Rural and Regional Affairs and Transport Legislation Committee

ANSWERS TO QUESTIONS ON NOTICE

Supplementary Budget Estimates October 2016

Agriculture and Water Resources

Question: 178

Division/Agency: Rural Industries Research and Development Corporation

Topic: Redundancy

Proof Hansard page: 15

Senator McCARTHY asked:

Senator McCARTHY: So only one staff member refused to go and took the redundancy, or are you saying that only one staff member—

Mr Harvey: At the moment, we have paid one redundancy, but we have expectations that there may be more redundancies. Our expectation is that there will be up to four more redundancies. Clearly, this move has been on the cards for quite a while, and a number of staff have voluntarily found other employment.

Senator McCARTHY: How many of those staff?

Mr Harvey: Approximately five. If you want that exactly, I will need to take it on notice.

Answer:

Since the announcement to relocate was made on 24 February 2016, there has been 6 staff that have left voluntarily to take up other employment opportunities.

Question: 179

Division/Agency: Rural Industries Research and Development Corporation

Topic: Annual Report Stats

Proof Hansard page: 16

Senator RICE asked:

Senator RICE: There was an article in *The Weekly Times* in August that said, according to the RIRDC's annual report last year, the organisation had 18 full-time equivalent staff.

Mr Harvey: Numbers do fluctuate from time to time, depending on what we have on our agenda. The numbers I based my figures on are the 16.

Senator RICE: Could you take on notice the difference between the 18 that was in your annual report and the 16?

Mr Harvey: Sure, absolutely.

Answer:

At 30 June 2015 the Corporation had 11 staff employed on a full time basis (including the Managing Director) and seven part-time staff members, 18 in total. We also had one staff member on maternity leave.

As at 30 September 2016 the Corporation has 16 staff.

A steady staff turn-over since the decision has seen several positions not replaced (or replaced via secondments and short term contracts) as the corporation moves towards a smaller structure.

Rural and Regional Affairs and Transport Legislation Committee

ANSWERS TO QUESTIONS ON NOTICE

Supplementary Budget Estimates October 2016

Agriculture and Water Resources

Question: 180

Division/Agency: Rural Industries Research and Development Corporation

Topic: Measure of Success going forward

Proof Hansard page: 17

Senator RICE asked:

Senator RICE: Can you take on notice whether it is the KPIs and the board or the criteria that you are using to judge the success and how you are going to measure that success as you go forward?

Mrs Hull: Absolutely. The board will undertake these discussions in further detail in December and we already have undertaken discussions. We will finalise those discussions in December, so I am happy to take that on notice and provide you with the outcomes.

Answer:

We are going to measure Rural Industries Research and Development Corporation's success going forward based on the KPIs of the board, which the board intends to finalise at its December meeting and can be subsequently made available to the committee.

Rural and Regional Affairs and Transport Legislation Committee

ANSWERS TO QUESTIONS ON NOTICE

Supplementary Budget Estimates October 2016

Agriculture and Water Resources

Question: 181

Division/Agency: Rural Industries Research and Development Corporation

Topic: Cost-Benefit Analysis

Proof Hansard page: 17

Senator RICE asked:

Senator RICE: Was there a cost-benefit analysis done of the relocation prior to it being undertaken?

Mr Harvey: My understanding is that a costing was done.

Senator RICE: But was there any articulation of the benefits?

Mr Harvey: I would need to take that on notice. That was before I joined the organisation.

Senator RICE: Could you please answer that and, if that cost-benefit analysis was done, whether it is a public document?

Answer:

An independent cost benefit analysis was carried out early in the period leading up to the decision to relocate the Corporation to Wagga. This analysis wasn’t released publically but utilised during deliberations by the Board on the best option for the future of the Corporation.

Rural and Regional Affairs and Transport Legislation Committee

ANSWERS TO QUESTIONS ON NOTICE

Supplementary Budget Estimates October 2016

Agriculture and Water Resources

Question: 182

Division/Agency: Rural Industries Research and Development Corporation

Topic: Staff Relocation

Proof Hansard page: 18

Senator RICE asked:

Senator RICE: So how many staff who were with the organisation before the move are not going to be with the organisation afterwards—11?

Mr Harvey: It is around 11. I will need to check the numbers.

Answer:

As the time the question was asked, we had a total of 16 staff.

Of the 16 staff, 9 will no longer be with the organisation after the relocation is complete.

Question: 183

Division/Agency: Rural Industries Research and Development Corporation

Topic: Rental charges

Proof Hansard page: 20

Senator McCARTHY asked:

Senator McCARTHY: You have given us the rental for Canberra and for Wagga. What about for Hay and Gunning?

Mr Harvey: They are working from home.

Senator McCARTHY: So no cost to you?

Mr Harvey: I would need to take that on notice. There may be some minor costs—but very small.

Answer:

Total cost of the two home offices is $862 per annum for internet services.

Rural and Regional Affairs and Transport Legislation Committee

ANSWERS TO QUESTIONS ON NOTICE

Supplementary Budget Estimates October 2016

Agriculture and Water Resources

Question: 184

Division/Agency: Rural Industries Research and Development Corporation

Topic: Board considering a move

Proof Hansard page: 20

Senator RICE asked:

Senator RICE: You do not know over what period of time the board had been considering a move?

Mr Harvey: Again, I was not there, but I would have thought it would have been at least two years.

Senator RICE: Can you take that on notice—check back through the board minutes and see when they first started thinking about moving?

Mr Harvey: Sure.

Answer:

Relocation first appeared on the Board meeting agenda in August 2014 after a letter was received from the Minister on 22 July 2014.

Question: 185

Division/Agency: Rural Industries Research and Development Corporation

Topic: Kangaroos

Proof Hansard page: Written

Senator RHIANNON asked:

Please provide in an excel spreadsheet an updated list of RIRDC projects and reports regarding kangaroos, that are currently in progress or have been completed since the beginning of 2016.

a) project title and id/publication numbers

b) link to the publication

c) recipients of the RIRDC funding for the project, and their locality/state

d) objective summary

e) cost of the project

Please provide copies of those reports where available, preferably digital copies.

Answer:

There is one kangaroo project that has been completed since the beginning of 2016.

Project title	**Project ID**	**Link to publication**	**Recipients of funding**	**Objective summary**	**Cost of project**
Development of a Kangaroo Industry RD&E Plan	PRJ-010505	Not published- for internal and industry guidance only	Russell Pattinson, Miracle Dog Pty Ltd (Lancerfield, Victoria)	The primary objective of this project is to prepare a five year RD&E plan that reflects the kangaroo industry's research, development and extension activity priorities.	$17,345

Rural and Regional Affairs and Transport Legislation Committee

ANSWERS TO QUESTIONS ON NOTICE

Supplementary Budget Estimates October 2016

Agriculture and Water Resources

Question: 186

Division/Agency: Rural Industries Research and Development Corporation

Topic: Kangaroos

Proof Hansard page: Written

Senator RHIANNON asked:

DAFF and RIRDC signed a funding agreement for $290,000 from the national Landcare program for the Sustainable Wildlife Project (effective 1 February 2007). The link to that project no longer works on the RIRDC website http://www.rirdc.gov.au/research-project-details/custr10_DRC/PRJ-003171:

a) To whom and how and for what was the grant dispersed?

Please provide copies of any reports or documents resulting from the project, and the internet link to the same if available.

Answer:

Rural Industries Research and Development Corporation contracted Australian Wildlife Services to deliver the project. The project started on 1 March 2007 and finished 30 June 2008. Australian Wildlife Services selected a number of providers, through an open call for providers, to assist in the delivery of the project. George Wilson of Australian Wildlife Services was the principle investigator of the project.

Project objective summary:

To support implementation of the plan for trials of on-farm sustainable wildlife enterprises at two sites -- Maranoa Wildlife Management Conservancy and Murray Darling Rangelands Conservancy.

- define a framework that enables landholders to share the proceeds of harvested wildlife
- estimate kangaroo numbers that enable landholders to more effectively manage populations and integrate wildlife with their property and natural resource management plans
- identify markets for products that are badged as leading to net conservation gain
- share information of experiences from the trial sites and encourage regional collaboration in natural resource management and wildlife planning

Question: 186 (continued)

Copies of the project reports and outputs are attached.

Attachment A: Building connections between kangaroos commerce and conservation in the rangelands - Ampt&Baumber (Journal article)

Attachment B: Building Cooperation and Collaboration in the Kangaroo Industry (published but not available online)

Attachment C: Barrier Ranges Kangaroo Plan May 09 (Journal article)

Attachment D: Landholder Collaboration in Wildlife Management - Cooney Cooperative (published but not available online)

Attachment E: Optimising mixed-grazing strategies for semi-arid Australian rangelands Moloney PhD (hearn) (Journal article)

Attachment F: Sharing Skippy (Journal article)

Attachment G: Sustainable Wildlife Enterprises Trials June 08 Final Report (Journal article)

Attachment H: Marketing Kangaroo Meat from the Maranoa Wildlife Conservancy draft final report.

Building connections between kangaroos, commerce and conservation in the rangelands

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ABSTRACT

The role of landholders in kangaroo harvesting is an issue that has been revisited often over time as circumstances continue to change within the kangaroo industry, within rural communities and within national and international conservation frameworks. It is again time to assess the state of play. The kangaroo industry has, after more than 30 years of operation, a legitimate claim to being sustainable. But where does it stand in relation to current international thinking on sustainable use and in relation to the broader conservation goals for Australia's rangeland environments?

This paper presents strategies for linking the kangaroo harvest with conservation in the sheep rangelands through models that can provide economic returns and a greater management role for landholders in the kangaroo industry. According to the principles of conservation through sustainable use (CSU), when local people receive direct economic returns from the sustainable use of wildlife, they can gain incentives to undertake species and habitat conservation. This is not happening with kangaroo harvesting at present and if it is to be achieved we need improved knowledge of kangaroo grazing dynamics, increased valuing of kangaroo products, pathways for landholders to engage with the industry and a clear will on the part of government agencies responsible for managing the harvest to move beyond the frameworks that have traditionally guided kangaroo management policy in Australia.

Key words: Kangaroos; sustainable use; conservation; harvesting; wildlife management; rangelands; total grazing pressure; adaptive management

Introduction

Now is an excellent time for revisiting the place of kangaroos in Australia's rural industries. After 30 years of harvesting under a quota system it is clear that the industry is sustainable and will not lead to the extinction of the four commercial species. The rhetoric of pest control is making way for the rhetoric of sustainable use. Occasional episodes of opposition are having less impact as the community develops greater acceptance of the harvest and its increasingly professional and scientific basis.

Although it is difficult to obtain reliable figures on kangaroo meat consumption, its position in the domestic marketplace is undergoing significant change. It is now available in major Australian supermarket chains in a diversity of products and in much larger volumes than just a few years ago. With supply controlled by harvest quotas and impacted on by drought in recent years, it has been demonstrated that increased demand can lead to an increase in the prices offered by processors.

This is occurring in the context of a declining wool industry with falling sheep numbers and wool returns, declining terms of trade and increased reliance on off-farm incomes. This is exacerbated by periods of extreme drought and the increasing realisation that traditional industries will not provide the economic driver for better natural resource management in many areas. Landholders are moving into meat sheep and goats, and there are increasing calls for diversification into tourism and other enterprises. Incentives are being sought for conservation-orientated management through market-based instruments and programs such 'enterprise based conservation'. Catchment targets are being set for larger areas of native vegetation and larger areas 'managed for conservation'.

Kangaroos clearly have a role in this emerging situation. They are abundant, superbly adapted animals that compete less with domestic stock than is conventionally thought. They range across the landscape utilising herbage where it is available, causing localised increases in total grazing pressure. While their numbers fluctuate, they restock themselves after droughts. They provide high quality products with growing demand and an increasing price without global competition.

Despite this, landholders currently have negligible participation in the kangaroo industry and receive little or no economic return from it. They have been willing to cooperate with the harvest regulation system and pass on their potential ownership of the resource to the industry without any expectation of an economic return. Can they carve out a place for themselves in the industry? Do they want to? What are the potential benefits for them and for conservation if they do? And if the potential is there, why aren't they already doing it? These questions are central to this paper.

So what will it take to get landholders into the industry? While it would be true to say that there is a degree of cultural resistance and significant scepticism towards it, there are landholders who have tried in the past and are willing to try in the future. We believe there are four critical components to facilitating the process:

1) More accurate knowledge obtained and communicated to stakeholders on kangaroos' contribution to total grazing pressure and the extent to which they compete with sheep;
2) Increased value of kangaroo products as compared to other products (i.e. wool in particular);
3) More flexible State kangaroo management plans with clearly stated aims and provision for adaptive management trials that encourage rather than inhibit landholder involvement in and returns from harvesting;
4) The development of enterprise models through which landholders can claim a legitimate role in the industry and through which they can gain some economic benefit.

Significant commercial involvement of landholders in the kangaroo industry is unlikely to occur unless there is an increase in end prices paid for kangaroo products. However, increased prices and markets for kangaroo products alone will not provide conservation incentives if landholders are not able or prepared to get involved in the industry. Furthermore, any decision by landholders to become producers of kangaroo products rather than (or as well as) producers of other commodities such as wool will be a business decision and, as such, the potential income from kangaroos needs to be measured accurately alongside the costs of managing kangaroo production on a property. Ideally, these critical components should all be addressed together to achieve conservation benefits through commercial kangaroo harvesting.

In the following section we describe in more detail the trends and issues summarised above that lead us to the conclusion that now is a good time to push for changes in the industry and the way it is regulated. In the subsequent two sections we review the current state of knowledge of kangaroos in rangeland environments and the state of the kangaroo industry, looking at the potential for increasing market demand and thus the value of kangaroo meat. We then explore the current regulatory environment (with greater emphasis on NSW) and outline changes that could lead to a more flexible system. Finally, we describe models for landholder involvement, including a staged model that the FATE Program is developing in collaboration with the Barrier Area Rangecare Group north of Broken Hill.

Is it time for change?

The current situation

The commercial kangaroo harvesting industry in Australia means different things to different stakeholders. To many landholders, it is simply a cost-effective means of reducing their stock's competition for pasture and water; to some wildlife protection groups it is a threat to the very existence of the kangaroo species it harvests; to some 4000 people employed in the industry (Kelly 2004, 2005a) it is a livelihood; and to advocates of the concept of conservation through sustainable use (CSU), it is a potential way to create incentives to conserve native habitat through commercial returns to landholders.

This paper focuses on the latter point – the potential for creating incentives for conservation through the commercial returns generated by the sustainable harvesting of kangaroos. This idea is not new and indeed has been debated vigorously, particularly following Grigg's (1987) call for commercial use of kangaroos to form "a better economic base for our rangelands". As the viability of the concept is so highly dependent on complex economic, social, ecological and political factors that vary over time, it is only natural that the kangaroo debate be regularly revisited.

At this point in time, a number of factors require integration into the ongoing discourse. The 2004 report into "Kangaroo Management in the Murray-Darling Basin" (Hacker *et al.* 2004) presented a number of recommendations for managing kangaroos as a component of total grazing pressure, while the 2005-2010 Kangaroo Industry Strategic Plan (Kelly 2005a) outlines the industry's vision and priorities for the next five years. There are also ongoing ramifications from the Senate Committee Report into Commercial Utilisation of Australian Native Wildlife (Rural and Regional Affairs and Transport References Committee 1998), including the exploration of sustainable wildlife enterprises by the Rural Industries Research and Development Corporation (RIRDC) in response to the Senate Committee's recommendations.

Furthermore, in the international realm, the Convention on Biological Diversity and IUCN (World Conservation Union) have endorsed the Addis Ababa Principles and Guidelines on Sustainable Use of Biodiversity (Secretariat of the Convention on Biological Diversity 2004), which emphasise the potential for sustainable use activities to lead to sustainable development and create incentives for conservation.

It is clear from the 30-plus years of commercial kangaroo harvesting in Australia, and the extensive research that has been conducted over that time, that this is a use of a renewable natural resource that is demonstrably sustainable in terms of population numbers, species distributions and genetic diversity. The sustainability of the harvest has been demonstrated repeatedly in published research (e.g. Pople and Grigg 1999) and as part of management plan assessment processes, including reviews by the Administrative Appeals Tribunal in 2003 and 2004. The recent situation analysis undertaken as part of the review of the NSW Kangaroo Management Program (Olsen and Low 2006) concludes that "there is little doubt that current rates of harvest are sustainable" and that "any genetic impact of harvesting is minimal" (p7).

Briefly, populations of the four large species commercially harvested across New South Wales, Queensland, South Australia and Western Australian – namely the Eastern Grey Kangaroo *Macropus giganteus*, Western Grey Kangaroo *Macropus fuliginosus*, Red Kangaroo *Macropus rufus* and Wallaroo/Euro *Macropus robustus* - have been shown to remain viable at the harvest levels of 8-10% that are routinely achieved. Modelling also shows that larger harvests would be sustainable, especially given the significant level of male bias in the harvest (Grigg 2002). As Hacker *et al.* (2004) asserted, the industry is also capable of a significant degree of self-regulation, as "the commercial industry is not viable at kangaroo densities that might threaten the conservation of the species" (p54).

Research into the genetics of harvested populations (Tenhumberg *et al.* 2004) has shown that a moderate level of dispersal from unharvested refuges into harvested areas is sufficient to prevent long-term genetic changes in kangaroo populations that could arise from size-selective harvesting (i.e. targeting the largest males). Dispersal from such refuges is a feature of kangaroo harvesting in each State, due to both land tenure (i.e. National Parks where harvesting is not permitted) and the existence of areas that are uneconomic to harvest (Hacker *et al.* 2004).

However, while populations of large kangaroos have been shown to be secure under current commercial harvesting regimes, it is less certain that kangaroo harvesting, as it occurs at present, is really a good example of the conservation benefits that can be achieved through the sustainable use of wildlife. The key concept underpinning conservation through sustainable use (CSU) is that by placing a commercial value on a species, we can enhance the conservation of that species and its habitat by creating incentives to use the resource sustainably and protect the ecosystems that support it.

At present it cannot be said that commercial kangaroo harvesting has really led to any deliberate actions by landholders to conserve kangaroos or their habitat. Indeed, the success of the large kangaroo species since European settlement is incidental rather than deliberate, as the conditions that pastoralists have created to maximise sheep production across the Australian rangelands (i.e. creation of artificial watering points, conversion of woodland to grassland and exclusion of predatory dingoes) have also inadvertently favoured the large kangaroo species (Grigg and Pople 2001). Where this has occurred, however, the impact on other aspects of biodiversity has been negative. This is especially true of small mammals such as bilbies, bettongs, bandicoots and potoroos. The loss of these species from the rangelands has removed key ecosystem engineers, with consequent impacts on soil biota, water infiltration, plant diversity and fire regimes (Martin 2003).

It is likely that large kangaroos have prospered in spite of the attitudes of landholders towards them, rather than because of their attitudes. Judging by Grigg's (2002) statement that "most landholders still regard kangaroos mainly as pests" (p53), if it had been technically and economically feasible – and legally permissible – for pastoralists to eradicate kangaroos from their properties many may have done so by now, in the same way that other perceived pests, such as the Thylacine and Dingo, have been eradicated or severely reduced in numbers. We recognise that the term "pest" carries a lot of connotations and does not necessarily represent the way that all landholders view kangaroos. Undoubtedly many landholders value having kangaroos in the landscape and eradication is not their desire, but what is clear is that perceptions of kangaroos as too numerous and a cost to production are far more prominent amongst landholders than perceptions of kangaroos as an economically desirable presence on their land.

How could commercial kangaroo harvesting lead to conservation outcomes?

In contrast to the current situation, a conservation through sustainable use (CSU) approach aims to ensure that species will be conserved because they are valued, not simply because they are difficult to eradicate. The focus of CSU is on ensuring that the use of wildlife is undertaken in a way that is ecologically, economically and socially sustainable and examples of CSU vary with differing ecological, economic and social factors. Some of the best-known examples of CSU include the conservation of southern African wildlife through the creation of numerous private reserves for wildlife tourism and hunting, the contribution of harvesting to the recovery of Saltwater Crocodile populations in the Northern Territory (Webb 2002), and the role of deer stalking estates in preventing Red Deer in Scotland from going the way of other Scottish forest-dwelling mammals and becoming extinct due to forest clearing (Inskipp 2000).

Webb (2002) stated that "the central aim of most CSU programmes is to create incentives for habitat conservation" (p14). A focus on habitats is vital as CSU is not just about conserving the utilised species, but the habitat that supports it and a myriad of other species. Citing the contribution that the controlled harvest of Saltwater Crocodiles and their eggs has made in encouraging landholder protection of habitat for Saltwater Crocodiles in the Northern Territory, Webb (2002) stated that "relatively small economic returns can change the perception of a wildlife species or a patch of habitat from a liability to an asset" (p14).

There are some parallels with this asset vs. liability issue in the case of kangaroos. A preference amongst Eastern Grey Kangaroos for native vegetation mosaics that feature interspersed woodlands, forests and grasslands has been reported in studies of disturbed semi-arid woodlands in Queensland (McAlpine 1999) as well as on farmland in the Australian Capital Territory (Viggers and Hearn 2005). This preference can often lead to reserves or remnant woodlands being perceived to be a liability for the role they play in sheltering kangaroos that then move onto adjacent grazing or cropping land (Viggers and Hearn 2005). This, in turn, can create a disincentive to undertake revegetation activities and even lead to illegal clearance of sheltering vegetation (Grigg and Pople 2001). A commercial return for landholders from kangaroos that utilise these vegetation mosaics could change them from a liability to an asset and provide an incentive for conservation and revegetation activities across the heavily cleared landscapes that coincide with much of the Eastern Grey's range.

However, in the semi-arid sheep rangelands, which cover about 40% of the continent (Grigg 2002) and where the bulk of the commercial kangaroo harvest takes place, the key issue is total grazing pressure (TGP) rather than revegetation or protection of remnants. This represents a significant deviation from other CSU models such as those shown for crocodiles (Webb 2002), in that kangaroo habitat is not separate from livestock habitat but instead is shared with sheep across much of Australia's rangelands and actions undertaken to benefit sheep (eg increase in watering points, control of dingoes) have also benefited kangaroos. While kangaroos themselves may be seen as a liability in the rangelands, their habitat is clearly an asset and is valued for its productivity. As such, it is not so much a matter of protecting habitat specifically for kangaroos in the rangelands as it is a matter of better managing the land that supports both livestock and kangaroos.

Gordon Grigg has long advocated the concept of "sheep replacement therapy for rangelands" (Grigg 1987, 1989, 2002) and it may indeed be possible that in some areas, under the right economic conditions, a total shift from sheep to kangaroos could take place. However, this does not mean that total replacement of sheep with kangaroos is the only way for CSU benefits to be achieved, nor does it necessarily mean the goal of any CSU initiative should be to increase kangaroo numbers. Croft (2000) emphasises the importance of considering potential synergies between herbivores and points to experiences in South Africa where springbok and merino sheep are grazed together for economic sustainability. Similarly, strategic cattle grazing has been shown to enhance elk and deer habitat in the western USA (Short and Knight 2003).

The benefits that could result from exploring these synergies in relation to kangaroos and sheep could include;

- reducing disincentives to revegetate or destock areas for conservation that may arise because these activities can lead to localised kangaroo population increases;
- increasing incentives to create more kangaroo-friendly and biodiversity-friendly vegetation mosaics;
- supplementing and diversifying pastoral incomes to resist economic pressures to over-stock; and
- delivering greater flexibility in managing total grazing pressure by reducing the dependence on the existing industry which will only operate in locations where, and at times when, it is profitable to do so.

If landholders come to value kangaroos in the same way as domestic stock and are therefore prepared to invest a greater amount of time and money into kangaroo management, they may be able to adapt some of the best practice stock management approaches to managing kangaroos, such as;

- reducing numbers heavily going into drought;
- maximising breeding potential relative to grazing pressure by harvesting with a strong male and/or juvenile bias; and
- rotating or adjusting grazing pressure through restricting access to watering points.

This may not be a typical approach to CSU but it may well play an important role in facilitating some of the desired shifts towards managing rangelands for improved conservation outcomes. A testable hypothesis of any CSU approach to kangaroo management in the rangelands would be whether commercially valuing kangaroos could lead to the implementation of these sorts of strategies and whether they could improve management of total grazing pressure and improve landscape function and biodiversity in the rangelands.

Links with regional NRM targets and management actions

The goal of creating incentives for landholders to undertake conservation work is a particularly important one in Australia at the present time. The move to regionalised natural resource management (NRM) under Commonwealth and State government agreements creates requirements for the setting of State-wide and regional NRM targets and for the creation of regional NRM bodies. In the case of NSW for example (Natural Resources Commission 2004), some of the draft State-wide NRM targets for 2015 include:

- a net increase in native vegetation cover, diversity and connectivity;
- a net increase in riparian vegetation extent;
- reduced risks to conservation status of species and communities; and
- deep-rooted perennial vegetation coverage of *all* critical recharge zones.

There is a need for substantial incentives to deliver these targets on a landscape scale and the potential for some of these incentives, such as trading schemes and auctions, has been explored through a National Market-Based Instruments Pilot Program (Anon 2002). Landholders can incur significant financial costs through the revegetation of land and other management actions, as well as associated lost income from restrictions on clearing, reductions in stocking rate or reductions in areas under cultivation. Conservation incentives can provide a counter to these costs and CSU is one potential way of generating such incentives to protect or restore habitat. In some areas, returns from kangaroo harvesting could encourage the conversion of cleared land to the types of patchy woodland mosaics that have been shown to benefit some kangaroo populations.

State-wide targets are not equally applicable in all regions and in Australia's arid and semi-arid sheep rangelands, such as the Western and Lower Murray Darling catchments in western NSW, regional NRM targets are less likely to focus on the extent of native vegetation and more likely to focus on quality of cover, biodiversity and landscape function. For example, the draft Catchment Plan for the Western Catchment Management Authority (2005) in northwest NSW, identifies the following land and biodiversity targets which have particular relevance to kangaroo management:

- Quality and quantity of vegetation managed to maintain and/or improve designated cover capable of preventing soil erosion (i.e.: designated cover greater than or equal to 40%).
- Ecological communities of high conservation value are adequately protected.
- In each of the other ecological communities, 12% of the area will be managed for conservation within 10 years of Catchment Plan approval and 25% within 25 years.

These catchment targets have a strong focus on private land and will be delivered through programs aimed at promoting sustainable agriculture, improving pest management, rehabilitating native pasture vegetation communities and negotiating agreements with landholders to manage lands for conservation (Western Catchment Management Authority 2005). A key element in delivering these outcomes on private pastoral land will be improved management of total grazing pressure (TGP), in which kangaroo harvesting has a key role to play. Reductions in domestic stock across the rangelands are likely to reduce the economic viability of pastoral enterprises unless alternative sources of income are found. Incentives that could be generated by a kangaroo CSU initiative are particularly important for rangelands where traditional production activities are becoming less economically viable.

Of course, amidst this discussion it is important to remember that CSU is only one conservation tool that is available, and is not designed to replace all other approaches or leave conservation entirely up to market forces. There is also a need to consider the possible perverse incentives and other pitfalls of sustainable use approaches. Using an earlier example, while Red Deer populations may have been enhanced due to the value placed on them in Scotland, an overpopulation now threatens rather than protects habitat in some locations (Inskipp 2000). Similarly, a perverse incentive to clear land could arise in relation to red kangaroos, which have been shown in Queensland to prefer areas subject to recent large-scale clearing over woodlands (McAlpine *et al.* 1999). As such, measures such as land-clearing and threatened species regulations will always be vitally important to back up any incentives from CSU with appropriate regulatory measures.

How can kangaroo harvesting be managed to achieve conservation through sustainable use?

Useful guidance in this area comes from the Addis Ababa Principles and Guidelines on Sustainable Use (Secretariat of the Convention on Biological Diversity 2004), which have been endorsed by the Parties to the Convention on Biological Diversity (CBD) and the IUCN. This document states that "encouraging sustainable use can provide incentives to maintain habitats and ecosystems, the species within them, and the genetic variability of the species" (p7) and sets out the principles that need to be followed when managing sustainable use activities. These include complementary regulations, access rights, involvement of local people, removal of perverse incentives, adaptive management, communication and education, and management at appropriate scales (generally devolved as locally as possible).

The Addis Ababa Principles (Secretariat of the Convention on Biological Diversity 2004) highlight the need for the economic benefits of resource use to flow to local people who have legal rights of ownership or access and powers of management over these resources if incentives for conservation are to be created. Similarly, Webb (2002) emphasises the importance of involving local people as active partners if CSU is to be realised and the Northern Territory Strategy for Conservation through the Sustainable Use of Wildlife has amongst its guiding principles that "landowners must be key beneficiaries from any use of wildlife that takes place on their lands" (Parks and Wildlife Commission of the Northern Territory 1997, p3).

In our view, the fundamental aspect that must be remedied before kangaroo harvesting can truly become an example of CSU is the involvement of landholders and the flow of significant economic returns to them, as they have primary stewardship over kangaroo habitat. While the language of kangaroo harvesting amongst government agencies, scientists and the industry may have changed from pest control to sustainable use in recent years, attitudes are yet to undergo the same transformation for those who are most impacted by kangaroos and in the best position to manage them – landholders. As Croft (2004) comments on the rebadging of kangaroo management as sustainable use: "a change in the purpose for the commercial killing of kangaroos is yet to see a significant change in the value of the end products and the valuing of their producer" (p101).

Grigg (2002) and Dawson and Munn (in press) argue that perceptions of kangaroos as pests or problem animals are often overstated, as the extent of their contribution to total grazing pressure (TGP) and their levels of competition with sheep may have traditionally been over-estimated. However, for as long as a landholder is not making any commercial gain from kangaroos, any cost incurred by the presence of kangaroos on the landholder's production of valued products such as wool, however small, is bound to tip their view of kangaroos towards the "pest" rather that "resource" side of the equation.

Kangaroos in the rangelands

Australia's sheep rangelands provide the most likely site for investigating landholder-based kangaroo enterprises in the near future, due to the high densities of kangaroos, large landholdings, established kangaroo industry presence and decreasing viability of traditional wool production over time. This is an area where landholders are increasingly being squeezed by declining returns and increasing costs, sheep numbers are continuing to fall at a time when higher production levels are needed to stay profitable and recurring government investment is required in the form of drought relief in order to keep many enterprises afloat.

In many parts of the rangelands, overgrazing (by stock, feral and native herbivores) has contributed to loss of vegetation cover, soil erosion and potentially permanent changes in landscape function (Donohue *et al.* 2005). Many of these impacts have their origins in overgrazing and severe drought in the late 19th century (Australian State of the Environment Committee 2001) and demonstrate the economic and ecological challenges of maintaining production and managing environments that feature highly variable climates and substantial alteration due to 150 or more years of grazing (Eldridge and Koen 2003).

There has been a significant decline in the last decade in the number of farms involved in extensive sheep production and there is a very high reliance on off-farm income amongst Australian farm businesses with an annual EVAO (estimated value of agricultural output) of less than $100 000 (Synapse Research & Consulting Pty Ltd and Bob Hudson Consulting Pty Ltd 2005). While this situation provides a potential threat to rangeland health through pressure to carry more sheep to break even, it also provides an opportunity through the fact that, as sheep grazing becomes more marginal, alternative sources of income such as kangaroos can become more attractive.

However, before landholders can effectively enter the kangaroo industry, they will need accurate information on the potential costs and returns from a kangaroo enterprise such as modelling of income and expenditure (Stayner 2005) and on the effect of kangaroo density on wool production, land condition and biodiversity (Hacker *et al.* 2004). If kangaroos can gain an economic value for landholders, even if it is only a small value, it will then become vitally important to accurately quantify the relative use of the land's pasture and water resources in order to produce a kangaroo as opposed to being used for some other form of production, such as wool.

Much has been written about the flaws of comparing sheep and kangaroos under the traditional model of total grazing pressure (TGP) which measures TGP in terms of dry sheep equivalent (DSE). DSE is based on the forage consumed by a 45kg Merino wether (or ewe without a lamb) and kangaroos are often assumed (eg by Departments of Agriculture) to have a value of 0.7 DSE based on a comparison of the resting metabolic rates of the two animals (i.e. an average kangaroo would consume 70% of the amount of a standard 45kg sheep).

Grigg (2002) observed that this TGP model is flawed in two main ways. Firstly, he noted that an average kangaroo generally weighs a lot less than 45kg, especially in a harvested population. Secondly, if field metabolic rates (FMR) are used instead of resting rates (i.e. metabolic rate across resting, foraging and all other activities), kangaroos may require even less feed again, possibly making the true DSE as low as 0.15-0.2. Olsen and Low (2006) favoured a DSE of 0.48 based on recent empirical data from Dawson and Munn (in press).

Overall, it appears that kangaroo DSE is much less than traditionally thought and competition is only ever really significant at times when pasture resources are scarce. In their recent review, Olsen and Low (2006) concluded that "kangaroos and livestock do not compete strongly for food (at least in the rangelands), that resource availability drives the grazing system, and that mixed species grazing regimes are more productive and ecologically sound" (p65).

An integrated TGP management approach could provide an avenue for improving rangeland health while ensuring continued pastoral income by focusing on strategic use of domestic stock (e.g. rotational or tactical grazing, destocking during drought) and strategic harvesting of kangaroos (e.g. heavier harvesting entering drought, male-bias to optimise harvest, maintaining breeding population through drought, predicting kangaroo movements as part of a rotational harvesting strategy). Kangaroos could offer landholders potential offsets to loss of income in times of drought, particularly as harvesting going into drought generally represents 'compensatory mortality' (i.e. harvesting animals that are likely to die anyway).

Despite these possibilities, Olsen and Low (2006) noted that at present there is "no integration of commercial harvesting with grazing practices" (p54). Landholders are ill-equipped to undertake such integration of sheep and kangaroo management in the absence of the financial incentives required to manage kangaroos for their production value and clear guidance on synergistic grazing strategies.

If landholders start to place a significant resource value on kangaroo production, there could be an incentive to invest more time and money in integrating kangaroos into TGP management, but better knowledge must be made available to landholders on what an optimal mixed grazing system might look like. The undertaking of further research into this area, particularly under an adaptive management approach, and the dissemination of the results of this research to landholders is a vital component of changing kangaroo harvesting into a true example of conservation through sustainable use.

Increased commercial value of kangaroos

The Kangaroo Industry Strategic Plan 2005-2010 (Kelly 2005a) outlines the present state of the industry and the strategies for increasing demand and prices for kangaroo products. Currently, 60-70% of kangaroos taken are processed for pet food due to lack of sufficient demand for meat for human consumption. In addition to this, skin-only shooting, while declining as a proportion of the overall harvest, continues in Queensland due to the prices paid for whole carcasses being outweighed by the costs of transport and storage, particularly in remote areas. In most years, supply outweighs demand and annual harvest quotas are not reached, however, drought in recent times across much of Australia has resulted in population declines and a serious undersupply issue for the kangaroo industry (Kelly 2005a).

A number of avenues are currently being pursued to increase the returns from each kangaroo carcass. These include promotion of the meat's health qualities and environmental credentials through videos, newsletters and websites (Kelly 2003, 2004) and the introduction of kangaroo meat into the curricula of chef courses (Kelly 2005b). The kangaroo industry also continues to develop new products and recipes and target new markets in Australia and overseas. Acceptance of kangaroo by the domestic smallgoods sector could also contribute significantly to demand.

With regard to kangaroo skins, while the strategic plan identifies a need for improved quality control, Grigg (2002) argued that there is little scope to increase prices, as manufacturers can turn to cheaper leathers such as calf when kangaroo prices rise, as they currently do when shortages occur.

The Kangaroo Industry Strategic Plan sets a target for 2015 of 80% of kangaroo meat being sold within Australia at prices 10% higher (in real terms) than present (Kelly 2005a, p8). In Australia, a small but relatively stable market exists for human consumption of kangaroo meat despite relatively little promotion, while the overseas market is larger but less stable (Kelly 2005a). In recent times kangaroo products have become more accessible in Australian supermarkets, particularly with a major supermarket chain resuming stocking kangaroo after a hiatus brought about due to protest actions by animal liberationists in the 1980s (Kelly 2004). However, little is known about the market sectors that currently consume kangaroo in Australia and what marketing interventions would be most effective in boosting consumption.

Aside from the obstacles presented by trying to encourage Australians to consume a cute, furry national icon and the animal welfare claims disseminated by animal liberationists, the low consumption of kangaroo meat amongst Australians has been attributed to inherited English ideas, perceptions of kangaroo as a low-quality meat, poor butchering and unfamiliarity with cooking a very lean meat that becomes tough when overcooked (Hercock 2004, Hercock and Tonts 2004). Hercock (2004) also hypothesised that the relatively strong acceptance of kangaroo meat in continental Europe (particularly in France, Belgium and Germany) may be due to an established culture of game meat consumption which is less present in Australia. Supporting this is the assertion by Wynn *et al.* (2004) that Australians have a bias against darker coloured meats that is not evident amongst German consumers.

Grigg (2002) saw the European and US markets, where game meat has historically been appreciated, as the logical way to expand the market for kangaroo meat. Potential market growth may exist with reduced consumer confidence in farmed and lot-fed meats following outbreaks of 'mad-cow disease' and foot-and-mouth disease around the world. There is also an ongoing trend towards free-range, chemical-free and organic meats in developed countries (Hercock 2004). Another potential consideration is the growing trend in consumer-behaviour towards the *centrally-conscious consumer*, who is more likely to respond to the health attributes of kangaroo products rather than any social or environmental management benefits (Mulcahy 2004).

A sensible way forward on this issue is through detailed studies of consumer choice behaviour in kangaroo consumption to inform marketing approaches tailored towards specific market sectors. A recent study funded by the Rural Industries Research and Development Corporation (RIRDC) looked at the influence of factors such as species, age and handling on taste, tenderness and variability of meat quality (Wynn *et al.* 2004). Implementation of these findings by processors and harvesters could lead to increased human consumption of kangaroo meat through improved product consistency and consumer satisfaction.

The FATE (Future of Australia's Threatened Ecosystems) Program at the University of New South Wales, in conjunction with the School of Marketing, University of Technology, Sydney (UTS), is conducting research funded by RIRDC looking at the attributes that influence consumption of kangaroo meat through discrete choice experiments. Such attributes would include price, health benefits and environmental credentials. This proposal has a key focus on the use of kangaroo meat in smallgoods manufacture within Australian, as uptake from the smallgoods industry could improve carcass values overall and lead to returns flowing to landholders.

For the existing kangaroo industry, greater landholder involvement is not currently a priority under the 2005-2010 Strategic Plan (Kelly 2005a). It is the position of the industry generally that landholders can get involved by becoming harvesters (shooters), and the idea of landholders deriving returns as the producers and managers of kangaroos understandably represents a threat to existing industry players through potentially having to share their revenue with landholders. However, in the longer-term, landholder involvement could actually be vital for the industry to grow. While increased landholder involvement is not an objective of the Industry Strategic Plan, improving the supply chain is (Kelly 2005a, p19) and it could be argued that you can't really have one without the other. Direct landholder-processor engagement could improve quality control and continuity of supply through improved consistency in the age, gender and species of kangaroos harvested and the timing of the harvest.

If conservation benefits can be shown to result from the sustainable use of kangaroos, it could open new markets based on the environmental attributes of kangaroo products and the wildlife stewardship of landholders. Landholder involvement could also potentially increase the size of the harvest and thus supply for the industry, through measures such as creating native vegetation mosaics that support kangaroos, strategic harvesting to maximise compensatory mortality and strategically maintaining breeding populations of kangaroos to repopulate following droughts. Changing perceptions of kangaroos from a pest to a resource at the landholder level may also translate to a greater valuing of kangaroo meat by consumers, as the continuing pest association in the consumer consciousness is likely to reinforce perceptions of low quality and low value products.

Change of focus in Kangaroo Management Programs

If incentives for conservation through use are to be generated through commercial kangaroo harvesting then government agencies responsible for managing the harvest need to be more pro-active in facilitating a legitimate role for landholders in the harvesting and post-harvest handling of kangaroos. Conservation agencies have traditionally been most involved in gathering data on kangaroo populations, setting harvest quotas and regulating where, how and by whom the harvest is carried out. This role has emerged as a result of balancing landholder desires for pest control with the kangaroo industry's need for continued supply and the need to demonstrate that the harvested species are adequately protected. In recent years, the terminology of State management plans has switched to sustainable use of a natural resource, with pest control not overtly mentioned, but there is little recognition within the plans of the social and economic factors that are tied to this resource use, or the broader ecosystem context of kangaroo harvesting and the potential for sustainable use to provide incentives that could contribute to regional NRM objectives.

In our opinion, State management plans for the commercial harvest of kangaroos (Queensland Parks and Wildlife Service 2002; New South Wales National Parks and Wildlife Service 2001; Department for Environment and Heritage 2002; Department of Conservation and Land Management 2002a&b) are achieving their goals in relation to protecting and sustaining viable kangaroo populations, but they are also contributing to a system that sidelines landholders, is inflexible for shooters who are tempted to 'work around' the system and doesn't deliver, in the eyes of landholders, adequate control of kangaroo numbers when they need it most. What is needed is a more flexible approach that removes barriers to landholder involvement while maintaining adequate control over the harvest.

Hercock (2004) proposed a model for the management of the kangaroo industry based on a management board with responsibility for the promotion and development of the kangaroo industry as well as its regulation. Different agencies, with responsibilities for conservation, market development and research could all sit on the board and govern the industry overall. Depending on how it was set up, such a model could encounter issues with conflicts of interest as, unlike in other food and fibre industries where supply can be adjusted in accordance with demand and price, kangaroo management will always have a requirement for harvest quotas to be set independently of demand to ensure long-term sustainability. However, this suggestion does draw attention to a point that has been neglected all too long in kangaroo management – that economic and social factors need to be incorporated into harvest management regimes and the aims and policies related to these factors need to be explicitly stated.

As is made clear in the Addis Ababa Principles and Guidelines (Secretariat of the Convention on Biological Diversity 2004), which were developed for use by precisely the sorts of agencies that are involved in managing kangaroo harvesting in Australia, creating the right conditions for the sustainable use of wildlife is about more than just having good scientific data, strong regulatory controls and clearly defined rights of access. It is also about ensuring that the benefits of use are received by those who are in positions of stewardship over the resource and the ecosystems that support it. All kangaroo management programs do not currently, but should, recognise the following key concepts of the Addis Ababa Principles (Secretariat of the Convention on Biological Diversity 2004):

"Sustainable use is a valuable tool to promote conservation of biological diversity, since in many instances it provides incentives for conservation and restoration because of the social, cultural and economic benefits that people derive from that use." (p5) and

[Managers of sustainable use activities should]: "Require adaptive management plans to incorporate systems to generate sustainable revenue, where the benefits go to indigenous and local communities and local stakeholders to support successful implementation" (p12) and

"Promote economic incentives that will guarantee additional benefits to indigenous and local communities and stakeholders who are involved in the management of any biodiversity components" (p19)

Current State plans do not clearly state the economic and social outcomes they aim to deliver through the sustainable use of kangaroos, but in practice their licensing and quota-setting regimes impact on a wide array of economic and social factors. The ways in which licences and harvest tags are issued affects who can carry out the harvest, where it occurs, when it occurs and how the economic benefits of the harvest are distributed. The historical development of the kangaroo industry has created a licensing regime in which kangaroo processors have the greatest amount of flexibility in generating economic returns and landholders have the least.

Processors carry significant risk, as they have to make substantial investments such as plant and staff and are subject to fluctuations in market demand for kangaroo products as well as fluctuations in supply due to climatic patterns, but they also have the flexibility to manage this risk by changing the prices they pay to shooters as well as shifting their supplier base to other locations. Kangaroo shooters have less flexibility than processors to respond to these fluctuations, but they at least have the ability to refocus their efforts on other areas where the economics of shooting may be more viable. Landholders do not have the flexibility to shift their location and thus are most affected by fluctuations in kangaroo populations and distribution. This uncertainty, combined with poor bargaining power when acting alone, makes it difficult for landholders to negotiate a return from shooters or processors for kangaroos harvested on their properties.

Instead of working to counter these difficulties for landholders, State management programs often create additional barriers which make it hard for landholders to plan ahead or group together to increase their bargaining power and manage kangaroos that move across property boundaries. Licensing regimes vary from State to State, but restrictions such as limiting the period for which harvest tags are valid, making tags non-refundable, limiting the number of shooters that can operate on a property and making tags non-transferable across properties can create barriers to industry entry. Hacker *et al.* (2004, p54), in their review of kangaroo management in the Murray-Darling basin, also identified a lack of knowledge regarding the "economic conditions required to induce pastoralists to incorporate kangaroos into their enterprise mix".

We argue that sustainable use of the harvested kangaroo species, in the full sense of the term, should be the overarching aim of all kangaroo management programs and that the social, economic and ecological sustainability of the resource use should all be taken into account, as per the Addis Ababa Principles and Guidelines. In this light, kangaroo management plans should remove obstacles to landholder involvement and actively explore, through an adaptive management framework, management models that can enable landholders to gain greater flexibility in managing the harvest on their properties, collaborate with their neighbours and begin to incorporate kangaroos into their enterprise mix.

Models for landholder involvement

There are a number of ways in which landholders could attempt to derive a return from kangaroos harvested on their properties. Perhaps the simplest way is for them to undertake the harvesting themselves and sell the product to established processors. A number of landholders already do this and they have the advantages of knowing their territory well and being able to incorporate land-management goals into their activities, even if these represent a cost (e.g. shooting feral animals at the same time or targeting harvesting on areas most in need of grazing reductions rather than areas that are simply easiest).

One major downside to this approach is that landholders generally work long hours during the day on their pastoral enterprises and are likely to be reluctant to undertake night-time kangaroo shooting in addition to this, especially given the increasing average age of landholders and decrease in paid labour on properties. A single property is generally incapable of supplying an acceptable income through kangaroo-shooting alone, meaning that giving up domestic stock in favour of kangaroos will be uneconomical unless there is a large rise in price. The massive fluctuations in kangaroo numbers on a single property over time also create a level of uncertainty that makes such a venture very risky.

A second option is to request some kind of royalty that must be paid when shooting is undertaken. This could be negotiated with a shooter or processor individually in return for access to the landholder's territory or as part of a blanket royalty scheme imposed at State level. Limited payments to some landholders for the harvest of kangaroos on their properties has taken place in South Australia, where it has emerged as a result of competition between processors for kangaroo supply. These payments, generally $1 per kangaroo, are not covered by the South Australian Kangaroo Management Plan and are a matter of negotiation between landholders, harvesters and processors (Farroway 2005 pers comm).

Generally, competition for kangaroo supply has not been sufficient for landholders to extract such a royalty, as shooters and processors could simply go to another landholder who is not requesting any return and the landholder who misses out could lose their only real means of managing kangaroo grazing pressure. A blanket royalty scheme would be likely to be met with major opposition from existing processors and harvesters and may prove difficult to administer. Presumably, landholders would still have the right to forgo their royalty payment if they chose, and many may in fact do this if they felt uncomfortable about taking money out of a shooter's pocket or found that shooters would no longer service their property because it had become uneconomic. Such problems could thus undermine any royalty scheme, but, if any of the State management programs wanted to truly say they were implementing the Addis Ababa Principles and Guidelines relating to generating sustainable revenue and guaranteeing additional benefits to local stakeholders the they would at least have to assess this option.

The third option is for landholders to carve out a role for themselves that adds value to the industry and for which they can expect some remuneration other than from undertaking the harvest themselves or from simply providing access. Landholders could add to the industry by enabling harvesting to become more efficient (e.g. predicting where kangaroos will be and when), by enabling larger harvests (e.g. monitoring populations and maintaining greater breeding potential), ensuring continuity of supply (e.g. working closely with harvesters and processors to supply the right quantities at the right time) or by facilitating marketing opportunities based on land management and wildlife stewardship credentials (e.g. certification as sustainable or organic land managers). These options would generally require a significant degree of collaboration across properties due to the fact that kangaroos are a common pool resource that moves freely across property boundaries.

Despite the lack of focus by government agencies, the kangaroo industry and the pastoral industry in exploring these options, a number of models for collaborative landholder participation in the kangaroo industry have emerged in recent years. The Tilpa Rangelands Investment Company (TRIC) in western NSW entered into a collaborative kangaroo harvesting venture from 1995-1998 (Henry and Watson 1998). TRIC investigated ways for its member landholders to gain returns from kangaroo harvesting with the aim of providing incentives for better total grazing management. TRIC's kangaroo enterprise, which focussed largely on skins, ultimately failed to secure a stable place in the kangaroo value chain for landholders. This was largely due to:

- the difficulties of establishing a viable value-adding operation on the skin side of the industry without large volumes and established networks; and
- the difficulties of gaining a return for landholders from the low margins on the meat side of the industry.

However, TRIC's action research identified a number of key factors for gaining industry entry, particularly the importance of landholders undertaking a role that adds value to the existing industry, rather than just expecting to be allowed or legislated in. Many factors affecting the feasibility of kangaroo enterprises have changed since the TRIC experience; such as kangaroo population densities, carcass prices, export and domestic markets and identities of industry players. Stayner (2004, 2005) has considered the TRIC experience amongst many other factors in his analysis of the economics of collaborative kangaroo enterprises, providing a knowledge base for further adaptive management projects to build on.

One such project is the establishment of Wildlife Management Conservancies (WMCs) (Wilson and Mitchell 2005) under the Rangelands and Wildlife Subprogram of the Rural Industries Research and Development Corporation (RIRDC). The WMC model consists of neighbouring landholders who "come together voluntarily to pool resources, plan collaboratively and benefit both economically and socially while also enhancing the sustainability of their properties and the region" (p8). WMCs investigating kangaroo enterprises have been established in southwest Queensland (Maranoa WMC) and along the NSW/Victorian border near Mildura (Barkindji WMC).

The FATE program is also working on models for communal landholder management of kangaroo resources and has also obtained funding through RIRDC's Rangelands and Wildlife Subprogram. The FATE approach is based on a common property resource system whereby neighbouring properties can explore managing a kangaroo enterprise as a single unit, with the benefits distributed on the basis of the proportion of resources each property contributes to the overall enterprise (Williamson *et al.* 2003).

FATE has embarked on a project involving a group of 27 large pastoral properties that form the Barrier Area Rangecare Group (BARG) in north-western New South Wales (NSW), covering over 1 million hectares in total. These properties, which run sheep and cattle (and also depend on a significant amount of off-farm income) have been collaborating for some time on NRM activities such as feral animal control, weed control and sustainable grazing management. The partnership between BARG and the FATE Program aims to expand this collaboration by managing free-ranging kangaroos as a common property resource, with associated monitoring and management of total grazing pressure across the BARG properties.

BARG and FATE have embarked on an adaptive management trial that seeks to explore ways in which kangaroo enterprises could contribute to both conservation outcomes and economic viability of pastoral properties. Adaptive management is a key principle of managing sustainable use activities (Secretariat of the Convention on Biological Diversity 2004) and involves a cyclic process of continuous improvement with landholders and researchers developing new strategies, putting them into practice and monitoring their impact. The NSW Kangaroo Management Program contains special provisions for approving adaptive management trials and FATE and BARG are negotiating for a greater degree of flexibility in harvesting across property boundaries that will allow BARG to pool harvest tags, undertake harvesting strategically in accordance with total grazing pressure priorities and use their collective bargaining power to enter into more secure financial arrangements with kangaroo harvesters and processors.

Monitoring needs to be a key component of any adaptive management approach to kangaroo management and this trial will monitor kangaroo harvest patterns as well as rangeland health across the trial site using Landscape Function Analysis (LFA) (Tongway and Hindley 2004). Management-induced changes in rangeland health can be very difficult to measure due to high climatic variability and long-term alterations to rangeland health due to grazing (Eldridge and Koen 2003). Collaborative action amongst landholders may provide significant advantages for monitoring through comparisons between neighbouring properties of different ecosystems, stock management strategies and kangaroo harvest strategies and integration with existing data sources such as the Rangeland Assessment Program (RAP), which has operated in NSW since 1989.

Conclusions

While demonstrably sustainable, the current kangaroo industry does not yet fit the model of conservation through sustainable use (CSU) and in order for this to happen, greater landholder involvement in the industry is essential. Landholder involvement could drive significant innovation in management of both the kangaroo harvest and kangaroo habitat, resulting in strategies that improve landscape function and biodiversity. Landholder involvement could also improve the supply chain, enhance product quality and reliability and provide marketing opportunities relating to environmental outcomes.

The conservation outcomes that could result from a successful kangaroo CSU strategy are consistent with regional NRM targets such as:

- increasing the area of conservation on private land (by providing an alternative source of income from such land);
- increasing the area of native vegetation (by creating incentives for vegetation mosaics that suit kangaroos); and
- increasing the extent of ground cover in rangelands (through improved control of total grazing pressure).

If it can be demonstrated that CSU is possible via kangaroo harvest, the industry will be able to unambiguously utilise its environmental credentials in marketing and public relations. This could create a self-reinforcing effect, whereby an increased value of kangaroo products leads to greater landholder returns, greater landholder involvement, conservation outcomes, marketing opportunities through environmental credentials and even greater value for kangaroo products.

For these outcomes to result, kangaroo products need a significant jump in value to get the ball rolling, landholders need mechanisms to get involved in the industry and accurate data is required on the costs of kangaroo production and potential synergies with sheep grazing. At the same time, management of the kangaroo harvest must continue to ensure that the sustainability of kangaroo populations is protected from unregulated market forces and that perverse incentives are not created that drive negative conservation outcomes.

Steps towards the goal of creating a successful CSU model for kangaroo harvesting have been underway for many years and are building in momentum. However, we believe a change in focus is needed from State kangaroo management plans (KMPs) to reflect the principles of sustainable use endorsed in documents such as the Addis Ababa Principles and Guidelines for Sustainable Use (Secretariat of the Convention on Biological Diversity 2004), which have been developed in the time since the current KMPs were approved. As KMPs come up for review, a broader consideration is needed of the economic and social factors that affect kangaroo harvesting activities and ways that these can be linked with broader conservation goals.

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Building Cooperation and Collaboration in the Kangaroo Industry

— Towards a role for landholders —

RIRDC Publication No. 10/013

RIRDC Innovation for rural Australia

Australian Government

Rural Industries Research and
Development Corporation

Building Cooperation and Collaboration in the Kangaroo Industry:

Towards a role for landholders

By Peter Ampt and Alex Baumber

March 2010

RIRDC Publication No 10/013
RIRDC Project No. PRJ-000680

ISBN 1 74151 989 6
ISSN 1440-6845

Building Cooperation and Collaboration in the Kangaroo Industry. Towards a role for landholders
Publication No. 10/013
Project No. PRJ-000680

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Electronically published by RIRDC in March 2010
Print-on-demand by Union Offset Printing, Canberra at www.rirdc.gov.au
or phone 1300 634 313

Foreword

The Barrier Ranges Sustainable Wildlife Enterprise Trial, conducted over three years from July 2006 to June 2009, is a participatory action research study that focuses on the present and future role of landholders in the kangaroo industry. Through a range of strategies involving extensive consultation, analysis, intervention and adaptive management, the study has examined key aspects of the commercial kangaroo harvest system. It has revealed a complex set of interactions between landholders, harvesters, regulators and processors in the case study area and beyond, and has implemented changes to components of the system and assessed the impact of those changes.

This research shows why landholder participation in the industry is very low at present and points to specific innovations that could increase it. Some of these innovations can be picked up by landholders immediately, some require changes to regulatory practices and others can be implemented by processors and the industry as a whole. Better integration of kangaroo harvest with land management can provide benefits to the landscape, and this research has also trialled Landscape Function Analysis as tool to help landholders make better environmental management decisions. This research can help the industry as a whole build a better value chain and access more secure and high value markets, which will provide benefits to all those involved in the industry.

This research identifies changes which could be made to the regulation of the commercial kangaroo harvest to encourage transparency and innovation; landholders and harvesters could form collaborative groups to develop quality harvest management in local areas; processors could pursue quality above compliance and the industry as a whole could seek greater visibility in actively pursuing increased domestic consumption.

This report is an addition to RIRDC's diverse range of over 1900 research publications and it forms part of our Rangelands and Wildlife Systems R&D program, which aims to facilitate a more diverse rural sector, enhanced biodiversity and innovative industries based on non-traditional uses of the rangelands and their wildlife.

Most of RIRDC's publications are available for viewing, free downloading or purchasing online at www.rirdc.gov.au. Purchases can also be made by phoning 1300 634 313.

Peter O'Brien
Managing Director
Rural Industries Research and Development Corporation

Acknowledgments

The authors would like to acknowledge the significant contributions and support of:

- Our Broken Hill-based research officers Katrina Gepp and Kristy Andrews for your energetic, thorough and resourceful approach that was a central component of the research
- The Western Catchment Management Authority and its Broken Hill staff for hosting our research officer and providing administrative, practical and moral support, in particular Catchment Officers Louise Turner, Melinda Fletcher and Michelle Manion
- Members of the BRSWET Steering Committee for active and committed attendance at meetings and honest and thoughtful contributions to the progress of the trial
- The executive and membership of the Barrier Area Rangecare Group for hosting and supporting the trial, providing honest and committed feedback and outstanding hospitality
- David Tongway for his expertise in the use of Landscape Function Analysis
- Richard Stayner and Jonathon Moss from the Institute of Rural Futures at UNE for expert advice and for conducting economic modelling
- Peter van Herk for the production of the BaRaRoo Business Case
- Steve McLeod, Tony Pople for conducting the kangaroo population survey
- Margaret Chapman of University of Queensland for collaboration on the landholder survey, Amanda Ampt for setting up the database and Ji Chen for data entry and analysis for landholder survey
- Maxine Crowley from Competent Appointment Services in Broken Hill for administering the tag allocation process for the group licence
- Staff and management of the Kangaroo Management Program of NSW DECC with special thanks to Noni McArthy for setting up the group licence system
- FATE Project Officer Sue Stevens for managing the General Licence process and for research and financial administration
- Sarah Doornbos for coordinating the production of the final report
- FATE research collaborators Rosie Cooney and George Wilson for research and strategic guidance
- Professor Mike Archer, Dean of Science, UNSW for providing the vision and support for the FATE Program.

The total budget for this project (both cash and in-kind) was $486 794, which included $205 645 from RIRDC, $144 441 from UNSW and $136 708 from other sources including Western CMA, NSW DECC, BARG members, AEMS and consultants.

Abbreviations

AEMS	Agricultural and Environmental Management Services
AM	Adaptive Management
BaRaRoo	Barrier Ranges Kangaroo enterprise
BARG	Barrier Area Rangecare Group
BRSWET	Barrier Ranges Sustainable Wildlife Enterprise Trial
CMA	Catchment Management Authority
CSU	Conservation through Sustainable Use
DECC	Department of Environment and Climate Change
DPI	Department of Primary Industries
DSE	Dry Sheep Equivalent
EBC	Enterprise-Based Conservation
EFA	Ecosystem Function Analysis
FATE	Future of Australia's Threatened Ecosystems
GL	General Licence
KMP	Kangaroo Management Plan
KMZ	Kangaroo Management Zone
LFA	Landscape Function Analysis
MLLE	Multiple Lines and Levels of Evidence
NPWS	National Parks and Wildlife Service
NRC	Natural Resources Commission
PAWD	Pastoralists' Association of West Darling
PAR	Participatory Action Research
PVP	Property Vegetation Plan
RAP	Rangeland Assessment Program
RMAP	Rangeland Management Action Plan
RIRDC	Rural Industry Research and Development Corporation
SWE	Sustainable Wildlife Enterprise
SWOT	Strengths, Weaknesses, Opportunities and Threats
TGP	Total Grazing Pressure
TRIC	Tilpa Rangeland Investment Company
UNE	University of New England
UNSW	University of New South Wales
WCMA	Western Catchment Management Authority

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Executive Summary

What the report is about

This report documents the Barrier Ranges Sustainable Wildlife Enterprise Trial undertaken by the Future of Australia's Threatened Ecosystems (FATE) Program from UNSW between June 2006 and June 2009. FATE and several consultants worked closely with key stakeholders (members of the Barrier Area Rangecare Group, Western Catchment Management Authority, kangaroo harvesters, the Kangaroo Management Program at NSW Department of Environment and Climate Change and some kangaroo processors) in an attempt to develop a collaborative kangaroo harvesting enterprise involving landholders.

This research is important because, after three decades of commercial kangaroo harvesting, there is negligible involvement of landholders in the industry. Despite calls for a greater emphasis on conservation through sustainable use, the kangaroo industry remains separate from land management. Despite calls from experts that Australia's rangelands are more suitable for growing kangaroos than conventional livestock and that there are significant benefits to be achieved from a shift to kangaroos, it has not occurred.

This project set out to devise, with stakeholders, a path towards a viable business based on kangaroo harvest that takes into account environmental, social, industrial and economic factors.

Who is the report targeted at?

Landholders, kangaroo harvesters, kangaroo harvest regulators, kangaroo processors and researchers interested in sustainable land management and providing opportunities to diversify rural enterprises.

Background

Sustainable use of wildlife has become widely accepted internationally as a strategy to secure conservation outcomes as well as supporting human livelihoods. To encourage sustainable use of Australia's native wildlife, RIRDC has launched the Sustainable Wildlife Enterprises program. Kangaroo harvesting has been identified under the SWE program as a key enterprise option to be explored by landholders interested in diversifying their incomes and achieving conservation outcomes through the commercial use of native species.

Aims/objectives

The major objective of the project was to investigate whether a Sustainable Wildlife Enterprise (SWE) based on kangaroo harvesting can provide incentives to manage rangelands for biodiversity conservation and landscape rehabilitation. In order to achieve this objective, the project aims to:

1. Develop a collaborative kangaroo enterprise that provides returns to landholders.
2. Develop a collaborative approach to kangaroo management across the BARG area.
3. Integrate kangaroo management with other enterprises on the participating properties to achieve improved management of total grazing pressure.
4. Establish and undertake community monitoring of landscape function and kangaroo populations to inform adaptive management
5. Document the process and develop a model for similar initiatives in other locations.

Methods used

An adaptive management approach was used to develop, trial, monitor and adapt a model for a collaborative kangaroo enterprise among members the Barrier Area Rangecare Group in the far west of NSW. The project consisted of several components: investigation of past harvest and population dynamics of kangaroos in the trial area; trial of a special group harvesting licence to facilitate collaboration among landholders; training of landholders in Landscape Function Analysis and progress towards a multi-property monitoring scheme; a survey of landholders across the WCMA region of NSW to gather baseline information on kangaroo management practices and landholder perspectives; economic modelling to test financial feasibility of likely enterprise scenarios and a business case for a collaborative kangaroo enterprise. These components were integrated with a thorough analysis of the kangaroo industry.

Results/key findings

The project was successful in developing a collaborative approach to kangaroo harvest management across the BARG area, developing a model for application to other areas and undertaking initial monitoring of landscape function and kangaroo populations. However, due to the short harvest trial duration, low harvest levels and difficulties negotiating with the kangaroo industry, it was not successful in obtaining returns for landholders and had limited success in integrating kangaroo management with other enterprises.

Analysis of harvest data reinforced the need for landholders to collaborate to generate practical and economic benefits from kangaroo harvest. Despite a protracted delay in gaining approval, three successive group licences were trialled successfully, providing an alternative harvest regime for consideration by the regulator. While the participants were positive about the potential of the group licence, its full potential was not assessed due to a lack of kangaroo influxes during the trial. Landholders were successfully trained in LFA and a group monitoring system was planned and partly implemented. A web-based information sharing system for kangaroo harvest management and for monitoring landscape function was not delivered by a research partner. A business plan was developed for a collaborative kangaroo harvest enterprise. It aims to deliver a premium kangaroo product and, based on economic modelling, would be viable if a premium price could be obtained. Trial participants were unwilling to embark on the venture in the absence of a premium price and the perceived unwillingness of processors to recognise the role a local management group could play in value-adding to harvest management.

The project has identified significant potential for collaboration between landholders and harvesters and greater understanding has been gained on the factors influencing income potential of collaborative kangaroo harvesting. The research identified implications and generated recommendations for the various stakeholders involved in kangaroo harvest, regulation, processing, marketing and industry development.

The key findings of the research are:

- the commercial kangaroo harvest system is complex and resistant to change;
- there are significant risks and barriers to change in the kangaroo industry due to weaknesses in value chain and consumer misconceptions;
- while opportunities for individual landholders to participate are severely limited, there are significant opportunities for involvement of groups of landholders collaborating with each other and with harvesters and chiller operators;
- there are fundamental problems with the harvest regulation system that encourage people to work around the system and that hinder innovation;

- harvesters stand to gain from collaboration with each other and with landholders;
- processors are in a position to encourage innovation and stand to gain from providing incentives for groups to manage harvest locally;
- a stronger focus on the development of a premium line of kangaroo meat will benefit the industry;
- Further work should be done with landholders to develop self monitoring using Landscape Function Analysis.

Implications for relevant stakeholders

Landholders are capable of and interested in monitoring resource condition using Landscape Function Analysis to help guide their own management and to generate evidence of good environmental stewardship. Their data could help contribute to regional information on environmental performance with additional research.

Landholders can gain greater control of kangaroo harvest and create opportunities for gaining an economic return from kangaroos if they collaborate with neighbours and kangaroo harvesters. Harvest variability is too high on an individual property basis.

For regulators, offering a Group Licence as an alternative to a single property licence can help generate opportunities for developing kangaroo enterprises. The current regulatory system has serious flaws which lead to some non-compliance which is largely undetected and impacts on the integrity of harvest data and trace-back.

For kangaroo harvesters, being part of a co-operative group with landholders and other harvesters can generate benefits such as security of access and continuity of harvest.

Chiller operation is a critical step in the kangaroo harvest system that, if neglected, represents a significant risk to the industry.

Processors continue to dominate the industry. Great benefits could be generated for the industry as a whole if they were to recognise the potential of and provide incentives for quality local management of kangaroo harvest and chillers.

Developing a premium line of kangaroo meat and testing it in the market may be a critical step towards achieving the Kangaroo Industry's aim of increased domestic human consumption of kangaroo manufacturing meat.

Recommendations

1. Landholders should attempt to find a kangaroo harvester with whom they can establish clear lines of communication in an effort to achieve kangaroo population management and other potential benefits (such as feral animal management) in return for security of access and harvest support.
2. Where practical, landholders should attempt to form a group, preferably of neighbouring properties, and negotiate with a reliable harvester or harvesters by offering harvest support and access rights to the whole group in exchange for desired harvester behaviour such as a commitment to harvest when necessary and the management of feral animals. This can be achieved under the current Occupiers and Trappers Licences but there are advantages to using a group General Licence.
3. Landholder groups in areas where kangaroo populations are high and for whom effective kangaroo management is a high priority should use the information generated by this trial to develop workable kangaroo management strategies in collaboration with harvesters and processors. In particular, they should determine whether the production of a premium line is possible and work

towards establishing a co-operative which provides incentives for provision of quality in return for a premium price.

4. Landholders and landholder groups interested in generating evidence of environmental stewardship and seeking objective means of assessing the impact of management practices on resource condition should consider implementing a system based on Landscape Function Analysis.

5. Harvesters should consider approaching landholder groups and other landholders to collaborate on harvest management in their area. This project has demonstrated clear benefits from collaboration and cooperation across properties and between harvesters. Harvesters can take a leading role in this.

6. Property specific tags should be phased out. This is because they are not sufficiently flexible to allow for the habits of kangaroos and the livelihoods of harvesters and they are not necessary to ensure zone quotas are upheld. In states where they occur, tag-swapping is practiced which compromises harvest data and trace-back reliability. Whilst it is illegal, tag-swapping is difficult to detect and therefore ineffectively enforced.

7. If property specific tags are retained, penalties for using them on another property should be replaced by a requirement for such use to be reported. This would require minimal changes to the existing system, would remove the perverse incentive to falsify harvest returns, would provide more reliable harvest data and would improve the accuracy of trace-back.

8. If property specific tags are retained, a group licence similar to the one tested in this trial should be made available to groups that provide coordination and administration of harvest.

9. The system of Fauna Dealers Licences should be reviewed to remove the barrier for a local kangaroo harvest management co-operative or corporation to develop a business independent of existing processors.

10. The NSW KMP should include more detail on social, cultural and economic objectives.

11. The adaptive management provisions in the NSW KMP should be streamlined and broadened to provide a clearer path for researchers to design and implement adaptive management trials.

12. Investigation should be undertaken into the possibility of generating a line of kangaroo meat from the existing value chain that is of sufficient quality and consistency to demand a higher price from the domestic restaurant, food service, gourmet and specialist retail market. Consideration should be given to the contribution of size, age, species, field processing, chilling, transport and location to the achievement of a market-appropriate quality differential.

13. The kangaroo industry should develop and implement incentives for landholder groups, harvesters and chiller operators to meet and exceed compliance to develop quality rather than incentives solely based on quantity.

14. The possibility of providing a processing service to harvest management groups should be investigated that allows them to have their animals processed for a fee while retaining ownership through to the retailer.

15. A task force should be set up that aims to develop a national kangaroo harvest regulation system that removes differences between states, is based on ecologically sustainable development and allows for devolution of management to local groups that can demonstrate their ability to successfully manage the harvest. Consideration should be given to a system of tradable tags.

16. The industry should support the development of a system driven by quality rather than quantity. This will involve supporting research into the measures needed to generate differentiated products,

assess the potential volume of those products and develop the markets for those products. This research suggests that achieving a quality driven system could involve providing incentives to local business / landholder / harvester groups to provide quality harvest and chiller management.

17. The industry should explore innovative ways of increasing the visibility of kangaroo meat and awareness of its positive market attributes.

18. The industry should develop closer ties with landholders and landholder groups and seek to work more closely on mutually beneficial areas such as integrating commercial kangaroo harvest with good land management. Through this the industry can utilise the promotional benefits of landholder involvement and support for the industry, which links closely with consumer attitudes looking farmer 'management' of kangaroo production. One possible mechanism is to support the establishment of a National Kangaroo Grower and Harvester Association.

1. Introduction

1.1 Sustainable Wildlife Enterprises

Sustainable use of wildlife has become widely accepted in recent years as a strategy to secure conservation outcomes at the same time as supporting human livelihoods (CITES 1992; IUCN 2000; CBD 2004). Use of wild resources, it is argued, can generate incentives for conservation of wild species and ecosystems, and these incentives can counteract the powerful drivers currently operating for conversion of biodiverse natural landscapes to intensive production (Webb 2002; Hutton and Leader-Williams 2003; CBD 2004). In Australia, many writers have highlighted the potential benefits of sustainable use of wild fauna and flora and called for its wider adoption (Grigg, Hale et al. 1995; Wilson 1995; Senate RARATR Committee 1998; Lunney and Dickman 2002; Webb 2002; Archer and Beale 2004).

To encourage sustainable use of Australia's native wildlife, the Rural Industry Research and Development Corporations (RIRDC) Rangelands and Wildlife Subprogram have launched the Sustainable Wildlife Enterprises program. The initiative seeks to trial new ways of managing native species to provide profitable and sustainable income generating options for landholders. A Strategic Plan for Trialling the Sustainable Wildlife Enterprises (SWE Plan) concept has been produced and published by RIRDC in 2005 through its Rangelands and Wildlife Research Program and with the support of the National Landcare Program. The SWE Plan sets out guidelines for conservation-based enterprises as an incentive to restore native on-farm habitat. The trials will seek to determine whether alternative production systems enable the value of wildlife resources to operate as an incentive to protect and maintain habitat and to enhance biodiversity on private lands, to increase the resilience and long term sustainability of the agricultural sector in rangelands, to reduce the costs of land rehabilitation and to strengthen the viability of rural communities.

Emu on Fowlers Gap

The Future of Australia's Threatened Ecosystems Program (FATE), a small research group based at UNSW, is working on conservation through sustainable use (CSU) and common property strategies to improve natural resource management. The FATE Program's objective is to investigate whether CSU approaches involving the commercial use of Australia's native species could enhance the long-term conservation of Australian biodiversity and increase the resilience and economic viability of rural and regional Australia. The FATE approach is fundamentally consistent with the work being undertaken by the Rangeland and Wildlife Systems under the Sustainable Wildlife Enterprises (SWE) Strategic Plan.

Both the FATE Program and the SWE Program have identified kangaroo harvesting as a key enterprise option to be explored by landholders interested in diversifying their incomes and achieving conservation outcomes through the commercial use of native species. Australian scientists have repeatedly called for landholders in the Australian rangelands to manage and earn income from the kangaroos on their land, and move away from sole reliance on non-native stock species (Grigg 1989; Grigg 1995; Ampt and Baumber 2006). Potential benefits include more effective management of total grazing pressure, reducing stocking densities, reduced land degradation, incentives for habitat and vegetation retention and rehabitation, and diversified income streams for landholders (Grigg 1989; Grigg 1995; Ampt and Baumber 2006). A further benefit of increased reliance on kangaroo production is the trivial greenhouse gas emissions they produce, compared to the very large methane emissions involved in sheep and cattle production (Diesendorf 2007). In spite of almost two decades of calls for increased landholder involvement in the commercial kangaroo industry, they have gained little traction. Today landholders remain almost completely uninvolved in kangaroo management, and kangaroo use generates minimal or nil benefits for habitat conservation among the landholders who manage land. There are multiple reasons why this hasn't happened, one of them being that little attention has been paid to the question of exactly how landholders could be involved and gain economic benefits.

This report presents the results of the Barrier Ranges Sustainable Wildlife Enterprise Trial (BRSWET) conducted by the FATE program as part of the larger program funded by RIRDC to develop Sustainable Wildlife Industries (SWEs) in the rangelands. The Trial integrates kangaroo management with good land management for the benefit of the rangelands and rangeland communities. To understand the origins of the project it is necessary to have some feel for its context, so we begin with a detailed historical backdrop of the barrier ranges and its kangaroos leading to the Barrier Ranges Sustainable Wildlife Enterprise Trial.

1.2 The Barrier Ranges

The Barrier Ranges area, north of Broken Hill in Western NSW, is a microcosm of much of Australia's semi-arid rangelands. It has an average rainfall of between 200-300mm per year (of moderate to high variability) and is covered with native vegetation such as bluebush, saltbush, grasslands, and sparse woodlands of Mulga (an Acacia) and other small trees. It is crossed by ephemeral streams vegetated with river red gum (Eucalyptus) and associated species. Geomorphically, it consists of alluvial and rolling plains, lowlands, hills and tablelands interspersed with dune fields and sand plains. Prior to colonial occupation, Wiljakali, Malyankapa and Pandjikali people lived in the area.

Explorer Charles Sturt named the Barrier Ranges in 1841 and pastoralists began settling the area in the 1850s, using the Darling River as their main trade route. The vast shrublands were quickly stocked with sheep over the following decades. The devastating droughts in the 1890s resulted in massive stock losses and land degradation. The area is now under the jurisdiction of the NSW Department of Lands, having been divided into Western Lands Leases overseen by the Western Lands Commissioner.

During the 20th Century, pastoralism continued with a proliferation of bores sunk to extend the areas available to grazing. Crises such as rabbits and droughts occurred, leading to massive soil loss and local extinctions of many species, including small native mammals. This has impacted on the structure and function of the remaining native vegetation and the subsequent productivity of the land for grazing purposes. For the past eight to ten years the area has remained in the grip of drought with only minor reprieves.

Bird life on station dam, Fowlers Gap Station

Land tank, SE of White Cliffs, showing impact of stock around watering points

Presently, the Barrier Ranges is settled by grazier families on Western Lands Leases who are under considerable pressure on multiple fronts. Traditional enterprises (such as wool growing) are returning marginal incomes. Some landholders are acquiring additional leases to achieve an economically viable area, taking on large areas of land. This leads to extreme labour demands, so traditional enterprises such as wool growing become less feasible, as infrastructure is difficult to maintain under these circumstances with fencing and stock water requiring ongoing attention. Pressure to generate off-farm income is driving some families to separate during the week with partners living in the nearest large town to work and be close to schools. Many families have off-farm investments in property and shares and include ancillary businesses. In some cases this means that generating income from the pastoral enterprise is no longer critical.

In addition to wool growing, there is interest in meat sheep breeds and many landholders make a significant income from trapping and selling feral goats. For some families, these enterprises have displaced wool growing because of the increased global demand for sheep and goat meat and because the labour demands are much less than for wool growing.

Since 1990 federal money has been available under a number of schemes for landholders to carry out conservation-orientated works on their properties. These include the historic decade of Landcare (1990-2000) the associated Natural Heritage Trust program, regionalisation and the current 'Caring for our Country' initiative. Regionalisation of natural resource management led to the establishment of the Western Catchment Management Authority (WCMA), a key intermediary between individual farmers and federal funding. Like all regional bodies, the WCMA has developed catchment targets for land and vegetation (ground cover greater than or equal to 40% to prevent soil erosion) and biodiversity (ecological communities of high conservation values adequately protected and 25% of other ecological communities managed for conservation within 25 years).

The State's *Native Vegetation Act 2003* and Regulations have put conditions on management that restrict landholders' rights to clear and modify native vegetation. One of the biggest impacts of this in the Barrier Ranges is to require landholders to prepare a Property Vegetation Plan (PVP) before being able to manage the encroachment of invasive native scrub: a contentious issue because while proliferation of native shrub can be classified as native vegetation under the Native Vegetation Act, landholders generally view it as being over-run by woody weeds. Some landholders are also involved in the NSW State Government's Enterprise-based Conservation Scheme. This scheme pays them per ha to reduce their stock numbers and/or manage for a minimum ground cover target.

In response to these pressures and to the availability of the federal money, the Barrier Area Rangecare Group (BARG) was established by interested landholders in 2002. It is an active, incorporated Landcare group of landholder families with a wide range of ages, property sizes and backgrounds. Through BARG, they collaborate on weed and feral animal control, grazing management and other aspects of rangeland health. BARG members have been successful in gaining access to Western Catchment Management Authority (CMA) funding for a range of activities including goat trapping, invasive native scrub control and improved stock water management. They are clearly committed to maintaining their pastoral, outback station lifestyle despite the pressures described above. As a result they are keen to develop diversified income streams.

Feral goats on Fowlers Gap Station

1.3 Kangaroos in the rangelands

The vast arid landscape of the Barrier Ranges also supports varying populations of four different species of large kangaroos; Reds, Western Greys, Eastern Greys and Wallaroos. Numbers vary according to the seasons, but these species have been very successful despite the dramatic changes in the landscape since Europeans arrived. Pastoralists traditionally view these kangaroos as pests because, apart from shooting the occasional kangaroo for pet food, they obtain no direct material benefit from them and perceive them as a potential threat to the profitability of their enterprise. During good seasons kangaroo numbers increase, then as the landscape dries they can move large distances seeking feed in the paths of storms and in wash out areas where there is green vegetation. They occasionally descend on properties in large numbers at these times. At other times they are ever present in the landscape. Many landholders are convinced that kangaroos cost them many thousands of dollars through competition with domestic stock and the damage they do to infrastructure.

In Queensland in the 19th century, kangaroos were officially considered vermin and bounties were paid. At the same time their commercial potential was being discovered, with a growing skin trade in the late 1800s and into the 1900s. Kangaroo meat was also used for pet food, and with the collapse of the rabbit industry after the introduction of myxomatosis in the 1950s, it became more valuable. Over the next few decades legislation was introduced into most states to control the harvest. By the 1970s all states had legislation that offered protection to kangaroos as native animals but issued licences to cull kangaroos either for damage mitigation or for commercial use. An industry grew around the cull, supplying skins to tanneries and lean meat to both pet food manufacturers and to a growing market for human consumption overseas and in Australia. Many of the pioneers of the industry are still in business. They have worked hard to develop domestic and export markets for kangaroo meat, promoting it as a healthy alternative to traditional red meats.

Kangaroos on Fowlers Gap Station

The Barrier Ranges are in the Tibooburra and Broken Hill commercial kangaroo management zones under the management of the NSW Kangaroo Management Program in the NSW Department of Environment and Climate Change (DECC). The goal of this program is to:

> Maintain viable populations of *kangaroos* throughout their ranges in accordance with the principles of *ecologically sustainable development* (Department of Environment and Conservation NSW 2006)

Each year the DECC commissions a population survey which estimates the populations of the 4 commercial species of kangaroo and sets a quota for harvest which is usually about 15% of the estimated population. Landholders can apply for an 'Occupier's Licence' to harm kangaroos on their properties. The licence involves purchasing royalty tags from the Kangaroo Management Program of DECC and specifies a 'Licensed Trapper' who will undertake the harvest. The trapper fixes a royalty tag to each harvested kangaroo and offers them for sale to a registered fauna dealer.

Several studies have been done recently about the commercial kangaroo industry (Chapman 2003; Thomsen and Davies 2007) that came to the following shared conclusions:

- It is rare for landholders to derive direct income from kangaroo harvest.
- Landholders perceive that regulatory regimes are a key disincentive to their participation in the industry.
- Despite many landholders regarding kangaroos as a potential resource, they provide access for harvest because they derive indirect benefit due to reduction in kangaroo numbers.

1.4 The Barrier Ranges Sustainable Wildlife Enterprise Trial

The problem at the centre of this project is declining sustainability of pastoralism in the rangelands and the perceived lack of alternative enterprises. Linked to this is public pressure to manage land for enhanced environmental outcomes. FATE is interested in whether landholder returns from kangaroos can simultaneously improve the viability of rangeland enterprises and create incentives to conserve rangeland habitat. Such conservation outcomes may result from diversifying away from sheep (with a commensurate reduction in grazing pressure) and/or by more effective control of kangaroo grazing pressure through the commercial harvest.

FATE first became involved with BARG in March 2005 when the FATE program manager attended a meeting and discussed the issues around kangaroos in the rangelands. The positive response from the meeting stimulated a preliminary funding proposal which was accepted by the Rural Industries Research and Development Corporation (RIRDC) in October 2005.

FATE then assembled a team and attended a BARG meeting in November 2005, at which a core group of ten BARG landholders expressed interest in participating in a trial to learn about better ways of managing kangaroos for multiple benefits. In the meeting it was clear from the landholders that the stimulus for their involvement was the belief that:

- kangaroos made a significant impact on total grazing pressure, especially in dry times when landholders reported influxes of kangaroos onto drought reserve paddocks, flood out areas and in the path of storms where 'green pick' was evident
- the existing quota setting and tag allocation system was not flexible enough to respond quickly to influxes of kangaroos
- the existing industry was preventing economic returns to landholders from kangaroos harvested from their property.

A full proposal for the Barrier Ranges Sustainable Wildlife Enterprise Trial was submitted by FATE to RIRDC in January 2006 which was funded from July 2006 until June 2009.

2. Objectives

The major objective of the project was to investigate whether a Sustainable Wildlife Enterprise (SWE) based on kangaroo harvesting can provide incentives to manage rangelands for biodiversity conservation and landscape rehabilitation. In order to achieve this objective, the project aims to:

1. Develop a collaborative kangaroo enterprise that provides returns to landholders.
2. Develop a collaborative approach to kangaroo management across the BARG area.
3. Integrate kangaroo management with other enterprises on the participating properties to achieve improved management of total grazing pressure.
4. Establish and undertake community monitoring of landscape function and kangaroo populations to inform adaptive management
5. Document the process and develop a model for similar initiatives in other locations.

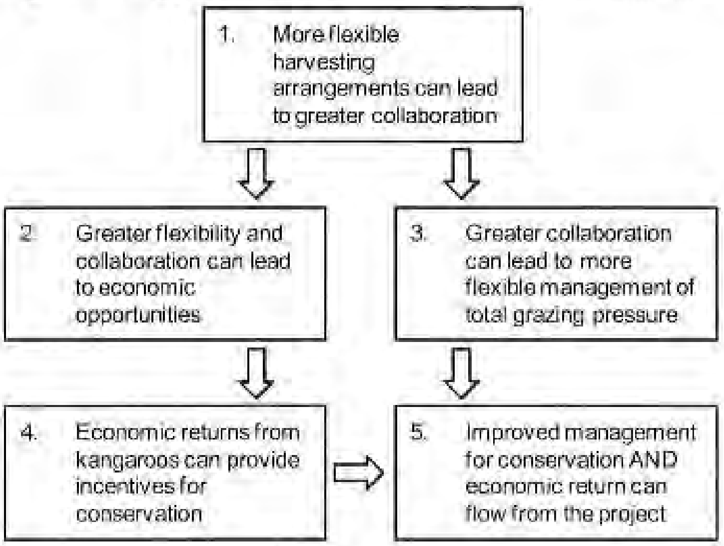
2.1 Hypotheses

These strategies follow an adaptive management framework by which a model for a collaborative kangaroo enterprise is developed, trialled, monitored and adapted over the three year life of the project. The trial tests the following hypotheses:

1. More flexible licensing arrangements can lead to greater collaboration between landholders
2. Greater collaboration can lead to economic opportunities for landholders in the kangaroo industry
3. Greater collaboration can lead to more strategic control over kangaroo grazing pressure
4. Economic returns from kangaroos can drive incentives for conservation

The interrelation between these hypotheses is illustrated in Figure 2.1.

Figure 2.1 Hypotheses for the Barrier Ranges Sustainable Wildlife Enterprise Trial



2.2 Desired outcomes of research

1. Improved understanding of the feasibility of collaborative landholder involvement in kangaroo harvesting and its potential benefits for rangeland management.

2. Development of a model for kangaroo harvesting initiatives based on the experience of the BARG members, flexible enough to be adapted to the different economic, social and environmental factors operating in different locations.

3. Increased landholder involvement in kangaroo harvesting across Australia's rangelands and increased acceptance of sustainable kangaroo harvesting as a viable land-use option.

3. Methodology

This section outlines the methodologies used to guide the project as a whole. Chapters 4-9 all deal with different components of the project and have their own methodologies which relate just to that component. At the conclusion of each of Chapters 4-9 there is a short summary of what that chapter contributes to the whole project.

The research methodology for the overall project is best described as participatory action research (PAR). This involves working with the people whom the research is supposed to benefit with behaviour change as a key outcome. It usually goes through several stages:

- understanding the context;
- engaging stakeholders;
- working with stakeholders to design an intervention;
- implementing the intervention;
- evaluating the intervention;

Ultimate success is measured by continuation of the intervention in some form after the 'project' ends.

The management approach used can be described as active and integrative adaptive management which is used to guide the intervention. Adaptive management recognises that in complex situations the solution to problems and the best path to improving problem situations are rarely evident or uncontested at the outset. Often information comes to light through the problem solving process that makes altering the path or even re-defining the problem necessary. Adaptive management sets out to collect evidence along the way that can inform the process and encourage flexibility in incorporating new knowledge. There are several alternative models (Stankey, clark et al. 2005):

- Incremental – reactive, muddling through, no purposeful direction.
- Passive – sequential learning, frame a single best approach along a linear path.
- **Active – designed to provide feedback on which approach is best, parallel learning.**
- Participation-limited – focuses on the interface between scientists and managers, leaving out the public - expert-driven by command and control.
- **Integrative – public engaging as peers building working relationships with managers and scientists, social learning.**

In this project we endeavoured to use active and integrative adaptive management which is strongly compatible with participatory action research.

3.1 Reasons for the chosen methodology and adaptive management approach

We had three key reasons for using PAR and adaptive management in this project:

1. The situation was highly complex: the problem is complex, with various and conflicting values, multiple objectives, and entrenched histories.

2. There was structural support for the use of adaptive management: The RIRDC Program under which we sought funding suggested that adaptive management was a key strategy in developing sustainable wildlife enterprises and the Kangaroo Management Plan also had provision for adaptive management trials. As researchers we had strong motivation to drive the process and had secure support from UNSW for our work.

3. There was good potential for participation: FATE could see clear applicability for adaptive management cycles to be built into the research process. Despite our open admission that we were not sure how far the project would go, we had a willing group of landholders committed enough to sign up to the project and to join a Steering Committee. Several harvesters volunteered to join the Steering Committee out of their loyalty to the landholders involved and to have a stake in the process. We knew that this support was dependent on progress, and that the research team would be doing most of the work. However it was imperative to gain support for each step and provide feedback and opportunities to influence the directions that we took.

The following points summarise key components in the adaptive management cycle that we needed to include in the process when appropriate:

Learn

- The group needed critical information and understanding of key components of the complex systems relevant to kangaroo management.
- We needed to canvass the views and suggestions of the group.
- We needed to negotiate key steps with other parties on behalf of the group without knowing in advance what the outcome would be.
- We needed to provide continual informal access to us to allow opportunities for dialogue.
- We needed to identify gaps in knowledge as they became apparent and seek to fill the gaps.

Describe

- We needed to be able to describe and model key parts of the process and provide opportunities for the group to contribute to the models.
- We needed to provide experts to build and conduct economic and business models for possible strategies.

Predict

- In deciding on the next steps we needed the benefit of the group's and outsider's experience on how our actions would impact others.
- We needed to develop scenarios for an outcome that satisfied the group's motivation and diminished their scepticism.

Do

- We clearly needed action before we could know the next steps. This was particularly true when it came to testing a different regulatory framework.
- The FATE Program was committed to participatory action research.

3.2 Collecting evidence and managing the trial

Each of the trial hypotheses outlined in Chapter 2 (Figure 2.1) required learning, describing, predicting and doing stages with specific feedback before proceeding to the next stage. We adopted a multiple lines and levels of evidence (MLLE) approach. A summary of the types of evidence we have used for each hypothesis is summarised in Table 3.1 below. Strategies we employed to manage the trial are summarised in Table 3.2 below.

Table 3.1 Trial hypotheses and description of evidence.

Trial hypothesis	Description of evidence
More flexible harvesting arrangements can lead to greater collaboration	• Meeting agendas and minutes • Trial progress as documented in newsletters • Documented feedback from participants • Western Division Landholder Survey
Greater flexibility and collaboration can lead to economic opportunities.	• Documented discussion of economic opportunities. • Development of an enterprise plan. • Development of a business plan. • Establishment of business entity. • Success of business entity. • Documented feedback from participants. • Adoption of business model by other groups.
Greater collaboration can lead to more flexible management of total grazing pressure.	• Western Division Landholder Survey. • Document the process of tag distribution. • Describe any influx events and how the trial responded • Contrast trial response with status quo or previous influx events. • Documented feedback from participants
Economic returns from kangaroos can provide incentives for conservation.	• Success of business entity. • Documented feedback from participants. • Impact of trial on BARG and other landholders. • Date from monitoring using Landscape Function Analysis.
Improved management for conservation AND economic return can flow from the project.	• Adoption of business model by other groups. • Document examples of collaborative kangaroo enterprise being successfully incorporated into sustainable management

Table 3.2 Strategies used to manage the trial and applied to different components

Key Strategy	Key events/ dates/ frequency	Description
Employ locally-based Research Assistant	Half-time from July 2006 until June 2009	Arranging meetings, contacting people between meetings, answering calls regarding the project, writing newsletters, helping to plan and manage training courses and meetings, writing minutes. When the Group Licence started in 1 May 2008, this position also administered the Occupier and Trapper Declarations, tag purchase from DECC and, Trapper returns to DECC. From late 2008, this position supervised and supported a private administrative services firm that was contracted to on-sell tags to harvesters and maintaining tag and harvest databases.
Steering Committee	Established Oct 06, met 14 times either face-to-face or teleconference	Landholder, Harvester, WCMA and FATE representatives. Made decisions about General Licence and on-going strategy on behalf of other participants.
Regular newsletters	23 produced between Sept 2006 and June 2009	Sent to all BARG members to keep them informed of progress of the trial and to call for participation.
Attendance at BARG meetings	8 meetings between March 2005 and June 2009	Through FATE's attendance at these meetings all BARG members had the opportunity to hear about the progress of the trial and ask questions. There were key meetings in the early stages that provided the support FATE needed to formulate and conduct the trial on behalf of BARG.
Involvement of Harvesters	Initial Shooters' meeting August 2006, Steering Committee membership, General Licence participation.	Attended by 15 shooters and 2 processors, followed by harvesters' inclusion on Steering Committee (2-4) and signing up to General Licence (16).
Involvement of Processors	Various formal and informal contacts.	Shooters' Meeting August 2006, KMAP meeting Oct 2006, Attendance of one to SC mtg July 2007, contact through 'Choosing Kangaroo' Project, contact through other SWE projects, Broken Hill Workshop (see Chapter 9).
Involvement of regulators	Ongoing from July 2005 until June 2009 and beyond	Discussion to develop understanding of the harvest system, negotiations prior to implementing General Licence, operation of the General Licence, Broken Hill Workshop (see Chapter 5).
Linkages with other landholder groups	Various formal and informal contacts	Tilpa Rangeland Investment Company (TRIC) attended BARG meeting, Meeting with RMAP, correspondence with PAWD, informal contact and visits to Mitchell/Maranoa, Broken Hill workshop.
Broken Hill Workshop	Feb 2008, 50 participants	Brought together key processors, regulators, harvesters, landholders and researchers from NSW, Queensland and South Australia in an historic meeting (see Chapter 9).
Use of consultants and other outside expertise	David Tongway Richard Stayner Peter van Herk Margaret Chapman Catherine Allan Steve McLeod and Tony Pople	Landscape Function Analysis Economic modelling Business Case Development Landholder Survey Adaptive Management Kangaroo population survey
Exit interviews of participants	3 landholders and 3 harvesters interviewed by phone during June 2009.	Asked about reasons for involvement, impact of involvement, operation of General Licence, future of kangaroo enterprises.

3.3 Progress of the trial

We were committed from the outset to ensuring that the trial itself should be focused on processes that enable the stakeholders to adaptively manage their resources for multiple benefits. We were also committed to use the adaptive management provision in the Kangaroo Management Plan (KMP). It was clear early in the project that there was considerable uncertainty about the likely outcomes of different stages of the process and how they would impact on future directions. As a result, there was no point in being linear and prescriptive in planning the project. As a consequence, we made a deliberate decision that our project management would be adaptive. To keep us on track, we involved a recognised adaptive management expert practitioner (Catherine Allan) to oversee the progress of the trial.

What followed was a serious commitment by the FATE team to adaptively manage the group of participating landholders (and kangaroo harvesters) through a series of stages. The FATE team wanted to understand how landholders could add value to kangaroo industry, why landholders weren't involved, and what it would take to get them involved. Learning was involved by all parties, and at the outset it was unclear how different players would react as new information came to light.

In this process FATE played the role of *agent provocateur*, stimulating dialogue by bringing people together regularly and joining BARG events –we kept turning up. We knew that to shift the system, thinking had to move beyond the status quo and this wouldn't happen quickly or without sustained and regular effort. In the spirit of researching *with* people, we were very open about the approach we were taking and were clear about not being certain at the outset about where the project would go. We were emphatic about the need for us to gain feedback from them, and they expressed a willingness to embark on the journey and keep up with what happened.

Our approach meant that we were working simultaneously on several aspects of the study in parallel. Initially, the most dominant aspect was the adaptive management trial of the General Licence which, due to protracted delays, impacted on other aspects of the project. As we gathered information on other aspects, changes to the original plan were necessary. Table 3.3 shows where our initial plans were altered as a result.

A critical component was to employ a local research officer who was the face of the project and the voice at the other end of the phone, providing an accessible avenue for expressing views about the project that might not have come out at more formal meetings. The research officer was critical in managing stakeholder expectations, reinforcing our chosen strategies and directions and following people up about commitments. We produced a regular newsletter and maintained good group management practice – agendas, minutes, housekeeping.

Table 3.3 GANTT chart from initial RIRDC proposal February 2006. Original timelines hatched or marked with an asterisk (MS = Milestone).

Updates as of 1 June 2009 in grey.

	Task	2006/2007				2007/2008				2008/2009				Prerequisite Tasks
		Jul - Sep	Oct - Dec	Jan - Mar	Apr - Jun	Jul - Sep	Oct - Dec	Jan - Mar	Apr - Jun	Jul - Sep	Oct - Dec	Jan - Mar	Apr - Jun	
Stage 1	Initial planning workshop involving key stakeholders.	* MS												• Establishment of BARG Kangaroo Steering Committee, collation of data, UNSW ethics approval, building of BARG-specific GIS/EMS. • Discussions with NSW DEC on landholder involvement. • Appointment of local research officer
	Development of collaborative harvesting trial for 2007 based on outcomes of workshop. – delayed by negotiations with DECC	*	* MS											• Decision by BARG to proceed with project following workshop. • Developed adaptive management trial of Group Licencing following recognition of need for multi-property approach
	Establish business structure for collaborative enterprise and position in supply chain. – development of co-op model and business case		*											• Engagement of consultant on collaborative business arrangements (Richard Stayner) • Incorporation of EBC into ec. Modelling (Moss and Stayner) and inclusion of separate business case (van Herk)
	Train landholders in LFA and kangaroo monitoring, establish monitoring sites and commence monitoring. – took longer than expected due to difficulties with weather and getting landholders together		*	*										• Engagement of consultants on LFA (David Tongway) and kangaroo monitoring (Tom Garrett) • Developed LFA monitoring system but didn't implement, monitored kangaroo harvest when GL in place.
Stage 2	Implement adaptive management harvesting trial under approved 2007 quota. – commenced over 1 year later than planned			*	*	*	*							• Approval of trial and issuing of quota by NSW DEC.
	Mid-year review of 2007 adaptive management trial, involving stakeholder workshop. – major review workshop held in Feb 08					* MS								• Completion of FATE kangaroo marketing project (results to be considered for application to BARG) • Major workshop bringing other SWEs, harvesters, regulators, processors and researchers together.

Table 3.3 – continued GANTT chart from initial RIRDC proposal February 2006. Original timelines hatched or marked with an asterisk (MS = Milestone).

Updates as of 1 June 2009 in grey.

	Task	2006/2007				2007/2008				2008/2009				Prerequisite Tasks
		Jul - Sep	Oct - Dec	Jan - Mar	Apr - Jun	Jul - Sep	Oct - Dec	Jan - Mar	Apr - Jun	Jul - Sep	Oct - Dec	Jan - Mar	Apr - Jun	
	Develop revised collaborative harvesting trial for 2008 based on outcomes of review workshop.					*	* MS							• – was initial rather than revised harvesting trial
Stage 3	Implement revised adaptive management trial under approved 2008 quota. – started in May 08 rather than January							*	*	*	*			• Approval of trial and issuing of quota by NSW DEC.
	Mid-year review of 2008 adaptive management trial involving stakeholder workshop.									* MS				• Review undertaken at 4-month intervals through the Steering Committee and at the end of the trial instead
	Depending on outcome of review workshop, develop revised collaborative harvesting trial for 2009.									*	*			• Will occur only if BARG members decide to proceed. • Applied for 3rd licence for period Feb-June 2009.
	Apply for further funding (also dependent on review).									*	*	*		• Only if BARG members decide to proceed and require further funding.
Stage 4	Commence 2009 collaborative harvest if desired.													• Will occur only if BARG members decide to proceed. • Feb-June 2009 harvest undertaken under group licence
	Evaluation of 2007 and 2008 trials, involving workshop. – interviews with participants instead of workshop, due to difficulties getting people together											*		• Compilation of final data following completion of 2008 trial harvest
	Preparation of final report and submission to RIRDC.											* MS		
	Presentations to conferences, field days, landholders, NRM bodies and industry groups.													• to be determined

3.4 Components of the trial

As kangaroos were the key wildlife enterprise, it was essential that we develop and share an understanding of the past harvest and population dynamics of kangaroos in the area, as well as to record thoroughly the impact of the changes to kangaroo harvest management as they were implemented. This is the focus of Chapter 4. A key conclusion of this work was that it was critical for landholders to act collectively to generate any returns or to influence kangaroo harvest on their properties. This led us to work towards the changes in the regulatory regime that are the focus of Chapter 5, in particular the collaborative General Licences that ran from May 2008 to June 2009.

Throughout the first year, the researchers elucidated a vision for the system managed for higher standing biomass, higher biodiversity, increased groundcover, improved landscape function, all of which are consistent with good natural resource management, and for which management of total grazing pressure is essential. Overall it was aiming towards a strategy for generating income from a landscape managed for resilience. To bring landholders into this process in a practical way, we undertook to train as many landholders as possible in Landscape Function Analysis (Tongway and Hindley 2004) and through that training to encourage them to incorporate landscape function information into the decision-making process. This component is dealt with in Chapter 6.

In order to understand how the BARG related to the broader population of Western Division, South Australian and Queensland landholders with regard to kangaroo management, we undertook a survey which is the focus of Chapter 7. As one of our key objectives was to determine whether, following the completion of the project, the landholder and harvester group could continue the work, we contracted economic modellers and a business consultant to undertake economic modelling of likely enterprise scenarios and to develop a business case for a potential SWE, which we called BaRaRoo (Barrier Ranges Roo). In a separate SWE project, a model for a co-operative for kangaroo harvest management (Cooney 2008) was developed. This is dealt with in Chapter 8.

In parallel, FATE embarked on a project to better understand consumers' beliefs, attitudes and behaviours around the choice and consumption of kangaroo meat. It was through this project that FATE directly engaged processors. The report produced from this project (Ampt and Owen 2008) became a key component of the thinking in 2008 at the Broken Hill Workshop organised as part of the trial. This aspect is the focus of Chapter 9.

Chapters 4 to 9 each have their own methodologies and a brief summary of the contribution that the chapter contributes to the whole project. These are picked up in the implications and recommendations Chapters 10 and 11.

4. Kangaroo harvest and population data

4.1 Objectives

Past harvest and population data for the Barrier Ranges area was analysed and compared to data for the BRSWET group licence harvest in 2008/09 according to the following objectives:

- identify spatial and temporal harvest trends across the trial area;
- better understand what factors are most significant in influencing harvest patterns (e.g. kangaroo populations, property accessibility, shooter dynamics);
- determine if the group harvest trial (2008/09) had a discernible impact on harvest patterns;
- identify harvest management options that could improve harvest efficiency or reduce harvest uncertainty across the trial area.

4.2 Methods

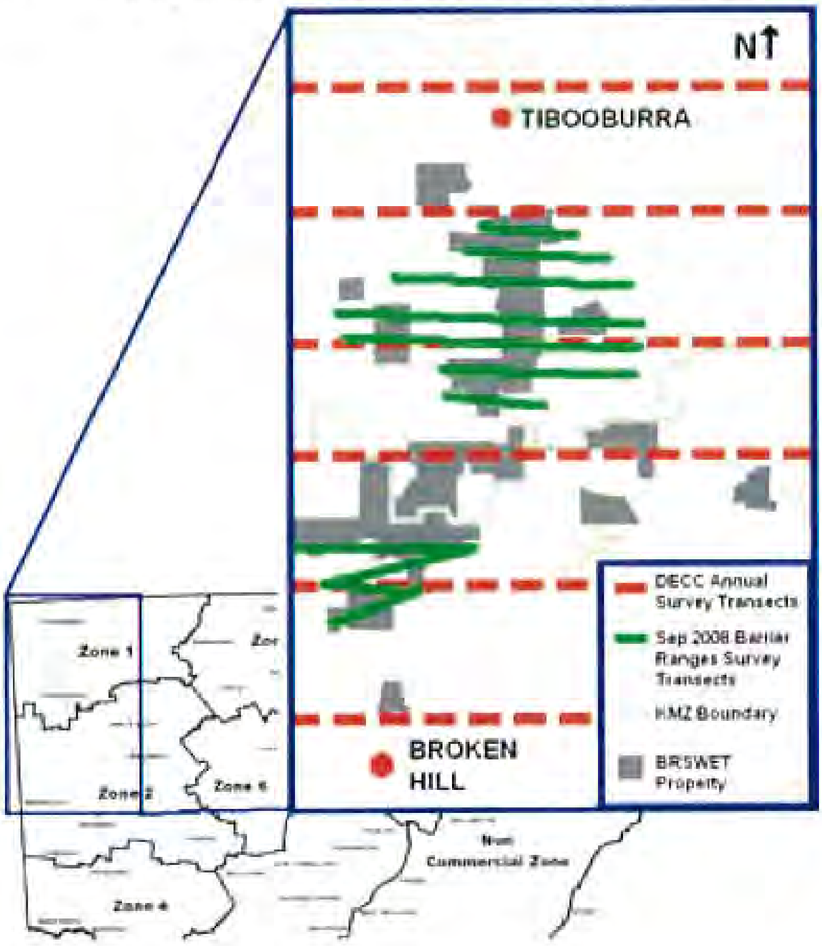
Past kangaroo harvest statistics for the period 2001-2007 were compiled for the 20 properties (16 landholders) participating in the Barrier Ranges Sustainable Wildlife Enterprise Trial (BRSWET). These statistics covered the three main harvested species: the Red Kangaroo (*Macropus rufus*), Eastern Grey Kangaroo (*M. giganteus*) and Western Grey Kangaroo (*M. fuliginosus*). Harvest data was supplied by the NSW Department of Environment and Climate Change (DECC) from its database of Occupier's Licences (issued to landholders) and harvest returns (submitted by shooters). The 20 properties included one non-harvest refuge, UNSW's Fowlers Gap Arid Zone Research Station.

The 2001-2007 kangaroo harvest data was analysed to determine spatial and temporal patterns. Mean annual harvest and variation was calculated for each property. A number of factors were analysed to determine correlations with harvest size and temporal variability, including rainfall, shooter dynamics, kangaroo species breakdown and distance to major geographic features such as towns, roads and national parks. Kangaroo harvest data was also compiled for the twelve months of the BRSWET General Licence period (1 May 2008-30 April 2009; further details in Chapter 5) and compared with the 2001-2007 harvest data.

Kangaroo population data was not available at the property scale for direct comparison with harvest statistics. However, data at the regional (Kangaroo Management Zone) scale was available for the years 2001-2008 from DECC's annual aerial surveys and data at the BRSWET group scale was obtained in September 2008 through a separate fixed-wing aerial survey funded by RIRDC (Pople, McLeod et al. 2009). DECC's surveys are undertaken in June/July each year using methods outlined by Payne (2008b). The September 2008 survey was approximately five times more spatially intensive than the DECC surveys but employed the same standard methodology, such as 100m wide transects, standard flying speed and height and correction factors from Cairns and Gilroy (2001) to account for kangaroos missed by observers. Due to the differing seasons between the two surveys, different temperature correction factors from Cairns and Gilroy (2001) were used.

Figure 4.1 shows the BRWSET properties used for harvest data analysis, along with survey transects flown in the September 2008 survey and in DECC's annual surveys.

Figure 4.1 Map of September 2008 survey transects, annual DECC transects and BRSWET properties, Broken Hill and Tibooburra Kangaroo Management Zones (KMZs), NSW.

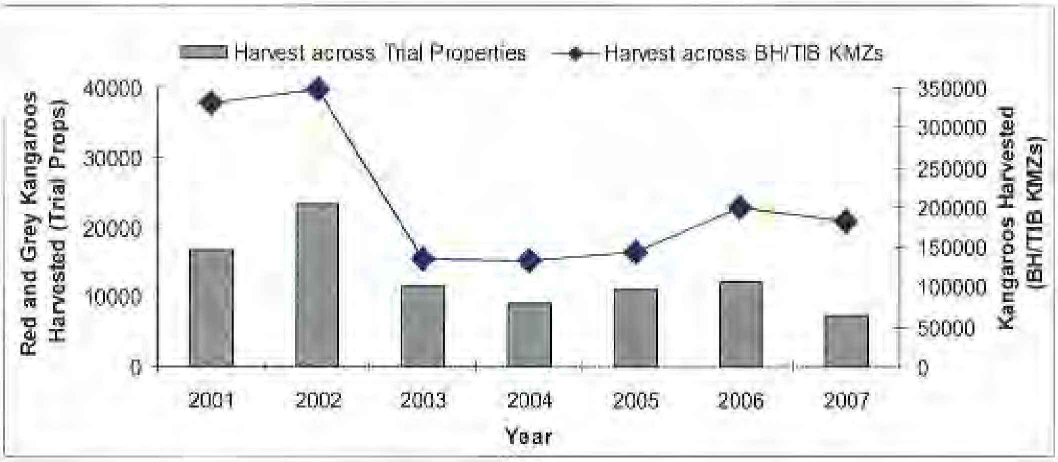


4.3 Results

4.3.1 Analysis of pre-trial harvest data 2001-2007

Figure 4.2 shows 2001-07 harvest totals for the 20 BRSWET properties, ranging from 23 211 (in 2002) down to 7312 (in 2007). The 2001-07 average was 13 012 red and grey kangaroos per year. The temporal variability pattern across the BRSWET properties was broadly similar to that for the Broken Hill and Tibooburra KMZs combined (DECC 2009). A small number of wallaroos harvested in 2001 and 2002 are excluded.

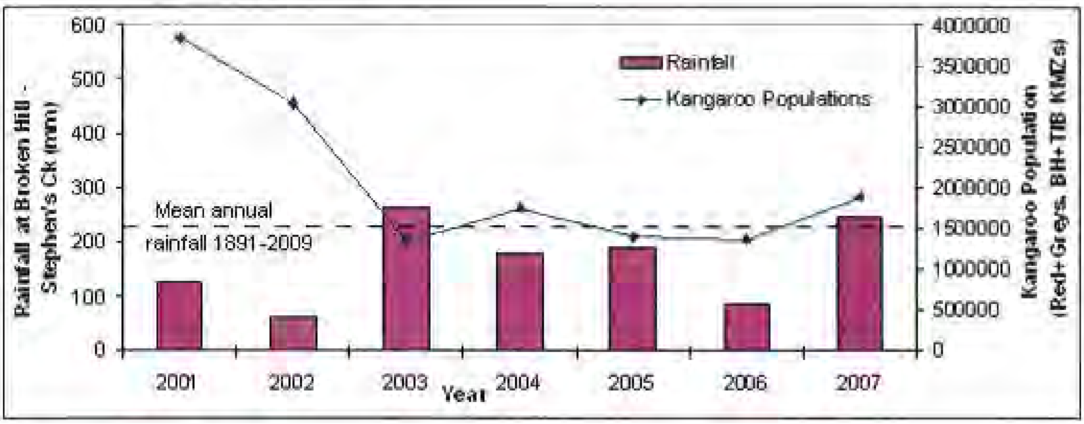
Figure 4.2 Total annual harvest of red and grey kangaroos for trial properties compared with the combined Broken Hill and Tibooburra KMZs 2001-07 (DECC 2009).



Overall, for 2001-07, the 20 BRWSET properties made up 6.17% of the total harvest from the two KMZs, slightly more than the proportion of the total land area of the KMZs that they accounted for (6.08%). Red kangaroos made up 83% of the harvest across the BRWSET properties (66-94% on individual properties). In comparison, reds made up 70% of the BH KMZ harvest and 88% of the Tibooburra KMZ harvest for 2001-07.

Figure 4.3 shows rainfall at Broken Hill and red and grey kangaroo populations across the Broken Hill and Tibooburra KMZs for comparison with the 2001-07 harvest data.

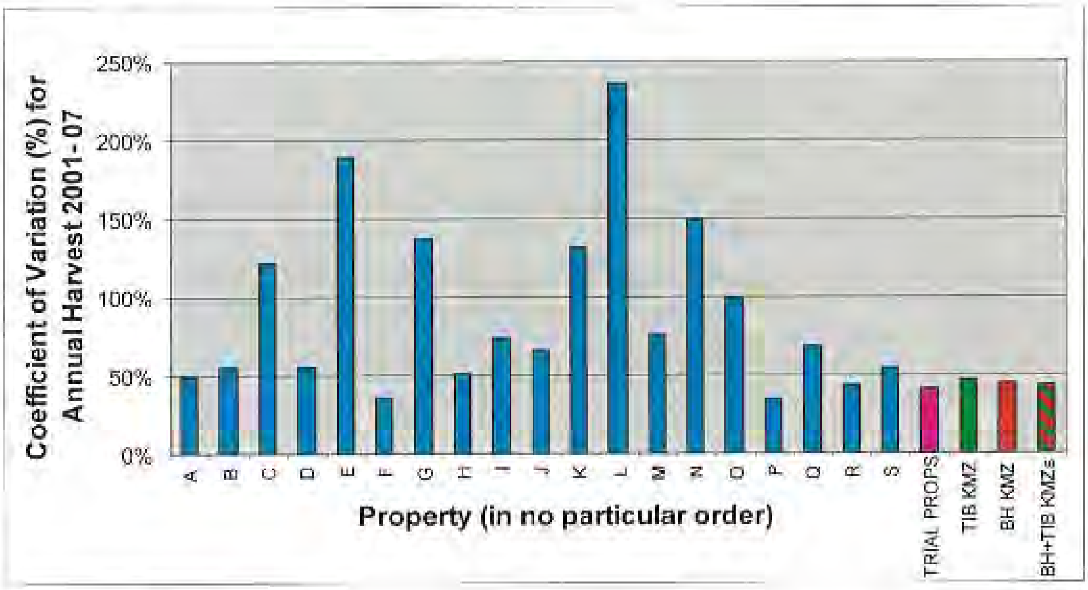
Figure 4.3 2001-07 kangaroo populations for Broken Hill and Tibooburra KMZs (Payne 2008a) compared with rainfall at Broken Hill - Stephen's Ck Reservoir (Bureau of Meteorology 2008a).



While rangeland kangaroo populations are broadly determined by rainfall, and harvest levels are broadly determined by populations (Olsen and Low 2006), a number of other factors play a role (Jonzén, Pople et al. 2005). Time lags are to be expected, with McCarthy (1996) finding that regional-scale red kangaroo population changes in South Australia were most closely related to the previous year's rainfall. This lag effect is evident in the 2001-07 data, with the big population fall in 2003 coming in response to low rainfall levels in the preceding two years (rather than the rainfall in 2003 itself which was actually above average). Harvest levels can also show lag effects due to kangaroos congregating in drought and being easier to harvest, thus pushing up harvest levels while populations are in decline. This is reflected in the fact that regional harvest levels actually increased from 2001 to 2002, and again from 2005 to 2006, despite population and rainfall being in decline.

As much as harvest levels fluctuated across the group as a whole, analysis shows that variability was considerably higher for individual properties, with some recording coefficients of variation (CV) in annual harvest as high as 200% (Figure 4.4).

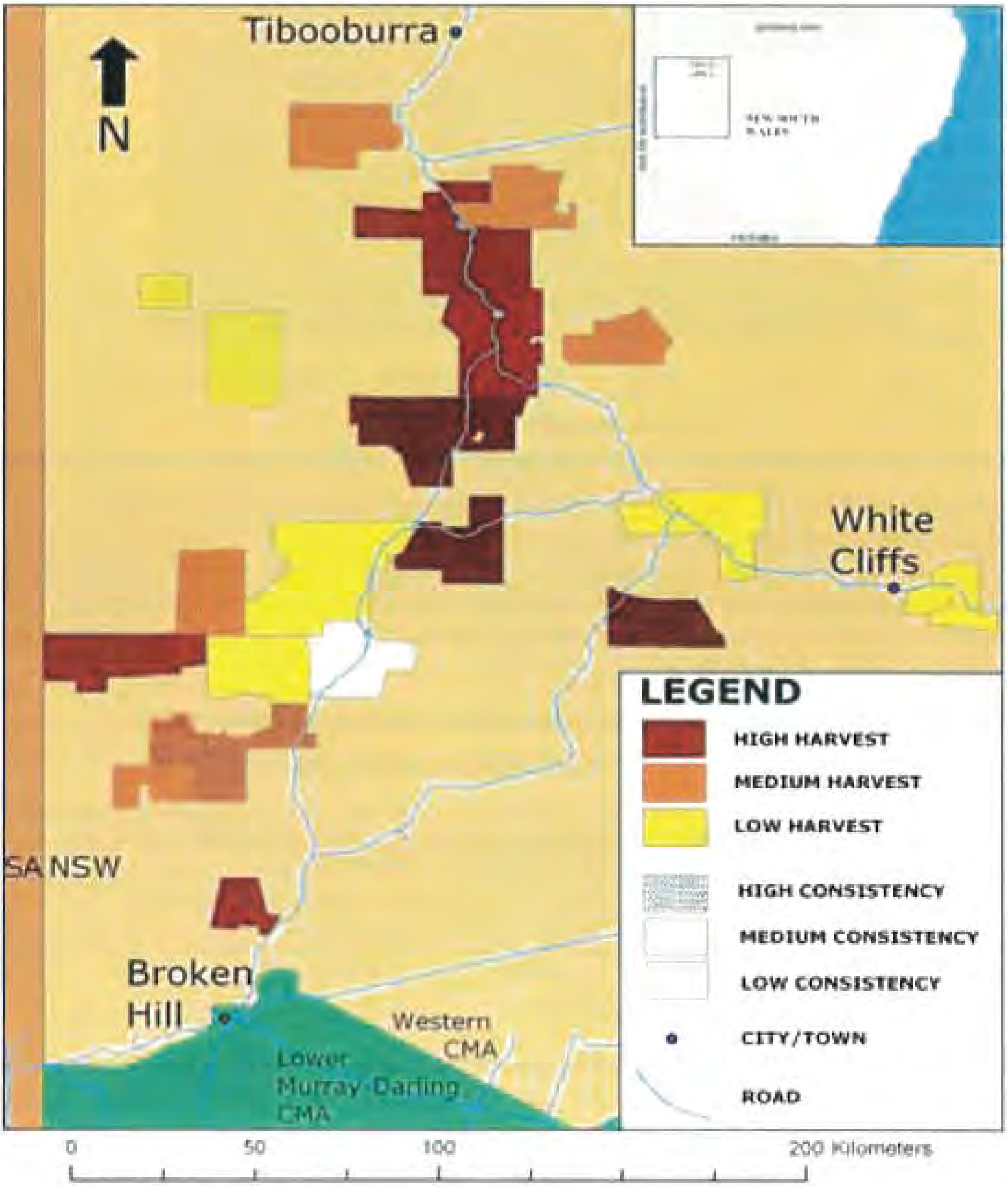
Figure 4.4 Coefficient of variation (CV) for the annual harvest on each of the 19 harvested properties 2001-2007 (UNSW's Fowlers Gap Arid Zone Research Station is excluded as it had no harvest). Columns at the right show CV for the 19 properties' combined annual harvests (TRIAL PROPS), CV for the Tibooburra KMZ's annual harvests (TIB KMZ), CV for the Broken Hill KMZ's annual harvests (BH KMZ) and CV for the annual harvests across both KMZs (TIB+BH KMZs).



Managing such high levels of temporal harvest variability creates risks for landholders, both in terms of their ability to control kangaroo grazing pressure and in terms of making investments in a kangaroo enterprise. As seen in Figure 4.4, the level of harvest variability was lower for the group as a whole than it was for the majority of individual properties. This indicates that most landholders (17 out of 19) could reduce their exposure to the risks of harvest variability by acting as a group. Notably, analysis did not show that simply adding more and more properties would continue to reduce variability, as the CV was slightly higher at the scale of a Kangaroo Management Zone (KMZ) than it was for just the 19 properties combined (i.e. ~60 000–90 000 km^2 versus ~9000 km^2).

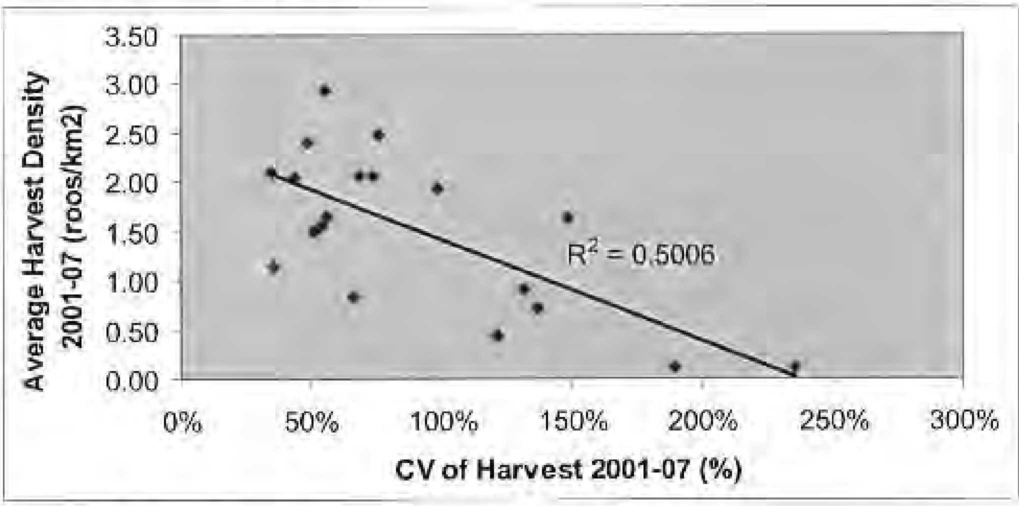
The spatial distribution of the kangaroo harvest over the period 2001-2007 was also highly variable (Figure 4.5). Harvest density across the properties' combined area of 8850 km^2 averaged 1.47 kangaroos/km^2/year, but for individual properties, the average harvest density ranged from a low of 0.11 kangaroos/km^2/year (excluding Fowlers Gap which averaged zero) to a high of 2.94 kangaroos/km^2/year.

Figure 4.5 Harvest density and harvest consistency across the 20 properties 2001-2007. Categories for harvest density are: High (2-3 kangaroos/km2/year), Medium (1-2) and Low (<1). Categories for consistency are: High (CV<50%), Medium (CV 50-100%) and Low (CV>100%).



A zone of high harvest density (>2 kangaroos/km^2/year) is found in the centre-north of the trial area, along the Silver City Highway. However, notable outliers also occur in the southeast and southwest of the group. A zone of high harvest consistency (CV<50%) is concentrated in the central area. Figure 4.6 shows that there is a broad correlation (R^2=0.5) between harvest density and harvest consistency on individual properties (i.e. those with higher harvests tended to also have lower variability).

Figure 4.6 Harvest density for each of the 19 harvested properties (average over 2001-2007) versus temporal harvest variability for each property (CV for each property's harvest 2001-2007).



