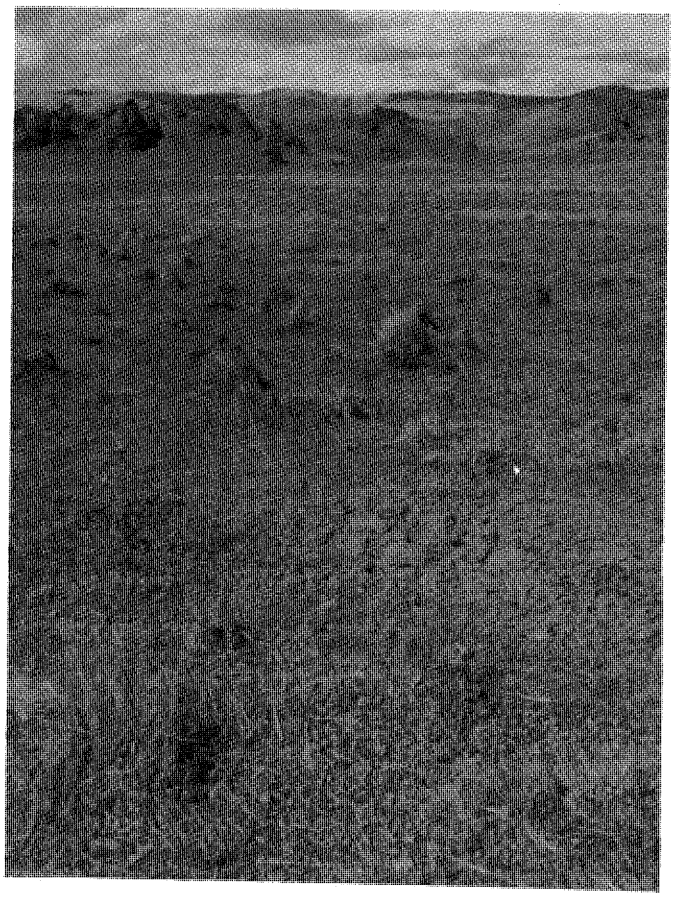


Photo credit: Helen Hughes

Galloway Station, Central Otago, near Manorburn Dam. "Holding Paddock" : intense stock grazing pressure at times.

Photo credit: Dana Peterson

Simons Hill Station, Mackenzie Basin. Acheron soils; aluminium toxicity.

Figure 2.4: Land degradation and hawkweed dominance in Central Otago, Mackenzie Basin, and Inland Marlborough, 1990-91. Dominant cover hawkweed and bare ground, with scabweeds and remnant tussock.

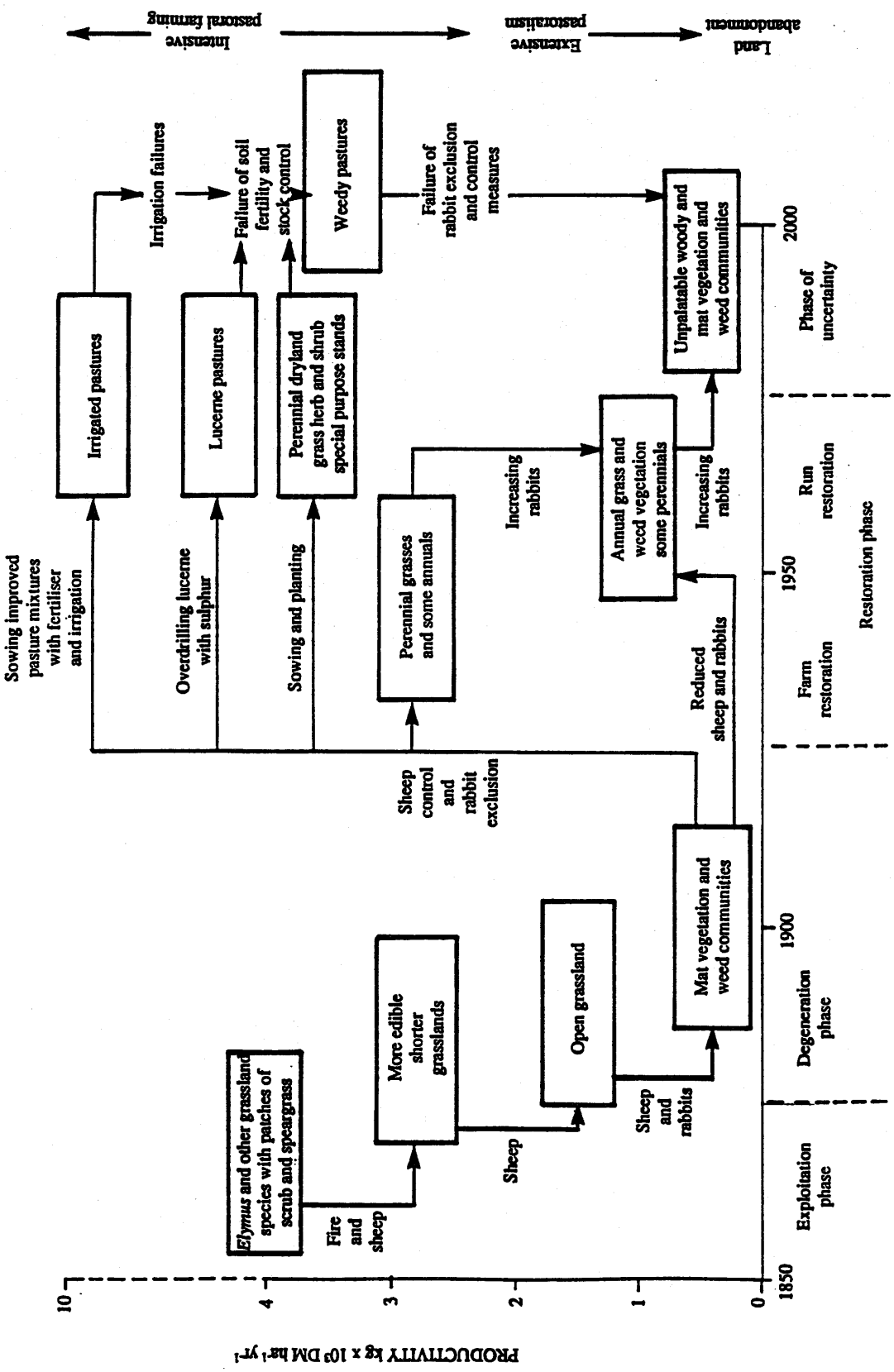


Figure 2.5 Vegetation Changes in Pastoral History (semi-arid brown-grey earths)

Source: Kevin O'Connor, pers. comm., 1991.

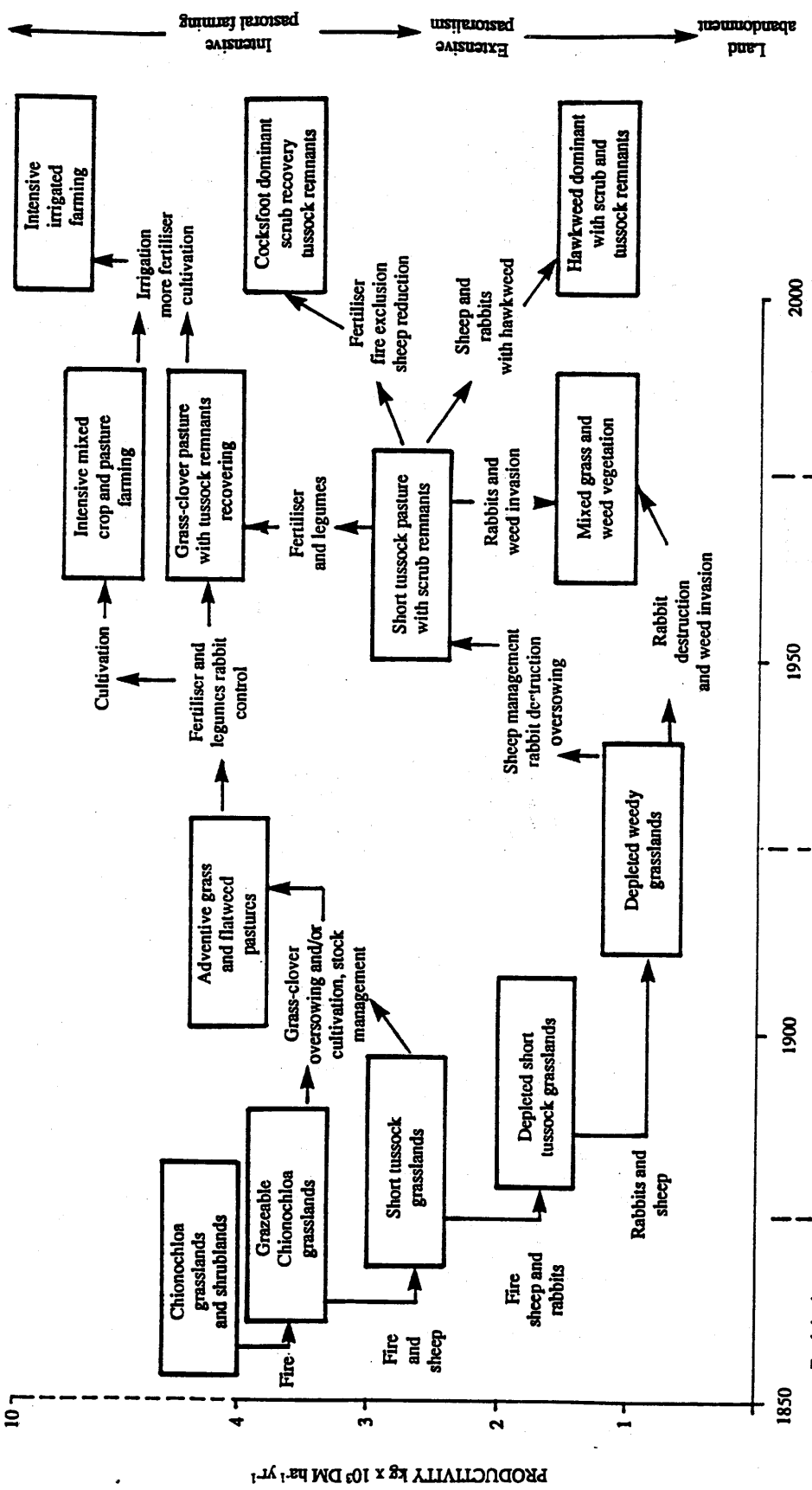


Figure 2.6 Vegetation Changes in Pastoral History (sub-humid yellow-grey earths)

Source: Kevin O'Connor, pers. comm., 1991.

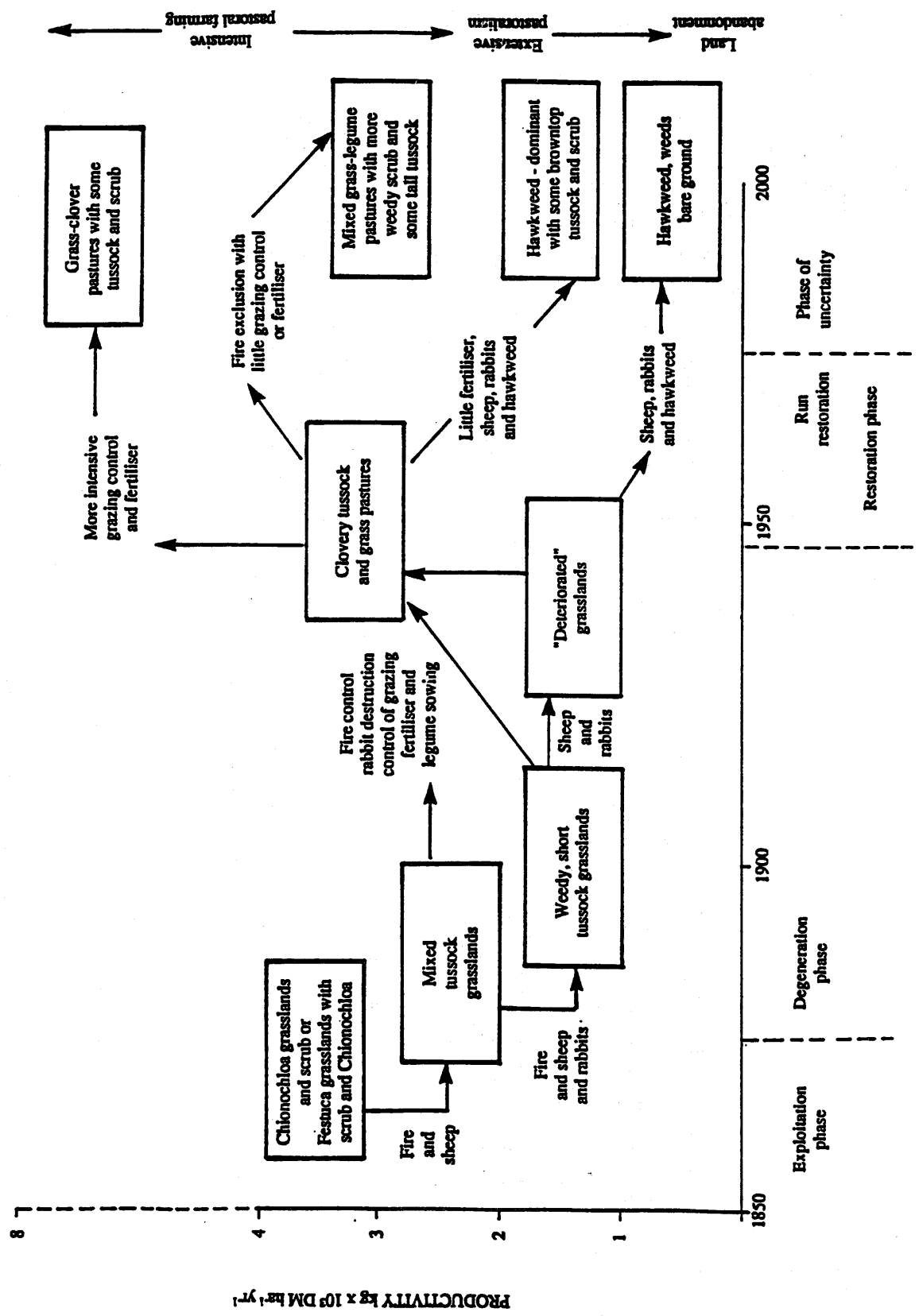


Figure 2.7 Vegetation Changes in Pastoral History (sub-humid yellow-brown earths)

Source: Kevin O'Connor, pers. comm., 1991.

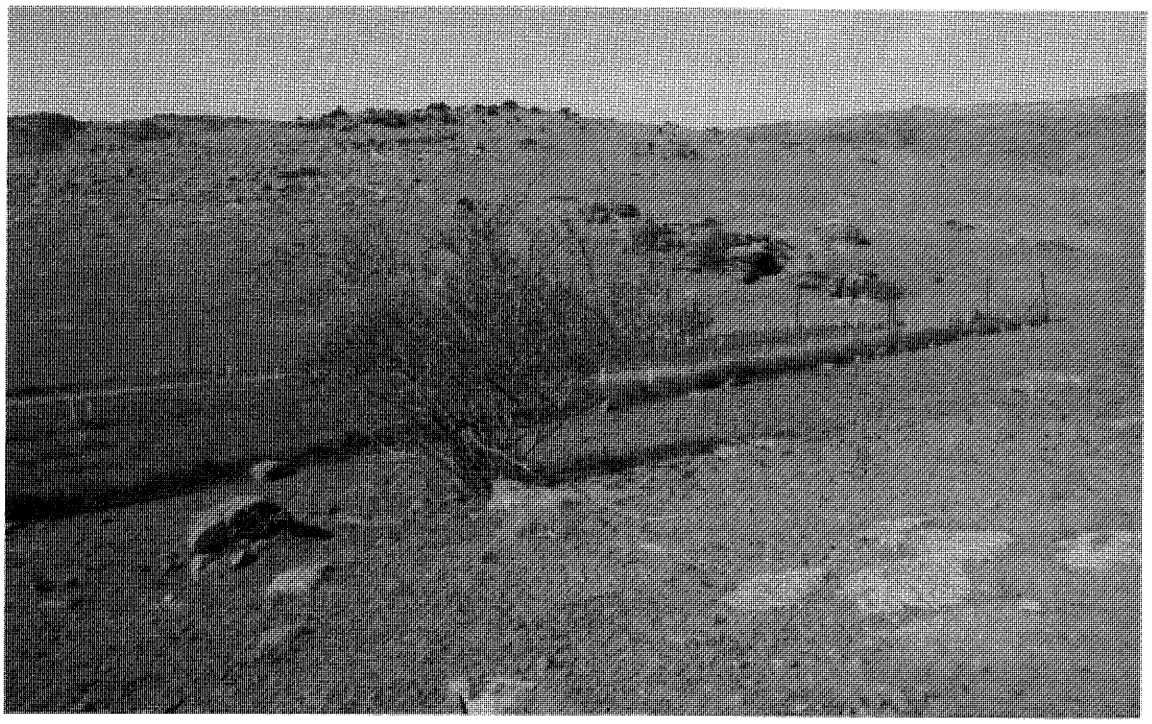


Photo credit: Dana Peterson

Natural recovery of native and oversown species after removal of grazing pressure, Earnscleugh Station, Central Otago. Both rabbits and livestock are excluded by the fence. Foreground; bare ground, scabweed, hard grazed pasture species, sweet brier. Sunny face, brown-grey earths.

Photo credit: Dana Peterson

The 'roadside verge effect', Central Otago. Background; sheep and rabbits. Foreground: rabbit only. Livestock grazing opens out vegetation and improves rabbit habitat.

Figure 2.8: **Effects of rabbit and livestock grazing pressure, Central Otago, 1990.**

2.3 Rabbits

> *"It would appear that over three generations of occupancy, especially in the back country, each generation has had to have the lesson of rabbit infestation driven home with attendant hardships, frustrations, desolation and ruin, through lack of continuity of effort when the rabbit numbers were low and not considered a further menace, or through the lack of capital required to deal with the problem effectively."*
>
> Bill Chisholm, Manager of Moleworth Station
> (quoted in McCaskill, 1969)

High rabbit populations essentially represent ***uncontrolled over-grazing.***

Rabbits are both a cause of desertification, because they exert intense grazing pressure on the vegetation, and a symptom of desertification, as they thrive in environments desertified by their own and other influences. Rabbit control is therefore an essential part of finding a solution to the desertification problem.

