THE MANAGEMENT OF NATURAL GRASSLANDS ON THE RIVERINE PLAIN

OF SOUTH-EASTERN AUSTRALIA

Shirley Diez and Paul Foreman

Produced by CNR (Bendigo) and funded by ANCA

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Research and the collation of information presented in this report was undertaken with funding provided by the Australian Nature Conservation Agency.
The Project was undertaken for the National Reserve Systems Co-operative Program.
Project Number N405

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The Report may be cited as:

Diez, S. and Foreman, P. (1996).
The Management of Natural Grasslands on the Riverine Plain of South-eastern Australia
Australian Nature Conservation Agency, NRSCP Project Number N405
Unpublished report

Copies of the report may be borrowed from the library

Australian Nature Conservation Agency
GPO Box 636
Canberra, ACT 2601
Australia

1996
Produced by the Department of Conservation and Natural Resources, Bendigo, Victoria.
With funds received from the Australian Nature Conservation Agency (ANCA), Canberra, Australia

Printed on recycled paper to help conserve our natural environment

Cover illustration by Shirley Diez:
An impression of Scaly Buttons *Leptorhynchos squamatus*

Acknowledgments

We would like to thank the following people for assistance: Natalie Baxter (CLPR Bendigo) for help with soil texture and colour analysis and Vanessa Barri for help with some of the field work in Victoria. For providing site history information regarding publicly managed land in NSW, we would like to thank: Dick Honeyman (Jerilderie Shire), John Duryea (Hay RLPB), Tom Burke (Urana RLPB), Norm Robinson (Jerilderie RLPB). For support during the initial stages of this work we would like to thank people within the National Parks section of CNR, particularly Grant Hull, Chris Ashe and Phil Hamer.

We extend our thanks and appreciation to the following land-holders and managers. They were generous with their time and knowledge, and allowed us to include their properties in this study: John and Glenice Nevinson, The Chappel Family, Jack and Jean Wishart, Dorothy Davies, Michael Coughlan, Basil Bolton, Peter and Sarah Seely, Tony Blackford, Bob Sefton, and Peter and Jim Chalmers.

For assistance with site location in New South Wales and logistics we thank Martin Driver (Greening Australia Deniliquin), Bill Mulham, John Brickhill (NPWS), Rick Webster, and Phil Maher. For inspiration, good food and entertainment during field trips we thank Liz Ashby, John Benson and Marianne Porteners, from the Royal Botanic Gardens, Sydney.

We extend our thanks to Jim Crosthwaite, DCNR Economist, Melbourne, for his contribution of text and ideas for section 1.2.2 of this document. Also Kerri Northey, DCNR, Melbourne, who provided information on Public Authority Management Agreements for the Appendices.

For their time, conversation, and ideas we thank all of the above and Neville Scarlett, Ian Lunt, David Baker-Gabb, Sue Hadden, John Morgan and Bob Parsons. For critical comments on drafts, we would like to thank Rob Price, Phil Maher, John Brickhill, Bernie Young and John Cooke.

Funding for this project was provided by the Australian Nature Conservation Agency (ANCA), through the National Reserve Systems Co-operative Project (NRSCP) and we would particularly like to thank John Lumb and Craig Kelly for their assistance.

CONTENTS

SUMMARY

The Riverine Plain grassland community of south-eastern Australia is considered an endangered ecosystem and contains many rare or threatened flora and fauna. Today's grasslands are remnants of what were formerly vast saltbush and largely treeless plains. The least modified grasslands have a high species diversity, sometimes with more than 30 indigenous vascular plant species per 100 square metres. Such remnants are often surrounded by relatively degraded vegetation as a consequence of exotic pasture establishement, cereal cropping, or irrigation. The majority of grassland remnants examined have survived because land-managers did not over-graze or plough their land, although in most cases there was no conscious attempt to preserve biodiversity in grasslands.

The purpose of these guidelines is to provide advice to land managers wanting to manage natural grasslands for conservation purposes. They are based on data collected during the period July to November 1995, and also incorporate anecdotal information provided by various land managers.

The historical context of Riverine Plain grasslands, and their composition and structure are described. Ecological and economic rationale are provided for the conservation of native grasslands. General grassland conservation management objectives and recommendations are covered, and appropriate land management practices suitable for remnant grasslands are discussed. These recommendations are based on historical and current management practices carried out at both private and public sites which retain remnant grassland in good condition.

The key principles for the conservation management of Riverine Plain grasslands are:

- That at sites with a history of grazing, periodic light grazing should continue (with caution). Likewise, burning should continue at those sites that have a history of frequent burning.
- Monitoring of the effects of implemented management practices should be seen as an essential part of the management process. It must be carried out regularly by land managers to ensure that the conservation objectives of maintaining floral diversity and structure are being met (methods are recommended in this report).
- That practices resulting in large scale soil disturbance (such as ploughing and cropping) are clearly detrimental and must be prevented.
- That the introduction of new weeds should be avoided.
- Excessive soil compaction, stock pugging and trampling should be prevented.

Specific management recommendations for a range of land tenure types in both Victoria and New South Wales are provided. Crown and freehold land in both states are included, as well as roadsides, Travelling Stock Routes (TSR) and Rail Reserves. Brief summaries of the current and historical management practices at each type of site, as well as the generalised flora and fauna values are included. Each description concludes with a series of recommendations for the continued protection of those sites.

Finally, instructions are given for the development of site specific management presciptions. There are clear steps to follow, and a series of questions to answer, which, when completed will assist the manager in making management decisions on an on-going basis.

The recommendations made in this document have been developed as a result of 6 months intensive collection of both field data and historical / anecdotal information. They are clearly preliminary and are not intended to be definitive at this stage. Data collection (research and

monitoring) and communication between managers must continue in order to refine them further. It is hoped that this document will provide workable directions for the effective management of grasslands on the Riverine Plain in the short term.

BACKGROUND

Natural lowland grasslands of south-eastern Australia have been reduced and fragmented to such an extent that they are considered one of the most endangered ecosystems in Australia (Parsons 1994). It is estimated that as little as 0.5 % of natural grasslands and grassy woodlands remain in Victoria, although they originally covered almost one third of the state (Lunt 1991). As a result of this depletion, grasslands now contain a disproportionately large number of threatened species. On the Riverine Plain, there are few areas reserved for the protection of grassland flora, and the majority of remnants are located on private property (Foreman 1995a, Maher in prep. 1996).

Traditionally, conservation reserves have been managed by removing all forms of disturbance. However, recent research suggests that this may not be a suitable policy for grassland conservation. This work has indicated that disturbance, such as periodic light grazing or burning may be necessary to preserve grassland structure and biodiversity (Foreman in prep).

Limited information currently exists on the conservation management of riverine grassland remnants. This document has been designed to begin to establish a broad framework for identifying and implementing management regimes that at least preserve existing nature conservation values. This framework is based on the concepts summarised below:

- Permanently excluding a previously grazed grassland from grazing will probably lead to a decline in floristic species richness. If a policy of no disturbance is maintained in significant grassland remnants, their unique nature conservation values may soon be lost.
- Some form of disturbance is necessary for maintaining the structure and quality of the grassland; but that excessive disturbance in the form of ploughing/cropping or over grazing is detrimental.
- Domestic stock grazing is the most practical tool for applying what has so far proven to be a suitable regime of disturbance.
- Burning previously unburned natural grassland areas could also lead to a decline in species richness and threaten fauna populations.
- Although management for the protection of invertebrates was beyond the scope of this project, it is believed that managing for floristic diversity and structure will also maintain suitable habitat for this component of the biota. This hyothesis is yet to be tested.

Baker-Gabb (1993) outlines some general grassland management information for landholders in the Riverina, although the primary focus was the preservation of Plains-wanderer (*Pedionomus torquatus*) habitat. In response to a need for more information, this document has been designed to assist land-managers in the integration of conservation management for both flora and fauna. This integration is based on the known ecology of specific elements of the flora and selected vertebrate fauna such as Plains-wanderer, Striped Legless-lizard (*Delma impar*) and Fat-tailed Dunnart (*Sminthopsis crassicaudata*).

This document is targeted primarily at land-managers on the Riverine Plain who are managing for conservation purposes on public land. It will also be of use to managers of public land and private property where conservation is not the sole management objective. In Victoria, a number of important remnants are already designated conservation reserves, most of which are managed by the National Parks Service of The Department of Conservation and Natural Resources (CNR). At this stage there are no reserves in the NSW Riverina specifically set aside for the protection of grasslands. If or when such reserves are created, they will be the responsibility of the New South Wales

National Parks and Wildlife Service (NPWS).

The technical deficiencies in grassland conservation management have prompted the development of this study. It is not a strategic document and at no time attempts to address the critical resourcing and political issues surrounding the full and effective implementation of the proposed recommendations. It should be used as background information from which site specific management guidelines / plans can be developed. Issues such as the conservation of significant remnants on freehold land via incentives and other mechanisms are not addressed in this document, but should be dealt with at the policy and planning levels of government agencies.

CHAPTER ONE

Introduction

1.1 What are Riverine Grasslands?

Riverine grasslands are found on the flood-plains of the Murray River and its tributaries (McDougall *et al.* 1994, Foreman 1995a). The Riverine Plain[1], covering the eastern part of the Murray Basin, has been described as "a series of very gently sloping alluvial fans, and the flood-plains onto which they merge" and covers about 76, 800 km^2 (Butler *et al.* 1973). It is bordered by the foothills and ranges of central and eastern Victoria (Foreman 1995) and in New South Wales, the Riverina is bordered by the foothills to the east and the semi-arid Mallee areas and sandy ridges to the north and west of Hay (Butler *et al.* 1973). The Riverine Plain incorporates semi-arid areas with annual rainfall around 300 mm near Hay, to around 400 mm at Mitiamo, and around 420 mm in the Jerilderie area. The soils range between red-brown earths to grey, brown and red clays and are prone to wind erosion resulting in 'scalds' (Butler *et al.* 1973).

The study area stretches from north of Bendigo, west to Swan Hill, and across the Murray River to Hay, Narrandera and Jerilderie (Fig 1). The approximate boundaries of the study area are 143° 70' and 146° 40' East longitude, and 34° 50' and 36° 50' South latitude.

It is certain that the native vegetation of these treeless plains has altered greatly over the past two centuries as a consequence of the broadscale clearing of shrubs and over-grazing[2] (Moore 1953, McDougall *et al.* 1994). It is likely that much of this vegetation developed from communities originally dominated by *Atriplex versicaria* (Beadle 1948), or *Acacia pendula* - *Atriplex numularia*

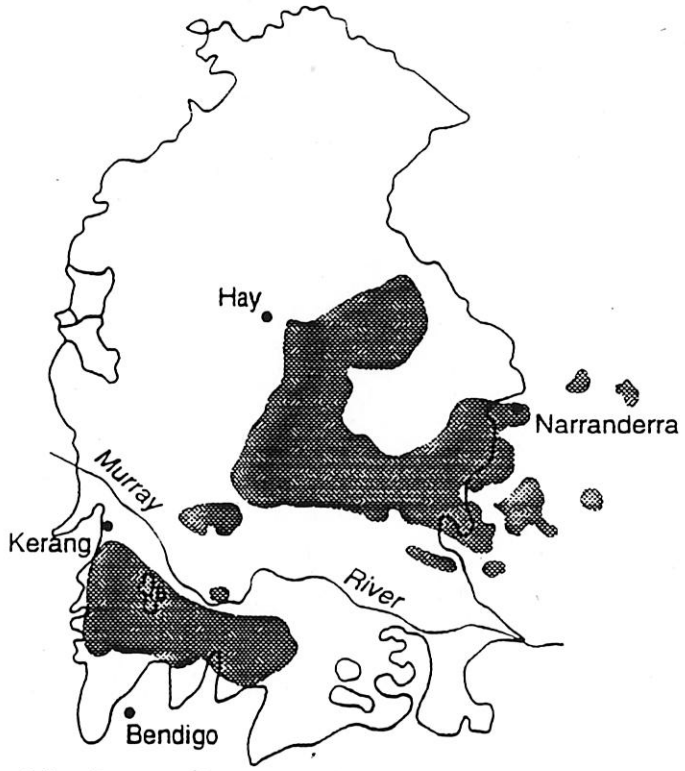

Figure 1 *Map of the Riverina Biogeographic Region showing the former distribution of grasslands and the location of the sites included in this study. (Compiled from Thackway and Cresswell 1995, and McDougall and Kirkpatrick 1994)*

[1] Throughout this work, the New South Wales portion of the Riverine Plain will be referred to as the Riverina, and the Victorian portion will be referred to as the Northern Plains.

[2] 'Overgrazing' is used throughout this document to describe a level of grazing which is detrimental to the health of a grassland. See section 2.3.1

shrubland (Moore 1953). As such all remnants are modified to some extent, and none remain in pre-settlement condition.

Over the past 150 years a large proportion of the Riverine Plain has been converted into agricultural land. The most significant remnants of the original vegetation usually contain rare and threatened plants such as Red Swainson-pea (*Swainsona plagiotropis*), Spurred Spear-grass (*Stipa gibbosa*) and the Yellow-tongue Daisy (*Brachyscome chrysoglossa*). They also provide habitat for threatened fauna such as Plains-wanderer, Striped Legless-lizard and a variety of other reptiles, invertebrates, birds, and mammals which are restricted to grasslands.

1.1.1 A range of land tenures: their relevance to management

Remnants of Riverine Plain grasslands are found in both states in a range of land tenures. These include:

- Small, scattered remnants along roadsides in Victoria, and larger remnants along the Travelling Stock Routes (TSR) in New South Wales,
- Rail side reserves in Victoria.
- Other public reserves (with patches varying from medium to high quality in Victoria).
- A selection of exceptional sites on freehold land in both states.

In NSW there are as yet no grassland reserves on the Riverine Plain, but there are some grassland areas on government owned land managed for purposes other than conservation.

It is important to take historical management / tenure into consideration because of the extent to which management can influence species composition. Grasslands which have been created under different management regimes will only retain their characteristic species composition if the appropriate management regime is maintained. For example, in Victoria, the Northern Plains grassland community has been divided into several sub-communities believed to be formed as a result of their previous management history (Foreman 1995a): They are referred to as (a) Grazed annual grassland, and (b) Roadside/Rail grassland. A similar situation may exist in the Riverina where at least four types of grasslands have recently been described (John Benson, pers. comm.). 'Land Tenure' has thus been chosen as a natural means of sorting sites and developing appropriate management recommendations (see Chapter Four).

1.1.2 Types of grasslands

Native grasslands can be divided into several categories, according to their history (Foreman 1995b). These are:

- Exotic grasslands where most of the vegetation is introduced.
- Natural grasslands which refers to any vegetation thought to have been 'treeless' prior to European settlement - regions often referred to as 'sparsely wooded', 'treeless, grassy or salsolaceous plains' by early explorers and surveyors.
- Artificial (secondary) grasslands which were formerly grassy woodlands where the trees have been removed.

It is possible to further divide natural grasslands into species-rich and species-poor grasslands (Fig 2).

1.1.3 Structure and composition of Species-poor and Species-rich Grasslands

Species-poor natural grasslands are described as Closed Tussock Grasslands, composed mostly of perennial native tussock grasses, with few or no native herbs. They generally contain less than 10 indigenous vascular plant species per 100 square metres (Foreman, unpublished data) and are dominated by exotic species such as clover, treefoil and annual grasses. These native pastures are valuable in their own right as an agricultural resource and may also provide temporary habitat for significant species such as Plains-wanderer (Baker-Gabb 1993). Although the recommendations in this report have been designed to apply to species-rich natural

grasslands, they may also be relevant for species-poor grasslands.

Community R1.2. McDougall *et al.* (1994) describe it as "a herbland without a structural dominant (but locally dominated

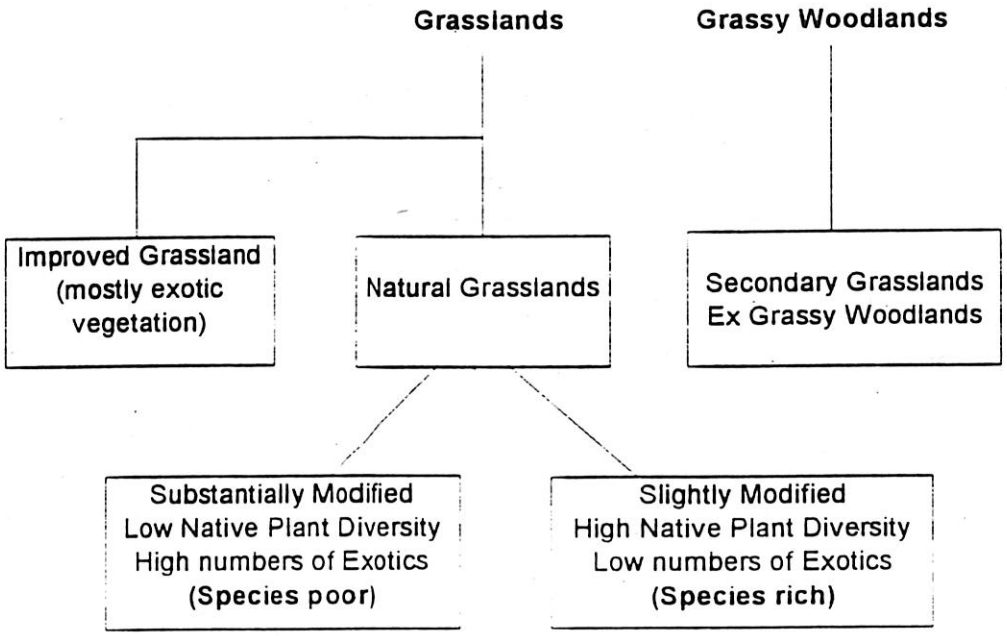

Figure 2: *Diagram showing the relationships between types of Grasslands. The Natural Grasslands refered to in this figure are believed to have been dominated by large shrubs such as Boree Acacia pendula (Moore 1953).*

The grassland vegetation of Victoria's Northern Plains, is described as "a herbland with no particular dominant, or an Open to Closed Tussock Grassland, dominated by Wallaby Grasses (*Danthonia setacea* and *D. caespitosa*), Spear grasses (*Stipa scabra* and *S. gibbosa*) and Spider Grass (*Enteropogon acicularis*), or occasionally an open (grassy) shrubland dominated by a variety of species" (Foreman 1995a).

In Victoria, species-rich grasslands contain greater than 10 indigenous species per 100 square metres, although they usually contain a total between 20 - 30 species, and sometimes upto 35 species (Foreman, unpublished data and John Benson pers comm). These areas are notable also because of their relatively low weed cover (with the exception of Small-flowered Onion Grass *Romulea minutiflora* which occurs in great abundance at most sites).

For NSW a similar vegetation type has been described as Jerilderie Plains by one or more Asteraceae or Chenopodiaceae) and sometimes an Open to Closed Tussock Grassland". Although based upon only four quadrats, the dominant grasses are the same, and it is likely that the Jerilderie community described is similar to that in Victoria.

A substantial component of the biomass of species-rich native grasslands is made up of native annual and perennial herbs. Depending upon the time of year, a grassland may appear to be dominated by wildflowers, many of which complete their life cycle before the native grasses begin to flower. Perennial herbs found in Riverine Plain grassland include Bulbine Lily (*Bulbine bulbosa*), Variable Sida (*Sida corrugata*), Common Everlasting (*Chrysocephalum apiculatum*), Red Swainson-pea (*Swainsona plagiotropis*) and Grassland Bindweed (*Convolvulus erubescens*). These perennial plants reflect seasonal conditions in their spring flowering and seeding preformance. In contrast, annual herbs such as Paper-

daisies (*Rhodanthe* sp.), Small-flowered Goodenia (*Goodenia pusilliflora*) and Wooly Mantle (*Eriochlamys behrii*), tend to fluctuate in numbers depending on the winter rainfall levels (Foreman unpub data).

The structure of grassland vegetation (both species-rich and species-poor) appears to play a very important role in determining the suitability of habitat for fauna. Recent research has shown that fauna such as Tessellated Gecko *Diplodactylus tesselatus*, Spade-foot Toad *Neobatrachus* sp. and Fat-tailed Dunnart are not found in dense grasslands, yet are recorded in open structured grasslands (Sue Hadden, *pers. comm.*).

1.1.4 Flowering and growth activity

Within a grassland community, different components of the vegetation are active at different times of the year. According to their peak growing times, sensitivity to drought and response to rainfall and climatic variability, native grasses may be divided into winter-active (cool season) grasses and summer-active (warm season) grasses (Groves and Williams 1981). Data collected from natural grasslands of the Riverine Plain during this study indicate that most of the annual herb component are at their flowering peak in September in NSW, and September and October in Victoria (Appendix 1). Perennial herbs have a longer period during which they flower and seed.