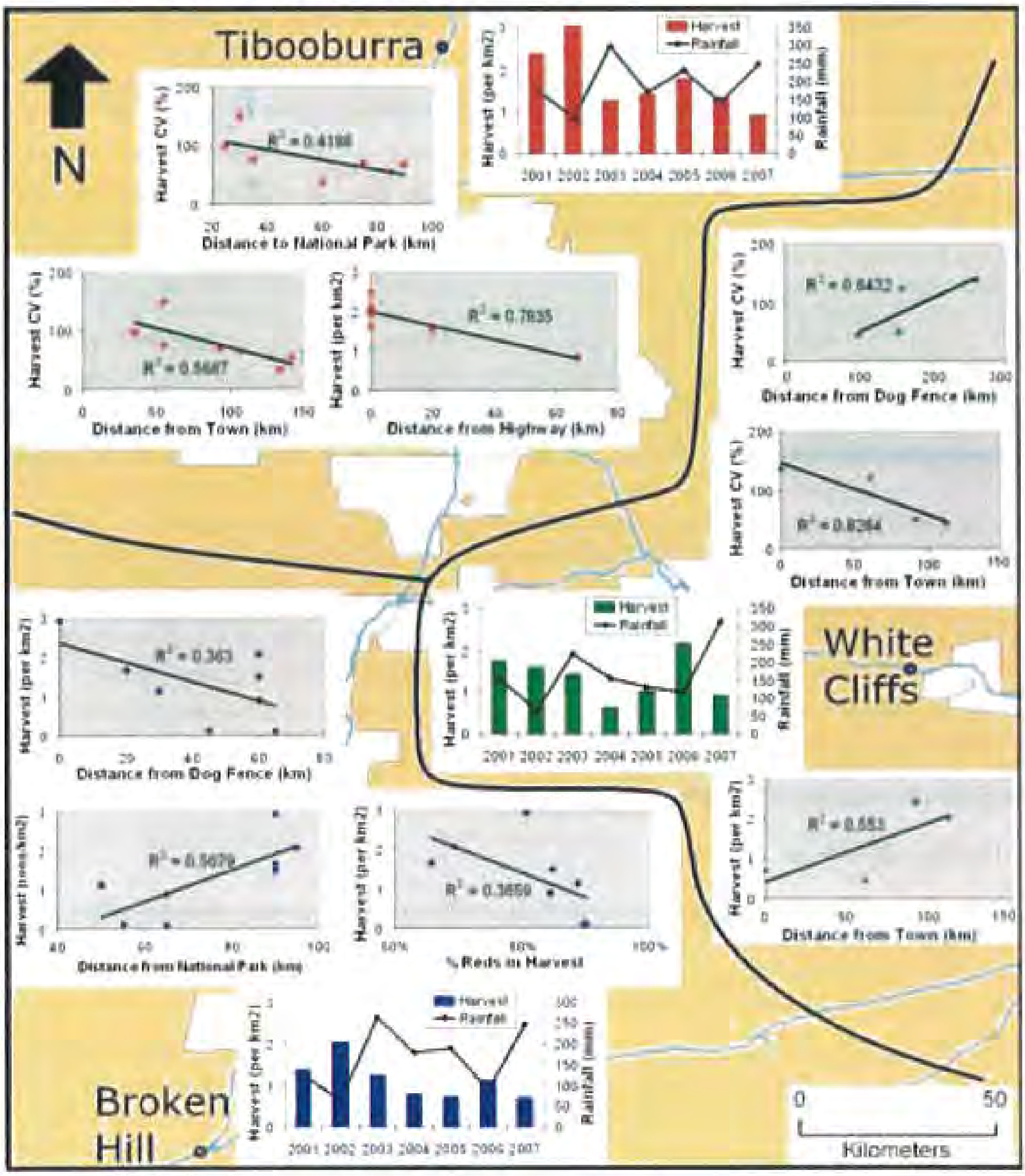
As the only population data available for 2001-2007 is at the regional scale, property-scale comparisons between harvest and population were not possible. However, by dividing the properties into three regional subgroups (based on proximity to Broken Hill, Tibooburra or White Cliffs), certain factors were identified that may be influential on harvest levels. Within each regional subgroup, property-scale harvest density (kangaroos harvested/km^2/year) and harvest variability (CV of annual harvest) were plotted against several factors (Table 4.1).

Table 4.1 Factors affecting local kangaroo populations and shooter behaviour

Factors affecting local kangaroo populations	**Factors affecting shooter behaviour**
Distance of property (straight-line) from nearest national park	Distance of property by road from nearest town (Broken Hill, Tibooburra or White Cliffs)
Distance of property (straight-line) from dog fence (NSW/SA border)	Distance of property by road from the Silver City Highway (major regional road)
Percentage of red kangaroos in the property's total harvest	Percentage of property's harvest taken by primary shooter

Figure 4.7 highlights the most significant correlations for each subgroup. The Broken Hill subgroup consists of nine properties, Tibooburra consists of seven and White Cliffs of four.

Figure 4.7 Most significant correlations with property harvest size and harvest variability in each of the three subgroups 2001-07. Rainfall data for Broken Hill (Stephen's Ck reservoir), Tibooburra (post office) and White Cliffs (post office) from Bureau of Meteorology (2008 a, b & c).



The three subgroups had broadly similar rainfall and harvest patterns with some minor differences. The Tibooburra subgroup showed the biggest drop in harvest levels from 2002 to 2003, but was also the quickest to rebound to harvest growth (in 2004). The White Cliffs subgroup had achieved the greatest harvest rebound by 2006, despite missing out on the 2005 rainfall bump recorded at Broken Hill and Tibooburra.

Distances from the nearest town, highway, national park and the dog fence showed different relationships with property-scale harvest size and variability in each subgroup. Around Broken Hill, harvest levels were positively correlated with distance from the nearest national park (Mutawintji), which clashes somewhat with anecdotal evidence presented by some trial members that being near national parks increases kangaroo grazing levels (and hence the need to harvest). However, for the Tibooburra subgroup, properties closer to Sturt National Park did tend to have higher harvest variability, which supports anecdotal evidence of red kangaroos migrating out of the park in a highly variable manner during drought years.

Distance from the dog fence running along the NSW/SA border was one of the more significant factors around Broken Hill (higher harvest closer to the fence) and White Cliffs (more stable harvest closer to the fence). At White Cliffs, this result is difficult to interpret due to the greater distances from the fence (all properties over 100 km) and the small sample size (only four properties). Around Broken Hill, it may be evidence of a 'funnelling' effect of kangaroos moving along the fenceline (anecdotally reported by members of the trial group).

Around White Cliffs, properties further from town tended to show larger and more stable harvests. For the Tibooburra subgroup, properties also showed greater harvest stability the further they were from town. While these results need to be interpreted with caution given the small sample sizes, it would not appear that being more distant from the nearest town posed any major barriers to attracting and retaining a stable shooter during this period. Around Tibooburra, distance from the Silver City Highway was related to lower harvest levels. However, this could be due to either shooter factors (e.g. access difficulties) or kangaroo population factors (e.g. areas away from the highway may be more rugged and/or less productive). The dominance of a property's primary shooter (i.e. % of harvest taken by them) was not a good predictor of either harvest size or variability in any of the subgroups over the 2001-07 period.

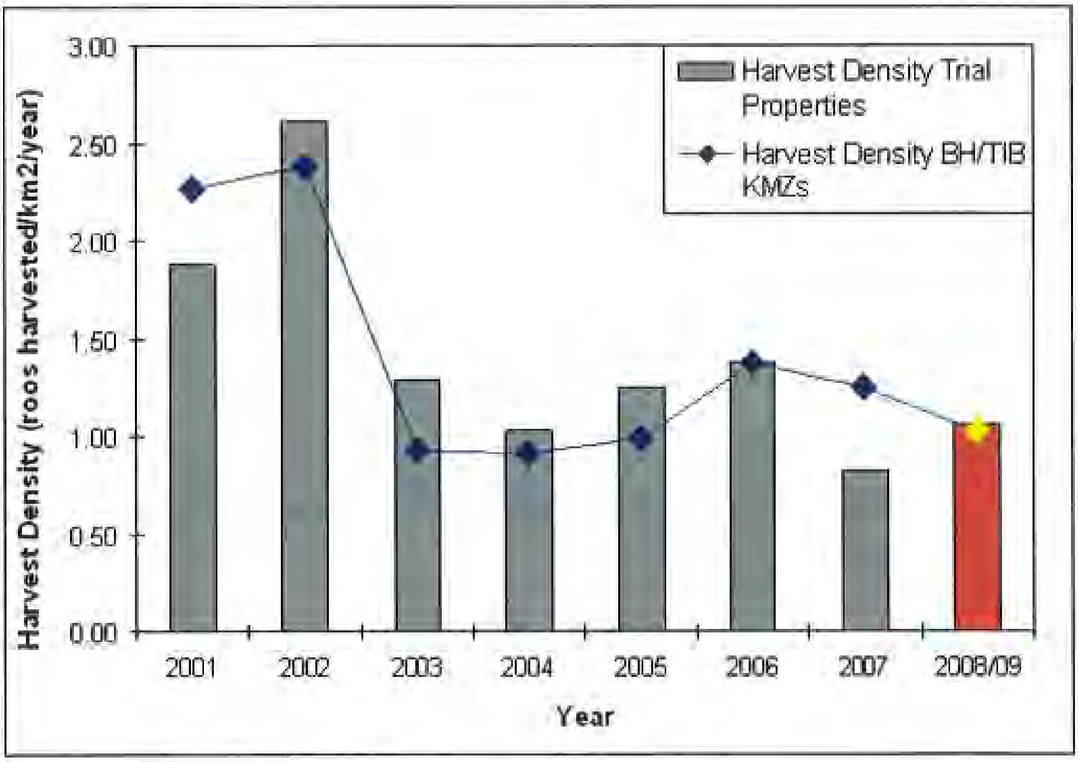
When looking at all properties together, the proportion of red kangaroos in the harvest showed the strongest correlations with both harvest size and harvest variability of any of the factors explored. Overall, properties with a higher proportion of red kangaroos in the harvest tended to have a lower harvest size (R^2=0.12) and greater harvest variability (R^2=0.16). This effect was most significant for the Broken Hill subgroup. The lower harvest size may be related to the fact that red kangaroos are more dominant in the north of the area (i.e. in the Tibooburra KMZ) and this area saw a sharper decline than the southern area (i.e. Broken Hill KMZ) in both kangaroo populations and harvest levels between 2001 and 2007 (Payne 2008a). The relationship between a higher proportion of red kangaroos and greater overall harvest variability may be due to the fact that red kangaroos migrate further and aggregate more during droughts (Pople, Phinn et al. 2007).

4.3.2 Data analysis for trial year

For the trial year (1 May 2008-30 April 2009), the total harvest across the participating properties was 9485 kangaroos. This was relatively low compared to the 2001-2007 harvest average of 13 012 but was higher than the 2007 harvest of 7312. Red kangaroos made up 86% of the harvest, slightly higher than the 83% they made up from 2001 to 2007.

As shown in Figure 4.8, the harvest density for the trial properties during the trial year (1.07 kangaroos harvested/km^2/year) was slightly higher than harvest density recorded for 2008/09 across the wider Broken Hill and Tibooburra KMZs (1.01 kangaroos harvested/km^2/year). Furthermore, the trial area showed a trend of increasing harvest density from 2007 to 2008/09 while the broader region showed a declining trend.

Figure 4.8 Harvest density for the 20 trial properties and the broader region (Broken Hill and Tibooburra KMZs). Comparison for 2008/09 covers slightly different harvest periods[1].



The total group harvest was highly variable across the 12-month trial period, peaking at 1685 kangaroos/month in July 2008 and dropping to a low of zero in January 2009 (Figure 4.9). The zero figure for January 2009 was due there being a one-month gap between General Licences at that time (March 2009 had the lowest harvest while a General Licence was in place with 57 kangaroos). The CV for monthly harvest across the total group was 82%, with variability higher at the subgroup scale (Broken Hill subgroup CV 114%, Tibooburra 179% and White Cliffs 136%) and at the property scale (several properties had a CV over 200%).

As with the 2001-07 annual harvest data there was a broad correlation between high harvest and high consistency (i.e. low variability) amongst individual properties during the 2008/09 trial (Figure 4.10).

[1] 2008/09 harvest data for the trial group covers the 12-month period 1 May 08 – 30 April 2008. 2008/09 harvest data for the Broken Hill and Tibooburra KMZs covers the 15-month period 1 January 2008-31 March 2009, converted to a 12-month average by multiplying by 12/15.

Figure 4.9 Monthly harvest levels across the trial group May 08 – April 09.

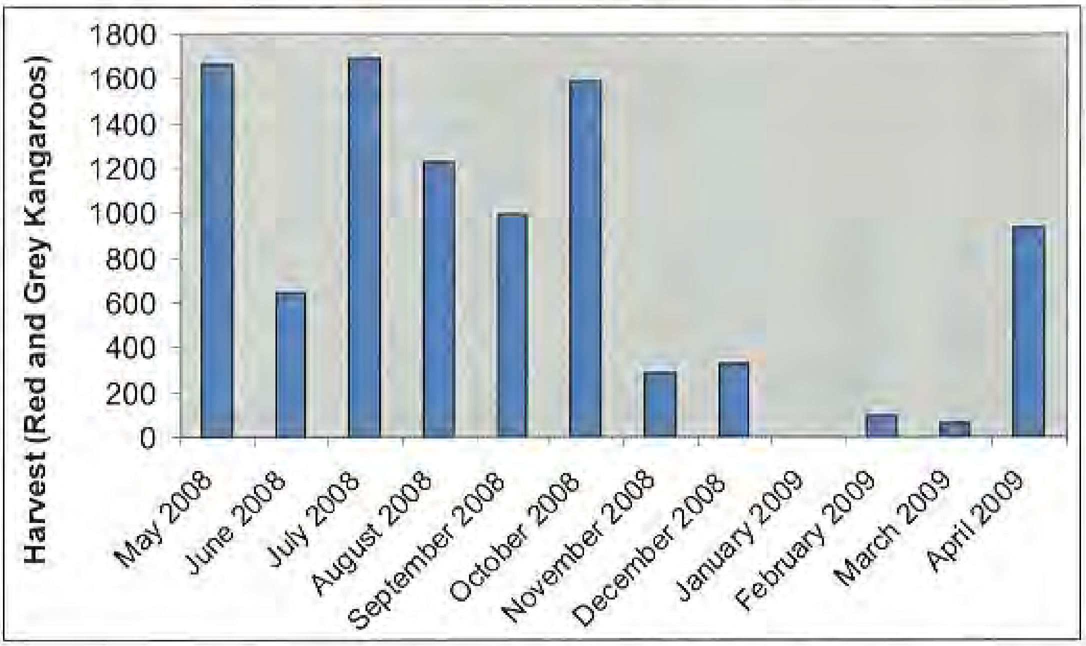
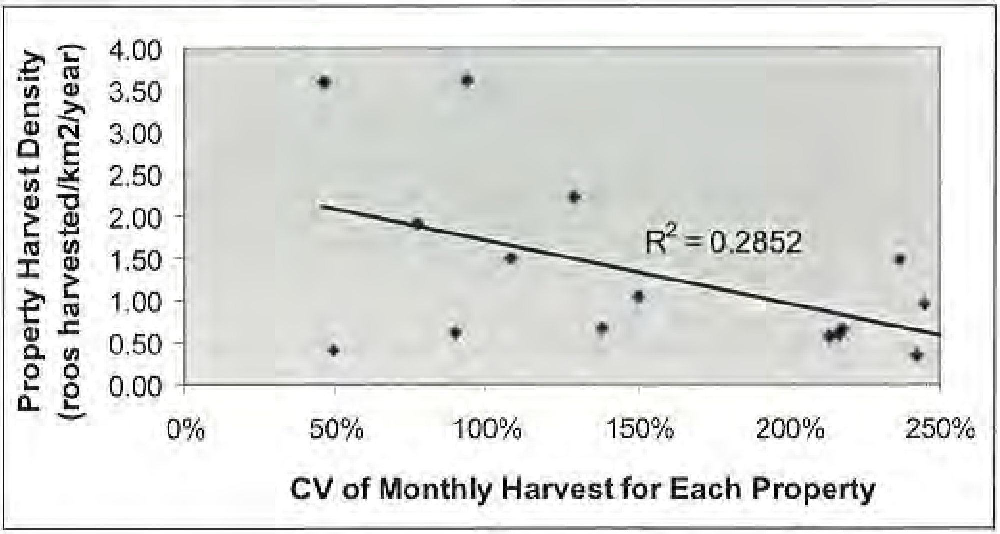


Figure 4.10 Harvest density versus CV of monthly harvest for each trial property 2008/09. CVs could only be calculated for 16 properties (as others recorded less than two harvest months).

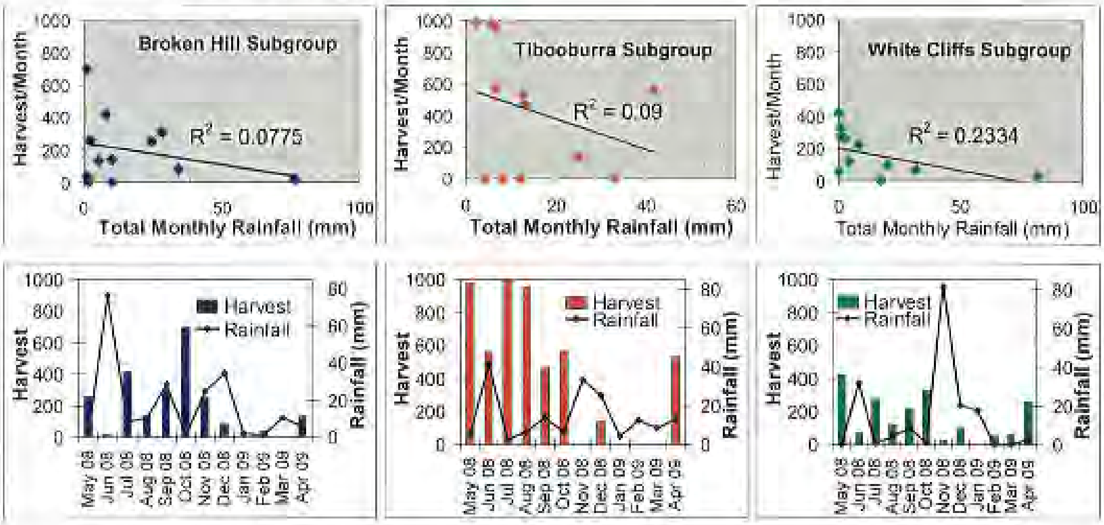


There was a pronounced drop in harvest levels during the hotter months (November-March). Anecdotal evidence from trial participants suggests that this was caused by a combination of factors affecting shooter effort and success, including difficulty finding kangaroos, longer days (shorter nights for harvesting), holidays for harvesters/ landholders and processor shutdowns. The zero harvest in January 2009 occurred due to a lapse between group licences and practical difficulties getting the next licence in place during the holiday season (interest in harvesting was low at this time regardless).

Rainfall and harvest showed a mixed relationship throughout the trial year. Overall, there was a weak negative correlation between monthly rainfall and monthly harvest levels in each subgroup (Figure 4.11). This appears to be mainly due to the impact of periods of high rainfall (>20mm/month) depressing harvest levels due to difficulties in getting access to harvest areas (anecdotally reported by harvesters). At lower monthly rainfall levels, the relationship between rainfall and harvest disappears.

It is also notable that these high rainfall events were often much more pronounced in some regions than others (e.g. the June 2008 event at Broken Hill and the November 2008 event at White Cliffs).

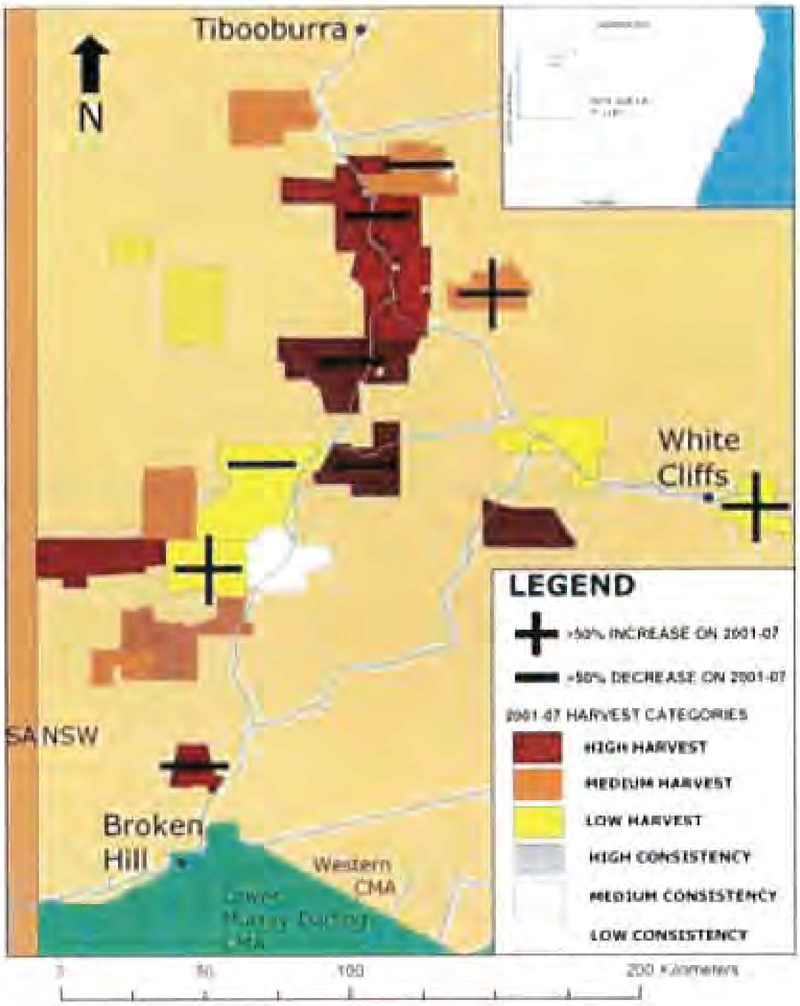
Figure 4.11 Harvest v rainfall for each month of the trial within the Broken Hill, Tibooburra and White Cliffs subgroups.



There were also no discernible patterns between rainfall and harvest at the regional scale over the full trial year (May 2008-April 2009). In the Tibooburra subgroup, rainfall for the trial year was down 20 mm on the 2001-07 average and harvests were lower than the 2001-07 average by 48%. In the Broken Hill subgroup, harvests were also down (46% below 2001-07 average), but rainfall was actually 40mm higher than the 2001-07 average. In White Cliffs, rainfall was on par (within 3mm of 2001-07 average) and so was the harvest (within 3% of 2001-07 average).

Figure 4.12 highlights the properties with the biggest changes in the trial year compared to the 2001-07 period (more than 50% above or below their 2001-07 average). There are clusters of properties in the centre and the north of the group which recorded harvests well below their 2001-07 average, while the properties recording big increases were scattered.

Figure 4.12 Properties with biggest positive and negative changes in trial year harvest compared to 2001-07 average. Only properties with >50% change on 2001-07 harvest average highlighted.



The population survey undertaken across the trial area in September 2008 produced a total red and grey kangaroo population density estimate of 11.01 kangaroos/km^2 (Table 4.2). If this density is assumed to apply to the entire 8,850 km^2 of the trial area, the total 2008 population of red and grey kangaroos would be 97 473 and the trial year harvest of 9485 would represent 9.7% of this population. The harvest percentage for red kangaroos would be 9.3% of the population (well below the 17% figure used by DECC to set annual red kangaroo harvest quotas for each KMZ) and for greys it would be 14.4% (close to the 15% figure used by DECC to set annual grey kangaroo harvest quotas for each KMZ)[7].

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[7] Eastern and western grey kangaroos are combined for the purposes of this analysis as they cannot be distinguished from the air.

Table 4.2 Estimated red and grey kangaroo population density across trial area from September 2008 survey, with 2008 DECC estimates for each KMZ for comparison. Sep08 data based on 100m wide transects, using bioregional and temperature correction factors from Cairns and Gilroy (2001). Standard errors include measurement error and bioregional correction factor error.

	Sep08 Density Estimate +/- standard error (/km^2)	Population Estimate for 8,850km^2 Trial Area	Harvest rate for 2008/09 (Harvest/ Pop'n)	DECC Density Estimate for BH KMZ 2008 (/km^2)	DECC Density Estimate for TIB KMZ 2008 (/km^2)	DECC 08 EstimateAcross BH+TIB KMZs
Reds	10.00 ± 3.90	88 532 ± 34 527	9.3%	13.10 ± 1.44	11.06 ± 1.25	12.33 ± 1.91
Greys	1.01 ± 0.44	8942 ± 3895	14.4%	4.84 ± 0.74	1.70 ± 0.68	3.65 ± 1.01
Total	11.01 ± 3.92	97 473 ± 34 746	9.7%	17.94 ± 1.62	12.75 ± 1.43	15.99 ± 2.16

The combined density figure for red and grey kangaroos obtained in the September 2008 survey is 31% lower than that estimated by DECC for the combined Broken Hill and Tibooburra KMZs in June/July 2008. Excluding the possibility that kangaroo populations changed substantially between June and September, this appears to indicate that the trial area has substantially lower kangaroo densities than the overall KMZs in which it is found. This result is somewhat surprising given that the trial group has consistently shown a higher harvest rate (in terms of kangaroos harvested per km^2) than the combined KMZs and a broad correlation is generally found between kangaroo populations and harvest levels across the Australian rangelands (Olsen and Low 2006). However, a number of other factors need to taken into account, such as the level of error in the surveys, consideration of harvest refuges and factors affecting harvest effort and success.

Firstly, when the survey errors indicated in Table 4.2 are taken in account, DECC's KMZ population densities and those of the BRSWET area survey are not significantly different from one another. Secondly, the harvest statistics that suggest the BRSWET area has a higher harvest rate than the broader KMZs (Figure 4.8) may be somewhat misleading. 96% of the BRSWET study area is available for harvest (Fowlers Gap being the other 4%), which is a substantially higher proportion than for the broader KMZs. Overall, around 5% of the area of the Tibooburra and Broken Hill KMZs is National Park/Reserve and landholder survey results (see Chapter 7) indicate that around 10% of properties may also be harvest refuges where commercial harvesting of kangaroos does not occur. Thus, the average harvest density across the KMZs will be dragged down by these non-harvest areas meaning that, even if population densities were the same between the KMZs and the BRSWET study area, a lower harvest density would be expected to appear in the KMZ data. There are also a number of possible reasons why the BRSWET properties might harvest at higher-than-average levels even if they do have lower-than-average population densities. These reasons include the properties' proximity to the Silver City Highway (access for shooters and chiller collectors) and to the dog fence (funnelling effect discussed in relation to Figure 4.7).

One interesting aspect of the harvest during the year of the general licence was that one property had its highest ever harvest – more than any other property during the year and higher than any yearly harvest on any of the participating properties for the past seven years. After consultation with the landholder and harvester on that property, it was clear that it was the biggest difference was that the harvester was living on the property for months at a time so the number of harvest days was greater than ever before. According to the landholder, there might have been slightly more kangaroos than in previous years. It is reasonable to conclude from this that greater harvest in this case was due to increased harvest intensity, and thus that harvester availability and effort can be a critical determinant of harvest level.

4.4 Discussion

This data analysis highlights the high levels of temporal variability in the kangaroo harvest in the Barrier Ranges and the critical business risk this poses to landholders. No landholders were actually running a kangaroo enterprise during the analysis period, but such risks pose a clear barrier to investment. This is a point clearly identified by landholders in the trial, who have expressed concerns about investing in or relying upon a kangaroo resource that can very easily disappear or "clear out on you" (ABC TV 2008). However, the analysis also shows that, when working as a group, landholders can substantially reduce the harvest variability business risk to which they are exposed. In many ways, such a risk-mitigation strategy is analogous to the way that kangaroo shooters attempt to secure a wide-ranging harvest 'territory' and processors spread their chillers across a large area[3].

The 2001-07 data analysis shows that working as a group has the potential to reduce variability in annual harvest levels, while the data from the 2008/09 group trial shows that this also holds true in relation to monthly harvest rates (i.e. CV for monthly harvest was lower at the group scale than the subgroup or property scale). Furthermore, a group of this size would also have a greater capacity to maintain supply in the face of high rainfall events that can depress harvest levels, as these events often affect some parts of a region but not others. Such a group may also have appeal for processors, who could be able to secure access to a larger and more consistent supply of product by entering into cooperative agreements with the landholders and harvesters.

Spatial harvest variability was also high in the data analysed. This has important implications for a collaborative kangaroo enterprise. Properties with consistently high harvest levels are likely to have a much greater stake in any collaborative venture than properties with low harvest levels. These spatial patterns would also impact on the placement of any chillers operated jointly by the group. As shown in Figure 4.13 below, chillers placed at the northern, eastern and south western edges of the central area of high harvest and high consistency would be able to benefit from this area's consistent supply, as well as providing access for harvesters working on the less consistent properties further from the centre.

Ephemeral creek line after rain, Eastern Barrier Ranges - kangaroos may descend on areas like this in large numbers.

[3] Thomsen and Davies (2007) report that shooters in South Australia, to minimise the risk of a poor harvest, often seek exclusive access to more land than they can realistically shoot. Such a strategy minimises risks to the shooter, but at the expense of landholders (unable to deal with high kangaroo numbers), younger shooters (unable to obtain territory) and the industry as a whole (fails to take full available quota).

Figure 4.13 Hypothetical locations for three chillers across the trial area designed to balance harvest consistency with accessibility for all properties. Circles show 80 km straight-line distance from each chiller (equivalent to approximately 100 km driving distance).

In the absence of property-scale kangaroo population data, spatial harvest trends could only be partially explained. However, it would appear that factors such as the percentage of red kangaroos in the harvest and proximity to national parks and the dog fence play some role in determining the size and variability of the kangaroo harvest on a property. These factors are expressed differently in different subregions. Distance from town does not appear to be a major barrier to attracting a reliable harvester.

With only one year of group harvesting being undertaken as part of BRSWET, it is difficult to draw definitive conclusions about the effect of the group licence on harvesting activities. However, given that the group harvest in 2008/09 showed an increase on 2007 levels while the overall harvest for the Broken Hill and Tibooburra KMZs showed a decline, it would appear that the group licence was not a barrier to effective harvesting for the landholders and harvesters who participated. It may have had a positive impact. This is discussed further in Chapter 5.

The September 2008 population survey produced a somewhat surprising result, with density estimates for the BRSWET area that were much lower than DECC's estimates for the broader KMZs. While a number of possible explanations for this outcome have already been discussed, it also highlights an important issue for a group of landholders seeking to collaboratively manage their kangaroo harvest. Group harvest quotas are likely to differ significantly depending on whether they are based on a local estimate of kangaroo populations, past harvest levels or the proportion of the KMZ area that the group makes up. If the September 2008 population estimates were used to set a 2009 group quota for BRSWET, such a quota would be relatively low and the group may find itself coming close to meeting it, even with a harvest that is below past levels (and even if ample quota is still available across the KMZs as a whole). The potential ramifications of each group quota option would need to be considered carefully.

A summary of the key points from the discussion follows:

- The 2001-07 harvest in the BRSWET area followed broad patterns for the Broken Hill and Tibooburra KMZs, with higher harvests in 2001 and 2002 followed by years of lower harvest induced by drought. The BRSWET area showed a slightly above-average harvest level for 2001-07 compared to the broader KMZs.

- The 2008/09 harvest trial year saw an increased harvest in the BRSWET area compared with 2007 levels (although it was still down on the 2001-07 average). This compares with a harvest decrease in the broader KMZs over a similar time period. This is an indication that the trial was not a barrier to effective harvest and may have even increased harvest effectiveness.

- Temporal harvest variability is very high in this region. However, group-scale variability is lower than that which most individual properties are exposed to, providing a strong argument for collaboration in managing a kangaroo enterprise and responding to kangaroo influxes.

- Spatial harvest variability is also very high, with contributing factors potentially including distance from national parks, the dog fence and main roads. Properties with a higher proportion of red kangaroos tended to have lower and more variable harvests for 2001-07. These factors influence the potential placement of chillers and division of income from any collaborative enterprise.

- Local population monitoring in 2008 suggests that the area has a lower-than-average population density compared to the Broken Hill and Tibooburra KMZs overall, despite its slightly higher-than-average harvest rate. Differences in seasonal conditions and spatial extent and large error values make comparisons difficult. More monitoring is required for definitive conclusions. However, this does highlight that harvest quotas based on local monitoring could be more problematic than quotas based on past harvest rates or proportion of KMZ area.

5. Adaptive management trial of General Licence

A key element of the Barrier Ranges Sustainable Wildlife Enterprise Trial (BRSWET) was to undertake an adaptive management experiment involving a special group harvesting licence that could facilitate collaboration. This trial fell under Aim 5 ('facilitate adaptive management and research') of the NSW Commercial Kangaroo Harvest Management Plan (Department of Environment and Conservation (NSW) 2006 p28). Following extended negotiations, a final plan for this adaptive management experiment was accepted by DECC and harvesting was undertaken from May 2008 to June 2009 under three collaborative General Licences issued under s120 of the NSW *National Parks and Wildlife Act 1974*. Harvest data for 1 May 2008-30 April 2009 was available for this report.

5.1 Objectives

The final adaptive management trial plan submitted to DECC identified the following objectives:

1. To test whether more flexible approaches to licensing and use of harvest tags can lead to greater collaboration between neighbouring properties.
2. To test whether greater landholder collaboration across property boundaries can provide a tool for more effective management of total grazing pressure.
3. To test whether more flexible licensing arrangements and greater collaboration between properties can lead to economic returns for landholders by establishing a valued role for them in the kangaroo industry.
4. To test whether economic returns for landholders from kangaroo harvesting can create incentives to manage land for conservation.

Objective 1 is the main focus of this chapter. It is based on the notion that the sharing of harvest tags amongst a number of properties and shooters could offer mutual benefits and lead to greater collaboration.

Objective 2 recognises that kangaroos can cause significant grazing pressure at certain times and in certain locations and that managing these impacts strategically may be improved with cross-property cooperation. Measuring the success of this objective was dependent on the success of the licensing trial, as only once collaboration had occurred could it be assessed for its role in managing grazing pressure. The role of the licensing trial in facilitating such collaboration is covered in this chapter, while other aspects of collaboration are discussed in other chapters, including insights from the analysis of harvest and population data (Chapter 4), collaboration on landscape monitoring using Landscape Function Analysis (Chapter 6) and landholder attitudes toward collaboration (Chapter 7).

Objective 3 is based on a recognition that the current licensing regime gives kangaroo processors (holders of Fauna Dealer's Licences) the greatest amount of flexibility in generating economic returns and landholders (holders of Occupier's Licences) the least. Processors can choose where and from whom they wish to purchase kangaroos and shooters (holders of Trapper's Licences) can choose which properties they will harvest on, giving both capacity to respond to spatial variations in kangaroo populations and harvest levels. Landholders, as demonstrated through the harvest data analysis in Chapter 4, can experience extremely high levels of harvest variability at the property-scale and do not have the option of shifting their geographic location. Cross-property collaboration may provide an option for increasing harvest stability and reducing the business risks resulting from high harvest variability. Other economic benefits could also result from increased bargaining power with processors and more efficient and cost-effective harvest management. Results obtained through the licensing trial are discussed here, while other results are presented in Chapter 8 (economic analyses and business case).

Objective 4 recognises that, in addition to greater control over total grazing pressure, there are other ways in which kangaroo harvesting could potentially lead to improved conservation outcomes. Anecdotal evidence suggests that kangaroo populations often increase when areas are destocked to allow regeneration and, while this is currently a disincentive to remove stock, it could become an incentive if landholders can obtain an economic return from an increased kangaroo harvest. Such returns could lead to increases in the destocking of land, including under formal arrangements such as the Western CMA's Enterprise-Based Conservation (EBC) scheme, where landholders are paid a stewardship payment to manage part of their land for conservation.

The testing of this objective was largely dependent on the trial group obtaining economic returns from their kangaroo harvest. This was not possible given the short duration of the General Licence harvest trial (12 months) and the harvest conditions during this period. Thus, most results for this objective are theoretical and are covered in Chapter 7 (landholder survey) and Chapter 8 (economic analysis and business case).

5.2 Methods

5.2.1 Development of adaptive management experiment

The major steps involved in negotiating an adaptive management experiment with DECC are outlined in Table 5.1. FATE began the process seeking a period of robust and engaged discussion with DECC before settling on a mutually-agreed plan that sought answers to management questions on behalf of the researchers and the regulators. However, the overall process stretched out to well over two years due to disagreements about legal issues, the applicability of Conservation through Sustainable Use (CSU) to abundant species such as kangaroos and the kinds of scientific data necessary for an adaptive management experiment with such a strong focus on socio-economic issues. These problems were compounded by a lack of detail in the Kangaroo Management Plan (KMP) on requirements for adaptive management experiments, a lack of engagement by DECC with the initial development process and subsequent delays for legal advice and consultation with stakeholders.

Table 5.1 Negotiations on adaptive management experiment

Date	Action
July 2005	FATE discussed with DECC possible adaptive management scenarios for members of the Barrier Area Rangecare Group (BARG).
September 2005-February 2006	DECC agreed to provide in-kind support for preliminary and full BRSWET proposals submitted to RIRDC
February 2006	FATE asked DECC about issuing a collective Occupier's Licence.
March-May 2006	FATE obtained permission from 25 BARG properties to access their past kangaroo harvest data and requested data from DECC.
July 2006	BRSWET commenced with RIRDC-funding. FATE met with DECC to discuss possibilities for AM trial and query on group Occupier's Licence.
August 2006	FATE submitted draft adaptive management plan to DECC, with supporting legal advice on the issuing of a group Occupier's Licence.
August 2006	DECC informed FATE that its legal advice indicated it could not issue a group Occupier's licence. DECC declined to provide legal advice.
September 2006	FATE responded, proposing a group General Licence instead.
October 2006	DECC agreed to explore use of General Licence, but raised concerns about the trial's scientific methods and ability to ensure compliance.
January 2007	New NSW Kangaroo Management Plan 2007-2011 commenced.
February 2007	FATE consulted landholders and shooters and submitted revised plan. FATE presented plan in person to the NSW Kangaroo Management Advisory Committee.
June 2007	DECC consulted with Kangaroo Management Advisory Committee and informed FATE that they wouldn't approve the trial due to concerns about methodology, applicability of CSU for kangaroos and lack of stakeholder support (notably from the Pastoralists of West Darling - PAWD).
July 2007	FATE responded to DECC, raising concerns about DECC's assessment and providing a revised letter of support from PAWD, who felt their initial response was misunderstood.
August 2007	UNSW Dean of Science wrote to NSW Minister reiterating concerns.
October 2007	DECC met with FATE and expressed support for trial.
November 2007	FATE submitted revised adaptive management trial plan to DECC
December 2007-March 2008	Logistical details were finalised. FATE finalised list of landholders and shooters. DECC obtained further legal advice.
April 2008	General Licence application and final adaptive management plan approved by DECC for commencement on 1 May 2008.

5.2.2 Group licensing

Under the adaptive management trial, General Licences (GLs) were issued under Section 120 of the *National Parks and Wildlife Act 1974* (NPW Act) to allow the commercial harvesting of kangaroos on 20 properties owned by 16 landholders (15 landholders on GL3). These General Licences covered the periods May-August 2008 (GL 1), September-December 2008 (GL 2) and February-June 2009 (GL 3). Harvest statistics for this report were compiled up to the end of April 2009. The conditions on the General Licences were analogous to those on a Commercial Occupier's Licence (e.g. compliance with Code of Practice, use of harvest tags, requirement to submit harvest returns), with minor variations in wording to reflect the multiple-property nature of the General Licences. Any trappers wishing to harvest on the properties covered by a General Licence had to be listed prior to its commencement, with a total of 17 trappers participating in the trial (16 in GL1, 17 in GL2, 12 in GL3).

DECC assigned portions of their regional harvest quotas to the BRSWET group for 2008 and 2009. These were based on the proportion of the total area of the Broken Hill and Tibooburra Kangaroo Management Zones (KMZs) that the BRWSET properties made up (6.14%) and the proportion of the harvest year that the General Licence covered (four months initially). This quota-allocation process was designed to have no impact on the regional sustainability of kangaroos, as KMZ harvest levels would not be affected.

The quota requested for the period May-December 2008 was based on the area of the properties compared to the entire Broken Hill and Tibooburra KMZs and was for 15 300 animals, being: 12 750 red kangaroos, 1150 eastern grey kangaroos and 1400 western grey kangaroos. For GL 1, the group initially requested that a total 4-month quota of 6400 red kangaroos, 600 eastern grey kangaroos and 700 western grey kangaroos be 'pencilled-in' for the group to provide security in harvest planning. A rough allocation of harvest tags to shooters was agreed to by the BRSWET steering committee for GL 1 based on the past harvest levels on the properties each shooter usually covered. Eight thousand (8000) tags were issued under this initial licence, covering roughly 52% of this quota. Based on returns for the months of May, June and July, 3975 of kangaroos were harvested over this three-month period (3469 reds, 237 eastern greys and 269 western greys).

Based on these harvest figures, the second General Licence requested for a maximum harvest number of 4000 kangaroos to be harmed (3500 reds, 240 eastern greys and 260 western greys) in the period 1 September- 31 December 2008.

The 'pencilled-in' quota for GL3 was for 6091 red kangaroos and 1592 grey kangaroos (total 7583 animals) to be harmed in the period 1 January to 30 April 2009. When the licence was issued, it was agreed with DECC to be for the period 1 January 2009 to 30 June 2009, as the trial was ending on 30 June 2009. The actual number of tags issued for this 3rd General Licence was 4000 (with an option to purchase more up to the 'pencilled in' quota figure). These tags were all issued by mid-June 2009.

However, neither the total quota nor the allocation of tags to shooters was seriously tested under any of the General Licences due to poor harvest conditions in 2008 and 2009.

5.2.3 Issuing of tags and record-keeping

Tags were purchased in bulk by UNSW at the commencement of each licence, and then on-sold to trappers at cost. DECC agreed to allow unused tags to be 'rolled-over' from GL1 into GL2 (although not into GL3 as this was a separate harvest year). Only tags which remained in FATE's pool of unallocated tags could be rolled-over. Tags that had already been distributed to trappers could not be rolled-over and had to be returned to DECC for a refund (which was a special concession as refunds are not usually permitted). Trappers could use their allocated tags on any property listed on the General Licence for which they had permission from the landholder (signing up to the General Licence did not oblige a landholder to allow any trapper onto their property). Tags could not be swapped between trappers and DECC had to be kept informed of who held which tag at all times.

KMP developed a spreadsheet to keep track of which tags had been allocated to each shooter and FATE developed a separate spreadsheet to record payment details (trapper's name, account details, number of tags purchased and how tags were paid for). Upon purchasing of tags, trappers were issued with a hand-written receipt and paper trapper return forms for them to keep records of where and when tags were used. An invoice from the UNSW finance system was then prepared to enable the money from tag sales to be banked and recouped by the FATE program. This was then sent to the RIRDC-funded FATE Local Research Officer who was based at Western CMA offices in Broken Hill, who passed on this 'official' invoice to the trapper.

For General Licences 1 (May-August 08) and 2 (September-December 08), tags were distributed by the FATE Local Research Officer in Broken Hill. However, due to problems arising from the part-time nature of this position, it was decided to contract out the selling of tags to a local business for General Licence 3 (January-April 09). The contractors were 'Competent Appointment Services' (CAS), a business services and employment agency that were open normal business hours, providing some certainty about when tags were able to be purchased.

In the initial stages of General Licence 1, KMP staff developed the tag spreadsheet, visited Broken Hill to train the FATE Local Research Officer in its use and worked closely with the Local Research Officer on any teething problems. Some interaction occurred between FATE and KMP once the system was up and running, generally to request data and try to sort out discrepancies between trapper returns and chiller returns. For General Licence 3, the CAS staff received some initial training, a manual and ongoing support from FATE staff in both Broken Hill and Sydney.

The KMP required record-keeping both when tags were issued and by trappers to reconcile tags shot monthly. When tags were issued the data collected was:

- tag numbers
- quota of reds, eastern greys and western greys to be shot.

This data was entered by FATE into the spreadsheet developed by KMP for tracking tags, and was then used by KMP to match with data collected from tagged animals in chillers.

Trappers were required to keep records of:

- which property the tags were used on
- the species, weight and gender of the animals trapped
- the number of the chiller where the animals were deposited.

The data for these returns needed to be filled into the returns each night trapping occurred and kept until the end of the month. At the end of each month, trappers had to complete a return providing information about demographics of animals trapped at each property and chillers shot to. This information had to be submitted on two forms: one by property and again as a 'group return'. These records were then sent to the FATE research officer for collation and forwarding to the KMP at the end of each month.

'Trapper books' were introduced in GL 3 to ease this process. These were bound books, with triplicate copies, that trappers used to record: the date, permit number, trapper licence number, property name; and numbers, weights and demographics of animals shot.

These requirements were essentially a compromise between the desire of the BRSWET participants for more flexibility in the issuing of tags and the requirements of KMP for accountability in the tag-issuing chain. FATE would have initially liked greater flexibility in tag-issuing, including the ability for trappers to swap tags amongst themselves (with paperwork) and roll any unused tags into the next licence period (or alternatively have licences longer than four months at a time). KMP's priorities were to ensure that they knew who was in possession of particular tags at all times so that they could ensure compliance with the Code of Practice and other licence conditions and trace kangaroo carcasses at processing works back to individual shooters and properties.

5.2.3 Contact with participants before and during the trial

A steering committee was set up in 2007 consisting of four landholders, three shooters, three FATE staff, a Western CMA representative and a representative of the Fowlers Gap research station. FATE remained in close communication with intending and eventual participants in the trial through personal contact with the local Research Officer, newsletters, steering committee meetings and BARG meetings. An agenda and minutes were completed for all meetings and the Research Officer documented all informal contact. In the final stages of the trial the research officer conducted telephone interviews with all available participants which included specific questions about the General Licence trial.

Interviews were conducted by phone during June 2009. Attempts were made to interview all landholder and Harvester participants. Three landholders and three harvesters were interviewed. The interview pro-forma is in Appendix A. In addition, numerous phone calls between landholders, harvesters and researchers took place during the trial, from which very valuable information was gathered informally.

5.2.4 Other methods

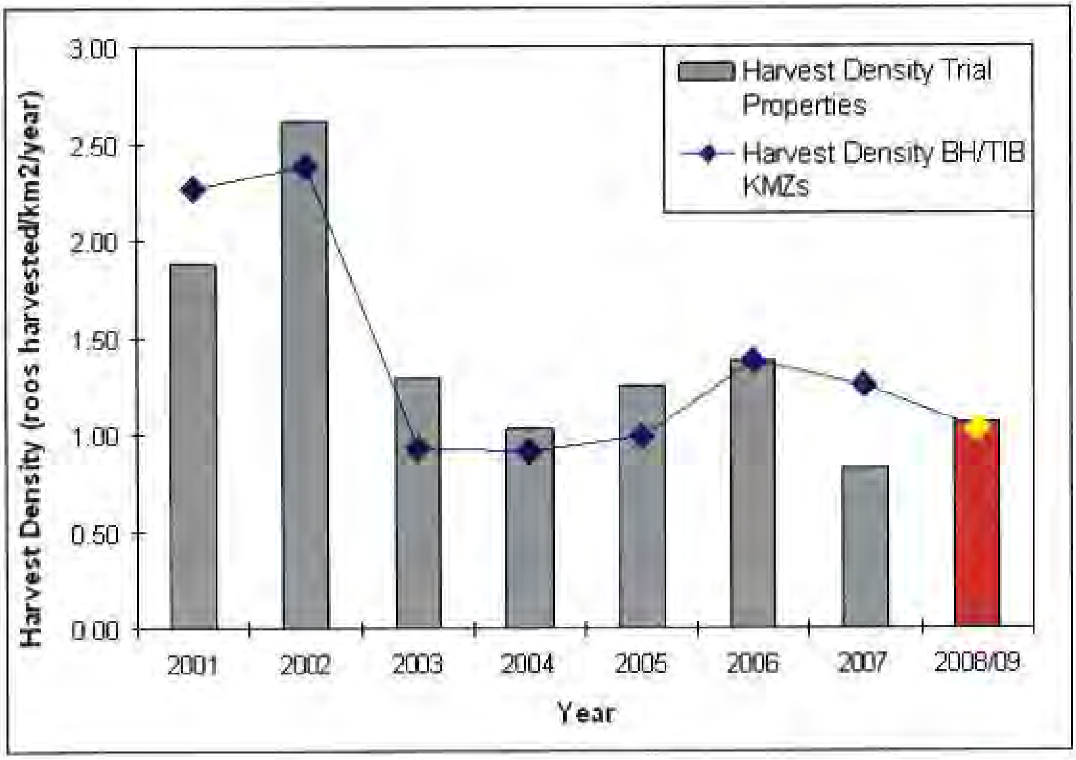
In addition to the use of a General Licence, the adaptive management plan submitted to DECC outlined a number of other management actions. These are covered in other chapters of this report, including Chapter 4 (analysis of harvest data), Chapter 6 (use of LFA), Chapter 7 (landholder survey) and Chapter 8 (economic analyses).

5.3 Results

5.3.1 Collaborative harvest under General Licences May 2008 - April 2009

As discussed in Chapter 4, the total harvest over the trial harvest period (1 May 2008 - 30 April 2009) was 9485 kangaroos. This was relatively low compared to the 2001-2007 harvest average of 13 012 but was higher than the 2007 harvest of 7312. As shown in Figure 5.1, the harvest density for the trial properties during the trial year (1.07 kangaroos harvested/km^2/year) was slightly higher than the 2008 harvest density across the wider Broken Hill and Tibooburra KMZs (1.03 kangaroos harvested/km^2/year) within which the trial properties fell. Furthermore, the trial area showed a trend of increasing harvest density from 2007 to 2008/09 while the broader region showed a declining trend.

Figure 5.1 Harvest density for the 20 trial properties and the broader region (Broken Hill and Tibooburra KMZs). Comparison for 2008/09 covers slightly different harvest periods[4].



[4] 2008/09 harvest data for the trial group covers the 12-month period 1 May 08 – 30 April 2008. 2008/09 harvest data for the Broken Hill and Tibooburra KMZs covers the 15-month period 1 January 2008-31 March 2009, converted to a 12-month average by multiplying by 12/15.

The adaptive management plan submitted to DECC identified one key performance indicator relating to the obtaining of a General Licence, as follows:

Performance Indicator	Results
5.1.1 Success in obtaining a joint General Licence and the number of landholders choosing to participate.	Three general licences were successfully obtained. Participation level was high, with 15-16 landholders and 12-17 trappers listed on each. Harvest levels for the trial were also high relative to regional levels.

5.3.2 Administration of General Licences and harvest tags

Tag-issuing

Trappers generally found it easier to purchase tags on the General Licence trial than for a normal single-property licence, due to tags being available from Broken Hill rather than Dubbo. The part-time availability of tags for GLs 1 and 2 was overcome in GL 3, when CAS was contracted to distribute tags. During the period of the trial there were several changes to the way single property tags were issued so comparison is difficult. The General Licence system compares favourably with tag issue from Dubbo and the tags purchase before the 15th day of each month. It is comparable with the current system which is tag issue from Broken Hill all month. It can take well over a week for this mail to reach the more remote areas of western NSW: another reason why the single-property system makes it difficult to respond to influxes of animals in a timely manner.

The distribution and selling of tags though, was administratively cumbersome, as there was much 'paperwork' (both paper and electronic) and many people involved in this process, including trappers, FATE research assistant, FATE project officer, and tag distributors (currently contracted). In future this could be streamlined by simplifying the process and involving less people in the tag distribution process: preferably just one person located in Broken Hill, distributing tags, reconciling all the paper work and doing the invoices.

The FATE Local Research Officer in Broken Hill was only funded as a part-time position, and so it did occur under GLs 1 and 2 that trappers came to purchase tags on days when she was not in the office. Sometimes other CMA staff 'sold' the tags; and on a small number of occasions nobody was available and trappers were unable to purchase tags at all. Trappers may have travelled long distances to town to get the tags and not been able to purchase them, and issues like these did cause some to become disgruntled with the system. Some difficulties arose when the research assistant was not available and others were delegated to issue tags. These issues were resolved before General Licence 3 commenced, but not before record discrepancies became an issue for both FATE and KMP.

Contracting out the issuing of tags to CAS resulted in more reliable access of shooters to tags, but CAS required constant support from FATE staff to ensure all aspects of transactions were properly completed. This was probably due to CAS being insufficiently familiar or engaged with the rest of the General Licence program to make sensible decisions during transactions.

For General Licence 3, contracting out the issuing of tags cost around 75% of the value of the tags purchased, and around 100% of the value of the tags actually issued until the end of April 2009.

Invoicing

Once some teething problems had been overcome, issuing invoices through the UNSW finance system worked well. The invoices were then forwarded to the Broken Hill tag issuing person to be marked as 'paid' (if the tags had been paid for when they were collected), then forwarded to the trapper. It was the responsibility of the tag issuer to hold and bank the money from the tag 'sales', as they were in the best position to know which tags had been paid for, and also because money from sales of tags could not be banked to UNSW without an invoice number.

This system could definitely be improved upon, and some trappers became disgruntled when sent invoices that had inadvertently not been stamped 'paid'. A system where the trappers were able to receive an 'official' invoice at time of purchasing tags, indicating what monies were paid or owing, would be better. This could be achieved by either: UNSW allowing the tag issuer access to its financials system, or KMP selling the tags directly to the trappers, or via another intermediary that could access DECC financial system (not UNSW). Either way, time spent on issuing invoices and opportunity for administrative error would be greatly reduced. These may not seem good ideas from an auditing perspective, but most systems can restrict system access to the component the user requires.

Record keeping

Some of the trappers thought that the paperwork required was too onerous, and this discouraged them from being part of the trial. The more similar the paperwork is to that for the single-property system, the easier it will be for trappers to fulfil paperwork requirements.

Many trappers expressed their dissatisfaction with the way the system operated at times. They considered the paperwork too onerous, and felt they were reporting the same data several times. Record keeping for trappers needs to be made as simple as possible and take into consideration that the level of literacy and numeracy skills of some trappers might be quite low.

The difficulty of fulfilling the record keeping for some trappers also impacted upon the ability of FATE staff to provide accurate and timely monthly summaries to KMP. However, as the trial has progressed, and trapper books have been introduced, this improved greatly.

Interaction between FATE and KMP

More interaction and discussion between FATE and KMP regarding administrative systems and record keeping might have helped avoid some of the issues mentioned here, particularly during key times of change in the trial such the issuing of new General Licences and changes to staff and admin processes. While the need for collecting of the data and maintaining a chain of accountability for tags is well understood, the feeling at FATE was that the KMP's administrative requirements were inflexible, and might have been able to be improved with some discussion and cooperation. The KMP project officer had been given very little time for the project, as it was a very small portion of their duties, and this may have impacted on their capacity to liaise with FATE and develop more workable procedures and processes.

5.3.3 Feedback on trial from participants

Participants expressed significant frustration with the protracted delay in gaining approval for the General Licence but, despite this, attendance at Steering Committee meetings remained high and interest was maintained through until late 2008 (see Chapter 9 for further details).

The following two performance indicators from the adaptive management plan relate to the administration of harvest tags:

Performance Indicator	Results
5.1.2 Landholder and shooter satisfaction with the methods of distributing tags and access rights amongst shooters.	1/3 landholders and 2/3 harvesters said tags were more readily available under this system and this was supported by responses to this question at Steering Committee meetings.
5.1.3 Number of transactions required for shooters to obtain tags throughout the year and the time taken between landholder/shooter identifying need for harvest and obtaining necessary tags necessary.	Apart from occasional problems this occurred efficiently. In the trial year (May 08-Apr 09), there were 5.3 tag transactions required per 1000 roos harvested. This compares with 3.8 transactions per 1000 roos for 2001-07 across the BRSWET properties.

It was hypothesised that the trial might have resulted in a lower administrative load overall if trappers sought fewer batches of tags because they could use them across several properties. The higher number of tag transactions under the trial indicates that this did not occur. However, this result does not necessarily mean that the trial caused administrative loads to increase unnecessarily. The higher number of transactions per 1000 kangaroos harvested may have had more to do with the fact that shooters could generally get tags more easily and thus may have sought them in smaller and more regular batches. The low harvest level relative to the 2001-07 average would also have contributed to trappers seeking smaller batches of tags.

It proved impractical to measure the exact time that a need for harvest was identified by a landholder or trapper. Also, such data is not collected under the normal DECC system for comparison.

Some delays in obtaining tags were encountered due to the part-time nature of the local coordinator position but this was rarely, if ever, a problem for harvesters.

The following performance indicator from the adaptive management plan relates to the post-trial feedback from participants:

Performance Indicator	Results
5.1.4 Desire to continue with group licensing arrangements following the end of the initial trial at the end of 2008.	All respondents said they would sign up to the General Licence if it were continued by FATE and were supportive of keeping it running without FATE if suitable arrangements could be made. Several harvesters expressed regret when the general licence was not renewed after 30 June 2009.

5.4 Discussion

5.4.1 Licensing arrangements

As a result of the trial, an avenue has been developed in NSW for the use of a General Licence that enables a group of landholders and trappers to collaboratively manage kangaroo harvest tags across property boundaries. This is outside of the normal system of Occupiers' Licences. As far as the landholders and trappers were concerned, harvesting continued in much the same way as before, with trappers working on the properties they were used to working on and following much the same harvest planning and communication strategies with the landholders with whom they had an existing relationship. This was a deliberate strategy negotiated within the steering committee to alleviate anxiety about possible unwanted consequences of the group licence regime. It is clear from this strategy that 'business as usual' was possible under the alternative group licence strategy.

Participants noted that benefits included greater access to tags and greater autonomy in deciding how tags would be allocated. During the trial, the group increased its harvest while the broader region was experiencing a harvest decline. This may have been a direct consequence of the alternative licence arrangements. The short duration of the trial (one year as opposed to the two years initially planned), relatively poor harvest conditions and the deliberate strategy of keeping arrangements as much like 'business as usual' as possible meant that it was unrealistic to expect a significant amount of change in trapper and/or landholder behaviour.

There was only one reported instance of a large kangaroo influx on a district property during the trial period. Researchers were not informed of this until after the trial period had ended. The harvester was able to harvest heavily and satisfactorily minimise the impact of the influx by tag swapping - using tags issued for other properties outside of the trial. While this practice is illegal, it is apparently widely practiced.

Chapter 9 deals further with landholder and trapper views of the trial and how they impact on broader industry issues.

A number of the administrative difficulties encountered during the trial, such as unavailability of administrative staff and record-keeping errors could be put down to 'teething' problems. However, due to the short duration, there was not much opportunity to settle into processes and systems beyond this teething phase. Many administrative issues and additional costs related to the double-handling of processes such as the submission of trapper returns and invoicing for tag payments. Such double-handling was inevitable given the novel nature of many of the trial processes and the fact that existing DECC systems and databases had been set up for single-property arrangements under an Occupiers' Licence framework. Such processes would need to be reformed and better integrated if a group harvesting system operating under a General Licence was to become a permanent component of kangaroo harvest management in NSW.

Problems also arose due to a combination of the bureaucratic processes at an institution such as UNSW and the distance of UNSW's administrative base from the trial location. Future group harvest administration would benefit from being closer to the harvest site and from a simplified corporate structure. There is a strong case for the devolution of appropriate responsibility to the group with simplified reporting and auditing processes within the limits of the legislation.

Over the longer-term, it may be expected that a group licensing system could reduce the DECC workload for licence and tag administration. Indeed, under the 2008/09 trial, DECC had to directly handle only three General Licence transactions rather than 50 individual tag transactions which would have otherwise fallen under Occupiers' Licences. However, any savings here would have been outweighed by the additional DECC resources dedicated to getting the trial off the ground (e.g. development of new database, sorting out teething problems) and doubling-handling of harvest returns.

Chapter 8 (economic modelling and business case) further explores administrative costs and possible corporate structures for future collaborative harvesting arrangements.

5.4.2 Adaptive management under the KMP

A key issue for FATE in the development of the trial was a lack of clarity from DECC about the process for development and approval of adaptive management experiments. This makes it difficult for stakeholders other than DECC to engage in adaptive management (e.g. landholders, harvesters, processors or researchers such as FATE). Our experience with DECC's adaptive management processes turned out to be costly, time consuming and contained a strong bias in favour of maintaining business as usual.

There is also a strong bias in the KMP towards facilitating adaptive management experiments in areas such as kangaroo ecology, population estimation and harvest modelling rather than social or economic aspects of the kangaroo harvest. This is reflected in the fact that two of the key goals of this trial - to improve control of kangaroo grazing pressure and to carve out a sustainable economic role for landholders - are not stated goals of the KMP. This is not to say that control of kangaroo grazing pressure and the distribution of economic returns are not of concern to DECC. Indeed, DECC undertakes a number of specific management actions in these areas, including:

- the release of 'special quota' when zone quotas are exhausted but grazing pressure persists (designed to assist landholders in their goal of controlling kangaroo grazing pressure)
- limiting the number of licensed processors in order to ensure their economic sustainability (a longstanding policy that is not stated in the KMP itself)
- a moratorium on new trapper licences recently introduced for much the same reason as the limit on processor licences.

The reasons why goals such as management of grazing pressure and economic viability are omitted from the KMP are partly political. There has been a deliberate shift in rhetoric away from 'pest control' to 'sustainable use' in Australian kangaroo management and there is also a need for DECC to portray itself as a manager of protected kangaroo species that is not influenced by the economic goals of industry participants. However, the lack of explicit goals in these areas makes it very difficult to argue the case for adaptive management proposals such as BRSWET and means that there is very little data available on factors such as the efficacy of the commercial kangaroo harvest in reducing total grazing pressure or the success of licensing policies in delivering desired socio-economic outcomes.

As an example, despite having no stated goals on the economic participation of landholders in the kangaroo industry, no policy prescriptions to enable participation and no monitoring of participation, DECC dismissed our initial proposal in August 2006 by stating that it "does not consider that the failure of most landholders to participate in the commercial kangaroo industry beyond providing access for licensed trappers is due to legislative or policy impediments". This set the tone for the protracted negotiations that followed and, based on the results of the landholder survey presented in Chapter 7, clearly contradicts what many landholders think about legislative and policy barriers to their participation in the industry.

A summary of the discussion follows:

- The trial showed that a group of landholders and shooters can successfully manage the allocation of harvest tags amongst themselves. This was apparent in the fact that the group expressed a desire to continue if funding for administrative costs could be obtained.

- The group also increased their harvest on 2007 levels while the rest of the region was in decline overall. This shows that group licensing was not a burden on the ability of shooters to harvest and may have been a benefit.

- Quotas were not threatened in 2008/09 and it is unknown how well the allocation of tags would hold up under such a circumstance. For example, conflict might arise if tags were running out and several harvesters were vying for the remaining tags.

- The administrative burden of the trial was high. However, much of this relates to the teething problems inevitable for any new system and the double-handling caused by DECC retaining control over processes and not fully devolving responsibility to the group. A longer trial would be needed with progressively more responsibility devolved over time to get a complete picture of administrative loads.

Our experience with DECC and the adaptive management provisions of the KMP indicates that:

- Adaptive management should involve the clear statement of all goals that drive policy. Without clear statement of goals, it is often very difficult to argue the case for adaptive management proposals such as BRSWET. Very little data is likely to be available for comparison and objectives of the research team are likely to clash with unstated goals of regulators and other stakeholders. Such impacts result in a heavy bias towards maintaining the status quo.

- Plans espousing adaptive management need to state clearly what factors can be experimented with (e.g, population monitoring, quota-setting, socio-economic considerations) and by whom (regulators only, ecological researchers, socio-economic researchers). Without such guidance, very few experiments will get off the ground.

- Adaptive management should be viewed holistically, not as simply the implementation of experiments that are unconnected from the rest of management. Adaptive management means that all management actions should be seen as experiments, not just those that deviate from the status quo. The manner in which the KMP approaches adaptive management at present creates a strong bias towards maintaining business-as-usual.

6. Use of Landscape Function Analysis by landholders and the establishment of community monitoring

A key component of this project is to determine whether the integration of kangaroo management into domestic stock and land management activities can generate landscape-scale environmental benefits. Measuring the impact of management activities in the rangelands is problematic due to the extreme climatic and geographic variability and the dramatic impact of weather events on environmental condition. Except in situations where there has been obvious management failure, extensive research and long-term monitoring has been inconclusive in linking management activities with land condition in the rangelands (Stafford Smith, Morton et al. 2000).

As a consequence, we did not expect any measurable changes in environmental outcomes during this trial. We didn't expect to detect noticeable changes that could be attributed to different kangaroo strategies due to the short duration of the trial. We weren't expecting measurable change in landscape function during the course of the project nor were we testing different kangaroo management regimes against each other for their effect on landscape function. As stated in the previous chapter we adopted a deliberate strategy of trying to keep key aspects of management constant to allay anxiety about possible adverse effects of our intervention,

Despite these difficulties, the team was keen to at least begin the process of engaging landholders with environmental monitoring that was also relevant to production. Following an exploration of possible monitoring methodologies, Landscape Function Analysis (LFA) was chosen for this study because LFA:

- is based on underlying landscape properties not the specifics of particular locations
- is simple and straightforward enough to be done without detailed and specific knowledge and skills and yet is scientifically rigorous
- has a numerical component for incorporation onto databases and GIS systems
- links directly with NRM targets and links on ground management with those targets
- is applicable to land under a range of management strategies from cropping to conservation and all types in between.

In addition, we judged that there was a strong likelihood that LFA:

- could be done by landholders as part of their normal routine and would mean something to their day-to-day management
- could provide a common language that is shared across regions and industries and between conservation and production
- is cost effective enough to allow many sites to be monitored frequently
- could complement other more detailed assessments that are more localised.

It became the key component of the fourth objective for this project: to 'establish and undertake community monitoring of landscape function (and kangaroo populations) to inform adaptive management'. Please note that localised community monitoring of kangaroo populations under the trial is dealt with in Chapter 4.

Interactive adaptive management would involve landholders aiming towards maintaining or improving land condition using LFA as a monitoring tool. Information generated by LFA can determine the dynamic range of function of a targeted land type and show, through periodic monitoring, how land is responding to management treatments which can be active or passive in nature. Whilst individual landholders could undertake this process, incorporating it into a Landcare group strategy would generate additional benefits. A range of management strategies undertaken in a district could be monitored in parallel and over time to generate social learning. This is consistent with farming systems research advocating work at the interface between biophysical systems and social management systems (Keating and McCown 2001).

The WCMA provided additional funding on top of that supplied by RIRDC to support this component of the project.

6.1 Objectives

The key objective of this component of the project is to establish and undertake community monitoring of landscape function to inform adaptive management. We divided this objective into the following components:

- learning LFA and applying it to an individual property
- group monitoring using LFA.

This is the first attempt, of which we are aware, to systematically train landholders in LFA, to evaluate the effectiveness of the training, to assess the usefulness of LFA to landholders and to attempt to incorporate LFA into a group monitoring system.

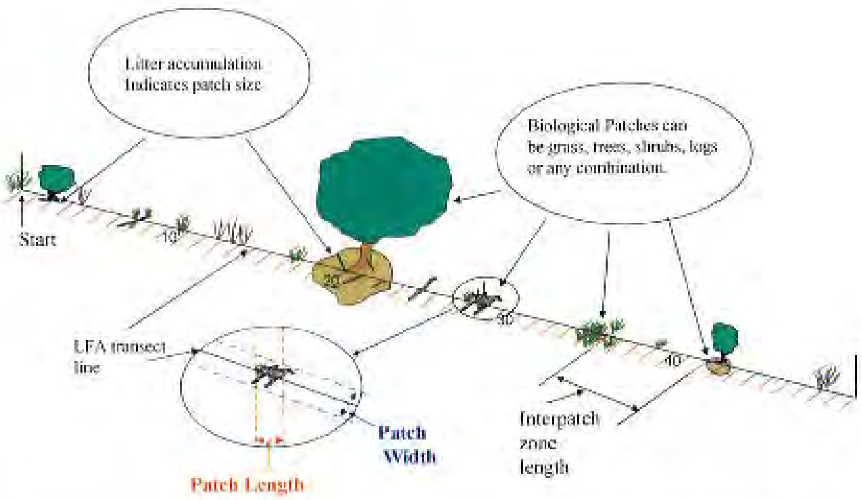
6.2 Methods

6.2.1 Landscape Function Analysis

Landscape Function Analysis (LFA) is a rigorously developed method based on a clearly articulated conceptual framework that is backed up with decades of meticulous analytical research. It can be used to assess and monitor how an area of land (defined as a 'hill slope' in the methodology, meaning an area of land that will either have a defined slope, however gentle, or a directional environmental driver such as slope or prevailing wind direction) is functioning as a biogeochemical system and the extent to which it is self-regenerating (Tongway and Hindley 2004). It is extensively used in mine reclamation and in rangeland monitoring, particularly in WA (Watson, Richardson et al. 2006; Watson, Novelly et al. 2007). If used in a time sequence and in context, LFA can show the extent to which a landscape is retaining and using its vital resources. LFA is a central part of a broader method, Ecosystem Function Analysis (EFA) which incorporates further assessments to more fully characterise the functional performance of plants and animals.

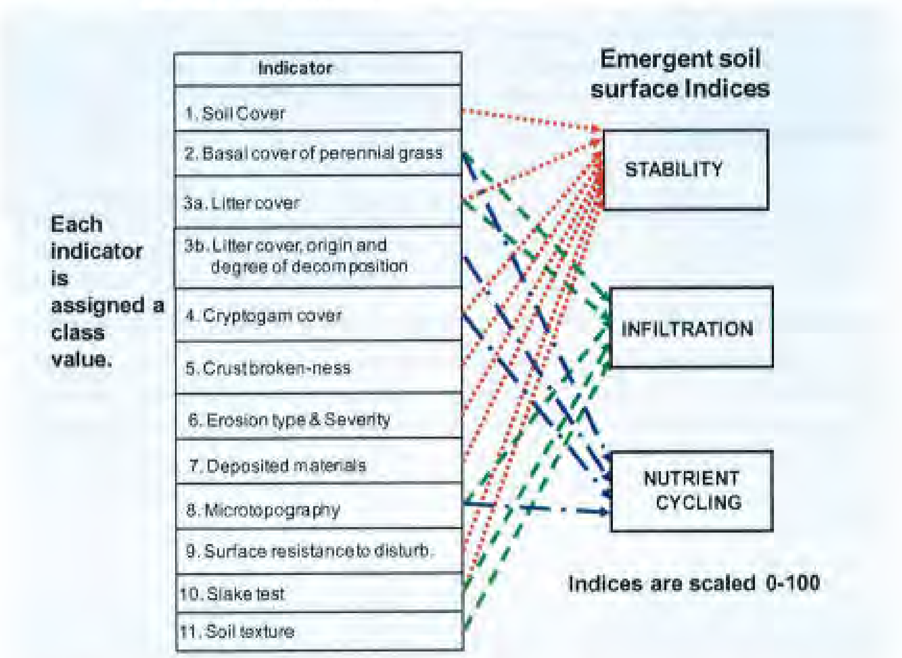
LFA involves collecting data on a downslope (or down wind) transect. The transect is divided into sections according to whether it is accumulating resources (called a patch) or losing resources (called an interpatch). The pattern of different sections (patches and interpatches) is called landscape organisation (Figure 6.1). Each section is then analysed according to its soil surface characteristics by using 1m sampling sites in each section, and applying 11 Soil Surface Indicators (SSIs) to each sampling site. This process is called soil surface analysis (Figure 6.2). All data (site description, landscape organisation and soil surface analysis) are entered into a purpose built software package to generate information that characterises the site and calculates indices for stability, water infiltration and nutrient cycling. It generates the information immediately so that interpretation of the results can begin on the day of monitoring.

Figure 6.1 Landscape organisation



Geomorphic entities such as flats and slopes may also be patches and interpatches, respectively.

Figure 6.2 Soil Surface Analysis – how soil surface indicators contribute to the generation of soil surface indices.



6.2.2 Learning LFA and applying it to an individual property

This research involved an adaptive learning cycle incorporating the development and trialling of an on-site training package, an evaluation of its use leading to modification, its use in the modified form by new groups, then the opportunity for further modifications. The evaluation incorporated comparing the use of LFA by novices to its use by an expert and follow-up interviews with those trained.

During 2006 a two-day on-site LFA training package was developed. It was trialled at Fowlers Gap Arid Zone Research Station in November 2006 to a group comprising landholders from the Barrier Area Rangecare Group (BARG), WCMA personnel and representatives from the Natural Resources Commission (NRC). The training culminated in participants undertaking an LFA without assistance on two transects that had been previously analysed by an LFA expert. These data were then compared and the results fed back to the groups at the conclusion of the training. It became clear that learners were using a range of approaches to landscape organisation reflecting significant misconceptions. As a result some groups generated LFA indices that were different to the expert, while for other groups results were consistent with the expert.

David Tongway conducting LFA training, Fowlers Gap, November 2006

In response to the trial the training package was modified to place more emphasis on the landscape organisation phase of the procedure. The modified training package was then used with another group of BARG landholders, DPI research staff and a landholder from another area at a second Barrier Ranges property (Mt Woowoollahra Station) in October 2007. This time participants were more consistent in describing landscape organisation, but the soil surface analysis component was rushed due to shortening of the course due to logistical difficulties.

Participants doing their own LFA transects, Fowlers Gap, November 2006

After each LFA training session, feedback about the opinions and observations of participants was obtained by discussing the following topics with each group:

- the success of the training course
- personal responses to LFA as a methodology for use by landholders
- whether LFA should form the basis for a community monitoring system.

A third training course took place at Wanaaring in June 2008 with local landholders as well as people from Western Australia who came specifically to learn LFA. The training course, scheduled over two days, had to be shortened to two half days due to rain preventing access to the isolated location. This limited the extent to which this training course could provide clear evidence supporting the reliability of LFA data generated by landholders.

During 2008, multiple attempts were made to arrange follow up visits to landholders trained in LFA. For a range of reasons no visits took place. Instead, semi-structured interviews are yet to be conducted with landholders following their being trained in LFA. The interviews will be undertaken by phone or in person. A protocol for the interviews was developed to guide the interviewer and ensure all desired areas were covered (see detailed proforma in Appendix B).When these interviews have been completed the results will be published.

The broad purpose of the landholder interviews was to explore their experience of the LFA training in their personal context. The questions to which answers were sought were:

- How do landholders read their land? What are the markers for them of land under stress on which they might make decisions, for example, to reduce stock or move stock on or de-stock?
- What land management tools do they have at their disposal. Are they adequate?
- How did they respond to training in LFA? Did it make sense to them? Were they able to integrate it with what they already know and do? Do they now use anything from the training formally or informally?
- How did they react to training in LFA? What aspects worked? What aspects did they find difficult? What parts of the training were unclear?

- Are they interested in using LFA for group monitoring?

6.2.3 Group monitoring using LFA

Whilst LFA training was being planned and undertaken, a parallel effort was made to define the parameters for a community-based LFA monitoring program in the BARG area. This involved selecting a set of key land types (KLTs) for the area and determining locations within each key land type for the monitoring of representative sites which landholders could use of a reference point for sites they monitor on their own properties.

A number of methods were used for selecting key land types through a consultative process involving BARG landholders, FATE, Western CMA, David Tongway and David Eldridge (NSW DNR and UNSW). Discussions at a BARG meeting in 2006 identified 11 different terms for land types that were in common usage amongst landholders in the area (Flood Country, Alluvial Plain, Banded Saltbush, Saltbush/Bluebush, Sand hills, Sand plains, Mulga rises, Mulga Woodland, Gibber Plain, Sandstone Hills, Mitchell Grass Country). These terms were based on a combination of geomorphology and vegetation type. It was recognised that the list was not exhaustive and that there would be substantial overlap between the terms, but it provided a broad framework for how landholders categorised their landscapes, how many different categories were present in the area and the terms that were in common usage.

A number of existing land mapping datasets were consulted to determine a set of key land types that would meet a number of aims, as follows:

- Categories should be based on a combination of geomorphology and vegetation type.
- The number of categories and terms used should reflect landholder perceptions.
- The number of categories should be manageable (considering that at least three reference sites were likely to be needed within each key land type).
- KLTs should be consistent with categorisations used in other monitoring programs, especially the Rangelands Assessment Program (RAP) coordinated by the NSW Department of Natural Resources.

The RAP Rangetypes and the NSW Landsystems data that they are based on were identified as the most likely options, especially given that RAP sites were already being monitored in the trial area. Other possibilities were considered and rejected, including the Major Vegetation Sub-categories used in NVIS data (too many categories and didn't reflect position in landscape enough), Regolith data (too broad and didn't factor in vegetation enough) and Soil Conservation Service categories (not consistent with RAP/Landsystems data).

The RAP Rangetype categories themselves were considered to be too broad for the required purpose, as there were only four RAP Rangetypes in the trial area and two of these dominated (Sandplain and Bluebush). However, the digital landsystems dataset that underlies the RAP categories further divides the NSW Western Division into 251 separate landsystems, grouped into 20 range types and nine physiographic categories. It was determined that the best categorisation would be achieved by using the nine physiographic categories in combination with the four RAP rangetypes. Theoretically, this could result in 36 categories (9x4), but in practice many categories did not occur in the trial area and the "Ranges" physiographic category was excluded as being too steep for practical use in an LFA monitoring strategy.

The end result was a set of six key land types that were dominant in the trial area (see Table 6.1 and Figure 6.3), providing a manageable number of categories for community monitoring based on both geomorphology and vegetation that reflected landholder terms and categories and were consistent with the existing RAP categorisation.

Table 6.1 Key land types for LFA monitoring strategy in BRSWET area.

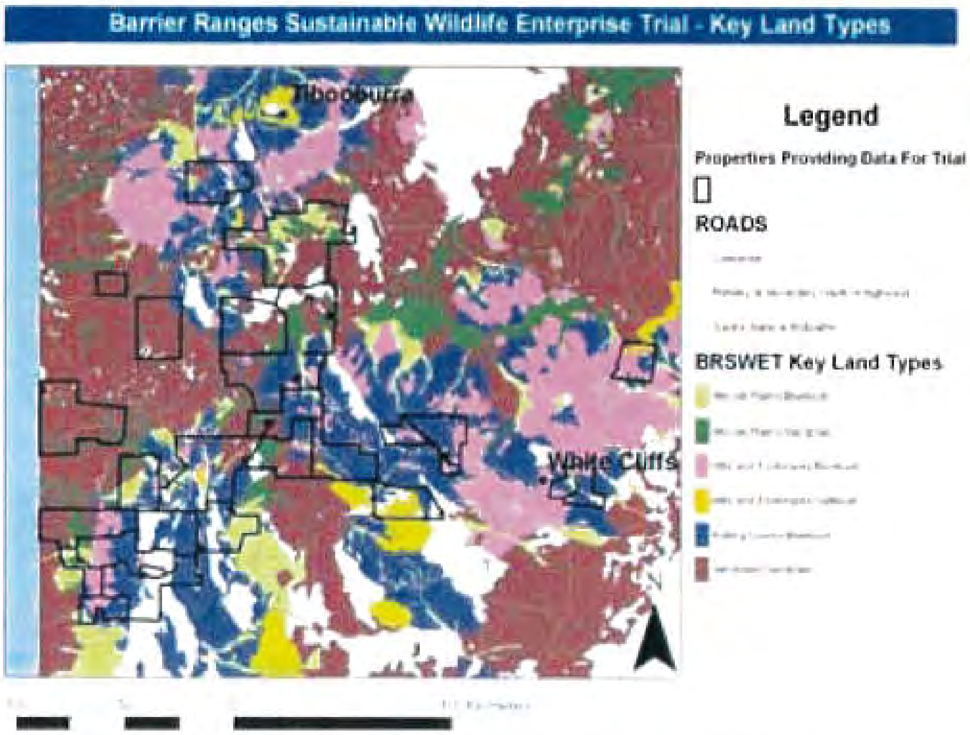
Physiographic Category	Rangetype (RAP and other names)	Key Land Type Code	Approx Percentage of Area covered by category
Dunefields/Sandplains	Sandplain	SP_sp	40%
Alluvial Plains	Sandplain	AP_sp	5%
	Bluebush	AP_bb	7%
Rolling Downs and Lowland	Bluebush	RD_bb	17%
Hill and Footslopes/Tablelands	Bluebush	HF_bb	12%
	Saltbush	HF_sb	2%

Note: most of the remaining trial area was classed as "Ranges" and excluded from the monitoring strategy. Other Physiographic/Rangetype combinations were negligible in their extent across the trial area.

Plains and Foothills Landscape, Fowlers Gap

Rocky Hills Landscape, Fowlers Gap

Figure 6.3 Distribution of key land types across BRSWET area.



Data Source: Land Systems of Western New South Wales

6.2.4 Planning for reference sites

Through discussions between the FATE Program, David Tongway and landholders participating in LFA training, a basic group monitoring strategy was devised based on centralised monitoring of reference sites in each key land type, which involved landholders undertaking their own monitoring and comparing their results to the relevant reference sites. It was determined that three reference sites would be ideal for each key land type – one representing a site in good condition, one in medium condition and one in poor condition. Monitoring of these reference sites would be undertaken by FATE (at least initially) every Spring and Autumn, with results distributed to participating landholders for comparison with sites they may wish to monitor on their own properties.

The initial Spring monitoring round could be combined with landholder interviews that involve presenting a monitoring package to each landholder. The package could contain the LFA manual, results for each reference site monitored and a map of their property showing where each of the key land types occurred. Training and assistance with initial monitoring could also be provided.

To monitor three reference sites within each of the six key land types, a total of eighteen sites would be needed. A greater number than this may actually need to be visited in order to find sites in good, medium and poor condition, however, it may be possible to locate transects in different condition very close together to save time (e.g. two sites on either side of a fenceline or in the same paddock but different distances from water). Two to three days in the field may be required to complete this monitoring of reference sites and ideally, LFA data from these reference sites would be processed before being discussed with landholders.

David Tongway describing impact of vegetation on sandhills

Prior to the trial we had engaged Agricultural and Environmental Management Services (AEMS) to jointly develop a web-based tool to incorporate LFA into land management systems. AEMS prepared an LFA template for their online property management system and intended to adapt it to hold and manage the kinds of cross-property reference data produced by this community monitoring program. AEMS personnel were involved in field work conducting LFAs in the Barrier Ranges but were unable to deliver on the web-based tool. We were able to accumulate some of the data needed but difficulties with gaining access to properties and availability of landholders at critical times prevented us from implementing the multi-property system.

Our next task was to conduct LFAs on each of these categories on sites that provided a range of conditions from severely degraded to 'as good as you can get'. This enabled us to establish the dynamic range of LFA values for each land category which could then provide a benchmark from which individual landholders could compare the state of their own land of the same land category. We undertook these LFAs both as a small research group and during LFA training sessions (November 2007 and August 2008) on the Barrier Ranges.

6.3 Results

6.3.1 Learning LFA and applying it to an individual property

Participation

A total of nine BARG landholders representing six properties were trained in two training courses (November 2006 at Fowlers Gap and August 2007 at Mt Woowoollahra). This was fewer than was anticipated. Enrolment for the first training course was very strong (22), necessitating our rejection of some landholders due to limited places. Subsequently, more than half failed to show for the course, but by then it was too late to replace them. Bookings for the second training course originally scheduled for March 2007 were strong (12), but it had to be postponed due to a severe storm on the day which prevented access to the venue. The earliest we were able to reschedule was August 2007, when fewer landholders were available.

Feedback from participants

Participant responses immediately after the training courses were very encouraging. They reported enjoying the course as a practical, hands-on experience. Several described how the course opened their eyes to how landscapes function rather than just assessing condition, which is generally limited to information on pasture species.

Participants in the first course described landscape organisation as the most difficult part whereas this was not a problem in the modified course offered to the second group. There were comments about how confidence grew through the course as they were encouraged to participate rather than just watch. Several practical suggestions were made at each of the first two courses that were used to further refine the method and the course.

When asked about the relevance of LFA, participants were very positive. One described it as:

> 'better compared to some other methods (tactical grazing) as it provides a deeper and more 'whole' understanding of how soil, vegetation and landscape function.'

It was described as very relevant and several instances were described where knowledge of landscape function would be of benefit. Two participants reported that, following training, they were already looking at their land differently, indicating that they were already making informal use of the principles behind LFA without actually doing a formal transect.

Following the second course there was strong support for setting up a multi-property monitoring system using LFA. There was unanimous support for the view that such a system would generate considerable benefits and would be self-sustaining after an initial training and set-up period.

Stock and kangaroo exclusion, Emu Paddock, Fowlers Gap

Attempts by the researchers to visit landholders trained in LFA to further evaluate the impact of the training and to implement the multi-property monitoring system were unsuccessful. The reasons for this were either:

- times set aside by researchers to achieve this were not suitable to landholders;
- landholders were in a period of personal or occupational crisis (Chapter 10, Section 10.1).

Comparison of LFA done by landholders and experts

During the three training courses, data were collected to allow comparisons between the LFAs done by landholders who were just learning and those done by the recognised expert in LFA, David Tongway. Some of these data (broadly representative of all of the data) are presented below in Table 6.2 and Figure 6.4. These data allowed the researchers to assess where learners differed from the expert so as to improve the training to bring learners closer to the expert in subsequent training sessions.

David Tongway working on an LFA transect on stony banded saltbush, Fowlers Gap, November 2006

During the first training course, it became clear that learners had generated misconceptions about landscape organisation which came out during discussion in the final stages of the course and impacted on their data. This is demonstrated in Figure 6.4 where the expert identified four different zones, Group B identified three zones and Group E identified two zones along the same transect. Learners also hadn't sampled sufficiently often (as shown in red). However, despite these differences, overall LFA assessments were similar between the expert and the two learner groups as shown in Table 6.2. This is an indication of the robustness of the LFA methodology.

During the second training course, more emphasis was placed on the landscape organisation stage and, as a result, learners' classifications were close to those of the expert. In Table 6.3 landscape organisation data are presented from the same transect done by the expert and two landholder groups, and apart from some additional zones and some differences in zone names, all three are essentially the same. This was similar for a second transect. Unfortunately the second training course was cut short due to access and weather problems so the soil surface analysis component did not receive sufficient emphasis and the consistency of the final LFA data was patchy.

Figure 6.4 Comparison of Landscape organisation transect 5 by expert and learners at Fowlers Gap, November 2006.

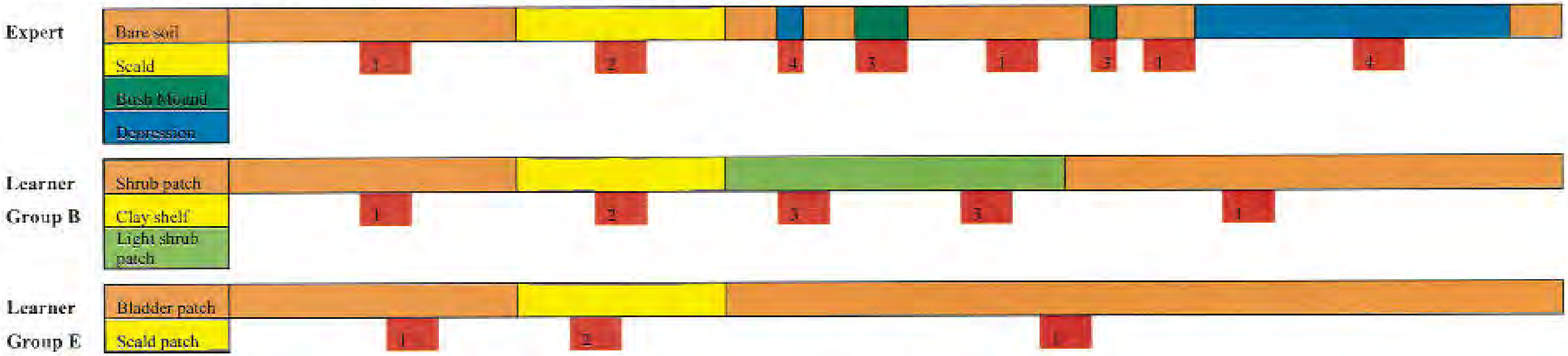


Table 6.2 Comparison of LFA done by landholders and experts on transect 5 at Fowlers Gap in Nov 2006.

Transect 5	Landscape			Soil Surface Assessment		Individual zones contribution to the whole Landscape			
	Zone	**Mean Zone Length (m)**	**%**	Stability	Std err	Infiltration	Std err	Nutrients	Std err
Expert	Bare soil	2.11	51.1	31.5	0.4	14.0	0.3	12.7	0.8
	Scald	3.84	15.5	7.0		2.5		1.4	
	Bush Mound	0.90	3.6	2.4	0.0	1.1	0.1	0.9	0.0
	Depression	2.46	29.8	17.1	0.7	8.3	0.3	7.3	0.7
	Total		100.0	58.0	1.1	25.9	0.6	22.3	1.1
Learner Group B	Shrub patch	7.13	57.3	32.9	1.4	15.0	0.4	12.0	2.7
	Clay shelf	3.82	15.3	6.0		2.2		1.4	
	Light shrub patch	6.82	27.4	14.4	1.4	6.6	0.7	5.1	0.6
	Total		100.0	53.3	2.8	23.9	1.1	18.5	3.3
Leaner Group E	Bladder patch	10.58	85.0	59.5	2.1	24.2	1.1	25.5	2.5
	Scald patch	3.74	15.0	6.0		2.2		1.4	
	Total		100.0	65.5	3.0	26.4	1.6	26.6	3.5

Table 6.3 Comparing landscape organisation data between expert and learner groups on transect 2 at Mt Woowoollahra in Oct 2007.

MtWW:	Master		MtWW:	Group A		MtWW:	Group B	
Transect:	2		Transect:	2		Transect:	2	
Distance (m)	Patch width (cm)	Patch/ Interpatch Identity	Distance (m)	Patch width (cm)	Patch/ Interpatch Identity	Distance (m)	Patch width (cm)	Patch/ Interpatch Identity
0			0			0		
1.55		Sandy slope	1.55		mound slope			
3.25		bare soil	3.25		bare soil	3.37		bare soil
3.7	36	shrub hummock	3.72	36	shrub mound	3.63	23	shrub mound
8.8		bs	8.61		bs	8.8		bs
10.5	83	sh	10.6	80	sm	10.53	90	sm
12.55		bs	12.55		bs	12.45		bs
15.3		annual hummock	15.28	105	wood debris	15.04	158	sm
18.3		bs	18.3		bs	18.3		bs
23.5	810	sh	23.5	810	shrub thicket	22.65	850	shrub thicket
						26.85		bs
						27.9	123	sm
29.6		bs	29.55		bs	29.5		bs
30.4	70	sh	30.4	70	sm	30.3	70	sm
36.6		bs	36.6		bs	36.57		bs
38.3	590	shrub litter	39	590	wd	39.15	590	st
45.5		bs	45.4		bs	48.83		bs
50		bare crusted soil	50	520	bare crusted soil	50	550	sm

6.3.2 Results of group monitoring using LFA

There was strong support from landholders trained in LFA for the establishment of a multi-property monitoring system using LFA. In anticipation of this response, FATE had prepared the following monitoring program description which was presented to the groups following the training course.

BARG Landscape Monitoring and Assessment Program:

'The Barrier Area Rangecare Group is a proactive, social community group aiming to achieve long term sustainable landscape management by implementing recognised and innovative land management strategies.'

Reasons for monitoring:

- Provide an additional tool for landholders to use to read their land and understand how it is responding to seasonal and management changes.
- Provide landholders with benchmarks for important landscape types against which they can compare the condition of their land.
- Provide evidence over time of changes in landscape condition and landholders' level of land stewardship.
- Provide reliable and rigorous information on which individual landholders and BARG as a whole can base management and strategic decisions such as domestic stocking rates, control of invasive native scrub, control of introduced pests and kangaroo harvesting strategies.
- Develop a model that, if successful, can be used in other locations both in WCMA and other areas to provide CMAs with reliable and timely information on resource condition.

Field data collection and analysis:

- Landscape Function Analysis (LFA) will be used as the basis of data collection and analysis. Through LFA, indices for soil stability, water infiltration and nutrient cycling can be generated through a well designed methodology.
- Important land types will be defined using broad RAP (Rangeland Assessment Program) land types refined to be meaningful across the BARG properties. Three Key Land Types will be selected that best represent the landscape and the objectives of the landholders.
- Reference Sites will be located on participating properties; at least two for each of the three Key Land Types.
- Landholders will learn LFA. Data will be collected on whether they have learnt to conduct the LFA consistently during the training.
- Landholders will establish sites on their properties which correspond as closely as possible to one or more of the Key Land Types and will undertake to monitor regularly (a minimum of twice yearly).
- Critical locations that have higher levels of growth and thus higher potential herbivore populations (eg 'wash-out' areas or areas that have received water from a localized storm) could be identified and monitored as additional sites.
- Each landholder can enter their data onto data sheets. They (or the team) can transfer the data onto the LFA software program to generate the 3 indices. The team can add the data to the GIS.

Turning data into information:

- When new data comes in, the team will enter the data onto the LFA software, do the calculations and provide feedback to the landholder about how to interpret it.

- The team will develop information via print and the website that will help landholders to understand what their data means using the LFA framework. For example, it might show whether measured values mean that the landscape is functioning well in relation to the Reference Sites and other sites on other properties.

- The team will record and maintain the data, maintaining a balance between confidentiality and making an appropriate level of information available to help make sense of data from individual properties. The team will have access to all data but landholders will be able to de-identify themselves from the data that is viewed by others. The data will appear in GIS format with access to layers managed in accord with the wishes of the landholders and researchers.

Turning information into action plans:

- The reliable and rigorous information generated from the data can provide evidence on which individual landholders and BARG as a whole can base management and strategic decisions such as domestic stocking rates, control of invasive native scrub, control of introduced pests and kangaroo harvesting strategies.

- It will enable BARG to demonstrate any movement towards improved environmental stewardship based on sound and systematic evidence.

Landholders agreed in principle to base a subsequent monitoring system on this. This project has provided the starting point for this group and others to develop a monitoring system. We also have collected some of the data necessary to establish a monitoring program in the Barrier Ranges on two of the Key Land types, Sandplains; and rolling plains and foothills. Some of these data are presented below in Table 6.4 – 6.7.

Table 6.4 Best possible Banded saltbush/bluebush—stony site inside Emu Paddock at FG.

Zone	% of transect	Stability	Infiltration	Nutrient cycling
Stony interpatch	40	65	23	16
Shrub band	60	69	30	30
Best Overall		67	27	24

Best possible banded saltbush site inside Emu Paddock, Fowlers Gap

Banded saltbush outside Emu Paddock, Fowlers Gap

Table 6.5 Worst available Banded saltbush/bluebush—stony site (not worst possible) outside Emu Paddock at FG.

Zone	% of transect	Stability	Infiltration	Nutrient cycling
Stony interpatch	75	55	19	10
Shrub mound	20	60	31	26
Alluvium	5	45	16	9
Best Overall		56	22	13

Table 6.6 Best available Sandplain—(not nearly best possible) at The Veldt.

Zone	% of transect	Stability	Infiltration	Nutrient cycling
Sandy dune	45.5	36	32	8
Shrub patch	25.5	41	37	15
Gilgai	29	45	20	16
Best Overall		40	30	12

Table 6.7 Worst available Sandplain— (not nearly worst possible).

Zone	% of transect	Stability	Infiltration	Nutrient cycling
Sand plain	79	36	21	8
Shrub mound	21	38	31	12
Best Overall		36	24	9

6.4 Discussion

Whilst circumstances intervened that prevented the research plan from being thoroughly followed, it is clear that the LFA course improved as a result of the learning cycle and that novices using the modified package can generate data very similar to the expert after a two-day training course. In addition, landholders responded very positively to LFA, expressing a desire to incorporate it into their day-to-day management as well as work together with other land managers to develop group monitoring using LFA. It is already clear that:

- Landholders are capable of learning LFA in a two-day training course.
- Landholders readily understood the concepts behind LFA and were able to integrate them into their existing knowledge and understanding of the landscape.
- Landholders perceived LFA to be useful in that it enhanced their understanding of the landscape and provided an additional tool to help inform their management.

Even if LFA is not conducted formally following training, LFA lends itself to informal appraisal by landholders once the principles are understood.

A two-day training course is the ideal for landholders to learn the basics of LFA and to be able to begin using it informally on their property. Follow up contact of at least one day is needed to develop a more formal on-farm LFA monitoring system that is tailored to an individual property. In order to develop a multi-property monitoring system, all members of the group would need to go through this process. The next step would be to work together with expert help to choose key land types and set up benchmark transects across sites to establish best and worst LFA values for each key land type in the area covered by the group. It would then only require one member of the group to collate this information and make it available to the others. They could then conduct their own LFA measurements and compare them to previous measurements on the same site and with the group benchmarks.

For LFA to be used as a basis for broader scale resource condition monitoring that contributes to a wider dataset, further evaluated training courses are needed to generate sufficient data on which to conduct statistical analysis to measure the significance of differences between novices and the expert conducting LFA. Follow-up interviews are still required to assess aspects of the training in and use of LFA. It is also conceivable that landholders themselves could become LFA data collectors for wider use of LFA by regional bodies. Illustrated local region manuals or 'glovebox guides' could be developed to maintain and reinforce the principles.

Three performance indicators relating to LFA were identified in the Adaptive Management trial plan submitted to DECC in March 2008 (see Chapter 5). Key findings against these performance indicators are as follows:

Performance Indicator	Key Finding
Number of landholders in the group trained in LFA and number of landholders undertaking LFA transects on their properties.	Nine landholders representing six properties were trained in LFA. A number have reported applying LFA principles on their properties, but not the formal undertaking of LFA transects.
Success in setting up representative LFA sites for each major rangetype which are monitored at least once annually.	Key range types across the BRSWET area were identified and an outline of a group monitoring program was developed. Benchmark data was obtained for representative sites on some range types.
Degree to which landholders are prepared to share data on other aspects of total grazing pressure through cross-property GIS.	AEMS did not deliver on the proposed cross-property GIS. Future data-sharing would be dependent on the adoption of a group monitoring strategy.

Key points from the discussion follow:

- Sufficient work was done through this project to establish that LFA is a suitable methodology for landholders to use to monitor land condition.
- Exposure to LFA training encouraged landholders to aspire to a multi-property monitoring system to allow them to measure themselves up against local benchmarks to inform their adaptive management. This would open the way to their collecting evidence of stewardship.
- Establishment of a co-operative SWE could therefore involve an environmental management system that incorporated community monitoring using LFA to work towards sustainable land management independent of enterprise.
- More work needs to be done on developing LFA training packages, evaluating them and developing a system for linking community monitoring with agency monitoring before landholder LFA can be incorporated into broader resource condition datasets.

7. Survey of landholder perceptions of kangaroo issues

7.1 Objectives

A survey was undertaken of landholders across the Western Catchment Management Authority's (WCMA) region of NSW between March and June 2008. The main objectives of the survey were:

- to obtain baseline information about landholders' management of kangaroos against which the outcomes of BRSWET could be assessed
- to identify key differences and similarities between the BRSWET group and other landholders
- to determine future directions for landholder involvement in kangaroo management in western NSW.

7.2 Methods

A 1999 survey undertaken in southwest Queensland (Chapman 2003) was used as a starting point for the survey methodology. Margaret Chapman, of the University of Queensland's School of Natural and Rural Systems Management provided a copy of the 1999 survey and collaborated with FATE to extensively modify the questions. Key issues of interest for BRSWET were incorporated and questions that were not considered effective in 1999 were amended. The final survey covered basic data such as property size, age and income streams, attitudes towards kangaroos, measures employed to control total grazing pressure, perceived effectiveness of the kangaroo industry, attitudes towards different kangaroo enterprise models and attitudes towards collaboration with neighbours. The 28 survey questions included a mixture of response types, requiring respondents to select one or more responses from a list, to rank possible options in order of preference or to provide comments.

WCMA provided access to their landholder database and the survey was mailed to 419 landholders in the WCMA area in March 2008. A pre-paid return envelope was included and reminder letters were sent in June 2008. The Pastoralists' Association of West Darling (PAWD), the peak representative body for pastoralists in the region, also provided support for the mail-out.

The mailing list included 23 Barrier Ranges landholders who had been exposed to BRSWET. These 23 envelopes were specially marked so that their responses could be viewed as a subset of the total. This subset included landholders participating in the BRSWET group licence, as well as others who had only been exposed to elements of the trial's planning and development.

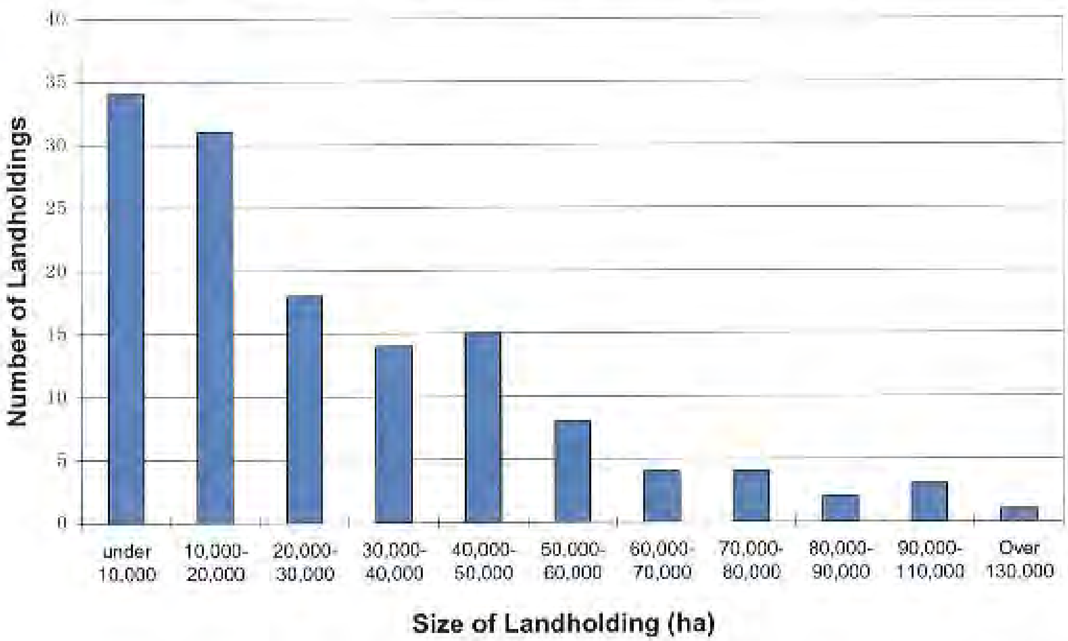
The response rate overall was 35% (145 responses out of 419), with 61% for the Barrier Ranges subgroup (14 responses from 23 sent). Not all questions were completed on each survey, meaning that the sample size was reduced for many questions. Results were compiled and analysed between June 2008 and February 2009 and were then discussed with trial participants in June 2009.

7.3 Results

7.3.1 Baseline data

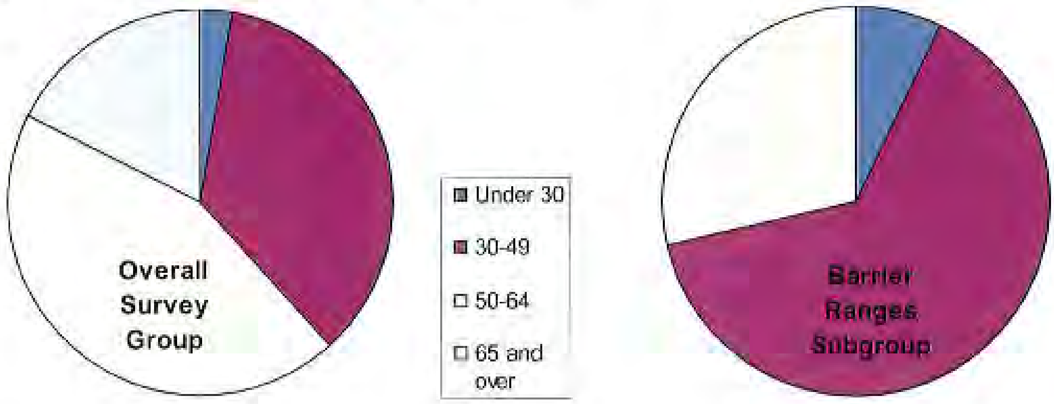
The average landholding size amongst survey respondents (n=145) was 28 000 ha (Fig. 7.1). The average amongst the Barrier Ranges subgroup (n=14) was higher at 53 000 ha, reflecting the fact that the area has lower average rainfall, is more rugged, does not contain any major towns and does not border the Darling River.

Figure 7.1 Distribution of landholding size amongst survey respondents.



Barrier Ranges respondents were also younger on average (Fig. 7.2), with only 36% aged 50 or over (n=14) compared to 61% overall (n=145). This reflects anecdotal evidence that the area features a concentration of younger landholders.

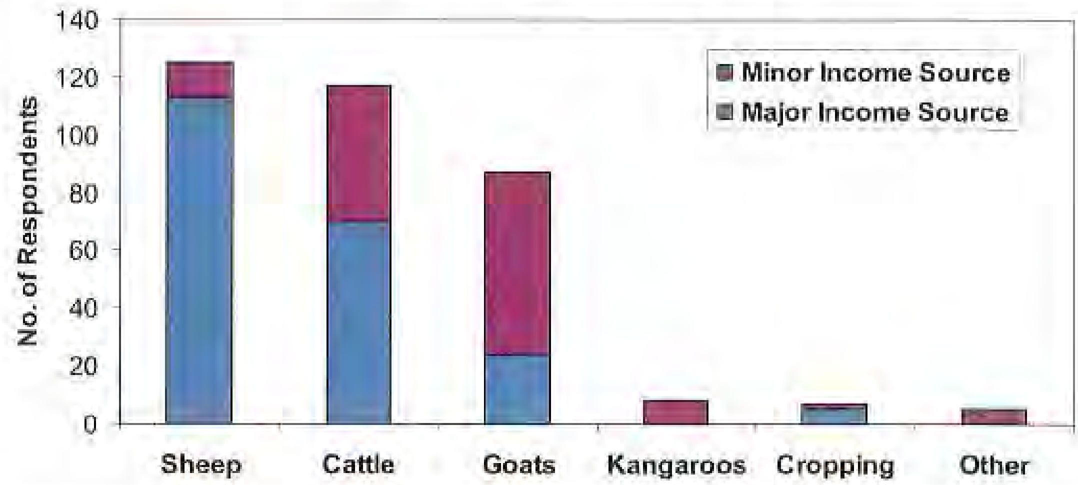
Figure 7.2 Age distribution of survey respondents.



7.3.2 Income streams

Sheep grazing was the most significant income source for respondents, followed by cattle grazing and goats (Fig. 7.3). No respondents said that kangaroos were a major income source, although 6% (n=144) said they were minor (also 6% for the Barrier Ranges subgroup; n=14). The only major difference amongst the Barrier Ranges subgroup was that sheep were somewhat more dominant (100% major income source v 78% overall).

Figure 7.3 Income streams amongst survey respondents (n=144).



In terms of commercial kangaroo management, 89% of respondents (n=145) said that they allowed commercial shooters to harvest on their properties, but only 12 landholders (8%) reported more active participation, consisting of:

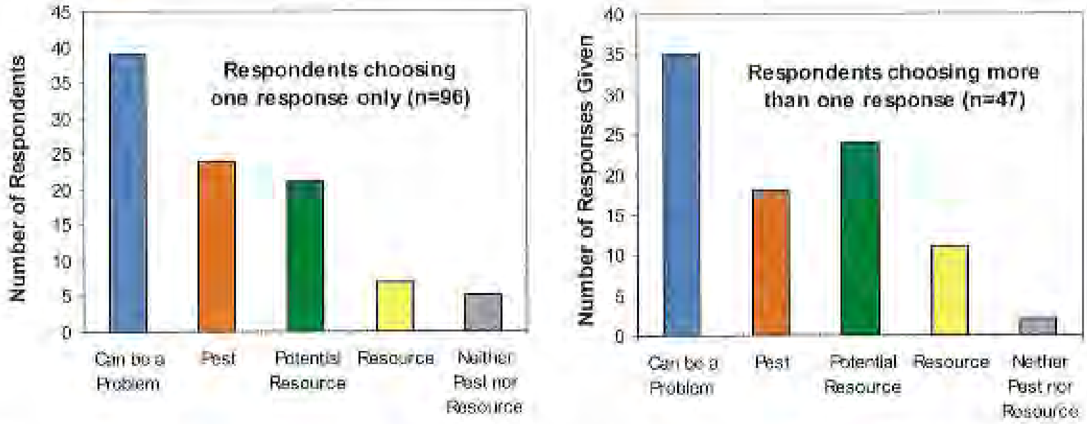
- eight who harvested commercially themselves (two of these also had chillers)
- two who owned or operated chillers but did not harvest personally
- one who received a payment from their shooter
- one who identified commercial value in kangaroos for tourism.

While landholder income from kangaroos was clearly low, there was some inconsistency between the answers given to different questions. Twelve landholders reported participation in the activities listed above, but only five reported that they or a family member earned income from these activities. Both of these figures differ from the number of respondents (8) who listed kangaroos as a minor income source (see Fig. 7.3 above).

7.3.3 Attitudes toward kangaroos

When asked to choose which term they felt best described kangaroos (from a list provided), the most popular response was 'can be a problem at times', followed by 'pest' and 'potential resource' (Fig. 7.4). One-third of respondents misinterpreted the question and selected multiple responses. Therefore, two series of data are shown in Figure 7.4; one based on those who chose one answer only and one based on those who selected multiple answers. Both data series show very similar patterns, with the only major difference being the order of 'potential resource' or 'pest' as second or third. The Barrier Ranges subgroup (n=14) also showed these broad patterns, with 'can be a problem' clearly ranking first.

Figure 7.4 Terms selected by respondents to 'best describe kangaroos'.

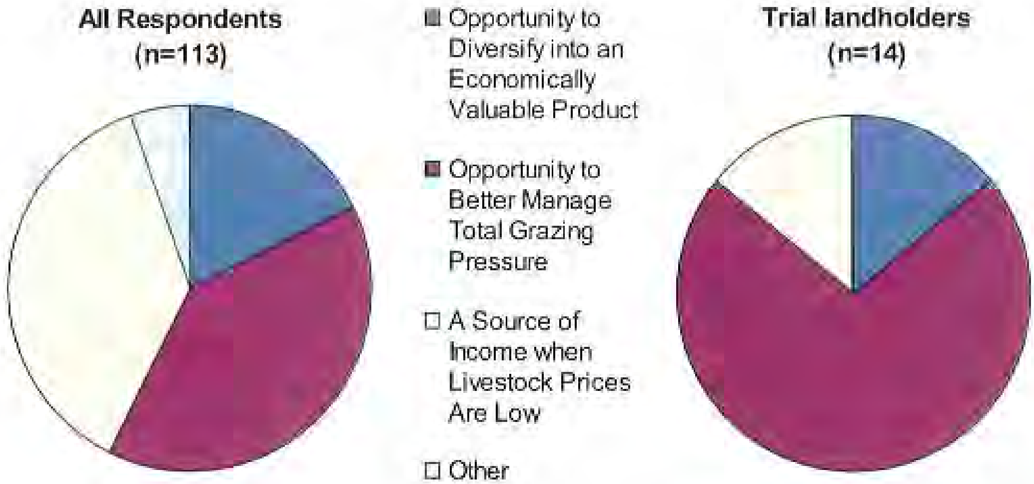


These results challenge the common assumption that landholders view kangaroos primarily as 'pests' and support the findings of Thomsen and Davies (2007) in South Australia. In their interviews with 21 landholders, Thomsen and Davies (2007) also found that 'a problem at times' (or 'a nuisance at times') was the most common description of kangaroos. However, we would not yet conclude as Thomsen and Davies (2007) did in South Australia that 'landholders view kangaroos as a resource, not a pest' (Thomson and Davies 2007, p. xii), given that the 'pest' and 'potential resource' descriptions were ranked so closely in this NSW survey.

The nuanced way in which respondents viewed kangaroos was further highlighted by how they ranked their reasons for being interested in kangaroo management (Fig. 7.5). The statement that kangaroo management 'provides an opportunity to better manage total grazing pressure' was ranked first by 39% of respondents (n=113), almost equal to 'provides a source of income when livestock prices are low' at 37%. Thus, the two top-ranking responses came from opposite ends of the pest versus resource spectrum.

Interestingly, a disproportionately high number of landholders in the Barrier Ranges subgroup selected grazing pressure management as their number one reason for being interested in kangaroos (71%; n=14). While better management of grazing pressure has been an identified goal of this group since the commencement of the trial, it is somewhat surprising that this reason so heavily out-ranked an interest in kangaroo income.

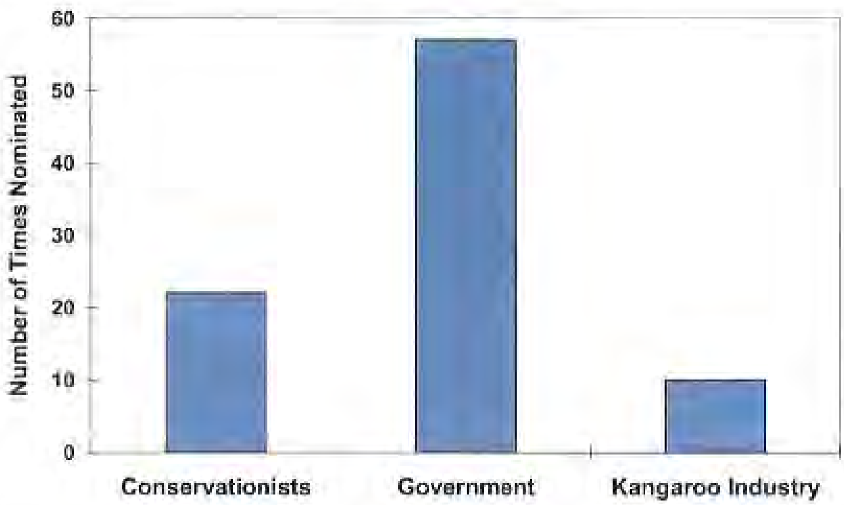
Figure 7.5 Reasons selected for being interested in kangaroo management.



66% of respondents (n=145) felt that kangaroos had been a significant financial cost on their property during the last 5 years. Just over half of these attempted an estimate of such costs, with the median estimate being \$20 000-\$30 000 for an average year. These costs were seen to lie mostly in pasture loss/foregone stocking potential, followed by damage to fences and watering points. 51% (n=145) felt that graziers should be compensated for these costs. With regard to who should pay such compensation[5], three main groups were identified (n=77):

- government (including specific agencies as well as generic terms such as 'taxpayers')
- conservationists (a.k.a. 'environmentalists' or 'greenies')
- kangaroo industry (including processors and shooters).

Figure 7.6 Groups seen as liable for compensation.



Results were slightly different for the Barrier Ranges subgroup (n=14), with less regarding kangaroos as a significant cost (50% v 66% overall) and a lower median estimate of costs (\$10 000 v \$20 000 - 30 000 overall). In addition, responsibility for compensation was seen as lying mostly with industry

[5] Question allowed anyone to be nominated (i.e. no list was provided) and allowed multiple nominations.

(four nominations) rather than government (two nominations). This is reflective of the view commonly expressed within trial group meetings that the kangaroo industry should compensate landholders for providing it with a valuable resource.

7.3.4 Measures to control total grazing pressure (TGP)

Commercial shooting was the most common measure reported for managing kangaroos in the past 5 years, with 90% of survey respondents (n=145) either allowing a commercial shooter onto their property or undertaking commercial shooting themselves. In contrast, only 52 landholders (36%) reported using non-commercial shooting (25 by themselves, 14 by someone else and 13 doing both). The most common kangaroo management actions apart from shooting were turning off watering points (19% of respondents) and fencing kangaroos out of certain areas (17%).

Landholders were also asked to report non-kangaroo-related grazing pressure management actions (from a list provided), with the following actions being most common (n=142):

- temporarily spelling paddocks to allow regeneration (89%);
- harvesting feral goats (71%);
- controlling rabbits (35%);
- permanently destocking paddocks to allow long term regeneration (25%);
- fencing out feral goats (21%).

No major differences were reported by the Barrier Ranges subgroup.

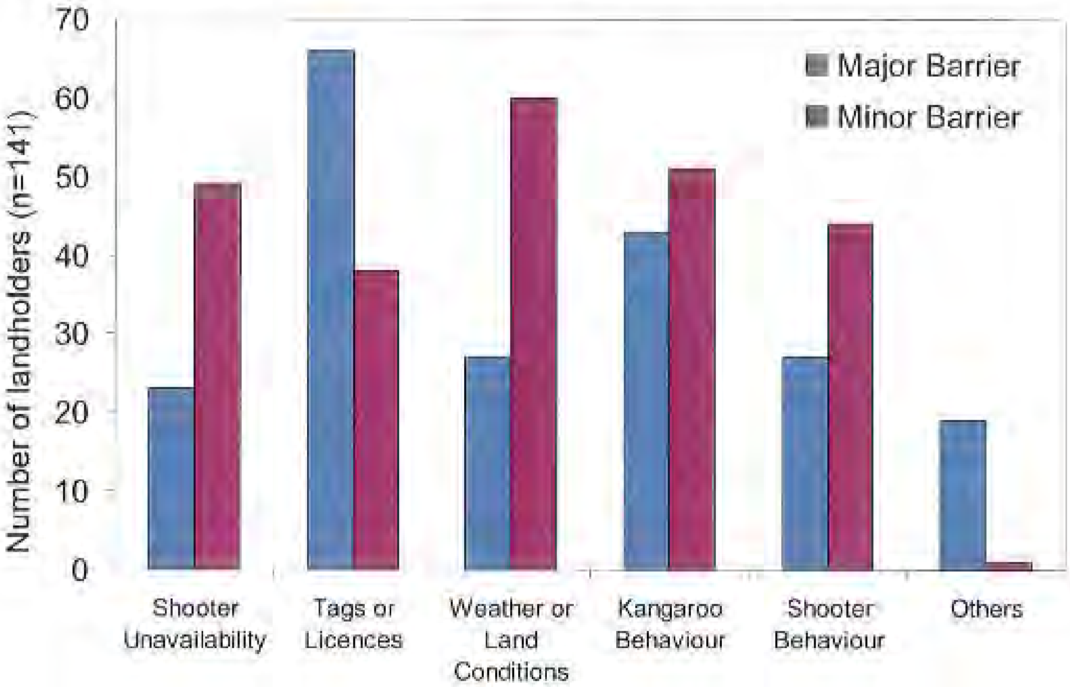
Nine landholders amongst those surveyed (6%; n=145) reported participation in the WCMA's Enterprise-Based Conservation (EBC) scheme. Under the EBC scheme, landholders are paid to manage parts of their properties for conservation, which generally involves destocking paddocks or significantly reducing stock numbers. Most areas under EBC agreement were 2000-6000 ha, although two respondents had only a few hundred hectares under agreement and one had 50 000 ha. EBC participation amongst the Barrier Ranges subgroup was proportionate to the survey group overall (one out of 14 = 7%).

7.3.5 Effectiveness of kangaroo control

Landholders were asked to rate the effectiveness of the commercial kangaroo industry in reducing kangaroo grazing pressure in their district. Results were mixed, with 'partially effective' being most commonly selected (62%; n=142), followed by roughly equal selection of 'effective' (20%) and 'not effective' (18%). The Barrier Ranges subgroup (n=14) tended to see the industry as more effective overall, with 64% selecting 'partially effective', 36% selecting 'effective' and none selecting 'not effective'.

Landholders were then asked to nominate which factors (from a list provided) they felt were barriers to the effective control of kangaroo grazing pressure on their properties (Fig. 7.7). Getting tags or licences was seen to be the greatest barrier, followed by kangaroo behaviour and weather/land conditions. The Barrier Ranges subgroup also nominated getting tags or licences as the greatest barrier, although weather/land conditions was ranked second ahead of kangaroo behaviour.

Figure 7.7 Barriers to effective control of kangaroo grazing most selected.



To further explore the effectiveness of commercial harvesting, landholders were asked for details of one 'major kangaroo influx event' they had experienced over the past five years. 58% of respondents (n=145) reported such an event[6], with 67 landholders giving an estimate of the influx size. Many gave an estimate of 'thousands', making statistical analysis difficult. Excluding these responses, the median estimate is 2000-3000 kangaroos (which may well be what was meant by 'thousands' anyway).

When asked to nominate the causes of their influx, drought/seasonal conditions was ranked highest (48%; n=87), followed a specific storm or rainfall event (43%). 6% noted that it was both drought conditions generally and a rainfall event specifically that caused the influx, although it's likely this combination also applied to many others who only cited one factor or the other. The presence of crops was the only other significant cause reported (7%).

Among the 87 landholders who described an influx, 66 of them (76%) used shooting to control numbers at that time, with 91% of these using commercial tags. When asked whether shooting was effective, results were mixed. 46% selected 'no', 45% selected 'yes' and 9% either selected both or otherwise indicated that shooting was partly effective.[7]

Interestingly, the size of the influx did not have a clear influence on perceptions of effectiveness, with those reporting influxes of over 10 000 just as likely to say shooting was effective as those reporting less than 1000 (Fig. 7.8). Those who gave 'thousands' as an estimate were most likely to see shooting as ineffective, however this may simply indicate that by saying 'thousands', many respondents meant 'too many to control'. As with kangaroo management overall, difficulty getting tags was the most commonly cited barrier to effective management of influxes.[8]

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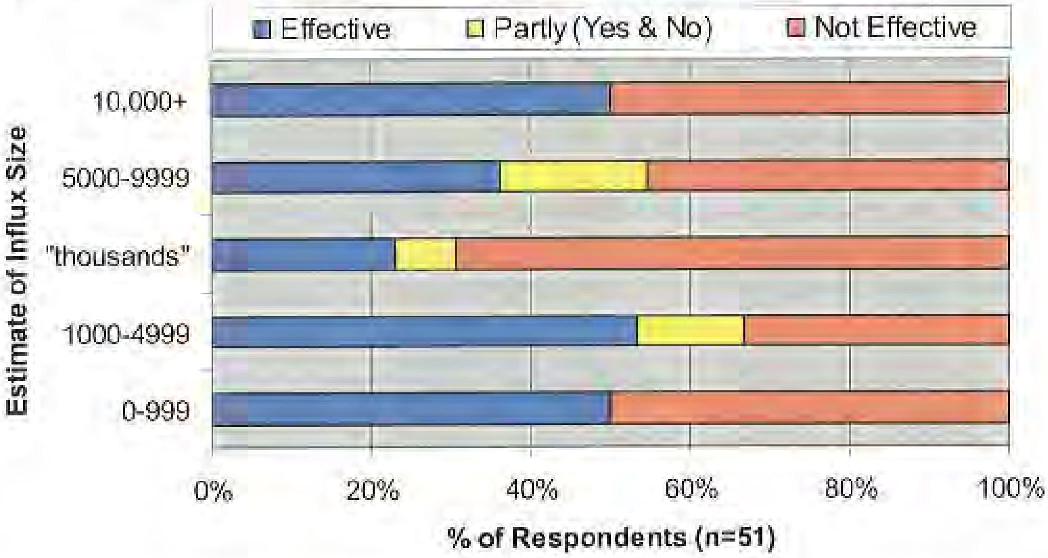
[6] These 145 responses include three 'no responses' that were interpreted to mean 'no influx'.