The lands involved in the Rabbit and Land Management Programme are shown in Figure 2.9, with detail of the 'high' and 'extreme' problem areas shown in Figure 2.9 and 2.10. For comparison, the extent of the problem in the 1940's is shown in Figure 2.11.

The Rabbit and Land Management Programme has highlighted the long-term unaffordability of conventional control in these areas and has more fully documented the extent of the problems of bait and poison shy rabbits.

Changes in funding

In the 1980's taxpayer subsidy of rabbit control was progressively removed, causing reduction in rabbit control efforts, particularly follow-up controls. It became increasingly obvious that production from some lands was not sufficient to pay for rabbit control costs, and rabbit prone areas receiving inadequate follow-up work experienced severe increases in rabbit numbers. Analysis of pest control funding trends in the dry tussock grassland indicates that in the Mackenzie Basin, there was lack of financial support from landholders for adequate rabbit control, suggesting strongly that the current rabbit problems were partly of their own making.[9]

Effect of changed weather patterns

During visits to the rabbit problem areas, the Commissioner's review team asked landholders "why has the rabbit come back?". The most frequent response referred to the removal of taxpayer funds for rabbit control and the substitution of a 'killer' policy with a 'control' policy. However, there were also several references to abnormal weather

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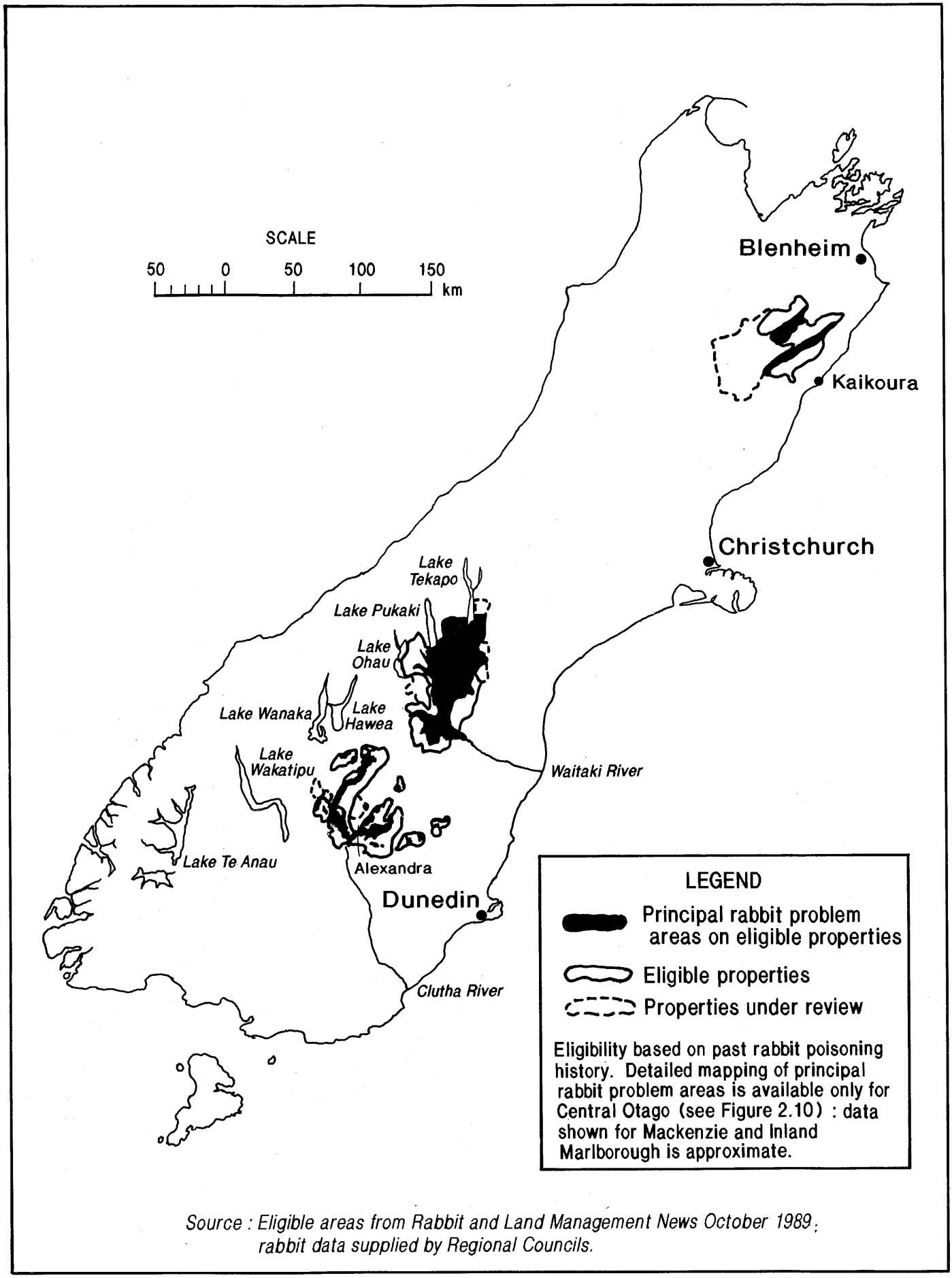
[9] Taylor Baines and Assoc., 1990, pp.13, 37, 38.



Source : Eligible areas from Rabbit and Land Management News October 1989; rabbit data supplied by Regional Councils.

Figure 2.9 Principal rabbit problem areas of South Island lands eligible for inclusion in the Rabbit and Land Management Programme.

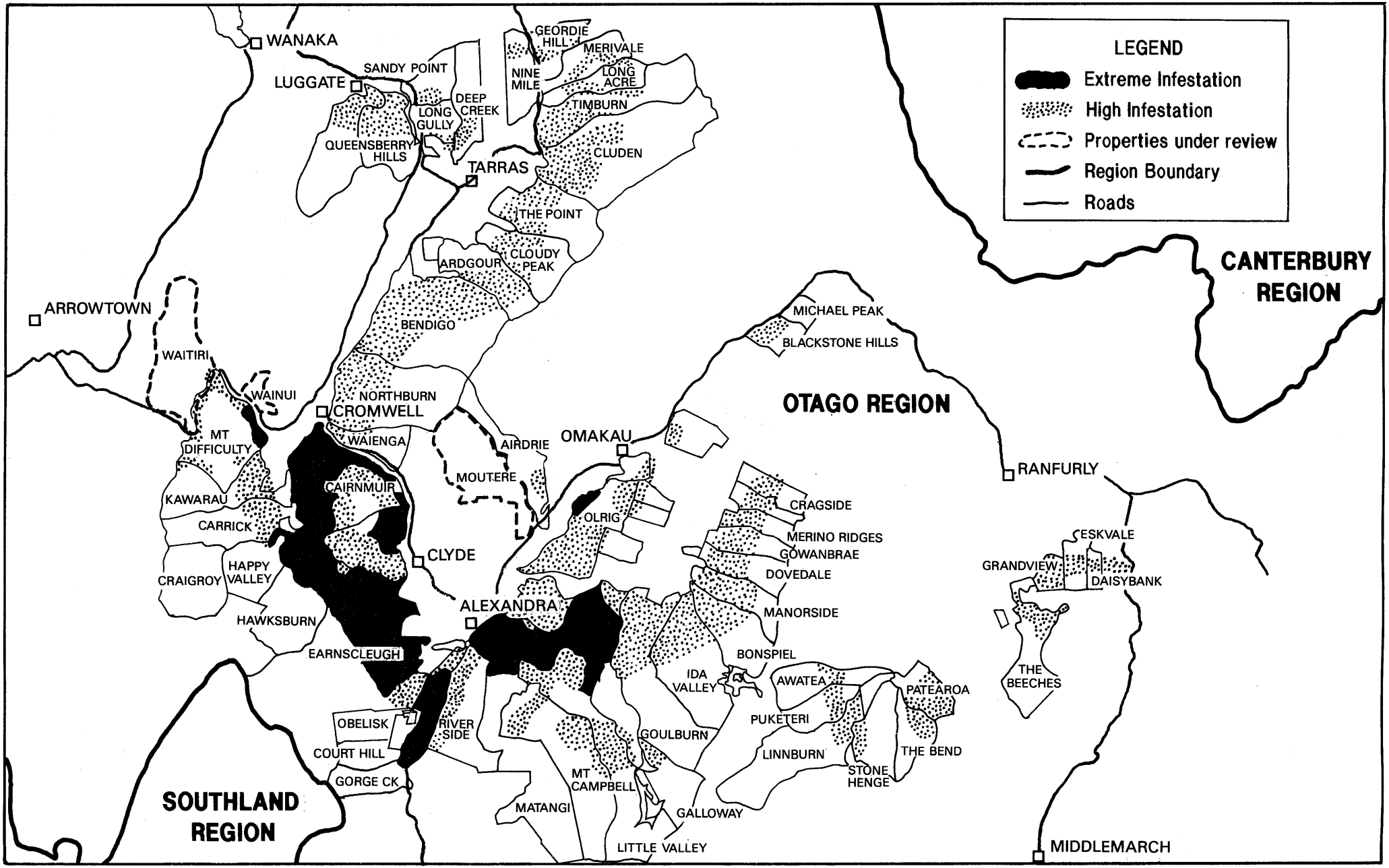


Figure 2.10 Rabbit and Land Management Programme – indicative plan of properties with high and extreme zones of rabbit infestation, Central Otago.

Source : Otago Regional Council

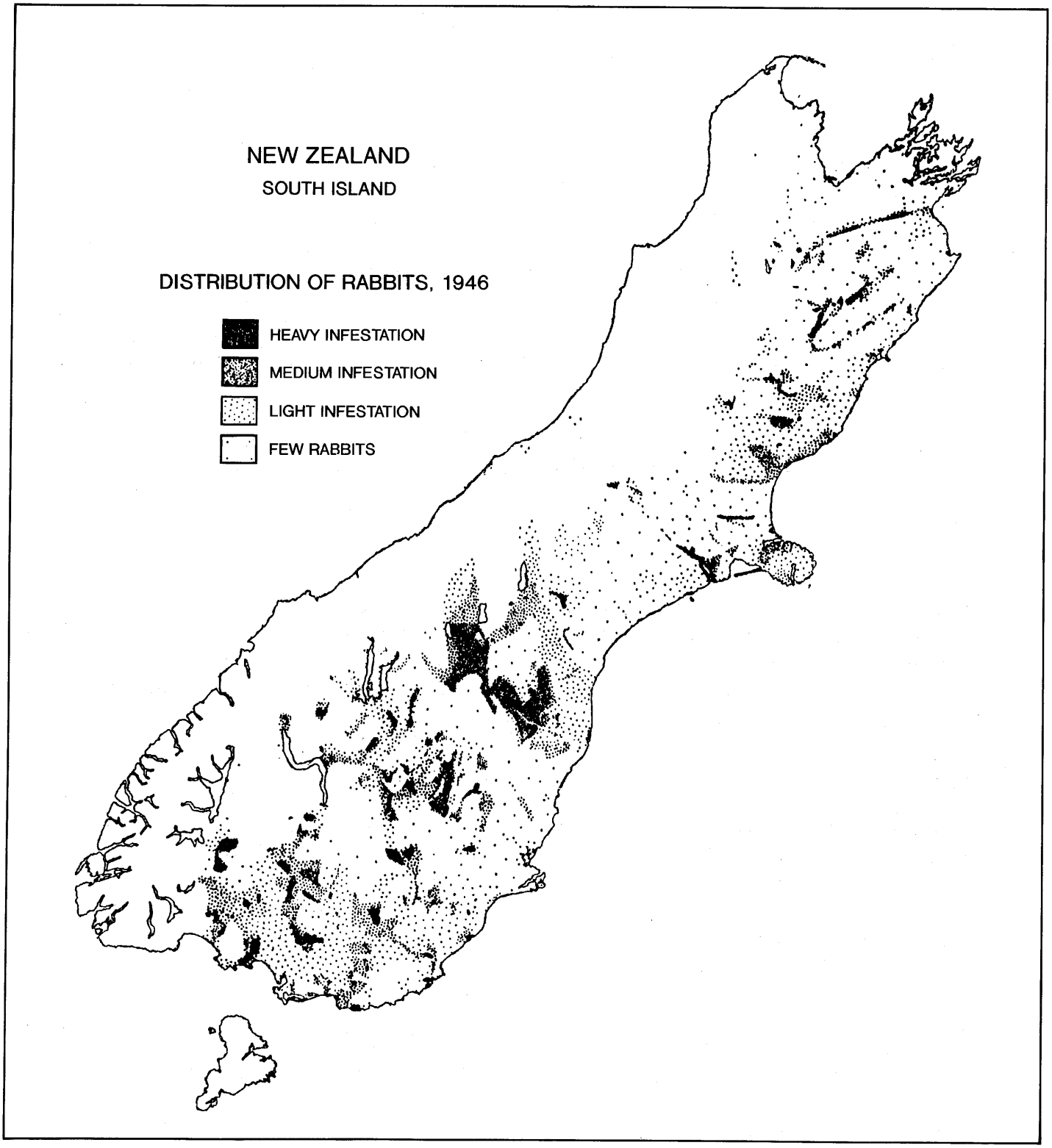


Figure 2.11: Extent of the rabbit problem prior to 1950.

Source: Royal Commission to Inquire Into and Report on the Sheep Farming Industry in New Zealand, 1949.

patterns in recent years. Most commonly the changes referred to were *milder winters* (favouring rabbit breeding) and a *shift of rainfall to warmer months when more was lost through evapotranspiration* (adding moisture stress to the vegetation and exacerbating rabbit impacts).

In order to document the shifts in weather patterns observed by landholders, the review team sought analysis of days of frost (intensity of winters) and soil moisture deficit (loss of moisture) over the last 40 years. Graphs are presented in Appendix 5. This analysis did illustrate some minor long-term changes to days of frost (Alexandra fewer days of frost, Lake Tekapo and Molesworth more days of frost), but no significant long-term change in the soil moisture deficit that was over and above natural variability. Similarly, in the analysis of weather patterns in Central Otago by MAFTech confirmed there had been a minor drought in recent years, but nothing unusual for that normally drought-prone area.[10]

The cyclic nature of droughts is well known to landholders. Variable weather that favours rabbits and stresses vegetation are inherent qualities of the dry tussock grassland environment.

Need for new controls

While rabbit numbers are now controlled throughout most of New Zealand by the disease coccidiosis and predators (including cats, ferrets and stoats), these natural controls are not effective in the areas under consideration because low rainfall restricts coccidiosis, and shorter rabbit breeding seasons and winter poisonings result in shortages of young rabbit prey to carry predators over the winter.

New methods of control are needed for the dry tussock grasslands. In Australia, rabbits in marginal pastoral lands are controlled through a range of controls including active predators (particularly foxes), myxomatosis, and follow-up poisoning and warren ripping. In Central Otago, the Mackenzie Basin, and parts of Inland Marlborough the only effective controls available are poisoning and shooting. If these controls fail or are unaffordable, there is no effective control for rabbits in these areas. Reliance on a single method of control inevitably runs the risk that a population will selectively breed resistance to the control agent, as appears to be the case with bait and poison shy rabbits.

Public calls by pastoral farmers for myxomatosis, as a new and cheaper tool that would also control bait-shy rabbits, arose in 1983, and again in 1985, 1987 and 1990.

It is clear that local communities cannot afford to continue current levels of farming of rabbit prone pastoral lands over the long term without more effective and more affordable rabbit control methods. The question that must be asked, however, is how

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[10] Jarvis, 1990.

to attain sustainable land use and management given the harsh environment and presence of pests and weeds.

2.4 Hawkweeds

Hawkweeds (*Hieracium spp*) have been characterised by a number of landholders as being of greater consequence than rabbits. The Commissioner's review team has been told by the local communities of the 'creeping grey hand' of hawkweed, and the tragedy of the familiar tawny tussock being steadily replaced by a 'grey carpet' that has neither scenic nor pastoral value. The review team observed extensive areas where hawkweeds are now the dominant species in the Mackenzie (particularly on the infertile Acheron soils), Inland Marlborough (particularly on Molesworth Station), and Central Otago (smaller areas near Manorburn Dam). These are illustrated in Figures 2.1 and 2.4. The map of hawkweed distribution (Figure 2.12) demonstrates that nearly all areas of the eastern South Island hill and high country are affected by hawkweeds, to a greater or lesser degree. Exceptions include some high alpine grasslands and some very wet (super-humid) and very dry (semi-arid) areas. Levels of abundance in classes 'common' and 'conspicuous' have the potential to increase where environmental and management conditions are favourable to hawkweeds.

Hawkweeds may be a symptom of desertification, one of its causes, or both. The Commissioner's review team frequently heard the view from scientists and landholders that hawkweeds were aggressive weeds which 'knocked out' healthy native tussock and introduced pasture grasses. A number of scientists, however, have proposed that the preferred species were weakened and/or lost through other influences (e.g. grazing pressure by rabbits and livestock, fire, drought, decline in soil fertility) and the hawkweeds were suitably adapted as stress tolerators to compete under those conditions. Research has so far been unable to prove which theory is right.[11]

The only control for hawkweeds to show any potential to date is topdressing and oversowing, but this is only effective where there is available moisture.[12] This option is also unaffordable to establish or maintain in most of the depleted dry tussock areas with dense hawkweed cover.

Biological controls have been proposed for hawkweeds.[13] There is some concern, however, about the potential result of eliminating hawkweeds with a biological control agent. In some desertified areas of the Mackenzie Basin, Central Otago and Inland

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11 For example, the 'allelopathic' effect of hawkweeds (exuding of chemicals that kill or inhibit growth of other species) has not been shown to be a significant effect (Makepeace et al., 1985), and recent research suggests that hawkweeds only move in where tussock grassland has been damaged through other outside causes (M. Tresconova, pers. comm., 1990).