1.1.5 Threats past and present

It is almost impossible to attempt to reconstruct the original plains flora (McDougall *et al.*, Foreman 1995a). Much of the Riverine Plain (particularly NSW) has lost the shrub component of the vegetation to massive overgrazing and clearing. Overgrazing resulted in the loss of vegetation and topsoil, and caused great dust storms particularly during droughts (Butler *et al.* 1973, Dorothy Davies *pers. comm*). Overgrazing is still an issue, as land-holders are frequently pressured to over-stock.

Today dry-land cropping and irrigation are very real threats to native grassland remnants on the Riverine Plain. Although much of the region has traditionally been grazed (it is marginal cropping country), farmers often seek other forms of income. Short term cropping of previously un-cropped areas occurs, particularly in the higher rainfall regions of Victoria's Northern Plains. Recently, irrigation for rice has become the most significant problem for grasslands in the southern parts of the NSW Riverina. This process results in broadscale vegetation destruction.

It is also possible that, unlike woody vegetation communities, grasslands may not benefit from permanent exclosure[3] from stock. When these areas are not managed in any way (*ie.* excluded from all forms of disturbance), the grasses can become thick and rank, and spaces for herbs and wildflowers will diminish. If this happens, the conservation values may be lost. Thus, for grasslands, 'doing nothing' may have disasterous results.

Many of the native grassland sites are now small isolated patches in a sea of mostly exotic vegetation. Soil disturbance almost always results in weed invasion, recovery from which is slow. Generally, the most weed free sites are those that are large, lightly grazed and free of soil disturbance.

1.1.6 Conservation status

Native Grasslands (dominated by the genera *Themeda*, *Danthonia* or *Lomandra*) have been described as being amongst the most poorly protected ecosystems in Australia (Specht 1981). Northern Plains grasslands in Victoria are considered endangered, with few sites remaining, and almost none reserved and managed for conservation purposes (Foreman 1995a). Northern Plains grasslands are also listed as threatened under the *Flora and Fauna Guarantee Act* (1988).

[3] 'Exclosure' refers to a fenced area which is designed to exclude grazing by domestic livestock

The situation is very similar in New South Wales, where there are no reserves established for native grasslands and most remnants are found on private land and along Travelling Stock Routes (TSR). The remnants in NSW are generally larger than those in Victoria, a difference probably due to climate and land use. Species-rich grasslands would appear to be much less common than species-poor grasslands, but their distrinution in NSW is unknown at this stage. Some flora and fauna surveys have been undertaken in the Riverina (Baker-Gabb, 1990, Benson *et al.* in prep., Maher 1996 in prep.), but as yet there have been no systematic searches for natural species-rich grassland sites in NSW.

The status of grasslands in NSW is uncertain at this stage. SEPP 46 legislation has recently been developed to prevent excessive clearing of native vegetation in NSW. It is currently unclear to what extent native grassland vegetation is to be included in this legislation, which is to be reviewed shortly. In the interim, locally developed regional management plans are being put in place.

1.2 Why manage and conserve grasslands in the Riverina?

1.2.1 Ecology

The retention and management of native grasslands has several benefits. Most importantly, they are unique ecosystems containing a diverse range of plants and animals and worthy of conservation in their own right. Although Grasslands contain many species which occur in other vegetation types, there are species, such as the Red Swainson Pea, which are endemic to Riverine grasslands and depend upon the adequate protection of grasslands for their survival (DCE 1992). Eleven percent of flora recorded from the grasslands of south-eastern Australia are considered as rare or threatened (McDougall & Kirkpatrick 1994). Grasslands are also home to a variety of threatened fauna.

The *Flora and Fauna Guarantee Act* (1988) in Victoria, provides the legislative framework for the adequate conservation of biological diversity within the state. Protecting flora and fauna in the wild has become a requirement and obligation under law in Victoria.

Protecting and maintaining floristic richness and structure of grasslands has other benefits. Grasslands are natural areas which people can visit, learn about and enjoy. The component flora may provide seed sources for local revegetation projects, and others may possess qualities which make them useful to industry. They also have important economic potential for the wild food industry and for pastoralists.

1.2.2 Economic issues for farmers on the Riverine Plain

A range of benefits or values have been attributed to native pasture in Australia (Lodge & Whalley 1987, Mitchell 1994, Rankin 1993, Simpson 1993). Benefits in the context of current farming systems fall into the categories of:

- adaptation to climatic variability and extremes,
- ease of management,
- lower input costs,
- better wool quality,
- reduced stock health costs,
- lower fire risk, and
- soil and water protection.

On the other hand, some farmers like to retain native vegetation areas for personal reasons relating to lifestyle. They may be happy with their current lifestyle and income, and may not be interested in improvement options which increase stock numbers and the associated increase in risk, worry and work.

There are some specific factors that may disadvantage native pasture (whether already present or sown) when compared to sown pasture or cropping options. Such paddocks will generally need to be run at a lower stocking rate, particularly for species-rich grasslands. There is likely to be insufficient spring growth for fodder

conservation or for putting weight on stock. Also, land managers generally have a poor knowledge of species composition and appropriate management techniques. Native grasslands may have a poor tolerance of heavy grazing, and there may be stock damage caused by the seeds of some species.

The disadvantages associated with alternative pasture and cropping systems may be more important to farmers, than the benefits of native pasture. Capital costs, price fluctuations, risks of pasture establishment failure and crop failure have been taken into account in a preliminary ecconomic assessment, with returns to moderately stocked native grassland found to be not significantly below alternatives (Crosthwaite 1995). On the relatively few farms relying largely on species-rich grasslands, increased stocking rate from low to moderate levels, which may result in the loss of some important species, is likely to translate directly to higher income.

Farmers who identify and manage their native grass resource are unlikely to be worse off financially, and may reap additional benefits in the future - particularly if they carefully evaluate investment opportunities elsewhere (on-farm or off-farm). However, if this is not recognised now, the potential value of these areas of native grassland may be lost. Farmers may be able to capitalise on alternative opportunities such as wildflower products and ornamental grasses, native grass seed harvesting, and tourism ventures. Such options are being adopted, or are under active consideration, by some farmers.

1.3 Disturbance hypothesis: theory of historical change

Grasslands are amongst the most intensively studied ecosystems internationally and a great body of ecological theory has emerged as a consequence. One key principle is that an intermediate level of disturbance (fire, grazing or other forms of natural perturbation) is necessary to maintain the structure and species diversity of a grassland community (Grime 1979). This document has been designed to show how the intermediate disturbance hypothesis applies to remnant semi-arid Riverine Plain grasslands in both NSW and Victoria and how this theoretical concept translates into practical on-ground conservation management prescriptions.

There is evidence in south-eastern and eastern Australia supporting the relevance of the intermediate disturbance hypothesis to lowland native grassland ecosystems.

At one extreme, what happens when all disturbance is excluded? In western Victoria, Stuwe (1986), Scarlett and Parsons (1982 & 1990), Lunt (1991) and McDougall & Kirkpatrick (1994) all recognise the need for maintaining a burning regime in order to prevent the vigorous summer growth of Kangaroo-grass (*Themeda triandra*) from suppressing the less competitive co-existent forbs. On the Northern Tablelands of NSW Tremont (1994) demonstrated that the species richness of a temperate grassland excluded from grazing (and all other disturbances) for 16 years, dramatically declined in comparison to controls. In Victoria exclosures in a semi-arid grassland (400 mm, seasonal rainfall) (Foreman, unpublished data) observed no decline in species richness after 3 years, although trends in the density and cover of the annual component of the flora suggest that a reduction in species richness may result with only a few more years of exclusion from disturbance. This work has also shown that exclosure will quickly render the vegetation less habitable for fauna (*ie.* cover of bare ground declines to near zero).

Furthermore, surveys of remnant grasslands in northern Victoria (Foreman 1995a) showed a marked divergence in the patterns of composition on the basis of post-settlement management (disturbance

history). Freehold land grazed lightly and (usually) continuously, tended to have a strong representation of a range of indigenous annual herbs, and relatively few perennial forbs. It was characterised by the complete absence of shrubs. By comparison, immediately adjacent roadsides, rail reserves and some blocks of public land generally not subject to frequent grazing, supported many perennial forbs, a scattering of indigenous shrubs and virtually no annual herbs.

At the other extreme, what happens when disturbances are of the wrong type or excessive? Tremont and McIntrye (1994) concluded for the Northern Tablelands of NSW, that exotic species will replace native forbs when substantial outside or 'unnatural' disturbance occurs. In practical terms this conclusion means that disturbances such as cultivation or irrigation will quickly result in the replacement of much of the indigenous flora with exotic species. This effect not only influences floristic composition, but also alters vegetation structure which in combination usually reduces habitability for a range of indigenous fauna.

How does domestic stock grazing tally in the list of outside disturbances? It could not be argued that grazing by stock is a natural disturbance, yet its presence and action in long grazed environments has modified the vegetation to such an extent that some researchers have suggested that grazing has determined or created the species composition currently present (Leigh *et al.* 1989). This vegetation is so robust and stable that Groves and Williams (1981) suggest that probably only severe and prolonged grazing events (usually associated/compounded by drought), would result in permanent adverse changes to the remaining vegetation. However, despite the fact that grasslands may recover from some forms of severe perturbation, such disturbances can result in structural decline, which will place immediate pressures on fauna such as Plains-wanderer (Baker-Gabb *et al.* 1990). These considerations must be taken into account if we are to manage for both flora and fauna.

Furthermore, Prober and Thiele (1995) concluded for White Box (*Eucalyptus albens*) grassy woodland remnants of the wheat-sheep belt of eastern Australia that continuation of past management will allow for maintenance of the vegetation in its current state. This concept of maintaining the '*status quo*' (with caution) underpins these guidelines as the best short term response to the pressing need to develop workable and effective grassland conservation management directives to land managers both inside and outside the public sector.

This document will help to define exactly how intermediate disturbance should be applied to remnant species-rich grasslands in the Riverina to maintain current composition and structure by defining what constitutes too little disturbance and excessive disturbance.

CHAPTER TWO

General Grassland Conservation Management Recommendations

2.1 Management and the '*status quo*'

Maintenance (or slight modification) of the current management regime with the objective of maintaining the composition and structure of the vegetation is referred to as '*status quo*' management.

There are a range of land management practices available to land managers. Some of these are clearly detrimental to the integrity of native grasslands and should be avoided. These are generally the sudden changes to normal management practices (*eg.* cropping in a previously un-ploughed field). In contrast, other practices, will assist in the protection and possibly enhancement of nature conservation values.

2.2 Management Objectives:

The aim of maintaining the floral and faunal values of native grasslands may be achieved by:

- maintaining an open structure,
- avoiding soil disturbance,
- minimising weed invasion, and
- avoiding soil compaction.

On land where conservation is not the main management objective these recommendations should be considered when management decisions are being made.

Monitoring (Chapter three) is an essential part of the management process because the long-term effects of various practices are not yet fully understood. It is necessary as a way of ensuring that the management practices are not degrading the ecological values of the site. With time, more information will be collected, by land managers and others, and these may lead to further modifications to the conservation management framework proposed in this report.

2.3 Keeping the open structure

Maintaining the open structure of native grasslands is necessary to provide breeding and feeding habitat for fauna such as the Plains-wanderer (Baker-Gabb *et al.* 1990), the Striped Legless-lizard and the Fat-tailed Dunnart (Hadden, pers. comm.) and may also be important for the recruitment and persistence of components of the native annual flora (Foreman, unpublished data). Management 'disturbance' to maintain the open structure may take the form of either burning or grazing.

2.3.1 Graze or burn according to historical practices

Prescription burning for fire protection does not appear to have been a common practice in the Riverine Plain (McDougall *et al.* 1994). Data collected (during this study) from regularly burnt Rail Reserves in Victoria indicate that burning may have greatly reduced or even eliminated the annual component of the flora at those sites. Historically grazed areas suddenly subjected to a burning regime may loose a proportion of the flora, particularly annuals. Similarly, for rail reserves, the change from a burning regime to a grazing regime could result in the loss of species intolerant to grazing. Further, the annual component lost historically is unlikely to be re-gained by changing the management regime. Thus, changing from burning to grazing or vice versa is not recommended for significant grassland areas, particularly where rare or threatened species are present. An exceptional circumstance may be the protection of a specifically targeted species which is known to respond well to an alternate management regime.

The complete removal of grazing or cessation of burning is not appropriate for Riverine Plain grasslands for the following reasons:

- Such management may eventually result in a decrease in species richness.
- Some form of 'disturbance' (grazing or burning) is required to ensure that the structure is maintained, and that the vegetation does not become dominated

by grasses. Structural decline would render the vegetation uninhabitable for some important fauna.

The effects of a sudden removal of either of these two types of 'disturbance' on the vegetation are not yet fully understood. It is therefore recommended that whichever management practice (grazing or burning) has been used to maintain the vegetation to date, should be continued into the future.

Those sites which have not been subject to any management in the past (*ie.* it seems that they have neither been grazed nor burnt) should be treated cautiously. Whilst disturbance is recommended for grasslands in general, the lack of disturbance in this context will probably not cause further deterioration of the sites conservation values in the short term. Clearly further research is required to determine what management approach is most suitable for maintaining conservation values. If, however, disturbnace is necessary (fire protection purposes for example) burning would be preferred because the vast majority of the plants present would be perennial. As these sites often support small but significant remnant shrub populations, burning should not occur more frequently than every 3 to 5 years.

2.3.2 Grazing

Native grassland vegetation may vary in its structure as a consequence of the intensity of grazing, and by seasonal factors. Although the exact boundaries between an acceptable grazing level, and over or under-grazing are not known, some generalisations may be made at this stage.

Figure 3 *Native grassland vegetation that has been 'under-grazed' (bare ground cover < 9 %, native grass over-lapping cover > 50 %, based on data collected from sites in Victoria). Note the absence of annual herbs in this illustration.*

Figure 4 *Native grassland vegetation that has been over-grazed (bare ground cover > 25 %, native grass over-lapping cover < 20 %, based on data collected from sites in Victoria). Note the abundance of bare ground in this illustration.*

Figure 5 *Native grassland vegetation that has been grazed at an 'ideal' level (bare ground cover 9-22, native grass over-lapping cover 20-50, in Victoria). Note the annual herb cover and diversity in this illustration.*

'Under-grazing'
In the absence of grazing by stock (under-grazing), grasses become rank and thick (Fig 3), especially in higher rainfall areas. As a result, inter-tussock spaces and the cover of bare ground will diminish, and species richness may drop (Foreman, unpublished data). Since Plains-wanderers require low vegetation and a proportion of bare ground for nesting and feeding (Baker-Gabb 1990), under-grazing can render habitat unsuitable for the persistence of Plains-wanderer.

'Over-grazing'
Over-grazing is defined as grazing which reduces vegetation cover to very low levels and that of bare ground to correspondingly high levels (Fig 4). Grasslands are particularly vulnerable to over-grazing when dry conditions prevail: such as over autumn, or during droughts.

An 'ideal' level of grazing
It is likely that there is a level of management (or grazing) which is ideal for both the persistence of flora and fauna (Fig 5). This level is intermediate between over-grazing and under-grazing and will vary from site to site and between states.

Time of year
To maintain floristic diversity it is necessary to provide opportunity for flowering and seed set of native plants. As the majority of Riverine Plain flora flower and seed between the months of August and November (Appendix 1), it is suggested that paddocks containing significant grassland vegetation should be rested at this time of year. This strategy should also protect the Plains-wanderer, which breeds during spring (Baker-Gabb 1990).

Types / numbers of stock
Most properties included in this study grazed Merino sheep (with a few head of cattle) at a traditional, light stocking rate for their area. The traditional stocking rate for northern Victoria is generally 2.5 sheep (or equivalent)/ ha (*ie.* 1 dry sheep equivalent (dse[4]) / 1 acre), with some properties grazing at 0.6 dse / 1 ha (*ie.* 1 dse / 1-3 acres). In NSW most farmers tended to graze at 1 dse / 1 - 1.5 ha (3-5 acres).

Where conservation is the main management objective, it is most appropriate to graze at these more conservative levels, and modify the regime if necessary according to the results of subsequent monitoring. At this stage sheep are the preferred stock for grazing of grassland reserves, primarily because of their relatively smaller size and body weight compared with cattle.

Droughts
The Melbourne Weather Bureau (Peter Blake *pers. comm.*) has defined drought conditions as follows: "when the rainfall total for a period of 3 months or more is in the first decile range (*ie.* falls in the lowest 10% of all previous records)." In extremely dry conditions, where there is loss of cover, and large amounts of bare ground, stock should be removed rather than risk damage to the vegetation. Grazing during droughts should be avoided, and no grazing should be allowed until the vegetation begins to recover. For private land managers, where some stocking is necessary, the stocking rate should be dropped considerably during and after a drought.

In the Riverina, species-rich grasslands can become overgrazed in the autumn, leaving the Plains-wanderer with insufficient cover (Phil Maher, pers. comm.). If Plains-wanderers are known to be present, these areas should not be grazed until after the Autumn break[5].

[4] "For the purposes of these guidelines, one dry sheep equivalent (dse) is a 45 kg adult dry sheep consuming feed for 12 months (Muir and Simpson 1990). One head of cattle is roughly equivalent to 10 dse (White and Bowman 1981).

[5] the autumn break may be defined as the first substantial rains in autumn.

Intensive grazing events

Short-term intensive grazing events at any time of the year may have the same effects as over-grazing during the summer. Plains-wanderers may be seriously affected by such events: they may leave the site because of its lack of cover, and return only when the vegetation begins to regain its structure, or they may not return at all (Baker-Gabb *et al* 1990). Although the effects of intensive grazing events upon grassland flora are less clear, the time of year will certainly be important eg. intensive grazing in spring would almost certainly have a negative impact on reproductive performance.

2.3.3 Burning

Sites which have been regularly burnt in the past, should continue to be burnt rather than grazed. Although the full and long-term effects of fire upon particular components of grassland vegetation are not yet fully understood, it is known that the timing of burns may be important. The behaviour of weeds following a burn is also largely unknown and to some extent unpredictable. With careful monitoring and further research more insights may be gained relating to the behaviour of these systems under a burning regime.

For fire protection works on roadsides, ploughed mineral earth breaks are not recommended. Mineral earth breaks will encourage weed invasion. For roadsides abutting significant native vegetation, the use of fire may be a more appropriate technique. The avoidance of soil disturbance is critical for these sensitive areas (refer to 'roadsides', section 3.1.3).

Time of year

Traditionally most Rail sites on the Northern Plains were burned before Christmas (spring and early summer), with any remaining areas burnt in autumn (*pers comm.* Neville Scarlett and Peter Campbell). Unfortunately it seems that native flora remaining on rail sites often have opposite management requirements *ie.* some would benefit from a spring burn while others benefit from an autumn burn (Neville Scarlett *pers. comm.*). One way of dealing with this problem may be to alternate the timing of burns between these two seasons. It is therefore suggested that burns continue to take place either in early summer (November - December), or in early autumn (March - April). If the burns are then carried out every 2-3 years, recruitment opportunities for plants with either life history strategy may be accomodated. When autumn burns are carried out, it is most important that no burning takes place after the autumn break (John Morgan, *pers. comm.*), when growing plants are very sensitive. If a burn has not been carried out before this time, the burn should be postponed until the following season.

Fauna

If rare or threatened fauna are present at long-burnt sites, burning regimes should be considered very carefully, and carried out in autumn if at all. For example, grassland birds nest during the spring and reptiles such as the Striped Legless-lizard may not escape the effects of fire unless the ground has dried out enough to contain cracks (Coulson 1990). Where areas of high quality grasslands are generally small and scattered, burns may temporarily eliminate the only locally available habitat over a large area. All of these factors should be taken into consideration when planning a burn or writing a management plan for a specific site.

2.3.4 Mowing / slashing

Mowing or slashing is not recommended as a management option for native grasslands. Processes such as these are likely to result in the loss of bare ground areas, by creating large amounts of litter. Mowing can also promote the presence of exotic species (see Lunt 1991). This scenario would certainly reduce the habitat value for the threatened fauna discussed previously, and could also affect the regeneration potential of native herbs. If fire protection is important, autumn burning may be more

appropriate where flora and fauna values are high.

2.4 Avoiding soil disturbance

Soil disturbance should be avoided at all times. Disturbance damages the structure of the soil and the vegetation, and can greatly enhance the potential for weed invasion.

2.4.1 Ploughing, cropping and irrigation

The historical data collected for this project indicate that the diverse range of native grassland flora cannot persist where ploughing or cropping have taken place. After long periods without cropping native grasses may return, but they do so as the species-poor grasslands described in chapter one. Ploughing results not only in the destruction of individual plants, but soil disturbance also paves the way for invasion by weeds. Similarly, it is unlikely that native vegetation will ever return where land has been levelled and prepared for irrigation.

