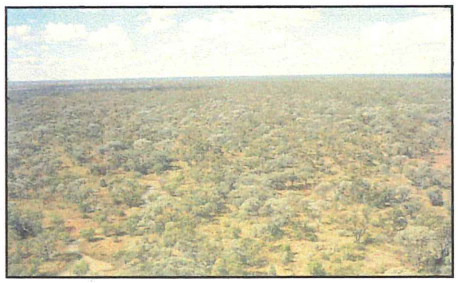
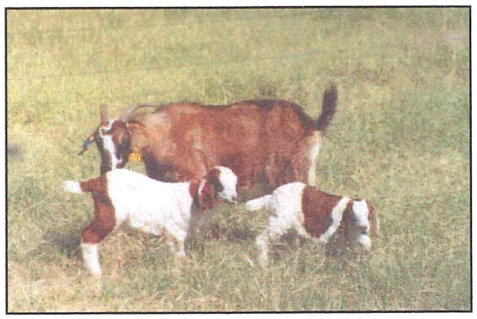
Tactical management of total grazing pressure in the mulga lands of the Murray-Darling Basin

FINAL REPORT
JUNE 2000





Queensland Government
Department of Primary Industries

MURRAY-DARLING BASIN COMMISSION

NSW Agriculture

CSIRO

Tactical management of total grazing pressure in the mulga lands of the Murray Darling Basin

PROJECT D7050

Murray Darling Basin Commission
Strategic Investigations and Education Program

FINAL REPORT
June 2000

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Report QO00012
ISSN 0727-6281

This final report describes the methods, outputs and outcomes of the project *'Tactical Management of Total Grazing Pressure in the Mulga Lands of the Murray-Darling Basin'*, funded by the Murray - Darling Basin Commission. This project was a co-operative activity between the Department of Primary Industries, Queensland, CSIRO Wildlife and Ecology and NSW Agriculture.

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Executive summary

This project was funded by the Murray-Darling Basin Commission (MDBC) Strategic Investigations and Education Program, the Queensland Department of Primary Industries (QDPI), CSIRO Wildlife and Ecology, and New South Wales Agriculture (NSW Ag.). It commenced in January 1997 and was completed in June 2000. QDPI, the lead agency for this project, worked closely with CSIRO Wildlife and Ecology, NSW Ag., and grazier groups. This project also had strong input from graziers, industry organisations, government departments, and community groups. More than 300 people were involved in one or more activities of this project.

The purpose of this project was to combine the local knowledge and experience of graziers, the outcomes of rangeland research, and the views of the wider community to identify goals, information, tools and practices required for the profitable and sustainable management of total grazing pressure in the mulga lands.

Mulga (*Acacia aneura*) communities occur in semi-arid and arid environments on red earth soils, where rainfall is low (150-500mm/yr) and erratic, and where long periods of little rainfall are common. They are estimated to occupy 1.5 million km^2 or about 20% of the Australian continent, and about one fifth of the Murray-Darling Basin.

Total grazing pressure (TGP) is the ratio of herbivore demand for forage to the availability of forage. The forage consists mainly of pasture and browse, and the herbivores are largely sheep, cattle, goats, macropods, and rabbits. TGP is high when there are many herbivores and little plant food, typically occurring after many months of low rainfall. Excessive TGP results in over-utilisation of native plants, and if continued will lead to degraded landscapes.

The long-term success or failure of all grazing strategies hinges around the ability of graziers to manage the frequency and severity of defoliation of individual plants. Graziers attempt this by altering the kinds and numbers of domestic grazing animals over both time and space, using combinations of grazing strategies such as set stocking, cell grazing, rotational grazing, and rotational resting. However, there are few mechanisms available to reduce the numbers of native and feral herbivores that at times constitute a significant proportion of the TGP.

The participatory approach adopted by this project and the large number of organisations and stakeholders involved, required the project to have a number of interacting components. This structure was designed to adapt the project to the needs of participating groups, with the aim of achieving a high level of stakeholder ownership, acceptance and adoption of project outputs. The project consisted of a large project team, a Core Grazier Group, and a Community Consultative Group (CCG). It also had close links with two regional reconstruction initiatives (WEST 2000 in western NSW, South West Strategy in Qld), Landcare, and individual graziers.

A wide range of methods was used to develop and promote the outputs of the project. The main methods employed were regular project team meetings, grazier survey, grazier workshops, meetings and tours with the CCG, a newsletter, postal survey, media interviews and articles, and participatory rangeland research.

The main outputs and recommendations of this project are briefly noted under each of its five objectives.

Objective 1.
Planning, research and communication partnerships formed between industry and community groups in the mulga lands of the Murray-Darling Basin.

Sustainable grazing in the mulga lands is dependent on satisfactory outcomes in all of its ecological, socio-economic, and political facets. Achieving this complex and difficult goal requires consideration and active support of all stakeholders. These stakeholders collectively possess a wide range of expectations, knowledge, skills and resources needed to achieve sustainable grazing in the mulga lands.

The main outputs relevant to communication and partnerships were the Charleville CCG tour report, the CCG newsletter, the International Rangelands congress paper, and the Ecologically Sustainable Development conference presentation.

These activities and associated reports noted the benefits of working in partnership with stakeholders and end-users. This included improved communication with stakeholders, mobilising individuals and groups, generation of outputs relevant to end-users, improved understanding among stakeholders, and building on existing knowledge. However, successful partnerships require large investments in commitment and time, and need to be flexible and fruitful if they are to persist. Working in a range of partnerships throughout this project has provided valuable insight into the way different partnerships function, their cost, benefits, and areas for improvement. This insight has been captured in the following recommendations:

Recommendations

1. Projects that involve a large number and diverse range of stakeholders and end-users should have a small Project Steering Committee (PSC) and a larger Community Consultative Group (CCG). The PSC should consist of the funders of the project and perhaps a representative of two or three of the most relevant State and Commonwealth government departments. The CCG could consist of up to 15 to 20 people, with single representatives of the main stakeholder and end-user groups.

2. Members of the PSC and CCG should be actively involved in projects, report project outputs to their organisations, and then communicate the comments of their organisation to the project group.

3. Partnerships with stakeholders and end-users should commence at the beginning of projects, preferably at the project design and planning stage. Effective partnerships require that all project members are equal in their capacity to contribute to and change projects, and hence projects and their participants must be flexible, and willing and able to change.

4. Projects should fund the costs (time, travel, accommodation) of stakeholder and end-user participation. Without this there is inequality between project members, and effective partnerships will not develop.

5. Stakeholders and end-users involved in projects should meet and spend time together in the regions that are the focus of project activities; in this case the mulga lands. Face-to-face contact in a relaxed rural setting is a good environment for people to exchange views, information, and to jointly develop strategies for managing grazing. These forums have

resulted in trust, common understanding, and collaborative efforts amongst groups that generally regard themselves as adversaries.

6. Research that aims to produce information, tools and practices for use by pastoral industries should be conducted on grazing properties, and either led by graziers or have strong grazier involvement in all stages of the work.

7. Scientists, and government land administrators should value the knowledge and skills of graziers, and use this to develop grazing management strategies for the mulga lands.

8. There is likely to be considerable value in continuing the work of effective groups of stakeholders and end-users after the completion of three-year projects. The relationships, understanding and knowledge of the group have developed to levels where further efforts are likely to be very fruitful.

Objective 2.

Identification of the long-term goals of pastoralists for managing TGP

The management of TGP in the mulga lands should occur in accordance with considered and clearly defined goals. These goals need to encompass ecological, economic and social elements of the mulga lands grazing system, and they must be relevant, achievable, and appropriate. To achieve these requirements it is necessary for the main stakeholders to participate in the identification, and development of goals.

This project identified the stakeholders, and then brought them together to develop goals and strategies for managing TGP in the mulga lands of the Murray-Darling Basin. A subset of these was then identified as the goals and actions that can be implemented by pastoralists.

The following list of stakeholders was agreed to by the whole workshop group: aboriginals; animal welfare groups; consumers; education/information providers; environmental organisations (non-government); financiers; government; land tenure holders; local community; mining; resource users (eg. kangaroo industry, fishing industry, bush foods, honey, timber, graziers); service providers; and tourism and recreation.

Workshops in Charleville 1996 and 1999, Roma 1997 and Bourke 1999, recognised the need for goals and strategies to be developed and implemented with the full cooperation of stakeholders, including government. They recorded a number of actions or processes that would facilitate stakeholder participation in the development and implementation of grazing goals.

Three broad goals for the management of TGP are:
1. Ecologically sustainable grazing systems;
2. Economically and socially sustainable sheep, cattle and goat grazing industries;
3. Economically sustainable kangaroo industry (not supported by participating community conservation groups; see paragraph below).

The majority of stakeholders and end-users found it difficult to identify clear and specific goals and objectives. In most cases participants nominated actions, and hence a large number of strategies and actions were recorded. Agreement and cooperation of all stakeholders is needed if the goals and objectives for managing TGP in the mulga lands are to be realised.

However, at this time the Nature Conservation Council of New South Wales, the Wildlife Preservation Society of Queensland, and the Australian Conservation Foundation are opposed to the commercial use of macropods, and therefore do not support the third goal above.

Recommendations

1. Workshops are required for stakeholders and end-users to meet and develop specific objectives, targets and performance indicators for the management of total grazing pressure. Existing broad goals are not suited to grazing management at the property scale.

2. Meetings of stakeholders and end-users that are held to formulate goals and objectives should contain a training component that assists participants identify true goals and objectives for the grazing industries.

3. Community, industry and government stakeholders need to help the end-user (grazier) to achieve the goals and objectives of ecologically sustainable grazing in the mulga lands.

4. Mechanisms need to be developed that enable consumers to reward pastoralists that achieve high standards of environmental management. In this way powerful market forces would be used to encourage ecologically sustainable land use.

Objective 3.
User friendly early warning indicators of vegetation and soil change by grazing refined by participatory research and development.

The purpose of this objective was to identify practical early warning indicators of adverse change in vegetation and soil. Project activities focused on plant, landscape and soil indicators suitable for use by pastoralists in managing TGP in the mulga lands.

A large number of signs are used by graziers and scientist as indicators of total grazing pressure, particularly soil and vegetation change. Examples of these are height of perennial grasses, level of water infiltration, availability of palatable grasses, level of utilisation of preferred grasses near stock waters, and height of browse lines.

The large number of signs of vegetation, soils and animals used by graziers are potentially very well suited to monitoring grazing pressure and changes in the condition of natural resources. The challenge is for graziers and researchers to work together to develop monitoring systems acceptable to both groups.

The main outputs for this activity was a grazier manual titled, *Understanding more about your landscape*, annual reports on a tactical rest study, two grazier survey report booklets, grazier workshop reports, and a milestone report on early warning indicators.

Recommendations

1. Further work is needed to integrate the systematic monitoring procedures of scientists with the early warning signs used by graziers. The purpose of this work would be to produce rigorous monitoring procedures that are suitable for use on pastoral properties.

2. Deliver training courses on natural resource monitoring to Landcare and Integrated Catchment Management Groups, for use in monitoring the on-ground outcomes of their projects. Vegetation and soil monitoring could be used by groups to demonstrate project

progress, justifying allocation of further funds. People involved in these projects would develop monitoring skills that could be applied to their own properties.

3. Further work be undertaken to incorporate rangeland monitoring procedures into recognised international standards such as ISO 14000. This standard contains an adaptive management process, facilitating continual improvement in the application of monitoring procedures, and continual adjustment to match changing circumstances and requirements.

Objective 4.
Practical tools for monitoring and managing herbivores at property and group-property scales evaluated and refined through research and community participation.

The successful management of TGP requires knowledge of the number of herbivores on a property and an ability to change that number as the availability and/or quality of pasture varies over time. Graziers often state that they do not know the number of macropods and feral herbivores (goats, rabbits) present on their properties. They also generally do not have tools that can be used to modify numbers of these animals. An inability to manage native and feral herbivores is likely to significantly reduce the sustainability of grazing, as these animals often make up half of the TGP on properties.

The grazier survey recorded many signs used by graziers to indicate the numbers or grazing pressure of herbivores on their properties. This included amount of dung and tracks, numbers of camps, numbers of animals seen at waters, and numbers seen along roads. The project team evaluated a number of methods that could be used to monitor numbers of animals. Work was done on self-mustering congregations, spotlight transects, mechanical counters, diet composition, and several procedures for counting dung. Of these, the most efficient and effective procedure was the step-point dung counting method developed by NSW Agriculture.

Self-mustering of stock and feral goats, and congregation of macropods were investigated by the project as potential means of managing numbers of herbivores. Self-mustering appears to be a valuable tool for managing total grazing pressure, but further work needs to be undertaken during a drier period of time to complete evaluations of these devices.

Graziers generally are able to adjust numbers of domestic stock and feral goats, as they can freely muster these animals, and then redistribute, agist, or sell them. In fact, tactical management of domestic stock appears to be more sustainable and more profitable than continuous grazing. This strategy enables high stocking rates in good seasons, followed by de-stocking through agistment or sale during drought.

Macropods are much more difficult to manage, due to their mobility, lack of effective and efficient control methods, high numbers, and relatively low value. Macropod populations are largely driven by rainfall, and numbers in the mulga lands are artificially high, due to provision of permanent water and predator control. A sequence of wet years leads to high densities, placing considerable pressure on grazing enterprises and perennial grasses. The commercial industry with its restricted quota and selective harvest is unable to control numbers of macropods, and hence the surplus often die at the onset of the next drought. There is a need for stakeholders to develop successful management strategies for macropods in the rangelands.

Recommendations

1. Further work is required to trial and adapt methods that graziers and other land managers can readily use to monitor numbers of herbivores on pastoral properties. A suitable method should then be packaged and promoted to rangeland graziers.

2. State and Commonwealth governments should provide funds through regional adjustment strategies such as WEST 2000 and South West Strategy, to control access to water by domestic and feral stock, and macropods, providing a mechanism for controlling grazing pressure and the distribution of grazing. Funds could be provided for construction of self-mustering enclosures at artificial water points, and for fencing off natural water-courses. This would also conserve riparian vegetation.

3. Using a full cost-benefit analysis, compare the economic and ecological outcomes of two grazing management strategies: continuous set stocking, and tactical management. Promote the results to rangeland graziers and encourage a shift to the preferred grazing strategy.

4. Increase the harvest rate of macropods in some years to prevent populations of red kangaroos, grey kangaroos and wallaroos from exceeding the carrying capacity of the rangelands. Investigate the use of flexible harvest rates as a mechanism for managing population size, where the harvest rate would be varied in response to changes in population size and growth rate.

Objective 5.
Tools and knowledge for managing TGP incorporated into regional initiatives and Catchment Management and Landcare groups.

An important objective of this project was to work with the large rural and regional reconstruction strategies of West 2000 in NSW, and South West Strategy in Qld; and with Catchment Management and Landcare groups to promote the outputs of the project. These organisations and groups are well placed to promote project outputs to the grazing community and other stakeholders, and address constraints to sustainable management of grazing.

Members of the project team were involved in the WEST 2000 TGP program, the South West Strategy Natural Resource Management Group, Landcare groups, and the Qld Landcare Council. The project has also had input into the natural resource management strategies of the Qld. Murray-Darling Basin, and the Maranoa-Balonne catchment.

Interaction with many groups and individuals during this project resulted in the project outputs being widely circulated throughout the mulga lands of the Murray-Darling Basin. This has occurred through the media, workshops, field days, surveys, participatory rangeland research, newsletters, publications, reports, and a large and diverse project team.

Recommendations

1. Large projects should possess a dedicated communication/extension officer. This person would be responsible for liaison with related projects or strategies, exchanging information, and achieving cooperation and collaboration of activities.

2. Projects should develop and implement a communication plan for project activities that involve or relate to other organisations.

3. Conduct a full cost-benefit analysis, particularly financial and ecological outcomes, of popular grazing land management practices, and widely communicate the results to the grazing industry. Practices that warrant evaluation are: prescribed burning, management of macropods, goat farming, conservative stocking, and agistment of stock during drought.

Overall conclusions

It is now possible to manage total grazing pressure to achieve ecologically sustainable use of pastoral properties in the mulga lands. Graziers and scientists collectively possess much of the knowledge and skills required for grazing to be ecologically sustainable. However, from a farm perspective, the difficult challenge will be to identify and implement sustainable grazing practices that are also profitable. Hence it will be necessary to continually adapt grazing practices to the ever-changing needs, characteristics and resources of grazing enterprises, land administrators, and consumer markets.

The development and adaptation of grazing practices should be led by graziers, with assistance provided by individuals and organisations that possess relevant information and skills. The graziers and grazing properties should be the "engine rooms" for generating grazing practices that are both sustainable and profitable. Under these circumstances developments are likely to be more rapid, better targeted to the needs of grazing enterprises, and both more highly regarded and more widely adopted by graziers.

If graziers are to instigate and drive the development of sustainable grazing practices, how is this to occur? How do they bring together all of the people and organisations that possess the knowledge and skills needed for grazing to be successful?

The current natural resource management network is a framework that brings together people and information. However, it is massive, complex, and cumbersome, and can be quite daunting to access and operate within. Also, compliance with the administrative procedures put in place to ensure that public and industry funds are appropriately spent frustrates people who have a strong desire to simply "get on with the job" of resource management. It is doubtful that this network provides an effective forum for graziers to access the people, knowledge and skills that they require for sustainability.

Sustainability and profitability need to be addressed simultaneously, in a framework that is compatible with the whole grazing enterprise. Perhaps this is why many graziers are now turning to commercial consultants and to each other to provide the information and assistance they need to improve their businesses. Consultants and grazier groups tend to take a business orientated approach to the management of natural resources, and this is more appealing and better suited to graziers.

However, the current commercial framework or production chain for most if not all primary industries has a fundamental flaw with regard to sustainability - the market price of meat and fibre is not linked to the condition of the natural environment of production systems. Instead, consumer markets generally demand cost-efficient meat and fibre, and thus the costs associated with managing the natural environment have been excluded. This system does not motivate primary producers to actively manage the natural environment.

The International Standard for Environmental Management Systems (ISO 14000) provides one mechanism for using the immense power of market forces to advance environmental management. Properties that are certified under this system may be in a position to maintain market access and/or secure premium prices for their meat and fibre. Under these circumstances consumers would reward pastoralists for actively reducing the environmental impacts of grazing. This would motivate graziers to seek out, use and build on the information and best practices currently available. It would also allow them to engage consultants, purchase equipment, network with agencies and groups, and undertake training to improve the sustainability of their enterprises.

This alliance between consumers and producers appears to be logical and reasonable, and has the potential to closely align profitability with ecological sustainable development (ESD). The purchasing power of consumers living in the cities, comprising around 85% of the Australian population, would be a very effective driver of ESD practices. However, effective communication and marketing strategies would be required to obtain the high level of consumer participation required for this alliance.

Overall recommendations

1. Sustainable grazing practices need to be embedded in flexible management systems that have the capacity for continual improvement and continual adaptation to changing circumstances.

2. There is a clear need for a more holistic approach to the management of natural resources, including the economic and social components that are related to sustainable grazing practices. The MDBC Basin Sustainability Program provides a framework for such an integrated approach. It needs to be translated into the context of the local production system.

3. A commercially orientated natural resource management strategy should be developed as an additional framework for graziers, where profitable grazing is synonymous with sustainable grazing.

4. Rangeland scientists will need to assist graziers develop and validate the systematic methods for monitoring vegetation, animals and soils that are required by environmental certification programs, such as ISO 14000.

5. Government and industry to fund communication and marketing strategies that are required to inform consumers of the important role they play in achieving ecological sustainability in primary production systems.

Acknowledgments

This project has been made possible through the generous donation of time and resources from many individuals and organisations. Most importantly the project was made possible through funding provided by Dryland Program of the MDBC, Strategic Investigations and Education Program. The Sheep and Wool Institute, part of the Agency for Food and Fibre Sciences of QDPI, CSIRO Wildlife and Ecology, NSW Agriculture, The Woolmark Company, and the National Landcare Program also contributed significant funds to this project.

This collaborative project involved a number of government agencies, industry groups, and community groups from New South Wales, Queensland and the ACT.

Valuable contributions to the project were made by staff of CSIRO Wildlife and Ecology (Rod Edmundson, David Tongway, Norman Hindley and Monica van Wensveen), and QDPI (Peter Connelly, Darrell Horrocks, Will Muller, Peter Johnston, Robert Aisthorpe, Cathy Carman, and Nicole McLennan).

This project also acknowledges the time and effort of many people involved in project activities. More than 300 people have been involved in one or more of the project activities.

Thank you to members of the Community Consultative Group for their input, open minds, interest, and friendly approach. They provided the project with valuable insights into the views of the wider community, and contributed fresh ideas and information to the development of grazing management practices.

Thank you to the members of the Steering Committee for their support, advice, and direction. They have ensured that the project met its objectives, and that all outputs where relevant to stakeholders in managing total grazing pressure in the mulga lands.

The 'core grazier' groups in NSW and Qld contributed much to this project. Thank you to Dick and Diedre Beshman, Dawn Cartwright, Fay Cooney, James and Libby Gardiner, Beanie MacKenzie, Michael McKellar, Jacqui and Tony Mills, Bernard O'Shannessy, Shane and Kerry Smiles, and Margaret Vetter. Their cheery, enthusiastic and insightful contributions greatly enriched the project.

Thank you to the many other graziers who contributed to this project through involvement in surveys, interviews, on-farm research, workshops and field days. This certainly helped the project to produce information and tools that were more relevant to the grazing industry.

We also appreciate the assistance provided by Lisa Robins. Lisa was always available to provide advice that greatly improved project outputs, and she facilitated a high level of communication between the project and the Murray-Darling Basin Commission.

Alison Bates made significant improvements to the format and over-all appearance of this report.

Finally we thank the MDBC for supporting this project, and particularly for allowing the project to be modified to suit the needs and expectations of participating stakeholder groups.

Project reports and publications

The documents listed below are based on work largely undertaken during this project, and therefore were predominantly funded by the Murray Darling Basin Commission, DPI, NSW Agriculture, and CSIRO Wildlife and Ecology.

*Indicates reports/documents that are the property of other organisations, but have contributions and/or funding from this MDBC project.

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Tactical management of total grazing pressure in the mulga lands. Proceedings of the Community Consultative Group workshop, Roma 16 and 17 October 1997. By Lester Pahl QDPI, Sheep and Wool Institute) and Ian Perkins (LPM Creative Rural Solutions).

CCG News, a newsletter mailed to the Community Consultative Group in October 1998.

Tour of the mulga lands: balancing profitability and sustainability. Charleville, Queensland, 8-10 June 1999. By Jill Heywood and Lester Pahl. QDPI, Sheep and Wool Institute.

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Graziers' perceptions of total grazing pressure in the mulga lands of the Murray-Darling Basin. Part A. Signs and management. By Kathy Carman, Jill Heywood and Lester Pahl QDPI, Sheep and Wool Institute, and Steve Marsden CSIRO Wildlife and Ecology.

Graziers' perceptions of total grazing pressure in the mulga lands of the Murray-Darling Basin. Part B. Property information. By Kathy Carman, Jill Heywood and Lester Pahl QDPI, Sheep and Wool Institute, and Steve Marsden CSIRO Wildlife and Ecology.

Managing total grazing pressure: outcomes from the NSW workshops, October to November 1998. By Rod Edmundson, Ken Hodgkinson and Steve Marsden. CSIRO Wildlife and Ecology.

Managing total grazing pressure: outcomes from the workshops, September to October 1998. By Jill Heywood. QDPI, Sheep and Wool Institute.

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Tactical management of total grazing pressure

*Development of a field procedure for assessment of total grazing pressure and herbivore populations. By Michael Constable, Ron Hacker and Gavin Melville. NSW Agriculture. (Work largely funded by West 2000 and NSW Agriculture. Part funding from MDBC)

Understanding more about your landscape: a method for monitoring landscape productivity. By David Tongway and Norman Hindley. CSIRO Wildlife and Ecology.

Degree of dietary overlap between sheep, cattle, goats, red kangaroos, grey kangaroos and wallaroos in south west Queensland. By Bronwyn Franco. University of Queensland, Gatton.

Developing techniques for estimating macropod abundance from dung deposits on a sheep grazing property in south west Queensland. By Shawn Capararo, Jackie Maher, Ben Williamson, and Lester Pahl.

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Tactical rest for rangeland management: a scientist/grazier project. Report 1. September 1997. By Ken Hodgkinson and Allan Reid (CSIRO Wildlife And Ecology), Peter Johnston (QDPI), and Ron Hacker (NSW Ag.).

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Walker, J. W. and Hodgkinson, K. C. (1999). Grazing management: new technologies for old problems. In 'People and Rangelands Building the Future, Proceedings VI International Rangeland Congress. Vol. I.' (Ed. D. Eldridge and D. Freudenberger). pp. 424-430. (VI International Rangeland Congress, Inc.: Townsville).

Books

Graziers' experiences in managing mulga country. By Jill Heywood, Ken Hodgkinson, Steve Marsden, and Lester Pahl.

* Self-mustering enclosures: cost effective, multi-purpose and safer, by Peter Connelly, Darrell Horrocks, Lester Pahl, and Katrina Warman. (Work funded by The Woolmark Company, the Natural Heritage Trust, MDBC, and Department of Primary Industries, Queensland)

* A glove box guide to tactical grazing management of the semi-arid woodlands, by T. Campbell and R. Hacker. NSW Agriculture. (Work largely funded by the Natural Heritage Trust and NSW Agriculture, with part funding from MDBC)

Chapter 1

Project background

1.1 Project conception

This project was initiated at a Dubbo workshop in February 1996, *Scoping a Participative Research Program on Total Grazing Pressure in the Mulga lands of the Murray Darling Basin.* Its purpose was to develop projects that would provide tools for managing TGP. Over 50 people from many organisations developed 12 research projects. This three-year project was the first in the portfolio to be funded by the MDBC Strategic Investigations and Education program, commencing in January 1997. The Department of Primary Industries Queensland (QDPI), lead agency for this project, worked closely with CSIRO and NSW Ag.

The project addressed the following MDBC goal: Availability of basin wide risk assessments on the probability of the long-term sustainability of broad-acre uses in dry-land regions, and the development of policies and programs which accelerate adoption of best management practices where existing uses are likely to be sustainable.