12 Scott, Robertson and Archie, 1990; Scott, 1990a.

13 Grundy, 1989; Scott, 1990b.

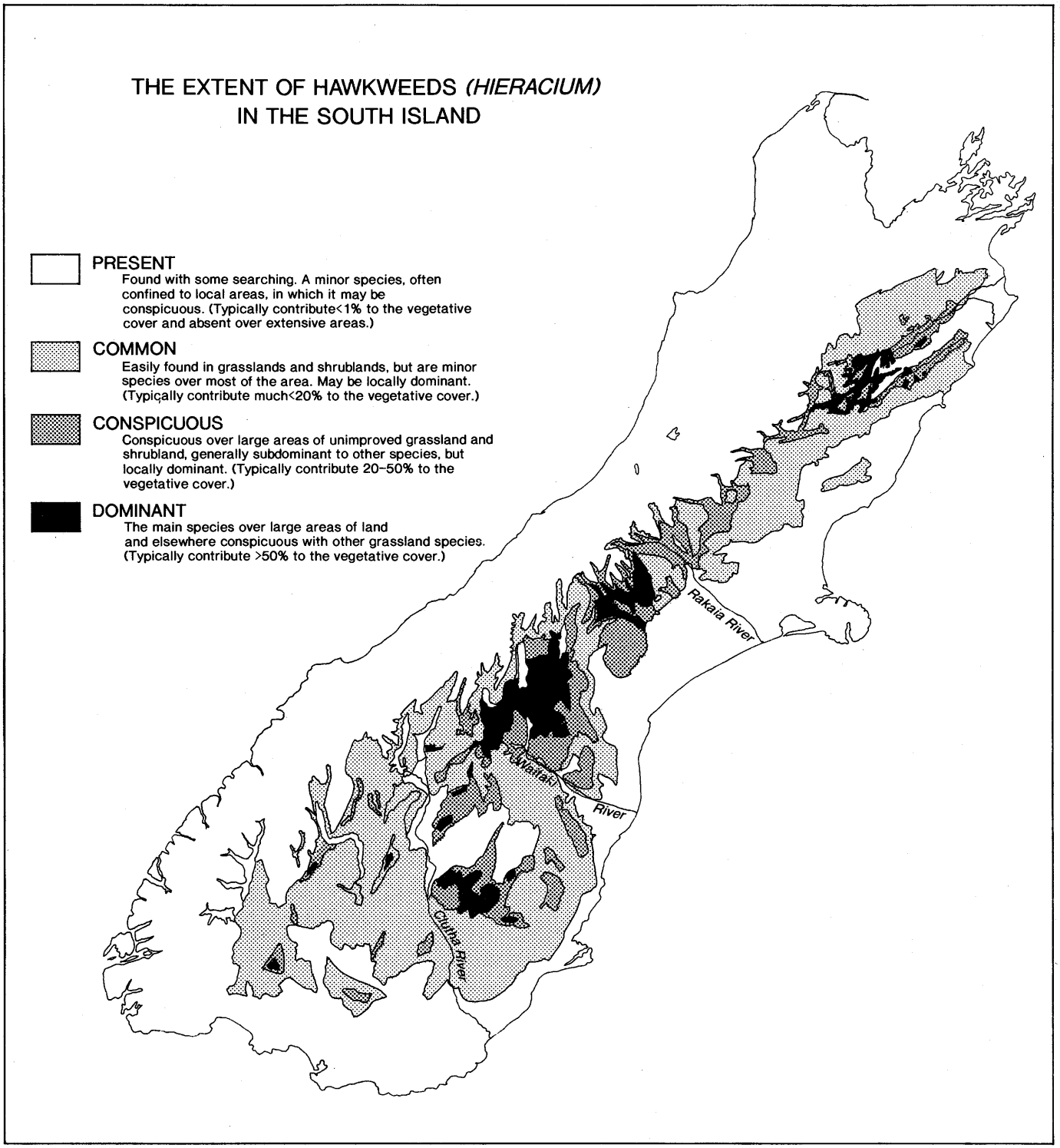

Figure 2.12

Source: Grant Hunter, DSIR Land Resources

Marlborough viewed by the review team, hawkweeds are virtually all that is left holding the soil (the bare patches not covered by hawkweed, scabweed, or remnant tussock 'stumps' are subject to frost-heave and wind erosion). It would be essential to replace these hawkweeds with some other plant species to prevent widespread soil erosion if biological control were introduced to reduce the vigour of hawkweeds.

The introduction of myxomatosis or other viral rabbit controls on their own would do nothing to solve the hawkweed problem. Even if grazing pressure is the most important contributor to the success of the low-growing mouse-ear hawkweed, the removal of rabbit grazing pressure may not necessarily cause a reversal of the vegetative change. Any competitive advantages for hawkweed offered by lowered soil fertility and harsh microclimates would remain.

2.5 Stakeholders

When considering public authority involvement in the environmental management of dry tussock grasslands a complication is the number of institutions concerned. The greater the number of institutions, the more difficult it is to gain cooperation between them and achieve the support of all 'stakeholders' to a land management programme.

At the central government level the Commissioner of Crown Lands is responsible for pastoral leases and has contracted with Landcorp to act as the Crown's agent.

Conservation lands are administered by the Department of Conservation. The Rabbit and Land Management Programme is administered by the Ministry of Agriculture and Fisheries while implementation of the Programme is carried out by the Regional Councils.

Research information is supplied by MAFTech, Department of Scientific and Industrial Research, Department of Conservation and the universities.

Attempts have been made to coordinate some elements of the programme through the establishment of advisory committees. A National Advisory Committee was set up by MAFTech to guide the Rabbit and Land Management Programme, and the New Zealand Mountain Lands Committee set up a Hawkweeds Core Group which reported to the Minister for the Environment on the extent of the hawkweed problem. ***There is an urgent need to clarify responsibilities, to improve coordination and communication between agencies and with landholders and to identify the accountability of the various agencies.***

The Ngai Tahu Trust Board must also be considered a stakeholder. While no recommendations specific to the dry tussock grasslands were made in the Waitangi Tribunal's 1991 report on the Ngai Tahu claims covering the South Island, the form of

the settlement to be agreed to between Crown and Ngai Tahu is as yet unknown. In the interim, Ngai Tahu should be invited to participate in stakeholder groups considering the future of the dry tussock grassland, and be kept informed of proceedings.

3.0 GOVERNMENT INITIATIVES

3.1 Rabbit and Land Management Programme

In reviewing conclusions reached in the Commissioner's 1987 Audit and this review of the Rabbit and Land Management Programme, ***the Commissioner is still convinced land use changes are necessary to achieve a long-term solution to land degradation in the dry tussock grasslands.*** In 1987 the following issues were identified as requiring action:

- reclassification of land on the basis of resource use sustainability, including where necessary boundary adjustments of some pastoral leases;
- removing restrictions as to land use on pastoral holdings and leases;
- encouraging sustainable land use practices.

The encouragement of more sustainable land uses is a goal of the Rabbit and Land Management Programme.

The idea behind the Programme was to provide a 'window of opportunity' for necessary changes in land management through taxpayer and ratepayer subsidy of conventional rabbit controls, so that land use in the marginal lands could move toward a more sustainable form.

These lands are predominantly Crown pastoral leases, and most areas requiring protection from degradation are a Crown resource. In denying the introduction of a potentially cheaper form of rabbit control (myxomatosis), the Crown agreed to assist with funding the more expensive conventional controls for an interim period. The intent was that changes in land management would take place during the interim five- year funded period and avoid the need for a continued long-term rabbit control subsidy.[1]

In its first year of operation, the Programme has concentrated on the killing of rabbits, seeking to lower the population to levels appropriate for continued pastoral production or changes in land use. However, the first year's rabbit control was undertaken in the absence of property plans and therefore without an agreed framework for necessary land use and land management change. There was insufficient time for property plans to be developed and landholders were not prepared to commit themselves to plans which they did not believe they could afford.

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1 Baines, 1991, pp.1, 3, 17.

In its second year of operation, the property plans are to be finalised, so that the Programme may begin to integrate rabbit control with land management and land use change, including options other than traditional pastoralism.

The Commissioner's review team is confident that MAFTech and Regional Council staff involved with the Programme are committed to a transition to more sustainable land management and appropriate land use. However, a transition to sustainable land management or to changes in land use under the Programme is by no means assured.

A detailed review of the Rabbit and Land Management Programme contracted by MAF[2] indicates that good progress has been made in implementing the Programme in its first 12 months. Of most importance are the forging of working relationships between 'stakeholders', and a growing awareness of land management issues beyond the narrow issue of rabbit control. There is also greater awareness of the problem of land degradation by the general public, particularly in the urban constituencies of the Otago and Canterbury Regional Councils.[3]

At this stage nearly $5 million of taxpayer and raterpayer funds has been used to kill rabbits with no connection to signed property plans. Property plans must be the prerequisite to any further expenditure of public money, so as to better guarantee moves to change land use and management.

Clear statement of Programme goals and the objectives for particular types of land are required. With only generalised goals, there is insufficient detail to measure against and determine whether sustainable management objectives have been achieved or public money effectively spent.

The 1991 MAF review of the Programme noted considerable uncertainty among land managers and agencies about how general principles could actually be applied to specific objectives in property plans.[4] Once property plans are drawn up, this detail may become more visible.

Officials have also observed there is a lack of affordable or effective land management options for the most rabbit-prone lands.[5] Where there is a lack of proven techniques or

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2 Baines, 1991.

3 Councillors of Otago and Canterbury Regional Councils, pers. comm.

4 Baines, 1991, pp.20, V-1, V-6.

5 Baines, 1991, p.2.

alternative land uses, technology transfer or more research may be required before practical changes can be identified.

Changes to a pastoral system can be made within a five year period but time is required to:

- classify and characterise the types of land under consideration;
- reach consensus on goals for each land type;
- identify management or land use changes necessary to attain these goals;
- obtain landholder cooperation for land management or land use changes;
- identify new plant species required (e.g. saltbush 'forage banks', trees for modification of microclimate alteration, species for revegetation and erosion control) and obtain stock for planting;
- conduct research to establish and field test management options for degraded lands; and
- identify and implement alternative rabbit controls.

There appears to be inadequate landholder and community agreement about the need for changes in land management. Indications point instead to a strong local community desire to have the most effective form of rabbit control possible so that traditional pastoral land use can carry on as usual. However recent initiatives by farmers visiting Australia to learn of similar land management concerns have increased community awareness of what may be required in New Zealand.[6]

There should be a clear understanding that even with a viral control such as myxomatosis there will still be the need for other follow-up rabbit controls, as well as reduced stocking rates and increased spelling of land to allow biological recovery (i.e. build up of soil organic matter). This may require 'restructuring' of some property boundaries to ensure economic farm units and redress imbalances between 'summer' and 'winter' country, and between productive and degraded lands.

Ideally, property plans for neighbouring properties should be developed together, with community involvement. Decisions and actions on one property often affect neighbours. To be most effective changes will need to occur across property boundaries. At present there appears to be no mechanism for community (as opposed to individual landholder) involvement.

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[6] Jopp and Fastier, 1991.

3.2 Regional Council pest management

The Regional Councils of Canterbury, Otago and Nelson/Marlborough have borne the entire responsibility for implementing the Rabbit and Land Management Programme. Despite being new institutions, with new staff in some instances unknown to landholders, they have nevertheless achieved a great deal. The poisoning operations that have had to be carried out have been on a massive scale (mainly due to the cessation of adequate control operations in some areas over the past five years) and are a highly visible area of Council expenditure. For example, operations in Canterbury required five aeroplanes, a helicopter, 250 truck and trailer loads of carrots, and 494 tonnes of oats to poison 133,566 ha.[7]

Otago, Canterbury, and Nelson/Marlborough regions have now reviewed their method of levying rates for pest control. Criteria and adjustment methodologies are desirable so as to reduce cross subsidisation, recognise the inherent proneness of the land for pests, and to recognise sound management practice so that rates can be levied which better reflect user-pays principles. Setting the land classifications for determining appropriate rates for weed and pest control has not been easy and required much consultation with property owners.

The Regional Councils inherited the classification systems for rates operated by the former Pest Boards, which often bore little relationship to pest proneness or the cost of undertaking work in particular areas. There was also cross subsidisation of hill and high country farmers by lowland farmers. The Councils resolved to introduce a more equitable system. The Canterbury Regional Council for example prepared a differential rating classification map using the New Zealand Land Resources Inventory database incorporating the most recent soil information available for the region.

This new system, based on soils as the indicator of rabbit proneness, also incorporates information on vegetation cover (improved pasture or forestry), the proximity to rivers (which often harbour high numbers of rabbits in braided riverbeds), and rabbit control history over the last 6-8 years. An exception in the system is for the Selwyn Pest District which had operated a user pays system which will be continued on a trial basis for a further three years.

The Nelson/Marlborough Regional Council's new approach to levying rates has not met with any significant landholder opposition.[8] The objectives have been to eliminate cross subsidisation of poisoning costs by shifting the responsibility of funding on to properties

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7 Canterbury Regional Council 14/11/90 Report to Southern Area Committee.

8 Nelson-Marlborough Regional Council 10/10/90 Letter to Parliamentary Commissioner for the Environment.

where most of the work is required and to providing a system with sufficient flexibility to recognise the result of pest control carried out by ratepayers independent of the Council. This has the potential to reduce the rateable area on the property. Monitoring and administrative costs are funded through the general rate.

Final classifications have now been made although it is inevitable further fine-tuning will be required. The Councils are to be congratulated on achieving classifications that recognise land capability factors and the history of land management and rabbit control. This approach is a significant break-through in determining a basis for setting rates and in general the approach has received the support of the landholders.

These classifications could not have been done in Wellington by Central Government agencies; they had to be done in the region where local knowledge and expertise exist. Nor could land classification have been done by the present District Councils, who have neither the resources nor the expertise.

New problems face the Regional Councils in the second year of Programme operations. Otago Regional Council estimates that the area requiring poisoning (120,000 ha), is approximately double that of two years ago and that 72 percent of the season's bait is required for areas outside the Rabbit and Land Management Programme area.[9] Canterbury needs to complete poisoning the central area of the Mackenzie Basin and also estimates more bait will be needed than in 1990. Sufficient supply of bait becomes an additional problem.

The scale of the immediate problem in the Mackenzie required a coordinated approach. However future poisoning programmes, given the planning that has already been done, could be contracted out to registered operators.

The Rabbit and Land Management Programme has provided data revealing the magnitude of rabbit control costs (previously subsidised) and the implications for land management. For Central Otago and the Mackenzie Basin nearly half the landholders in the Programme considered the costs were not financially viable for their properties, and detailed economic analysis in the Mackenzie Basin indicated that about 65 percent of landholders would not be able to afford the total cost of their Programme share over the five years.[10] The costs of weed and pest control require reduction if all existing farm units are to remain viable.

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9 Otago Regional Council 10/12/90 letter to PCE.

10 Baines, 1991, p.V, VI-8.

The impact of the Programme on the Regional Councils is also severe. For example one-third of Otago's regional budget ($7.38 million) is committed to agricultural pest management with $280,000 from the General Rate for the Programme. The willingness and ability of ratepayers to continue to fund the Programme is doubtful. Without the taxpayer contribution of $14.64 million for the total programme over the five years, the programme is not affordable by the landholder or the ratepayer.

In addition, the present discrepancy in the assistance provided to landholders whose properties are within the Rabbit and Land Management Programme and those who have similar problems but are outside the Programme, needs to be addressed. The new land classifications for pest rates could provide a basis for revising Programme boundaries and establishing a more equitable system.

3.3 Initiatives relating to hawkweeds

In March 1990 the New Zealand Mountain Lands Institute convened a workshop on the impact of hawkweeds on tussock grasslands in an attempt to assess the extent of the problem, and advised the Minister for the Environment accordingly. The Minister asked the Institute to prepare a proposal for an investigative programme and management strategy for hawkweeds and a Hawkweed Core Group was set up as a sub-committee of the Mountain Lands Committee. Two regional meetings were held in Canterbury and Otago prior to a further workshop in October 1990 which brought together existing knowledge and expertise on the subject.

The Core Group reported to the Minister for the Environment in December 1990 that "the hawkweed problem appears to be the latest manifestation of what could be described as a continuing tussock grassland degradation problem". Ministers of Lands, Conservation, Agriculture, Forestry, and Research, Science and Technology have appointed officials to work together with the Ministry for the Environment on strategy development.

3.4 Conservation concerns

A large number of representative natural areas have been identified in most of the ecological districts of the dry tussock grasslands by surveys under the Protected Natural Areas Programme and recommended for protection.[11] Rabbit grazing and hawkweed encroachments are rapidly reducing the conservation values of these natural areas. Negotiations are continuing between the Department of Conservation and landholders about suitable means of protection. There are costs involved in protection, including survey, possibly fencing and ongoing managment, including weed and pest control,

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[11] Espie et al, 1984.

whether protection is achieved by covenant, land exchange or purchase. Additional resources would enable the Department to achieve protection for more of the representative natural areas identified in the Protected Natural Areas Programme.

The Department recognises that changing the land use from pastoralism to a mixture of more sustainable uses including forestry and agroforestry could dramatically change the vegetative cover. This would have impacts on indigenous flora and fauna and on landscapes. There are several species and ecosystems which must be protected within a strategy which achieves overall conservation goals.[12]

Landscape change should be carefully planned. Information on the location of recommended areas for protection, locations of endangered species (e.g. black stilt), and landscape values should be incorporated with land resource inventory information in the development of property plans and for regional planning.

3.5 Information and Research

Interagency coordination

Of concern to the review team is the fragmentation of research related to degradation of the dry tussock grasslands. If sustainable land use is to be attained in the dry tussock grasslands of the South Island, integration of the necessary research is required. Hawkweed and rabbit control research should form part of a larger integrated research programme addressing sustainable land use options for dry tussock grasslands. The new Crown Research Institute structure may allow better integration and coordination of research.

Hawkweeds

Recommendations of the Hawkweeds Core Group[13] for cooperation and consultation between the proposed Hawkweed Strategy Group and the Rabbit and Land Management Programme is endorsed and deemed essential until the latter programme is broadened to encompass all aspects of sustainable land management in the dry tussock grasslands.