It is known that Plains-wanderers may be permanently eliminated where cultivation and sowing to improved pasture have taken place (Bennett 1983). Plains-wanderers and other species such as Fat-tailed Dunnarts may find temporary refuge in cereal stubble and low crops (Baker-Gabb 1990, Baker-Gabb 1993, Hadden *pers. comm.*), but require the better quality grassland remnants for long-term protection.

2.4.2 Dumping of soil

Roadside vegetation is particularly vulnerable to the effects of earthworks, where dumping of soil or road-making materials occurs. Not only are the crushed plants killed, but weeds can colonise these newly disturbed areas (figure 6).

(photograph)

Figure 6

Photograph showing soil dumping along a roadside. Weeds have invaded the disturbed area of the site.

Habitat enhancement projects such as tree-planting and dam / wetland construction can also cause weed problems if not sited carefully.

2.5 Minimising weed invasion

Weeds may be described as 'plants out of place' and, further, environmental weeds can be described as those that invade native vegetation and adversely affect regeneration and survival of the indigenous flora and fauna (Carr *et al.* 1992). They are generally introduced colonisers of disturbed areas. Where grassland remnants are small, the potential for weed invasion is increased when soil disturbance occurs. During this study no weeds with the potential to cause major problems in the absence of disturbance were recorded. There are, however, some simple steps that should be taken to minimise the chances of the introduction of new weeds to sites containing areas of natural grassland.

2.5.1 Movement of soil or hay

To reduce the potential for introduction of new weeds, the movement of soil or feed should be minimised in and around grassland remnants. In conservation reserves, stock should be removed during dry times rather than bringing in hay or feed. For private properties, feeding areas should be confined to those areas of paddocks traditionally used, or to degraded areas. If possible clean, weed free hay should be obtained.

2.5.2 Weed infestations

In Reserves managed for the conservation of natural grasslands, outbreaks of weeds should be dealt with as soon as is practical. Sheep or other livestock may carry weed seed to weed-free areas with great efficiency. For example, more than 500 viable seeds of Onion Grass *(Romulea rosea)* may pass through the rumen of a sheep per day (Eddy and Smith 1975). In

NSW, where *Romulea* spp. are not ubiquitous, sheep should not be moved from areas known to contain *Romulea* spp. or other weeds, to areas known to be free of such weeds.

2.6 Avoiding soil compaction: trampling and pugging

Soil compaction is another form of disturbance that should be avoided or minimised. It can result in problems with recruitment, weed invasion, and possibly changes in local hydrology. On a smaller scale soil compaction can cause problems for phytophagous (consumers of the living parts of plants) fauna such as insects (Andrzejewska and Gyllenberg, **DATE and REF: SH**)

Flora and fauna surveys involving the use of heavy vehicles should be carried out from designated tracks where possible. Vehicle use should be limited during wet times of the year. General vehicle use for maintenance around the property should be restricted to tracks. During the flowering season, rare species and annual flora may be vulnerable to trampling. Large groups of visitors to flora reserves should be encouraged to remain on vehicle tracks, and avoid trampling over the grasslands. Similarly, researchers should limit travel to vehicle tracks where possible.

The grazing of heavy stock such as cattle during wet periods can result in another form of soil disturbance and compaction. Pugging of the soil and damage to large numbers of individual plants can result. Such disturbance was observed in winter 1995 along roadsides in the Mitiamo area (*pers. obs.*), where droving stock irreparably damaged vegetation where they were camped, and damaged large numbers of individual plants when on the move. The situation may be less serious in NSW due to the size of remnants and the number of stock.

CHAPTER 3: MONITORING

3.1 Why Monitor?

These recommendations have been developed as a result of 6 months intensive study and data collection, and incorporate the collective knowledge of many land managers, local people and researchers. However, they are not definitive and may require fine tuning over time. In order to decide if management is achieving the conservation objectives (health/balance), a form of monitoring will be required. Monitoring is essential to ensure that no species are lost and that the goal of maintaining floristic diversity and structure of native grasslands is being achieved. A separate monitoring system will be required if the progress of a particular species is of interest.

The importance of monitoring has been stressed throughout these guidelines as a method of ensuring that conservation management objectives are being met. Monitoring can be either direct or indirect. Direct monitoring involves techniques that focus directly on the important conservation values in question *ie.* flora and fauna. This type of monitoring includes detailed vegetation surveys and the compilation of flora lists. Indirect monitoring involves techniques that focus on the habitat *ie.* the vegetation and structure. Whilst direct monitoring is usually the most desirable, the methods involved are often time-consuming and of a highly technical nature. They are therefore usually used only by professionals and researchers. Indirect monitoring, on the other hand, is a relatively straight forward rapid technique, more suited to the needs of land managers.

3.2 Theory

Indirect monitoring assumes predictable relationships between disturbance and vegetation structure (habitat) and between vegetation structure and the reproductive success of the component flora and fauna. Under the intermediate disturbance hypothesis (section 1.3), both excessive and minimal disturbance will eventually lead to a decline in species richness as linked to changes in the cover of native vegetation (Fig 7). In Riverine grasslands a combination of some bare ground and a reasonable cover of perennial grasses and forbs appears to represent the most suitable vegetation structure.

Detailed measurements of the cover of major structural components of grasslands have been taken from 20 sites in New South Wales and Victoria (Appendix 2). Of the ten major structural components measured, two (bare ground and native perennial grasses) possessed the following important characteristics:

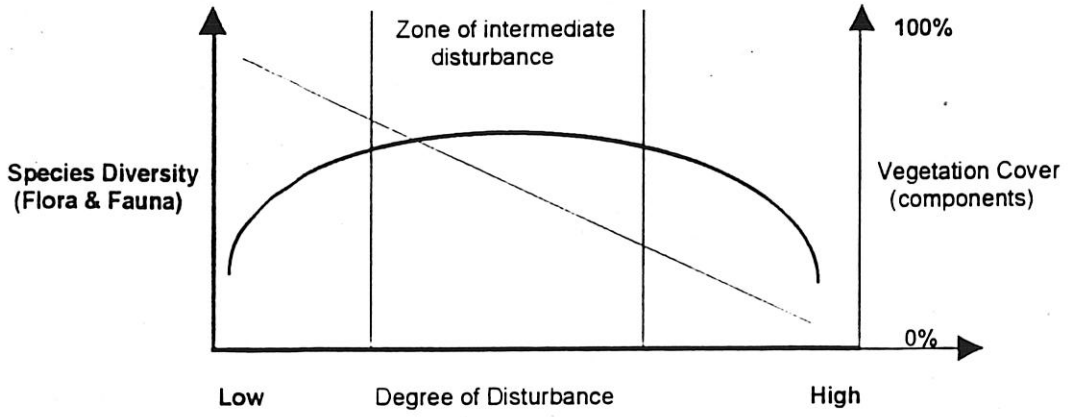

Figure 7: *The intermediate disturbance zone within which species diversity and vegetation cover could be considered as ideal. At either the low or the high ends of the scale, diversity and cover qualities are reduced. Source: Adapted from Collins and Barber (1985)*

- Sensitivity to disturbance in a negative or positive way, and respond to both high and low disturbance levels. Fig 8 shows data collected from grazed and not grazed sites. This data clearly illustrates that both 'bare ground' and 'native perennial grasses' respond in a predictable way to grazing: *ie.* grass cover is consistently higher in areas excluded from grazing when compared to grazed areas, and bare ground cover is consistently lower in areas which are excluded from grazing, when compared to areas which are grazed.
- Resilience to fluctuations in climate (*ie.* drought). It is clear that even in drought events such as that experienced in 1994, the bare ground and native perennial grass components remain at relatively stable levels, when compared with widely fluctuating elements such as the annual native herbs (Fig 8).

Bare ground proved to be the most stable component (temporally and spatially, between and within sites) in both NSW and Victoria. It was a consistently good predictor of general habitat health and the impact of a disturbance regime.

Bare ground cover ranges:

Victoria	9 - 22 % (av. 15.5)
NSW	10 - 22 % (av. 16)

The winter grass component was the other reliable predictor. It seemed to be less stable than bare ground, and was divided into two forms:

a) **Sparse grass vegetation**

Victoria	18 - 30 % (av. 25)
NSW	20 - 40 % (av. 30)

b) **Thick grass vegetation**

Victoria	30 - 50 (av. 40)
NSW	40 - 60 (av. 50)

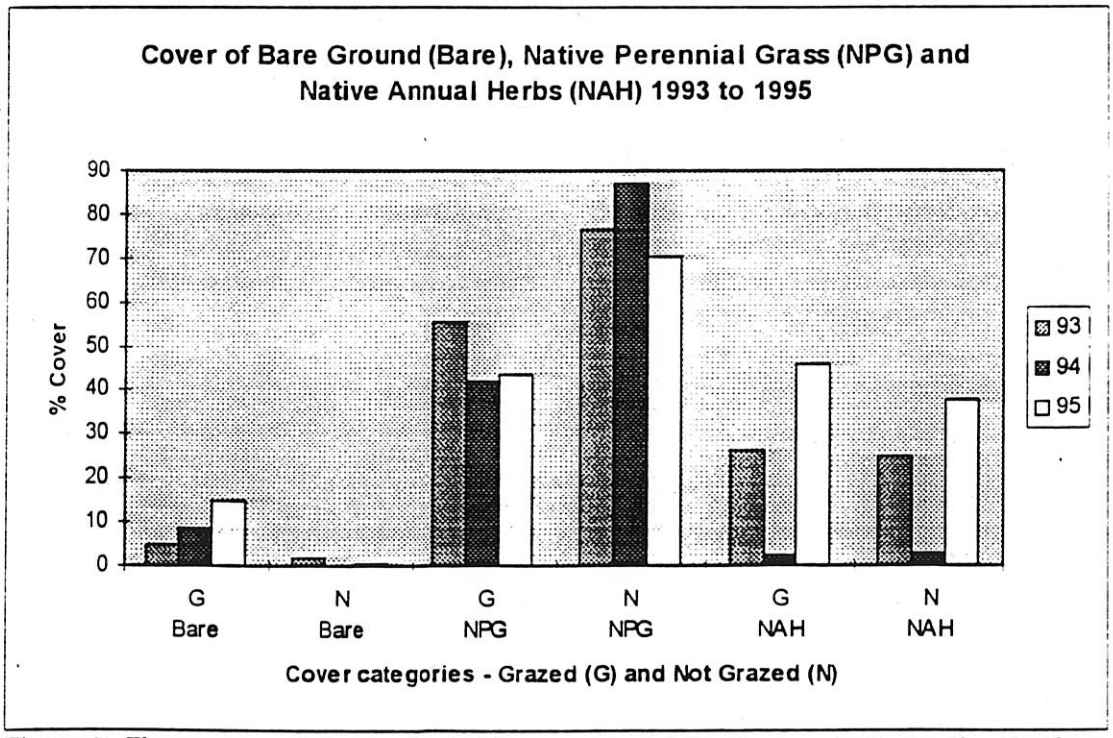

Figure 8: *Three years of data collected from a grazed / not grazed site on the Northern Plains of Victoria, showing the resilience of bare ground and grass cover to fluctuations in climate (Foreman unpublished data).*

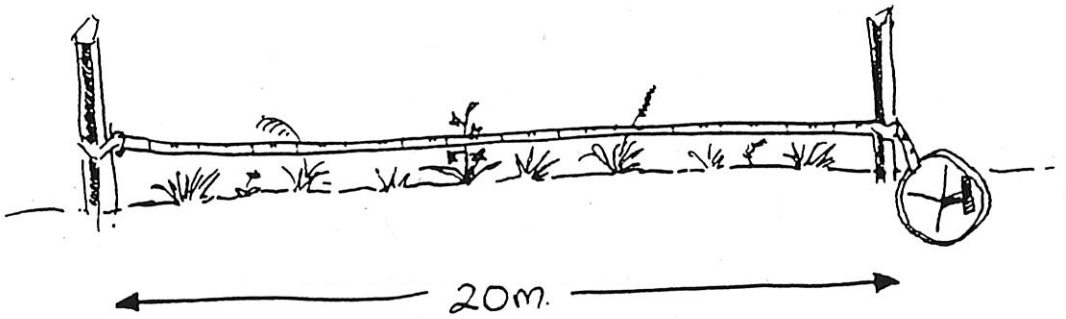

Figure 9: *Setting up the transect.*

The monitoring system presented in this document is based on measurements of average over-lapping vegetation cover along 20 m transects. For comparisons of growth from year to year, transects should be permanent and carried out in the same season each year. Annual measurements will indicate if there has been an increase or decrease in the cover of the vegetation or some other change in the structure. These data will assist the land manager to make decisions regarding stocking rates for the following season.

3.3 How to monitor:

Timing

The percentage over-lapping cover ranges produced as a result of this study, were collected between the months of July and November. For practical and realistic comparisons data should be collected between those five months. For rail sites in Victoria, where burning is a management practice, data should not be collected immediately following a burn. It should be monitored in summer prior to the burn or in the following spring.

Selecting the sample site

Those areas containing the highest quality vegetation should be selected as sample sites, since it is these better quality areas which are to be managed. Areas with particularly high weed cover, or those within natural depressions should be avoided. The structure and composition of wetter areas, for example, is quite different to that of the natural grassland areas. Including these types of areas in a transect will give an inaccurate impression of the characteristics of the grassland vegetation at the site.

Materials

To measure the vegetation cover a stiff wire 'pointer' should be used (any piece of stiff wire 3mm thick, and about 1m long will be suitable). It may be useful to paint the top of the pointer in some bright colour, so that it can be easily found if misplaced. To record data, a clip board and copies of the transect sheets included in Appendix 3 will be required.

Marking a permanent transect

Cover changes in specific paddocks will be more easily detected if permanent transects are used. These can be marked with stakes 20 metres apart and tall enough to be seen when the grass is high. Stock may knock over wooden stakes, so star pickets are recommended for permanent transects. If the top of the stakes are dipped in paint (white or yellow) they will be easy to locate.

Replication

A minimum of three permanent transects should be placed at each site. This will ensure that a more accurate representation of the structure of the whole site is obtained.

Recording data

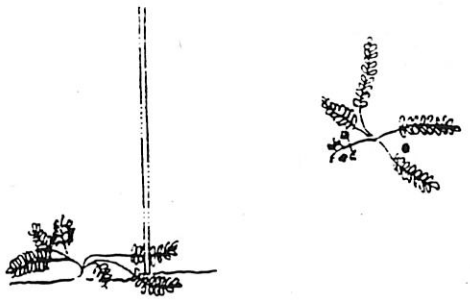

Figure 10a *Illustration showing when to record 'bare ground'. Although the pointer falls in the centre of a perennial herb, 'bare ground' is recorded.*

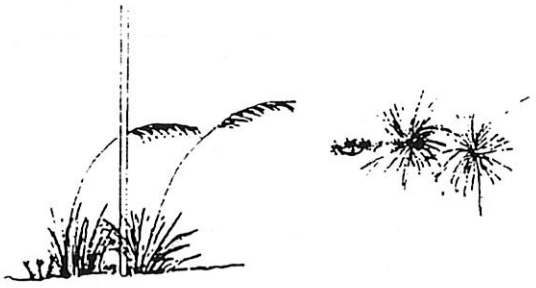

Figure 10b *When the pointer is obviously touching a plant, it must be recorded. This illustration shows 'Winter Grass'.*

	0.2	0.4	0.6	0.8	1.0	1.2	1.4	1.6	1.8	2.0	2.2	2.4	2.6
Bare Ground	/			/					/				/
Litter		/											
Sum. Grass			/								/		
Wint. Grass		/			/	/		/				/	
An.Nat.Herb					/		/	/					
An.Ex.Herb			/		/					/			
Per.Nat.Herb			/			/							
Per.Ex.Herb										/			
An.Ex.Grass										/			

Figure 11 *Portion of a data sheet showing how to record the data. Note that when bare ground is recorded, there can be no other categories recorded.*

The quality of the data recorded depends upon the familiarity of the recorder with the local flora. It is essential to record the percentage over-lapping cover of at least bare ground and native perennial winter active grasses[6]. In addition it may be useful to make similar measurements for native annual and perennial herbs, summer active grasses and annual exotic grasses. The method used for data collection is as follows:

1. Set up the 20 m permanent transects. Choose areas of high quality native grassland within the study area or paddock. Attach a 20m tape measure to a fixed stake and stretch it out fully, attaching the end to the other stake (Figure 9).
2. Place a stiff wire pointer (approx. 1m long) at intervals of 20 cm along the transects. At each point, record the type of vegetation or feature (functional group) touching the wire pointer, and fill in the data sheet (for a sample data sheet showing vegetation types see Appendix 2). 'Bare Ground' must only be recorded where there is no vegetation or litter touching the point (Figure 10a and 10b). All other functional groups (eg. winter active native grass, annual native herb, litter) can be recorded simultaneously, if they are touching the pointer (Figure 11).
3. Once the end of the transect has been reached, add up all the data for each type and record the totals. A minimum of three transects should be carried out at each site. Data can then be averaged for each site.

[6] Native perennial winter active grasses are those grasses which actively grow over winter, and then flower in the spring. Danthonia species (Wallaby Grasses, White-top *etc.*) and spear grasses may be described as winter active. Summer active grasses are those which grow more vigorously during the warmer months, and flower later in summer. Curly Windmill Grass and Kangaroo Grass may be described as summer active. Both types of grasses are perennial, and so are present all year round.

3.4 Interpreting the data

The over-lapping cover of grass, annual herbs, perennial herbs and bare ground are the features which will be measured at each point along the transect. The cover ranges for bare ground and winter grass which have been obtained for grasslands in both states are shown in Table 1. Cover data which falls within these ranges, or does not vary significantly from previously collected data, should indicate that the management practices are appropriate at particular sites.

State	%B.G.	% W.G.
Victoria's Northern Plains (range)	9 - 22	20 - 50
NSW Riverina (range)	10 - 22	20 - 60

Table 1 *Vegetation cover ranges for the two main functional group components for New South Wales and Victoria (B.G. is Bare Ground, and W.G. refers to Winter active Grass).*

If over-lapping cover falls outside these ranges stocking rate should be raised or lowered accordingly. Local knowledge should be applied to determine a suitable stocking rate. Monitoring may need to be carried out more often initially, in order to fine tune the appropriate stocking rates. It is important to note that local weather conditions (including wet or dry spells) will affect growth rates and cover, and must be taken into account.

3.5 Other monitoring techniques

Photographs

For those private land managers who are unable to carry out structural (transect) monitoring, taking photographs from the same point each season may be a useful means of comparing growth and diversity. Setting up a photo-point is easy (from Green *et al.* 1994). A photopoint peg is placed 10m in front of a marker peg. Against the marker peg, lean a blackboard with site details and the date written on it. Twice, or four times a year a photograph of the site should be taken from immediately behind the photopoint peg, facing the marker peg. The top of the marker peg should be in the centre of the camera's viewfinder. Another photograph should be taken from directly above the centre of the site. A collection of such photographs should provide a good record of the overall structure of the site, and any changes that may occur over time.

Step-pointing

This technique is similar to the point quadrat method, but instead of using a steel pointer, you use your foot. A point is marked on the toe of one boot, and the assessor then walks 200 steps, recording what is touching the point at each step (resulting in 100 points). Although this method is relatively quick and easy to carry out, a three-dimensional picture of the vegetation structure is not provided because part of the vegetation is hidden under the boot.

More detailed techniques

There are a variety of other techniques available to land managers who require more information. These techniques are slightly more complex to carry out and the assistance of experienced biologists may be required.

Flora

- species richness, species cover, frequency and density
- demographic monitoring: usually reserved for rare or threatened plants. This technique involves intensive work on one particular species. It may also be used for monitoring the behaviour of specific weeds or shrubs

Fauna

- Spotlighting at night for mammals / birds
- Elliott or Pit-fall traps for reptiles, mammals and amphibians
- Walking transects for birds (sight and sound)
- Scats

For particular details regarding these techniques and others, it would be necessary to contact the Flora and Fauna section of CNR in Victoria, or NPWS in New South Wales.

3.6 Involving local people

Monitoring is not only an essential tool for measuring the success of certain management strategies, it is also a useful way of involving local people and interested groups in management issues. Some of the alternative monitoring techniques (and perhaps also the transect monitoring) may be carried out by interested volunteers in the community. Fostering a community-based interest and involvement in the management of public land will have broader impacts. It may influence thoughts about how local landholders manage their own land.

CHAPTER FOUR

Management Recommendations for Specific Types of Sites

Various land tenure sites usually have different management histories. These differences are reflected in the current structure and composition of the remaining native vegetation. This chapter deals with management recommendations designed to protect the unique qualities of specific types of sites.

4.1 VICTORIA

4.1.1 Crown Reserves (Victoria)

Manager
CNR North-West Area.

Size range and properties
8.9 ha (20 acres) to 126 ha (310 acres). Yassom Swamp, Patho Flora Reserve, Tang Tang Swamp, and the old Mysia School Site were included in this study.