1.2 The mulga lands

Mulga (*Acacia aneura*) communities are estimated to occupy 1.5 million km^2 or about 20% of the Australian continent (Johnson and Burrows 1981), and also occupy around a fifth of the Murray-Darling Basin (Figure 1.1).

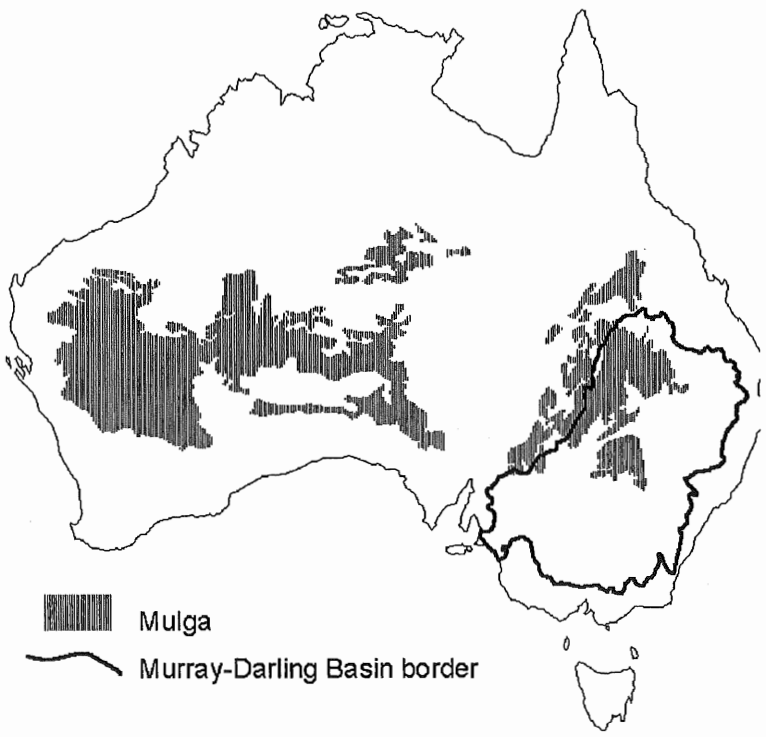

Figure 1.1 Map of Australia's mulga lands and the Murray-Darling Basin.

They occur in semi-arid and arid environments on red earth soils, where rainfall is low (150-500mm/yr) and erratic, and where long periods of little rainfall are common (Hodgkinson 1995).

Mulga country often occurs alongside other types of country such as the Mitchell grasslands, spinifex, flood and gidgee country . Together these types of country support a rich array of plant and animal life as well as supporting a multitude of land uses.

Brigalow woodland

Mitchell grass downs

River red gum community

Poplar box woodland

Gidgee woodland

Despite the low human population, the difficult environment and long distances to markets, pastoralism within a natural resource management framework is considered to be sustainable in the mulga lands (Hodgkinson and Tongway 2000). This view is based on observations and measurements of pastoral properties that have a good ecological condition after more than 100 years of grazing.

The sustainable manage of pastoral properties within these semi-arid lands requires a great deal of knowledge. Unlike other pastoral areas, the soils are infertile, rainfall is low, erratic and mostly non-seasonal, fire is required to keep native shrub levels down, and perennial grasses, the main source of forage, are not adapted to survive heavy and persistent grazing.

Much of the knowledge required for sustainable natural resource management in the mulga lands can not therefore be borrowed from other agricultural regions. Successful pastoralists have developed "banks" of local knowledge on how to be sustainable.

Scientists have studied the inherent complexity and uniqueness of these lands, biota and interactions between environmental and biological components for several decades. Although incomplete, sufficient studies have been conducted and sufficient knowledge from pastoralists has been documented to develop conceptual models for managing the natural, economic and human resources of the mulga lands.

1.2.1 The mulga lands: past and present

The mulga lands have changed considerably in vegetation structure since European settlement when the vegetation was thought to be predominantly grasslands with scattered shrubs and trees. Prior to settlement, fire that was more frequent and more widespread kept the shrublands and woodlands open.

Open grassy mulga woodland

The introduction of domestic stock and feral animals to the country dramatically increased grazing pressure in the mulga lands. The addition of watering points and removal of predators supported introduced animals and enabled increases in native animals such as the large macropods. This placed enormous pressure on perennial grasses. The suppression of fire in the grazing lands allowed native shrubs to establish and increase during favourable rainfall periods, transforming open grasslands into dense shrublands and woodlands.

Over-grazing of grasses that favours shrub invasion

Thick mulga regrowth

Dense mulga woodland with little understorey

Poplar box woodland with shrub understorey

The mulga lands of the Murray-Darling basin have retained much of their original native flora and fauna (Beutel 1995, Cowley 1998), in spite of widespread vegetation modification and soil loss (Griffin and Hodgkinson 1986, Miles 1993). Biological diversity has been conserved in this region because there are many grazing properties in good condition (see Johnston *et al.* 1996) that provide large areas of wildlife habitat.

The livelihoods of graziers in the mulga lands depend on native plant communities, and thus they are highly motivated to conserve natural resources. Perhaps this is why Heitschmidt and Walker (1996) regard grazing the rangelands as one of the most sustainable forms of land use known.

1.2.2 The mulga lands are not static

The mulga lands continuously change in response to climate, fire and grazing. Changes can be slow and insidious (such as the establishment of shrub seedlings over many years until they appear as a blanket of vegetation), while major episodic events, such as drought, fire or flood, have sudden and profound effects on the structure and composition of vegetation.

1.2.3 Conserving water and nutrients

The landscapes of the mulga system in the Murray-Darling basin consist of a mosaic of run-off and run-on patches. Run-off areas are typically bare of vegetation and are unable to obstruct flows of water during heavy rainfall. Run-on areas, comprising perennial grasses, litter, logs, shrubs, trees and/or mulga groves, play a crucial role in capturing and storing this run-off (see Ludwig *et al.* 1997).

Run-on patch of perennial grass that is trapping debris from a bare run-off area

In this way, water, soil, nutrients and seed are captured, concentrated and conserved by run-on areas of the landscape. By trapping these resources, these patches become enriched over time and become very productive. It is these enriched, run-on areas that provide most of the forage for grazing and critical habitat (especially as refuge during drought) for native flora and fauna.

1.2.4 Land uses

Historically, the mulga lands have supported sheep and cattle grazing industries since the 1850s (Drysdale 1995). These industries were responsible for the establishment of the communities and associated infrastructure for the vast inland areas of NSW and Qld, and while their prominence has declined in recent years they are still the mainstay of the economies and social fabric of these regions.

Currently, the mulga lands support many other land uses including indigenous culture, nature conservation, mining and tourism. Land use is changing and diversifying as shown by the growth of alternative industries, such as flora and fauna harvesting. The challenge for the mulga lands is to balance the social, cultural and economic needs of its people and land uses with the maintenance of land resources and conservation of biodiversity.

1.3 Total grazing pressure

Total grazing pressure (TGP) is defined as the ratio of the demand for forage by herbivores to the availability of forage.

$$TGP = \frac{\text{Animal Demand for Forage}}{\text{Availability of Forage}}$$

The forage consists mainly of pasture and browse, and the herbivores are largely sheep, cattle, goats, macropods, and rabbits.

Sheep

Cattle

Goats

Red kangaroo

TGP is high when there are many herbivores and little plant food, typically occurring after many months of low rainfall. Excessive TGP results in over-utilisation of native plants, and if continued will lead to degraded landscapes (Freudenberger 1996).

Over-grazing that leads to loss of perennial vegetation

Today, the TGP of a typical property in the mulga lands of western Qld is low to moderate, as several years of above average rainfall has produced large quantities of forage. Each square kilometre of this typical grazing property now supports around 42 macropods, 32 sheep, and 1 cow. The total grazing pressure is devised from sheep (46%), macropods (42%), and cattle (12%), on an animal equivalent basis. In NSW, the composition is similar, but in recent times goats may be as high as 46% of the TGP (Landsberg and Stol 1996). This grazing pressure is sufficient to over-graze properties during the next drought. Land managers will then need to lower total grazing pressure by reducing numbers of domestic, native and feral herbivores.

1.3.1 Managing TGP

The long-term success or failure of all grazing strategies hinges around the ability of management to control the frequency and severity of defoliation of individual plants (Heitschmidt and Walker 1996, Hodgkinson *et al.* 1999). Graziers attempt this by altering the kinds and numbers of domestic grazing animals over both time and space, using combinations of grazing strategies such as set stocking, cell grazing, rotational grazing, and rotational resting. The use of fencing to partition different types of country or to create smaller paddocks can also give greater control of domestic grazing pressure, as can the positioning and opening/closing of watering points. However, there are few mechanisms available to reduce the numbers of native and feral herbivores that at times constitute a significant proportion of the TGP.

1.4 Project purpose

This project focused on the tactical management of TGP, being the day-to-day or seasonal adjustments made to numbers of grazing animals and/or their plant-food resources.

The purpose of this project was to combine the knowledge and experience of graziers, the outputs from rangeland research, and the views of the wider community to identify goals, information, tools and practices required for the profitable and sustainable management of TGP in the mulga lands.

1.5 Project structure

The participatory approach adopted by this project and the large number of organisations and stakeholders involved, required the project to have a number of interacting components. This structure (Fig.1.2) was designed to adapt the project to the needs of participating groups, with the aim of achieving a high level of stakeholder ownership, acceptance and adoption of project outputs.

1.5.1 Project funding

This project was largely funded by the MDBC and QDPI. The first year of this project was partly funded by the Natural Heritage Trust and the Woolmark Company. These organisations contributed funds to the construction and cost –benefit analysis of self-mustering enclosures, and the establishment of field research study sites.

The project also linked closely with a WEST 2000 project titled *Development of a field procedure for assessment of TGP and herbivore populations*. This project, run by NSW Ag., developed a grazier procedure for monitoring numbers of kangaroos and relative kangaroo grazing pressure. A second project of NSW Agriculture titled, *Management aids for rangeland pastoralists*, produced two glove box guides that help graziers identify plants and tactically manage total grazing pressure. Our MDBC project produced the third booklet in this series of grazier publications, *Graziers' experiences in managing mulga country*.

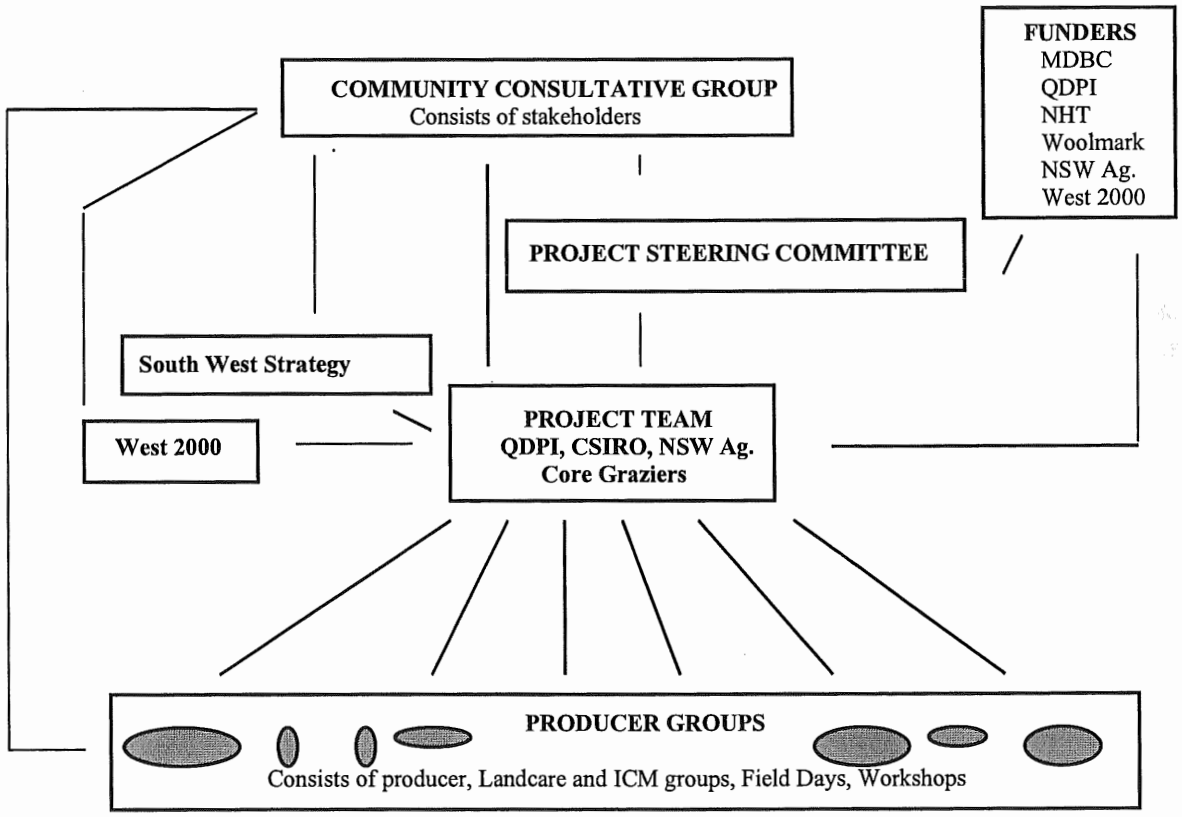

Figure 1.2 Components and their linkages within the project.

1.5.2 Project team

The core project team consisted of Mr Peter Connelly (QDPI), Mr Rod Edmundson (CSIRO Wildlife and Ecology), Ms Jill Heywood (QDPI), Dr Ken Hodgkinson (CSIRO Wildlife and Ecology), Mr Darrell Horrocks (QDPI), Mr Steve Marsden (CSIRO), Dr Lester Pahl (project leader from QDPI), and Mr Allan Reid (CSIRO Wildlife and Ecology).

In addition the following people contributed to the project at different stages: Dr Peter Johnston (QDPI), Mr David Tongway (CSIRO Wildlife and Ecology), Ms Monica Van Wensveen (CSIRO Wildlife and Ecology), Mr Norman Hindley (CSIRO Wildlife and Ecology), Mr Warren Muller (CSIRO Wildlife and Ecology), Dr Ron Hacker (NSW Agriculture), Mr Robert Aisthorpe (QDPI), Mr Will Muller (QDPI), Ms Kathy Carmen (QDPI), and Ms Nicole McLennan (Natural Heritage Trust).

1.5.3 Core graziers

A number of graziers worked closely with the project team and were considered team members This core grazier group consisted of Dick and Diedre Beshman, Dawn Cartwright, Fay Cooney, James and Libby Gardiner, Beanie MacKenzie, Michael McKellar, Jacqui and Tony Mills, Bernard O'Shannessy, Shane and Kerry Smiles, and Margaret Vetter.

They formed two Core Grazier Groups, one in NSW and the other in Qld. These graziers contributed to all aspects of the project including planning, implementation, and preparation of reports.

1.5.4 Steering Committee

The Steering Committee, formed in June 1997, was established for the purpose of directing and reviewing the project, and for reporting to the MDBC. The Steering Committee consisted of the following members: George Smith (Chair, QDNR, and member of the Dryland Issues Working Group), Ken Hodgkinson (CSIRO Wildlife and Ecology), Ron Hacker (NSW Ag), Peter Johnston (QDPI), Lester Pahl (QDPI), Jacqui Mills (NSW grazier 1998-2000), Rory Treweeke (WEST 2000), Brenda Allan (Agriculture Fisheries and Forestry Australia), Wayne Hall (QDNR), Neil Cadzow (Qld grazier), Robert Crichton (South West Strategy), Guy Fitzhardinge (NSW grazier 1997-8), and Allan Wilson (Woolmark Company).

1.5.5 Grazier groups

These were groups of graziers who collaborated on aspects of the project. This occurred through interviews, workshops, and field days (see Chapter 3).

1.5.6 Community Consultative Group

The necessity to involve a large number of stakeholders in the project led to the establishment of a second group. This group consisted of representatives from community, government and industry organisations that have an interest in managing grazing animals in the mulga lands. This ensured that the expectations of the wider community for rangeland management were adequately represented in the project.

1.6 Project methods

The methods employed in this project are described in chapters three to seven. However, a short account of some of the main methods is provided to give the reader an overview of project methodology.

1.6.1 Project team meetings

The project team met on many occasions to reflect on past activities and plan future events. Members of the project team also regularly met with core graziers and the Steering Committee to evaluate and plan project activities. The wide geographical spread of people involved in the project resulted in meetings being held in centres throughout NSW and Qld. When this was not possible or unnecessary, communication occurred through tele-conferencing.

1.6.2 Grazier survey

A survey of 74 grazing properties in the mulga lands of the Murray-Darling Basin was conducted during the first year of the project. The interview survey collected the local knowledge of graziers on the signs used in assessing TGP, the actions taken to manage it, and the constraints faced.

1.6.3 Grazier workshops

A series of seven workshops was held throughout Qld and NSW. These were designed to provide more information about the project, review and discuss the grazier survey, identify further information and tools required by graziers to manage TGP, and desired outputs of the project. These workshops also served a social role and helped to build rapport between the project team and the producers.

1.6.4 Community Consultative Group activities

Workshops, western tours and a newsletter were used to involve the CCG in discussions on the management of TGP in the mulga lands. This provided a number of opportunities for a wide range of groups to voice their views and expectations on the management of grazing in the mulga lands.

1.6.5 Participatory rangeland research

QDPI, CSIRO Wildlife and Ecology and NSW Ag. compiled, developed and evaluated information and techniques that graziers can use to monitor and manage vegetation, soil and grazing animals. Cooperative research carried out on commercial grazing properties included the development of indicators of the condition of vegetation, soils and animals, and evaluation of tactical resting, techniques for monitoring numbers of macropods, and evaluation of self-mustering enclosures for managing TGP.

The remaining chapters of this final report discuss the methods, outputs, results, and outcomes associated with each of the five project objectives. The following chapter provides a description and explanation of the objectives and the associated outcomes of the project.

Chapter 2

Project objectives

The five objectives of this project are described and explained below, along with relevant project outputs.

Objective 1

Planning, research and communication partnerships formed between industry and community groups in the mulga lands of the Murray-Darling Basin.

Partnerships within this project involve regular interaction between members of the project team, stakeholders and/or end-users (graziers). This occurred through meetings, workshops, tours, field days, field research, interviews, telephone, e-mail and mail.

Partnerships formed during this project were largely between the project team and the grazing community, and to a lesser extent with stakeholders represented on the CCG. This group, representing stakeholders from industry, government and community, served to represent the views and expectations of the wider community.

Project Output B is associated with Objective 1:
High level of involvement by industry and community groups in developing the program for managing TGP.

Objective 2

Identification of the long-term goals of pastoralists for managing TGP.

These are the goals that provide graziers and other land managers with targets for managing TGP on pastoral properties of the mulga lands. In many cases pastoralists were also asked to achieve goals of the wider community.

Project Output C is associated with Objective 2:
Goals for managing TGP that represent the expectations of the wider community.

Objective 3

'User friendly' early warning indicators of vegetation and soil change by grazing refined by participatory research and development.

Within the scope of Objective 3, the following terms should be construed as meaning:

- vegetation - primarily perennial grasses, and to a lesser extent shrubs and annual grasses;
- indicators of soil change - those indicators that can be reasonably used by graziers, such as soil cover (living and dead matter), level of dust, and water penetrating capacity; and
- early warning indicators – eg. total pasture yield, biomass of desirable plants, growth stage, level of pasture utilisation, cover and height of pasture, and height of browse lines.

This objective was broadened to include indicators of stock waters and seasons, and of the condition and behaviour of native, domestic and feral animals, as these are also used by graziers to manage grazing pressure.

Project Output D is associated with Objective 3:
Practical indicators and acceptable levels of vegetation and soil change developed for each goal that can be used in the management of TGP.

Objective 4

Practical tools for monitoring and managing herbivores at property and group-property scales evaluated and refined through research and community participation.

Within the scope of Objective 4, the word 'herbivore' should be construed as meaning sheep, cattle, kangaroos and goats, and to a lesser extent, pigs, emus and rabbits.

Emphasis was on paddock and property scale investigations, rather than group property investigations. Specific tools were those that could be used by graziers to monitor and control herbivore numbers.

Project Output E is associated with Objective 4:
Practical tools developed for monitoring and managing numbers of herbivores.

Project Output F is also related to Objective 4:
Recommendations for total herbivore stocking rates acceptable to industry organisations and community groups.

It was not possible to recommend total herbivore stocking rates for grazing properties, as this requires assessments of each property over a range of seasons and years. Hence this outcome was replaced with:
Promotion of a tactical management framework that helps graziers make decisions on appropriate total herbivore stocking rates, drawing on rangeland research outcomes and practical grazier experience.

Graziers can use this strategy to identify and monitor appropriate indicators of the sustainability of grazing, and then manage total stocking rates to maintain these indicators in a desirable condition. This is a tactical framework for managing TGP, with the focus on achieving the goals of managing grazing pressure. The number of herbivores is then just one of the variables managed to achieve the desired goals.

Objective 5

The tools and knowledge for managing TGP incorporated into regional initiatives (South West Strategy and West 2000), and Catchment Management and Landcare Groups.

An important objective of this project is for large regional strategies, West 2000 in NSW, South West Strategy in Qld, and Catchment Management and Landcare groups to promote the outputs of this project, and help implement practices for monitoring and managing TGP.

Project Output A is associated with Objective 5:
Inclusion of the project outcomes into the South West Strategy and West 2000 regional initiatives.

The following chapters describe and discuss the methods, outputs and outcomes for each of these five objectives.

Chapter 3

Objective 1

Planning, research and communication partnerships formed between industry and community groups in the mulga lands of the Murray-Darling Basin.

3.1 Introduction

This objective has given rise to the stakeholder partnership approach of the project. Partnerships commenced early in the project with the addition of the Core Grazier Group to the project team, and has continued through the grazier interviews, grazier workshops, Community Consultative Group (CCG) meetings and newsletter, and Steering Committee meetings. This has effectively linked together graziers, rangeland researchers, government, community and industry.

Sustainable grazing in the mulga lands is dependent on satisfactory outcomes in all of its economic, ecological, and social facets. Achieving this complex and difficult goal requires consideration and active support of all stakeholders. These stakeholders collectively possess a wide range of expectations, knowledge, skills and resources needed to achieve sustainable grazing in the mulga lands.

Consequently, the project has worked closely with industry, community and government stakeholders with the intent of producing relevant, practical, acceptable and achievable practices for managing TGP.

3.2 Methods

The project used a number of mechanisms for building and maintaining partnerships. A project Steering Committee consisting of major stakeholders, including funders, was formed early in the project. Involvement of the large number of other stakeholders was facilitated through the operation of the CCG. Grazier partnerships were encouraged through close association with two Core Grazier Groups, and through extension activities and on-property research.

3.2.1 Steering Committee meetings

The aim of the Steering Committee was to provide direction for the project and ensure it met the agreed objectives. The membership of the Steering Committee was designed to provide input from a wide range of people and included representatives from MDBC, QDPI, Department of Natural Resources Queensland, CSIRO Wildlife and Ecology, NSW Agriculture, West 2000, South West Strategy, Agriculture Fisheries and Forestry Australia, the Woolmark Company, and the grazing community. This group met on six occasions to discuss the progress of the project, ratify changes and provide guidance on project activities. The Steering Committee also reviewed all major documents produced by the project.

3.2.2 CCG workshop at Roma

The first meeting of the CCG was held in Roma in October 1997. This meeting involved 52 people representing organisations with an interest in the management of TGP in the mulga lands. Its purpose was to identify the stakeholders and the goals of graziers for managing TGP. A facilitator was employed to plan the process and to manage the group dynamics. For more detail on this method refer to the section on the Roma workshop in Chapter 4.

3.2.3 CCG questionnaire

A questionnaire was produced and sent to all participants from the Roma workshop to obtain feedback on the outputs of the first CCG meeting. This questionnaire was designed to determine the level of agreement for objectives and stakeholders identified at the workshop and to gather suggestions on changes to the structure and functioning of the CCG. The questions relating to the CCG were: should the size and format of the next CCG workshop be altered?, and what ideas do you have for continuing communication between members of the CCG?

3.2.4 CCG tour at Charleville

The tour visited Charleville from 8-10 June 1999 and involved a group of 15 people who represented the main organisations of the original CCG. This group was termed the CCG Working Group and contained representatives from: Nature Conservation Council of NSW, Australian Conservation Foundation, Queensland Parks and Wildlife Service, Wildlife Preservation Society of Queensland, Queensland Conservation Council, QDPI, CSIRO Wildlife and Ecology, Environment Australia and the local grazing community. The group was selected to provide a cross section of views on grazing management in the mulga lands.

The purpose of the tour was threefold. It aimed to:

- provide people with a greater understanding of the mulga lands;
- build good communication networks; and
- document the views of a range of stakeholders on managing TGP in the region.

The agenda was designed to achieve these goals and was focussed on creating a casual forum for information and opinion sharing. Some of the key events were:

- Presentations to provide the big picture view of the mulga lands. These presentations covered: natural resources and major industries, nature conservation status and activities in the mulga lands bio-region, the South West Strategy, and a graziers' perspective on balancing profitability and sustainability at the property level;
- A field trip that began with a stop at the QDPI Research Station 'Croxdale,' where the group discussed issues related to impacts of grazing, effects of locking up country and resilience of mulga country. The group then proceeded to 'Mayfield,' a local grazing property, where they travelled across the property with the owners and discussed management of kangaroos and feral goats, burning, woody weeds and mulga regeneration. The tour concluded with a visit to the town common where the group looked at the outcomes of clearing and burning a very thick mulga woodland; and
- A session to identify TGP management issues on the final day where people were divided into four groups – community conservation, government environment, government production and grazing industry. Each group was asked to provide answers to the question: what do you see as the main issues in relation to managing TGP in the mulga lands. Responses were recorded and reported back to the group for discussion.

Community Consultative Group visit to Charleville

3.2.5 CCG workshop at Bourke

The final gathering of members from the CCG was held at Bourke in December 1999. The purpose of this workshop was to discuss the management of TGP. Participants identified issues, desired outcomes, impediments and current activities. They then considered what future actions could be taken to further progress the desired outcomes.