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12 Statement to the Parliamentary Commissioner for the Environment, from Department of Conservation 1990.

13 Robertson, 1990, p.9.

The Rabbit and Land Management Programme

A MAFTech sponsored workshop in 1989 identified research and surveillance needs for the Rabbit and Land Management Task Force.[14] The broad activities of the Rabbit and Land Management Programme, in particular the Rabbit and Land Management Monitoring Group and the MAFTech Semi-Arid Lands Research Group evolved from this workshop.

Research topics of significance identified by the workshop included: aspects of impact of rabbits on the landscape; livestock and rabbit grazing interactions under different environmental habitats; revegetation opportunities for rabbit-prone habitats following 'successful' control operations (including both forage/browse species and nonforage/non-browse species); land use alternatives, particularly mosaics of smaller systems (including non-pastoral land uses) that can survive in a rabbit dominated landscape; spatial distribution and intensity of bait avoidance or neophobia; inheritable aspects of the trait and risks of spread; identification of rabbit predators; their numbers and movements and diet throughout the year; the impact of current control techniques; improved poisoned baits (e.g. anticoagulants) for landholders' use; and rabbits as a resource, e.g. cost effectiveness and market analysis, safari rabbiting studies and required legislative needs. The Rabbit and Land Management Programme has subsequently identified the urgent need for research into social and economic issues.[15]

Some of these topics have been undertaken as part of the Rabbit and Land Management Monitoring Programme which includes determining the extent and rate of spread of neophobia, establishing definitive criteria for and classification of land for rabbit proneness, vegetation condition and trend, rabbit population trends, developing anticoagulant poisons, and social and economic analysis and monitoring.[16]

New research proposals for 1991/92 by MAFTech and DSIR Land Resources and DSIR Grasslands[17] address many of the questions related to land use and biological control (predator and viral) of rabbits as well as providing new information related to rabbit management and the transfer of information and technology to the key users (landholders and Regional Councils) by way of Decision Support Systems.[18] DSIR

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14 Bell et al, 1989.

15 Morgan Williams, pers. comm., 1991; Taylor Baines and Associates, 1990; Baines, 1991.

16 Williams and Ross, 1990.

17 J M Williams, pers. comm., 1991; D Leslie, pers. comm., 1991.

18 The first of this series is due for release in March 1991.

Land Resources research will provide baseline information about the physical and ecological characteristics and processes operating in degrading tussock grasslands.

Focus of research by agencies and universities

Information was sought from agencies on all research related to land use in the dry tussock grasslands (whether completed, current or proposed) and was evaluated by the review team. A register listing the project titles provided by the agencies has been compiled and is available from the Commissioner's Office on request.[19].

Past research has been targeted at improvement of dry matter productivity in the pastoral system, including evaluations of various legume and grass species suitable for low rainfall areas. Some work has also been done on dryland tree and shrub species for soil conservation/land rehabilitation application. MAFTech, DSIR Grasslands and the Forest Research Institute are the major research agencies involved in these areas.

Research agencies are now well aware of the problems of rabbits and hawkweeds in the dry tussock grasslands and there are a number of new research proposals to the Foundation for Research, Science and Technology related to the control of rabbits and hawkweeds, and land resource assessment, evaluation and modelling are also proposed. In addition to research proposals which focus on continuing the existing pastoral use of these lands there are several proposals to use trees as an alternative land use. Coordination of these proposals is highly desirable.

Practical application

The Commissioner's review team found among landholders a perception that there is little information available on practical field tested techniques which can be utilised for land use change or the rehabilitation of degraded dry tussock grasslands. A greater focus on practical application and sharing of information is required.

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19 This register is however not fully comprehensive and direct comparisons between the projects of various agencies is limited as information was not supplied in a standard form.

4.0 A COORDINATED APPROACH TO ACHIEVE SUSTAINABLE LAND USE

" The elusiveness of the concept of sustainability has brought its validity into question for some. But there are many words that are used in public policy goals that can never be defined precisely - for example, 'equity' and 'efficiency'.

"... it may be more helpful to think about unsustainability rather than sustainability. We strive to make society more equitable by removing specific inequities; we strive to make the economy more efficient by removing specific inefficiencies. Can we strive to make our national development more sustainable by eliminating unsustainable practices?".

Janice Wright, 1990

The Rabbit and Land Management Programme was set up to assist moves toward more sustainable land use in the 'rabbit prone' dry tussock grasslands. However, land use and land management changes have yet to be agreed on and implemented. Conventional rabbit control is far more expensive than was originally envisioned and the spread of hawkweed may be an even greater threat to pastoralism in the high country than rabbits. A viral control such as myxomatosis has been proposed as an additional tool to lower costs and better control 'bait shy' rabbits.

There are several decision options available to the Minister of Agriculture. The principal implications of these decisions are summarised in Table 4.1. Only the first two options are likely to assist reduction in land degradation. However, none of these options are likely to arrest the spread of hawkweed.

Most of the degraded tussock grasslands are Crown land in pastoral lease. Government has a responsibility to halt and if possible reverse degradation of the Crown land resource over the long term. A 'window of opportunity' (offered by rabbit control subsidy and/or introduction of viral controls) should be used to achieve transition to more sustainable land use and management and restoration of degraded lands. The challenge is to design programmes which ensure that the necessary change will take place. Traditional pastoralism may no longer be feasible in some areas.

The current management framework for Crown pastoral lease lands, although well intentioned and successful in encouraging pastoral development, has nonetheless been unable to protect the Crown land resource from degradation over many thousands of hectares. A better system is required, one that encourages alternative land uses that are sustainable in the long term, ensures that land managers can maintain the land in times of economic or environmental stress, and holds Crown agencies and landholders accountable for the condition of the land they are managing on behalf of the New Zealand public.

TABLE 4.1 : Decision options relating to the Rabbit and Land Management Programme and viral rabbit controls

DECISION OPTIONS	PROBABLE EFFECTS ON RABBIT CONTROL, COSTS, THE LAND RESOURCE
'PROGRAMME STATUS QUO' Viral control not approved. R & LM Programme runs full 5 years.	Rabbit control on marginal pastoral lands will continue to be unaffordable without Programme subsidy. Rabbit over-grazing in all but 'bait shy' areas can be controlled until subsidy stops. 'Bait shy' rabbit populations will not be controlled, and may be induced in new areas if poisoning relied on too heavily. Property plans may encourage land use changes, but change options and funding to implement changes limited. Regional ratepayers may be unable to continue funding their share of the Programme for the full 5 years. Spread of hawkweed will continue. ***Land degradation will continue once the Programme terminates except where rabbit controls can be afforded or property plans encourage effective land use change.***
'PROGRAMME + VIRAL CONTROL' Viral control approved. R & LM Programme runs full 5 years.	Rabbit control costs will not decline until the last 1-2 years of the Programme, as virus introduction will take time. Follow-up controls will still be required to maximise benefits of viral control. Rabbit control on marginal pastoral lands may still be unaffordable long term. Where follow up can be afforded, rabbit overgrazing will be controlled until the virus attenuates. Land degradation will continue if land insufficiently spelled from grazing pressure. Programme funding available to implement land use changes may be inadequate. Regional ratepayers may be unwilling to fund their full share of the Programme. Woody weeds may increase with improved rabbit control. Spread of hawkweed will continue. ***Land degradation will continue or will re-emerge if rabbit grazing replaced by livestock grazing and/or viral controls not followed up or replaced as they attenuate. Property plans may encourage land use changes and arrest land degradation.***

DECISION OPTIONS	PROBABLE EFFECTS ON RABBIT CONTROL, COSTS, THE LAND RESOURCE
'VIRAL CONTROL ONLY' Viral control approved. R & LM Programme abandoned.	Necessary rabbit control will not be affordable for some properties during the virus establishment period; neither will be the necessary follow-up controls, once a virus is working. Woody weeds may increase with improved rabbit control. Spread of hawkweed may continue. ***Land degradation will continue or will re-emerge if rabbit grazing replaced by livestock grazing and/or viral controls allowed to attenuate.***
'DO NOTHING' Viral control not approved. R & LM Programme abandoned.	Rabbit over-grazing unlikely to be sufficiently controlled. Rabbit control on marginal pastoral lands will be unaffordable for many properties. 'Bait-shy' rabbit populations will not be controlled, and may be induced in new areas if poisoning relied on too heavily. Spread of hawkweed will continue. Property plan guidance re land use changes will not be available. Most land use changes (apart from destocking) will not be viable in the presence of high rabbit numbers. ***Land degradation will continue.***

Evolution of the Rabbit and Land Management Programme could provide the basis for a better system.

4.1 Evolution of the Rabbit and Land Management Programme to a Sustainable Land Use Programme

The Rabbit and Land Management Programme has played a valuable part in introducing the concept of sustainable ecosystem management to landholders in the chronic rabbit-prone areas. While initially the programme focused on the immediate problem of killing rabbits, it is necessary that the Programme be broadened and extended to encompass fully the concept of sustainable land use and encourage the development of local solutions to land degradation.

The problems of land degradation in the dry tussock grasslands extend well beyond the areas which are presently badly affected by rabbits. A broadened sustainable land use programme would need to be extended to cover all of the dry tussock grassland areas where the gradual process of land degradation is becoming alarmingly conspicuous by the spread of hawkweeds. A sustainable land use programme is likely to involve consideration of a whole suite of different land uses and will be aimed more broadly than sustainable pastoralism.

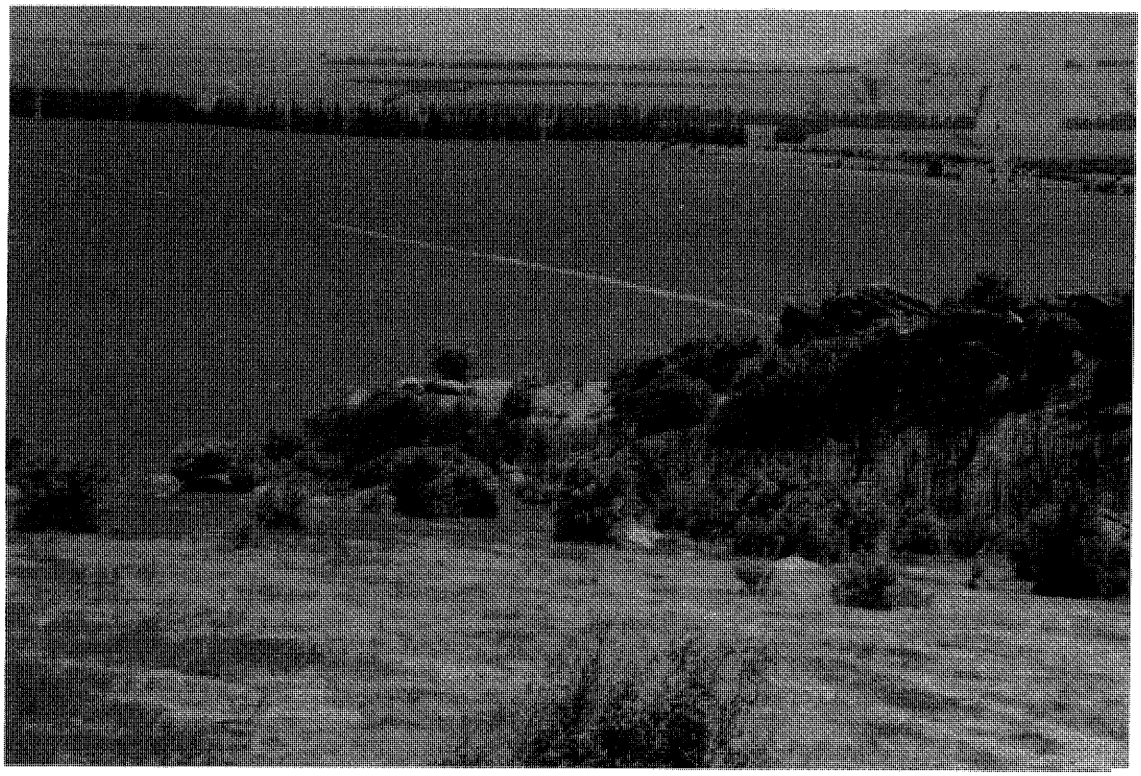
Local and regional initiatives will be essential, as Crown assistance will be restricted to clarifying land use goals and providing research and technology transfer.

If maximum sustainable land management benefits are to be 'captured' from a 'window of opportunity', several basic conditions are required:

- ***defining the goals*** for land use planning;
- ***land classification*** based on land capability and resource use sustainability;
- ***devising appropriate measures*** of land condition and other key factors related to meeting goals;
- ***commitment to goals*** by 'stakeholders' ('ownership' of the problem and solutions);
- ***monitoring*** to check whether goals are being met;
- ***sufficient resources*** to meet goals (information, skills, tools, and funds).

Land use planning for the dry tussock grasslands has two interdependent goals:

- sustainable land use;
- social and economic development of rural communities.



'Mosaic' of high production lands (centre), trees (background), and inherently rabbit-prone 'hot spots' (foreground).

Biological control of sweet brier using goats (righthand paddock).

Figure 4.1: **Land management variations, Central Otago, 1990.**

Queensberry Hills Station. Photo credits: David Leslie.

Photo credit: David Leslie

Trial forage and shelter species, Bendigo Station, Central Otago. Grazing pressure excluded. DSIR Fruit and Trees trial plots, 1987.

Photo credit: Dana Peterson

Successful tree growth on degraded aluminium toxic Acheron soils; note hawkweed cover in foreground. Corsican pines, planted ca. 1965. Molesworth Station, Inland Marlborough, 1991.

Photo credit: Dana Peterson

Natural spread of pines in degraded dry tussock grasslands, Mackenzie Basin. 'Wilding pines' are spreading from shelterbelt despite the presence of rabbit grazing.

Figure 4.2: Alternatives for revegetation

Attainment of these might see land use patterns evolving that

- involve a variety of different land uses;
- avoid monocultures, for example, exclusive pastoralism or large tracts of plantation forestry;
- enrich and blend with the character of the natural landscape;
- consider conservation needs, e.g. encourage species diversity and protection of threatened communities and species;
- rehabilitate landscape damage, e.g. loss of vegetative cover, erosion scars;
- encourage and plan opportunities for recreation and tourism.

A future scenario for the Mackenzie Basin for example might see an aesthetic blend of reshaped and more financially robust pastoral properties grazing cattle, sheep, goats, deer, as appropriate to land type and management need; having areas in agro-forestry with larger blocks of production forestry, either as wide shelterbelts or stands on severely degraded land or land with aluminium toxicity; and with some landholders operating on-farm activities for tourists and conservationists. Elsewhere larger blocks of privately managed plantation forests across formerly desertified lands could blend in with managed conservation areas and rural townships designed to service and process 'products' from or for the land.

This somewhat idyllic picture has to be tempered with the constraints imposed by present and future capital investment and the ability or otherwise of adjusting property boundaries. As a vision for the future however, it may encourage changes which avoid recurrence of the land degradation cycle.

4.1.1 Land classification

The degraded lands are not all alike in their characteristics and capabilities to sustain pastoral production, to 'pay their own way' with rabbit or weed control costs, to sustain alternative land uses, to require and respond to restoration measures, or to offer opportunities to protect intact tussock grassland. ***Defining the suitability of the land for particular land uses is a necessary first step to achieve land restoration.***

'Classification' of pastoral lease land based on resource use sustainability was recommended by the Commissioner in her 1987 audit. The New Zealand Land Resource Inventory has been used by the Regional Councils to classify lands for pest rating purposes and to assist in the preparation of 'property plans' under the Programme. The same system should be used for the 'categorisation' of Crown pastoral lands proposed as part of the new Land Bill.

The first categorisation needs to be made between lands which are still suitable for pastoral production, and those that are not. The 'Farmland' and 'Restricted' categories under the proposed Land Bill could be appropriate, as long as protection of the soil resource is given precedence over economic viability in deciding where the boundary lies.

A further category is required for degraded land with no farming or nature conservation potential. Once the extent of these lands is known, future land use and management can be planned.

4.1.2 Property plans

The property plans under the Rabbit and Land Management Programme should be based on an appropriate land classification system and be able to clarify land use goals, specify measures of land condition, and provide for monitoring.

In essence, the 'property plans' are modern equivalents to, and commonly have evolved from, the old 'farm conservation plans', with an added dimension of rabbit proneness and control history. Property plans based on a land inventory survey would provide a framework to assist moves to more sustainable land uses and rationalisation of property boundaries. ***The plans will require annual review to benefit from new information and technology as it becomes available.***

The review team sees agreement on property plans as a useful starting point to assist genuine moves to more sustainable land management and a commitment by the 'stakeholders' to the need for change.

4.1.3 Weed and pest control tools

Integrated weed and pest management may include biological and cultural controls, use of resistant or tolerant cultivars, microbial pesticides, pheromones, sterilisation and chemical controls.[1] ***What has become obvious in rabbit control is that reliance on one form of control is counter-productive. Any pest population will favour selection of individuals able to resist the form of control.***

Accordingly the need for research and movement towards use of a broad range of controls is endorsed. Introduction of any biological control must be done in conjunction with present chemical and physical methods. Attention should also be given to re-commercialisation,[2] predator enhancement,[3] repellents,[4] and any 'tool' capable of

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1 IUCN, 1990.

2 See section on legislative framework: Agricultural Pests Destruction Act, 1967.

integration into the system. The advantages and disadvantages of various methods are given in Table 4.2.

There is only one known viral control - myxomatosis - for which introduction could be scheduled immediately, but it requires vector establishment and a scientific infrastructure that will take two or three years to establish. The infrastructure would need to be maintained on a long-term basis.

Suggestions have been made that the rabbit flea could be introduced immediately and a decision made on myxomatosis at a later time. This would pose the risk of an illegal introduction of the myxoma virus, possibly an attenuated strain, which would reduce the effectiveness of any subsequent introduction.

Any approval given for the introduction of myxoma-flea complex or Viral Haemorrhagic Disease should be based on scientific advice.

Successful integration of rabbit control methods with weed control and land management practices will require assistance from research agencies and cooperation with land managers. Vigilance cannot be relaxed and research will always be required to ensure control methods are viable and affordable.