Conservation Values
These reserves contain sizeable examples of Northern Plains Grasslands. These reserves provide habitat for a range of rare or threatened flora and fauna. Two of these sites (Mysia and Yassom Swamp) are known to support significant populations of indigenous salt bushes. Although not all of these species are rare or threatened, remnant salt bush vegetation in any condition is very rare in Victoria. Understanding the reproductive requirements of salt-bushes and the integration of these requirements with the management of the herbaceous flora is an important issue for reserves.

Management History
None of these reserves have been cropped, ploughed or levelled. The sites have a varied history; one was a grazed water reserve (Patho), and the others have a history of grazing, generally by sheep. In effect, they were all treated as freehold land up until the 1980's. Yassom Swamp and Patho Flora reserve have a history of pugging, and overgrazing. The old school site (Mysia), may have been used for loam extraction in some sections and has recently been grazed by sheep and rested every few years. It has a history of having been grazed bare in the past. All sites have only recently been reserved for conservation purposes, and active management for the maintenance of the structure of native grasslands is yet to begin. The Mysia site and Tang Tang Swamp are currently grazed very lightly by stock. The Yassom and Patho reserves have not been subjected to a grazing regime recently.

Vegetation Type and Flora
These reserves are Open to Closed Tussock Grasslands dominated by perennial native grasses. These communities may be described as a "Grazed Annual Grassland" (Foreman 1995a) because of their grazing history which has sustained the annual flora. The Mysia School site and Yassom Swamp have a scattered woody shrub component present (including Rohrlach's Bluebush *Maireana rohrlachii* and Cotton Bush *M. aphylla*). The common species and over-lapping cover range of components of the vegetation are as follows:

- perennial native herbs (*Chrysocephalum apiculatum*, *Maireana* spp., *Swainsona* spp., *Bulbine bulbosa*, *Wurmbea dioica* and *Sida corrugata*) cover 15 - 45 %,
- perennial native grasses (*Danthonia* spp., *Stipa* spp. and *Enteropogon acicularis*) cover 15 - 50 %,
- annual native herbs (*Calocephalus sonderi*, *Goodenia pusilliflora*, *Isoetopsis graminifolia*, *Triptilodiscus pygmaeus*, and *Rhodanthe corymbiflorum*) cover 10 - 40 % and
- exotic annuals/grasses (**Lolium rigidum*, **Hypochaeris* spp., **Avena* sp., and **Arctotheca calendula*) cover 5 - 15 %.

Within Reserves the vegetation quality is patchy. Weed cover is variable, with the highest cover at Tang Tang Swamp, and

the lowest at Patho Flora Reserve. In Yassom Flora Reserve, which has been excluded the longest from grazing, species richness has dropped and vegetation structure has declined (Foreman, pers. obs.). This deterioration may be adversely affecting the nature conservation values of that reserve.

Threats

For sites specifically set aside for conservation purposes, where gross destruction in the form of cultivation is not likely, the most significant threat is the absence of controlled disturbance management. The complete absence of disturbance, or the occurrence of uncontrolled illegal grazing events (deliberate or inadvertent grazing by local graziers or transient drovers), could cause these sites to suffer in the long term. This type of uncontrolled grazing could adversely affect significant components of the vegetation such as the salt bushes.

Irrespective of the management regime, the introduction and spread of particular weeds could compromise natural conservation values. A pertinent example is Tang Tang Swamp, which has been grazed lightly by cattle, and most intensively during the spring. The abundance of broad-leaf weeds at the site suggests that current management may be inappropriate.

Recommendations

- Where required, periodic sheep grazing should be re-introduced to grassland reserves from which it has been removed in recent times. One possible strategy which may be useful to facilitate grazing, is to offer a local sheep grazier free or low-cost agistment during late autumn and winter, at a specified stocking rate (< 1dse/ha).
- There should be no grazing during August, September, October and November, to allow the flowering and seeding of native flora, and prevent the disturbance of Plains-wanderers during their breeding season (where present). In dry years there should be no grazing until after the autumn rains have fallen.
- Reserves should be fenced and locked, and the key held by CNR in order to restrict stock access to the appropriate times of year.
- On-site signage should describe the management strategy and provide a contact number for the party responsible for the management of the site. Local interest groups should be made aware of the values of the site, where appropriate.
- There should be no grazing of cattle (particularly in wet winters).
- Monitoring (as described in these guidelines) should be carried out by land managers (CNR) in late spring, and used to direct the grazier the following season. In addition all reserves should have a grazing exclosure to provide a means of comparing disturbance regimes.
- Sites with a shrub component should be managed differently. The shrubs and adjacent areas should be completely excluded from grazing and monitored for regeneration, where possible.
- Burning should not be used as a management tool in the short term, due to a lack of understanding of the ecological consequences. More information may come to light in the future, as the results of experimentation become available.

4.1.2 Rail Reserves (Victoria)

Manager

Public Transport Corporation (and CNR in some instances).

Size range and Properties

These sites are generally quite small, narrow, linear strips of land. High quality areas are patchy within these strips, often occupying less than 1 ha (2.47 acres). The Hunter Rail Reserve, and the Echuca / Strathallan Rail Reserve were studied. Other sites of significance which are not Rail reserves, but are not able to be grazed by domestic stock should be included in

this section, and managed in a similar way. Examples include the Echuca Aerodrome, and Golf Courses with significant grassland areas.

Conservation Values

These sites contain numbers of rare and threatened Victorian flora (including small populations of shrubs), and examples of the Northern Plains Grassland community. Their value as faunal habitat is unknown.

Management History

All rail reserves in Northern Victoria have a history of annual burning, at least until 1987 (Peter Campbell, Bendigo PTC *pers. comm.*). The burning usually took place during late spring and early summer, but was probably patchy. In some instances, adjoining neighbours burnt patches when they saw fit, and wetter areas may not have burnt (Neville Scarlett *pers. comm.*). Rail reserves would have been burnt regularly, but any one patch may not necessarily have been burnt every year. Since 1987 most sites have not been burnt or in any other way disturbed. Grazing has been permanently excluded from these sites in most cases, although stock have been moved along the Echuca / Strathallan line, due to its proximity to the stock route.

Vegetation Type and Flora

These reserves support Closed grasslands dominated by perennial native grasses. The community has been described as "Road/Rail Grassland" (Foreman 1995) because of the lack of annual herbs and the relatively high over-lapping cover of perennial herbs (often grazing intolerant species). This vegetation structure may be explained by their burning history, and the lack of or infrequency of grazing.

These sites contain patches of native flora in good condition. The common species and over-lapping cover range of components of the vegetation are as follows:

- Perennial native herbs (cover 20 - 45 %),
- Perennial native grasses (sometimes including Kangaroo Grass *Themeda triandra*) cover 20 - 40 %,
- Annual native herbs are uncommon, cover < 10 %,
- exotic annuals are low (< 5 %) and exotic annual grasses cover 5-15 %.

Threats

Although these sites are obviously able to tolerate the effects of burning, particular burning regimes could have detrimental effects upon the vegetation. In the absence of further knowledge regarding the effects of fire, the traditional management practices should be mimicked where possible (particularly if threatened fauna are present). Inadvertent grazing and pugging could be a real threat for sites long excluded from domestic stock. Weed invasion is an issue that must be addressed, particularly for these linear areas which have a high proportion of 'edge'. Weeds also need to be considered in relation to the timing of burns, and this is an aspect which needs further careful research (Lunt 1991). For rail lines that are still in use, damage during access and maintenance of lines could be a threat, and should be avoided.

Recommendations

- There should be further detailed surveys undertaken, to identify all significant remnants along used and disused railway lines in Victoria. This information should be compiled and used to develop a register of sites which should be managed according to the recommendations in these guidelines.
- All significant sites should be protected from mis-management by being placed under an appropriate conservation management agreement (Public Authority Management Agreements, see Appendix 4).
- Continue the exclusion of domestic livestock.
- Soil disturbance should be avoided. Vehicles should be used for routine maintenance only, and restricted to access tracks.

- Fencing should be used to define the boundaries of sites and prevent accidental mechanical disturbance. The sites should be signposted to indicate their significance, and contact numbers should be given for each of the agencies involved in their management.
- The burning regime should continue as a method of reducing biomass and maintaining the structure. Due to a paucity of knowledge, careful records concerning the response of grassland to fire should be kept. Initially, burns should be conducted every 2-3 years and take place in late spring / early summer, or in early autumn (before the break). If threatened fauna are known to be present, burns should be conducted in autumn, if at all (see Chapter two, section 2.3.3). Burns must not be carried out after the autumn break, when growing plants are extremely sensitive to fire. Participation by the local CFA should be encouraged.
- Monitoring should be carried out by land managers (CNR) in spring (NOT after a burn), and used to direct the action for the following seasons.

Conservation Management Options
Land Management Cooperative Agreements (Conservation, Forests and Lands Act 1987), Public Authority Co-operative Management Agreements (PAMA) (see Appendix 4).

4.1.3 Roadsides (Victoria)

Managers
Local Shire Councils and Vic Roads.

Size range and Properties
These are patchy linear areas of around 1 ha (2.47 acre) or less, and between 5-15 m wide, scattered along roadsides. Sites around the Mitiamo area were studied.

Conservation Values
The values of roadsides are equivalent to those of rail reserves.

Management History
It is likely that the species rich areas have never been ploughed, but may have been burned occasionally for fire protection. Some sections of the roadside have been ploughed as mineral earth fire breaks, and these are now dominated by introduced annual flora. Stock apparently used roadsides in the Mitiamo area extensively in the past. Although there are no detailed records available, mobs of up to 2,000 head of cattle, or 10,000 sheep were known to move through the area during drought times (Graham Hall, Loddon Shire Council, *pers. comm.*). Roadsides are likely to have been grazed bare during drought times. More recently the grazing events appear to have been infrequent but intense, and some areas may not have been grazed for some time.

Vegetation Type and Flora
These reserves support Closed grasslands dominated by perennial native grasses. The community may be described as a "Road/Rail Grassland" (Foreman 1995) ecause of the lack of annual herbs, and relatively high over-lapping cover of perennial herbs which have arisen as a result of their history of irregular high intensity grazing, and (possibly) occasional burning. The common species and over-lapping cover range of components of the vegetation are as follows:

- perennial native herbs usually ranges between 10 - 30 %, and may be very high occasionally due to the presence of *Chrysocephalum apiculatum*.
- Perennial native grass cover 10 - 30 %, Annual native herbs are uncommon cover < 10 %,
- exotic annuals are more common (10 - 30 %) and
- exotic annual grasses are also reasonably common, probably as a result of soil disturbance, cover 20 - 30 %.

Threats
The key threat for these types of sites is a lack of controlled disturbance which could, in the long term, reduce the species

richness of a site, and result in an increase in weed cover. Cattle pugging is a very real problem during the wet winters, especially where stock are camped overnight. Weeds need to be managed carefully since areas are quite small and linear, and thus subject to invasion. Ploughing for fire breaks results in soil disturbance which can encourage the invasion and growth of exotic weeds and grasses (DCE 1992). Soil disturbance resulting from tree planting and road management activities are also a big threat.

Recommendations

- There should be further detailed surveys undertaken, to identify all significant remnants along roadsides in Victoria. This information should be compiled and used to develop a register of sites which should be managed according to the recommendations in these guidelines.
- Sites of significance should be signposted to indicate their importance, and contact numbers should be provided for each of the agencies involved their management.
- Fencing is recommended for sites that are considered particularly vulnerable to threatening processes.
- Local Shire Councils should be informed about the location of sites of significance. If suitable, Public Authority Management Agreements should be formed with the local Shire (see Appendix 4).
- Ploughing of roadside vegetation for mineral earth firebreaks should cease near sites adjoining significant vegetation areas, and alternatives sought. Occasional burning may be a suitable option for some sites of significance, both as a way of reducing biomass for fire control, and also to provide opportunities for recruitment of perennial forbs such as *Swainsona* sp. (burning should be carried out as per 'Rail Reserves').
- Travelling stock, numbers should be controlled, and records should be kept regarding numbers of stock, and sites grazed. Except for the movement of local stock, all droving should cease on and in the vicinity of recognised significant sites.
- Local stock should not be allowed to travel through sensitive areas during August, September, October and November, very dry summers or extremely wet winters. Stock should not be permitted to move along any roadside during particularly wet winters.
- Earthworks should not be carried out by Shires without confirming the status of a site. Soil should not be dumped on roadside vegetation, but carted away. This will not only protect remnant vegetation, but also prevent weed invasion as a result of soil disturbance.

Conservation Management Options

Public Authority Co-operative Management Agreements (PAMA). See Appendix 4.

4.1.4 Freehold Land (Victoria)

Manager

Private owners / managers

Size range and Properties

Entire properties range from 600 to 1300 ha, and paddocks range from 43.5 to 240 ha. Three private properties were studied; namely Riverine Plain 1 (RP1), 1 paddock, Riverine Plain 2 (RP2), 3 paddocks, and Riverine Plain 3 (RP3), 2 paddocks.

Conservation Values

The three properties that were studied included relatively large (up to 800 ha) areas of species rich Grazed Annual Grassland in exceptional condition. They contained significant rare and threatened flora such as *Stipa gibbosa*, *Swainsona plagiotropis*, *Maireana excavata*, *M. humillima*, *Ptilotus erubescens* and a significant annual component generally missing from roadsides and rail reserves. Possibly due to the size and / or integrity of these sites, the values for fauna are also exceptional. Plains-wanderers have been

recorded at some of these sites (Maher and Baker-Gabb 1993) and they also contain extensive important habitat for other species such as Fat-tailed Dunnart, Striped Leggless Lizard and Hooded Scaly-foot.

Management History

These properties have several things in common:

1. They have never been ploughed, cropped or levelled.
2. The properties are grazed very lightly at a rate of approx. 1 sheep / hectare (or 1dse/3 acres).
3. They are never or are infrequently burned (only by lightning strike).
4. Most properties had a history of being grazed bare in past droughts.

Recent management history varies slightly with each property. Some managers spell individual paddocks at certain times of the year for periods up to a few months. In this way they use a type of rotational grazing system. Other managers use a continuous grazing system, where stock are removed only for brief periods for the purpose of shearing. One manager lowers the numbers of stock when particularly dry Septembers occur, and most have had to hand-feed during droughts. Most managers run a few head of cattle with the sheep.

Vegetation Type and Flora

These areas of private property, like the crown reserves, may be considered as species rich herblands with no obvious dominants, or Open grasslands dominated by perennial native grasses. The community may be described as a "Grazed Annual Grassland" (Foreman 1995) because of the high representation of annual herbs encouraged by grazing. They have no shrubs because of their history of frequent light stock grazing. The major components of the vegetation are as follows:

- perennial native herbs cover 10 - 20 %,
- perennial native grasses cover 30 - 50 %,
- annual native herbs cover 15 - 30 %,
- exotic annual herbs cover 5 - 20 %. and
- exotic annual grasses cover 5 - 20 %.

Threats

A change in land use from grazing to cropping or irrigation is a major threat to the integrity of these sites. Such a change could be initiated by current land managers, or could arise following a change in ownership of the property. Over-grazing during drought times is a real threat for fauna, and may also affect recruitment of flora in the next season. Individual plants may also be affected / killed as a result of continual heavy grazing. Cattle may cause pugging in wet winters. Inappropriate grazing during the spring flowering and seeding period, as well as the breeding season for Plains-wanderers should also be considered as a threat. Weeds are less of a problem at these sites, unless major soil disturbance occurs.

Recommendations / suggestions

- Although some areas of private property have been included in surveys for Plains-wanderer (Maher in prep. 1996), and some have been included in other studies (Foreman 1995a, McDougall and Kirkpatrick 1994), there is still a need for comprehensive surveys to identify significant areas of freehold land on the Northern Plains.
- Paddocks containing areas of botanical / faunal significance should not be ploughed or cropped under any circumstances. Strategies need to be developed to ensure that important sites are managed in a way that suits land-holders whilst maintaining the natural conservation values.
- The general stocking rate (1dse / ha or 1-3 acres) should be maintained or lowered in significant paddocks.
- Avoid winter grazing of water-logged paddocks by cattle, where possible.
- Grazing of paddocks during drought times should be avoided or stocking rates reduced to prevent over-grazing. During severe droughts, stock should be

removed from normal paddocks and contained in another part of the property to assist in retaining vegetation cover (CNR 1994). In Victoria, funds are available for farmers to initiate the construction of stock containment areas.

- Stock should be removed (or stocking rate lowered to 1 sheep/ 5 acres) in the spring (during the months of August, September, October and November) to allow the native vegetation to flower and seed.
- Where Plains-wanderers are known to be present, care should be taken to prevent over-grazing during autumn.
- Where appropriate, monitoring (flora and fauna) should be carried out by the land-manager or CNR in late spring, and results used to assist the land-manager to make decisions for the following season.

Conservation Management Options
Conservation Covenants (Vic), LandCare, Section 75D LandCare Taxation arrangements, Agistment/ Compensation / Leasing. See Appendix 4.

4.2 NEW SOUTH WALES

The extent and conservation value of species-rich Riverine Grasslands, and the occurrence of various components of the flora is uncertain in NSW. It is believed that around 4.9% of the Jerilderie area (Maher 1996) contains suitable grassland habitat for Plains-wanderer. This vegetation is found on the red earths. On the basis of field work undertaken for this project and Benson *et.al.* (in prep.), species-rich grassland is far less common than the typical unimproved species-poor native pastures which appear to occupy a large proportion of the Riverina's pastoral land. Further survey is required to clarify this matter and officially attach a conservation status to the species-rich grasslands in NSW.

4.2.1 Travelling Stock Routes (NSW)

Managers
Rural Lands Protection Board (RLPB): Hay, Jerilderie, Urana, Deniliquin.

Size range and Properties
Roadsides are generally very wide in NSW, and where good patches of remnant vegetation are present, these are often large (average size around 36 ha or 88 acres). Vegetation quality is not constant along roadsides. Specific TSR's included in the study were Cocketgedong TSR (near Urana), Old Urana Road TSR (Jerilderie) and Gum Creek TSR (north of Jerilderie towards Hay).

Conservation Values
The status of these grassland communities is unknown in NSW. The sites contain various flora which are rare and threatened at the national level. The habitat value of these sites for fauna is unknown.

Management History
None of the TSR have ever been ploughed, but they have been frequently grazed by both sheep and cattle. Very large mobs of sheep (2-5,000) moved through the area during dry summers in the past, and sites would often be grazed bare (John Duryea, *pers. comm.*). There was a lot of stock movement in drought times, though water was a limiting factor.

Currently, most RLPBs endeavour to ensure that mobs are not too large, and that there is 1 week to 10 days or more between mobs. Some shires have not encouraged sheep to use the TSR in recent times due to foot-rot controls. Rules require stock to be continually on the move, at a rate of 5-6 km / day for cows and calves, and 10 km / day for dry cattle. This movement is regulated by available watering points. There is not generally very much movement in the winter, or in good summers when food is plentiful. The heaviest use of TSR still appears to be during drought times.

Vegetation Type and Flora
In places along TSR the flora is in exceptional condition. The Old Urana

Road TSR and the Cocketgedong TSR are best described as species-rich herblands without structural or an open tussock grassland dominated by perennial native grasses. These are described as community R1.2 (Jerilderie Plains) by McDougall *et al.* (1994), which is floristically and structurally very similar to frequently grazed grasslands in both Victoria and NSW. The over-lapping cover range of components of the vegetation are as follows:

- Perennial native herbs cover 10 - 30 %,
- Perennial native grasses cover 20 - 50 %,
- Annual native herbs, cover 5 - 15 %,
- exotic annual herb cover < 5 % and
- exotic annual grasses (< 5 %).

Because these areas experience recurring intensive grazing events, the cover of grasses and perennial herbs seems to fluctuate fairly dramatically. The TSR on Gum Creek is slightly different to the other two sites, possibly due to past management history, and is best described as an open to closed tussock grassland. It is generally species-poor, but has a large annual component. According to the descriptions offered by McDougall *et al.* (1994), this TSR probably also fits into community R1.2, although it is species-poor and has a notably depauperate perennial herb component. Annual herb cover was up to 30 %, and grass density was comparatively high, with between 60 and 75 % over-lapping cover.

Threats

Overgrazing, grazing during seeding time, and pugging during wet periods are all threats to significant sites along TSR's in NSW. Roadside fire protection practices such as mineral earth breaks can cause irreversible damage to vegetation, as can stock camping. The lack of knowledge regarding the existence and location of natural grassland areas is one that could be rectified with a systematic survey. At present it is difficult for the laypersons to distinguish species-rich sites from others.

If TSR are ever incorporated into paddocks prepared for irrigation / rice, this may be considered a substantial threat. Broadscale effects as a result of salting (particularly near irrigation areas) may occur in the future.