This workshop aimed to include those who had participated in the tour plus a number of additional people from the original CCG. Further information on this workshop is provided in Chapter 4.

3.2.6 Activities of the Core Grazier Groups

Core Grazier Groups were formed in Qld and NSW at the start of the project. These groups formed in different ways and performed slightly different roles in each state. In Qld, an advertisement was placed in the local newspaper looking for a local grazier to work as a project officer. Six graziers responded and rather than selecting one, they were asked if they would like to form a group and be employed by the project on a casual basis. Throughout the life of the project the core graziers met with members of the project team on nine occasions to discuss their involvement and help plan project activities. Participants were paid for their time, travel and accommodation.

In the early stages of the project the 'core graziers' form Qld helped develop the grazier survey, test the pilot survey, and conduct the main survey in their region. They helped to compile and categorise the survey data and proof read the report. Core graziers also helped to organise and run the survey workshops in their region.

In the next stage of the project the group worked together to identify products that could be produced by the project. These included – a publication that recognised grazier knowledge, media articles in the press and a CCG tour of the mulga lands. The core graziers then assisted in the production of these products.

In NSW, the Core Grazier Group was formed later than in Qld. The group of eight graziers were invited to form the group because of their participation in the tactical rest for rangeland

management project or because they were known to be interested in the issue of management of TGP. The group met on three occasions to provide input and direction into the four workshops held in NSW in late 1998, the development of paddock scale investigations, and the publication *Graziers' experiences in managing mulga country.* Participants were paid a sitting fee and costs for travel by the project.

Meeting of NSW core graziers in Cobar

3.2.7 Grazier partnerships through research

Two of the research components of the project were conducted on grazing properties and provided an opportunity to build networks and partnerships with the co-operating graziers.

The tactical rest study began in 1997. The properties were selected by personal contact after discussion with NSW Ag. and QDPI. An important research consideration was to select properties that provided a wide geographic spread across rainfall types and graziers who were keen to be involved in the research. Grazier involvement in the study included: recording rainfall and stock numbers and making decisions about when to open and close the tactical rest site. The collection of data on the landscapes and plants was made by CSIRO Wildlife and Ecology, NSW Ag. and QDPI staff. Each year a report on the general results has been prepared and given to participants. Participants then came together at a field day at one of the 10 properties, *Adgingbong* near Cunnamulla in November 1999 to discuss the results obtained so far and the future of the study. It was unanimously agreed to keep the study going and for agencies to seek external funding to achieve this goal. Further details on the methods are provided in the four annual reports, *Tactical rest for rangeland management: a scientist/grazier project*, by Ken Hodgkinson *et al.*

The second form of on-property research involved an evaluation of self-mustering enclosures that were designed to muster sheep, cattle and goats, and to congregate kangaroos. Thirty-four enclosures spread over seven grazing properties were used by graziers to manage TGP. The owner/operators contributed to the cost-benefit analysis by providing data on mustering costs, numbers mustered and timing. Further information on self-mustering is provided in Chapter 6.

3.2.8 Grazier partnerships through extension

Participation of individual graziers was sought through extension activities. The first activity conducted by the project was a survey designed to gather information on how graziers

currently monitor and manage TGP. This survey involved face to face interviews with graziers on 74 properties. The next activity was a series of seven one-day workshops held throughout Qld and NSW to follow up on the survey results. These workshops resulted in interaction with 82 graziers across the mulga lands (see Chapter 5 for more information on the workshops).

In 1997 two 'mind-mapping' workshops were held at Louth and Coolabah involving a total of 16 people. The purpose of these workshops was to identify and link the "levers" that graziers consider influence the on- and off-property management of TGP. Further information on these workshops is provided in Chapter 6.

In November 1999 a field day was held at *Adgingbong* to discuss the results of the tactical rest study. This event attracted ten graziers from Qld and NSW (see Chapter 5 for details).

In 1999 and 2000, David Tongway and Norman Hindley from CSIRO Wildlife and Ecology conducted three field days (Charleville, Coolabah and Cobar). The purpose of the field days was to explain the indicators used in assessing soil condition and the formal procedure for reading the landscape. Valuable feedback was obtained from graziers which has been incorporated into grazier manuals. The two field days at Charleville attracted a total of 22 graziers and 20 government agency staff. Chapter 5 contains more information on this subject.

3.2.9 General communication

Communication and interaction with industry and community occurred when project team members attended meetings of groups and wrote articles for the media. This included involvement with community groups such as the South West Strategy, West 2000 and Landcare. Articles were prepared for the *Mulgaline*, the *Western Division Newsletter*, local newspapers, and the newsletter for members of the CCG. Project staff were also interviewed on regional radio stations. Some of the topics covered were: tactical management of TGP, the CCG tour, project updates, Reading the Landscape field days, and diet composition.

3.3 Outputs

Project papers, reports and workshop proceedings are briefly described below. Other outputs such as the proceedings of the Bourke and Roma CCG workshops are described in Chapter 4. Outputs on research partnerships are presented in Chapters 5 and 6.

3.3.1 Minutes from meetings

Minutes were recorded for meetings of the Steering Committee and the Core Grazier Group. These minutes recorded attendance, topics discussed, and decisions made. There were six Steering Committee meetings, nine 'core grazier' meetings in Qld and three in NSW. Minutes are available for each of these meetings.

3.3.2 CCG Newsletter

A newsletter titled, *CCG News,* was produced and mailed to all participants from the original meeting of the CCG at Roma in October 1997. The first edition covered feedback received from the questionnaire, comments on the kangaroo industry and the macropod management program, and an update on the project. It was mailed to the CCG in October 1998.

3.3.3 CCG questionnaire feedback

Feedback was received from 21 people. Responses regarding the size and format of the workshop suggested that a smaller group would be better, the length was okay, and that future meetings needed better facilitation, focus and a clearer understanding of the group's purpose. Suggestions for continuing communication between members of the CCG included a newsletter, tele-conferences, smaller group meetings, one-on-one updates, workshops, and e-mails. Chapter 4 contains information on the comments of CCG members on stakeholders and goals for grazing in the mulga lands.

3.3.4 CCG Charleville tour report

The tour report, *Tour of the mulga lands: balancing profitability and sustainability*, was published and distributed to participants. This report began with a summary of the tour and a description of what was involved. It then looked at some of the views and issues related to managing grazing in the mulga lands that had been identified by participants on the tour. Views presented included, the need for case studies to compare successful long-term properties with abandoned places, the need for greater recognition of graziers' knowledge, and concern about the poor understanding of environmental requirements for many native flora and fauna. The report also contained a series of papers presented as background information at the start of the workshop. These papers covered natural resources and major industries, nature conservation status and activities in the mulga lands bio-region, the South West Strategy, and a graziers' perspective on balancing profitability and sustainability at the property level.

3.3.5 Ecologically Sustainable Development (ESD) Conference presentation

This presentation titled, *Encouraging uptake of ecological sustainable practices by pastoralists in the mulga lands*, by L. Pahl and J. Heywood, examined the different approaches taken to encourage adoption of sustainable practices. It described the adversarial approach and the divisions this can create. It considered the use of regulations, such as the Western Lands Act, the implementation of guides and codes of practices, and the use of incentives as a means of encouraging sustainable practices. Finally, it concluded with a discussion of the partnership approach, an example of how this is being applied within the project and the potential for this to provide a more open, cooperative and participative way to address the challenges of ESD.

3.3.6 International Rangelands Congress paper

This paper was titled, *A partnership approach to managing total grazing pressure in the mulga lands,* by J. Heywood and L. Pahl. It covered how the partnership approach had been applied in this project and some of the benefits and requirements of the process. Benefits were an opportunity to build on existing knowledge, a better understanding of the views of others, and outcomes that are more meaningful and relevant. The requirements of partnerships were considered to be commitment, time and flexibility. This paper was published in the proceedings of the VI International Rangelands Congress and was presented at the conference as a poster display.

3.4 Discussion

This discussion focuses on the benefits and requirements of partnerships, and finishes with an evaluation of methods used to establish and maintain partnerships. The term partnership refers to the participation of individuals and organisations in project activities. It varies from a few interactions such as with members of the CCG, to ten or more interactions as with the core

graziers. Many other individuals and organisations participated in the project on at least one occasion, with examples being the grazier survey and the Roma workshop of the full CCG.

3.4.1 Benefits of working in partnerships

Partnerships can deliver significant benefits, including larger and more effective communication networks, mobilising assistance from other groups, greater relevance of the outputs for end-users, improved understanding of stakeholders, and building on existing knowledge.

3.4.1.1 Improved communication with stakeholders

Participation of people and organisations in project activities can result in a receptive audience for future messages and a communication link to a large number of other people. It is generally accepted that people who have been involved with project activities or who have an awareness of a project are more likely to be involved in further project activities, read project publications, newsletter articles and so on. Therefore, links with a wide range of people through involvement in project activities has increased opportunities for successful communication. Partnerships in this project have been established with key representatives from conservation groups, kangaroo and grazing industry organisations, government departments in Qld and NSW, Landcare and the grazing community. This has allowed for transfer of information on project objectives, outputs and products to be targeted at receptive people within an organisation. It has also provided the opportunity to draw on their knowledge and skills.

There is also the possibility of a flow on effect with information transferred beyond the members of the partnership to neighbours, friends and colleagues. This can act to further increase the size of the audience exposed to the project's aims, activities and products. The project partnerships did achieve this flow on effect in some instances but it is difficult to assess just how much of this occurred. It can be said, however, that maximum positive flow on will occur when people are motivated and enthusiastic about the project and its outputs, and feel valued in their partnership role. Feeling valued occurs when people believe that their contributions are respectfully considered, and particularly if these contributions are seen to have an influence on the project.

3.4.1.2 Mobilising individuals and groups

At the meeting of the CCG Working Group in Bourke in December 1999, part of the group process involved producing a list of 'future actions'(see section 4.3.4) that could be taken. These actions were designed to address the gaps that had been identified in the current approach to managing TGP in the mulga lands. Where possible, individuals were asked to accept responsibility for progressing certain actions. Some of these actions included, field days and tours, investigation of educational packages, taking issues back and progressing them within organisations, and incorporating some of the ideas raised at the workshop into new and existing projects.

In this way the partnership that existed with this group resulted in individuals and organisations accepting responsibility to follow up on actions and to work with other representatives to improve the management of TGP.

3.4.1.3 Relevant outputs for end-users

Involvement of end-users in the planning of project outputs or in the running of on-farm property trials, helps to produce products more relevant to their needs. For example, a

recurring theme in discussion with graziers at workshops and with the Core Grazier Group was the desire to see greater recognition of graziers' knowledge. As a result, the final publication has focussed on ten grazier case studies, supplemented with results from research. The feedback to this approach has been positive and reflects the benefits of involving the end-users.

Another example has been the work of David Tongway and Norman Hindley of CSIRO Wildlife and Ecology. The production and evolution of their manual, *Understanding more about your landscape,* has involved road testing the procedure with grazier groups, gathering feedback, and incorporating these changes into the next edition. This represents use of the action learning cycle (plan, act, reflect and generalise), and ensures a more user friendly method. The more user friendly, the more likely it will be adopted.

Research partnerships in the form of on-farm experiments provide another example of how project partnerships have resulted in products with greater credibility and relevance to graziers. Both the tactical rest study and the self-mustering trials have gathered feedback from the end-users on usefulness, practicality and possible improvements. Trialing a new management tool on a commercial property allows for end-user assessment and also demonstrates its applicability at a property scale.

Building strong partnerships allows people to feel confident enough to make suggestions for improving the impact of project activities and outputs. However, to build this kind of relationship there must be a real commitment by the project to seriously consider all suggestions and to implement at least some. This requires a certain amount of flexibility within the project.

3.4.1.4 Improved understanding of stakeholders

An increased understanding of stakeholders can be obtained by involving them in project activities. For example, the tours of the mulga lands at Bourke and Charleville involved people from community conservation groups, the grazing community, and government departments. They learnt much about each other through the interactions and discussions that occurred in this relaxed and enjoyable setting. This gave participants of groups that are often opposed an opportunity to discuss issues in a friendly and open manner, and gain valuable insight into the views and expectations of other stakeholders.

3.4.1.5 Building on existing knowledge

Partnerships provide an opportunity to avoid duplication and to build on existing knowledge. For example, graziers possess a large pool of local knowledge on grazing management in the mulga lands. The core grazier groups enabled the project to form close links with the local grazing community and provided access to the knowledge of people in the area. This knowledge was accessed through a grazier survey, grazier workshops and case study interviews. By combining grazier knowledge with scientific research the project has been able to produce more comprehensive and relevant products, and deliver them to a more receptive audience.

3.4.2 Requirements of working in partnerships

Commitment, flexibility and time are three of the requirements for working in partnerships that have been identified during this project.

As mentioned above, for members in the partnership to make a meaningful contribution there must be room for change within a project. This project has changed considerably from the original plans due to communication with various stakeholders, especially the core graziers. This has highlighted the need for the project team to be open to change and the need for funding organisations to be willing to accept modifications arising from the partnerships. Without this flexibility the partnership process becomes a token gesture and can actually build resentment if people feel their time and contributions are being ignored.

In order to achieve a strong partnership and genuine outcomes, there needs to be a high level of commitment from all parties involved. The degree of commitment seen in this project varied with individuals and groups and, by far, the most effective partnership occurred with the core graziers who as a group demonstrated the highest level of commitment. Maintaining this commitment and enthusiasm for the partnership requires positive, frequent interaction and success. Certainly, people are more likely to be committed to a partnership that is producing successful outcomes.

Finally, the project has involved a wide range of people and organisations in the partnership process (see Appendix 1). It has required a significant amount of time to initiate the networks, build trust between the parties and then to use these links to achieve meaningful results. For example, even with a small, geographically close group such as the core graziers it took at least six months before it began to operate as partnership. It took this period of time for the project team and the core graziers to develop rapport, and for the core graziers to observe that their contributions were valued, resulting in improvements to project activities. For a larger more distant group, such as the CCG, developing an effective partnership has taken much longer. This is due to the less frequent contact between the project team and these groups before and during the project.

3.4.3 Evaluation of methods for establishing and working in partnerships

This section reflects on the methods used to develop and work within partnerships in this project and to make some assessment of the strengths, weakness and areas for improvement.

3.4.3.1 Steering Committee

The Steering Committee has worked well. One of the strengths of this group has been its composition, made up of a mix of individual graziers, government, and industry from Qld, NSW and the ACT. Another strength has been the group's ability to take a big picture view of the project, to offer guidance and ensure the project achieved its objectives.

A major value of Steering Committee has been its capacity to consider and then make decisions on proposed modifications to the project. This is particularly important for projects like this that participate with a large number of stakeholders. The Committee also played an important role in interpreting project objectives and outputs, and making changes to these where this was necessary.

The weaknesses of this group have been the infrequency of contact between the project and committee members, and the turnover of members due to people changing employment. More frequent contact between meetings, possibly through tele-conferencing, could be a useful improvement to the Steering Committee partnership. However, Steering Committee members may not have time for these extra commitments to the project.

On reflection, improvements in efficiencies may have occurred if the Steering Committee consisted of a smaller number of the major stakeholders, mainly the funders of the project. This small group could have been responsible for the administration and final direction of the project, with guidance from the Community Consultative Group that represents the large number of stakeholders and end-users. Meetings of a smaller group would have cost less and would have been easier to coordinate.

A small Steering Committee and a larger Community Consultative Group may suit projects such as this which need to involve a large number of stakeholders and end-users.

3.4.3.2 Community consultative group

The CCG partnership process had a somewhat difficult start but achieved a number of desirable outcomes throughout the life of the project. Feedback received from participants of the first CCG workshop in Roma and the project team resulted in a decision to reduce the size of the CCG. Subsequent events such as the tour of the mulga lands and the workshop at Bourke, involved only 14 and 16 people respectively. These events resulted in positive interaction between participants and evaluations conducted at the close of each workshop revealed that people had gained a better understanding of others. Although the partnership between the project and the group and between individuals within the group took some time to develop, it has provided some useful outcomes to the project. It produced a list of goals and actions for managing grazing pressure in the mulga lands, a shared understanding of the issues, and personal relationships between a diverse range of stakeholders.

Reflection on the process for engaging the CCG suggests a number of ways in which the process could have been improved. Here is an example of an alternative model. Firstly, a small group of 15 – 20 would be selected providing single representation from the main stakeholder groups. This group would be constant throughout the life of the project, apart from the usual turnover within organisations. The first activity with the group would be aimed at developing good working relationships between members and creating a shared understanding of the issues. This activity may be something like the tour of the mulga lands, held as part of this project. Depending on the level of knowledge, the next activity may be designed to further increase understanding of the issues or may, if the group's knowledge is sufficient, progress into the identification of goals and actions. It would then be useful if individuals from the group volunteered to take action and progress identified issues. Further meetings could be used to report on progress and revise plans and a periodic newsletter could be used to keep the group up to date between meetings.

3.4.3.3 Core graziers

The partnership with the core graziers has been the most effective of all partnerships formed in this project. The strengths of the Core Grazier Group have been the relative geographic closeness of the group (300 km radius of Charleville), the frequent interaction via phone, fax, letters and in person. Close proximity also enabled direct input by them into planning and running project activities.

Some suggestions put forward on how the operation of the Core Grazier Group could be improved included provision of extension training for members, and making better use of the specialist skills or interests of core graziers instead of everyone being involved in all activities.

3.4.3.4 Grazing community

Finally the partnerships developed with the grazing community through extension and research have helped to promote adoption of practices, create greater awareness of the project and its products and provide ideas on products that will meet the needs of the grazing community. Once again the effectiveness of these partnerships was reduced by the infrequency of contact.

3.4.4 Outcomes of project partnerships

Another valuable outcome of this MDBC project has been the continuation of partnerships into new projects and activities. For example, five of the six members of the Core Grazier Group in Qld have chosen to participate in a new Natural Heritage Trust (NHT) project. This project will determine carrying capacities for properties in western Qld. Similarly, graziers and scientists in the NSW mulga lands will continue their partnerships in projects funded by the WEST 2000 TGP program.

Several members of the CCG will also continue their interaction with the western Qld NHT carrying capacity project, providing further opportunities for stakeholders to work together on managing TGP. Individual and groups of graziers that interacted with this MDBC project now form an audience more receptive to the outputs of natural resource management projects.

3.4.5 Conclusion

From these experiences it would seem that a number of benefits result from partnerships, including better communication of results, more relevant outputs, improved understanding of stakeholders, and building on existing knowledge. However, to be effective there is a requirement for commitment, flexibility and time. Working in a range of partnerships throughout this project has provided valuable insight into the way different partnerships function, their cost, benefits, and areas for improvement.

3.5 Recommendations

1. Projects that involve a large number and diverse range of stakeholders and end-users should have a small Project Steering Committee (PSC) and a larger Community Consultative Group (CCG). The PSC should consist of the funders of the project and perhaps a representative of two or three of the most relevant State and Commonwealth government departments. The CCG could consist of up to 15 to 20 people, with single representatives of the main stakeholder and end-user groups.

2. Members of the PSC and CCG should be actively involved in projects, report project outputs to their organisations, and then communicate the comments of their organisation to the project group.

3. Partnerships with stakeholders and end-users should commence at the beginning of projects, preferably at the project design and planning stage. Effective partnerships require that all project members are equal in their capacity to contribute to and change projects, and hence projects and their participants must be flexible, and willing and able to change.

4. Projects should fund the costs (time, travel, accommodation) of stakeholder and end-user participation. Without this there is inequality between project members, and effective partnerships will not develop.

5. Stakeholders and end-users involved in projects should meet and spend time together in the regions that are the focus of project activities; in this case the mulga lands. Face-to-face contact in a relaxed rural setting is a good environment for people to exchange views, information, and to jointly develop strategies for managing grazing. These forums have resulted in trust, common understanding, and collaborative efforts amongst groups that generally regard themselves as adversaries.

6. Research that aims to produce information, tools and practices for use by pastoral industries should be conducted on grazing properties, and either led by graziers or have strong grazier involvement in all stages of the work.

7. Scientists, and government land administrators should value the knowledge and skills of graziers, and use this to develop grazing management strategies for the mulga lands.

8. There is likely to be considerable value in continuing the work of effective groups of stakeholders and end-users after the completion of three-year projects. The relationships, understanding and knowledge of the group have developed to levels where further efforts are likely to be very fruitful.

Chapter 4

Objective 2

Identification of the long-term goals of pastoralists for managing TGP

4.1 Introduction

The management of TGP in the mulga lands should occur in accordance with considered and clearly defined goals. These goals need to encompass ecological, economic and social elements of the mulga lands grazing system, and they must be relevant, achievable, and appropriate. To achieve these requirements it is necessary for the main stakeholders to participate in the identification, and development of goals.

This project identified the stakeholders, and then brought them together to develop goals and strategies for managing TGP in the mulga lands of the Murray-Darling Basin. A subset of these was then identified as the goals and actions that can be implemented by pastoralists.

4.2 Methods

The Community Consultative Group (CCG) of the project came together on three occasions to identify stakeholders, issues, goals and strategies required for the successful management of TGP. A questionnaire was also used to collect views of the CCG on management goals and stakeholders.

4.2.1 CCG workshop at Roma

The first CCG activity was a two day workshop at Roma in October 1997. This was attended by 52 people representing a wide range of organisations and stakeholders interested in the mulga lands (see Appendix 1).

This workshop had two aims:

1. Agree on a list of stakeholders who have a legitimate right to contribute to the program for managing TGP
2. Produce a list of mutually acceptable goals of graziers for managing TGP in the mulga lands

Workshop processes are described in the workshop proceedings, and are summarised below.

The entire workshop participated in a discussion on categories of stakeholders and through a brainstorming process agreed on a list of stakeholder categories. A broad list was initially developed and then narrowed down under a series of headings.

Community Consultative Group workshop in Roma

The workshop plan was to accept and build on the broad goals for rangeland management formulated at other forums. These were sent to workshop participants for their consideration prior to the workshop. Participants were then asked to identify specific objectives that could be addressed by graziers through management of their pastoral properties, using the broad goals as a guide. However, many participants wished to discuss broad goals before moving onto more specific objectives.

The entire workshop participated in a discussion on categories of goals for managing TGP in the mulga lands. There was some difficulty in defining these categories of goals so the workshop was divided into small groups that were asked to define what they saw as broad goals. These were then presented these to the whole workshop.

The workshop again split into small groups and each group was asked to develop a list of specific achievable objectives under the broad goals as earlier defined by their group. These specific objectives were then presented to the whole workshop. The whole workshop then participated in a process of discussion aimed at refining the list of objectives.

4.2.2 CCG questionnaire

Following the workshop, all members of the CCG were asked a number of questions about the outputs and functioning of the group (see previous chapter for description of the mail questionnaire). In particular, participants were asked two questions, one on stakeholders and the other on goals for managing TGP in the mulga lands.

These questions were:

1. Do you agree with the list of stakeholders developed at the workshop (Roma)? Are there any you wish to add or delete, and if so, why? Any other comments or suggestions?
2. Do you agree with the list of objectives for managing TGP? Again, are there any you wish to add or delete, if so, why? Any other comments or suggestions?

Members of the CCG were asked to mail the questionnaire back to the project team.

4.2.3 CCG tour to Charleville

This tour of the CCG working group to Charleville took place from 8–10 June, 1999. This tour is described in the preceding chapter.

The final morning of the tour was devoted to identifying, documenting and presenting participant's views on what they considered to be the main issues in managing the grazing animals and vegetation in the mulga lands. This included comments on goals and actions for managing TGP.

4.2.4 CCG workshop at Bourke

The CCG working group met for a second time at a two day workshop at Bourke, on 1-2 December, 1999.

The aims of this workshop were to:

- identify the outcomes that individuals or organisations wanted to achieve by managing TGP in the mulga lands;
- determine the level of support for these outcomes;
- identify potential actions that individuals or organisations would take to achieve the outcomes; and
- share knowledge and provide an opportunity to express views on the management of TGP.

The workshop commenced with introductions of participants, an outline of the project, and a brief account of the purpose and activities of the workshop. This short session was followed by a tour of a commercial grazing property, and presentations that provided the grazier, scientist, kangaroo harvester, and conservation perspective on the management of total grazing pressure. Participants then returned to the workshop to record and discuss important issues raised during the property tour.

Community Consultative Group visit to Bourke

The last session of the first day was spent recording specific outcomes that each group hoped to achieve over the next 5 to 10 years through the management of TGP.

The second day began with a recount of the desired outcomes of grazing management, and then participants were asked to identify current and/or past activities that would help achieve these outcomes. Then, participants recorded impediments to achieving the goals, and actions they could take to reduce their impact. The group then started to plan the actions, including identification of individual organisations that would take responsibility for each action.

4.2.5 Graziers' experiences in managing mulga country

This publication of the project, *Graziers' experiences in managing mulga country,* largely consisting of case studies of grazing properties, contains a number of goals identified by graziers. This book is described in more detail in chapter seven. Graziers interviewed for the case studies were given an opportunity to list the goals of their pastoral enterprise.

4.3 Outputs

The outputs from the three CCG workshops, the CCG questionnaire and the grazier case studies are presented below.

4.3.1 CCG Roma workshop Proceedings

The workshop report, *Tactical management of total grazing pressure in the mulga lands: proceedings of the community consultative group workshop, Roma 16 and 17 October 1997,* contains details on the results of this first CCG workshop.

The sections of the workshop proceedings on stakeholders and grazing goals are relevant to this chapter, and are presented below.

4.3.1.1 Stakeholders

It was concluded at the workshop that there were a large number of stakeholders associated with the management of TGP in the mulga lands.

The following list of stakeholders was agreed to by the whole workshop group:

- Aboriginals;
- Animal welfare groups;
- Consumers;
- Education/information providers;
- Environmental organisations (non-government);
- Financiers;
- Government;
- Land tenure holders;
- Local community;
- Mining;
- Resource users (eg. kangaroo industry, fishing industry, bush foods, honey, timber, graziers);
- Service providers; and
- Tourism and recreation.

4.3.1.2 Goals

A small number of goals and many actions for managing TGP were identified at this workshop. These are listed in the workshop proceedings and have also been incorporated in the combined list of goals and actions presented at the end of this section.