The lack of an effective control for hawkweeds where topdressing and oversowing are not a viable option requires a united approach by local groups, local government and research institutes.

A possible side effect of implementing more cost effective rabbit control may be an escalation in weed control costs. There is some evidence that past increases in woody weeds followed improvements in rabbit control. The property plans may need to address this and evaluate alternatives to chemical control for woody weeds.

The ability to diversify and change land use may be a key to resolving some current weed problems. The review team was interested to learn that on some properties sweet briar was being replaced with a tree crop and on others controlled by goats. Landholders in some areas dominated by hawkweeds have advocated a 'forest cycle' to modify the environment.

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[3] e.g. Dr J Flux's work with cats in Central Otago.

[4] Kairomones in lion dung have been isolated which repel grazing species from crops. (Ross Fletcher, DSIR Chemistry, quoted in Terra Nova, Feb. 1991, p.8) and research is required into the active ingredient in biodynamic 'peppering' (ash of skin and testes said to repel rabbits and possums).

TABLE 4.2 : AVAILABLE AND PROPOSED RABBIT CONTROL METHODS
Summary of principal drawbacks, unknowns, and benefits.

CONTROL METHODS	DRAWBACKS	UNKNOWNS	BENEFITS
CHEMICAL CONTROLS			
1080 (Sodium mono - fluoroacetate)	Poisoning of non-target species. Too frequent usage or at too low dosage can lead to bait shyness and/or poison avoidance. Removes food supply of rabbit predators; may limit survival of predators over winter. Current reliance on single overseas manufacturer (which has lost licence to sell in own country) leaves supply vulnerable. Not effective for bait-shy or 1080-shy rabbits. Increasing objection by environmental groups to its use in New Zealand.	Long-term impacts on ecosystem, eg population levels of non-target species, effectiveness of predators, and addition of fluorine to soil.	Water soluble and biodegradable. Breaks down to naturally occurring compounds. Derived from naturally occurring plant toxin. Sub-lethal doses of 1080 metabolised and excreted in 2-3 days. No toxic residues detected in environment over medium term, in research to date. Cheaper than other currently available bait-based chemical alternatives. Both cheaper and more effective than mechanical control methods for primary control.
Anticoagulants (eg Brodifacoum, Pindone)	Poisoning of non-target species. Presently more costly than 1080. Sub-lethal doses of some anticoagulants (eg Brodifacoum) take 3 months to be metabolised and excreted. Until excreted could enter human food chain via livestock. Pindone residues appear to be metabolised after 16 days.	Medium to long term fate of chemicals in the environment in field operations.	Anticoagulants retain their fatal impact longer after poisoning than 1080, so theoretically rabbits are less likely to react with bait shyness or poison avoidance. Appears to be less toxic to predators and farm dogs than 1080. Can be used on 1080-shy rabbits.
Bait-based contraceptive drug	Preliminary research suggests that drug would be relatively costly (at least until mass produced), ineffective for bait-shy populations, and would have to be re-administered on a regular basis. Not effective on bait-shy rabbits.	Effectiveness under field conditions. Effect on non-target species.	Has potential to be considered more humane than other methods.

Note : Arsenic, strychnine, and phosphorus were used during the early years of rabbit control in NZ, but are not considered here. Arsenic and strychnine killed humans as well as animals and remain persistent in the environment. Phosphorus caused the rabbit an extremely painful death and is dangerous for operators to handle.

CONTROL METHODS	DRAWBACKS	UNKNOWNS	BENEFITS
PROPOSED VIRAL CONTROLS			
Myxomatosis	**Symptoms of disease abhorrent to many people;** considered inhumane to rabbits. Takes 8-30 days to kill a rabbit. **Irreversible and cannot be contained.** Vaccinations for domestic and commercial rabbits required. **Will attenuate over time.** Current 'mortality factor' in Australia estimated at 40-60% (vs 95%+ required for primary control). Requires a vector to spread. May encourage complacency about the need for follow-up controls.	**Effect on predator-prey balance (control on rabbits, possible increase of predation on native species).** **Effect on NZ native species** (eg the kiwi). **Whether unwanted 'passenger' viruses would come with and/or be spread by the flea.** Effectiveness where rabbits live in burrows rather than warrens (most of dry tussock grassland). Effectiveness in areas below 355 mm rainfall.	**Biological rather than chemical control.** Proven species-specific in 38 years of Australian field experience. **Lower cost than chemical or mechanical controls alone (although follow-up required).** More virulent strains can be reintroduced after earlier strains attenuate (but effects relatively short-lived). **Likely to provide a 'breathing space' of at least a decade, during which land use and management changes can be implemented.**
VHD (Viral haemorrhagic disease, or 'the Spanish Rabbit Flu')	Irreversible and cannot be contained. Vaccinations required for domestic and commercial rabbits. Unlikely to be ready for field testing until at least 1993, if not 1995. Appears to die out after 5 years in the field. Considered inhumane by animal rights groups. Takes 12-36 hours to kill a rabbit. May encourage complacency about the need for follow up controls.	Whether species-specific long-term. Virus only known since 1984. Effect on NZ species or NZ varieties of domestic species. Effect on predator-prey balance (control on rabbits, possible increase of predation on native species).	Biological rather than chemical control. Does not require a vector species to spread. In 5 years of experience overseas, appears to be specific to rabbits. Kills rabbits faster than myxomatosis. Could provide a 'breathing space' of about 5 years to implement land use changes, after which the disease could die out locally unless reintroduced. Lower cost than chemical or mechanical controls alone (although follow-up required).
Genetically engineered attenuated myxoma virus (Immuno-contraception)	Many people uncomfortable with encouraging genetic engineering. Research will probably have to run for another 5-10 years before efficacy and safety of method known. Irreversible and could not be contained. Requires vector to spread. May encourage complacency about the need for follow up controls.	Whether a genetically engineered myxoma virus will remain species-specific. Degree of control the immuno-contraception would exert on wild rabbit population.	Reduces fertility of rabbits. A biological rather than chemical control, but not 'natural'. Unlikely to cause physical suffering to the rabbits; they would simply fail to reproduce as quickly. If effective, likely to be lower cost than chemical or mechanical controls alone, although follow-up probably still required.

CONTROL METHODS	DRAWBACKS	UNKNOWNS	BENEFITS
OTHER BIOLOGICAL CONTROLS			
Enhanced predator role	Research in dry tussock grassland only just beginning. Other methods of control likely to be required as well.	Whether regular poisoning depletes predator population over winter. Whether cost-effective methods of maintaining predators over winter exist. Effects of larger predator populations on non-target species (eg Black Stilt).	Biological and 'natural' control. Predator species already present in problem areas (eg feral cats, stoats, ferrets, harriers).
Biodynamic 'peppering' (scattering ash from rabbit skins and testes)	Requires faith in a method as yet incomprehensible to modern science. Rabbits driven off one property likely to cause problems elsewhere. Labour intensive, and therefore costly if labour must be hired. (Ash needs to be renewed on a regular basis.)	Whether it will be effective for large populations of rabbits in the dry tussock grassland.	Biological and 'natural' control. Proponents have found it to work on a small scale in some areas. Causes no apparent physical suffering to rabbits (drives them away, does not kill them).
Planting non-forage species (trees and shrubs unpalatable to rabbits)	Removes areas from pastoral use. Requires rabbit control during establishment period (degree of control depends on species used). Labour-intensive for species that cannot be aerially sown. Not appropriate for all of rabbit problem area (environmental and social limitations). Will change landscape character locally.	Whether revegetation options available for depleted lands. Whether funding for establishment available.	Trees can create microclimates more favourable to pasture growth (agroforestry). Economic land uses other than pastoralism possible on small scale in some areas (eg tree crops, thyme honey). Tree planting could provide employment. A 'tree cycle' may restore organic matter and help reverse land degradation. Tree planting could provide employment.
Phytotoxins in red clover (infertility effect)	Likely to also cause infertility in livestock; only useful for non-breeding stock or where stock excluded. Research only just begun, and research funding uncertain.	Whether useful on a large scale under pastoral use. Whether red clover can sustain itself in problem areas without ongoing inputs. Costs of establishment and maintenance.	Biological and 'natural' control. Potentially a low cost supplemental control method. Potential for assisting the creation of buffer zones around any areas 'left to the rabbit'.

CONTROL METHODS	DRAWBACKS	UNKNOWNS	BENEFITS
MECHANICAL CONTROLS			
Shooting, trapping, gassing burrows, ripping warrens	Labour intensive and thus costly. Only useful as a follow-up method; primary kill necessary through other causes. Causes suffering to rabbit unless cleanly shot, or killed instantly in trap or burrow. Traps capture rabbit predators as well. Gassing and ripping most effective with warrens; in NZ rabbits in dry tussock grassland live in burrows instead. Terrain in many areas prevents access for ripping machinery.		Can provide cost-effective 'follow up' to maximise impact of a primary kill from other causes. Can provide employment.
Rabbit proof fences	Require frequent maintenance; labour intensive and costly. Costly to establish. No such thing as a totally rabbit proof fence; some will always get through.		If maintained, effective as a boundary for other control methods. If maintained, have potential for protecting productive lands from rabbit 'hot spots'.
OTHER PROPOSALS			
Recommercial-isation of the feral rabbit	Not an effective 'control' on its own; additional methods required for rabbit control on pastoral lands. Harvest likely to focus on 'easy' rabbits; much of problem area (rugged or isolated terrain) likely to be avoided. Requires change of legislation (section 121, Agricultural Pests Destruction Act). Legislation planned but not introduced.	Whether sufficient domestic or overseas markets exist for rabbit meat and/or rabbit fur. Whether 'rabbit farming' could be sufficiently controlled so as not to threaten adjacent pastoral farming lands.	Likely to be a useful 'supplementary' rabbit control method. Views rabbits as resource rather than (or as well as) a pest. Some economic return possible from killing rabbits. Potentially a source of additional employment (if sufficient markets exist). 'Rabbit farming' concerns can be anticipated in legislative safeguards.
'Leaving it to the rabbit'	Not a 'control' method per se; rather, allowing nature to find its own balance without human intervention. Abhorrent to many people. Has in essence occurred in some areas already (stock withdrawn and control unaffordable). 'Uncontrolled overgrazing' by rabbit likely to continue, contributing to land degradation. Rabbit population likely to 'boom and bust', causing periods of rabbit starvation (=suffering).	Whether long term 'equilibrium' rabbit population can co-exist with ongoing vegetative cover (Butchers Dam experiment for 13 years suggests it is possible). Whether in absence of regular poisoning predator-prey balance may improve.	If feral rabbit recommercialised, will provide easy harvest of rabbits in those areas. No direct labour or capital costs; (however, considerable environmental and social costs from land degradation).

4.1.4 Monitoring of land condition

Monitoring is essential to ensure that taxpayer (and ratepayer) funds are effectively used to meet community goals.

At the moment there is no agreement or consistency of approach in measurement between landholders, agencies, or scientists on early warning indicators for monitoring of land condition, or a benchmark below which land condition should not degrade. An agreed measure of land condition is required to assess land management performance against. ***It is necessary for Government to convene a group of scientists and 'stakeholders' to devise a basic method for monitoring land condition in the Crown lands currently in pastoral lease in the South Island, so as to more effectively protect and enhance this public resource.***

One method of monitoring which could be begun almost immediately would be the setting up of permanent photopoints at various representative locations on each property. Photographs taken at the same time each year could be readily compared by the landholder giving an indication of the relative condition of the vegetation.

The development of monitoring methodology should build on approaches developed in Australia by identifying 'key indicators' for sustainable use of pastoral land, with suitable adaption and application in the New Zealand situation. A possible benchmark could be an agreed percentage of bare ground.

In order to maintain themselves and future generations on the land, the landholders will have the greatest incentive to receive early warning of problems. Provision of a clear method of measuring land condition will provide certainty for both the landholder and the Crown. If holders of Crown leases and licences were required to make a yearly return in a land condition monitoring programme, subject to audit, the necessary data could be collected in a regular and efficient manner.

Regular monitoring of the condition of the dry tussock grasslands under Crown control should be a requirement under the lease or licence. As well, property plans within a sustainable land management programme should include a requirement for regular monitoring of land condition. Recognition of early degradation could alert the property holder to the need to change management practice. Too far advanced degradation could mean a mandatory requirement to destock and control rabbits, or relinquish the lease or licence.

4.1.5 Technology transfer

Breaking the 50-year cycle of land degradation requires a determined, coordinated research effort. Interdisciplinary cooperation and an ecological 'whole systems' approach in research programmes and the transfer of results to landholders in a practical form is required. It is essential that knowledge be preserved and built on and that the research is conducted in a framework recognising natural landscape variations within the tussock grasslands.

Research is particularly required to better understand the processes involved in ecosystem stability and degradation; to design resource management systems so as to maintain output while avoiding degradation of the resource base; and to design monitoring systems that can give early warning of land degradation.

For landholders to be able to move towards more sustainable uses of the dry tussock grasslands they must have ready access to the best scientific information available from a wide range of disciplines. Extension services and appropriate forms of technology transfer are essential if landholders are to be fully informed about the land use options which are available to them.

Since the MAF Consultancy Service became fully chargeable on a user pays basis, some farmers are unable to afford to buy this information and expertise. ***An incentive to landholders to move toward sustainable land use and management could be the provision of subsidised technical advice to landholders, including advice about alternative land uses such as agroforestry and forestry.***

4.2 Institutional framework

After only one year of operation of the Rabbit and Land Management Programme there is an encouraging consensus among public authorities as to possible future directions. The Regional Councils, MAF, DOC and Landcorp have indicated that future management of land, rabbits and hawkweeds should ensure that benefits gained are sustained in the long term. The Regional Councils in particular have made it clear that introduction of any viral rabbit controls should be conditional upon satisfactory provisions to capture the long term benefits.[5]

Management of the land is always constrained by the wishes of the public, which are reflected in legislation and institutions administering the legislation. At the present time local government restructuring has given Regional Councils a major role in natural resource management including water and soil conservation and weed and pest control.

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5 Letters from Regional Councils and agencies to Commissioner; Baines, 1991.

Their ability to integrate these responsibilities and achieve effective environmental planning and management will be strengthened by passage of the Resource Management Bill.

The institutional framework for' overseeing land management and land use change, particularly for lands at risk, requires some careful consideration. Capability to address interacting components is essential, and single purpose agencies are no longer appropriate if complex environmental problems are to be solved. ***Institutions will need to be multidisciplinary and have the expertise and capability to deal with environmental problems.*** Effective methods of gaining and retaining experience and maintaining an effective 'institutional memory' are also required.

Regional Councils have a major role in ensuring that management of the dry tussock grasslands in Central Otago, the Mackenzie Basin and Inland Marlborough will continue to support communities and provide economic and social benefits. Their objectives for achieving sustainable land use will require property plans, monitoring of land condition, and access to appropriate research results.

The enormity of the problem makes it imperative that sufficient and appropriate resources and expertise are available. This problem is not solvable by small local communities on their own. However the small local communities, and the landholders, are the key to successful implementation of property plans. They are also an important source of local knowledge, particularly when organised into groups to work on common problems.

4.2.1 Agencies and organisations

Effective implementation of many of the recommendations made by this review are dependent on certain institutional arrangements being made to implement and deliver sustainable land use.

A proposed institutional framework is schematically shown in Figure 4.3, and the components are described below.

1 Stewardship groups (landholders)

These might be organised on a catchment basis comprising properties of similar land type and with common land use potential and problems. They are implementors of change and could assist evaluation of improved technologies in a whole farm context. User advice as to research needs and feed-back about information provided would be important functions. The individual property plans developed with regional councils would make an ideal framework for

cooperative catchment-based planning and diversification, improved land use and management. The 'owners' of the problem are those best able to find solutions to the problem.

Existing models for stewardship groups in the dry tussock grasslands are the Kurow/Hakataramea Resource Conservation Committee and the Roxborough Combined Conservation Group.

2 Land Protection Committees of the Regional Councils

These Committees would include representative members of the stewardship groups. The Committees should ideally come under the Environment and Policy Planning arm of the Council. Besides having a liaison function between the stewardship groups and the Regional Council, they would have delegated authority to make decisions within the policies set by the Council. Decisions could be made on the objectives for property and weed and pest control plans, as well as eligibility criteria for landholder inclusion within established programmes. Ensuring compliance with and enforcement of conditions would also be an important role. These Committees would interact with Crown Research Institutes about research needs and results of technology applications.

3 Regional Councils

These will be responsible for setting the goals and objectives for sustainable land management, allocating resources, and setting conditions to achieve objectives. An important distinction needs to be made between the responsibilities of the elected members of Council and the management responsibilities of the staff.

Staff should be regularly review classification of the land based on its suitability and advise Council of any consequent need to change policies. In collaboration with the Commissioner of Crown Lands' agent, and with landholders, they will prepare property plans, catchment plans, regional water and land resource assessments and weed and pest control plans. Staff will have the responsibility for checking on the results of monitoring and compliance with the plans. In order to maintain a separation between policy and service delivery, Regional Councils should not be involved with service delivery such as implementing poison programmes. Provided the planning is done within the objectives set, weed and pest control can be carried out by registered contractors.