[7] 'Yes' and 'no' were the only options given for this survey question, thereby reducing the number of responses indicating partial effectiveness.

[8] With regard to influxes, respondents could nominate any barrier (i.e. no list of barriers was provided).

Figure 7.8 Effectiveness of kangaroo shooting versus estimated size of influx.



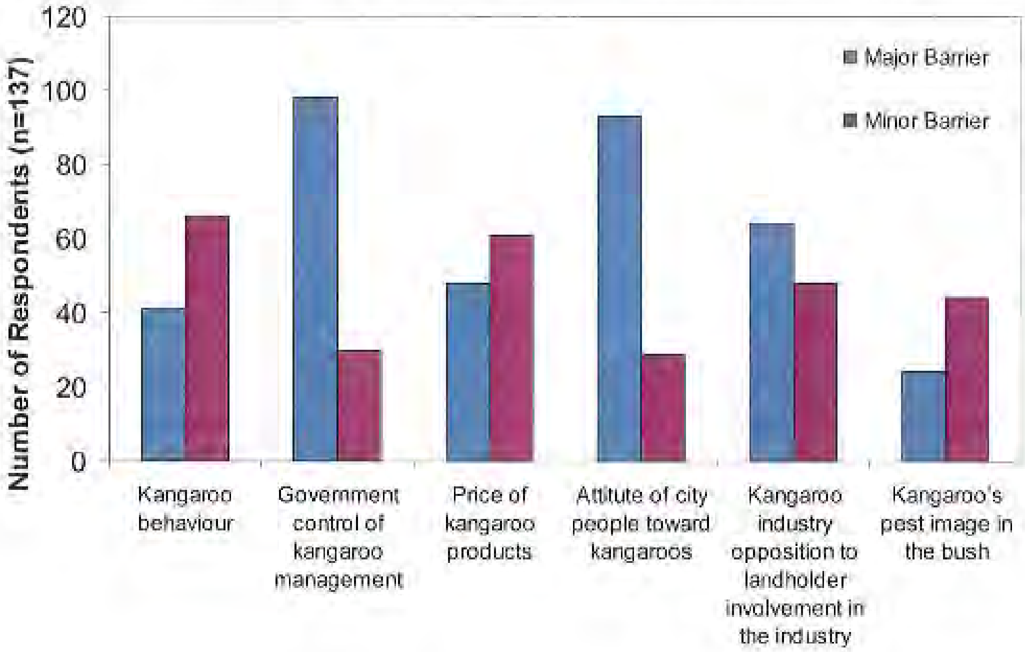
A smaller percentage of landholders in the Barrier Ranges subgroup had experienced a major influx (36% v 58% overall), but those who did reported larger numbers of kangaroos (median estimate of 5000 v 2-3000 overall). They were also more likely to see shooting as effective (67% v 45% overall). Identified causes (storms, drought) and barriers (tags) were similar.

Overwhelmingly, when asked where they had obtained most of their knowledge about the commercial kangaroo industry and its impacts on land management, landholders selected their own observations (71%; n=109). The next most common answers, information from shooters and processors (12%) and from other graziers (6%) were ranked well behind.

7.3.6 Potential for earning income from kangaroos

When asked to nominate which factors (from a list provided) landholders saw as barriers to gaining income from kangaroos (Fig. 7.9), government control of kangaroo management (including quota-setting and licensing) ranked first, followed by the attitude of city people toward kangaroos and kangaroo industry opposition to landholder entry. While the price of kangaroo products is often cited as the biggest barrier to landholders gaining entry to the industry (e.g. Grigg 2002; Payne 2006 pers comm), it only ranked fourth as a major barrier amongst respondents to this survey.

Figure 7.9 Potential barriers to landholders gaining income from kangaroos.



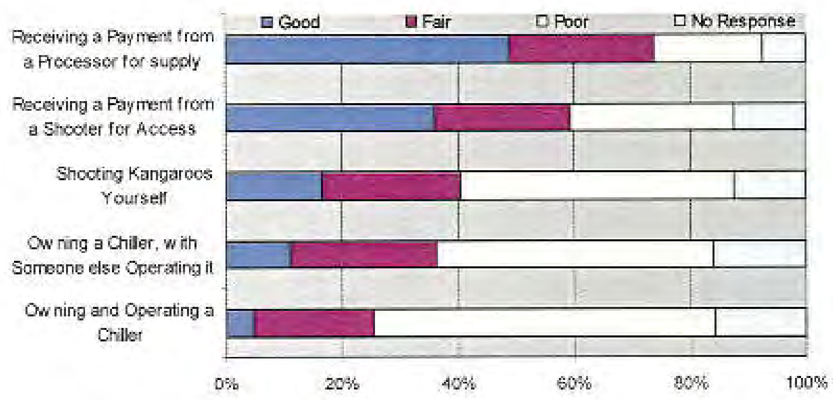
The Barrier Ranges subgroup differed slightly from the overall survey group, with kangaroo industry opposition ranking higher (equal first with government control) and price (third) being ranked ahead of city attitudes (fourth). This may be reflective of the fact that this group has gone further than most in attempting to enter the industry, encountering industry opposition and price issues first-hand as well as through interaction with other groups such as the Tilpa Rangeland Investment Company (Henry and Watson 1998).

Figure 7.10 shows how respondents rated five different models for obtaining income from kangaroos (Fig. 7.10), based on:

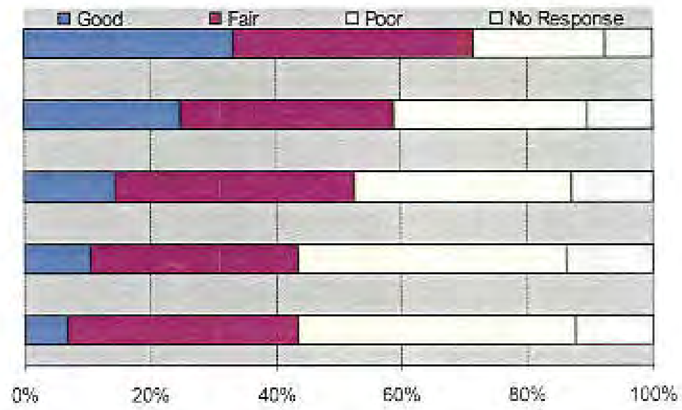
- how compatible they were with existing grazing enterprises;
- how much income potential they offered;
- how fair they were;
- which option was best overall.

Figure 7.10 Ratings for Different Models of Landholder Involvement in the Kangaroo Industry.

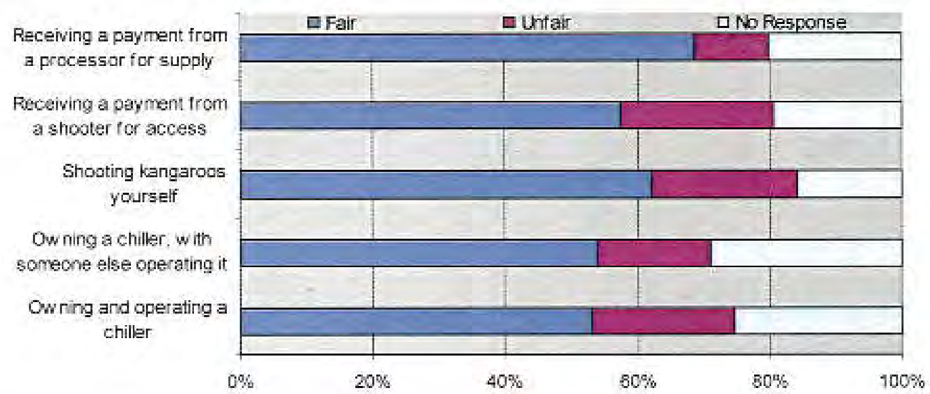
(a): Compatibility with existing grazing enterprises (n=145)



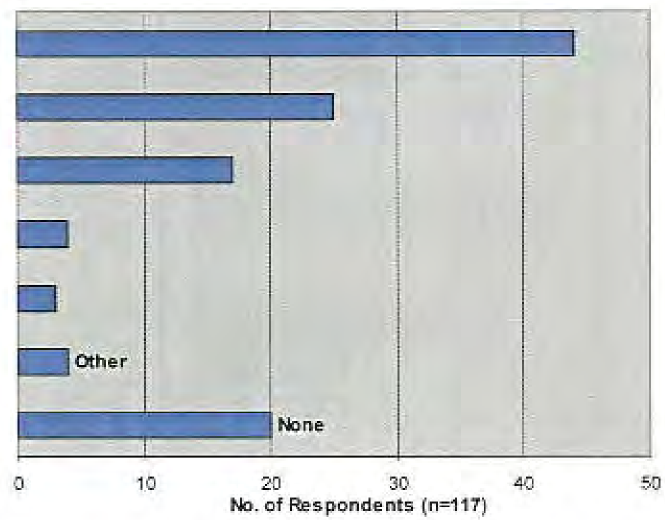
(b): Income potential (n=145)



(c): Fairness (n=145)



(d): Best option overall (n=117)



The option of landholders receiving a payment from a processor for supply was ranked first in relation to all criteria. The options of receiving a payment from a shooter and landholders shooting kangaroos themselves were ranked second and third respectively in terms of overall preference, compatibility and income potential. However, payments from shooters were seen as less fair than landholders shooting kangaroos themselves. Options involving landholders owning or operating chillers were seen as undesirable under all criteria.

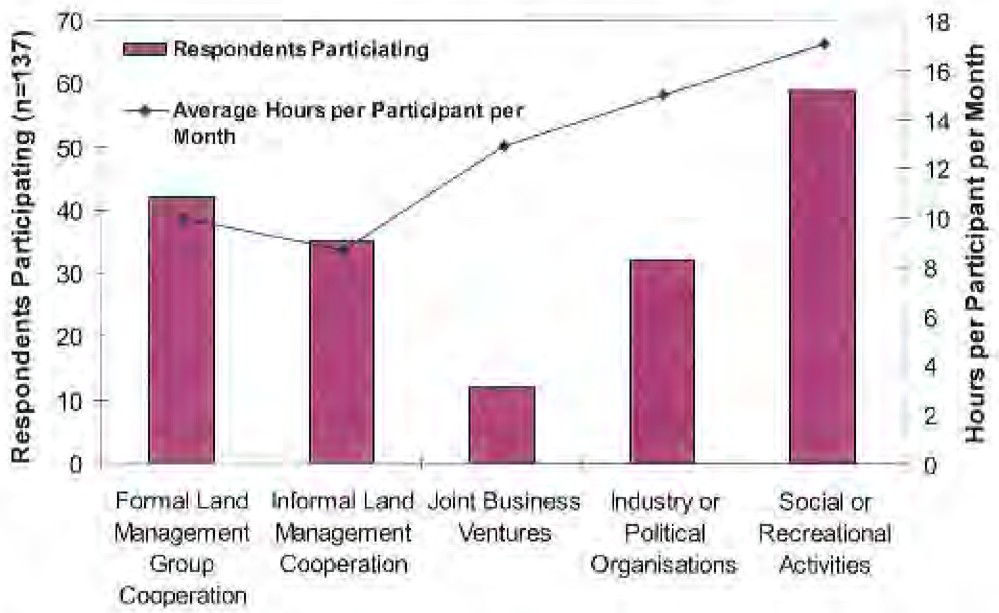
Comments were sought in relation to the fairness criteria. Extra workload and costs were the main concerns regarding landholders becoming shooters or owning/operating chillers. Concerns for shooters were also expressed, including there not being enough money in it for payments to landholders and shooters doing landholders a favour by shooting. Some considered it unfair to shooters for landholders to take up shooting (deprives them of a job) and for processors to have to make payments to landholders (they might pay shooters less as a result). In contrast to the high level of concern about landholders and shooters, only two respondents raised concerns about potential negative impacts on processors.

The only major difference for the Barrier Ranges subgroup was that processor payments were not the most-preferred option in terms of income potential, being outranked by the option of landholders becoming shooters.

7.3.7 Potential for collaboration

52% of respondents (n=137) indicated that they currently collaborate with other landholders in their district on land management, business, political or social activities. Among these, social/recreational activities had the highest participation, followed by formal land management group cooperation, informal land management cooperation and industry or political organisations (Fig. 7.11). Joint business ventures were not common in this region (9% of respondents). For the Barrier Ranges subgroup, formal land management activities were more common that social/recreational activities, although other activities followed the overall group pattern.

Figure 7.11 Reported participation in collaborative activities (number of respondents participating and average hours per participant per month).

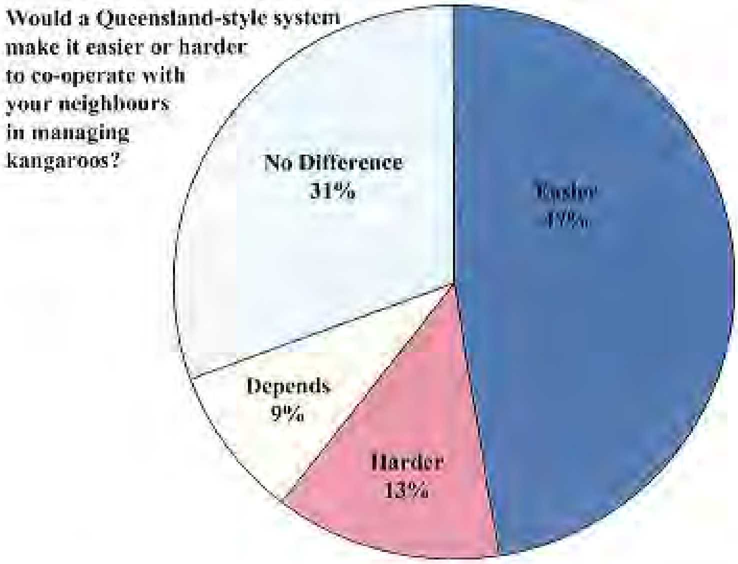


In terms of time spent on collaborative activities, social or recreational activities again came out the highest, both for the average hours per participant (i.e. amongst those who said they participate in that activity) and for the total hours spent on these activities overall. However, it is notable that while joint business activities and collaborative industry/political activities are undertaken by relatively low numbers of landholders, these activities are more time-consuming for those who participate in them.

When asked how they view the potential need for cooperation to manage kangaroos as an economic resource, 92% agreed that 'cooperation is a good idea and should be encouraged' and only 8% disagreed (n=130). This breakdown was the same for the Barrier Ranges subgroup (n=13).

Landholders were then asked how they would feel about a system similar to Queensland's being introduced in NSW, whereby commercial harvest tags are not tied to individual properties, but rather are purchased centrally for use on any property (Fig. 7.12). 47% felt this would make cooperation easier, 31% felt it would make no difference and 13% felt it would make things harder (n=137).

Figure 7.12 Attitudes towards a change to a Queensland-style system.



Comments in favour of a switch to a Queensland-style system related to:

- Kangaroos move across property boundaries/shooters should be able to also (15 respondents).
- Shooters do this anyway/change would make it legal (seven respondents).
- It enables a quicker response to influxes/storms (four respondents).
- It requires less paperwork (two respondents).

For those selecting 'harder', 'depends' or 'no difference', comments included:

- Less accessible properties would have more trouble getting shooters (seven respondents).
- It is harder to ensure that the shooter actually reduces numbers on your property (five respondents).
- It would result in more trespassing/illegal shooting (four respondents).
- Tags are easily available now (two respondents).

Landholders were also asked whether communication and collaboration could be improved between graziers, the kangaroo industry and government. 56% of respondents (n=124) felt that cooperation between the industry and graziers could be improved, with most comments calling for greater feedback from the industry, payments to landholders and for shooters to listen to landholders more. A greater proportion of respondents, 78% (n=134), felt there was room for improvement between government and graziers. Most comments were that government agencies should to listen to graziers more (especially in relation to kangaroo numbers), agencies provide more feedback to graziers and that agencies should make more tags available or make them easier to obtain.

7.4 Discussion

7.4.1 Baseline data

A range of baseline data was obtained for kangaroo management in the Western CMA region, including that:

- The most commonly-reported tools for TGP management were commercial kangaroo harvesting and destocking of paddocks. This validates the focus of BRSWET on creating incentives for improved management in these two areas.
- While commercial shooting of kangaroos on properties was widespread (90% of respondents), very few landholders obtained income from kangaroos (<10%). This is strongly consistent with previous studies.
- Kangaroos were widely seen to have significant costs, but the common assumption that landholders view them primarily as 'pests' was challenged by the finding that 'a problem at times' was a more accurate description.
- This survey provides some evidence of a shift towards the view that kangaroos are a potential resource for landholders. Interest in kangaroos as substitute income for livestock ranked about equal with interest in managing them to reduce TGP.
- Respondents were equivocal about the effectiveness of commercial shooting to control kangaroo numbers, both overall and in relation to specific influxes. However, the Barrier Ranges sub-group, which had above average harvest rates, were more likely to see commercial harvest as an effective means for controlling kangaroo numbers. This may be as a result of the greater knowledge and visibility of the industry as a result of their involvement in this trial.
- The greatest perceived barrier to effective control of kangaroos was government control over licensing and tags. This was also the greatest perceived barrier to landholders obtaining income from kangaroos. Price was seen to be less of a barrier to obtaining kangaroo income than is often assumed.
- There were also comments about the incompatibility of a property-based tag system for a resource that freely moves across property boundaries. Tag swapping was mentioned in comments as an apparently widespread practice resulting as a consequence of too rigid a system. On balance, a switch to a Queensland-style system was seen as offering more positives than negatives.

There were some notable similarities and differences between this survey and the 1999 survey in SW Queensland (Chapman 2003). Both revealed low income levels from kangaroos (4% harvesting professionally in SW Queensland compared with 5.5% in this survey). Both also highlighted government control as the greatest perceived barrier to obtaining income from kangaroos (price was second in SW Queensland as opposed to city attitudes in this survey).

Respondents to this survey saw commercial shooting as less effective than in the SW Queensland survey (where 64% said it significantly reduced grazing pressure) and viewed the need for collaboration in obtaining kangaroo income more positively (92% positive v 61% in SW Queensland). This difference between the states may be due to their different kangaroo tag systems. NSW has property-based tags while in Queensland, harvesters apply for tags that can be used on any property. As a result, landholders in NSW have more to gain through collaboration.

7.4.2 Barrier Ranges subgroup

Members of the Barrier Ranges subgroup were younger, had larger properties and were more dependent on sheep for income than the overall group. They also tended to have a greater interest in managing kangaroos to reduce TGP rather than for income. One possible explanation for this is that exposure to BRSWET has actually reduced interest in obtaining income from kangaroos (e.g. by exposing the difficulties involved in obtaining processor payments). While the data is not really sufficient to draw definitive conclusions, further support for this interpretation comes from the fact that, unlike the overall group, the subgroup considered processor payments to offer lower income potential than becoming a shooter.

The subgroup's greater focus on TGP management as a reason for being interested in kangaroos is also puzzling, as they tended to estimate lower average costs for kangaroos, have a lower incidence of influxes (albeit with bigger numbers per influx) and see current commercial management as more effective. One interpretation is that the subgroup's greater belief in the industry's effectiveness in controlling kangaroos leads to a view of kangaroo harvesting as a more important component of TGP management. Another possibility is that Barrier Ranges landholders may have interpreted the question regarding their interest in kangaroo management differently to the overall group. Having been exposed to Conservation through Sustainable Use (CSU) ideas through BRSWET, they may be more likely to see commercial management of kangaroos as a way to make reductions in livestock levels (and hence TGP) by earning alternative income, rather than seeing kangaroo harvesting purely as a way to reduce kangaroo numbers.

Key points from the discussion follow:

- On balance, a movement to a Queensland-style tag system that allowed shooters to move across property boundaries legally and respond to influxes more quickly would be a positive development for landholders in this survey. However, such outcomes may depend on the exact nature of any change in system and trade-offs would be required against some perceived negatives of the Queensland approach.

- Widespread tag swapping reduces confidence in the trace-back capacity of the system, a key quality requirement for access to markets and risk management strategy. Rather than making it illegal and therefore unmeasurable and uncontrollable, it would seem very sensible to encourage trappers to self-report when they do it without penalty.

- Some form of payment from processors appears to be the most-preferred option for landholders to obtain kangaroo income, although there is also a strong feeling that the government should be liable for the costs of kangaroos. Landholder sympathies toward shooters work against shooter payments and lack of time and money work against chiller options. The option of landholders becoming shooters also has disadvantages of time requirements and poor compatibility with existing grazing businesses. However, considering that it is currently the main way for landholders to earn income from kangaroos and was ranked highly for income potential amongst the Barrier Ranges subgroup, it may have some growth potential.

- Survey respondents were overwhelmingly positive about the need for collaboration in managing kangaroos as a resource, but careful consideration is needed in relation to how this is approached. It may be most efficient to incorporate kangaroo collaboration into existing social or land management activities, as many landholders participate in these already. Conversely, collaboration on kangaroo management may be more difficult if it takes the form of a joint business venture, both because very few landholders participate in such ventures already and because they are relatively time-consuming. Work within BRSWET also supports these notions, with much higher landholder attendance and more efficient use of time when meetings have been incorporated into social or Rangecare group events rather than being stand-alone activities.

- Overall, there appears to be a reasonable level of interest in this region for landholders to take on greater management of kangaroos as an economic resource. However, considering the barriers that exist to achieving this, an active adaptive management approach that explores possible enterprise options with trial groups of landholders would appear prudent (such as that followed with BRSWET). This survey has highlighted a number of priorities for further research, including collaborative management based around existing social networks, potential payments from processors and possibly government, impact of collaborative arrangements on shooters and landholder-shooters and alternative licensing and tagging arrangements that reduce delays and facilitate the movement of shooters across property boundaries.

8. Economic modelling and business case

This chapter covers two main areas of work under BRSWET – economic modelling of collaborative kangaroo harvest management options and the development of a business case for a collaborative kangaroo enterprise based on the group involved in the BRSWET. This was undertaken in the context that landholders couldn't expect to get something for nothing. For landholders to gain income from the kangaroos harvested on their properties, they would have to work within the current system and develop ways of adding value to the system. We have assumed that, when the extra value is recognised, the landholders could anticipate a premium price.

The economic modelling work was subcontracted to Jonathan Moss and Richard Stayner at the Institute for Rural Futures at the University of New England (UNE). The business case development was subcontracted to Peter van Herk (business and industry development consultant). This chapter also draws on work undertaken by Rosie Cooney (FATE Research Fellow at UNSW) which explored different models for landholders to share benefits from kangaroo harvesting (Cooney 2009).

8.1 Objectives

The UNE economic modelling featured the following objectives:

- Investigate the economic desirability of several different cooperative kangaroo harvesting models from the perspective of the landholders in the Barrier Area Rangecare Group (BARG).
- Determine the combination of income from conservation management, kangaroo harvesting and other sources (such as carbon credit payments) that would make the Enterprise Based Conservation (EBC) land-use option more economically attractive to landholders in Western NSW.
- Determine the sensitivity of the models to a variety of harvesting and land-use scenarios.

The key objectives of the business case analysis were:

- To develop a business framework, based on knowledge gained during the BRSWET, that described and assessed the viability of a collaborative enterprise comprising landholders and harvesters that managed harvest in the Barrier Ranges.
- To explore the achievement of quality of harvest, quality of storage and quality of processing through profit and determine membership requirements, & peer group regulation to ensure the business is reputable, consistent and reliable.

This business framework was designed to realise the income potential of improved kangaroo harvesting practices and quality, facilitate strategic alliances with processors, increase market demand, obtain regular and reliable markets, holistically manage kangaroo populations, generate income for landholders and work collaboratively with government and industry.

The discussion section (8.4) pulls the economic modelling, business case and co-operative development components together.

8.2 Methods

8.2.1 Economic modelling

The UNE economic modelling involved the construction of economic models for five proposed harvesting scenarios. A hypothetical conservation area was included for each participating property similar to the Western CMA's Enterprise Based Conservation (EBC) scheme. This area was de-stocked of domestic stock and it was assumed that kangaroo populations would increase in these areas.

The five models explored were:

A. Landholders obtain their own harvesting licence, vehicle and equipment and operate as individuals (used as a 'base case' as some landholders do this already).

B. Landholders cooperatively purchase a harvesting vehicle but each pays a shooter to harvest on their own property using the vehicle (one vehicle per five properties).

C. Landholders operate as a cooperative and receive a price premium from processors for quality kangaroos and/or for the quality control of field harvest and field processing practices.

D. Landholders operate as a cooperative, running a chiller (or chillers) owned by processors. Landholders receive a margin from processors for operating chillers and a margin for quality.

E. Landholders operate as a cooperative, which purchases and runs chillers and receives a margin from processors for quality.

Table 8.1 Baseline data and assumptions used in the models.

Parameter	Data/Assumption	Source/Justification
Property size	Average size: 44 266 ha. Range: 18 000-82 000 ha	20 properties participating in the BRSWET General Licence in 2008/09.
Baseline harvest levels	Average annual harvest per property: 685 kangaroos/yr Range of annual average harvests across properties: 42-1371 kangaroos/yr	2001-2007 harvest data for the 19 BRSWET properties that harvest kangaroos (i.e. excludes Fowlers Gap)
Conservation area	Assumed to cover 23% of each property.	Average proportion de-stocked under EBC scheme (Moss 2007).
Kangaroo increase in conservation area[9]	Population is assumed to increase in conservation areas by up to 300% following the removal of stock. This is assumed to result in an increase of up to 300% on 2001-07 harvest levels[10]. This was included to show the sensitivity of the results to an increase in kangaroo numbers as a result of destocking.	300% is conservative compared with Norbury and Norbury's (1993) observed increase in kangaroo dung following removal of sheep (600%) and Wilson and Edwards' (2008) estimate that removal of cattle and sheep from rangeland Australia could increase kangaroo populations by 240 million (5 to 10-fold increase on 2001-08 levels).
Carcase weight	Average: 22.5 kilograms	Stayner (2007)
Size of foray	40 kangaroos obtained from average foray (i.e. per night)	Stayner (2007)
Labour cost per foray	10 hours per foray @ $25 per hour = $250 per foray Where harvest labour is undertaken by the landholders themselves, this amount is included to reflect the opportunity cost of their time.	Stayner (2007)
Capital (fixed) costs	Total = $42 510 (mostly made up of vehicle $35 000, rack $4000, hot water unit $1500 & rifle $1000)	Stayner (2007)
Interest rate on capital items	9.95%	Assumed that a loan is taken out covering the useful life of capital items
Useful life of capital items excluding chiller and generators	8 years	Stayner (2007)
Running costs for vehicle	$0.65 per kilometre	Stayner (2007)
Kangaroo price at chiller	$0.80 per kilogram	Stayner (2007)

[9] De-stocked revegetation areas were assumed to provide a resource that acts as a 'sink' to which kangaroos are attracted (Norbury and Norbury 1993). The harvest of kangaroos from such areas was assumed to be consistent with conservation objectives (Gardiner 1986). It is recognised that, due to the highly variable and non-equilibrium nature of kangaroo populations, more complex responses would be expected that assumed in this simple population response model (Bayliss and Choquenot 2002).

[10] These models employed a simple assumption that the 2001-07 harvest on each BRSWET property was directly proportionate to that property's kangaroo population. As discussed in Chapter 4, real-world dynamics are much more complex, affected by factors such as accessibility and harvester behaviour.

Parameter	Data/Assumption	Source/Justification
Chiller purchase and set-up costs	Small chiller = $11 000 Generator = $2000.	Assumed that a loan is taken out covering the chiller costs at 9.95% p.a. over the assumed useful life of 10 years
Chiller running costs	Power = $5000 p.a. Maintenance = $1000 p.a. Labour = $40 per foray (i.e. $1 per kangaroo)	
Number of chillers	Minimum of three needed to service the BRWSET area spatially and capacity-wise.	Peter Ampt (pers. comm. 2009). Chillers assumed to have capacity of 150 carcases when storing at a rate to ensure premium quality.
Commissions and price premium for quality	Price premium for quality = $0.05/kg (model baseline) $0.03-0.30/kg (model range) Commission for operating a processor-owned chiller = $0.07/kg If group also owns chiller = additional $0.08/kg	
Proportion of kangaroos for which a price premium is paid for quality	Baseline assumption is that price premiums apply to 20% of kangaroos harvested. Ratios of 10% and 100% also modelled.	Peter Ampt (pers comm. 2009).
Distribution of payments to individual members	For cooperative models, landholder margins were assumed to be distributed to landholder members based on the proportion of total harvest that occurred on their property.	Considered fairest starting point given the large variation between property harvest levels at present. Landholders undertaking shooting would receive payment for that activity as any other shooter would.

In addition to the five models described above, the UNE modelling work also involved development of a bio-economic model analysing a series of hypothetical income streams for UNSW's Fowlers Gap research station (Table 8.2). A 15-year model of pasture growth and animal dynamics was used, based on the GRASP model described by Littleboy and McKeon (2005). It was adapted to include stochastic weather, flock dynamics and an economic component, as described in Moss (2008).

Table 8.2 Income parameters and assumptions for the Fowlers Gap bio-economic model.

Income Parameter	Data/Assumption	Source/Justification
Stewardship payment	\$20,000 annually to manage 8,495 hectares as a conservation area (23 per cent of property)	Assumed to be similar to the Western CMA's EBC scheme.
Carbon payment	Kangaroos emissions = 0.003 tonnes CO_2e/kangaroo/year. Sheep emissions = 21.1 grams CO_2e per kilogram of total standing dry matter consumed. Agricultural emissions assumed to be included in future carbon emissions trading scheme (ETS). Baseline assumption carbon prices of \$23 per tonne CO_2e avoided (prices of \$10-51 also considered)	Kempton *et al.* (1976) Kurihara, Magner et al. (1999) Wilson and Edwards (2008) Switzer (2008)
NSW Western Lands Lease Rebate	Rebate of \$0.30/ha/annum if land is conserved. \$0.45 if land is conserved in perpetuity	Shepherd (pers comm. 2006)
Kangaroo Population Dynamics	Numerical response function: $r = -a + c\left(1 - e^{-dV}\right)$ Assumed starting population in conservation area was 878 kangaroos, rising to 2553 following removal of sheep.	See Bayliss (1987) for equation parameter values for red and western grey kangaroos. Baseline populations based on average harvest levels across BRSWET properties 2001-07 and assumption that harvest = 15% of population.
Kangaroo pasture consumption	1 kangaroo = 0.35 dry sheep equivalent (DSE)	- Dawson and Munn (2007) - University of Sydney (2009)
Kangaroo income	\$0.05/kg price premium paid for each kangaroo harvested from conservation area.	Same baseline assumption as for models above.

8.2.2 Business case

The business case development (available on request from the corresponding author) involved:

- a SWOT (strengths, weaknesses, opportunity and threats) analysis for a potential Barrier Ranges Kangaroo enterprise (BaRaRoo)
- review of the kangaroo harvesting and processing chain, identifying potential opportunities for BaRaRoo to position itself
- analysis of the key factors constituting quality in the kangaroo sector;
- analysis of a potential cooperative model for BaRaRoo involving landholders and harvesters, drawing on model analysis undertaken by Cooney (2009)
- Development of a process for implementation of a cooperative kangaroo business (BaRaRoo)
- Financial analysis of key costs and income sources for a cooperative kangaroo enterprise
- Analysis of potential roles for BaRaRoo in future industry and market development in conjunction with other industry stakeholders.

The financial analysis component of the business case development drew on results obtained through the economic analysis undertaken by UNE. Collaboration between the two project managers ensured that key assumptions and data sources were complementary between the projects.

8.3 Results

8.3.1 Economic modelling

Model A (landholders acting as individual harvesters)

Of the 19 properties modelled, five show a profit when labour costs were excluded (range of profits $18 to $5361). However, with labour included as an opportunity cost to landholders, all 19 properties show negative returns (Table 8.3). Even with a three-fold increase in kangaroo numbers on conservation areas (other 77% of property is assumed to retain 2001-07 population levels), returns would be negative.

Table 8.3 Profit expected under Model A for the 19 BRSWET properties.

Increase in kangaroo population in the conservation area	Number of properties that would be feasible	Net kangaroo harvesting business return			Return on capital		
		Minimum	Mean	Maximum	Minimum	Mean	Maximum
No increase	0	-$5657	-$4591	-$3089	-13.31%	-10.80%	-7.27%
1.5-fold	0	-$5198	-$4003	-$2320	-12.23%	-9.42%	-5.46%
2-fold	0	-$4736	-$3415	-$1551	-11.14%	-8.04%	-3.65%
3-fold	0	-$3811	-$2241	-$19	-8.97%	-5.27%	-0.04%

Model B (landholders cooperatively owning vehicle)

Under this model, with one harvest vehicle shared amongst 5 properties, 18 of the 19 properties show a profit (Table 8.4). The mean annual return amongst these 18 landholders would be **$1250/property/yr** rising to **$2707** if a three-fold harvest increase from conservation areas is achieved. This equates to an average number of harvest nights of 17.1 per property (25.3 nights if a three-fold population increase occurs on conservation areas). Thus, each shared harvest vehicle would be used for 85 nights per year (126 with population increase).

Table 8.4 Annual returns for the 18 properties where the cooperative model will be viable.

Increase in kangaroo population in the conservation area	Number of properties that would be feasible	Net kangaroo harvesting business return			Return on capital		
		Minimum	Mean	Maximum	Minimum	Mean	Maximum
No Increase	18	$66	$1250	$2687	0.39%	18.85%	38.73%
1.5-fold	18	$138	$1614	$3454	3.10%	23.75%	45.98%
2-fold	18	$165	$1979	$4222	5.81%	28.65%	53.26%
3-fold	18	$219	$2707	$5755	11.23%	38.45%	67.78%

Model C (landholder cooperative receiving price premium for quality)

Assuming a premium of $0.05/kg is paid to the landholder group for 20% of the kangaroos they supply to a processor and profits are divided according to each property's harvest level, landholders would obtain, on average, **$154/property/yr** at baseline (2001-07) harvest levels (Table 8.5).

Table 8.5 Landholder returns from price premium payments from processor, assuming a premium for 20% of kangaroos harvested.

Harvest increase in conservation area		Landholder returns under price premium scenarios (premiums in $/kg)								
		$0.03	$0.05	$0.08	$0.10	$0.13	$0.15	$0.20	$0.25	$0.30
None	Minimum	$5	$9	$14	$19	$24	$28	$38	$47	$57
	Mean	$77	$154	$231	$308	$385	$462	$616	$771	$925
	Maximum	$154	$308	$463	$617	$771	$925	$1234	$1542	$1851
1.5-fold	Minimum	$5	$11	$16	$21	$26	$32	$42	$53	$63
	Mean	$86	$172	$259	$345	$431	$517	$690	$862	$1034
	Maximum	$172	$345	$517	$690	$862	$1035	$1380	$1725	$2070
2-fold	Minimum	$6	$12	$18	$23	$29	$35	$47	$59	$70
	Mean	$95	$191	$286	$381	$477	$572	$763	$954	$1,144
	Maximum	$191	$382	$572	$763	$954	$1145	$1526	$1908	$2290
3-fold	Minimum	$7	$14	$21	$28	$35	$42	$56	$70	$84
	Mean	$114	$227	$341	$455	$568	$682	$909	$1136	$1364
	Maximum	$227	$455	$682	$910	$1137	$1365	$1820	$2275	$2730

A premium of $0.30/kg would result in a mean return of **$925/property/year** at baseline harvest rates. Kangaroo population increases on conservation areas are not as significant as in Models A and B, but a three-fold increase on such areas would boost landholder returns by about 48% on baseline harvest levels. If premiums are obtained for 100% of kangaroos harvested by the group, then returns are five times higher than those shown in Table 8.5, with a $0.05/kg premium at baseline harvest levels resulted in a mean return of **$771/property/year** and a $0.30/kg premium with a three-fold conservation area population increase resulting in a mean return of **$6891/property/year.**

Model D (landholder cooperative operating chillers and receiving quality premium)

Table 8.6 shows results for Model D. Net returns are negative at baseline (2001-07) harvest levels with a commission of $0.07/kg for chiller operation paid on all kangaroos harvested and a $0.05/kg quality premium paid on 20% of kangaroos harvested. Even with a three-fold conservation area harvest increase, net returns remain negative. Energy is the most significant cost, followed by labour.

Table 8.6 Costs, income and net returns from Model D. #Assumes $0.07/kg commission for chiller operation (on 100% of kangaroos harvested) and $0.05/kg quality premium (on 20% of kangaroos).

Increase in kangaroo population in the conservation area	Annual labour cost	Annual energy cost	Annual maintenance cost	Total annual cost	Total annual commission and premium#	Annual income for distribution to landholders
No increase	$13 013	$15 000	$3000	$31 013	$23 423	-$7590
1.5-fold	$14 557	$15 000	$3000	$32 557	$26 203	-$6354
2-fold	$16 104	$15 000	$3000	$34 104	$28 987	-$5117
3-fold	$19 193	$15 000	$3000	$37 193	$34 547	-$2646

Model E (landholders own and operating chillers and receiving quality premium)

This model shows a net profit of $9662/yr for the group, assuming baseline harvest levels, a commission of $0.15/kg for chiller ownership and operation and a quality premium of $0.05/kg on 20% of harvested kangaroos (Table 8.7). This equates to a mean return of **$509/property/yr**.

Table 8.7 Costs, income and net returns from Model E. #Assumes $0.15/kg commission for chiller ownership and operation (on 100% of kangaroos) and $0.05/kg quality premium (on 20%).

Increase in kangaroo population in the conservation area	Annual labour cost	Annual energy cost	Annual maintenance cost	Annual purchase and setup cost	Total annual cost	Total annual commission #	Annual income for distribution to landholders
No increase	$13 013	$15 000	$3000	$6172	$37 185	$46 847	$9662
1.5-fold	$14 557	$15 000	$3000	$6172	$38 729	$52 405	$13 676
2-fold	$16 104	$15 000	$3000	$6172	$40 276	$57 974	$17 699
3-fold	$19 193	$15 000	$3000	$6172	$43 365	$69 095	$25 730

As seen in Table 8.7, a three-fold increase in kangaroo harvest on conservation areas would increase overall returns by approximately 266% over baseline levels to $25 730/yr for the group - a mean of **$1354/property/yr**.

Comparison of models and sensitivity analyses

Table 8.8 Comparison of models using baseline assumptions (2001-07 population and harvest levels). $0.05/kg quality premium on 20% of kangaroos is assumed in C, D & E. $0.07/kg commission for chiller operation in D and $0.15/kg commission for combined chiller ownership and operation in E.

	Landholder Returns under each Kangaroo Harvesting Models				
	A	B	C	D	E
Minimum	-$5657	$66	$9	-$800	$31
Mean	-$4592	$1250	$154	-$399	$509
Maximum	-$3089	$2687	$308	-$24	$1018

Model B offers the best returns per landholder, while Models A and D have negative returns. While Model E offers better returns than C, this is partly a reflection of the fact that E incorporates the quality premiums used in C and builds on them with a chiller ownership and operation commission. Without the price premiums, Model E would still do better than Model C in the baseline analysis, but small variations in price premiums or chiller commissions could change this result.

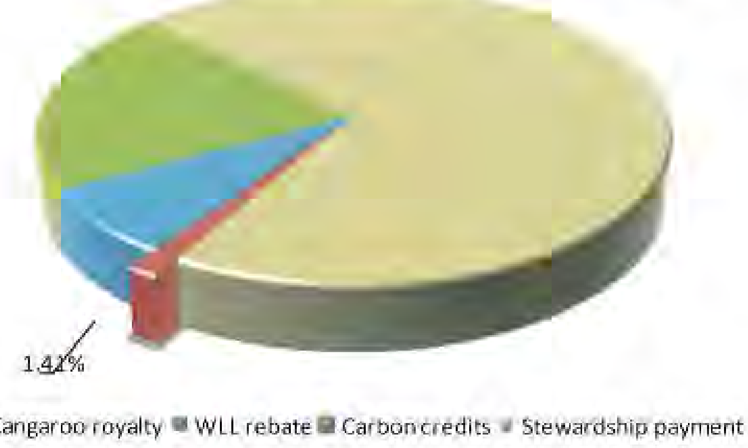
A number of further sensitivity analyses were also undertaken. If processors only offered price premiums for smaller kangaroos (average 16 kg rather than 22.5 kg based on an assumption that younger animals have better meat quality), Model C would be most affected (a 40% decline in returns). If a lower carcass size is assumed for all kangaroos in all models, impacts are greatest for Models A, B, D & E, which would deliver negative returns under a 16 kg carcass average (C cannot become negative due to the lack of any direct costs to landholders). Conversely, an increase in average size to 25 kg increases returns by over 50% in Model E and over 100% in Model B.

Changes in chiller commissions also have significant impacts on the models. An increase in chiller operation commissions of 3-4c/kg would produce a positive return for Model D. Conversely, a drop of 2c/kg for chiller operation and 2c/kg for chiller ownership (i.e. a total of $0.11/kg rather than $0.15/kg) would push Model E into negative territory. Changes in interest rates were also explored, but were much less significant.

Fowlers Gaps bio-economic model

Under the bio-economic model developed for Fowlers Gap, the potential for increased kangaroo harvest income from a hypothetical de-stocked conservation area (8495 ha, 23% of property) was relatively insignificant compared to other income sources (Figure 8.1). The most significant hypothetical income source within the conservation area was the stewardship payment under an EBC-style scheme ($20 000/yr), followed by potential carbon payments under a future ETS ($23/tonne of CO_2e avoided) and Western Lands Lease rebates.

Figure 8.1 Components of total profit from a hypothetical conservation area on Fowlers Gap.



Increased kangaroo income made up only 1.4% of conservation area income. This was based on a bio-economic model which showed that the kangaroo populations (and hence harvest) across this area would increase on average by almost 300% with the establishment of the conservation area (from a population of 878 to 2553). While there is actually no harvesting on Fowlers Gap at present, the assumption was made that an annual harvest of 15% of the kangaroo population would occur and that each kangaroo harvested from the conservation area would attract a \$0.05/kg price premium for the landholder. Under these assumptions, the kangaroos harvested from the conservation area would provide \$431 per annum on average. If only 20 per cent of the kangaroos harvested receive a \$0.05 per kilogram royalty for premium quality, kangaroo harvesting in the conservation area would be expected to generate \$86 per annum on average.

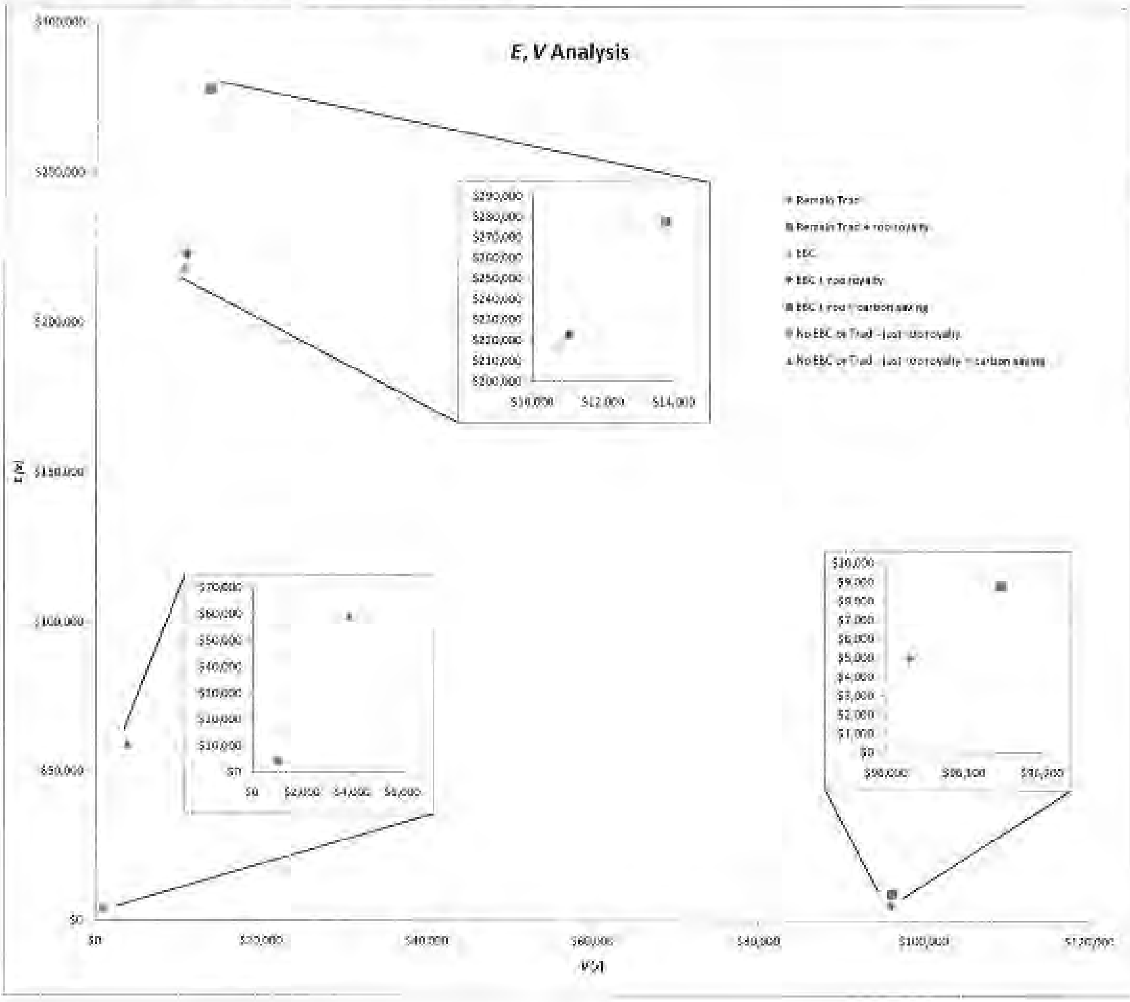
The carbon price used (\$23/tonne of CO_2e avoided) was based on analysis of the proposed Australian ETS by The Treasury (2008). Other carbon prices were explored, including the proposed price cap for the first 5 years of the ETS (\$40/tonne) and observed prices from the European ETS. An increase in the hypothetical carbon price from \$23/tonne to \$40/tonne would increase the contribution of carbon credits to the total profit from the conservation area from 20.19% to 30.56%. It is important to emphasise that agricultural emissions are not expected to be covered by an Australian ETS until at least 2015, if at all.

Table 8.9 Annual carbon credit income at different carbon prices for hypothetical conservation area on Fowlers Gap. [a] **(The Treasury 2008),** [b] **(Ford, Gurney et al. 2009),** [c, d and e] **(Point Carbon 2009).**

		Annual Carbon Credit			
	Cost CO2 per tonne	Minimum	Mean	Maximum	Standard Deviation
Estimated initial price (Australian ETS)	AUD\$23.00[a]	\$1043	\$6182	\$8202	\$1220
Price cap (for first 5 years of the Australian ETS)	AUD\$40.00[b]	\$1814	\$10 751	\$14 265	\$2121
Lowest historical cost (European Scheme)	AUD\$10.26[c]	\$465	\$2758	\$3659	\$544
Spot price 24 February 2009 (European Scheme)	AUD\$19.10[d]	\$866	\$5134	\$6812	\$1013
Highest historical cost (European Scheme)	AUD\$51.46[e]	\$2334	\$13 831	\$18 351	\$2729

Figure 8.2 compares expected profitability (E) and associated variability in profit (V) for seven different land-use options over a fifteen year period. This chart shows that for the case study property, kangaroo harvesting coupled with stewardship payments is a superior to the option of remaining with a traditional sheep enterprise (due to the higher expected value and lower variance). Adding carbon payments on top of stewardship payments and kangaroo royalty income would make it even more attractive.

Figure 8.2 EV analysis to determine the optimal land-use option for the case study landholder. Note that it is possible to retain a traditional sheep enterprise and still obtain a kangaroo royalty (however, due to a lower kangaroo population, this royalty will be less than if the area is destocked).



The option at the bottom-left of Figure 8.2 highlights the hypothetical results if the area was destocked for conservation but the only income obtained from it was kangaroo income (i.e. no stewardship payment or carbon income). This option would be less attractive than conventional grazing due to the lower expected profitability. However, variance in profitability under the kangaroo option is lower than for conventional grazing (due to greatly reduced costs) and this lower risk may be attractive to some landholders. If carbon credits for reduced methane emissions are included but stewardship payments are unavailable, the option of removing domestic stock and harvesting kangaroos will be more attractive than conventional grazing (higher expected income, with a lower variance).

8.3.2 Business case analysis

Table 8.10 shows results of the SWOT analysis undertaken for a hypothetical collaborative kangaroo enterprise established in the Barrier Ranges (BaRaRoo).

Table 8.10 SWOT Analysis for hypothetical BaRaRoo collaborative enterprise.

Strengths	Weaknesses	Opportunities	Threats
• Ecologically sustainable kangaroo resource • Large land holdings offering relatively stable kangaroo populations as compared to the Broken Hill and Tibboburra regional areas • Simplified bureaucratic and regulatory processes in keeping with the nature of the resource and harvesting methods • Ability to respond quickly to harvest kangaroo population influx in localised areas • High level of credible research and development by FATE • Excellent research, academic and political resources for continual support of BaRaRoo by the FATE program • Proactive landholders and trappers desiring the objectives of increased income, sustainable land and wildlife management and reduction of bureaucratic hurdles	• Slow or difficult to obtain responses from landholders and trappers to communications by BaRaRoo administration • Significant distance between stakeholders which inhibits the ability to meet and communicate face-to-face • Lack of dedicated full-time business and market development activity (i.e business development manager) • Relatively long timeframe before BaRaRoo can operate as a completely independent financial entity, thus requiring financial subsidy for implementation in a reasonable time frame • Difficult to obtain leadership and commitment as members have full time commitments elsewhere	• If introduced stock are replaced with kangaroos as a source of income • Potential carbon credits (kangaroos do not emit methane) • Increased biodiversity with associated benefits • Simplified animal husbandry and land management • Changes in market trends desiring: • Low fat foods • Ecologically sustainable products • Green credentials	• Drought continues long enough for stakeholders to lose interest due to lack of viable kangaroo harvesting numbers • Loss of kangaroo meat markets - due to inconsistent quality- before BaRaRoo can secure stable long-term markets • Discontinuation of support for BaRaRoo on a political and financial level • Discontinuation of the current General Licence and reimposition of the standard regulatory and bureaucratic framework

The review of the kangaroo harvesting and processing chain highlighted potential roles for BaRaRoo in the kangaroo harvest that takes place in the paddock, along with field storage and delivery. Figure 8.3, from Cooney (2009), outlines the basic structure of such a cooperative. Figure 8.4 expands on the roles undertaken by each type of member and the potential outcomes.

Figure 8.3 Potential operating model for a landholder/harvester cooperative (Cooney 2009).

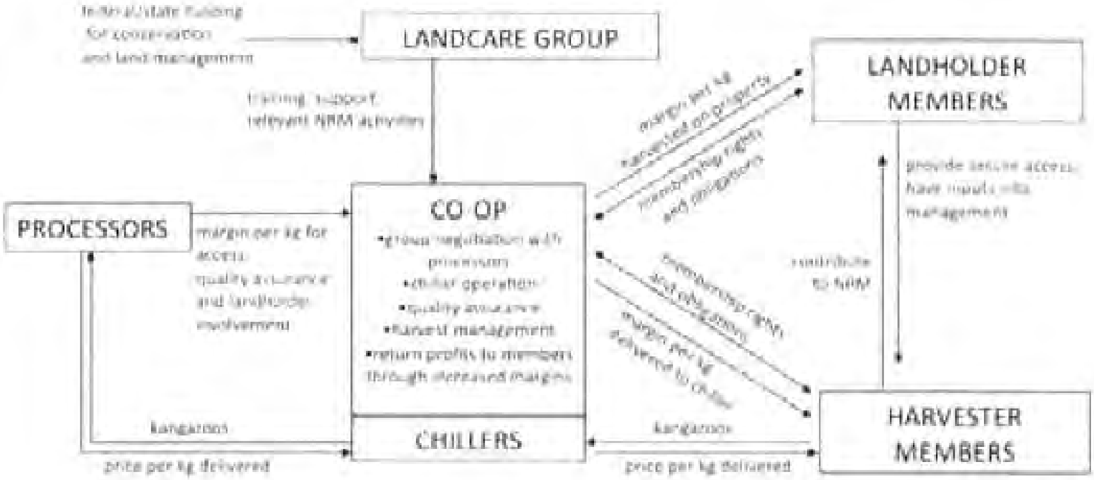
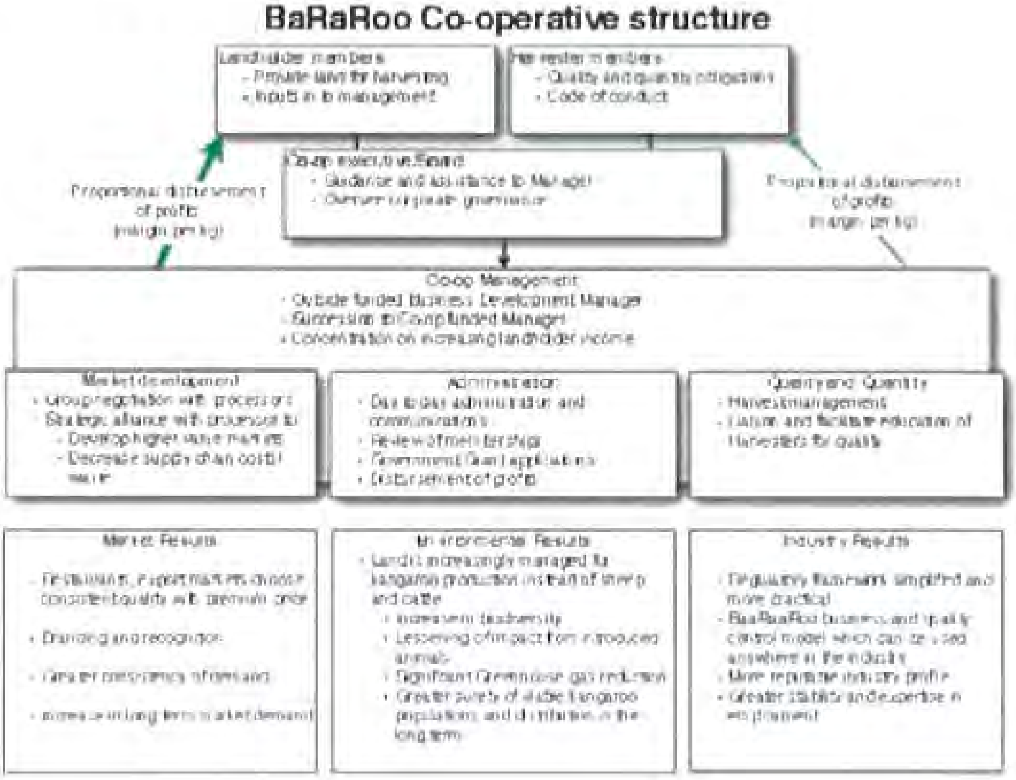


Figure 8.4 BaRaRoo co-op structure developed by Peter van Herk.



Kangaroo product quality was highlighted as a key element which a co-op such as BaRaRoo may need to target. Analysis of kangaroo industry quality issues determined that:

- Restaurateurs and food service operators that already use kangaroo meat call for more consistent quality and this inhibits them from more active promotion. Existing buyers of kangaroo meat are variety seeking consumers who look for a point of difference and do not necessarily buy meat in supermarkets. They would buy it more often if it was in gourmet butchers and premium food distributors and outlets. The current product is not visible to them, hindering development of this market.
- Loin fillet is of consistent quality in terms of tenderness, but other large cuts are tougher from older (larger) animals. The industry can easily sell higher quality cuts but sells other cuts at very low prices, impacting on the profitability of the whole industry.
- Of the kangaroos delivered at the chiller, only a certain proportion are premium carcasses which will provide premium quality cuts of meat, but the same price is paid to the harvester regardless of the quality of carcass.
- A significant proportion of kangaroo meat is used in pet food or is exported but high protein filler in smallgoods, both lower-priced products. Generally, not all of the carcass is used for human consumption, as prime cuts are removed and the rest relegated to pet food. This method of processing reduces the overall value of the carcass.
- A good-quality carcass can be used completely for human consumption with the prime cuts being sold as large pieces, smaller cuts being sold as diced meat and mince. This is similar to beef scotch fillet, stewing steak and mince respectively.
- If good-quality carcasses are separated at time of delivery (or even before delivery) and processed independently to ensure the whole carcass enters the higher value markets, the carcass is far more valuable than a carcass which has mixed value or is purchased in the same batch as lower quality carcasses.

Quality issues could be addressed by restricting harvesting on BaRaRoo properties to shooters who were Shooter Members of the BaRaRoo cooperative. This would allow for imposition of higher quality standards that are above compliance and exclusion of shooters who are unwilling or unable to implement the higher st6andards. The cooperative could also own chillers and include chiller operators as Members. Strategic alliances would be sought with processors interested in purchasing premium quality product from the cooperative, as well as working on industry development and marketing.

While it is expected the BaRaRoo overall number of members would be relatively stable over time, there will be people leaving and entering the business who will have vested interests in success and profitability. The initial stakeholders will have invested significant unpaid time in meetings, trials and changing of methods. This input can be considered as an investment in future business success and the stakeholders would assume to reap rewards commensurate with being founding Members. As the business evolves, new stakeholders will be capitalising on the investment of the founders and with reduced risks.

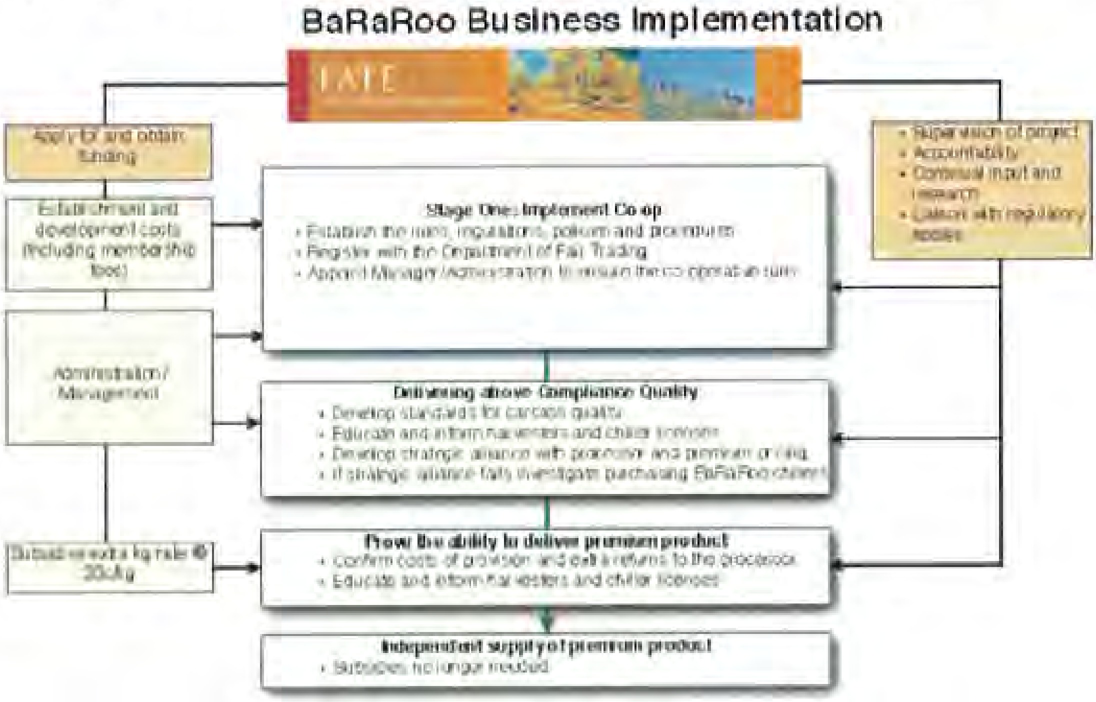
For a variety of reasons the performance of Members may rise and fall over time. A once productive member may become non-cooperative, or simply uninvolved. If this Member has part ownership of corporate assets or significant voting power the business can become dysfunctional. Such a situation can demoralise other owners who are working diligently but see their investment diluted by the uninvolved shareholders. This situation can create factions and encourage the proactive Members to form alternative business activities and structures to ensure the results of their hard work comes to them and not those who are seen as 'bludging'. Thus, the ability for the business to be able to give and take away membership on a transparent and objective criteria is important. Table 8.11 outlines some key recommendations regarding rules for a BaRaRoo co-op.

Table 8.11 Key issues and recommended rules for BaRaRoo co-op.

Issue	Recommended Rules
Landholder membership criteria	• Provision of land to the co-operative for the purposes of harvesting • Must allow unrestricted entry to approved trappers according to co-operative policy and codes of conduct (developed with Landholder input)
Shooter membership criteria	• Minimum supply of carcasses per year (level to be determined) • Operates according to the adopted BaRaRoo harvesting requirements relating to quality control and Landholder relationships (as well as statutory regulations)
Combined membership	• To hold each category the Member must fulfil the membership criteria of each category. A Landholder who is also a trapper contributes in two ways to the Co-Operative and is involved in two distinct commercial activities. These two commercial activities are individually eligible for the proportional disbursement of dividends/income from the co-operative
Voting rights	• Each membership confers one vote to the Member. Consequently combined membership allows for a vote for each category entitling the holder to two votes if they hold two categories.
Losing membership privileges	• Membership criteria specific enough to allow objective assessment of performance. Main aim is to ensure consistency of quality and production, not to punish Members for temporary changes in circumstances. • Annual review of Member performance (with interim review possible if nominated by peer). • Review undertaken by Manager, revocation of membership decided by Board. • Reputations protected by confidential review (only seen by Manger and one reviewing Board member unless disputed)
Distribution of profits according to proportional inputs	• While other membership rules are based on fixed factors (e.g. payment of membership fee & adherence to quality standards), distribution of profits would be based on variable factors. • Landholder returns based on size of property, historic contribution of kangaroos to total harvest and actions undertaken to increase population and harvest levels (e.g. de-stocking). • Shooter returns based on number of kangaroos harvested, reliability and level of quality achieved. • Founding membership and start-up costs would be considered long-term liabilities of the co-op to be repaid as profits are obtained.

Figure 8.5 outlines the key steps involved in implementing a business structure such as is proposed for the BaRaRoo co-op. Key issues that will need to addressed include the level of investment required from founding members or other sources (e.g. external funding) and the leadership of such a project, given that FATE's leadership under the RIRDC-funded trial ceases in June 2009. Annual membership fees of around $200-300 per member have been proposed.

Figure 8.5 BaRaRoo business implementation plan developed by Peter van Herk.



Financial analysis by Peter van Herk showed that higher quality standards could potentially increase chiller costs by \$0.06/kg, mostly due to a lower storing rate of carcasses in chillers (110 kangaroos/chiller compared with 150 at present). A kangaroo quality premium of at least \$0.06/kg would be needed to cover this cost increase. No additional harvester costs were assumed in order to implement best practice.

Over the longer-term, a premium of approximately \$0.30/kg would be needed to cover the costs of a Business Development/Co-operative Manager (Tables 8.12 & 8.13).

Table 8.12 Possible annual revenue from premium pricing options.

Possible revenue from different premium pricing							
Base information							
Historical harvest quantity				20,000			
Expected harvest quantity				17,000			
Average carcass weight				22			
Total kg				374,000			
Extra $/kg	$0.10	$0.15	$0.20	$0.25	$0.30	$0.35	$0.40
$ collected	$37,400	$56,100	$74,800	$93,500	$112,200	$130,900	$149,600

Table 8.13 Possible Annual Costs for Business Development/Co-operative Manager.

Business Development/Co-operative Manager			**Total**
Base Salary			$60,000
Super and Workers Comp	9%	3%	$7,200
Holiday leave loading	17.50%		$875
Vehicle lease	770	/mth	$9,240
Fuel	100	/wk	$5,200
Office Rent	100	/wk	$5,200
Phone and Internet	150	/mth	$1,800
Travel	250	5/mth	$15,000
Office costs	50	/mth	$600
Total			$105,115
$/kg price premium to pay for Co-op manager			**$0.30**

A part-time manager (most likely employed from within the landholder group) could significantly reduce costs (although not by 50%). Analysis results for this option suggested a premium of $0.20/kg would be required to cover such costs.

Given these cost factors and the desire for landholders to obtain profits from kangaroos, prices paid by processors may need to be around 36% higher than those presently paid to harvesters.

Table 8.14 Total cost analysis for a premium-quality BaRaRoo co-op.

Costs	$/kg
Proactive part time management	$0.20
Extra Chiller costs	$0.06
Desired Return to landholder	$0.05
Total premium /kg	**$0.31**
Existing price	$0.85
Final price / kg sought as a minimum	**$1.16**

An alternative 'bare-bones' option was also considered in which the only costs were one-off co-op establishment ($9000 for a consultant) plus annual costs ($9100 p.a.) for a coordinator who was employed to handle tags and prepare reports to DECC only. The costs of this model would come close to being covered by membership fees of $200-300, but would not offer resources to develop quality assurance standards or to maintain collaborative relationships with processors.

Another alternative option would be for BaRaRoo co-op development to be undertaken as part of a much larger research and development project. This could include working with a processor partner to analyse key factors in ensuring quality supply, as well as trialling different approaches to the marketing of premium quality kangaroo with branding from the BaRaRoo co-op. This would involve the development of quality guidelines and marketing strategies. It would have the advantage of requiring only a small number of harvesters and a small quantity of kangaroo meat to test options that could be taken up by the broader group. Indicative costs for a two-year project to implement such a project are \$200 000-400 000 total.

8.4 Discussion

Economic analysis showed that landholders becoming harvesters themselves offered the greatest economic returns, but only if they could share the key capital expense of a harvest vehicle (Model B). Landholders becoming harvesters and each owning a harvest vehicle (Model A) showed negative returns because the low levels of harvest available on a single property did not justify investment in a dedicated harvest vehicle. However, the option of landholders sharing a vehicle across properties has several practical difficulties, including access to the vehicle and lack of flexibility in harvesting. In practice, most landholders who undertake kangaroo shooting share a vehicle between their kangaroo harvesting activities and their other farm enterprises.

The option of chiller ownership and operation (Model E) showed medium levels of profitability. Chiller operation alone (with chiller owned by a processor - Model D) was unlikely to offer a positive return due to the investment of labour required relative to commission levels. While relatively profitable, Model E was highly susceptible to changes in carcass weight and processor commissions, indicating that chiller ownership could end up being a net liability for landholders if decreases in either of these factors occurred.

The option of processor price premiums for quality (Model C) produced quite low levels of return under baseline assumptions (\$0.05/kg premium and no population increase). Much higher premiums (~\$0.30/kg), combined with population increases on conservation reserves, would be required in order to make this option a particularly attractive one for landholders. This is further emphasised by the findings of the business case analysis which showed that premiums of around \$0.26-0.36/kg would be required just to cover the costs of a co-op manager, before any profits were disbursed to members. A co-op could be established without such a manager, although price premiums for quality would be much less likely without someone to ensure compliance with quality standards and to handle the relationship with processors.

It is also important to note that the models explored are cumulative. Those involving landholders shooting (Models A and B) could be added onto Model C to benefit from quality premiums as well or onto Model E to benefit from the full range of profits from shooting, chiller ownership, chiller operation and quality price premiums.

Overall, these results reflect some of the findings of the landholder survey (Chapter 7). Chiller options were least-preferred by surveyed landholders, reflecting the high set-up costs and potential risks shown here through the economic sensitivity analyses. Taking up shooting was found in the survey to be the most common way for landholders to earn kangaroo income at present and surveyed landholders in the Barrier Ranges also felt this option provided the greatest potential for returns. However, this contrasted with overall WCMA landholders, who felt that processor payments offered a better potential for returns. This difference may be due to Barrier Ranges landholders having looked at this option more closely, but it should also be noted that processor payments were considered "best overall" by both Barrier Ranges and WCMA landholders. The economic analysis indicates that this could be due to the lower risk to landholders under this option, as returns from processor premiums can only diminish but not become negative. Such attitudes could change if landholders were asked about their willingness to pay for a co-op manager to help them obtain such premiums.

The bio-economic model developed for Fowlers Gap indicated that, while kangaroo income combined with either stewardship payments or carbon credits offers a viable alternative to conventional grazing, this was mostly due to the income from stewardship payments or carbon credits, with kangaroo income being a minor component. Kangaroo income on its own would be unlikely to offer a better return than conventional stock grazing. Furthermore, the model showed that kangaroo income would be unlikely to "tip the balance" toward conservation management rather than conventional grazing, as either stewardship or carbon payments would be able to do this on their own.

However, despite their lower profitability compared with conventional grazing, kangaroo enterprises do appear to have less variable profitability for landholders (mainly due to the lower investment costs involved). This may be appealing to some landholders who are seeking a lower-risk option but cannot obtain stewardship or carbon payments. As indicated in Chapter 4 (harvest statistics), collaboration with one's neighbours has the potential to further lower such variability in kangaroo income.

Future funding decisions will determine the extent to which large numbers of landholders can access stewardship payments through EBC. Under the original West 2000 Plus pilot EBC scheme ten landholders were paid an average of about $65 000 each to undertake strategic grazing only on land managed for conservation. Western CMA took over the scheme which now has 60 000 hectares under conservation agreements with nine additional landholders at a total cost of $4.1 million. WCMA has bids in to the Caring For Our Country Investment program to continue and extend the scheme and in addition is seeking philanthropic contributions. Landholders who have already entered the scheme have clearly benefited, but it is probably unrealistic to assume that the scheme will ever benefit a majority of landholders. As a result more direct commercial market arrangements that are not subject to public funding will remain the best available option in the foreseeable future.

The option of a landholder/harvester cooperative explored in the business case analysis has many appealing traits, as was confirmed by several harvesters and landholders at the BRSWET Workshop in February 2008 (see Chapter 9). These include low set-up costs, simple structure, provisions for entry and exit and mechanisms for differential distribution of profits according to resources invested. The main difficulty for a co-operative enterprise based around obtaining price premiums from processors is that the level of coordination involved is likely to require a costly co-op manager. Thus, such a group is likely to require continued subsidisation (unsustainable in the long-term) or be able to demonstrate very significant advantages for a processor in terms of quality assurance and/or marketing opportunities.

Another issue that the Steering Committee viewed as a problem was the restriction in the number of Fauna Dealers Licences (FDLs). This means that any landholder group wishing to 'own' and trade in kangaroo carcasses would need to reach agreement with an existing FDL holder to operate under their licence. Whilst the Tilpa Rangeland Investment Corporation successfully applied for their own FDL some years ago, and DECC has previously undertaken a review of the FDL policy, this remains a barrier to innovation in the value chain.

A summary of the key points from the discussion follows:

- Landholders becoming harvesters may be the best option in terms of economic returns, but requires the greatest investment of time and labour. The option of processor price premiums for quality showed quite low levels of return under economic analysis. Very high premiums (~$0.30/kg) are likely to be required in order to make this option an attractive one for landholders.

- The option of a landholder/harvester cooperative has many appealing traits, including low set-up costs, simple structure, provisions for entry and exit and mechanisms for differential distribution of profits according to resources invested.

- The business case analysis showed that high price premiums would be required just to cover the costs of a co-op manager, before any profits were disbursed to members. A co-op could be established without such a manager, although price premiums for quality would be much less likely without someone to ensure compliance with quality standards and to handle the relationship with processors. Thus, such a group must be able to demonstrate very significant advantages for a processor in terms of quality and/or marketing or will require continued subsidisation.

- From economic analysis, it would appear that chiller options could offer good returns for a committed and well-managed landholder group, but this needs to be balanced against negative attitudes towards chiller options revealed through the landholder survey discussed in Chapter 7.

- Land-use options based on stewardship payments, carbon credits and kangaroo income could be more attractive than conventional grazing. However, kangaroo income would only be a small component of this and would unlikely to 'tip the balance' towards conservation management.

The ways in which the findings of this chapter can be used are largely controlled by the processors and will be dealt with in the next Chapter.

9. Kangaroo industry responses

This chapter deals with the interaction between the project and the kangaroo industry as a whole, bringing relevant activities within and beyond this project into the picture. We viewed the existing kangaroo industry and its various components as a complex human activity system that has evolved over several decades and has been quite resilient in the face of factors that impact on the system. In fact, much of the resistance that we encountered throughout the project can be related to industry players having worked very hard to keep the industry going and being sceptical about interventions such as this project. If we were to have accepted the wisdom of key industry players in the beginning we would not have embarked on the project. Whilst the industry remains resilient in the face of the change that we were exploring, we remain confident that change along the lines this project has moved can be good for the industry in the long run, but perhaps the time is not now.

9.1 Objectives

- To develop knowledge and understanding of the way the kangaroo industry works nationally and locally.
- To bring that knowledge to the participants within the project so that it can influence the direction of the trial (AM principles).
- To use that knowledge to generate research questions that can help develop the industry.

9.2 Methods and results

The key activities that inform this chapter are summarised in Table 9.1. The overall project methodologies described in Chapter 3 were used to bring knowledge and understanding of the industry to the trial participants. The development of research questions that can help further develop the industry flow from FATE's analysis of the industry gained through our engagement with the key activities.

White Cliffs Landcare Forum participants at Mound Springs

Table 9.1 Key project activities that build knowledge of the kangaroo industry.

Key Activity	Timing/ frequency/ duration	Description	Summary of results
Industry analysis by FATE prior to BRSWET	Began with FATE's inception at the Australian Museum in 2002 and continued through the BRSWET.	Scoping study completed by George Wilson for FATE in 2003, Consultation with industry figures. FATE Marketing think tank in Broken Hill 2003 culminating in publication (Ampt and Baumber 2006).	Lack of landholder involvement in the kangaroo industry prevents it from generating benefits of conservation through sustainable use (CSU) and it continues despite calls for change. FATE outlined a case for change and set about trialling it. See Chapter 1 for a more detailed summary.
'Choosing Kangaroo' Project	Preliminary Proposal submitted to RIRDC New Animal Products Program September 2006, funded 2007 and completed 2008.	Steering Committee including KIAA, a kangaroo processor and a small goods manufacturer, consumer survey using discrete choice methods, manufacturer and retailer survey using semi-structured interviews culminating in a final report	Final report (Ampt and Owen 2008) stated that domestic kangaroo meat consumption is increasing slowly among mostly 'variety seeking' urban consumers, kangaroo meat is barely considered by mainstream meat manufacturers and retailers, mince is a key potential growth area, widespread misconception that kangaroos are farmed, weak links in the value chain occur around harvest and immediate post-harvest.
Shooters' meeting	August 2006	Attended by 15 shooters and two processors	Strong suspicion and scepticism about the project was expressed forcefully by a vocal minority of shooters that: landholders 'wanted something for nothing' and; FATE were trouble-makers that would damage the industry. Some of the less vocal participants ultimately became involved in the Steering Committee.
Key BARG meetings	November 2005,	Well attended meeting at which FATE and consultants outlined plans and story of Tilpa Rangeland Investment Company was told.	Provided the level of support needed to complete the full RIRDC proposal and generated the resolve to work with FATE to explore avenues for landholder involvement.
	August 2006	Well attended meeting after Project commenced and following Shooters' meeting.	Established Steering Committee, provided permission for FATE to access harvest data, passed three key resolutions that opened the way collaboration with harvesters.
Steering Committee	Established Oct 06, met 14 times either face-to-face or teleconference	Landholder, Harvester, WCMA and FATE representatives. Made decisions about General Licence and on-going strategy on behalf of other participants. Forum for discussing harvest, chiller and processor practices.	Whilst they have their differences, landholders and harvesters have strong interests in common and working together can generate opportunities that are resisted under the present industry structure. Examples of undetected non-compliance with existing regulations were described. Through a co-operative arrangement, the delivery of strong compliance is possible and there is clear potential for delivery of quality above compliance.

Table 9.1—continued Key project activities that build knowledge of the kangaroo industry.

Key Activity	Timing/ frequency/ duration	Description	Summary of results
SWE Workshop Broken Hill	Feb 2008, 50 participants (see appendix C for full list of attendees).	Brought together key processors, regulators, harvesters, landholders and researchers from NSW, Queensland and South Australia in an historic meeting.	Outcomes were: Landholders and harvesters need to work together on their common interests and should work towards a national kangaroo grower and harvester association; there is a need for greater transparency and understanding of each others' interests which could generate considerable benefits to the industry; there are ways for landholders and harvesters to add value to the industry and; commercial and regulatory models being developed through SWE projects may have broad applicability. For a full report of the workshop see Appendix C.
Kangaroo industry development activities	Two events during 2008 following release of 'Choosing Kangaroo' report (Ampt and Owen 2008).	Chef's Roundtable on Kangaroo meat at 'Wildfire' Restaurant, Circular Quay, Sydney May 2008. 12 Chefs attended DSRD event at State Parliament in Sept 2008 hosted by Lindey Milan with a panel including KIAA President, Native food advocates and FATE Manager, involving five high profile chefs and attended by 70 food trade and food media guests and 80 others.	There was a high level of interest from the chefs and food service people present in kangaroo as a meat and the story behind kangaroo. Long-term celebrity chef supporters of kangaroo meat presented favourite dishes, experts discussed issues following questions from the floor. The event generated very strong support for kangaroo meat with 87% reporting improved perceptions and 94% of trade people likely to use it. Need expressed for more marketing and a premium line with clear regional and quality attributes. Described risk to businesses due to the relative invisibility and inconsistent quality of existing products. There is a strong potential for significantly higher prices to be paid for premium product.
NLIS project	Meeting held in Sydney in Feb 2009 to demonstrate potential for a particular inventory system to trace-back from point of sale to origin.	Organised by Qld DPI and attended by processors, regulators, researchers and harvester/chiller operator and hosted by technology company.	Meeting recognised the need for trace-back and were impressed by the potential of the technology that was demonstrated to achieve it. The possibility of linking harvest regulation to trace-back was discussed and viewed as desirable but considered unlikely due to cost.
Informal contact	Numerous phone and face-to-face conversations with harvesters and landholders during the trial.	Anecdotal reports of tag swapping and other ways of working around the regulatory system and instances of illegitimate harvester and processor practices.	Tag swapping and bringing in extra shooters under a single Trapper's Licence are accepted ways that harvesters deal with large influxes of kangaroos on their 'territory'. Property specific tags and penalties for tag swapping do not deter this.

9.3 Discussion

The landholder and harvester support for BRSWET which was established through BARG, shooters' and Steering Committee meetings and facilitated by the research officer was critical to the instigation and implementation of the project.

Industry responses to BRSWET have changed during the life of the project. Whilst harvesters, processors and other industry representatives repeatedly expressed scepticism and suspicion, they have engaged on various levels with the project and the FATE Program as demonstrated by the activities in Table 9.1 above. The project has clearly been a stimulus for significant discussion in the industry and time will tell whether this has a lasting impact. Whilst many of the industry's concerns with the approach we have taken have proven to be legitimate and accurate, others have been the result of misinformation and rumour. A key benefit of engaging with the industry over the period of the trial has been that areas of confusion and suspicion have been worked through.

For example, the strident and forcefully articulated suspicion from some harvesters towards the landholders and FATE personnel (expressed at the Shooters' Meeting) did not prevent key harvesters from joining the Steering Committee. In a key BARG meeting (August 2006) immediately following the Shooters' Meeting, landholders acted swiftly to pass three resolutions that clearly stated intentions to try and slow the rumour mill of misinformation that had stirred up the Shooters' Meeting. These resolutions were:

> **Resolution 1:**
>
> The intention of the BARG/FATE group is to work in collaboration with trappers and processors to improve the flexibility, stability, consistency and security of kangaroo harvest across the participating properties. It is not the intention of the group to charge shooters and/or processors access rights or kangaroo royalties.
>
> **Resolution 2:**
>
> The meeting has agreed that the best approach for the project would be for the BARG/FATE group to create a model that would ultimately provide better services and advantages for trappers, processors and landholders through managing harvest quota and tags, coordinating shooting activities across properties and ensuring secure supply for processors.
>
> **Resolution 3:**
>
> This meeting of the BARG/FATE group recognizes there are significant barriers in the existing kangaroo management program to landholders having the ability to collaborate and to undertake strategic planning of kangaroo harvests. The meeting supports and requests that Peter Ampt and Alex Baumber act on their behalf in discussions with the Department of Environment and Conservation on the future development of an adaptive management trial that removes these barriers.

Harvester representatives on the Steering Committee were open and forthcoming in their views and brought a depth of knowledge and understanding of the industry from their point of view to the discussion. As several of the harvesters have been in the industry for many decades and have a long history of working with the processors, and some also managed chillers, the process yielded useful information and understanding. It made it possible to develop scenarios whereby a cooperative group of landholders and shooters could undertake many of the harvest management activities currently done under difficult circumstances by processors. If such a group was able to guarantee access to a dedicated and skilled group of professional harvesters, risk of non-compliance with existing regulations would be significantly reduced, and with little additional effort, the achievement of a consistently higher quality product, above compliance, should be possible.

The industry co-operated with and provided in-kind support for the 'Choosing Kangaroo' project (Ampt and Owen 2008), which provided clear recommendations in terms of uses for kangaroo manufacturing meat and marketing strategies. It also recommended action on:

- correcting the public misconceptions regarding how kangaroos are produced and harvested
- addressing the lack of confidence in kangaroo meat from meat processors and retailers because of its relative invisibility and doubts about quality.

These recommendations, the other findings generated by BRSWET and our analysis of the future of the industry suggest that quality management in the value chain and the positive practical and public relations role that landholders could play in the industry are key issues. These issues were discussed in detail at the SWE workshop in Broken Hill in February 2008. Processor representatives at that workshop maintained a unified front that the industry had quality sorted and that business as usual was fine, but individual processors approached FATE afterwards to express off-the-record support. KIAA representatives also expressed agreement regarding the approach we were taking through BRSWET, including acceptance of the potential role of landholders and the importance of developing the domestic market.

Participants in the Broken Hill Workshop, February 2008

The industry development activities in which FATE was an instigator or key participant have reinforced the recommendations of the Choosing Kangaroo project. It is clear that resistance to kangaroo meat exists but it is a small proportion of the population and is overwhelmed by those that already accept or are open to it. It is also clear that current kangaroo consumers are variety seekers, a consumer group that are willing to try new things and are prepared to pay for what they want. In contrast, the industry structure is biased towards kangaroo as a commodity rather than a desirable product with strong positive attributes for which consumers may be prepared to pay a premium price.

In the domestic market, eating kangaroo is not yet mainstream or 'normal'. In this respect kangaroo meat is still a niche product. It is clearly risky to try to generate a premium quality niche product out of a niche industry. Existing processors have looked at it and apparently judged that it is too risky. Any premium line will need to establish a point of difference to achieve a premium price in the market. To do this the commodity product will need to be de-valued in the eyes of the prospective consumers of the premium product. This flies against the kangaroo industry's position of supplying a well-regulated quality product. Under this logic, processor reluctance to embrace premium quality is understandable. However, business as usual from the industry will mean continued slow adoption domestically and increasingly risky reliance on exports. This was reinforced in discussions that took place with industry leaders at Kangaroo Industry Development activities.

Evidence suggests that existing quality standards and practices are holding the industry back both from its existing variety-seeking consumers and from more conservative potential consumers. Australians have shown that they can embrace new eating habits. New ethnic cuisines, for example, have apparently started with variety seekers in inner city suburbs and spread to the broader population. The food industry is saying that it is unsure about the visibility and reliability of kangaroo meat. Consumers are saying that they are open to it but it is not visible or familiar enough. Variety seekers are the same demographic that looks for a story behind their purchases, and existing consumers include 'kangatarians' – people whose only meat of choice is kangaroo due to health and animal welfare considerations. Premium lines exist in other industries and have been successful in generating low volume, high value products. Mainstream supermarkets have picked up many of these products after they have proved to have established a market. The kangaroo industry would appear to be well placed to explore these possibilities and generate a different future.

This project has identified existing short comings in the value chain and has show that there is potential for local management, by landholders and harvesters, to overcome those shortcomings. Further, local collaboration supported by the processor side of the industry could develop a pilot premium line that could be compared to the regular line. From this process the potential market for a differentiated product could be determined.

Even if the existing industry chooses to ignore or fails to support these opportunities, the NSW regulator could make it possible for local groups to develop small-scale regional enterprises that are independent of the commodity industry. By issuing additional fauna dealer licences to local co-operatives, the regulator could open the way to innovative approaches that would need to survive in the market place in parallel to the existing industry. This would allow the development of enterprises that deliver low volume premium products directly to select markets within the existing industry structure.

10. Discussion

This chapter is divided into three sections. The first addresses the performance indicators identified in the adaptive management plan submitted to DECC, describes the key findings and identifies where they are dealt with in the report. The second picks up on discussion points from Chapters 4-9 and integrates them. The third is a description, from a book chapter about the BRSWET, which describes the nature of the problem situation.

10.1 Achievement of performance indicators

Table 10.1 Achievement of performance indicators.

Performance Indicator	Key Finding	Data Sources
5.1.1 Success in obtaining a joint General Licence and the number of landholders choosing to participate.	• Three General Licences were obtained over the course of the trial, with the number of landholders relatively high (16 for GLs 1&2 and 15 for GL 3).	• Adaptive Management Group Licensing Trial (Chapter 5)
5.1.2 Landholder and shooter satisfaction with the methods of distributing tags and access rights amongst shooters.	• 1/3 landholders and 2/3 harvesters said tags were more readily available under this system and this was supported by responses to this question at Steering Committee meetings. • Landholder survey showed that issues relating to the normal tag/licensing system were perceived to be the greatest barriers to effective control of kangaroo grazing and landholder entry into the industry.	• Post-trial interviews (Chapter 5) • Landholder survey (Chapter 7)
5.1.3 Number of transactions required for shooters to obtain tags throughout the year and the time taken between landholder/shooter identifying need for harvest and obtaining necessary tags.	• In the trial year, there were 5.3 tag transactions required per 1000 kangaroos harvested. This compares with 3.8 transactions per 1000 kangaroos for 2001-07. • The higher number of transactions indicates that the option of using tags across several properties did not reduce administrative load. However, it may have more to do with the fact that shooters could get tags all month and thus may have sought them in smaller batches. • It proved impractical to measure the exact time that a need for harvest was identified (also, such data is not collected under the normal system for comparison). • Some delays in obtaining tags were encountered due to the part-time nature of the local coordinator position. However, this was not considered a problem by the shooters.	• Adaptive Management Group Licensing Trial (Chapter 5) • Post-trial interviews (Chapter 5)

Performance Indicator	Key Finding	Data Sources
5.1.4 Desire to continue with group licensing arrangements following the end of the initial trial at the end of 2008.	• Landholders and shooters were willing to continue under group licensing arrangements. However, administrative costs were prohibitive in the absence of additional funding. • In the landholder survey, 92% (both overall and in Barrier Ranges) felt that collaboration was a good idea and should be encouraged.	• Post-trial interviews (Chapter 5) • Landholder survey (Chapter 7)
2.2 Perceived effectiveness of collaborative response to localised population increase events.	• Landholders indicated that were no substantial influxes during the trial period to test the response. However, a significant influx late in the trial on a district property was reported. The harvester was able to harvest heavily using tags issued for neighbouring properties, a clear and specific example of tag swapping of benefit to shooter, landholder and environment. • Harvest data suggests that the trial posed no barrier to successful harvest response (increased harvest compared to 2007, while overall KMZs declined). • Landholder survey showed current regime is perceived to have mixed effectiveness (20% effective, 18% not effective, 62% partially)	• Landholder consultation (Chapter 9) • Harvest data (Chapter 4) • Landholder survey (Chapter 7)
2.2 Number of landholders in the group trained in LFA and number of landholders undertaking LFA transects on their properties.	9 landholders representing 6 properties were trained in LFA. A number have reported applying LFA principles on their properties, but not the formal undertaking of LFA transects.	• LFA training (Chapter 6)
2.3 Success in setting up representative LFA sites for each major rangetype which are monitored at least once annually.	Key rangetypes across the BRSWET area were identified and an outline of a group monitoring program was developed. Benchmark data was obtained for representative sites on some rangetypes.	• LFA group monitoring (Chapter 6)
2.4 Degree to which landholders are prepared to share data on other aspects of total grazing pressure through cross-property GIS.	AEMS did not deliver on the proposed cross-property GIS. Future data-sharing would be dependent on the adoption of a group monitoring strategy.	• LFA group monitoring (Chapter 6)
3.1 Success of landholders in the group in obtaining a commercial return from kangaroos harvested under the trial	• Landholder group was not successful in obtaining commercial returns during the trial. This was due to the short trial duration, low demand for kangaroo during the period and scepticism of some processors. • Economic modelling suggests landholders becoming shooters holds highest income potential, followed by joint chiller ownership. Payments from processors for quality assurance hold good potential if	• Landholder/harvester consultation (Chapter 9) • Economic modelling (Chapter 8) • Landholder survey (Chapter 7)

Performance Indicator	Key Finding	Data Sources
	premiums are large (30c/kg) and apply to all kangaroos harvested. • Surveyed landholders ranked processor payments highest, with chiller options very unpopular. • Current landholder income from kangaroos is very low (5.5% report minor income, mostly from shooting).	
3.2 Success of landholders in devising a method of distributing economic returns amongst themselves collaboratively.	• As no kangaroo income was obtained, no distribution occurred. • Cooperative model explored offered strong potential as an option for distributing returns. • Different roles need to be considered in distributing returns (shooting, chiller operation, harvest management and landholders with high harvest and low harvest properties).	• Business case (Chapter 8) • Stakeholder consultation (Chapter 9)
4.1 Change in perceptions of kangaroos as a resource amongst participating landholders.	• Landholder survey found that dominant perception of kangaroos is "can be a problem at times", with "pest" and "potential resource" roughly equal.	• Landholder survey (Chapter 7) • Post-trial interviews (Chapter 5) • Landholder consultation (Chapter 9)
4.2 Involvement of participating landholders in managing land for conservation under the Western CMA's Enterprise-based conservation program and the degree to which collaboration and income from kangaroo harvesting has influenced their decision-making	• Current involvement in EBC program amongst landholders surveyed was 6% across WCMA area and 7% in Barrier Ranges. • No direct impact from kangaroo income observed as income from kangaroos not obtained in trial. • Economic modelling suggests kangaroo income combined with either stewardship payments or carbon credits offers a viable alternative to conventional grazing. However, this is mostly due to the stewardship or carbon income, with kangaroo income being a minor component.	• Landholder survey (Chapter 7) • Economic modelling (Chapter 8)
4.3 Reported conservation actions by landholders involved in the trial such as reducing stock numbers to conserve key areas and protection of native vegetation mosaics that promote biodiversity	• Surveyed landholders reported the following major conservation actions: commercial kangaroo shooting (90%), spelling paddocks to allow regeneration (89%), harvesting feral goats (71%). • Significant shifts in behaviour were not reported as a result of the licensing trial (due to the short duration and lack of kangaroo income). • Changes in interpretation of land condition and triggers for management intervention were reported as a result of LFA training.	• Landholder survey (Chapter 7) • Post-trial interviews (Chapter 5) • LFA training (Chapter 6)

10.2 Discussion to integrate Chapters 4-9

Participation of landholders in the kangaroo industry

This trial has confirmed that landholders in the arid and semi-arid rangelands continue to derive most of their declining on-farm income from conventional pastoral activities and goat trapping. The few landholders that are involved in the Enterprise Based Conservation Scheme receive a 'stewardship' payment for managing for conservation, but apart from that, engagement in economic activities serving established markets remains the key on-farm income generating activity.

The trial also confirms that the extent to which landholders are active participants in the kangaroo industry remains minimal. The nature of that participation for the vast majority is to apply for an Occupiers Licence and provide access to licensed trappers. A very small number are part-time trappers, mostly on their own properties, and an even smaller number own and / or manage a chiller.

This trial also sheds significant light on the reasons why landholder participation is so low. The key barriers from the landholders' point of view to their gaining income from kangaroos are government control over kangaroo management, perceived attitudes of city people to kangaroos and industry opposition to their involvement in that order. The trial worked closely with landholders and harvesters and gained their support and co-operation to test a new strategy for making government control less of a barrier. In the process, other aspects of regulation were scrutinised sufficiently to reach the conclusion that the system of regulation that has evolved could be much better both for landholders and trappers. Recent consumer research cited in this report challenges the view that city attitudes are a barrier, but the perception of industry opposition was reinforced during the trial.

While landholders ranked the price of kangaroo products as less of a barrier, this trial has shown that the price offered by processors at the chiller door leaves little or no margin for landholders to generate any income. It is clear that unless the legislation is changed to make payment of a royalty to landholders mandatory (a highly unlikely and probably undesirable scenario), landholders will have to add value to the process or product to have any chance of earning a price premium from processors.

The data collected on historic harvest on participating properties and the harvest data from the trial of the group licence provided further reasons for the lack of landholder involvement. Extreme harvest variability was evident at a property level for most properties, and the low per property harvest showed that it is extremely unlikely for an individual property to generate a large or consistent enough harvest to justify the expense of setting up an enterprise. This was reinforced by the economic modelling. Only those properties that had a consistently high harvest could begin to justify the expense.

The potential of multi-landholder co-operation and collaboration with harvesters

The trial provides evidence that, while the potential for a landholder to act individually is very low, there is a strong case that collaboration between neighbours may be the key to their ability to add value to the industry, and thus to generate some income from kangaroos harvested from their properties. This was reinforced by the harvest data which shows that group harvest variability is much less than that for individual properties.

Key pieces of evidence included:

- Much evidence for the benefits of landholder collaboration was obtained.
- Harvest analysis shows that collaboration has significant potential to reduce the exposure of landholders to harvest variability. This could have benefits both in terms of reduced exposure to business risk for a kangaroo enterprise and greater ability to respond to highly variable influxes of kangaroos onto a single property.
- Landholder survey results also showed positive attitudes to collaboration amongst landholders.

- The trial showed that a group of landholders and shooters can successfully manage the allocation of harvest tags amongst themselves. This was apparent in the fact that the group expressed a desire to continue if funding for administrative costs could be obtained. The group also increased their harvest on 2007 levels while the rest of the region was in decline overall. This shows that group licensing was not a burden on the ability of shooters to harvest.

- However, quotas were not threatened in 2008/09 and it is unknown how well the allocation of tags would hold up under such a circumstance (i.e. would conflict emerge?).

In consultation with stakeholders, the trial pursued the potential of collaboration further by developing a group licence and tag allocation system, conducting economic modelling on several collaboration scenarios and developing a business case for a kangaroo harvest management co-operative. Whilst these initiatives still require refinement, they are sufficiently well developed to become a starting point for the BARG group and others to develop a collaborative enterprise.

A significant aspect that had already emerged was the strong potential for collaboration to generate mutual benefit between a group of landholders and the harvesters that operate on their properties. There had been a significant shift in attitude between landholders and harvesters during the progress of the trial from scepticism and suspicion to openness and a willingness to contribute constructively. Close contact between landholders and harvesters in the trial steering committee revealed the extent of the common interests of both. This was taken further with the development of a model co-operative that included both groups and incorporated chiller management and ownership.

This model provides significant possibilities, not just for better kangaroo management and potential income for the business, but for improvement in quality, both within and beyond compliance. It raised the possibility of the group taking over the role of field manager now paid for by processors (thus reducing their costs) while providing better quality control. This concept was originally suggested by a processor's field manager and a small-scale processor and enthusiastically received by the stakeholder meeting held in Broken Hill in February 2008. A key to its success would be that, as members of the co-operative, harvesters and chiller operators would have a vested interest in its success and the group could control who is involved.

Lessons on income potential of kangaroos and collaborative business structures included:

- This trial was unable to obtain returns for landholders for a number of reasons, the most critical being its short duration, a severe industry downturn and resilience of the existing system to change. However, the trial generated additional knowledge from which, landholders, harvesters, regulators and processors can benefit.

- The option of a landholder/harvester cooperative has many appealing traits, including low set-up costs, simple structure, provisions for entry and exit and mechanisms for differential distribution of profits according to resources invested.

- The main difficulty for a co-operative enterprise based around obtaining price premiums from processors is that the level of coordination involved is likely to require a costly co-op manager. Thus, such a group is likely to require continued subsidisation (unsustainable in the long-term) or be able to demonstrate very significant advantages for a processor in terms of quality assurance and/or marketing opportunities.

- The option of processor price premiums for quality showed quite low levels of return under economic analysis. Very high premiums (~\$0.30/kg) are likely to be required in order to make this option a particularly attractive one for landholders. This is further emphasised by the findings of the business case analysis which showed that high premiums would be required just to cover the costs of a co-op manager, before any profits were disbursed to members. A co-op could be established without such a manager, although price premiums for quality would be much less likely without someone to ensure compliance with quality standards and to handle the relationship with processors.

- From economic analysis and the landholder survey, it would appear that chiller options are risky and expensive, but could offer good returns for a committed and well-managed landholder group. These options were least-preferred by surveyed landholders, reflecting the high set-up costs and potential risks shown through the economic sensitivity analyses.

It was a perhaps overly optimistic hope that, by the conclusion of this trial, there would be group of landholders ready to take on the challenge of setting up a collaborative enterprise. That hope was in part generated by the enthusiasm and optimism of the BARG. The group was building up when the trial was instigated and it probably reached a peak of activity (social, agricultural and environmental) through 2006-7. This corresponded with the early implementation stages of the *Native Vegetation Act 2003* and Regulations, particularly to do with the Invasive Native Shrub module and the time when WCMA incentive and other funds were readily available. Since that time WCMA funding has been restricted, the drought has continued and the kangaroo industry has had a pronounced downturn due both to lack of supply and the loss of a major export market. There was a corresponding decline in attendance at BARG meetings and events that has corresponded with the difficulties we have had in getting people together for this project. This, coupled with the complexity of the problem with which the trial grappled, contributed to the final decision to not pursue a business venture.

Arguments for reform of the regulatory system

- The landholder survey results showed that normal government licensing and tagging arrangements were widely perceived as the greatest barriers to both effective control of kangaroo grazing and landholder entry into the industry. This was also reflected in the desire of the group to continue managing their own tags rather than have to switch back to DECC's management.

- One complication for this study (as well as the collection of data under the normal system) is the strong incentive for harvesters to work around the system (e.g. tag-swapping). This is due to the fact that the property-scale tag allocation system works against the natural movement patterns of kangaroos and the strategies of harvesters to mitigate the risk that harvest variability poses to their income stream (Thomsen and Davies 2007). Cross-property approaches such as those of this trial are more consistent with these natural patterns. However, it should also be recognised that trials such as this may not actually show a measurable increase in the level of flexibility available to harvesters, simply because harvesters already have the unrecorded and unmeasured option of tag-swapping to resort to when additional harvest flexibility is required.

- Tag-swapping introduces potential error into harvest results, although the degree to which this occurs is unknown. While such practices do not pose sustainability risks (regional harvest is still bound by quotas) it works against the principles of Conservation through Sustainable Use (CSU). In particular, such approaches violate the principle that, where possible, regulatory arrangements should be compatible with the social and economic goals of local communities rather than working against them. Obviously, if the goals of local people are fundamentally incompatible with conservation aims, then some conflict between local goals and regulation is to be expected, but this is not the case here and such conflict could be removed with regulatory reform.

- Overall, 47% of landholders surveyed indicated that they felt a Queensland-style system would be easier (most others said 'no difference'). This would appear strong grounds for further trialling alternative arrangements where tags are not bound to individual properties. This trial has shown how a general licence could be used as tool for facilitating such trials without needing to amend legislation.

- During protracted and detailed discussion in the steering committee on the business case for a collaborative enterprise, the DECC policy limiting the number of Fauna Dealer's Licences was viewed as being a key factor maintaining status quo in the industry and preventing innovation. This policy is not included in the legislation so a review of policy could look at its impact and explore alternative models. There is nothing in the Kangaroo Management and Harvest Plan that justifies its inclusion.

- The contact that the FATE team has had with kangaroo harvest regulation in three states (NSW, SA and Qld) has highlighted the differences between them and, as the industry operates across all of those states, obviated the need for coordination between states. If these states and the Commonwealth were to contribute to a task force to generate a common set of regulations, the cost would be shared and the resulting benefit to the industry could be significant. Cooperation in conducting kangaroo population surveys could also provide potential benefits in terms of efficiency and accuracy.

- The adaptive management provisions in the NSW system made the trial of the group licence possible. However the process of gaining approval was complex, expensive and time consuming. A more streamlined, well-defined process would lower the barrier to researchers seeking to help the regulator would result in more progress towards a better regulatory system.

- The development of more localised population surveys that integrate with larger scale surveys would help in understanding the relationships between local populations and local harvest patterns and therefore the viability of local harvest management. However, as indicated in Chapter 4, careful consideration is required before using local population surveys to set local harvest quotas, as factors such as past harvest rates and local needs for grazing pressure management are also important.

10.3 The complexity of the problem

The problem at the centre of this project is declining sustainability of pastoralism in the rangelands and the perceived lack of alternative enterprises. Linked to this is public pressure to manage land for enhanced environmental outcomes. The FATE team viewed landholder involvement in kangaroo management as a management option with potential to improve this situation. In taking on landholder involvement in kangaroo management as a key component, the team immersed itself in a complex environmental management problem. A description of this complexity (Ampt 2009) was included in a book about implementing adaptive management (Allan and Stankey 2009) and is reprinted here.

Multiple uses and multiple objectives

The Barrier Ranges are used primarily for pastoral activities, but the wider community has an interest in their iconic outback cultural status and in maintaining environmental values. In the same way, kangaroos can be used for meat and skins, to promote local tourism, and as a component of our community well-being – we are happier in the knowledge that they are there in their natural environment. They are also used as a pawn in the political game around animal rights in that they are convenient media target for animal activists. The objectives of the key stakeholders are diverse, sometimes overlapping and sometimes in competition as is described further below.

A mix of scales of interest and boundaries of responsibility

Landholders primarily operate at the single property scale except when they are active in a group like BARG; harvesters operate on several properties to spread their risk – kangaroos regularly move across property boundaries so harvesters follow. Full-time harvesters may have up to ten properties on which they harvest regularly while part-timers may have two or three; regulators have a state-wide perspective that in NSW is divided into zones. They assess population and quota at a zone level but apply policy and issue tags at an individual property level. Processors operate across Australian states to ensure they can maintain continuity of supply to large processing plants. Processors may employ area managers to coordinate the harvest effort across localities. They locate field chiller boxes depending on where the harvest is occurring to minimise transport to chillers.

Landholders are primarily responsible for their own property but may recognise the benefits of acting collectively on a number of natural resource management activities. They are also accountable for the impact of their actions off-farm and are restricted in their on-farm actions by legislation, regulation and policy of government departments. They provide access to the kangaroo resource to harvesters through the licence system. They provide this free of charge because they generally perceive it is better that the kangaroo population is controlled, that if commercial shooters didn't do it they would have to and it would cost them money. If landholders acted collectively, they could choose to exercise power over the harvest by demanding certain conditions be met for access with the ultimate threat of closing down the industry through denying access if those conditions were not met. In reality this is unlikely to happen. Many landholders appreciate the role that shooters play in management and in small local communities.

Harvesters are responsible for ensuring they comply with the licence conditions and for maintaining good relationships with landholders on whom they rely for access to the resource. They are also responsible for the quality of their work, which includes maintaining their equipment, kangaroo selection, marksmanship, field processing and transport to field chiller boxes. A load of kangaroos can and will be rejected at the chiller if they are too small or are unhealthy, if they are not head shots (ensuring instant death), if they have been processed carelessly in the field or if they don't arrive at the chiller in time to be chilled to the required core temperature in the specified time. Harvesters also have to administer the royalty tags correctly and complete accurate harvest returns to the Kangaroo Management Program.

Divergent needs and desires of stakeholder groups

Landholders wanted better control of grazing pressure due to kangaroos and were curious whether they could generate any income from kangaroos. They were sceptical but had a sufficient level of interest to support FATE in going forward and supported the Steering Committee. There were BARG members who were passively resistant or disinterested in the trial, others that were content to observe its progress and those that volunteered for the Steering Committee and put time into participating in meetings.

Initially most harvesters were suspicious of the trial, and some were strongly antagonistic. At a public meeting in August 2006 FATE and landholders were accused of various degrees of stupidity, opportunism and self-interest. There was widespread scepticism about whether any of the initiatives were worth anything. Views were forcefully expressed that landholders just wanted something for nothing and that the only likely result of the initiative was that harvesters would be squeezed because any income for landholders would come at the harvesters' expense. It became clear during this meeting that what harvesters needed was secure access to the resource, more consistent demand for the product from processors and a fairer and more predictable price at the chiller.

Processors need to be able to manage supply to maintain continuity and to match supply to market demand. They do this by manipulating the price they offer at the chiller and by closing or moving chillers for which the supply is inadequate. They value reliable and efficient harvesters and provide strong incentives to some to keep them loyal.

Processors were dismissive about the project. They maintained a consistent line collectively that the industry is functioning fine without landholder input and without FATE's intervention. This position is not surprising, as, they retain control over price and supply through regional managers and relationships with key chiller operators and shooters while working hard to maintain markets. A small processor trying to break in expressed a desire to work with landholder groups who could coordinate harvest and maintain quality management to ensure consistent and better than average quality for specific markets.

The regulators (The NSW Kangaroo Management Program of DECC) were sceptical but had the adaptive management provision in their Kangaroo Management Plan (dealt with later in this chapter) so were obliged to engage with the project. They remained clearly focused on the goals of the Kangaroo Management Program and the need to fully comply with their legislative obligations. They expressed the view that the current system was flexible enough to allow landholders to participate more fully, and that the reason they didn't was because of the lack of an adequate profit margin in the industry.

Tight economic imperatives around ecosystem exploitation

A continuation of pastoralism requires ongoing maintenance of pastoral infrastructure (fences, yards, stock water, roads, vehicles, silos, sheds and significant labour associated with stock management (shearing, crutching, drenching, lamb-marking, mustering) all of which come at a considerable cost in terms of time, labour and capital. Commodity prices are uncoupled from this, and the (until recently) cost-price squeeze pushed landholders onto bigger and bigger areas to make an economic return. Critical components of productivity are lambing percentages and wool clip. Both rely on maintaining stock numbers and improving genetic lines of stock, a strategy that is not compatible with the extreme year to year variability of feed in the semi-arid rangeland environment. There is a trade-off between production per animal and production per ha that is mediated by stocking rate, but landholders generally attempt to maintain as high a stocking rate as they can to maximise economic return.

While landholders derive no economic return from kangaroos harvested from their properties any kangaroo is a threat to the profitability of their pastoral enterprise. A complicating factor in this is the increasing reliance of landholders on off-farm income.

Harvesters have to make a significant outlay to get into the business. Once licensed, their big challenge is minimising the harvest effort. The distance travelled and wear and tear on vehicle are major costs. If Kangaroo density is low the cost per harvest increases. Studies (Hacker, McLeod et al. 2004) indicate that the commercial industry is not viable at kangaroo densities that might threaten the viability of the commercial species. This indicates that with current cost structures harvesters will cease harvesting long before a critical density is reached.

Reduced ecosystem health and ecosystem services

The WCMA Catchment Action Plan sets targets aimed at improving ecosystem health and the provision of ecosystem services. These are to some extent in competition with economic imperatives as outlined above. These targets exist despite major rangeland monitoring systems lacking any systematic biodiversity component (Fisher, Eyre et al. 2008) and reporting little positive or negative change in range condition (Eldridge and Grant 2004; Eldridge and Grant 2004). Catchment action plans emphasise incentives which, in the judgment of the WCMA Board, will move the catchment towards the targets. The targets are precautionary in that they are judged to be sufficient, if achieved, to maintain or improve biodiversity and enhance the provision of ecosystem services. A key ecosystem service is the resilience of the ecosystem and cultural and aesthetic benefits of knowing we are managing ecosystems to maintain and enhance biodiversity.

However, land management remains dominated by the private good need to generate income from pastoralism, and the public good need for improved ecosystem health remains under-resourced. This suggests that strategies that combine private good and public good will be beneficial.

Significant technical information on parts of the system

Sufficient technical information existed on parts of the system such as:

- land systems in the area
- the colonial history of the rangelands of Western NSW

- grazing management
- rangeland ecology
- past kangaroo harvest data
- extensive biological, geological and ecological research from the Fowlers Gap Arid Zone Research Station situated in the Barrier Ranges
- kangaroo behaviour, biology and ecology; kangaroo population survey methodology and results
- landscape function
- a landholder survey on kangaroo management from Queensland
- research consumer attitudes.

An extensive review of this literature revealed to the researchers significant areas where the functioning of the system was far from optimal according to the principles of ecologically sustainable development. As a consequence, there were potential benefits in intervening in the system using an adaptive management framework.

Competing or open mandates, with different policy options and system targets

The Kangaroo Industry Association of Australia aims to significantly increase domestic consumption of kangaroo meat and actively promotes the health and environmental attributes of kangaroo.

Presently landholders provide free access to the resource because they accept the pest status of kangaroos. This is despite significant scientific evidence that kangaroos and sheep only compete when biomass gets below a critical threshold. As a pest control strategy, the commercial industry has limited effectiveness because kangaroo densities that are required to make harvesting profitable are considerably higher than those that landholders perceive to be desirable (Hacker, McLeod et al. 2004). Also, large influxes of kangaroos rarely are dealt with effectively by commercial harvesters because of difficulties with getting enough harvesters with tags to the influx quickly enough (Landholder survey 2008 unpublished).

While this continues, landholders give away any bargaining power they have in the industry. Increased landholder involvement in the industry has been perceived as a threat by processors, largely because it raises the possibility that landholders will exercise influence to gain commercial benefit from the harvest. Yet landholders increasingly see kangaroos as a potential resource and good relationships between landholders and harvesters are common and mutually beneficial (Thomsen and Davies 2007). Many consumers also hold a view that landholders are actively involved in some way in bringing kangaroo meat to market (Ampt and Owen 2008).

The regulators are charged with ensuring harvest is consistent with maintaining sustainable kangaroo populations and a humane harvest according to the principles of ecologically sustainable development. Landholders (Chapman 2003); Landholder Survey 2008 unpublished) report that regulatory arrangements restrict their ability to manage kangaroo component of total grazing pressure especially in times of influx and prevent them from adding value to the industry. Harvesters reluctantly report that it is normal for them to 'work around' the property specific tagging system and use tags issued for one property on another.

There are also problems with the funding of the regulation. KMP is supposed to operate on a cost recovery basis but is currently running at a loss because population surveys and administration are costing more than income from the sale of royalty tags. Processors are not (according to KMP) likely to contribute further, so KMP is anticipating a large increase in cost of royalty tags which currently cost 80c per tag.

11. Implications

11.1 Implications for the kangaroo harvesting, processing and marketing system

The work undertaken for this project provides significant information for stakeholders in the kangaroo harvesting, processing and marketing system. It can be argued that this system is relatively stable and resilient, but has significant shortcomings. There are considerable barriers to change in the industry and lack of change is causing problems currently that threaten the viability of the industry in the future. Key features of the current system include:

- Wild kangaroos are harvested at night almost exclusively by self-employed licensed shooters who field process the kangaroos and transport them to field chillers. The kangaroos are cooled and stored in the field chillers until they are collected and transported to processing plants that may be many hundreds of kilometres away.

- Most field chillers are owned by processors who pay a chiller operator a price per kilogram to manage the receipt, storage, cooling and dispatch of the kangaroo carcasses and do the paperwork.

- A very small volume of product goes into human consumption either in the domestic market or for export at moderate prices. This product is the large primal cuts such as loins, fillets, rumps, topside and silverside.

- The bulk of the product, known as manufacturing meat, goes into low priced export human consumption and pet food products.

- No significant premium quality product exists – what premium market exists is generated by sorting at the processor but is not serving the needs of restaurants and food service. Meat quality research has found that eating quality declines with age in all cuts other than the loins and fillets. If the carcass is hung by a leg (common practice) the meat in the hanging leg is toughened compared to the other leg. This research has not been acted upon.

- Processors offer harvesters a per kilogram price depending on demand.

- Harvesters gain no economic advantage from maintaining high quality, and can often get away with supplying non-compliant product due to the organisation of chillers.

- Landholders have little chance of generating any economic return from kangaroos harvested from their properties and routinely provide access to their properties to harvesters. They accept this as the only viable way of controlling kangaroo populations on their properties.

- Whilst there have been some attempts to organize the harvesters, they remain unrepresented and powerless.

It is very difficult for any one stakeholder in the system to implement change. The industry is heavily regulated, and while compliance with regulation is probably quite strong, there clearly are areas where undetected non-compliance occurs. In a global environment where quality control and trace-back is becoming a condition of access to markets, the kangaroo industry is at risk.

The loss of export markets in Europe during 2008 on the grounds of (contested) micro-biological contamination highlights the nature of the risk of non-compliance or even apparent non-compliance to the industry. Recent publicity from opponents of the industry (Good Weekend, May 23, 2009) questioning harvest and chiller practices also threatens access to markets.

There is risk associated with the fact that there is a common misconception that kangaroos are farmed, or at least that farmers are involved the process of bringing them to the market (Ampt and Owen 2008); a misconception that is even reinforced in the rural press[11]. Consumers have difficulty with connecting their meat to an animal, and for kangaroo this is particularly acute due to the iconic status of the kangaroo and the 'Skippy factor'. Any apparent revelation that is unexpected can lead to lack of trust in the product. The gritty reality of the harvest can be sufficient to deter would-be kangaroo consumers. There would appear to be greater risk to the industry of allowing this misconception to continue than to tell it like it is. Whilst there is no quantitative data on it, there appears to be a growing band of people, for whom the term 'kangatarian' has been coined, who see kangaroo meat as the best choice from environmental, health and animal welfare grounds.

11.2 Implications for landholders

Under current regulatory, industry and marketing conditions:

- There is insufficient opportunity for individual landholders to gain economic return from the kangaroos legally able to be harvested from their properties.
- There is an opportunity for groups of landholders to work together to provide harvest infrastructure in collaboration with harvesters.

Under current industry and marketing conditions and using a group licence similar to the one trialled in this project:

- Landholders can gain greater control over harvesting at a landscape scale, making a more rapid response to local influxes of kangaroos possible because they can call on any harvester on the group licence if the regular harvester is not available or if large numbers of kangaroos appear.
- Landholder groups can generate greater bargaining power with harvesters by offering secure access to larger areas. This provides the opportunity for them to set conditions for access, such as control of feral animals, that provide conservation and business benefits. Without a group licence this is possible but more difficult.

If regulators were to allow landholder / harvester co-operatives to trade in harvested kangaroos, and processors were to offer contract processing:

- Co-operatives could take the risk of testing the market for a premium, regionally-branded line of kangaroo meat.
- This would provide an opportunity for landholders to generate a viable business based on kangaroo harvest that also delivered more control over the impact of kangaroo on other enterprises.

If regulators and processors were to recognise the benefit of landholder / harvester cooperatives and provide incentives for them such as a premium price:

- Co-operatives could manage tag allocation, harvest and chiller functions and could potentially deliver beyond compliance quality.
- The industry could confidently use landholder participation and conservation benefit as key marketing strategies.

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[11] *'China deal to keep roo farmers on the hop'*, online at http://sl.farmonline.com.au/news/nationalrural/agribusiness-and-general/general/china-deal-to-keep-roo-farmers-on-hop/1554774.aspx. Accessed on 30/06/2009 11:15:00 AM.

- This would provide an opportunity for landholders to generate a viable business based on kangaroo harvest that also delivered more control over the impact of kangaroo on other enterprises.

11.3 Implications for regulators

Our experience with using the adaptive management provisions of the NSW KMP highlights a number of points:

- Adaptive management should involve the clear statement of all goals that drive policy. Without clear statement of goals, it is often very difficult to argue the case for adaptive management proposals such as BRSWET. Very little data is likely to be available for comparison and objectives of the research team are likely to clash with unstated goals of regulators and other stakeholders. Such impacts result in a heavy bias towards maintaining the status quo.

- Agency Plans that call for adaptive management need to state clearly what factors can be experimented with (e.g. population monitoring, quota-setting, socio-economic considerations) and by whom (regulators only, ecological researchers, socio-economic researchers).

- Adaptive management should be viewed holistically, not as simply the implementation of experiments that are unconnected from the rest of management. Plans should not have 'adaptive management sections' whereby some aspects of management are open to adaptive approaches and others are not. Under true adaptive management, all management actions should be seen as experiments, with clear processes of goal-setting, monitoring and review.

Harvesters work around the current regulatory system in a number of ways including tag swapping. This is a sign that the system is not sufficiently flexible to accommodate harvester requirements and the risk of getting caught is insufficient a deterrent. There is currently no way of knowing how widespread tag swapping is because it is illegal and reporting of it risks incurring penalties. It creates a hole in the trace-back capacity of the regulatory system and ensures that harvest data are inaccurate. It is difficult to see the wisdom of continuing with a system that is largely unenforceable and apparently incompatible with the viability of harvesters' businesses and the aims of the system.

If the penalties for tag swapping were removed and replaced with a requirement for harvesters to report tags used on the wrong property, it would improve both trace-back and the integrity of the data. In the longer term it would be better to work towards a more flexible purposefully designed system of harvest regulation that could be implemented in all states.

The limit on Fauna Dealers Licences in NSW is one factor that reinforces the control of the industry by the processors. This trial suggests that relaxing this policy and looking at the option of a specific licence category for landholder and harvester cooperatives may provide greater opportunities for innovation in the industry.

11.4 Implications for harvesters

Successful harvesters maintain access to prime kangaroo territory by maintaining the trust and loyalty of landholders at the same time as remaining loyal to a processor. The trial revealed instances where harvesters that were loyal to a particular processor achieved significant benefits such as a premium price or an occasional cash bonus. These harvesters probably supply a large percentage of the product for some processors. Harvesters without a special relationship with a processor are subject to variations in the price they receive and the willingness of processors to pick up kangaroos from chillers that they supply. These harvesters are vulnerable, especially if they harvest full-time.

Part-time harvesters generally have other sources of income and can move in and out of the industry. By raising the price, processors can attract them when they need more product, and drop the price if supply is too high for the demand. As such they fulfil a useful role in an industry in which populations fluctuate with the availability of feed, and markets come and go. However, it is harder for them to maintain secure access to land because landholders may become dissatisfied with the degree of population control that they achieve. This may prompt the landholder to seek a different shooter, or to conduct damage mitigation shooting. Conflict can also occur between part-time and full-time harvesters when harvestable populations are low and competition exists for available territory and quota.

The trial has shown that there are potential advantages for a harvester to join a group of landholders and other harvesters. Trail participants could see the advantage of having clear rules for membership that make it possible to gain greater control over harvesting strategies and quality of harvest. Being part of a may also provide more reliable access for harvesters and deal with part-time shooters attempting to take over country.

11.5 Implications for chiller operators

Chiller operation is a critical step in compliance and yet chiller operators work with minimal supervision and are lowly paid (currently around 7 cents per kg). Chiller operators' income is determined by the weight of kangaroos going through the chiller. They have no control over how many kangaroos are delivered to the chiller but they have a vested interest in maximising the number that is collected by the processor after chilling and storage. They are accountable to the regulators through the returns that they submit each month, but they currently have no stake in the quality of the kangaroos that go through.

Chiller operators should ideally inspect each load that arrives at their chiller and either accept it or reject it according to whether it is compliant with the regulations. If a harvester delivers a load to a chiller that is below compliance, it is in the processor's interest for that load to be rejected by the chiller operator. If this occurs, the harvester receives a strong and immediate message that compliance is essential, providing a strong incentive for the harvester to improve the quality of their work to ensure a load is not rejected. However, if chiller operators accept non-compliant loads and get away with it, they are better off financially because they are paid on quantity, not quality.

If the load is accepted they then supervise the hanging of the carcasses in the chiller to ensure there is adequate ventilation to facilitate cooling to the specified core temperature in the specified time. Uneven stacking or overloading a chiller can lead to carcasses cooling too slowly for compliance, but if operators get away with it they end up with more money in their pockets.

It was clear from discussions with harvesters and chiller operators that variation exists between operators as to what they will accept and how they run their chillers. Also, it is common practice for harvesters to unload carcasses directly into a chiller without the chiller operator being present. This represents a significant risk to the industry as this is a critical point for ensuring compliance.

Chiller operators also ensure that the chiller is kept clean and the unit is in proper working order. If the chiller is owned by a processor (as most are) then if the chiller malfunctions the owner fixes it. If it is locally owned the owner/operator fixes it in return for a higher payment (currently an additional 8 cents per kg).

11.6 Implications for processors

Processors dominate the industry by setting the prices paid to harvesters and chiller operators. They compete with each other for harvest territory and for markets but collaborate on other issues. They have helped shape a complex system that has built-in safeguards developed over many years of working with harvesters, regulators and buyers. However, there are clear signs that gaining access to and maintaining reliable export markets is becoming more difficult, and the industry's objective of increasing domestic human consumption of manufacturing meat remains problematic.

The management of compliance and quality from field harvest through to the collection of the product from chillers is a major weak link in the industry. This weakness is difficult and costly for processors to rectify because of the remoteness and wide separation of chillers and the solitary and night-time nature of the work. The payment structure for harvesters and chiller operators rewards quantity, not quality and casual or haphazard supervision increases the risk of non-compliance.