Recommendations

- That a systematic survey of all species-rich remnants be undertaken. Sites of significance should be marked on the ground and signposted. Contact numbers should be given for each of the agencies involved in their management.
- RLPB should be informed about the location of sites of significance, and if possible a Management Agreement signed with NPWS to ensure protection of those sites. The relevant management bodies should be liaised with at all times.
- No camping of stock should be allowed at, or adjacent to, sites of significance.
- Ploughing of TSR for mineral earth firebreaks should be prohibited, and alternatives sought.
- Travelling stock numbers should be limited, and records kept, to help determine if the current system is appropriate.
- To avoid damage to vegetation, stock should not be allowed to travel through signposted, sensitive areas during spring, and droughts. Similarly, stock travelling in large mobs, or along narrow areas should not be allowed to move through in extremely wet winters.
- Alternatively, areas of significance could be fenced to control stock access and number. (strategic exclosure system, see below). If this system were used, gates should be pad-locked to prevent inadvertent destruction by camping (John Duryea, *pers. comm.*). Funding assistance should be sought for fencing costs.
- Detailed records of grazing activity should be kept by RLPB.

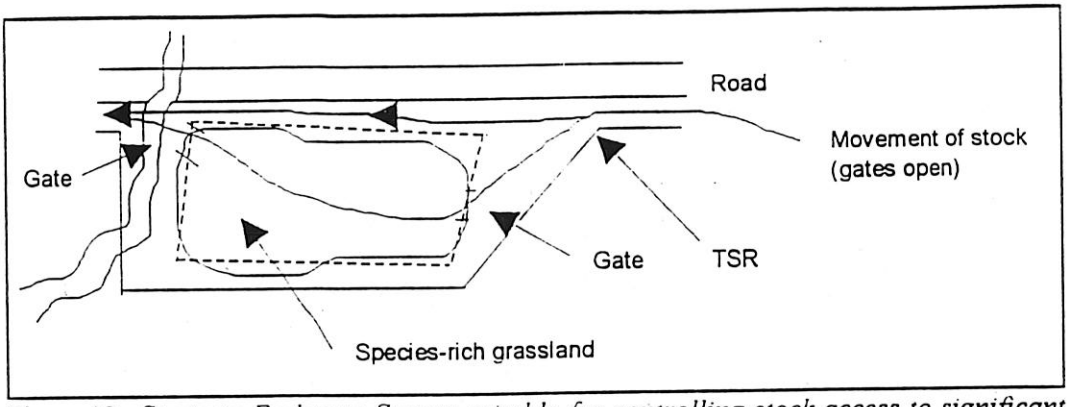

Figure 12a *Strategic Exclosure System suitable for controlling stock access to significant areas of TSR at critical times of the year. This figure shows the movement of stock when gates are open.*

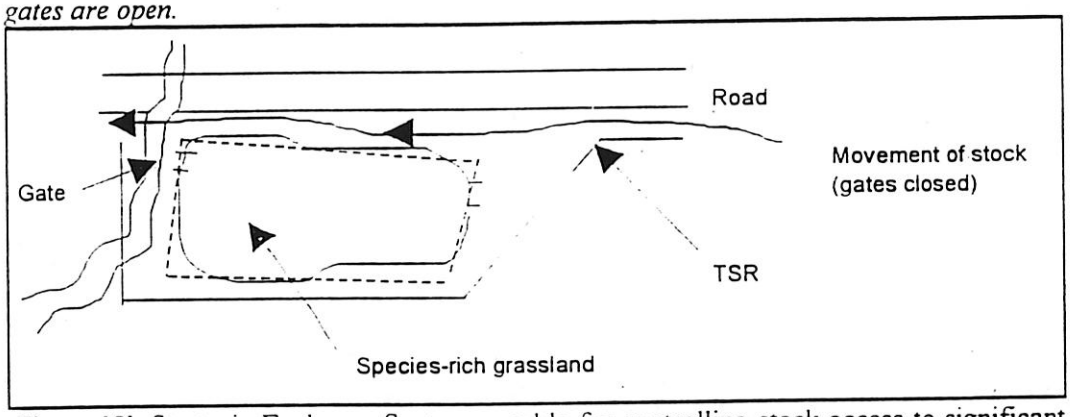

Figure 12b Strategic Exclosure System suitable for controlling stock access to significant areas of TSR at critical times of the year. This figure shows the movement of stock when gates are closed.

4.2.2 Strategic Exclosure System (SES)

This system is based upon that recommended by David Baker-Gabb (1990), and involves the establishment of a stock-proof fence around the perimeter of known areas of species-rich grasslands within a private paddock or TSR (see Figures 12a and 12b). These will allow for the exclosure of stock at strategic times of the year, when the vegetation is sensitive or vulnerable to disturbance.

These times include

- wet winters or other wet times when the soil is water-logged and vulnerable to pugging,
- dry summer and autumn periods and other times of drought
- spring flowering periods

Points to note:
Two gates will allow a relatively unimpeded movement of stock. The movement of stock through the species-rich area can be controlled by opening (Figure 12a) or closing the gates at both ends of the exclosure (Figure 12b), to allow grazing/no grazing at strategic times of the year. Gates should be locked open or locked closed to avoid misuse as temporary holding paddocks. The key should be kept and administered solely by RLPB Rangers or land-managers, who will be responsible for making the decisions regarding stock movement through the area. They will also be responsible for keeping the necessary records regarding this movement.

Conservation Management Options
Although Public Authority Management Agreements are not currently used in NSW, a similar kind of agreement should be considered. See Appendix 4.

4.2.3 Freehold Land (NSW)

Manager

Private owners / managers

Size range and Properties
506 ha (1250 acres) to 700 ha (1729 acres). Two private properties were included in this study. One property contained sites Riverine Plain 4 (RP4) and Riverine Plain 5 (RP5), and the other property, was site Riverine Plain 6 (RP6) in which 1 paddock was studied.

Conservation Values
The conservation values of these NSW grassland communities are uncertain at this stage. They are home to various nationally rare and threatened flora, and to fauna such as the Plains-wanderer (Baker-Gabb 1990) Hooded Scaly Foot (*Pygopus nigriceps)* and Narrow-nosed Planigale (*Planigale tenuirostris)*. (Phil Maher, pers. comm.).

Management History
None of the sites have been ploughed, cropped or levelled. They have no history of regular burning. Both sites have been grazed bare in the past. Recent history is quite different for the two sites. Both properties run Merino sheep and stock lightly at around 1 dse / 2 ha (1 dse / 5 acres). Both properties agist small numbers of cattle occasionally. RP4 and 5 are de-stocked in autumn, and the other is never de-stocked.

Vegetation Type and Flora
The two properties have quite different floral components, probably as a result of both historical and recent management factors as well as edaphic differences.

RP4 and 5 contain a higher diversity of herbs, both annual and perennial. They could be described as a species rich herbland without structural dominants or an open grassland dominated by perennial native grasses. These communities best fit the description of "Grazed Annual Grassland" (Foreman 1995a), or Community R1.2 (Jerilderie Plains) as described by McDougall *et. al.* (1995) because of the high numbers of native annual herbs, low numbers of perennial herbs and the absence of shrubs due to the grazing history. The common species and over-lapping cover range of components of the vegetation are as follows:

- Perennial native herbs cover 10 - 40 %,
- perennial native grasses cover 40 - 50 %,
- annual native herbs, cover 5 - 30 %, around 10 % or less
- exotic annual herbs, and
- exotic annual grasses (mostly **Lolium rigidum*) cover < 10 %.

Site RP 6 is a species-poor open to closed tussock grassland dominated by *Danthonia setacea*, *Chloris truncata* and some *Stipa nodosa* and *Sporobolis caroli*. Although species-poor, it contains some unusual species such as *Leuchochrysum molle*, *Podolepis muelleri* and *Minuria cunninghamii* as well as a range of more common species which may link the site to the Cotton Bush Community (map unit 21) described in Porteners (1993).

Threats
As with the Victorian sites, the single most important threat to the integrity of these areas is a change in land use from grazing to irrigation for rice growing or cropping. Such a change could be initiated by current land managers, or could arise following a change in ownership of the property. Over-grazing during autumn and drought times is a threat for fauna (Maher 1996), and may also affect recruitment of flora in the next season. Heavy grazing during the spring flowering and seeding period, the breeding season for Plains-wanderers should also be considered as a threat.

Recommendations
- More detailed flora and fauna surveys should be carried out to identify significant sites on private property beyond the Jerilderie area in New South Wales.

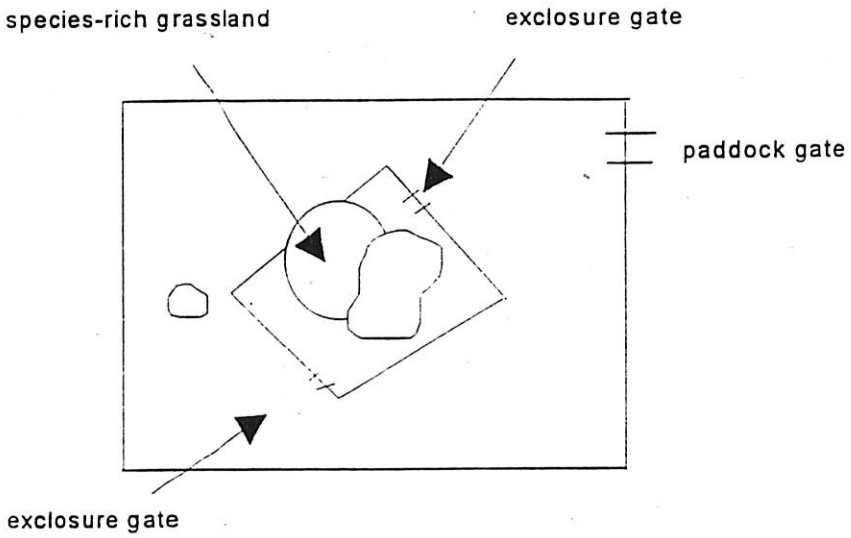

Figure 13 *Illustration of the use of a strategic exclosure in a private paddock. The fence encloses the species-rich grassland areas. Gates at either end of the exclosure, allow stock to move through easily for most of the year when the gates are open.*

- Paddocks containing areas of botanical / faunal significance should not be ploughed, cropped, or prepared for irrigation. Surveys should be conducted before permission is given for large areas to be irrigated.
- The general stocking rate should be maintained, or lowered to around 1 dse / 1-2 ha (1 dse / 3-5 acres) (Phil Maher, pers.comm.), for those paddocks where Plains-wanderers are known.
- Stock should be removed (or stocking rate lowered) in the months between August and November to assist the flowering and seeding of native flora. Where Plains-wanderers are known or suspected to be present, care should be taken to avoid overgrazing during autumn. If possible grazing should be removed during autumn or kept low until after the autumn break (Maher 1996).
- Alternatively, areas of significance within paddocks could be strategically exclosed by fencing, during the sensitive periods for fauna and flora (see Baker-Gabb 1990, and SES, discussed above for TSR). This system would be suitable in NSW because the paddocks (often around 600 ha or 1500 acres) are so large that an exclosure of 20 - 160 ha (50 - 400+ acres) would not significantly affect the management of the rest of the paddock for a short period of time (Fig 13).
- Avoid winter grazing of water-logged paddocks by cattle, where possible.
- Grazing of paddocks during drought times should be avoided if possible. Stocking rate should be reduced to around 1dse/4 ha (10 acres) (Phil Maher, pers.comm.) to avoid over-grazing. During severe droughts, stock should be removed from normal paddocks and contained in another part of the property to assist in retaining vegetation cover (CNR 1994).
- Monitoring should be carried out in late spring, and used to assist the land manager to make decisions regarding management in the following season.

Conservation Management Options
Voluntary Conservation Agreements. See Appendix 4.

4.2.4 Crown / Public Land NSW

Managers
Department of Defence, Jerilderie Shire, University of New South Wales.

Size range and Properties

60 ha (150 acres) to 607 ha (1500 acres). Properties included in this study were: Jerilderie Shire Land (Jerilderie), University of NSW / CSIRO land (near Conargo) and Department of Defence Land (Morundah).

Conservation Values

The conservation value of grassland communities such as these are unknown in NSW. They contain various significant species of flora such as *Brachyscome muelleroides*, *Lepidium monoplocoides* and *Leptorhynchos scabrus*. Plains-wanders and Common Dunnarts have been recorded at one of these sites (Phil Maher, *pers. comm.*) and it is likely that other fauna are present.

Management History

None of the species-rich areas of these properties have ever been cropped, ploughed or levelled. Most have a history of being lightly stocked with sheep. The Department of Defence Property has a history of being particularly lightly stocked at around 1dse/2 ha or 5 acres Recent history is quite varied between the properties. One property has maintained low level sheep grazing, with small numbers of cattle at times (Dept. Defence), another runs sheep and cattle (CSIRO), and the other has converted completely to intermittent grazing by cattle with some horses (Jerilderie Shire).

Vegetation Type and Flora

The Department of Defence site and the Jerilderie Shire site may both be described as species rich herblands or as open grassland with the notable presence of *Tripogon loliformis*. These communities best fit the description of "Grazed Annual Grassland" (Foreman 1995), or Community R1.2 (Jerilderie Plains) as described by McDougall *et. al.* (1995) because of their grazing history. The over-lapping cover range of components of the vegetation are as follows:

- Perennial native herbs (particularly characterised by the presence of *Lomandra effusa* at Dept Defence site only) cover 10 - 30 %,
- perennial native cover 15 - 40 %,
- annual native herbs cover around 20 %,
- exotic annual herbs less than 20 %
- exotic annual grasses (mostly *Aira* sp.) cover <15 %.

The Dept. of Defence site is strikingly similar to RP1 in Victoria, both in terms of structure and composition. The UNSW (CSIRO) property was grazed by both sheep and cattle, and was relatively poor floristically, with a high annual herb component (10 - 40 %), and a very low perennial herb component (around 10 %). It may be described as an open to closed grassland. Grass cover is quite high (between 45 and 60 %). Accordingly, this site is most similar to that described as Annual Grazed (Northern) Grassland, by Foreman (1995), which is a variation on the Grazed Annual Grassland because of the conspicuous presence of native annuals coexisting with a variety of perennial tussock grasses.

Due to different management practices at each site, the flora are quite varied. The Department of Defence property which is grazed lightly is in excellent condition. It is floristically very diverse, with potentially exceptional habitat for fauna. The Shire property which runs only cattle and horses is currently suffering badly from pugging. Although it is possible that the site is over-grazed, the Jerilderie Shire property maintains a high species diversity at present.

Threats

It is important to note that although these types of sites are often owned and managed by public agencies, conservation may not be the primary management objective. At times it is not a consideration at all. The major threats for these types of sites then, are sudden changes in management practices. Although it is unlikely that any of the sites will be cropped or prepared for irrigation, managers must be made aware of the values of the sites so that such

catastrophes may be avoided. Overgrazing may be a future problem for some sites. The property owned and managed by the Jerilderie Shire is threatened by its small size and close proximity to the township, as well as potential development adjacent to the site. It is also threatened by the damage caused by cattle pugging during wet winters. Changes in hydrology as a result of abutting development could affect the native flora and increase the possibility of weed invasion.

Recommendations

- The management bodies should be informed of the significance of sites and encouraged to manage accordingly.
- Paddocks containing areas of botanical and/or faunal significance should not be ploughed or cropped.
- The general stocking rate should be maintained or lowered. Leasees should be given strict guidelines regarding stocking levels.
- Stock should be removed in the months between August and November, to assist the flowering and seeding of native flora. Where Plains-wanderers are known or suspected to be present, the site should be grazed very lightly or not at all until after the autumn break.
- Weeds should be monitored and controlled by the various managers where appropriate.
- There should be no grazing by cattle in wet winters.
- Grazing of paddocks during drought times should be avoided if possible. Stocking rate should be reduced to avoid over-grazing.
- Monitoring should be carried out by land managers in late spring, and used to direct the grazing levels for the following season.

Conservation Management Options

A type of Public Authority Management Agreement (PAMA) such as those used in Victoria may be suitable. See Appendix 4.

SECTION FIVE

5.1 Drafting up your management guidelines

A two page assessment sheet (Appendix 6) has been included to help managers develop their own site specific conservation management plan based on the principles in this report. This form helps you to ask certain questions and gather certain information that is relevant to the conservation management of the grassland vegetation and its component flora and fauna. Upon completion it will document all the necessary actions for implementing an appropriate (conservation targeted) disturbance/management regime and does not represent a complete management plan for a particular site. The assessment sheet has the following 9 parts:

- Part 1: State and tenure - the type of remnant grassland will have implications for management
- Part 2: Site size and shape
- Part 3: Nature conservation values - document all known conservation values and try to gather more information if you feel there is a deficiency
- Part 4: Recent land management regime - How has the site been managed over the last 10 to 20 years? as it is likely that this regime should be maintained for conservation purposes. Try to gather as much information from knowledgeable locals or other relevant land managers as you can.
- Part 5: Current vegetation structure - This section asks you to establish and make the measurements of the current structure of the vegetation as outlined in the monitoring section. On the basis of these results decide whether your site has thick or sparse grassland vegetation.
- Part 6: Disturbance levels - Firstly place the upper and lower threshold numbers for winter grass and bare ground in the smaller bold box. Secondly, place your monitoring results for these two variables in the UNDER, OK or OVER boxes. Finally, on the basis of this exercise tick, for both variables, whether the vegetation appears to be (a) under disturbed, (b) over disturbed or (c) OK. Note if the disturbance rating is different for the two variables - say BG = OK and Winter grass = Under disturbed, consider the overall rating to be OK as this sort of anomaly is probably the result of the inaccuracy of the method.
- Part 7: Recommended grazing regime - The following points should be kept in mind when filling out this most critical part of the assessment sheet: (a) the broad type of disturbance you described in part 4 is the most desirable under the "*status quo*" approach to conservation management. (b) If the disturbance level is too high (over-disturbed), then you need to reduce its level - in other words remove all disturbance for the next 12 months or lower stocking rate depending on how over-disturbed the site is. (c) If the disturbance level is too low (under-disturbed) usually because all disturbance has been removed for some time, then you need to increase its level - in other words reintroduce a light stocking rate or begin burning according to past management practices, (d) If the disturbance level is OK then you need not do anything different from what has been happening in the immediately previous years - although there maybe slight changes which could be introduced. These may include timing (continuous to rotational grazing) or modifying stock feeding practices.
- Part 8: Management implementation - Summarise the disturbance regime you have decided on and how it will be implemented. Include such detail as the owner of the stock to be agisted, and who is responsible for ensuring that the program is implemented exactly as intended etc.
- Part 9: Other management measures - include any additional actions that relate to the disturbance regime you

have decided upon such as the exlusion of woodlands, shrublands or wetlands present on the reserve that would be vulnerable to stock grazing.

- Site map: indicates the location of any features relevant to the assessment of conservation values and the development of a vegetation management plan

NOTE: You should attempt to undertake the monitoring and review the details of your management plan at least once every 12 months preferably over the spring period.

5.2 Future Research (applications *etc.*)

To date there has been little or no field work carried out on the long-term effects of various management practices upon Riverine grasslands. As a result, these interim guidelines have been based heavily upon historical and local knowledge of land-managers. It is essential that further research be carried out so that management practices can continue to be modified and improved.

Various assertions and theories have been developed throughout this work, and these need to be substantiated. For example, the effects of fire on the flora and fauna of Riverine grasslands are largely unknown. Early results of recent experiments carried out on Victoria's Northern Plains indicate that floristic richness may be reduced when fire is applied annually to previously unburnt sites (P. Foreman, unpublished data, 1993-1995). From these same data it also appears that some exotic species may be lost when sites are regularly burned. Similarly, there is very little known about the effects of fire on the distribution and survival of fauna in native grasslands on the Riverine Plain. Clearly, detailed research is necessary before management tools such as fire may be considered as an option for areas that have previously been unburnt. It is thus very necessary for land-managers, particularly those managing public lands, to keep detailed and accurate records of management practices and their effects. With this incoming data, our information base will be greatly improved.

Appendix 5 contains a list of government departments and individuals with an interest in natural grasslands on the Riverine Plain. Some of these contacts may be able to assist with management techniques and plant identification. Some would be interested in hearing about remnant grassland sites or speaking to private land-managers interested in managing partly for conservation.

5.3 Application of these recommendations to other grasslands in Australia

Throughout this work there have been four important concepts proposed for the management of grasslands on the Riverine Plain. These four general concepts may be of use when considering strategies for the management of grasslands elsewhere in Australia. Specific guidelines should not be directly translated to sites outside of the Riverine Plain, without careful consideration of the climate, vegetation type, site histories and current management practices.

- The first concept is that of the maintenance or slight modification of *status quo* management. This type of management is always important when the effects of other forms of management are unknown or detrimental. It is unlikely that the native vegetation will be modified further by maintaining the *status quo*.