The goals and actions recorded at Roma can be summarised under the following five headings:

1. To develop integrated grazing animal management practices that optimise productivity (profitability), sustainability and biodiversity;
2. To gain a better understanding of natural environmental processes to aid future management decisions;
3. To develop and enhance cooperation, communication and consultation between all stakeholders;
4. To develop more responsive and accountable Government administration, consultation and legislation; and
5. To develop and maintain a viable economic environment for the grazing industries.

4.3.2 CCG questionnaire feedback

This questionnaire enabled members of the CCG to comment on two outputs of the Roma CCG workshop, namely the list of stakeholders and the goals for grazing.

When asked if they agreed with the list of stakeholders, 16 members said yes and four said no, claiming that graziers were the only stakeholders. Two other respondents wished to divide the list into primary (graziers) and others (interest groups) stakeholders. However both people recognised the benefits of involving all groups in deliberations on management of TGP.

When all members of the CCG were asked if they agreed with the list of goals, 14 members said yes, although some of these felt that this project could not achieve all of the goals identified at the workshop. Four members noted that many of the goals should be rewritten, as they were worded as actions or strategies.

4.3.3 CCG Charleville tour report

The results of this CCG exercise are contained within the tour report, *Tour of the mulga lands: balancing profitability and sustainability*. The section of this report on views and issues contains information on goals and strategies for managing TGP. Participants of the tour were not asked specifically to identify goals and actions for managing TGP, and those described below came from a group consisting of representatives of community conservation organisations. Most of the outputs from this tour were the issues and views that were of interest or importance to the tour group.

4.3.3.1 Response to the goal of commercial use of macropods

While it was not the intention of this meeting to identify goals, a number of groups expressed their disapproval of a goal raised at previous workshops. The Nature Conservation Council of New South Wales, the Wildlife Preservation Society of Queensland, and the Queensland Conservation Council are all officially opposed to the commercial use of macropods. However, the representatives of these groups noted that not all members of their organisations were opposed to this.

4.3.3.2 Strategies

1. Undertake case studies that compare long-term successful properties with abandoned and degraded properties with regard to:
   - condition of pasture;
   - TGP;
   - biodiversity; and
   - clearing practices.
2. Form kangaroo harvesting cooperatives consisting of a professional kangaroo shooter and several grazing properties.
3. Trial bounties for feral animals (ie cats and foxes) where professional kangaroo harvesters would receive payment for controlling these animals.

4.3.4 CCG Bourke workshop report

The results of this third CCG activity are recorded in the workshop report, *Working together to manage total grazing pressure in the mulga lands: workshop findings*. This report contains information on desired outcomes (goals) and strategies for managing TGP. These have been incorporated in the list of goals and strategies presented at the end of this section.

The three main goals identified at Bourke were:

- sustainable grazing systems that maintain biodiversity and ecosystem function in the mulga lands;
- economically viable grazing industry; and
- economically viable kangaroo industry.

4.3.5 Graziers' Experiences in Managing Mulga Country

This project publication contains case studies on how graziers manage pastoral properties in the mulga lands. One grazier interviewed during these case studies provided a vision for managing grazing properties that is consistent with the views of many graziers contacted during this project.

Vision

"Our aim in managing the land is to provide ourselves with a reasonable living, consistent with the capability of the land. First of all we're looking after ourselves, we want to grow a good product, we want to be proud of what we grow and we want to maintain the resource that we've got. We want to continually improve the quality of our stock so as to ensure sufficient returns without putting too much domestic grazing pressure on the pastures."

4.3.6 Processes for developing and implementing goals

Participants of workshops in Charleville 1996 and 1999, Roma 1997 and Bourke 1999, recorded the need for goals and strategies to be developed and implemented with the full cooperation of stakeholders, including government. They identified eight actions needed to facilitate stakeholder participation.

Actions required to facilitate stakeholder involvement in goal setting:

1. Form regional groups to provide a forum for consultation.
2. Improve and maintain communication between stakeholders by:
   - sharing information;
   - meetings of landholders, conservationists, community and government in the mulga lands; and

- developing processes for communication between city, country, and government.

3. Increase community understanding of rangeland issues by:
   - communicating issues to the wider community; and
   - including issues relating to rural communities and industries in the curriculum of educational institutions.
4. Adopt a whole of government approach aligned with stakeholder needs.
5. Government to consult constructively with stakeholders before signing international treaties that impact on TGP.
6. Apply a consistent policy approach across the region (within the government and between governments (NSW and QLD).
7. Government and community recognition of landholders who implement monitoring systems and develop sustainable land management practices.
8. Land managers to make major contributions to TGP plans.

4.3.7 Goals and actions for managing TGP

The goals, strategies and actions of all stakeholders for managing TGP recorded at the Charleville, Roma and Bourke workshops, and in the grazier case studies have been combined below. However, at this point in time (June 1999) the Nature Conservation Council of New South Wales, the Wildlife Preservation Society of Queensland, and the Australian Conservation Foundation are opposed to the commercial use of macropods, and therefore do not support the third goal below.

Goals:

1. Ecologically sustainable grazing systems;
2. Economically and socially sustainable sheep, cattle and goat grazing industries; and
3. Economically sustainable kangaroo industry.

The list below contains the strategies and actions associated with each grazing goal. Those that can be implemented by pastoralists on grazing properties are written in italics.

Goal 1.
Ecologically sustainable grazing systems.

Strategy 1.
Develop, refine and implement sustainable grazing practices.

Actions:

1. Document, develop and promote best management practices including:
   - practical techniques for graziers to assess numbers of non-domestic animals at the property/paddock level;
   - practices that give rise to long-term stability (improve condition of resource/land) of the grazing industries;
   - developing practical tools for monitoring water/soil/vegetation condition; and
   - tools to more effectively manage TGP.
2. Develop sustainability indicators for:
   - the natural resource base; and
   - biodiversity.
3. Promote development of property management plans.
4. Conduct environmental impact assessment of goat farming.
5. All National Parks to have permanent managers in place within the next five years.

6. Manage TGP to achieve appropriate mix for time and local requirements.
7. Regenerate native grasses.
8. Reduce woody weeds.
9. Conserve biodiversity and ecosystem function.
10. Maintain grass cover of soils.
11. Ensure that pastures are diverse in composition and dominated by palatable, perennial and productive species.
12. Protect the 10% of species groups that are sensitive to grazing.
13. State agencies to lead by example in managing their land, and use research stations as demonstration areas.
14. Attain a 'stable' and productive environment by managing 'leaks' from the system.
15. Implement improved landscape management that considers:
    - dryland salinity;
    - carbon accounting;
    - native vegetation;
    - water allocations and flows; and
    - native species conservation.
16. Initiate 'landscape plans' for property management that provide an integrated approach (eg water, kangaroos and vegetation) that also provide the basis for regional cooperation.
17. Establish self managed regional groups of graziers with codes of practice for tactical management of TGP, agreed to by State and federal bodies.
18. Improve the management of TGP through records collected from property monitoring programs.
19. Ten % of graziers investigate self-developed, adaptive, TGP management systems on their own properties.
20. Monitor and evaluate strategies to ensure current grazing strategy outcomes continue to be relevant and 'best practice.'
21. Develop management prescriptions for retarding/controlling the increase in unpalatable shrubs (woody weeds).
22. Cap bores and replace all bore drains with piped artesian water to fenced tanks and troughs.
23. Reduce impact on pastures from non-domestic stock (kangaroos and ferals) at critical times (eg after burning) to a level that allows pasture to recover and improve.
24. Reduce long-term size of feral animal populations:
    - reduce pigs, goats and rabbits to target densities by controlled harvest; and
    - trial bounties for feral animals (ie cats and foxes), where professional kangaroo harvesters would receive payment for controlling these animals.

Strategy 2.
Collect and use information on the natural environment.

Actions:
1. Conduct continuing research in an integrated (strategic) framework including research into the biological control of woody weeds.
2. Conduct an environmental audit, past and present including:
    - map and determine conservation status and change in vegetation communities; and
    - documentation of biodiversity through further surveys.
3. Identify long and short-term triggers of change in TGP.
4. Continually monitor and record rangeland condition by:

- developing agreed procedures for assessing biodiversity on properties and the impact of TGP; and
- monitoring the extent of condition change in the landscape due to domestic and non-domestic animals.

5. Conduct rapid salinity testing in certain regions for input into:
   - WAMPS (Water Allocation Management Plans);
   - RVMPS (Regional Vegetation Management Plans);
   - South West Strategy; and
   - West 2000.
6. Study fauna in the mulga lands to identify:
   - habitats that should be conserved;
   - recovery plans;
   - relationships with nutrient cycles;
   - impacts from TGP; and
   - other impacts.
7. Share and release Landsat imagery, SLATS (State Land and Trees Study) and herbarium mapping.
8. Disseminate information on habitats of rare and threatened species to landholders.
9. Improve understanding of the ecology and dynamics of the system.
10. Increase the understanding of managers of TGP and practical tools required for tactical management.
11. Increase the understanding and awareness of graziers of perennial grass thresholds and appropriate management of these grasses.
12. Make use of and capture the knowledge and experience of peers.
13. Case studies that compare long-term successful properties with abandoned and degraded properties with regard to:
    - condition of pasture;
    - TGP;
    - biodiversity; and
    - clearing practices.

Goal 2.
Economically and socially sustainable sheep, cattle and goat grazing industries.

Actions:

1. Ensure grazing enterprises are economically viable (ie income can support a comfortable standard of living).
2. Increase profit margins and reduce reliance of landholders on government grants.
3. Ensure rates and rents are tied to past year's stock numbers (ie past year's domestic stock grazing pressure).
4. Allow income equalisation deposits to save money for drought.
5. Market TGP management.
6. Develop and maintain viable markets for all grazing animals.
7. Increase research and development on goats for the purpose of developing:
   - the feral goat resource into a domestic, commercial industry; and
   - a meat goat industry.
8. Demonstrate that good land management practices are profitable.
9. Landholders to use economic, social and environmental indicators for land management and monitoring.
10. Develop sustainability indicators of the economic impact of grazing pressure.

11. Provide financial incentives to landowners to reduce numbers of domestic stock and manage feral animals.
12. Consumers purchase meat and fibre from the mulga lands production systems because they have achieved world-renowned standards in ecological sustainability.

Goal 3.
Economically viable kangaroo industry.

Actions:
1. Pay 60 cents per kg or an average of $10 per skin.
2. Increase grazier and community participation in kangaroo management with regard to:
   - objectives for kangaroo management; and
   - mechanisms for feedback on the effectiveness of kangaroo management programs.
3. Undertake market and product development for kangaroos.
4. Retain skin shooting for remote areas.
5. Dedicate a portion of the total quota to carcass only.
6. Allocate a portion of the state kangaroo quota to individual full-time shooters.
7. Adopt a more flexible kangaroo management program that accounts for local/regional conditions, including land management aims.
8. Distribute the commercial kangaroo quota to individual properties in proportion to stock carrying capacity (on a request-only basis).
9. Allocate commercial kangaroo quotas to regions within the state.
10. Extend the commercial macropod harvest season to a full 12 months.
11. Introduce flexibility in the kangaroo quota system and associated costs (license fees).
12. Introduce a special circumstances commercial kangaroo quota (where there is a need to control kangaroos after the quota has closed eg. paddock spelling, drought), allowing kangaroos shot under Section 25 permits to be available to the commercial industry.
13. Ensure strict health and hygiene protocols are in place and enforced for game meat.
14. Develop more cost-effective commercial kangaroo harvesting techniques.
15. Ensure that the size and number of kangaroos are maintained.
16. Develop a more effective commercial kangaroo harvesting/marketing industry by:
   - achieving outcomes that allow kangaroos to be managed as a resource;
   - cleverly market the kangaroo industry to increase human consumption of kangaroo meat; and
   - undertaking long-term industry promotion with consistent support from government.
17. Undertake community education aimed at supporting graziers and the sustainable kangaroo harvesting industry (positive information on grazing and kangaroo industries).
18. Form kangaroo harvesting cooperatives consisting of a professional kangaroo shooter and several grazing properties.
19. Trial bounties for feral animals (ie cats and foxes), where professional kangaroo harvesters would receive payment for controlling these animals.

4.4 Discussion

4.4.1 Stakeholders

The majority of the members of the CCG agreed that all of the organisations listed at the Roma workshop were stakeholders in the management of TGP in the mulga lands. These people recognised that a wide range of organisations should have some input into the management of the mulga lands.

Only four CCG respondents disagreed with this list, claiming that graziers were the only stakeholders. They argued that graziers have more to lose than the other groups, and that graziers are the people who will implement and pay for grazing management strategies. These people appear to be concerned that grazier livelihoods could be at risk if other organisations were given an opportunity to influence land management practices.

Two people suggested that the stakeholders should be divided into two groups: primary stakeholders and interest groups. They regarded the primary stakeholders as the landowners who manage and derive an income from properties in the mulga lands. The second group consisted of organisations that have an interest only in the mulga lands. However, both of these people suggested that these groups should not be ignored, as they are politically influential and can offer a different perspective.

Overall, there appears to be agreement that stakeholders of the mulga lands includes many industry, community and government organisations. It is recognised that all groups have something to offer, and that management of grazing in the mulga lands is unlikely to be successful without their input and cooperation. All stakeholders will need to contribute in some way if their expectations for ecologically and economically sustainable grazing are to be fulfilled. This is evident from the large number of participative actions recorded at workshops.

4.4.2 Process for identifying goals and strategies

The large number and diverse stakeholders involved in this project demonstrated considerable enthusiasm for coming together to discuss the management of grazing in the mulga lands. This was particularly so for workshops that included a tour of grazing properties. This type of forum provided an interesting and informal setting for discussions, and also enabled participants from outside the region to become familiar with the mulga lands landscape. Overall, the workshop tours of the mulga lands were very successful. They produced considerable information on the management of grazing pressure, and resulted in the development of good working relationships between urban stakeholder groups, western graziers and industry organisations. These forums should continue, as they appear to build trust, common understanding, and collaborative efforts amongst stakeholder groups that previously regarded themselves as adversaries.

A new NHT project in western Queensland, Building community capacity to determine integrated safe carrying capacities, will continue these forums. Members of the CCG Working Group of the MDBC have been invited to continue their role in this new project.

The MDBC may consider providing funding to their projects which involve a large number of diverse stakeholder groups, particularly where these groups have little previous experience with each other. It may also be beneficial for members of industry groups from the rangelands to visit and experience community conservation group activities in the capital cities. This would help break down some of the barriers that currently prevent these groups from reaching agreement on the management of natural resources.

4.4.3 Development of grazing management goals

All stakeholders found it difficult to identify clear and specific goals for the management of TGP. In most cases stakeholders nominated actions instead of goals, and when goals were identified they were quite broad. While the precise reason or reasons for this are unknown, some suggestions are offered.

The difficulty in formulating specific management goals may have been due to a lack of experience in goal setting. It is not easy to describe a clear target or outcome, and it appears that most people are inclined to phrase these as actions at their first attempt. Further attempts to identify goals with stakeholder groups should be preceded by a discussion of the difference between goals and actions.

Another possible reason for the difficulty in setting specific goals is that the mulga lands and markets for grazing products are highly variable and unpredictable. Perhaps precise targets cannot be met in such an economically, ecologically and socially variable system.

It is also possible that insufficient knowledge of the mulgaland grazing system prevented stakeholders from identifying specific goals. Stakeholders may need to increase their first hand knowledge of this region before they are able to identify specific management goals. The workshop tours run during this project would help all stakeholders increase their understanding of each other and of the mulga lands grazing system.

One last possible reason for the inability to set precise goals is the general lack of systematic grazing management strategies amongst graziers. It is unlikely that graziers would feel confident about achieving specific goals if they do not systematically monitor and manage TGP.

4.4.4 TGP goals and actions

This project has developed goals and actions for the management of TGP in the mulga lands that are consistent with the '*National Principles and Guidelines for Rangeland Management,*' that was developed with input from industry, government and community stakeholders. It addresses the diverse social, cultural, environmental and economic issues relevant to communities throughout Australia's rangelands. The report provides a 25-year vision and three overarching and inter-related goals for the use of the rangelands:

The rangeland strategy vision is:
The Australian community is committed to achieving ecologically sustainable rangeland management, supporting diverse social, cultural and economic activities.

The rangeland strategy goals are:

1. Conservation and management of the natural environment;
2. Sustainable economic activity; and
3. Recognition and support for social, aesthetic, cultural and heritage values, diversity and development.

Goals identified in this project such as ecologically sustainable grazing systems, and economically sustainable live-stock and kangaroo industries are closely aligned with the goals of the National Rangeland Strategy. Similarly, actions like developing and using sustainability indicators for biodiversity, native vegetation, and soils, and implementing best management practices would also help achieve the goals of rangeland management.

4.4.5 Goals of pastoralists for managing TGP

The goals and actions identified during CCG workshops are those of all participating stakeholder groups. However, graziers alone cannot achieve some of these goals. It is important for the whole community and government to recognise that graziers will require

their assistance if the goals of the wide community are to be achieved. For example, graziers may require assistance with the development and application of sustainability indicators, and the conservation of all of the biodiversity of their properties. Graziers will also need assistance with improving the economic sustainability of their industries, particularly increasing profit margins. It is important that the wider community has a greater appreciation of the link between environmental management and economic performance. Graziers are unlikely to improve their management of rangeland ecology when consumers regard price as the main attribute of meat and fibre products.

4.4.6 Implementing goals and actions

While it is now possible to progress many of these wide community goals and actions, a high rate of implementation should not be expected. Some of the goals and actions identified and promoted by this project will be seriously considered and addressed by graziers, but many others will be either unaware or unwilling to adopt them. Graziers will need to be actively assisted by all stakeholders if the majority of the wide community goals for managing TGP are to be achieved.

The Project Steering Committee, CCG, MDBC, the project team (QDPI, NSW Ag, CSIRO Wildlife and Ecology), and programs such as the Natural Heritage Trust will continue to progress grazing goals. Regional programs like the South West Strategy in western Qld also play an important role in promoting sustainable grazing practices. The pastoral enterprises assisted by this strategy are required to manage stock numbers in accordance with safe carrying capacity assessments, and to establish long-term vegetation and soil monitoring sites. However, the number of the grazing enterprises in south west Qld involved in this strategy is small.

While the level of project activity within the rangelands is high, generating much information and many tools for improving the management of grazing, this is generally not sufficient to overcome the influence of market forces. Consumers often purchase food and fibre on the basis of price, and in effect provide financial incentives for maximising stocking rates. In this economic environment it is difficult to implement the wide community goals and strategies identified by this and other projects.

The development and promotion of ecologically sustainable grazing practices by regional strategies such as West 2000 and South West Strategy, and conservation programs such as the Natural Heritage Trust are often negated by the large and powerful markets for food and fibre. A high level of adoption of sustainable grazing practices by pastoralists in the mulga lands is unlikely to occur unless actively encouraged by consumer markets. International certification schemes such as ISO 14000 now provide mechanisms to align markets with sustainable grazing practices. Potentially, this provides a powerful force for the adoption of the information, tools and practices developed by projects.

Compliance with ISO 14000 could begin with a relatively simple example of environmental impact that is well understood by graziers, being the chemical residues contained in wool clips. Graziers could be assisted by QDPI and other agencies to develop an environmental management system required by ISO 14000. This system involves the identification of the environmental impacts of grazing in the rangelands, the formulation of environmental policies and objectives, setting of targets for wool contamination, description of plans, implementation of actions to reduce levels of chemicals, and monitoring of the results.

This environmental management system would initially focus on the minimisation of chemical residues in wool. Conceivably, it could take two or more years before participating graziers feel that this issue is under control. The system could then be expanded to address other environmental impacts, such as adverse affects on vegetation, soil, water, and biodiversity. Again, graziers could be assisted by industry and government agencies in the development of appropriate environmental management systems, and the targeting of receptive markets.

The development of acceptable and effective environmental management systems for rangeland grazing is also an activity that could be proposed to a CCG or similar group. The involvement and endorsement of the major stakeholder groups will be necessary for consumers to develop a high level of confidence in the certification and marketing system.

4.5 Recommendations

1. Workshops are required for stakeholders and end-users to meet and develop specific objectives, targets and performance indicators for the management of total grazing pressure. Existing broad goals are not suited to grazing management at the property scale.

2. Meetings of stakeholders and end-users that are held to formulate goals and objectives should contain a training component that assists participants identify true goals and objectives for the grazing industries.

3. Community, industry and government stakeholders need to help the end-user (grazier) to achieve the goals and objectives of ecologically sustainable grazing in the mulga lands.

4. Mechanisms need to be developed that enable consumers to reward pastoralists that achieve high standards of environmental management. In this way powerful market forces would be used to encourage ecologically sustainable land use.

Chapter 5

Objective 3

User friendly early warning indicators of vegetation and soil change by grazing refined by participatory research and development.

5.1 Introduction

Achieving ecologically sustainable grazing in the mulga lands begins with actions to achieve sustainable use of vegetation and soils. These natural resources can be damaged by over-grazing, and in severe cases can result in losses of productivity and biodiversity. The purpose of this objective was to identify practical early warning indicators of adverse change in vegetation and soil.

This chapter describes plant, landscape and soil indicators suitable for use by pastoralists in managing TGP in the mulga lands. It draws on data obtained from a survey of 74 properties in the mulga lands, from results of grazier workshops, and current rangeland research.

5.2 Methods

5.2.1 Development of the manual – *Understanding more about your landscape*

This manual provides a method for monitoring landscape productivity. The first step in the process is to examine landscape organisation. This refers to the arrangement of obstructions that slow or divert water and regulate the flow of resources. The second step is to assess a number of soil surface indicators. There are nine indicators that need to be assessed: soil type, soil cover, perennial plant cover, litter cover, lichen and moss cover, forms of erosion, loose and mobile material, soil surface crust brokenness and the slake test. The manual explains why each indicator is important and contains a series of photographs to help score observations in the field.

Field days were conducted at Cobar and Byrock in May 1999 and at Charleville in March 2000. In both locations David Tongway and/or Norman Hindley from CSIRO Wildlife and Ecology were present to discuss and demonstrate the field procedure, and to gather feedback from participants.

At Charleville, the day began with a presentation by David on how the method had been developed and some of the benefits that could be gained from its use. The group then proceeded to the field where they used a manual to work through the procedure, and record and interpret results. The group then returned to the meeting area where they provided feedback to David and Norman on how they felt the method and manual could be improved and made more user friendly. A similar format was followed at the NSW field days.

"Reading the Landscape" field day at Charleville

5.2.2 Tactical pasture rest study

This tactical rest of pasture study was conducted on ten properties across the mulga lands of the Murray-Darling Basin from 1996 to the present. The first year of this study was funded by The Woolmark Company, while the remaining years were funded by MDBC. The properties involved were: *Adgingbong*, Cunnamulla; *Alice Downs*, Morven; *Autumn Vale*, Thargomindah; *Bulgoo*, Cobar; *Glenvue*, Byrock; *Lake Mere*, Louth; *Moble*, Quilpie; *Wallen*, Cunnamulla; *Wapweelah*, Enngonia and *Woodlands*, Coolabah.

The objectives of the study are to:

1. determine the effect of no grazing, tactical short-term resting, and continuous grazing on the density and composition of palatable grasses, unpalatable grasses and shrubs, and on the functioning of landscapes of different types throughout the mulga lands; and
2. communicate the findings to the pastoral industry.

Each site contained three plots. The first plot was surrounded by a three metre fence that completely excluded grazing animals (rabbits and larger herbivores). The second plot was for the treatment of tactical rest, and was also surrounded by a similar fence that could be temporarily removed at either end. It was rested from grazing when:

- the total rainfall over the previous three months was below 75 mm and remained below this level for a further two months, **or**
- the average grazed height of palatable perennial grasses reached or fell below 10 cm, **or**
- there had been sufficient rain to grow a crop of seed.

The third plot was not fenced, and was always available to all grazing animals in the paddock.

Tactical rest (left) and non-grazed sites on Alice Downs

The graziers collect records on rainfall, the dates of opening and closing the tactical rest sites, and livestock numbers in the paddock. Once a year staff from CSIRO Wildlife and Ecology, NSW Ag. and QDPI visited the sites and, in each plot, measure:

- roughness of soil surface and its components; and
- grass, shrub and tree density and the species present.

Data collected each year was collated, and a report given to participating graziers. The total data set collected over three years was analysed and included in the year 2000 annual report.

5.2.3 Cunnamulla tactical rest field day

A field day was held at *Adgingbong*, Cunnamulla on 22 November 1999 to share the results of the tactical rest experiment. All graziers involved in the experiment were invited with a total of ten graziers and six government agency staff attending the day.

The morning session began with introductions and a visit to the tactical rest site at *Adgingbong*. Background on the project was given by Ken Hodgkinson and discussion in the field was based around the differences between the closed, open and tactically rested plots. David Tongway also gave a brief demonstration of his method for reading the landscape.

Adgingbong field day discussion of tactical rest

After lunch there was a presentation on how the project was initiated and the results to date. Group discussion then focussed on a number of questions: "what are your thoughts about the project?", "what does tactical management mean to you?", "what are the benefits and costs of tactical management?", and "what additional things would help you use tactical rest more effectively?" A report on the field day is incorporated into the 2000 annual report, *Tactical rest for rangeland management study.*

5.2.4 Grazier survey

The survey was designed to gather information on how graziers currently monitor and manage TGP. The survey involved face to face interviews with graziers on 74 properties through out the mulga lands of the Murray-Darling Basin. The study area was divided into eight regions and eligible properties randomly sampled to select three properties per region for the pilot survey, and 10 properties per region for the main survey. Eligible properties for the survey they had to meet the following criteria: have mulga trees, be lived on, and for the owner/manager to have at least five years experience in managing mulga country. The final criterion was that the owner/manager made the management decisions for the property.

The questionnaire was developed through input from the Qld 'core grazier' team, NSW core graziers, staff from QDPI, CSIRO and NSW Ag. A number of test interviews and a pilot survey were conducted, the feedback gathered, modifications made and the survey questions finalised. The questions covered background property information, signs noticed during times of high and low grazing pressure, signs used to estimate grazing pressure from feral, native and domestic animals, and actions taken at times of high and low grazing pressure.