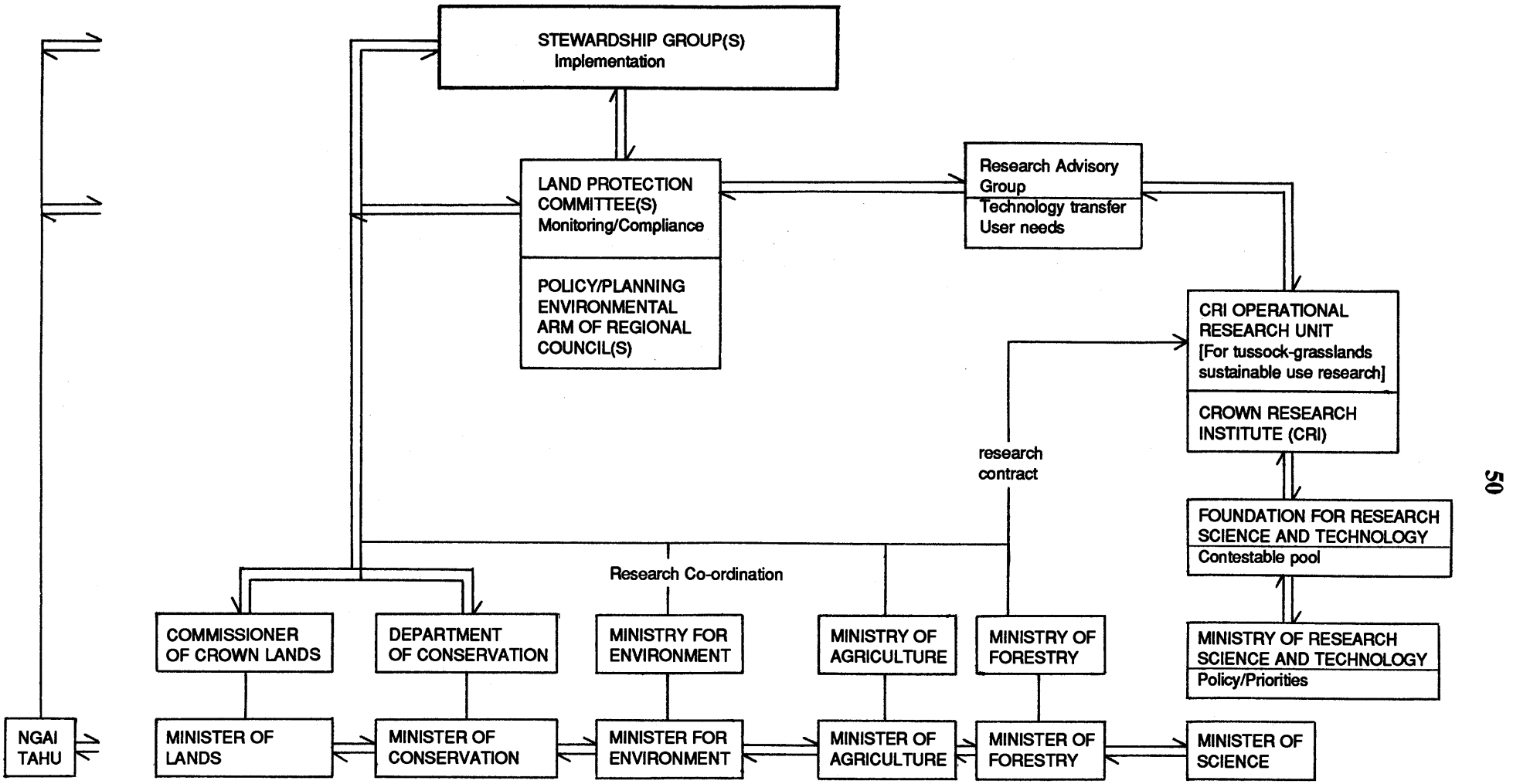

Figure 4.5 Possible Institutional Framework for Supporting Sustainable Use of the Dry Tussock Grasslands.

Regional Council staff will require training in a range of subjects including weed and pest control, monitoring land condition, silvicultural and agricultural practices, soil conservation and erosion control. Training in such areas should be given high priority. New Zealand can gain valuable experience and information on dryland management and pest control from closer contact with Australia.

4 Crown Research Institutes

As part of science restructuring, Crown Research Institutes (CRIs) will be operational from July 1992. One of the South Island CRIs should have the focus, staff experience and skill base to coordinate and integrate the research needs for the dry tussock grasslands.

There would need to be clear separation of public-good from operational research. For public-good research, the Ministry of Research, Science and Technology (MoRST) sets the research priorities with the Foundation for Research, Science and Technology (FoRST) operating the contestable pool of funds for which science providers make application. For operational research, funds in the form of a contract to the CRIs should come from the Minister of Lands who has responsibility for the dry tussock grasslands in Crown ownership, as well as the Ministers of Agriculture, Forestry, Conservation and Environment. The public interest in these lands encompasses values broader than agriculture. To ensure transparency and distinction between funding sources, the CRI would be expected to establish an Operational Research Unit whose sole focus is tussock grassland research - strategic (public good) and operational - including technology transfer functions for end users of the information.

5 CRI Operational Research Unit

This unit would synthesise existing and available data into appropriate technology packages for landholders and planners.

A vital part of any research planning structure is the transmission of research findings from the scientific community to the users of the new information, in this case the landholders and land management agencies. Information and technology transfer is essential, not only of New Zealand research results but also of overseas (especially relevant Australian) research findings. Ideally research advisory groups could act as research 'brokers', both relaying land-users' information requirements to research agencies and disseminating research findings to all interested parties.

It is important for the end users of research results to be involved in formulating research proposals so that their knowledge of the land is incorporated and research is geared to provide information which will directly assist them to manage the land in a way which is sustainable.

Research advisory groups with representatives from landholder groups as well as relevant government departments and the Regional Councils would assist in coordinating research related to the various aspects of land use in the degrading tussock grasslands.

It is envisaged that the Operational Research Unit would evolve from MAF's Rabbit and Land Management Monitoring Group and Semi Arid Lands Research Group. Its Advisory Group could evolve from the National Advisory Committee (NAC) of the Rabbit and Land Management Programme, and the Hawkweed Strategy Group.

4.2.2 Legislation

Functioning of the institutions is guided by the legislative framework. Deficiencies in the legislation require amendment.

Land Act 1948

The current legislation does not require that the marginal pastoral lands of the South Island are sustainably managed.

Section 99 of the Land Act 1948 requires Crown land under pastoral lease or license to be "properly farmed", using the "rules of good husbandry", and requires that the land be kept "free from wild animals, rabbits, and other vermin and comply with the provisions of the Agricultural Pests Destruction Act 1967". However, these provisions have not prevented a loss of vegetative cover on the land nor build-up of damaging populations of rabbits.

As administrative and case law has evolved for the pastoral leases, even explicit requirements are not strictly enforceable.[6] Either the Land Act must be changed, or maintenance of the land in a particular condition enforced through some other mechanism.

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[6] D. Gullen, Pastoral Lands Officer, DOSLI, pers. comm.

The undefined and unenforceable requirements of 'good husbandry' in the Land Act have not prevented degradation of the Crown land resource. In addition to restrictions on stock numbers, the legislation should direct that conditions be imposed with regard to the physical condition of soil and vegetation, and provide for vegetation monitoring and enforcement by suitably trained personnel. This may require retention of new skills for administration of pastoral leases.

Where conflicts arise between pursuit of primary production and protection of the land resource over the long term, the legislation should clearly favour land resource protection.

There is a clear need to allow greater flexibility in the land uses permissible under pastoral leases and licences. Decisions on, for example, agroforestry or plantation forestry could be a matter for the lessee and Regional Council planners rather than the Commissioner of Crown Lands. Obligations to obtain permission from the Commissioner of Crown Lands for other than pastoral land use are enshrined in the Land Act (section 108) and should be amended so as to encourage land use changes where they will contribute to improved sustainability of the land resource and the local community.

Discussion papers on Land Act revision have addressed *land categorisation*. This is envisioned as a mechanism to aid rationalisation of land tenure. Categorisation or classification is however also required to clarify land use objectives for Crown lands.

Special attention is required to the future of degraded dry tussock grasslands. Lands that are no longer useful for pastoral production and are so thoroughly degraded that 'recovery' will be very slow if it can occur at all (such as areas dominated by hawkweeds, scabweed, or bare ground), are currently envisioned as part of the 'Conservation' category for transfer to the Department of Conservation even though little of conservation value may remain. Without explicit funding for management, addition of these lands to the Conservation estate may drain already under-funded initiatives to protect conservation resources elsewhere. Degraded lands should not be allocated to any agency unless goals for these lands have been identified and are in accordance with the management objectives of the recipient agency, management and restoration costs are estimated, and a specific funding allocation made.

Currently some farm units in the dry tussock grassland have a poor balance of good land and degraded land, and 'summer' and 'winter' country. Categorising land and readjusting property boundaries to improve farm viability at the time the lease is available for sale or reallocation should be a priority.

Resource Management Legislation

The Resource Management Bill has the potential to provide a framework for integrated environmental management which will aim to achieve sustainable management of natural resources. Passage of the Bill will greatly assist Regional Councils and Crown agencies to address the problems of the dry tussock grasslands.

Agricultural Pests Destruction Act 1967

In her 1987 audit, the Commissioner recommended that section 121 of the Agricultural Pest Destruction Act 1967 be repealed, so as to recommercialise the feral rabbit. The MAF internal review of the Rabbit and Land Management Programme after its first year has also recommended that recommercialisation be considered as an additional rabbit control tool.[7] The repeal of section 121 has been part of discussion papers on a proposed Biological Security Bill, but to date the Bill has not been introduced into the House.

Photo credit: Alexander Turnbull Library, Wellington.

A rabbiter collecting rabbit skins for sale in Central Otago

Figure 4.4: Commercial use of the feral rabbit prior to 1947.

7 Baines, 1991, p.2.

Currently section 121 of the Act prohibits sale of fur or meat from rabbits. An Order in Council waives this restriction for domestic and commercial rabbits. Section 121 was introduced in order to discourage people from 'farming' rabbits instead of 'eradicating' them. However, we now know that 'eradication' of rabbits in these highly rabbit-prone areas is impossible.[8]

On its own, rabbit harvest cannot control rabbits sufficiently to fully protect pastoral production or the land resource. However, recommercialisation will encourage rabbit harvest as one more control mechanism to help lower the rabbit population and provide some income from a resource which since recommercialisation has only imposed costs.

4.3 Who pays?

Even if a decision is made to introduce a new viral rabbit control such as myxomatosis, effective introduction is at least two or three years away. In the meantime attempts to halt the present land degradation are to a large extent dependent on the Rabbit and Land Management Programme. The major area of land is Crown owned in pastoral lease and hence Government has a responsibility to ensure the land is maintained in good health. Accordingly the continuation of taxpayer funds for the five years of the Programme is strongly supported.

However the Programme will be unable to assist those farmers whose debt burden is too high or whose land is too far degraded to be easily rehabilitated. These farmers require assistance to leave the land. Their decisions would be made easier if they knew assistance for the family unit would be provided once the pastoral lease was surrendered. Support to allow the family unit to start again elsewhere is preferable to subsidising present farm practices which have led to land degradation.

A third area of taxpayer assistance should be the funding of public good research and the transfer of information.

Administration of weed and pest control programmes is the responsibility of the Regional Councils. Continuation of this administration is likely to be funded by the ratepayer. Differential rating systems to reward good management and recognise the weed and pest proneness of land will add a user pays element. Using ratepayers' money to actually deliver weed and pest control should be avoided.

Introduction of new weed and pest control tools should be paid for by those who will benefit the most i.e. the landholders. This should include the necessary scientific support

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8 'Eradication' of the rabbit has not been accomplished in the dry tussock grassland with over 20 years of taxpayer subsidy and diligent effort, or in Australia with the use of myxomatosis.

services. The identification of appropriate cost recovery mechanisms such as a special land tax, or an additional fee for pastoral leases is required.

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"We as lessees and land managers in the high country must take on the responsibility of drawing up our set of objectives for future land management and land use. We need to convince ourselves that we have the ability, the knowledge and the expertise to manage our land and to set in place long-term sustainable strategies - what's more, we can do it a damn sight better than the bureaucracy. These objectives should be established by the "grassroots" farmers, in each area and cover all tenures in the high country, not just pastoral land ...

"It will require a commitment and a preparedness to change which will be extremely difficult, but the alternative for us is to be locked into a system of outside experts dictating what should happen and an ever-increasing inability for us to influence our own business decisions, indeed our own destiny."

Pat Garden, 1991 [9]

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[9] Chairman, South Island High Country Committee, Federated Farmers. From Speech notes, South Island High Country Field Day, Glenorchy, 1 March 1991.

5.0 CONCLUSIONS AND RECOMMENDATIONS

The principal problem of the dry tussock grasslands is *land degradation*, not just rabbits. Rabbits and hawkweeds are symptoms of land degradation, as well as partial causes. Changes to land use and land management are required in some areas to ensure that a human presence can be sustained long-term in the dry tussock grassland environment. The solution to the problem lies principally with landholders who are able to take responsibility for setting and implementing a long-term sustainable strategy for the land.

For many decades prior to 1984, farming of the dry tussock grasslands was subsidised by the taxpayer. Rabbit control efforts were subsidised on a $1 for $1 basis, and a host of development and stocking subsidies encouraged pursuit of high production from the land. Subsidies masked the true economic viability of some properties in this marginal pastoral environment, and as subsidies were progressively removed conventional rabbit control and maintenance of fertiliser inputs became in many cases unaffordable.

In the Commissioner's 1987 audit a five-year programme was recommended to encourage changes toward more sustainable land use through providing a 'window of opportunity' via taxpayer/ratepayer subsidy of rabbit control costs. It is now recognised by all stakeholders that there are constraints to obtaining commitment to these changes during a five-year period. Even with a longer 'window' (through greater subsidy and/or introduction of viral controls), there are still constraints to the necessary changes taking place.

Changes to land management and land use to better adapt to a degraded and naturally harsh environment require landholder cooperation. Landholders are the most important stakeholders in this respect, and they and their local communities have the most to gain over the long term from making these changes. Achieving change is difficult in times of economic hardship, although there is some evidence of initiatives being taken by landholders, and further initiatives would be assisted by practical farm scale demonstration of alternative land management and land use options.

Most of the land in question is Crown land, and Government has a responsibility to halt, and if possible find the means of reversing, degradation of this resource over the long term. The past and present legislative and administrative frameworks have been inadequate to protect this resource, despite the best of intentions by stakeholders. A better framework is required, one that encourages alternative land uses that are sustainable in the long term, ensures land managers can maintain good land condition through times of economic or environmental stress, and holds Crown agencies and landholders accountable for the condition of the land they are managing on behalf of the New Zealand public. A means of measuring and monitoring the condition of the land is essential.

The enormity of the problem makes it imperative that sufficient and appropriate resources and expertise are available. The problem is not solvable by local communities on their own. Nor is it solvable until local communities identify what changes to present land management and land use must be made.

The onus for land management must be placed on the individual landholder, within guidelines set by Government. Assistance can be provided by the Regional Councils who have many of the necessary skills, a regional focus, and the ability to integrate technical information in a practical manner.

New more affordable options for weed and pest control are required, whether to assist existing land use to continue or to allow new land uses to be established. These new controls need to be used in conjunction with present methods. Denying commercialisation of the feral rabbit is no longer appropriate.

The introduction of a viral control such as myxomatosis is likely to provide savings on rabbit control costs and more effective control of the small pockets of bait-shy and poison-shy rabbits over the short to medium term. It would also remove the resentment among landholders that the larger community is denying them a cost-effective tool. However, unless conventional controls are continued as follow-up and present land use and management is changed, in some areas the land will continue to degrade over the long term.

Myxomatosis remains abhorrent to many people, principally because of a perception that it causes cruelty to rabbits, and a fear that there may be unknown side-effects on New Zealand's native fauna or unwanted viruses brought in with and/or transmitted by the flea.

The decision on whether to introduce myxomatosis and/or other viral rabbit controls is a political choice, and must be made in light of the best information available from the advisors of the Ministers of Agriculture, Lands, Environment, Conservation, and Science. Similar advice is required for decisions on how to control hawkweeds.

There is no simple solution to the degradation of the dry tussock grassland, and solutions must evolve over time through cooperation among the stakeholders. The review team advocates an ongoing sustainable land use programme evolving from the present Rabbit and Land Management Programme. As a beginning, there must be a policy commitment to truly sustainable land use, the design of structures to improve participation of landholders and local communities in land use decisions, and improvements in the practical availability of research results on diversification and land use change options for the dry tussock grasslands. Legislative encouragement of sustainable land management through passage of the Resource Management Bill is required.

Accordingly, the Commissioner makes the following recommendations.

TO THE MINISTER OF AGRICULTURE

1. That the Rabbit and Land Management Programme be continued for its full five-year term, but with more realistic expectations about what can be achieved, more precise terms of reference, and measurable objectives. The Programme's terms of reference should include:

   (a) completion of rabbit controls on the balance of the Programme lands not covered in 1990, but only where property plans have been agreed to;
   (b) selection of attainable goals for enhancement of vegetative cover for each class of land in property plans as identified by the Regional Councils;
   (c) collection of rabbit population data from ongoing monitoring programmes on eligible properties;
   (d) 'technology transfer' of available research findings on sustainable land management, alternative land uses, and alternative pest controls, at no charge to those who have signed property plans; and
   (e) establishment of viral rabbit control if approved.

   (Section 3.1)

2. That if introduction of myxomatosis is approved:

   (a) the rabbit flea be thoroughly tested for unwanted 'passenger' viruses so as to help minimise the risks to New Zealand from the introduction;
   (b) flea breeding and introduction be tightly controlled and monitored by a scientific team, borrowing on Australian expertise;
   (c) the timing for release of the myxomatosis virus be only under the advice of the scientific team, so as to obtain the maximum benefit from the introduction;
   (d) ongoing scientific and technical support be provided for monitoring the effectiveness of the virus, its spread throughout the country, and reintroduction of virulent strains as the original introduction attenuates;
   (e) no further taxpayer funds be spent on conventional rabbit controls under the Rabbit and Land Management Programme after all Programme eligible lands with signed property plans have been covered once by rabbit control works under the Programme; and,
   (f) cost recovery be implemented so that those who will most benefit from myxomatosis will pay for the introduction programme.

   (Section 4.1.3, Table 4.2)

3. That if any viral rabbit control is introduced, the costs of protecting commercial and domestic populations of rabbits be funded as part of the introduction programme.

   (Section 4.1.3, Table 4.2)

4. That research into alternative rabbit control methods, as well as focusing on primary controls, should also include methods which may act as secondary controls, deterrents, or be useful in lands retired from production. This research should include predator enhancement, fertility control via baits and phytotoxins in red clover, investigation of the possible deterrent effect in biodynamic 'peppering', and pheromones or kairomones of possible use in rabbit control.

(Section 4.1.3, Table 4.2)

5. That in cooperation with Regional Councils the formation of local landholder stewardship groups be encouraged in the dry tussock grassland areas, that they be provided with the latest information on sustainable dryland management techniques in an accessible and practical form as part of an ongoing sustainable land management programme, and that they be consulted in the selection of research topics.