- The concept of **intermediate disturbance** as necessary for maintaining species diversity and structure will certainly be applicable for the management of other Australian grassland areas. Some form of disturbance (grazing by domestic or native animals, or burning) must be applied to grasslands managed for nature conservation purposes.

- **Monitoring** the response of vegetation to the imposed management regime is an essential part of the process that has been developed for Riverine Grasslands. Where new or unusual forms of management are being adopted for remnant grasslands, monitoring must be seen as part of that management, and necessary in order to fine-tune the process.

- Fourthly, when designing management strategies for other areas it will be a useful process to divide grassland remnants into **land tenures**. In this way site histories may be clearly compared and specific management strategies may be more easily developed.

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APPENDIX 1

Phenological data showing peak flowering times for selected flora in Victoria and New South Wales

VICTORIAN FLORA		June	July	August	September	October	November	December
Species	**Family**							
Ptilotus erubescens	Amaranthaceae						●	
Ptilotus exaltatus	Amaranthaceae		◆	●	●	●	●	●
Ptilotus spathulatus	Amaranthaceae			◆	●	●	●	●
Ptilotus macrocephalus	Amaranthaceae						●	
Daucus glochidiatus	Apiaceae			◆	●	●	◆	
Eryngium ovinum	Apiaceae				◆	●	●	◆
**Arctotheca calendula*	Asteraceae			◆	●	●	◆	
Brachyscombe lineariloba	Asteraceae				◆	●	●	◆
Calocephalus citreus	Asteraceae						◆	
Calocephalus sonderi	Asteraceae					◆	●	●
Calotis anthemoides	Asteraceae			◆	●			
Calotis scabiosifolia	Asteraceae		◆	●	●	◆		
Chrysocephalum apiculatum	Asteraceae		◆	●	●	●	●	◆
Craspedia globosa	Asteraceae				◆	●	●	◆
Cymbonotus ?sp	Asteraceae	◆	●	◆				
Hyalosperma sp.	Asteraceae			◆	●	●	◆	
**Hypochoeris sp.*	Asteraceae			◆	●	●	◆	
Isoetopsis graminifolia	Asteraceae			◆	●	◆		
Lemooria burkittii	Asteraceae			◆	●	◆		
Leptorhynchos sp	Asteraceae			◆	●	●	◆	
Microseris lanceolata	Asteraceae			◆	●	◆		
Pogonolepis muelleriana	Asteraceae				◆	●	◆	
Rodanthe corymbiflorum	Asteraceae			◆	●	●	●	◆
Rodanthe pygmaea	Asteraceae		◆	●	●	◆		
Triptilodiscus pygmaeus	Asteraceae			◆	●	●	●	◆
Vittadinia sp	Asteraceae			◆	●	●	◆	
Wahlenbergia gracilenta	Campanulaceae			◆	●	●	◆	
Wahlenbergia sp.	Campanulaceae				◆	●	●	
Maireana humilima	Chenopodiaceae			◆	●	●	◆	
Maireana pentagona	Chenopodiaceae			◆	●	●	●	◆
Convolvulus erubescens	Convolvulaceae				◆	●	●	●
Drosera peltata	Droseraceae		◆	●	◆			
Swainsona murrayana	Fabaceae			●				
Swainsona plagiotropis	Fabaceae				●		◆	
Swainsona procumbens	Fabaceae		◆	●	●	●	◆	
Swainsona sericea	Fabaceae		◆	●	●	●	◆	
**Erodium botrys*	Geraniaceae	◆	●	●	●	◆		
Goodenia pusilliflora	Goodeniaceae		◆	●	●	●		
**Romulea minutiflora*	Iridaceae	◆	●	●	●	◆		
**Romulea rosea*	Iridacea	◆	●	●	●	◆		

**Salvia verbenaca*	Lamiaceae			◆	●	◆		
Teucrium racemosum	Lamiaceae					◆	●	
Arthropodium fimbriatus	Liliaceae			◆	●	●	◆	
Bulbine bulbosa	Liliaceae		◆	●	●	●	◆	
Dianella sp	Liliaceae				◆	●	●	●
Hypoxis sp.	Liliaceae	●	●	●	●	◆		
Thysanotus patersonii	Liliaceae				◆	●	●	
Wurmbea dioica	Liliaceae	●	●	●	●	◆		
Linum marginale	Linaceae				◆	●	◆	
Sida corrugata	Malvaceae			◆	◆	●	●	◆
Diuris lanceolata	Orchidaceae		◆	●	◆			
Prasophyllum sp	Orchidaceae		◆	●	◆			
Pterostylis sp	Orchidaceae		◆	●	◆			
Oxalis perenans	Oxalidaceae		◆	●	●	●	●	
**Aira sp.*	Poaceae			◆	●	●	◆	
**Avena sp*	Poaceae				◆	●	●	◆
Chloris truncata	Poaceae				◆	●	◆	
Danthonia sp.	Poaceae				◆	●	●	●
Homopholis proluta	Poaceae				◆	●	◆	
Lolium rigidum	Poaceae				◆	●	●	◆
Stipa sp.	Poaceae				◆	●	●	◆
Ranunculus sp.	Ranunculaceae		◆	●	◆			
Asperula conferta	Rubiaceae		◆	●	●	●	●	
**Parentucellia latifolia*	Scrophulariaceae			◆	●	●	◆	

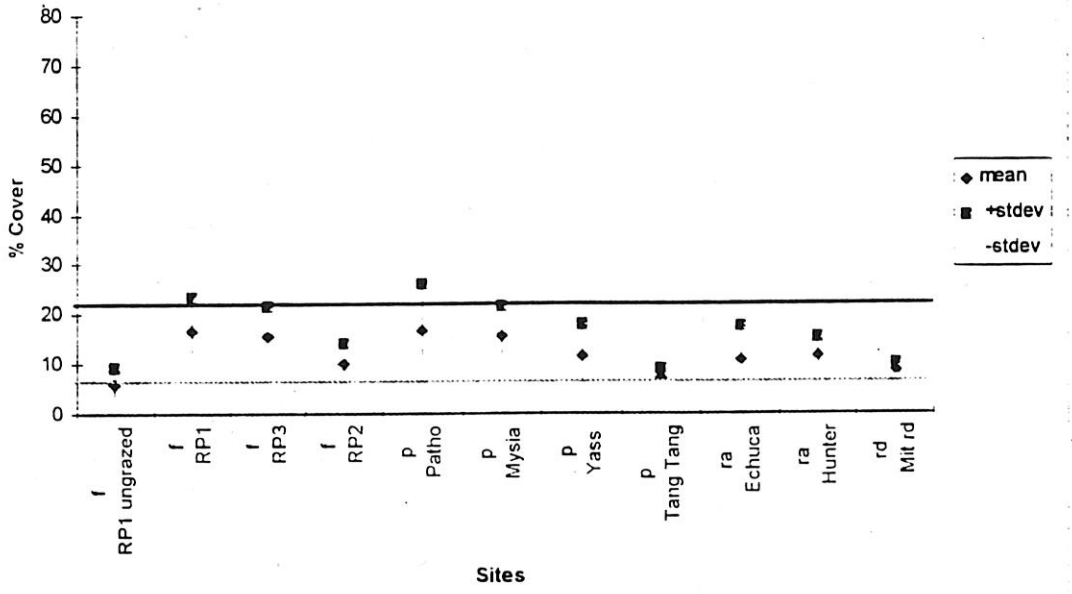
NSW FLORA

Species		June	July	August	September	October	November	December
	Family							
Ptilotus exaltatus	Amaranthaceae						●	
Ptilotus spathulatus	Amaranthaceae					●		
Daucus glochidiatus	Apiaceae				●	◆		
Eryngium ovinum	Apiaceae							
**Arctotheca calendula*	Asteraceae			◆	●	◆		
Brachyscombe chrysoglossa	Asteraceae				●			
Brachyscombe lineariloba	Asteraceae				●	◆		
Calocephalus citreus	Asteraceae						●	
Calocephalus sonderi	Asteraceae						●	
Calotis scabiosifolia	Asteraceae		●	●	●	◆		
Chrysocephalum apiculatum	Asteraceae		◆	●	●	●	◆	
Hyalosperma sp.	Asteraceae				●	● ◆		
**Hypochoeris sp.*	Asteraceae				●			
Isoetopsis graminifolia	Asteraceae			◆	●	◆		
Lemooria burkittii	Asteraceae				●			
Leptorhynchos sp	Asteraceae				●			
Leucochrysum molle	Asteracea				●	●	◆	
Microseris lanceolata	Asteraceae			◆	●	◆		
Rodanthe corymbiflorum	Asteraceae			◆	●	◆	◆	

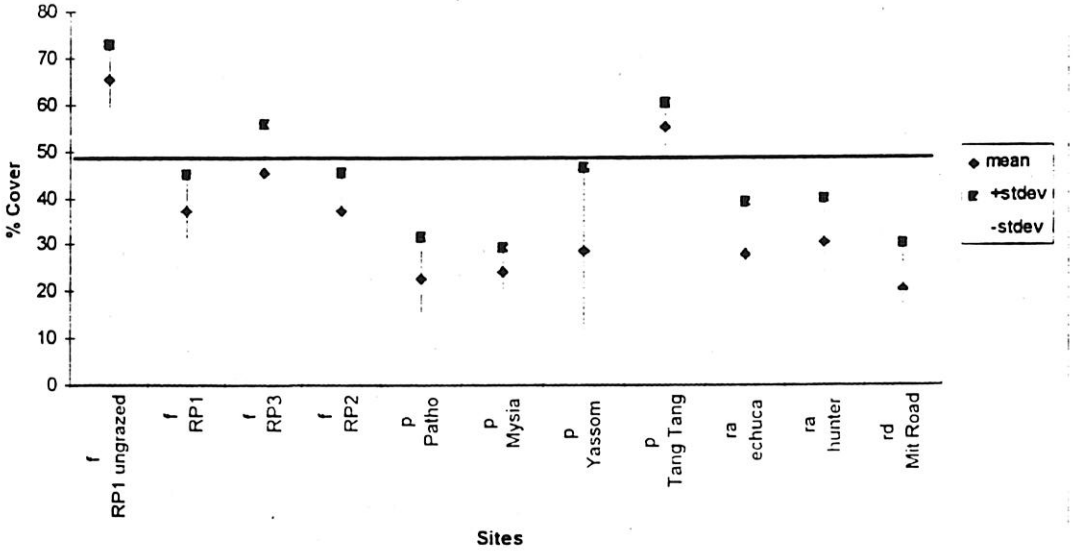
Rodanthe pygmaea	Asteraceae				●	● ◆		
Triptilodiscus pygmaeus	Asteraceae				●	●	◆	
Vittadinia sp	Asteraceae					● ◆		
Wahlenbergia gracilenta	Campanulaceae					●		
Wahlenbergia sp.	Campanulaceae				●			
Maireana excavata	Chenopodiaceae				●	● ◆		
Maireana humilima	Chenopodiaceae					● ◆	◆	
Maireana pentagona	Chenopodiaceae				●	● ◆		
Convolvulus erubescens	Convolvulaceae					●	●◆	
Drosera peltata	Droseraceae							
Swainsona murrayana	Fabaceae					● ◆		
Swainsona plagiotropis	Fabaceae		◆	●	●	◆		
Swainsona procumbens	Fabaceae		◆	●	◆			
Swainsona sericea	Fabaceae	◆	●	●	●	◆		
**Erodium botrys*	Geraniaceae				● ◆			
Goodenia ? elongata	Goodeniaceae					●	● ◆	
Goodenia pusilliflora	Goodeniaceae		◆	●	●	◆		
**Romulea minutiflora*	Iridaceae		●	◆				
Teucrium racemosum	Lamiaceae				◆ ●		●	
Arthropodium fimbriatus	Liliaceae				●	●	●	
Bulbine bulbosa	Liliaceae			◆	●	◆		
Hypoxis sp.	Liliaceae		●	●	◆			
Thysanotus patersonii	Liliaceae						●	
Wurmbea dioica	Liliaceae		●	●	● ◆	◆		
Linum marginale	Linaceae			●	●	●	◆	
Sida corrugata	Malvaceae				●	◆	●	
Oxalis perenans	Oxalidaceae						● ◆	
Chloris truncata	Poaceae					● ◆		
Danthonia sp.	Poaceae				●	◆	● ◆	
Enteropogon acicularis	Poaceae				●	●	◆	
Homopholis proluta	Poaceae							
Lolium rigidum	Poaceae					●	◆	
Stipa sp.	Poaceae				●	● ◆	● ◆	
Ranunculus sp.	Ranunculaceae			●				
Asperula conferta	Rubiaceae				●	◆		
Solanum sp	Solanaceae						●	

APPENDIX TWO Transect data collected from sites in NSW and Victoria

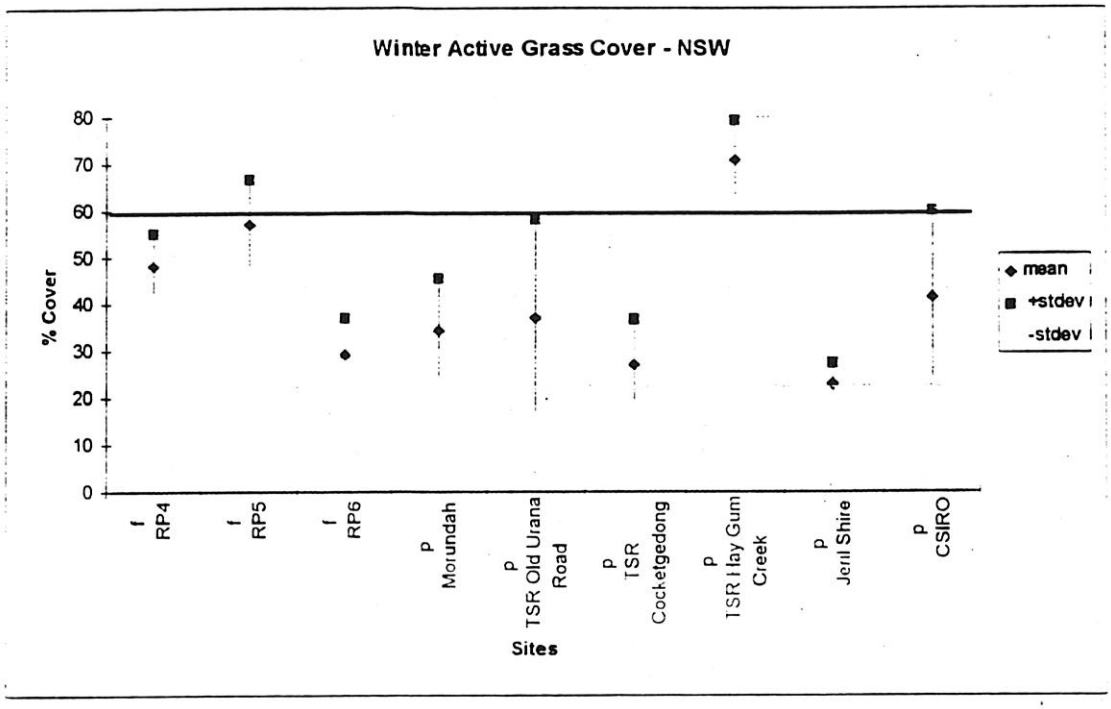
Bare Ground Cover - Victoria

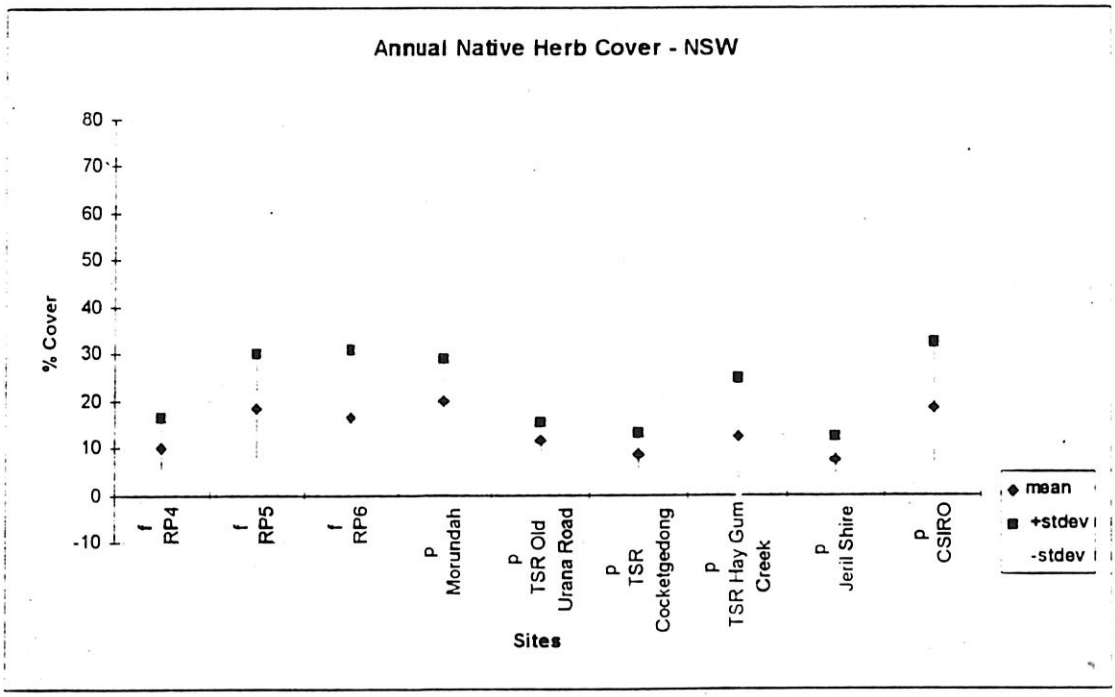


Winter Active Grass Cover - Victoria

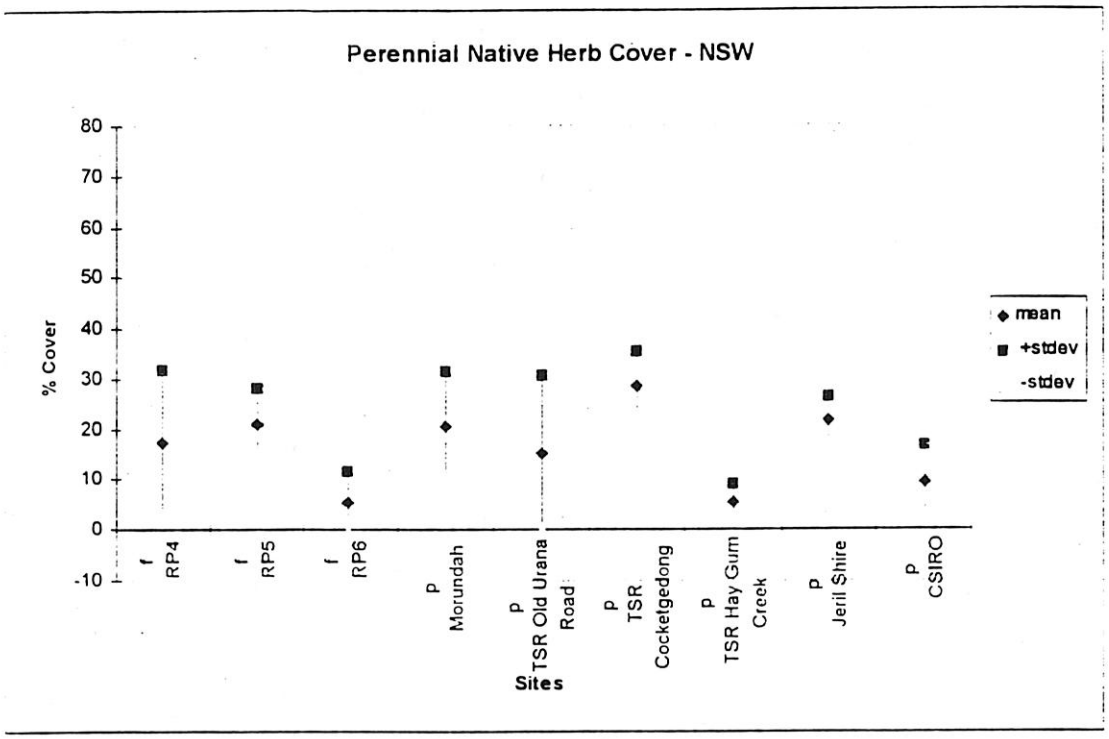


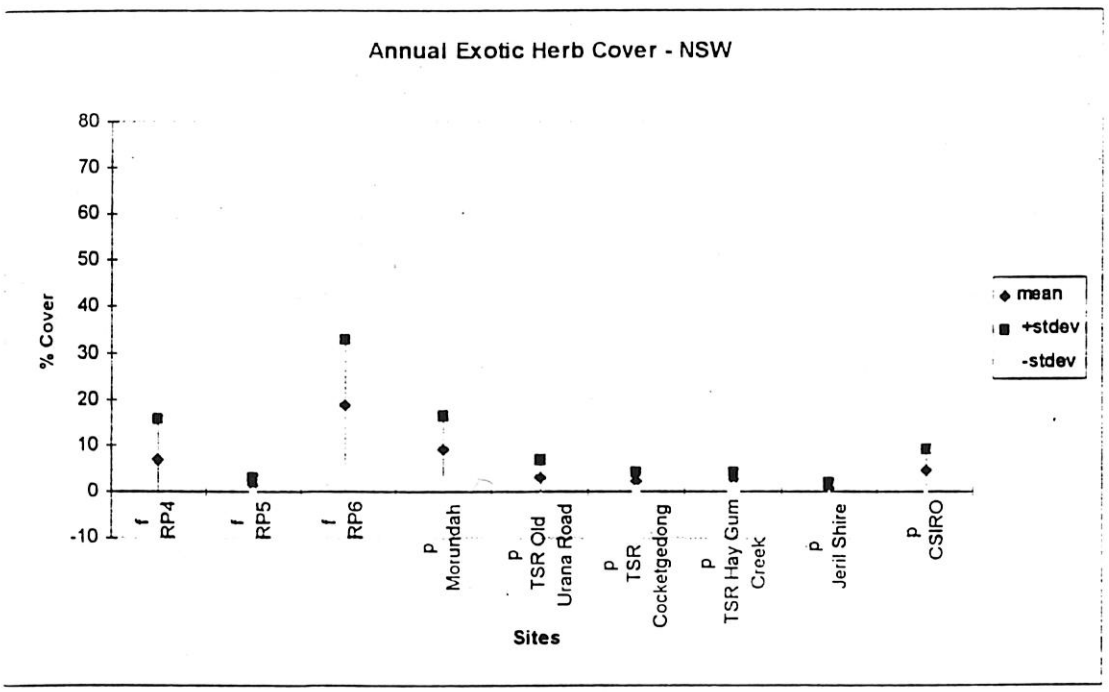
APPENDIX 2


Winter Active Grass Cover - NSW
% Cover
80
70
60
50
40
30
20
10
0
f RP4
f RP5
f RP6
p Morundah
p TSR Old Urana Road
p TSR Cocketgedong
p TSR Hay Gum Creek
p Jeril Shire
p CSIRO
Sites
mean
+stdev
-stdev