The main survey was conducted from November 1997 to January 1998. In Qld, interviews were conducted by the seven 'core graziers' and each grazier was responsible for all interviews in their region. In NSW, project team members from CSIRO Wildlife and Ecology conducted the interviews.

After all interviews had been conducted the data was collated, the answers to all open-ended questions were categorised and results from the closed questions were entered into a spreadsheet and analysed. The results were then compiled and presented in a two part report titled *Graziers' perceptions of total grazing pressure in the mulga lands of the Murray-Darling Basin.* The report was distributed widely to graziers and scientists.

5.2.5 Grazier workshops

A series of seven grazier workshops were held throughout Qld and NSW between September and October 1998. In Qld the workshops were held at Cooladdi, Yaralla and Augathella, and in NSW at Weilmoringle, Louth, Cobar and Byrock. The objectives of these workshops were to review and discuss the results of the grazier survey, identify further information and tools required by graziers to manage TGP, and plan future directions for each grazier group. These were run slightly differently in each state.

The activities of the workshops held in Qld were:

- Introductions, expectations, agenda, project background.
- Introduction to the survey report – an outline of how the survey report was put together and what it contained.
- Discussion of signs – an exercise conducted in small groups where people were asked to consider the signs outlined in the survey report, highlight those they considered most useful and add any extras.

- Discussion of actions – an exercise conducted in small groups where people were asked to consider the actions outlined in the survey report, highlight those they considered most useful and add any extras.
- Research update – an update/report on current research for monitoring and managing TGP.
- Setting direction for future involvement in the project.
- Evaluation.

Grazier workshop in Queensland

In NSW the format for the four workshops was:

- Introductions, expectations, agenda, project background.
- Discussion of the survey report –this involved a group exercise aimed at identifying those tools/indicators that graziers in the workshop use with confidence and those that they would like to further develop.
- Presentation on possible products to be produced by the project including, the Glovebox guide, on property research, indicator skills development and identification of off farm constraints.
- Discussion of how products will be developed.
- Evaluation.

5.2.6 NSW Agriculture tactical management publication

A second project of NSW Agriculture titled, *Management aids for rangeland pastoralists*, produced two glove box guides that help graziers identify plants and tactically manage total grazing pressure. It was funded by the Natural Heritage Trust and NSW Agriculture. The second book, *A glove box guide to tactical grazing management of the semi-arid woodlands*, by T. Campbell and R. Hacker, describes a technique for monitoring vegetation soils, and animals. Members of the project team contributed to a number of sections of this publication. This included input by David Tongway and Norm Hindley to the section on Landscape Function, Ken Hodgkinson on utilisation of key perennial grass species, and review of the document by Lester Pahl.

5.2.7 TGP indicators identified by core graziers

A meeting of the Qld Core Grazier Group on March 27 1999 put together a list of 'key' indicators for vegetation, soil and animals. The indicators for this list were drawn from the

survey report, raw data, workshop findings and the group's experience. It was intended that some of these indicators would be included in the NSW Ag. glove box guide on monitoring for tactical management. However a lack of knowledge on how this large number of indicators are used by graziers prevented them from being incorporated in this publication.

5.3 Outputs

5.3.1 Understanding more about your landscape Manual

CSIRO Wildlife and Ecology incorporated the changes suggested by graziers at the field day into a new edition of this manual, resulting in a more user friendly methodology for reading the landscape. Components of this new version have also been incorporated in the NSW Agriculture publication *Glove box guide to the tactical grazing management of the semi-arid woodlands*. The manual contains instructions and photographs of the procedure to be followed to determine the health of the landscape. The early-warning indicators of landscape dysfunction are a number of measured attributes relating to surface obstructions to water flow and soil surface features.

5.3.2 Tactical pasture rest study and Cunnamulla field day reports

An annual report was produced for each of the three years (1997-2000) of the tactical rest study. Each report presented a summary of the raw data collected across the ten sites. The 2000 report also includes a series of photographs showing the closed, tactical and open plots at each site. The study was set up knowing that changes due to grazing pressure differences would probably occur slowly at most sites unless rainfall at a site initiated a large recruitment event. The changes measured so far at each site are small but importantly, trends are apparent when all sites are considered.

This 2000 report shows that there have been some statistically significant changes in the plant composition of the plots over the three years but the changes are still at an infant stage. In most plots there has been rainfall-induced change in plant composition and density and all treatments have changed in synchrony. However in 3 and 4 of the 10 sites, the grass and shrub densities, respectively, have changed at different rates because of the grazing treatments applied. In these few sites the grass densities have risen substantially with no grazing and the tactical rest treatment is lower but ahead of open paddock grazing. Some improvement can be attributed to the tactical rest treatment. The grazing treatments also influenced quite strongly the ingress of new shrubs with the non-grazing treatment often showing the largest increase. In Cunnamulla the participating graziers expressed support for continuing the project and being involved as partners in the study.

5.3.3 Grazier survey reports

The two part report titled, *Graziers' perceptions of total grazing pressure in the mulga lands of the Murray-Darling Basin,* presents the results of the grazier survey conducted in early 1997. Part A focuses on the signs that graziers use to make decisions and the actions they currently take to manage grazing pressure on their property. Part B provides background information about the properties covered by the survey – their enterprises, country types and sources of labour.

More specifically, the section on signs provides some interesting data on what graziers observe and what they are currently using to assess grazing pressure. Table 12 of Report A provides a summary of the signs acted on and the stage of these signs when action is taken. It shows that:

- 72% of graziers interviewed used the condition and performance of stock as an indicator for action;
- 58% used the amount of feed available;
- 45% used the condition and quality of feed;
- 28% used availability and condition of waters; and
- 27% used weather, rainfall and expectations of future seasonal conditions.

Some specific signs that graziers acted on included:
- when a fair percentage of buffel gets down to six inches;
- when there is an increase in the browse line of low mulga;
- when corkscrew grass starts declining; and
- when old cows get poor and calves are doing it tough.

5.3.4 Grazier survey raw data

The raw data from the survey contains all of the responses of graziers. This is a particularly useful data set for the open ended questions where some of the detail was lost in the categorisation of individual responses. This raw data contains some specific examples of the signs that people noticed about the seasons, stock waters, domestic stock, native animals, feral animals, pastures and soils at times of high and low grazing pressure. It also provides detail about the signs used to estimate and make decisions about the grazing pressure from feral, native and domestic animals. The signs recorded during the survey have been combined with the signs compiled from grazier workshops and a core grazier meeting (full list of signs is provided in Appendix 1).

5.3.5 Key signs of grazing pressure identified by core graziers

The Qld Core Grazier Group and the project team identified some key signs from the list compiled during the grazier survey. Key signs were listed for soils, pasture and vegetation assessment, TGP, and animal condition (Appendix 2).

5.3.6 Grazier workshops report from Qld

This report, *Managing total grazing pressure: outcomes from the workshops*, contains a summary of the actions which graziers felt were useful in limiting grazing pressure from domestic, native and feral animals. Included in this was an assessment of the advantages and disadvantages associated with each action.

The report also recorded signs that graziers considered useful in making decisions about when to reduce TGP. A large number of signs on the condition and performance of stock, availability of feed, condition and quality of feed, availability and condition of waters, behaviour of stock, weather, markets, kangaroos, goats, pigs and soils were recorded at these workshops. These are listed in Appendix 3.

5.3.7 Grazier workshops report from NSW

The workshop report, *Managing total grazing pressure: outcomes from the NSW workshops*, describes the discussion and outcomes from the four workshops held in NSW.

Graziers at these workshops indicated their level of confidence with using tools for monitoring grazing pressure, and the assistance they required. The majority of participants felt comfortable with their skills in deciding stock condition and slippage. This included direct assessment by looking or feeling stock, observation of herbivore behaviour, and observations of consumption of indicator plants.

Graziers were also reasonably comfortable with deciding on the status/condition of paddocks. Most were confident that they could assess how well paddocks held rainfall and grow feed, and the abundance of native fauna.

Graziers were much less confident about deciding if the forage resource was under threat. Most participants required assistance to assess critical times for perennial grass survival. Approximately one third of graziers at the workshops also required assistance with techniques for assessing the numbers and trends of feral goats and kangaroos.

Similarly, there was little confidence in deciding how long the existing forage supply would last, using rainfall records and assessing or measuring forage amount. Most graziers indicated that they required help with the use of *Rainman* in determining the probability of growth-promoting rains in the next three months.

5.3.8 Milestone report on indicators

The milestone report on indicators was produced by Ken Hodgkinson and David Tongway, CSIRO Wildlife and Ecology, and reports on indicators for the field assessment of soils and vegetation.

The report covers four main topics:

1. Literature on indicators of vegetation and soil change in the mulga lands.
2. Data collected in the grazier survey of the mulga lands (1997) with particular attention to the techniques used by graziers to determine the level of forage supply, vegetation status and changes in soil characteristics.
3. User-friendly early warning indicators of vegetation and soil change developed by CSIRO Wildlife and Ecology.
4. Opportunities for grazier training in the use of indicators through manuals, field days and workshops.

Review of literature showed that the status of the mulga lands in the Murray-Darling Basin is often poor. This would impact on the profitability and viability of pastoral businesses.

Methods are available for broad-scale assessment and monitoring of mulga lands and these are still evolving. Early-warning indicators of adverse change for on-property use has only been recently been developed by CSIRO Wildlife and Ecology after basic research and further development with graziers.

A "grazier-friendly" methodology for landscape function assessment was developed with groups of graziers from Cobar and Charleville and incorporated into the Glove box guide to tactical management of the semi-arid woodlands to be published by NSW Agriculture. This manual will be printed and widely distributed by the National Land and Water Resources Audit.

A simple means of predicting accelerated death of perennial grasses under grazing was developed. Two factors consistently account for death of these long-lived plants; the availability of water in the soil and the level of grazing. The "death traps" for perennial grasses appear to be "set" by grazing and "sprung" by drought. A partnership project of scientists and graziers began evaluation of an early-warning system for perennial grass mortality and the linked management response of tactical resting from grazing. Equivocal

results to date suggest the system will be successful and simulation modelling provided proof-of-concept for tactical rest advantages.

A survey of graziers conducted by this project in November 1997 revealed that many already observe soil, landscapes and perennial grass features so prospects for adoption of these new early-warning methods for detecting approaching adverse change in an adaptive management framework are reasonable.

5.4 Discussion

5.4.1 Combining grazier and scientist approaches to monitoring

Graziers use many signs, and have an interest in improving their skills in interpreting these. However, they are unlikely to use these signs in a systematic way to monitor vegetation and soil. Scientists, on the other hand, have a preference for a structured approach to interpreting indicators of vegetation and soil change. The question is, where do these two approaches meet and how can they be integrated to create a user friendly but rigorous approach to monitoring?

The work of David Tongway and Norman Hindley presents a possible model for achieving this. The grazier manual, *Understanding more about your landscape,* has been developed by converting years of scientific research into a methodology for monitoring key indicators of landscape health. The method was trialed with end-users who have provided feedback, resulting in improvements to the manual. Thus, it has been an iterative process of improvement involving scientists and the end-users. Although it presents a systematic method for assessment, every effort has been made to ensure it practical and effective.

The monitoring tools developed by scientists and graziers can be presented to groups of graziers for their appraisal. The process used at the NSW grazier workshops is an example of this approach. Graziers identified monitoring tools that they felt confident using, and those that they would like help with. Then, graziers and scientists could plan workshops, field days or one-on-one meetings to provide people with the knowledge and skills to competently use a range of monitoring tools.

5.4.2 How do we encourage uptake?

There are some useful signs and tools that workshop and survey results suggest graziers are not using to any great extent. Examples include *Rainman* and the SOI for predicting future rainfall, and tools for assessing soil condition.

In order to encourage uptake it is necessary to define why this material is not being used and to look at ways of overcoming these factors. In some cases it may require the development of a user-friendlier product but in other cases it may simply require appropriate extension targeted at interested groups and individuals.

Working in conjunction with Landcare groups may be a useful way to encourage uptake. With increasing pressure from funding organisations to monitor on ground projects, groups are looking for ways to assess change over time and indicators, such as pasture composition and soil condition can be a useful guide. Therefore, by working with groups to read and interpret indicators of project performance, individual land managers are gaining skills that may then be applied to their property management.

Another method for developing interest and skills in the use of indicators is one-on-one interaction. As part of this project there has been some work done with a goat producer at Morven in south west Qld to develop a set of indicators that can be used to assess the impact of goats on the system. Working with individuals to develop a package that meets their needs and then provide the necessary training can be a useful way to encourage uptake.

5.4.3 What are 'the best' early warning indicators

Outlined below are some of the 'key' indicators that have been identified by scientists and graziers. These provide early warning of adverse change in vegetation and soil, and can be used to initiate a change in management, such as a reduction in stock numbers, the resting of pastures or a change in the mix of herbivore species.

Early warning indicators of soil and vegetation change include (signs which have been incorporated in systematic monitoring procedures are marked with an asterisk):

1. Browse line becomes apparent and increases in height.
2. Variety of grasses available in Mitchell grass country decreases.
3. *Amount of pasture available.
   eg remove stock when two thirds of pasture eaten
   eg remove stock when 50% of grass is eaten
   eg when you know you are likely to run out of feed and rain is unlikely, such as little feed left going into winter non-growing season
4. Amount of browse available.
   eg remove stock when around half of the leaf of young mulga has been browsed.
5. Amount of soft herbage in the winter months.
6. *Palatable grasses eaten first, and begin to be eaten out.
7. *Height of grasses or proportion grazed.
   eg when a fair percentage of the buffel is eaten down to six inches
8. Stock begin to eat unpalatable plants.
9. Stock grazing in areas of paddocks not normally frequented eg. ignore wind.
10. Tracks to waters become more obvious.
11. *Amount of preferred species left after grazing: eg buffel grass, Mitchell grass, mulga mitchell, *Enneapogon*, *Stipa*, and forbs.
12. Level of utilisation of preferred grasses near waters.
13. When corkscrew grass starts declining.
14. Level of utilisation of seedling grasses.
15. Amount of leaf (flag) present on grasses.
16. When the tops of Mitchell grass have been removed.
17. *Level of water infiltration and water shedding.
18. *Number of obstructions on the soil surface that slow and catch run-off.
19. Southern Oscillation Index (SOI) and other climatic indices

Many of these signs are used by graziers to help them make decisions associated with the management of total grazing pressure. While this project did not identify how graziers use these signs, it is believed that graziers observe them as they travel through paddocks, and then make decisions based on the overall appearance of vegetation, animals and soils.

Scientists have developed several methods for using these signs. The project milestone report titled, *Landscape, soil and grass indicators for pastoralist use in tactically managing Total Grazing Pressure in mulga lands of the Murray-Darling Basin,* describes how the height of

perennial grasses, rainfall, and soil surface features can be used in a systematic way to identify adverse landscape change.

Also, the NSW Ag. publication, *Glove box guide to the tactical grazing management of semi-arid woodlands*, describes methods for monitoring forage availability, utilisation levels of key pasture plants, shrub cover, soil cover, soil condition, animal condition, and total grazing pressure.

There is certainly scope to further develop systematic procedures for monitoring early warning signs of adverse change in the landscape, based on many of the signs used by graziers. This would result in a blend of grazier and scientist procedures for monitoring the rangelands, and be attractive to both the pastoral industry and land administrators. This will be partly continued by a QDPI grazing management project in western Queensland, funded by NHT. A number of these signs will be examined for inclusion in an adaptive management framework for monitoring and managing TGP.

5.4.4 Conclusion

Whilst it is apparent that implementation of methods for rangeland monitoring is now possible, further development is needed. A large number of indicators of rangeland health, and monitoring frameworks are available for use, but these need to be adapted to suit the capabilities and resources of graziers.

The large number of signs of vegetation, soils and animals used by graziers are potentially very well suited to monitoring grazing pressure and changes in the condition of natural resources. The challenge is for graziers and researchers to work together to develop monitoring systems acceptable to both groups.

5.5 Recommendations

1. Further work is needed to integrate the systematic monitoring procedures of scientists with the early warning signs used by graziers. The purpose of this work would be to produce rigorous monitoring procedures that are suitable for use on pastoral properties.

2. Deliver training courses on natural resource monitoring to Landcare and Integrated Catchment Management Groups, for use in monitoring the on-ground outcomes of their projects. Vegetation and soil monitoring could be used by groups to demonstrate project progress, justifying allocation of further funds. People involved in these projects would develop monitoring skills that could be applied to their own properties.

3. Further work be undertaken to incorporate rangeland monitoring procedures into recognised international standards such as ISO 14000. This standard contains an adaptive management process, facilitating continual improvement in the application of monitoring procedures, and continual adjustment to match changing circumstances and requirements.

Chapter 6

Objective 4

Practical tools for monitoring and managing herbivores at property and group-property scales evaluated and refined through research and community participation.

6.1 Introduction

The successful management of TGP requires knowledge of the number of herbivores on a property and an ability to change that number as the availability and/or quality of pasture varies over time.

Graziers often state that they do not know the number of macropods and feral herbivores (goats, rabbits) present on their properties. They also generally do not have tools that can be used to modify numbers of these animals. An inability to manage native and feral herbivores is likely to significantly reduce the sustainability of grazing, as these animals often make up half of the TGP of properties.

For these reasons graziers have requested that tools be developed to enable them to monitor and control numbers of macropods and feral goats.

6.2 Methods

This section is divided in two. The first part describes methods for monitoring numbers of each herbivore species, and the second is on management or control of numbers.

Part A. Monitoring numbers of herbivores

This project interviewed graziers to determine the mechanisms used to monitor herbivores, and also examined a number of techniques that could be used to monitor the abundance of native and feral herbivores in paddocks.

6.2.1 Grazier interviews

Graziers were interviewed during a survey of 74 pastoral properties between November 1997 and January 1998. They were asked to identify the signs they used to estimate grazing pressure of domestic, native and feral herbivores. Graziers also identified signs used to estimate grazing pressure at workshops run in several locations across the mulga lands (see Chapter 5).

6.2.2 Self-mustering congregations

Thirty-four self-mustering enclosures were designed and constructed during a previous Landcare/Woolmark project in the mulga lands of south west Qld. These consisted of 1.2 and 1.4 m high fences built around artificial water points and were primarily used to trap domestic stock and feral goats. The top 30 cm of fences were covered with a strip of fine mesh to prevent entanglement of macropods. Domestic stock accessed water in the enclosures through

one set of spear gates and exited through another. The exit gates can be set so that domestic stock and goats are prevented from leaving the enclosure, effectively and efficiently mustering these animals.

Self-mustering enclosure

Entry and exit spear gates, main gate, and fence of a self-mustering enclosure

These enclosures can also be used for obtaining a qualitative estimate of the numbers of native and feral herbivores present in paddocks. This can be done by trapping goats at regular intervals and observing the change in relative numbers over time, and by congregating and counting kangaroos on the outside of the enclosures.

The exit spear gates were set by graziers on several occasions over two years to prevent feral goats from leaving the enclosure. Trapped goats were collected and retained in holding paddocks. Domestic stock were released unless these were also required.

The self-mustering enclosures also possess swing gates built into the fences that enable macropods to readily access water. Macropods use these swing gates in preference to the spears used by stock, and quickly learn to enter and exit enclosures through these devices during the night.

Swing gate in the fence of a self-mustering enclosure

Trials to congregate macropods were undertaken over May to June 1998 at four paddocks on commercial grazing properties. The swing gates were locked in the afternoon with the aim of congregating macropods at night. The number of macropods observed within 100 m of self-mustering enclosures in two paddocks and uncontrolled water points in two other paddocks were then recorded over three consecutive nights. The swing gates were opened each night after the counts of animals were completed.

6.2.3 Spotlight transects

Spotlighting along transects (13 to 18 km) within four paddocks was investigated for its potential to provide an index of kangaroo density. These transects consisted of existing roads and tracks that covered the majority of each paddock. On three consecutive nights the transects were traversed in a 4WD vehicle with two occupants. The person in the rear of the vehicle with the spotlight identified species of macropod sighted and determined the distance to the animal using a laser range-finder. This information was radioed to the driver of the vehicle who recorded this as well as the odometer reading on a micro cassette recorder. All information was later transcribed to record sheets including weather conditions on each night.

In this way all macropods observed along transects within each paddock were recorded and converted to number of animals per kilometre of transect. In an attempt to reduce the impact of variable visibility between paddocks due to differences in tree density, the number of animals seen within 50 m of the transect was also recorded.

The numbers of macropods seen in the four paddocks were then compared with the average density of macropods at the sites determined from aerial surveys. Helicopter surveys, using the methods developed by Qld Parks and Wildlife, were undertaken twice yearly to provide estimates of macropod and feral goat density at four study sites.

6.2.4 Mechanical counters

The swinging access gate used by herbivores at self-mustering enclosures has been modified by attaching a small mechanical counter (Line Seiki RSL-204-5). This counter clicks over each time macropods and feral goats pass through the gate to access water.

A length of 6mm mild steel rod has been shaped and positioned on the access gate so that a kangaroo passing through the gate depresses the rod with its back. The rod then lowers the

activation arm of the mechanical counter, registering a tally on the meter. As the kangaroo clears the access gate the activation arm on the counter is reset by an internal compression spring, aided by the addition of an expansion spring attached to the opposite end of the mild steel rod. Counters can be mounted on both sides of an access gate

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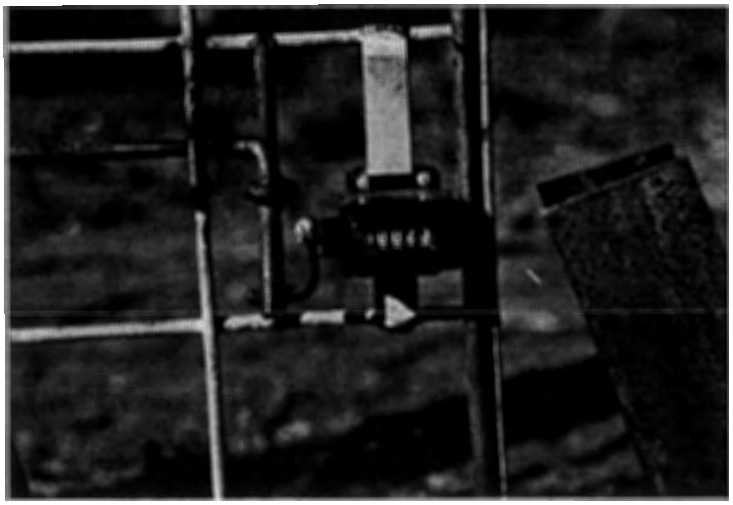

Mechanical counter installed on a swing gate

This counting access gate was used to monitor the number of animals accessing artificial water points and passing through a fence line between paddocks.

6.2.5 Diets of herbivores

The diet composition and grazing patterns of herbivores also provide signs of the level of grazing pressure. The grazier survey and grazier workshops recorded a number of diet related signs that can be used to monitor grazing pressure.

This project analysed the diets of herbivores in mulga communities. The diet composition of free-ranging sheep, cattle, feral goats, wallaroos, red kangaroos, and eastern grey kangaroos was determined through faecal pellet analysis. Dung of a number of individuals of each species were collected on three separate transect lines that followed roads to the east, south and west of Charleville. Dung samples were combined for each species of herbivore and the plant species present were identified from leaf cuticle patterns observed with a microscope. The methods for this work are described in detail in the report, *Degree of dietary overlap between sheep, cattle, goats, red kangaroos, grey kangaroos and wallaroos in south west Queensland mulga lands,* by B. Franco, June 1999.

6.2.6 Dung counts

The density of herbivore dung within paddocks has been used frequently as a quantitative measure of animal numbers and to determine relative grazing pressure (percentage of the TGP contributed by each herbivore species).

The use of dung as a measure of relative grazing pressure is dependent on there being a close relationship between the time spent grazing at a site and the amount of dung left on the ground during the grazing period. This was examined using solar powered video cameras.

6.2.6.1 Video filming of grazing

A solar powered system using ten 77-watt solar panels supplied power to four 130-amp hour 12-volt batteries. Two 12-volt DC time lapse video recorders and two CCTV cameras operate with minimum illumination, and when linked with an infra-red light source were used to monitor animal activity in complete darkness. A 100 watt Hella fog lamp with infra-red filter was incorporated into the system and activated at night by a light sensitive switch. A voltmeter allowed monitoring of power levels in the batteries and an amp meter indicated the power input from the solar panels. The whole system was set up as a stand-alone unit in the field.

Solar powered video filming equipment

Two areas of 540 m^2 were pegged out using steel pickets marked with white paint and reflective tape. The area was five metres wide at the front and 28 m wide at the rear and 40 m long. Hinge joint wire and white shade cloth were erected along the rear perimeter of the area to direct the movement of herbivores and act as a backdrop whilst viewing videotapes.

Prior to sampling the left and right perimeter of the study area was defined by string lines and a transect plot one metre wide was marked across the area using two lengths of string line. The ground within the plot was systematically cleared of all dung and the rear length of string line was moved forward to create another one metre plot. This process was repeated till the full length of the study area was cleared of all dung.

The video units were activated on internal timers to film for a 24 hour period and the study area was again marked as described. Fresh dung was collected and its position on the site recorded on a site plan. All fresh dung was dried at 80^0C in a Clayson OM 1000 oven for 48 hours and weighed. Sampling was carried out over five working days and then the system was turned off for two days. This filming sequence was repeated until sufficient results were obtained.

The videotape for the 24 hour grazing period was reviewed each day and the amount of time animals spent within the study area was recorded. The total number of minutes each species spent grazing within the study area was plotted against the amount of dung collected from a species for that observation period.

6.2.6.2 Step-point counts

WEST 2000 funded a NSW Ag. project to develop a procedure for estimating the composition of TGP and the number of kangaroos in paddocks. It is described in detail in the report to West 2000, *Development of a field procedure for assessment of total grazing pressure and herbivore populations*. This MDBC project also provided funds to this WEST 2000 project for the development of this kangaroo monitoring procedure, and the two projects worked together to trial this kangaroo monitoring procedure. This and representation on the project Steering Committee were the main contributions by Ron Hacker to this MDBC project.

In summary, this technique determines the relative frequency of sheep and macropod dung by step-point counting within paddocks. This ratio of sheep to macropod dung is combined with sheep numbers in a formula to calculate kangaroo numbers within a paddock.