The industry is vulnerable from the point of harvest to the collection of kangaroos from the chiller. Trace back capability is limited due to harvesters 'working around' the regulations and the removal of harvest tags at the processing plant. Guaranteeing compliance is difficult with harvesters operating without supervision in isolated places in the middle of the night. Existing arrangements to ensure compliance are haphazard and expensive when done properly. Processors rely on loyal harvesters and chiller operators to whom they sometimes provide incentives. Where this is in place it can work well. However, the structure of industry does not embed these incentives so it appears relatively easy for harvesters and chiller operators to get away with non-compliance.

A locally managed harvest and chiller co-operative of the type investigated in this project has the clear potential to provide the quality management that the industry needs. Under the current system, it is up to processors to send the right signals to landholders and harvesters to encourage them to take on the task. This project suggests that the co-op will need to be paid a premium of at least 30c per kg to provide quality compliance. At present, processors have indicated that they are unwilling to do this.

12. Recommendations

12.1 Recommendations for landholders

1. Landholders should attempt to find a kangaroo harvester with whom they can establish clear lines of communication in an effort to achieve kangaroo population management and other potential benefits (such as feral animal management) in return for security of access and harvest support.

2. Where practical, landholders should attempt to form a group, preferably of neighbouring properties, and negotiate with a reliable harvester or harvesters by offering harvest support and access rights to the whole group in exchange for desired harvester behaviour such as a commitment to harvest when necessary and the management of feral animals. This can be achieved under the current Occupiers and Trappers Licences but there are advantages to using a group General Licence.

3. Landholder groups in areas where kangaroo populations are high and for whom effective kangaroo management is a high priority should use the information generated by this trial to develop workable kangaroo management strategies in collaboration with harvesters and processors. In particular, they should determine whether the production of a premium line is possible and work towards establishing a co-operative which provides incentives for provision of quality in return for a premium price.

4. Landholders and landholder groups interested in generating evidence of environmental stewardship and seeking objective means of assessing the impact of management practices on resource condition should consider implementing a system based on Landscape Function Analysis.

12.2 Recommendations for harvesters

5. Harvesters should consider approaching landholder groups and other landholders to collaborate on harvest management in their area. This project has demonstrated clear benefits from collaboration and cooperation across properties and between harvesters. Harvesters can take a leading role in this.

12.3 Recommendations for regulators

6. Property specific tags should be phased out. This is because they are not sufficiently flexible to allow for the habits of kangaroos and the livelihoods of harvesters and they are not necessary to ensure zone quotas are upheld. In states where they occur, tag swapping is practiced which compromises harvest data and trace-back reliability. Whilst it is illegal, tag swapping is difficult to detect and therefore ineffectively enforced.

7. If property specific tags are retained, penalties for using them on another property should be replaced by a requirement for such use to be reported. This would require minimal changes to the existing system, would remove the perverse incentive to falsify harvest returns, would provide more reliable harvest data and would improve the accuracy of trace-back.

8. If property specific tags are retained, a group licence similar to the one tested in this trial should be made to groups that provide coordination and administration of harvest.

9. The system of Fauna Dealers Licences should be reviewed to remove the barrier for a local kangaroo harvest management co-operative or corporation to develop a business independent of existing processors.

10. The NSW KMP should include more detail on social, cultural and economic objectives.

11. The adaptive management provisions in the NSW KMP should be streamlined and broadened to provide a clearer path for researchers to design and implement adaptive management trials.

12.4 Recommendations for processors

12. Investigate the possibility of generating a line of kangaroo meat from the existing value chain that is of sufficient quality and consistency to demand a higher price from the domestic restaurant, food service, gourmet and specialist retail market. Consider the contribution of size, age, species, field processing, chilling, transport and location to the achievement of a market-appropriate quality differential.

13. Develop and implement ways of providing incentives for landholder groups, harvesters and chiller operators to meet and exceed compliance to develop quality rather than incentives solely based on quantity.

14. Evaluate the possibility of providing a processing service to harvest management groups that allows them to have their animals processed for a fee while retaining ownership through to the retailer.

12.5 Recommendations for the kangaroo industry as a whole

15. A task force should be set up that aims to develop a national kangaroo harvest regulation system that removes differences between states, is based on ecologically sustainable development and allows for devolution of management to local groups that can demonstrate their ability to successfully manage the harvest. Consideration should be given to a system of tradeable tags.

16. The industry should support the development of a system driven by quality rather than quantity. This will involve supporting research into the measures needed to generate differentiated products, assess the potential volume of those products and develop the markets for those products. This research suggests that achieving a quality driven system could involve providing incentives to local business / landholder / harvester groups to provide quality harvest and chiller management.

17. The industry should explore innovative ways of increasing the visibility of kangaroo meat and awareness of its positive market attributes.

18. The industry should develop closer ties with landholders and landholder groups and seek to work more closely on mutually beneficial areas such as integrating commercial kangaroo harvest with good land management. Through this the industry can utilise the promotional benefits of landholder involvement and support for the industry, which links closely with consumer attitudes looking farmer 'management' of kangaroo production. One possible mechanism is to support the establishment of a National Kangaroo Grower and Harvester Association.

Appendices

Appendix A: Interview proforma

BRSWET interviews with landholders and harvesters

Interviews conducted by Kristy Andrews via telephone between May 20 and June 5. Kristy will take notes on a new pro forma for each interview. Interviewees will not be identified to anyone except Kristy unless they agree to have their name on the pro forma. If they do, they will only be known to members of the research team. It will not be possible to link any information in the final report with any particular interviewee.

Landholder?	Harvester?	Steering Committee member?
Name (optional):		

Thank for agreeing to be interviewed, and thank for being part of this project. This interview will allow us to accurately describe the contribution that this project has made and to help determine future research directions. It has been made necessary because of the difficulty of getting people to face-to-face meetings. Please speak your mind openly and honestly. Only Kristy will know what you have said (and the research team if you allow your name to go on this pro-forma).

Question 1-7 (All interviewees)

1. What involvement have you had in the trial?
   a. First meeting – put name down as a supporter of the idea
   b. Permission to use harvest data
   c. Steering Committee member
   d. Attended training in Landscape Function Analysis
   e. General Licence participant
   f. Reading Newsletters
   g. Listening to reports at BARG meetings
   h. Other

2. What would you say was your main reason for being interested in the trial? Was it
   a. for better control of kangaroo grazing pressure,
   b. the potential to earn income from kangaroos,
   c. both of these reasons or
   d. something else?

3. Has your involvement been worthwhile? Please explain.

4. What have you learnt as a result of your involvement?

5. Have you changed the way you deal with kangaroos or other land management as a result of the trial? Please explain.

Questions 8-14 (General Licence Participants and Steering Committee members only)

6. How successful is the Group Licence (Group Tags)? What works well? What doesn't work well?
7. Were you satisfied with the way that tags were distributed under the trial? Compared to the way that National Parks & Wildlife handle tags, was the trial better, worse or the same?

8. Did the trial make it any difference in how you could respond to influxes of kangaroo? If so, was it better or worse and why?

9. Would you continue to sign up to the General Licence if:
   a. FATE continues to run it?
   b. The group runs it?
   c. Other?

10. One of the objectives of the trial was for the group to take over the general licence and to establish a collaborative kangaroo enterprise that at least pays for itself and provides better management of large kangaroo influxes. Do you still want this to happen? What are you prepared to do to help it happen?

11. What do you think the group tag trial has achieved?

12. What would you like to see happen as a result of the trial?

Questions 15-16 (All Interviewees)

13. What future do you see in:
    a. A co-op or company of landholders and/or harvesters managing a profitable local kangaroo harvesting business?
    b. A premium line of kangaroo meat that returns bigger margins to a kangaroo harvesting business?

14. Is there anything else you would like to say about the project and this area of work?

15. What did we do right?

16. What did we do wrong?

Appendix B: Interview proforma

Landholders trained in LFA

Land and enterprise description

- History on land, brief description of enterprises, land, land types
- Time on present property and plans for future.

Land manager

- Experience prior to present property, experience in the district and on present property? How well do you know your land?
- How did/do you learn land management? Who was influential? Any formal training? How would you rate yourself as a manager? Are you still learning? Any courses undertaken?

Making management decisions about land condition

- How would you describe the condition of your property/properties?
- Is it stable/improving/deteriorating?
- Focus on particular paddocks or land types that may be improving or declining. What are the signs of decline? What are the signs of improvement? Are there any critical observations that would ring alarm bells or would make you feel confident things are going well?
- On what basis do you make that judgement?
- Do some areas of the property cause you concern? Why?
- What management actions are available to you to improve problem areas? What actions have you used? What was the result? Do you have plans for the problem areas?

Stock management

- How do you decide on stocking rate? Does stocking rate vary much from paddock to paddock? What types of country can you stock more heavily? How do you decide (on the basis of what information) to vary SR? What is happening to your SRates over time – increasing? Decreasing?
- Apart from adjusting SR, do you have any other stock management strategies?
- Time control? Spelling paddocks? Cell and/or rotational grazing?

Other land management strategies

- Any other land management strategies? INS control, water ponding/spreading etc
- Any particular strategies to prepare for drought and to cope during drought?
- Management of weeds, ferals, wildlife?

LFA and LFA training

- When did you do LFA training? What did you think of the training?

- How useful was the training? What stays with you about the training?

- Has LFA training effected how you manage your land? Are there any differences in how you read the land now that you have been introduced to LFA? Have you used it since the training? Do you intend to use it? Are you interested in further training? Do you want to be involved in group monitoring?

- Do you see any benefit in group monitoring using LFA? What advantages might it provide?

Appendix C: Sustainable Wildlife Enterprises Workshop

Musicians Club Broken Hill, 14/15 February 2008

A workshop was held in Broken Hill on 14 and 15 February 2008 to bring together members of the three landholder/harvester groups (Barrier Area Rangecare Group - BARG, Mitchell and District Landcare Association and Rangeland Management Action Plan-RMAP) who have been working on projects under the Sustainable Wildlife Enterprises (SWE) research program funded by RIRDC, National Landcare Program and others.

The workshop also featured invited speakers addressing specific issues affecting kangaroo management and SWEs. Representatives of the kangaroo industry, state and federal government agencies, regional NRM bodies and other landholder groups also participated in the workshop, which culminated in a panel discussion featuring representatives of the different stakeholder groups present on the topic of "the role of landholders in the kangaroo industry".

Workshop Presentations

George Wilson and Katrina Gepp presented the following background presentations on the SWE program and the Barrier Ranges trial specifically:

- George Wilson, Rural Industries Research and Development Corporation : Sustainable Wildlife Enterprises - Can commercial value of wildlife make rangeland agriculture more sustainable?
- Katrina Gepp, Western CMA and FATE Program UNSW: Introduction to the BARG/FATE Trial

Other presentations from the workshop have been organised according to theme below. Adobe Reader is required to view presentations and can be downloaded free at http://www.adobe.com/

Summary of Workshop Discussion

The key themes explored through the workshop were:

- Managing risk (as individuals or as a group of harvesters and landholders)
- Commercial models for landholders and harvesters
- Aligning regulatory structures with landholder and harvester interests
- Capitalising on new marketing opportunities
- Supply chain issues and transparency in the kangaroo industry

The issue of risk in the kangaroo industry was revisited a number of times. Paul Moloney looked at rangeland landholders managing risk by diversifying incomes into different livestock as well as kangaroos and Alex Baumber looked at the risks posed to landholders by high variability in kangaroo numbers. Individual landholders are exposed to risks from large and unpredictable numbers of kangaroos coming onto their properties and consuming resources and also, if they are looking to invest in a kangaroo enterprise, they face business risks in trying to provide a stable supply of kangaroos to market. Data from the Barrier Ranges indicates that landholders can reduce the harvest variability they are exposed to individually by grouping together.

- Paul Moloney, RMIT University: Reducing risk through diversifying rangeland incomes
- Alex Baumber, FATE Program UNSW: Collaboration and managing risks in landholder kangaroo enterprises

Rosie Cooney's model for setting up cooperatives involving landholders and harvesters as members generated a large amount of discussion at the workshop (see Rosie's presentation below). The cooperative model could allow landholders and harvesters to set standards for hygiene and quality, invest in chillers and other equipment, negotiate collective supply arrangements with kangaroo processors and potentially market a specific line of kangaroo products sourced from their group.

The coop model received mostly positive comments from landholders, harvesters and even processors, although key questions also arose about the costs of managing a coop, the balance of power between landholders and harvesters and the need for good communication. Overall, there was a strong interest in learning more about the coop model as it develops. The Mitchell and District Landcare Association and their associated harvesters will be exploring this model in further detail and Rosie will be working on developing a version of the coop model for BARG to explore.

- Rosie Cooney, FATE Program UNSW: Models for landholder engagement in the kangaroo industry

The issue of how well regulatory structures work in with the interests of landholders and harvesters was discussed at length. Margaret Chapman demonstrated that landholders in Queensland saw government controls over kangaroos as a disincentive to get involved in the kangaroo industry, although greater discussion overall was dedicated to the regulatory issues in NSW and South Australia. Dana Thomsen outlined a number of ideas on how legislative and policy frameworks could be amended to create incentives for landholders and harvesters to revitalize the industry in SA. Harvester numbers in SA are in decline and the harvest rarely exceeds 50% of the available quota, yet around 200,000 carcasses are imported from interstate by SA processors annually. Many reasons were suggested for this at the workshop, including the remoteness of the SA rangelands and competition for young workers with the mining industry, however, Dana argued that policy changes such as greater tag flexibility, group licensing, reduced barriers to new harvesters and incentives for major harvesters could all make a difference.

Alex Baumber summarised the experiences of FATE and BARG in developing a group licensing system under the Department of Environment and Climate Change's NSW Kangaroo Management Program. This process has been a long one, with many challenges, although significant progress was made at side meetings during and after the workshop on progressing a group licence for BARG members and harvesters. It was also stressed by people involved with the trial that the group's motivation is as much about developing a more flexible system of licensing and tagging for better land management as it is about generating economic returns from kangaroos.

The challenges posed by a single property licensing system, as exists in NSW and SA (where tags can only be used on one property and not transferred), were debated at the workshop. Whilst FATE argued that such a system makes collaboration more difficult, Nicole Payne of DECC argued that the current system has a lot of flexibility for landholders, but many aren't aware of how it can be used. Dana Thomsen also argued that tying tags to a specific property works against harvesters' interests by preventing them from focusing their harvest effort where kangaroo numbers are greatest at a given point in time.

A number of examples were cited in the workshop of where regulators make decisions based on ensuring the economic viability of the kangaroo processing industry (eg limiting the number of fauna dealers in NSW, setting minimum carcase weights for economic rather than conservation reasons and banning skin-only shooting). This indicates that regulators are clearly prepared to step beyond the species-protection role emphasised in their management plans. Harvesters and landholders can therefore reasonably expect their economic interests to figure in decision-making too - provided that they express those interests clearly and lobby for them.

- Margaret Chapman, University of Queensland: **Factors affecting landholders views of kangaroos as an economic resource in SW Queensland**

- Dana Thomsen, SA DEH: The role of landholders in the commercial kangaroo harvest in SA
- Alex Baumber, FATE Program: Experiences with the Barrier Ranges adaptive management trial

The marketing of kangaroo products with landholder involvement was explored by Peter Chudleigh and Peter Ampt on the Friday morning session of the workshop. Peter Chudleigh concluded that a market niche could be developed for environmentally-badged kangaroo products but it would be challenging and would require high quality, clear environmental credentials and heavy promotion. Peter Ampt's presentation on FATE's consumer choice research showed that attractively-priced kangaroo mince and deli meats were the most promising options for increasing the sales of manufacturing meat on the domestic market.

Peter Ampt also reported that most consumers surveyed were unaware that kangaroos were wild-harvested and suggested that promoting a connection to landholders and a positive environmental message could offset any negative reaction to the idea of wild harvest. The ideas of regional and environmental badging received strong support from landholders involved with the SWE program. There wasn't much indication from processors at the workshop regarding whether they thought these ideas had commercial potential, however, there was discussion on the fact that one processor (Macro Meats) had recently introduced an environmental badge for its domestic supermarket packages, highlighting that kangaroos were softer on the environment than sheep or cattle and did not produce methane, a highly potent greenhouse gas. The issue of kangaroos vs cattle regarding the production of methane received considerable media attention in late 2007, both in Australia and overseas.

- Peter Chudleigh, Agtrans Research: Marketing of products from SWEs
- Peter Ampt, FATE Program UNSW: Consumer choice behaviour and lessons for the marketing of kangaroo meat

Supply chain issues in the kangaroo industry were covered in a number of workshop presentations and also generated a large amount of discussion in their own right. Meat quality, quantity and consistency of supply and skin size were three of the main areas discussed. The issue of transparency and accountability in the kangaroo industry came up a number of times and in some ways the workshop helped to bring about improvements in these areas by attempting to understand supply chain issues from the points of view of the different stakeholders.

The main issues regarding quality from processors' perspective were detailed as: how well dressed a carcase is; how quickly it enters a chiller after shooting; how it is stored in the chiller; and whether the carcase has been affected by dust or dirt. The view was expressed that these issues are less about final product quality reaching the consumer and more about yield – the better condition the carcase is in when it reaches the plant, the greater the yield of high-value cuts and the less meat that is wasted or downgraded. Quantity issues were based around efficiency and reliability of carcase collection – if a large number of carcases can be collected reliably from fewer locations, this adds value to the industry through efficiency gains.

The issue of skin size generated considerable discussion. Processors reported a glut of small skins and a number of measures they have undertaken to address this problem, including refusing to take smaller kangaroos, encouraging regulators to lift minimum weights and implementing a two-tied pricing structure, where kangaroos above the desired weight attract 80c/kg and those below 40c/kg. Harvesters particularly take issue with the two-tied pricing system, as it leaves them in the difficult position where landholders who have concerns about large numbers of small kangaroos (especially in Qld) are pressuring harvesters to take them , whilst processors are pressuring harvesters not to deliver small kangaroos through pricing mechanisms which make it uneconomic.

Opportunities were identified for landholder and harvester groups working together to improve a number of these supply chain issues. The Mitchell group has been negotiating for a return from processors if certain steps are implemented, such as reducing the number of shoot-and-let-lie licenses, imposing voluntary weight restrictions and applying standards that exceed regulatory requirements - all of which would benefit the industry overall. The small skin issue is a clear case where a better understanding of each stakeholders' business needs could be to the benefit to all – landholders could receive a return for accepting some of the impacts of smaller kangaroos, whilst processors could pay more to get a consistently larger-sized skin and a sustainable source of maturing kangaroos and harvesters could escape being squeezed from both ends.

Outcomes

There were a number of clear messages coming out of the workshop discussions:

- **Landholders and harvesters need to work together on their common interests:** This was reflected in a decision taken after the workshop by members of the three SWE groups to work towards a National Association of Kangaroo Growers and Harvesters. The SWE groups were initially formed around landholder organisations and sought to find economically valued roles for landholders in the kangaroo industry. However, these groups have morphed over time to include strongly-motivated kangaroo harvesters and much of the progress so far has been driven by the knowledge and interests of harvesters. Each of the groups has agreed to nominate a landholder, harvester and landcare/NRM representative to work towards the formation of a national association and FATE has agreed to provide secretariat support, including a website which can act as an information exchange for the SWE groups. The association's name, status, membership, aims and future funding requirements will all be considered over coming months.

- **There is a need for transparency and understanding each others' interests**: A number of participants (particularly landholders and harvesters) felt that the level of information-sharing, transparency, accountability and unity in the kangaroo industry was less than for other primary production industries. Partly this was explained by the ever-present need to defend the very existence of the industry from attacks by animal rights and "wildlife protection" groups, however, many participants argued that this lack of unity and transparency was a threat to the industry in itself. Understanding the business needs of each stakeholder and the ways in which decisions taken by one player impact on the others, particularly through business arrangements involving processors, harvesters and landholders, may help to resolve some of these issues.

- **There are ways for landholders and harvesters to add value to the industry**: The kangaroo processing industry indicated that, as a whole, it would continue to be hostile to any landholder/harvester proposals that did not add value to the industry. A number of different ways of adding value to the industry were discussed at the workshop, generally falling into two categories – increased sales (eg creating new markets or attracting higher prices from consumers) and reduced costs (eg efficiency gains through less transport or higher yields). In addition, it was also argued that the ability of a group to provide a processor with exclusive access to their product adds value as well. Discussions with processors collectively have not been able to identify which of these options present the best opportunities for landholder/harvester groups and therefore negotiations with individual processors would seem to provide the best course of action. Deals between individual processors and landholder/harvester groups may initially be based around the benefit of exclusive access, but over time other ways of adding value to the industry overall may be demonstrated - which could help overcome the collective resistance of the processing industry.

- **Commercial and regulatory models may have broad applicability**: There was strong interest amongst landholders, harvesters and other stakeholders in learning from the experiences of other groups with regard to commercial and regulatory models. The experiences of the Mitchell group with their processor negotiations and cooperative model and the experiences of the Barrier Ranges group with group licensing arrangements should be shared with other interested parties. The agreement to work towards a National Association of Kangaroo Growers and Harvesters should assist with this process and the new SWE website and contact group will facilitate further information-sharing.

We've attempted to cover the key points here, but of course there was a lot more discussed over the two days than we can fit in this summary. If you feel that any key points have been left out or misrepresented, please let us know by email or post a comment on the SWE blog.

The SWE website and blog will also feature news and information on developments taking place as part of the establishment of the National Association and other activities arising from the workshop.

Attendees at the SWE workshop

Name	Organisation
Alan Brady	
Alex Baumber	Researcher - FATE Program
Andrew White (Blue)	Trapper - BARG, BRSWET Steering Committee
Angus Whyte	Landholder - Rangeland Management Action Plan, Wentworth
Annabel Walsh	Landholder - Rangeland Management Action Plan, Wentworth
Brian Ingram	Landholder - Rangeland Management Action Plan, Wentworth
Carley Walker	Landholder - Longreach Qld
Charlier Girdler	Trapper, BRSWET Steering Committee
Dana Thomsen	Department of Environment and Heritage, South Australia
Devon Johnson	Trapper - Barrier Area Rangecare Group
Doug Jobson	Processor - Macro Meats
George Wilson	RIRDC Program Manager
Greg Bates	Processor - Vacik Distributors
Ian Brown	Processor - Australian Meats
Jim O'Connor	Landholder - BARG, BRSWET Steering Committee
John Kelly	Executive Officer - KIAA
Katrina Hannigan	Researcher - FATE Program
Kevin Ingram	Landholder - Rangeland Management Action Plan, Wentworth
Leon Zanker	Landholder - Tilpa district
Louise Turner	Catchment Officer - Western CMA, BRSWET Steering Committee
Margaret Chapman	Researcher - University of Queensland
Melinda Fletcher	Catchment Officer - Western CMA
Michelle Mannion	Landholder - BARG, Western CMA
Michelle O'Connor	Landholder, BARG
Michelle Scott	Federal Government - DEWHA
Nicholas Swadling	State Government - Queensland DPI
Nicholas Walker	Landholder - Longreach Qld
Nicole Payne	NSW DECC - Kangaroo management
Noni McCarthy	NSW DECC - Kangaroo management
Paul Moloney	Researcher - RMIT University
Peter Absolon	Kangaroo Shooter - South Australia
Peter Ampt	Researcher - FATE Program

Name	Organisation
Peter Chudleigh	Consultant - AgTrans
Rainie Weston	Landholder - BARG
Richard Anderson	Landholder - BARG, BRSWET Steering Committee
Rob Kemp	Trapper - Barrier Area Rangecare Group
Rob Seekamp	Landholder - Pastoralists Association of West Darling
Robyn Ingram	Landholder - Rangeland Management Action Plan
Rocky Pellegrino	Trapper - Barrier Area Rangecare Group
Rosie Cooney	Researcher - FATE Program
Sandy Bright	Landholder - Pastoralists Association of West Darling
Sheree Scott	Coordinator - Rangeland Management Action Plan
Stacey Henry	Coordinator - Mitchell and District Landcare Group
Tom Garrett	Trapper and Board member - SW NRM Qld

Glossary

BaRaRoo:	The Barrier Ranges Kangaroo business proposal.
Chiller:	Generally and insulated and refrigerated container which will accumulate, hang and chill approximately 100 carcasses waiting to be delivered to the meat processor. Usually owned by the meat processors.
Chiller Operator:	The person contracted to manage the chille, usually a harvester but can be a Landholder or professional Chiller Operator.
Field processing/ Dressing:	The cleaning of a carcass once shot by decapitation and removal of internal organs.
Harvester:	The person who holds a Trappers License and is legally entitled to shoot kangaroos under the official regulatory system – called a Trapper in the regulatory system
Land Holder:	A person who holds land under freehold title or under a Western Lands Lease
Member:	A person who is considered a Member of a co-operative on the basis of meeting membership criteria
Processor:	Carcasses are broken down in to meat and skin products at an abattoir
Returns:	The forms filled out by Harvesters to record information on species, quantities, area harvested, weights and in the future for BaRaRoo, carcass quality
Shooter:	Another term for Harvester or Trapper
Shooting:	The kangaroo is mesmerised by a bright spotlight at night and shot through the brain. Studies have shown death is instantaneous and it is considered more humane than subjecting an animal to the transport, holding and processing at an abattoir. Using more than one bullet significantly reduces profitability,so accuracy is important.
Trapper:	Another term for Harvester, derived from the Trapper's License they hold
Coliform:	A rod-shaped bacterium, esp. Escherichia coli and members of the genus Aerobacter, found in the intestinal tract of humans and other animals. Its presence in water indicates faecal contamination and can cause diarrhoea and other dysenteric symptoms
FATE:	Future of Australia's Threatened Ecosystems program. A project run through the University of NSW http://www.fate.unsw.edu.au/

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Building Cooperation and Collaboration in the Kangaroo Industry

— Towards a role for landholders —

by Peter Ampt and Alex Baumber

Publication No. 10/013

The Barrier Ranges Sustainable Wildlife Enterprise Trial, conducted over three years from July 2006 to June 2009, is a participatory action research study that focuses on the present and future role of landholders in the kangaroo industry. Through a range of strategies involving extensive consultation, analysis, intervention and adaptive management, the study has examined key aspects of the commercial kangaroo harvest system.

It has revealed a complex set of interactions between landholders, harvesters, regulators and processors in the case study area and beyond, and has implemented changes to components of the system and assessed the impact of those changes.

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Cover photo: Kangaroos on Fowlers Gap Station in the Barrier Ranges, Western NSW

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Barrier Ranges Kangaroo

Quality you have never had
Quality you can rely on

A business and industry development model.

April 2009

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Glossary

Word or phrase	Meaning
BaRaRoo	The name given to this buisness proposal **Ba**rrier **Ra**nges Kanga**roo**
Chiller	Generally and insulated and refrigerated container which will asccumulate, hang and chill approximately 100 carcasses waiting to be delivered to the meat processor. Usually owned by the meat processors.
Chiller Operator	The person contracted to manage the chille, usually a harvester but can be a Landholder or professional Chiller Operator.
FATE	Future of Australia's Threatened Ecosystems. A project run through the University of NSW http://www.fate.unsw.edu.au/
Field processing/ dressing	The cleaning of a carcass once shot by decapitation and removal of internal organs.
Harvester	The person who holds a Trappers License and is legally entitled to shoot kangaroos under the official regulatory system
Land Holder	A person who holds lands under a Western Lands Lease
Land Owner	A person who holds land under freehold title
Member	A person who is considered a Member of a co-operative on the basis of meeting membership criteria
Processor	Carcasses are broken down in to meat and skin products at an abattoir
Returns	The forms filled out by Harvesters to record information on species, quantities, area harvested, weights and in the future for BaRaRoo, carcass quality
Shooter	Another term for Harvester
Shooting	The kangaroo is mesmerised by a bright spotlight at night and shot through the brain. Studies have shown death is instantaneous and it is considered more humane than subjecting an animal to the transport, holding and processing at an abbittior. Using more than one bullet significantly reduces profitability so accuracy is important.
Trapper	Another term for Harvester, derived from the Trapper's License they hold
Coliform	a rod-shaped bacterium, esp. Escherichia coli and members of the genus Aerobacter, found in the intestinal tract of humans and other animals. Its presence in water indicates faecal contamination and can cause diarrhoea and other dysenteric symptoms

1. Executive Summary

To date, significant work has been undertaken to develop a group of 17 landholders with a combined area of over 900,000 ha. Also within this group are kangaroo harvesters which could be considered as the pick of the industry. FATE has undertaken significant work in regards to investigating kangaroo populations and harvesting rates in this area, the regulatory environment and implementing improvements, through to looking at consumer tastes and market requirements.

There is now the need to turn the research, findings and results into commercial and industry development reality.

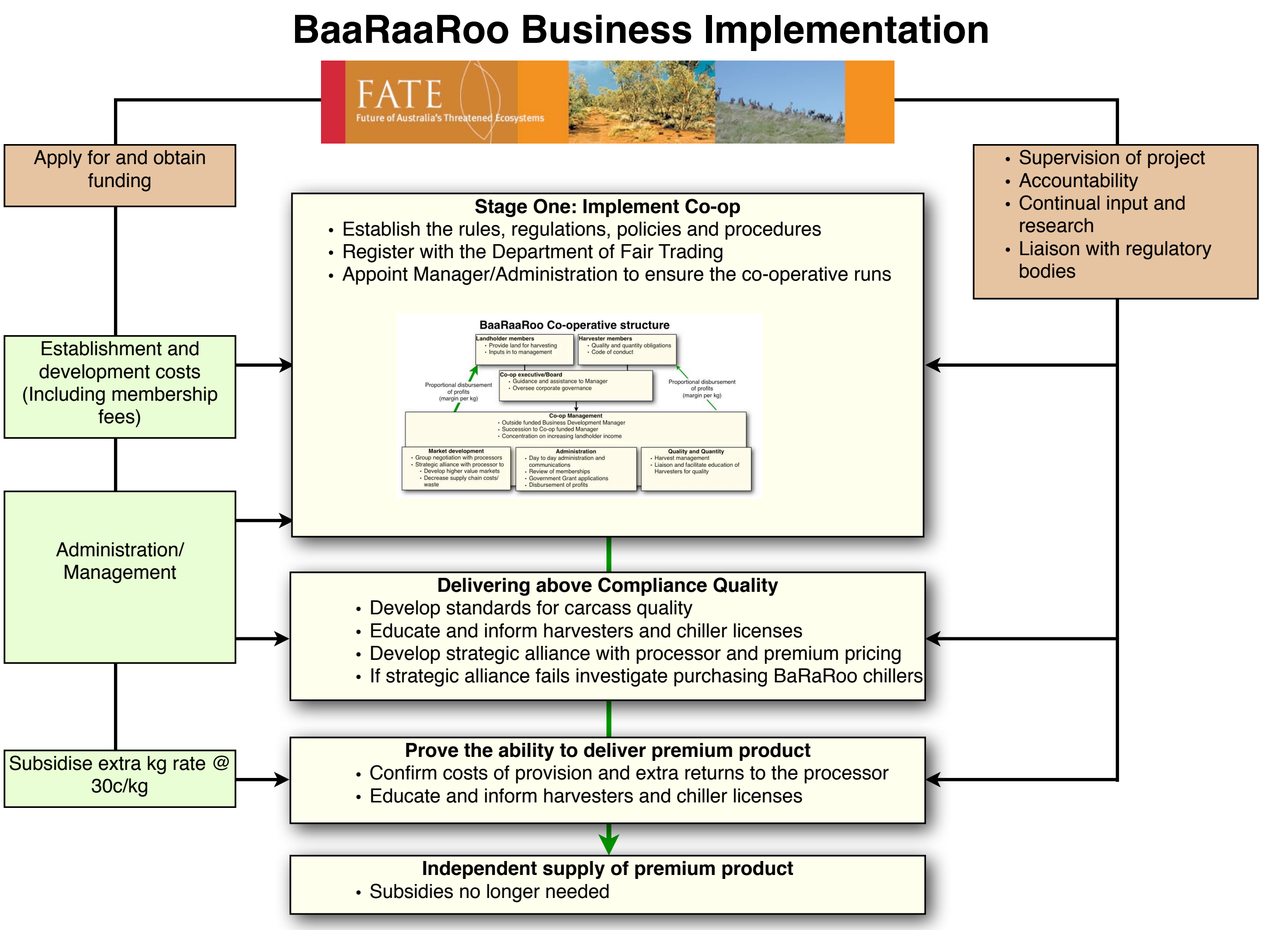
This revolves around

- developing a consistent quality of supply from a group of landholders and harvesters dedicated to quality and industry development
- Developing the link between landholder livelihood and the kangaroo for the purposes of population husbandry and the resultant increase in biodiversity and environmental health
- Developing strategic alliances with processor for the provision of quality kangaroo meat product into quality conscious markets
- Undertaking brand marketing to develop consumer confidence in identifiable quality and to develop regular purchasing patterns resulting in continual strengthening of domestic demand and gaining (and retaining) export markets

Financing such an ambitious an industry wide development is complex.

Until processors can develop markets based on consistent supply of quality they cannot pay a premium price for the supply of consistent quality. Without premium prices any supply organisation, such as BaRaRoo, cannot fund the required business development to supply consistent quality.

To address these issues the following process is proposed



1.1. Budget for implementation

1.1.1. <u>Outside expertise and costs</u>

Implementation of a cooperative required by BaRaRoo will require consultation and development of

- Membership performance criteria
- Disbursement arrangements for profits
- Policy and procedure
- Dispute resolution
- Application for registration

This will cost of approximately $9,000 if outside consultancy is engaged.

1.1.2. <u>Cooperative costs and Income</u>

1.1.2.1. Costs

The Cooperative will cost approximately

1.1.2.2. Income

Income is limited to Membership fees (to be agreed apon) at the initial stages which should generate

17 Landholders @ $200= $3400
15 harvesters @ $300= $4,500

1.2. Development in conjunction with BRR

In conjunction with the above implementation it is proposed FATE will be involved in further industry market development as outlined in Section 7 onwards.

2. Introduction

2.1. This Document

2.1.1. Document development

This document was commissioned to formulate a business plan for development of a kangaroo supply co-operative which would have the major objective of supplying consistent quality into the markets. During development of the plan it became clear that there were significant interrelated issues that also needed to be addressed if the original objectives were to be met. The issues finally addressed span from the kangaroos harvested through to consumer confidence in the product on the supermarket shelves.

This document attempts to achieve the original intention as a business plan for the formation of a cooperative and Sections 1-6 deal with this. It cannot provide the necessary financial analysis for a normal business implementation plan as reliable income streams cannot be determined until the market is better developed.

2.1.2. To be used by

This document is designed to be used:

- by Landholders wishing to form a co-operative group for the purposes of consistent quality supply
- as a guide by a future business development manager (or organisation) engaged to implement all or part of this document
- by organisations (government and private) looking for potential encompassing and long-term solutions to environmental, social, and economic issues which are, or can be, impacted by kangaroo harvesting.

2.2. Required reading

The rationale behind this business document are provided in two appendices documents. It is strongly recommended that any potential stakeholders read these papers to fully understand the depth of reasoning, logic and rationale that has led to this document.

2.2.1. Sharing Skippy: Models for Involving Landholders in Kangaroo Management in Australia

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2.2.2. Barrier Ranges Sustainable Wildlife Enterprises Trial

A joint initiative of the Barrier Area Rangecare Group (BARG) and the Future of Australia's Threatened Ecosystems (FATE) Program, UNSW

This is an internal document outlining the reasons for the kangaroo management trial which has resulted in this business plan.

2.3. Industry Background

In the need to balance the aims of nature conservation and the impact on agriculture from abnormally high native animal populations, kangaroo management programs were developed in each State of Australia.

It was recognised by conservation bodies that certain kangaroo species had undergone significant population increases due to human activities. For example, the Eastern Grey Kangaroo lives in woodlands during the day and grazes in open grasslands late evening to morning. Agriculture has significantly increased the habitat and consequently the population of the species. The Red Kangaroo will travel significant distances to graze on new growth as a result of discrete rain events. The introduction of tanks (farm dams) and bore watering points has provided water which allows Red Kangaroo populations to increase and remain relatively sedentary. This can lead to overgrazing and adverse impact on the habitat.

The objectives of the State conservation bodies' regulation of harvesting is to allow reduction in population numbers while still maintaining both population viability and geographic distribution.

Broad area aerial population surveys are undertaken by the New South Wales National Parks and Wildlife Service to ascertain population numbers and distribution on as district and regional level. From the resultant population estimates a yearly harvestable quota is determined (17% of estimated populations).

It is from this point onwards where difficulties in regulation & implementation arise.

In NSW, the state which contains BaRaRoo, Landholders apply to the regulatory body for tags, one tag represents one kangaroo for that specific property and must be attached to the carcass.

In an ideal world, when a request for tags to reduce kangaroo populations is lodged, the licensing authority would

- Consider the overall distribution of the kangaroos
- Have specific knowledge of the area
- Undertake an inspection to ascertain local impact within days of application
- Issue tags and licenses in a frame to address rapid influxes of kangaroos on to crops or new pastures.

In reality:

- Staff are too restricted to inspect every property
- Kangaroos are very mobile and not necessarily present when inspections take place
- The application process can be time-consuming and Landholders have become loath to go through the process of applying for tags
- Kangaroo Harvesters are not able to follow kangaroo herds from property to property unless every property is licensed and have obtained tags
- Conservation Department bureaucracies are generally not sympathetic to private enterprise wildlife Harvesters

2.4. Future of Australia's Threatened Ecosystems (FATE)

This organisation has been the instigator and driver for the Barrier Ranges Sustainable Wildlife Enterprises Trial and the development of BaRaRoo. This body operates from the University of New South Wales. Simplistically, FATE's overall aims are to investigate and encourage methods of increasing Australia's biodiversity in degraded environments. FATE considers utilising native a natural resources is better for the ecosystem than using introduced species with their associated foreign impacts.

To create a change in western New South Wales land management and utilisation it is better if income can be generated from lower impact native resources with a resultant increase in biodiversity and ecosystem health. For this to be achieved a financial return needs to be obtained by Landholders from native resources such as kangaroos, feral animals, timber, etc.

Consequently, FATE has consistently researched the kangaroo harvesting industry for the purposes of developing a holistic regulatory, harvesting, processing, value adding and marketing framework to

- Decrease bureaucratic hurdles
- Increase income to all participants, particularly the Landholders
- Successfully manage kangaroo populations for income and conservation values

- Increase quality control as an integral aspect of operations
- Increase market profile through consistent quality and results in marketing activities

2.4.1. Barrier Ranges Sustainable Wildlife Enterprises trial

This trial was approved under the alternative kangaroo management provision of the NSW kangaroo Adaptive Trial Management provisions and the result has led to the formation of this business plan.

Essentially, the trial involves a number of Landholders with a combined total area of 1 million hectares. Instead of allocating tags on a property by property basis in small lots, tags are issued for the whole area for the whole quota period and used by the Harvesters according to where the populations are affecting the Landholders.

This system can allow:

- Harvesters to respond quickly to Landholders with population influxes
- Harvesters to follow populations across properties
- strategic planning of harvesting over the year to
  - smooth out population variations
  - supply consistent volumes to processors

To justify to the regulatory bodies this change of procedure, research has been undertaken to show how population dynamics over the trial group compare with the population dynamics of the Broken Hill and Tibboburra regions. It was found that the BaRaRoo group has a more stable population dynamic than either the Broken Hill or Tibboburra harvesting regions BRR overlaps.

2.4.1.1. Theory meets practice

It is the legal requirement for Harvesters to attach a tag issued to a specific property only on the kangaroos harvested on that property. However, considering:

- tags are generally allocated based on broad area population estimates;
- Licenses are generally issued without site inspections and may not truly represent local population distribution;
- The practicalities of Harvesters working at night;
- Kangaroo populations moving over a number of properties ;

these requirements are generally impractical and often not adhered to by the Harvesters.[1]

BaRaRoo addresses this inherent regulatory non-compliance.

1 Experiences of the author NSW NPWS District Ranger, Narrabri, Kangaroo industry licensing, 1986

3. BaRaRoo Business Description

3.1. Business objectives

3.1.1. To develop a business framework which encourages quality of harvest, quality of storage, quality of processing through profit, membership requirements, & peer group regulation and encouragement so as to ensure the business is reputable, consistent and reliable.

3.1.2. To realise the potential income which can be derived from kangaroos through better commercial harvesting practices, consistency of quality

3.1.3. To develop a strategic alliance with a processor so BaRaRoo can be involved in the development of a value added premium market through financial and organisational arrangements of mutual advantage

3.1.4. To increase market demand by offering a consistency of quality and supply volume obtained through a self interested co-operative whose Members uphold the objectives of quality, reliability and consistency of supply

3.1.5. To obtain regular and reliable markets based on quality, customer satisfaction and increase market penetration so as to properly utilise surplus kangaroo populations to increase income to Landholders, Harvesters and processes

3.1.6. To holistically manage and harvest kangaroo populations over a broad area in keeping with kangaroo population dynamics in the practicalities of harvest, storage and processing through flexibility in tag allocation, population survey and chiller management

3.1.7. To develop incomes for Landholders from kangaroo populations so that Landholders become positively involved in population and harvesting management

3.1.8. To work closely with the Government, industry, processors and other agencies (eg FATE) to develop the kangaroo industry in regards to supply, quality, branding and regulatory reform.

3.2. SWOT Analysis: BaRaRoo

3.2.1. Strengths

- Ecologically sustainable kangaroo resource
- Large land holdings offering relatively stable kangaroo populations as compared to the Broken Hill and Tibboburra regional areas
- Simplified bureaucratic and regulatory processes in keeping with the nature of the resource and harvesting methods
- Ability to respond quickly to harvest Kangaroo population influx in localised areas
- High level of credible research and development by FATE
- Excellent research, academic and political resources for continual support of BaRaRoo by the FATE program
- Proactive Landholders and trappers desiring the objectives of
  - increased income
  - sustainable land and wildlife management
  - Reduction of bureaucratic hurdles

3.2.2. Weaknesses

- Slow or difficult to obtain responses from Landholders and trappers to communications by BaRaRoo administration
- Significant distance between stakeholders which inhibits the ability to meet and communicate face-to-face
- Lack of dedicated full-time business and market development activity i.e business development manager
- Relatively long timeframe before BaRaRoo can operate as a completely independent financial entity, thus requiring financial subsidy for implementation in a reasonable time frame
- Difficulty to obtain leadership and commitment as Members have full time commitments elsewhere

3.2.3. Opportunities

- If introduced stock are replaced with kangaroos as a source of income
  - Potential carbon credits (kangaroos do not emit methane)
  - Increased by biodiversity with associated benefits
  - Simplified animal husbandry and land management
- Changes in market trends desiring
  - Low fat foods
  - Ecologically sustainable products
  - Green credentials

3.2.4. Threats

- Drought continues long enough for stakeholders to lose interest due to lack of viable kangaroo harvesting numbers
- Loss of kangaroo meat markets - due to inconsistent quality- before BaRaRoo can secure stable long-term markets
- Discontinuation of support for BaRaRoo on a political and financial level
- Discontinuation of the current BaRaRoo kangaroo harvesting regulatory concessions and re-imposition of the standard regulatory and bureaucratic framework

3.3. Kangaroo Harvesting and Processing Overview

Kangaroo Harvesting and Processing Process Overview

	Process	Description	Quality Issues to be addressed	Industry Notes	BaaRaaRoo
In the paddock	Kangaroo harvested in the wild by a licensed shooter at night. Field dressed and delivered to the Chiller before dawn	A specially rigged vehicle, satisfying food industry standards, drives through the bush. A bright spotlight mesmerises the animal which is head shot, more humane than abattoirs. The animal is field dressed.	Disreputable shooters may operate in daylight with a decrease in carcass quality due to prolonged time and heat between harvest and chilling Insufficient cleaning (laziness) decreases carcass quality	Shooting and field processing kangaroos attracts a variety of individuals, some who do not operate ethically or with a concept of quality.	Co-operative shooters have membership based on quality, consistency and reliability Only Co-operative shooters can harvest on member's properties and use any co-operative chillers (if the co-operative ends up owning chillers)
Field Storage and delivery	The Chiller Operator checks quality and accepts or rejects carcasses.	A refrigerated container located at strategic positions around the region accumulates carcasses for pick up and delivery to the processor.	Non-selective harvesting (laziness and lack of 'big picture' involvement) decreases carcass quality Non-selective acceptance by Chiller Operator lowers industry standards. Low quality carcasses rejected by one chiller may be accepted by another	Chiller is generally owned by a meat processor(abattoir). Privately owned chillers tend to be the first overlooked when the market declines More rapid chilling (better quality retention) requires more space between carcasses and thus lowers productivity of chiller	Chiller Operators are Co-operative members with quality criteria mandatory. Corporate control ends here Strategic alliances and arrangements start here A strategic alliance with a processor enables use of specific and quality controlled chillers
Carcass processing	Meat processor grades for quality and market demand	The carcasses are broken down in to meat and skin products at a licensed abattoir	Lack of consistent quality due to the above and volume prevents processors developing reliable premium products		A strategic alliance with a meat processor enables the development of a consistent quality product for market development
Products and Marketing	Marketing is up to the processors and smallgoods manufacturers. No industry based marketing	Meat is sold directly as pet food, to supermarkets and some to further value adding processors (butchers and smallgoods manufacturers)	Lack of quality control has lost export markets (coliform counts too high)	The demand for kangaroo meat is growing but hampered by lack of consistent quality to give consumers and restaurants confidence in consistency of taste, tenderness and shelf life	Quality control throughout the process provides consistent and reliable product for specific image branding and marketing

3.4. Products & Services

3.4.1. <u>Position in the value adding chain</u>

BaRaRoo's direct commercial activity ends at the provision of carcasses to the chiller which is the sale point to the processor. Part of this business plan is to look at the feasibility of BaRaRoo purchasing its own chillers to ensure delivery of quality.

3.4.2. <u>Kangaroo Products</u>

A product can be defined at the stage when one party obtains payment and the other has unhindered use of the item. For example the iron ore deposit is a product sold by the government (via royalties), the extracted iron ore is a product of the mining company, the nail is the product of the manufacturer and the house is the product of the builder. The product stages of the kangaroo industry are partially muddied by the regulatory system but essentially the are

Product	Sold By	Bought by	Industry Notes	BaRaRoo product difference
Live Kangaroos	Government via tags/ royalty	Harvester	The kangaroos gain sustenance from the land and add to farm management costs but farmers cannot obtain any direct income as they can from introduced livestock or pest species. Thus kangaroos are seen as pest and of no commercial value	Better selection of kangaroos Quality control by chillers • Better carcasses • Consistent quality • Consistent supply
Carcasses	Harvester	Meat Processor	Product quality can vary though price remains the same	
Meat and skin products	Meat processor	Markets	Quality is variable making it difficult to keep long term quality markets (restaurants, butchers and export) Markets are regularly gained and lost accordingly.	**Services to Strategic Partner** Strategic marketing alliance with BaRaaRoo to sell consistent quality to quality markets and gain higher price

Note: Government regulation, tracking and accountability ends when the carcass becomes processed meat and the hide becomes tanned.

3.4.3. <u>BaRaRoo Services</u>

One of the objectives of this BaRaRoo is to gain a higher price for selected carcasses BaRaRoo will be looking to assist in processor obtain higher value markets. This will be dealt with in greater detail below.

3.5. Providing Quality

The success of any product relies on the product meeting customer expectations. If quality is inconsistent customer expectations are not always met and sales decline.

Currently, the Kangaroo industry does not have a consistent method of supplying quality carcasses and specific processing of such. As a result, market development is retarded. The retarded market and limited demand provides no incentive to incur the extra costs to provide consistent quality. Catch-22.

BaRaRoo aims to assist the breaking of this cycle by providing consistent quality so processes and other stakeholders can provide consistent quality to the market for developing demand. Of course, BaRaRoo expects to obtain a higher price for this extra quality.

3.5.1. <u>The reason for quality</u>

3.5.1.1. Markets

Restauranteurs and food service operators that already use kangaroo meat call for more consistent quality and this inhibits them from more active promotion. Existing buyers of kangaroo meat are 'variety seeking' consumers who look for a point of difference and do not necessarily buy meat in supermarkets. They would buy it more often if it was in gourmet butchers and premium food distributers and outlets. The current product is not trusted, hindering development of this market.

3.5.1.2. Greater returns

To obtain profitability for the development of the group, industry and landholder

3.5.1.3. Current Quality Situation

Loin fillet is of consistent quality in terms of tenderness. Other large cuts are tougher from older (larger) animals. The industry can easily sell higher quality cuts but sells other cuts at very low prices, impacting on the profitability of the whole industry. Of the kangaroos delivered at the chiller only a certain proportion are premium carcasses which will provide premium quality cuts of meat. The same price is paid to the harvester regardless of the quality of carcass.

A significant proportion of kangaroo meat is used in pet food, a lower-priced product. Generally, not all of the carcass is used for human consumption as prime cuts are removed and the rest relegated to pet food. This method of processing reduces the overall value of the carcass.

A good-quality carcass can be used completely for human consumption with the prime cuts being sold as large pieces, smaller cuts being sold as diced meat and mince. This is similar to beef scotch fillet, stewing steak and mince respectively.

If good-quality carcasses are separated at time of delivery (or even before delivery), processed independently to ensure the whole carcass enters the higher value markets, the carcass is far more valuable than a carcass which has mixed value or is purchased in the same batch as lower quality carcasses.

3.6. Chiller Operations

Chiller ownership by the co-operative for the purposes of convenience and profit must be considered.

3.6.1. Chiller description

A chiller is generally an insulated and refrigerated shipping container set up on stilts so its entry and exit doors are on the same level as the refrigerated pickup truck. The chillers are located in townships which are relatively central to the harvesting area and the harvesters.

3.6.2. Throughput and productivity

A 20’ chiller holds 200-240 carcasses though a rate of 150 carcasses per week is considered to be good chiller throughput. To double the space for each carcass to speed cooling down and consistent temperature (quality), the chiller would hold half that amount brining productivity down to 110 carcasses per week, a 27% decrease in throughput. See Section 6.1.1 for the effect on price.

3.6.3. Procedure

Carcasses are brought to the chiller before sunrise where they can be chilled and accumulated for pickup at a later date. There are relevant Australian standards on how quickly the carcasses need to be chilled and the maximum time they can be kept in storage.

3.6.4. Quality control

Kangaroos can be unloaded into a chiller without the chiller operator present however, it is the chiller operator who signs off on the quantity and quality of the carcasses. A good chiller operator will educate the harvester on matters of quality with the ultimate ability of refusing carcasses which are below the standards required.

In reality if a harvester’s cull is refused due to low quality the harvester can often ahve the opportunity to drive to another chiller which will accept the inferior product. Maintaining quality standards in the industry is difficult under these circumstances. Thus the industry need for BaRaRoo.

3.6.5. Ownership

The majority of the chillers are owned by meat processors. The processor will pay a chiller operator rate per kilogram to maintain and staff the chiller. At the time of this plan this rate was $.09 per kilogram.

Some chillers are owned by a harvester and the meat processor will pay an extra amount to the chiller operator in allowance for the costs of infrastructure.

3.6.6. Chiller business security

When the market experiences downturn the meat processors will obtain carcasses from their own chillers before purchasing from chillers that are independently owned. This is simply because the processor wishes to ensure it fully utilises its own overheads.

Consequently, Harvester/chiller operators are in a less secure position in regards to making sales at obtaining a return on chiller equipment investment when the market is experiencing a downturn.

3.6.7. Return on chiller ownership

As can be seen from the following calculations extra profit can be obtained by operating and/owning a chiller. The convenience of having the chiller in a convenient location is also of advantage. The advantages can be outweighed in the long run if the processor favours their own chillers in a market downturn. If the chiller is made 'on the cheap' through fortuitous purchase of second hand equipment, or is built cheaply by the owner, the chiller owner can operate at a profit however, to do so in the long-term, depends on obtaining a similarly priced replacement.

Return on Chiller Ownership	New Chiller	Cheap Chiller
Income		
Carcasses per week	150	150
Average carcass weight (kg)	22.5	22.5
Total kgs	3,375	3,375
$/kg extra processor pays owner to own chiller	$0.08	$0.08
Total extra income due to owning the chiller	**$270**	**$270**
Costs		
Capital cost	$11,000	$5,000
Establishment costs	$4,000	$500
Total Establishment	**$15,000**	**$5,500**
Interest rate	9.5%	9.5%
Loan Term (years)	10	10
Loan repay per month	$194.10	$71.17
Loan repay per week	$45.14	$16.55
Running costs		
Electricity or generator costs/week	100	100
Maintenance/year	$1,000	$1,000
Maintenance/week	$19.23	$19.23
Total weekly costs	$164.37	$135.78
Chiller profit Harvester owned per week	**$105.63**	**$134.22**
Estimated profit per year	$5,493	$6,979
Gross Return on investment per year (not including labour costs)	**36.62%**	**126.90%**
Total Gross profit for three chillers	**$16,478**	**$20,938**
Less Labour costs		
4 Hours required per week @ $25/hour total wage cost Per chiller per year of 52 weeks	$5,200	$5,200
Total labour cost per year for three chillers	$15,600	$15,600
Total profit/loss	**$878**	**$5,338**

3.6.8. Strategic advantages of chiller ownership

If BaRaRoo owned its own chillers it has a strategic advantage of controlling a significant supply of kangaroo carcasses. The group have a greater ability to negotiate on price. This strategic positioning will take time to develop as currently the chillers used by the group's harvesters see to a number of processors.

If a viable strategic alliance with a processor can be developed the financial security and strategic advantages would be valuable.

3.6.9. BaRaRoo desire for chiller ownership.[2]

In FATE's 2008 landholder survey there was a negative landholder reaction when asked about chiller ownership or operation. Chiller ownership and chiller operation were ranked below

- receiving a payment from a processor
- receiving a payment from a shooter

[2] Alex as per his comments, how to reference?

- becoming a shooter on all 3 criteria asked (compatibility with existing grazing business, income potential and fairness).

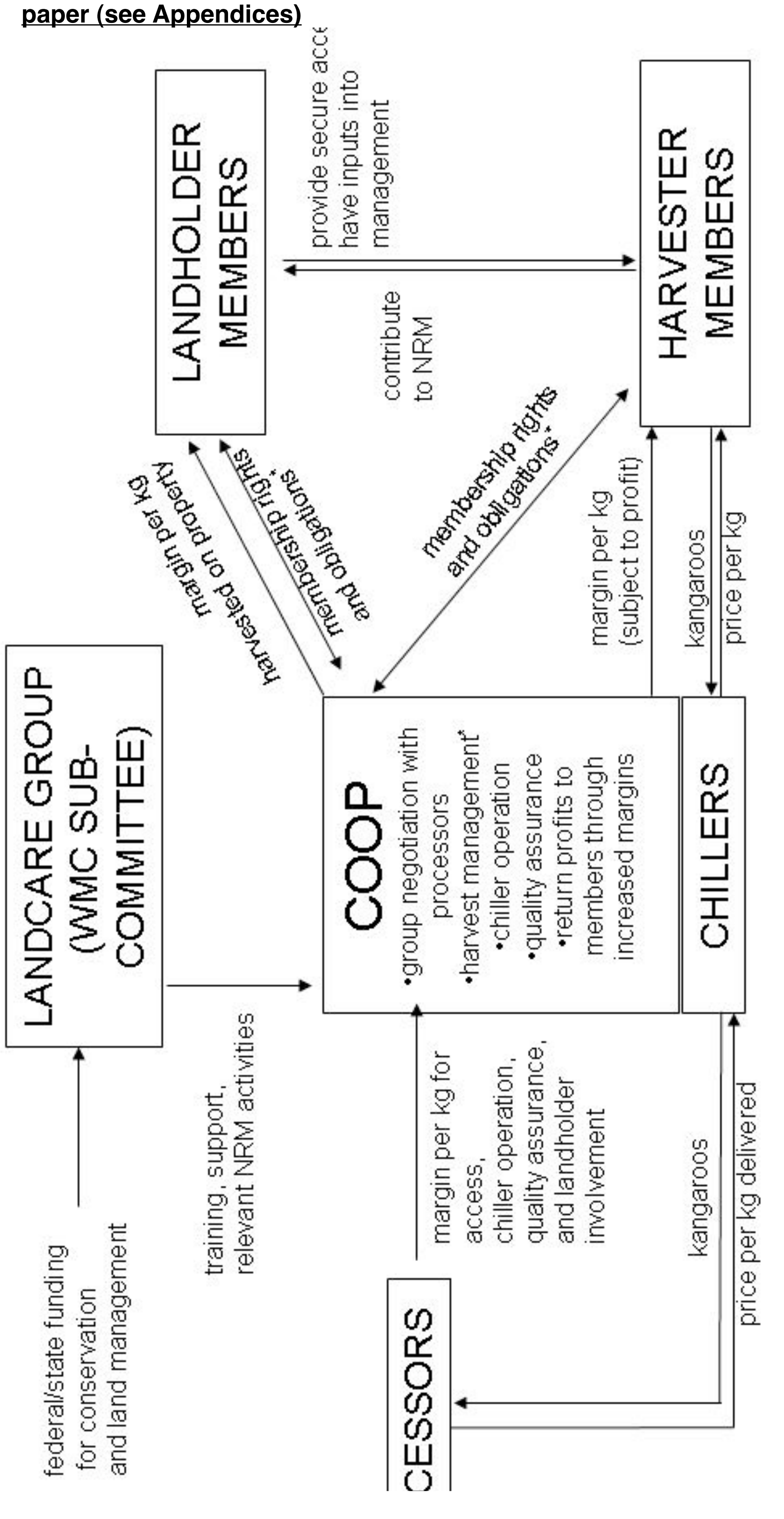
Those who provided comments cited time and workload as key reasons.

4. BaRaRoo Management

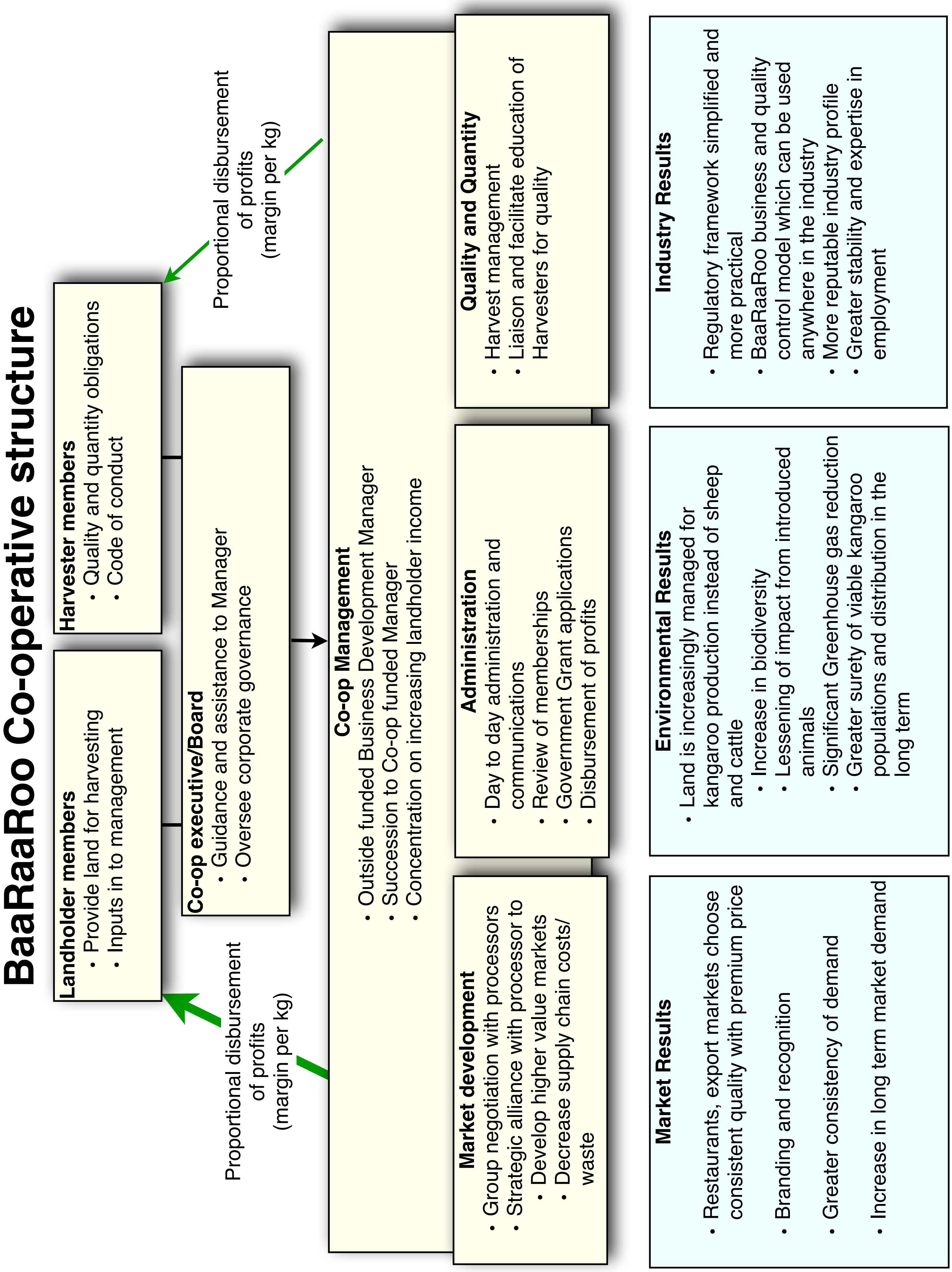
4.1. Choosing a BaRaRoo Corporate Structure

The chosen business structure is a Co-operative. The information below provides the rationale. Details of different legal structures are in the appendices for the information of Members and the reader.

4.1.1. The interrelationship between the Cooperative and stakeholders as per the Sharing Skippy paper (see Appendices)



4.1.2. **Cooperative Structure**



4.1.3. Note on terminology:

- 'Member' generally refers to a person who is a Member of an organisation such as a co-operative.
- 'Owner' refers to a person who has legal ownership of whole or part, such as a proprietary company.

4.1.4. Member and business characteristics

A business entity will need to consider the following.

4.1.4.1. Member Activity/role/function

Members will be

- Landholders or land owners who manage the land kangaroos will be harvested from
- Harvesters who will harvest the kangaroos
- A combination of any of the above

4.1.4.2. Changing membership over time

While it is expected the Members/owners to be relatively stable there will be people leaving and people entering the business who will have vested interests in success and profitability.

4.1.4.3. Founding investment and greater long term returns

The initial stakeholders have invested significant time in meetings, trials, changing of methods which has been unpaid. This input can be considered as an investment in future business success and the stakeholders would assume to reap rewards commensurate with being founding Members.

As the business evolves new stakeholders will be capitalising on the investment of the founders and with reduced risks.

4.1.4.4. The effects of changing membership commitment

For a variety of reasons the performance of Members may rise and fall. A once productive Member may become no-co-operative, or simply uninvolved. If this Member has part ownership of corporate assets or significant voting power the business can become dysfunctional.

For example, a proprietary company shareholder may no longer contribute or invest further into the company but still be entitled to shareholders dividends and retains their proportional share of increasing asset values and business profits as a result of the, often unpaid, work of other shareholders. In one case known to the author of this report shareholders are faced with the requirement to borrow funds (on top of their initial founding investments) to buy out a shareholder who did not contributed tangibly to the business assets in the first place.

Such a situation can demoralise other owners who are working diligently but see their investment diluted by the uninvolved shareholders. This situation can create factions (eg destructive voting bloc factions), and encourage the proactive Directors to form alternative business activities and structures to ensure the results of their hard work comes to them and not those who are seen as 'bludging'.

The ability for the business to be able to give and take away membership on a transparent and objective criteria is important.

4.1.4.5. Quality/performance control

One of the objectives of BaRaRoo is to maintain a consistency of quality and quantity.

In normal business transactions quality control can be maintained by choosing the desired quality product from the supplier.

This is not so easy in the kangaroo industry where the professionalism of Harvesters and chiller operators varies considerably.

BaRaRoo must be able to encourage, or enforce, quality and consistency as an integral part of its operation.

4.1.5. Important practical differences between business structures relevant to BaRaRoo

4.1.5.1. A proprietary company's characteristics relevant to operational requirements of BaRaRoo

- Shareholders hold shares in the company owning as much of the company as their proportion of shares
- It is convoluted and difficult to have shareholders sign away traditional rights of financial ownership
- Various share types can be voting or non voting
- A shareholder can vote in proportion to the amount of shares they own (if the shares have voting rights) and can buy shares from others and increase their influence
- Shareholders cannot have their shares taken away from them, they must voluntarily relinquish the shares (sale or gift)
- Shares can be sold to third parties who may not embrace or contribute to the initial objectives
- Shareholders cannot be coerced, because of share ownership, to fulfil conditions of corporate governance or supplier performance

4.1.5.2. A Co-operative's characteristics relevant to operational requirements of BaRaRoo

- Members have only one vote each
- Memberships can be different categories according to the role of the Member eg supplier, processor, Landholder, harvester
- Membership can be conditional on factors such as
  - Quality, quantity, reliability of supply
  - Membership activity (eg attendance at key meetings)
  - Operation within the guidelines of the co-operative eg
    - Code of conduct
    - Submission of paperwork
    - Operating in a reputable and legal manner
    - Co-operation with other Members

4.2. BaRaRoo Co-operative operating guidelines

Below sets out the basic principles for the development of the co-operative's rules, regulations, policies and procedures.

4.2.1. Fixed and variable factors

4.2.1.1. Fixed factors

These factors do not change significantly according to circumstance such as variations of production. They can be likened to Fixed Costs in financial terms.

Fixed factors can be considered as the overarching principles and operational parameters which apply to all Members and operations of the Co-Operative.

For BaRaRoo business operations the Fixed Factors are

1. Consistent quality of carcasses for the purpose of establishing higher selling price
2. consistency in quantity for the development of reliable markets and strategic alliances with a processor

4.2.1.2. Variable factors

These factors can change significantly according to circumstances such as variations of production. They can be likened to Variable Costs in financial terms.

For BaRaRoo business operations the Variable Factors are factors such as

1. Landholders with different land areas
2. Landholdings with traditionally and significantly different kangaroo production
3. Harvesters with varying production levels
4. Future changes in productivity due to deliberate and positive kangaroo management activity

4.2.1.3. Delineation between Fixed and Variable factors

It is important to separate fixed and variable factors in the same way it is important to separate fixed and variable costs in financial analysis.

The separation will be achieved by the co-operative by

1. Membership structure based on productivity and quality (fixed factors)
2. Distribution of profits and benefits according to proportional inputs (variable factors)

4.2.2.Membership structure classes based on productivity and quality

As outlined above, ensuring constant participation, productivity and quality is important for the long-term aims of BaRaRoo. Membership based on these features is probably the simplest method of communicating and enforcing these key factors.

4.2.2.1. Landholder membership

Membership criteria

- Provision of land to to the co-operative for the purposes of harvesting
- Must allow unrestricted entry to approved trappers according to co-operative policy and codes of conduct (developed with Landholder input)

4.2.2.2. Trapper membership

Membership criteria

- Minimum supply of carcasses per year (level to be determined)
- Operates according to the
    - adopted BaRaRoo harvesting requirements
    - Statutory regulations
    - Relationship with Landholders
- Quality controls specific to BaRaRoo

4.2.2.3. Combined membership

A Member can hold more than one membership category, for example Landholder AND Harvester membership.

To hold each category the Member must fulfil the membership criteria of each category. A Landholder who is also a trapper contributes in two ways to the Co-Operative and is involved in two distinct commercial activities.

These two commercial activities are individually eligible for the proportional disbursement of dividends/income from the co-operative (see below)

4.2.3.Voting rights

Each membership confers one vote to the Member.

Consequently combined membership allows for a vote for each category entitling the holder to two votes if they hold two categories.

4.2.4.Losing membership privileges

The membership criteria will be specific enough to allow objective assessment of performance and quality so that objective decisions can be made.

Note: The main aim of the membership criteria is to ensure consistency of production and quality, not to penalise Members whose circumstances have temporarily changed.

While policy and procedure detail is to be finalised it is likely the broad guidelines will be:

- Membership performance reviews will be undertaken automatically at the end of each financial year and assessed according to membership criteria
- Member performance is automatically reported in the end of year reports and automatically reviewed by the Board for determination of membership
- Interim breaches of membership criteria by any Member can be requested by any other Member. (encouraging peer regulation)
- The Manager undertakes all interim reviews with verification by a nominated Board Member
- Revocation of Membership is a decision of the Board

4.2.4.1. Protection of Member's reputations

In the development of this document examples of poor Harvester professionalism were reported to be

- commencing shooting too early in the day (carcasses stay warm for too long)
- not placing carcasses in chillers until well after sunrise (carcasses stay warm for too long)
- providing carcasses not conforming to regulations (not cleaned and dressed to industry specifications)

Note: the Harvesters given as examples were not Members of BaRaRoo.

Dealing with issues such as these requires enough information and 'investigation' to unquestionably revoke membership. If the concerns are found to be unwarranted or un-proven, a person's reputation can suffer unnecessarily. Likewise, incorrect or mischievous claims against a Member can also damage reputation.

The Board will consist of Co-Operative Members so confidentiality in any special review of Member performance is important. Consequently, the Manager of the co-operative, who is not a Member, undertakes the review and a nominated Board Member verifies the information to ensure the Manager has been diligent. If it is found that the Member is non conforming the issue is then presented to the Board for action.

4.2.5.<u>Distribution of profits according to proportional inputs</u>

Eventually the co-operative will generate income and disburse profits and benefits to Members.. It is possible the co-operative will also generate profits derived from expansion into value adding enterprises at a later date.

Landholders who have greater harvesting rates due to

- Area
- Inherent productivity
- De-stocking of introduced animals
- Active kangaroo management

contribute a greater income to the co-operative.

Harvesters who

- harvest more consistently (reliance on the job as a profession)
- harvest at higher volumes (efficiency, knowledge, expertise)
- provide better quality (selection of prime animals, adhere better to best practice harvesting methods)

contribute more to the profitability of the co-operative.

4.2.5.1. Determining proportional returns to Landholders

FATE has already analysed properties who will be in the co-operative to determine which are reliably more productive than others and thus obtain greater proportions of profit distribution.

Historical trends or using information on Harvesters records can determine the proportions of contribution.

Mechanisms for determining changes in land management to increase kangaroo populations and harvesting volume will be developed in the Co-operative's policy and procedures.

4.2.5.2. Determining proportional returns to Trappers

According to quality and quantity of carcasses delivered and shown on the Shooter's returns.

4.2.5.3. Founding members and start up costs

Founding members will have invested in start up costs separate to the membership fee. In the development of the detailed Cooperative policies and procedures these funds could be considered

1. As long term liabilities to the Cooperative to be repaid as profits are obtained
2. As justification for greater share of profit disbursement over a period of time

as decided by the members.

It is likely to be considered that the first option is the simpler due to investment is not lost if the member leaves the cooperative.

5. Implementation of a BaRaRoo Co-operative

5.1. Considerations

To instigate BaRaRoo a number of issues confronting business development must be considered. The issues are, or arise from:

- The remoteness and distance between stakeholders
- Group dynamics
- Individualism of Members
- The time and dedication which can be expected to be interested by stakeholders
- Availability of Member funds for up front to investment
- Short-term cash flow and income issues with Members
- Scepticism by Members that the regulatory and market hurdles can be overcome
- Business development process
- The need to change existing paradigms in the regulatory, harvesting, processing and marketing environments

5.1.1. Investment by Members

5.1.1.1. Availability of funds

The Members have been suffering drought and a resultant reduction of incomes in the industry for some time. This does not diminish the long term value of the industry but it does impact on the ability of Members to significantly contribute and invest in new ventures.

5.1.1.2. Wariness of investment in new ventures

The kangaroo industry reputation is considerably influenced by:

- Government regulatory systems considered (rightly or wrongly) as impractical and inefficient by those directly involved and those considering business development in the supply side of the industry
- Industry participants who are reputed to be less than ethical, honest or legal
- Adverse press from extremist environmentalists

Note: BaRaRoo considers it is addressing these issues through its formation and anticipated future actions.

The Members of BaRaRoo are in the weakest negotiation position in the industry. They are generally dictated to by the processes and regulators who set the prices, methods of operation, and stifle negotiations and competition. This is fairly typical in the agriculture industry.

With little individual self-determination in the industry BaRaRoo Members need to be <u>shown</u> that they can make changes.

The Members of BaRaRoo have come together with the hope of being able to make changes but until political, regulatory, and commercial success is clearly demonstrated the desire to invest money and time will remain weakened by past experience.

Consequently it is unlikely the Members can afford to invest in the Co-Operative to the level where a dedicated business development manager can be appointed.

5.1.2. Leadership

BaRaRoo, to date has had its leadership provided by the FATE program. This program has developed the project, brought people together, maintained the vision provided the communication and followup, and provided a central focus point.

At the time of this plan this leadership was losing momentum due to

- the cessation of funding
- The completion of
    - the initial tasks of group formation
    - Completion of the new regulatory systems
    - Initial research goals

- Lack of resources to progress the project from the research stage to business implementation and development

The development of any group business, cannot be undertaken by a group of people who have full-time commitments in other areas. It must be driven by a dedicated individual (or close knit partners) who has multi-tasking skills in communications, business systems, business operations, logistics, organisation and marketing.

It is rare to find an individual in a group, such as BaRaRoo, who is prepared to sacrifice a portion of their livelihood to develop a business for the group unless they are paid accordingly and their position is clearly recognised. As mentioned above, the historical lack of self determination of Landholders and Harvesters in the kangaroo industry has not bred confidence to tackle the issues.

Consequently, BaRaRoo has been the result of dedicated individuals in FATE ultimately working to address larger scale environmental, economic, and social issues.

This does not imply that Members of BaRaRoo are not dedicated or do not have skills, it just means that it will require some measure of success to engender self-perpetuating enthusiasm in Members so as to encourage investment of time and resources.

Consequently, the long term objectives of BaRaRoo will require a dedicated business development manager to provide the initial skills, time and energy.

5.1.3. Income stream for initial business development

As discussed in the financial section of this business plan the main source of future income of the co-operative will be from obtaining a higher price from the sale of carcasses. This cannot be obtained in the first instance as the processor will need to experience the quality and reliability of supply and also be sure they have a market which is prepared to pay for the same.

5.1.4. Management/Administration/Business development

For any business entity to operate it must have a clear administration, management and communication.

BaRaRoo suffers from considerable distance between stakeholders, and for a number of Members lack adoption of newer methods of communication such as email and internet. Members have properties to run which includes significant time spent in summer keeping water up to stock. Running a business and the administration and accountability required is difficult for landholders.

FATE has provided this service to date.

5.2. Business Development process

It is relatively inexpensive to set up a co-operative business using volunteerism from the Members. An organisation developed in this manner would be limited in effectiveness due to the reasons above: finances, leadership, and available time.

BaRaRoo business development and ultimate success relies not only on its internal structures and performance but very much on proactive and strategic marketing of a quality product.

The time, skills and costs to properly achieve this are significant. As mentioned above, FATE to date has provided the impetus and insight and energy to bring the project together but FATE has limited ability to take the project into a business reality due to

- Ceasing funding for the project
- It is primarily a research body with a different skills set to a business development body

However, BaRaRoo recognises that what it is trying to achieve has major positive outcomes for the economy, industry and the environment of the rangelands and considers that this may gain support from sources of financial support with similar objectives, i.e. Government and industry bodies.

BaaRaaRoo Business Implementation

Apply for and obtain funding

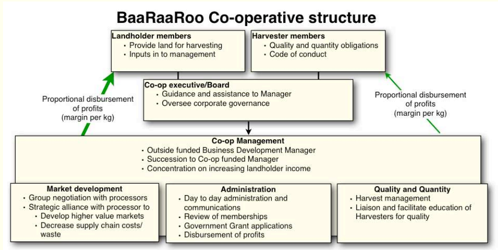
Establishment and development costs (Including membership fees)

Administration/ Management

Subsidise extra kg rate @ 30c/kg

- Supervision of project
- Accountability
- Continual input and research
- Liaison with regulatory bodies

Stage One: Implement Co-op
- Establish the rules, regulations, policies and procedures
- Register with the Department of Fair Trading
- Appoint Manager/Administration to ensure the co-operative runs



Delivering above Compliance Quality
- Develop standards for carcass quality
- Educate and inform harvesters and chiller licenses
- Develop strategic alliance with processor and premium pricing
- If strategic alliance fails investigate purchasing BaRaRoo chillers

Prove the ability to deliver premium product
- Confirm costs of provision and extra returns to the processor
- Educate and inform harvesters and chiller licenses

Independent supply of premium product
- Subsidies no longer needed

6. Financial

6.1. Costs of providing quality

6.1.1. Chiller Cost

Cost of reduced chiller throughput due to increased quality		
The chiller is only affected if it would normally stock more than 110 carcasses per week.		
	Chiller Manager	Chiller Owner*
Existing rate	$0.09	$0.08
Good chiller throughput per week	150	150
Quality carcass throughput	110	110
Price/kg increase for same income to cover costs	36%	36%
Extra chiller rate /kg	$0.033	$0.029
Required Chiller rate /kg	$0.12	$0.11
Total Increased Chiller costs /kg	**$0.06**	
* The extra cost paid to the independent chiller owner would also be incurred by processor owned chillers		
Extra Harvester Costs		
Assuming no extra costs, just good practice	**$0.00**	

6.1.2. Co-operative Management

This section deal with the long term costs of a cooperative. The establishment and holding costs of a cooperative are not significant. However, the maintenance of a Co-operative has legislative governance and reporting requirements which must be complied with to prevent penalties. Financial reporting from a an accountant is required each year and above a certain turnover the accounts must be audited.

For a turnover of less than $10,000 per year exemptions in reporting can be applied for.

If the cooperative is to function well in the longer term it must generate an income which can be used for the development and betterment of the business.

The development of a cooperative can vary in its costs according to where the management can be obtained.

6.1.2.1. Possible Incomes from premium returns

Eventually, cooperative management would be funded by a premium obtained on premium quality Kangaroo carcass sales.

If the cooperative can establish a premium for all of its carcasses the following income streams can be envisaged.

Possible revenue from different premium pricing							
Base information							
Historical harvest quantity				20,000			
Expected harvest quantity				17,000			
Average carcass weight				22			
Total kg				374,000			
Extra $/kg	$0.10	$0.15	$0.20	$0.25	$0.30	$0.35	$0.40
$ collected	$37,400	$56,100	$74,800	$93,500	$112,200	$130,900	$149,600

6.1.2.2. Using outside management

In this scenario all expertise and infrastructure is external. An external manager must spend more time in communications, travel,organising and overheads. The estimated costs for an independently engaged cooperative manager:

Business Development/Co-operative Manager			**Total**
Base Salary			$60,000
Super and Workers Comp	9%	3%	$7,200
Holiday leave loading	17.50%		$875
Vehicle lease	770	/mth	$9,240
Fuel	100	/wk	$5,200
Office Rent	100	/wk	$5,200
Phone and internet	150	/mth	$1,800
Travel	250	5/mth	$15,000
Office costs	50	/mth	$600
Total			$105,115
$/kg price premium to pay for Co-op manager			**$0.30**

6.1.2.3. Utilising Co-Op members

An energetic and suitably experienced/qualified person from within cooperative members is likely to reduce costs significantly due to established infrastructure, communication, understanding of the members and importantly, another income source so full time employment is not required to retain the Manager. The estimated costs for an internally engaged cooperative manager:

Business Development/Co-operative Manager			**Total**
Base Salary (1/2 time)			$30,000
Super and Workers Comp	9%	3%	$3,600
Holiday leave loading	17.50%		$438
Vehicle lease	770	/mth	$9,240
Fuel	100	/wk	$5,200
Office Rent	100	/wk	$5,200
Phone and internet	150	/mth	$1,800
Travel	250	5/mth	$15,000
Office costs	50	/mth	$600
Total			$71,078
$/kg price premium to pay for Co-op manager			**$0.20**

6.2. Premium price required for future sustainability

Costs	$/kg
Proactive part time management	$0.20
Extra Chiller costs	$0.06
Desired Return to landholder	$0.05
Total premium /kg	**$0.31**
Existing price	$0.85
Final price / kg sought as a minimum	**$1.16**

6.3. Income generation

The ultimate long term solution to kangaroo management is to provide a positive commercial link between those responsible for animal husbandry and the kangaroo.

Industry Income Generation Sources

Income Source	Who receives	Coming back to the landholder?
Tags sales	Government	If administration and regulation is simplified and costs drop can some of this go back to landholders. Current opinion considers this is highly unlikely.
Land Access fees	The landholder	Informal and not often obtained. This money is paid by the harvester. As no formal arrangements exist or are formally recognised, determining a workable rate is difficult at this stage. This needs further investigation
Chiller fees and wages	Chiller operator	Only if the landholder owns the chiller and extra payments cover costs only.
Carcass sales	Harvester	The harvester owns the carcass, not the landholder
Meat sales	Processor	Only through a premium paid to a group for providing premium quality (this BaRaRoo project)

6.3.1. Carcass sales

This is potentially the best position to obtain extra income for a group of landholders and harvesters which can provide a product of higher quality and value. The co-ordination of such a group comes at a cost which can absorb a significant, if not all, the extra income generated.

Until further research is undertaken in the margins available for providing high quality carcasses the income generation cannot be reliably determined.

This table is also presented in Section 6.1.2.1

Possible revenue from different premium pricing							
Base information							
Historical harvest quantity				20,000			
Expected harvest quantity				17,000			
Average carcass weight				22			
Total kg				374,000			
Extra $/kg	$0.10	$0.15	$0.20	$0.25	$0.30	$0.35	$0.40
$ collected	$37,400	$56,100	$74,800	$93,500	$112,200	$130,900	$149,600

6.3.2. Income from kangaroo ownership

Under the current regulatory and legislative environment the government owns the kangaroos (though they grow on landholders land). The income from tag sales is used to pay for:

- Kangaroo population surveys
- Licensing
- Regulation

If the system becomes simplified due to

- changed legislation
- a commercial incentive for landholders to encourage and husband kangaroo populations

- Organisations such as BaRaRoo which provide demonstrated sustainable, environmentally responsible and accountable harvesting regimes

costs are likely to be reduced. Obtaining these savings to strengthen the link between the landholder and kangaroos is ideal but realistically probably very difficult.

6.3.3.Income from 'land access' fees

Some landholders have special arrangements with harvesters who pay so much per kangaroo harvested from the property.

These arrangements are illegal as the Landholder is not recognised under law as having any ownership of the kangaroos and are not allowed to sell Crown property. Such payments are disguised as access fees or 'camping' fees.

When these fees are paid by harvesters the arrangement gives the Harvester exclusive access to good harvesting areas. However, Landholders who have lower quality harvesting areas or are surrounded by neighbours who did not ask for such fees cannot obtain an income from this source.

Harvesting kangaroos is not a job which in the general population chooses to undertake because of the conditions, the variations of income and sometimes, the bureaucracy that is involved. Reducing the income of harvesters by making them pay for both tags and a price per head to the landholder could potentially upset the viability of harvesting as a profession.

Imposing any levy or fee arbitrarily on harvesters would need significant consultation and research if it was to be considered.

6.3.4.Chiller fees and ownership

As discussed in other areas of this document operating a chiller is essentially a break even point providing some labour income for the chiller manager. Income derived from chiller managing or ownership does not create a significant profitable income which would be required for industry development or creating the link between landholders and kangaroo.

However ownership of three chillers **would return approximately $16,000 per year** to the cooperative which would assist with administration in the early stages.

6.3.5.Membership fees

Members would pay a fee to the cooperative each year. Obviously Members will wish to see a net return for this membership fee. The fee is to be determined but at the stage of this plan a yearly fee of $200 per landholder and $300 per shooter is considered. This would need to be agreed to by the Members on formation of the cooperative.

17 Landholders @ $200= $3400
15 harvesters @ $300= $4,500

6.3.6.Meat sales

This section of the market is too removed from the landholder and BaRaRoo to be considered as a potential income source.

6.4. Cooperative establishment costs

To establish the cooperative as a 'bare bones' structure for the purposes of developing a legal entity to further develop the BaRaRoo project:

BaRaRoo Co-operative establishment		
Co-operative structure, policies and procedures, and registration (FATE or consultant)		
Meetings/liaison with members	4 days	$4,000
Developing Rules and registration	3 days	$3,000
Travel and On-costs		$2,000
Total		**$9,000**
Cooperative Administration costs per year		
Tag issue		$2,000
Cooperative running per year		
Administration/governance/reporting/accounts/ memberships	12 days	$3,600
Telephone, office and travel	$2,000	$2,000
Accountancy and legal	$1,500	$1,500
Total Yearly costs		**$9,100**
Income		
Landholder Membership at $200/year	$3,400	
Harvester Membership at $300 per year	$4,500	
3 x Chiller ownership $0 per year after wages paid	$0	
Total Income		**$7,900**
Profit/Loss		**-$1,200**

7. Industry & Market Development in conjunction with BaRaRoo

The following is the approach which will be undertaken for further development of the kangaroo industry and market in relation to BaRaRoo.

7.1. Project development if funding could be obtained

BaRaRoo does rely on the kangaroo meat market to be developed for its long term success. This document is oriented to industry development based on a an approach of using the resources of organisations (FATE) and individuals (BaRaRoo members). The below diagram highlights a more co-ordinated approach if funding could be obtained.

7.1.1. Business Development Manager Terms of Reference

The following Terms of Reference will serve as a guide for engaging and appropriate person for BaRaRoo development. The final terms of reference will depend on

- the type of funding
- The level of individual commitment and skills offered from the membership of BaRaRoo
- The level of financial support obtained by FATE, the processor and the industry for market development

I. Introduction

The BaRaRoo project is a collection of 27 landholders and their kangaroo Harvesters with the ultimate objective of providing consistent quantity and quality to the Kangaroo meat markets. To do so requires a mixture of its own business development, business development of the meat processor and market development. Only its own business development is within its control. Work with the processor and market/industry development will be undertaken using strategic alliances and co-operation.

II. Business Development Manager is expected to undertake the following tasks

A. BaRaRoo Development

- Formulate the rules and regulations, policies and procedures of the cooperative
- Communicate and co-ordinate between the members
- Organise and implement meetings
- Development and implement a succession plan for the long term
- Develop specific BaRaRoo business and marketing plan relevant to unfolding processor and market situation
- Find and apply for relevant funding as applicable
- Implement identity and branding and website as per budget

B. Processor strategic alliance

- Work with the selected meat processor and the development of quality control and quality/ branded product from the market
- Develop premium pricing strategy and implementation in keeping with market development

C. Industry development

- Seek industry involvement and funding for the development of markets
- Engage in the government departmental and political level to gain support for market development and legislative change in regards to kangaroo management.
- Liaise, work with and take direction from the FATE program

III. Expected outcomes

- Regular reporting on progress and outcomes
- Appropriate corporate governance and accounts
- BaRaRoo co-operative operating independently and funded by premium prices
- Effective and operating policies and procedures providing consistent quality of kangaroo carcass supply to the processor
- Clear documentation of BaRaRoo operations so that the co-operative can be instigated in other areas
- Demonstrated achievement according to the above

IV. Timeframe

The project will continue over two years and it is expected the minimum time commitment will be (not including travel time)

- Month 1-6   10 working days per month on average
- Month 6-12 7 working days per month on average
- Thereafter   5 working days per month on average

V. Project management

The project manager will report and take direction from

A. FATE in regards to
   - Industry development
   - Political and government negotiations
   - Research and development matters
   - Market development

B. The Board of BaRaRoo in regards to
   - Development of quality standards
   - Policies and procedures
   - Day-to-day management
   - Corporate governance
   - Budgets and finances
   - Organisational structure
   - BaRaRoo marketing and identity
   - Processor strategic alliance and negotiations

The following are to be completed when the Tenders/Applications are called for

VI. **Administrative Matters**
VII. **Confidentiality**
VIII. **Privacy**
IX. **Contact details**

7.1.2. Type of Business Development Manager: Consultant or full time employee?

A Business Development Manager could be gained by two methods, a Consultant engaged on a contract or a full time employee.

7.1.2.1. Consultant

The 'right' consultant can offer business development expertise and experience which cannot be obtained from employees within an affordable price range. A consultant is generally more expensive on an hourly basis than a full-time employee however:

- They are generally not required on a full-time basis as they can facilitate and achieve tasks in a more efficient and effective manner due to experience and contacts
- Has a ceiling fee covering all of their own on costs so a fledgeling organisation does not have too provide workers compensation, superannuation and other employment on costs.
- The higher skills sets and experiences and contacts can prevent mistakes and inefficiencies from occurring

The consultancy industry is like any other service provider, it has good and bad providers. The "right" consultant would need to show the following characteristics

- Experience in business development (structures, marketing, product development)
- Excellent communication skills with Kangaroo Harvesters, Landholders, bureaucrats, and politicians
- Real business experience, not just academic or consultancy
- Project management skills over the long-term
- Energy and dedication to tasks and can demonstrate they are task driven not payment/rules driven
- Genuine philosophical and practical alignment with the objectives of the project
- Demonstrated mobility (not desk bound)
- Approachable, not hidden in a corporate structure
- Appropriate qualifications and experience relevant to the project
- Approachable manner and not 'all knowing' as the kangaroo industry has a very low 'bull' tolerance

7.1.2.2. Full time Employee

It is more likely that a full-time employee would come after the initial major business and market development simply because of the high expertise required in the initial stages.

However, if there is a possibility of gaining an appropriately skilled manager in the first instance a consultant, if required, can be used to mentor the manager.

The permutations of the arrangements will depend on on the people and skills available closer to implementation.

7.2. Strategic alliances

BaRaRoo at its early stages of formation will not be in the position to be responsible for marketing of a premium meat product as it's formal commercial activities end with supply of carcasses to the processor.

However, as BaRaRoo is ultimately trying to establish a market for its products, which exists on the other side of the meat processor, the processor must become engaged in the process.

It will do this through two main strategies

1. A strategic alliance with a processor to ensure supply and have input into the marketing of quality product
2. Working with the industry for the development of branding, marketing, brand awareness, consumer acceptance

7.2.1. <u>BaRaRoo will offer a strategic partner</u>

1. Resources of the FATE program
    - Market research
    - Political and market contacts
    - Assistance in accessing government industry development funding

2. Collaboration in regards to
    - Selection of quality animals
    - Specific harvesting and processing requests

3. Priority in
    - Supply
    - Communications
    - Business matters

4. Assistance in marketing such as
    - Development of brand and identity (depending on funding)
    - Public appearances
    - Availability for television and media exposure

Long term Kangaroo Industry Development

Stage One

Initial Research and Development (FATE)
- Alternative kangaroo management structure and methods finalised and implemented
- Market and kangaroo management research completed
- 16 landholders and 900,000 hectares and their harvesters brought together
- Strategic Business planning completed

Stage Two
June 2009- 2014

Resources required to progress

External funding for Project Development Manager
- 2 years minimum (preferably 4)
- Implement Co-operative
- Strategic alliance with Processor
- Industry development
- Marketing development
- Approximately $200,000-400,000

Market development funds.
$ To Be Determined

Funds for continued FATE input
$ To Be Determined

BaRaRoo Implementation
- Organisational structure
- Development of Strategic Alliances
- Management and communications
- External funding

Processor
- Selected as having the same market objectives of consistent quality and volume
- Works with BaRaRoo and industry in product and market development

Industry
- Assists in market development
- Branding
- Information and marketing
- Research in to margins and premium pricing

FATE
Continues
- Research
- Political and industry positioning of the project
- Long term legislative change

Stage Three
Noticeable in 2014?

Outcomes (Time frame depends on resources applied)

BaRaRoo
- Environmental outcomes (default)
- Simplified and efficient kangaroo management mechanisms
- Quality control
- Consistency of supply
- Vehicle for industry management change (transferable model)
- Financially self sufficient

Processor
- Funds quality suppliers paying premium prices for premium carcasses
- Gains extra income from increased pricing for premium pricing

Consumers (Market)
- Consistent quality for
  - restaurant menus,
  - Smallgoods and value adding
  - Export markets
- Consumer awareness
  - Health
  - Environmental
  - How to cook

Government (Society)
- Reduced regulatory costs (profitable?)
- Efficient kangaroo management
- Increased Environmental health
- Sustained Export and local markets
- Regional employment and economies

7.3. Developing the Market

The meat industry is a complex industry with many stakeholders. The industry has a number of regulatory arms, industry bodies and associations.

Undertaking an individualistic and solitary marketing campaign is likely to be lost amongst the plethora of activity in the marketplace. However, interest in the Kangaroo industry is growing significantly amongst consumers, processes and the government who are increasingly recognising the health, environment and social advantages of utilising an environmentally low impact and productive animal.

Consequently, it is proposed to galvanise this interest into a co-ordinated and concerted marketing campaign. This campaign would need to be long-term as consumer attitudes take time to develop and export markets need to see consistency and quality over an extended period of time to have the confidence to invest in their own markets.

The proposed marketing process is represented in the diagram below. However, the significant vested interests by various stakeholders is likely to refine this process as the marketing plan is developed.

7.3.1. Government and industry input

Government, as part of its role, undertakes activities of social and economic engineering and to do so provides incentives and disincentives accordingly.

This project addresses some very significant issues and eminently corresponds with some of government's objectives in key areas of social, economic and environmental realms.

If government can see these benefits and assess them as issues they wish to see solved then it is likely the BaRaRoo project can attract funding for appropriate development.

Government programs vary in their amounts, objectives and timeframes and the plethora of programs and the varying eligibility criteria make the searching and application process complicated. It will take commitment of time and resources of current stakeholders to undertake this task.

This plan will be used to gain available funding.

7.3.1.1. Engaging in the industry

The Kangaroo Industry Association of Australia is undertaking industry marketing www.kangaroomeat.net.au was launched on 6th April.

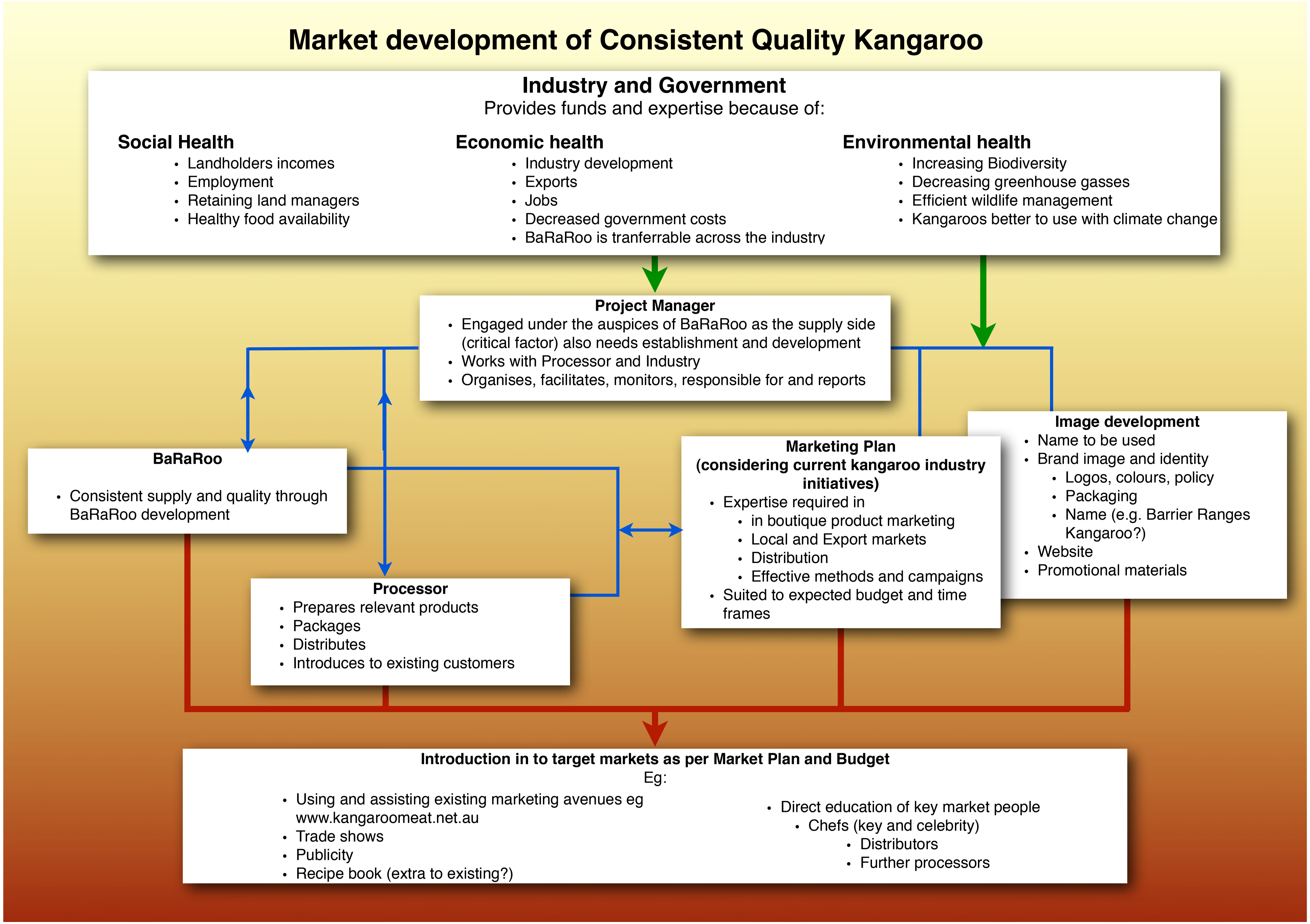
BaRaRoo marketing activities will compliment and utilise, with permission, any industry activity as much as possible. BaRaRoo will only divert from current industry marketing activity to fill voids in marketing directions and activity.

7.3.2. Project management

Any project requires leadership and direction and at the time of this document this leadership was coming from FATE.

As BaRaRoo is the result of FATE the development of the project efficiently comes under the auspices of BaRaRoo, particularly as the supply side is so important.

It is also important that the suppliers (Landholders and Harvesters) are engaged in the process of market development, not only to reinforce the tenets of quality but also to ensure longer term larger goals are met in regards to kangaroo population encouragement for harvesting purposes.



Market development of Consistent Quality Kangaroo
Industry and Government
Provides funds and expertise because of:
Social Health
Landholders incomes
Employment
Retaining land managers
Healthy food availability
Economic health
Industry development
Exports
Jobs
Decreased government costs
BaRaRoo is tranferrable across the industry
Environmental health
Increasing Biodiversity
Decreasing greenhouse gasses
Efficient wildlife management
Kangaroos better to use with climate change
Project Manager
Engaged under the auspices of BaRaRoo as the supply side (critical factor) also needs establishment and development
Works with Processor and Industry
Organises, facilitates, monitors, responsible for and reports
BaRaRoo
Consistent supply and quality through BaRaRoo development
Processor
Prepares relevant products
Packages
Distributes
Introduces to existing customers
Marketing Plan
(considering current kangaroo industry initiatives)
Expertise required in
in boutique product marketing
Local and Export markets
Distribution
Effective methods and campaigns
Suited to expected budget and time frames
Image development
Name to be used
Brand image and identity
Logos, colours, policy
Packaging
Name (e.g. Barrier Ranges Kangaroo?)
Website
Promotional materials
Introduction in to target markets as per Market Plan and Budget
Eg:
Using and assisting existing marketing avenues eg www.kangaroomeat.net.au
Trade shows
Publicity
Recipe book (extra to existing?)
Direct education of key market people
Chefs (key and celebrity)
Distributors
Further processors

7.3.3. BaRaRoo

BaRaRoo not only supplies kangaroos but can also supply an important marketing face to consumers. The BaRaRoo members are not only demonstrators of ecological sustainability and colourful characters which are appealing in marketing programs, but also very pragmatic people important for the development of practical and efficient solutions to land management and the regulatory environment.

7.3.4. The processor

The processor is pivotal in ensuring quality carcasses are used in providing a quality product. The processor will need to grade carcasses and process separately using different packaging and presentation. The processor will be expected to approach their current markets with the new product and also to gain a higher price.

The processor must be engaged with BaRaRoo to ensure appropriate carcass quality and also engaged with the development of the marketing and branding which will directly impact on their own business

The longer term objectives of FATE and government will be to transfer any working models to other areas. The process can view this as an opportunity or as a threat.

If the processor undertakes their role well and invests appropriately this project could offer the processor significant long-term market share and the ability to expand in to other areas that adopt the BaRaRoo methods.

7.3.5. Image development

Image development will be critical to address particular consumer attitudes of environmental sustainability and quality. This will not only be issues such as logos and colour but also the environment and acceptability of packaging and advertising.

Colours and logos should be tested on the potential consumers in the market to gain confirmation and it should not be assumed that any overseas markets will have the same branding perceptions as another.

7.3.6. Marketing plan

A marketing plan is important to ensure maximum cost effectiveness and to ensure the target market and the methods of marketing are peer reviewed before implementation. This project is too important to get it wrong.

7.3.7. Taking it to the market

The size and complexity of campaigns will depend upon the budget.

The Kangaroo Industry Association of Australia is undertaking marketing. Its strategy, long-term planning and budget is unknown to this document. It remains to be seen if further funds can be obtained for the BaRaRoo project.

www.kangaroomeat.com.au the latest marketing tool but does not mention anything in regards to a quality product or specific branding, the two major unique selling points of BaRaRoo.

While the kangaroo industry does not pay any levies to the Meat and Livestock Association this should not prevent it from obtaining marketing funds from other avenues.

7.4. Implementing co-ordinated funded development

7.4.1. Cash Requirements

7.4.1.1. Business Development Manager (Independent consultant)

BaRaRoo Ideal business development budget		
This budget can be used flexibly, say employing a consultant less and a successor more		
Business Development Manager		
Months 1-6 10 days per mth	60	$60,000
Months 6-12 7 days per mth	42	$42,000
Months 6-24 5 days per mth	60	$60,000
Total		**$162,000**
Travel allowance		
Sydney to BH		
Time x 2 @ $400 per day	$800	
Vehicle 1200 km x 2 x .67c/km Can be used for flights and hire car	$1,608	
Hotel and living @ $150 per night 4 nights	$600	
Per trip	$3,008	
Once per month for two years	24	**$72,192**
Administration Costs		**$5,000**
Total Consultancy cost		**$239,192**
BaRaRoo Costs		
Branding, website and corporate identity		$5,000

7.5. Financial analysis

At this stage a full evaluation of the financial outcomes cannot be properly developed due to the variable and unknown future income streams.

Regardless of commercial viability of a cooperative the concept of consistent supply of quality product is important for the industry, the environment, and society.

8. Appendices

I. About the Author and observations on group business development
II. Different Corporate Structures
III. Sharing Skippy
IV. BARGE paper

I. About the author and observations on group business development

This business was prepared by Peter van Herk. Mr van Herk has particular experience directly relevant to BaRaRoo.

- 1984-88 District Ranger, Narrabri District. Responsible for the District kangaroo management program, surveys, property inspections, tag allocation, Trappers licenses
- 1988-2000 furniture design and manufacture (business owner/developer)
- 1996-1998 instigator and export manager for Daplar, a consortium of value-added timber manufacturers marketing into Japan
- 1995-2002 timber drying and processing (business owner/developer)
- 2002 to present: business model and implementation of the Australian Arid Zone Timber project for the development of markets for timbers in the semi-arid areas of Australia (initially facilitated by FATE). This is a group of land holders working as a group similar to BaRaRoo
- 2002 to present: full-time business development consultancy in business planning and industry development incorporating
    - The Broom Bush Industry strategic plan
    - Industry business, marketing and strategic plans for metal fabricators, agricultural products, community organisations, restaurants and cafes
    - Manager of the Bush Food Sensations program. Mentoring and developing 10 Aboriginal businesses in the food industry and group development

The above experience has directly influenced development of this document.

While business systems, corporate governance, unique selling points, sustainable competitive advantages are very important for business success it is often the skills, personalities and motivations of individuals which can ultimately determine success or failure.

Development of a sole owner business is significantly different to developing a business which is owned by a group. The dynamics and organisational structures are completely different as are the participant's motivations, goals and desires.

A sole business owner, or couple, will often mortgage their property, borrow money from the bank and work extraordinary hours to achieve their business and personal goals. A person in a group will rarely do this as they cannot fully control the outcomes, thus the perceived risk is much higher.

There is also a difference in group development characteristics between groups made of business entities and groups made of nonbusiness individuals.

A. Groups formed from business entities
   Business entities generally apply business analysis to the objectives which can be achieved in group co-operation. Factors such as group purchasing, greater market dominance, stronger ability to advocate within the industry, entering new markets, lowering costs by sharing capital equipment, increasing sales by selling and purchasing within the group are very strong reasons for business entities to combine. The individual businesses then invest according according to the returns they perceive.

B. Groups formed by non-business entities/people
   A group formed by people relatively unfamiliar with business development can have difficulties in perceiving longer term business development outcomes relative too short term sacrifice. Analysis and decisions are based far more on pre-existing paradigms and emotions rather than new information and analysis. Arranging combined purchasing, meetings, marketing, accounting, corporate governance, communications, and the benefits of group activity are harder to obtain and visualise.

   Often individuals in such groups perceive that success is diluted as it is shared with other people.

In the development of groups such as consortiums and co-operatives I have found that it is critical to have at least one main driving person who is accepted by the group on a professional basis. This is generally obtained by employing a motivated person from outside the group who brings objectivity and the appropriate business development skills to the group. Government funding bodies also recognise the strength of having dedicated project managers as compared to group committees comprised of people who have full-time commitments elsewhere.

A business development manager, or project manager's, effectiveness is greatly enhanced by having a professional, dedicated and motivated Member of the group as their supervisor. This is preferably the chairperson.

II. Different corporate structures

Summary regarding forms of association for cross-property kangaroo (or other wild resource) management

Compiled by Rosie Cooney, August 2007.

Based on initial web-based research supplemented by discussion with UNSW lawyers and participants in collaborative resource management in Australia and southern Africa.

Introduction
When people want to work together to achieve various aims, a variety of mechanisms and structures are available. Which of these is used will depend on the context and what they want to achieve. Specifying exactly what the parties want the organisation to achieve is a critical first step. Some of the key factors that will then be important in making a choice of organisational structure to achieve these aims include

- flexibility
- liability of individuals involved
- perpetual succession (whether the organisation persists after its Members die or leave),
- financial and administrative burdens of establishment and operation, and
- tax implications.

Legal advice will be necessary and should be sought when establishing any structure beyond an incorporated association.

1. Contractual relationships
A web of contracts could be established between Landholders, Harvesters and processors establishing mutual rights and obligations. This is a less formal structure. However, such a network may be expensive to establish as it would require extensive legal input in contract negotiation period. Substantial change in circumstances would require contract re-negotiation. Exit or entrance of individuals to the collaborating group may require re-negotiation. For these reasons collaborative action based purely on contractual obligations is not considered further.

2. Unincorporated associations
These have no legal personality: they cannot enter enforceable contracts, sue or be sued, and Members may be personally responsible for debts or other actions against the group. They therefore can be ruled out, as there is strong interest among Landholders in ownership of chiller boxes, establishing contracts, and other activities requiring legal personality.

3. Incorporated associations
These are incorporated under State/Territory law. Incorporation establishes an organisation as a legal entity, allowing it to continue regardless of changes to membership, accept gifts and bequests, buy and sell property, enter into enforceable contracts, incur debts, sue or be sued in its own name, and establishing limited liability of Members. It may allow a body to apply for Government grants. There are certain costs compared to unincorporated associations, including that books are open to public scrutiny and a public officer must be appointed. An incorporated association can carry on business.

Compared to companies, the advantages of an incorporated association are that it is cheaper and simpler to administer. There is less paperwork and fewer expenses. They are much more lightly regulated than companies. The disadvantage is that any profits made should be used to further the objectives of the association, not provide personal gain for its Members. Additionally, if the association wishes to conduct activities at a national rather than state level (such as selling to processors based in other states, for instance) there may be difficulties as legislation varies across jurisdictions.

Note that Mitchell and District Landcare Association is an Incorporated Association. Some Landcare organisations establish both incorporated associations and companies.

4. Companies
Another option is to register under the Commonwealth *Corporations Act 2001* as a company. Compared to incorporated associations, advantages of a company include:

- can make and distribute profits for its Members or shareholders
- ability to conduct national or international activities, under Commonwealth law
- ability to apply for federal grants and sponsorship
- a more secure and transparent governance system (in terms of financial record-keeping and company housekeeping)
- possibly higher status in public perception.

Disadvantages include:

- higher level of regulation means more expensive and complex structure to establish and maintain e.g.

- registered office required. This can belong to the representative accountant or lawyer, but may require payment.
  - lawyer likely to be required at set-up stage, particularly around development of rules regarding membership and rights and obligations
  - financial record-keeping more onerous and likely to require professional accounting services.
- decision making process may be more cumbersome
- public exposure (disclosure and registration of information and directors, etc.)
- additional responsibilities under Corporations Law for any directors associated with the company.

Companies have a choice between a constitution and replaceable rules (or a mix of both). (Replaceable rules are the internal management rules of a company set out under the *Corporations Act 2001* (s 141), and replace the need for a constitution). The constitution sets out the governance structure, function and objectives of the company.

There are several forms of relevant companies. They can be limited by guarantee or by shares, and be public or private (proprietary).

a. Public company limited by guarantee
A company limited by guarantee has no share capital. Each Member agrees to guarantee the debts of the company up to a fixed amount specified in writing (usually $2), but is under no obligation to provide capital to the company while it is a going concern. As there are no shareholders, dividends are not distributed.

The governance structure, function and objectives of the company, and the rights and obligations of Members, would be set out in its constitution. This could also specify that membership is limited in specific ways (such as to Harvesters, Landholders or processors). Note that negotiation of rights and obligations of Members would require significant legal input. Rules and requirements for financial record-keeping and reports are stringent. Public companies have greater disclosure and reporting requirements than proprietary companies. Six-monthly and annual disclosure rather than continual (as for a listed company) is required. At least three Directors are required. These companies can not be listed on the ASX.

The company limited by guarantee is not widely used in commercial or trading transactions, as it does not raise share capital. However, where the primary purpose of the company is not to raise capital but to, say facilitate co-operative action and establish a framework for contracting, it may be appropriate. It is very widely used by non-profit organisations where the primary objective is to grant membership and obtain limited liability.

Capital could be raised for establishment and operation of a company limited by guarantee through e.g. attracting a seed grant from regional development bodies, or by exacting a levy on all transactions facilited by it (x c/kg of kangaroo harvested and sold pursuant to its arrangements).

Compared to proprietary companies limited by shares (see below), advantages include:
- easier to make rules about membership and specify purposes of company.

b. Proprietary company limited by shares
This is the most common type of company. Each member's interest in the company is represented by the number of shares the Member holds in the capital of the company. Among other things, the liability of Members is limited to the unpaid amount (if any) on each share. Creditors of the company cannot access the personal assets of the shareholders. Directors of the company can make a 'call' on the shares and require the Members of the company to pay to the company the unpaid amount on their shares. The number of shareholders is restricted (from one to fifty). Proprietary companies cannot be listed on the ASX.

Advantages of proprietary compared to public companies include:
- less burdensome reporting and administrative requirements:
- no need for AGM
- small prop. companies have no need to appoint auditors and have limited financial reporting
- annual disclosure of financial information not required.

c. Public company limited by shares
This structure would primarily be relevant if the intention was to package the venture as an investment opportunity for the public. As this is not the intention here, and this is an expensive process, it will not be considered further.

5. Co-operatives
A Co-operative is an entity voluntarily owned and controlled by the people for whom it was established and who use its services. In Australia they are registered under State cooperatives legislation. Coops have legal personality. Coops have a long history in Australia. Coops have been established in the past decade for purposes as diverse as fuel supply, telecommunications provision, farm forestry, organic farming, processing and selling knitting yarn, and marketing lambs (see http://www.coopdevelopment.org.au/).

Key elements of a co-operative include the following:
- observance of the 'co-operative principles' (see http://www.fairtrading.qld.gov.au/OFT/oftweb.nsf/web+pages/2C1F1FE194D6B6334A256B570012CAD0?OpenDocument), including

    - democratic control with each Member possessing an equal voting right (one Member, one vote)
    - voluntary and open membership
    - limitation upon the interest received on shares
    - minimum number of Members required (in Qld, at least five)
    - economic participation: capital is controlled and distributed in equitable way
- they return value via membership rights (rather than dividends)
- Member liability is limited to the fully paid up value of their shares in the co-operative
- state legislation set out requirements regarding keeping of records, audit of accounts, establishment of a registered office
- can raise capital by issuing shares or borrowing money
- will generally be taxed as companies, but may qualify for special treatment.

Compared to companies, they have the advantages of:
- less complex and costly establishment
- lower reporting requirements
- products may be more attractive to buyers who support the coop ethos (reported by SMARTimbers Vic)
- they may maintain more Member loyalty, because of the democratic structure. This could be important in the long-term if the aim is to bind Landholders and Harvesters to operating through the organisation, even if, for instance, there is the opportunity to undercut it by selling outside it
- it is one-Member, one-vote, which may appeal to smaller Members
- assistance and advice in establishing a co-operative may be available through http://www.coopdevelopment.org.au/

However, there are also disadvantages (cf. a company):
- they are less flexible in terms of membership and governance structure
- lack of uniform regulation across the Commonwealth
- decision-making can be slow and unweildy. For instance, SMARTimber have found that making decisions can be time-consuming
- it is one Member, one-vote – arguably some Members, perhaps those with very large landholdings, should have more voting weight than others.

6. Joint venture
A joint venture is a relationship that exists between parties carrying on a particular commercial undertaking in common for their individual as opposed to mutual gain.

A joint venture is not, in itself, a legal structure, but rather a joint operation between two or more structures. Joint ventures may be between two or more partnerships, companies, or co-operatives, or some combination of the three. They are usually formed to undertake a specific project, particularly in circumstances where the parties would be unable to undertake that project individually.

The terms of the joint venture agreement are usually sealed in a contractual arrangement with an operating agreement similar to a partnership agreement.

While joint ventures are not appropriate as the primary body to enable collaboration between Landholders, they may be appropriate for the undertaking of specific projects or enterprises that take place within the broader organizational environment provide by the chosen structure. For instance, if the group established a company structure that had among its objectives facilitating development of a premium kangaroo product, some Members might establish a joint venture to carry out a specific enterprise, such as perhaps trialling a value-adding process or selling into a new market.

7. Partnership
A partnership is the relationship that exists between people who are carrying on a business in common with a view to profit. While it has the advantages of being simple and flexible, it is unsuited to the goal of enabling collaboration among Landholders in kangaroo management. It does not establish limited liability, each partner is liable for all of the partnership's debts, and it does not establish legal personality. It will therefore not be considered further.

NSW OFFICE OF Fair Trading DEPARTMENT OF COMMERCE for consumers & traders

Comparative table on legal entities

BUSINESS ITEMS	ASSOCIATION	CO-OPERATIVE	COMPANY
Registration costs	Reservation of name $40.* Registration $105.*	Registration of trading co-operative $196.* Registration of non-trading co-operative $127.*	Reservation of name $40. Registration of company without share capital $330. Registration of a company with share capital $400. Professional costs.
Registers to be kept	Members, committee members.	Members, directors and shares; loans, debentures, deposits and securities given and taken; subordinated debt; co-operative capital units (CCUs); fixed assets; notifiable interests, and memberships cancelled.	Members, directors, option holders and debentures and charges.
Obligations to register	Changes in public officer, public officer's address, association's name, objects and rules.	Changes in directors, registered office, co-operative name, rules, auditor, charges, debentures and declaration of interest by directors.	Changes in directors, secretary, registered office, name, auditor (if applicable), and principal place of business and changes to constitutions of public companies.
Annual financial reporting	Submit annual statement to AGM and lodge with the Registry. A $45 fee applies. Late lodgement fees apply.	Send audited accounts and required reports to members prior to AGM; submit to AGM and lodge with the Registry. Non-trading co-operatives only required to give notice that reports are available for inspection. No fees apply if lodged with Registry within 28 days after AGM.	Send accounts and required reports to members prior to AGM; submit to AGM and lodge with ASIC. Members may request that accounts are not forwarded. Small proprietary companies (as defined by section 45A of the Corporations Act 2001) are generally not required to provide the annual financial report. No fees apply for lodgement of financial reports if lodged within the prescribed period of 4 months of the end of the financial year – 3 months for disclosing entities. Professional costs.
Audit	No audit necessary unless required by rules or by Charitable Fundraising Act.	Audit in accordance with regulations which require audit by registered company auditor. Smaller co-operatives may come within the Class Order which provides certain exemptions.	Audit required, must appoint a registered company auditor, or authorised audit companies or auditing firms. Small proprietary companies are generally exempt.

* fee current as at 1 July 2008

<u>**Important Notice**</u>: Please note this is a summary giving you some basic information. It does not cover the whole of the relevant law.
This summary avoids legal language wherever possible as a result, there may be some generalisations about the application of the law.
Some provisions of the law referred to have exceptions or important qualifications, in most cases the particular circumstances need to be taken into account when determining how the law applies. This summary is not a substitute for professional advice and should not be relied on as legal advice.

Comparative table on legal entities

BUSINESS ITEMS	ASSOCIATION	CO-OPERATIVE	COMPANY
Insurance	Nil required by Associations Incorporation Act 1984.	Nil required by the Co-operatives Act 1992.	Nil required by the Corporations Act 2001.
Trade	There are restrictions on trading.	No restriction on trading other than as contained in the rules.	No restriction on trading other than as contained in the constitution.
Interstate recognition	Limited recognition outside NSW – may apply to ASIC for an ARBN if operating outside NSW.	Need to apply for foreign registration as a co-operative in other states.	Full recognition throughout Australia on incorporation.
Ease of incorporation	▪ Application for registration. ▪ Model rules may be adopted.	▪ Application for registration. ▪ Model rules may be adopted. ▪ Approved disclosure statement required. ▪ Legal assistance may be required.	▪ Application for registration. ▪ Depending on size/type of company replaceable rules can be adopted or a special constitution. ▪ Legal assistance may be required.
Management	Model rules provide for a minimum of 7 committee members including a president, vice-president, treasurer, secretary and 3 ordinary members.	Number of directors can vary. The Registry recommends a minimum of 3 directors. 1 secretary who must ordinarily reside in Australia.	Proprietary company: minimum 1 director resident in Australia; not required to have a secretary. Public company: minimum of 3 directors resident in Australia and 1 secretary.
Official documents	Association's full name must appear on all documentation.	Co-operative's full name must appear on all documentation.	Company's full name and ACN must appear on all documentation.
Registered office	Not required. The public officer's address is the official address for service of documents.	Registered office required. Notice to be displayed stating the name of the co-operative and identification of the premises as its registered office.	Registered office required, notice of registered office must be lodged with ASIC; company name must be displayed.
Members	Minimum 5. No upper limit.	Minimum 5. No upper limit.	The main forms of company are proprietary and public companies. A proprietary company may have no more than 50 employee shareholders. There is no limit on the number of members for a public company. For further information about companies see www.asic.com.au.
Active membership	Nil.	Members must undertake a minimum level of activity within the co-operative to retain membership as specified in the rules.	Nil.
Voting	The principle of one member one vote applies.	The principle of one member one vote applies.	One vote usually attached to each share.

NSW OFFICE OF Fair Trading DEPARTMENT OF COMMERCE for consumers & traders

Comparative table on legal entities

BUSINESS ITEMS	ASSOCIATION	CO-OPERATIVE	COMPANY
Profits	Non-profit organisation. No distribution to members. Profits remain in the association.	Non-trading co-operative unable to distribute profits. Trading co-operative may distribute profits. Distribution is limited by the Act and Regulations.	No limit on dividends. Any distribution usually in proportion to shares held.
Governing legislation	Associations Incorporation Act 1984 (NSW)	Co-operatives Act 1992 (NSW)	Corporations Act 2001 (C'wlth)

Australian Government

Rural Industries Research and Development Corporation

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Models for landholders to share benefits from kangaroo harvesting

RIRDC Publication No. 08/150

Rangeland & Wildlife Systems R&D Program

RIRDC Innovation for rural Australia

Australian Government

Rural Industries Research and
Development Corporation

Landholder Collaboration in Wildlife Management

Models for landholders to share benefits from kangaroo harvesting

by Rosie Cooney

February 2009

RIRDC Publication No 08/150
RIRDC Project N0 *PRJ 000066*

ISBN 1 74151 739 7
ISSN 1440-6845

Landholder Collaboration in Wildlife Management – Models for landholders to share benefits from kangaroo harvesting
Publication No. 08/150
Project No. PRJ 000066

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Published in February 2009
Printed by Union Offset, Canberra

Foreword

This report is about landholder involvement in the management of wildlife in Australia. The objective of this study is to develop, evaluate and trial models for rangeland landholders to be involved in wildlife management and share the benefits of wildlife harvesting on their lands. It examines and evaluates a set of broad options for landholders to be involved in and benefit from kangaroo harvest, based on assessment of current management practice and selected overseas experience. It then proposes and develops in detail a model based on collaboration and benefit-sharing between harvesters and landholders.

This research is important because there are good arguments that involving landholders in kangaroo management can help deliver better rangeland outcomes in terms of conservation and land management, on one hand, and more diversified and resilient rural incomes, on the other. These arguments have been made for many years, but little attention has been paid to developing and evaluating models for making it happen. This research fills this gap.

This work supports the implementation of the RIRDC-sponsored Sustainable Wildlife Enterprise trials. These pilot initiatives aim to integrate wildlife management into agricultural systems to provide incentives for more conservation-friendly land management practices. The primary target of this research is the Maranoa Wildlife Management Conservancy, an SWE initiated by the Mitchell and District Landcare Association in cooperation with local kangaroo harvesters. Other major targets are participants in other SWE trials, land managers, Landcare groups, catchment/regional management authorities in areas of commercial kangaroo harvest, kangaroo processors and industry bodies, and regulators and policymakers with responsibility for kangaroo management and land management.

This study proposes to the Maranoa SWE a model based on the establishment of a trading cooperative ("the Coop") for kangaroo management, processing and marketing. Landholders and shooters would be equal members of the Coop and share equitably in its benefits. All members benefit from the greater negotiating power of the Coop in relation to processors, the establishment of cooperative, long-term relationships between the groups, and the potential for development of high-value niche products reliant on landholder involvement.