(Section 4.2.1)

6. That section 121 of the Agricultural Pests Destruction Act 1967 be repealed, so as to recommercialise the feral rabbit.

(Section 4.2.2)

TO THE MINISTER OF LANDS

7. That categorisation of Crown lands proceed promptly, that the categorisation be based on New Zealand Land Resources Inventory data so as to focus on land use suitability, and that maps of indicative categorisation be made available to landholders, Regional Councils, and Crown agencies so as to facilitate cooperative ventures for improving the balance of land types between pastoral leases and pursuit of boundary adjustments as appropriate.

(Sections 4.1.1 - 4.2.2)

8. That in all Crown dealings relating to the South Island dry tussock grasslands the Ngai Tahu Trust Board be invited to participate and be kept informed.

(Section 2.5)

9. That no pastoral lease should be sold or reallocated until it has been categorised, and boundaries with adjacent lands readjusted as necessary to improve farm viability.

(Sections 3.1, 4.2.2)

10. That conditions on land use be relaxed in Crown pastoral lease and licence agreements to encourage alternative land uses.

(Section 4.2.2)

11. That regular monitoring of land condition be a condition under pastoral leases, pastoral occupation licenses, and any other contracts for management of Crown land in the dry tussock grasslands, using the method and baseline of land condition established by the monitoring working group set up by the Minister of Science (see recommendation 20); and that compulsory destocking and pest control and if necessary resumption of pastoral leases and licences by the Crown is enforced where monitoring of land conditions shows that land condition has declined.

(Sections 3.1, 4.1.4, 4.2.2)

12. That knowledge of ecological processes and a broad range of land use options including forestry for the dry tussock grasslands be included in training programmes for staff enforcing Crown Pastoral lease and licence condtions.

(Section 4.1.5)

13. That explicit attention be given to the future management of the degraded dry tussock grasslands under Crown control, and that they not be designated for transfer to any agency unless management goals have been identified, those goals align with agency objectives, and explicit and sufficient funding is made available for management and restoration of those lands.

(Section 4.2.2)

14. That biological controls developed for hawkweeds not be introduced into the dry tussock grasslands unless replacement species are available and established in the areas now dominant in hawkweeds, so as not to exacerbate soil erosion problems.

(Section 2.4)

TO THE MINISTER OF SCIENCE

15. That in structuring the Crown Research Institutes, every effort be made to facilitate interdisciplinary cooperation and an ecological 'whole systems' approach in research programmes.

(Section 4.1.5)

16. That all research related to the dry tussock grasslands be formally coordinated.

(Section 4.1.5)

17. That topics for dry tussock grasslands research be finalised after consultation with a research advisory group comprising representatives of all stakeholders.

(Section 4.2.1)

18. That dry tussock grasslands research results be disseminated to the advisory group, landholders and public authorities in readily accessible and practical form.

(Section 4.2)

19. That in consultation with the Ministers of Lands, Agriculture, Conservation, Forestry and Environment, a multidisciplinary research team (an Operational Research Unit within a Crown Research Institute) be set up to support sustainable management of the dry tussock grasslands. Priority should be given to the following:

(a) synthesis of existing and available data into practically useful form for landholders and land management agencies;
(b) understanding the processes involved in ecosystem stability in the dry tussock grasslands, including dynamics of organic matter and soil fertility in the unimproved dry tussock grasslands subject to pastoral use, and environmental and land management factors which contribute to dominance of hawkweeds;
(c) designing monitoring systems that can give early warning of land degradation;
(d) alternative weed and pest control mechanisms; and,
(e) development and demonstration of low-maintenance plant species for dry tussock grasslands (including tree, herbage, forage and crop species).

(Sections 3.5, 4.1.5, 4.2.1)

20. That in consultation with the Ministers of Lands and Conservation a working group of scientists and stakeholders be convened to devise a basic method for monitoring land condition (e.g. soil and vegetation) on Crown leases and licences in the dry tussock grasslands, including the identification of early warning signs of degradation and establishment of a baseline below which land condition should not be allowed to degrade.

(Section 4.1.4)

21. That information about the locations of areas recommended for protection in the Protected Natural Areas Programme and endangered species be acquired from the Department of Conservation and be added to the New Zealand Land Resource Inventory.

(Section 3.4)

22. That New Zealand maintain formal links with appropriate Australian research organisations, including the provision of funds, to enable New Zealand to benefit from Australian expertise and development of new dryland management and rabbit control tools.

(Sections 4.1.3, 4.1.4, 4.2.1)

TO THE MINISTER OF FINANCE

23. That the nature of assistance available to farming family units who wish to relinquish their pastoral lease and to make a new start be made known as soon as possible.

(Section 4.3)

24. That cost recovery mechanisms are identified and imposed on those who will benefit the most from introduction of viral control for rabbits.

(Section 4.3)

TO THE MINISTER OF FORESTRY

25. That information on practically tested forestry options for the dry tussock grasslands such as agroforestry, windbreaks for altering microclimates, woodlots, tree crops, and larger scale forestry be disseminated to landholders and Regional Councils.

(Section 4.1.5)

TO THE OTAGO, CANTERBURY, AND NELSON/MARLBOROUGH REGIONAL COUNCILS

26. That each Council establish, preferably under an Environment Planning and Policy arm, a Land Protection Committee including representatives of local groups with delegated authority to make decisions within Council policies and with the responsibility of providing to Council an annual report including a statement on the ecological condition of the land.

(Section 4.2.1)

27. That eligibility criteria for the inclusion in Rabbit and Land Management Programme be based on soil type, vegetative cover and rabbit proneness as well as rabbit poisoning history.

(Sections 3.1, 3.2)

28. That consideration be given to adding local information on landscape values to the land resource inventory system in deriving land classifications.

(Section 3.4)

29. That the formation of local land stewardship groups be promoted, to encourage cooperative local solutions to shared land management problems and evaluate and disseminate new information on land use and management options.

(Section 4.2.1)

30. That the basic method for monitoring land condition in the dry tussock grasslands as devised by the working group set up by the Minister of Science (recommendation 20) be integrated into monitoring programmes in the property

plans and in other farm or catchment plans in operation in the region where appropriate.

(Section 4.1.4)

31. That the results of land condition monitoring programmes (recommendation 20) be used in setting differential rates with incentives for good environmental management.

(Section 4.3)

32. That staff training be supported so as to benefit from research findings on locally relevant techniques for sustainable land management, including alternative land uses and where appropriate to update knowledge of rabbit control and dryland management techniques developed in Australia.

(Section 4.2.1)

33. That staff activities focus on planning, supervision and monitoring and that primary and follow-up weed and pest control operations are contracted out to registered contractors.

(Section 4.2.1)

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APPENDIX 1 DEFINITION OF TERMS

Attenuation is the natural tendency of a virus to lose effectiveness over time, through development of immunity in the host and/or reduction in virulency of the disease.

Brown-grey earths are soils which occur in semi-arid parts of Central Otago and the Waitaki Valley. Formed from schist and greywacke bedrock and sediments, under short tussock grasslands with annual rainfalls less than 500 mm.

Dry tussock grasslands are tussock grasslands principally below 1000 metres in altitude east of the main divide, generally with hard tussock (*Festuca novae-zelandiae*) and silver tussock (*Poa cita*) dominant, now generally depleted with many introduced pasture and weed species. Scrubland of native and introduced species (e.g. Matagouri, sweet briar) common if not removed by pastoralists.

Ecological sustainability is allowing for the perpetuation of an ecosystem while using components of that ecosystem, and ***sustained yield*** is what can be removed from an ecosystem without affecting its ability to maintain or regenerate itself.[1]

Economic sustainability means that over the long term the income or return from investment is equal to or greater than the cost of inputs, as measured in dollars. It is the ability of the community to afford something over the long term, within the narrow constraints of those things valued in monetary terms.

Desertification is the end result of a process of sustained land degradation (soil and vegetation) in low rainfall zones caused at least partly by human activity. Degradation reduces both resilience and productive potential to an extent which can neither be readily reversed by removing the cause nor easily reclaimed without substantial investment.[2]

Desertification was identified as a problem in the rabbit-prone areas of the South Island in the Commissioner's 1987 audit.[3] Symptoms of desertification that can be observed in marginal pastoral lands in the South Island are:

* Increased incidence of bare ground and exposed subsoil;
* Rate of soil loss greater than rate of soil formation;
* Erosion of soil previously held by plants or covered by leaf litter;
* Decrease in 'standing biomass' (mass of living plant material);
* Decrease in 'species diversity' (fewer plant species present);
* Increased abundance of species that survive well in low-fertility soils (e.g. sheep's

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1 NZ Ecological Society, 1990.

2 Ridley Nelson, 1990.

3 PCE 1987, pp.35-36.

sorrel, hawkweed); and

* Increase in species that can compete under heavy grazing pressure (e.g. low-growing species such as scabweed and hawkweed).

Hawkweeds are introduced species of the genus *Hieracium* (previously termed *Pilosella*). Species particularily common and of concern in the study area are *Hieracium pilosella*, or 'mouse-ear hawkweed' (a very low-growing form) and *Hieracium praealtum* or 'king devil hawkweed' (a more upright form).

Immuno-contraception is a new form of vertebrate pest control being developed through genetic engineering in Australia. In theory, a benign form of a species-specific disease (for the rabbit, a non-fatal strain of myxomatosis) can be modified to carry species-specific genes that will render the target population less fertile. The altered virus could also be termed a genetically modified organism (GMO). Field trials will not be possible until many more years of research, particularly on species-specificity of the generally modified virus.

Kairomone: a chemical substance emitted by one species which has an effect on a member of another species.

Land classification: the arrangement of land units into various classes based on the properties of the land or its suitability for some particular purpose.

Land management change: changed management of existing land use, e.g. changed stocking rate.

Land use: the primary or primary and secondary use(s) of land such as cropping land, timberland, improved pasture land, wildlife reserve, ecotourism etc.

MAF: Ministry of Agriculture and Fisheries.

Marginal land is land that returns barely enough to meet expenses in a specific land use. ***Marginal pastoral lands*** are lands which by virtue of climate, soils and introduced and endemic species are able to produce limited income for pastoralists and are subject to chronic challenges to production (drought, erosion, pest plagues).

Myxomatosis is a viral disease which in its more virulent forms is fatal to the European rabbit. The disease itself is indigenous to the American continent and is not natural to the European rabbit. The myxoma virus requires a vector to spread in wild rabbit populations, and introduction of the rabbit flea would be required to spread the disease in the rabbit problem areas of New Zealand. The disease is species-specific and fatal strains take from 8 to 30 days to kill a rabbit.

Pheromone: a chemical substance emitted by one animal that acts as a signal to another of the same species.

Scabweeds *are* native species of the genus *Raoulia*, of low cushion-forming habit

particularly able to thrive in sites such as abraded stream margins and areas of severe soil loss. They were prominant during earlier periods of desertification in the South Island (e.g. early 1900's, 1940's).

Sustainable management is managing the use, development, and protection of natural and physical resources in a way, or at a rate, which enables people to meet their needs without compromising the ability of future generations to meet their own needs.[4]

VHD is Viral Haemorrhagic Disease - also known as the 'Spanish virus'. It is a recently discovered viral disease, apparently specific to rabbits, which has seriously affected commercial rabbit populations in China, North America and Europe, and spread to the wild rabbit population in Spain. Fatal strains of the virus take up to 36 hours to kill a rabbit. Species-specificity trials are now underway in Australia.

Yellow-brown earths *('dry' upland and high country)* are soils which occur in the Mackenzie Basin and Upper Clutha Valley, with smaller areas in the high country of Canterbury and Marlborough. Formed directly from greywacke on steep mountains, also from morainic deposits, alluvium, and loess of greywacke and schist origin. Altitudinal range 300-650m; in places up to 1000 m in central Marlborough. Rainfall ranges mainly from 500 to 900 mm per annum. Low soil moisture storage limits growth in summer.

Yellow-grey earths are soils which form on mainly loessial parent materials where rainfalls range from about 500 mm to about 850 mm per annum. Vegetation at time of European settlement was mainly short tussock grassland (fescue and silver). Seasonal moisture deficiency is characteristic.

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[4] This was also used as the definition for 'sustainable development' by the World Commission on Environment and Development, 1987.

APPENDIX 2 THE TERMS OF REFERENCE AND CRITERIA FOR THIS REVIEW

TERMS OF REFERENCE

Objective

With the objective of maintaining and improving the quality of the environment, to review the Rabbit and Land Management Programme as approved by Government in May 1989, and report on whether it is likely to assist long term sustainable management of rabbit prone areas of the South Island high country with severe risk of land degradation.

To report on:

1. *Appropriateness of problem definition and recommendations in Parliamentary Commissioner for the Environment's 1987 audit on the proposal to introduce myxomatosis;*

2. *Implementation of the recommendations of the Parliamentary Commissioner for the Environment and the Rabbit and Land Management Task Force in 1987 and 1988;*

3. *Evaluation of the Rabbit and Land Management Programme to date, including constraints on its successful operation; and,*

4. *Additional or revised recommendations which may be required to Parliament, Ministers, agencies or others.*

CRITERIA

In the Commissioner's 1987 audit, the criteria for a solution were:

* *it should be sustainable over the long term*
* *it should be environmentally sound*
* *it should be acceptable to the wider public.*

For this review, the criteria chosen for evaluation of the Rabbit and Land Management Programme and options for addressing land degradation were:

* ***Ecological sustainability***
* ***Economic sustainability***
* ***Equity in allocation of costs and benefits***
* ***Ability to arrest, reverse, or prevent land degradation.***

APPENDIX 3 THE COMMISSIONER'S 1987 RECOMMENDATIONS

*Orginal text from **'Investigation of the Proposal to Introduce Myxomatosis for Rabbit Control'** Volume I, pp.86-91, and commentary on implementation*

RECOMMENDED TO THE MINISTER OF AGRICULTURE:

That the European rabbit flea/myxoma virus complex not be introduced for rabbit control.
Accepted. Note the Commissioner commented in the text that introduction should not be approved 'at this time'.

Amend the Animals Act 1967 to increase the fine for illegal introductions to $20,000

> **This may be accommodated in a new Biological Security Bill and/or proposed New Organisms legislation (consultations commenced, but neither drafted as yet).**

If an illegal introduction of myxomatosis is made, withdraw Government support for rabbit control and set up a monitoring programme convened by MAF and paid for through APDC funding.

> **No official response.**

Amend the Agricultural Pests Destruction Act 1967 to:

(a) *remove the classification of rabbits as a pest of national importance (with MAF to consult with local Councils on whether rabbits are declared pests of local importance), and*

(b) *remove commercial restrictions on feral rabbit products.*
These changes are scheduled for inclusion in a new Biological Security Bill, not yet drafted.

That the Crown assume direct control of the intractable areas in the Alexandra Pest Destruction District.

> **Not accepted.** However, the Crown has indirect control through the Rabbit and Land Management Programme.

That a special scientific group be appointed to devise a strategy for the neophobic (bait-shy) rabbit problem, and that funding for this group be diverted from APDC funds previously allocated for the Alexandra area.

> **Not accepted.** However, additional funding for scientific work was allocated from Vote: MAF starting in 1989.

That $100,000 from APDC budget be allocated to set up task force(s) and $5 million once-off allocation be made for an integrated land management package.

The Task Force was funded as recommended in March 1988. In May 1989, the Government approved $16.37 million over 5 years for the Rabbit and Land Management Programme.

RECOMMENDED TO THE MINISTER FOR THE ENVIRONMENT:

That local short-term task forces be set up to address land management and rabbit control issues in more detail in areas of high to moderate risk of rabbit infestation.

The Minister of Agriculture enacted this recommendation. A Rabbit and Land Management Task Force was set up covering central Otago, Mackenzie and Marlborough, and reported its recommendations to Government in September 1988.

RECOMMENDED TO THE MINISTERS OF LANDS AND CONSERVATION:

That classification of land in the Pastoral Leases be reviewed on the basis of resource use sustainability, with due regard to the task force recommendations.

The review of the Land Act (still underway) may address this.

RECOMMENDED TO THE AGRICULTURAL PESTS DESTRUCTION COUNCIL:

That areas most at risk of rabbit infestation be more precisely mapped according to environmental factors, and that Boards be encouraged to rate lands according to risk of rabbit infestation.
That APDC funding not be available for night shooting or poisoning of the same area every year, and that scientific monitoring of control programmes be implemented.

The Minister directed APDC to respond to these recommendations, but no reply was received before APDC was disestablished.

RECOMMENDED TO THE FARMING COMMUNITY VIA FEDERATED FARMERS:

That a levy of about 0.1 % by the NZ Wool Board be considered to fund rabbit research.

No official response.

APPENDIX 4 1988 RECOMMENDATIONS OF THE MINISTER OF AGRICULTURE'S TASK FORCE ON RABBIT AND LAND MANAGEMENT

*Recommendations from **The Report of the Rabbit and Land Management Task Force** September 1988, p.IX.*

1 To ensure that the actions we propose are implemented we recommend the establishment of a ministerial committee by the Minister of Agriculture in consultation with the Minister for the Environment.

2 The ministerial committee to be responsible and accountable for the future distribution of TPI* for rabbit and land management and specifically to:

- establish regional consultative groups;
- ensure implementation of integrated rabbit and land management packages via property plans;
- facilitate the exit of landholders on the most severely effective holdings to allow alternative uses where appropriate;
- take particular note of the neophobic/bait avoidance problem and focus on limiting its spread.

3 That the Minister of Agriculture and the Minister for the Environment annually appropriate $5.169 million (1988) for integrated rabbit and land management and surveillance in semiarid regions only, and that this figure be phased in as the current TPI* is phased out between now and 1992.

4 That the Cabinet Policy Committee minute of 15 December 1987 (P (87) M44/2) (item L) directing "... MAFTech to allocate increased scientific resources from Vote Agriculture to deal specifically with the rabbit management problems of the intractable area ..." be actioned.

*TPI = Tax Payer Input

Appendix 5 Weather analysis graphs

Prepared for the review team by Ron McGann and Lesley Coutts, NZ Meteorological Service, Wellington.