This procedure was trialed in Brigalow paddock at Charleville in June 1998, and in six other paddocks in NSW between April 1998 and February 1999.

6.2.6.3 Transect counts

A transect counting method was also used to monitor dung in Brigalow paddock in June 1998. The number of dung pellets present at these sites was recorded for domestic, feral and native animals including sheep, cattle, goats, rabbits, emu, wallaroo, and red and eastern grey kangaroos. Pellets were counted on a 1 m wide transect line that varied in length from 150 to 400 m, depending on the number of pellets encountered. Evaluation has shown that field workers are able to accurately measure the amount of dung present on the ground. This work was presented in the paper titled, *Correcting counts of herbivore dung for operator-bias in the mulga lands,* by L. Pahl, N. McLennan, F. Muller and R. Aisthorpe at the International Rangeland Congress in Townsville in July 1999.

Variation in the size of macropod, cattle and emu dung, was dealt with by counting dung in units of a standard size. The macropod standard was 23 mm x 16 mm x 16 mm and the cattle and emu standard was 110 mm x 110 mm x 20 mm. All dung was then converted to kg/ha.

6.2.6.4 Modified transect counts

The transect procedure above was adapted to make it more suitable for use by graziers. The modified procedure is described in detail in the report titled, *Developing techniques for estimating macropod abundance from dung deposits on a sheep grazing property in south west Queensland,* by S. Capararo, J. Maher, B. Williamson and L. Pahl.

The study area for this work was *Merigol*, a sheep and cattle grazing property approximately 60 km west of Charleville. Stock numbers were provided by the property owner, and macropod and feral goat numbers were estimated on two occasions by counting these animals along transect lines. On the first occasion 85 km of transect lines were walked by observers, and was increased to 167 km during the second survey. The program 'Distance'(Buckland *et al.* 1993) was then used to give estimates of the number of feral goats and macropods in individual paddocks and the entire property.

Dung was surveyed at a total of 208 sites across seven paddocks. Only fresh dung of sheep and macropods was counted during the study. Fresh dung had a dark and shiny appearance and may have been slightly cracked if recently wet by rain and then dried. Dung with this appearance was estimated to be up to two months old (Landsberg and Stol 1996). Due to its similarity to

sheep dung, goat dung was included in the sheep dung counts. Counts of pellets of sheep and macropod were converted to kg/ha using average pellet weights.

The relative proportions of sheep and macropod dung and sheep numbers were used to calculate macropod numbers using the formula below.

$$\text{Macropod No.} = \frac{\text{Macropod Dung Density}}{\text{Sheep Dung Density X 0.75*}} \text{ X Sheep No.}$$

* 0.75 was used by Constable and Hacker (1999) as the sheep equivalent of one macropod.

6.2.6.5 Quadrat counts

Dung pellets were also counted within a 0.5 m^2 quadrat located at 3 m intervals on the line transects in Brigalow paddock in June 1998. The total number of quadrats varied from 68-102, depending on the time available to count dung at each point. This time period was determined by the time taken by the person counting dung using the transect method at the same site. This enabled the comparison of the amount of information gathered by each method in a similar period of time period.

It was assumed no dung was missed within quadrats due to the small size of the area being searched. Average pellet weights were used to convert pellet number to pellet weight (kg/ha).

Part B. Managing numbers of herbivores

This project used a range of activities to record and trial methodologies for managing numbers of herbivores. This included grazier forums and property trials.

6.2.7 Grazier forums

The interview survey of 74 pastoral properties, seven grazier workshops held between September and November 1998, and two mind-mapping workshops in 1997 recorded a wide range of practices used by graziers to control numbers of herbivores.

6.2.8 Graziers' experiences in managing mulga country

The inspiration for this publication came from grazier workshops and from discussion with the Core Grazier Groups. Graziers requested greater recognition of local knowledge and recognised the value of discussion with other producers. Research also shows that graziers rate discussion with other graziers as a frequently used and valued resource for gaining information. (Underwood, 1983)

A decision was also made to associate this publication with the two glove-box guide books of NSW Ag. The first of these books on identification of rangeland plants has been very well received by graziers, and provided a positive environment for the introduction of our publication. This will follow on from the second NSW Ag. publication on tactical management that describes a range of procedures for monitoring soils, vegetation and animals.

Work on *Graziers' experiences in managing mulga* country began in December 1998 with identification of the audience and the main messages. The project team and the core graziers defined the objectives and desired outcomes for the publication, and then developed a format

that would meet these requirements. It was decided that the most effective format would be one that focussed on grazier case studies.

Ten properties from across the mulga lands of Qld and NSW were selected by core graziers and the project team to provide a cross section of land types, enterprises and operational philosophies. These graziers were approached and asked if they wished to participate and, if so, whether they would prefer to write their own story or be interviewed. All graziers chose to be interviewed and have the case study written by the project team. Interviews were conducted between June and November 1999.

The interviews were recorded on mini cassettes, transcribed by project team members and then structured around the topics of grazing strategy, species mix, pasture management, domestic stock management, and feral and native animal management. Once completed the case studies were returned to interviewees for approval and editing.

Other sections of the publication, such as the introduction, mulga lands environment and common themes in grazing management, were completed by members of the project team. Further to this, a meeting of the project team was held in Brisbane to work on the draft and to determine appropriate topics for comment boxes. Each person was assigned responsibility for gathering the necessary information and compiling it into a suitable comment box. These were then inserted into the text.

Once the full document was put together, it was closely examined and edited by members of the project team. The necessary modifications were made and it was then sent to an editor where further improvements were made. The draft publication was sent to 38 people for comment and feedback. The final stages involved incorporation of feedback, final editing, approval by the project Steering Committee and the Dryland Working Group of the MDBC, design and layout, publishing, distribution and evaluation.

6.2.9 Self-mustering

Self-mustering enclosures were designed and built around 34 artificial water points on seven grazing properties (see section 6.1.2 above for further descriptions). Monitoring of the use of these enclosures continued through this MDBC project, providing information that was used in a cost-benefit analysis.

The self-mustering enclosure design was also trialed with goats on a QDPI research station at Charleville. The continued operation of the enclosures on commercial grazing properties and the QDPI research station resulted in some refinements of the spear gates that provide entry and exit for stock.

6.2.10 Macropod congregation

A trial to concentrate macropods at existing self-mustering exclosures commenced in October 1999, after obtaining approval from Queensland Parks and Wildlife (permit number WO/000669/99/SAA) and the Western and Local Animal Ethics Committee of QDPI (project number WLAEC 015). This trial was also designed to record the behaviour of macropods that congregated at waters.

Six water points were selected at two sites (12 points in total). At each site three water points were controlled by closing self-mustering exclosures (treatments). The three remaining points were left open to allow animals free access to water (controls). All water points were

separated by a minimum distance of 6 km with alternative water points available in intervening and adjacent areas. As in Hacker and Freudenberger (1997), efforts were made to separate the nearest treatment and control water points by a minimum distance of 10 km to ensure that denial of access to treated waters was unlikely to influence macropods numbers at untreated waters. This criteria is based on work by Croft (1991) who found that the weekly cumulative movements of red kangaroos were less than 6 km. This trial was postponed due to persistent rainfall that provided alternative water sources for macropods at the study sites. The methods that will be used to complete this work are briefly described below (see Fig. 6.1).

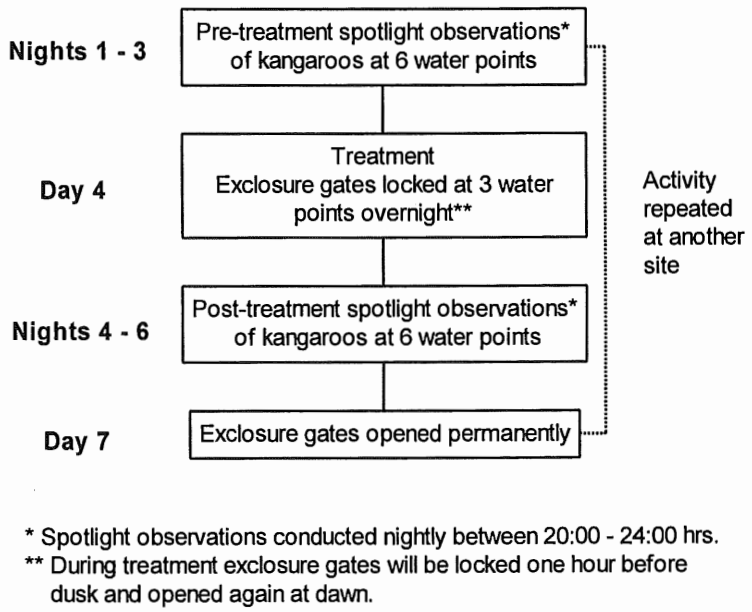

Figure 6.1 Experimental procedure for monitoring kangaroo behaviour at exclosed water points.

Water points will be visited between 20:00 and 24:00 hrs for six consecutive nights. Spotlight surveys at ten minute intervals for a period of 30 minutes at each water point will be undertaken and numbers of each species and their behaviour will be recorded. The first observations will be made while exclosures are open, and then on the forth night, half of the exclosures will be shut one to two hours before dusk, ensuring that there are no animals within the exclosure. Swing gates will also be set to open outwards, allowing the exit of any animals that find their way inside the exclosures.

Water points will be visited again at dawn each day, the number of macropods on the outside of the exclosure recorded, and exclosures opened to allow animals to access water. Upon completion of the activity (Day 7) all exclosures will be opened permanently.

This work commenced in November 1999, but was post-phoned due to persistent rain and an abundance of green pasture. Macropods do not visit artificial waters under these conditions, and hence this experiment will be re-continued during the next dry season.

6.3 Outputs

The outputs of this project for the objective on monitoring and management tools are described under the headings of monitoring numbers of animals, monitoring diets of herbivores, and managing numbers of herbivores.

Part A. Monitoring numbers of herbivores

6.3.1 Grazier interview reports

Interviews with 74 properties and discussions at workshops provided a wide range of signs that graziers use to monitor the abundance of herbivores. These signs are described in the project publication, *Grazier perceptions for total grazing pressure in the mulga lands of the Murray-Darling Basin: Part A, signs and management.*

Graziers use a number of signs of herbivore grazing pressure during regular trips around their properties. These signs are:

1. Numbers of kangaroos and goats seen during the day.
2. Numbers of kangaroos and goats seen during the night.
3. Numbers of animals seen around waters.
4. Dung more obvious on ground due to less ground cover.
5. Amount of dung and tracks around waters.
6. Amount of dung present in pastures.
7. Smell of kangaroo urine in pasture.
8. Number of kangaroo camps.
9. Level of use of pads running through fences.
10. Level of use of pads running to waters.
11. Damage to fences.
12. Amount of pasture and browse removed from spelled paddocks.
13. Number of shrubs ring-barked by rabbits.
14. Number of active rabbit burrows.
15. Number of kangaroos along roads and close to homes.

Graziers use these signs to help them make decisions on the need for reducing numbers of macropods and feral goats on their properties.

6.3.2 Self-mustering congregation proposal

The self-mustering enclosure design, including fences, swing gates, and spear gates, have proven effective in trapping goats. A small mob of 20 feral goats, consisting of billies, nannies and kids, were regularly caught and held in a paddock at Charleville to test a spear gate designed to self-muster sheep, goats and cattle. The feral goats had no previous experience with spear gates.

Animals were allowed free access to a water point enclosure in the paddock for a period of two weeks. On the 18 August 1998, the main gate was closed and access was allowed only through the open frames of the spear gates. No spears were in position at this stage of training. Animals were considered to be freely accessing the enclosure nine days later. At this time the top two spear arms were set in position and the sheep and goat spear arms were set in the reverse training position.

Four days later the goat spear arms were set in position using the spacing collars designed to widen the gap between the point of the spears. The sheep spear arm was left in the reverse training position, and after two days all spacing collars were removed to close the gap. A further two days later all spear arms were set in their correct positions.

All goats accessed the enclosure for the first time with all the spear arms in place on the 6 September 1998, 20 days after training began. After 23 days of training all animals were accessing the spear gates freely and could be trapped easily.

Small mobs of feral goats, ranging in size from a few to 50, were trapped on a number of occasions at the study sites by graziers. However, this coincided with a high regional harvest effort using bikes, dogs, vehicles and planes, resulting in a much reduced feral goat population. Furthermore, the several years of higher than average rainfall also limited the use of self-mustering enclosures for trapping feral goats. As a consequence the project could not evaluate the capacity of self-mustering enclosures to be used as a tool for monitoring the relative abundance of feral goats.

Spot-lighting surveys of kangaroos that accumulated around locked self-mustering exclosures revealed that very few animals were seen near waters during this work due to wet weather (Table 6.1). The exceptions were wallaroos in Gap Paddock, but this was due to the very high density of this species at this site rather than an accumulation at waters. Green grass and pools of water provided most of the water needed by kangaroos at the time of this experiment.

Table 6.1 Average number of macropod species seen over three nights within 100 metres of water point enclosures (Brigalow and Gap paddocks) and uncontrolled waters (Woolshed and Drum Ck. paddocks).

Paddock average	**Eastern grey Kangaroo**	**Wallaroo**	**Red Kangaroo**	**Black striped Wallaby**	**Total**
Paddock	No. Seen	No. Seen	No. Seen	No. Seen	No. Seen
Mulga sites					
Brigalow					
	0	0	0	0	0
Woolshed					
	1.3	0	0	0	1.3
Brigalow/gidgee sites					
Drum Ck.					
	1	4.67	0	0	5.67
Gap					
	0	29.3	0.33	0	29.7

6.3.3 Spotlight transects results

A large number of macropods were recorded in the four paddocks spotlighted by vehicle (Table 6.2). Comparisons show that only one macropod per kilometre was observed at the Charleville study sites (Brigalow and Woolshed), compared with 15 to 23/km at the Augathella/Tambo sites. The aerial surveys found that the average density of macropods at the Charleville sites was around 16 animals/km^2 while at the northern sites the density was around 40 animals/km^2, suggesting at least a two-fold difference. This compares with a 15 to 23-fold difference obtained by the spot-lighting records, indicating significant over-estimation for some sites.

Table 6.2 Average number of macropods observed over three consecutive nights of spot-lighting transects during two surveys.

Paddock	Eastern grey Kangaroo		Wallaroo		Red Kangaroo		Black striped Wallaby		Total	
	No. Seen	No. per km	No. Seen	No. per km	No. Seen	No. per km	No. Seen	No. per km	No. Seen	No. per km
Brigalow (13.2 km)										
average	12	0.88	1	0.05	0	0.00	0	0.00	13	0.98
average	7	0.56	8	0.61	0	0.00	0	0.00	15	1.14
Woolshed (18.2 km)										
average	8	0.44	9	0.49	1	0.05	0	0.00	18	0.99
Drum Ck. (15.8 km)										
average	30	1.90	136	8.61	31	1.96	14	0.89	211	13.35
average	33	2.09	170	10.76	42	2.66	1	0.06	246	15.57
Gap (18.2 km)										
average	9	0.49	357	19.62	0	0.00	0	0.00	366	20.11
average	4	0.22	418	22.97	7	0.38	0	0.00	429	23.57

One reason for the discrepancy between spot-lighting records and aerial surveys may be differences in visibility of kangaroos due to variation in tree density between paddocks. To account for the limitation on visibility imposed by tree and shrub cover the records from above were re-analysed, with only the animals seen within 50 m of the transects included in the results (Table 6.3). This greatly reduced the difference in the results between the mulga (Brigalow and Woolshed) and brigalow/gidgee (Drum Ck and Gap) sites. However the spotlight results still appear to over-estimate kangaroo abundance at the latter sites, possibly because of the presence of large numbers of wallaroos compared with the mulga paddocks. Wallaroos appear to be much more docile that either grey or red kangaroos, and thus are less likely to flee when approached by a vehicle at night. For this reason, spotlight counts of wallaroos are likely to record more of these animals in paddocks compared with counts of grey and red kangaroos populations of equal density.

Table 6.3 Average numbers of macropod species seen over three nights within 50 m of the vehicle spot-lighting transects in the four paddocks.

Paddock	Eastern grey Kangaroo		Wallaroo		Red Kangaroo		Black striped Wallaby		Total	
	No. seen	No. per km	No. seen	No. per km	No. seen	No. per km	No. seen	No. per km	No. seen	No. per km
Brigalow (13.2 km)										
average	5.3	0.4	7.7	0.58	0	0.00	0	0.00	14	1.06
Woolshed (18.2 km)										
average	2.3	0.12	6.3	0.34	1	0.05	0	0.00	9.67	0.53
Drum Ck. (15.8 km)										
average	4.67	0.3	64.3	4.07	7	0.44	0	0	76	4.81
Gap (18.2 km)										
average	0	0	129	7.07	1	0.05	0	0.00	130	7.12

6.3.4 Mechanical counter results

Mechanical counters were installed on swinging access gates at the QDPI Mulga Block Reserve at Charleville in a paddock divisional fence and in a self-mustering enclosure.

The operation of the two mechanical counters in the divisional fence has been monitored for 18 months. Kangaroos have been freely accessing the swing gates to pass from one paddock to another and no adverse effects have been recorded in the mechanical counter operation. Over two thousand counts have been registered on both counters.

The mechanical counters on the access gates incorporated into the self-mustering enclosure have operated successfully in free access mode and have recorded the numbers of animals entering and leaving traps. However, they have been damaged from the forced entry attempts from macropods when the access gates were locked in a self-mustering situation. This damage is likely to increase at locations where feral pigs use the swing gates to access water.

6.3.5 Herbivore diet composition report

The diet composition of herbivores is used by graziers as a sign of TGP. Signs of increasing grazing pressure include:

- stock begin to browse shrubs/trees;
- palatable grasses begin to be eaten out around waters;
- stock eat unpalatable plants; and
- stems of buffel grass are eaten.

The full results of the dietary analysis work are presented in the report, *Degree of dietary overlap between sheep, cattle, goats, red kangaroos, grey kangaroos and wallaroos in south west Queensland mulga lands,* by B. Franco, June 1999. Figure 6.2 below presents the results of this work.

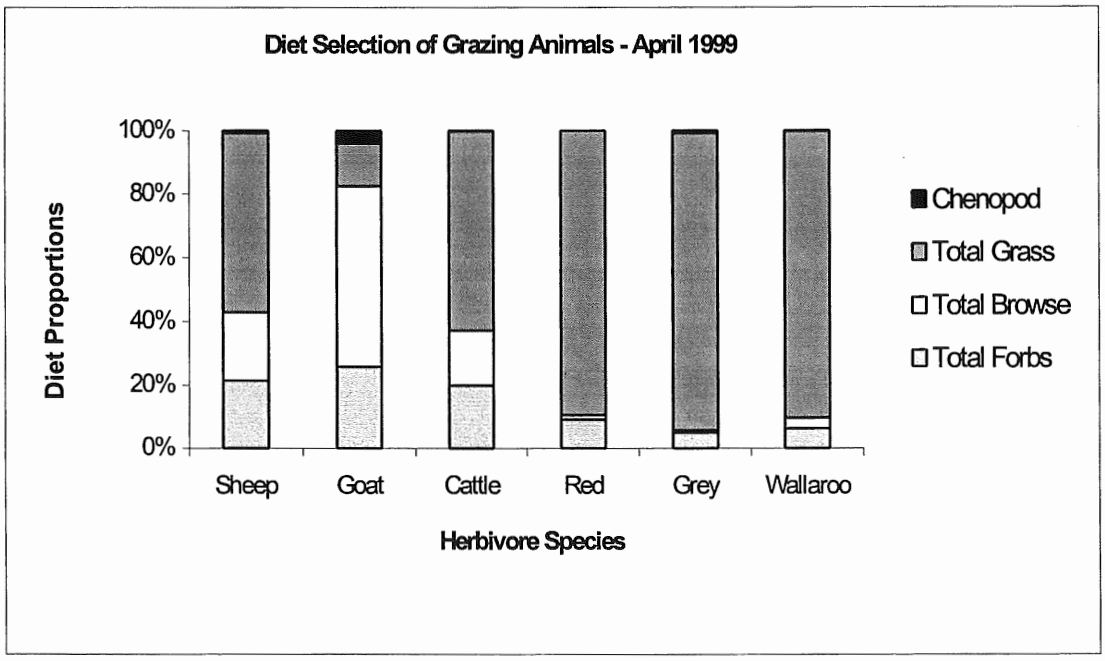

Figure 6.2 Results of the micro-histological analysis categorised under major vegetative groups

In summary, the study found a large level of dietary overlap between grey kangaroos and wallaroos, and between sheep and cattle respectively. The macropods were predominantly grass eaters, making up around 90% of their diets.

The red kangaroo differed to the other macropods in the type of grass genera consumed, and also consumed a greater amount of total forbs and browse.

Sheep and cattle exhibited a broader diet, containing relatively large amounts of grass and browse. Feral goats differed to all others in that their diet was dominated by browse.

6.3.6 Dung count results

The outputs relating to dung count procedures used to monitor numbers of herbivores are presented under several headings.

6.3.6.1 Video filming of grazing

The preliminary results of the video filming of grazing animals is contained within the International Rangelands Congress (Townsville 1999) proceedings paper, *Monitoring sheep and macropods by video to determine grazing time*, by P. Connelly, D. Horrocks, and L. Pahl. The main results are summarised below.

Relationships between dung weight and grazing time were derived for sheep and macropods grazing mulga pasture associations. The relationship between grazing time (Y) and dung weight (X) for sheep and macropods is presented in Figure 6.3 below. Grazing time and dung weight for both sheep and macropods were significantly correlated ($R^2 = 0.77$, $P<0.001$). This shows that the amount of dung found on the ground is closely related to the time spent grazing at that site by these herbivores. Hence dung weight can be used as a surrogate for grazing time.

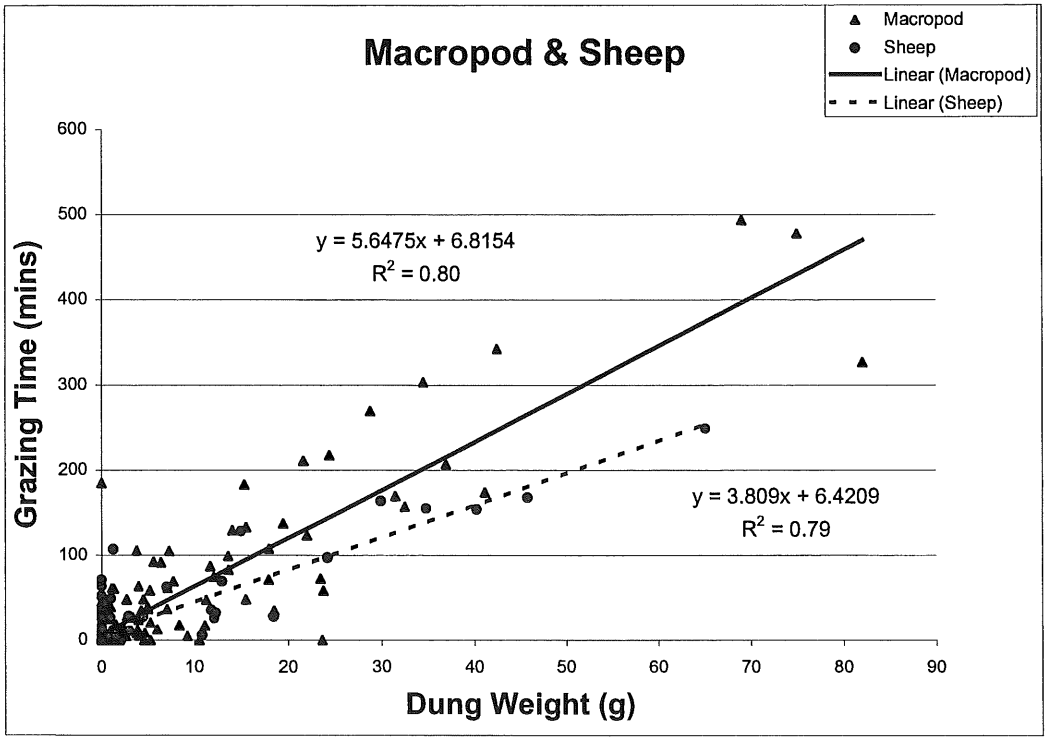

Figure 6.3 Relationship between grazing time and dung weight for sheep and macropods grazing mulga pastures.

6.3.6.2 Step-point count report

The step-point dung sampling procedure provided estimates of the composition of TGP (proportions of macropod and sheep), and of the number of macropods present in paddocks. The results are described in detail in the NSW Ag. report, *Development of a field procedure for assessment of total grazing pressure and herbivore populations,* by M. Constable, R. Hacker and G. Melville, March 2000.

This step-point technique provided estimates of macropod numbers similar to those produced by line transect counts of animals, dung weight and pellet counts. This procedure appears to provide good estimates of the number of macropods present in paddocks when the step-point counts of dung are adjusted with a regression equation.

The raw data collected by the step-point procedure in Brigalow paddock at Charleville in June 1998 shows that the TGP consisted of 58% sheep and 42% macropods. A regression equation incorporating these figures was then used to calculate the number of kangaroos present in this paddock (Hacker and Melvillle 2000). The subsequent result compared very well with 70:30 sheep:macropod ratio determined from grazier records and the line-transect counts of macropods.

6.3.6.3 Transect count results

Dung counts along each transect in the Brigalow paddock at Charleville were converted to kg dung/ha for sheep and macropods. TGP in this paddock was estimated at 67% sheep and 33% macropods. The time taken to count the dung in the field was generally less than the time taken for the step-points, and the same as the time taken for the quadrats.

6.3.6.4 Modified transect count results

The results of this work are described in detail in the report, *Developing techniques for estimating macropod abundance from dung deposits on a sheep grazing property in south west Queensland,* by S. Capararo, J Maher, B. Williamson and L. Pahl.

The two foot-transect counts of macropods for the entire property of *Merigol* produced densities of 29.5 and 41.5 macropods/km^2 (Table 6.4). The second count provided the most reliable result, as it involved two times the sampling effort, and was done with more care and the experience gained from the first survey. Hence, the density of macropods on 'Merigol' is likely to be 41/km^2, with the total number being 3,495 macropods. The average for the two surveys was 35.5/km^2 or 3,026 macropods.