Implications and variations of this model are explored, and a series of recommendations made for the Maranoa SWE and participants in other SWEs; Landcare groups and catchment/regional natural resource management bodies in areas of commercial kangaroo harvest, kangaroo processors, and relevant regulators and managers, particularly those at state level with responsibility for kangaroo management.

This project was funded from funds provided to RIRDC by the National Landcare Program to investigate aspects of Sustainable Wildlife Enterprise (SWE) trials

This report, an addition to RIRDC's diverse range of over 1800 research publications, forms part of our Rangelands and Wildlife Services R&D program, which aims to facilitate a more diverse rural sector, enhanced biodiversity and innovative industries based on non-traditional uses of the rangelands and their wildlife. Most of our publications are available for viewing, downloading or purchasing online through our website:

- downloads at www.rirdc.gov.au/fullreports/index.html
- purchases at www.rirdc.gov.au/eshop

Peter O'Brien
Managing Director
Rural Industries Research and Development Corporation

Acknowledgments

This work has benefited from particularly extensive input and discussion with the following individuals, who I would like to acknowledge and sincerely thank: Tom Garrett, Project Officer, Maranoa Wildlife Management Conservancy, kangaroo harvester and box operator; Stacey Henry, Landcare Coordinator, Mitchell; Alex Baumber, Project Officer, FATE Program; Peter Ampt, Program Manager, FATE Program, and George Wilson, Program Manager, RIRDC.

The need for the examination of sharing structures is identified in the Strategic and Implementation plans for the SWE trials.

I would particularly like to acknowledge Carley and Nick Walker in raising the idea of property level employment of kangaroo managers outlined in Chapter 5, and discussing it extensively; and Alex Baumber for development and much discussion on ideas about regulatory change to support landholder groups in Chapter 6.

I would also like to acknowledge and sincerely thank for the following for their valuable contributions, thoughts, and input: Brad Cooper, kangaroo harvester, Roma; Bim Struss, landholder, Mitchell area; Jeff Campbell, landholder, Mitchell area; Merv Phillips, landholder and harvester, Mitchell area; Alan Brady, chiller box operator, Westmar; Ray Borda and Doug Jobson, Macro Meats, Adelaide; Dana Thompson, Kangaroo Manager, South Australia; and Sheree Scott, RMAP Project Officer, Wentworth; and all the other landholders and harvesters from the SWEs and beyond that have taken part in the meetings and workshops outlined in Chapter 2.

Abbreviations

CSU	Conservation through Sustainable Use
DMG	Deer Management Group
FATE	Future of Australia's Threatened Ecosystems
MWMC	Maranoa Wildlife Management Conservancy
NSW	New South Wales
Qld	Queensland
RIRDC	Rural Industries Research and Development Corporation
SA	South Australia
SWE	Sustainable Wildlife Enterprise

Contents

Executive Summary

What the report is about
This report is about landholder involvement in the management of wildlife in Australia. It examines and evaluates a set of broad options for landholders to be involved in and benefit from kangaroo harvest, based on assessment of current management practice and selected overseas experience. It then proposes and develops in detail a model based on collaboration and benefit-sharing between harvesters and landholders.

This research is important because there are good arguments that involving landholders in kangaroo management can help deliver better rangeland outcomes in terms of conservation and land management, on one hand, and more diversified and resilient rural incomes, on the other. These arguments have been made for many years, but little attention has been paid to developing and evaluating models for making it happen. This research fills this gap.

Who is the report targeted at?
This research supports the implementation of the RIRDC-sponsored Sustainable Wildlife Enterprise trials. These pilot initiatives aim to integrate wildlife management into agricultural systems to provide incentives for more conservation-friendly land management practices. The primary target of this research is the Maranoa Wildlife Management Conservancy, an SWE initiated by the Mitchell and District Landcare Association in cooperation with local kangaroo harvesters. Other major targets are participants in other SWE trials, land managers, Landcare groups, catchment/regional management authorities in areas of commercial kangaroo harvest, kangaroo processors and industry bodies, and regulators and policymakers with responsibility for kangaroo management and land management.

Background
Land degradation, biodiversity loss and income vulnerability remain serious major problems in the Australian rangelands. Recent years have seen the growth of interest in sustainable commercial utilisation of native wild plants and animals, as an innovative strategy both to support more diversified and resilient rural communities and economies and to provide incentives for wildlife/habitat conservation and improved land management. In response, three Sustainable Wildlife Enterprises (SWEs) sponsored by RIRDC are underway in NSW and Qld, in conjunction with rangeland Landcare groups. These seek to involve landholders in wildlife management and increase economic benefits to them from wildlife populations, in order to generate incentives to retain and restore on-farm habitat and biodiversity. The current focus of each of these SWEs is on the commercial kangaroo harvest. Involving landholders in managing and benefiting from kangaroo management could aid in habitat retention, better total grazing pressure (TGP) management, and income diversification. A major challenge for these groups is developing clear operational models for how landholders could become involved, taking into account relationships with harvesters and processors, the regulatory context, and land management priorities. Various models for such involvement have been suggested, but none have been evaluated in detail.

Aims/Objectives
The objective of this study is to develop, evaluate and trial models for rangeland landholders to be involved in wildlife management and share the benefits of wildlife harvesting on their lands. The major beneficiaries of this work are the participants in the Maranoa Wildlife Management Conservancy, an SWE under implementation by the Mitchell and District Landcare Association, Qld, for whom these models are primarily intended. Further beneficiaries are participants in other SWE groups, and land managers, Landcare groups, and catchment/regional management authorities in areas of commercial kangaroo harvest.

Methods used

This work proceeded through desk-based literature research and analysis, and discussion and dialogue with key stakeholders including SWE participants, harvesters, box operators, landholders and processors. It proceeded through examining current practice in regulation and management of commercial kangaroo harvest in Australia, drawing out key weaknesses from the perspectives of environmental sustainability and various stakeholders. Overseas examples of landholder involvement in wildlife management were examined, in order to seek lessons relevant to the Australian context. A series of broad options were developed and evaluation. Based on these analyses, a detailed model was developed and presented to the SWE for implementation.

Results/Key findings

Current practice in commercial kangaroo regulation and management has a number of weaknesses. Landholders gain no benefits from the kangaroos on their land, and their ability to manage the kangaroo component of total grazing pressure is limited. Relationships between landholders and harvesters are often poor, and potential for cooperation on issues such as feral animal control is not realised. Harvesters have little security of access to country for harvesting and little ability to bargain on price with processors. The processing industry as a whole relies for supply of their resource on landholders, who would seek to reduce populations as far as feasible if means became available. Individual processors cannot ensure reliable and consistent supply, as this would require guaranteed access to country.

Examination of overseas examples of collaborative landholder involvement in wildlife management revealed no clear analogues for kangaroo management. In particular, the commercial rather than recreational nature of the harvest, and the particularly tight government control of wildlife in Australia, strongly suggest that Australia must develop unique models for kangaroo management. However, three examples presented and discussed here illustrate several useful lessons. First, where landholders benefit from sustainable use and management of wildlife, this can dramatically shape how they manage that land and the wildlife on it. Second, that collaboration among neighbouring landholders in management of wildlife populations can be effective and beneficial. Third, these examples illustrate how good management can be fostered through a cooperative, supportive stance of government agencies toward landholder involvement in collaborative wildlife use and management.

Landholders in Australia have a range of possible options for gaining a stake in kangaroo management and harvest. They could require payment from shooter in return for access to their properties. They could become licensed harvesters themselves. They could employ kangaroo managers on their properties, either individually if feasible or in a group. Or they could collaborate with each other and with kangaroo harvesters. Evaluation of these models indicates only the last has the benefits of fostering better relationships with harvesters, gaining the negotiating power of a group, involving landholders in management of harvest (rather than simply gaining benefits), and promoting management at the cross-property scale required for populations that move regularly across property borders. The proposed detailed model is therefore based on this latter option.

This study proposes to the Maranoa SWE a model based on the establishment of a trading cooperative ("the Coop") for kangaroo management, processing and marketing. Landholders and shooters would be equal members of the Coop and share equitably in its benefits. All members benefit from the greater negotiating power of the Coop in relation to processors, the establishment of cooperative, long-term relationships between the groups, and the potential for development of high-value niche products reliant on landholder involvement. Activities of the Coop would initially focus on collective bargaining with processors on behalf of its members; chilling and holding of kangaroo products produced by its members; and quality assurance. In the future, the aim would be to expand into development of premium products, badged on the basis of environmental standards (land management, biodiversity), regional identity, and/or landholder involvement; and potentially into processing and marketing to buyers further toward the consumer end of the chain.

The major obligation for landholder members is that they provide exclusive access to Coop harvester members to their properties for harvest. A further obligation for landholders is that landholders do not use damage mitigation permits on their properties. The major obligation for harvester members is that kangaroos harvested on Coop member properties are supplied exclusively to the Coop chiller box, up until its capacity is reached. They further commit to implement any quality assurance schemes developed by the Coop.

A cooperative business structure appears appropriate for this enterprise for a number of reasons. The most salient reasons are that its limited membership, user-controlled and democratic structure are well suited to an enterprise where encouraging cooperation is a key objective. The model developed here draws on some of the features that have contributed to the success of "new generation cooperatives" in recent years for producers in the USA and Canada. Development of this Coop could be substantially assisted by cooperation and support from government agencies through such mechanisms as allocation of a group quota to the Coop, for it to manage and allocate among its members.

Implications for relevant stakeholders

1. For the Sustainable Wildlife Enterprise initiated by the Mitchell and District Landcare Association, the Maranoa Wildlife Management Conservancy, the major implication of this work is that the model presented in Chapter 6 is the recommended model to pursue their objectives.

   This model involves establishing a harvest management, processing and marketing cooperative with both landholders and harvesters as members. While implementing this model will involved substantial inputs of time, effort, and some money, and will require the establishment of a relationship of trust and cooperation between landholders and harvesters, it offers the potential for both landholders and harvesters to benefit through:
   - collective bargaining to gain best market terms for the product they both play a role in producing
   - more effective kangaroo management at a cross-property level, both to meet production objectives and for better management of TGP
   - more cooperative relationships between landholders and harvesters, including harvester participation in ferals control and weed management
   - more secure and exclusive access to country for harvesters
   - reduced use of shoot and let lie tags (non-commercial damage mitigation culling), and
   - equitable sharing of profits.

2. For Landcare groups and regional/catchment management bodies, the model recommended here offers them a potential option to meet objectives of better management of total grazing pressure, improved diversification of landholder incomes and better socio-economic resilience, and better management of feral animals and weeds at the local level.

3. For processors, collaboration between landholders and harvesters in kangaroo management, according to the recommended model, could offer real benefits to them as well. Establishment of a cooperative involving landholders and harvesters opens the way to:
   a. assuring an exclusive, consistent source of supply from the properties involved
   b. improved quality management from field to fork, through development and implementation of best-practice quality assurance programs
   c. harvest management measures that allow improvements to meat quality, such as selection of specific age/sex/species combinations
   d. implementation of sophisticated, GPS-based traceback systems
   e. environmental branding based on conservation-friendly land management practices of landholders.

For relevant regulators and policymakers, particularly managers of state kangaroo management programs, the implications of this work are that landholder involvement in kangaroo management is feasible and potentially beneficial in meeting a suite of land management and industry development objectives. Government support for such initiatives would greatly assist their implementation and empower landholders to take a more active role in kangaroo management, in cooperation with relevant government entities. Recommended support includes:

f. providing advice and technical and scientific support to groups seeking to collaborate on kangaroo management
g. providing funding for such initiatives
h. supporting the allocation of quota to collaborating landholder/harvester groups, subject to certain conditions such as adequate procedures to ensure chain of custody of tags
i. exploring other approaches to conditionally devolve more kangaroo management rights to collaborating groups, in return for these groups taking on a larger role in sustainable management.

1. Introduction

Past conventional agriculture in Australia's rangelands has led to severe degradation of the natural resource base, and threats to ecosystem services including biodiversity conservation, salinity control, water quality and soil fertility (Beeton et al. 2006). At the same time, economic returns from rangeland agriculture have declined, and face worsening terms of trade, limited potential for increased productivity, drought, and climate change. In response to these factors and to overseas conservation experiences, recent years have seen the growth of interest in sustainable commercial utilisation of native wild plants and animals, as an innovative strategy both to support more diversified and resilient rural communities and economies (Indigenous and non-Indigenous), and to provide incentives for wildlife/habitat conservation and improved land management (e.g.Grigg 1995; Senate RARATR Committee 1998; Lunney and Dickman 2002; Webb 2002; Archer and Beale 2004). A range of initiatives are currently underway in Australia's rangelands that seek to involve landholders in wildlife management, increase economic benefits to them from wildlife populations, and change the status of wildlife from a pest to a valuable resource. In particular, three Sustainable Wildlife Enterprises (SWEs) sponsored by RIRDC are underway in NSW and Qld (Wilson and Mitchell 2004). The innovative nature of these initiatives means they face a number of challenges – new governance processes and mechanisms are required to enable and facilitate this approach to reconciling economic development and environmental sustainability. This study seeks to contribute to the development of these SWEs, and to conservation through sustainable use more broadly, through developing and evaluating models for landholders to become involved in and share benefits from wildlife use.

1.1 Sustainable use as an approach to conservation and rural economies

Sustainable use of wildlife has become widely accepted in recent years as a strategy to secure conservation outcomes at the same time as supporting human livelihoods (CITES 1992; IUCN 2000; CBD 2004). Use of wild resources, it is argued, can generate incentives for conservation of wild species and ecosystems, and these incentives can counteract the powerful drivers currently operating for conversion of biodiverse natural landscapes to intensive production (Webb 2002; Hutton and Leader-Williams 2003; CBD 2004). The argument for this strategy of "conservation through sustainable use" (CSU) rests on the recognition that there is an urgent need to increase the extent to which humans value biodiversity in order to motivate commitments to its conservation. Habitat loss and degradation remains, by a long margin, the most serious current cause of threat to species worldwide (IUCN 2004), and this is driven by the values that people can derive from intensive use. One means to add value to wild landscapes is use of wild resources that generates benefits to people. This can include consumptive use such as harvesting for meat and hides, bushfoods, safari hunting, or fishing, and non-consumptive use such as tourism.

In Australia, many writers have highlighted the potential benefits of sustainable use of wild fauna and flora and called for its wider adoption (Grigg, Hale and Lunney 1995; Wilson 1995; Senate RARATR Committee 1998; Lunney and Dickman 2002; Webb 2002; Archer and Beale 2004). Much of the attention has focussed on kangaroos, with repeated calls for landholders in the Australian rangelands to manage and earn income from the kangaroos on their land, and move away from sole reliance on non-native stock species (Grigg 1987; Grigg 1987; Grigg 1988; Grigg 1989; Grigg 1995; Grigg 2002; Ampt and Baumber 2006).

1.2 The Sustainable Wildlife Enterprise trials

This study is part of a wider RIRDC initiative focussing on pilot Sustainable Wildlife Enterprises (SWEs) (Wilson and Mitchell 2004). The aim of the SWE initiative is to examine the potential for increased commercial use of native wildlife (harvesting, tourism, bushfoods, fisheries, reintroductions etc) to serve as an incentive for landholders to retain and restore on-farm habitat and biodiversity. The intention is to promote the integration of these enterprises within existing conventional farming production, rather than replacing them. Three pilot SWEs have been established, supported by RIRDC's Rangeland and Wildlife Systems Program, and each involving local Landcare groups. The pilot SWEs are the Murray-Darling Rangeland Conservancy, located on the Murray River near Wentworth in NSW; the Maranoa Wildlife Management Conservancy in the Maranoa- Balonne catchment near Mitchell, Qld; and a collaborating group of landholders in the Barrier Ranges near Broken Hill. The latter project is carried out by the FATE Program at UNSW in collaboration with the Barrier Ranges Rangecare Group.

The project reported here supports the broader RIRDC-sponsored project focussed on the development of the Maranoa Wildlife Management Conservancy (Project MDL-1a). Current objectives of this broader project are:

- To define a framework that enables landholders to share the proceeds of harvested wildlife
- Estimate kangaroo numbers that enable landholders to more effectively manage populations and integrate wildlife with their property and natural resource management plans
- Identify markets for products that are badged as leading to net conservation gain, and
- Share information and experiences from the trial sites and encourage regional collaboration in natural resource management and wildlife planning.

This project squarely addresses the first objective. While the Maranoa group is, in the long term, interested in pursuing a range of options for wildlife management, the current focus is on kangaroos. This research therefore focuses on kangaroos.

1.3 The potential benefits of involving landholders in kangaroo management

How do general arguments about conservation through sustainable use translate to use of kangaroos in the rangelands? One line of argument has been consistently championed by Gordon Grigg (1987; 1987; 1988; 1989; Grigg 1995; Grigg 2002). Grigg has called for "sheep replacement therapy" as an antidote to twin problems: the status of the kangaroo as a pest in graziers' minds, despite its high regard in the public consciousness; and widespread severe land degradation in the rangelands. Grigg argues that landholders who are earning income from kangaroos will be more likely to perceive them as a valuable resource. Income from kangaroos would mean landholders could maintain overall productivity (and better land condition) with reduced levels of stock (Grigg 1995). If the value of kangaroos rose to the point that kangaroos became more profitable than sheep, graziers could seek to maximise their production by de-stocking completely. While kangaroo populations might increase, they would have less impact on the rangelands than sheep, due both to much lower energetic requirements and a probable lower foot pressure (see discussion in Grigg 1995).

Ampt and Baumber (2006) have recently developed this thinking, and elaborate additional conservation and economic benefits that could be gained through landholders having a role in kangaroo management and gaining income from kangaroos (alongside stock). These benefits include habitat retention, better total grazing pressure (TGP) management, and income diversification. First, habitat retention would be particularly favoured in areas where eastern greys dominate. This species favours vegetation mosaics, so if landholder gained benefits from kangaroos, they would be more likely to maintain or restore areas of native vegetation. Second, the critical potential benefit is better management of TGP (as Grigg also emphasises), and Ampt and Baumber develop more detailed ideas in this respect. Currently, landholders have little flexibility in managing kangaroos for the purposes of managing TGP - it may be difficult or impossible to find a shooter willing and available to manage large aggregations in a timely way. If they were themselves involved in management, they may be able to better target harvest pressure to manage aggregations, and better integrate kangaroo management with property management priorities. They could carry out a range of actions to reach TGP goals, such as harvesting heavily going into drought, providing supplementary feed in drought, or maximising productivity per unit grazing pressure by adjusting age/sex ratio of targeted animals. Third, diversified incomes mean reduced pressure to over-stock, particularly in drought.

There are therefore clear arguments for applying the concept of CSU to kangaroos in the Australian rangelands, both to promote economic diversification and resilience and to promote long-term ecosystem benefits. A key missing element, however, is exactly how landholders should be involved. This forms the primary subject of this report.

1.4 Structure of this report

Objectives and methods for this study are set out in Chapter 2. Chapter 3 surveys kangaroo management in Australia and highlights a series of problems with the current system. Chapter 4 seeks lessons for Australia from examination of examples of landholder involvement in wildlife management overseas. Chapter 5 develops and evaluates a series of options for landholders to be involved in and share the benefits from kangaroo harvesting within current regulatory frameworks. In Chapter 6, a specific and detailed model for the Maranoa Wildlife Management Conservancy is articulated and explained. Chapter 7 discusses these results, and implications and recommendations for key stakeholders are set out in Chapter 8.

2. Objectives and Methods

2.1 Objectives

The objective of this study is to develop, evaluate and trial models for rangeland landholders to be involved in wildlife management and share the benefits of wildlife harvesting on their lands. The specific focus is the group of landholders that have established the Maranoa Wildlife Management Conservancy, under the auspices of the Mitchell and District Landcare Association Inc, in Mitchell, Qld. As the major current option for wildlife-based enterprise for this group involves kangaroo harvesting, this study focuses on kangaroos. Models are examined in terms of their potential to deliver environmental and NRM benefits, and their impacts on other key players in the product chain, the harvesters and processors.

2.2 Methods

Desk-based literature research was carried out focussed on wildlife and specifically kangaroo management in Australia and international examples of landholder involvement in wildlife management. This included academic literature, "grey" literature, legislation and policy, project planning documents, and websites.

The project was informed by wide consultation and discussion with kangaroo harvesters, regulators, landholders, Landcare coordinators, consultants, and relevant academics. In particular, the attitudes and experiences of key stakeholders involved with the MWMC were sought by face to face or telephone discussion, including the landholders involved with the MWMC, the Mitchell and District Landcare coordinator, the Project Officer, and key local harvesters and box operators.

A series of meetings and workshops provided input to assessment of kangaroo management in Australia (Chapter 3), development of options (Chapter 5), and development and trial of the proposed model (Chapter 6). These included:

- A meeting of landholders and local harvesters in Charleville, 15 June 2006, organised by the Mitchell and District Landcare group and involving a site visit to the United Game Processing works. This was attended by the author in advance of commencing this study
- The Macropod Industry Forum held by the Qld Environmental Protection Authority and Department of Primary Industries and Fisheries in Charleville on 21 August 2007, including a wide range of kangaroo industry stakeholders
- A meeting between representatives of the MWMG and Macro Meats, 21 August 2007, at which a variant of the model proposed here was presented and discussed with the latter
- A meeting of the Maranoa Wildlife Management Conservancy on 12 March 2007, organised by Mitchell and District Landcare, at which this project was introduced and comments sought
- A meeting of the Maranoa Wildlife Management Conservancy on 3 February 2008, at which the proposed model was presented for discussion among landholders, box operators and harvesters, agreement on the broad outline of the model was gained, and a working group established to take it forward
- A meeting of landholder and harvester participants from all three SWEs, regulatory officials, and kangaroo processors in Broken Hill, 14-15' February 2008, organised by the FATE Program, at which the proposed model was presented and discussed
- A meeting of the MWMC Kangaroo Working Group on 3 March 2008, Mitchell, in which plans were made to implement the concept of the proposed model and draft Coop rules were discussed.

3. Commercial kangaroo harvest in Australia

This section provides necessary context for exploration of models for engaging landholders in wildlife management and sharing benefits. It begins by outlining current regulation and operating practice for the commercial kangaroo harvest. It then goes on to highlight some key issues and problems of current arrangements. The focus is on the states in which SWEs are located – Qld and NSW.

3.1 An overview of regulation and management practice

3.1.1 State and Commonwealth regulation

While there are around 48 macropod (Family Macropodidae) species, only 5 are subject to commercial harvest on the mainland in Australia – red *Macropus rufus*, eastern grey *Macropus giganteus*, western grey *Macropus fuliginosis*, euro (wallaroo) *Macropus robustus*, and whiptail wallabies *Macropus parryi* (Queensland only), and only the first four are commercial exported. Throughout this paper the term "kangaroos" is used to refer to these commercially harvested species only.

Kangaroo harvest is regulated at both Federal and state levels in Australia. States have the primary responsibility for regulation of take, killing and trade of protected species (all macropods are protected), while the Federal government regulates export. States regulate and manage the commercial harvest through a wide range of functions, including monitoring of populations through regular surveys, establishment of sustainable harvest quotas, and implementation and enforcement of a strict licensing and tagging system. All harvested kangaroos are tagged with a unique, self-locking tag. Harvesters and processors must be licensed and are subject to reporting requirements. Extensive animal welfare and food hygiene requirements to be followed by harvesters and processors are also regulated at state level.

In addition to managing the commercial harvest, States may authorise non-commercial culling to assist landholders to mitigate damage to crops or land. For damage mitigation culling, landholders faced with large aggregations can apply for what will be referred to throughout this paper as "shoot and let lie" tags. These are issued directly to landholders and are not subject to a quota. In general, carcasses are left in the field and do not enter commercial trade, although Qld and NSW both allow some to enter commercial trade under a small "special quota" (NSW DECC 2007; Qld Government 2008).

All export of kangaroo products requires approval from the Commonwealth. In practice, States submit five-year management plans for approval as a "wildlife trade management plan" by the Commonwealth under s303 of the *Environmental Protection Biodiversity Conservation Act* 1999. Kangaroo products from states with an approved plan will be granted export permits.

3.1.2 Kangaroo harvesting

Kangaroos are harvested at night by harvesters using high-powered rifles, searchlights, and a modified utility vehicle fitted with facilities for initial field dressing (removal of viscera, head and tail) and hanging of carcasses. They require permission from landholders to access properties, and in NSW and Qld the properties that a shooter may shoot on are either specified on the harvester's licence or are specified when tags are issued. Numbered, self-locking tags are affixed to carcasses when shot. Carcasses are delivered each morning to a refrigerated chiller box (remote or in town), where shooters are paid. These boxes are owned and operated either by independent box operators or processors. Processor refrigerated trucks pick up carcasses regularly and deliver them to processing plants. At processing plants, skins (and tags) are removed from carcasses and skins are sent to a tannery. Processors often play a major role in operating chillers, organising shooters, and ensuring supply and quality.

3.1.3 Landholder involvement

In all states, shooters require permission from landholders to enter their properties to harvest kangaroos. Shooter will generally initially contact landholders to request access to their country. Shooters may shoot on a property from their own motivation or in response to a request from a landholder, who may direct shooters to areas where they know there are large aggregations. In Qld this will generally be the only landholder involvement, as tags are issued directly to shooters. These tags can then be used on any property. In NSW it is technically landholders who are granted an "occupier's licence" to commercial harvest on their land. However, in shooters will usually physically bring the application forms for signature to landholders, submit forms, pay fees, and receive the tags.

3.1.4 Property rights and kangaroos

It is worth briefly exploring the situation with respect to property rights over kangaroos, as property rights are typically crucial aspects in determining which stakeholders can gain benefits from wildlife, and how (Hanna, Folke and Maler 1996). The concept of "ownership" or "property" includes a bundle of related rights. Property rights to shared natural resources can be broken down as follows (adapted from (Schlager and Ostrom 1992). The first apply at the individual level, the third to fifth concern collective decision-making among the group sharing the resource:

- Access: the right to enter a defined physical property
- Withdrawal: the right to obtain the products of a resource e.g. catch fish, harvest animals, collect water
- Management: right to regulate patterns of use of a resource and potentially enhance productive capacity
- Exclusion: right to determine who will have an access right, and how that may be transferred
- Alienation: the right to sell or lease either of the above two rights.

In Australia, most of these rights with respect to kangaroos are held by the Crown. All native wildlife, including kangaroos, are explicitly or implicitly the property of the Crown in all States (Cooney 2006). They become the property of authorised harvesters when shot under licence. Consequently landholders only exercise access rights. They exercise these in a *de facto* rather than formal sense – as they exercise control of access to land on which kangaroos live, they control access to kangaroos. The withdrawal rights – rights to harvest kangaroos - are controlled by the state but can be gained by appropriately licensed harvesters, including the landholders themselves if they seek to harvest kangaroos. However, there is nothing to prevent landholders organising themselves to exercise management rights, exclusion rights, and alienation rights at the level of a group of landholders, within the rules established by the state with regard to these rights. So, for instance, looking at management rights, the state may establish an overall quota, but a group of landholders could regulate patterns of resource use across their properties within this quota.

3.2 Problems with current practice

The commercial kangaroo harvest is probably the largest terrestrial harvest of vertebrates in the world. It is demonstrably biologically sustainable for the species concerned (Pople and Grigg 1999). From the perspective of kangaroo conservation, then, there are few immediate problems. However, more broadly and from a longer-term perspective, there are some significant issues with current practice, both from the perspective of some of the key stakeholders, and from the perspective of ecological sustainability. Problems are discussed from the point of view of landholders, harvesters, and processors in turn, although some cut across the groups. Ecological, natural resource management issues are discussed in relation to landholders.

3.2.1 Landholders and land/natural resource management

From the point of view of landholders, the most obvious drawback of current practice is that the kangaroos on the land that they manage primarily represent a cost to them. While anecdotal reports suggest a minority of landholders charge fees to harvesters for access on to their properties, and a minority of landholders are also licensed kangaroo harvesters, otherwise, however, landholders receive no benefits from the kangaroos on their land. Kangaroos are perceived by many landholders as costing them considerable amounts of money, primarily through reducing the feed available to stock. (For instance, one landholder interviewed estimated kangaroo costs on her properties at A$300 000 annually). While the actual impacts of kangaroos on stock production are disputed (Olsen and Low 2006), the impacts may be greatest at times of drought, which is when landholders are most financially stressed. Landholders receive no compensation for these costs, leading them to view kangaroos as a pest rather than a resource.

Equally or more important for landholders is that they play only a very minimal role in management of the kangaroo contribution to total grazing pressure (TGP). While kangaroos are an important component of grazing pressure, landholders have little effective means to manage them. The commercial harvest is a blunt instrument – landholders may not be able to get harvesters to come to their property when they want them, kangaroo management is not integrated with property level management, zone quotas may have run out when local densities are extremely high or having major impacts, there is a lower weight limit for the commercial harvest, and so forth.

These two problems for landholders have knock-on environmental consequences (some of which have been outlined in the Introduction). Scant landholder involvement in managing harvest means management of TGP is suboptimal. Kangaroo pose disincentives to landholders when they seek to de-stock or spell pastures to allow regeneration, such as for conservation schemes, in rotational/cell grazing, or in drought. This often leads to an influx of kangaroos seeking the "green pick" in regenerating pastures. Confronting such an influx can be a disincentive for landholders to actually take stock off pastures – if feed is simply going to be eaten by kangaroos, and given that landholders earn nothing from kangaroos, there may be little benefit to pasture condition. Lack of benefits from kangaroos means there are no incentives to retain or restore native vegetation to provide cover for kangaroos, and continuing incentives to clear to reduce kangaroo populations. Further, if new techniques for controlling and reducing kangaroos become feasible, as things stand they would be keenly sought by landholders. Such techniques include technology to control kangaroos access to water points based on machine recognition of species, fencing out kangaroos using macropod fences (single properties or groups), and in the longer-term, biocontrol techniques such as immunocontraception. This could become a conservation issue if landholders sought to exclude kangaroos from large areas of the rangelands.

3.2.2 Landholder-harvester relationships

A further issue for both landholders and harvesters, with environmental implications, is that there is generally little cooperation between shooters and landholders. Lack of communication or common interest between the groups means there is no integrated management of kangaroos at local or regional level in order to balance and meet the needs of both. For landholders, kangaroos are primarily a pest, to be reduced to the extent feasible. For harvesters (and processors) the kangaroos are the resource on which their livelihoods and businesses rely. In consequence, their interests are to maintain an abundant stock, and to manage harvesting to have minimal reduction of population, such as focusing harvesting on males. This divergence sets the stage for widespread discord between landholders and harvesters.

If these relationships were established on a more secure footing, harvesters could make important contributions to property management and NRM. For instance, as shooters drive from property to property, they are capable of rapidly spreading noxious weeds. Cooperation could see landholders requiring and/or harvesters implementing procedures to prevent this. Shooters could contribute to controlling feral animals such as cats and foxes.

One shooter interviewed indicated that he did stop to shoot any feral animals sighted for properties where he had a good relationship with the landholder, but not for others. If all shooters across a range of neighbouring properties were committed to shooting any feral animals seen, this could make a substantial contribution to local ferals management. With better cooperative relationships shooters could also contribute to property management in ways such as checking water points and fences. On their part, lack of strong relationships generally mean that landholders provide little security to shooters (discussed further below).

3.2.3 Harvesters

Probably the major problem kangaroo shooters currently face is that they have no bargaining power as individuals, leaving them vulnerable to fluctuations of price and market conditions. They work individually and are paid per kg of kangaroo delivered at the chiller door. With certain exceptions, any particular shooter is of minimal value to a processor - if one refuses to accept a price, processors will have little trouble in securing adequate supplies from others. Prices are subject to large fluctuations in response to a wide range of relevant conditions, such as international terms of trade, availability of product, and price behaviour of competitors. Harvesters are at the "bottom of the food chain" in the kangaroo industry – they currently have little ability to negotiate security, better cash returns or other benefits.

This situation has been exacerbated by an influx of shooters into the market in recent years in Qld and NSW. Many of these are "weekenders" rather than professionals – individuals who have other jobs but shoot occasionally or on weekends to supplement their income. This increases competition between shooters for access both to limited quota to country, and further reduces the bargaining power of individuals with processors. In some areas, there have many fewer tags available than those sought by shooters, meaning longstanding full-time professionals cannot plan their shooting, and can have serious difficulty maintaining a livelihood. For example, in NSW, the numbers of kangaroo shooters increased from 620 in 1996 to 860 in 2007 (Lawson 2007). Competition over tags led NSW to use a ballot system to distribute tags, as a first-come first-served system was leading to people camping out on the NPWS doorstep the night before tags were released, and many missing out. The number of licences issued to shooters is generally not restricted, despite repeated industry calls in NSW and Qld to cap the number of licences issued, as happens routinely in fisheries management[1]. Currently NSW has responded to these calls by adopting a moratorium (still in place at time of writing) on the issue of new licences (N. Payne, pers. comm.). The over-supply of shooters has some potentially poor consequences for standards in the industry. Weekend shooters are likely to be less experienced, less technically proficient, and less stringently observe welfare and food safety standards than those who rely on harvesting as their full-time livelihood.

Improvement of professional standards in general is not promoted by the current system. Harvesters have little to gain by investing in higher standards of practice in areas such as harvesting and handling of carcasses. With some rare exceptions, they do not gain higher prices for delivering carcasses that have been handled better. Part-timers, by their nature, have little incentive to invest in the long-term future of the industry, its standards, or its reputation. The Queensland Macropod and Wild Game Harvesters Association have been involved in developing technological innovations such as the use of data loggers and bar codes to enable traceback systems (Australian Government 2003). However, unless these are adopted by processors, harvesters are not in a position to influence their uptake.

The second major problem harvesters face is that they rely for their livelihood on landholders continuing to grant them access to their properties. At any point, a landholder can decide, for any reason, to stop allowing a shooter onto their property. For instance, a landholder may decide to have their kangaroos shot by a different shooter or to carry out shooting themselves. Likewise, shooters have no security that they will be the only shooter allowed on to a property. Particularly when there are many kangaroos on a property, landholders may grant access to additional shooters, undercutting the benefits for the long-term shooter.

[1] For instance, this issue was raised at the Qld Macropod Industry meeting, Charleville, August 2007

3.2.4 Processors

Current practice has many advantages for processors – they benefit from the lack of any group voice for harvesters and the competition between them, and can largely dictate the terms on which they acquire product. However, over the long term they are in a very insecure position. They are perhaps one of the only global industries for which continued access to their fundamental resource relies completely on people who would like to see it virtually eliminated from their lands. Unlike other primary industries, their resource is not managed by land managers for production and increase, but rather as a pest. This becomes a more serious problem in light of growing interest in some parts of the rangelands in erecting macropod fences around one or a group of properties, to exclude kangaroos completely. Technologies for selectively excluding kangaroos from watering and feeding points are being developed (with extensive government support), using machine vision technology to identify individuals and open or close gates. On this point, for example, researchers see an objective as aiming "to stop the artificial build-up of feral populations so that introduced and native animals do not become pests" (Foreshew 2007). The kangaroo harvesting and processing industry currently relies on kangaroos becoming pests, in order to motivate landholders to allow harvesters on to their land, so these developments pose a very significant long-term threat.

While this is a long-term threat for the processing industry as a whole, individual processors also face difficulties in securing reliable and consistent supply, as they have little contact or relationships with landholders. Landholders can at any point switch shooters and allow access to a shooter servicing a chiller box of a different processor on to their land.

A problem affecting processors, but also all other stakeholders, is the comparatively low value and variable quality of kangaroo meat. Kangaroo still has a small (if growing) market in Australia and overseas. The price per kg is substantially lower than for other red meats, and there is no attempt to market differentiated kangaroo products. Some of the obvious marketing points for kangaroo include environmental messages, such as "free-range" living conditions, organic, chemical-free, lower contribution to greenhouse gases, and environmental management. Critically, however, many of these marketing opportunities require the involvement of landholders. On the quality front, regular eaters of kangaroo meat (the author included) often find high variation in tenderness between samples of the same cut. Supply of product to discriminating buyers such as high-end restaurants will require uniformly high quality. Landholder involvement could open up quality management options such as managing populations to ensure high populations of species species/age/sex combinations that are of high value to consumers.

4. Landholders and Collaborative Wildlife Management: some overseas experiences

This section examines some selected overseas experiences of landholder involvement in wildlife management. It does this to set kangaroo management in a broader context for comparison, and specifically to see whether overseas models could offer useful "templates" for application in Australia. In the course of this analysis, however, it became clear that kangaroo management offers some unique challenges, and no adequate analogues could be found globally. For this reason this chapter is quite brief, and aims primarily to provide some good international illustrations of landholder involvement in wildlife management and draw some broad insights to guide development of options for Australia. These examples all involve *collaborative* wildlife management – that is, where landholders are cooperating with each other (neighbours) in order to manage wildlife at a larger scale than individual properties. This emphasis is chosen because commercially harvested kangaroos move freely and frequently across property boundaries, so a cross-property level is more appropriate for their management (Ampt and Baumber 2006). Collaborative experiences therefore provide more relevant insights for our purposes.

4.1 Wildlife Conservancies in southern Africa

The first example selected is Conservancies in southern Africa, covering a set of rather differing experiences across Namibia, Botswana, South Africa and Zimbabwe. Each has differing regulatory environments and specific experiences, but key general features are summarised here. "Conservancy" here refers to mean groups of properties across which wildlife is collectively managed (although it can also refer to single properties) (Goodwin et al. 1997). Save Valley in Zimbabwe, for instance, included at one point[2] 23 landholders and 340 000 ha (Muir-Leresche and Nelson 2000). Some key drivers of the development of Conservancies have been over-stocking and land degradation, drought and the desire to be more resilient to drought, the returns from wildlife management, conservation of species, soil, water and habitat, and the opportunity to manage resources at a more appropriate scale (Goodwin et al. 1987). Conservancies are established for both socio-economic and environmental objectives: for example "to develop a system of land use based on the management of natural resources which is ecologically sound, economically viable, financially profitable, satisfying to its members and politically and socially acceptable…" (Chiredzi Conservancy, see Goodwin et al. 1997). Typically the perimeter of the area is game-fenced, but there are few game fences within. Agricultural activities may continue within Conservancies, including running livestock and even irrigated agriculture, particularly while the Conservancy is being established.

Across all these countries, landholders are conditionally empowered to manage most wildlife on their land. For instance, in Namibia, once a group of landholders has fulfilled the requirements for a Conservancy (including establishing a perimeter fence), they are explicitly stated to be the owners of "huntable game" (including oryx, springbok, kudu, warthog, buffalo and bushpig), and can utilise these with no permitting requirements. "Protected" species can be used under a permit system. Game may be commercially bought and sold, and income from use and sale retained by farmers (Jones 1999). In Zimbabwe no licence or other authorisation is required to establish a Conservancy – landholders are designated as the "appropriate authority" to manage wildlife under the relevant legislation, and may simply band together to do so (Goodwin et al. 1997).

[2] Conservancies in Zimbabwe have been greatly affected in recent years by land redistribution policies, illegal land seizures and economic collapse under the Mugabe government. References here should be understood as referring to the situation up till about 2000.

In South Africa, game ranches can be established under a licencing regime that similarly devolves most wildlife management functions for game species to landholders who meet the requirements of the legislation. In all of these countries, landholder rights over wildlife, involvement in wildlife management, and promoting benefits from wildlife to landholders has been an explicit objective of government policy. In each of these countries there have been very significant benefits to wildlife conservation management as a result, as well as economic benefits. For instance, in South Africa, the ca 11000 wildlife ranches on private land managed cover ca 20.5 million ha (16.8% of the land surface), as compared to the only 7.5 million ha (6.1%) of Government protected areas (Bothma and Sartorius von Bach In press).

Income from wildlife management activities on Conservancies (and private wildlife ranches in general) derives from hunting, tourism (phototourism, birdwatching, fishing, horseriding, etc); and game cropping for meat and skins. Conservancies generally sign a voluntary agreement or Constitution committing them to undertake joint wildlife management activities. They agree on arrangements for collaborative management of the wildlife, sharing revenues from wildlife operations, allocation of costs for joint projects, and other collective sharing of benefits and responsibilities as appropriate ventures (Goodwin et al. 1997). Collaborative management measures may include establishing quotas, game patrols to deter poaching, maintaining fencing, monitoring, reintroductions, culling, wildlife sales, and so forth. A management committee will generally establish quotas for hunting or culling based on sound scientific advice and management planning (R Martin, pers. comm.).

It is important to note however that not all functions are shared – many remain within the responsibility of individual landholders. Wildlife on a Conservancy is not common property managed by a single body – rather, individuals make decisions about management on their land, subject to guidelines and restrictions agreed by all to avoid misuse of a shared resource (Du Toit, cited in Goodwin et al. 1997). In particular, individual properties primarily generate income at the level of the individual property, through sale of hunting rights, operating guest lodges and tours, and so forth. However, where commercial activity is to take place at the level of the group, say through purchasing animals for restocking that will travel across the properties, the Conservancy may establish a commercial organisation for these purposes.

4.2 Red deer management in Scotland

Landholders take a major role in the management of red deer on estates in Scotland (see Gordon and Hope 1998; Deer Commission of Scotland undated). Populations have expanded dramatically since the 1950s, as deer are viewed as an asset to estate owners for their value for sport shooting and venison. Red deer are *res nullius* – they are not owned by anyone, but the owner of the land on which they roam holds the right to shoot or capture them. They are managed primarily through sport-shooting: landholders may carry out sport shooting themselves or sell the rights to do so.

Deer are both asset and pest, to different groups. Deer are of value to the owners of estates for sport shooting and meat, and this has driven large increases in population. However, these populations can damage the natural regeneration of native pine, birch and oak woodlands and damage crops (Gordon), and so there is potential for conflict between estate owners, on one hand, and farmers, forestry interests, and urban-based environmentalists, on the other. Deer populations are managed to control their numbers to avoid negative impacts on the herd or the environment, and to maximise the number of mature stags. Production of venison is generally a by-product of these activities, rather than a primary motivation, although it can provide an important income stream to estates.

Red deer wander freely across estate boundaries. Many estate owners manage deer through voluntary Deer Management Groups (DMGs), supported by the Deer Commission of Scotland, a statutory authority with responsibility for deer management (see ADMG undated). DMGs have been promoted by the Deer Commission to enable communal management across property boundaries. These groups are encouraged to develop Deer Management Plans with guidance from the Deer Commission. These have specific aims of encouraging discussion and trust between deer managers, promoting wider awareness of deer management issues, assisting deer managers to arrive at informed decisions, safeguarding deer-related employment, maximizing economic returns from deer, preventing habitat degradation, protecting interests such as agriculture and forestry, and improving deer health (Gordon and Hope 1998; Deer Commission for Scotland undated). Interventions covered include not only shooting, but also other management tools such as fencing and feeding, developing guidance on best practice, increasing training uptake, and improving professionalism and discipline in wild deer management. The aim is for DMGs to take ownership over and responsibility for their interventions and their consequences. To this end Deer Management Plans include provision for the group carrying out their own monitoring and reporting against their objectives, rather than requiring that this be done by external governmental bodies such as the Deer Commission for Scotland or Scottish Natural Heritage. Likewise the Deer Commission only advises and assists DMGs on management measures, such as quotas, rather than setting quotas themselves. It further plays a role in doing counts, carrying out research, disseminating best practice, assisting in training, working with other agencies on wider policy issues, and advising Scottish Ministers on all deer matters in Scotland.

4.3 Wildlife "Co-ops" in the USA

In some states of the USA, recent years have seen the growth of organisations involving collaboration among neighbouring landholders to manage, restore and improve wildlife and habitat, often called "Co-ops" or Wildlife Management Associations (WMAs). Many focus on hunting in particular, managing habitat and feed for game species (e.g. ensuring farm activities provide for year-round supply of adequate vegetation), quotas, management measures to raise the trophy quality of hunted game, build populations, and so forth. Others seek to improve birdwatching, fishing, or simply ecosystem health and quality.

Texas offers a particular well-developed example, with the first WMA established in the 1950s (Texas Parks and Wildlife 2004; Williams 2007) (Wagner et al. 2007). Now over 160 Wildlife Management Associations exist, managing around 770 000 ha (Texas Parks and Wildlife 2004; Wagner et al. 2007). These WMAs focus mainly on deer. Effective management for deer hunting – managing a herd for sustainable offtake of high-quality trophies (antlers) – must be done through collaboration, as populations move freely across property boundaries. A major driver for their establishment is driven by declining returns for traditional land uses. By contrast, returns from leasing out land for recreational deer hunting is increasing – in prime deer habitat, hunting now yields more value than traditional agriculture. In addition to these more utilitarian ends, WMAs have a strong conservation and land stewardship ethic (Wagner, 2007), and have been successful in restoring quality wildlife habitat and populations in many areas (Texas Parks and Wildlife, 2004).

Establishment of a WMA generally involves landholders getting together and agreeing to adhere to a non-binding agreement on how to manage wildlife. Landholders are typically supported by biologists from the Texas Parks and Wildlife Authority in drawing up a Wildlife Management Plan based on scientific advice, including measures such as setting hunting quotas. Establishment of a WMA may entitle landholders with particular benefits such as special permits (Texas Parks and Wildlife, 2004). Members voluntarily choose to implement the provisions of the Management Plan on their land, and participate in data collection and reporting observations.

4.4 Insights for Australia

None of these contexts offers us a straightforward analogy for management of kangaroos. One major difference is that all these examples involve recreational hunting as a major source of the value of wildlife on private land, rather than commercial harvesting for meat and skins, although in the southern African and red deer examples this is an important additional source of revenue. Recreational hunting involves much higher values for small numbers of animals taken – landholders are selling the experience, not the product. Another implication is that recreational hunters do not need to derive a livelihood from their activity, while commercial hunters do. A second major difference is that the state exercises much tighter control of property rights in wildlife in Australia than in any of these contexts. In Australia the Crown "owns" wildlife across all States, either explicitly (in state legislation) or implicitly (through exercising all rights to take, kill, hold, move etc). Landholders in Australia have only the de facto right of access through controlling access to their properties. In the southern African countries discussed landholders can gain most property rights under certain conditions, and in Scotland and the USA landowners control (with some limitations) the right to hunt and manage deer on their land.

A model for landholders to be involved in and benefit from kangaroo management will therefore be a unique one. However, we can draw some broad general lessons and guidance from surveying these experiences.

The first is simply the straightforward observation that where landholders benefit from sustainable use and management of wildlife, this can dramatically shape how they manage that land and the wildlife on it. The figures presented above for South Africa illustrate the power of sustainable use of wildlife by landholders in not just changing attitudes toward the specific species concerned, but driving widespread shifts toward wildlife as a primary land use. In Scotland, the rights of estate owners to sport-shoot and manage deer have driven a major population increase, and a change in perception of deer from a pest to a valued resource. Indeed, such is their value as assets to landholders that many wish to maintain them at levels too high for healthy forest regeneration (Pearce 1993).

Second is the benefit of collaboration among neighbouring landholders in management of wildlife populations. All these examples illustrate that landholders can effectively embark on voluntary collaboration in wildlife management, with many benefits for wildlife, habitat, income and recreation. Examples from the USA and southern Africa illustrate that such collaboration can take place alongside maintenance of traditional agriculture based on individual properties. One point to note is that none of these examples involve individuals surrendering all autonomy over their decisions to a higher-level collaborative body. Instead, in each of them individuals continue to make decisions and earn most income from wildlife on their own property, but voluntarily choose to make these within the framework of agreed guidelines and management frameworks. Many rural landholders have a strong independent ethos, and it may be that structures which lock individuals too tightly into collective decision-making will be resisted.

Third is the cooperative, supportive stance of government agencies toward landholder involvement in collaborative wildlife use and management in all these examples. In southern Africa, empowering landholders to manage and use wildlife has been an explicit conservation policy. In the Texas example here, state agencies provide support and scientific advice to assist landholders to establish collaborative groups. Further, they are provided with regulatory incentives to enter into wildlife management, through gaining benefits such as special permits. Likewise in Scotland, the Deer Commission for Scotland supports and advises estate owners in forming groups and developing management plans. In Australia there is no history of landholder involvement in kangaroo management, so it is not surprising that there is no history of government support to landholders to facilitate this. However, these models offer useful illustrations of cooperation between government agencies and landholders on wildlife management, achieving conservation and ecosystem management benefits at a low government cost.

5. Options for Landholder Involvement in Kangaroo Management

5.1 Background

To enable integrated management of kangaroo populations, for effective control of total grazing pressure, for kangaroos to provide incentives for habitat conservation, and for secure access of the kangaroo industry to its resource, landholders will need to become involved with kangaroo management or benefit from them in some way (see Introduction and Chapter 3). This will require substantial change in ways of operating and doing business, and potentially regulatory and policy change as well. While voices such as Gordon Grigg's have long called for the involvement of landholders in kangaroo management and harvest (Grigg 1987; Grigg 1987; Grigg 1988; Grigg 1989; Grigg 1995; Grigg 2002), these calls have gained little traction. Today landholders remain almost completely uninvolved in kangaroo management. One reason for this may be that little attention has been paid to the question of exactly how landholders could be involved and gain economic benefits. What roles would they carry out? How would they influence management? How would they work with the existing kangaroo industry – the harvesters and processors? How would they derive income?

Some possibilities have been highlighted in work to date. Grigg has argued that if the price for kangaroo products rose, graziers would become interested in being involved in harvesting them. He (1987a) points to instances in Queensland of graziers harvesting kangaroos themselves, particularly when sheep prices are low. He has also raised the possibility that landholders could require payment from shooters, and briefly outlined a concept by which landholders could receive an allocation of property-specific tags that they could use or sell (1995). Martin (1995) assumes that landholder involvement will involve mustering, branding and tagging, like domestic stock. More recently, Ampt and Baumber (2006) outline a model in which landholders collaborate to jointly manage kangaroos across their properties, and become more involved in raising quality standards and development of a differentiated product. However, detailed examination of the range of options available, how they would operate, and their various advantages and disadvantages is lacking.

The objectives of this chapter are to set out options for landholders to be involved in kangaroo management and benefit from the kangaroos on their land, and evaluate their implications for key stakeholders and for rangeland sustainability. Most options are possible within existing regulation and policy frameworks, and where this is not the case, the changes required are indicated. Practical operation of each model is described and relevant issues related to licensing, regulation, or general feasibility highlighted. These models are then evaluated in terms of their likely contribution to incentives for conservation and better TGP management, to benefits to landholders, and to benefits to harvesters and processors where these are relevant.

These are models for how landholders could become more involved in kangaroo management and/or gain benefits from this kangaroo harvest. Note that these two aspects do not always go hand-in-hand – in some of these options landholders gain a larger role in management but do not gain any income, while in other they gain a benefit but don't expand their role in management. Note also that this categorisation of options is necessarily quite broad and doesn't canvass every possible arrangement – for many of these options there could be endless minor variations on how each operates in practice.

5.2 Landholders require payment from shooters

5.2.1 Description

The most straightforward way for landholders to gain an economic return from the kangaroos on their land is to require shooters to pay them to enter onto their land to harvest kangaroos. This is already happening in some areas. For instance, participants at the Macropod Industry Forum in Charleville, Qld, in August 2007, spoke of instances of this occurring in the region. Landholders may require harvesters to make a payment in return for access to their land, which could be levied per night or per kangaroo shot. Landholders do not actually own kangaroos, so cannot actually sell kangaroos to shooters. However, there seems no reason why they cannot make access to their land conditional in this way.

5.2.2 Evaluation

The benefit of this arrangement for landholders is straightforward – they gain some income from the kangaroos on their land. This could, if the returns were great enough, encourage them to view kangaroos as less of a pest and more of a resource. A drawback of this approach for landholders is that this approach does not lead to a greater landholder role in kangaroo management, and will not enable them to better control TGP. Harvest management remains unchanged. Further, this approach will only be effective if there is competition between shooters for access to country, and shooters are willing to pay. Individual landholders have little bargaining power – if shooters can gain country elsewhere, they will simply shoot there.

Most importantly, this approach is likely to cause resentment among shooters and destabilise relationships with them. Shooters have made very clear in the course of the implementation of each SWE trial that they view such an approach as unfair and will strongly resist it. In practice, access to country is a limiting factor for many of them, and if landholders forced them to pay many would have to pay, which would substantially decrease their already thin profit margins. Further, workshops and consultations made clear that most landholders also view such a charge as unfair, and do not want to impose an additional financial burden on kangaroo shooters, who they perceive as delivering a valuable service.

5.3 Landholders become licenced shooters themselves

5.3.1 Description

The second fairly straightforward method of both gaining economic benefits from kangaroo harvest and of playing a role in kangaroo management is for landholders to become licenced kangaroo shooters themselves. Grigg (1987; 1987; 1995) refers to instances of graziers in western Queensland starting to harvest kangaroos from their properties in the mid-1980s, when prices for wool dropped. While it is not clear how widespread this practice is, several individuals involved in the ongoing SWEs are both landholders and harvesters. Harvesting is generally an additional activity to grazing, carried out for additional income when time and property management permits.

Commercial harvesting licences (which have various different names in different states) are not limited in number in any state. Any landholder can gain the appropriate licence from the State regulatory authority under the same terms as any other applicant. This will require a valid firearms licence, completion of a short accreditation course for professional shooters, and completion of the relevant game meat handling and hygiene course. Landholder harvesters would, like other shooters, sell carcasses to chiller box operators and gain the price/kg being offered. If they sought to shoot on other properties as well as their own, they would need to secure agreement from those landholders and, in NSW, apply for tags for those specific properties. Currently, some landholders operate chiller boxes on their properties, usually owned by a processor, so could simply shoot into these boxes.

Gaining commercial harvester's licences would not prevent landholders applying for shoot-and-let-lie permits to manage aggregations of kangaroos which are under the legal weight limits for commercial harvest, or when annual quotas are exhausted.

5.3.2 Evaluation

Under this model, landholders would gain economic benefits from sale of kangaroo carcasses that they shoot. Further, they would take over kangaroo management on their own properties, so should be able to better manage TGP. For instance, they will be able to plan their own time and the number of tags they hold to ensure they can target aggregations in a flexible and timely fashion and according to their property management priorities. They may also have better information than other harvesters about where aggregations are. Further, in NSW, where tags must be used on a specified property, they will generally have on hand a supply of tags for their own properties, which may not be the case with a commercial shooter.

On the down side, harvesting kangaroos involves a specially equipped vehicle, specialist skills that may be arduous and time-consuming to acquire, and extensive work at night. Assuming landholders maintain their other agricultural activities - running stock and cropping – the demands of these activities mean that landholders may not have the time to take on additional night work.

From an environmental management perspective, the fact that landholders gain economic benefits under this model should help change their perceptions of kangaroos from a pest to a valuable resource, with the potential habitat conservation benefits linked to this. However, this option only allows for kangaroo management at the level of individual properties, rather than at the cross-property level required for effective management of a shared resource.

5.4 Landholders employ kangaroo managers

5.4.1 Description

One model that has received little attention to date is the idea of individual landholders or groups of neighbouring landholders employing a "kangaroo manager", in the way that they might employ a farm manager or other on-station staff. Such a manager would have the task of devising how to best manage kangaroos as a component of overall property management, in a way that maximizes revenue to the landholder(s) and minimizes negative impacts on other productive activities such as sheep or cattle production, as well as carrying out harvesting, marketing produce to processors, and potentially operating a chiller box on-site. The manager would receive a salary from the landholder (perhaps supplemented by a per-kg payment as an incentive), while the income from sale of kangaroo meat and hides would go to the property owner. While kangaroo managers might physically sell kangaroos at a chiller box, income could be directed straight to the landholder by the chiller box operator, or returned in some way to the landholder by the manager.

Management could encompass strategies to maximize local kangaroo populations, in areas or conditions where this would yield returns. For instance, some areas of a property might be very attractive to kangaroos, but of marginal importance for cattle. These areas might be de-stocked in favour of encouraging kangaroo aggregations for harvest. Harvest could be timed to maximize production: for instance, going into a drought, when vast numbers of kangaroos typically starve, managers could seek to harvest at the maximum rate possible, in order to harvest before individuals lose weight and to minimize effects of drought on remaining populations.

On very large properties with large kangaroo numbers, individual properties might be able to employ kangaroo managers. In other areas, several neighbouring properties could employ a manager to work across their properties. This would probably work best where there is a basis of collaboration already established - for instance, they could be employed to work across a group of properties already cooperating in a local Landcare group, or across properties owned by family members.

There are some issues to be negotiated with this model in terms of meeting regulatory requirements. Once they are shot, kangaroos become the legal property of the licensed shooter, rather than the property of the landholder. However, under this model returns from the sale of kangaroos must flow to the landholder, rather than the harvester. Presumably this could be resolved through contractual provisions between landholder and manager, specifying that income from kangaroos was the property of the landholder as a condition of employment.

5.4.2 Evaluation

This model gives landholders control of kangaroo management, either at a property-level or cross-property scale. It returns economic benefits to the landholder, as long the returns from kangaroos (plus any benefits from better kangaroo management, such as reduced grazing pressure at critical times) outweigh the cost of paying a kangaroo manager. It avoids the conflicts of the previous model, with respect to property management being too time-consuming to allow for kangaroo harvesting at night. It fosters kangaroo management as a well thought out component of overall property management, integrating it with NRM and agricultural priorities. As the kangaroo manager is a farm employee, it entrenches a strong relationship between the and the landholder, which can enable the harvester to contribute to NRM and property management activities such as feral control, weeds management, and checking water points and fences. It is comparatively simple to implement, particularly if individual properties are large enough to support a kangaroo manager alone. The benefit for the kangaroo harvester is that they have a stable, secure income and no competition for country to shoot on. While some harvesters undoubtedly prefer to work independently, this may be attractive to many.

One challenge for this model is that there are probably few properties that would harvest enough kangaroos to make employment of such a kangaroo manager economically viable, so it would have to be done by a group of properties working together. While this is probably a good thing in terms of facilitating larger-scale kangaroo management, joint employment of a single kangaroo manager by a consortium of properties, to work across all of them, will require substantial cooperation and trust to be built up. A further challenge is that this model shifts the risk involved in kangaroo harvesting from an individual harvester to the landholder(s). If kangaroo harvesting is unprofitable, it is the landholder who loses financially, rather than the harvester. Few landholders may be willing to take on this risk, given that most have little direct experience with the harvest, or close relationships with kangaroo harvesters. Despite these challenges, this model has many strengths, and could have much potential where landholders are highly motivated to improve kangaroo management on their properties, particularly where they are dealing with high densities of kangaroos.

5.5 Collaboration among landholders

5.5.1 Description

Landholders could establish a collaborative group to play a role in harvest management, chiller box operation, processing and marketing, and seek to build relationships with shooters who were interested in cooperating on these objectives. This group could focus on some or all of a range of specific functions, which are discussed in turn below. An initial issue is to what extent landholders and harvesters work together as members of the same collaborating group to benefit all, as distinct from landholders primarily collaborating with each other, and contracting or making arrangements with individual shooters. Many of the possibilities discussed under this model could be done in either manner, and the difference this aspect could make in practice will be discussed where relevant.

5.5.1.1 Collective bargaining with processors

A collaborating group could negotiate collectively with processors to gain the best market price for kangaroos supplied. The group can offer a processor:

- exclusive access to kangaroos from collaborating properties. If the group consists of a large enough group, an economically significant supply of product could be involved. How attractive this is to processors will rely on the level of demand for product and the level of competition between processors
- if shooters were involved, the group could also offer exclusive access to product from those shooters. In many areas there is an oversupply of shooters, so this may not be particularly attractive. However, some shooters are known by processors to supply consistently good-quality product, so having these as part of the group could be an advantage
- stopping or limiting the use of shoot-and-let-lie permits (see below at 5.5.1.3) by collaborating landholders. This could be attractive to processors interested in ensuring long-term, abundant sources of supply
- consistent high-quality kangaroos, through implementing quality assurance schemes and high standards of harvesting and handling (see below at 5.5.1.5). If shooters were part of the group, they would be implemented as conditions of membership. If not, landholders could require that shooters accepted and implemented these standards as a condition for access to their properties.

In return, the group could seek from processors an additional margin per kg of meat delivered, over and above the standard market rate (usually consistent between different processors and locations). This margin can then be returned to the group, with any profits to be divided among members. The division of profits will depend on who is in the group and what each of them have had to do to secure the greater return. If only landholders are group members, any profits can be divided equally. In this case, however, part of the pre-profit margin secured will probably need to be paid to harvesters on a per kg basis, in recognition of the higher standards of practice they have been asked to implement. If landholders and harvesters are both group members, they will need to reach agreement on how to divide profit between them in an equitable manner. For instance, if harvesters have had to make big changes to their practice, while landholders have had to make only minor changes, the group may consider it equitable to return a greater share of benefits to harvesters, and *vice versa*.

5.5.1.2 Chiller box operation

The collaborating group could own and/or operate one or more chiller boxes themselves. They could buy or lease their own chiller, and engage a box operator to run it. The group would manage and oversee the chiller, including developing and implementing standards for operation.

Taking on box operation means they can additionally offer processors a high standard of box operation to ensure meat quality. Meat quality and shelf life are critically affected by aspects such as how close together carcasses are hung, how soon they reach the desired temperature and how consistently that temperature is maintained. The industry standard for processors to pay to box owner/operators is about 15c/kg, of which 7-10c goes to the person physically running the box. So, for example, if the collaborating group secured 20c/kg for their product from processors as a box owner/operator, after paying the person physically running the box they would have a return of 10-13c/kg to cover group operating expenditures and generate benefits for members.

The distribution of benefits again depends on who is in the collaborating group. If the collaborating group consists only of landholders, shooters could be paid as usual at the chiller box, and processors could make an additional payment at appropriate intervals to the landholder group. Harvesters may be able to negotiate an additional price per/kg from the landholder group, in view of any additional standards/procedures they are following. If the group consists of both landholders and shooters, it will need to decide as a group how to distribute profits among its members. Harvester members could be paid a better price per kg at the chiller box, with any additional profits distributed among landholder members, or harvesters could be paid the going rate at the chiller box, with any profits regularly distributed between landholder and harvester members.

In some states, there are some licensing issues to deal with if this model is pursued. In Qld, there should be no obstacle to landholders obtaining the Commercial Wildlife Licence required under the *Nature Conservation (Wildlife Management) Regulation 2006* in order to operate a chiller and buy wildlife. In NSW, under the *National Parks and Wildlife Act 1974*, a Fauna Dealer (Wholesaler) licence (FD licence) is required to buy kangaroos from harvesters. However, the the number of FD licences in NSW is restricted - in general, no new licences are issued (Macarthur Agribusiness and Econsearch P/L 2003). They may be able to obtain their own licence either by buying one from an existing holder (licences turn over at about the rate of 1/yr), or by making a case to the regulatory agency (NSW Department of Environment and Climate Change) to issue an additional licence. This is not impossible, but it will involve additional uncertainty and effort. Alternatively they could operate as a sub-licensee of one of the processors who currently hold the FD licences. This, however, locks them into a single relationship and gives them little flexibility for bargaining with different processors for the best price for their product. In addition, under this arrangement kangaroos would remain the property of the licence holders, and not be owned at any stage by landholders. While it is not clear that this would be a problem in practice, it could restrict options for negotiation, processing and marketing.

5.5.1.3 Harvest management

The collaborating group could play a role in managing the harvest at an individual property and a group level: addressing TGP management priorities, integrating the harvest with regional, sub-catchment and property level priorities, and responding to large aggregations. They could manage the harvest to increase offtake, including through avoiding the use of shoot-and-let-lie permits, or targeting specific age-sex classes. The extent to which the group sought to be involved in management would depend on the group's resources and needs, and the extent to which shooters are part of the collaborating group or peripheral to it. The group could develop and implement a kangaroo management plan for the group of properties involved, based on scientific advice. The group could share information and communicate regularly, gather input on kangaroo densities and priorities from landholders, carry out monitoring to assess local kangaroo populations, collate information on level and location of harvest, keep track of collaborating shooters and pass on landholder input to them, potentially keep track of how many tags each shooter has available for each property (in states where this is necessary), and assist landholders in meeting TGP management priorities.

5.5.1.4 Group quota and tags

Quota and tags could be assigned to the group as a whole, rather than to specific landholders or harvesters. How this would operate, and how it would change current practice, depends on the state.

In NSW, tags can only be used on the property for which they are issued, as specified on the relevant Occupier's Licence. This limits the degree of possible collaboration between landholders in harvest management. It is not possible, for instance, for harvest effort to be easily planned and coordinated across the group of properties - if kangaroo aggregations move from one property to another, tags for that property will need to be applied for and received before they can be targeted. Collaboration across properties in harvest and TGP management could be made substantially easier if quota and tags could be issued to the group as a whole, rather than to individual landholders, with tags able to be used on any property across the group.

The FATE Program at UNSW and the Barrier Ranges Rangecare Group (BARG) have developed a model for how this could work. This has been approved by the NSW Kangaroo Management Plan as an "adaptive management trial" under the NSW Kangaroo Management Plan 2007-2011.Under this model, the group of landholders is granted collectively a general licence (under s120 of the NSW *National Parks and Wildlife Act*), containing equivalent provisions to an occupier's licence, and a quota. The quota is determined by calculating the land area of collaborating properties as a proportion of the land area of the zone: the group is allocated the corresponding proportion of the annual zone quota. It is then up to the group how they allocate this quota among harvesters. They can direct harvest effort across the group of properties according to kangaroo movements and the TGP management priorities of landholders. As now, shooters would own carcasses they shoot and sell them to box operators.

In Queensland, the situation is somewhat different because tags are issued directly to shooters, rather than landholders, and can be used anywhere within the harvest zone. (Qld has only three harvest zones, each of which covers an enormous area). This arrangement has the benefit of flexibility for shooters, avoiding some of the hurdles facing cross-property collaborative management in NSW. If kangaroos move across property boundaries, tags can follow them, enabling a group of landholders to plan and manage on a larger scale. However, they still face problems of competition for limited quota, and the problem of quota running out before the end of the year. If a collaborating group of landholders, or landholders and shooters, could be granted their own "ring-fenced" quota it would allow them to plan and manage with more predictability. However, it should be noted that a group of landholders/shooters receiving a quota and tags represents a greater change from current practice in Qld than NSW, and may require legislative change. The potential for groups to secure their own quota is returned to in the following Chapter.

5.5.1.5 Quality assurance, product differentiation and marketing

The collaborating group could play a role in developing premium, high-value kangaroo products, labelled and marketed on the basis of high quality standards and/or environmental attributes.

Quality standards and practices could encompass, depending on assessment of the market and negotiation with processors:

- selection of animals in the field (e.g. selection of species species/sex/age/size characteristics, or healthy animals)
- field dressing methods
- transport to chillers (e.g. no. of hours before reaching a chiller)
- ensuring even and quick chilling of animals and avoiding overcrowding in the chiller
- enabling traceback of animals to the paddock, through tracking technologies used by harvesters, box operators and processors.

Labeling and marketing on an environmental basis could highlight high standards of land management and biodiversity-friendly practices, the low greenhouse gas emissions associated with kangaroos, or perhaps implementation of an EMS system such as Landcare's Australian Land Management System. There are a variety of issues to be thought through here, such as whether labels would be applied to kangaroo only or all products from the collaborating properties, whether first party, second party or third party certification is most appropriate, and what sort of attributes will be most attractive to the market.

Recent research associated with the development of the SWEs has explored characteristics of the market for kangaroo products. Ampt and Owen (2008) point to slow (if ongoing) increase in consumption of kangaroo meat, but also the need for clear messages surrounding the sustainability of the harvest and hygiene (among others) in order to maintain this growth. SWEs offer a potential advantage in meeting this need. Chudleigh et al.(In review) found that kangaroo product from SWEs could best be marketed by positioning it as a gourmet, environmentally branded, and high quality product. They emphasise that all three would be vital – the environmental message alone would be unlikely to attract significant market advantages.

Taking these products to market and securing a benefit for landholders could be done in different ways. The landholder/shooter group could enter into long-term contractual arrangements to supply high-quality products to processors, and take responsibility for maintaining and assuring quality standards. The processor would have to be willing to invest in labeling and marketing a differentiated product, as well as have systems in place to track the premium product. Alternatively, the landholder(/shooter) group could produce the premium product, pay a processor to process it on a contract basis, and market the product themselves. Indeed, the group could eventually invest in processing product themselves.

5.5.1.6 Evaluation

Most of the options above could be pursued by a group of landholders alone, who then made harvesting on their properties conditional on harvesters meeting certain conditions that the landholder group established. Achieving collaboration and agreement between a group of landholders will clearly be easier than achieving it between landholders and harvesters. Landholders and harvesters frequently do not see eye to eye, and tend to be on opposite sides of the fence on many kangaroo management issues. Organisation of a group of landholders to pursue some of the options above is likely to be far less time-consuming. However, while this might appear initially simpler, there are disadvantages to taking this option. The major drawback of the landholders-only approach is that it offers little to harvesters, and harvesters are likely to actively oppose it. Under this model, harvesters continue to have no negotiating power, and their position is further weakened by the strengthened position of landholders, who as a group are able to dictate terms of access to harvesters. Further, if harvesters are not part of the group, they will not have any incentive to promote the interests of the group as a whole, rather than evade its standards or rules when possible. Finally, harvesters have specialised expertise and industry understanding that landholders generally do not have. For these reasons, it is assumed in all comments below that the involvement of both landholders and harvesters as partners in a collaborative group is preferred and pursued.

The landholder/shooter collaborative model, with all its variants, appears to represent the most promising of the options so far. Landholders and harvesters both benefit from a stronger bargaining position through negotiating as a group rather than as individuals. Landholders benefit through gaining economic returns from kangaroos and from greater involvement in kangaroo management, allowing better management of TGP. Harvest management across properties, at an ecologically meaningful scale, is facilitated. Harvesters benefit from more secure access to country, better economic returns, and from landholder support of measures such as stopping use of shoot-and-let-lie tags. They also gain recognition and rewards for implementing higher professional standards. Better relationships between landholders and harvesters benefit both, with harvesters having more security and respect, and the potential for cooperation on aspects of NRM such as feral control, weeds, and checking fences and water points.

Achieving such collaboration will involve substantial costs for the individuals involved, and these need to be weighed in decisions to collaborate. Time and effort are required to increase understanding and reach agreement among the groups. Capital and staff are required to take on major activities and invest in items such as a chiller box. A level of financial risk is involved. Ongoing participation in management and decision-making will be required from all members. For shooters, being part of a collaborative group means having less independence regarding where and when they shoot, and for landholders, it involves an additional responsibility and drain on limited time.

6. The proposed model: a Kangaroo Coop to benefit landholders and harvesters

A collaborative model appears to hold the most promise for securing landholders a role in kangaroo management. This opens up as many questions as it answers, as there is a huge range of potential variations on the basic collaborative model presented above. This chapter proposes and explores in detail an operating model for engaging landholders in kangaroo management, based on collaboration between landholders and harvesters. It was developed to address the needs and priorities of the Maranoa Wildlife Management Conservancy, a Sustainable Wildlife Enterprise established by the Mitchell and Districts Landcare Association, in conjunction with local harvesters. It is therefore tailored to the regional conditions, regulatory framework, and kangaroo management prevailing in that area. A short background on the history of the group is given, followed by a description of the basic features of the model. Key aspects are then explained and discussed in more detail, followed by a description of the presentation and trial of the model with the major target group.

6.1 Background: the Maranoa Wildlife Management Conservancy

The Mitchell and District Landcare Association is based in Mitchell, on the Maranoa in western Queensland. It is the umbrella association for many local Landcare groups around the town. For several years, this group has been engaged in exploring options for establishing a Sustainable Wildlife Enterprise, with support from RIRDC, and have established the Maranoa Wildlife Management Conservancy. As commercial harvest of kangaroos offers the most obvious wildlife-based enterprise for the group, this has been the focus of their efforts. As yet the group remains an informal organisation. At the inception of this study, the group had carried out a range of activities: information and awareness-raising activities among landholders and harvesters to lay a basis for collaboration, workshops to explore issues surrounding collaboration, initial negotiations with processors, and a survey of kangaroos across the area. The model put forward here was developed in close collaboration with key stakeholders from this group.

6.2 The model

6.2.1 Outline of the model

6.2.1.1 Coop function and structure

A trading cooperative is established – the Maranoa Kangaroo Harvesters and Growers Coop. The Coop's primary activities are kangaroo management, processing and marketing (with processing understood here to include operation of chiller boxes). Membership of the Coop is limited to those who support the business of the Coop - landholders and harvesters. All members benefit from the greater negotiating power of the Coop in relation to processors, the establishment of cooperative, long-term relationships between the groups, and the potential for development of high-value niche products reliant on landholder involvement.

Its major activities initially will focus on collective bargaining with processors on behalf of its members; chilling and holding of kangaroo products produced by its members; and quality assurance. In the future, the aim is to expand into development of premium products, badged on the basis of environmental standards (land management, biodiversity), regional identity, and/or landholder involvement; and potentially into processing and marketing to buyers further toward the consumer end of the chain. For a visual representation of the Coop's functioning, see Fig 1.

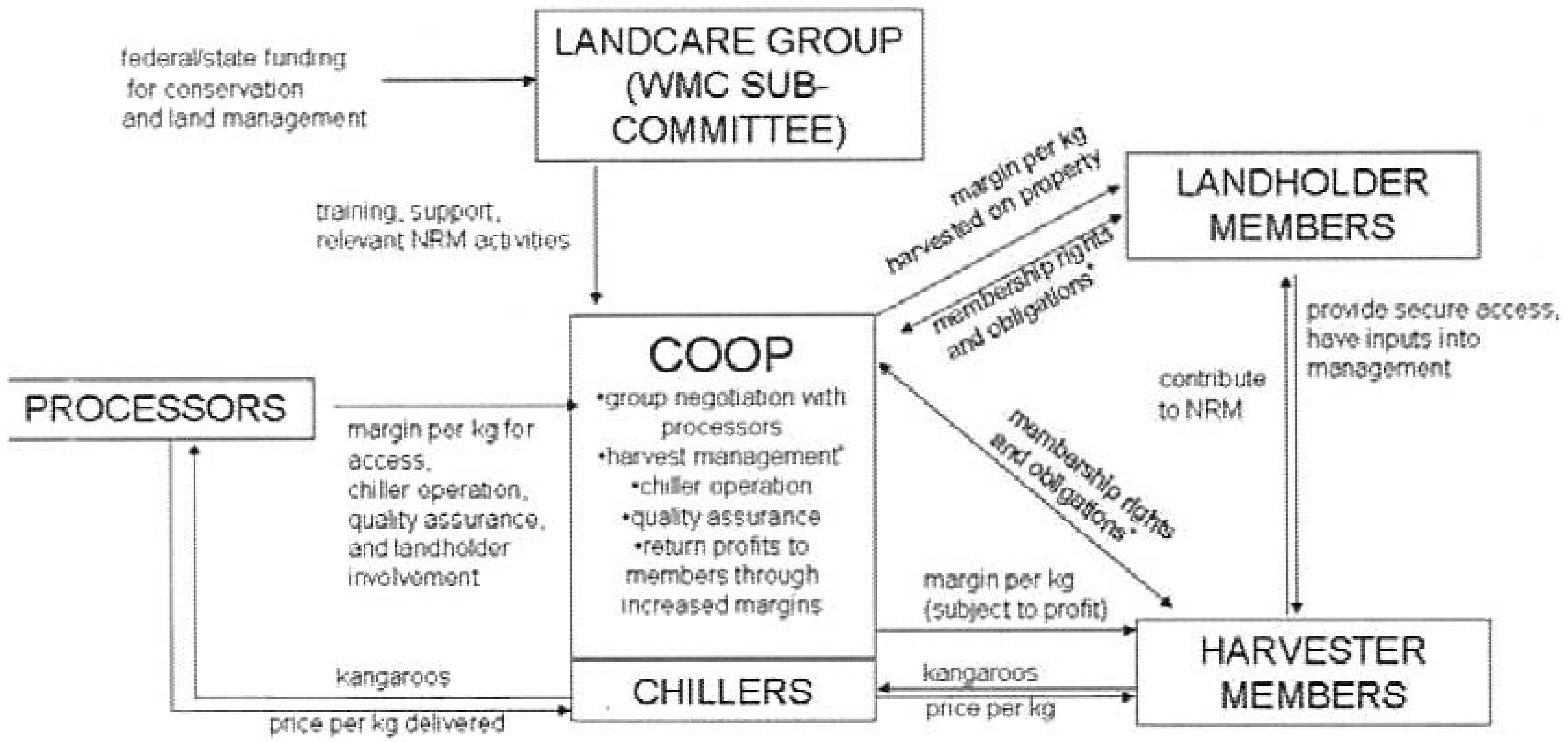

Fig 1. Visual representation of the proposed Maranoa Kangaroo Harvesters and Growers Coop

Members of the Coop can purchase two different kinds of shares – landholder or harvester shares – with varying rights and obligations. Negotiations with processors are carried out by the Coop on behalf of the group as a whole. The Coop owns/leases and operates one or more chiller boxes. Harvester members supply the chiller boxes with kangaroos harvested on landholder members' land. The Coop plays an active role in developing and implementing best-practice quality standards of carcasses produced, which could include standards of animal selection, harvesting, field dressing, transport, and chilling. The Coop seeks to negotiate an additional margin per kg from processors, on top of the standard prevailing market price/kg. As bargaining points, the Coop can offer processors

- Exclusive access to product from the properties of landholder members,
- Consistent high-quality product, and
- No use of damage mitigation permits by landholders.

Future avenues for exploration include specific size ranges (larger animals yield more profit to processors), selection of specific size/sex/age/species combinations that may have particular meat attributes, commitment to specific target volumes, and environmental labeling.

6.2.1.2 Rights and obligations of members

The major obligation for landholder members is that they provide exclusive access to Coop harvester members to their properties for harvest. They do not allow harvesters who are not members to harvest on their land – if their current harvester is not willing to become a member, they will no longer be able to harvest there. Member harvesters are given secure and exclusive access to country – no other harvesters will be allowed on against their will. Landholders still make all decisions about which shooters access their land, and are under no obligation to allow any specific member harvester on to their land, but any harvest on their land must be by a member harvester. A further obligation for landholders is that landholders do not use damage mitigation permits on their properties. This benefits the Coop by increasing future offtake.

The major obligation for harvester members is that kangaroos harvested on Coop member properties are supplied exclusively to the Coop chiller box, up until its capacity is reached. If the chiller operator indicates the Coop chiller is full, kangaroos can be sold elsewhere.

6.2.1.3 Returning value to members

At chiller boxes, the Coop (through a box operator) pays shooters on a per kg basis at standard market rates. The processor pays the negotiated rate to the Coop. The industry standard margin for a box owner/operator is 15c, so the Coop would be seeking ca 20c/kg and upward, on top of the price/kg paid to harvesters. Out of this the Coop pays the box operator a sum per kg (industry standard is 7-10c). The rest goes toward covering the Coop's costs and generating profit for its members.

The profits of the Coop are returned to its members on the basis of their contribution of kangaroos to the Coop. So landholders benefit on the basis of the amount of kangaroo harvested on their land, and harvesters on the basis of how much they have delivered to the chiller. The benefits paid to members would vary from time to time in line with the profitability of the Coop, its capital needs, and business strategy. These benefits could be distributed among members at the end of the financial year or by whatever arrangement was advantageous in terms of administrative and tax implications.

6.2.1.4 Governance and staffing

The Coop's decision-making proceeds on a one-member one-vote basis. All members, regardless or share class, land area, or volume of business transacted with the Coop, have an equal say, in line with Cooperative principles. A Board of Directors is elected by the membership from among its members. The Board of Directors oversees the running of the Coop, establishes strategy and policy, appoints and manages staff, ensures financial and legal obligations are met, and so forth. Independent directors (non-members) can also serve as Directors, and may bring important skills such as specialised business expertise.

The Coop employs staff to pursue the activities of the Coop, such as developing business strategy; expanding membership; implementing quality assurance programs; negotiation with processors; developing marketing strategies; compilation and maintenance of records on harvest; regular liaison and communication among members; overseeing chiller box operation and maintenance, including meeting regulatory requirements; and financial record-keeping and reporting. A Managing Director should be appointed, initially on a part-time basis, and a chiller box operator will be required.

6.2.1.5 Relationship with Landcare group

The Coop maintains a close working relationship with the Maranoa Wildlife Management Conservancy, which is a sub-group of the Landcare group. Since membership is overlapping, this should not be difficult. The Landcare group retains responsibility for elements of kangaroo management that fall within its remit (i.e. are related to land and TGP management), such as supporting landholders in integrating kangaroo management within property management, training and support in EMS implementation, gaining scientific input to guide harvest strategies, or carrying out kangaroo surveys. It can seek financial support to support these activities from state and Federal sources.

6.2.1.6 Raising capital

In terms of capital needs, for the Maranoa group some funding of the parent Landcare group will assist in the early stages. The Landcare group has purchased two chiller boxes, which represent the major investments required, and has funding to assist in establishment of the Coop. Minor additional capital will be raised by the purchase of shares by members. These are priced at a low figure of ca \$50-500, in order to encourage membership. The Coop can borrow from financial institutions, and regional and industry development funding may be available.

The following sections explore some aspects of this Coop in more detail, and explain and justify some of the choices made in formulating it.

6.2.2 Why a cooperative?

Various forms of organization can be used to facilitate cooperation among people to achieve shared objectives. In this case, an initial consideration is that the Coop itself needs to have legal personality, in order that it can own assets (such as chiller boxes), it can enter into contracts, sue and be sued, members are not personally liable for its debts, and so forth. A second consideration is that one aim of the Coop is to return economic benefits to its members. This rules out non-commercial structures such as incorporated associations and public companies limited by guarantee.

The major options are therefore a company (limited by shares) or a trading cooperative. Companies, which are registered under the Commonwealth *Corporations Act 2001* can be either public or private. Public companies limited by shares are primarily geared to facilitate public investment, which is not a current aim of this enterprise. They are also relatively expensive to establish. This brings the major choice down to a private company or a coop.

Private companies are the most common type of company. Key attributes for our purposes include the following:

- Companies are owned by the shareholders. Each member's interest in the company is represented by the number of shares the member holds in the capital of the company.
- Member liability is limited to the unpaid amount (if any) on each share.
- The company pays profit to shareholders in the form of dividends on shares, which can be traded by members.
- Private companies are restricted in size – they may have only up to fifty members.
- Private companies have low financial administration and reporting requirements: they do not require that an AGM be held, do not require that accounts be audited, and do not need to disclose their accounts to a regulatory body.

A cooperative has been defined by the International Cooperatives Association, the peak body supporting cooperatives globally, as "an autonomous association of persons united voluntarily to meet their common economic, social and cultural needs and aspirations through a jointly-owned and democratically-controlled enterprise". Key features of trading cooperatives, those which return profit to their members, are as follows:

- A coop is owned and controlled by those for whom it was established and who use its services. Only those who use or contribute to the business of the Coop can be members.
- Voting is one-member one-vote, rather than on the basis of shareholdings.
- The Board has control over who joins the Coop.
- Coops are registered under state law – in Qld, the *Cooperatives Act 1997*.
- There must be at least five members (under Qld legislation).
- Member liability is limited to the fully paid up value of their shares.
- Coops return value to members on the basis of member entitlements rather than shareholding.
- Their establishment is less complex and costly than companies.
- In Qld many of the requirements applied to public companies by the *Corporations Act* are applied to coops. Like public companies, they must hold an AGM, have audited accounts, and make annual disclosures to the Office of Fair Trading.

Globally, cooperatives are strikingly successful. A recent review revealed that the largest 300 cooperatives combined would rank in tenth place assessed against national economies. They held assets of US$30-40 trillion and had an annual turnover of nearly US$1 trillion, only marginally smaller than Canada in ninth position (International Cooperative Alliance 2008). Agricultural cooperatives are among the most successful sectors. For instance, this review shows that the Zen-Noh agricultural co-operative in Japan, the largest cooperative in the world, has a turnover of US$63 billion, and Europe's largest dairy business is a cooperative with a turnover of over US$7 billion.

Coops have a long history and a rather mixed reputation in Australia (Lyons 2001). However, they continue to be important entities in agricultural businesses in particular. Here they gain for producers the benefits of bargaining power when selling their produce and some have taken on processing as well. While relatively few in number, compared to coops in other sectors, most large coops are agricultural (Lyons 2001) and many are successful and long-established. For instance, Australia's largest dairy business is Murray Goulburn Co-operative. Over recent years, as agriculture faces challenges of globalisation and greater competition, coops have been established for purposes as diverse as fuel supply, telecommunications provision, farm forestry, organic farming, processing and selling knitting yarn, and marketing lambs (see generally (Cooperative Development Services undated). In Qld the number of registered cooperatives is holding steady (ca. 200), and in NSW is growing (>800) (Qld and NSW Offices of Fair Trading, pers. comm.).

Coops have some important strengths for pursuing the mutual objectives of landholders and harvesters:

- They are cheaper to establish, which is not insignificant given that starting capital for the enterprise is low
- The democratic voting structure (one-member one-vote) may be better to maintain an equitable and balanced representation of the interests of the two groups in decision-making (landholders and harvesters), rather than voting on the basis of shareholding (which will favour those with more capital to invest in shares). This may foster loyalty and better cooperation, which is essential for its success
- While reporting and governance obligations are stronger, and this imposes greater costs, the greater robustness and transparency required to fulfill these obligations should be viewed as an asset
- Coops return value via membership rights, rather than shares. They can return benefits to members on basis of the amount of business they transact with the Coop, such as the kg of kangaroo they produce for chilling and marketing by the Coop. It may be possible to do this under a company structure – for instance, landholders and harvesters could invoice the Coop at the end of each year for an agreed per/kg payment, decided by the Coop on the basis of their financial position, and the Coop would pay no dividends on shares. But this is not the way companies are designed to operate, and it is likely to be more straightforward to do this under a coop structure.
- Possibly the most important advantage of a coop is its more stable and easily controlled membership. Only those who contribute to the business of the Coop can be members, and the Board must approve new members, while private companies generally place few restrictions on the transfer of shares. These restrictions on Coop membership should facilitate cooperation among the group. Further, it should help to maintain the access to land that underpins the entire enterprise – a stable group of landholder members are required to ensure supply of kangaroos. The Coop can manage its membership to ensure it has roughly the right proportion of landholder and harvester members, and adequate chiller capacity to service them.
- Members of a coop seek to pursue their ends collectively, rather than simply seek financial returns on their investment, as in a company. They may therefore be more likely to act for the long-term good of the organization and support its aim of service to its members, as well as its broader community and environmental ethos.
- Products from a coop may have a market advantage, as many in the community support the cooperative ethos. This has been the experience of at least some farm forestry cooperatives, for instance (Andrew Lang (SmarTimber , pers. comm.).
- Assistance and advice in establishing and running a coop may be available from Office of Fair Trading Qld.

The major disadvantage to pursuing a coop model in this context concerns raising capital from investors. Coops can of course borrow money from financial institutions, and raise a certain amount of capital from their members. However, coops are less attractive to investors than companies, not only because of their restrictions on membership, but because shares cannot be easily transferred, do not pay dividends (generally) and do not appreciate in value. Coops thus face restrictions in terms of raising capital for expansion. It is this factor that has driven the de-mutualisation (conversion to a standard company) of some cooperatives in Australia in recent years. Some of these problems have been addressed by new forms of cooperative that have been developed in the agricultural sector in recent years, discussed further below.

In any case, however, a cooperative structure offers distinct advantages in facilitating the collaboration that is at the heart of this enterprise, particularly through restricted membership and democratic decision-making. This initiative is not simply a profit-making entity (although it has to be economically viable), and adopting a structure designed to return profit to shareholders does not appear well-adapted to meet its aims.

6.2.3 New forms of agricultural cooperatives

Recent decades have seen the emergence of new forms of agricultural marketing and processing cooperatives that seek to overcome many of the limitations of the traditional cooperative model. A variety of these can be distinguished on the basis of how ownership rights are distributed, and arrayed along a spectrum from a traditional cooperative to a investor-owned company (Chaddad and Cook 2004). One of the most successful models, particularly in the USA, is the "new-generation cooperative"(NGC). These cooperatives have emerged in recent years in response to a set of problems facing primary producers, particularly drought and declining prices, and have been very successful in increasing income for producers. Their key attributes can be described as follows (see Stefanson, Fulton and Harris 1995; Coltrain, Barton and Boland 1999; O'Connor and Thompson 2001; Fulton and Sanderson 2002). The processing capacity for the coop is determined in advance, which determines the total amount of product members can deliver to plant. NGC members purchase shares of equity stock, which convey the right and obligation to deliver a proportional number of units of product to be processed/marketed. The price of shares is determined by dividing the capital required for establishment by the number of units of farm product that can be absorbed by processing facility. So, for instance, a producer might buy one share, which would entitle and oblige him or her to deliver one unit, 10 t, of wheat for processing. If five shares are held, 50 t can and must be delivered. The number of shares is held constant – membership is closed. Importantly, NGCs also involve the establishment of a market for shares – these can be traded and can appreciate in value.

The NGC coop is not appropriate for kangaroo processing, because it fundamentally relies on members committing to deliver a predictable volume of primary produce. This is not possible for kangaroos, where the harvesters and landholders who produce kangaroos are at the mercy of climatic fluctuation and population movements. However, the model proposed here has some aspects which deviate from traditional cooperatives and are similar to NGCs. First, the Kangaroo Coop model includes an *obligation* for members to deliver product for processing and marketing, not just the right. Landholders must ensure the kangaroos from their property go to the Coop chiller (by only allowing access to member harvesters), and harvesters must sell product from Coop member properties to the Coop chiller. By contrast, traditional cooperatives involve the right for members to have product processed by the coop, but they are free to take their product elsewhere if they receive a better price. Second, traditional coops usually accept a range of quality in farm produce, whereas NGCs typically contract with members for stipulated quality as well as volume. In the model presented here, the Coop stipulates specific quality standards to be fulfilled by harvesters, as well as standards of land management to be applied by landholders (no shoot and let lie shooting).

6.2.4 Balancing power between landholders and harvesters

As one harvester can cover several properties, to have the right balance of landholder and harvester members there will generally need to be several times as many landholders as harvesters in the Coop. There is consequently a need to build mechanisms into decision-making procedures to ensure that harvesters have an equitable say in decision-making and management i.e. that the landholder majority cannot control decision-making without harvester support. This is particularly important in view of the fact that the robustness and stability of the organization depends on all its members feeling that they are gaining equitable benefits.

This can be achieved through the following mechanisms:

- Quorum at meetings should require a minimum number of harvesters to be present, as well as a minimum number of members overall.
- Voting should require the support of a majority of each group for a resolution or decision to be carried. So with 20 people voting, including 5 harvesters, a resolution would require at least 8 of the landholders *and* 3 of the harvesters to support it for it to be successful. This system should encourage both groups to find approaches that work for both.
- The Board of Directors should contain a minimum number or proportion of harvesters, say 40%. So, in an election for Board positions, if a straightforward vote count would not result in an adequate number of harvester Directors, a seat that must be filled by a harvester (to reach an adequate proportion) should be filled by the harvester candidate gaining the most votes.

6.2.5 Equitable benefit-sharing

The model proposed here involves the allocation of benefits to members based on a per kg payment to harvesters for kangaroos shot (in addition to prevailing market rates), and to landholders for kangaroos harvested on their property. This leaves open the question of how exactly benefits should be divided between harvester and landholder groups. These could be allocated equally, or the Coop could establish an equitable formula that took into account the contributions that each group to profits gained by the Coop. For instance, if the Coop was gaining a margin/kg above market rates primarily due to some substantial or costly changes to the practice of harvesters, the Coop could decide that harvesters should receive a greater share of profits and a higher payment per kg than landholders. In any case, the allocation of benefits will need to be decided through a clear and transparent Coop decision-making process, such as at the annual general meeting, and these might be revised as circumstances, practice, and the business environment changes.

Returning value to landholders on the basis of a per kg payment for kangaroos harvested on their land is not the only option. One alternative option would be on the basis of land area. The rationale for this is that where kangaroos are harvested does not necessarily reflect the land they use. They could be using shelter on one property during the day, but feed on a second property where they are shot at night. If benefits are distributed according to where they are shot, the landholder of the first property will receive nothing, despite the fact he or she may be providing critical habitat to large populations. While this is a valid point, distributing benefits on the basis of land area has the disadvantage of providing no direct incentives for landholders to value the kangaroos on their property, as their income is not linked to a measure of the number of kangaroos on their property. They receive the same benefit in any case. Linking the number of kangaroos harvested on one's property to the level of benefit received provides a strong incentive for landholders to value kangaroos and see them as an important asset, with the various broader NRM and conservation benefits this could bring.

In the case of shooter benefits, one alternative option for returning value to shooters is to pay them more per kg at the chiller door, rather than through periodic distribution. One problem with this is that at any one point in time the Coop will not have a clear idea of its profits and what would constitute an equitable share. However, this remains a potential option, and may make joining the Coop initially more attractive to harvesters.

6.2.6 Harvest and TGP management

In the model proposed here, the major short-term harvest management measure instituted is agreement by landholders to stop using the non-commercial shoot and let lie tags. The primary motivation for this initially is that this establishes a favourable bargaining position with processors. Once the Coop is established and operating, however, it should benefit all involved by increasing future offtake. Decisions on use of non-commercial culling will need to be reviewed in light of changing conditions – while under current conditions this will not have a great impact on landholders in the region, there may be situations where large aggregations cannot be managed through the commercial harvest. In this case a clear procedure for use of shoot and let lie tags will need to established, and decisions on their use will need to be made in negotiation with the Coop rather than unilaterally. Where possible, however, the Coop will seek to avoid or minimize their use through harvest planning and management.

Effective harvest management will require that the Coop develop a harvest management plan that meets priorities of the Coop, the landholders, and the harvesters, as well as contributing to sub-catchment and catchment level NRM objectives. Major objectives are likely to include management of TGP and ensuring consistent high production. The plan should be based on sound scientific advice and could address timing of harvest, location of harvest, sexes, ages and species targeted. Landholders could seek to integrate these harvest plans with property management to promote both economic and conservation/land management objectives.

6.2.7 Expanding to include independent box operators and truck drivers

In the model put forward here, only landholders and harvesters are Coop members. But there are other players involved who could potentially benefit from becoming Coop members, and benefit the Coop by joining. In particular, many boxes in Qld are owned by independent box operators. When the capacity of the Coop expands beyond the chiller boxes it now owns, rather than investing in more boxes it could collaborate with these box operators. Box operators could purchase a third class of share. Membership would entitle the box operator to receive and chill kangaroos from Coop properties, and would require that they preferentially (or even exclusively) accept kangaroos from Coop member properties and/or harvesters. They would apply quality standards developed by the Coop for chiller operation. Box operators would benefit by being part of a larger bargaining group, and would benefit the Coop by avoiding the need to make major capital investments in order to expand.

6.2.8 Marketing and badging

The Coop develops strategies for raising the value of its product through improving quality and labeling it on the basis of environmental attributes. In the first instance, the Coop will develop and implement a Quality Assurance program at best-practice level, including systems to monitor and ensure consistency. Looking longer term, the work of Chudleigh et al (In review) suggest a potential niche for environmentally branded, gourmet products of high quality. This study suggests that an effective "environmental story" needs to be clear and backed up by authoritative demonstration of its claims (Chudleigh et al. In review). Some options that could work for the Coop are canvassed here:

- One environmental benefit of eating kangaroo is its lesser contribution to global warming than domestic stock (Diesendorf 2007). However, while an important message to get across, this claim can be made with respect to any kangaroo and would not attract any market advantage to the Coop.

- Landholder involvement in kangaroo management itself may be attractive to consumers. Recent work appears to indicate that a large proportion of the public is not aware that kangaroos are harvested wild, without management from landholders (Ampt and Owen 2008). The Coop could highlight the message that only their kangaroo is managed with the involvement of landholders, which may be more palatable to some sectors of the public.
- The product could be labeled as originating from a Sustainable Wildlife Enterprise, with objectives of better land management and biodiversity conservation. For these claims to carry weight, however, the contribution of the SWE to these objectives would ideally be monitored and verifiable, which will not be the case for some time.
- Coop landholders are all Landcare members, and this could be the basis of a marketing message. Landcare guards the use of its trademark very closely, however (G. Wilson, pers. comm.), and gaining permission to use it could be challenging.
- Coop member landholders could all implement an Environmental Management System, such as Landcare's Australian Landcare Management System (ALMS). This provides a robust assurance of good land management to the consumer.

6.3 How could regulatory practice support this model?

There are a number of ways in which government regulatory practice could change to support this model. These ideas draw in part on some of the overseas experiences presented in Chapter 4, particularly the supportive and cooperative relationships established in these countries between local landholders and government wildlife management agencies, and the greater role in management given to landholders who demonstrated that they met particular conditions or requirements.

6.3.1 Allocation of quota to the Coop

Currently, harvesters apply for and are allocated tags in Qld on an individual basis. It would be a major benefit to the Cooperative if it could apply for its own quota to be used on Coop properties by Coop harvesters. This would allow it to manage how and when quota was allocated across harvesters and how it was used on properties across the Coop, in line with its agreed management planning and to meet shared Coop objectives. It would avoid uncertainty for harvesters and the Coop around whether they will obtain adequate tags, and allow them to manage tag allocation to avoid running out of tags at the end of the year.

The annual allocation could be initially determined on the basis of land area, taking into account habitat type and past harvest rates. Annual quota allocated to the group need not be exhaustive i.e. the group could apply for more if it foresaw greater demand, but this additional allocation would be subject to remaining quota and not guaranteed. This quota could be further linked to conservation activities carried out by the collaborating group. For instance, groups that carried out restoration of vegetation or reduced stocking rates could be granted a higher quota, providing an incentive for such activities.

The group allocation of quota should be conditional on a group meeting certain conditions and requirements, including specifying the properties involved, specifying the harvesters involved, putting forward a procedure to trace chain of custody of tags and inform the regulatory agency regarding which tags have been allocated to which shooter. In return for taking on additional management responsibilities, the group is being granted additional management rights of a secure quota and the power to decide on tag-allocation amongst the group.

This would be facilitated by including a section in the Qld Wildlife Trade Management Plan for kangaroos specifying the requirements and procedure for group allocation of tags. It is not clear whether this would require regulatory change – it may be possible for the authority to simply set aside an agreed quota of tags for the group, to be distributed to Coop harvesters as required throughout the year.

6.3.2 Conditional devolution of most management rights to the Coop

Landholders and harvesters willing and able to take on a yet greater role in kangaroo management could be supported by granting them greater roles in management, along the lines of the successful overseas examples outlined in Chapter 4. Landholders who met certain requirements could be empowered to manage kangaroos without state-imposed quotas, subject to monitoring that demonstrated sustainability of harvest. Requirements for landholders to gain the right to establish their own management measures could include implementing an effective population survey protocol, developing a sound sustainable management plan agreed by all stakeholders and based on science, and establishing procedures for regular reporting to the regulatory agency. The major benefit for the Coop of this approach is that harvest quotas will be based directly on local kangaroo densities – these may be higher than the statewide average. Further, local densities may be boosted by local land management measures, such as de-stocking some areas or conserving vegetation, and this will be reflected directly in quotas. Further, groups can use adaptive management approaches to determine the impact of local management measures including different harvest strategies.

6.3.3 Tradeable quotas

A further elaboration is that quota allocated to groups of collaborating landholders/harvesters could be tradeable within their harvest zone. If a group had excess quota it could sell quota to other collaborating groups (or even to individual harvesters), or if it had a quota shortfall it could buy quota from other collaborating groups (or potentially from the government agency as well). Effectively a market would be established for quota. This would provide additional flexibility to the Coop: for various reasons it may have a low harvesting level in one year, but could still benefit from their harvest allocation by selling it on, maintaining the economic incentive to value kangaroos. Cooperating groups that needed additional quota to maintain production volume could buy it from other groups.

Tradeable quota has been tried in the past in kangaroo management – in South Australia from 1996 to 2001 (Thomsen and Davies 2007). That system was based on trading between individual landholders and few actually took up the option to trade quota, with most simply authorising use of their quota by shooters/processors with no compensation. Several features of this individual-property trading system made it inflexible and cumbersome to use. Landholders were generally unaware of the option to trade their quota and faced very high transaction costs to sell it – they had to contact another individual landholder and reach agreement on sale and price. Further, quota could only be used on specified properties, not used across properties, making the system inflexible for harvesters. Finally, landholders selling quota for individual properties had little bargaining power, particularly since densities of kangaroos in SA are generally low. A group system like the one outlined here would get around many of these problems, however, as collective bargaining both cuts down on transaction costs and means quota controlled by a group is large enough to have some real economic value. Further, in the Queensland system tags can be used across any properties within the harvest zone, enhancing flexibility.

6.4 Trial of the model with the Maranoa SWE

The model outlined above was trialled with its major target group, the Maranoa Wildlife Management Conservancy, the SWE established by the Mitchell and District Landcare Association. It was presented to a meeting of involved landholders, harvesters and box operators in early February 2008. It was discussed at some length and an in-principle decision was taken by the group to further examine this model with a view to its implementation. A Working Group was established for this purpose. The model was then presented and discussed at a meeting involving participants from all three SWEs, in Broken Hill in February. The model received widespread support from many participants (see FATE 2008). Some long established industry participants stated that it was the first model they had seen throughout their involvement with the kangaroo industry that they believed could work. The Maranoa SWE Working Group met again in early March. At this meeting, as an initial step toward establishing a formal Coop, they agreed a set of obligations of membership of an informal Coop (attached in Appendix 1) and further actions toward securing membership were agreed.

7. Discussion

This research set out to develop, evaluate and trial models for rangeland landholders to be involved in wildlife management and share the benefits of wildlife harvesting on their lands. Based on consideration and analysis of current kangaroo management practice, overseas experience, and the range of options open to landholders, this research proposes a model based on the establishment of a kangaroo management, processing and marketing cooperative, involving landholders and harvesters as members. It is tailored to the circumstances of an SWE in Qld but could be easily adapted for operation in other states.

While this model appears to be feasible, practical, and offer a range of benefits, its successful establishment will face a number of challenges. It will require ongoing commitment from the landholders, the Landcare group, and harvesters involved. For landholders, kangaroos are a peripheral preoccupation – their time is often under pressure from their current property management priorities, and it may be difficult for them to maintain focus and activity toward establishing a Coop arrangement. While they may all wish for better management of kangaroos, and for economic returns, this does not necessarily translate into a willingness to commit the time and effort required to sustain such an initiative. For harvesters, the concept of landholder involvement in kangaroo harvest is typically a threatening one. In workshops and discussions carried on throughout this project, harvesters frequently expressed concerns that landholders would charge them for access to properties, and this would make the already thin profits from kangaroo harvesting even thinner. Establishment of a Coop will critically rely on the building up on trust and cooperation between these groups. Harvesters will need to recognise that grouping together with landholders and with each other can strengthen their position, and landholders will need to be prepared to work cooperatively with harvesters, not seek to impose an agenda on them.

Similarly, there is much scope for better relationships with processors. The industry body for kangaroo processors, the Kangaroo Industry Association of Australia, is generally perceived as unsupportive of landholder involvement in kangaroo management, and this was borne out by their input into workshops during this project. However, the model set out here indicates a range of benefits for processors as well. These include in particular exclusive access to a consistent, high quality source of supply, and the potential to develop niche products that are labelled and marketed on the basis of conservation-friendly land management.

These challenges could be substantially reduced with supportive policy and regulatory practice. The overseas models examined in Chapter Four illustrate well the benefits that can gained by establishing cooperative relationships between government and land managers. These models all empower land managers to play a larger role in wildlife management and harvest, including through devolving some aspects of property rights. Viewing the relationship between government and landholder groups as a partnership for wildlife management involving power-sharing opens the way for a suite of measures to encourage and support landholders who take a more active role. Extended management rights and privileges for collaborating groups can be awarded to those groups that demonstrate their ability and willingness to become engaged in sustainable wildlife management, and could be an effective regulatory "carrot" for regulators to encourage conservation-friendly land management practices. Probably the most important immediate change in regulatory practice that could be made to support a wildlife management Coop of the form envisaged here is to provide for the allocation of a harvest quota to a group, to enable them to hold their own quota and allocate it among collaborating harvesters and landholders. Further measures and mechanisms, including providing technical and scientific advice, (conditionally) devolving the power to set quotas at a group level, and establishing tradeable quotas could further support collaborative groups to take responsibility for kangaroo management.

8. Implications and Recommendations

1. For the Sustainable Wildlife Enterprise initiated by the Mitchell and District Landcare Association, the Maranoa Wildlife Management Conservancy, the major implication of this work is that the model presented in Chapter 6 is the recommended model to pursue their objectives. This model involves establishing a harvest management, processing and marketing cooperative with both landholders and harvesters as members. While implementing this model will involve substantial inputs of time, effort, and some money, and will require the establishment of a relationship of trust and cooperation between landholders and harvesters, it offers the potential for both landholders and harvesters to benefit through:

- collective bargaining to gain best market terms for the product they both play a role in producing
- more effective kangaroo management at a cross-property level, both to meet production objectives and for better management of TGP
- more cooperative relationships between landholders and harvesters, including harvester participation in ferals control and weed management
- more secure and exclusive access to country for harvesters
- reduced use of shoot and let lie tags (non-commercial damage mitigation culling), and
- equitable sharing of profits.

2. For Landcare groups and regional/catchment natural resource management bodies, the model recommended here offers them a potential option to meet objectives of better management of total grazing pressure, improved diversification of landholder incomes and better socio-economic resilience, and better management of feral animals and weeds at the local level.

3. For processors, collaboration between landholders and harvesters in kangaroo management, according to the recommended model, could offer real benefits to them as well. Establishment of a cooperative involving landholders and harvesters opens the way to:

- assuring an exclusive, consistent source of supply from the properties involved
- improved quality management from field to fork, through development and implementation of best-practice quality assurance programs
- harvest management measures that allow improvements to meat quality, such as selection of specific age/sex/species combinations
- implementation of sophisticated, GPS-based traceback systems
- environmental branding based on conservation-friendly land management practices of landholders.

4. For relevant regulators and policymakers, particularly managers of state kangaroo management programs, the implications of this work are that landholder involvement in kangaroo management is feasible and potentially beneficial in meeting a suite of land management and industry development objectives. Government support for such initiatives would greatly assist their implementation and empower landholders to take a more active role in kangaroo management, in cooperation with relevant government entities. Recommended support includes:

- providing advice and technical and scientific support to groups seeking to collaborate on kangaroo management
- providing funding for such initiatives
- supporting the allocation of quota to collaborating landholder/harvester groups, subject to certain conditions such as adequate procedures to ensure chain of custody of tags
- exploring other approaches to conditionally devolve more kangaroo management rights to collaborating groups, in return for these groups taking on a larger role in sustainable management.

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Appendix 1

Maranoa Kangaroo Harvesters and Growers Cooperative Membership Declaration

By signing this statement and paying the joining fee of $11, I am joining the Maranoa Kangaroo Harvesters and Growers Coop and committing myself to the following:

1. Each landholder will provide exclusive access to their property to one individual Coop member harvester at any one time
2. Harvesters will sell kangaroos from Coop member properties exclusively to the Coop chiller boxes. However, if the Coop box operator indicates the Coop boxes are full, they are free to sell elsewhere
3. Landholders will not apply for or use damage mitigation permits
4. Harvesters will implement any Quality Assurance schemes developed by the Coop.

Members will have the following rights:

1. the Coop will collectively bargain on their behalf to secure the best market price for their product
2. they receive an equitable share of any profits made by the Coop.

This is an interim set of rights and obligations, and they will be reviewed with your input as the process towards establishing a formal Cooperative progresses.

SIGNED

WITNESS

DATE

WHEN SIGNED, PLEASE RETURN THIS FORM AND $11 TO:

The Landcare Coordinator
48 Cambridge St
PO Box 94
Mitchell 4465

Cheques should be made out to Mitchell and District Landcare Assoc. Inc.

Landholder Collaboration in Wildlife Management

Models for landholders to share benefits from kangaroo harvesting

RIRDC Publication No. 08/150

This report is about landholder involvement in the management of wildlife in Australia. It examines and evaluates a set of broad options for landholders to be involved in, and benefit from, kangaroo harvest based on assessment of current management practice and selected overseas experience. It then proposes and develops a detailed model based on collaboration and benefit-sharing between harvesters and landholders.

The research is important because there are good arguments involving landholders in kangaroo management that can help deliver better rangeland outcomes in terms of conservation and land management, on one hand, and more diversified and resilient rural incomes, on the other. These arguments have been made for many years, but little attention has been paid to developing and evaluating models for making it happen. This research fills this gap.

The aim of this Program is to facilitate a more diverse rural sector, enhanced biodiversity and innovative industries based on non-traditional uses of the rangelands and their wildlife.

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RIRDC Innovation for rural Australia

Optimising mixed-grazing strategies for semi-arid Australian rangelands

A thesis submitted in fulfillment of the requirements for the degree of

Doctor of Philosophy

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May 2011

Abstract

Currently in semi-arid Australian rangelands properties produce mainly beef and wool on marginal lands. A major area of concern is grazing pressure. Kangaroos are considered to have a considerable impact on grazing pressure, and for that reason they are often considered pests by landholders. It has been thought that converting from farming European stock to native wildlife would have environmental benefits. The commercial benefits from the change are unclear. Through construction of a plant-herbivore model, the dynamics of cattle, sheep and kangaroo commodities are examined. Simulations were constructed so as to estimate the expected value for each and the correlation between the different commodities. Portfolio analysis using mean-variance, average value-at-risk, and multi-objective optimisation projects were used to analyse different allocations of forage to each herbivore. The effect of an enforced reduction in methane emissions is also explored. From the analysis it seems that diversification of herbivores (including kangaroos) is optimal on marginal lands, for the risk adverse, and to reduce methane emissions.

Declaration

I certify that except where due acknowledgement has been made, the work is that of the author alone; the work has not been submitted previously, on whole or part, to qualify for an other academic award; the content of the thesis is the result of work which has been carried out since the official commencement date of the approved research program; any editorial work, paid or unpaid, carried out by a third party is acknowledged; and ethics procedures and guidelines have been followed.

Paul D. Moloney

May 26, 2011

I would like to dedicate this work to my family and friends. Without their support this would never have happened.

Acknowledgements

I would like to acknowledge the support of the Rural Industries Research and Development Company for providing the funding for this research. Additionally I would like to thank my supervisors, Prof. John Hearne, Prof. Iain Gordon and Dr. Steven McLeod. Their ideas and support have helped shape this thesis. I would also like to thank the staff and students in the School of Mathematical and Geospatial Sciences at RMIT University for their encouragement and friendship. I would like to thank Dr. Maryam Esmaeili for our collaboration on meat supply chains. I would like to thank Kenneth Read for assisting in the editing process. Finally I would like to thank my family, especially Emma who helped edit the final drafts and my son Bryn, whose early arrival added to the challenge.

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Chapter 1

Introduction and Literature Review

Historically pastoralists have seen native species as competition for the available biomass and therefore detrimental to their core business of maintaining a large, healthy herd of domesticated stock. In Australia the main native species that fall into this category are kangaroos and wallabies. Since the introduction of European settlement many species of macropod marsupials have declined in number, some to extinction. However, the larger macropods, Red Kangaroo *Macropus Rufus*, Eastern Grey Kangaroo *M. giganteus* and Western Grey Kangaroo *M. fuliginous*, have greatly increased in number (Calaby and Grigg, 1989; Dawson, 1995). In an attempt to control their numbers, culling and then harvesting for meat and skins has been allowed in most states. Since the 1980's efforts have been made to increase the acceptance and scale of the kangaroo harvesting industry (Grigg, 2002), especially with regards to human consumption of their meat. Their skins are highly sort after due to their leather's strong yet supple nature, while the meat is very lean and high in iron. Ecologically, the hoofed domestic species, introduced from Europe, break up the fragile rangeland soils much more than kangaroos and clearing of scrub and bushland has resulted in a loss of habitat for many other native species. Rather than seeing the possible ecological and economic benefits, landholder's are reticent to diversify into kangaroos (Williams and Price, 2010). They generally see them as a pest that needs to be eradicated due to their impact on total grazing pressure (Pople and Grigg, 1999; Grigg, 2002).

1.1 Introduction

The Australian rangelands occupy nearly three quarters of the continent and are home to 2.3 million people. The rangelands are an economically important region to Australia, contributing more than 4 billion dollars of agricultural production as well as supporting substantial tourism and mining industries. They are also a major component of the natural resource base for Australia in terms of vegetation and biodiversity. Significant economic and social transformations are currently taking place in the rangelands and rangeland ecosystems are under pressure. Increasingly, there are constraints on and opportunities for development of the grazing and agricultural industries in rangelands. There are current and emerging tensions between grazing and the sustainability of natural resources, including biodiversity. Key questions that need to be addressed concern the nature of trade-offs, and their impacts concerning agricultural production and biodiversity.

Methods and strategies that jointly promote profitable grazing enterprises and sustainable use of the rangelands have therefore made fertile grounds for research.

Biodiversity monitoring and reporting is becoming an increasingly important component of policy development in Australia. Some enterprises hope to use biodiversity monitoring to showcase their improved environmental management of native plants and animals and the ecosystem services on which they depend (Smyth and James, 2004). However, there have been few incentives for rangeland graziers to implement management practices that would promote biodiversity without complementary increases in or maintenance of productivity or profitability (Anon., 2000). Most conservation objectives were seen as additional to sustainable production and pastoralists did not feel that they could deliver on these objectives.

The benefits of undertaking sustainable natural resource management (SNRM) activities are not always readily apparent for either production nor conservation purposes. This uncertainty in the outcome, as well as the long time lags involved for the activities to yield returns, reduces the perceived benefits of undertaking SNRM for all land managers. Overgrazing is one of the main causes of land degradation in the Australian rangelands (Anon., 2001). Solutions for addressing this problem have generally involved reducing stocking rates, but it is not clear how profitable grazing enterprises would remain under these reduced stocking conditions.

An alternative suggestion is that landholders could utilise commodities from both domestic livestock and wildlife (Grigg, 1987, 1989, 1995, 2002; Wilson and Edwards, 2008). Without bio-economic analysis of this alternative grazing system it is unclear if grazing enterprises could remain profitable. By investigating the population levels and management strategies of both domestic livestock and wildlife, an optimal solution can be found in terms of the perspective of economic returns and risk (variability in returns). Because the optimal strategy can specifically include constraints for increasing biodiversity and conservation, adoption of the results of this work will not only give rise to increased economic benefits but also improvements in the sustainable use of the rangelands.

Attempts at modelling herbivore grazing in the Australian rangelands have usually considered either the ecology or the economics of the system (Tisdell, 1973; Collins and Menz, 1986; Caughley *et al.*, 1987). However, management of grazing herbivores in the rangelands depends on considering both the ecology and economics of these systems. Informed decisions will most likely flow from studies that have explicitly integrated ecology and economics (Choquenot *et al.*, 1998).

The thesis addresses the issue by examining what mix of grazing herbivores provide optimal trade-off between risk and return. In particular the focus is on the Maranoa region in southern Queensland (see Figure 1.1). The results of the models developed can inform graziers as to possible impacts of changing traditional grazing practices in the rangelands to include native species. This extends recent research into alternative harvesting strategies for kangaroos in the Australian rangelands since it integrates wildlife harvesting with domestic stock (cattle and sheep) grazing in an economically optimal way.

1.2 Literature Review

1.2.1 Kangaroos: Ecology and Harvesting

Kangaroo biology and ecology provides some interesting variations on domestic stock. For instance, red, and sometimes eastern grey, kangaroos use embryonic diapause. This means that they can carry a viable embryo in their uterus for many months whilst carrying pouch young. After post-partum mating (only days after the last birth) the development of the new embryo is limited to the blastocyst (pre-embryonic) stage and remains at this stage until either the pouch young is lost or lactation is reduced towards the end of pouch life for the current joey. The mean gestation time for red kangaroos is 33.2 days (with a standard deviation of 0.2 days), spending a further 235 days (on average, with a standard deviation of 2 days) before exiting the pouch permanently. The result of which is that there is usually only between 1-3 days between the permanent exit of one pouch young and the birth of the next (Dawson, 1995). This means that during relatively good times, each mature fecund female can produce 1.5 kangaroos per year. Another difference to standard domestic stock is that kangaroos, being non-ruminant forestomach fermenters, meaning they produce negligible amounts of methane (0.003t head^{-1}year^{-1}), which is a greenhouse gas (Wilson and Edwards, 2008). Compare this to cattle and sheep, which use enteric fermentation, that produce large amounts of methane (1.67t head^{-1}year^{-1} and 0.14t head^{-1}year^{-1} respectively) which accounts for 11% of Australia's total greenhouse gas emissions (Wilson and Edwards, 2008). Hence, switching at least some production from cattle and sheep to kangaroos could result in a decrease in total greenhouse gas emissions in Australia (Garnaut, 2008). More generally the native kangaroos have less of a negative impact on biodiversity compared to the livestock introduced by Europeans (Williams and Price, 2010).

Red kangaroos reach sexual maturity between 15 and 20 months for females and 24 and 48 months for males. Eastern greys take an average of 18 and 48 months for females and males respectively to reach sexual maturity. While males can continue to make significant contributions to breeding once mature, females tend to have reduced fecundity after the age of 9 years until becoming infecund by age 12 to 15 years. Mortality rates are high in juvenile kangaroos, particularly in males, and the reasons why are not fully understood (Dawson, 1995). In some areas 83% of mature western grey kangaroo females may have pouch young, while only 27% also have young at foot (YAF) (Arnold *et al.*, 1991). The main factor for this high mortality is thought to be that as much of their nutrients go into formation of bone and muscle, little goes into fat, making them particularly susceptible to feed shortages. Another factor is predation by dingoes and foxes. More recent studies comparing densities either side of dingo fences suggest that predation by dingoes in semi-arid rangelands is more significant when an area is in drought when normally abundant prey, namely rabbits, are scarce (Newsome *et al.*, 2001). Predation by foxes is found to be influential only in temperate areas (Banks *et al.*, 2000).

Research has been conducted into the feed intake and preferences of kangaroos and domestic stock so as to enable them to determine the level of competition between species for the available food supplies. As a result functional responses of kangaroos, sheep and other animals in arid conditions have been estimated (Short, 1985). The functional responses enables the estimation of feed intake given the biomass available, which is important in determining the effect of animals on the available plant life. It was found that kangaroos preferred young grass and green forbs due to the fact that they are easier to digest Caughley *et al.* (1987); Moss and Croft (1999); Davis *et al.* (2008). More recently Rafferty *et al.* (2010) studied the feed preferences of western grey kangaroos, comparing captive and wild populations. Also of importance is any competition for resources, where one species has a deleterious effect on another. While competition is possible between the red and grey kangaroos, the level of competition is unclear as they have different feed and microhabitat preferences (Dawson, 1995). Dudzinski *et al.* (1982) considered interaction between cattle and red kangaroos, and found that while both consume grass as the mainstay of their diet, the parts that they grazed differed, except in cases of extreme drought, and hence no competition occurred when cattle numbers are controlled. They also found a lack of facilitation, in that the kangaroos were not attracted to areas recently grazed by cattle. Dawson and Ellis (1994) looked at competition between kangaroos and sheep and found it only occurred during very dry winters. During these times sheep that grazed with kangaroos lost more weight and grew slightly less wool than sheep kept separate from kangaroos. Kangaroos in sheep free paddocks had higher body weights, although their diets remained the same. A study of population dynamics in the semi-arid pastoral zones of South Australia by Jonzen *et al.* (2005) found, counter intuitively perhaps, that in their best models, sheep and cattle densities had a positive effect on the population growth rate of red kangaroos, even more than rainfall. They postulated this was due to the sheep and cattle acting as a surrogate for the availability of forage.

The functional response of kangaroos has been modelled using several methods. The functional response is the change in the population size as the density of its food changes. Bayliss (1985) calculated numerical response functions for both red and western grey kangaroos using both Michaelis-Menton and Ramp functions. Caughley *et al.* (1987) developed numerical response for red kangaroos using an Ivlev function to determine growth rate in response to available forage. Caughley's numerical response has been used subsequently to explore population dynamics of kangaroos and possible affects of harvesting at different rates (Caughley *et al.*, 1987; Bayliss and Choquenot, 2002). Alternative models have used rainfall (as a proxy to biomass) to predict population growth. These include stochastic Ricker models (Cairns and Grigg, 1993; McCarthy, 1996; Jonzen *et al.*, 2005), and spatial kriging models (Pople *et al.*, 2007). Rainfall was found to be insufficient to produce reasonable estimates for western grey kangaroos (Cairns *et al.*, 2000). Bayliss (1985) noted that the rates of increase seemed to be dependent on the current age and gender structure of the population. Hacker *et al.* (2003) used a physiological structured population model to account for the influence on age and gender demographics in their model. A more detailed description of the mathematical models used occurs in Section 1.2.4.

Body condition reflects an animal's nutritional state. It combines current and recent differences between required and available food. The body condition of kangaroos has been monitored and recorded most effectively using a kidney fat index (Caughley *et al.*, 1987; Moss and Croft, 1999). This procedure requires the kidney to be assessed for the percentage of fat attached to the kidney. Moss and Croft (1999) determined that the amount of green grass biomass was the best predictor for the body condition of red kangaroos. It was also noted that there was a lag between body condition and pasture biomass of approximately three months.

Kangaroos, unlike domestic stock and many other wild animals move freely between farms, national parks and other areas, due to their ability to jump fences. This leads to the situation of having free-roaming stock within demarcated ownership boundaries (Pople and Grigg, 1999). They will move from location depending on the availability of food and water. A landholder who reduces their stocking rate of sheep, and hence increases the availability of food, is likely to receive an increase in their kangaroo numbers whether that was their desired outcome or not. Therefore, if a landholder wanted to increase their average kangaroo stocking rate, reducing its sheep stocking rate could increase the net kangaroo immigration onto the property Moloney and Hearne (2009). This may make the landholder in question unpopular with other landholders in the area, as they may believe that some of the enticed kangaroos may venture onto their property Pople *et al.* (2007). Conversely, a landholder may attempt to increase their stocking rate of sheep to create a net emigration of kangaroos, however, this could increase the risk of overstocking.