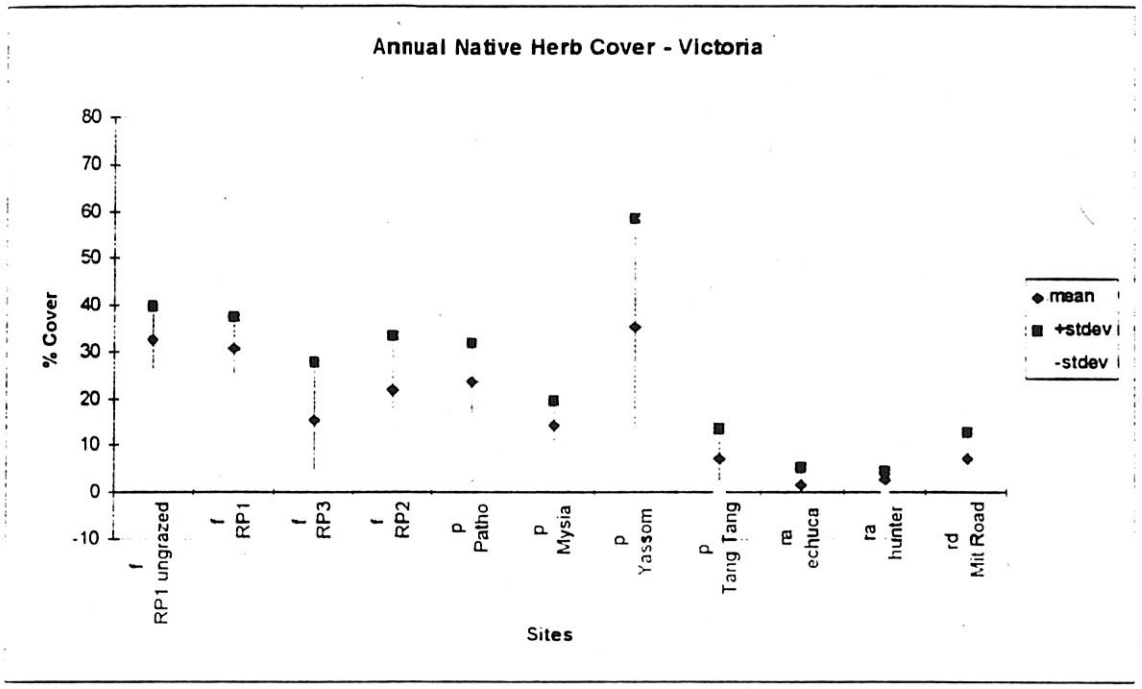

Annual Native Herb Cover - NSW
% Cover
80
70
60
50
40
30
20
10
0
-10
f RP4
f RP5
f RP6
p Morundah
p TSR Old Urana Road
p TSR Cocketgedong
p TSR Hay Gum Creek
p Jeril Shire
p CSIRO
Sites
mean
+stdev
-stdev

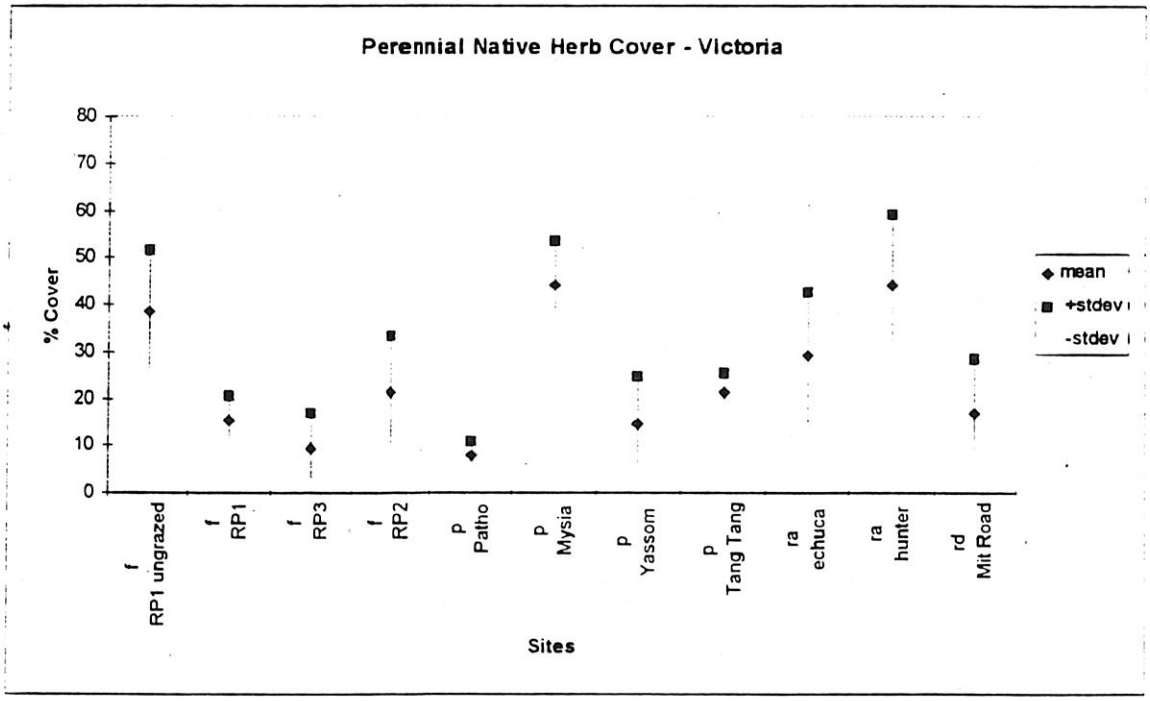
APPENDIX 2


Perennial Native Herb Cover - NSW
% Cover
80
70
60
50
40
30
20
10
0
-10
f RP4
f RP5
f RP6
p Morundah
p TSR Old Urana Road
p TSR Cocketgedong
p TSR Hay Gum Creek
p Jeril Shire
p CSIRO
Sites
mean
+stdev
-stdev

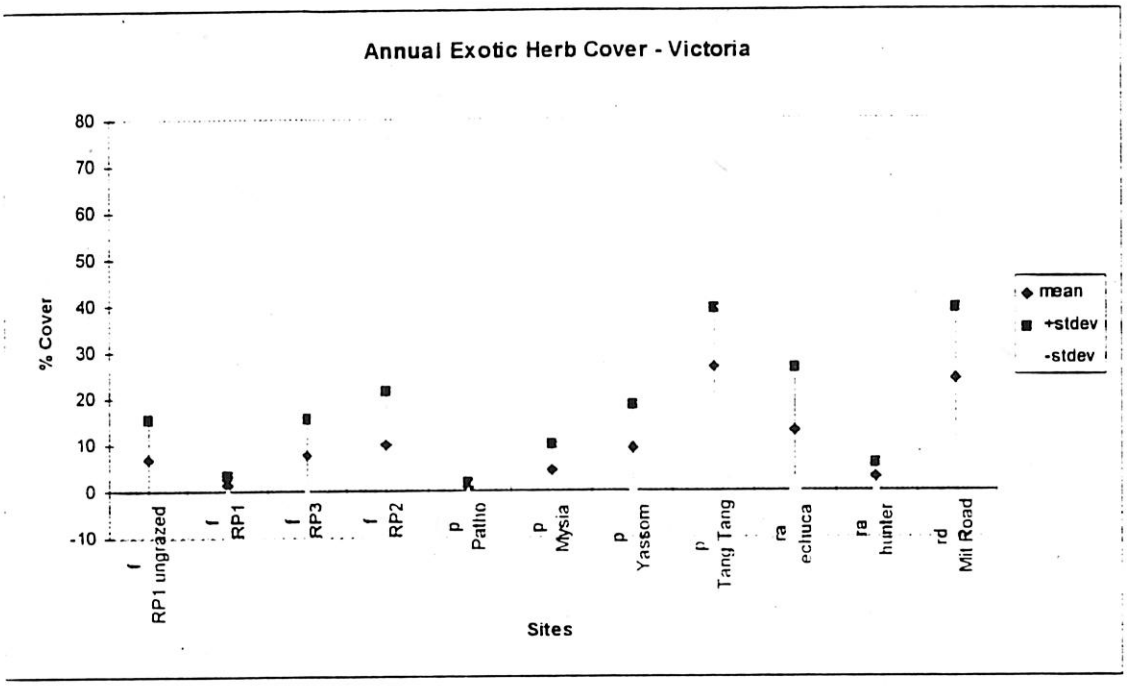

Annual Exotic Herb Cover - NSW
% Cover
80
70
60
50
40
30
20
10
0
-10
f RP4
f RP5
f RP6
p Morundah
p TSR Old Urana Road
p TSR Cocketgedong
p TSR Hay Gum Creek
p Jeril Shire
p CSIRO
Sites
mean
+stdev
-stdev

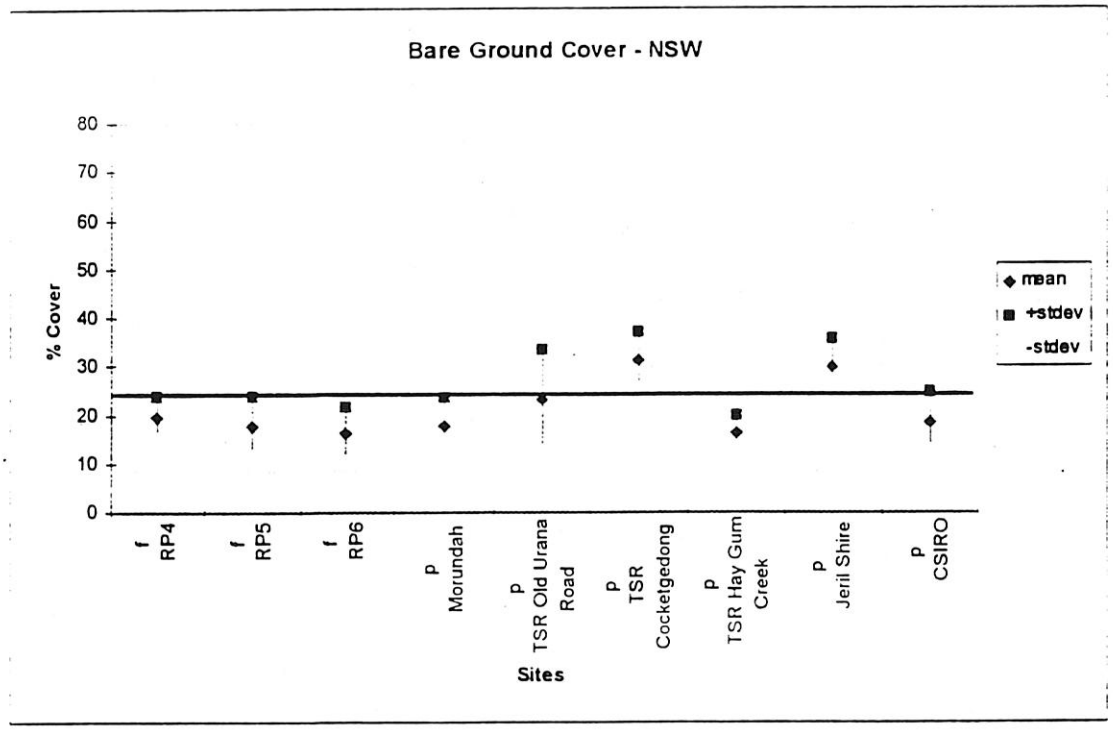
APPENDIX 2


Annual Native Herb Cover - Victoria
% Cover
80
70
60
50
40
30
20
10
0
-10
f RP1 ungrazed
f RP1
f RP3
f RP2
p Patho
p Mysia
p Yassom
p Tang Tang
ra echuca
ra hunter
rd Mit Road
Sites
mean
+stdev
-stdev

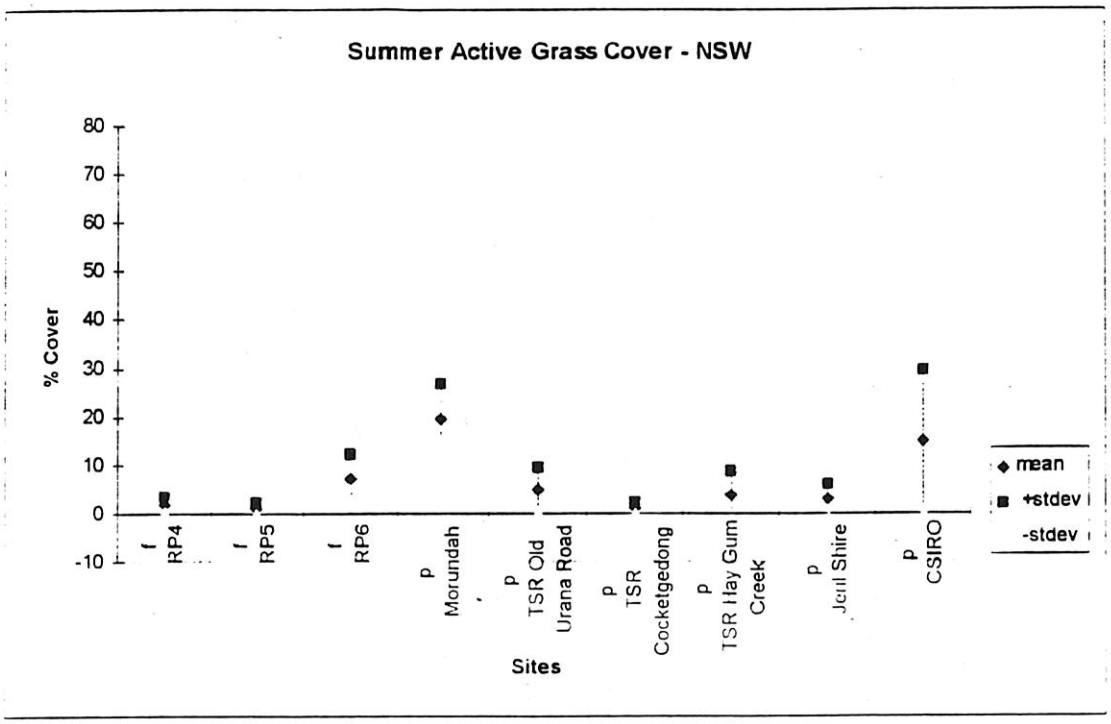

Perennial Native Herb Cover - Victoria
% Cover
80
70
60
50
40
30
20
10
0
f RP1 ungrazed
f RP1
f RP3
f RP2
p Patho
p Mysia
p Yassom
p Tang Tang
ra echuca
ra hunter
rd Mit Road
Sites
mean
+stdev
-stdev

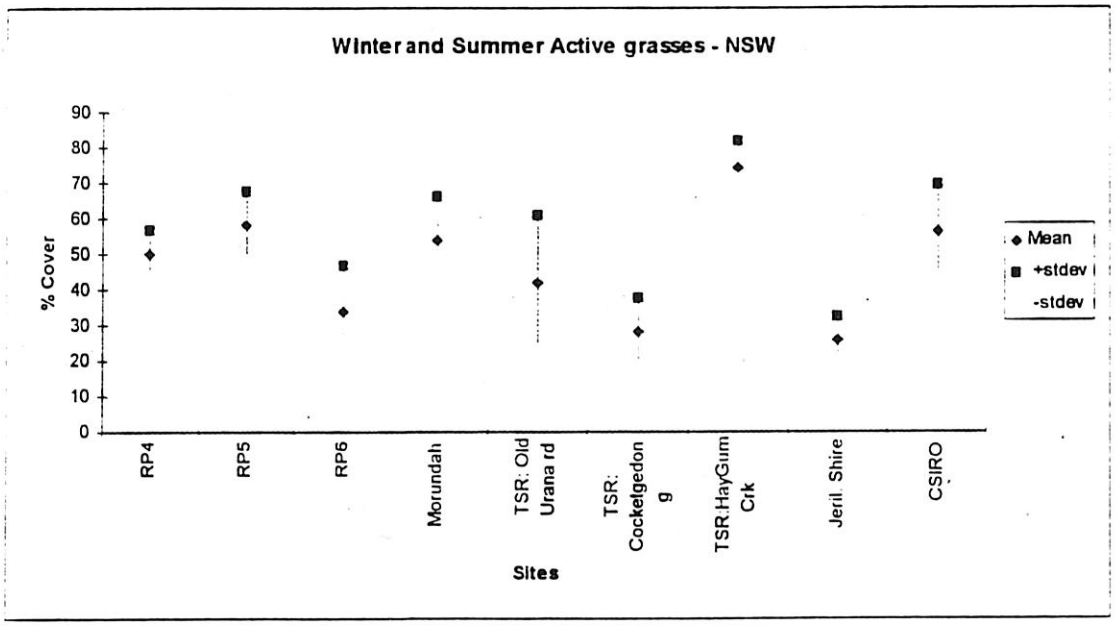
APPENDIX 2


Annual Exotic Herb Cover - Victoria
% Cover
80
70
60
50
40
30
20
10
0
-10
mean
+stdev
-stdev
f RP1 ungrazed
f RP1
f RP3
f RP2
p Patho
p Mysia
p Yassom
p Tang Tang
ra ecluca
ra hunter
rd Mil Road
Sites


Bare Ground Cover - NSW
% Cover
80
70
60
50
40
30
20
10
0
mean
+stdev
-stdev
f RP4
f RP5
f RP6
p Morundah
p TSR Old Urana Road
p TSR Cocketgedong
p TSR Hay Gum Creek
p Jeril Shire
p CSIRO
Sites

APPENDIX 2


Summer Active Grass Cover - NSW
% Cover
80
70
60
50
40
30
20
10
0
-10
f RP4
f RP5
f RP6
p Morundah
p TSR Old Urana Road
p TSR Cocketgedong
p TSR Hay Gum Creek
p Jeril Shire
p CSIRO
Sites
mean
+stdev
-stdev


Winter and Summer Active grasses - NSW
% Cover
90
80
70
60
50
40
30
20
10
0
RP4
RP5
RP6
Morundah
TSR: Old Urana rd
TSR: Cocketgedong
TSR:HayGum Crk
Jeril Shire
CSIRO
Sites
Mean
+stdev
-stdev

APPENDIX 3 - FIELD ASSESSMENT SHEET

	0.2	0.4	0.6	0.8	1.0	1.2	1.4	1.6	1.8	2.0	2.2	2.4	2.6	2.8	3.0	3.2	3.4	3.6	3.8	4.0	4.2	4.4	4.6	4.8	5.0
Bare Ground																									
Litter																									
Sum. Grass																									
Wint. Grass																									
An.Nat.Herb																									
An.Ex.Herb																									
Per.Nat.Herb																									
Per.Ex.Herb																									
An.Ex.Grass																									

	5.2	5.4	5.6	5.8	6.0	6.2	6.4	6.6	6.8	7.0	7.2	7.4	7.6	7.8	8.0	8.2	8.4	8.6	8.8	9.0	9.2	9.4	9.6	9.8	10.0
Bare Ground																									
Litter																									
Sum. Grass																									
Wint. Grass																									
An.Nat.Herb																									
An.Ex.Herb																									
Per.Nat.Herb																									
Per.Ex.Herb																									
An.Ex.Grass																									

	10.2	10.4	10.6	10.8	11.0	11.2	11.4	11.6	11.8	12.0	12.2	12.4	12.6	12.8	13.0	13.2	13.4	13.6	13.8	14.0	14.2	14.4	14.6	14.8	15.0
Bare Ground																									
Litter																									
Sum. Grass																									
Wint. Grass																									
An.Nat.Herb																									
An.Ex.Herb																									
Per.Nat.Herb																									
Per.Ex.Herb																									
An.Ex.Grass																									

	15.2	15.4	15.6	15.8	16.0	16.2	16.4	16.6	16.8	17.0	17.2	17.4	17.6	17.8	18.0	18.2	18.4	18.6	18.8	19.0	19.2	19.4	19.6	19.8	20.0
Bare Ground																									
Litter																									
Sum. Grass																									
Wint. Grass																									
An.Nat.Herb																									
An.Ex.Herb																									
Per.Nat.Herb																									
Per.Ex.Herb																									
An.Ex.Grass																									

APPENDIX 4

Conservation management options for grasslands on the Riverine Plain

Public Authority Co-operative Management Agreements (PAMA)
(information kindly provided by Kerri Northey CNR, Melbourne)

Public Authority Management Agreements are agreements between the Department of Conservation and Natural Resources and a public authority under Section 25 of the *Flora and Fauna Guarantee Act* 1988.