Table 6.4 Macropod density (animals per km^2) calculated at *Merigol* from two foot transect surveys.

Species	November 1999	February 2000	Mean
Grey Kangaroo	14.8	17.9	16.4
Wallaroo	10.4	17.5	14.0
Red Kangaroo	(14%)	(4%)	-
Unknown Macropod	(20%)	(11%)	-
Combined Estimate	29.5 14.3 %CV	41.5 13.2 % CV	35.5

The foot transect counts also provide estimates for the number of macropods present in each paddock (Table 6.5). The total of the individual paddock estimates resulted in a higher overall property count, that is most likely due to the high variance and associated errors with the smaller paddock data sets.

Table 6.5 Macropod abundance at *Merigol* from two foot-transect surveys. Figure in brackets is the % CV.

Paddock	November 1999	February 2000	Mean
Anderson	293 (25.3)	522 (24.5)	408
Gorge	406 (39.7)	682 (21.6)	544
Lilly	218 (44.6)	644 (29.9)	431
Patterson	425 (43.6)	302 (35.5)	365
Rockwell	237 (29.8)	278 (21.4)	258
Woolshed	684 (33.7)	896 (20.7)	790
Total (6 paddocks)	2,263	3,324	2,794
Erac	621 (27.9)	613 (22.2)	617
No. 1	94 (8.4)	173 (59.7)	134
Grand Total (Property)	2,850 (14.3)	4,019 (13.2)	3,435

Sheep dung, macropod dung, and sheep numbers were then used to estimate numbers of macropods for the whole property. The total number of macropods estimated to be in the six paddocks that contained sheep is 2,793, with a density of 42/km^2. When all seven paddocks were used (includes Erac that had no sheep), the macropod population estimate was 3,485, with a density of 41/km^2.

Macropod number and density was also estimated for individual paddocks using sheep and macropod dung, and sheep numbers (Table 6.6).

Table 6.6 Estimated macropod numbers in paddocks at 'Merigol' calculated from relative proportions of macropod and sheep dung.

	Macropod No.
Anderson	616
Gorge	359
Lilly	284
Patterson	886
Rockwell	243
Woolshed	545
Total	2,933

The combined total for the paddocks was higher than the estimate provided by the whole property calculation above. The individual paddock estimates of macropods using dung compare very poorly with the foot transect counts of Table 6.5 above.

6.3.6.5 Quadrat count results

Dung counts from quadrats in Brigalow paddock were also converted to kg/ha. This indicated that TGP in this paddock consisted of 71% sheep and 29% macropods. The time taken to collect this field data was the same as that for the transect procedure, and generally less than that taken for the step-points.

Part B. Managing numbers of herbivores

Techniques for managing numbers of herbivores were recorded through a number of grazier forums and some were trialed through on-property research.

6.3.7 Grazier forum reports

The grazier survey booklet, *Grazier perceptions for TGP in the mulga lands of the Murray-Darling Basin: Part A, signs and management,* the NSW and Qld grazier workshops, and the mind-mapping workshops (*Total grazing pressure project mind-mapping workshops*, by K. Hodgkinson and S. Marsden) recorded practices used by graziers to manage numbers of herbivores. When feed supplies decline, domestic stock are generally sold or agisted, feral goats are mustered and sold, and macropods are harvested by professional shooters.

6.3.8 Grazier case study publication

Graziers' experiences in managing mulga country also describes practices used by graziers to manage numbers of herbivores, including agistment and selling of domestic stock, mustering feral goats, and harvesting kangaroos. They also noted a number of animal and pasture management practices used to influence the number of herbivores grazing on parts of their properties. Fencing off sections of paddocks allows graziers to control the number of domestic stock feeding at these sites. Reductions in grazing pressure are also achieved by fencing off or turning off waters, and by rotational grazing and resting. Some graziers also indirectly control kangaroo numbers by maintaining tall pastures that are not preferred by these animals. Others have made commercial harvesting of kangaroos more effective by focusing shooters on rested paddocks and recently burnt areas.

6.3.9 Self-mustering publication

Modifications to the spear gates were made to accommodate the smaller body width of goats. The two bottom sets of spear arms have been modified to close the entrance and exit gaps to 20 mm, preventing goats from escaping through the spear gates.

A slide gate has also been incorporated into the spear gate design to close off the exit and entry gates. The slide can also be set at different heights, effectively targeting particular species of stock for self-mustering. For example, the slide gate can be locked into a half-way position on the exit gate to allow sheep and goats to exit but retain cattle in the enclosure. Alternatively, the slide can be locked half-way on the entry spear gate to block cattle from entering and allow sheep and goats to access the enclosure for mustering.

Trials also found that the small opening in the spear gates required to trap goats discouraged sheep from entering the traps. When sheep are to be mustered two spacers have been introduced to widen this gap to 150 mm.

The costs and benefits of self-mustering was compared with those for traditional mustering (dogs, bikes, planes) at the properties where the self-mustering enclosures had been constructed.

For traditional mustering, the average cost per head at the four sites ranged from $0.16 to $0.33 for sheep, $0.67 to $3.86 for cattle, $2.15 to $3.52 for goats, and $4.51 to $9.86 for kangaroos (Table 6.7). There was substantial variation between mustering/harvesting events depending on the number of animals mustered or harvested. When the four sites were combined, the average mustering cost per head was $0.20 for sheep, $1.72 for cattle, $3.04 for goats, and $5.54 for kangaroos.

Table 6.7 Cost per head for traditional mustering of sheep, cattle, and goats, and harvesting of macropods at four locations.

Site	Sheep ($/hd)	Cattle ($/hd)	Goat ($/hd)	Macropod ($/hd)
Charleville Control	$0.17	$3.86	$2.64	$9.86
Charleville Treatment	$0.33	$2.67	$2.15	$8.02
Tambo Control	$0.17	$0.67	$2.91	$4,51
Tambo Treatment	$0.16	$1.33	$3.52	$8.36
Average	$0.20	$1.72	$3.04	$5.54

The average cost per head for self mustering at two sites ranged from $0.15 to $0.31 for sheep, and $0.54 to $1.12 for cattle (Table 6.8). When the two sites were combined, the average cost per head for self mustering $0.21 for sheep, $0.77 for cattle, and $0.70 for goats.

Table 6.8 Cost per head for self-mustering at the two study sites

Site	Sheep ($/hd)	Cattle ($/hd)	Goats ($/hd)
Charleville Treatment	$0.31	$1.12	$0.70
Tambo Treatment	$0.15	$0.54	n.a.
Average	$0.21	$0.77	$0.70

The project publication, *Self mustering enclosures: cost effective, multi-purpose and safer*, by Peter Connelly, Darrell Horrocks, Lester Pahl and Katrina Warman, provides further comparisons of the costs and benefits of self-mustering and traditional mustering.

6.3.10 Macropod congregation proposal

This experiment commenced in November 1999 but was postponed due to rain that provided alternative water sources for macropods. The project has had to rely on information collected by other projects on the capacity of self-mustering enclosures or similar devices to concentrate macropods, and on the observations of graziers.

6.4 Discussion

The long-term success or failure of all grazing strategies hinges around management's ability to control the frequency and severity of defoliation of individual plants over time and space (Heitschmidt and Walker 1996). Graziers do this by matching the kinds and numbers of grazing animals to the availability of vegetation. This requires knowledge of the number of herbivores present, the amount of pasture available, and an ability to change herbivore numbers when necessary.

Part A. Monitoring numbers of herbivores

Numbers of herbivores can be monitored in two ways. Firstly, visual signs observed across paddocks or properties provide graziers with information on qualitative or relative changes in herbivore numbers. Secondly, quantitative information on numbers can be obtained using systematic monitoring procedures.

6.4.1 Visual signs of numbers of herbivores

Graziers know the number of domestic stock present on their properties and do not need to monitor numbers of these. Native and feral herbivores are not constrained by fences, and come and go over time, resulting in substantial fluctuations in numbers. Graziers use signs to help them monitor changes in the abundance of these animals on their properties.

These signs tend to be used informally to provide qualitative estimates of the numbers of feral and native herbivores present on properties. Signs include the frequency of sighting animals, as well as indirect measures such as tracks and dung. Monitoring of native and feral herbivores using signs provides information on trends in abundance of these animals over time. Graziers would not know the number of each herbivore species present at any one time, and often under-estimate the number present on their properties. However, years of experience with reading signs and the impact associated with these would be sufficient for many graziers to make decisions on the need to manage native and feral herbivores.

6.4.2 Self-mustering congregations

Self-mustering enclosures also provide qualitative information on herbivore numbers. The number of feral goats trapped and the number of macropods that accumulate outside enclosures during dry weather both offer information on the relative abundance of these animals.

Few goats were trapped and macropods did not accumulate outside of enclosures during this project due to the regular rainfall experienced around Charleville. However the observations of graziers and other projects provide some insight into their capacity to provide qualitative estimates of herbivore numbers.

Graziers have observed macropods congregating around self-mustering enclosures when they have trapped feral goats. Large numbers of macropods have accumulated at waters during the night, and many of these were still at the enclosures the next morning.

Similar congregations of macropods have been observed when electrified wires or fences have been placed around artificial water points. Reports have shown that macropods will accumulate at waters when access is temporarily denied.

While the number of goats trapped and the number of macropods accumulating at waters are significantly influenced by weather, they are also a function of the number of these animals present in the immediate area. As with the other qualitative indices and signs, experience with the site and the weather conditions is required for this information to be useful for monitoring numbers of feral goats and macropods.

This technique, while reliant on dry weather, has considerable potential for monitoring feral goats and macropods. It is not labour intensive because it occurs at water points only, and is a component of the harvest activity for these animals.

6.4.3 Spotlighting transects

The number of macropods observed at night from a vehicle with a spotlight is poorly related to the density of these animals. This is due to variation in the visibility of animals at different locations, differences in the distribution of shelter and feeding sites, and the impact of weather and phases of the moon on kangaroo behaviour. For example, a spotlight transect that passes through a heavily timbered mulga paddock will record far fewer animals than a similar length transect through an open paddock. Similarly, a transect that passes through a narrow corridor where macropods concentrate to feed will record many more animals than a transect passing through sheltered areas nearby. As with the line-transect counts, accurate results from spotlighting requires many kilometres to be surveyed, averaging across many different conditions.

The number of macropods observed along spotlight transects can be used as an index of relative abundance. Experience with the results of spotlight surveys over time is again required for these counts to be useful for monitoring numbers of macropods.

An advantage of the spotlight transect technique is that it is less affected by weather than is water point congregations. A disadvantage is that it requires several hours of work at night to obtain sufficient counts of macropods.

6.4.4 Mechanical counters

Mechanical counters record the number of goats and macropods that pass through swing gates to access water in self-mustering enclosures. This qualitative estimate of animal numbers is similar to that provided by the congregations of these animals at enclosures. However it does not distinguish between goats and macropods, and is effected by pigs and other animals that may pass through the gates. While experience may enable mechanical counts to be used for monitoring, it is an expensive and unreliable technique.

6.4.5 Diets of herbivores

Changes in the composition of herbivore diets and the availability of palatable plants are used by graziers as signs of TGP. As grazing pressure increases herbivores consume more unpalatable plants and/or graze in parts of paddocks that are rarely visited. Both diet composition and grazing distribution are indexes of grazing pressure, and considerable knowledge of the diet and grazing behaviour of animals in paddocks is needed before this can be used to monitor grazing pressure.

6.4.6 Dung counts

Dung counts can and are used in a qualitative way by graziers to monitor grazing pressure. Counts of dung can also be incorporated into systematic procedures that provide accurate quantitative estimates of the numbers of animals and the composition of grazing pressure. Video filming of grazing has shown that the amount of dung left behind by herbivores is closely related to the time spent grazing by them in pastures of the mulga lands. Hence dung can be used to quantify grazing pressure.

This project examined three dung counting procedures for monitoring macropods and grazing pressure. The step-point procedure is relatively fast, requires little in the way of equipment, and produces accurate results when adjusted by a regression equation formula. It's only limitation is that it requires sheep to be present in paddocks, and thus cannot be used in paddocks that are rested or only have cattle. The step-point procedure is a practical means by

which graziers can accurately estimate kangaroo numbers and TGP. It is preferred to the quadrat and line transect methods which use dung weight to calculate grazing pressure and kangaroo numbers.

The quadrat technique was slow, sampled small areas of ground, and produced variable results due to the low sample size of dung. It is therefore not recommended as a procedure suitable for monitoring grazing pressure and/or numbers of macropods.

The line transect technique produced accurate results for the entire property, but was unable to estimate the number of kangaroos present in individual paddocks. It may have potential for estimating macropods in areas devoid of sheep, but this requires further investigation and development.

Part B. Managing herbivore numbers

6.4.7 Tools for mustering/harvesting herbivores

The limited data provided by this project suggests that self-mustering is cheaper than mustering stock by traditional means (dogs, vehicles, planes). While the mustering costs for sheep were similar, the costs of mustering goats and cattle were substantially reduced by using self-mustering enclosures. Similar savings using self-mustering have also been reported for goats in NSW and cattle in north Qld.

It should also be noted that the self mustering enclosures can be used to manage TGP. The enclosures examined in this project were used to trap cattle, sheep and feral goats, effectively reducing the costs of mustering each type of herbivore. These enclosures also have potential for harvesting macropods. A study by Hacker and Freudenberger (1997) observed that macropods could be congregated at waters using an electrified wire or fence, increasing the efficiency of harvesting or culling.

6.4.8 Strategies for reducing excess stock

Interviews and workshops with graziers recorded a wide range of practices used to match numbers of herbivores to the availability of feed on properties. For domestic stock common adjustment practices are selling, agistment, and reducing breeding. All actions have advantages and disadvantages that vary over time. For example, agistment may be preferred on an occasion as it allows graziers to retain a particular bloodline. On other occasions the low availability of agistment properties or the long distances involved in trucking stock make this option expensive, and selling stock will be preferred. Hence graziers weigh up the costs and benefits of these options at the time when stock adjustments are needed.

Graziers also manage numbers of herbivores at the scale of paddocks or parts of paddocks, in an attempt to evenly spread grazing pressure. Whole or parts of paddocks are rested by excluding stock with fences, and by closing artificial waters. Conversely, herbivores are encouraged into unfrequented parts of paddocks by placing additional waters in these areas. This enables graziers to reduce grazing pressure in parts of their property without having to reduce numbers of stock.

A reasonably common practice of graziers that reduces the need to manage herbivores is the use of conservative stocking rates. Many graziers maintain stocking rates in good seasons that are generally below carrying capacity at that time. This provides an opportunity for pasture yields to increase through growth and regeneration, providing feed for many months ahead.

The need to de-stock through sales or agistment, harvest kangaroos, and muster feral goats are all reduced by conservative stocking rates.

6.4.9 Continuous grazing versus tactical rest

Traditional sheep grazing enterprises in the mulga lands operate self-replacing flocks that are generally set stocked (continuous grazing). Tactical resting by agistment is an alternative grazing strategy during drought (Hacker and Hodgkinson 1996).

Modelling was used by CSIRO Wildlife and Ecology to compare the long-term profitability of the two strategies: set stocking and tactical rest by agistment. The results were presented to the VI th International Rangeland Congress (Hodgkinson *et al.* 1999).

A hypothetical mulga property of 23,000 ha (an average size) in the Cobar district of New South Wales was simulated by CSIRO Wildlife and Ecology. The property had a wether flock and income was derived exclusively from sale of wool and live sheep. Simulations were from June 1962 to December 1996 based on data from the Cobar Meteorological Station.

Average gross profit over the 33 years of the simulation is summarised in Table 6.9. Under set stocking, profit decreased continuously with increasing stocking rates. Under tactical resting, profit increased progressively over the range of stock densities studied.

Profit was higher under tactical resting and diverged with increasing stock density, particularly between 0.9 and 1.2 DSE/ha. The advantage reflects the higher productivity from the forage resource through reduced stock losses and increased wool production following tactical rest.

Table 6.9. Average gross profit over a 33 year period ($/ha/yr) for set stocking and tactical resting by agistment strategies.

Stocking Rate DSE/ha	Set Stocking $/ha/yr	Tactical Resting $/ha/yr
0.3	1.30	1.20
0.6	0.40	4.70
0.9	- 3.50	6.70
1.2	- 11.70	8.60

The simulations suggest that tactical rest by agistment is financially attractive. Average profits increased continuously with stock density under tactical resting but declined sharply at the highest stock density under set stocking. The main advantage of the tactical resting strategy is that it allows higher stock numbers to be carried during favourable seasons, while resting the pasture during drought.

Tactical rest by agistment is also more profitable than set stocking due to lower sheep deaths and the maintenance of wool production during drought. The cost of replacing drought-killed sheep is also avoided, sheep bloodlines are maintained and the pasture base is maintained or improved. Some negative impacts of agistment include introduction of weeds and parasites from other properties, and possibly poorer management of sheep while on agistment.

One assumption of this study is that agistment is freely available. If more graziers adopted the strategy agistment opportunities would be more competitive, and costs would rise. During widespread droughts the higher animal transport costs over longer distances may preclude agistment and force the sale of stock.

The implication of this simulation study by CSIRO Wildlife and Ecology is that tactical rest of domestic stock by agistment in the mulga lands is more profitable and ecologically sustainable than set stocking of sheep in the long-term.

6.4.10 Strategies for managing numbers of macropods

Graziers generally allow for macropod grazing pressure by running less stock than they would in their absence. This is at least partly due to their inability to control macropod numbers, so in many cases they have learnt to live with them.

Graziers show little concern for macropods when pasture is plentiful and their stock have sufficient feed. However, this attitude changes when feed becomes limiting, and macropods emerge from the more thickly timbered areas to chase remaining grass in the more open areas. At this time TGP can be very high, leading to over-grazing and damage to vegetation and soils. It is unfortunate that this very high level of use of rangeland vegetation results in little benefit, as a high proportion of macropod populations eventually die during drought. There is simply not enough feed to support the population which has grown over a series of average or above average rainfall years.

The number of macropods in the rangelands of western and central Qld are now at record levels, with a total of 21.8 million large macropods (grey kangaroo, wallaroo, red kangaroo) recorded in the harvest zone in 1999 (Qld Parks and Wildlife Service). On many grazing properties macropods now make up close to half of the TGP, creating substantial demand for food resources, principally perennial grasses.

Domestic stock numbers may have also increased over the last few years, as graziers have not needed to sell or agist them, and like macropods, their mortalities have been low and breeding success relatively high. However, depressed commodity prices for wool and beef have prevented large increases in numbers of domestic live stock.

When the next drought occurs, graziers can reduce numbers of domestic stock, and in dry times it is relatively easy to muster feral goats that also concentrate at artificial waters. However, what can the grazier do to manage kangaroos, which make up half of their TGP?

At this time the commercial macropod industry will be completely saturated, and will not be able to take the full quota. As this quota is only 15 to 20% of the number of macropods estimated in the harvest zone, there will be many other kangaroos that will die of starvation. Half of the current population, around 10 million animals, is likely to die during the next significant drought. Before these animals die they will combine with domestic and feral herbivores to over-graze perennial grasses at a time when they are most vulnerable. Heavy utilisation of grasses during drought results in significant mortality, and is a precursor to rangeland degradation.

At the moment there are very few options available for managing macropods in accordance with the carrying capacity of the rangelands. This greatly limits the capacity of pastoralists to manage TGP.

Graziers are able to obtain damage mitigation permits to cull macropods that over-graze and damage their properties. However, most do not, as they do not have the time to spend many weeks spotlighting and shooting macropods. They are far too busy managing their properties and domestic stock during the day to also spend much of the night shooting macropods.

At this stage we have little to offer graziers who experience high levels of macropod grazing pressure. They generally receive little income from the commercial macropod industry, and this industry is not able to manage macropods in accordance with land capability. It is then left to graziers to manage the over-abundance of macropods, and they essentially do not have the tools to do this. We criticise them if they let their stock die of starvation in droughts, but the deaths of 10 million macropods for the same reason largely goes unnoticed.

Macropod management has been grid-locked by a large and complex array of opposing social, economic and political agendas. At this stage the active opposition to most if not all strategies for managing macropods has far exceeded the will of government agencies and industry groups to deal with the obvious problems.

The high level of concern with macropod populations in the rangelands warrants continued efforts by stakeholders to reach agreement and find solutions. The MDBC funded project of NSW Ag. titled, *Evaluating alternative management strategies for kangaroos in the Murray-Darling Basin*, is currently working with stakeholders to improve the outcomes of macropod management.

6.5 Recommendations

1. Further work is required to trial and adapt methods that graziers and other land managers can readily use to monitor numbers of herbivores on pastoral properties. A suitable method should then be packaged and promoted to rangeland graziers.

2. State and Commonwealth governments should provide funds through regional adjustment strategies such as WEST 2000 and South West Strategy, to control access to water by domestic and feral stock, and macropods, providing a mechanism for controlling grazing pressure and the distribution of grazing. Funds could be provided for construction of self-mustering enclosures at artificial water points, and for fencing off natural water-courses. This would also conserve riparian vegetation.

3. Using a full cost-benefit analysis, compare the economic and ecological outcomes of two grazing management strategies: continuous set stocking, and tactical management. Promote the results to rangeland graziers and encourage a shift to the preferred grazing strategy.

4. Increase the harvest rate of macropods in some years to prevent populations of red kangaroos, grey kangaroos and wallaroos from exceeding the carrying capacity of the rangelands. Investigate the use of flexible harvest rates as a mechanism for managing population size, where the harvest rate would be varied in response to changes in population size and growth rate.

Chapter 7

Objective 5

Tools and knowledge for managing TGP incorporated into regional initiatives and Catchment Management and Landcare groups.

7.1 Introduction

An important objective of this project was to work with the large regional strategies of West 2000 in NSW, and South West Strategy in Qld; and with Catchment Management and Landcare groups to promote the outputs of the project.

These organisations and groups are well placed to promote project outputs to the grazing community and other stakeholders, and address constraints to sustainable management of grazing.

7.2 Methods

7.2.1 Contribution to West 2000 TGP program

Members of the project team from CSIRO Wildlife and Ecology and NSW Ag. were on the Total Grazing Pressure Activating Committee of WEST 2000. This committee developed and oversaw a number of initiatives in NSW including workshops at Bourke and Wanaaring, TGP management grants to manage TGP on properties and TGP on-property trials and demonstration sites.

This MDBC project also contributed funds to the development of the step-point kangaroo monitoring procedure that was developed by NSW Ag. for WEST 2000.

7.2.2 South West Strategy and West 2000 represented on Steering Committee

The Steering Committee contained representatives from South West Strategy and West 2000. The role of these representatives was to facilitate two-way communication between the relevant regional strategy and the project. Robert Crichton represented South West Strategy and Rory Treweeke represented West 2000.

7.2.3 Landcare and Catchment Management represented at Roma workshop

Landcare and Catchment Management were represented at the CCG workshop in Roma. These representatives were: Helen Agnew, Landcare Co-ordinator in Charleville; Peter Clarke, Queensland Landcare Council; Tonia Jackson, ICM Co-ordinator for the Warrego-Paroo Catchment, and Steve Orr, Executive Officer with West 2000. This interaction provided an opportunity to build links with these groups. It also supplied representatives with knowledge about the project and information on the tools and knowledge the project would produce. The Qld Landcare Council was also invited to the CCG workshop at Bourke, but was unable to attend.

7.2.4 Landcare involvement in NSW workshops

Four workshops were held across the mulga lands of NSW to discuss the results of the grazier survey and to examine areas for future action. Richard Etherington, Landcare co-ordinator for the Western Division, assisted CSIRO Wildlife and Ecology in the planning and facilitation of these workshops. Richard brought important experience and skills to the workshops but his involvement also allowed him to be exposed to the tools and knowledge being generated by the project. Members of a number of Landcare groups attended the workshops and took information back to their groups.

7.2.5 Goals from CCG workshops incorporated in natural resource strategy

The South West Natural Resource Management (SWNRM) Group, is developing a strategy to set direction and priorities for natural resource management in south west Qld. Part of this strategy covers the issue of managing TGP. Due to involvement of the SWNRM coordinator in the Roma CCG workshop the group was aware of the goals for managing TGP that had been generated by the project. A more complete list of these goals and actions were then forwarded to this group by the project team, and were partly incorporated into the strategy document.

7.2.6 Input and attendance at West 2000 TGP workshop series

A series of workshops were commissioned by West 2000 and conducted by Sinclair Knight Merz across the Wester Division of NSW. The purpose of these workshops was to identify the best management practices for TGP in the region. Two members of the project team attended the workshop in Wanaaring and three members were present at the workshop in Bourke. Involvement in these meetings facilitated transfer of information about the project and allowed team members to contribute their knowledge and experience about managing grazing pressure.

7.2.7 Landcare groups involved in the Reading the Landscape field day

Personal invitations to *Reading the Landscape field day* at Charleville were sent to each Landcare group in the region. As a result, four representatives from the Bollon Landcare group, four from the mid-Warrego, and one from the Warrego Landcare group attended the field day. In some cases their interest was how they could use the skills on their own property whilst in other cases the focus was on a method for monitoring Natural Heritage Trust funded projects.

7.2.8 Communication of project outputs

Many individuals and groups have participated in project meetings, workshops, survey, on-farm research, and tours. They have all received copies of the reports on each event/activity, and hence are well aware of project outputs.

7.2.9 Membership on Queensland Landcare Council TGP Working Group

Peter Johnston from QDPI chaired the Total Grazing Pressure Working Group of the Queensland Landcare Council. This was a short term group formed to raise awareness of TGP amongst government organisations. The group developed a ten-page brochure that was sent to a wide range of government organisations.

7.2.10 Input into the South West Nature Conservation Strategy

The South West Nature Conservation Strategy fits within the strategy currently being developed by the SWNRM Group. It is a fully developed component that includes goals, desired outcomes, and action plans. A member of the project team attended the session to

develop action plans and was able to contribute the knowledge and tools already developed for managing TGP as well as highlighting areas that had been identified throughout the project as requiring further action.

7.2.11 Attendance at South West Strategy and West 2000 meetings

Project team members have attended meetings in south west Qld of the South West Strategy, the SWNRM Group and the Regional Management team. On at least three occasions project team members have reported to the group on project activities and outputs. On other occasions team members have been present to listen, contribute and participate in meetings. One project team member is also a proxy member on the SWNRM Group and has attended several meetings of this group. She also assisted the group by facilitating a workshop to identify natural resource management priorities.