Habitat influences density and social groupings of western grey kangaroos (Coulson, 1993). McAlpine *et al.* (1999) investigated the effect of landscape structure on the density of red and eastern grey kangaroos, and common wallaroos in partially cleared semi-arid bushland in Queensland. They found linkages with the abundance of large kangaroo species and tree clearing practices, making it an important factor in conjunction with pasture productivity. Viggers and Hearn

(2005) monitored eastern grey kangaroos in south eastern Australia, particularly incursions from reserves onto farmland. They concluded that the kangaroos only dispersed where cover was available. Martin *et al.* (2007) argued that methodology used by Viggers and Hearn (2005) was flawed and insufficient data was obtained to draw their conclusions. These claims were rebutted in Viggers and Lindenmayer (2007), saying that the key claim, that landholders are at a disincentive to conserve remnant native vegetation, still held. Fukuda *et al.* (2009) found that fencing watering holes during a draught had little if any effect on the density of red kangaroos within 4km of the watering hole. Instead food availability was the main determining factor, as there is usually water within convenient reach of the kangaroos. Hence, fencing off watering holes during drought is not likely to have the desired effect of reducing kangaroo densities and allowing vegetation regeneration. The ideal free distribution *IFD* is an ecological concept implying that animals will move between areas so that the ratio of animals to carrying capacity in each area will be equal (Fretwell and Lucas Jr., 1969). Coulson (2009) concluded that it is likely that the ideal free distribution holds for kangaroos in a review of the literature, but did note that further research through different management practices is required. Wiggins *et al.* (2010) investigated shifts in home range after (lethal and exclusion) interventions on two common macropod species in Tasmania, pademelons (thylogale billardierii) and red-necked wallabies (macropus rufogriseus rufogriseus). Their results conformed to predictions based on the ideal free distribution.

Plans are being investigated into how kangaroo harvesting can return some money to the landholders (Pople and Grigg, 1999; Baumber *et al.*, 2009). Recent research regarding sustainable harvesting and alternative management strategies for kangaroos has indicated that the integration of wildlife harvesting and traditional rangeland enterprises may not be straightforward (Hacker *et al.*, 2003; Hacker and McLeod, 2003; McLeod *et al.*, 2004; Baumber *et al.*, 2009). For example, harvest strategies by individual kangaroo shooters may change the structure and dynamics of kangaroo populations to such an extent that they compromise other management goals, such as controlling total grazing pressure. Grazing pressure is the stress on vegetation, and therefore the ecosystem, from animal grazing.

Kangaroo (and wallaby) harvesting is controlled by state and federal governments. State governments set quotas and regulations that must be signed off by the Federal Government. This is due in part to the fact that as a native species, kangaroos (and wallabies) are under the protection of the crown. Each state has different protocols with regards to harvesting kangaroos and wallabies, what quotas are set and how the quotas are managed (Pople and Grigg, 1999). For instance, in New South Wales each region is given a quota of tags to be placed on each harvested kangaroo. These tags are then distributed to property owners, who can harvest (either themselves or engage external harvesters) until their tags are exhausted (Hacker and McLeod, 2003). In Queensland, each region is given a quota but it is the harvesters themselves that can purchase the tags, which can then be used to harvest kangaroos on private property (Office of the Queensland Parliamentary Counsel, 2010; Moloney *et al.*, 2011). In addition to the quotas to control the off-take, there are also conditions that are meant to ensure a stable, genetically diverse kangaroo population. In Queensland, with similar conditions elsewhere, these conditions include; minimum kangaroo densities; male off-take bias; and minimum weight limit for harvested kangaroos. Typically these are set to; a minimum kangaroo density of 2 kangaroos per km^2; a 70% male off-take bias; and a minimum live weight of $20kg$ or fully dressed weight of $13kg$ (Hacker *et al.*, 2003; Office of the Queensland Parliamentary Counsel, 2010). Fully dressed refers to a carcass of a harvested macropod with the following parts removed: head; viscera; each forelimb from the elbow joint; foot of 1 hind limb, from a point below the tarsal joint; other hind limb from a point midway between the knee and ankle joints; tail (Office of the Queensland Parliamentary Counsel, 2010).

1.2.2 Portfolio Analysis, Multiple Objective Programming and Bioeconomics

Often the driving force behind change in agribusinesses derives from the perceived benefit of that change. To create that leverage there is a need to examine whether the inclusion of kangaroo harvesting within a mixed grazing strategy for their enterprise can be financially beneficial to pastoralists. The decision of which animal to stock and at what levels is analogous to the question of which shares should be invested in and to what degree. This problem of portfolio optimisation has had different techniques developed over time to analyse the best strategy for optimising the return on investment while accounting for the risk involved in the investment. One of the first ways used to analyse risk and return is classical mean-variance portfolio selection (Markowitz, 1952, 1991). The scenario is a limited amount of funds are to be invested in a variety of assets (Steinbach, 2001). The goal is that each asset is allocated funds, $\boldsymbol{y}$, in such as way as to

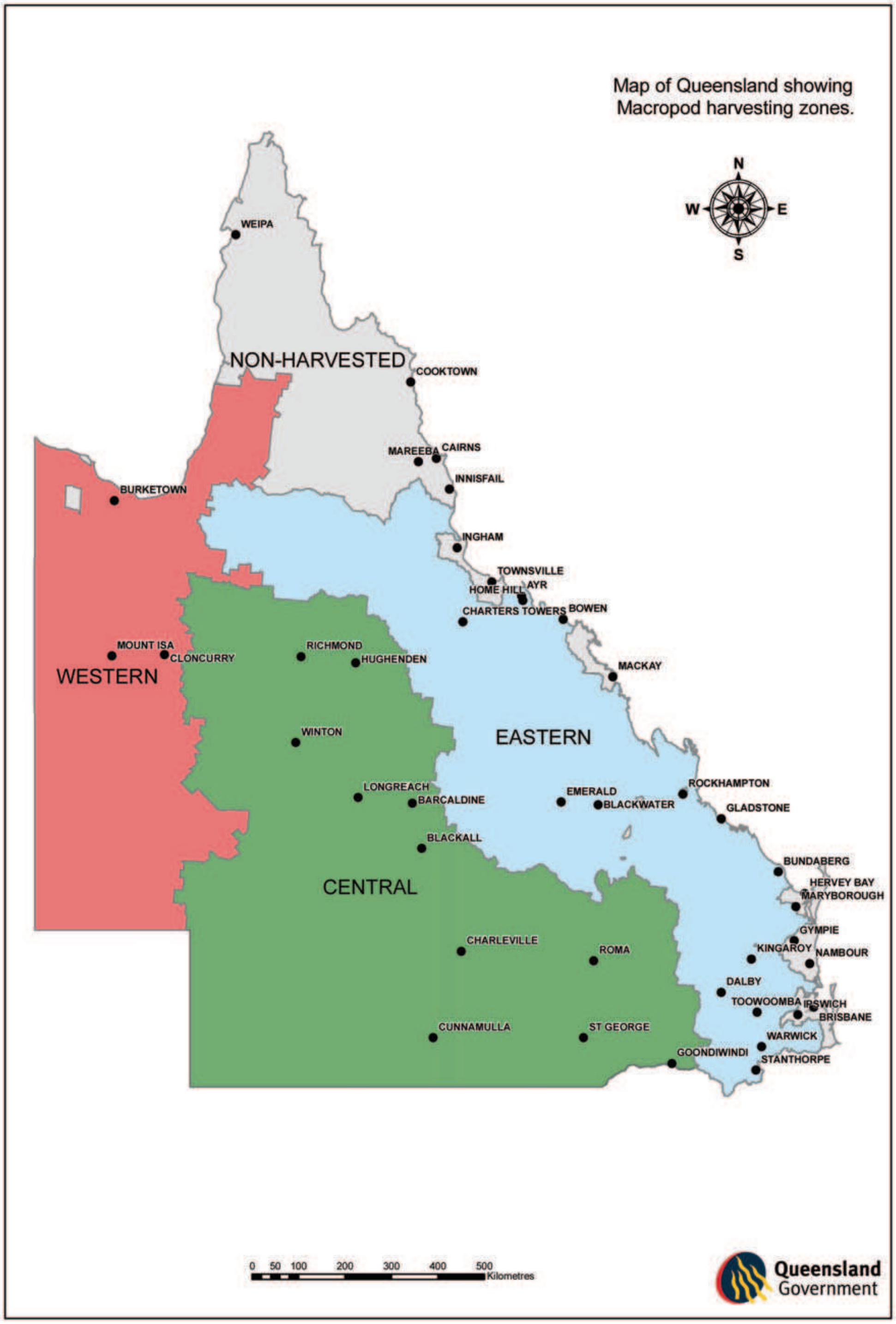


Figure 1.1: The map of the macropod harvest zones in Queensland. The Maranoa region is between Charleville and Roma. This map is from the Queensland Government Department of Environment and Resource Management.

trade-off maximising performance, $\rho(\boldsymbol{y})$, and minimising risk, $R(\boldsymbol{y})$,

$$\begin{aligned} \max_{\boldsymbol{y}} \quad & \pi\rho(\boldsymbol{y}) - \frac{1}{2}R(\boldsymbol{y}) \\ & s.t. \\ & \boldsymbol{e}^T\boldsymbol{y} = 1, \end{aligned}$$

where π is the trade-off parameter, $\boldsymbol{e} \in \mathbb{R}^n$ denotes the vector of all 1s and the *budget equation* $\boldsymbol{e}^T\boldsymbol{y} = 1$ specifies the initial wealth (without loss of generality set equal to one). This enables the conflicting objectives of maximising returns and minising risk to be addressed and the set of pareto-optimal portfolios to be calculated.

But is risk defined? Markowitz (1952, 1991) suggested that variance as a proxy for risk in mean-variance analysis. However, it has been noted that variance is not actual a measure of risk, but a measure of uncertainty (Rachev *et al.*, 2008). An alternative formulation more generally known as mean-risk analysis focuses on two main principles. Selecting the portfolio(s) with the minimum risk, given they meet a lower bound on expected performance. Selecting the portfolio(s) with the maximum performance, given they meet an upper bound on risk. Mathematically these can be written respectively as

$$
\begin{aligned}
\min_{\boldsymbol{y}} \quad & R(\boldsymbol{y}) \\
s.t. \quad & \boldsymbol{e}^T\boldsymbol{y} = 1 \\
& \boldsymbol{\mu}^T\boldsymbol{y} \geq \mu_* \\
& \boldsymbol{y} \geq \boldsymbol{0}
\end{aligned} \tag{1.1}
$$

and

$$
\begin{aligned}
\max_{\boldsymbol{y}} \quad & \boldsymbol{\mu}^T\boldsymbol{y} \\
s.t. \quad & \boldsymbol{e}^T\boldsymbol{y} = 1 \\
& R(\boldsymbol{y}) \leq R_* \\
& \boldsymbol{y} \geq \boldsymbol{0}
\end{aligned} \tag{1.2}
$$

where μ_* is the lower bound on expected performance and R_* is the upper bound on risk. A number of different measures for risk aversion related to risk premiums are discussed by Pratt (1960) and Rubenstein (1973) amongst others. How risk should be measured is still debated with each method having its own strengths and weaknesses: asymmetric risk measures including expectation of loss and semi-variance (Harlow and Rao, 1989); risk models with higher moments (Kraus and Litzenberger, 1976); and, *coherent* risk measures (Artzner *et al.*, 1997) have all been developed. Value at risk (VaR)is one of the most commonly used risk measures used in finance (Simons, 1996). Average value at risk (also known as conditional value at risk and expected shortfall) is superior to value at risk as a measure of risk as shown by Palmquist *et al.* (2002). *AVaR* calculates the expected value of return given the return is in the lowest ϵ of the distribution (see Equation 1.3). Multiple time period models in both discrete (Markowitz, 1991; Phelps, 1962) and continuous (Merton, 1971) time have been researched.

$$\mathrm{AVaR}_\epsilon(X) = \frac{1}{\epsilon}\int_0^\epsilon \mathrm{VaR}_p(X)dp \tag{1.3}$$

Using a mean-variance approach to analyse agricultural development was investigated by Freund (1956) and Turvey *et al.* (1988) while more recently Theron and van der Honert (2003), where the emphasis was on gross margins and long-term wealth as well as Hearne *et al.* (2008) as it related to stocking rates in game ranches. In the present analysis, risk is defined as the variance in returns and risk aversion is the degree to which the landholder desires to minimise risk compared to maximising returns.

Clark (1990) introduces the idea of economically optimal, yet sustainable harvesting of populations, in effect maximising growth rates and then harvesting at a similar rate, often refered to as maximal sustainable yield (MSY). These models have included common populations such as fish (Pikitch *et al.*, 2004). This idea was extended to finding the optimal two-species harvesting policies, on a Lotka-Volterra competitive model, by Mesterton-Gibbons (1996). He found that an optimal harvesting policy may drive one species to extinction given it is sufficiently easier to catch, even if the system would coexist in the absence of harvesting. Conrad (1999) explored the idea of a marine sanctuary on neighbouring fishing grounds using diffusion of biomass finding variation in biomass was reduced. Skonhoft (2005); Skonhoft and Olaussen (2005) investigated the economic effect of moose migration, where migration is driven by seasonal factors. The analysis showed that neglecting migration can cause sub-optimal population sizes and substantial profit transfer among landholders. Skonhoft (2007) used biomass to look at the bioeconomics for a park agency and locals for land animals on conservation reserves and farmers in sub-Saharan Africa.

Kangaroos are like fish and moose in some aspects. They have a common population available to be harvested by many. They have areas of sanctuary where harvesting is not allowed. There are even boundaries of where certain groups can harvest and others can't with international boundaries being akin to property boundaries. There are even harvest limits set. However, unlike fisheries, there is domestic stock to be considered as well, that we have a much greater control over. Unlike moose, there is competition for resources rather than predation on saplings for future logging. Skonhoft (2007) used a generalise model to look at mobile biomass, or a single species, without any captive stock. In the problem on interest there are both stock that is free-roaming across boundaries (that is publicly owned) as well as sedentary (privately owned) within the property competing for common forage.

1.2.3 Game Theory

The present situation is one where most of the power to influence commodity prices does not reside with the landholder. Game theory has looked into at how that power influences operational decisions. Game theory assumes that each player acts rationally and therefore makes decisions about which strategy is optimal given the information they know. It has been used to explore decision making across many fields including: economics; computer systems; politics; and, genetics (Choi, 1991; Sumaila and Apaloo, 2002; Aliprantis and Chakrabarti, 2011).

A strategic game is one in which n players (labelled 1, 2,..., n) each have a strategy set ($S_i,\ i \in \{1, 2, ..., n\}$) and a payoff function ($u_i,\ i \in \{1, 2, ..., n\}$). All players choose simultaneously and independently their strategy ($s_i \in S_i$) and receives payoff $u_i(s_1, s_2, ..., s_n)$ for each $i \in \{1, 2, ..., n\}$ (Aliprantis and Chakrabarti, 2011). The concept of Nash equilibrium points (*NEP*s) Nash (1951) revolutionised strategic game theory. An *NEP* is where no single player can do better by changing their strategy while all other players play the same *NEP*. More formally this can be written as $(s_1^*, s_2^*, ..., s_n^*)$ is an *NEP* iff

$$u_i(s_1^*, ..., s_{i-1}^*, s_i^*, s_{i-1}^*, ..., s_n^*) \geq u_i(s_1^*, ..., s_{i-1}^*, s_i, s_{i-1}^*, ..., s_n^*)$$

$\forall s_i \in S_i$ and $i \in \{1, 2, ..., n\}$. Therefore it is possible to have multiple *NEP*s in a strategic game. If the strategy set S_i is an interval, the payoff functions are continuous and have second-order partial derivatives in the interior of S_i then $(s_1^*, s_2^*, ..., s_n^*)$ is the only interior *NEP* of the game iff,

1. Each s_i^* is in the interior of the interval S_i.
2. $\dfrac{\partial u_i}{\partial s_i}(s_1^*, s_2^*, ..., s_n^*) = 0$ for each player i.
3. Each s_i^* is the only stationary point of the function $u_i(s_1^*, s_2^*, ..., s_n^*)$, s_i is in the interior os S_i.
4. $\dfrac{\partial^2 u_i}{\partial s_i^2}(s_1^*, s_2^*, ..., s_n^*) < 0$ for each player i.

Both cooperative and competitive (strategic) game theory has been widely used in economics and finance (Rosenthal, 1981; Sumaila and Apaloo, 2002). Game theory as an effective method has been used to describe and solve interaction mechanisms of the seller (landholder) and the buyer (processor) in a supply chain. For example, Yang and Zhou (2006) consider a two-echelon system with a seller and two competitive buyers where the seller has more power. They assume the product of one buyer is a substitute for the product of the other therefore, their demand function follows the Bertrand model. The optimal wholesale price and quantity ordered are obtained under different scenarios. A similar model is presented in Chen *et al.* (2006) where they also consider the impact of transaction costs, while Yao *et al.* (2005) consider the impact of value adding in the demand function. Xiao and Qi (2008) and Yang and Zhou (2006) consider similar demand functions with the former offering two different quantity discounts, an all-unit quantity and an incremental quantity discount to the buyer. In addition, propose several models in a supply chain which incorporate elements of competition and cooperation between a seller and a buyer under non-cooperative and cooperative games (Esmaeili *et al.*, 2009*b*,*a*). A significant shortcoming of all these models is that they only regard seller or buyer's profits without considering any constraints. In other words, to avoid the confounding of effect of constraints, they consider only a theoretical model.

1.2.4 Population Models

Population models in ecology can fall into several categories. There are many questions about the population to be answered to find the required category; is it measured in discrete or continuous time; is it age or size dependent; are stages discrete or continuous; are births a flow or a pulse; is there intraspecific competition; is there predation or interspecific competition; do the fertility and mortality rates change over time, stage or density; is the system deterministic or stochastic; are the genders significantly different; is spatial location important? Once these questions have been answered then an appropriate mathematical model can be selected. Whether it be a discrete system with a series of difference equation, a continuous process with ordinary differential equations, partial differential equations, or spatially distributed, there is a model to approximate the dynamic of interest in the population.

Initially we shall discuss unstructured population models. These are models where the population(s) can be considered a homogeneous group without losing too much information. Even before Malthus (1798) the idea of exponential growth in populations being bounded by some external factor due to intraspecific competition had been discussed (Seidl and Tisdell, 1999). Verhulst (1838, 1845) was the first to give this idea an equation, that of logistic growth (Equation 1.4) where N is the population, r is the relative growth rate (birth rate - death rate), and κ is the carrying capacity. Since then, the idea of carrying capacity has changed from an immutable constant upper limit to the population, possibly unknown, to a more abstract one of maximum density a range is capable of supporting (Dhondt, 1988), possible of changing over time and environment.

$$\frac{\mathrm{d}N}{\mathrm{d}t} = rN\left(\frac{\kappa - N}{\kappa}\right) \tag{1.4}$$

Notation	Definition
t	Time since the model initiated.
N	Total number of individuals in a species of animal.
V	Total available biomass.
r	Relative growth rate (births - deaths).
κ	Carrying capacity of the species.
α_{ij}	Affect the population of species j has on the population of species i.
ζ_i	The saturation rate of grazing for herbivores.
θ	The half-saturation constant (amount of available vegetation where herbivores intake is halved).
ξ	The vegetation to herbivore conversation rate.
χ	The zero population growth herbivore consumption rate.
a	Age of the cohort.
ω	The maximum age of survivorship.
$n_{x,t}$	Number of females of stage x at time t.
B_t	Number of female births at time t.
l_a	Fraction of newborn females surviving to age a (survivorship function).
m_a	Number of females born to a female of age a.
x	Stage of the individual.
$\mu(x,t)$	Mortality rate for individuals of stage x at time t.
$b(x,t)$	Birth rate for individuals of stage x at time t.
$g(x,t)$	Growth rate function for individuals of stage x at time t.

Table 1.1: Definitions of symbols used in the population models.

Simple logistic models for population growth have some intrinsic flaws. Exogenous environmental forces can alter the carrying capacity, κ, the relative growth rate, r, or a lag-factor in response time. The possible existence of tipping points, where κ, r or lag-factor are altered once a certain population has been reached (Seidl and Tisdell, 1999). Different models and methods for calculating carrying capacity were analysed by McLeod (1997), showing that complex characteristics, uncertainties and stochastic environments cannot be effectively modelled using this approach, unless it was used for determining short-term potential densities as a function of resource availability rather than long-term equilibriums. For a more complete look at logisitc type models see Banks (1994).

Functional response can be considered the rate at which a species consumes resources, given the availability of those resources. Holling (1959, 1965) introduced three types of functional responses. Type I is a linear response, consumption is directly proportional to the availability of the resources (eg Lotka-Volterra model). This is not always realistic, so sometimes, consumption is capped when the species is satiated. A Type II functional response is hyperbolic, the speed at which the consumption rate increases decreases as it approaches the satiation asymptote (eg Rosenzweig-MacArthur model). A Type III functional response is sigmoidal, reflecting inefficient foraging at low resource densities. Crawley (1992) discusses a fourth functional response, where the rate of consumption decreases with higher resource densities due to prey interference or toxicity. Figure 1.2 displays the behaviour of the four different types of function responses.

Interaction between competing species in a bounded system was first modelled by Lotka (1925) and Volterra (1926) (commonly now known as the Lotka-Volterra

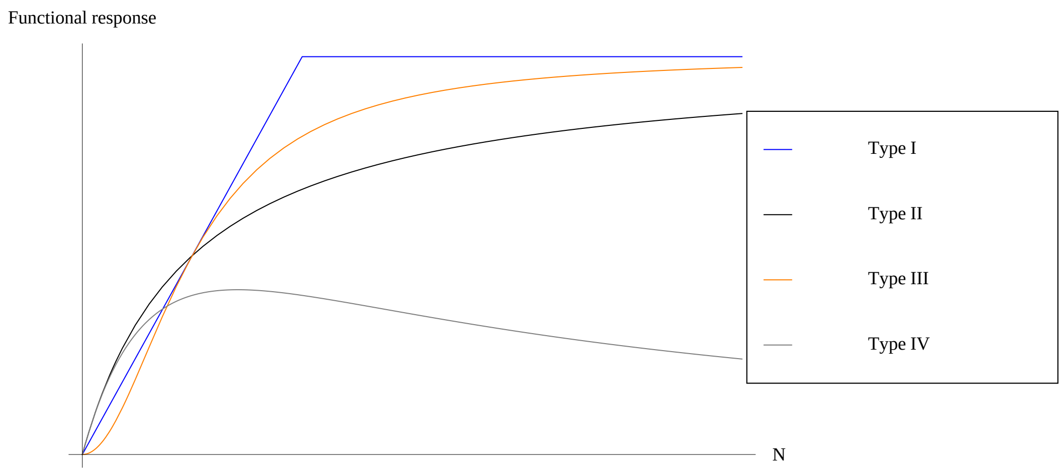


Figure 1.2: Plot comparing the four types of functional responses. Each has the same satiation level.

models) who studied a predator-prey scenario. Equations 1.5 and 1.6 represent the change in the number of prey and predators, respectively, where N_{Prey} and $N_{Predator}$ are population of prey and predators with α, β, γ and δ being the parameters for the interaction between the two species. It can be easily shown that these populations reach equilibrium when either both species are extinct, or $N_{Prey} = \frac{\gamma}{\delta}$ and $N_{Predator} = \frac{\alpha}{\beta}$. Subsequent models included density dependence, alternative functional responses, intraspecific and interspecific competition and facilitation between multiple species. Equation 1.7 represents the i^{th} equation in the system of s equations for a competitive Lotka-Volterra model with s species, where N_i, κ_i and r_i are the population, carrying capacity and relative growth rate for the i^{th} species and α_{ij} is the effect population of species j has on the population of species i.

The Lotka-Volterra equations are known to be unrealistic in their oscillations, due to its sensitivity to perturbations (Brauer and Castillo-Chavez, 2001). The stability near the equilibrium points can be determined by the eigenvalues of the Jacobian matrix from the system of equations (linearisation). If the eigenvalues are; real and negative, the equilibrium is a stable node; real and positive, the equilibrium is unstable; real and of opposite sign, the equilibrium is a saddle point; complex with negative real part, the equilibrium is a stable focus (spiral in); complex with positive real part, the equilibrium is an unstable focus (spiral out); purely imaginary there is a centre, stable or unstable focus (Kot, 2001). However, Smale (1976) proved that with a large number of species ($s \geq 5$) then the system could take on any dynamical behaviour.

$$\frac{\mathrm{d}N_{Prey}}{\mathrm{d}t} = N_{Prey}\left(\alpha - \beta N_{Predator}\right) \tag{1.5}$$

$$\frac{\mathrm{d}N_{Predator}}{\mathrm{d}t} = -N_{Predator}\left(\gamma - \delta N_{Prey}\right) \tag{1.6}$$

$$\frac{\mathrm{d}N_i}{\mathrm{d}t} = r_i N_i \left(\frac{\kappa_i - \sum_{j=1}^{s} \alpha_{ij} N_i}{\kappa_i}\right) \tag{1.7}$$

Grazing (or plant-herbivore) systems have been characterised as a variation on predator prey interaction (Edelstein-Keshet, 1986). The Rosenzweig-MacArthur system (Equations 1.8 and 1.9) is one of the earlier and still dominant plant-herbivore models. It includes logistic density dependency within vegetation and hyperbolic function response in the herbivore (Rosenzweig and MacArthur, 1963). In the system ζ can be interpreted as the saturation grazing rate per capita of herbivore, θ is the half-saturation point, ξ is the vegetation-herbivore conversion rate and χ is the consumption rate required to maintain the current density. Turchin and Batzli (2001) argued that while the Rosenzweig-MacArthur system is appropriate for interaction where the plant's biomass is accessible to the grazer, this is not the case for many perennial grasses and sedges, where at least 80% of their biomass is underground. When the latter case is true, initial recovery from grazing is much quicker than the logistic density dependence response. To counter this it is suggested (Turchin and Batzli, 2001; Turchin, 2003) that an initially linear regrowth model (Equation 1.10) is more appropriate and should replace Equation 1.8.

$$\frac{\mathrm{d}V}{\mathrm{d}t} = r_V V \left(1 - \frac{V}{\kappa_V}\right) - \frac{\zeta V N}{\theta + V} \tag{1.8}$$

$$\frac{\mathrm{d}N}{\mathrm{d}t} = \xi N \left(\frac{\zeta V}{\theta + V} - \chi\right) \tag{1.9}$$

$$\frac{\mathrm{d}V}{\mathrm{d}t} = u_V \left(1 - \frac{V}{\kappa_V}\right) - \frac{\zeta V N}{\theta + V} \tag{1.10}$$

Age or stage structured population models are appropriate when populations are heterogeneous. Difference equations can be used to model populations most effectively where the organism can be grouped into non-overlapping groups or generations measured over discrete time (Smith and Keyfitz, 1977; Kot, 2001; Tuljapurkar and Caswell, 1997). This could be due to the adults dying and are replaced totally by their progeny after some fixed interval, individuals undergo abrupt changes, or progress through series of discrete stages. The linear difference equation takes the general form as shown in Equations 1.11 and 1.12 and include such famous progressions as the Fibonacci sequence (when $l_a = 1$, $m_1 = m_2 = 1$ and $m_a = 0$ otherwise).

$$B_t = \sum_{a=1}^{t} B_{t-a} l_a m_a + G_t \tag{1.11}$$

where

$$G_t = \sum_{a=1}^{\omega} n_{a,0} \frac{l_{a+1}}{l_a} m_{a+1} \tag{1.12}$$

While the model from Equations 1.11 and 1.12 is interested in only the next generation, the age distribution of the population can be modelled as an extension of this by retaining the information via matrices (Equation 1.13). Matrices models that progress the population from one time step to the next are often referred to as Leslie matrices, named after Leslie (1945), who popularised their use. In practice these models often had constant state variables like birth and mortality rates to allow for easier computations. The advent of computing and the increase in its processing power has enabled extensions of these discrete models where these state variable can change with over time (Caswell, 2001).

$$\boldsymbol{n}_{t+1} = \boldsymbol{L}\boldsymbol{n}_t \tag{1.13}$$

where

$$\boldsymbol{L} = \begin{bmatrix} F_0 & F_1 & F_2 & \dots & F_{\omega-1} \\ P_0 & 0 & 0 & \dots & 0 \\ 0 & P_1 & 0 & \dots & 0 \\ \vdots & \ddots & \ddots & \ddots & \vdots \\ 0 & \dots & 0 & P_{\omega-2} & 0 \end{bmatrix} \tag{1.14}$$

$$P_a \equiv \frac{l_{a+1}}{l_a} \tag{1.15}$$

$$F_a \equiv P_a m_{a+1} \tag{1.16}$$

Alternatively, a structured population may have continuous time, and in this case partial differential equations, PDEs, are usually used. McKendrick (1926) originally used PDEs to model age-structured populations, but this approach was not popularised until the later work of von Foerster (1959). This work was later extended to include classification by size or physiological age by Sinko and Streifer (1967, 1969) amongst others. The general form of the equation is given in Equation 1.17 where Equation 1.18 is the boundary condition relating to the rate of recruitment of individuals of stage-0 (new born). This reduces to the McKendrick-von Foerster equation (Equations 1.19,1.20) when x represents age, as $a = x$ and $g(x) = 1$. Subsequently work has been carried out into the well-posedness and stability analysis and parameter estimation. More recently sensitivity equations for the initial conditions and various rates used in the equations have been studied by Banks *et al.* (2009), while Liu and He (2009) investigated stability in size-structured populations with resource dependencies and inflow of stage-0 individuals from external sources.

$$\frac{\partial n(x,t)}{\partial t} = -\mu(x,t)n(x,t) - \frac{\partial g(x,t)n(x,t)}{\partial x} \tag{1.17}$$

$$n(0,t)g(0) = \int_0^\infty b(x,t)n(x,t)\mathrm{d}x \tag{1.18}$$

$$\frac{\partial n(a,t)}{\partial t} + \frac{\partial n(a,t)}{\partial a} = -\mu(a,t)n(a,t) \tag{1.19}$$

$$n(0,t) = \int_0^\infty b(a,t)n(a,t)\mathrm{d}a \tag{1.20}$$

While the first-order partial differential equation from this form of structured population model may not be too difficult to solve in itself, the boundary condition complicates things quite a bit. Accurate numerical solution of the PDE models from Equation 1.17 and 1.19 can be difficult (Gurney and Nisbet, 1998). To counter this issue de Roos (1988); de Roos *et al.* (1992) formulated a method that not only provided a tool for numerical study of PDE models referred to as physiological structured population models, *PSPMs*, (alternatively referred to as Escalator Boxcar Train (Murray, 1993)) but could also be used as a population model in its own right. The idea is that, rather than simulating the dynamics of the density function $n(x,t)$ the *PSPM*s follows the progress of cohorts, mutually exclusive and exhaustive groups of width δt over the interval $(0, t+\delta t]$, that make up the entire population. Births are continuous so members of a new cohort, $n_0(x_b, t)$ are accumulated over δt from reproduction in the other cohorts. Note that births from the cohorts go into the "new born" cohort rather than their own cohort. Also, as cohort membership is decided by when the individuals are born, these cohorts are in effect isolated, cannot increase in population and decrease in population only through mortality. If interval δt is small enough, then the individuals in the cohort can be characterised by their average. In effect it is like sending a person, every δt to monitor a single cohort's develop over time. They monitor age, size, mortality and births (that do not enter their cohort, but the n_0 cohort). The equations for this model are given by Equations 1.21 to 1.24.

$$\frac{\mathrm{d}n_i(t)}{\mathrm{d}t} = -\mu\left(\sigma_i(t)\right) n_i(t) \tag{1.21}$$

$$\frac{\mathrm{d}\sigma_i(t)}{\mathrm{d}t} = g(\sigma_i(t)) \tag{1.22}$$

$$\frac{\mathrm{d}n_0(t)}{\mathrm{d}t} = -\mu(x_b)n_0(t) - \frac{\partial\mu(x_b)}{\partial x} + \sum_i b\left(\sigma_i(t), t\right) n_i(t) \tag{1.23}$$

$$\frac{\mathrm{d}\pi_0(t)}{\mathrm{d}t} = g(x_b)n_0(t) + \frac{\partial\mu(x_b)}{\partial x}\pi_0 - \mu(x_b)\pi_0 \tag{1.24}$$

For more details on the models discussed above see either Murray (1993), Tuljapurkar and Caswell (1997) or Kot (2001).

1.3 Thesis Format and Objectives

Currently in semi-arid Australian rangelands properties produce mainly beef and wool on marginal lands. A major area of concern is grazing pressure. Kangaroos are considered to have a substantial impact on grazing pressure, and for that reason they are often considered pests by landholders. It has been thought that converting from farming European domesticated stock to native wildlife would have environmental benefits. The perceived benefits include: restoration of native ecosystems; decreasing greenhouse gas emissions; and public health (substitution of other meat products for low fat, high iron, kangaroo meats).The commercial benefits from the change are unclear. These thoughts lead the three key questions that inform this thesis. Can the inclusion of kangaroo commodities increase resilience to landholders in semi-arid regions of Australia? If kangaroos were to be encouraged on one property, would this have detrimental impact on neighbouring properties? What impact would a requirement to reduce greenhouse gas emissions have on the viability of including kangaroo commodities?

Through construction of plant-herbivore models, the dynamics of cattle, sheep and kangaroo commodities are examined. Simulations were constructed so as to estimate the expected value for each and the correlation between the different commodities. Portfolio analysis using mean-variance, average value-at-risk, and multi-objective optimisation projects were used to analyse different allocations of forage to each herbivore, with and without methane emission reduction requirements. From the analysis it seems that diversification of herbivores (including kangaroos) is optimal on more marginal lands, for the risk adverse, and to reduce methane emissions.

If landholders can see a financial benefit from diversifying the commodities they produce then the environmental benefits could be a consequence. Chapter 2 uses a simplified scenario of price changes and fecundity to explore mixed-grazing strategies. It investigates reducing the risks involved in farming in a semi-arid rangeland in Australia through the inclusion of kangaroos. If this is not the case in the simplified scenario, then it is unlikely that diversification will be useful in a more detailed model.

Currently the kangaroo meat processors are in a dominant position, able to determine prices and quantities. What would happen if that were to change? The supply chain between landholder and processor using a game theoretical approach is explored in Chapter 3. Does migration have an effect on the landholders willingness to supply beef and kangaroo meat? What difference does a power imbalance between landholder and processor make to the scenario?

Allocating forage to different species is only possible if the population size of each species can be controlled, otherwise competitive exclusion and migration could override the allocations. The effect of kangaroos, a mobile species that can cross boundaries and cannot always be explicitly controlled, needs to be explored. Chapter 4 investigates the dynamics between vegetation and herbivores. Differential equations are used to; analyse the effect of mobility on MSYs; and the impact from neighbours in the form of large national parks and similarly sized commercial properties. What are the best options when considering interacting properties? When does the mobile herbivore dominate the captive herbivore?

Mitigation through income from kangaroos could help alleviate financial down turn experienced during drought. Added to this kangaroo numbers rapidly increase after a drought has broken, and harvesting could financially counter restocking costs of domestic animals (Dawson, 1995). For this reason developing an understanding of the herbivores reactions to weather conditions via a plant-herbivore model is required. Chapter 5 discusses the construction of a *PSMS* for kangaroo populations, underpinned by a pasture growth model calibrated to the area of interest. The model reacts to daily weather, predicting beef, wool, and kangaroo production. Issues related to its use and efficacy are noted.

Chapter 6 is the culmination of the research carried out in the previous chapters. Results from the simulated property and portfolio optimisation combine to examine the risk associated with different mixed-grazing options. Pareto-optimal efficient frontiers are constructed and conclusions are drawn about the extent of diversification. The affect of methane emissions reduction on the portfolio is also examined.

The conclusion discusses the finding of the research and possible consequence that follow. It also considers the effect of changes to the situation as well as further research that is required in the area to better inform some of the parameters and assumptions used in the models underlying this thesis.

Chapter 2

Initial Exploration of Viability of Mixed-Grazing

Currently landholders see kangaroos as a pest and of little to no value. Therefore the possible benefits replacing some cattle and sheep production with native herbivores is not realised. If landholders can see a financial benefit from diversifying the commodities they produce then the environmental benefits could be a consequence. As a first step it makes sense to explore whether it is possible that inclusion of kangaroos into the commodities that a property produces has some benefit to the landholder. Of particular interest is reducing the variability of relative returns. Do the relative returns of the property become more resilient to external forces when the commodities harvested are from both kangaroos and domestic stock? Also of interest is any possible difference in strategy, dependent on how marginal the land is. In particular, does the amount of money invested affect the optimal grazing strategies? The data used in the scenarios explored in this chapter are limited to average fecundity for kangaroos, as actual rates for different years are not known. If it can be shown that mixed-grazing is economically beneficial to landholders in the simplified case, then further analysis is warranted.

2.1 Formulation and Assumptions

Classical mean-variance portfolio selection involves a scenario with a limited amount of funds to be invested in a variety of assets (Steinbach, 2001). The goal is that each asset is allocated funds, $\boldsymbol{y}$, in such as way as to trade-off maximising returns, $\rho(\boldsymbol{y})$, and minimising risk, $R(\boldsymbol{y})$:

$$\begin{aligned} \max_{y} \quad & \pi\rho(\boldsymbol{y}) - \frac{1}{2}R(\boldsymbol{y}) \\ & s.t. \\ & \boldsymbol{e}^T\boldsymbol{y} = 1, \end{aligned} \tag{2.1}$$

where π is the trade-off parameter, $\boldsymbol{e} \in \mathbb{R}^n$ denotes the vector of all 1s and the *budget equation* $\boldsymbol{e}^T\boldsymbol{y} = 1$ specifies the initial wealth (without loss of generality set equal to one).

Analogous to the problem stated in Equation 2.1 is that of allocating the overall stock level to different species of domestic and native herbivores. This is done so as to trade-off the competing objectives of maximizing the relative return on investment and minimizing the risk involved in the investment. In Australia stock levels can be compared via units of dry sheep equivalents, independent of time. A dry sheep equivalent (dse) standardises the feed requirements of different animals across different species, using a 50kg, non-lactating Merino ewe as the standard for comparison. Hence, a dse of 3 equates to an animal that requires three times the feed of the aforementioned ewe (Millear *et al.*, 2003). So, the overall stock level can be defined as the total amount of dse that an area supports. Therefore the *budget equation* is replaced by the idea of overall stocking rate, K, in dse. Portions of the overall stock level are allocated to each species of interest, k_i, $i \in S$ in dse, where S is set of domestic and native herbivores. Obviously the proportion of the overall stock level allocated to each species will effect the populations, $x_i, i \in S$. While the expected return is dependent on the prices, p_i, and fecundity, f_i of the species.

Consider a typical property in central Queensland of 200km^2 supporting 12,000 dse or $60 dse/km^2$. Of interest is determining the proportion of the overall stock level that each species will be allocated. Without loss of generality it can be argued that proportional stock allocation would allow for scaling to similar availability of forage or property size. This would lead to a formulation similar to Equation 2.1 to allocate the proportions $q_i = k_i/K, i \in S$ in the following problem:

$$\max_{\boldsymbol{q}} \quad \frac{(1-\lambda)\boldsymbol{q}^T\boldsymbol{\rho}}{\rho^*} - \frac{\lambda\boldsymbol{q}^T\boldsymbol{\Sigma}_{\boldsymbol{\rho}}\boldsymbol{q}}{\Sigma^*_\rho} \tag{2.2}$$

$$s.t.$$

$$\boldsymbol{e}^T\boldsymbol{q} = 1$$

$$\phi_i \geq 0 \ \ \forall i \in S,$$

where the $\boldsymbol{\rho}$ terms are derived from the expected proportional increase in value from one year to the next of the species and ρ^* is the maximum expected return possible and Σ_ρ^* is the minimum variance for a given fixed cost. To balance the competing objectives of maximizing return and minimizing risk the λ term has been included as a measure of the degree of the investors risk aversion, 0 for no risk aversion (only concerned with the expected return), to 1 being completely risk averse (only wanting to minimize the fluctuations in returns). The benefit of this definition of risk aversion is in its intuitive nature. Risk will be measured using the variance of returns. While different measures can be used, an area attracting much discussion (Steinbach, 2001), variance will produce a result with a broad basis (Markowitz, 1991) and is commonly understood, whilst retaining the quadratic nature of the objective function.

To calculate the returns it is clear that both the fecundity and increase in price need to be included. The value of a population of animals from a given species can be calculated by multiplying the price of each animal by the number of animals owned. After one year the change in the value of the population would be due to changes in both price and population growth. Hence it can be easily shown that the return on an investment after one year is given by,

$$\rho_i = \frac{p_i x_i (1 + \Delta p_i)(1 + f_i) - p_i x i}{p_i x_i} = \Delta p_i + f_i + \Delta p_i f_i \tag{2.3}$$

where p_i, Δp_i and f_i are the price, change in price and fecundity respectively of species $i \in S$.

This formulation only includes the amount invested in stock. The value of the property, associated with land value and facilities, should also be considered in the investment amount. The inclusion of a term to account for the non-stock investment, say *NSI*, into the amount invested gives a new measure of growth, r_i (Equation 2.4, a variation on Equation 2.3),

$$r_i = \frac{p_i x_i(1+\Delta p_i)(1+f_i) + q_i NSI - (p_i x_i + q_i NSI)}{p_i x_i + q_i NSI} = \frac{\Delta p_i + f_i + \Delta p_i f_i}{1 + \frac{d_i NSI}{K p_i}}, \tag{2.4}$$

where d_i is the *dse* for species $i \in S$ as $x_i = \frac{q_i K}{d_i}$. Note that Equation 2.3 is the special case of Equation 2.4 when *NSI*=0. The result of the inclusion of a fixed cost term means that it is now a case of optimising

$$\begin{aligned} \max_{\boldsymbol{q}} \quad & \frac{(1-\lambda)\boldsymbol{q}^T\boldsymbol{r}}{r^*} - \frac{\lambda \boldsymbol{q}^T \boldsymbol{\Sigma_r} \boldsymbol{q}}{\Sigma_r^*} \\ & s.t. \\ & \boldsymbol{e}^T\boldsymbol{q} = 1 \\ & \phi_i \geq 0 \forall i \in S. \end{aligned} \tag{2.5}$$

It has been assumed that there is no substitutability of the commodities. Hence, the decision of the landholder will not affect the overall market and prices for each commodity. This simplification seems reasonable given the focus on a small region implementing a mixed-grazing strategy. It is also assumed that land holders have sufficient financial resources and can actively control the animal numbers on their properties. In reality this is straight forward for cattle and sheep assets, as they have the ability to buy or sell livestock, and fencing maintains an effective boundary for these species. However, kangaroos do not belong to the land holder. They are under the care of the Federal Government, meaning direct purchase and sales of kangaroos is not an option. To further complicate controlling the kangaroo population, properties can be thought of as having porous borders, with kangaroos easily jumping standard fencing. This presents the possibility of enticing kangaroos to an area from neighboring land if their numbers need to be increased. Unfortunately this also means a chance of losing kangaroos to "greener pastures". To address the issue of migration the property is considered to be part of a cooperative with common stocking levels on neighboring properties. With common stocking levels, there should be no net migration as all pastures would be equally attractive. Currently kangaroo harvesting cooperatives are being considered in at least two regions, one of which is the Maranoa (Baumber *et al.*, 2009). It is also assumed that the State's quotas for the number of kangaroos permitted to be harvested would not limit the harvesting of kangaroos on the property. From 2001 to 2007, nationally an average of 69.5% of the quota was utilized (Anon., 2009).

2.2 Illustration

Data was collected from The Australian Bureau of Agricultural and Resource Economics 2010, which is available to the public, and data from kangaroo harvesters, information not available in the public domain (T. Garrett, pers. comm., 2008). Data relating to the prices of beef, kangaroo meat, lamb and wool as well as fecundity rates for cattle and sheep was collated from 1988 to 2005 for the Charleville-Longreach region of Queensland. The price data are expressed in

2008-2009 Australian dollar values in terms of the revenue produced per animal (See Table B.1). This data was then used to produce matrices for the estimated mean, $E[\boldsymbol{r}]$, and covariance, $\boldsymbol{\Sigma_r}$, for the percentage return per year. It should be noted that in this region sheep are stocked for their wool, with only small amounts of lambs being sold for meat, while kangaroo harvesting, with no return to the landholders, has been established for some time. The *dse* values were calculated using this information and a Queensland Government conversion chart (Millear *et al.*, 2003) for the cattle (9 *dse*) and sheep (1 *dse*) with the rate often used by landholders for kangaroos (0.7 *dse*). This is an upper bound to the estimate for the kangaroos (Grigg, 2002; Munn *et al.*, 2009). These parameters give a scenario more likely to favor the status quo of domesticated livestock, due to the low *dse* estimates for domestic stocks and a high *dse* estimate for kangaroos.

The pareto-optimal solutions for the special case with non-stock investments not included (NSI = 0), are shown in the form of the efficient frontier (Figure 2.1). For cases with low returns, it can be seen that changing the stance to increase the expected relative return incurs a relatively small increase in the standard deviation (Figure 2.2). However, as the return becomes greater the increase in the risk grows at a faster rate. The solutions in the efficient frontier correspond to the allocation of forage (Figure 2.3), clearly favoring kangaroos when risk aversion is low ($\lambda < 0.24$), with sheep only being considered once $\lambda > 0.24$ and cattle only for moderate to high risk aversion, $\lambda > 0.6$.

If non-stock investment is now considered ($NSI > 0$), not only is there a reduction in the expected proportional returns as one would anticipate, but also the variance. This seems to be due to the fact that the larger and more expensive

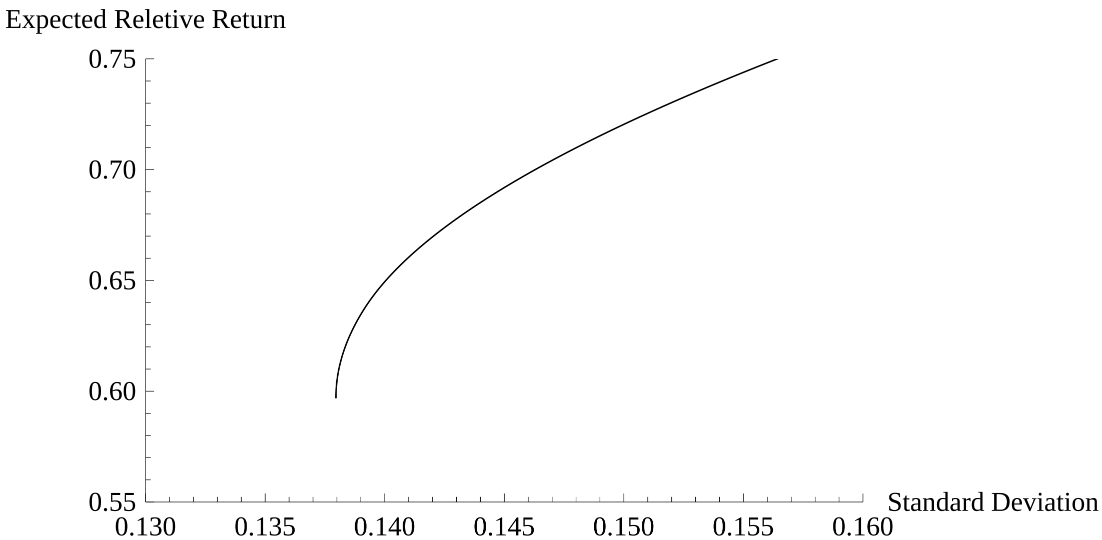


Figure 2.1: The efficient frontier for the optimal solutions to the forage allocations as shown by the expected percentage return on investments versus its risk, here measured as the standard deviation so that the units are equivalent.

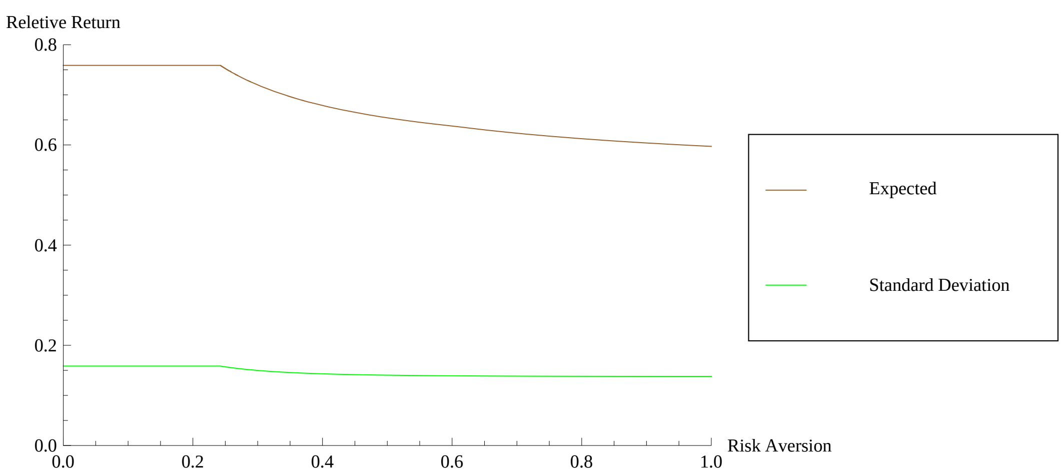


Figure 2.2: Plot of expected relative return and the standard deviation of the relative return as risk aversion, λ, varies, excluding non-stock investments.

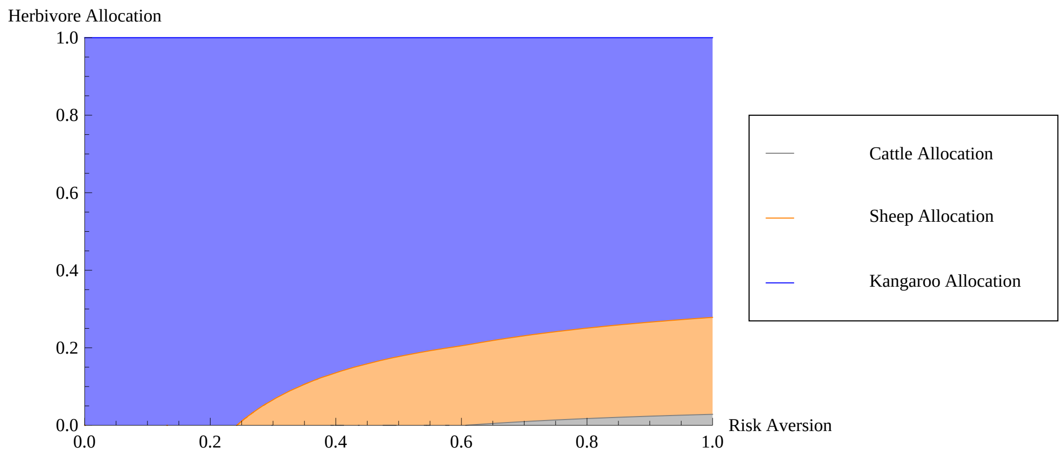


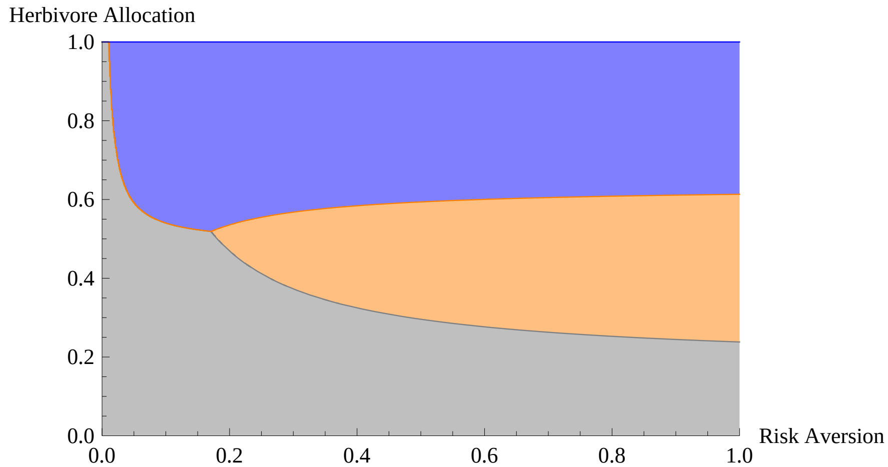
Figure 2.3: Plot of proportion of resources allocated to each species as risk aversion, λ, varies, excluding non-stock investments.

species have smaller variances and are hence less risky. In terms of worth per *dse* cattle are the most expensive whilst kangaroos are the least. As the property values increase, the slopes of the efficient frontiers are also decreasing, meaning that reducing the risk has less of an impact on the expected return. In terms of financial resilience, let us say a landholder is trying to minimize the frequency of poor returns. In one scenario a loss, on average, approximately once every 5 years became once every 250 years when a more risk averse position was taken. That was on a property with moderate value ($NSI = 2,500,00$) and the risk aversion measure went from $\lambda = 0$ to $\lambda = 0.5$. The return was reduced by 45.1%, but the stocking investment was also significantly reduced by some 66.9%. The scenario assumed that returns were normally distributed and only optimal solutions were considered.

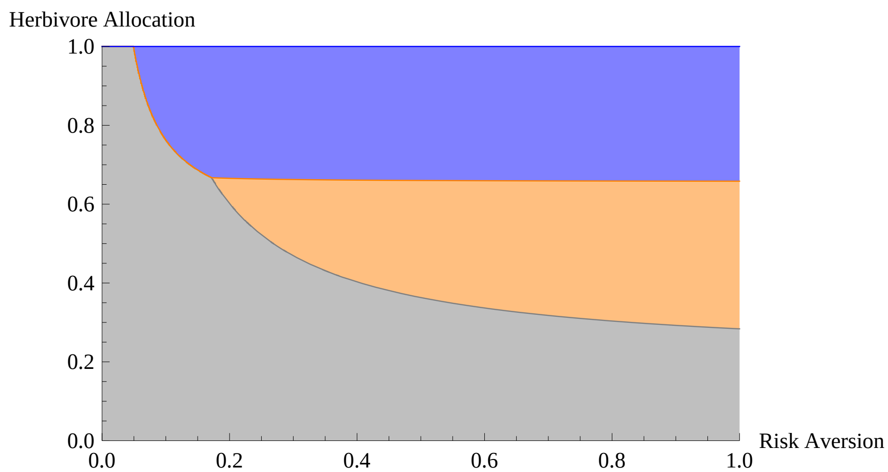
One obvious reason non-stock investments will differ between properties is quality of the pastures and availability of water. The greater the non-stock investments the more expensive species begin to be favored because their return on total costs increases relative to the less expensive species (Figures 2.4 and 2.5). From a non-stock investments of NSI $= 0$ (refer to Figure 2.3) to NSI $= 2,168,350$, when considering purely the returns ($\lambda = 0$), a strategy of solely stocking kangaroos is favored, due to their higher fecundity rate. At higher non-stock investments though, as seen in Figures 2.4a and 2.4b, where *NSI* is \$2,500,000 and \$5,000,000 respectively, cattle are favored when maximizing returns, due to their higher price per *dse*.

No matter the non-stock investments, once the landholders become even moderately risk adverse ($\lambda > 0.25$) a mixed strategy is preferred. This point is illustrated in Figure 2.4, where it is clear to see that when greater non-stock investment is required the forage allocated to cattle increases, reducing the kangaroo allocation as the sheep allocation plateau. Comparing the low (2.5a) and higher (2.5b) risk aversion strategies for different *NSI* reiterates the preference for mixed-grazing at both higher levels of risk aversion and *NSI*.

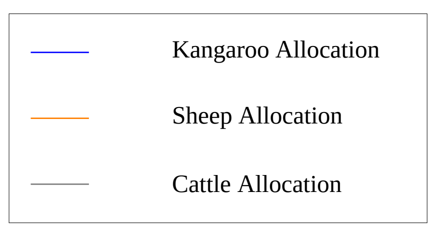
It is also noted that there is some disagreement in the literature as to the true value of the kangaroo's *dse*, with values from 0.15 to 0.7 quoted by different sources, the most recent of which suggests $\sim$0.4 (Munn *et al.*, 2009). If this value is changed from the 0.7 used above, then the resulting optimal scenarios change significantly (Figure 2.6). A smaller value of kangaroo *dse* reduces the resources allocated to cattle or even eliminates cattle from the optimal solution altogether, reducing the diversification down to just sheep and kangaroos.



(a) NSI=$2,500,00

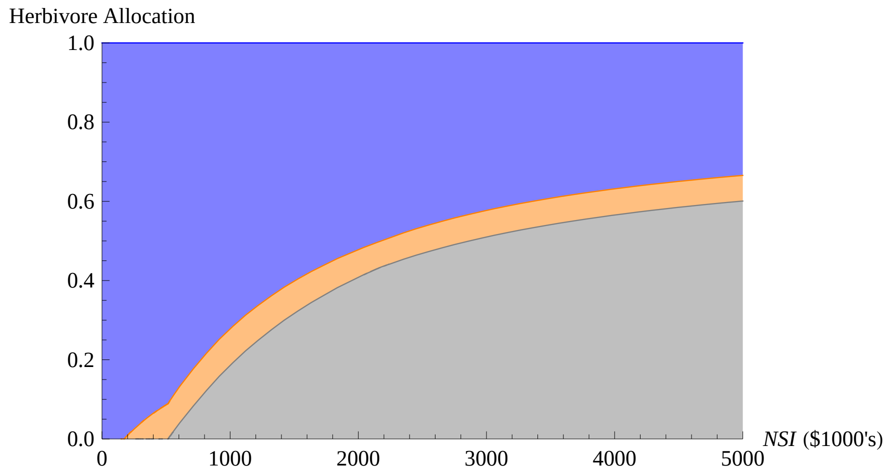


(b) NSI=$5,000,00

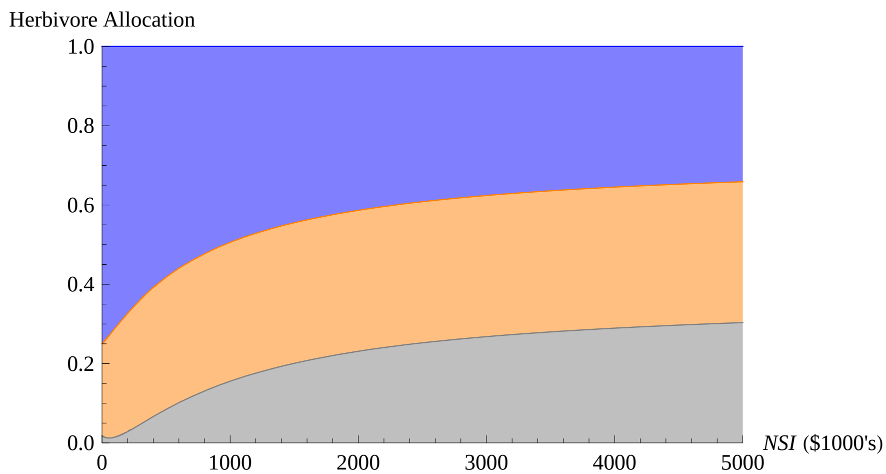


(c) Legend

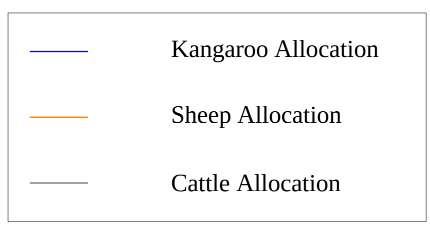
Figure 2.4: Plot of proportion of resources allocated to each species as risk aversion, λ, varies given a non-stock investment of $\$2,500,000$ and $\$5,000,000$.



(a) Low Risk Aversion

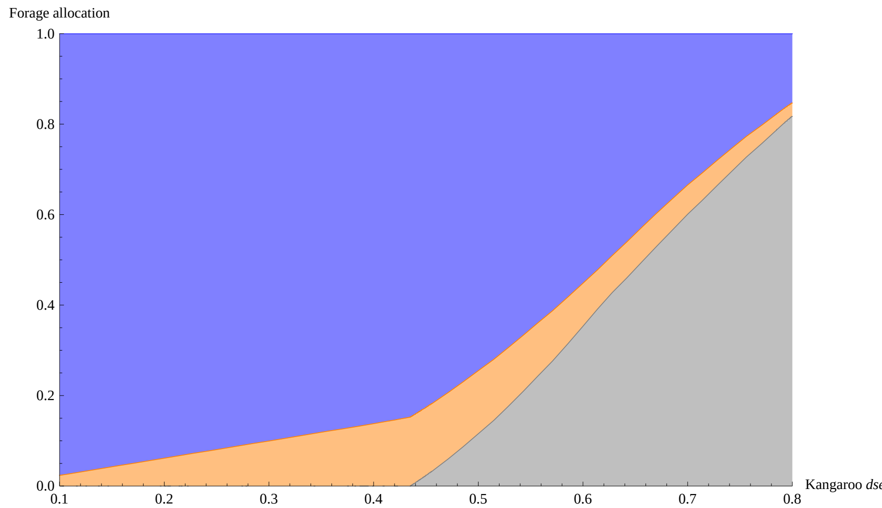


(b) High Risk Aversion

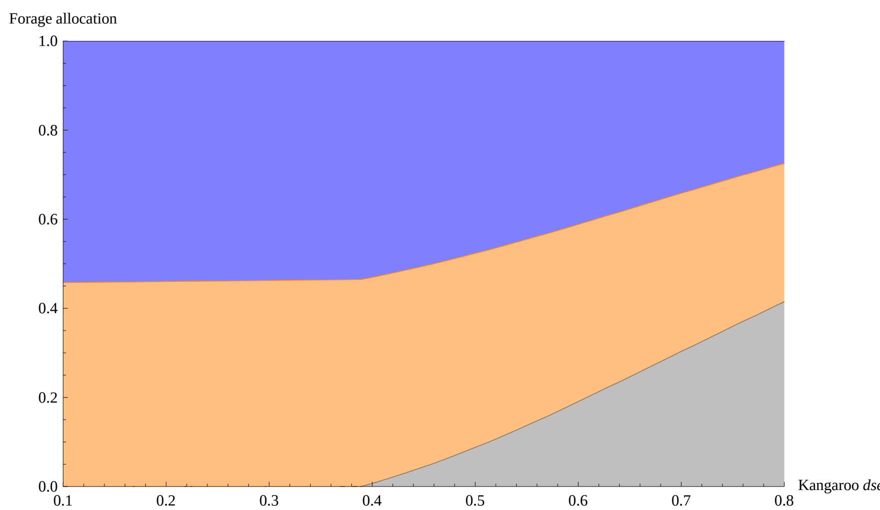


(c) Legend

Figure 2.5: Plot of proportion of resources allocated to each species as non-stock investment, *NSI* in thousands of dollars, varies given a risk aversion of $\lambda = 0.2$ and 0.8.



(a) Low Risk Aversion



(b) High Risk Aversion

Figure 2.6: Plot of proportion of resources allocated to each species as the value of kangaroo *dse* varies given a non-stock investment of $5,000,000 and a risk aversion measure of $\lambda = 0.2$ and 0.8

2.3 Discussion

Biodiversity benefits are not always easy to quantify or justify on the bottom line, however, the possible financial pay-offs of diversifying the commodities produced by the enterprize can be quantified. From this analysis it can be seen that, given the correct circumstances, active management of kangaroos could be a viable way of increasing the resilience of the land financially as well as ecologically. Diversification in semi-arid Australian rangelands seems to result in less volatility in returns on average. This is the case even where there is some uncertainty with regards to the true nature of the comparative impact of kangaroos. Different combinations of these parameter values, which seem to cover the plausible spectrum, all resulted in some form of diversification along the efficient frontier. Furthermore, as the land becomes more marginal, and decreases in value, there seems to be benefits with respect to returns from the inclusion of kangaroo harvesting.

Additionally it is noted that several practical difficulties need to be overcome before the systems considered in our model can be implemented. The relationship and distribution of returns between landholders and harvesters needs to be reviewed. Will harvesters continue to operate as they are currently but with some return to the landholders or will they work for the cooperative? Compared to beef sales, kangaroo meat has a very low market share and therefore elasticities with beef are not clear. Greater acceptance for kangaroo meat within Australia and internationally could affect its demand. If diversification into kangaroos was to increase, there may be a point were some of the assumptions may need to be altered. Further discussion on some of the issues can be found in Cooney *et al.* (2009).

Anecdotal evidence suggests that during times of hardship caused by drought, kangaroo harvesting becomes easier as they are forced to leave their sheltered bushland for clearings in search of any available forage. It is exactly at this time that landholders future incomes are decreased due to a reduction in their stocking rates of domestic species and the need to buy extra fodder. The affect on kangaroos during drought is an increase in mortality, after a lag of several months, which disproportionately affects juveniles and the elderly kangaroos (Caughley *et al.*, 1987). Mitigation through income from kangaroos could help alleviate some of this financial down turn. Added to this is the rapid increase in kangaroo numbers after a drought has broken, where harvesting could financially counter restocking costs of domestic animals (Dawson, 1995). For this reason developing this problem to include results from a better understanding of the herbivores reactions to weather conditions via a plant-herbivore model would be of some use. An extended *GRASP* model will be used later to capture the transient affects of drought and post-drought recovery. Allocating forage to different species is only possible if population size of each species can be controlled. Otherwise competitive exclusion and migration could override the allocations. The effect of a kangaroos (a mobile species that can cross boundaries and cannot always be explicitly controlled) is analysed later. Other areas in need of investigation include; differentiating the food types and food preferences of the species; considering the variance in kangaroo fecundity; and supply and demand in a meat supply chain. These areas may show further benefits. Although there are practical difficulties still to be overcome, the analysis strongly suggests that mixed-grazing involving kangaroos possibly offers benefits and is worth further investigation.

Chapter 3

Meat Supply Chain with Migration

Currently the kangaroo meat processors are in a dominant position, able to determine prices and quantities. What would happen if that were to change? This section focuses on the landholder and processing aspects in a supply chain to determine optimal stocking and harvesting rates. The landholder (seller) wishes to maximise their return whilst maintaining a sustainable property. They harvest kangaroos, the free-roaming stock, as well as the domestic stock. Whereas the meat processor (buyer) is trying to meet demand while minimising their costs. Several meat supply chain models are proposed and solved. The seller's model determines the optimal quantities of sheep and kangaroo to offer so as to maximise their income based on buying price. The property's carrying capacity, animal fecundity and mortality and (in the case of kangaroos) migration are taken into account. The optimal buying price and order quantity are determined for these substituted goods to minimise the processor's purchase cost where the order quantity is a function of buying price. The interactions between the processor and the landholder are modelled by both non-cooperative and cooperative games. The non-cooperative aspect is a seller-Stackelberg scenario, where the seller has more power than the buyer. In addition Pareto efficient solutions to the cooperative game model are provided.

3.1 Notation and Problem Formulation

This section introduces the notation and formulation used in the supply chain problem. Specifically, all decision variables, input parameters and assumptions underlying our models will be stated.

3.1.1 Decision Variables

The decision variable are the parameters that the landholder and processor have control over. Table 3.1 lists these variables and states which player has direct control of the variable.

Variable	Definition
p_s	The buying price of sheep (processor's decision variable)($/kg).
p_s	The buying price of kangaroo (processor's decision variable)($/kg).
γ_s	The fraction of sheep to sell (landholder's decision variable)(dimensionless).
γ_k	The fraction of kangaroo to sell (landholder's decision variable)(dimensionless).

Table 3.1: Decision variables used in the supply chain problem.

3.1.2 Input Parameters

The number of sheep (N_s) and kangaroos (N_k) per square kilometre is affected by many considerations. These include maximal growth rates of sheep (ν_s) and kangaroos (ν_k) comprising births and deaths. The cost of maintaining and harvesting a sheep or a kangaroo is c_s and c_k respectively. The property can only hold a limited number of sheep and kangaroo (κ_s and κ_k respectively) known as the carrying capacity. Competition for the forage between these species also needs to be considered. The effect of a single kangaroo on the sheep population is given by α_{sk}, while the reverse relationship is α_{ks}. The rate at which the kangaroos migrate per year ($\tau^\dagger$) needs to be considered due to the free-roaming nature of kangaroos as well as the kangaroo density of the world outside the property relative to the property (ϕ). All of these affect the rate of change in the sheep ($\dot{N}_s$) and kangaroo ($\dot{N}_k$) populations.

Note, as the prices are based on \$/kg the average weight of harvested sheep (w_s) and kangaroos (w_k) is needed as part of the objective function.

For the processer, the ordering quantity of sheep and kangaroo are based on Yang and Zhou (2006) as follows:

$$quant_i = D - a_i p_i + b p_j; \quad i, j \in \{s, k\}, i \neq j. \tag{3.1}$$

D represents the demand for sheep and kangaroo if their prices are zero ($D > 0$), b is the degree of substitutability between the two goods (the substitutability coefficient of the two products ($b > 0$)), a_i represents the measure of sensitivity between the amount ordered and price for good i ($a_i > b$), $quant_i$ and $quant_i$ are

Variable	Definition
N_s	The stocking rate of sheep ($sheep/km^2$).
N_k	The stocking rate of kangaroo ($kangaroo/km^2$).
$dotN_s,\ dotN_s$	The rate of change for sheep and kangaroo respectively ($animal/km^2/year$).
ν_s	The maximal growth rate of sheep ($sheep/year$).
ν_k	The maximal growth rate of kangaroo ($kangaroo/year$).
κ_s	The maximum stocking rate of sheep the property can maintain ($sheep/km^2$).
κ_k	The maximum stocking rate of kangaroo the property can maintain ($kangaroo/km^2$).
α_{sk}	The impact on sheep of each extra kangaroo ($sheep/kangaroo$).
α_{ks}	The impact on kangaroos of each extra sheep ($kangaroo/sheep$).
$\tau^{\dagger}$	The rate at which kangaroos can migrate to and from the property ($years^(-1)$).
ϕ	The kangaroo density of the national park (dimensionless).
$c_s,\ c_k$	The cost of maintaining and harvesting sheep and kangaroo respectively ($\$/kg$).
w_s	The average weight of the harvested sheep ($kg/sheep$).
w_k	The average weight of the harvested kangaroo ($kg/kangaroo$).
$quant_s,\ quant_k$	The quantity of sheep and kangaroo ordered (kg).
D	The total demand for sheep and kangaroo if their price were zero (kg).
$a_s,\ a_k$	The measure of sensitivity between the amount ordered and its price for sheep and kangaroo respectively ($kg/(\$/kg)$).
b	The degree of substitutability between the commodities ($kg/(\$/kg)$).
Z_1 , Z_2	The cost and profit equations for the processor and landholder respectively ($).

Table 3.2: Input variables used in the supply chain problem.

the ordering quantity of sheep and kangaroo respectively.

The rate of change in the sheep population, $\dot{N}_s$, is based on the Lotka-Volterra competition model (Kot, 2001) with includes harvesting and takes the form,

$$\dot{N}_s = \nu_s N_s \left(1 - \frac{N_c + \alpha_{sk} N_k}{\kappa_s}\right) - \gamma_s N_c \tag{3.2}$$

where the first term is for the growth of the sheep population and the second term is for the harvest rate of the sheep. The growth term is allows for intra- and inter-specific competition between sheep and kangaroo. The harvest term just specifies what fraction of the current sheep population being harvested at any given time.

Analogous to Equation 3.2 is the equation for the rate of change for the kangaroo population, with the addition of a term for the possible migration of kangaroos to and from the property and national park,

$$\dot{N}_k = \nu_k N_k \left(1 - \frac{N_k + \alpha_{ks} N_s}{\kappa_k}\right) - \gamma_k N_k. \tag{3.3}$$

The migration term depends on the numbers of sheep and kangaroos in the property as well as the kangaroo density in the national park and needs to calculate the number of kangaroos wishing to enter (or leave) the property from the national park. To this end, Migration$(N_s, N_k, \phi) = 0$ when the relative densities of the two regions are equal $\left(\frac{N_k + \alpha_{ks} N_s}{\kappa_k} = \phi\right)$ and the number migrating must be relative to the size of the properties carrying capacity for kangaroos (κ_k) as well as the fraction of those whom wish to migrate who actually migrate ($\tau^{\dagger}$). The diffusion equation for the migration rate can then be given as,

$$\text{Migration}(N_s, N_k, \phi) = \tau^{\dagger}\kappa_k\left(\phi - \frac{N_k + \alpha_{ks}N_s}{\kappa_k}\right) = \tau^{\dagger}(\phi\kappa_k - (N_k + \alpha_{ks}N_s)\,. \tag{3.4}$$

So combining Equations 3.3 and 3.4 will give the equation for the rate of change for the kangaroo population on the property,

$$\dot{N}_k = \nu_k N_k\left(1 - \frac{N_k + \alpha_{ks}N_s}{\kappa_k}\right) - \gamma_k N_k + \tau^{\dagger}(\phi\kappa_k - (N_k + \alpha_{ks}N_s)\,. \tag{3.5}$$

3.1.3 Assumptions

The proposed models are based on the following assumptions:

Assumption 1. *The target market of the processor includes customers who consume both sheep and kangaroo meat.*

Assumption 2. *The ordering quantities of sheep or kangaroo, is dependent on the buying price (pricing) of both goods and the property of the substituted products.*

Assumption 3. *The kangaroo population will endeavour to spread itself across the region so as to even out the fraction of the carrying capacity used.*

Assumption 4. *The rate of change for sheep and kangaroo numbers is a competitive model as defined by Equation 3.2 and 3.5.*

3.1.4 The Buyer's Model Formulation

The processor's objective is to determine the buying price and the ordering quantity of sheep and kangaroo such that the purchasing cost is minimized. The ordering quantity of sheep and kangaroo are influenced by the buying price of sheep and kangaroo according to our assumption. The processor's purchase cost is:

$$Z_1(p_s, p_k) = w_s p_s quant_s + w_k p_k quant_k = w_s p_s (D - a_s p_s + b p_k) + w_k p_k (D - a_k p_k + b p_s) \tag{3.6}$$

It can be shown that $Z_1(p_s, p_k)$ is a convex function under the condition that $4a_s a_k w_s w_k - ((w_s + w_k)b)^2 > 0$ with respect to p_s, p_k. Hence, the first order condition of $Z_1(p_s, p_k)$ with respect to p_s, p_k determines that p_s^*, p_k^* minimize $Z_1(p_s, p_k)$ where:

$$p_s^* = \frac{2Da_k w_s w_k + Db(w_s + w_k)w_k}{4w_s w_k a_s a_k - (w_s + w_k)^2 b^2}, \tag{3.7}$$

$$p_k^* = \frac{2Da_s w_s w_k + Db(w_s + w_k)w_s}{4w_s w_k a_s a_k - (w_s + w_k)^2 b^2}, \tag{3.8}$$

3.1.5 The Seller's Model Formulation

The landholder's objective is to determine the optimal offering of sheep and kangaroo such that the profit is maximized. Thus, the landholder's profit is:

$$\begin{aligned} Z_2(\gamma_s, \gamma_k) &= w_s(p_s - c_s)\gamma_s N_s + w_k(p_k - c_k)\gamma_k N_k \\ \text{subject to } \dot{N}_s &= 0 \\ \dot{N}_k &= 0 \end{aligned} \tag{3.9}$$

By considering constraints, γ_s, γ_k yields:

$$\gamma_s = \nu_s \left(1 - \frac{N_s + \alpha_{sk} N_k}{\kappa_s}\right) \tag{3.10}$$

$$\gamma_k = \nu_k \left(1 - \frac{N_k + \alpha_{ks} N_s}{\kappa_k}\right) + \frac{\tau^{\dagger}(\phi\kappa_k - (N_k + \alpha_{ks} N_s))}{N_k} \tag{3.11}$$

Since γ_s, γ_k are function of N_s and N_k for the sake of integrity, we will use $Z_2(N_s, N_k)$ instead of $Z_2(\gamma_s, \gamma_k)$. Substituting Equations 3.10 and 3.11 into Equation 3.9, the problem transforms into an unconstrained model of two variables N_s and N_k. It can be shown that $Z_2(x, y)$ is a concave function with respect to N_s and N_k, when $\alpha_{sk}\alpha_{ks} > 2$, which may not be the case, or more generally when

$$(\alpha_{sk}\varpi_s)^2 + (\alpha_{ks}\varpi_k)^2 > 2\varpi_s\varpi_k\kappa_s\kappa_k \tag{3.12}$$

where $\varpi_s = (p_s - c_s)\nu_s w_s$ and $\varpi_k = (p_k - c_k)\nu_k w_k$. Therefore, the optimal solution, N_s^* and N_k^* can be found by taking the derivative with respect to N_s and N_k such that:

$$N_s^* = \frac{\kappa_s\kappa_k(2\kappa_k m_s m_k \nu_s \nu_k - \kappa_s \alpha ks m_k^2 \nu_k(\nu_k + \tau^\dagger) - \kappa_k \alpha_{sk} m_s m_k \nu_s(\nu_k - \tau^\dagger))}{4\kappa_s\kappa_k m_s m_k \nu_s \nu_k - (\kappa_k \alpha_{sk} m_s \nu_s)^2 - (\kappa_s \alpha_{ks} m_k \nu_k)^2 - 2\alpha_{sk}\alpha_{ks}\kappa_s\kappa_k m_s m_k \nu_s \nu_k} \tag{3.13}$$

$$N_k^* = \frac{\kappa_s\kappa_k(2\kappa_k m_s m_k \nu_s(\nu_k - \tau^\dagger) - \kappa_k \alpha_{sk}(m_s \nu_s)^2 + \kappa_k \alpha_{sk}\alpha_{ks}\tau^\dagger m_s m_k \nu_s - \kappa_s \alpha_{ks} m_s m_k \nu_s \nu_k + \kappa_s(\alpha_{ks} m_k)^2 \tau^\dagger \nu_k)}{4\kappa_s\kappa_k m_s m_k \nu_s \nu_k - (\kappa_k \alpha_{sk} m_s \nu_s)^2 - (\kappa_s \alpha_{ks} m_k \nu_k)^2 - 2\alpha_{sk}\alpha_{ks}\kappa_s\kappa_k m_s m_k \nu_s \nu_k} \tag{3.14}$$

Where $m_s = (p_s - c_s)$ and $m_k = (p_k - c_k)$.

3.2 The Seller-Stackelberg Model

This section considers the interaction between landholder and processor as a seller-Stackelberg game, where the landholder as a leader has the initiative and can enforce the strategy on the processor as a follower. The leader makes the first move and the follower then reacts by playing the best move consistent with available information. The objective of the leader is to design their move in such a way as to maximize their revenue after considering all rational moves the follower can devise (Basar and Olsder, 1999). Therefore, in our model, the processor, obtains the best the optimal buying price p_s^*, p_k^* according to the processor's model, which is given by (3.7) and (3.8) respectively. The seller then maximize their profit $Z_2(N_s, N_k)$, based on the pair p_s^*, p_k^*. Thus, the problem reduces to

$$\begin{aligned}
Z_2(N_s, N_k) &= w_s(p_s - c_s)\gamma_s N_s + w_k(p_k - c_k)\gamma_k N_k \\
\text{subject to } \; p_s^* &= \frac{2Da_k w_s w_k + Db(w_s + w_k)w_k}{4w_s w_k a_s a_k - (w_s + w_k)^2 b^2} \\
p_k^* &= \frac{2Da_s w_s w_k + Db(w_s + w_k)w_s}{4w_s w_k a_s a_k - (w_s + w_k)^2 b^2}
\end{aligned} \tag{3.15}$$

Substituting all constraints into the objective function, the above seller-Stackelberg problem reduces to optimizing an unconstrained nonlinear objective function.

3.3 The Cooperative Game

The landholder and the processor may be able to increase their profits by choosing their policies in a cooperative way. For example, a manufacturer may build an exclusive product for a reseller using the profit sharing approach. This way, the partnership can be a win-win situation for both parties. In a cooperative game, the landholder and the processor work together to determine pricing and equal values for ordered and offered quantities in a Pareto efficient way. A solution is Pareto efficient when there is no other solution where one party can maintain it current profit while the other party attains a higher profit; i.e., when the gain by one party can be made only at the expense of the other party. Such cooperation is carried out through the joint optimisation of the weighted sum of the landholder's and processor's objective functions, e.i., the set of Pareto efficient solutions can be characterised by maximising (Esmaeili *et al.*, 2009*b*):

$$Z = \lambda Z_2 - (1-\lambda) Z_1, \qquad 0 < \lambda < 1,$$

that is,

$$Z = \lambda(w_s m_s \gamma_s N_s + w_k m_k \gamma_k N_k) + (\lambda - 1)(w_s p_s (D - a_s p_s + b p_k) + w_k p_k (D - a_k p_k + b p_s)) \tag{3.16}$$

The first order condition for maximizing Z with respect to p_s yields:

$$\frac{\partial Z}{\partial p_s} = 0 \Rightarrow \lambda = \frac{w_s(D - 2a_s p_s) + (w_s + w_k)bp_k}{w_s(\gamma_s N_s + D - 2a_s p_s) + (w_s + w_k)bp_k}, \tag{3.17}$$

which shows that $\lambda \in (0, 1)$. First order conditions with respect to p_k, N_s and N_k further yield:

$$p_k = \frac{w_k \lambda \gamma_k N_k + (\lambda - 1)(w_k D + (w_s + w_k)bp_s)}{2w_k a_k(\lambda - 1)}, \tag{3.18}$$

$$N_s = \frac{\kappa_s \left(w_s \nu_s m_s - w_k \alpha_{ks} \tau^\dagger m_k - N_k \left(\frac{w_s \alpha_{sk} \nu_s m_s}{\kappa_s} + \frac{w_k \alpha_{ks} \nu_k m_k}{\kappa_k} \right) \right)}{2m_s w_s \nu_s}, \tag{3.19}$$

$$N_k = \frac{\kappa_k \left(w_k(\nu_k - \tau^\dagger) m_k - N_s \left(\frac{w_s \alpha_{sk} \nu_s m_s}{\kappa_s} + \frac{w_k \alpha_{ks} \nu_k m_k}{\kappa_k} \right) \right)}{2m_k w_k \nu_k}. \tag{3.20}$$

Pareto efficient solutions can be obtained through a negotiation between the landholder and the processor over a fixed p_s, i.e. Equations 3.17 to 3.20 are solved simultaneously to obtain λ^*, p_k^*, N_s^*, and N_k^* for a fixed p_s. The other approach is to assume λ and solve Equations 3.18 to 3.20 for p_s and other variables.

The results show that the buying price in a cooperative game is less than that in the non-cooperative game. Let p_{2C}^* and p_{2N}^* be the optimal buying price in a cooperative and non-cooperative game respectively, i.e. p_{2C}^* is given by Equation 3.18 and p_{2N}^* by Equation 3.8. We obtain

$$p_{2C}^* = \frac{\lambda \gamma_k N_k}{2(\lambda - 1)a_k} + p_{2N}^* \tag{3.21}$$

where the first term of the equation is negative $\lambda \in (0, 1)$ and therefore $p_{2N}^* > p_{2C}^*$.

3.4 Computational Results

In this section, we present numerical examples which are aimed at illustrating some significant features of the models established in previous sections. We will also perform sensitivity analysis of two main parameters of these models. We note that Examples 1 and 2 below illustrate the seller-Stackelberg and cooperative models respectively. In the examples, we set $\kappa_s = 30$, $\kappa_k = 27$, $c_s = 0.3$, $c_k = 0.1$, $w_s = 45$, $w_k = 25$, $\tau^\dagger = 0.036$, $\alpha_{sk} = 0.4$, $\alpha_{ks} = 3$, $\nu_s = 0.45$, $\nu_k = 0.58$, $\phi = 1$, $a_s = 22.5$, $a_k = 25$, $D = 50$, and $b = 0.5$. These figures are based on research presented by Caughley *et al.* (1987) and Pople and Grigg (1999) and have some degree of variability associated.

3.4.1 Numerical Examples

Example 1 The seller-Stackelberg model produces the following optimal values for our decision variables: $p_s^* = 1.129, p_k^* = 1.143, \gamma_s^* = 0.3740, \gamma_k^* = 0.3488$, $quant_s^* = 25.17$, $quant_k^* = 24.85$, $N_s^* = 0$, $N_k^* = 12.66$, $\gamma_s^* N_s^* = 0$ and $\gamma_k^* k^* = 4.416$. The corresponding landholder's profits and processor's purchasing costs are $Z_2^* = 115.125$ and $Z_1^* = 1907.09$ respectively. This gives us a baseline to compare the cooperative solution against in the next example.

Example 2 We obtained Pareto efficient solutions by assuming that the landholder and processor has negotiated an agreement on the pricing of sheep $p_s = 0.7$. Equations (3.18) - (3.20) are then used to obtain p_k^*, N_s^*, and N_k^*. The final solutions are as follow $p_k^* = 0.5199, N_s^* = 3.599, N_k^* = 6.402, Z_2^* = 62.65$ and $Z_1^* = 1572.6$. Since, in the seller-Stackelberg model, the landholder has more power; we would expect that the profit of the landholder in the seller-Stackelberg be greater than in the cooperative model. However, the processor's purchasing costs in the seller-Stackelberg are greater than in the cooperative model. Therefore, the processor prefers the cooperative model as it reduces the purchasing costs compared to the cooperative model. More generally an increase in the price of sheep, p_s, results in an increase in the price of kangaroo p_k until $p_s > 0.9988$ when the value of p_k starts to decrease, as seen in Figure 3.1. It can also be seen that the landholder's profit is maximised $Z_2 = 86.0.2$ at a similar value of $p_s = 1.001$ (see Figure 3.2). These both occur after the number of sheep stocked drops (Figure 3.3) and kangaroo immigration starts to increase (Figure 3.4) due to the reduced density on the property. This reduced density on the property allows the landholder to harvest the "free" kangaroos that migrate.

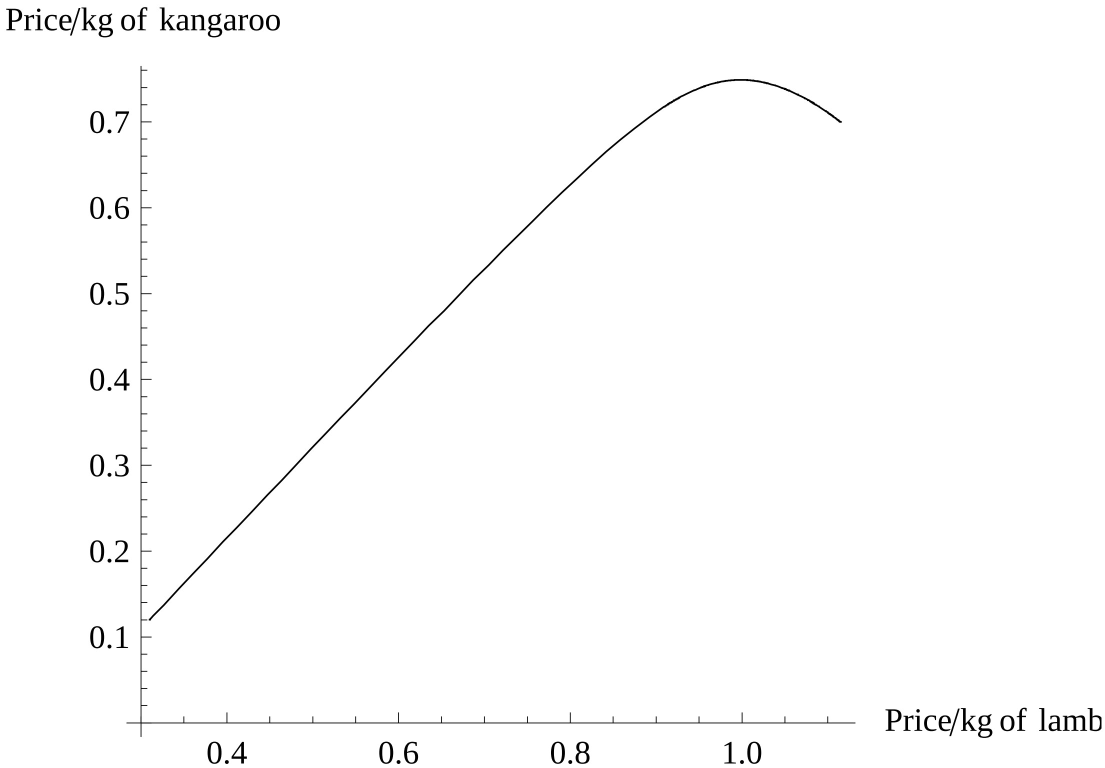


Figure 3.1: The optimal price for kangaroo meat, p_k, dependent on the price of sheep meat, p_s, using the cooperative model.

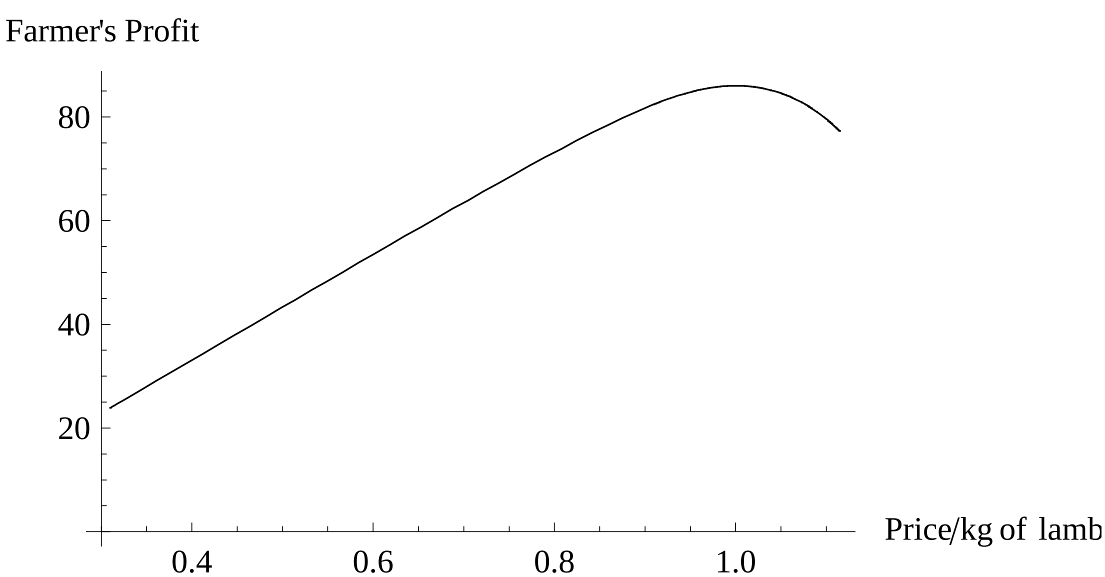


Figure 3.2: The optimal profit for the landholder, Z_2, dependent on the price of sheep meat, p_s, using the cooperative model.

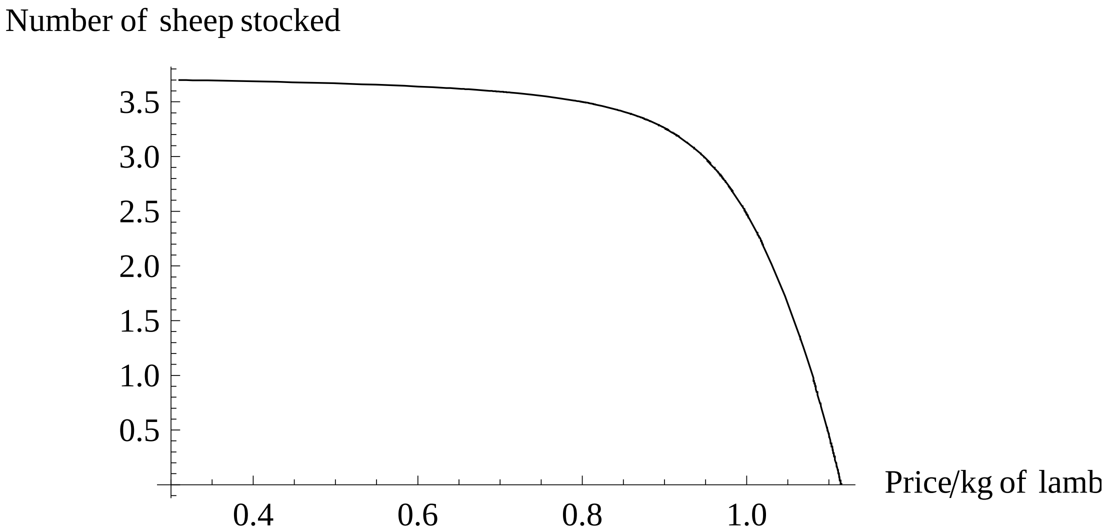


Figure 3.3: The optimal sheep stocking rate, N_s^*, dependent on the price of sheep meat, p_s, using the cooperative model.

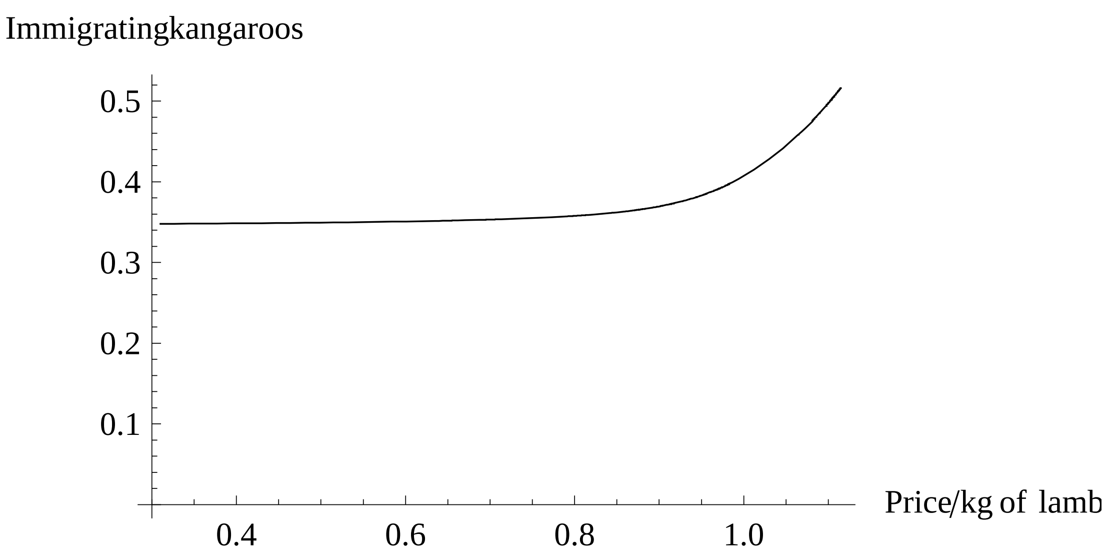


Figure 3.4: The number of kangaroos that immigrate dependent on the price of sheep meat, p_s, when the cooperative model is optimised.

3.4.2 Sensitivity Analysis

We investigate the effects of parameters ϕ and $\tau^{\dagger}$, two parameters related to the landholder's model. The reason for choosing these parameters in particular is due to the uncertain nature of the migration rate, $\tau^{\dagger}$ and the impact of changing the stocking density on the property compared to the outside environment could have important consequences for landholders. All parameters are fixed as in the previous examples ($p_s = 0.8$)but we allow ϕ and $\tau^{\dagger}$ to vary. Results of these sensitivity analyses are summarised in Figures 3.5 to 3.8. It can be seen that, as the comparative density, ϕ, has a positive relationship with the optimal price of kangaroo, p_k^* in Figure 3.5, landholder's profit, Z_2^* in Figure 3.6, the sheep stocking rate, N_s^* in Figure 3.7, and not surprisingly the migration numbers, Figure 3.8. Therefore, by controlling their own total grazing pressure with the domesticated animals and harvesting regime of the free-roaming stock, and making their land more desirable for kangaroos to immigrate it could actually improve their financial position.

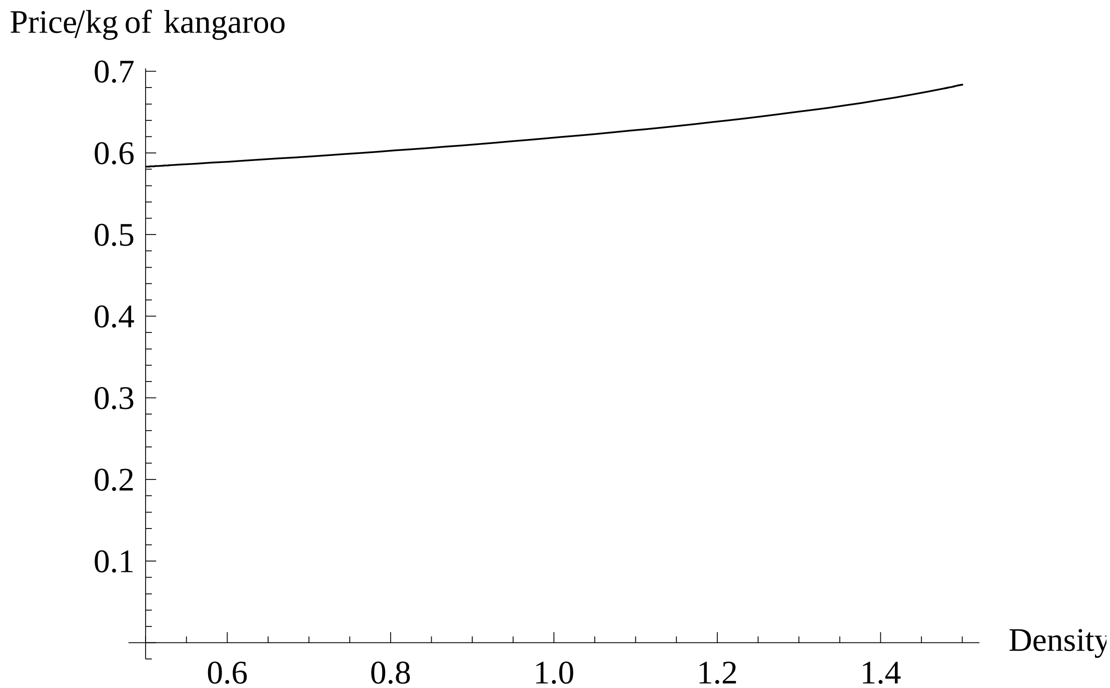


Figure 3.5: The optimal price for kangaroo meat, p_k, dependent on the comparative density of kangaroos, ϕ, using the cooperative model.

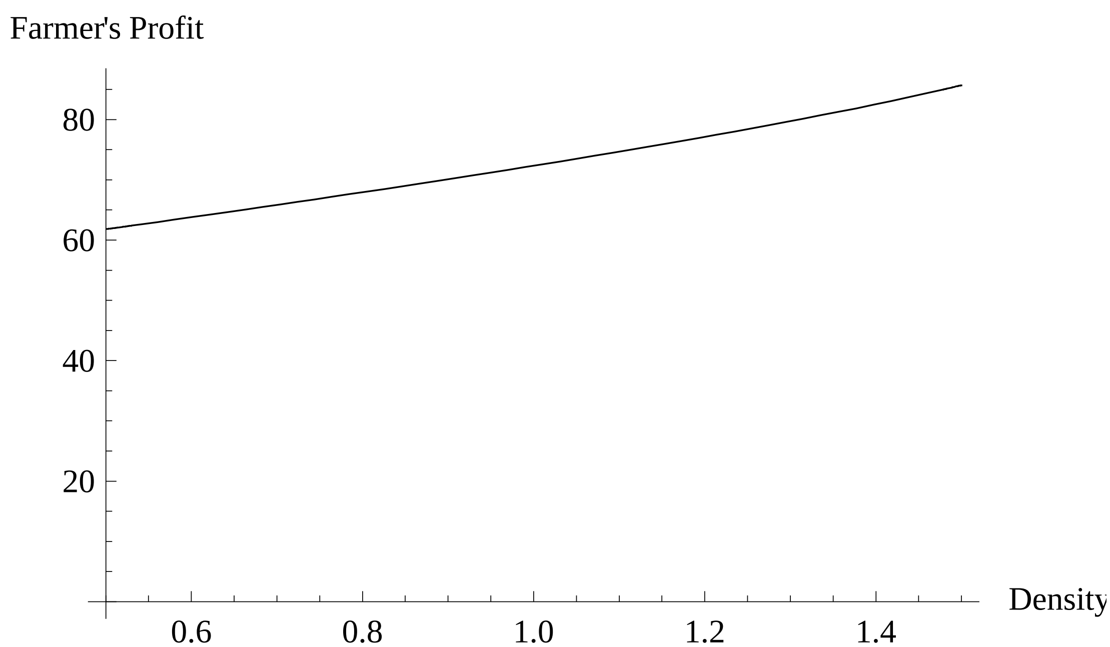


Figure 3.6: The optimal profit for the landholder, Z_2, dependent on the comparative density of kangaroos, ϕ, using the cooperative model.

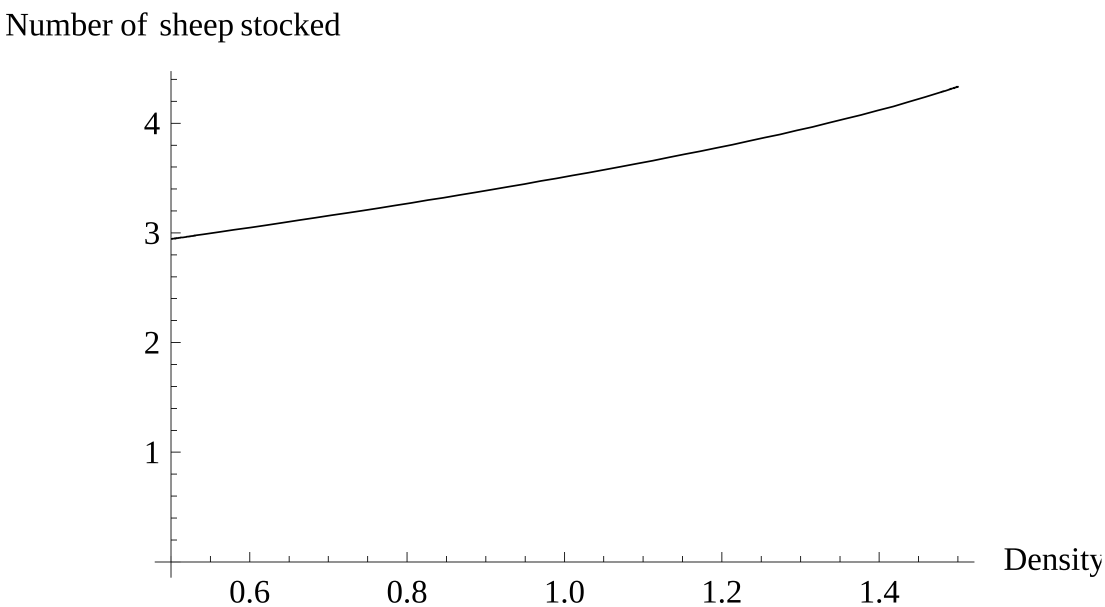


Figure 3.7: The optimal sheep stocking rate, N_s^*, dependent on the comparative density of kangaroos, ϕ, using the cooperative model.

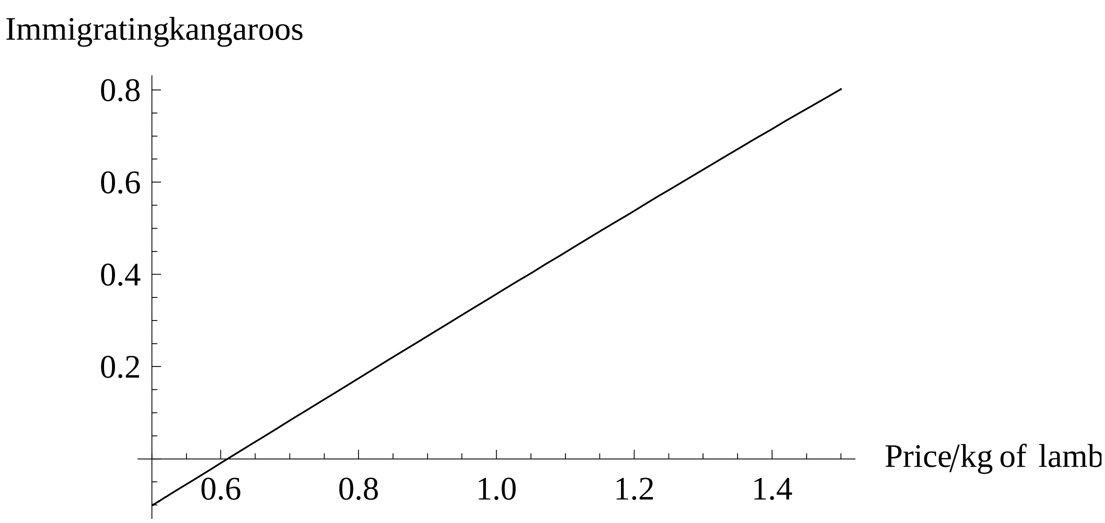


Figure 3.8: The number of kangaroos that immigrate dependent on the comparative density of kangaroos, ϕ, when the cooperative model is optimised.

Finally, the effect of the migration parameter β on results for the cooperative model is investigated. Varying this parameter from $\tau^{\dagger} = 0$ to $\tau^{\dagger} = 0.125$ changes the kangaroo immigration significantly, from 0 to 1.184, compared to the standing stocking rate of 7.690 and 7.297 respectively. Consequently the landholder's profit, Z_2^*, increased by 2.4%, due to a 10.8% increased harvesting rate for kangaroos, γ_k, paired with a 5.1% decrease in the kangaroo stocking rate N_k. However, the effect on the other variables is negligible, generally changing the no migration result by less than 1.8%. Hence, while this term may not be known, the accuracy of this term will have a minimal impact on the optimal solution.

Chapter 4

Plant-Herbivore Modelling

Allocating forage to different species is only possible if population size of each species can be controlled. Otherwise competitive exclusion and migration could override the allocations. The effect of kangaroos (a mobile species that can cross boundaries and cannot always be explicitly controlled) needs to be explored. Landholders have concerns that kangaroos negatively impact their operation through foraging on their properties (Pople and Grigg, 1999; Grigg, 2002). However, unique opportunities and challenges present themselves if the landholder is willing to diversify their commodities. Issues related to population dynamics on and between properties and regions is the focus of this chapter. What is the effect of a species that can circumvent property boundaries and do not belong to the landholder? Can decisions taken by the property managers (at least theoretically) control both native and domestic stock? How will neighbour's management goals affect each other? In this section theoretical models are used to explore these questions.

The initial models deal only with herbivores. It is used to investigate different harvest regimes, the effect of mobile herbivores, national parks and neighbouring commercial properties. These models can help explain some of the dynamics is the system, laying the foundation for the plant-herbivore system. The models are then expanded to include vegetation and it's affect on the system. When modelling a plant-herbivore system the type of model used will affect the results and therefore conclusions. For ease of comparison between species dry sheep equivalents will be used to measure the population of each herbivore. The models are for a square kilometre of semi-arid grazing land. The models use differential models with both continuous time and population, on an average km^2 representative of the system.

The notation and definition to be used in the plant-herbivore models is collated in Table 4.1.

Notation	Definition
S	The set of animal species use in the models.
$c,\ k,\ s$	The notation for cattle, kangaroo, sheep and total standing dry matter respectively.
N_i	The population of species $i \in S$ in dse/km^2.
V	The amount of vegetation, the total standing dry matter in kg/km^2.
ν_i	The maximal growth rate of species $i \in S$.
υ	The initial regrowth rate of the total standing dry matter.
γ_i	The harvest rate for this species.
η_i	The minimum population level before harvesting occurs for the species.
ς	The constant that converts harvest rate from the no minimum population limit case to the limit case.
κ	The carrying capacity of herbivores or total standing dry matter per km^2.
ϕ	The proportion of the carrying capacity used in the region surrounding the property.
τ	The parameter controlling the speed at which kangaroos transfer between regions.
ζ_i	The saturation rate of grazing for herbivores in $kg/dse/year$.
θ	The half-saturation constant (amount of available vegetation where herbivores intake is halved) kg/km^2.
ξ	The vegetation to herbivore conversation rate in dse/kg.
χ	The zero population growth herbivore consumption rate in $kg/dse/year$.

Table 4.1: Symbols used in the herbivore model.

4.1 Modelling a Herbivore Population

Consider a herbivore population whose growth rate is affected by the carrying capacity of the region in which they inhabit. An initial logistic model is constructed to model the population of a herbivore. Obviously the population is limited by factors such as area and availability of forage and water. Movement of herbivores to and from the region will be considered. As well as this, several harvesting regimes will be analysed.

4.1.1 A Herbivore in Isolation

It is widely known (Clark, 1990) that given the formulation for the change in population as

$$\frac{\mathrm{d}N}{\mathrm{d}t} = \nu N \left(1 - \frac{N}{\kappa}\right) - H(N) \tag{4.1}$$

where, H is the amount harvested, then the maximum sustainable yield (MSY) will be achieved when

$$N = \frac{\kappa}{2} \tag{4.2}$$

Typically the harvest is either a constant ($H_1(N) = h$) or a proportion of current population ($H_2(N) = \gamma N$). In this section these two options as well as a third option are explored. The third option (H_3) reflects that under certain conditions it is not viable for harvesters to seek kangaroos, one of the herbivores of interest (see Equation 4.3). Benefits of the H_3 formulation for harvesting are; that it reverts to equilibrium quicker after perturbation (i.e. it is more stable) than H_1 or H_2 as shown later; and that the likelihood of local extinction is reduced, as below the threshold, no harvesting takes place (Maynard Smith, 1974; McNair, 1986), effectively providing a refuge for the herbivores. Given that the government control harvesting it is an important consideration, as it is within the governments power to halt macropod harvesting (Office of the Queensland Parliamentary Counsel, 2010).

$$H_3(N) = \gamma^{\dagger} \max\{N - \eta, 0\} \tag{4.3}$$

The harvest formulation from Equation 4.3 retains the property that the MSY occurs at half the carrying capacity when γ is chosen as to maximise the sustainable yield and $0 < \eta < \frac{\kappa}{2}$ (see Appendix A.1). At this point it is noted that the optimal harvests (assuming $N > \eta$) are equal for all three regimes and that an arbitrary choice for $\gamma^{\dagger}$. Let $\gamma^{\dagger *} = \varsigma\gamma^{*}$, where $\varsigma \geq 1$ is an arbitrary scaling parameter, then with the previous sentence,

$$\begin{aligned}
H_2^*(N^*) &= H_3^*(N^*) \\
\gamma^* N^* &= \gamma^{\dagger *}(N^* - \eta^*) \\
\gamma^* N^* &= \varsigma\gamma^*(N^* - \eta^*) \\
\eta^* &= N^* \frac{\varsigma - 1}{\varsigma} \qquad (4.4)
\end{aligned}$$

inferring that $\gamma^{\dagger *}$ and η^* would be an optimal harvesting regime under H_3, given γ^* is the optimal value under harvesting regime H_2. When $\varsigma = 1$ then the variable harvesting regimes are equivalent ($H_2 = H_3$). In general, the effect of ς is to control the speed at which the system is returned to equilibrium. The larger ς the steeper the return gradient. However, in practice, if ς is too large it can cause instability as it can be prone to "overshooting" the equilibrium. The values

Harvest equation	N^*	H^*	γ^*	η^*	Effect of perturbation of ε from N^*
h (constant)	$\frac{\kappa}{2}$	$\frac{\kappa\nu}{4}$			$-\frac{\nu\varepsilon^2}{\kappa}$
γN	$\frac{\kappa}{2}$	$\frac{\kappa\nu}{4}$	$\frac{\nu}{2}$		$-\frac{\nu\varepsilon(\kappa+2\varepsilon)}{2\kappa}$
$\gamma \max\{N-\eta, 0\}$	$\frac{\kappa}{2}$	$\frac{\kappa\nu}{4}$	$\frac{\nu\varsigma}{2}$	$\frac{\kappa(\varsigma-1)}{2\varsigma}$	$\frac{\nu(\kappa^2-4\varepsilon^2-2\kappa\varsigma\max\{0,\varepsilon+\frac{\kappa}{2\varsigma}\})}{4\kappa}$

Table 4.2: Maximum sustainable yield properties for the three different harvesting regimes.

H^*, γ^* and η^* that maximise the different harvest equations are given below in Table 4.2.

Looking at the linearisation of each differential equation it is clear that the variable harvesting regimes are stable to perturbation (ε) from the equilibrium, as long as $\varepsilon > -\frac{\kappa}{2}$. The constant harvesting regime is only stable if $\varepsilon > 0$. Furthermore, it can be shown that harvesting of the form in Equation 4.3 reverts back to the equilibrium quicker than the proportional harvest regime, which is in turn quicker than the constant harvest regime (when it is stable). Figure 4.1 illustrates this point clearly.

The value of ς will directly affect the speed at which the population returns to equilibrium. The larger ς, the quicker it takes to regain equilibrium (as shown in Figure 4.1). However, if ς is too large, then there is a possibility that the system will fluctuate if the carrying capacity was to vary. From this point forward the constant harvesting regime will be ignored, due to its instability to perturbations. It is also clear that $H_2(N) \equiv H_3(N)$ when $\varsigma = 1$, hence, effectively $H(N) =$

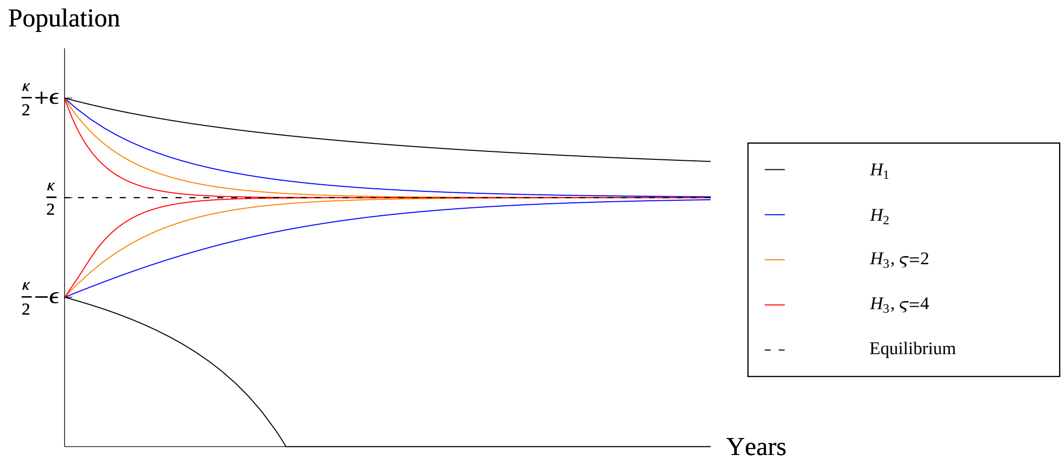


Figure 4.1: An illustration of the affect of perturbing the system above and below the equilibrium level, under the three different harvesting regimes and two different values of ς (2 and 4).

$H_3(N)$ hereafter.

4.1.2 Defining Herbivore Migration

As mentioned previously (Section 1.2.1) kangaroos can move freely between private property, national parks and other areas. For the purposes of the thesis, the movement from one region to another will be referred to as migration. The ability to migrate between property boundaries requires the addition of an extra term in the population rate of change of kangaroos. It has been noted that the primary influence on kangaroo density in a spatial context is food availability (McAlpine *et al.*, 1999; Fukuda *et al.*, 2009). Assume that the theory of ideal free distribution (IFD) (Fretwell and Lucas Jr., 1969) holds in this scenario. The *IFD* implies that animals will move between areas so that the ratio of animals to carrying capacity in each area will be equal. Works by Coulson (2009); Wiggins *et al.*

(2010) concluded that the macropods in their study tended to follow the IFD. For the purposes of the thesis the net movement will be referred to as migration, even though it may not be strictly migratory behaviour. The equation for the migration of kangaroos to the property and external areas would take the form,

$$\text{Migration} = \frac{1}{\tau}\frac{\kappa N_{\text{ext}} - \kappa_{\text{ext}} N}{\kappa + \kappa_{\text{ext}}} \tag{4.5}$$

where τ controls the speed at which the population moves between regions, N_{ext} and κ_{ext} are the population and carrying capacity for external areas respectively (see Appendix A.2 for a proof of this equation).

4.1.3 A Herbivore on a Property Bounded by a National Park

For the sake of simplicity the first scenario considered is where the kangaroo population external to the property is very large (say a large national park or other unharvested kangaroo population) and therefore the actions of an individual property owner does not affect the external population. In effect it can be considered that the external carrying capacity is infinite and that the ratio of kangaroos to carrying capacity is $\phi \left(= \dfrac{N_{\text{ext}}}{\kappa_{\text{ext}}}\right)$. Hence, Equation 4.5 becomes,

$$\begin{aligned}
\lim_{\kappa_{\text{ext}}\to\infty} \text{Migration} &= \lim_{\kappa_{\text{ext}}\to\infty} \frac{1}{\tau}\frac{\kappa N_{\text{ext}} - \kappa_{\text{ext}} N}{\kappa + \kappa_{\text{ext}}} \\
&= \lim_{\kappa_{\text{ext}}\to\infty} \frac{1}{\tau}\frac{\kappa\dfrac{N_{\text{ext}}}{\kappa_{\text{ext}}} - \dfrac{\kappa_{\text{ext}}}{\kappa_{\text{ext}}}N}{\dfrac{\kappa}{\kappa_{\text{ext}}} + \dfrac{\kappa_{\text{ext}}}{\kappa_{\text{ext}}}} \\
&= \lim_{\kappa_{\text{ext}}\to\infty} \frac{1}{\tau}\frac{\phi\kappa - N}{\dfrac{\kappa}{\kappa_{\text{ext}}} + 1} \\
&= \frac{\phi\kappa - N}{\tau}
\end{aligned} \tag{4.6}$$

Therefore combining Equations 4.1, and 4.6 results in,

$$\frac{\mathrm{d}N}{\mathrm{d}t} = \nu N\left(1 - \frac{N}{\kappa}\right) - H(N) + \frac{\phi\kappa - N}{\tau} \tag{4.7}$$

The solutions that maximises harvest in the scenario described by Equation 4.7 result in the following MSY,

$$H^* = \begin{cases} \dfrac{\kappa\phi}{\tau} & ,\nu\tau \leq 1 \\ \dfrac{\kappa(1 + \nu^2\tau^2 + 2\nu\tau(2\phi - 1))}{4\nu\tau^2} & ,\nu\tau > 1 \end{cases} \tag{4.8}$$

The condition $\nu\tau \leq 1$ can be interpreted as when the intrinsic growth is less than or equal to the fraction of herbivores that migrate. That implies that local population is dominated by the external population. Hence, the harvest rate is the quantity of herbivores that would migrate given no herbivores on the property. Therefore, the landholder's best option is to de-stock completely and concentrate purely on harvesting, allowing as many herbivores to migrate as possible. This scenario is highly unlikely to be the case in reality. The other part of the equation is when the intrinsic growth rate is greater than the fraction of herbivore migration.

Focussing on $\nu\tau > 1$ it can again be shown that the harvest regime is stable when $\varepsilon > -\frac{\kappa}{2}$. The equilibrium point for the harvesting regime is,

$$N^* = \begin{cases} \dfrac{\kappa(\nu\tau - 1)}{2\nu\tau} & , \nu\tau > 1 \\ 0 & , \nu\tau \leq 1 \end{cases} \tag{4.9}$$

The optimal harvest rate and minimum harvest level for the variable harvest regimes are,

$$\gamma^* = \frac{1 + \nu^2\tau^2 + 2\nu\tau(2\phi - 1)}{2\tau(\nu\tau - 1)} \tag{4.10}$$

$$\eta^* = \frac{\kappa(\nu\tau - 1)(\varsigma - 1)}{2\nu\tau\varsigma} \tag{4.11}$$

It should be noted that when infinite migration is included, the optimal harvesting solution (when $\nu\tau > 1$) results in the stocking level N^* to be greater than when the property is considered to be isolated. This fact is easily verified given,

$$\frac{\kappa(\nu\tau - 1)}{2\nu\tau} = \frac{\kappa}{2} - \frac{\kappa}{2\nu\tau} < \frac{\kappa}{2}$$

which shows that the difference in stocking rate under infinite migration is $\dfrac{\kappa}{2\nu\tau}$ lower than under isolation. As τ (and hence $\nu\tau$) increases, the optimal harvest and optimal herbivore population under infinite migration tend towards their respective solutions under isolation (Equations 4.12 and 4.13). These ideas are represented visually in Figure 4.2.

$$\lim_{\tau\to\infty} \frac{\kappa(1+\nu^2\tau^2+2\nu\tau(2\phi-1))}{4\nu\tau^2} = \frac{\kappa\nu^2\tau^2}{4\nu\tau^2} = \frac{\kappa\nu}{4} \tag{4.12}$$

$$\lim_{\tau\to\infty} \frac{\kappa(\nu\tau-1)}{2\nu\tau} = \frac{\kappa\nu\tau}{2\nu\tau} = \frac{\kappa}{2} \tag{4.13}$$

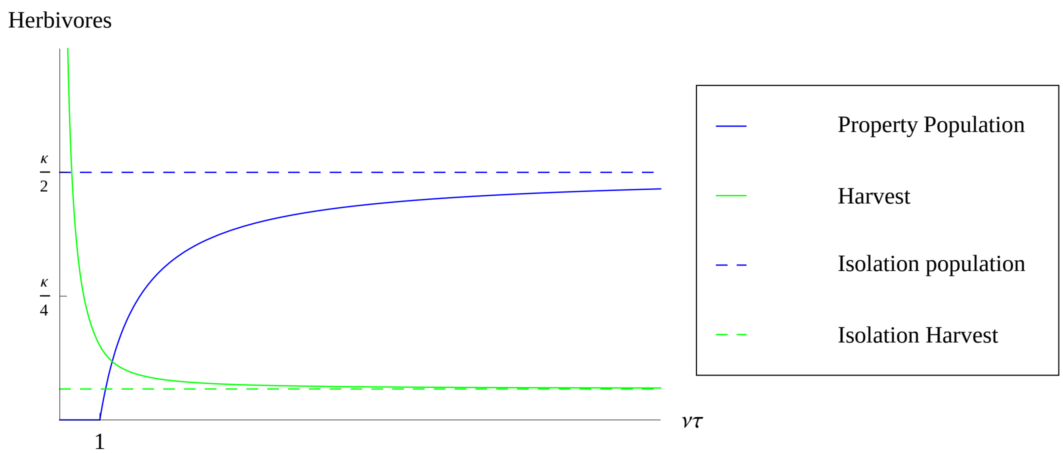


Figure 4.2: The optimal herbivore population and harvest rate under the migration from an infinite external population is compared to the optimal herbivore population and harvest rate under isolation (no migration).