The purpose of a Public Authority Management Agreement is to provide for the management of any taxon (flora or fauna), community of flora and fauna, or potentially threatening process. The taxon, community or potentially threatening process to be managed does not have to be listed as threatened on Schedule 2, or as a threatening process on Schedule 3 of the *Flora and Fauna Guarantee Act* 1988.

Public Authority Agreements are normally initiated by the Department of Conservation and Natural Resources, but can be initiated by a public authority. The agreements are voluntary and can be made with a single public authority or a group of authorities. A public authority is any body established for a public purpose by or under any Act.

The agreement must set out its purposes and aims, the duties and areas of responsibility of the parties and the date on which it begins and (if necessary) ends. Agreements may be changed or terminated by mutual agreement between the parties or according to the terms of the agreement.

In general agreements need only cover those aspects of management that impact on the management of the item. The agreement could set out the means by which decisions will be reached between the parties, practices that will be negotiated, practices that will not be undertaken and any obligations either party undertakes. Some examples of the type management practices that could be included in a Public Authority Management Agreement include:

- The control of pest plants and animals.
- The type (sheep, cattle, etc.) seasonality, number of head and areas to be accessed by grazing stock.
- The use of herbicides.
- The type and amount and provenance of plantings to occur at the site.
- The type and extent to which clearance could occur, including mowing, the construction of roads or tracks, and clearing of firebreaks.
- The frequency and timing of burning including burning for fuel reduction and weed control.
- Public access, including disturbance by humans for recreational activities such as horse riding.
- Vehicular access.
- Confidentiality of location or agreement to publicise location.
- Introduction of a works program.

One legal aspect that needs to be considered is that of liability (such as when burning is undertaken).

Four Public Authority Management Agreements are currently in force and a number of others are being negotiated. Shires, City Councils and Cemetery Trusts are examples of the types of authorities that have been involved with agreements so far.

If you have additional questions regarding Public Authority Management Agreements contact Flora and Fauna Guarantee Officers at CNR Offices or Kerri Northey of the Flora and Fauna Branch or 412 4955.

Land Management Cooperative Agreements (Conservation, Forests and Lands Act 1987)
This agreement may run with the title of the land if this is agreed upon. It is an agreement between landholders and the secretary to the Department of Conservation and Natural Resources.

Acquisition
The Victorian Conservation Trust purchases properties of significance with monies acquired by donation.

Conservation Covenants (Vic)
These are voluntary agreements between landholders and the Victorian Conservation Trust. The covenant is registered on the title and binds future owners of the land. The covenants can be put in place for groups with adjoining properties.

Land for Wildlife (Vic)
This is really designed to be a focus for exchange of information for landholders, and may not have much effect in relation to grasslands on the Riverine Plains.

LandCare
There are funds available for fencing works etc.

Section 75D LandCare Taxation arrangements
(summarised from brochure produced by the Commonwealth Department of Primary Industries and Energy, undated)
This section of the Income Tax Assessment Act 1936 provides tax deductions for capital expenditure on farm improvements which conserve water and prevent and treat land degradation. The deductions are available to primary producers on rural land (excluding mining / quarrying), and cover the costs of fencing for regeneration / treatment of land degradation, weed eradication, replanting and various construction works. Where a Land Management Plan (LMP) has been produced, the cost of fencing to divide land classes for the prevention of land degradation is also able to be claimed. The cost of the preparation of LMPs is also eligible for an outright deduction in most cases. Where fencing has been used to control degradation, total expenditure (100%) on the fencing may be claimed in the year of expenditure. More information and advice on section 75D tax arrangements are available from Commonwealth Government contacts as well as State and Territory land conservation offices. It is likely that these tax deductions may only appeal to the owners of larger properties.

Agistment/ Compensation/ Leasing.
This is an unusual arrangement that has been reached with NPWS/CNR regions and local landholders in relation to grazing by Cape Barren Geese in Tasmania and on Wilsons Promontory. Farmers are paid an annual agistment fee to compensate for production losses (at a rate of 1 goose = 0.25 sheep), and the geese are able to graze without harassment from stock or farmers. It was found that the amounts of money concerned were fairly small, and the procedure was relatively simple. Landholders filled in a claim form at the end of each 20 week goose grazing season.

Incentives like this may be suitable for landholders with Plains-wanderer habitat on their properties. Perhaps the incentives would be best directed towards 3 months grazing removal during the spring-early summer period, and removal of grazing during particularly wet winters. Since Plains-wanderers probably don't eat very much, and the paddocks would benefit from a rest anyway, the cost is not likely to be high. . Some landholders may see the regulated grazing removal as a restriction of their freedom, and might demand payment for the inconvenience. This is something that would have to be negotiated.

Voluntary Conservation Agreements

These are "a voluntary agreement between a landholder and the Minister administering the National Parks and Wildlife act." They "aim to conserve the natural, cultural and or scientific values of all or part of the land by agreed management". These are not equivalent to the Victorian Conservation Covenants, as they are implemented by different bodies. The scheme is relatively new in NSW, where landholders either show their interest or are actively sought out by NPWS staff. Where a significant parcel of land comprises parts of several properties, joint agreements are able to be formed with neighbours and the NPWS. The NPWS aims to represent a diversity of areas by conservation agreement. Grasslands are relatively un-represented at this stage.

Landholders benefit in two ways from Conservation Agreements:

1. They know that the land is able to be preserved and managed appropriately in perpetuity,
2. They may be eligible for financial assistance towards fencing materials, flora/fauna surveys and other specialist advice. A management plan may also be prepared for the property in conjunction with the NPWS.

APPENDIX 5

A list of contacts with an interest in grasslands on the Riverine Plain

Appendix: Names and Contact Numbers for persons with interest in or involved in the Management of Grasslands on the Riverine Plain			
Name	**Position / Title**	**Phone Number**	**Postal Address**
A			
Elizabeth Ashby	Botanist	(02) 231 8067	Royal Bot. Gardens Ecology Section, Mrs. Macquaries Road, Sydney 2000
Geoff Asgill	RLPB	(069) 931403	P.O. Box 21 Hay 2711
B			
David Baker-Gabb	Ornithologist	(03) 9 882 2622	RAOU, 415 Riversdale Road, Hawthorn East 3123
Max Bartley	Botanist	(03) 9 470 2498	School of Botany, La Trobe University, Bundoora 3083
Jim Balnaves	Pest Control Officer NPWS	(069) 627 755	NPWS P.O. Box 1049, Griffith 2680
John Benson	Botanist	(02) 231 8149	NSW Herbarium, Royal Botanical Gardens, Mrs Macquaries Rd.Sydney 2000
Tony Blackford	Manager	(058) 846 609	"Boonoke" Deniliquin, 2710
John Briggs	Threatened Species Officer CSIRO	(06) 246 5261	CSIRO Canberra
John Brickhill	NSW NPWS	(069) 627 755	NPWS P.O. Box 1049, Griffith 2680
Tom Burke	Ranger RLPB	(069) 208 011	Rural Lands Protection Board, Urana
C			
Peter Campbell	Public Transport Corporation	(054) 402 736	Bendigo
Andrew Chappell	Consultant, Land Use Services	(054) 422896	P.O. Box 2515, Bendigo Mail Centre, Bendigo 3550
Vanessa Craigie	Grassy Ecosystem Research Group	(03) 9 450 8697	ARI, Brown Street, Heidelberg 3084
D			
Roy Darling	Department of Defence	(06) 266 6235	Department of Defence, Queen Victoria Terrace, Canberra 2600 ACT
Rob Dick	NPWS	(02) 585 6548	Head Office,Land Conservation Branch, 43 Bridge Street, Hurstville, 2220.
Shirley Diez	DCNR	(054) 446674	P.O. Box 401, Bendigo 3550
Martin Driver	Co-ordinator	(058) 813 429	Greening Australia, P.O. Box 1010, Deniliquin 2710. NSW
E			
Karen Eardley	NSW NPWS	(02) 585651	P.O. Box 1967, Hurstville 2220
F			
Paul Foreman	DCNR	(054) 446676	P.O. Box 401, Bendigo 3550
G			
Roger Goode	NPWS	(06) 298 9718	NSW NPWS P.O. Box 2115, Queanbeyan 2620.

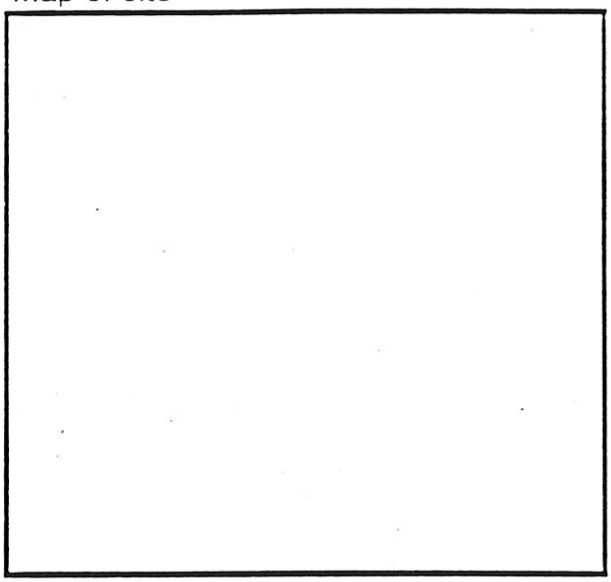
Rural Lands Prot. Boards	Urana	(069) 208 011	Urana
Rural Lands Prot. Boards	Jerilderie	(058) 861 203	Jerilderie
S			
Neville Scarlett	Botanist	(03) 9 479 2498	School of Botany, La Trobe University, Bundoora 3083
Rob Scriven	Soil Conservation Officer	(069) 931306	Dept. Land and Water Conservation, P.O. Box 408, Hay 2711
Jonathon Sanders	NPWS	(068) 811395	NPWS Western Zone, P.O. Box 1007, DUBBO 2830
Glen Scholz	Land and Water Conservation	(069)931306	126 Lachlan St. Hay 2711, NSW
Peter Seely	Manager, Univ. NSW Field Station	(058) 846 611	Conargo
Bob Sefton	Manager, "Boonoke"	(058) 846 609	"Boonoke", Deniliquin 2710.
Bill Semple	DLWC	(063) 638301	Department of Land & Water Conservation, P.O. Box 53, Orange 2800
Sarah Sharp	Grasslands Officer	(06) 2072125	
Dominic Sivertson	NPWS	(02) 5856444	NSW NPWS 43 Bridge Street, Hurstville 2220
W			
Rick Webster	RAOU Consultant Ornithologist	(058) 812201	P.O. Box 13, Deniliquin 2710
Owen Whitaker	Riverina Grasslands Soc. Pres.	(069) 245231	"Kimvale" Eurongilly 2663

Dick Green	Greening Australia	(069) 218202	P.O. Box 350, Wagga Wagga 2650
Darryl Green	DLWC	(068) 952 033	Department of Land & Water Conservation, Condobolin.
H			
Tim Hager	NPWS	(02) 5856547	P.O. Box 1967, Hurstville 2220
David Hart	Dept. Land and Water Cons.	(068) 952033	Condobolin 2877
Dick Honeyman	Shire Ranger	(058) 861 200	Shire of Jerilderie, Jerilderie 2716, NSW
K			
Craig Kelly	Program Co-ordinator, ANCA	(06) 250 0200	Australian Nature Conservation Agency, GPO Box 636, Canberra ACT 2601
L			
John Lumb	ANCA	(06) 250 0342	Australian Nature Conservation Agency, GPO Box 636, Canberra ACT 2601
Ian Lunt	Botanist	(03) 9 459 8600	ARI, Brown Street, Heidelberg 3084
M			
Phil Maher	Consultant Ornithologist	(058) 813 378	94 Hunter Street, Deniliquin 2710, NSW
Peta McKay	Land for Wildlife Officer	(050) 331 290	DCNR Swan Hill, P.O. Box 356, Swan Hill 3585
John Morgan	Botanist	(03) 9 479 2498	School of Botany, La Trobe University, Bundoora 3083, VIC
Peter Morison	Land for Wildlife Officer	(054) 446 638	DCNR Bendigo, P.O Box 401, Bendigo 3550
Bill Mulham	Consultant Botanist	(058) 811 830	"Mawarra", Deniliquin 2710 NSW
O			
Roger Oxley	DLWC	(058) 814 355	Department of Land & Water Conservation, 360 Whitlock St., Deniliquin 2710 NSW
P			
Bob Parsons	Botanist	(03) 9 479 2216	School of Botany, La Trobe University, Bundoora 3083, VIC
Jamie Pook	ANCA	(06) 250 0283	
Geoff Portbury	Ranger	(058) 861 200	Jerilderie Shire Council, Jerilderie 2716
Marianne Porteners	Botanist	(02) 231 8115	Royal Bot. Gardens. Ecology Section, Mrs. Macquaries Road, Sydney 2000
Rob Price	Ecosystems Co-ordinator	(054) 446626	DCNR Bendigo, P.O. Box 401, Bendigo 3550
R			
Rural Lands Prot. Boards	Balranald	(050) 201 691	P.O. Box 9, Balranald 2715
Rural Lands Prot. Boards	Hay	(069) 931 403	P.O. Box 21, Hay 2711
Rural Lands Prot. Boards	Deniliquin	(058) 811 055	P.O. Box 61, Deniliquin 2710
Rural Lands Prot. Boards	Moulamein	(058) 875 006	P.O. Box 16, Moulamein 2737

DRAFTING UP YOUR GRASSLAND MANAGEMENT GUIDELINES

PART 1: State & Tenure

Map of site



NSW ☐ ✓ Travelling Stock Route ☐ ✓

Freehold land ☐ ✓

Crown land ☐ ✓

VIC ☐ ✓ Crown land ☐ ✓

Rail reserve ☐ ✓

Road reserve ☐ ✓

Freehold land ☐ ✓

PART 2: Site size and Shape

Narrow linear ☐ ✓ Dimensions

Rectangular ☐ ✓ ☐ m x ☐ m

PART 3: Nature conservation values

Native flora: Common species

Native fauna: Rare or threatened species

Plains wanderer ☐ ✓

Fat-tailed Dunnart ☐ ✓

Legless Lizards ☐ ✓

Tessellated Gecko ☐ ✓

Other (specify) ☐ ✓

.....

Note:presence/absence can be based on either confirmed records or anecdotal information, but you should search to confirm all records. Employ the help of a wildlife ecologist if unsure of either searching techniques or identification.

Flora: Rare & threatened species (map)

Species-rich area (>10[20] sp/100 sq m) (map) ☐ ✓

Shrubland or Woodland areas (map) ☐ ✓

Gilgai, drainage points & wetlands (map) ☐ ✓

Other (specify).....(map) ☐ ✓

Employ a botanist if unsure of either searching techniques or species identification. Attach an additional page if list substantial

PART 4: Recent land management regime (last 10 to 20 years)

Burning

Pattern (map) ☐ Broad or Mosaic

Frequency ☐ Years

Last burnt ☐ Month & Year

Prescribed ☐ Yes/No

Prescribed: burning currently part of existing management by land owner

Grazing

Type ☐ Cattle, sheep or other

Rate ☐ Average DSE/ha

Timing

Continuous ☐ ✓

Summer - JAN FEB
Autumn - MAR APR MAY
Winter - JUN JUL AUG
Spring - SEP OCT NOV
Summer - DEC
(circle months)

Occassional disturbance

Type and circumstances.

PART 5: Current vegetation structure

Establish a minimum of three monitoring transects - see Chapter 3

Bare Ground ☐ %o.c.

Native winter grasses ☐ %o.c.

Native annual herbs ☐ %o.c.

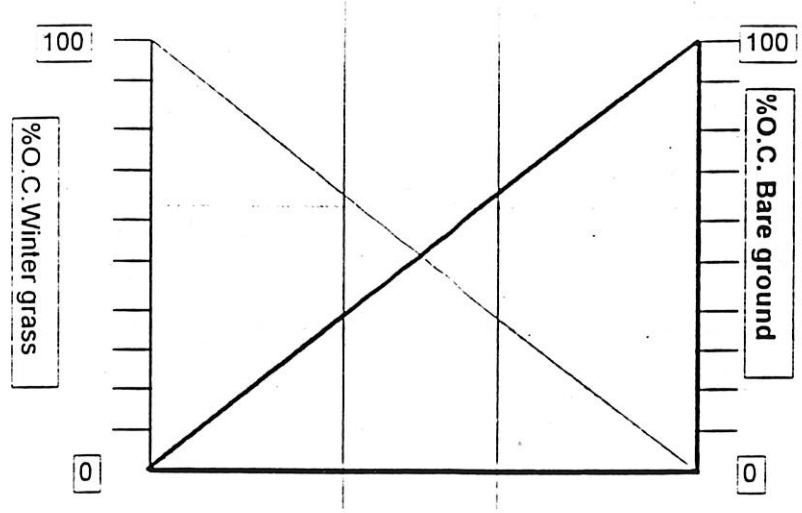
Native perennial herbs ☐ %o.c.

VIC	**<30%**	(18-30%)	**>30%**	(30-50%)
NSW	**<40%**	(20-40%)	**>40%**	(40-60%)
	Sparse grass		**Thick grass**	

Circle correct category and determine whether SPARSE or THICK grass vegetation

DRAFTING UP YOUR GRASSLAND MANAGEMENT GUIDELINES - page 2

PART 6: Disturbance levels



Disturbance rating (select one)

	BG		WIN		TOT
Under disturbed	☐	✓	☐	✓	☐
(Current regime needs to be intensified)					
OK	☐	✓	☐	✓	☐
(Current regime should be continued)					
Over disturbed	☐	✓	☐	✓	☐
(Current regime needs to be reduced)					

Thresholds

	BG	Winter	
		Sp	Th
VIC	9-22	18-30	30-50
NSW	10-22	20-40	40-60

	UNDER		OK		OVER	
WIN	☐	☐	☐	☐	☐	☐
BG	☐	☐	☐	☐	☐	☐

Place upper and lower thesholds from adjacent table in BOLD boxes for both Bare ground & Winter grass

Place monitonng results in larger boxes as they fall either side of the thresholds

PART 7: Recommended disturbance regime

Burning

Frequency ☐ Years

Timing Autumn ☐ Before Break

Summer ☐ Early summer

If significant fauna present an early summer burn should be avoided

Grazing

Type ☐ Cattle, sheep or other

Rate ☐ Average DSE/ha

Timing

Summer - JAN FEB Autumn - MAR APR MAY
Winter - JUN JUL AUG Spring - SEP OCT NOV
Summer - DEC (circle months)

PART 8:Management implementation

Include details of implementation eg. agistment arrangements with pastoralist

PART 9:Other management measures

Exclusion (fencing) of areas not supporting grassland (map) ☐ ✓

Note: You should attempt to undertake the recommended monitoing and review the details of your management plan at least every 12 months, preferably over the spring months