1. Air frosts

Total annual air frosts for Alexandra (Central Otago), Lake Tekapo (Mackenzie Basin), and Molesworth (Inland Marlborough), 1945-1990. Selected as a measure of severity of winters, with 'line of best fit' to ascertain any long term trends.

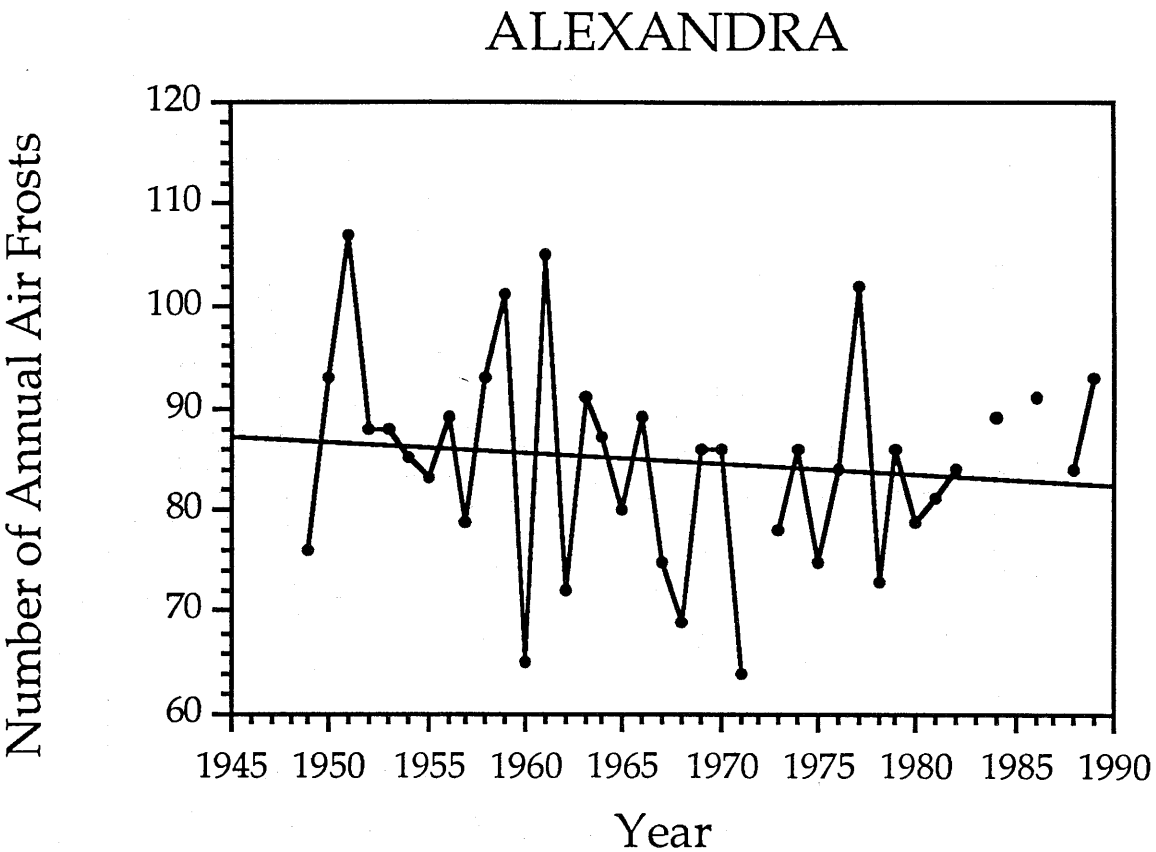
2. Soil moisture deficit

Total days of soil moisture deficit (wilting point) for Alexandra (Central Otago) and Lake Takapo (Mackenzie Basin), 1951-1988, showing deviation from the long term average. (Data for Inland Marlborough and more recent years unavailable).

Data has been divided into 'wetter months' (April through September) and 'drier months' (October through March), as the review team had been informed that there had been a seasonal shift in rainfall patterns.

Bars above the horizontal line show more days of soil moisture deficit than average (drier), and bars below the horizontal line show fewer days of soil moisture deficit than average (wetter).

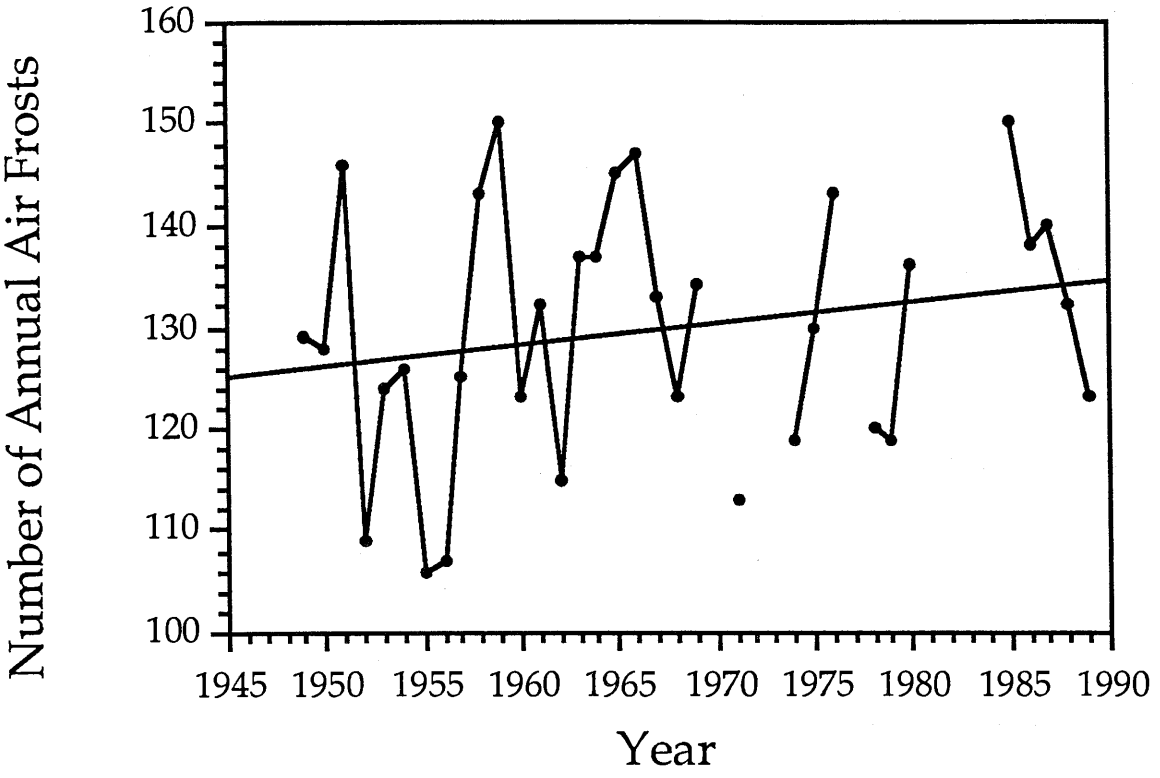
Average soil capacity values used for calculating soil moisture deficit: Alexandra 125mm, Lake Tekapo 200mm.



Line of best fit: y = 281.09 - 0.0099782x R2 = 0.013

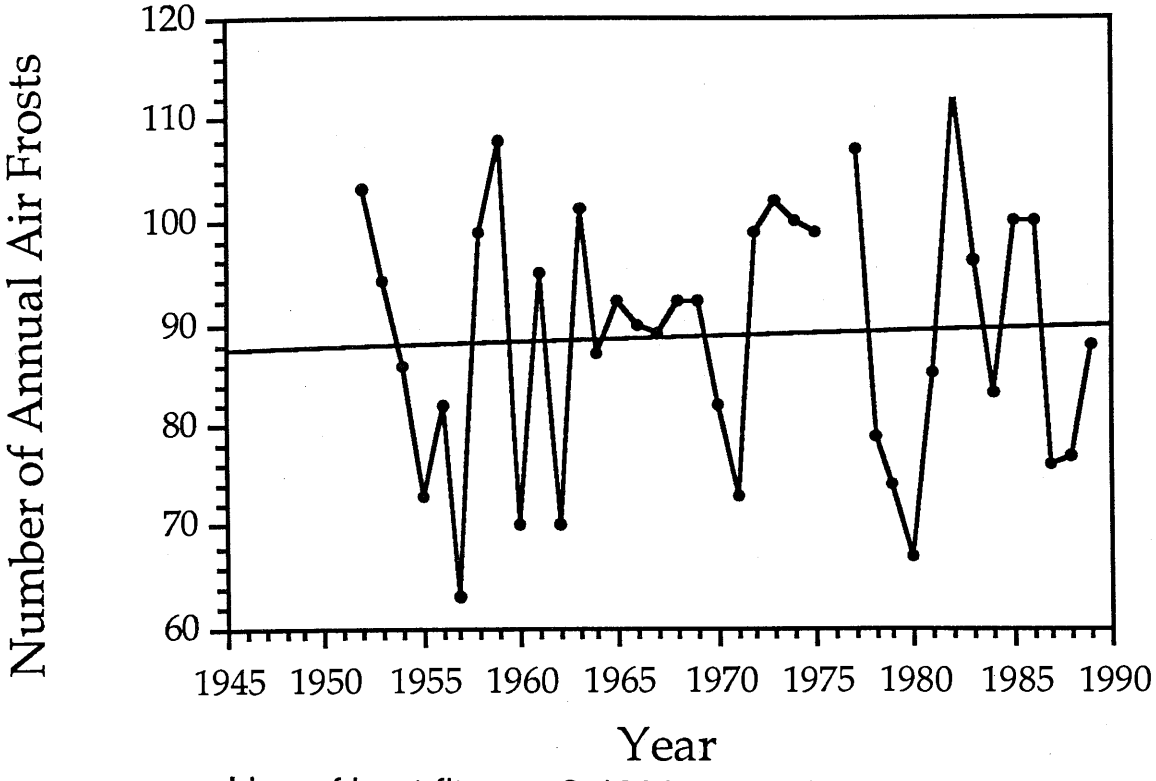
Note. From 01/1922-09/1983 the station was located at Lat. 45 16S and Long. 169 23E and was run by the MWD. From 10/1983 onwards the station is located at Lat. 45 15S and Long. 169 22E and run by the Borough Council.

MOLESWORTH

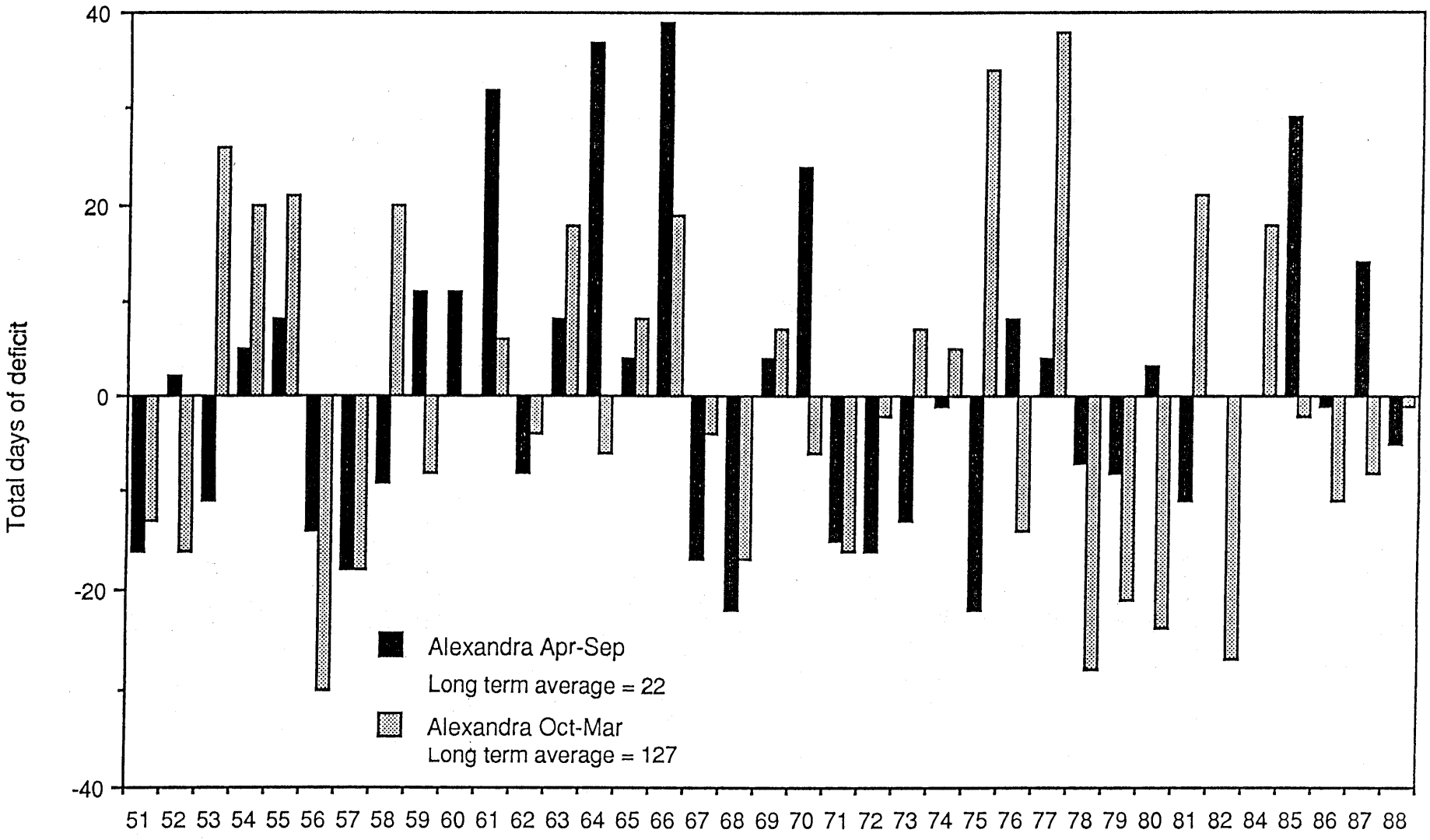


Line of best fit: y = -276.63 + 0.20661x
R2 = 0.042

LAKE TEKAPO

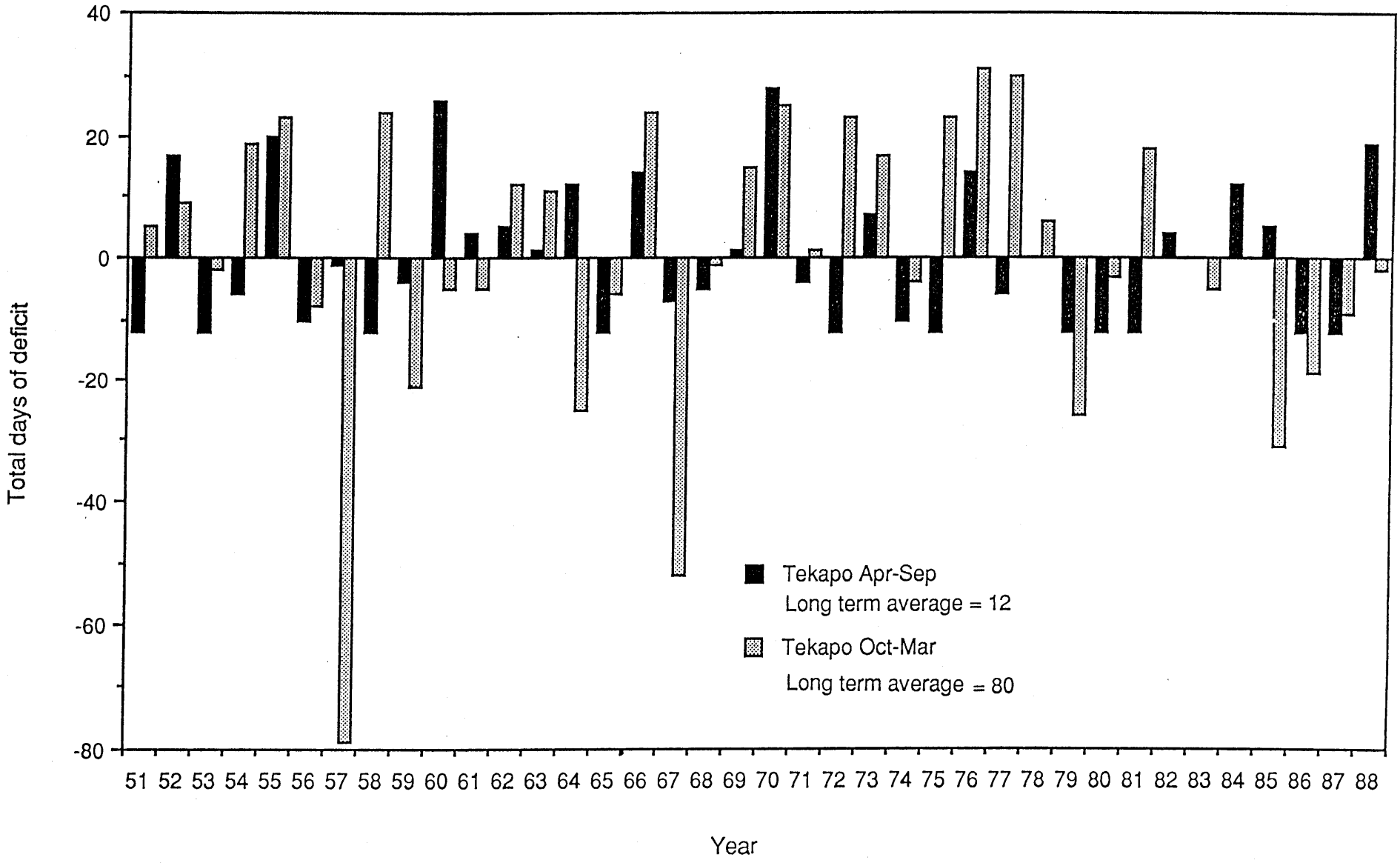


Line of best fit: y = -3.4280 + 0.0046813x
R2 = 0.002



Comparison of days of deficit (selected months) with the long term average.

Lake Tekapo days of deficit



Comparison of days of deficit (selected months) with the long term average.