Furthermore, it can be shown that, whilst

$$\phi > \frac{2\nu\tau-1}{4\nu\tau}$$

the optimal harvest is larger during infinite migration compared to no migration. This is an extreme case, where the external world has effectively infinite population willing to migrate to the property. This is realistic for a property that is relatively small compared to a large national park on its boundary.

4.1.4 A Herbivore on Two Properties with Common Boundary

The next scenario involves two properties with porous borders. Of interest is the impact that the properties can have on each other. Assume that Property 1 uses an optimal harvest regime at all times. Can the management regime of Property 2 have a detrimental effect, intentional or not, on the other property? If it does, then resistance to change may increase. The first Property 2 regime analysed is a constant stocking rate. That will give the equation of interest as follows,

$$\frac{\mathrm{d}N_1}{\mathrm{d}t} = \nu N_1 \left(1 - \frac{N_1}{\kappa}\right) - H(N_1) + \frac{N_2 - N_1}{2\tau} \tag{4.14}$$

The solution to the optimisation of $H(N_1)$ and N_1^* are given in Equations 4.15 and 4.16, while the harvest parameters under the variable harvest regimes are in given in Equations 4.17 and 4.18. Similar to Section 4.1.3, when the herbivores that migrate dominate the internal growth on Property 1 ($2\nu\tau \leq 1$) then the individuals that migrate are harvested $\left(\frac{N_2}{2\tau}\right)$. If that were the case then Property 1's harvest would rely purely on Property 2's stocking level. For the rest of this section it is assumed that $2\nu\tau > 1$.

$$H^* = \begin{cases} \dfrac{\kappa(2\nu\tau - 1)^2 + 8\nu\tau N_2}{16\nu\tau^2} & , 2\nu\tau > 1 \\ \dfrac{N_2}{2\tau} & , 2\nu\tau \leq 1 \end{cases} \tag{4.15}$$

$$N_1^* = \frac{\kappa(2\nu\tau - 1)}{4\nu\tau} \tag{4.16}$$

$$\gamma_1^* = \frac{\kappa(2\nu\tau - 1)^2 + 8\nu\tau N_2}{4\kappa\tau(2\nu\tau - 1)} \tag{4.17}$$

$$\eta^* = \frac{\kappa(2\nu\tau - 1)(\varsigma_1 - 1)}{4\nu\tau\varsigma} \tag{4.18}$$

The equilibrium points are stable for variable harvest regimes. The partial derivative of the growth rate is negative, when the equilibrium solutions are substituted in (Equation 4.19). Equation 4.19 clearly shows that as ς increases the system returns to equilibrium faster.

$$\frac{\partial}{\partial N_1}\left(\frac{\mathrm{d}N_1}{\mathrm{d}t}\right)\Bigg|_{N_1 = N_1^*} = -\frac{\varsigma}{4}\left(\nu\left(\frac{8N_2}{\kappa(2\nu\tau - 1)} + 2\right) - \frac{1}{\tau}\right) \tag{4.19}$$

From Equation 4.16 it is clear that the optimal stocking level for Property 1 does not depend on Property 2's stocking level. Therefore Property 1 should maintain the same population of herbivores, only altering their harvesting parameters as Property 2 changes their herbivore population. It can also be seen that as in Section 4.1.3 the optimal stocking level under migration is smaller than if the property was isolated. While the N_1^* maybe less than N^*, the harvest is greater, given that Property 2 does not reduce their stocking level below $\dfrac{\kappa}{2} - \dfrac{\kappa}{8\nu\tau}$ (see Appendix A.3 for proof). This can be interpreted as, whilst Property 2 has a population of herbivores close to or above half the carrying capacity

$\left(N_2 \geq \frac{\kappa}{2} - \frac{\kappa}{8\nu\tau}\right)$ then Property 1 can attract herbivores over the porous borders. Even though Property 1 herbivore level is constant $\left(N_1^* = \frac{\kappa}{2} - \frac{\kappa}{4\nu\tau}\right)$ their harvest will increase as Property 2 increases its herbivore population.

So far in this section only a constant herbivore population on Property 2 has been investigated, implicitly assuming their management regime could maintain that population and they had no interest in maximising their own harvest. The next scenario is where both properties are dynamically linked. Hence, the equations governing the system are Equation 4.14 and 4.20,

$$\frac{\mathrm{d}N_2}{\mathrm{d}t} = \nu N_2 \left(1 - \frac{N_2}{\kappa}\right) - H(N_2) - \frac{N_2 - N_1}{2\tau} \tag{4.20}$$

Assume that the land holder of Property 1 knows what is happening on Property 2 and vice-versa (perfect information in Game Theory parlance). The harvest on Property 1 while at equilibrium results in the following harvest,

$$H(N_1) = \frac{\kappa N_2 - 2\nu\tau N_1^2 + \kappa N_1(2\nu\tau - 1)}{2\kappa\tau} \tag{4.21}$$

given one of the following conditions hold,

$$N_1 = N_2 \text{ or } \left(0 < N_j < N_i < \kappa \text{ and } \nu > \frac{\kappa(N_i - N_j)}{2\tau N_i(\kappa - N_i)}\right), i, j = 1, 2\, , i \neq j \tag{4.22}$$

This leaves us with two scenarios, either the properties regimes are equivalent (cooperation) or one property has a smaller stocking level (competition). If the regimes are equal, then it is clear that,

$$H(N_1) = \frac{\nu N_1(\kappa - N_1)}{\kappa}\,, N_1 = N_2 \tag{4.23}$$

which, when optimised *w.r.t.* N_1, gives,

$$H(N_1^*) = \frac{\nu\kappa}{4} \tag{4.24}$$

$$N_1^* = \frac{\kappa}{2} \tag{4.25}$$

$$\gamma_1^* = \frac{\nu}{2} \tag{4.26}$$

$$\eta_1^* = \frac{\kappa(\varsigma - 1)}{2\varsigma} \tag{4.27}$$

Obviously an analogous result holds for Property 2. It should be noted that this MSY, population and regime parameters are the same as the isolation case from Section 4.1.1. This is to be expected, as when both properties are using identical regimes, there will be no net migration, so in effect it would be as if they were in isolation. If the properties do not set their populations to be equal then Property 1 would maintain their herbivore population at the level suggested in Equation 4.16. Substituting this into Equation 4.20 then Property 2's harvest rate is given by

$$H(N_2) = \frac{\kappa(2\nu\tau - 1)}{8\nu\tau^2} + N_2\left(\nu - \frac{1}{2\tau}\right) - \frac{\nu N_2^2}{\kappa} \tag{4.28}$$

It can be shown that Equation 4.28 is non-negative whilst

$$N_2 \leq \frac{\kappa}{2} + \frac{\kappa(\sqrt{4\nu^2\tau^2 - 1} - 1)}{4\nu\tau} \tag{4.29}$$

and therefore this condition limits the stable population on Property 2 whilst Property 1 is using their competitive strategy. If N_2 is greater than the upper limit of Equation 4.29 the herbivores are migrating quicker than they are being born. If Property 1 is using their optimal competitive strategy, maximising Equation 4.28 *w.r.t.* N_2 gives Property 2's optimal competition strategy,

$$H(N_2^*) = \frac{\nu\kappa}{4} - \frac{\kappa}{16\nu\tau^2} \tag{4.30}$$

$$N_2^* = \frac{\kappa(2\nu\tau - 1)}{4\nu\tau} \tag{4.31}$$

Under competition it is clear from Equation 4.30 that Property 2 has a reduced harvest when compared to the cooperative case. Furthermore, as shown in Appendix A.3 if Property 2's uses $N_2 = N_2^*$ then Property 1's harvest will also be inferior to the equal density case. Moreover, it can be shown that $N_1 = N_2 = N_2^*$ is a Nash Equilibrium Point (*NEP*) for the competitive game (Appendix A.4). Hence, the properties co-operating and maintaining equivalent herbivore populations produces the optimal strategy. The effect of cooperative and competitive strategies (where Property 2 acts first) are illustrated in Figure 4.3. Their individual harvests will be greater than if they try and compete with each other. In effect, with competition they are both trying to entice herbivore immigration whilst deterring emigration resulting in lower herbivore populations and harvests. Ironically, the populations and harvests are equal to each other, but lower than under cooperation. As would be expected, as the amount of migration decreases to approach no migration ($\tau \to \infty$) the competitive solutions approach the cooperative (and therefore isolation) solution.

Alternatively, it could be thought of as one property and the decision is

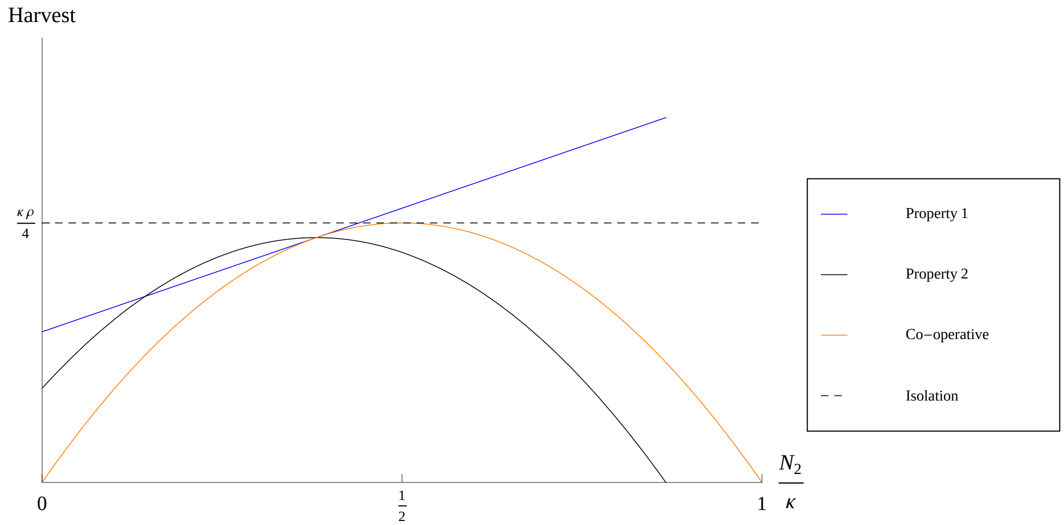


Figure 4.3: The harvest rates for Property 1 and 2 under competition as well as cooperative as Property 2 changes their herbivore population. The optimal harvest rate under isolation is included for comparison.

whether to have one large paddock (cooperative case) or two smaller paddocks with different herbivore populations (competitive case). The combined harvest rate for the separate paddocks, each with carrying capacity κ, is the sum of Equations 4.15 and 4.30 resulting in Equation 4.32. The single large paddock harvest rate will just be double that of Equation 4.24. Here N represents the herbivore population with regards to a second separate paddock and half the single large paddock, akin to Property 2. The harvest rate for the single paddock is larger when $\dfrac{\kappa(2\nu\tau - 1)}{4\nu\tau} < N < \dfrac{\kappa(2\nu\tau + 1)}{4\nu\tau}$. Since both arrangements maximise when $N = \dfrac{\kappa}{2}$, which is inside the interval, the single large paddock is superior (as illustrated in Figure 4.4).

$$\text{Combined paddock harvest} = \frac{\nu\kappa}{4} - \frac{\kappa}{16\nu\tau^2} + \nu N - \frac{\nu N^2}{\kappa} \tag{4.32}$$

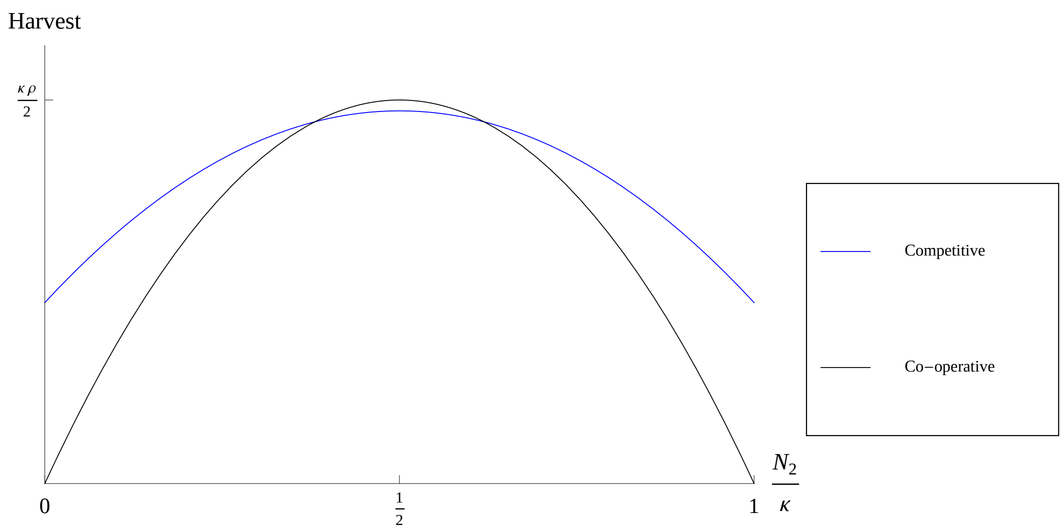


Figure 4.4: The harvest rates for combined separate (competitive) paddocks and the single large paddock (cooperative).

4.2 Modelling Two or More Herbivore Populations

Consider two or more herbivore populations whose growth rates are affected by the carrying capacity of the region in which they inhabit. The resources that limit the carrying capacity are now utilised by each herbivore in competition or facilitation. As particular interest is in the interaction between cattle, sheep and kangaroos on a commercial property, the herbivores are measured in the standardised units *dse* as typically used in Australia. The growth components of each differential equation take the form of the well known competitive Lotka-Volterra equations. The harvesting regimes are the same as those used in Section 4.1.2, with harvesting occurring only when the given population is above a predetermined mark. These considerations result in the following differential equation to be used for each herbivores population growth;

$$\frac{\mathrm{d}N_i}{\mathrm{d}t} = \nu_i N_i \left(1 - \frac{\sum_{j \in S} N_j}{\kappa}\right) - \gamma \max\{N_i - \eta_i, 0\} + \text{Migration Rate}_i \tag{4.33}$$

where the migration rate is set to zero when migration is not possible. That formulation (Equation 4.33) implies that we are considering a scenario where there are no niches. Gause's exclusion principle or the principle of competitive exclusion states that species occupying the same niche cannot coexist (Gause, 1934; Hardin, 1960). However, more recent ideas have called this "Law of Ecology" into doubt, allowing for species co-existence without niche separation (Rastetter and Ågren, 2002).

With different species in the model, the task of maximising becomes more difficult. In particular, what are we going to maximise, the total number of *dse*, the weight harvested, or the revenue created? These questions are better answered in Chapters 2 and 6. Suffice to say, that without a migratory herbivore, analytically the two herbivores interact similarly, with analogous solutions. In turn, which ever metric is optimised, you could think of it as allocating a proportion of the available total standing dry matter to each herbivore.

If the idea of allocating a proportion of the available forage to each given species is possible, then the species need to be able to co-exist. Hence, it needs to be shown that the species can co-exist in predetermined proportions, with and without the influence of migration.

4.2.1 Two or More Herbivores in Isolation

This scenario examines a property, with two or more herbivore species grazing on the same plants. The herbivores are restricted to the property, as there is no migration. Please note, as before, the herbivores populations are being measured in *dse*. If each species had the same maximal growth rate (ν_i) then they could be considered as one species for population density purposes. It would then follow that the overall harvest would be optimised in the same way it was optimised in Section 4.1.1. This is due to the fact that under the optimal harvest regime no one species could outgrow another species. The herbivore population size of each herbivore (N_i^*) would be the optimal overall population size (N^*) multiplied by the proportion of carrying capacity allocated to species i, ω_i, where $\sum_{i \in S} \omega_i = 1$. The optimal minimum harvest levels (η_i^*) would also be in the same proportions of η^*. The proportional harvest rates for each species would be identical, γ^*. Hence, the property managers desired allocation could be achieved by setting the minimal harvest levels for each herbivore as such,

$$\eta_i = \omega_i \eta^* \tag{4.34}$$

In reality, it is unlikely that the population dynamics of each species was identical.

In the more realistic case where the maximal growth rates of each herbivore are not equal similar allocations may be possible for either the overall population or the overall harvest. If the desire is to have the overall population proportions allocated via ω_i then Equation 4.34 should still be followed. Due to the different maximal growth rates, the amounts harvested will not be in the same ratio. It is most probably the amount of harvest that is of importance for meat production. To make sure the harvest amounts are in the correct proportions, the fraction of the optimal density and the minimal level for harvesting would be determined by,

$$\omega_i = \frac{\omega_i^\dagger \prod_{j \in S, j \neq i} \nu_j}{\sum_{k \in S} \left(\omega_k^\dagger \prod_{j \in S, j \neq k} \nu_j \right)} \tag{4.35}$$

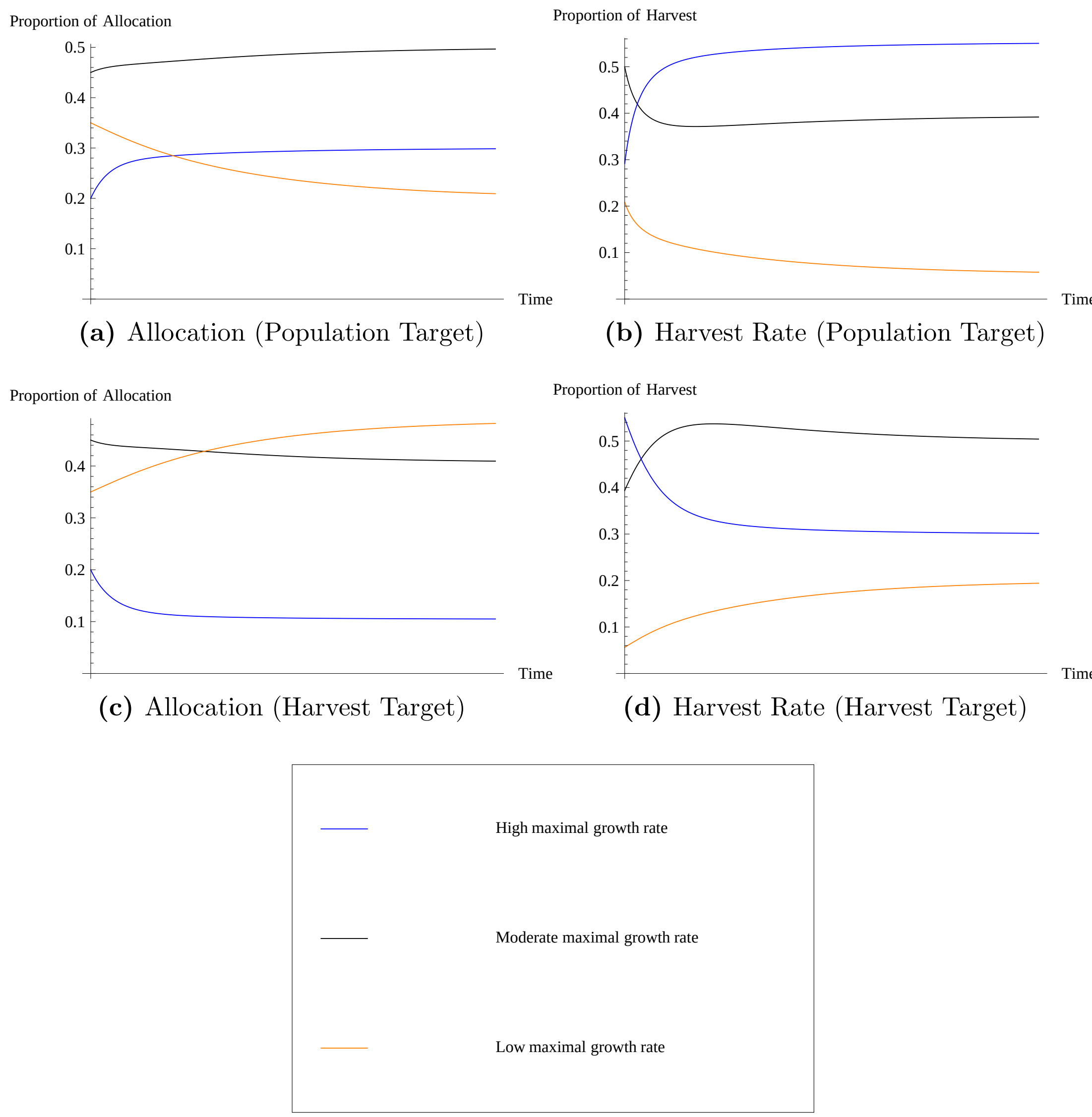
where $\omega_i^\dagger$ is the desired proportion of the overall harvest to come from herbivore group i. This allocation structure maintains the optimal utilisation of the carrying capacity as determined in Section 4.1. Making the following substitutions (Equations 4.36 to 4.38) into Equation 4.33 shows that it is an equilibrium solution and stable.

$$N_i = \frac{\kappa\omega_i}{2} \tag{4.36}$$

$$\gamma_i = \frac{\nu_i\varsigma}{2} \tag{4.37}$$

$$\eta_i = \frac{\kappa(\varsigma - 1)\omega_i}{2\varsigma} \tag{4.38}$$

Therefore, in a closed system, if the desired proportion (either of overall population or of amount harvested) are known, then the solution given above will utilise the carrying capacity optimally. To illustrate this Figure 4.5 shows the affect (over time) on three theoretical herbivore populations. The herbivores represent a collection of species with high, moderate and low maximal growth rates. The equilibrium solutions under the two methods of proportioning give very different results. These differences are most notable between the high and low maximal growth rate herbivores. Note for instance that when the target is the harvest proportions the population of the "low" group is greater than the others (Figure 4.5b), even though it has the lowest harvest proportion (Figure 4.5d) and vice-versa for the "high" group. Please note this is not the same as optimising the revenue, profit or some other objective. It is optimising the amount the system can produce sustainably.



(a) Allocation (Population Target)

(b) Harvest Rate (Population Target)

(c) Allocation (Harvest Target)

(d) Harvest Rate (Harvest Target)

(e) Legend

Figure 4.5: An illustration of the effect of different proportions for the population and harvest over time. The proportions are 0.3, 0.5 and 0.2 for the high, moderate and low maximal growth rate herbivores respectively.

4.2.2 Two or More Herbivores on a Property Bounded by a National Park

Now consider a system where one herbivore can migrate to and from the property and the external world, but others are bounded by the borders of the property. By looking at the scenario of a small property bounded by a large national park the extremes can be analysed. Of particular interest is when the captive herbivores are dominated by the region external to the property. Initially consider the case where there are only two herbivores, the first captive, and the second mobile. The equations governing this system will then be of the form of Equation 4.33 where the migration rates for the two herbivores are,

$$\text{Migration Rate}_1 = 0 \tag{4.39}$$

$$\text{Migration Rate}_2 = \begin{cases} \frac{\phi\kappa-(N_1+N_2}{\tau} & N_2 \geq 0 \text{OR} N_1 \leq \phi\kappa \\ 0 & \text{otherwise} \end{cases} \tag{4.40}$$

respectively. The alteration to the second migration rate from that used in Section 4.1.3 is due to the fact that you cannot have the mobile herbivore leave the property when there are none left on the property. It can then be shown that maximising the sustainable harvest rate of the captive herbivore can be achieved under the following conditions:

1. The mobile herbivore's population on the property is zero and the density of the captive herbivore is equal to the external density.

OR

2. The population of the mobile herbivore is less than the carrying capacity and the harvest rate for the mobile species must be less than the rate at which the mobile species would grow in the absence of the captive species.

AND EITHER

- The external density is greater than the internal density of mobile herbivores AND EITHER the external density is less than one OR the harvest rate of the mobile herbivore is greater than the migration rate would be if the property was at the carrying capacity.

OR

- The external density is one or more AND the harvest rate of the mobile herbivore is greater than the migration rate would be if the property was at the carrying capacity.

OR

- The density of the mobile herbivore on the property is greater than the external density AND the mobile herbivore is harvested.

If first of these conditions are met then the system acts as if there is no migration as internal and external densities are equal. In reality this is unlikely to happen, as the carrying capacity would not be constant, and the herbivores are likely to have different growth rates. Of the second set of conditions the most likely conditions to exist are when the external density is greater than the internal density of mobile herbivores. An external density less than the carrying capacity is plausible, if not expected under normal circumstances. Also a harvest rate for the mobile herbivore being greater than the migration rate when the property is at carrying capacity means that the mobile harvest is high enough to stop the property being dominated by the mobile herbivore. The following is the harvest regime for the optimal captive herbivore harvest.

$$H(N_1^*) = \begin{cases} \nu_1\phi\kappa(1-\phi) & \text{, Condition 1} \\ \dfrac{\nu_1(\gamma_2 N_2\tau + \kappa(1-\phi))\,(\nu N_2^2\tau + N_2\kappa(1+\gamma_2\tau - nu_2\tau) - \kappa^2\phi)}{(\kappa+\nu_2 N_2\tau)^2} & \text{, Condition 2} \end{cases} \tag{4.41}$$

$$N_1^* = \begin{cases} \kappa\phi & \text{, Condition 1} \\ \dfrac{\kappa^2\phi - N_2(\nu_2 N_2\tau + (1+\gamma_2\tau - \nu_2))}{\kappa+\nu_2 N_2\tau} & \text{, Condition 2} \end{cases} \tag{4.42}$$

$$\gamma_1^* = \begin{cases} \nu_1(1-\phi) & \text{, Condition 1} \\ \dfrac{\nu_1(\gamma_2 N_2\tau + \kappa(1-\phi))}{\kappa+\nu_2 N_2\tau} & \text{, Condition 2} \end{cases} \tag{4.43}$$

$$\tag{4.44}$$

The effect of the external density (ϕ) and the speed of migration (τ) are illustrated in Figures 4.6 and 4.7 respectively. It is noted that that internal density is higher than the outside density before the mobile herbivore is not present on the property (Figure 4.6). Also that the captive herbivore declines after the harvest rate of the mobile herbivore equals the migration rate, when the external pressure starts to dominate.

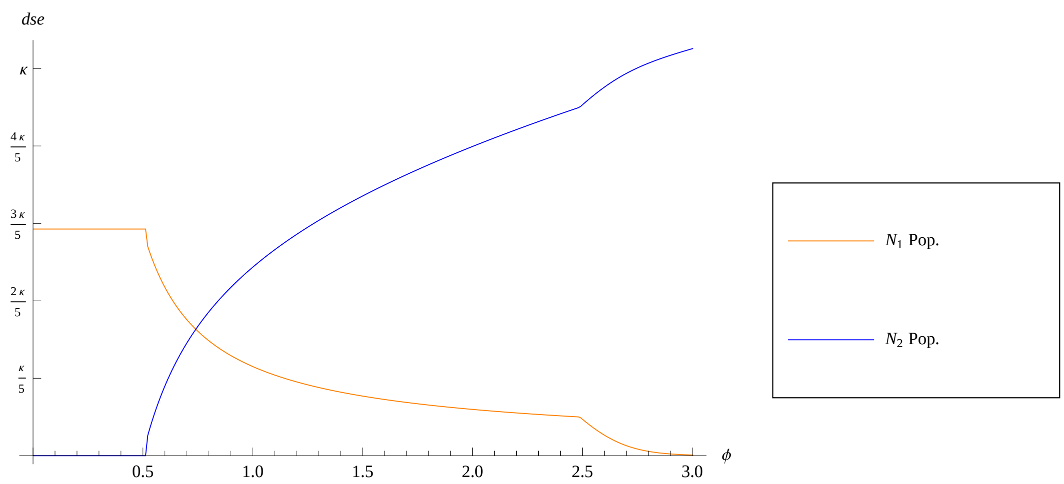


Figure 4.6: The stable populations of two herbivores (the first captive the second mobile) as the density of the external mobile herbivore changes.

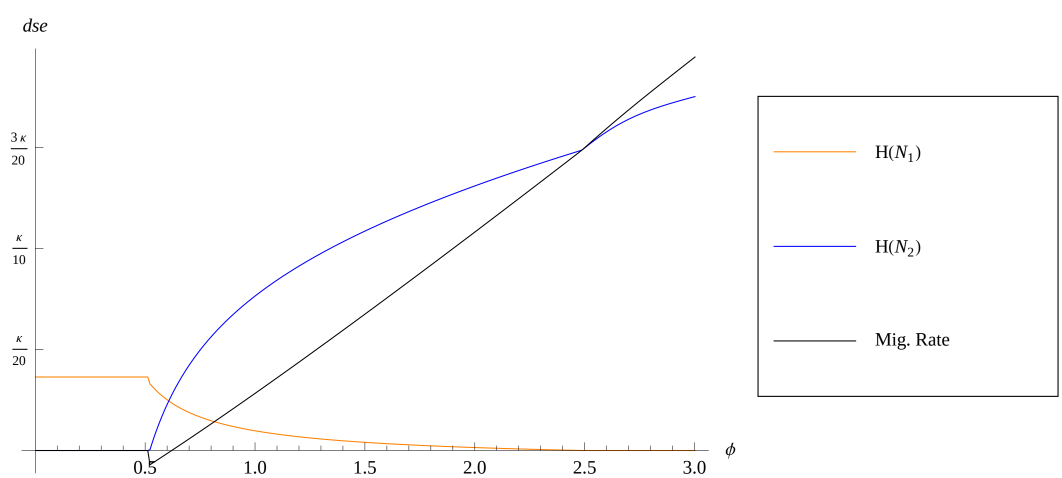


Figure 4.7: The harvest of two herbivores (the first captive the second mobile) and the migration rate, as the density of the external mobile herbivore changes.

4.2.3 Two or More Herbivores on Properties with Common Boundaries

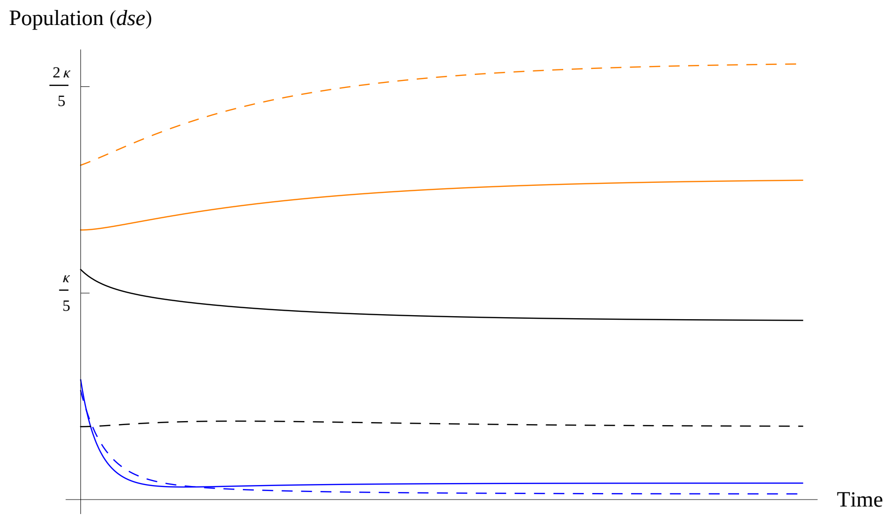
Attention is now turned to the other migration scenario. Consider two properties with common boundaries and three herbivores, only the third of which is mobile. The migration rate of the mobile herbivore onto Property 1 is given by,

$$\text{Migration Rate}_{1,3} = \begin{cases} \dfrac{N_{2,1} + N_{2,2} + N_{2,3} - (N_{1,1} + N_{1,2} + N_{1,3})}{2\tau} & Condition3 \\ 0 & \text{otherwise} \end{cases} \tag{4.45}$$

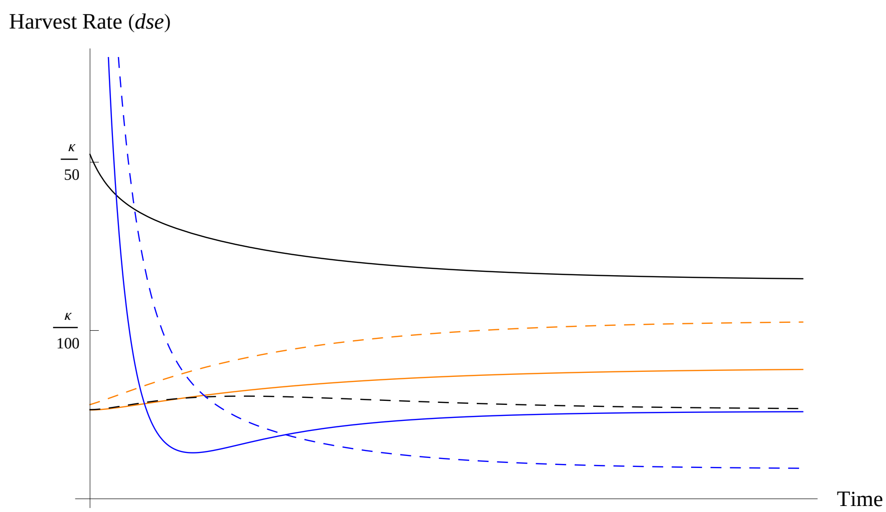
$$Condition3 \equiv N_{j,3} \geq 0 \text{ AND } N_{3-j,1} + N_{3-j,2} + N_{3-j,3} < N_{j,1} + N_{j,2} + N_{j,3}, j \in \{1, 2\}$$

Essentially this only allows emigration from Property 1 only if mobile herbivores are present and immigration to Property 1 if they are present on Property 2. An analogous equation to Equation 4.45 is used for Property 2.

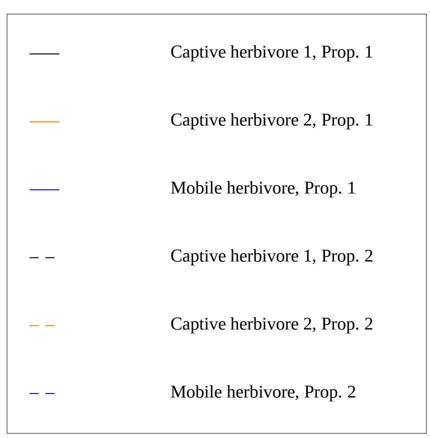
Through similar arguments to Section 4.1.4 the cooperative game arrives at solutions for optimal use of the carrying capacity as the isolation case. Hence, as long as the optimal strategies given in Section 4.2.1 are used, then the property owners can set their own internal proportions of each herbivore species. Therefore, the decisions of which species to stock at which levels will not affect the other property under cooperation. As an illustration, Figure 4.8 shows a scenario where the properties work in cooperation. Using the Equations 4.35, 4.37 and 4.38 the ratio of each herbivore are 5:3:2 and 3:6:1 for Property 1 and 2 respectively. The initial boundary conditions are non-optimal, however, the system is stable, converging to the desired solutions.



(a) Population



(b) Harvest Rate



(c) Legend

Figure 4.8: An illustration of two properties in cooperation stocking three herbivore species. Two are captive and one mobile herbivore are used. Initially the grazing is not optimal, but optimal harvest regimes are used.

4.3 Modelling Vegetation and a Herbivore Population

So far the models have used a constant carrying capacity. However, the number of animals an area can sustain depends (to some degree) on the availability of vegetation. Does having the herbivore population dependent on the available vegetation impact on the previous conclusions? Therefore next models of interest involves herbivores and the available forage or *tsdm*. As discussed in Turchin (2003) and Rockwood (2009), herbivore grazing can follow two standard forms; grazing the whole plant, including roots; or grazing on a plant where part of the plant has refuge, invulnerable to grazing. It can be argued that the grazing on grasses by cattle, sheep and kangaroos falls into the latter category. Therefore, a standard set of equations for modelling the dynamics of a grazing system is an initially linear growth model for the forage (Equation 4.46), with herbivore growth dependent on the availability of forage with a Type II functional response (Equation 4.47). Together these equations are known as the herbivory-regrowth model Turchin (2003).

$$\frac{\mathrm{d}V}{\mathrm{d}t} = \upsilon\left(1 - \frac{V}{\kappa_V}\right) - \frac{\zeta V N}{\theta + V} \tag{4.46}$$

$$\frac{\mathrm{d}N}{\mathrm{d}t} = \xi N\left(\frac{\zeta V}{\theta + V} - \chi\right) \tag{4.47}$$

4.3.1 Vegetation and a Herbivore in Isolation

As in Section 4.1.1 the first scenario considered is where the herbivore is bounded by impermeable fences. Harvesting is included in the variable form ($H_3(N)$)where there is a minimum population level required prior to harvesting commencing. This results in the modification of Equation 4.47 so that it becomes,

$$\frac{\mathrm{d}N}{\mathrm{d}t} = \xi N\left(\frac{\zeta V}{\theta + V} - \chi\right) - \gamma\varsigma \max\{0, N - \eta\} \tag{4.48}$$

Maximising the harvest component whilst Equations 4.46 and 4.48 are set to zero results in an optimal solution to the isolated vegetation-herbivore system. This solution is

$$\begin{aligned}
H(N^*) &= \frac{\xi\upsilon(\kappa\zeta + \theta\chi - \kappa\chi - 2\kappa\varphi_1)}{\kappa\zeta} && (4.49)\\
V^* &= \frac{\theta\chi}{\varphi_1} && (4.50)\\
N^* &= \frac{\upsilon(\theta\zeta + \kappa\varphi_1 - \theta(2\chi + \varphi_1))}{\kappa\zeta\varphi_1} && (4.51)\\
\gamma^* &= \frac{\xi\varphi_1(\kappa\zeta + \theta\chi - \kappa\chi - 2\kappa\varphi_1)}{\theta\zeta + \kappa\varphi_1 - \theta(2\chi + \varphi_1)} && (4.52)\\
\eta^* &= \frac{\upsilon(\varsigma - 1)(\theta\zeta + \kappa\varphi_1 - \theta(2\chi + \varphi_1))}{\kappa\zeta\varphi_1\varsigma} && (4.53)\\
\varphi_1 &= \sqrt{\frac{\theta\chi(\zeta - \chi)}{\kappa}} && (4.54)
\end{aligned}$$

when $\chi < \dfrac{\zeta\kappa}{\theta + \kappa}$. The condition can be interpreted as the amount of forage per herbivore to maintain the status quo must be less than the amount consumed per herbivore when the vegetation is at its carrying capacity. A perfectly logical condition. The equilibrium solution is asymptotically stable (see Appendix A.5

for proof), as illustrated in Figure 4.9. It should also noted from Figure 4.9 that using a minimum population level before harvesting ($\varsigma > 1$) allows the system to return to equilibrium quicker and without the large oscillations when compared to purely proportional harvesting ($\varsigma = 1$).

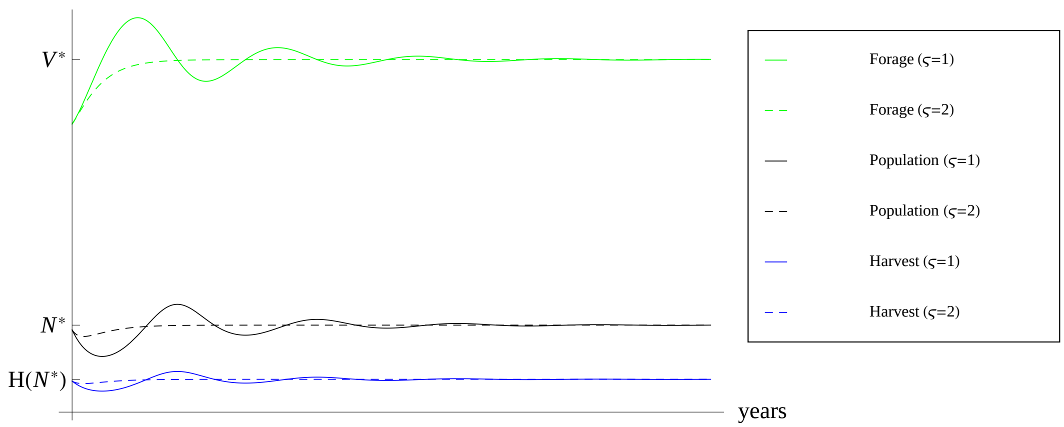


Figure 4.9: The population dynamics of a grazing system under two different harvesting regimes; no minimum herbivore population ($\varsigma = 1$); and a minimum herbivore population ($\varsigma = 2$). The forage, herbivore population and harvest rate under isolation (no migration) are shown for each harvesting regime.

4.3.2 Vegetation and a Herbivore with National Park Boundary

Using the *IFD* as stated in Section 4.1.2, it is the density of the animals that is of interest. In the scenario where only carrying capacity is considered, this density was with respect to the carrying capacity. Hence, in this scenario where forage is considered, it makes sense to use the density of animals with respect to the *tsdm*. Therefore, the general migration rate (Equation 4.5) can be modified by replacing carrying capacity κ's with V's for *tsdm*. The resulting migration rate under infinite external population is,

$$\text{Migration rate} = \frac{\phi V - N}{\tau} \tag{4.55}$$

The inclusion of the (infinite) migration rate into Equation 4.48 gives the system of differential equations using Equations 4.46 and 4.56.

$$\frac{\mathrm{d}N}{\mathrm{d}t} = \xi N\left(\frac{\zeta V}{\theta + V} - \chi\right) - \gamma\varsigma \max\{0, N - \eta\} + \frac{\phi V - N}{\tau} \tag{4.56}$$

The overall harvest rate of the system is maximised with respect to N and γ when,

$$H^*(N) = \frac{V^2(\zeta\kappa\phi + \upsilon\varphi_2) + \upsilon V(\theta + \theta\xi\tau\chi - \kappa\varphi_2) - \theta\kappa\upsilon(1 + \xi\tau\chi)}{\zeta\kappa\tau V} \tag{4.57}$$

$$N^* = \frac{\upsilon(\kappa - V)(V + \theta)}{\zeta\kappa V} \tag{4.58}$$

$$\gamma^* = \frac{\theta\kappa\upsilon(1 + \xi\tau\chi) - \upsilon V(\theta + \theta\xi\tau\chi - \kappa\varphi_2) - V^2(\zeta\kappa\phi - \upsilon\varphi_2)}{\upsilon\tau(\kappa - V)(V + \theta)} \tag{4.59}$$

$$\eta^* = \frac{\upsilon(\kappa - V)(V + \theta)(\varsigma - 1)}{\zeta\kappa\varsigma V} \tag{4.60}$$

$$\varphi_2 = 1 - \xi\tau(\zeta - \chi) \tag{4.61}$$

given combinations of conditions like: the amount of vegetation present is greater than that required for zero population growth; the rate of vegetation growth, without loss to herbivore, must be smaller than the amount of vegetation required to maintain the external population; current population is less than or equal to the external population density. The equations that maximise the harvest under equilibrium can be obtained, but they are too large to be included here. They also

Parameter	Value	Derivation
ν	0.65	The value used in Hacker *et al.* (2003) and within the range used in Caughley *et al.* (1987).
υ	80	Calculated using formulation from Turchin (2003).
κ	2000	Upper limit on based on *tsdm* estimates from Caughley *et al.* (1987).
ϕ	0.15,0.3,0.6	An average and high density using data from Dawson (1995)(kangaroos/tonne).
τ	10	Estimates of roughly 10% annual migration in Viggers and Hearn (2005).
ζ	290	Ad liberum grass consumption for a 30kg kangaroo using Equation 5.14 converted to $kg/year$.
θ	58.2	The *tsdm* where consumption is halved using Equation 5.14.
ξ	4.75	Calculated using formulation from Turchin (2003) ($kangaroos/tonne$).
χ	145	Calculated as half ζ as done in Turchin (2003).

Table 4.3: Parameter values used in the herbivore model.

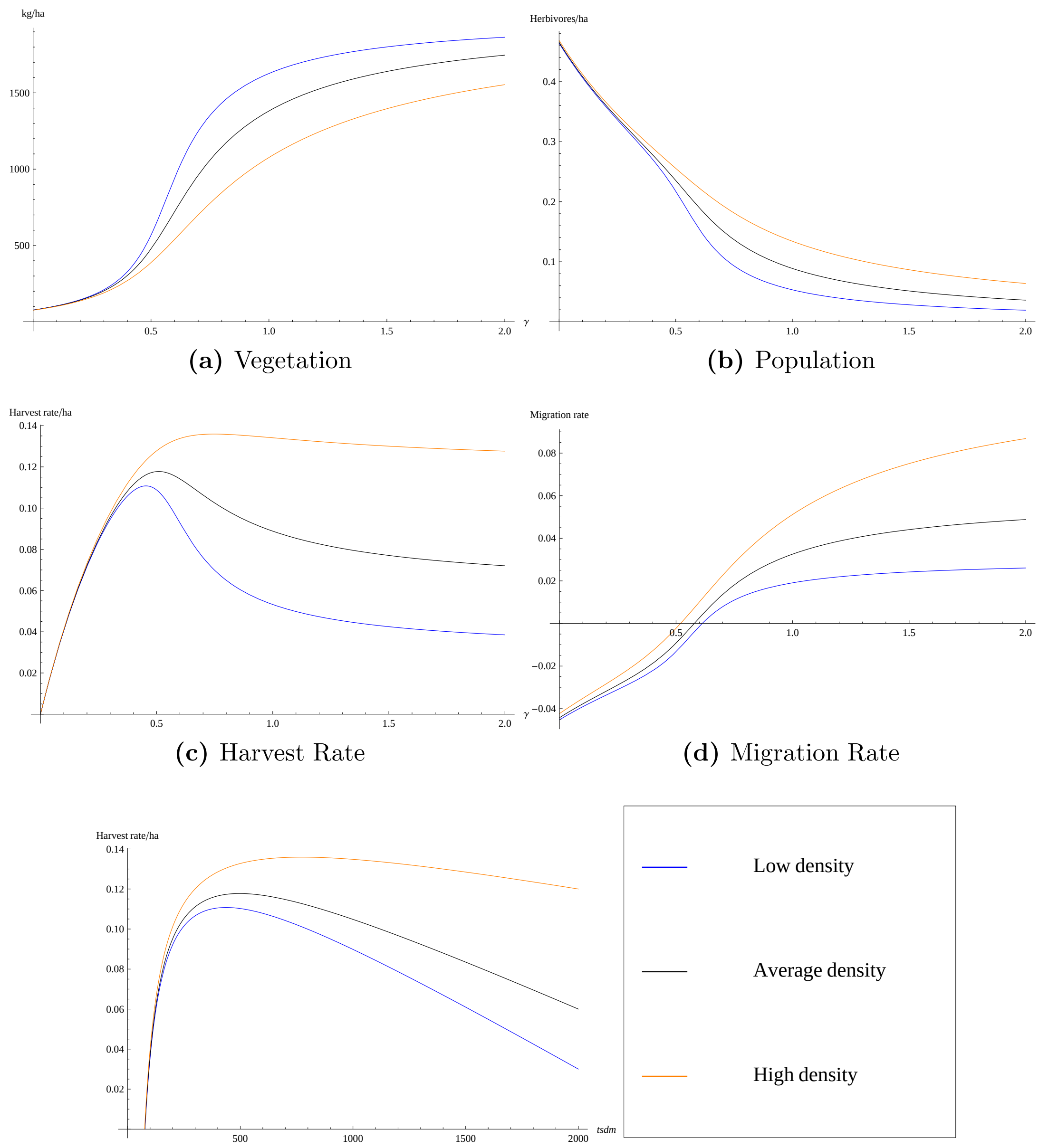
include similar conditions and different solution depending on growth rate of the herbivore compared to the migration rate, similar to those found in Section 4.1.4.

To illustrate the types of solutions that occur the parameters have been estimated and used in the calculations (see Table 4.1). Please note that these values are correct in order of magnitude, and are used to enable the illustration rather than as a definitive source. The high external density was selected so that immigration did not quite dominate the property.

From Figure 4.10 it can be seen that the equilibrium solutions are affected by the harvest proportion. It is noted that as the harvest proportion increases the different variables plateau. This is due to the fact that as the proportion harvested increases, the amount harvested converges to the migration rate, as all the herbivores on the property are harvested ($N \to 0$). Similar to the results from Section 4.1.3, when γ is relatively small the herbivore population on the property is larger than the external density and emigration occurs (Figure 4.10d). While losing herbivores through emigration is not generally desirable, it is possible that the optimal harvesting regime may have this occur. The benefit of harvesting from a higher population on the property (N) outweighed the leaking of the herbivores (Figure 4.10c). At both the low and average external densities (ϕ=0.15 and 0.3) the optimal equilibrium harvest proportion occurred when the migration rate was negative (migration rate of -0.018 and -0.008 respectively).

As previously noted (Section 4.1.3), when the external density increases the proportion of the population harvested (γ^*) increases (see Figure 4.11d). In particular, when the external density increases, immigration begins to dominate the properties optimal solution. The harvest increases (Figure 4.11c by relying on encouraging immigration (Figure 4.11e). This is managed through lowering the properties herbivore density and increasing the amount of vegetation (as seen in Figures 4.11b and 4.11a respectively) and then effectively harvesting all immigrants as they enter the property. When the external density is approximately 0.4 herbivores per tonne of forage the optimal harvesting regime results in neutral migration (see Figure 4.11e). When comparing the internal and external densities of herbivores per tonnes forage it can be seen (Figure 4.11f) that the relationship is not linear, but a negative convex curve, until there are no herbivores on the property ($N^* = 0$). This is to be expected given the external density remains constant and therefore larger in relative terms when the external density is larger.

So far the optimal dynamics when *tsdm* is considered is analogous to the

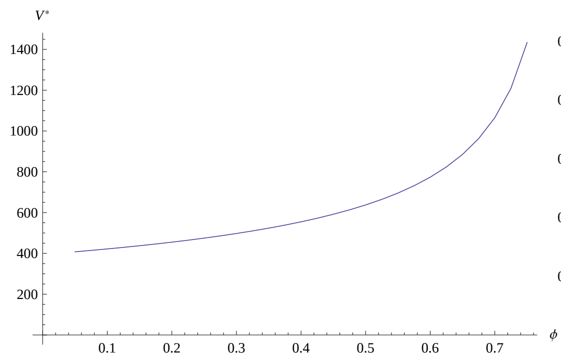


(a) Vegetation (b) Population

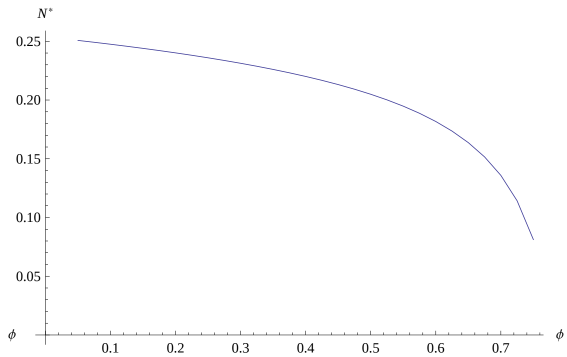
(c) Harvest Rate (d) Migration Rate

(e) Harvest vs. Vegetation (f) Legend

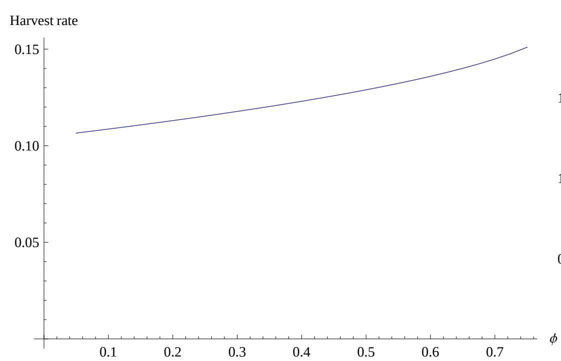
Figure 4.10: An illustration of the effect of different harvesting proportions (γ) for low, average and high infinite external densities (ϕ). Assumed parameters are given in Table 4.1



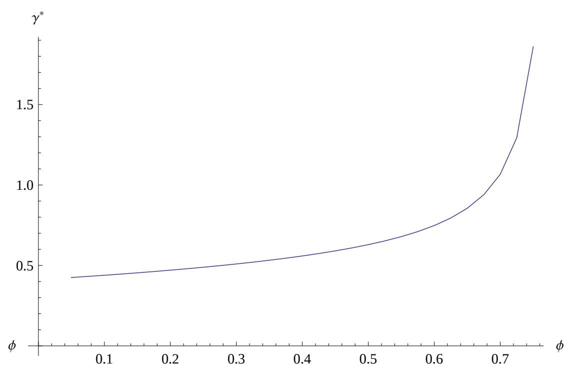
(a) Optimal Vegetation



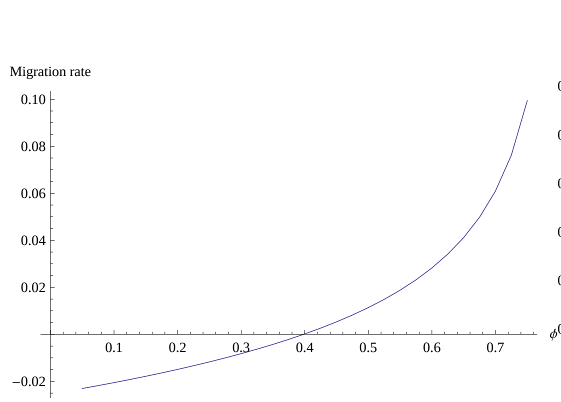
(b) Optimal Population



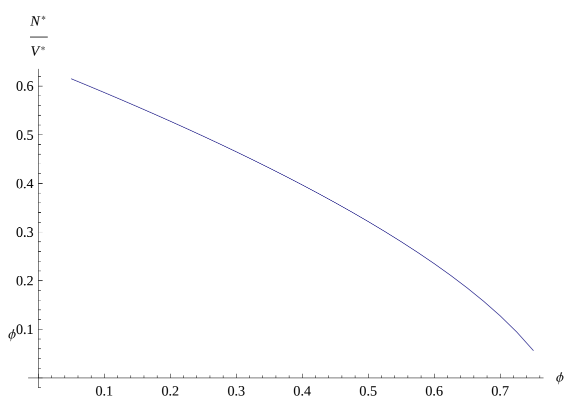
(c) Optimal Harvest Rate



(d) Optimal Harvest Fraction (γ^*)



(e) Migration Rate



(f) Internal Density

Figure 4.11: An illustration of the effect of infinite external densities (ϕ) on the optimal harvesting regimes. Assumed parameters are given in Table 4.1

straight carrying capacity case. The infinite migration scenario is useful to see some of the dynamics when a small property is bounded by a large national park.

4.3.3 Vegetation and a Herbivore on Two Properties with Common Boundary

The finite migration cases importance is in analysing the affect one property can have on its neighbour. Similar to Section 4.1.4 scenarios will look at optimal strategies on Property 1 given Property 2 maintains a given regime, a cooperative regime and a competitive regime. The differential equations governing the system are

$$\frac{\mathrm{d}V_i}{\mathrm{d}t} = \upsilon\left(1 - \frac{V_i}{\kappa_V}\right) - \frac{\zeta V_i N_i}{\theta + V_i} \tag{4.62}$$

$$\frac{\mathrm{d}N_i}{\mathrm{d}t} = \xi N_i\left(\frac{\zeta V_i}{\theta + V_i} - \chi\right) - \gamma_i \varsigma_i \max\{0, N - \eta_i\} + \frac{V_i N_{3-i} - V_{3-i} N_i}{\tau(V_i + V_{3-i})} \tag{4.63}$$

Solving Equation 4.62 set to zero with respect to N_i gives the equilibrium population size dependent on the vegetation available on the property (Equation 4.64).

$$N_i = \frac{\upsilon(\kappa_V - V_i)(\theta + V_i)}{\zeta \kappa_V V_i} \tag{4.64}$$

$$\gamma_i = \frac{\varphi_{3,i} + \xi(\kappa - V_i)(\zeta V_i - \chi(\theta + V_i))}{(\kappa - V_i)(\theta + V_i)} \tag{4.65}$$

$$\eta_i = \frac{\upsilon(\kappa_V - V_i)(\theta + V_i)(\varsigma - 1)}{\zeta \kappa_V \varsigma V_i} \tag{4.66}$$

$$H(N_i) = \frac{\upsilon(\varphi_{3,i} + \xi(\kappa - V_i)(\zeta V_i - \chi(\theta + V_i)))}{\zeta \kappa V_i} \tag{4.67}$$

$$\varphi_{3,i} = \frac{(V_{3-i} - V_i)(\theta V_i V_{3-i} - \kappa(\theta V_{3-i} + V_i(\theta + V_{3-i})))}{\tau V_{3-i}(V_i + V_{3-i})} \tag{4.68}$$

Therefore the equilibrium herbivore population on either property can be written in terms of just their respective vegetation levels. If Property 2 maintains a given vegetation level, that implies a certain level of herbivores. Using this premise, the harvest rate for Property 1 and 2 can be found and equations for the values of γ_1, γ_2, η_1, and η_2 found in terms of V_1 and V_2 (Equations 4.65 and 4.66). Equations 4.64 to 4.66 can be used to calculate the harvest rate (Equation 4.67). The harvest rate for Property 1 can then be maximised given the vegetation level on Property 2. Due to their length they have not been included. An illustration of the system designed to maximise Property 1's harvest rate based on the vegetation level is captured in Figure 4.12. Note that the herbivore population on Property 1 is fairly consistent despite the vegetation level on Property 2. Also note that migration rate is generally small compared to the harvest rate. Figure 4.12 highlights the fact that under the initially linear regrowth model, when vegetation density (compared to the carrying capacity of the vegetation) is low, then herbivore population is large. Theoretically as $V_i \to 0$ then the equilibrium solution infers $N_i \to \infty$.

Consider the scenario where both properties co-operate, in effect joining their two properties. The optimal harvesting regime for the combined property is the same as a single property in isolation for the reasons discussed in Section 4.3.1. Therefore, the optimal harvest regime for each property (under cooperation) is given be Equations 4.49 to 4.54. If the properties are in competition then the harvest rates (given perfect knowledge) for each property is given by Equation 4.67. Figure 4.13 illustrates the case where the two properties are in competition, co-operation and isolation. Using the parameterisation from Table 4.3, it can be

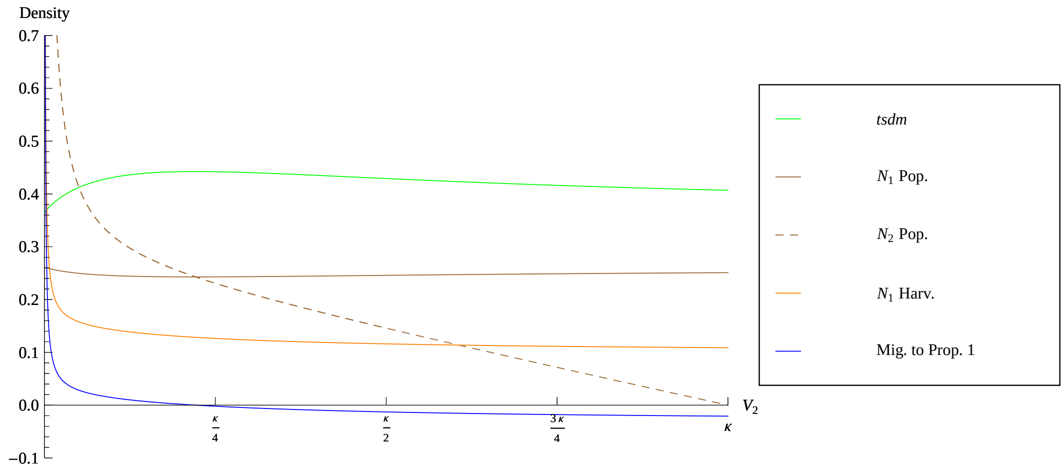
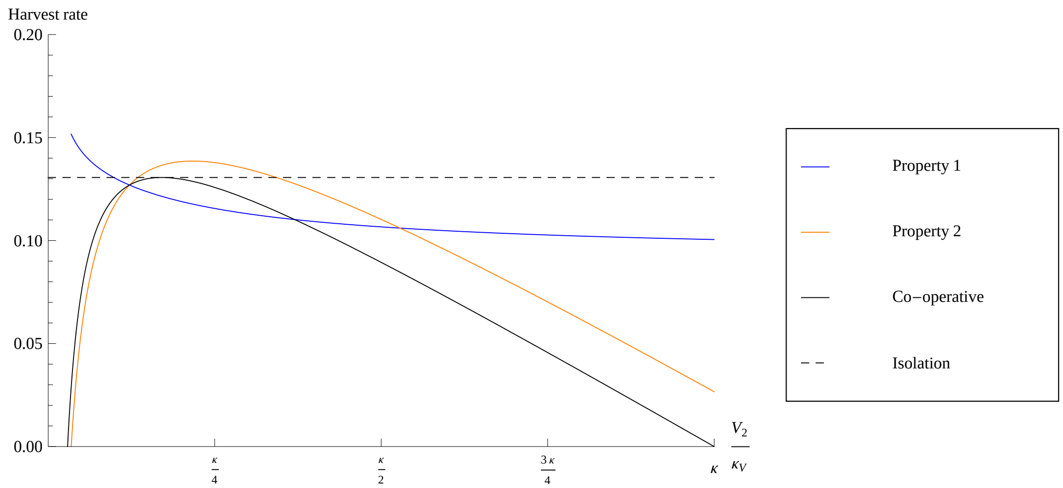
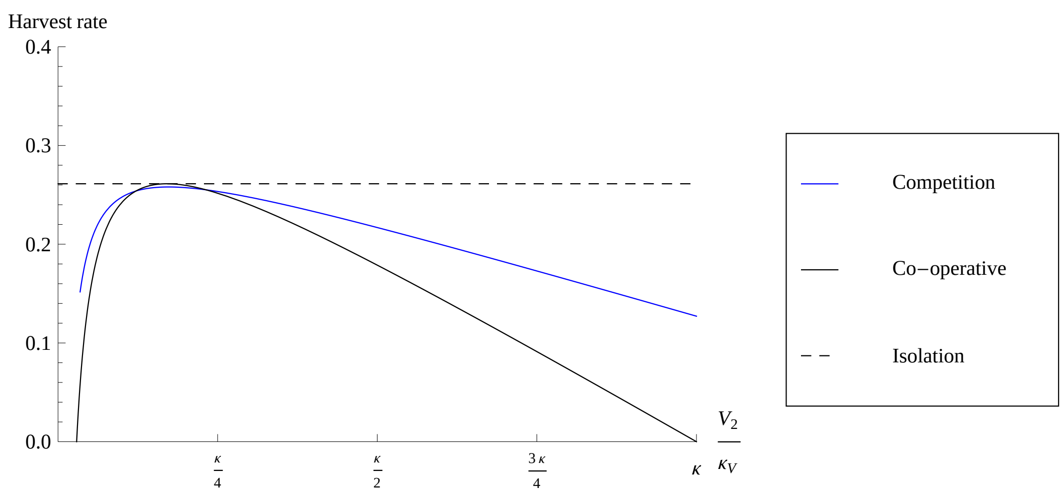


Figure 4.12: An illustration of Property 1 maximising their harvest rate dependent on the vegetation level of Property 2. Assumed parameters are given in Table 4.1

seen that one property always has a lower harvest rate compared to the optimal cooperative strategy (Figure 4.13a). Even when the harvests of both properties are combined, cooperation provides the greatest harvest rate (Figure 4.13b). It can be shown that this holds more generally when $\chi < \dfrac{\zeta\kappa}{\theta + \kappa}$.



(a) Separate Harvest



(b) Total Harvest

Figure 4.13: The harvest rates for Property 1 and 2 under competition as well as cooperative as Property 2 changes their herbivore population. This is then compared to the optimal harvest rate under isolation.

4.4 Discussion

The models used in this chapter give insight into some of the dynamics of a deterministic plant-herbivore system. It has been shown theoretically that stable solutions for plant-herbivore models, excluding and including migration, can be found. Moreover, these can be optimised in terms of their harvest, including herbivore preferences for the landholder.

When the property is isolated (herbivores are kept within its boundaries) harvests are optimised by leaving half the herbivore population untouched. The minimum level before harvesting in this scenario can be based purely on the carrying capacity and optimal growth rate of the forage. This fact causes competing needs when optimising revenue based on herbivore harvest and wool production. However, it is possible to control the herbivore populations so that a given proportion of the forage allocation is utilised by each species. Suppose a landholder wishes to allocate half their forage to wool production, two-fifths to beef production, and the remainder to kangaroo meat production. Then Equations 4.34 suggests harvest rates equal to the maximal growth rates for each species and setting refuge levels at an eighth, a tenth, and a fortieth of the carrying capacity respectively for sheep, cattle and kangaroos.

When the property is not isolated the outcomes are affected by what is happening in the external environment as well as internally. The relationship between the total dse/km^2 and that external environment can have a large effect on optimal strategies. Migration rates also have an impact on decision making. When neighbouring properties use the optimal harvesting strategy, their herbivore preferences should not affect the neighbours. Also, under the optimal harvesting strategies it is possible to have different combinations of herbivores as desired by the landholder. These two points infer that landholders decisions will have limited bearing on other properties, whether they utilise kangaroos or not.

The population models used in this chapter have been useful in exploring the effect of mobile species on internal populations and stability. However, the simplifications implicit in these models used do not account for external forces on the carrying capacity or available forage. A model that does account for the affect of weather and environment is contained in Chapter 5.

Chapter 5

Population Modelling with *GRASP*

Mitigation through income from kangaroos could help alleviate some of the financial down turn during drought. With rapid increase in kangaroo numbers after a drought has broken, harvesting could financially counter restocking costs of domestic animals. Therefore the kangaroos ability to react to changes in weather could be used to mitigate the affect of droughts and post-drought recovery in marginal areas. For this possibility to be explored fully a model that responds to environmental factors such as weather and soil condition needs to be used. The dynamics are important. When forage is scarce, and fodder has to be bought to maintain stock, the pest value of kangaroos is at its highest. When forage is plentiful landholders are not concerned by kangaroo numbers. There is so much forage it cannot be efficiently utilised. In particular the model needs to capture some of the nuances of kangaroo ecology conveyed in Chapter 1.2.1.

A model to predict biomass changes over time for Australian conditions was initially developed by Neil Flood and John Carter as the AussieGRASS model in 1995. Since then it has developed into what is know as *GRASP* today, which is what is used to estimate available biomass. *GRASP* can simulate the effect of weather, soil condition, stocking rates for either cattle or sheep and the associated production of beef or wool (Littleboy and McKeon, 2005). Part of the specified conditions of use of the *GRASP* code was that the main program itself was not to be altered, but changes were allowed to be made via adding sub-programs that can be included or excluded as required by the users. It is via these sub-programs that we constructed our kangaroo model. Unfortunately, this limited the ability of the kangaroo model. As a result, the entire *GRASP* program was re-coded for use in Mathematica.

The notation used in the kangaroo population model is collated in Table 5.1

5.1 The Kangaroo Population Model

The kangaroo population model is based on a previous physiological structured population model used in Hacker *et al.* (2003). It also includes the effect of the environmental conditions on the development and mortality of the kangaroo population. This enables dynamic feedback into the system so as to better simulate the effect of nutritional intake on the mammals. This approach has been used as we believe that the resilience of the plant-herbivore system is an important factor in the decision making process. If the non-traditional livestock can increase in numbers quickly after drought, their presence may help the pastoralist recover

Notation	Definition
$N_{f,i}, N_{m,i}$	The population of in cohort i of females and males respectively.
V	The total standing dry matter (vegetation) available.
age_i	The mean age of the members of cohort i.
$\mu(age_i, V)$	The mortality rate based on the age and forage available.
$\text{Harv}(gender, age_i)$	The harvest rate based on the age and gender of the cohort.
$\text{Migration}(gender, age_i)$	The migration rate for that age and gender of the cohort.
$Wt(gender, i)$	Average weight of the animals in that cohort, by gender.
$g(gender, age_i, V)$	The function of weight gain given the forage available and the gender and age of the animal.
$b(age_i, V)$	The birth rate for that group, given their ages, and available forage.
T_n	The point at which the n^{th} new cohort is established.
s	The primary sex ratio at birth.
$\text{Intake}(V, Wt)$	The function for the daily intake of forage for a member of the group, given their weight.
$\text{cond}(gender, i)$	The condition of the group, has a delayed effect included.
$delay$	The time delay for the groups condition.
$satiation$	The amount of available forage required for the animal to be satiated.
$peaten(t)$	The proportion of the total desired forage actually eaten.
$desire(t)$	The total amount desired to be eaten based on the available forage.
γ	The overall harvest rate for the species.
$refuge$	The minimum kangaroo density.
$pref_{gender}$	The harvest bias for the given gender.
$H(gender, i)$	An indicator function for if the animal is harvestable.

Table 5.1: Symbols used in the kangaroo population model.

quicker financially.

The *PSPMs* can be derived heuristically (de Roos *et al.*, 1992). Consider the change in population of animals. Suppose that the population is age-structured, age is continuous and that there is competition for a dynamically varying food supply. Then, by forming equal length cohorts, based on when the animal was born, and generalising the age-structured Leslie model, the *PSPMs* follows each age cohort as time passes. The population of each cohort increases via births and immigration and decreases with deaths and emigration. As each cohort is based on the age of the animal, births only affect the most recently formed cohort. New cohorts are formed after a set amount of time, usually based on the animals reproduction cycle. The old cohort numbers are increased by one at this point, making their cohort number represent their age in terms of the time between birth measurements. The model tracks not only the population, but also the size of each cohort. The current population is described via Equations 5.1 to 5.4. Please note that having different groups by gender allows for use of the fact that females and males are harvested at different rates and ages.

$$\frac{\mathrm{d}N_{f,i}}{\mathrm{d}t} = -\mu(age_i, \mathrm{cond}(f,i))N_{f,i} - \mathrm{Harv}(f,i) + \mathrm{Migration}(f,i) \tag{5.1}$$

$$\frac{\mathrm{d}N_{m,i}}{\mathrm{d}t} = -\mu(age_i, \mathrm{cond}(m,i))N_{m,i} - \mathrm{Harv}(m,i) + \mathrm{Migration}(m,i) \tag{5.2}$$

$$\frac{\mathrm{d}Wt_{f,i}}{\mathrm{d}t} = g(f, age_i, \mathrm{cond}(f,i)) \tag{5.3}$$

$$\frac{\mathrm{d}Wt_{m,i}}{\mathrm{d}t} = g(m, age_i, \mathrm{cond}(m,i)) \tag{5.4}$$

In addition to equations above, Equations 5.5 to 5.8 are boundary conditions required for each new cohort. These equations relate to the establishment of the new cohorts (births) in the next time period. At the beginning of each time period the existing cohorts must also be updated as given by Equations 5.9 to 5.12. In the following equations T_{n+1}^{-} and T_{n+1}^{+} represent the time just before and just after T_{n+1}.

$$N_{f,0}(T_{n+1}^{+}) = \sum_{i=0}^{Q-1} b(age_i, \text{cond}) N_{f,i}(T_{n+1}^{-}) \tag{5.5}$$

$$N_{m,0}(T_{n+1}^{+}) = sN_{f,0}(T_{n+1}^{+}) \tag{5.6}$$

$$Wt_{f,0}(T_{n+1}^{+}) = Wt_0 \tag{5.7}$$

$$Wt_{m,0}(T_{n+1}^{+}) = Wt_0 \tag{5.8}$$

$$N_{f,i+1}(T_{n+1}^{+}) = N_{f,i}(T_{n+1}^{-}) \tag{5.9}$$

$$N_{m,i+1}(T_{n+1}^{+}) = N_{m,i}(T_{n+1}^{-}) \tag{5.10}$$

$$Wt_{f,i+1}(T_{n+1}^{+}) = Wt_{f,i}(T_{n+1}^{-}) \tag{5.11}$$

$$Wt_{m,i+1}(T_{n+1}^{+}) = Wt_{m,i}(T_{n+1}^{-}) \tag{5.12}$$

The age related mortality of has been previously modelled (Hacker *et al.*, 2003) using a Weibull survival function (Equation 5.13), where AGE is the random variable for the age at which a kangaroo dies. It has been assumed that female and male kangaroos have the same age related mortality. However, it is noted that male kangaroo mortality is thought to be higher during the ages of 3 to 5 year old (Dawson, 1995). The functional response (the level of grazing dependent on the forage available) has been estimated (Caughley *et al.*, 1987) by the Equation 5.14. The functional response is used not only to determine the amount of forage consumed by a kangaroo at the current level of total standing dry matter, but also its condition. The condition of the cohort of kangaroos is estimated via a goal gap formulation (Equation 5.15), with the instantaneous condition (Equation 5.16). There is a delay term in the differential equation as it has been noted that the change in condition of kangaroos has an approximately 3 month delay related to a change in forage (Caughley *et al.*, 1987; Dawson, 1995; Moss and Croft, 1999; Bayliss and Choquenot, 2002).

$$S(age) = \mathrm{P}(AGE > age) = e^{-(0.614age)^{0.428}}, \tag{5.13}$$

$$\mathrm{Intake}(V, Wt) = 0.0623(1 - e^{-\frac{V}{84}})Wt^{\frac{3}{4}} \tag{5.14}$$

$$\frac{\mathrm{d\,cond}(gender, i)}{\mathrm{d}t} = \frac{\mathrm{condT(t)} - \mathrm{cond}(gender, i)}{delay} \tag{5.15}$$

$$\mathrm{condT} = \frac{peaten \times greeneaten \times \mathrm{Intake}(V, Wt)}{0.88eaten \times \mathrm{Intake}(satiation, Wt)} \tag{5.16}$$

$$peaten(t) = \frac{\min\{V, desire(t)\}}{desire(t)} \tag{5.17}$$

$$desire(t) = \sum_{gender} \sum_{i=0}^{Q} Intake(V, Wt_{gender,i})N_{gender,i} \tag{5.18}$$

As can be seen in Figure 5.1, once the available forage is greater than $300kg/ha$ the amount eaten plateaus. This can be thought of as the satiation level, the point at which the kangaroos appetite is satisfied. The satiation level was then compared to the actual amount eaten, both in terms of total and green forage, to determine the instantaneous condition. It is noted that the proportion of their diet that is green (alive) is important in determining kangaroo condition (Moss and Croft, 1999).

The condition is used as a proxy in the mortality and fecundity functions. The better the condition of the kangaroos the lower the mortality and higher

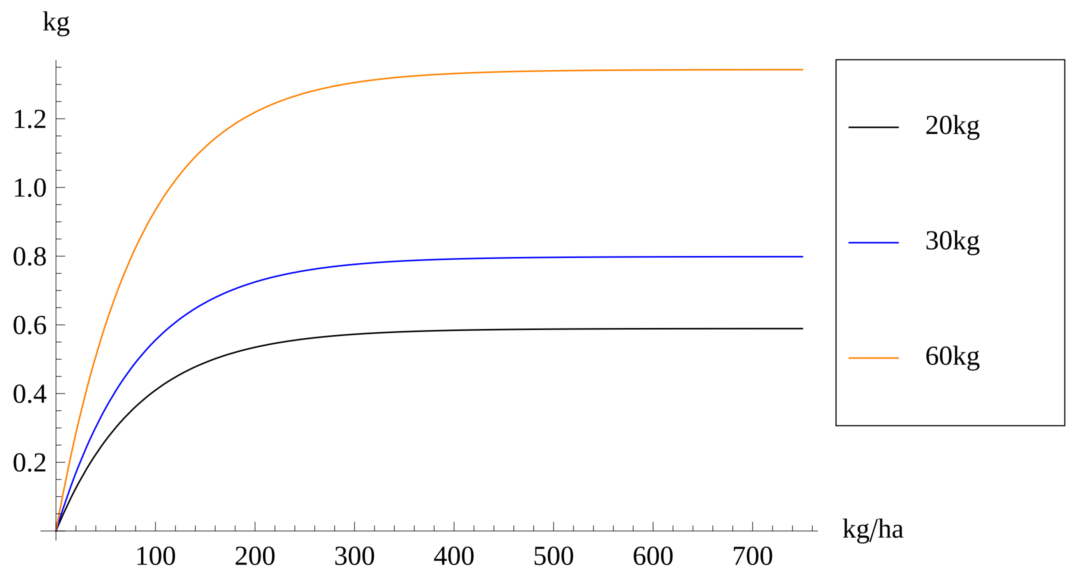


Figure 5.1: The function response for a $20kg$, $30kg$ and $60kg$ kangaroo. That is the amount eaten (kg) dependent on the available forage (kg/ha).

the fecundity (Caughley *et al.*, 1987; Dawson, 1995; Moss and Croft, 1999; Pople and Grigg, 1999). For this reason, both the fecundity and mortality functions have the average fecundity and mortality multiplied by different functions of the current condition.

The modelled mortality (Equation 5.19) of the kangaroos is the product of the mortality due to age and the effect of condition on mortality. Mortality due to age is derived as the hazard rate related to the survivorship equation (Equation 5.13). While the mortality related to condition is derived through the following arguments. When the condition is 1 (the kangaroo's hunger is sated) then the mortality should be average and therefore the multiplier should be 1. When the condition is close to 1, it can be assumed that the mortality is still approximately average and hence the multiplier should be relatively flat, with a slight negative slope. However, when the condition is above 1 (eating more than satiation levels) then the mortality should be smaller than average. According to Moss and Croft (1999) when vegetation is plentiful (and therefore intake is very close to the horizontal asymptote) then the mortality from pouch young to weaned is 85%. Alternatively, it is argued that as condition decreases, mortality increases. Furthermore, the rate at which mortality increases also increases as the condition of the kangaroo gets further from the satiation level. Over 4 months when food intake was at $25 - 50\%$ of ad libitum levels, the mortality rate was such that 40% of kangaroos died (Caughley *et al.*, 1987). Given those conditions a piece-wise function, based on two cubic functions both having a point of inflection at (1,1), was constructed. This function is shown inside the brackets in Equation 5.19 and Figure 5.2.

$$\mu(age, \text{cond}) = \frac{0.34736}{age^{0.572}} \left(1 - (\text{cond} - 1)^3 \times \begin{cases} 232 & ,\text{cond} \leq 1 \\ 33033.5 & ,\text{cond} > 1 \end{cases} \right) \tag{5.19}$$

The fecundity of kangaroos is modelled (Equation 5.20) as the product of the average fecundity given the females age and multiplier related to their condition. When considering the reproduction cycle of the kangaroo it has been noted that they can reproduce once every 8 months (Caughley *et al.*, 1987; Hacker and McLeod, 2003). This equates to a possible average of 1.5 young at foot per year per fertile female. Female kangaroos start reproducing from around 2 years of age and continue until 12. Their most productive from 4 to 10, with roughly 80% having pouch young (Arnold *et al.*, 1991). When their condition is too poor, kangaroos will either continually replace dead pouch young or have extended

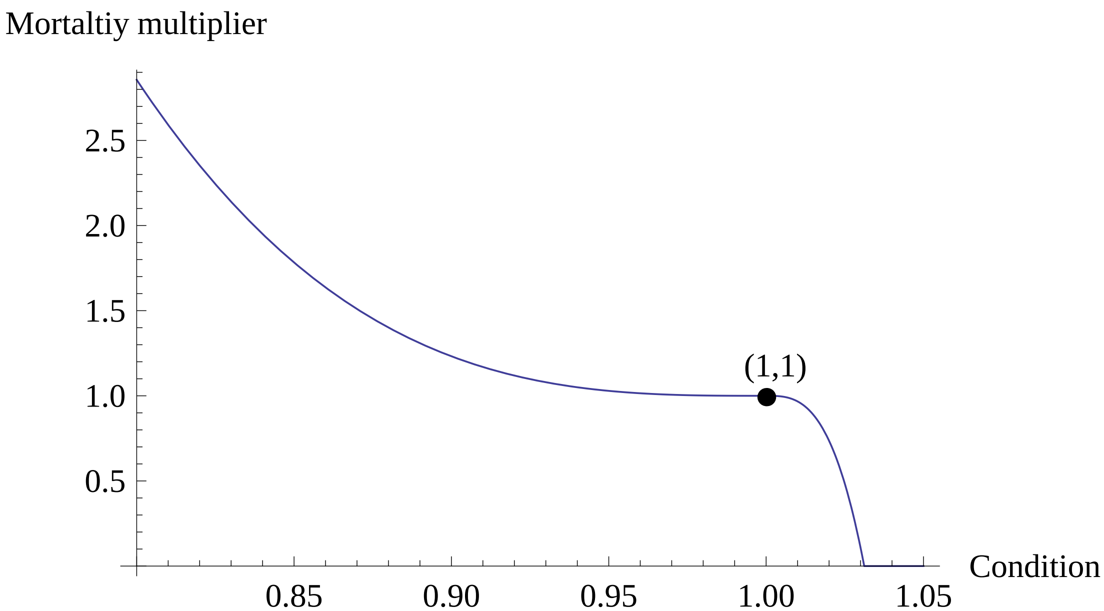


Figure 5.2: The mortality multiplier due to condition. When appetite is sated (condition is 1) the mortality is average. As condition decreases or increases, the mortality rate is increased and decreased respectively.

embryonic diapause (Caughley *et al.*, 1987; Dawson, 1995). In effect no successful births happen when condition is poor (Moss and Croft, 1999) or forage is scarce (less than 95kg/ha).

$$b(age_i, \text{cond}) = 2.724\sqrt{\text{cond} - 0.7}\begin{cases} 0.4(age_i - 2) & 2 \leq age_i < 4 \\ 0.8 & 4 \leq age_i < 10 \\ 0.4(12 - age_i) & 10 \leq age_i < 12 \\ 0 & otherwise \end{cases} \tag{5.20}$$

Kangaroo (and wallaby) harvesting is controlled by state and federal governments. State governments set quotas and regulations that must be signed off by the Federal Government. This is due in part to the fact that as a native species, kangaroos (and wallabies) are under the protection of the crown. Each state has different protocols with regards to harvesting kangaroos and wallabies, what quotas are set and how the quotas are managed (Pople and Grigg, 1999). In Queensland regions are allocated quotas that the harvesters purchase, which can then be used to harvest kangaroos on private property (Office of the Queensland Parliamentary Counsel, 2010; Moloney *et al.*, 2011). In addition to the quotas to control the off-take, there are also conditions that are meant to ensure a stable, genetically diverse kangaroo population. These include; minimum kangaroo densities; male off-take bias; and minimum weight limit on harvested kangaroos. Typically these are set to; a minimum kangaroo density of 2 kangaroos per km^2; a 70% male off-take bias; and a minimum live weight of $20kg$ or fully dressed weight of $13kg$ (Hacker *et al.*, 2003; Office of the Queensland Parliamentary Counsel, 2010). The kangaroo processors for human consumption have be known to set a higher minimum fully dressed weight (T. Garrett, pers. comm., 2008).

The harvest model for kangaroos therefore needs to include these conditions. There is a minimum density of kangaroos which must be met otherwise harvesting cannot commence. The harvest rate is a proportion of what can be harvested. To maintain the male harvest bias a stoichiometric formulation is used. Harvesting only occurs periodically, in this case on a monthly basis.

$$\text{Harv}(gender, i) = \frac{N(gender, i)\text{pot}_{gender} \min\{1, \frac{pref_{gender}}{1 - pref_{gender}}\}}{hs(gender)} \tag{5.21}$$

$$\text{pot}_{gender} = harvrate \times pref_{gender} \times hs(gender) \frac{\max\{\sum_{gender} hs(gender) - refuge, 0\}}{\sum_{gender} hs(gender)} \tag{5.22}$$

$$hs(gender) = \sum_{cohort_{gender}} H(gender, i)N(gender, i) \tag{5.23}$$

Migration in and out of the property could have an effect on the herbivore populations. It is thought (Caughley *et al.*, 1987; Viggers and Hearn, 2005; Coulson, 2009) that their average home range is relatively small ($< 1km^2$), although some individuals travel much larger distances. When forage is scarce and cover vegetation relocation is more likely. It is thought that macropods follow the structure of the *IFD*, but some evidence points more to the Rose Petal hypothesis (Coulson, 2009; Wiggins *et al.*, 2010). Given these ideas are still in dispute (Viggers and Hearn, 2005; Martin *et al.*, 2007; Viggers and Lindenmayer, 2007; Coulson, 2009) and the large impact migration could have on the modelled population the initial model assumed that there is no net migration.

5.2 Issues with *GRASP*

Several issue were discovered with the operation of *GRASP*.

- The grass basal area can be set to a constant or as a function of evapotranspiration. However, changes made to grass basal area, seemed to have no affect on *tsdm*. This component was included in the re-coded model.

- Similarly tree basal area is constant and changes seemed to have little if any bearing on the *tsdm*. For that reason, it was left out of the re-coded version. It could be argued that much of the land is pasture with trees only at the edges of paddocks.
- Frost was capable of causing the *tsdm* to reach zero after only one or two events. Using the original weather data there was such an event, one cold day and the entire *tsdm* was set to zero. When cattle was included, regrowth was eaten and reasonable levels of *tsdm* were achieved only after complete de-stocking. In the re-coded model the temperature limit at which *tsdm* loss was total was lowered sufficiently so as to exclude this event.
- Rain water that cannot be taken into the top layer of soil (runoff) is just lost to the system.
- The default setting for livestock is a constant stocking rate. This was not appropriate as the kangaroo population was dynamic. Therefore the stocking regime option which sets the next years (domesticated) stocking rate based on previous pasture growth and herbivore intake was selected.
- *GRASP* converting between between *beasts/ha* and weaner equivalents when calculating the amounts of each forage type eaten. This may be acceptable when the conversion rates between sheep and cattle are known. However, as stated earlier, this figure is in dispute Grigg (2002); Munn *et al.* (2009). Therefore it is more appropriate to work entirely in kangaroos for the kangaroo simulations.

After much effort it was decided that to enable *GRASP* to be extended to include kangaroo grazing, re-coding would be required if it were to be used. *APSIM*, a program based on *GRASP* was considered. However, within the program it is not possible to construct a dynamic herbivore and the base code is not available. For these reasons the decision to re-code *GRASP* was made. The extended *GRASP* model was coded in Mathematica and took several months (base *GRASP* was over a hundred pages of code). This meant that a thorough understanding of the processes used in *GRASP* has been gained.

5.3 *GRASP* Simulations

GRASP uses diurnal weather data to predicted total standing dry matter, animal weight gain, wool production and abundance. It is therefore important to be able to generate weather data to populate the simulations. Weather data from 1970 to 2008 was obtained from the Queensland Department of Environment and Resource Management (DERM) for Mitchell, Queensland. The data is from the *DataDrill* interpolations based on the *SILO* weather data sets from the Bureau of Meteorology. The data from *DataDrill* was designed for use with *GRASP* (Jeffrey *et al.*, 2001).

The goal was to be able to generate new weather data sets for use in the simulations. They would mimick the distributions of rainfall, temperature, evaporation, radiation and vapour pressure. Initial success was had modelling the rainfall. It used a combination of a three state Markov model, to determine rain state (no rain, start raining event, continue raining, or end rain event), and separate Weibull distributions for each month's daily intensity dependent of the rain state. Unfortunately evaporation, radiation and vapour pressure where not readily modelled. It was decided that an alternative method for generating new weather periods should be used. New weather data was generated for each month by bootstrapping. The data for each month was randomly selected, with replacement, from all the corresponding months in the original data. For instance, the first three months of a new weather data set may be January from 1980, February from 2003, March from 1997. This technique was used to generate 1000 instances of new weather data, each lasting 20 years.

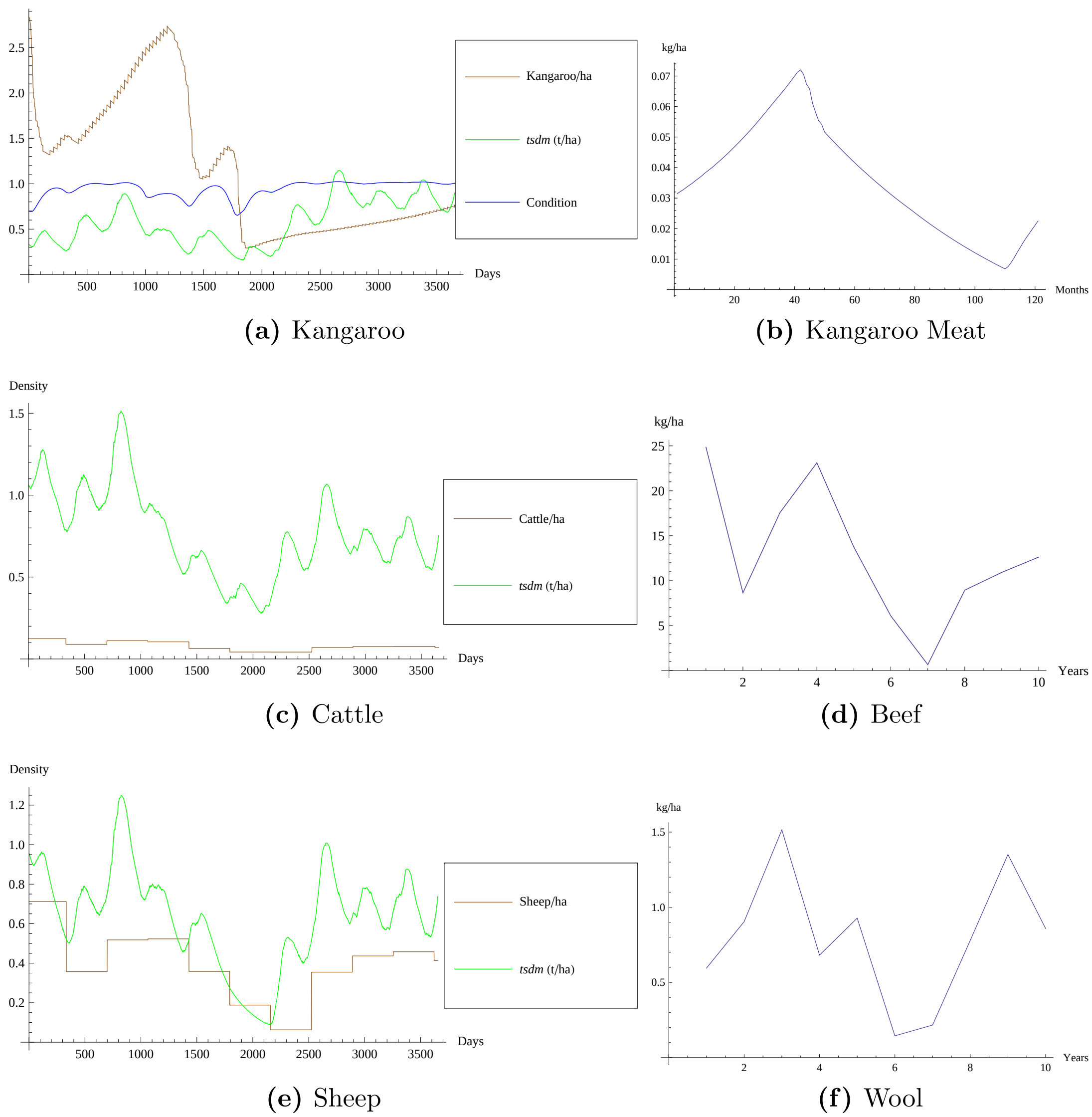
Simulations for cattle, sheep and kangaroo were then carried out separately, using *GRASP* and the same weather data. In effect it was assumed that the property was only stocking a single species in isolation. Each simulation used the same set of parameterisations for each species. Parameters related to pasture production were identical across all species. The initial total biomass was set to 1000kg/ha, divided into each group using the ratios found after running *GRASP* without grazing over the original data set (0.128:0.295:0.031:0.542 for green leaf: green stem: dead leaf: dead stem). The initialisation parameters for the re-coded *GRASP* that differ from the default settings are stated in Appendix B.2.

Once each fifteen year simulation was completed, results from the first five years were removed as an initialisation period. This approach falls in line with the suggested approach for *GRASP* Littleboy and McKeon (2005). The statistics of interest were then recorded for each simulation for each animal. These statistics (where applicable) were the mean yearly population, weights harvested per year, wool clips per year, and mean and standard deviation *tsdm*.

To illustrate what was generated by the extended *GRASP* program the data produced for one weather simulation sequence for each herbivore in Figure 5.3. Note that as expected, the kangaroo population falls sharply when condition is too low for too long (Figure 5.3a). Also note that commodity production is not entirely in lock step. Finally, it is clear that by looking at the *tsdm* under each herbivore, that different amounts of available forage are utilised, with kangaroos the most and cattle the least.

5.4 Discussion

After some trials and tribulations *GRASP* was extended to include kangaroo grazing and population dynamics. The results from the simulations highlight the fact that kangaroo population size can dramatically change depending on the environmental conditions, a feature which may be exploited to mitigate lost production during and post-drought. This seems to enable then to utilise the available forage to a greater degree when conditions change. Production levels for each animal have different lags to external events. This could be partially due to the fact that domestic stock was only brought and sold annually. To see if the differences in commodity production enhance resilience an agribusiness need to be explored. These herbivore simulations integral to the portfolio analysis conducted in Chapter 6, which will demonstrate to what degree mixed-grazing can improve resilience.



(a) Kangaroo **(b)** Kangaroo Meat

(c) Cattle **(d)** Beef

(e) Sheep **(f)** Wool

Figure 5.3: The results from the same weather data of extended GRASP.

Chapter 6

Results and Analysis

This chapter is the culmination of the ideas explored to in the previous chapters. Is mixed-grazing (including kangaroos) feasible from a financial point of view? Chapter 2 explored the idea of allocating the available forage in such a way as to optimise the trade off between possible revenue and consistency using by a multi-objective optimisation problem (MOP). This used historical data from a number of sources to estimate the covariance in revenue between cattle, wool and kangaroo production over time. The production rates of the different commodities were considered known and constant. Having a better understanding of the dynamics of the production of the commodities could influence the results of the portfolio optimisation. Chapter 4 developed the analysis of the dynamics between herbivores and the environment. It suggested that the actions of neighbours would not affect properties, whilst they all used an optimal harvesting regime. This is important as it can help allay landholder fears that an adjacent property "encourage" kangaroos could negatively affect their property. Also it addresses the concern mentioned in Section 2.1 that porous borders could result in a net loss or gain of herbivores. Hence a landholder can choose which ratio of herbivores to stock or harvest without impinging on neighbours. Admittedly nature reserves are not "optimally managed" for harvesting commodities, and therefore could possibly influence outcomes on any property. Chapter 5 introduced the plant-herbivore model *GRASP* and additional components designed to model the kangaroo population. This enables a better understanding of the dynamics of the different herbivores in the environment and the quantity of the commodities they produce.

Combining sections from the previous three chapters resulted in running simulations of different weather patterns. The data generated, can then be used in a *MOP* to construct an efficient frontier. Landholders can use the efficient frontier to help decide on the future of their enterprise. What combination of cattle, sheep and kangaroos will suit them given their level of risk aversion? Finally, what impact would the enforcement of methane emission reduction have on the optimal strategies?

6.1 Simulation Results

There are several components that require Monte Carlo simulations for use in the portfolio optimisation. The extended *GRASP* model is run with different simulated weather events to generate commodity production data. The data on the price (or change in price) of the commodities needs to be simulated. Using a combination of these results the relative returns can be simulated to inform the

Notation	Definition
$A_i(t)$	The number of animals i present at the beginning of year t ($animals/ha$).
k_i	The number of animals present if i is the only animal stocked ($animals/ha$).
$Wt_i(t)$	The weight of animals i present at the beginning of year t (kg/ha).
$Harv_i(t)$	The weight of meat harvested of animal i over year t (kg/ha).
$ValA_i(t)$	The value of the average animal i ($\$/animal$).
$ValW_i(t)$	The value by weight of an animal i ($\$/kg$).
NSI	The amount invested in the property outside of stock (Non-Stock Investment) ($\$/ha$).
$P_c,\ P_k\ , P_s$	The random variable for the relative change in price of cattle, kangaroos and sheep respectively (dimensionless).
$H_c^\dagger,\ H_k^\dagger$	The random variable for the amount of meat harvested relative to the original total weight for cattle and kangaroo respectively (dimensionless).
W	The random variable for the amount of wool produced in a year ($kg/sheep$).
$W^\dagger$	The random variable for the price of wool relative to the value of the sheep ($sheep/kg$).
L_i	The ratio of non-stock to stock investment for animal i (dimensionless).
$q_c,\ q_k\ , q_s$	The proportion of the property allocated to cattle, kangaroos and sheep respectively (dimensionless).
$\boldsymbol{q}$	The vector of the proportional allocation ($\boldsymbol{q} = \{q_c,\ q_k\ , q_s\}^T$).
$R_c,\ R_k\ , R_s$	The random variable for the relative return on cattle, kangaroos and sheep respectively (dimensionless).
$\boldsymbol{Q}$	The matrix containing the simulated relative returns for cattle, kangaroo and sheep (dimensionless).
$\boldsymbol{\mu}_R$	The vector of the expected relative return ($\boldsymbol{\mu}_R = \{E(R_c),\ E(R_k)\ , E(R_s)\}^T$) (dimensionless).
$\boldsymbol{\Sigma}_R$	The covariance matrix for the percentage returns on cattle, kangaroo and sheep.
μ_*	The minimum acceptable expected relative return (dimensionless).
Methane$_i$	The amount of methane emitted by animal i at average without competition density ($tonnes/ha/year$).

Table 6.1: Symbols used in portfolio optimisation.

Mean	Density (Hervibore/ha)	Commodity Production (kg/ha)	*tsdm* (kg/ha)
Cattle	0.077	11.172	767.9
Sheep	0.410	0.9644	683.6
Kangaroo	1.694	0.4998	530.3

Table 6.2: Overall mean yearly herbivore density, commodity production and *tsdm* from the extended *GRASP* model for each herbivore.

portfolio optimisation.

6.1.1 *GRASP* Simulation Results

A summary of the overall results of the simulations are given in Table 6.2. There are several notable points related to these results. Firstly, the production of beef is vastly greater in quantity than either of the other commodities produced, by a factor of over 10. This implies, that unless beef is much cheaper than either wool or kangaroo meat, it would seem that beef production would result in the greatest returns. Secondly, the relationship between the herbivore densities should relate to the *dse*'s mentioned earlier. The extended *GRASP* program keeps track of the quantity of each herbivore in terms of average cattle and sheep and monthly cohorts of kangaroos.

GRASP has been validated for biomass, beef and wool production in the Maranoa region (Littleboy and McKeon, 2005). Unfortunately kangaroo population numbers have not been monitored in any detail in the area, making validation of the kangaroo model difficult. By looking at the kangaroo density and comparing it to the sheep density the effective kangaroo *dse* can be estimated. If the simulated *dse* is not similar to the expected kangaroo *dse* it would be evidence that the model is invalid. Using the sheep as the standard, that gives a ratio of 5.32:1:0.24 for cattle:sheep:kangaroo quantities. However, the ratio to cattle (6.1 for a 200kg weaner as used in *GRASP*) and kangaroo (~ 0.35) seems low compared to its usual *dse* (Millear *et al.*, 2003; Munn *et al.*, 2009). These compared the amount eaten ad liberum and do not include any spatial measurement (sheep/ha for instance). However, in the simulations the *tsdm* is per hectare and the mean differs for each species. Converting the ratios to include the mean available forage as well results in a ratio of 4.74:1:0.32. The kangaroo conversion factor is in line with the most recent estimates and therefore support the model. Conversely the cattle conversion factor is low. The original *GRASP* model has been validated for both cattle and sheep, and that part of the program was not changed.

6.1.2 Pricing Simulation

Historical data on the prices of cattle, sheep, wool and kangaroos was collated from ABARE (2010) and kangaroo harvesters (T. Garrett, pers. comm., 2008). Using this data statistics on the measures of interest were estimated. The statistics included means, standard deviations and covariances for the relative change in the price of cattle, sheep and kangaroos as well as the ratio of wool price to sheep price (see Table 6.3). Multivariate regression, with time and annual rainfall as covariates, found no significant models. A Shapiro-Wilk multivariate normality test was conducted and the findings did not reject the assumption that the data was multivariate normal (p-value=0.1575). Hence the Cholesky factor of the

Statistic	Relative change in price per animal: Cattle	Kangaroo	Sheep	$\frac{\text{Wool Price}}{\text{Sheep Price}}$
Mean	0.0110	0.0659	0.0894	0.1956
Standard deviation	0.1149	0.1874	0.3736	0.1007
Covariance matrix	0.0132	0.0060	0.0074	-0.0029
	0.0060	0.0351	0.0058	-0.0043
	0.0074	0.0058	0.1396	-0.0143
	-0.0029	-0.0043	-0.0143	0.0101

Table 6.3: Summary statistics estimated from data from ABARE and kangaroo harvesters.

covariance matrix was used to generate the multivariate random numbers as per Gentle (2006). That is, let $\boldsymbol{Y}$ be a vector of independent identically distributed (*i.i.d.*) standard normal random variables, and matrix $\boldsymbol{A}$ be the Cholesky factor of the covariance matrix. Then, $\boldsymbol{AY} + \boldsymbol{\mu} \sim N(\boldsymbol{\mu}, \boldsymbol{\Sigma})$.

6.1.3 Relative Returns Simulation

The relative return on investment is calculated as the change in value from one year to the next of stock plus the value of production, relative to the original value (Equation 6.1).

$$R_i = \frac{\text{Value}(t+1, i) - \text{Value}(t, i) + \text{Production}}{\text{Value}(t, i) + q_i NSI} \tag{6.1}$$

When the commodity produced is meat (as in the case of cattle and kangaroo) then Equation 6.1 can be re-written to take the form of

$$
\begin{aligned}
R_i &= \frac{ValW_i(t+1)(Wt_i(t) + Harv_i(t)) - ValW_i(t)Wt_i(t)}{ValW_i(t)Wt_i(t) + q_i NSI} \\
&= \frac{ValW_i(t)(1+P_i)Wt_i(t)\left(1 + \dfrac{Harv_i(t)}{Wt_i(t)}\right) - ValW_i(t)Wt_i(t)}{ValW_i(t)Wt_i(t) + q_i NSI} \\
&= \frac{(1+P_i)\left(1 + \dfrac{Harv_i(t)}{Wt_i(t)}\right) - 1}{1 + \dfrac{q_i NSI}{ValW_i(t)Wt_i(t)}} \\
&= \frac{P_i + H_i^\dagger + P_i H_i^\dagger}{1 + L_i}
\end{aligned} \tag{6.2}
$$

where $H_i^\dagger = \dfrac{Harv_i(t)}{Wt_i(t)}$, $L_i = \dfrac{NSI}{ValA_i(t)k_i}$ and $i \in \{c, k\}$. It is noted that this is similar to the arguments made in Chapter 2.1 for Equation 2.3 the calculation of relative return. When considering the case of the percentage return from a product not related to the weight of the animal (sheep) the equation becomes,

$$
\begin{aligned}
R_s &= \frac{ValA_s(t)A_s(t)(1+P_s) - ValA_s(t)A_s(t) + W\text{WoolPrice}(t)}{ValA_s(t)A_s(t) + q_i NSI} \\
&= \frac{P_s + WW^\dagger}{1 + L_s}
\end{aligned} \tag{6.3}
$$

where $W^\dagger = \dfrac{\text{WoolPrice}(t)}{ValA_s(t)A_s(t)}$.

$\boldsymbol{Q}$ is the set of simulated observations of R_c, R_k, and R_s generated through the combination of the extended *GRASP* model and commodity prices. The extended *GRASP* simulations to generate $H_c^\dagger$, $H_k^\dagger$ and W. The price simulations gave P_c, P_k, P_s and $W^\dagger$. The current values ((ABARE, 2010) and T. Garrett, pers.

comm., 2010) for the price of cattle, kangaroo sheep and non-stock investments were used to give Value_i and NSI.

6.2 Portfolio Optimisation Using the Simulated Results

As mentioned previously landholders are not purely interested in maximising their return. They also have to weigh up the risks involved in each grazing strategy. To this end three techniques for optimal portfolio allocation are investigated, an efficient frontier constructed and their results compared. The classical mean-variance (M-V) portfolio optimisation method uses variance as a proxy for risk. Given the minimum acceptable expected return, this selects the portfolio with the least variation. The average value-at-risk ($AVaR$) portfolio optimisation method defines risk as the average loss in the worst $\epsilon\%$ of cases. Given the minimum acceptable expected return, this method selects the portfolio that minimises the $AVaR_\epsilon$. The multi-objective optimisation problem (MOP) method used uses a risk aversion metric to trade-off minimising variance (a proxy for risk) and maximising return.

6.2.1 Mean-Variance Optimisation

The benefits to the M-V approach relate to ease of use and understanding. Computationally it is easy to solve the quadratic optimisation. The idea of allocating resources is readily accepted. Both measures (expectation and standard deviation) are known to many people and can be explained with relative ease. The efficient frontier (the set of pareto-optimal solutions) gives a clear visual interpretation to the balance between return and a proxy for risk. Using the formulation given in Equation 1.1 and the notation in Table 6.1 the M-V requires the solution of the following problem,

$$\begin{aligned}
\min_{\boldsymbol{q}} \quad & \boldsymbol{q}^T \boldsymbol{\Sigma}_R \boldsymbol{q} \\
s.t. \quad & \boldsymbol{e}^T \boldsymbol{q} = 1 \\
& \boldsymbol{\mu}_R^T \boldsymbol{q} \geq \mu_* \\
& \boldsymbol{q} \geq \boldsymbol{0}
\end{aligned} \tag{6.4}$$

where $\boldsymbol{\mu}_R$ and $\boldsymbol{\Sigma}_R$ are estimated from $\boldsymbol{Q}$ and given below.

$$\boldsymbol{\mu}_R = \begin{pmatrix} 0.08018 & 0.00578 & 0.03118 \end{pmatrix}$$

$$\boldsymbol{\Sigma}_R = \begin{pmatrix} 0.00142 & 0.00017 & 0.00048 \\ 0.00017 & 0.00030 & 0.00002 \\ 0.00048 & 0.00002 & 0.00091 \end{pmatrix}$$

Solving the optimisation problem 6.4 for different values of μ_* (minimum acceptable relative return) gives the efficient frontier. Figure 6.1a shows the M-V efficient frontier, while Figure 6.1b shows the associated allocation. It is clear from Figure 6.1 that as the variance, and therefore relative return, increases the preference changes from kangaroos to cattle. Sheep allocation stays relatively stable until it is replaced by cattle at the higher variance levels. It is also noted that at either end of the variance scale not all herbivores are allocated to the property.

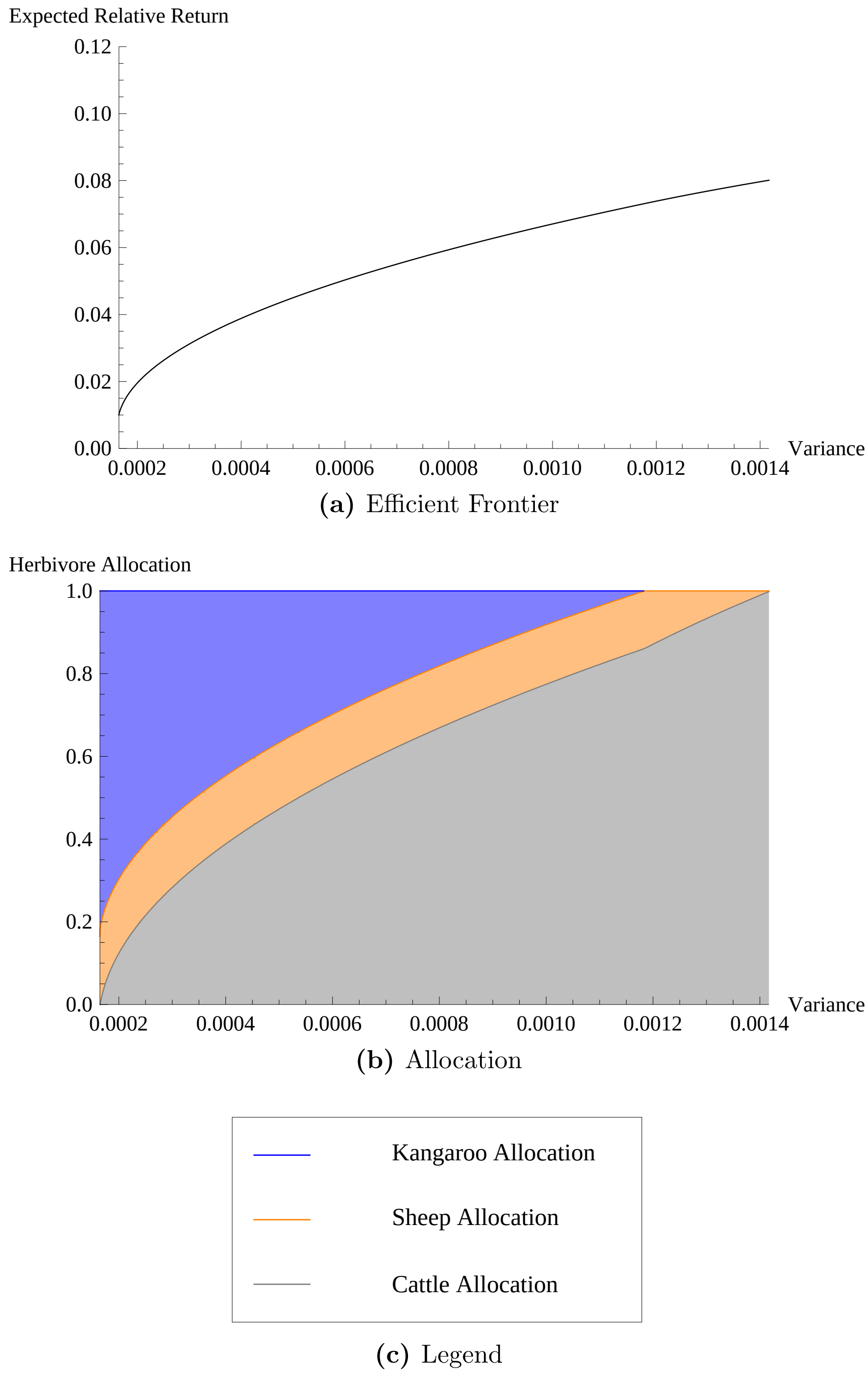


Figure 6.1: The efficient frontier of mean-variance plane. The shaded regions show how the allocation of forage is aligned to the variance.

To put these results in context, consider a landholder who has a $200km^2$ property and wishes to have an expected relative return of 7%. Their best option (in a *M-V* sense) would be an allocation of $162.9km^2$, $28.4km^2$ and $8.7km^2$ to cattle, sheep and kangaroo respectively. The expected return for this allocation would be $\$630,332$ given an investment of $\$9,004,740$ with a standard deviation of $\$296,470$.

There is one possible problem with the *M-V* approach in this case. To consistently give the best return for the same variance the underlying distribution of $\boldsymbol{Q}$ should be multivariate normal. This property is known as second-order stochastic dominance (*SSD*) (Rachev *et al.*, 2008). Using a Shapiro-Wilk multivariate normality test on $\boldsymbol{Q}$ gave a p-value $= 0.038$, which means at the usual significance level (0.05) the assumption that $\boldsymbol{Q}$ is multivariate normal is rejected. Therefore the *M-V* portfolio optimisation is unlikely to be *SSD*. Hence, it is possible the best return for the same variance has not been selected.

6.2.2 Average Value at Risk Optimisation

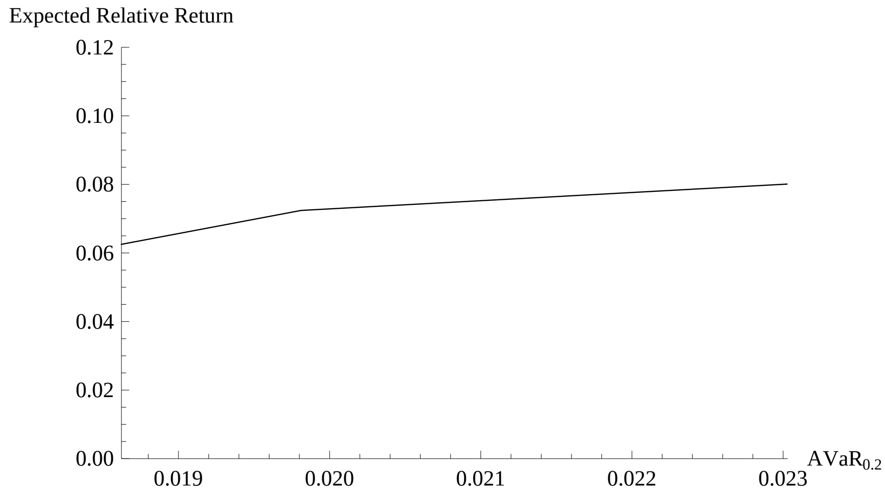
An alternative to classifying risk as variance is using a measure like average value-at-risk (*AVaR*, also known as conditional value at risk). *AVaR* is SSD without requiring multivariate normal returns (De Giorgi, 2005). *AVaR* is based on the expected return given that the return was in the lowest ϵ of the distribution. If the distribution is not known, the *AVaR* of a single return can be estimated from a sample via the Equation 6.5 (Rochafellar and Urasev, 2000).

$$\widehat{AVaR}_\epsilon(r) = \min_{\vartheta \in \mathbb{R}} \left(\vartheta + \frac{1}{n\epsilon} \sum_{j=1}^{n} \max\{-r_j - \vartheta, 0\} \right) \tag{6.5}$$

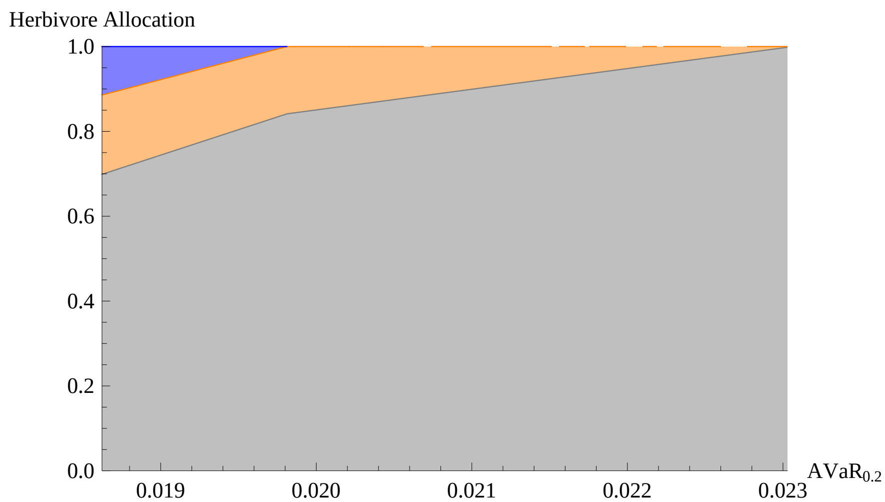
where ϑ is an auxiliary variable. Optimising the $AVaR$ for a portfolio can be done via the following optimisation problem (Palmquist *et al.*, 2002).

$$\begin{aligned} \min_{\boldsymbol{q},\vartheta,\boldsymbol{d}} \quad & \vartheta + \frac{\boldsymbol{q}^T \boldsymbol{e}}{n\epsilon} \\ s.t. \quad & -\boldsymbol{Q}\boldsymbol{q} - \vartheta \boldsymbol{e} \leq \boldsymbol{d} \\ & \boldsymbol{e}^T \boldsymbol{q} = 1 \\ & \boldsymbol{\mu}_R^T \boldsymbol{q} \geq \mu_* \\ & \boldsymbol{q} \geq \boldsymbol{0}, \boldsymbol{d} \geq \boldsymbol{0}, \vartheta \in \mathbb{R} \end{aligned} \tag{6.6}$$

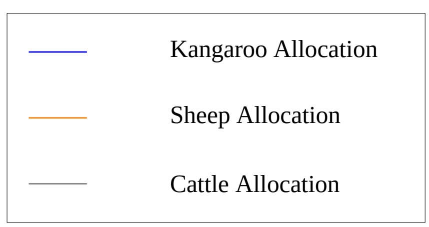
where $\boldsymbol{d}$ is a vector of auxiliary variables and ϑ is the additional parameter coming from the minimisation formula. Solving the optimisation problem 6.6 for different values of μ_* gives the efficient frontier. Consider the $AVaR$ at a tail probability of $\epsilon = 0.2$. That is the (relative) expected loss given that the return is in the bottom 20% of portfolio returns. Put another way, on average, every five years you would expect to have a loss this large. Figure 6.2a shows the $AVaR_{0.2}$ efficient frontier, while Figure 6.2b shows the associated allocation. It is clear from Figure 6.2 that as the $AVaR_{0.2}$, and therefore relative return, increases the preference changes from kangaroos to cattle. Sheep allocation stays relatively stable until it is replaced by cattle at the higher variance levels. It is also noted that at either end of the variance scale not all herbivores are allocated to the property. To put these results in context consider a landholder who has a $200km^2$ property



(a) Efficient Frontier



(b) Allocation



(c) Legend

Figure 6.2: The efficient frontier of mean-risk plane. The shaded regions show how the allocation of forage is aligned to the risk.

and wishes to have an expected relative return of 7%. Their best option (in a *AVaR* sense) would be an allocation of $161.3km^2$, $33.1km^2$ and $5.6km^2$ to cattle, sheep and kangaroo respectively. The expected return for this allocation would be $\$629,890$ given an investment of $\$8,998,430$ with an *AVaR* of $\$175,666$.

6.2.3 Multi-objective Optimisation Problem

Alternatively, the problem can be formulated as a *MOP*. The *MOP* formulation allows for greater diversity in what can be considered in the objective function. Using a similar formulation to that in Section 2.1 an objective function that trades off risk and return is,

$$\begin{aligned} \min_{\boldsymbol{q},\vartheta,\boldsymbol{d}} \quad & \frac{\lambda\left(\vartheta + \dfrac{\boldsymbol{q}^T\boldsymbol{e}}{n\epsilon}\right)}{AVaR^*} - \frac{(1-\lambda)\boldsymbol{\mu}_R^T\boldsymbol{q}}{\mu^*} \\ s.t. \quad & -\boldsymbol{Q}\boldsymbol{q} - \vartheta\boldsymbol{e} \leq \boldsymbol{d} \\ & \boldsymbol{e}^T\boldsymbol{q} = 1 \\ & \boldsymbol{q} \geq \boldsymbol{0}, \boldsymbol{d} \geq \boldsymbol{0}, \vartheta \in \mathbb{R} \end{aligned} \tag{6.7}$$

where $AVaR^*$ is the minimum *AVaR* and μ^* is the maximum relative return. The benefit of this formulation is two fold:

- It allows for the use of a single risk aversion parameter (λ) to determine the best grazing strategy.
- The risk and return components of the objective function are relative to their optimal values.

Comparison to the minimum risk and maximum return results in the strategy only changing once the relative reduction in risk outweighs the increase in return and vice versa. This is clearly illustrated in Figure 6.3. Think of the *AVaR* efficient frontier for the portfolio (Figure 6.2a). What the *MOP* then does is uses that as its feasible region for the optimisation of the linear objective function. Therefore the solutions must come from the vertices (and technically the edges) of the feasible region. As the risk aversion (λ) changes, it is only when the gradient of the objective function $\left(\dfrac{\lambda}{1-\lambda}\right)$ equals a gradient of the feasible region that the solution changes. When the gradients are equal, the the allocation could take any point on that edge. The *MOP* effectively compresses the possible allocations. In this case that compression results in only three allocations, low, moderate and high risk aversion as shown in Figure 6.3 and Table 6.4.

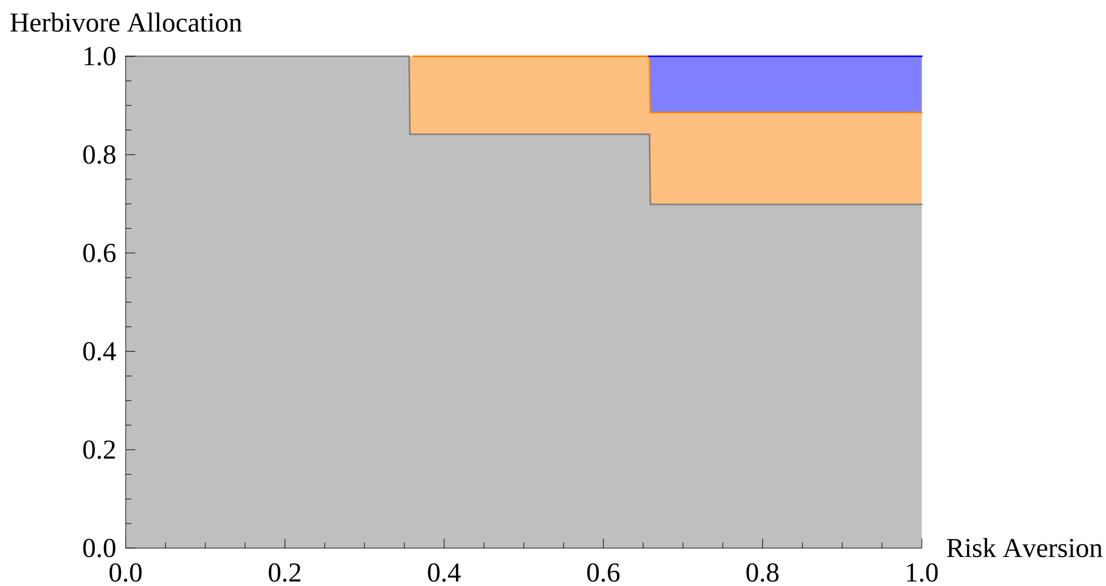


Figure 6.3: The allocation of the property to each species as the landholder's risk aversion changes.

Outcome	(Units)	Risk Aversion Low ($0 \leq \lambda \leq 0.356$)	Moderate ($0.356 \leq \lambda \leq 0.658$)	*High* ($0.658 \leq \lambda \leq 1$)
Investment	(\$)	9,090,560.	9,011,770.	8,956840.
Return	(\$)	728,154.	652,452.	560,000.
$AVaR_{0.2}$	(\$)	209,360.	178,528.	166,800.
Cattle	(ha)	200.0	168.3	139.8
Sheep	(ha)	0.0	31.7	37.4
Kangaroo	(ha)	0.0	0.0	22.8

Table 6.4: The investment, return, *AVaR* and herbivore land allocation under the *MOP* for a $200km^2$ property. Money in 2009/2010 dollars.