Four meetings of West 2000 were attended by project team members. They helped to develop and oversee on-property trials for the management of TGP, including the evaluation of a large number of proposals that came before the group.

7.2.12 Input into other natural resource management strategies.

Members of the project team attended meetings to discuss interim natural resource management strategies for the Qld Murray-Darling Basin, and the Maranoa-Balonne catchment, and commented on draft plans. The goals and actions generated by this project were communicated to these strategies for consideration.

7.3 Outputs

7.3.1 West 2000 TGP program

There were over twenty applications for grants to establish paddock scale studies of grazing management on pastoral properties and over $300,000 was allocated to establish the studies. A project officer appointed by NSW Ag. was advertised and the successful person began work in Cobar on 27 March. A meeting to develop the program for this person took place on 30 March and two project team members assisted in this process. A full 2-day meeting with the successful pastoralists and scientists was held in Cobar on 22 and 23 May.

The projects approved address these issues:

- effects of excluding kangaroos by erecting electric fencing;
- effects of controlling kangaroos and goats at different stocking rates;
- rotational v's continuous grazing;
- cell v's continuous grazing; and
- low TGP effects after prescribed fire.

7.3.2 Brochure for Queensland Landcare Council

This brochure was produced in February 1997 by the Grazing Pressure Working Group of the Queensland Landcare Council. It is a ten-page document that covers what is TGP, its impacts and influences, the need to manage TGP, current progress towards managing TGP and a list of references for further reading.

7.3.3 Natural resource management strategy for south west Qld

This project identified goals and actions for managing TGP that were incorporated into the *Natural resource management strategy for south west Qld.* As a result, the monitoring and management of TGP is a high priority for south west Qld.

7.4 Discussion

7.4.1 More people exposed to the project and what it is producing

Involvement with groups such as Landcare, South West Strategy and West 2000 allows for two-way communication through a well established network. Interacting with individuals who represent or belong to these groups can provide them with information on the tools and knowledge produced by the project. This can then be passed on to others in the group, allowing for greater exposure of information on the project and its products.

Considering the time required to develop effective partnerships (see chapter 3), using pre-established networks may also be a useful way to realise the benefits of partnerships without the same level of time and effort required for establishment. People working in these groups are familiar with each other and are likely to have developed effective operational procedures. This approach would still require time and effort to build a partnership with the project team and is unlikely to offer the same level of commitment as a group specifically designed to work on the topic of TGP.

7.4.2 Distribution of project outputs

A large number of individual graziers, government departments, community conservation groups, industry organisations, and regional strategies have been involved in project activities, and have received project reports. This has ensured that outputs of the project have been developed after consultation with stakeholders, and that reports on outputs have been widely circulated.

Major project publications (*Graziers' experiences in managing mulga country*, and *Self mustering enclosures: cost effective, multi-purpose and safer*) have been mailed out to several hundred grazing properties, Landcare Groups, and Integrated Catchment Management Groups in the mulga lands of the Murray-Darling Basin, and to members of the project Steering Committee and Community Consultative Group. This has ensured that publications of the project were received by a large number of stakeholders.

7.5 Recommendations

1. Large projects should possess a dedicated communication/extension officer. This person would be responsible for liaison with related projects or strategies, exchanging information, and achieving cooperation and collaboration of activities.

2. Projects should develop and implement a communication plan for project activities that involve or relate to other organisations.

3. Conduct a full cost-benefit analysis, particularly financial and ecological outcomes, of popular grazing land management practices, and widely communicate the results to the grazing industry. Practices that warrant evaluation are: prescribed burning, management of macropods, goat farming, conservative stocking, and agistment of stock during drought.

Chapter 8

Conclusions

This project has placed a great deal of importance on developing good working relationships with the end-users, the pastoralists of the mulga lands. This relationship was built on respect for their experience, knowledge and skills with managing TGP. The project team worked closely with graziers, exchanging ideas and information on grazing practices.

Community, industry and government stakeholder groups contributed to the project through workshops and tours. This enabled them to voice their expectations for management of the mulga lands, and to contribute to the formulation of strategies for achieving the goals of TGP management.

8.1 Working in partnerships

Partnerships with stakeholders can deliver significant benefits, including larger and more effective communication networks, a more receptive audience for project outputs, assistance from other groups, and greater relevance of the outputs for end-users. However, partnerships require that projects can be modified, and thus the project, the project team and the funder need to be flexible. Projects that have no room for change are unlikely to develop and maintain partnerships.

Effective partnerships also require a high level of commitment from all parties involved. The higher the level of commitment the more effective is the partnership. Maintaining this commitment and enthusiasm for the partnership requires positive, frequent, and fruitful interaction. This can be a challenge for three-year projects, as half of this time will be required to establish the project, and then the new partners may wish to modify the objectives. Preferably, partnerships should exist before projects commence, and ideally the partners should jointly develop project submissions.

8.2 The power of stakeholders

Participants of workshops run by this project generally agreed that grazing in the mulga lands had many stakeholders. Some people felt that the graziers were the primary stakeholders, and the others were interest groups. More recently it has been suggested that the graziers may be regarded as end-users, and industry, government and community groups as stakeholders. There was also general agreement that stakeholders working together were likely to achieve much more than one group alone. The large number and diverse stakeholders involved in this project demonstrated considerable enthusiasm for coming together to discuss the management of grazing in the mulga lands. Further opportunities should be provided for these groups to contribute to the formulation of sustainable grazing management practices.

Stakeholder meeting in the mulga lands at Charleville

8.3 Elusive grazing goals

All stakeholders found it difficult to identify clear and specific goals for the management of TGP. In most cases stakeholders nominated actions instead of goals. This may have been due to a lack of experience in goal setting, highly variable and unpredictable ecological and economic conditions, insufficient knowledge of the mulgaland grazing system, and general lack of systematic grazing management strategies amongst graziers. Whatever the reason, stakeholders were more action rather than target orientated. Consequently, a few broad goals were identified and many specific actions.

While more specific objectives and targets need to be developed in the future, the current goals and actions provide more than ample direction for the management of TGP in the mulga lands today.

Graziers will need to be actively assisted by all stakeholders if the majority of the wide-community goals for managing TGP are to be achieved.

8.4 A multitude of indicators of vegetation and soil change

Graziers use many signs of vegetation, soils and animals to help them make decisions about managing TGP. However, it is unlikely that they use these signs in a systematic way to monitor vegetation and soil, and thus little is known about how graziers use these signs or the effectiveness of this approach. Strengths of this monitoring procedure are that it potentially covers many elements of the grazing system, and enables graziers to look across the entire property reasonably quickly. Both attributes make this system suitable for tactical management of grazing. Weaknesses include lack of planning, irregular monitoring, difficulty of interpreting indicators, and lack of records.

Scientists, on the other hand, prefer a structured and systematic approach to monitoring indicators of vegetation and soil change. Strengths here include accuracy, repeatability, consistency, and records. However these procedures tend to monitor small areas over short periods of time, and often cannot be extrapolated to encompass the huge spatial and temporal variability of grazing properties. The challenge is for graziers and scientists to work together to combine strengths of a range of monitoring procedures.

A number of science based systematic monitoring procedures now utilise many of the signs used by graziers on their properties. Procedures include:

- *Understanding more about your landscape*
- *Early warning indicators of perennial grass collapse*
- *Glove box guide to the tactical grazing management of semi-arid woodlands*

8.5 Many ways to monitor numbers of herbivores

Numbers of herbivores can be monitored in two ways. Firstly, visual signs observed across paddocks or properties provide graziers with information on qualitative or relative changes in herbivore numbers. Visual signs include the frequency of sighting animals, as well as indirect measures such as tracks, camps and dung. These qualitative measures can also be built into more systematic monitoring procedures. Examples include congregations of herbivores at controlled waters, animals seen along spotlight transects, numbers recorded by mechanical counters, diet composition, and dung counts. Experience with reading signs, and knowledge of trends and impacts associated with these would be sufficient for many graziers to make decisions on the need to manage native and feral herbivores.

Quantitative information on numbers can be obtained using systematic monitoring procedures. Dung counts can be quite easily converted into numbers of kangaroos using fairly simple regression equations. The step-point dung counting procedure developed by NSW Ag. has been packaged for grazier use, and is now ready for use.

8.6 Domestic stock and feral herbivores can be controlled

Interviews and workshops with graziers recorded a wide range of practices used to match numbers of herbivores to the availability of feed on properties. For domestic stock common adjustment practices are selling, agistment, and reduced breeding. When the next drought occurs, graziers can reduce numbers of domestic stock, and in dry times it is relatively easy to muster feral goats which also concentrate at artificial waters. However, what can the grazier do to manage kangaroos, which can make up half of their TGP?

8.7 What can be done with macropods?

At this stage we have little to offer graziers who are experiencing high levels of macropod grazing pressure. Government agencies and industry groups are either not willing or do not have the mandate to manage numbers of macropods. Graziers are left with the problem of over-abundance of macropods, and also have no mandate, tools or resources to reduce macropod population size.

The problem of macropods in the rangelands is large. During the next drought as many as 10 million macropods are likely to die of starvation in the rangelands of Qld alone, and in doing so place enormous pressure on perennial grasses. Stakeholders need to work together to develop agreed goals and strategies for managing macropods, and with their combined weight persuade the agencies and organisations currently responsible for macropod management to implement these.

8.8 The "engine room" of sustainability

It is now possible to manage total grazing pressure to achieve ecologically sustainable use of pastoral properties in the mulga lands. Graziers and scientists collectively possess much of the knowledge and skills required for grazing to be ecologically sustainable. However, from a farm perspective, the difficult challenge will be to identify and implement the sustainable

grazing practices that are also profitable. Hence it will be necessary to continually adapt grazing practices to the ever-changing needs, characteristics and resources of grazing enterprises, land administrators, and consumer markets.

The development and adaptation of grazing practices should be led by graziers, with assistance provided by individuals and organisations that possess relevant information and skills. The graziers and grazing properties should be the "engine rooms" for generating grazing practices that are both sustainable and profitable. Under these circumstances developments are likely to be more rapid, better targeted to the needs of grazing enterprises, and more highly regarded and more widely adopted by graziers.

Government agencies and research organisations can make valuable contributions to the development of sustainable grazing practices, but they should not instigate and drive these activities. A traditional top-down approach to achieving sustainability has produced significant change in the attitudes and practices of some sections of the grazing industries. However this change has not occurred at the rate expected by the wide-community. Also, there are still many graziers who are either unaware of the information generated by these efforts, or are unwilling to adopt them.

If graziers are to instigate and drive the development of sustainable grazing practices, how is this to occur? How do they bring together all of the people and organisations that possess knowledge and skills that can improve the management of grazing? Is the current natural resource management network a suitable forum for graziers to obtain information?

8.9 Natural resource management network

Government agencies, funding organisations, industry groups, community groups, regional strategies, and Landcare and Catchment Management groups have been in existence for many years. They have established group processes and have a valuable network both within and beyond the local community. This network also contains a vast amount of information on the characteristics and management of natural resources, and much of this has relevance to the management of grazing enterprises in the mulga lands.

However, this natural resource management network is massive, complex, and cumbersome, and can be quite daunting to access and operate within. Thus, effective contact with this network is time consuming, and requires well developed communication skills. This demand increases substantially for projects that are funded by natural resource management programs. These must submit progress reports, continuing project applications, financial statements, and final reports. Furthermore, agencies and groups often need to comply with a number of internal administrative procedures, using up further resources. Compliance with network, agency and group procedures consumes resources that could have been used directly for on-ground activities. The administrative procedures that have been put in place to ensure that public and industry funds are properly spent can frustrate people who have a strong desire to get on with the job of resource management.

It is doubtful that this network provides an effective forum for graziers to access the people, knowledge and skills that they require for sustainability? Perhaps these graziers would be more attracted to a commercially orientated framework?

8.10. A commercial framework for sustainability

Sustainability and profitability need to be addressed simultaneously, in a framework that is compatible with the whole grazing enterprise. Perhaps this is why many graziers are now turning to commercial consultants and to each other to provide the information and assistance they need to improve their businesses. Consultants and grazier groups tend to take a business orientated approach to the management of natural resources, and this is more appealing and better suited to graziers. "Grazing for profit" and "holistic grazing management" are two examples of grazing strategies provided by commercial consultants that have attracted a high level of grazier interest. For example, around 40 graziers paid to attend a Resource Consulting Service field day on "Grazing for profit" in Augathella. A few weeks prior to this a well advertised meeting to discuss the management of total grazing pressure in the same town was attended by two graziers.

Consumers and producers alike appear to view the management of the environment and production of commodities as separate activities. Hence, efforts to conserve natural resources are often regarded as a "community service" that are the responsibility of community groups and government. Landcare, and now the broader Natural Heritage Trust, encourage and coordinate these efforts. These initiatives have provided valuable information and training, and should continue. However, they could be augmented by a production or commercially orientated framework that provides a home for these outputs.

The current commercial framework or production chain for most if not all primary industries has a fundamental flaw with regard to sustainability - the market price of meat and fibre is not linked to the condition of the natural environment of production systems. Instead, consumer markets demand cost-efficient meat and fibre, and thus the costs associated with managing the natural environment have been excluded. This system does not motivate primary producers to actively manage the natural environment.

The high level of active management of natural resources desired by many stakeholders can only be achieved if this is rewarded in the market place, thereby making profitable grazing synonymous with sustainable grazing. Many graziers in the mulga lands are looking for new ways to manage their properties, as the practices and enterprises of the past are not working for them. They are now receptive to new technologies and strategies, particularly those that have the potential to be both more profitable and more sustainable.

The International Standard for Environmental Management Systems (ISO 14000) provides one mechanism for using the power of market forces to improve environmental management. Properties that are certified under this system may be in a position to maintain market access and/or secure premium prices for their meat and fibre. Under these circumstances consumers would reward pastoralists for actively managing to reduce the environmental impacts of grazing. This would motivate graziers to seek out, use and build on the information and best practices currently available. It would also allow them to engage consultants, purchase equipment, network with agencies and groups, and undertake training to improve the sustainability of their enterprises.

This alliance between consumers and producers appears to be logical and reasonable, and has the potential to closely align profitability with ecological sustainable development. It deserves further investigation.

Consumer selecting meat in a super market

The development of grazing management strategies that are consistent with the ISO 14000 system of environmental management is one activity that will be proposed to the Community Consultative and Core Grazier Groups of this project. These groups have been invited to continue on into a new NHT grazing management project in western Queensland.

8.11 Recommendations

1. Sustainable grazing practices need to be embedded in flexible management systems that have the capacity for continual improvement and continual adaptation to changing circumstances.

2. There is a clear need for a more holistic approach to the management of natural resources, including the economic and social components that are related to sustainable grazing practices. The MDBC Basin Sustainability Program provides a framework for such an integrated approach. It needs to be translated into the context of the local production system.

3. A commercially orientated natural resource management strategy should be developed as an additional framework for graziers, where profitable grazing is synonymous with sustainable grazing.

4. Rangeland scientists will need to assist graziers develop and validate the systematic methods for monitoring vegetation, animals and soils that are required by environmental certification programs, such as ISO 14000.

5. Government and industry to fund communication and marketing strategies that are required to inform consumers of the important role they play in achieving ecological sustainability in primary production systems.

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Appendix 1

Organisations that participated in this project

Agriculture, Fisheries and Forestry Australia
Australian Conservation Foundation
CSIRO Wildlife and Ecology
Department of Land and Water Conservation, NSW
Environment Australian
Goat Industry Council of Qld
Graziers
Integrated Catchment Management (ICM)
Kangaroo Industry Association of Australia
Landcare NSW
Landcare Qld.
Murray Darling Basin Catchment
Nature Conservation Council of New South Wales
New South Wales Agriculture
New South Wales Farmers Association
Professional Shooters Association of Qld.
Qld Conservation Council
Qld Department of Natural Resources
Qld Department of Primary Industries
Qld Environmental Protection Agency
South West Strategy
United Graziers Association
West 2000
Wildlife Preservation Society Qld
Woolmark Company

Appendix 2

Signs used by graziers to manage TGP

A. Landscape function

- Soil cover.
- Area of sheet and gully erosion.
- Height of grasses.
- Level of water infiltration and water shedding.

B. Pasture and vegetation assessment

B1. Signs related to forage availability

- Stock spend more time grazing or looking for forage, rather than resting.
- Stock on the move but not grazing.
- Stock begin to browse shrubs/trees when pasture becomes limited.
  eg young mulga, kurrajong, leopard wood, wild orange, ironwood.
- Stock spend more time amongst mulga trees than in open pastures.
- Browse line becomes apparent and increases in height.
- Variety of grasses available in Mitchell grass country decreases.
- Amount of pasture available.
  eg remove stock when two thirds of pasture eaten
  eg remove stock when 50% of grass is eaten
  eg when you know you are likely to run out of feed and rain is unlikely, such as little feed left going into winter non-growing season
- Amount of browse available.
  eg remove stock when around half of the leaf of young mulga has been browsed
- When low mulga is depleted.
- Amount of soft herbage in the winter months.
- Nutrient content of stock dung.
- Palatable grasses eaten first, and begin to be eaten out.
- When the green tinge has gone off the grass (flag has gone).
- Height of grasses or proportion grazed.
  eg when a fair percentage of the buffel is eaten down to six inches
  eg before pasture is too far gone to recover
- Stock eat leaves that fall to the ground from trees.
- Limbs pulled down from trees.
- Mulga looks dry.
- Stock begin to eat unpalatable plants.
- Kangaroos start to scratch the soil looking for feed.
- Kangaroos and goats become more visible in open country and along roads.
- Kangaroos and goats begin to utilise food supplements.
- Stock grazing in areas of paddocks not normally frequented eg. ignore wind.
- Stock looking for supplements.
- Pads to water become more evident.
- Stems of buffel grass eaten.

- Dung becomes hard.
- Animals congregate and stay longer at waters.
- Areas within 1km of waters become bare due to heavy grazing.
- Palatable grass species disappear from around waters.
- Becomes dusty around waters.
- Large amounts of dungs from domestic, native and feral animals near waters.
- Tracks to waters become more obvious.

B2. Signs related to fuel availability

- Grass is dry.
- Unable to see much soil due to high ground cover.
- Pasture dense/thick.
- Large amount of feed present around waters.
- Large areas of pasture with seed heads visible.
- Stock grazing in large mobs.
- Stock spending much time resting/contented.

B3. Signs related to utilisation of key species

- Amount of preferred species left after grazing: eg buffel, Mitchell grass, mulga mitchell, Enneapogon, Stipa, and forbs.
- Level of utilisation of preferred grasses near waters.
- Level of utilisation of couch grass present along bore drains.
- When corkscrew grass starts declining.
- Level of utilisation of seedling grasses.
- Amount of leaf (flag) present on grasses.
- When the tops of Mitchell grass have been removed.

B4. Signs of shrub cover

- Amount of shrub cover.
- Number of seedling shrubs present in pasture.

C. Signs of animal numbers

- Numbers of kangaroos and goats seen during the day.
- Numbers of kangaroos and goats seen during the night.
- Numbers of animals seen around waters.
- Dung more obvious on ground due to less ground cover.
- Amount of dung and tracks around waters.
- Amount of dung present in pastures.
- Pasture smells of kangaroo urine.
- Number of kangaroo camps.
- Level of use of pads running through fences.
- Level of use of pads running to waters.
- Damage to fences.
- Amount of pasture and browse removed from spelled paddocks.
- Number of shrubs ring-barked by rabbits.
- Number of active burrows.
- Number of kangaroos along roads and close to house.

D. Signs of soils

- Red soils: loose and erode easily.
- Black soils: dry, cracked and crumbly.
- Depth of top-soil.
- Amount of organic material in soil.
- Area of bare ground.
- Size and area of erosion gullies.
- Amount of scalded ground with reduced water infiltration, and run-off is increasing.

E. Signs of animal condition and behaviour

- Calf or lamb percentages reduced.
- Calves and lambs stunted.
- Calves become woody.
- Sluggish and weak, dragging feet.
- Coats rough and dull.
- Stock visiting waters two or three times a day.
- Stock become poor and lose weight.
- Brightness and condition of stock's eye.
- Deaths, especially of young animals.
- Stock spend more time feeding or looking for feed.
- Old cows lose condition first.
- Mobs split up and scatter across the paddock.
- Tails of poor animals appear in the mob.
- Stock that are slab sided.
- Grey kangaroos lose condition.
- Produce less wool that is tender and contains more vegetable matter and dust.
- Female stock cycle less frequently.
- Poddy lambs come home when feed is limited.

F. Signs related to weather/climate

- Winter rather than summer rain.
- Lack of summer rain to grow grass.
- Little or no rainfall for long periods of time.
- Consecutive dry seasons.
- Two consecutive months of no rain.
- Extremely cold winters – frost.
- Extremely hot summers.
- No follow-up rain.
- Rain didn't fall at critical times for grass growth and survival.
- Persistent strong winds.

G. Long-term monitoring

- GrassCheck used on a few properties.
- Exclosures of CSIRO, QDPI, EPA present on some properties and National Parks.

Appendix 3

Key signs identified by the Queensland core graziers

Pasture and vegetation assessment

- When pasture quantity is in decline approaching a non-growing season.
- Increase in browse line of low mulga.
- When a fair percentage of buffel gets down to six inches.
- As soon as the green tinge is gone off grasses and the flag disappears.
- When the colour and texture of grass diminishes.
- When low mulga runs out.
- Where there is a lack of soft herbage in the winter months.
- GRASS CHECK.
- Identifying and monitoring desirable perennial grasses and transition grasses.

Total grazing pressure

- Dropping and tracks.
- Signs of their eating habits eg trees ringbarked, spelled paddocks eaten, higher browse line.
- Pigs rooting up the ground.
- Visual observation of animals.
- Evidence of kangaroo camps.
- Pasture contamination by urine and faeces of kangaroos.

Soils

- Cracks in black soils and dust from red soils.
- Compaction – amount of water penetrating the soil.
- Soil structure.
- Amount of ground cover.

Animal condition

- Energy levels.
- Texture of manure and assessments from drug sampling.
- Poddy lambs come home.
- Gloss of texture of coats (depends somewhat on the breed of animals).
- Watch the tail end of the mob.
- Condition of calves and size of udder.
- Animals on the move, looking for feed.

Appendix 4

Signs of grazing pressure identified at Queensland grazier workshops

Condition and performance of stock

- Before they get poor and lose condition.
- When see stock begin to slip and lose condition (energy level appears less).
- When sheep begin to weaken.
- When old cows get poor and calves are doing it tough.
- Watch tail end of mob - when they really slip take action.
- When sheep lose 30% of overall body weight (percentage not necessarily a guide).
- When sheep start stressing out (harder to manage), too weak to move.
- When stock get poor and/ or start to die (one would have made a decision earlier than when they started to lose condition).
- Texture of manure (conversion of feed).
- Weight gain ceases in relation to the target selling weight.
- Brightness and condition of the stock's eye.

Amount of feed available

- When a fair percentage of buffel gets down to 6 inches (peak).
- When pasture quantity is in decline approaching a non-growing season.
- Feed gets scarce.
- When pasture is too short for stock to feed adequately (relates to cattle not applicable as the stock numbers are needed to stay financially viable).
- As soon as have to supplementary feed, sell stock.
- Feed reduced to 50% coverage (percentage not necessarily a guide).
- When there's a lack of soft herbage (as a guide to specific locations).
- Before pasture is too far gone to recover.
- About 1 month before feed is depleted, before it gets too scarce.
- Increase in browse line of low mulga.
- 'Look and feel' when pasture has had enough grazing.
- A lot more wild life come in around house.
- Poddy lambs come home.
- Feed reduced to 50% coverage – disagree with this one.

Condition and quality of feed

- Diminishing supply of edible grass.
- When pasture quality is in decline approaching a non-growing season.
- As soon as the green tinge has gone off the grass (when the flag has gone).
- When nutrient value of grasses diminish (colour and texture).
- When the condition of stock tell you there is nothing in the grass.
- When corkscrew grass starts declining.
- When seed is mature.
- When young mulga lose half their leaves (very dry).
- When low mulga runs out.

- Increase in browse line of low mulga.
- More defined browse line of mulga.
- Watch for signs of a paddock being picked out.

Availability and condition of water
- When stock die due to bogging.
- When waters get low, water deteriorates and it is dangerous for stock to access as boggy.
- Amount of water available per animal.
- When surface waters begin to disappear.
- Surface water increases local grazing pressure.
- Lack of surface water decreases grazing pressure.

Behaviour of stock
- When stock start to chew young mulga.
- Stock walking around and looking for food, and not content.
- When stock gather on water points longer and eating supplements.
- Cattle breaking down higher branches - has some use but to be used in conjunction with other conditions (eg feed availability).

Weather
- When pasture is denuded, animals are being adversely affected and the likelihood of rainfall is slim.
- Dry autumn, sell surplus stock before winter which is a higher pressure time.
- When it rains, paddocks can be locked up from domestic stock to regenerate (harder to control native and feral animals).
- Look at amount of rain in growing season.
- Low feed/ dry at beginning of winter, sell off.
- Rainfall - 30% winter rain, 70% summer rain (figures are too definite).
- Depending on what climatic conditions we have just experienced eg. perhaps we are going to move stock from a paddock and then get a storm so we could leave them a bit longer.
- Use El-Nino prediction in deciding to lighten off stock (it is just a prediction).
- Use SOI and rain gauge.

Market prices/ financial pressures
- Make decisions early before market collapses.
- When markets are good.
- Increase or decrease stock when seasonal and market conditions coincide.
- If market is poor, may not reduce numbers/may make different decisions eg. Agistment.

Numbers of kangaroos, goats and pigs
- When numbers reach a truck load.
- When increase/plentiful, harvest.
- If tags available for kangaroos.
- When sight feral animals, trap and muster.
- Kangaroos 'migrate' from mulga country to better country when it becomes dry.
- Kangaroos move in near houses when it becomes dry to eat the less grazed country.

- Pigs start to eat carcasses more.

Soils

- Appearance of soil as an indicator – depth of topsoil.
- Vegetable matter in the soil.