6.2.4 Portfolios Considering Methane Emissions

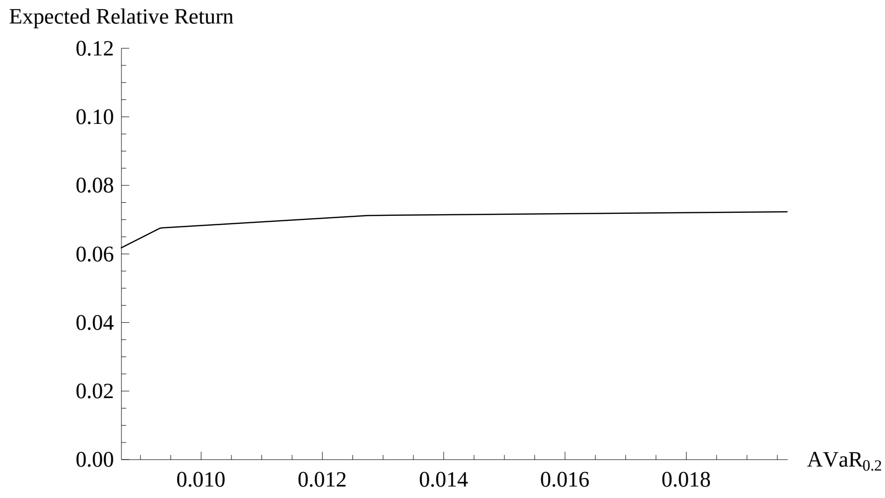
A consideration for landholders in the future may be carbon emissions. Cattle and sheep produce substantially more methane than kangaroos (Wilson and Edwards, 2008). Using average densities and emissions kangaroos emit less than a tenth and a twenty-fifth the methane of sheep and cattle respectively. Therefore, as if emission from agriculture were to be considered then kangaroo harvesting may become more appealing. Garnaut (2008) gave a target of 10% reduction carbon emission from 2000 levels by 2020.

Assuming the property was exclusively using cattle (the highest emitter of methane). Then using the 10% reduction target for an *AVaR* portfolio optimisation just requires the optimisation problem 6.6 to include another constraint,

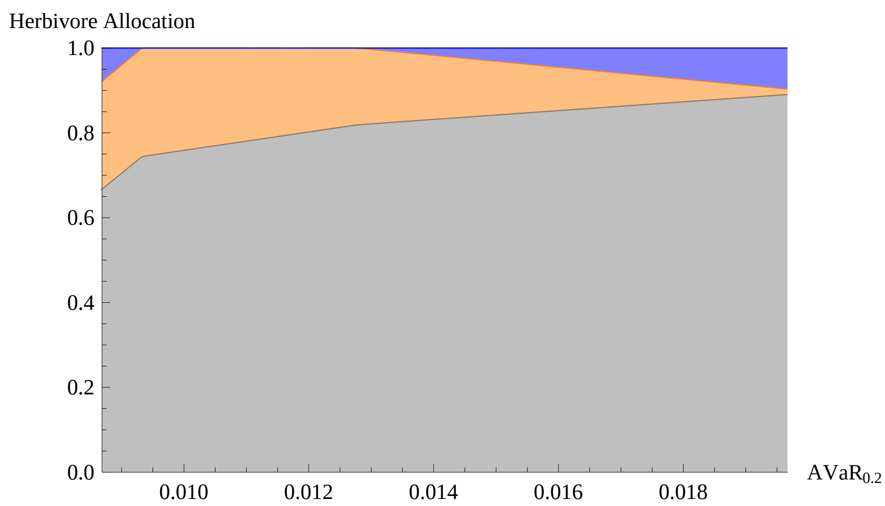
$$\mathbf{Methane}^T \boldsymbol{q} \leq 0.9\text{Methane}_c$$

where $\mathbf{Methane} = \{\text{Methane}_c, \text{Methane}_k, \text{Methane}_s\}$ is the average methane levels per hectare using each species exclusively. Reducing the methane emissions has also changed the optimal portfolios significantly. The efficient frontier for this new problem shows that the returns have been reduced compared to the solutions in Section 6.2.2 (see Figure 6.4a). The allocation of forage to each species has substantially changed (see Figure 6.4b). Note that at either end of risk aversion that all three herbivores are now allocated forage and that there is a section where the pareto-optimal solution does not include any kangaroo allocation. This is due to the fact that while sheep methane emissions are much higher than kangaroo emissions, they are still under half the emissions of cattle per hectare per year. Sheep also higher relative returns than kangaroo and so provide a better option for reducing emissions for the moderately risk adverse. When relative returns are more important, kangaroos low emission offset the much higher returns available through cattle allocation.

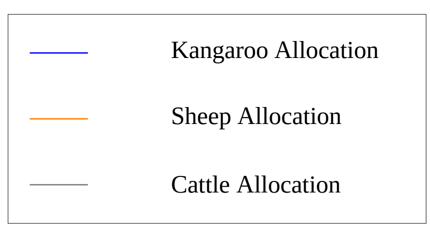
To put these results in context consider a landholder who has a $200km^2$ property and wishes to have an expected relative return of 7%. Their best option (in a $AVaR$ sense) with at least a 10% reduction in methane emissions would be an allocation of $158.8km^2$ and $41.2km^2$ to cattle and sheep respectively, with no kangaroo allocation. The expected return for this allocation would be $\$629,156$ given an investment of $\$8,998,950$ with an $AVaR$ of $\$104,371$ and methane emissions of 22.8 $tonnes/year$ (an 11.4% reduction).



(a) Efficient Frontier



(b) Allocation



(c) Legend

Figure 6.4: The efficient frontier of mean-risk plane including a 10% reduction in methane emissions from a cattle only base. The shaded regions show how the allocation of forage aligned to the risk.

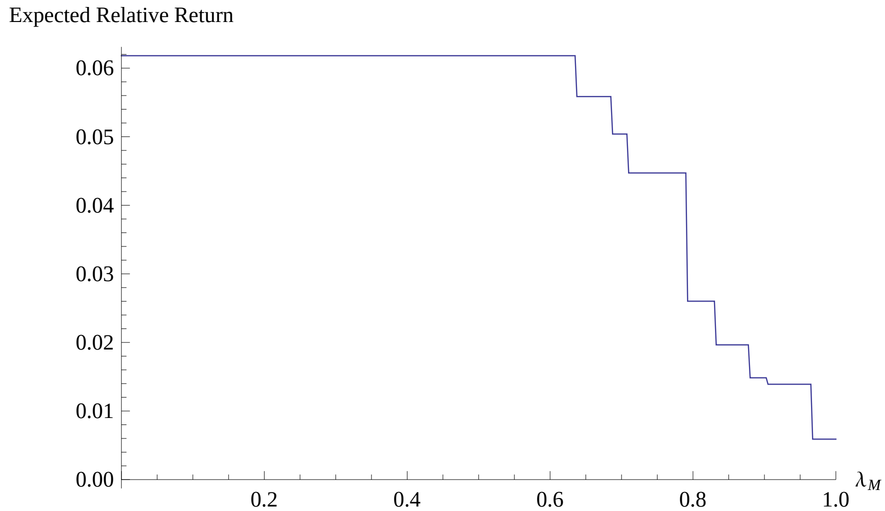
Presently it is unclear if a 10% reduction in carbon emissions will be enforced on agriculture in Australia. Therefore it may be more of a choice that a landholder may wish to consider their carbon emissions. The relative level of methane emissions can be dealt with via an *MOP*. Including a term minimising the methane emissions (compared to an exclusively cattle emission) results in the following *MOP*,

$$\begin{aligned} \min_{\boldsymbol{q},\vartheta,\boldsymbol{d}} \quad & \frac{\lambda_A\left(\vartheta + \dfrac{\boldsymbol{q}^T\boldsymbol{e}}{n\epsilon}\right)}{AVaR^*} - \frac{\lambda_R \boldsymbol{\mu}_R^T \boldsymbol{q}}{\mu^*} + \frac{\lambda_M \mathbf{Methane}^T \boldsymbol{q}}{\text{Methane}_c} \\ s.t. \quad & -\boldsymbol{Q}\boldsymbol{q} - \vartheta \boldsymbol{e} \leq \boldsymbol{d} \\ & \boldsymbol{e}^T \boldsymbol{q} = 1 \\ & \lambda_A + \lambda_R + \lambda_M = 1 \\ & \boldsymbol{q} \geq \mathbf{0}, \boldsymbol{d} \geq \mathbf{0}, \vartheta \in \mathbb{R} \end{aligned} \tag{6.8}$$

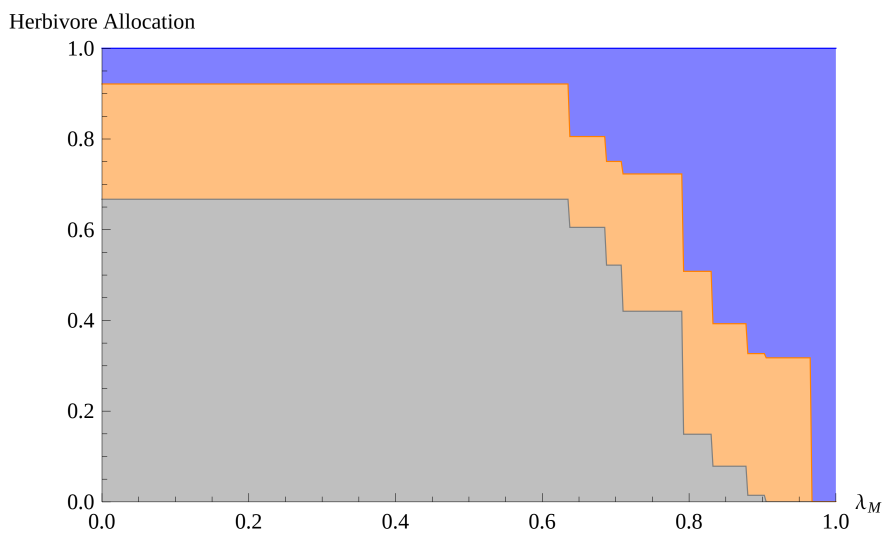
where $AVaR^*$ is the minimum *AVaR*, μ^* is the maximum relative return and λ_A, λ_R and λ_M are the preference weighting for minimising risk, maximising relative returns and maximising the relative decrease in methane emissions respectively. Two scenarios are used to illustrate the affect of including methane emission reduction on expected relative returns.

The first scenario involves an equal split of preferences between maximising returns and emission reduction and minimising risk. The resulting regime on a $200km^2$ cattle property has; an investment of \$8,935,790; a reduction in methane emissions of 21.6%; an expected return of \$552,341 (6.2%); an *AVaR* of \$77,616 (0.1%); and allocation of $133.4km^2$, $50.8km^2$ and $15.8km^2$ to cattle, sheep and kangaroo respectively. Note that the reduction in methane emissions quite large.

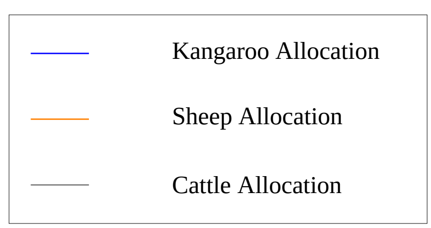
The second scenario involves exploring the affect of the preference for reducing methane emissions (λ_M), where the remaining preferences (λ_R and λ_R) are split in a ration of 3:1 respectively. It can be seen that when methane emission reduction is preferred that expected relative revenue falls (see Figure 6.5a) and the kangaroo allocation increases (see Figure 6.5b). For most methane emission reduction preferences ($\lambda_M < 0.625$) the solution is actually the same result as in equal weighting scenario.



(a) Expected Relative Return



(b) Allocation



(c) Legend

Figure 6.5: The expected relative returns against the preference for methane emission reduction. The shaded regions show how the allocation of forage aligned to the preference for methane emission reduction. The remainder of the preferences are shared between maximising returns and minimising risk in a ratio of 3:1.

6.3 Discussion

According to ABARE (2010) average rate of return since 1985 is 7.34% with a standard deviation of 7.65%. For the same expected relative return the efficient frontier using the *M-V* has a standard deviation of (3.42%). The *AVaR* for the average rate of return over the same period was estimated at 5.35%, compared to 1.44% with the portfolio optimisation simulation. Either portfolio method resulted in a reduction in the risk for the average property in the region.

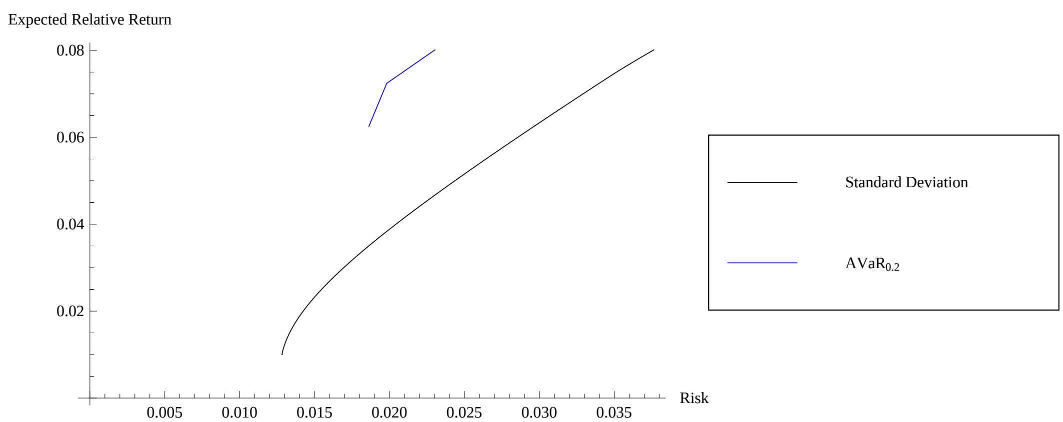


Figure 6.6: The efficient frontiers (in terms of risk) of both the *M-V* and *AVaR* approaches.

It is clear that when the comparing the *M-V* and *AVaR* efficient frontiers (Figure 6.6) that as expected the maximum relative returns are equal. However, it is noted that the minimum expected relative returns are quite different, with the *AVaR* the larger of the two. Simplifying the choice for the landholder through the *MOP* resulted in three scenarios, two of which had mixed-grazing profiles.

Consideration of methane emission reductions affected the allocation of forage. When a methane emission reduction target is set to 10% as cited by Garnaut

(2008) the result for a landholder only concerned with expected relative returns has; their expected relative return reduced from 8.0% to 7.2%; their *AVaR* reduced from 2.3% to 1.9%; and kangaroos are now included in the optimal portfolio. If the landholder is particularly concerned with reducing their methane emissions then kangaroos are an important part of the solution. However, this comes at considerable expense in substantially reduced expected relative revenue.

The analysis in this chapter highlights several points. Cattle give the best return to the point of excluding sheep and kangaroo if maximising returns is the only issue. When minimising risk (which ever way it is measured) a combination of cattle, sheep and kangaroos is preferred. However, in the majority of cases the reduction in risk would be considered by most to be too small compared to the reduction in expected relative return. Hence, it is unlikely in the current circumstances that landholders would convert much if any of their land over to kangaroo production. If carbon reduction measures need to be taken by the landholders in the future two results are clear for those focussing on expected relative returns; the expected relative returns will be reduced; and, kangaroos harvesting would increase to counter-balance the high emission herbivores.

Chapter 7

Conclusion

The present view amongst the majority of landholders in Australia is that macropods (kangaroos and wallabies) are pests that increase grazing pressure without any financial return to them. Hence, landholders allow harvesting to occur on their properties in order to reduce their numbers. They receive no explicit financial compensation from the harvesters, seeing it as pest control. However, it has been argued that converting some production to kangaroo commodities would have beneficial ecological and environmental consequences. Native species, including macropods, cause significantly less damage to fragile soils and the creation of wooded refuges would enhance kangaroo numbers and increase biodiversity. Kangaroos emit significantly less methane (a greenhouse gas) than either cattle or sheep (0.18% and 2.14% per head of their emissions respectively). Logically then, if it can be shown that diversifying commodities through mixed-grazing (including kangaroo) can be beneficial financially, the ecological and environmental gains would follow consequentially.

In the semi-arid rangeland of the Maranoa region of Queensland issues of grazing pressure and land degradation are even more important. In this environment enhancing a property's resilience is essential. Resilience can be improved through sustainable natural resource management and reducing financial risk. One way to analyse different stock options and their associated risks is through portfolio optimisation. Portfolio optimisation endeavours to select the strategy with the least risk for a given return. Each commodity is allocated a fraction of the available resources. In this case that resource can be considered the available forage, land or total grazing pressure. An exploratory portfolio analysis (see Chapter 2) showed that when the non-stock investment (*NSI*) was large the portfolio's preference was for herbivores of greater value. When the *NSI* for a property is low or the landholder was moderately risk adverse mixed-grazing involving all species was optimal. Effectively, kangaroo allocations were higher on more marginal properties.

Allocating forage to different species is only possible if population size of each species can be controlled, otherwise competitive exclusion, where one species dominates another, and kangaroo population movements could override the allocations. Also, concerns were raised during meetings with landholders in the Maranoa region about the effect of encouraging kangaroos on neighbouring properties. The effect from kangaroos (a mobile species that can cross boundaries and cannot always be explicitly controlled) was explored in Chapter 4. It concluded that, as long as steps are made to use the forage efficiently, then kangaroo movement between properties should not present a problem. Moreover, properties that border a national park or similar unharvested area could benefit from the kangaroo movement. Additionally, as long as forage is utilised efficiently and there is refuge from harvesting, then competitive exclusion should not occur. It was ultimately shown that a cooperative approach produced better results, an important consideration given a kangaroo harvesting cooperative is being established around Mitchell in the Maranoa region.

It is thought that many landholders over-estimate the impact kangaroos have on grazing pressure. This is evidenced in the landholder's belief that the impact of a kangaroo is $70 - 80\%$ of that of a sheep. More recent studies (Munn *et al.*, 2009) as well as the kangaroo population model used in this thesis (see Chapter 5) have the impact of at about half that rate. This point should be brought to the attention of landholders. A better understanding of the impact of kangaroo's may lead to different management strategies by landholders.

The analysis of the ecological and economic model emphasised several features outlined below. The amount of meat produced per hectare of kangaroo on average was quite small when compared to beef or even wool production (Table 6.2). Hence, if maximising returns is the only issue, cattle produce the best return to the point of excluding sheep and kangaroo. The model reflects that in the majority of cases the reduction in risk is too small to consider the inclusion of kangaroos. That is, only for the risk adverse was a combination of cattle, sheep and kangaroo preferred. Hence, it is unlikely in the current circumstances that landholders would convert much, if any, of their land over to kangaroo production.

For this conclusion to change substantially would one or more modifications to the current state-of-play regarding kangaroos, agribusinesses and government policies would be required. These modifications include;

- Reduce methane emission - A requirement to reduce methane emissions would increase the viability of inclusion of kangaroo because their methane emissions are very small relative to cattle and sheep (see Section 6.2.4).

- Increase the price paid for kangaroo meat - Kangaroo meat pricing is much less than that of other commodities produced. When *NSI* required is large, allocations of animals of low value (even if their reproduction rate is high) are reduced. If the price of kangaroo was to increase, its viability would improve.

- Place a value on kangaroo skins for the landholder or harvester - Currently the value of the kangaroo to a landholder or harvester does not seem to include a price for the skin (McLeod *et al.*, 2004). The skin is quite valuable in itself. If some of this value was to be reflected in the price paid for kangaroo carcasses, the allocations for kangaroo would increase.

- Reduce the high rate of juvenile mortality in kangaroos - Kangaroo juvenile mortality is so high that even though they can breed quickly, the quantity harvestable is relatively small. It is possible that the kangaroo juvenile mortality rate could be decreased, however, as kangaroos "belong" to the government and not the landholder, it is unclear as to why landholders would incur the expense given they are not the legal owner of the animal. If more young-at-foot survived, the population demographics would change and increase the quantity of harvestable kangaroos.

- Increase the rate at which kangaroos gain weight - The rate at which kangaroos put on weight is much slower than cattle. This is to be expected, as beef cattle are domesticated and have been selectively bred for weight gain. However, increased rate of weight gain should not arise through increased levels of fat as one of the key selling points of kangaroo meat is the fact that it is very lean. If kangaroos gained weight at a faster rate it would be more viable for landholders to diversify into kangaroo commodities.

- Amend policies concerning kangaroo population management - Live kangaroos cannot be legally bought and sold in Australia. Therefore, increasing population size on the landholder's property must be via births, enticement to immigrate, or reduction in harvest. Any of these options take time, unlike domestic animals, which can be readily bought and sold. If policy changes, then kangaroos could be farmed in a more traditional sense, kept within boundaries and owned by the landholder. That may allay some concerns landholder have about diversifying into an animal that they cannot own or control.

The list above addressed changes that may increase the uptake of landholders diversifying into kangaroo commodities. If diversification becomes more viable then the following are practical difficulties needing to be addressed: the relationship between processors and harvesters; the relationship between harvesters and landholders; and, limitations of harvest quotas. Considering the relationship between processors and harvesters, all the power is with the processors. They set the prices and can enforce requirements above that required by the government. Working together to ensure supply and quality could be beneficial to both parties. The relationship between harvesters and landholders also needs consideration. Currently harvesters operate across many properties without explicit financial return to the harvesters and landholders. Harvesters need permission to enter properties and landholders could harvest for themselves. Alternatively, co-operation between landholders and harvesters could guarantee access and quality of supply over a wider range of properties. Harvest quotas may also need to be redefined in the future. Greater acceptance for kangaroo meat within Australia and internationally could affect its demand, and this would impact its price and in term, the incentive to diversify. If diversification into kangaroos was to increase, there may be an issue with harvest quota's being reached. If the quota is reached, there is no incentive for the landholders to diversify.

Further research needs to be carried out on the speed at which kangaroos resettle in different areas. Understanding when and how quickly kangaroo mobs relocate is key to including migration into the extended GRASP model. That in turn would enable the construction of a spatial model. The model requires validation, but it is impracticable at present due to the substantial time and money that would be required to gather the data. Other areas for continuing research into mixed-grazing include the effect on the environment under different strategies. The *MOP* methodology would be key in the inclusion of biodiversity and conservation objectives.

A model for the dynamics of the plant-herbivore system and the economics that underlay grazing in semi-arid Australia has been created. Analysis of this model shows that under the current circumstances, combining native species into a mixed-grazing regime is preferable for the risk adverse, more marginal land, or if greenhouse gas emission reduction is required. If returns are considered more important, then domestic stock is dominant. When forage is used efficiently or landholders co-operate in setting stocking rates, a mobile species (such as kangaroo) should not impact neighbouring properties.

Appendix A

Proofs and Lemmas

A.1 Proof of MSY for alternative harvest function

Theorem 1. *When maximising the maximum sustainable yield (*MSY*) for a species its rate of change determined by*

$$\frac{dN}{dt} = \nu N\left(1 - \frac{N}{\kappa}\right) - \gamma \max\{0, N - \eta\}$$

then the MSY *is when the population is half the carrying capacity and the harvesting variables are;*

$$\gamma = \frac{\nu\kappa}{2(\kappa - 2\eta)}$$

given that $\nu > 0$ *and* $0 < \eta < \frac{\kappa}{2}$.

Proof. For the harvest to be sustainable, implies the rate of change is zero,

$$\frac{dN}{dt} = \nu N\left(1 - \frac{N}{\kappa}\right) - \gamma \max\{0, N - \eta\} = 0.$$

Solving this equation for N gives the possible solutions,

$$N = 0,\ \kappa,\ \text{or}\ \frac{\kappa\nu - \gamma\kappa \pm \sqrt{\kappa^2(\gamma - \nu)^2 + 4\nu\kappa\gamma\eta}}{2\nu}.$$

The solutions $N = 0$ or κ relate to when no harvesting occurs ($N < \eta$). Therefore, it is only the last solutions that are of interest. Looking at the derivative of the differential equation (*w.r.t.* N) and substituting in the last two equilibriums gives,

$$\mp\sqrt{\gamma^2 + \nu\gamma\left(\frac{4\eta}{\kappa} - 2\right) + \nu^2} + \begin{cases} 0, & \nu\kappa \pm \sqrt{\kappa(\gamma^2\kappa + 4\nu\gamma\eta - 2\nu\gamma\kappa + \nu^2\kappa)} > \gamma\kappa + 2\nu\eta \\ \gamma, & \text{otherwise} \end{cases}$$

It is clear that when considering the parameters are only positive, the first of those expressions is negative (as long as $0 < \eta < \kappa$), while the second is positive. Hence, the third of the original equilibria is stationary. Substituting the stationary equilibrium solution into the harvesting component and then maximising *w.r.t.* η gives the following solution for the optimal η,

$$\eta^* = \begin{cases} \frac{2\gamma\kappa - \nu\kappa}{4\gamma}, & 0 < \eta < \frac{\kappa}{2} \\ 0, & \text{otherwise} \end{cases}$$

Substituting this equation back into the harvesting component results in,

$$H^* = \begin{cases} \frac{\nu\kappa}{4}, & 0 < \eta < \frac{\kappa}{2} \\ 0, & \text{otherwise} \end{cases}$$

Note that the harvest equation is independent of γ. Hence, the values of γ and η that maximise the harvest are determined by the other, conditional on $0 < \eta < \frac{\kappa}{2}$. Therefore, the optimal harvest is when,

$$\gamma^* = \begin{cases} \frac{\nu\kappa}{2(\kappa - 2\eta)}, & 0 < \eta < \frac{\kappa}{2} \\ 0, & \text{otherwise} \end{cases}$$

Substituting either γ^* or η^* into the stationary equilibrium solution gives the population for optimal harvest (MSY) as,

$$N^* = \frac{\kappa}{2}$$

$\square$

A.2 Proposition of Migration equation

Proposition 2. *Assuming that the ideal free distribution (IFD) holds, then the rate of migration to Region 1 from Region 2 follows the equation*

$$Migration = \frac{1}{\tau}\frac{\omega_1 x_2 - \omega_2 x_1}{\omega_1 + \omega_2}$$

where τ controls the speed at which the population moves between regions, x_1 and x_2 and ω_1 and ω_2 are the populations and carrying capacities for Region 1 and Region 2 respectively.

Proof. The IFD infers that the ratio between population and carrying capacity in the regions and the overall ratio should be equal.

$$\frac{x_1 + x_2}{\omega_1 + \omega_2} = \frac{x_1}{\omega_1} = \frac{x_2}{\omega_2}$$

Concentrating on Region 1, the above implies

$$x_1 = \omega_1 \frac{x_1 + x_2}{\omega_1 + \omega_2}$$

Formulating the rate of change in migration using a goal-gap formulation give the following migration equation

$$\text{Migration} = \frac{1}{\tau}\left(\omega_1 \frac{x_1 + x_2}{\omega_1 + \omega_2} - x_1\right) = \frac{1}{\tau}\frac{\omega_1 x_2 - \omega_2 x_1}{\omega_1 + \omega_2}$$

where τ controls the speed at which the population moves between regions. Repeating the process for Region 2 shows that there is a conservation of population (emigration equals immigration). □

A.3 Proof of conditions for greater harvest with finite migration

Theorem 3. *Let two properties have equal carrying capacity and logistic herbivore growth rates. If they have porous borders, migration of herbivores between the properties is governed by by the* IFD. *When optimal harvesting regimes are used on Property 1 and if* $2\nu\tau > 1$ *and* $N_2 > \dfrac{\kappa(4\nu\tau - 1)}{8\nu\tau}$, *then*

$$H^*_{\textit{finite migration}} \geq H^*_{\textit{isolation}}$$

Proof. From Table 4.2 the optimal harvest under isolation is,

$$H^*_{\text{isolation}} = \frac{\kappa\nu}{4}$$

whilst from Equation 4.15 the optimal harvest under under finite migration is,

$$H^*_{\text{finite migration}} = \frac{\kappa(2\nu\tau - 1)^2 + 8\nu\tau N_2}{16\nu\tau^2}$$

when $2\nu\tau > 1$. Rearranging $H^*_{\text{finite migration}}$ to get the $H^*_{\text{isolation}}$ term isolated,

$$\frac{\kappa(2\nu\tau - 1)^2 + 8\nu\tau N_2}{16\nu\tau^2} = \frac{\kappa(1 - 4\nu\tau) + 8\nu\tau N_2}{16\nu\tau^2} + \frac{\kappa\nu}{4}$$

Now

$$\frac{\kappa(1 - 4\nu\tau) + 8\nu\tau N_2}{16\nu\tau^2} \geq 0$$

if

$$N_2 \geq \frac{\kappa(4\nu\tau - 1)}{8\nu\tau} = \frac{\kappa}{2} - \frac{\kappa}{8\nu\tau}$$

So if as N_2 no more than $\dfrac{\kappa}{8\nu\tau}$ below $H^*_{\text{isolation}}$ then,

$$\frac{\kappa(1 - 4\nu\tau) + 8\nu\tau N_2}{16\nu\tau^2} + \frac{\kappa\nu}{4} \geq \frac{\kappa\nu}{4} = H^*_{\text{isolation}}$$

Hence,

$$H^*_{\text{finite migration}} \geq H^*_{\text{isolation}}$$

under the given conditions. □

A.4 Proof of the value of the Nash Equilibrium Point for a herbivore with finite migration

Theorem 4. *Let two properties have logistic herbivore growth, harvest is the* MSY *rates and porous borders, where migration of herbivores between the properties is governed by by the* IFD*. Then the Nash equilibrium point for the competitive game is when*

$$N_1 = \frac{\kappa_1(\nu\tau(\kappa_1 + \kappa_2) - \kappa_2)}{2\nu\tau(\kappa_1 + \kappa_2)}$$

and

$$N_2 = \frac{\kappa_2(\nu\tau(\kappa_1 + \kappa_2) - \kappa_1)}{2\nu\tau(\kappa_1 + \kappa_2)}$$

Proof. Given that the harvest is the only pay-off and it is MSY, then the pay-off for each property (player) is

$$u_i(N_1, N_2) = \nu N_i \left(1 - \frac{N_i}{\kappa_i}\right) + \frac{\kappa_i N_{3-i} - \kappa_{3-i} N_i}{\tau(\kappa_1 + \kappa_2}$$

Then

$$\frac{\partial u_i}{\partial N_i}(N_1^*, N_2^*) = \nu \left(1 - \frac{2N_i^*}{\kappa_i}\right) - \frac{\kappa_{3-i}}{\tau(\kappa_1 + \kappa_2)} = 0$$

when

$$N_i^* = \frac{\kappa_i(\nu\tau(\kappa_1 + \kappa_2) - \kappa_{3-i})}{2\nu\tau(\kappa_1 + \kappa_2)}$$

is the only stationary point of the function. Finally

$$\frac{\partial^2 u_i}{\partial N_i^2} = -\frac{2\nu}{\kappa_i}$$

Hence, the criteria are met to conclude that (N_1^*, N_2^*) are the only *NEP* of the game. $\square$

A.5 Proof of stability for single harvested grazer system without migration

Theorem 5. *Given grazing system with a single harvested grazer and single vegetation that operate under a linear initial regrowth model,*

$$\begin{aligned}\frac{\mathrm{d}V}{\mathrm{d}T} &= \upsilon\left(1 - \frac{V}{\kappa}\right) - \frac{\zeta V N}{\theta + V}\\ \frac{\mathrm{d}N}{\mathrm{d}T} &= \xi N\left(\frac{\zeta V}{\theta + V} - \chi\right) - \gamma N\end{aligned}$$

, then the equilibrium solution, strictly in the first quadrant, is stable.

Proof. Introducing a change of variables to the grazing system such that;

$$V \equiv \theta x,\ N \equiv \frac{\theta \upsilon y}{\zeta},\ T \equiv \frac{t}{\upsilon}$$

gives the following rescaled system,

$$\begin{aligned}\frac{\mathrm{d}x}{\mathrm{d}t} &= \left(\frac{1}{\theta} - \frac{x}{\kappa}\right) - \frac{xy}{1+x}\\ \frac{\mathrm{d}y}{\mathrm{d}t} &= \frac{\xi}{\upsilon}y\left(\frac{xy}{1+x} - \left(\chi + \frac{\gamma}{\xi}\right)\right)\end{aligned}$$

Another substitution to simplify constants of;

$$a \equiv \frac{\chi + \frac{\gamma}{\xi}}{\zeta},\ b \equiv \frac{\xi\zeta}{\upsilon},\ c \equiv \frac{1}{\kappa},\ d \equiv \frac{1}{\theta}$$

results in the rescaled system being rewritten as

$$\begin{aligned}\frac{\mathrm{d}x}{\mathrm{d}t} &= \frac{(d-cx)(1+x)-xy}{1+x}\\ \frac{\mathrm{d}y}{\mathrm{d}t} &= by\left(\frac{xy}{1+x}-a\right)\end{aligned}$$

The vegetation isocline is when $\frac{\mathrm{d}x}{\mathrm{d}t} = 0$ and implies that is when

$$y = \frac{(d-cx)(1+x)}{x}$$

While the herbivore isocline is at $\frac{\mathrm{d}y}{\mathrm{d}t} = 0$ and implies that is when

$$y = 0 \text{ or } x = \frac{a}{1-a}$$

This gives us two equilibriums, but only one of interest (strictly in the first quadrant), as a solution without herbivores is not going to be optimal in terms of harvest in a closed system. Therefore the solution of interest is

$$(x_1, y_1) = \left(\frac{a}{1-a}, \frac{d(1-a)}{a} + d - c - \frac{ac}{1-a}\right)$$

Rewriting the scaled system can ease the analysis, so,

$$\frac{\mathrm{d}x}{\mathrm{d}t} = f(x)[g(x) - y]$$
$$\frac{\mathrm{d}y}{\mathrm{d}t} = by[f(x) - a]$$

where,

$$f(x) = \frac{x}{x+1}, \; g(x) = \frac{(d-cx)(1+x)}{x} = \frac{d}{x} + d - c - cx$$

Hence the Jacobian matrix for the rewritten system is,

$$\begin{bmatrix} f'(x)[g(x) - y] + f(x)g'(x) & -f(x) \\ byf'(x) & b[f(x) - a] \end{bmatrix}$$

Given that $f(x_1) = a, \; g(x_1) = y_1$ substituting the equilibrium solution (x_1, y_1) into the Jacobian matrix, it simplifies to,

$$\begin{bmatrix} ag'(x_1) & a \\ by_1 f'(x_1) & 0 \end{bmatrix}$$

The resulting characteristic equation is therefore

$$\lambda^2 - ag'(x_1)\lambda + abyf'(x_1)$$

By the Routh-Hurwitz criterion, the coefficients of λ must be positive for the equilibrium to be stable. As $a, \; b, \; f'(x_1), \; and \; y_1$ are all strictly positive (while $-1 < x_1 < \frac{d}{c}$), stability is inferred when $g'(x_1) < 0$. Simplifying $g'(x_1)$ and also reverting back to the original coefficients gives,

$$g'(x_1) = -c - \frac{d(1-a)^2}{a^2} = -\frac{\theta(\gamma+\xi\chi)^2 + \kappa(\gamma+\xi(\zeta-\chi)^2)^2}{\theta\kappa(\gamma+\xi\chi)^2}$$

which is strictly negative. Hence, the equilibrium solution strictly in the first quadrant, (x_1, y_1), is stable. □

Appendix B

Data Tables

Year	Value			Fecundity		
	Cattle	Kangaroo	Sheep	Cattle	Kangaroo	Sheep
1988	641.67	9.19	68.05	0.2568	0.65	0.1538
1989	632.85	10.33	58.03	0.2258	0.65	0.1651
1990	669.15	9.91	41.33	0.2073	0.65	0.1229
1991	649.79	10.97	26.25	0.2276	0.65	0.0123
1992	568.70	8.61	19.85	0.2323	0.65	0.0140
1993	580.69	9.24	24.53	0.2271	0.65	0.0463
1994	620.84	9.53	34.73	0.2271	0.65	0.0818
1995	510.06	9.47	37.73	0.2168	0.65	0.1172
1996	419.34	11.75	47.31	0.2337	0.65	0.1861
1997	481.27	16.87	50.67	0.2752	0.65	0.2410
1998	572.46	19.88	39.36	0.2798	0.65	0.2190
1999	641.61	14.82	32.74	0.2741	0.65	0.2164
2000	709.53	12.96	35.03	0.2536	0.65	0.2107
2001	794.98	15.76	46.09	0.2196	0.65	0.1349
2002	698.07	14.43	53.75	0.2410	0.65	0.0268
2003	605.67	13.02	56.27	0.2840	0.65	0.1867
2004	692.08	15.67	54.72	0.2743	0.65	0.2850
2005	721.70	21.16	55.95	0.2442	0.65	0.1044

Table B.1: The data relating to the value and fecundity of the different species considered in the model.

Parameter	Value	Source
Green leaf	128	Ratio after running *GRASP* over original weather data set.
Green stem	295	Ratio after running *GRASP* over original weather data set.
Dead leaf	31	Ratio after running *GRASP* over original weather data set.
Dead stem	542	Ratio after running *GRASP* over original weather data set.
Litter	400	Value after running *GRASP* over original weather data set.
SW_1	19.7	Value after *GRASP* over original weather data set.
SW_2	44.1	Value after *GRASP* over original weather data set.
SW_3	76.0	Value after *GRASP* over original weather data set.
SW_4	110	Value after *GRASP* over original weather data set.
frost_kill	-5	Lowered so that total *tsdm* event does not occur.
target_Util	0.3	Quoted as typical by the MLA (2010).

Table B.2: The parameterisations used to initialise the *GRASP* model that differ from the parameterisation.

Glossary

ad liberum - means "as desired".

AVaR - average value-at-risk is the expected loss, given the loss in the bottom ϵ of returns.

dse - dry sheep equivalent are the standard animal unit used in Australia.

GRASP - is a computer package used to calculate forage and stocking rates in semi-arid regions of Australia.

grazing pressure - is the stress on vegetation, and therefore the ecosystem, from animal grazing.

IFD - ideal free distribution is an ecological concept implying that animals will move between areas so that the ratio of animals to carrying capacity in each area will be equal.

macropod - are marsupials belonging to the macropodidae family, including kangaroos, wallabies, wallaroos and pademelons.

maximal growth rate - is instantaneous rate of growth rate under ideal conditions.

migration - for the purposes of this thesis it defines the process of mobile herbivores moving from one property or region to another.

mobile herbivore - is a herbivore that is not confined to a property, but can move freely between properties.

MOP - multi-objective optimisation problem.

M-V - mean-variance portfolio optimisation.

NSI - non-stock investment is the amount of money invested not including the value of the stock.

off-take bias - is where one section of the population is harvested at a higher rate.

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CSIRO PUBLISHING

www.publish.csiro.au/journals/trj *The Rangeland Journal*, 2009, **31**, 283–292

Sharing Skippy: how can landholders be involved in kangaroo production in Australia?

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Abstract. For 2 decades, calls for Australian rangeland landholders to expand their reliance on the abundant species of native kangaroos and decrease their reliance on introduced stock have been made. These calls have received recent impetus from the challenge of climate change. Arguments for landholder involvement in kangaroo production include reduced greenhouse gas emissions, better management of total grazing pressure, reduced land degradation, improved vegetation and biodiversity outcomes, and greater valuation of kangaroos by landholders. However, there is little understanding of how landholders could be involved in kangaroo harvest and production, and there is a widespread misconception that this would include domestication, fencing, mustering and trucking. This paper reviews the options for landholder involvement in managing and harvesting wild kangaroos, and assesses the possible benefits and feasibility of such options. We conclude that collaboration among landholders, as well as between landholders and harvesters, forms the basis of any preferred option, and set out a proposed operating model based on the formation of a kangaroo management, processing and marketing co-operative.

Additional keywords: conservation, co-operative, sustainable use, total grazing pressure, wildlife management.

Introduction

There are several cogent arguments in favour of Australian rangeland landholders expanding their reliance on the abundant species of native kangaroos and decreasing their reliance on introduced sheep, cattle and goats (e.g. Grigg 1987*a*, 1987*b*, 1995, 2002; Ampt and Baumber 2006; Garnaut 2008; Wilson and Edwards 2008). One set of arguments relies on reduced emissions of greenhouse gases, and the other builds on the concept of 'conservation through sustainable use' and involves better management of total grazing pressure, reduced land degradation, improving vegetation and biodiversity outcomes and improved valuing of kangaroos by landholders. However, missing in this debate is examination of the question of *how* landholders could be involved in kangaroo management. This is of particular current importance, as Garnaut's (2008) recent suggestion that kangaroo production could be increased to reduce emissions from livestock received widespread criticism based on the impracticability of domesticating kangaroos (e.g. Gray 2008). Work by Wilson and Edwards (2008), to which Garnaut referred, does not in fact advocate domestication of kangaroos, but rather analysed the production of low carbon meat from wild-harvested kangaroos on the rangelands where the kangaroo industry already operates. This paper reviews the options for landholder involvement in managing and harvesting wild kangaroos, and assesses their benefits and feasibility.

Why should landholders be involved in kangaroo management?

One suite of arguments involves the argument that greater use of kangaroo in place of stock could contribute to reducing the climate impact of agriculture (Diesendorf 2007; Garnaut 2008; Wilson and Edwards 2008). In 2007, agriculture contributed ~16.3% of Australia's greenhouse gas emissions, and the majority of methane emissions (58.9%) (Department of Climate Change 2009). Most (69.3%) of these agricultural emissions are due to emissions from livestock. By contrast, kangaroos utilise a different fermentation process in the gut which does not produce methane (Kempton *et al.* 1976). Recent analysis indicates that if 20% of domestic stock on the rangelands – where the kangaroo industry already exists – were replaced by kangaroos to produce the same amount of meat, Australia's greenhouse gas emissions would be reduced by 3% per annum by 2020 (Wilson and Edwards 2008). This proposal received influential endorsement as a greenhouse gas mitigation option for the rural sector in the final report of the Garnaut Climate Change Review in September 2008 (Garnaut 2008). Although kangaroos are currently commercially harvested in large numbers, the option of reducing stock numbers to boost their production relies critically on landholder involvement.

Another suite of arguments revolves around better management of total grazing pressure (TGP), a critical priority for rangeland management (Hacker *et al*. 2005). Stocking

 10.1071/RJ08025 1036-9872/09/030283

practices and the impact of native and exotic herbivores have caused severe and widespread land degradation and soil erosion in the rangelands (Condon 2002; Beeton *et al*. 2006). Currently, landholders effectively feed all these herbivores from their land, but while sheep, cattle, and sometimes goats are sold for profit, kangaroos are essentially 'given away' to commercial kangaroo harvesters. An initial benefit of landholder involvement in kangaroo harvest is that it may allow greater control over the kangaroo component of TGP by improving communication with harvesters and response times to major kangaroo influxes (Ampt and Baumber 2006).

Greater benefits could result if income from kangaroos was able to influence stock management practices, crucial elements in rangeland management (Stafford Smith *et al*. 2000). If landholders were able to obtain a return from harvest of kangaroos they may be able to maintain productivity at a reduced stocking pressure (Grigg 1987*b*, 1988). Although stock reduction could drive a commensurate increase in kangaroos, the net result of these actions if undertaken strategically could be to maintain productivity at a reduced impact, as kangaroos have much lower energetic requirements (Grigg 1989, 1995, 2002) and a probable lower foot pressure due to lack of hard hooves (Grigg 2002). There need not be a total shift of the nature suggested in Grigg's early calls for 'sheep replacement therapy for rangelands' (Grigg 1987*a*, 1988) in order for these TGP benefits to be realised.

Further, if landholders derived an income from kangaroos, a major disincentive that currently discourages landholders from conducting some environmentally beneficial practices would be removed (Ampt and Baumber 2006). Currently, landholders who destock areas or practice rotational grazing often face large influxes of kangaroos onto the 'green pick' of destocked paddocks. This both defeats the aim of regeneration, and discourages similar efforts. A similar disincentive exists in grassy woodland environments, where eastern grey kangaroos (*Macropus giganteus*), the most commercially important species, prefer mosaics of open grassland interspersed with woodland vegetation for cover (Viggers and Hearn 2005). This means that woodland remnants or revegetation sites can be a liability for landholders as they increase kangaroo numbers, resulting in a reluctance to undertake revegetation activities. To discourage kangaroos, landholders may even decide to convert these areas to pasture for stock. If landholders were involved in kangaroo harvesting, they would benefit from kangaroos through greater harvesting returns, thereby encouraging maintenance and restoration of remnant vegetation to provide habitat.

Increasing use of kangaroos could also help maintain healthy populations of kangaroos across their range. Increasingly, methods are emerging to decrease or entirely remove kangaroos from properties. Landholders have long been able to gain non-commercial 'shoot and let lie' tags to kill kangaroos damaging their crops or pasture, but there is great interest in new technologies that reduce kangaroo numbers through preventing them drinking, including through visual recognition at water points (Finch *et al*. 2006; Foreshew 2007), and research is underway on methods of immunocontraception (Cooper and Larsen 2006). An increasing number of landholders are moving towards fencing out kangaroos completely by macropod-proof fences. This removes kangaroos completely from large areas and will inevitably disrupt foraging and dispersal patterns of other species, including small macropods of conservation concern. Grigg has expressed his concern about the attractiveness of a 'magic bullet' that would effectively and cheaply reduce kangaroo numbers – should it become available, the pressure for its use by landholders would become irresistible (Grigg 1995).

There are economic as well as environmental arguments in favour of increased landholder involvement in kangaroo management, from a variety of perspectives. For landholders themselves, earning income from wild kangaroos enables diversified income streams, increasing resilience to economic and climatic shocks. For the current kangaroo industry, there could be benefits also through securing an assured future supply of product. Currently the kangaroo industry is in a uniquely vulnerable position – it is perhaps the only primary industry that relies on a product dependent on the resources of people who typically would like to eliminate it as far as possible. If the various efforts for kangaroo reduction outlined above prove successful, or the 'magic bullet' that Grigg fears does eventuate, supply of kangaroos over the long-term is in doubt. Proposals to reintroduce dingoes into the rangelands (e.g. Johnson 2006; Glen *et al*. 2007) could present a further long-term threat to the industry. Carving out a place for landholders in the value chain could open the way to establishing co-operative relationships geared towards a common objective of ensuring abundant and sustainable populations across the rangelands, and open avenues for new marketing approaches (Ampt and Owen 2008).

Why aren't landholders involved in kangaroo management?

With trivial exceptions, landholders currently play little to no role in kangaroo management, and gain no financial return and no incentives for habitat conservation from the kangaroo populations on their land. The commercial harvest of kangaroos in Australia is conducted by licenced commercial harvesters, who are invited or allowed by landholders to shoot on their properties. Landholders are motivated typically by the wish to reduce the costs imposed by kangaroo populations, or sometimes to grant access for harvesters to secure their livelihoods. Although calls for the involvement of landholders in kangaroo harvest go back some 2 decades (Grigg 1987*a*, 1987*b*), there has been virtually no progress towards this goal.

From an outside perspective, this situation appears remarkable – globally, this is perhaps the only terrestrial harvest of a commercially valuable resource that returns no income to the landholders involved. One reason often provided for lack of landholder involvement is the relatively low price of kangaroo products (Grigg 2002). Another possible factor is the structure of the product chain, which makes it hard for landholders to secure a cut without eating into the incomes of the harvesters they rely on to control their kangaroo grazing pressure. Many of the landholders themselves cite government regulation of the harvest as the major factor (Chapman 2003). There are cultural factors at play as well – there is a long-established perception of kangaroos as a pest rather than a resource, and landholders' expertise and inclination is focused on stock management rather than management of wildlife.

However, hampering any effort to move towards greater landholder involvement is lack of clarity regarding how they could become involved. What roles would they conduct? How would they influence management? How would they work with the existing kangaroo industry – the harvesters and processors? How would they derive income? Although some broad possibilities have been highlighted in work to date (Grigg 1995; Martin 1995; Ampt and Baumber 2006), this critical issue has received scant attention. Different models have very different implications for the benefits outlined above, and very different chances of being translated into reality. This paper is the first to critically review the options and assess their implications.

Models for landholder involvement in kangaroo management

In this paper we present and discuss a series of potential models that allow rangeland landholders to be involved in and benefit from kangaroo harvesting, based on desk review and wide stakeholder consultation (see Cooney 2009). Consultation has been undertaken through Sustainable Wildlife Enterprise (SWE) projects funded primarily by the Rural Industries Research and Development Corporation (Wilson and Mitchell 2005), particularly projects involving the Mitchell and District Landcare Association in south-west Queensland and the Barrier Area Rangecare Group in north-west NSW. Both groups have been exploring these issues since 2004 and have steering groups consisting of landholders, harvesters, regional natural resource managers and researchers from the FATE Program at UNSW and Australian Wildlife Services. The Mitchell group has concentrated on the commercial end of landholder involvement in kangaroo management by investing in a chiller and commencing negotiations with processors. The Barrier Ranges group has focused primarily on licensing and regulatory aspects, negotiating a special group licence in 2008 to allow harvest across several properties with a secure quota. The models presented here were developed in consultation with members of these groups and presented to a joint SWE Workshop for feedback in February 2008.

There is a series of options for how landholders could become more involved in kangaroo management and/or gain benefits from this kangaroo harvest. Several initial points must be noted. First, these two aspects – landholder involvement in management and gaining benefits – do not always go hand-in-hand. In some of these options landholders gain a larger role in management but do not gain any income, while in others they gain a benefit but do not expand their role in management. Second, this categorisation of options is necessarily quite broad; for many of these options there could be endless minor variations on how each operates in practice. Third, some commentators assume that landholder management of kangaroos would involve mustering, branding, and tagging, as for domestic stock (e.g. Martin 1995). We believe such domestication is both highly undesirable as well as unfeasible. All our options, therefore, assume kangaroos remain as a wild, free-ranging resource moving across the landscape regardless of property boundaries.

Landholders require payment from harvesters

The most straightforward way for landholders to gain an economic return from the kangaroos on their land is to require commercial harvesters to pay them in order to enter onto their land to harvest kangaroos. This option was raised by Grigg (1995), and anecdotal accounts and discussions with landholders indicate that this has happened in certain areas at times when demand for kangaroo products is high and there is a shortage of either quota or land with harvestable populations. Landholders may require harvesters to make a payment in return for access to their land or to their quota – this could be levied per night or per kangaroo. In all states and territories of Australia, either the Crown is explicitly recognised in legislation as owning all wild animals, or this is implicitly accepted in practice. Although landholders do not own and cannot sell kangaroos themselves, there seems no legal obstacle to them making access to their land conditional upon payments such as these. The exact nature of such arrangements depends on the licensing and tagging system in the state of harvest. In Queensland, where tags are issued directly to shooters, payment for access over a period of time might be most significant, and in states where tags are issued to landholders for a specific property, such as in NSW and SA, payment could be for the tag itself, representing a right to harvest one kangaroo. Further changes to quota-setting and tagging systems could potentially see trading of tags by landholders for use elsewhere, as occurred under SA's brief and under-utilised 1996–2001tradeable quota scheme (Thomsen and Davies 2007).

The benefit of this arrangement for landholders is straightforward – they gain some income from the kangaroos on their land. If the returns were great enough, this could encourage them to view kangaroos as less of a pest and more of a resource, and potentially motivate actions towards habitat conservation and reduced stocking levels. However, a drawback of this approach for landholders is that it does not lead to a greater landholder role in kangaroo management, and will not enable them to better control TGP. Harvest management remains unchanged. Further, this approach will only be effective if there is competition between harvesters for access to country, and harvesters are willing to pay. Individual landholders have little bargaining power – if harvesters can gain country elsewhere, they will simply shoot there.

Most importantly, this approach is likely to cause resentment among harvesters, and destabilise relationships with them. Harvesters, in general, view this approach as unfair, and will strongly resist it. Access to country is a limiting factor for many harvesters, and if paying for access became essential, it would substantially decrease their already thin profit margins. In addition, many landholders also view such a practice as unfair to harvesters, and do not want to impose an additional financial burden on the harvesters who they perceive as delivering a valuable service and as valued members of the community (this study; Chapman 2003; Thomsen and Davies 2007). This model is for these reasons both undesirable and unlikely to be widely adopted, at least in the absence of a major increase in kangaroo prices and harvester profit margins.

Landholders become licenced harvesters themselves

The second fairly straightforward method for landholders to both gain economic benefits from kangaroo harvest and play a role in kangaroo management is for them to become licenced kangaroo harvesters themselves. Grigg (1987*a*, 1987*b*, 1995) raises this option and refers to instances of graziers in western Queensland starting to harvest kangaroos from their properties in the mid-1980s, when prices for wool dropped. Currently, it is uncommon but not extraordinary for landholders to also conduct some commercial kangaroo harvesting – several individuals involved in the RIRDC trials did so. Harvesting is generally an additional activity to grazing, conducted for additional income when time and property management permits.

Landholders would require appropriate licences to carry out commercial harvesting. Commercial harvesting licences (which have various different names in different states) are not limited in number in any state (although NSW has currently established a moratorium of uncertain duration on new licences (N. Payne, pers. comm.). Gaining a licence will require a valid firearms licence, completion of a short accreditation course for professional harvesters, and completion of the relevant game meat handling and hygiene course. Landholders could shoot on other properties as well as their own as long as they secured agreement from those landholders and, in some states, secured tags for those specific properties. Landholders could still apply for non-commercial 'shoot-and-let-lie' permits to manage aggregations of kangaroos which are under the legal weight limits for commercial harvest, or when annual quotas are exhausted.

Under this model, landholders would gain economic benefits from the sale of kangaroo carcasses that they shoot. This is likely to contribute to changing their perceptions of kangaroos from a pest to a valuable resource, with the potential land management and habitat conservation benefits linked to this. Further, they would take over kangaroo management on their own properties, so should be able to better manage TGP. For instance, they may have better information than other harvesters about where aggregations are, and be better able to target these aggregations in a flexible and timely fashion. They can also manage kangaroos according to their property management priorities. Landholders are in a good position to make strategic judgements about whether it is worthwhile reducing stock in some paddocks in order to increase kangaroo numbers (e.g. if a paddock is marginal for stock but reliable for kangaroo harvesting it may make economic sense to destock).

A major disadvantage of this model (as well as the previous payment-from-harvesters model) is that it provides only for kangaroo management at the level of individual properties, rather than at the cross-property level required for effective management of a shared resource. As kangaroos move freely across property boundaries at a variety of spatial and temporal scales in response to changes in local resource availability (Pople *et al*. 2007), management at the scale of individual properties is unlikely to be effective, either for reliable kangaroo production or for TGP control, particularly for smaller properties. A further disadvantage of this model is that harvesting kangaroos involves a specially equipped vehicle, extensive work at night and specialist skills that may be arduous and time-consuming to acquire. Assuming landholders maintain their other agricultural activities – running stock and cropping – the demands of these activities mean that landholders may not have the time or desire to take on additional night work (Thomsen and Davies 2007). For these reasons, particularly the limitation of single-property management, this option is not a favourable one.

Landholders employ kangaroo managers

One model that may help to overcome the conflicts of the previous model is the idea of individual landholders or groups of neighbouring landholders employing a 'kangaroo manager', in the way that they might employ a specialist feral animal manager or other on-station staff. Such a manager could have the task of devising how to best manage kangaroos to maximise revenue to the landholder(s) and minimise negative impacts on other productive activities such as stock production, as well as conducting harvesting, marketing produce to processors and potentially operating a chiller box on-site. Income from sale of kangaroo meat and hides could go to the property owner, while the manager could receive a salary from the landholder (perhaps supplemented by a per-kg payment as an incentive).

Management could encompass strategies to maximise local kangaroo populations, in areas or under conditions where this would yield returns. For instance, some areas of a property might be very attractive to kangaroos, but of marginal importance for cattle or sheep. These areas could be de-stocked in favour of encouraging kangaroo aggregations for harvest. Harvest could be timed to maximise production: for instance, going into a drought, when vast numbers of kangaroos typically starve, managers could seek to harvest at the maximum rate possible, in order to harvest before individuals lose weight, and to minimise effects of drought on remaining populations.

On very large properties with large kangaroo numbers, individual properties might be able to employ kangaroo managers. In other areas, several neighbouring properties could employ a manager to work across their properties. This would probably work best where there is a basis of collaboration already established – for instance, they could be employed to work across a group of properties already cooperating in a local Landcare group, or across properties owned by family members. Establishing and maintaining such cooperation would, however, no doubt be challenging.

There are some issues to be negotiated with this model in terms of meeting regulatory requirements. Under state licensing legislations, kangaroos, once shot, become the legal property of the licenced harvester, rather than the property of the landholder. However, a key feature of this model is that returns from the sale of kangaroos flow to the landholder, rather than the harvester. Presumably, this could be resolved through contractual arrangements between landholder and manager.

This model gives landholders full control of kangaroo management, either at a property-level or cross-property scale. It returns economic benefits to the landholder as long as the returns from kangaroos (plus the benefits from better kangaroo management, such as reduced grazing pressure at critical times) outweigh the cost of paying a kangaroo manager. It fosters kangaroo management as a well thought out component of overall property management, integrating it with NRM and agricultural priorities. As the kangaroo manager is a property employee, it encourages a strong relationship between him/her and the landholder which can lead to the harvester contributing to NRM and property management activities such as feral control, weeds management, and checking water points and fences. It is comparatively simple to implement, particularly if individual properties are large enough to support a kangaroo manager alone. The benefit for the kangaroo harvester/manager is that they have a stable, secure income and no competition for country to shoot on. Although some harvesters undoubtedly prefer to work independently, this may be attractive to some. This model has many strengths, and may have potential where landholders are highly motivated to improve kangaroo management on their properties, particularly where they are dealing with high densities of kangaroos.

Collaboration among landholders and harvesters

Landholders could collaborate with each other to play a role in harvest management, chiller box operation, processing and marketing; and could seek to build relationships with harvesters interested in working together on these objectives.

With respect to harvest management, a collaborating group could develop science-based kangaroo management plans to integrate the various management priorities for kangaroos: TGP management, kangaroo production, and broader regional, subcatchment and property level priorities. To facilitate good management the group could share information and communicate regularly, gather input on kangaroo densities and priorities from landholders, carry out monitoring, collate information on level and location of harvest, and keep track of collaborating harvesters and pass on landholder input to them. Collaborative harvest management could be facilitated by the group gaining a group harvest quota – this point is returned to below.

The group could negotiate collectively with processors to gain the best market price for kangaroos supplied. Processors could be willing to pay the group an additional 'margin' over and above the standard market price per kilogram (usually consistent between different processors and locations) if the group can 'value-add'. A collaborating landholder(/harvester) group can offer a processor the following benefits:

(1) exclusive access to kangaroos from collaborating properties. Informal discussions with processors suggest that a secure, long-term supply of product, if large enough, is an attractive proposition, as maintaining consistent supply can be problematic for them. At the moment processors have no direct contact with landholders, so have no security of supply from particular areas of country;
(2) secure access to high-quality product. Meat quality and shelf life are critically affected by aspects such as how carcasses are handled in the field, how close together they are hung in chiller boxes, and how soon they reach the desired temperature. Discussions with industry members indicate high-quality carcasses already sometimes attract higher prices. If the collaborating group implements high quality harvesting/chilling standards, this should be attractive to the processors interested in the higher-value end of the market;
(3) a commitment by collaborating landholders to stop or limit the use of non-commercial culling on their land. Currently 'damage mitigation permits' or 'shoot-and-let-lie' tags are widely used for non-commercial culling of large aggregations of kangaroos, and these kangaroos in general cannot be used commercially. Stopping such culling is of obvious appeal to processors interested in ensuring long-term, abundant sources of supply; and
(4) collaboration in developing differentiated, premium kangaroo products that are labelled and marketed on the basis of high quality standards and/or environmental attributes. Many potential marketing points require the involvement of landholders.

This margin can then be returned to the group, with profits to be distributed to members in an equitable way.

Operation of a chiller box by a landholder(/harvester) group raises licensing issues in NSW. Here, the group would require a Fauna Dealer (Wholesaler) licence ('FD licence') in order to buy kangaroos from harvesters (under the *National Parks and Wildlife Act 1974*). The number of FD licences is restricted – no new licences are generally issued (Macarthur Agribusiness and Econsearch P/L 2003). The group could obtain their own licence only by buying one from an existing holder (licences turn over at about the rate of 1/year), or by making a case to the regulatory agency (NSW Department of Environment and Climate Change) to issue an additional licence [as occurred with the Tilpa Rangeland Investment Co. in the mid-1990s (Henry and Watson 1998)]. Although this is not impossible it involves additional uncertainty and effort. Alternatively they could operate as a sub-licensee of one of the processors who currently hold the FD licences. However, this locks them into a single relationship and gives them little flexibility for bargaining with different processors. In addition, under this arrangement kangaroos would remain the property of the licence holder, and not be owned at any stage by landholders, which could restrict options for negotiation, processing and marketing.

The group could gain flexibility and security in harvest management by having a harvest quota (and tags) allocated by the regulator to the group as a whole, rather than to individual properties or harvesters. This is particularly relevant in NSW, where currently tags can only be used on the specific property for which they are issued, limiting the degree of possible collaboration between landholders in harvest management (Ampt and Baumber 2006). Here, for instance, it is difficult for harvest effort to be easily planned and coordinated across the group of properties – if kangaroo aggregations move from one property to another, tags for that specific property will need to be applied for and received before they can be targeted. Recently, the FATE Program at UNSW and members of the Barrier Ranges Rangecare Group (BARG) have gained approval for a trial in which tags are allocated to a group of collaborating landholders, rather than to individuals. Here, the quota is determined by calculating the land area of collaborating properties as a proportion of the harvest zone land area – the group is allocated the corresponding proportion of the annual zone quota. The group then decides how to allocate this quota among harvesters – they can direct harvest effort across properties according to kangaroo movements and the TGP management priorities of landholders.

In Queensland, tags are issued directly to harvesters who can use them anywhere within the harvest zone. (Qld has only three harvest zones, each of which covers an enormous area.) This approach has the benefit of flexibility for harvesters, avoiding some of the hurdles facing cross-property collaborative management in NSW. If kangaroos move across property boundaries, tags can follow them, enabling a group of landholders to plan and manage on a larger scale. However, they still face problems of competition for limited quota, and the problem of quota running out before the end of the year. If a collaborating group could be granted their own 'ring-fenced' quota (which could be based on the kind of proportional area calculation outlined above) it would allow them to plan and manage with more predictability. A group of landholders/harvesters receiving a quota and tags represents a greater change from current practice in Qld than NSW, however, and may require legislative change.

The biggest challenge in implementing this kind of collaboration may be the fact that landholders do not often collaborate with other landholders, let alone with harvesters. Although achieving a sufficiently high level of cooperation will take time and effort and will only occur if common purpose and benefit are clearly recognised, there are precedents for landholder collaboration: in sharing of labour and equipment, in marketing co-operatives, and in Landcare groups. Collaboration undertaken to date by landholders involved in the RIRDC projects in Mitchell (Qld) and the Barrier Ranges (NSW) gives cause for hope on this front, as does the collaboration of the Tilpa Rangeland Investment Co. in NSW in the 1990s.

This collaborative approach could either be pursued by a group of landholders alone or by landholders and harvesters working together. Achieving collaboration between a group of landholders will clearly be easier than achieving it between landholders and harvesters. Landholders and harvesters frequently do not see eye-to-eye, and tend to be on opposite sides of the fence on many kangaroo management issues. However, although landholders 'going it alone' appears simpler, there are drawbacks. A landholders-only approach offers little to harvesters, and harvesters are likely to actively oppose it. Harvesters would continue to have no negotiating power, and would not have any incentive to promote the interests of the group as a whole, rather than evade its standards or rules when possible. As part of the group, they would bring specialised expertise and industry understanding that landholders generally do not have. In turn, by collaborating with landholders harvesters could gain secure access to country, and get the benefits of negotiating as a group with processors, rather than as an individual with no bargaining power.

The landholder/harvester collaborative model, with all its variants, represents the most promising of the options so far. Landholders and harvesters both benefit from a stronger bargaining position through negotiating as a group rather than as individuals. Landholders benefit through gaining economic returns from kangaroos and from greater involvement in kangaroo management, allowing better management of TGP. Harvest management across properties, at an ecologically meaningful scale, is facilitated. Harvesters benefit from more secure access to country, better economic returns, and from landholder support of measures such as stopping use of shoot-and-let-lie tags. They also gain recognition and rewards for implementing higher professional standards. Better relationships between landholders and harvesters open the way for cooperation on aspects of NRM such as feral control, weeds, and checking fences and water points.

A proposed operating model: a trading co-operative for kangaroos

This section builds on the previous analysis and presents one potential model for landholders and harvesters to collaborate in kangaroo management for mutual benefit and ecological sustainability. It was developed as an option for consideration for the Maranoa Wildlife Management Conservancy, a Sustainable Wildlife Enterprise sponsored by the Rural Industries Research and Development Corporation, established by the Mitchell and Districts Landcare Association, Qld, in conjunction with local harvesters. It is, therefore, tailored to their needs and priorities and the regional conditions, regulatory framework, and kangaroo management prevailing in that area, although it could be easily adapted for groups operating in other contexts.

This model proposes the establishment of a trading co-operative under the *Cooperatives Act 1997*(Qld) ('the Co-op'). A co-operative is an organisation owned and controlled by those for whom it was established and who use its services. Membership of the Co-op would be limited to those who support the business of the Co-op – in this case landholders (who produce kangaroos on their land) and harvesters (who harvest and field dress them and transport them to chillers). Although a variety of organisational forms could be used to achieve collaboration, co-operatives have had and continue to have considerable success in facilitating collaboration and gaining the benefits of collective bargaining for primary producers. The model presented here is influenced by relevant features of the 'new generation co-operatives' that have expanded in recent years in North America (Coltrain *et al.* 2000; Fulton and Sanderson 2002).

In this model the Co-op's function is kangaroo management, processing and marketing (see visual representation of the functioning of the Co-op in Fig. 1). Note processing is understood here to include operation of chiller boxes. The Co-op's activities would initially focus on collective bargaining with processors on behalf of its members; chilling and holding of kangaroo products produced by its members; quality assurance; and playing a role in harvest management. In the future, the aim would be to expand into development of premium products, badged on the basis of environmental standards (e.g. organic, land management, biodiversity), regional identity, and/or landholder involvement; and potentially into processing and marketing to buyers further towards the consumer end of the chain.

Key benefits for landholders and harvesters from establishing a Co-op are:

(1) the greater negotiating power of the Co-op in relation to processors,
(2) the establishment of co-operative, long-term relationships between the groups, and
(3) returns from providing higher-value products.

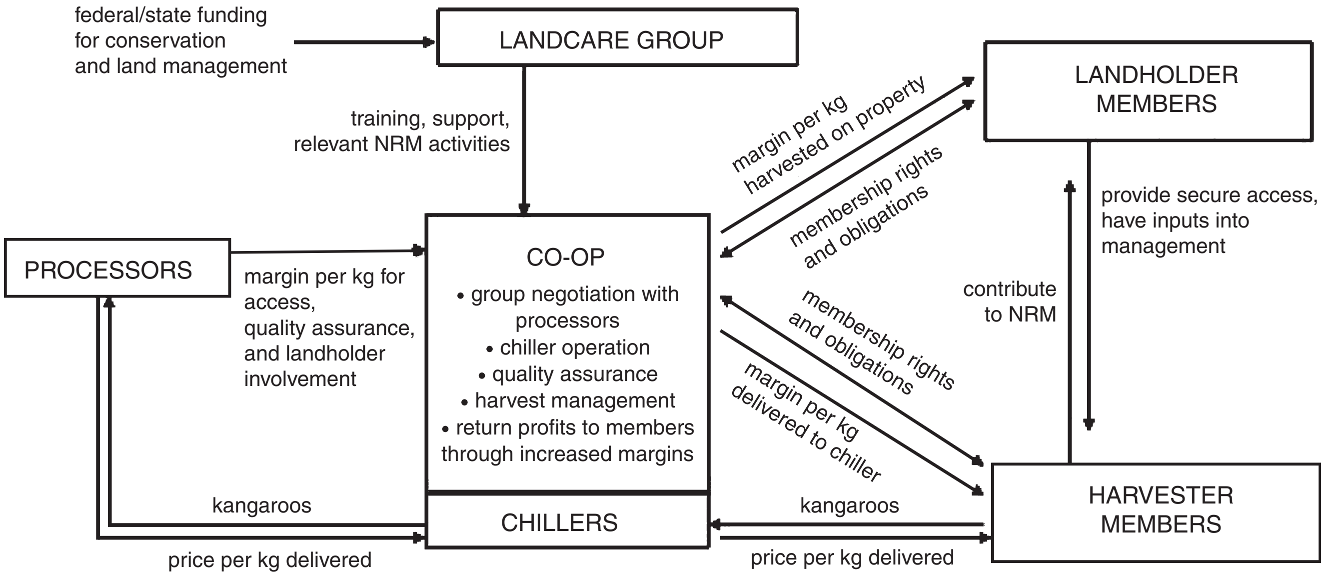

Fig. 1. Visual representation of the Co-op. The co-operative has landholder and harvester members, each of whom have certain rights and obligations of membership. The co-operative carries out a range of functions including operating chiller boxes, and retains strong links with its 'parent' Landcare group. The co-operative sells kangaroos to processors, gaining an additional margin over standard price/kg for the additional services it provides, and distributes profits to its members.

How would it work?

In this proposed model (see Fig. 1), the Co-op owns and operates one or more chiller boxes, supplied with kangaroos from Co-op harvesters harvesting on Co-op landholders' land. The Co-op plays an active role in developing and implementing best-practice quality standards, which could include standards of animal selection, harvesting, field dressing, transport, and chilling. Crucially, negotiations with kangaroo processors are carried out by the Co-op on behalf of the group as a whole. The Co-op could offer processors:

(1) exclusive access to product from the properties of landholder members,
(2) consistent high-quality product, and
(3) reduced or no use of 'damage mitigation permits' to shoot kangaroos by landholders.

In return the Co-op would seek an additional margin per kg from processors on top of the standard prevailing market price/kg.

Landholder and harvester members of the Co-op would each have rights and obligations, and their co-operation would change the relationship between them (Fig. 1). The major obligation for landholder members would be that they provide exclusive access to Co-op harvester members to their properties for harvest. They would not allow harvesters who are not members to harvest on their land – if their current harvester is not willing to become a member, they can no longer harvest there. Member harvesters, thus, gain secure and exclusive access to country. A further obligation for landholders could be that they do not use the 'damage mitigation permits' that are currently widely used for non-commercial culling of large aggregations. This would benefit the Co-op and the processors they supply by increasing future off-take. The major obligation for harvester members would be that kangaroos harvested on Co-op member properties are supplied exclusively to the Co-op chiller box (subject to capacity). Additionally, they agree to implement any best-practice standards of harvesting and field dressing practice developed by the Co-op. Further aspects of co-operation between landholders and harvesters could include landholders having input into harvest management (e.g. where and how many kangaroos are harvested on their properties), and harvesters playing a broader role in property NRM activities, such as helping to control feral foxes, pigs or cats, ensuring weeds are not spread across properties, or checking water points and fences.

The Co-op would maintain a close working relationship with its 'parent' Landcare group, which could retain responsibility for elements of kangaroo management that fall within its remit, such as supporting landholders in integrating kangaroo management within property management, training and support in EMS implementation, gaining scientific input to guide harvest strategies, or conducting kangaroo surveys.

Harvest management

A key aim of this arrangement would be to promote better, more integrated kangaroo harvest management that meets priorities of the Co-op, the landholders, and the harvesters, as well as contributing to subcatchment and catchment level NRM objectives. Major objectives are likely to include better management of TGP, ensuring consistent high production, and producing product with preferred characteristics. The plan should be based on sound scientific advice and could address timing of harvest, location of harvest, sexes, ages and species targeted. For instance, the group could manage the harvest to reduce specific aggregations, reduce kangaroo populations going into drought, increase overall production (e.g. through avoiding the use of shoot-and-let-lie permits), or to produce kangaroos with desirable meat characteristics (e.g. through targeting specific age-sex classes). Kangaroo management could be integrated with property and landscape level stock management to maximise overall productivity – for instance, areas marginal for stock could be de-stocked to maximise kangaroo aggregations and harvest.

Profits and incentives

The profits of the Co-op would be returned to its members on the basis of their contribution of kangaroos to the Co-op. Landholders would benefit on the basis of the amount of kangaroo harvested on their land, and harvesters on the basis of how much they have delivered to the chiller. For landholders, the generation of income from kangaroos would mean that kangaroos start to become a resource, rather than a pest, with consequent incentives for decreased stocking rates and vegetation and habitat retention and rehabilitation (Ampt and Baumber 2006).

Marketing and environmental labelling

The Co-op could develop strategies for raising the value of its product through improving quality and labelling it on the basis of environmental attributes. Recent research has explored characteristics of the market for kangaroo products. Ampt and Owen (2008) point to slow (if ongoing) increase in the numbers of consumers of kangaroo meat within Australia, but also the need for clear messages surrounding the sustainability of the harvest and hygiene (among others) in order to maintain this growth. Chudleigh *et al*. (2009) found that kangaroo products from landholder-based groups could best be marketed by positioning them as a gourmet, environmentally branded, and high quality product. The Co-op model offers potential advantages in meeting this need.

On the marketing side, some messages that could work for the Co-op are as follows:

(1) one environmental benefit of eating kangaroo is its reduced contribution to global warming compared to domestic stock (Diesendorf 2007; Garnaut 2008; Wilson and Edwards 2008). However, while an important message to get across, this claim can be made with respect to any kangaroo and would not attract any market advantage to the Co-op in particular;
(2) landholder involvement in kangaroo management itself may be attractive to consumers. Recent work indicates that a large proportion of the public is not aware that kangaroos are harvested wild, without management from landholders (Ampt and Owen 2008). The Co-op could highlight the message that only their kangaroo is managed with the involvement of landholders, which may be more palatable to some sectors of the public;
(3) the product could be labelled as originating from a Sustainable Wildlife Enterprise, with objectives of better land management and biodiversity conservation. For these claims to carry weight the contribution of the SWE to these objectives would ideally be monitored and verifiable;
(4) Co-op landholders are all Landcare members, and this could be the basis of a marketing message; and
(5) Co-op member landholders could all implement an environmental management system (EMS), such as the Australian Landcare Management System (ALMS). This provides a robust assurance of good land management to the consumer.

If kangaroo meat is to achieve greater mainstream acceptance and be taken up by major food processors and have greater prominence in retail stores and food service, then the harvest and post-harvest process will need to be more closely managed and have greater transparency (Ampt and Owen 2008). In two events organised for chefs in Sydney in 2008, the view was strongly expressed that a differentiated, premium product was critical, and that present eating quality is inconsistent. These views clearly suggest that raising the bar on kangaroo meat quality is necessary, and it is this role that could be undertaken by a Co-op. The Co-op could enter into long-term contractual arrangements to supply high-quality products to processors, and take responsibility for maintaining and assuring quality standards.

At present, processors appear unwilling to invest in labelling and marketing a differentiated product. Not only are they pessimistic about the economic viability of creating a niche market for what is already a niche product, they may not have systems in place to track the premium product. However, there are positive signs that some companies in the industry are prepared to take this on. The current Kangaroo Industry Association Strategic Plan (Kelly 2005) targets significant increases in domestic consumption, especially the use of secondary cuts in smallgoods. In recent consumer research, smallgoods and mince were found to be the most promising products for expansion in domestic consumption and processors are actively implementing recommendations (Ampt and Owen 2008). In the interim, landholder(/harvester) groups could produce the premium product, pay a processor to process it on a contract basis, and market the product themselves. Indeed, the group could eventually invest in processing the product themselves.

Discussion

Greater landholder involvement in kangaroo management in Australia would open the way to a lower carbon meat industry, a higher value kangaroo industry, better TGP management, and incentives for reduced stocking pressure and habitat conservation. Collaboration between landholders and harvesters is central to the proposed Co-operative model set out here, and to any cross-property model for landholder involvement in kangaroo management. Such collaboration represents a substantial change from current practice and will require ongoing commitment from the landholders and harvesters involved. For landholders, kangaroos are a peripheral preoccupation – their time is often under pressure from their current property management priorities, and it may be difficult for them to maintain focus and activity towards establishing collaborative arrangements. Although they may all wish for better management of kangaroos and for economic returns, this does not necessarily translate into a willingness to commit the time and effort required to sustain such an initiative.

For harvesters, the concept of landholder involvement in kangaroo harvest is typically a threatening one. Successful establishment of a collaborative arrangement involving harvesters will critically rely on the building up of trust and cooperation between these groups. Harvesters will need to be convinced that grouping together with landholders and with each other can strengthen their position, and landholders will need to be prepared to work cooperatively with harvesters, not seek to impose an agenda on them.

Similarly, there is much scope for better relationships with processors. The industry body for kangaroo processors, the Kangaroo Industry Association of Australia, is generally perceived as unsupportive of landholder involvement in kangaroo management. However, the model set out here indicates a range of benefits for processors as well. These include in particular exclusive access to a consistent, high quality source of supply, and the potential to develop niche products that are labelled and marketed on the basis of conservation-friendly land management.

These challenges could be substantially reduced with supportive policy and regulatory practice. A wide range of countries has moved in recent decades towards supporting a greater role for private landholders in management of wildlife (Child 1996; Bond *et al*. 2004; Texas Parks and Wildlife 2004; Wagner *et al*. 2007). Viewing the relationship between government and landholder groups as a partnership for wildlife management involving power-sharing opens the way for a suite of measures to encourage and support landholders who take a more active role. Extended management rights and privileges for collaborating groups could be awarded to those groups that demonstrate their ability and willingness to become engaged in sustainable wildlife management, and could be an effective regulatory 'carrot' to encourage conservation-friendly land management practices.

Key regulatory practices to address in order to facilitate the kinds of collaborative models envisaged here include the current inability of harvesters in some states to use harvest tags across property boundaries, the difficulties for landholders in gaining ownership of harvested kangaroos (and the right to sell them), and the lack of a mechanism to secure a group quota which would provide a degree of security over harvest planning. A mechanism to enable allocation of a harvest quota to a group is probably the most important immediate change that would support such cooperation. This would enable them to hold their own quota and allocate it among collaborating harvesters and landholders. Further measures and mechanisms could provide additional support for collaborative groups in taking a larger role in kangaroo management (Cooney 2009), including providing technical and scientific advice, (conditionally) devolving the power to set quotas at a group level, and establishing tradeable quotas.

Acknowledgments

This work has benefited from particularly extensive input and discussion with Tom Garrett, who we would like to sincerely thank. We would particularly like to acknowledge and thank Carley and Nick Walker for the origins of the 'kangaroo manager' model. We would also like to acknowledge and thank the following for their valuable input: Brad Cooper, Stacey Henry, Bim Struss, Jeff Campbell, Merv Phillips, Alan Brady, Ray Borda, Doug Jobson, Dana Thomsen and Sheree Scott; and all the other landholders and harvesters from the SWEs and beyond that have taken part in meetings and workshops.

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Manuscript received 6 June 2008; accepted 2 December 2008

Australian Government

Rural Industries Research and Development Corporation

Sustainable Wildlife Enterprise Trials

Commercial value as an incentive for changing on-farm land management practices

A report for the National Landcare Program in accordance with the final milestone of the DAFF Deed of Grant to RIRDC under the Sustainable Wildlife Project

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Acknowledgments

This report has been prepared with financial support from the Australian Government's National Landcare Program. It draws together the results of a group of project teams engaged to undertake and facilitate the Sustainable Wildlife Enterprise Trials. We would like to sincerely thank the project teams who have made this report possible:

Alex Baumber, Project Officer, FATE Program

Deborah Archbold, Deborah Wilson Consulting Services

Jeff Campbell, Landholder and Chairman Mitchell and District Landcare Association

Julia Telford, Border Rivers Catchment Coordinator QMDC

Peter Ampt, Program Manager, FATE Program

Peter Chudleigh and Sarah Simpson, Agtrans Research

Rosie Cooney, Consultant and Research Fellow, FATE, UNSW

Stacey Henry, Mitchell and District Landcare Coordinator

Sheree Scott, RMAP Project Officer, Wentworth

Steven McLeod, NSW Department of Primary Industry

Tom Garrett, Coordinator, Maranoa Wildlife Conservancy, kangaroo harvester and box operator

The valuable input from the landholders and kangaroo harvesters, box operators and processors as well as those who participated in meetings and workshops is gratefully acknowledged. In particular I would like to acknowledge and thank for their valuable contributions Ray Borda and Doug Jobson, Macro Meats, Adelaide.

Abbreviations

ALMS	Australian Landcare Management System
CSU	Conservation through Sustainable Use
DMP	Damage Mitigation Permit
DSD	Qld Department of Sustainable Development
EPA	Environmental Protection Agency (Queensland)
FATE	Future of Australia’s Threatened Ecosystems
MDLA	Mitchell & District Landcare Association
MWMC	Maranoa Wildlife Management Conservancy
MDRC	Murray Darling Rangelands Conservancy
NRS	National Reserve System
NLP	National Landcare Program
NSW	New South Wales
Qld	Queensland
QMDC	Queensland Murray Darling Committee
QDNRW	Queensland Department of Natural Resources and Water
QDPIF	Queensland Department of Primary Industries and Fisheries
RIRDC	Rural Industries Research and Development Corporation
SA	South Australia
SWE	Sustainable Wildlife Enterprise
SWNRM	South West NRM proprietary Ltd
WMC	Wildlife Management Conservancy

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Executive Summary

What the report is about

This report summarises progress, lessons learnt and opportunities identified in the Sustainable Wildlife Enterprise (SWE) trials, which are testing if commercial value of wildlife can be an incentive for changing on-farm land management practices. The trials are about greater use of wildlife species that are adapted to the Australian environment and climate to provide resources such as food, while at the same time encouraging biodiversity conservation and habitat protection.

Who is the report targeted at?

This report is for the National Landcare Program in accordance with the final milestone of the DAFF Deed of Grant to Rural Industries Research and Development Corporation (RIRDC) under the Sustainable Wildlife Project.

It could also be useful as input to the Caring for our Country and Australia's Farming Future Program Strategic Planning processes.

Background

Australian agriculture needs to operate in new and different ways if it is to achieve sustainable use of Australia's natural resources and counter land degradation and declining farm viability. If financial and productivity incentives are provided to landholders to participate in the sustainable use of wildlife, the private sector is more likely to respond favourably. Sustainable commercial use of wildlife can provide large benefits for biodiversity conservation by promoting natural habitats. It can also provide green house gas mitigation advantages through the partial replacement of ruminant livestock with non-ruminant species such as kangaroos.

The SWE trials have been managed by RIRDC under contract to the National Landcare Program. They explore ways that landholders can be empowered to participate more actively in kangaroo management. The trials give effect to the key recommendations of the 1998 Report of the Senate Rural and Regional Affairs and Transport References Committee into the Commercial Utilisation of Native Australian Wildlife which encourages the benefits produced from sustainable use.

Aims/objectives

The SWE goal is to develop commercially viable native species enterprises providing resources such as food, while at the same time encouraging biodiversity conservation and habitat protection and integrating tourism and Indigenous aspirations. The outcome sought is increased security for Australia's biodiversity, a more diverse rural sector and innovative agricultural industries that incorporate uses of wildlife that are conservation-based.

Methods used

The National Landcare Program (NLP) has made a three year investment in the Sustainable Wildlife Enterprises (SWE) trials managed by RIRDC. The strategies and implementation methodology are set out in the plans published by RIRDC in 2005.

Two Wildlife Management Conservancies (WMCs) were formed consisting of groups of landholders with similar management issues and collective environmental goals. The sites are one on the Maranoa-Balonne catchment near Mitchell in southwest Queensland – known as the Maranoa Wildlife Management Conservancy (Maranoa WMC), and one at the junction of the Darling and Murray Rivers near Wentworth in New South Wales / Victoria – initially known as the Barkindji Biosphere, but now known as the Murray Darling Rangelands Conservancy (MDRC). A third SWE trial site funded by RIRDC and the University of New South Wales consists of a collaborating group of landholders in the Barrier Ranges (BARG) near Broken Hill.

The NLP investment included supporting research into what is the most effective framework for landholders to become involved in and share the proceeds of harvested wildlife; a study of potential market demand for differentiated produce from Wildlife Management Conservancies (WMCs); surveys of kangaroo populations and consideration of the attributes of a wildlife stewardship scheme, which might be part of sustainability certification. It also funded a workshop towards the end of the funding cycle that was designed to share information on the project to date and encourage collaboration in natural resource management and wildlife management.

Results/key findings

With assistance from the researchers, members of the wildlife management conservancies have:

- commenced commercial harvesting on a small scale with their own chillers and harvesters in operation (Maranoa WMC)
- Established a cooperative trading structure that needs to be tested to determine if it can ensure an economically viable working arrangement between the landholders, harvesters and processors
- Commenced a trial with NSW Department of Environment and Climate Change (DECC) of a group licensed quota and tag system that will give landholders and harvesters involved in the project the ability to function collaboratively - as though harvesting on one property. (BARG)
- Surveyed kangaroo populations, estimated sustainable harvests and are ready to examine varying strategies for altering sex ratios and age classes
- Conducted marketing research that indicates that kangaroo product from SWEs could best be marketed by positioning it as a gourmet, environmentally branded, and high quality product
- Built on a strong "Landcare ethic" and have been closely involved in catchment management planning
- Formed the National Association of Kangaroo Growers and Harvesters to facilitate future collaboration between landholders, harvesters and Natural Resource Managers to help progress the SWE concept
- Are gradually being accredited under the Australian Landcare Management System (ALMS). They are ready to implement a proposed wildlife stewardship scheme.

Progress could have been faster. The drought hampered initial progress. Turnover of Landcare project officers have been regular and disruptive. Continuity of support is most important to maintaining the commitment of landholders especially when they are under stress. Testing whether landholders can benefit from the kangaroos on their properties takes a long time because it requires a major change in land use, making continuity of support even more critical.

Nevertheless the trials have begun to show the promise that commercial value of wildlife can act as an incentive to engage landholders in wildlife management, conservation of biodiversity, maintenance and even restoration of on-farm wildlife habitat.

Implications for relevant stakeholders

The trials are well positioned to continue and to expand, particularly in western Queensland. The number of interested and committed landholders is growing.

Changing the status of kangaroos from a pest to a resource is a paradigm shifting and complex undertaking involving not only activities which farmers can control but also chain management, and marketing.

The WMCs also have enthusiastic industry connections; although major sections of the kangaroo industry feel threatened by the SWE trial developments. Kangaroo harvesters in particular, are concerned they will be the losers when landholders are in the production process. The project is addressing their concerns by seeking to increase value by focusing on quality and reliability of supply.

Considerable greenhouse gas (GHG) savings are possible through greater use of kangaroos on the rangelands in lieu of cattle and sheep.

Given the size of the benefits which could be derived from greater use of native species and the prospect of contributing to significant carbon savings, a relatively large investment over three years to continue the SWE trials would seem appropriate.

The SWE concepts could be incorporated into the Caring for our Country Strategic Plan. In 2008/9, initial carryover support could be provided to the NRM bodies in the SWE trial sites. In subsequent three years, Caring for our Country could contract outcomes probably with the NRM bodies.

Recommendations

An extension of the trials is an option, especially when Australian agriculture is looking for adaptation strategies for climate change.

Continued support will enable regional cooperative management of kangaroos and other wildlife that integrates landholders into the industry.

- Continuation of the trials could occur in southern QLD and western NSW through collaboration with NRM bodies - SW NRM, QMDC, Desert Channels and Western CMA
- The concepts of extending NLP support could be incorporated into the Caring for our Country (CoC) Strategic Plan
- The initial carryover support could be provided in 2008/9 to the NRM bodies in the SWE trial sites pending the contracting for subsequent years under the CoC Strategic Plan
- A three year program would seek
  - $450 k in 2008/9 and
  - $1 m in following three years
- Additional support could come from contributions from other sources - e.g. the mining industry, and philanthropy.

1. Introduction

“Australia faces an unprecedented challenge from climate change. We risk losing our natural heritage, our rivers, landscapes and biodiversity. We have a brief opportunity to act now to safeguard and shape our future prosperity”. (Australia 2020 Summit Initial Summit Report April 2008)

Begun in 2004, Sustainable Wildlife Enterprise (SWE) trials are an innovative attempt to meet the type of challenges highlighted at the Australia 2020 Summit. The trials represent a “bold and visionary approach to managing and utilising our wildlife and saving and restoring biodiversity in the process” (Tim Lee, ABC TV's Landline program 9 March 2008).

SWE aims to examine the potential for increased commercial use of native wildlife to act as an incentive for landholders to retain and restore on-farm habitat and biodiversity. They seek to involve landholders in wildlife management, increase economic benefits to them from wildlife populations, and change the status of wildlife from a pest to a valuable resource while at the same time improving outcomes for wildlife.

The RIRDC Rangelands and Wildlife Program received support from the National Landcare Program (NLP) to assist with the implementation of SWE. Initial support included 2004 funding for the preparation of a strategic and implementation plan and 2005 funding for initial implementation of on-farm sustainable wildlife enterprise trials at two sites. In 2007 funding was provided to continue the two trials and provide support for research and development and information exchange to help overcome the challenges associated with the innovative SWE initiative.

This report has been prepared to meet the requirements of the DAFF Deed of Grant to RIRDC for National Landcare Program funding under the Sustainable Wildlife Project. The final milestone of the Deed required” a final report is to be provided to the Department of Agriculture Fisheries & Forestry in accordance with Schedule 4. The report is to address the extent of work completed measured against the performance indicators, what outcomes have been achieved by the project and the future benefits of the project”. It presents progress at the two trial SWE sites sponsored by the NLP and provides information on the RIRDC funded BARG project, results from the supporting research into establishing a framework for landholders to become involved in and share the proceeds of harvested wildlife, and marketing the produce from Wildlife Management Conservancies (WMCs). It also outlines proposals for continuing to support for the trials. Table 7 in the Attachments provides Schedule 3 from the Deed of Grant, which aligns outcomes, key performance indicators and milestones for the project.

Chapter 1 contains the background and rationale for the project, its objectives and methods, highlights the issues facing the project – thereby addressing KPI 1 “Accurate identification of the issues and options for resource management, licensing, ownership and tenure, royalties, and sharing of structures.”

Chapter 2 discusses progress at the two NLP sponsored WMCs and the RIRDC sponsored BARG Group. It addresses KPI 2 “Acceptance by landholders and wildlife agencies of the accuracy of estimates of distribution and abundance of wildlife populations” by presenting the results of kangaroo surveys.

Chapter 3 describes the progress in development of the Wildlife Stewardship Scheme which is part of the outcome associated with KPI 2 “Enhanced capacity of land managers to effectively and efficiently monitor and manage kangaroos and to integrate property, and natural resource management plans”.

Chapter 4 presents the results of the supporting research that developed a framework to help landholders be involved in and share the benefits from kangaroo harvesting. This was the milestone “Initiation of framework for landholders to share proceeds of harvested wildlife”.

Chapter 5 presents the results of the supporting research on marketing kangaroo products that are badged as leading to a net conservation gain. This was milestone "Identification of size and location of markets for produce from WMC enterprises that are badged as leading to a net conservation gain and processes for supplying those markets" and KPI "Building on the enterprise options outlined in the earlier study on market viability of products".

Chapter 6 provides the results of a workshop towards the end of the project that was designed to share information on the project to date and encourage collaboration in natural resource management and wildlife management. It addresses KPI "Effective sharing of information and experiences during the conduct of the trials."

Chapters 7 and 8 provide implications and recommendations for key stakeholders in a Discussion and Recommendations.

The SWE concept

Conventional agriculture in Australia typically utilises foreign species of plants and animals, many of which require significant resource inputs (including land, and chemical inputs such as pesticides and fertilisers) to achieve production levels competitive with world markets. In combination with Australia's fragile soils and variable climatic conditions, the use of some conventional farming techniques has seen broad scale environmental degradation, particularly in Australia's rangelands where soil fertility and low rainfall limit natural production capacity.

The rangelands have a disproportionately high proportion of Australian threatened and extinct wildlife: 61% of mammal extinctions, 83% of threatened mammals and 59% of threatened birds. Thus climate, ecosystem processes (grazing and productivity) and population-regulating effects of feral predators interact to have a transformative impact on native wildlife. (Dunlop and Brown 2008, National Reserve System interim report p55)

Native species are particularly well adapted to Australia's unique environment, allowing them to survive our climatic extremes and thrive in our soils. Native species and the natural landscapes that support them perform many key functions that maintain the health of our soil, water and air resources, and so provide the foundation of our landscape productivity.

Attaching a value to native resources through commercial development has the potential to provide alternative sources of income in areas where conventional farming may no longer be sustainable or profitable. The SWE initiative seeks to determine whether commercial recognition of these values can also provide environmental benefits. It seeks to trial whether native species, having evolved in Australia's unique environment, can provide profitable and sustainable production options for landholders.

SWE Strategic Plan

In June 1998, the Senate Rural and Regional Affairs and Transport References Committee recommended an experimental management trial, preferably in the rangelands, to investigate biodiversity conservation based on commercial uses for native flora and fauna. The design of the trial should draw on the success of similar experiences in southern Africa and elsewhere.

In 2004 the National Landcare Program invested in the preparation of a Strategy and Implementation plans to give effect to the Senate recommendations. (Wilson, G. & Mitchell, B. 2005) It set out the SWE goal as commercially viable native species enterprises providing resources such as food, while at the same time encouraging biodiversity conservation and habitat protection and integrating tourism and Indigenous aspirations. The mission is increased security for Australia's biodiversity, a more diverse rural sector and innovative agricultural industries that incorporate uses of wildlife that are conservation-based.

The plan proposed the formation of Wildlife Management Conservancies consisting of neighbouring landholders who "come together voluntarily to pool resources, plan collaboratively and benefit both economically and socially while also enhancing the sustainability of their properties and the region".

Commencing in 2005, two WMCs' were formed consisting of groups of landholders with similar management issues and collective environmental goals. The sites are one on the Maranoa-Balonne catchment near Mitchell in southwest Queensland – known as the Maranoa Wildlife Management Conservancy (Maranoa WMC), and one at the junction of the Darling and Murray Rivers near Wentworth in New South Wales / Victoria – initially known as the Barkindji Biosphere, but now known as the Murray Darling Rangelands Conservancy (MDRC).

Conservancy landholders worked closely with their respective regional Landcare Coordinators for Mitchell and District Landcare Association, and Rangeland Management Action Plan (RMAP) to achieve environmental outcomes that are in line with regional National Resource Management (NRM) priorities.

A third SWE trial site funded by RIRDC and the University of New South Wales consists of a collaborating group of landholders in the Barrier Ranges near Broken Hill. This third project is carried out by the FATE Program at UNSW in collaboration with the Barrier Ranges Rangecare Group.

The 2005 funding also enabled the scoping of sustainable wildlife enterprise options with the potential to become self-supporting economically viable enterprises whilst contributing to biodiversity conservation. Wildlife enterprises initially considered were far ranging, including kangaroo harvesting, tourism, forestry, bushfoods, fisheries and biodiversity credits. This preliminary scoping of landholder aspirations at both sites indicated most interest in enterprises focused on kangaroo management, with grazing pressure and associated land degradation from kangaroo populations being identified as a primary land management concern. Due to the broad scale interest in kangaroo management, both wildlife management conservancies decided to focus on the commercial harvest of kangaroos as the core initiative. The option is still there for additional enterprises of interest to individual or select landholders to provide complementary products and services.

Increasing pressure on sustainability and biodiversity

Since the commencement of the SWE project, there has been increased acknowledgement of the need to find innovative ways to protect our environment and of the need to increasingly include private investors and landholders in the process. The Australia 20 20 Summit clearly highlighted the environmental challenges confronting Australia:

> "Australia faces an unprecedented challenge from climate change. We risk losing our natural heritage, our rivers, landscapes and biodiversity. We have a brief opportunity to act now to safeguard and shape our future prosperity". (Australia 2020 Summit Initial Summit Report April 2008)

Globally, and in Australia, concerns have been raised about the impact of climate change on the effectiveness of disjoint, fixed protected areas. (Binning and Young, CSIRO briefing *Philanthropy sustaining the land*). In their interim report on Australia's National Reserve System (NRS) (Dunlop and Brown 2008) agree with this concern and argue that there is a need to find new ways to conserve widespread and diverse habitat to conserve species. Dunlop and Brown also highlight the daunting impact of climate change:

> Without significant reductions in GHG emissions, future climate change in Australia will be unlike any previous changes due to the extensive fragmentation and modification of habitat by human activities, the presence of exotic species, decreasing (rather than increasing) water availability, and the rate, magnitude and direction of temperature change (Dunlop and Brown, 2008 p10).

The bioregional framework used to develop the NRS is an excellent process for strategically developing a system of protected areas that will remain effective under climate change. However, to be effective the bioregional framework must be implemented as widely as possible through the NRS and other habitat protection programs.

There is also a need to manage habitat for specific conservation outcomes (facilitating change or maintaining suitable habitat for vulnerable species) and to reduce threats. Habitat protection may also be required to maintain the connectivity required for various ecological processes that occur at landscape scales, including the movement of species in response to disturbance and climate change. However, in some situations habitat connectivity will facilitate processes with undesirable outcomes, including the spread of fire and the expansion of species that may exclude threatened species. Protection of isolated areas of habitat, as well as well-connected ones, would reduce those risks.

Increasing private landholder involvement in conservation

To help meet these challenges, there has been a shift to recognise the vital role that private landholders can play in national conservation plans.

This recognition has come in a number of forms. The Australian Government's $50 million Environmental Stewardship Programme pays for landholders to protect some of the continent's most endangered ecosystems.

Other projects such as Western Australia's *Gondwana Link*, the *Alps* in Victoria *to Atherton* in Queensland, and the *Kosciusko to Coast* join up patches of bush on private land to create wildlife corridors, either by purchasing linking properties, or by offering landholders a range of tenure and management conditions. Landholders may receive incentives to build wildlife refuges and enter binding conservation agreements creation of protected areas over important intact linkages, including conservation covenants on private land, changes to land management such as through leasehold conditions, or allowing regrowth of native vegetation.

Voluntary Conservation Agreements exist whereby landholders protect special parts of their property in perpetuity, are the highest and most guaranteed form of protection, but there is also BioBanking – under which developers pay landholders with high conservation value land to protect areas as compensation for biodiversity loss arising from development – and regulatory frameworks, such as new native vegetation protection laws.

Binning and Young take a different approach, arguing that traditional approaches to public conservation through National Parks will not work in all regions and recommend following the United States of America approach of using tax incentives to increase the involvement of the private sector in conservation. In the United States of America, conservation on private lands is supported by over 1500 Land Trusts that raise funds through corporate and individual donations.

The SWE project is another program that provides incentives for private landholders to become involved in conservation.

SWE follows a framework, the SWE strategic plan, which sets out mechanisms and processes to support the development of regional wildlife plans that integrate habitat management, sustainability and property management plans.

SWE Implementation Plan

The SWE Implementation Plan prepared with NLP support, has four operational sections the first dealing with Conservation Activities, then Production Initiatives, Marketing and finally Research and Evaluation.

The Conservation section describes priorities and actions to support the establishment of WMCs using existing structures such as Landcare groups, and the scope for partnerships for WMC enterprises. It describes objectives and actions for preparing regional natural resource and wildlife management plans, survey needs, GIS and data management support, identification of NRM protection priorities and sustainable harvest estimates.

At the property level, property management planning seeks to integrate wildlife and agricultural production, enterprise development, conservation works, habitat improvement and threat reduction.

The section on Production Initiatives describes opportunities for wildlife production including plants, bush foods and plant products, live plants, seeds and tube stock for conservation plantings. It also covers animals, including meat and skins, and live sales for conservation programs. It flags the need for projects on managing products along the production chain.

The section describes tourism opportunities, drawing attention to projects and support of nature based tourism facilities and related services, wildlife spotting and nature based tourism experiences. Ecosystem services are seen as an emerging production initiative with a wide variety of mechanisms and markets.

Marketing is the topic which includes sales promotion through branding and labelling strategies and marketing trials. It recognises the need for differentiated marketing of WMC products. It also deals with communications, the media and agencies.

The fourth section of the plan focuses on projects in Research and Evaluation, including advice and training needs, adaptive management processes and sustainability indicators including ecological economic and sociological monitoring. It defines the need for supporting research contracts on sustainability certification, quality control and animal welfare.

2007-2008 Funding

In 2007 2008 projects were commissioned to:

- to define a framework that enables landholders to share the proceeds of harvested wildlife
- estimate kangaroo numbers that enable landholders to more effectively manage populations and integrate wildlife with their property and natural resource management plans
- identify markets for products that are badged as leading to net conservation gain, and
- share information and experiences from the trial sites and encourage regional collaboration in natural resource management and wildlife planning.

These objectives consolidate the aim of the trials as outlined in previous funding which is to provide site specific and demonstrable information about:

- appropriate types of management, organisation and governance arrangements
- rates of sustainable use
- changes in biodiversity and the natural resource base, enhancement of landscapes and reductions in land degradation

- commercial viability of native species enterprises, particularly those that integrate tourism and indigenous aspirations
- methods for integrating enterprises with existing performance management frameworks such as EMS
- markets for produce from enterprises that lead to a net conservation gain; and options for resource ownership and tenure, financial systems and alternative capital structures.

The SWE trials strongly align with and support NRM plans. SWE seeks to establish mechanisms and processes, which in the long run would be self funding, to attain NRM aspirational targets and resource condition particularly for the assets land and soils, riverine flood plain and wetland, vegetation and biodiversity, and weeds and pests. SWE seeks to use the value of native species and wildlife to address the loss of species, dryland salinity, soil erosion and water quality.

SWE is based on the premise that giving landowners more responsibilities and rights over wildlife and a commercial value to wildlife, will act as incentives to restore habitats, reclaim degraded areas, maintain landscapes and encourage biodiversity conservation. One of the key attributes for a successful SWE trial is an existing administrative structure to form the basis of the proposed WMCs. Existing NRMs and their existing sub-structures (Landcare groups etc) help provide this structure. NRM plans are established to support practical action by landholders, community, Landcare groups, Traditional Owners, local government and Industry groups at a regional scale on one hand; and manage NRM investment from Australian and State governments on the other. This is consistent with WMCs, which are established to develop regional wildlife plans that integrate habitat management, sustainability and property management plans. A major challenge for these groups is developing clear operational models for how landholders could become involved, taking into account relationships with harvesters and processors, the regulatory context, and land management priorities. Various models for such involvement have been suggested, but none have been evaluated in detail.

Methods

The SWE trials are a large and complex, multidisciplinary undertaking, taking place over a number of years. As previously outlined, this SWE project consisted of establishing the two pilot SWE's and providing supporting research advice. Four distinct, but interrelated projects were commissioned by DAFF.

First, the Maranoa Wildlife Management Conservancy (Maranoa WMC) and Murray Darling Rangelands Conservancy (MDRC) pilot SWEs were established, where landholders worked with each other and their local Landcare groups to find ways to estimate, manage and integrate wildlife with their property and NRM plans. A third SWE trial funded solely by RIRDC has collaborated with the two SWEs on this project. The third SWE consists of a group of landholders in the Barrier Ranges near Broken Hill and is carried out by the Future of Australia's Threatened Species (FATE) Program at UNSW in collaboration with the Barrier Ranges Rangecare Group (BARG).

All three SWE sites identified kangaroo management as having the most immediate potential for landholder involvement in wildlife. This occurred both because a commercial kangaroo industry already existed and because a common challenge across the groups is the management of macropod species on their land.

The second 2007_8 project involved a study undertaken by Dr Rosie Cooney of the FATE Program, to develop, evaluate and trial models for rangeland landholders to be involved in wildlife management and share the benefits of wildlife harvesting on their lands. The specific focus of the study was the group of landholders that established the Maranoa WMC, under the auspices of the Mitchell and District Landcare Association Inc, in Mitchell, Qld. As the major current option for wildlife-based enterprise for this group involves kangaroo harvesting, the study focused on kangaroos. Models were examined in terms of their potential to deliver environmental and NRM benefits, and their impacts on other key players in the product chain, the harvesters and processors.

The third project was marketing research undertaken by Agtrans Research was to identify the size and location of markets for produce from WMC enterprises that are badged as leading to a net conservation gain and support the establishment of processes for supplying those markets. This project was specifically associated with the development of the Maranoa region WMC, and focused on identifying the characteristics of markets for kangaroo meat from the Maranoa conservancy so that marketing may best proceed to capture those markets. The focus of the project was on the connection between environmental management and the demand for kangaroo meat.

Finally, a SWE workshop was run 14 & 15 February 2008 at Broken Hill to share information and experiences from the trial sites and encourage regional collaboration in natural resource management and wildlife planning. The meeting brought together members of the three WMCs and representatives of the kangaroo industry, various state and federal government agencies, regional NRM bodies and landholder groups.

Defining the issues that the Trials sought to address

The innovative nature of these initiatives means they face a number of challenges. This section provides a discussion of the sorts of issues that historically made it difficult for landholders to benefit from the wildlife on their properties. The research work associated with the project aimed to help overcome these impediments and make it easier for landholder involvement in kangaroo management and sharing in its benefits. Many of the issues are dealt with in greater detail in the research publications associated with this project.

The 1998 Senate Committee into Commercial Utilisation of Native Australian Wildlife recognised some of these issues. It stated that to date factors including regulations and associated lack of development of markets have inhibited the commercial use of Australian wildlife. It was thought timely to consider a review of the regulatory constraints affecting the sustainable commercial utilisation of wildlife in order to assist with further development of sustainable industries and improve conservation outcomes.

The section begins by describing the current sustainable use of kangaroo in Australia, current regulation and operating practice for the commercial kangaroo harvest. It then goes on to highlight some key issues and problems with current arrangements. The focus is on the states in which SWEs are located – Qld and NSW.

Sustainable use of kangaroos

Although the SWE concept applies to the value of all wildlife, and their value could contribute to encouraging conservation outcomes, these projects have a specific focus on kangaroos. They are abundant in the temperate Australian rangelands where cattle and sheep are raised, competing with them in dry times and being labelled by livestock producers as pests. They are not contained and roam from property to property seeking out best pastures in response to local rainfall. Under current arrangements it is rare for landholders to benefit from the kangaroos on their lands or play a role in their management.

Kangaroo harvesting is the shooting of kangaroos for their meat and skins. It is a process that is regulated under nationally coordinated wildlife trade management plans. Kangaroos are shot in the field at night using a high- powered spotlight and a high- powered rifle by certified and licensed shooters. A Code of Practice requires head shots and instantaneous death. Most carcasses are processed to human consumption standard and kangaroo meat is currently exported and sold in Australia to the food service industry, retail outlets and also to the pet food industry. Kangaroo harvesters are generally independent small businesses paid per kilogram for the kangaroo carcasses they supply to processors.

Quotas are set based on scientific studies and rigorous monitoring of population numbers and breeding patterns and are only set for species which are abundant and not threatened by endangerment. National parks within the commercial harvest areas provide an additional safety net for populations where little or no harvesting occurs. Endorsement of the management program from professional ecologists and wildlife managers and their associations has been consistent. Table 1 shows kangaroo population estimates compiled from recent aerial and ground surveys, species by species for the commercial kangaroo harvest areas. The actual national population is significantly higher as these figures do not include estimates for areas not surveyed.

Table 1 Kangaroo populations for commercial harvest areas for 2001 – 200625

Year	**Red Kangaroo *(Macropus rufus)***	**Western Grey *(Macropus fuliginosus*)**	**Eastern Grey *(Macropus giganteus)***	**Wallaroo/Euro *(Macropus robustus)***	**Total**
2006	7,892,774	2,642,224	10,424,926	2,647,005	23,606,929
2005	7,753,247	2,625,708	10,876,498	3,380,838	24,636,291
2004	7,987,250	3,019,320	11,111,840	3,196,511	25,314,921
2003	8,727,856	2,610,931	13,875,828	2,999,906	28,214,521
2002	13,633,816	3,764,289	23,383,249	3,064,178	43,845,532
2001	17,434,513	3,424,992	29,721,271	6,849,250	57,430,026
Six year average	10,571,576	3,014,577	16,565,602	3,701,234	33,841,370

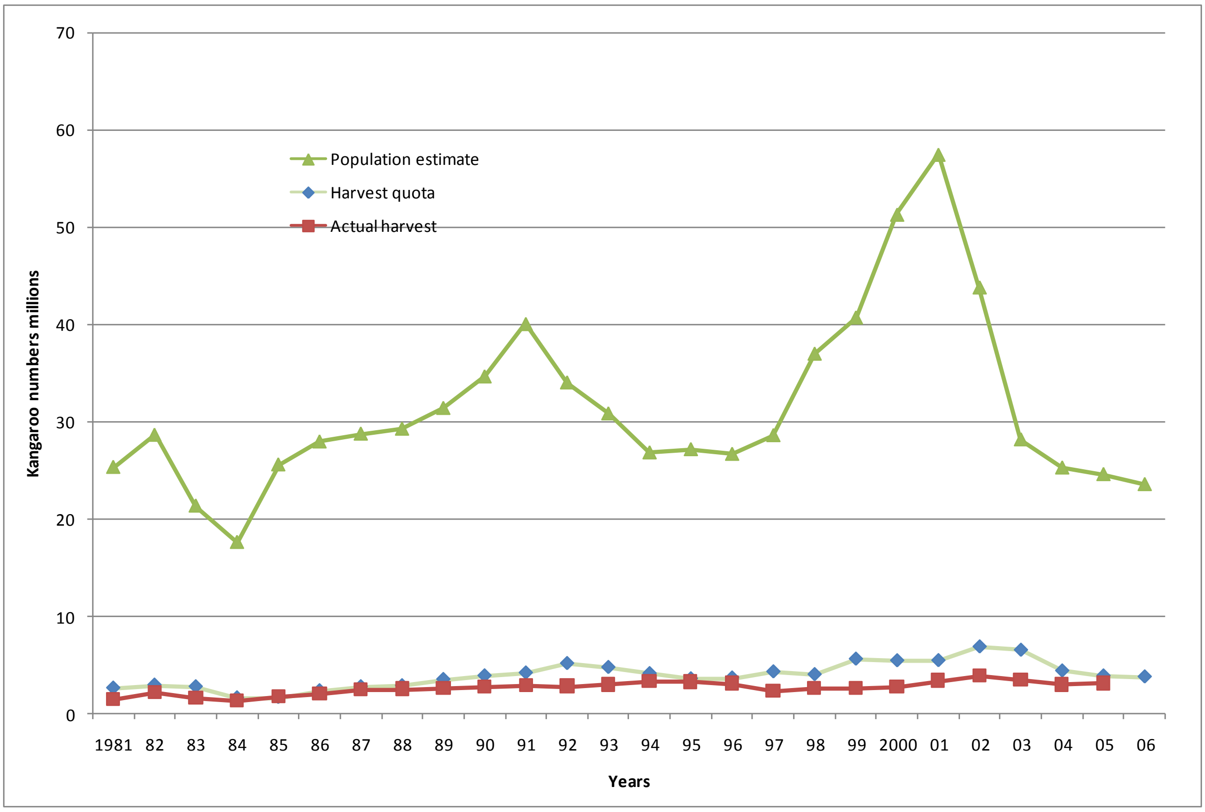

Figure 1 Kangaroo population estimates quotas and harvests for commercial zones 1982 to 2006

Figure 1 shows population estimates for 25 years from 1981 to 2006 for commercially harvested red kangaroos (*Macropus rufus*), eastern grey kangaroos (*M. giganteus*), and western grey kangaroos (*M.*

fuliginosus) and euros/wallaroos (*M. robustus*). Populations can grow rapidly in years favourable for breeding and survival, for example 1996 to 2001, and droughts can depress populations equally rapidly Harvest quotas are set at 15 % of estimated populations following recommendations of field investigations. Figure 1 Kangaroo population estimates quotas and harvests for commercial zones 1982 to 2006 also shows that harvests are a small proportion of the population and unrelated to fluctuations. From 2001 - 2006, harvests took 6 - 13% of the population or 51 - 81% of the available quota[25].

After 30 years of harvesting under a quota system it is clear that the industry is sustainable and will not lead to the extinction of the four commercial species. The community is developing greater acceptance of the harvest and its increasingly professional and scientific basis. (Ampt & Baumber article) The recent situation analysis undertaken as part of the review of the NSW Kangaroo Management Program (Olsen and Low 2006) concludes that “there is little doubt that current rates of harvest are sustainable” and that “any genetic impact of harvesting is minimal” (p7).

Kangaroo harvest regulations

One problem for developing wildlife enterprises is that the government retains control over most wildlife management functions, and many uses are prohibited. A study carried out in 2006 examined the regulatory and policy barriers to sustainable use of wildlife, in order to inform the development of this project.

Kangaroo harvest is regulated at both Federal and state levels in Australia. States have the primary responsibility for regulation of take, killing and trade of protected species (all macropods are protected), while the Federal government regulates export. States regulate and manage the commercial harvest through a wide range of functions, including monitoring of populations through regular surveys, establishment of sustainable harvest quotas, and implementation and enforcement of a strict licensing and tagging system. All harvested kangaroos are tagged with a unique, self-locking tag. Harvesters and processors must be licensed and are subject to reporting requirements. Extensive animal welfare and food hygiene requirements to be followed by harvesters and processors are also regulated at state level.

In addition to managing the commercial harvest, States may authorise non-commercial culling to assist landholders to mitigate damage to crops or land. For damage mitigation culling, landholders faced with large aggregations can apply for what will be referred to throughout this paper as “shoot and let lie” tags. These are issued directly to landholders and are not subject to a quota. In general, carcasses are left in the field and do not enter commercial trade, although Qld and NSW both allow some to enter commercial trade under a small “special quota” (NSW DECC 2007; Qld Government 2008).

All export of kangaroo products requires approval from the Commonwealth. In practice, States submit five-year management plans for approval as a “wildlife trade management plan” by the Commonwealth under s303 of the *Environmental Protection Biodiversity Conservation Act* 1999. Kangaroo products from states with an approved plan will be granted export permits.

In all states, shooters require permission from landholders to enter their properties to harvest kangaroos. Shooters will generally initially contact landholders to request access to their country. Shooters may shoot on a property from their own motivation or in response to a request from a landholder, who may direct shooters to areas where they know there are large aggregations. In Qld this will generally be the only landholder involvement, as tags are issued directly to shooters. These tags can then be used on any property. In NSW it is technically landholders who are granted an “occupier’s licence” to commercial harvest on their land. However, shooters will usually physically bring the application forms for signature to landholders, submit forms, pay fees, and be given the tags.

Existing kangaroo management regulations are not conducive to involvement by a group of landholders wanting to better manage the free ranging kangaroo. Landholders and harvesters involved in the project would generally prefer a group licence to be issued... The licence would make it possible for a group of properties to function as one, with tags issued to the group usable on all group-licensed properties.

Price of Kangaroo products

A problem affecting all stakeholders in kangaroo harvesting, is the comparatively low value and variable quality of kangaroo meat. There is a lack of financial incentive for landholders to become involved in the kangaroo industry. Kangaroo still has a small (if growing) market in Australia and overseas. Macro Meats, a South Australian based game meat processor specialising in Australian Game meat production demonstrates the growing Australian market with an annual growth of domestic demand for fresh kangaroo meat of 140% between 2005 and 2007.

The price per kg is substantially lower than for other red meats, and there is little attempt to market differentiated kangaroo products. It often ends as mince of unknown origin. However Macro Meats markets their gourmet product, providing in pamphlets with recipes and focusing on their free range 'natural' credentials. Some of the obvious marketing points for kangaroo include environmental messages, such as "free-range""free-range" living conditions, organic, chemical-free, lower contribution to greenhouse gases, and environmental management. Critically, however, many of these marketing opportunities require the involvement of landholders.

On the quality front, regular eaters of kangaroo meat often find high variation in tenderness between samples of the same cut. Supply of product to discriminating buyers such as high-end restaurants will require uniformly high quality. Landholder involvement could open up quality management options such as managing populations to ensure high populations of species species/age/sex combinations that are of high value to consumers.

Nonetheless, with supply controlled by harvest quotas and impacted on by drought in recent years, it has been demonstrated that increased demand can lead to an increase in the prices offered by processors. While kangaroo numbers fluctuate, they restock themselves after droughts. They provide high quality products with growing demand and an increasing price without global competition.

Another major information gap concerns the demand for kangaroo products. Is there a big potential demand for a high-value, environmentally friendly product? What sort of perceptions do people currently have of kangaroo products, and what sort of marketing might affect these perceptions? The FATE Program at University of New South Wales and the University of Technology, Sydney, has been carrying out detailed marketing studies, surveying thousands of consumers to help shape marketing strategies for kangaroo.

Achieving premium prices for premium product

Effective marketing and product differentiation are essential in ensuring market demand and premium prices are achieved for produce.

The trials are seeking to determine whether accreditation as a sustainable production system will enable the WMC's to obtain premium prices for their products. It is envisaged that WMC members will gain access to higher valued markets through the development of collective marketing strategies highlighting the environmental credentials of WMC products, including those derived from conventional enterprises.

Managing free ranging populations

Arguments that landholders can benefit from kangaroos on their land while improving conservation have been made for many years, but little attention has been paid to developing and evaluating models for making it happen. There are clear arguments for applying the concept of CSU to kangaroos in the Australian rangelands, both to promote economic diversification and resilience and to promote long-term ecosystem benefits. A key missing element, however, is exactly how landholders should be involved. This forms the primary subject of this report. The project commissioned to look at management structure by Dr Rosie Cooney seeks to fills this gap.

Professor Gordon Grigg from University of Qld has called for “sheep replacement therapy” as an antidote to twin problems: the status of the kangaroo as a pest in graziers’ minds, despite its high regard in the public consciousness; and widespread severe land degradation in the rangelands. Grigg argues that landholders who are earning income from kangaroos will be more likely to perceive them as a valuable resource. Income from kangaroos would mean landholders could maintain overall productivity (and better land condition) with reduced levels of stock. If the value of kangaroos rose to the point that kangaroos became more profitable than sheep, graziers could seek to maximise their production by de-stocking completely. While kangaroo populations might increase, they would have less impact on the rangelands than sheep, due both to much lower energetic requirements and a probable lower foot pressure.

Additional conservation and economic benefits could be gained through landholders having a role in kangaroo management and gaining income from kangaroos (alongside stock). These benefits include habitat retention, better total grazing pressure (TGP) management, and income diversification. (Ampt and Baumber 2006) First, habitat retention would be particularly favoured in areas where eastern greys dominate. This species favours vegetation mosaics, so if landholder gained benefits from kangaroos, they would be more likely to maintain or restore areas of native vegetation. Second, the critical potential benefit is better management of TGP, and Ampt and Baumber develop more detailed ideas in this respect. Currently, landholders have little flexibility in managing kangaroos for the purposes of managing TGP - it may be difficult or impossible to find a shooter willing and available to manage large aggregations in a timely way. If they were themselves involved in management, they may be able to better target harvest pressure to manage aggregations, and better integrate kangaroo management with property management priorities. They could carry out a range of actions to reach TGP goals, such as harvesting heavily going into drought, providing supplementary feed in drought, or maximising productivity per unit grazing pressure by adjusting age/sex ratio of targeted animals. Third, diversified incomes mean reduced pressure to over-stock, particularly in drought.

Landholder involvement

To facilitate landholder involvement in the kangaroo industry, the research shows there is a for a collaborative business structure; to market the product; and to change some regulations. Some of these are already being trialled. The collaborative structure has the potential to provide a range of wider benefits to those involved and to the local area, including access to alternative markets such as the organic meat market and the growing home delivery market. It will also provide an integrated approach to the management of the kangaroo resource resulting in wider social benefits.

However barriers to collaboration were also identified early on through discussion with harvesters and landholders from within the groups. In particular there was landholder need to accept they need to know more about kangaroo ecology and habits. They were also greatly constrained by competition for their time and the drought.

2. Progress with the SWE Trials

Progress with trials

This Chapter provides an overview of the successes and challenges of the two project sites, the Maranoa and the Murray Darling Wildlife Management Conservancies. Although the BARG trial is not funded under this project, a progress report on the BARG site is relevant and is also included.

Maranoa Wildlife Management Conservancy

Location and membership

The Maranoa Wildlife Management Conservancy (Maranoa WMC) is located on the upper reaches of the Maranoa River in south west Queensland, within Booringa Shire. It extends north of Mitchell towards the Carnarvon Ranges and the northern extremity of the Murray Darling Basin catchment area.

The Maranoa WMC is comprised of landholders and properties in the Maranoa River and Box Creek Landcare groups under the Mitchell & District Landcare Association. In addition to the original 22 landholders making up the Maranoa WMC, interest has expanded further south to the Dunkeld and Middle Road Landcare groups, where 36 landholders have expressed interest in becoming involved to some extent, in the Maranoa WMC. Figure 2 below shows the location of the Maranoa Landcare groups, and Table 2 describes their location and characteristics.

The region is predominantly cattle grazing and kangaroo and wallaby country. Exceptionally high numbers of kangaroos move through the landscape, and there is often little incentive for land managers to spell or rest country according to sustainable grazing land management principles. The impact that macropods are having on the environment is well recognised and is a priority land management issue for land managers in the region.

Native forest management is also a priority issue for many of the landholders.

The Booringa Shire Council has an active interest in the project. It has been supporting alternative forestry based enterprises, - there are substantial cypress pine forests in the region, tourism initiatives both those involving farm stay and town based accommodation. It is a strong supporter of Indigenous participation and enterprise development.

The latest phase of the on ground SWE trial follows from previous research that investigated the scope of five possible SWE within the Mitchell & District region – eco and cultural tourism, sustainable production systems, kangaroo products, native plant products and aquaponics (hybrid aquaculture and hydroponic system). In 2005, the SWE project settled on the opportunity for landholder involvement in kangaroo management, as this industry was identified as having the most potential in the immediate future, both financially and to meet NRM priorities.

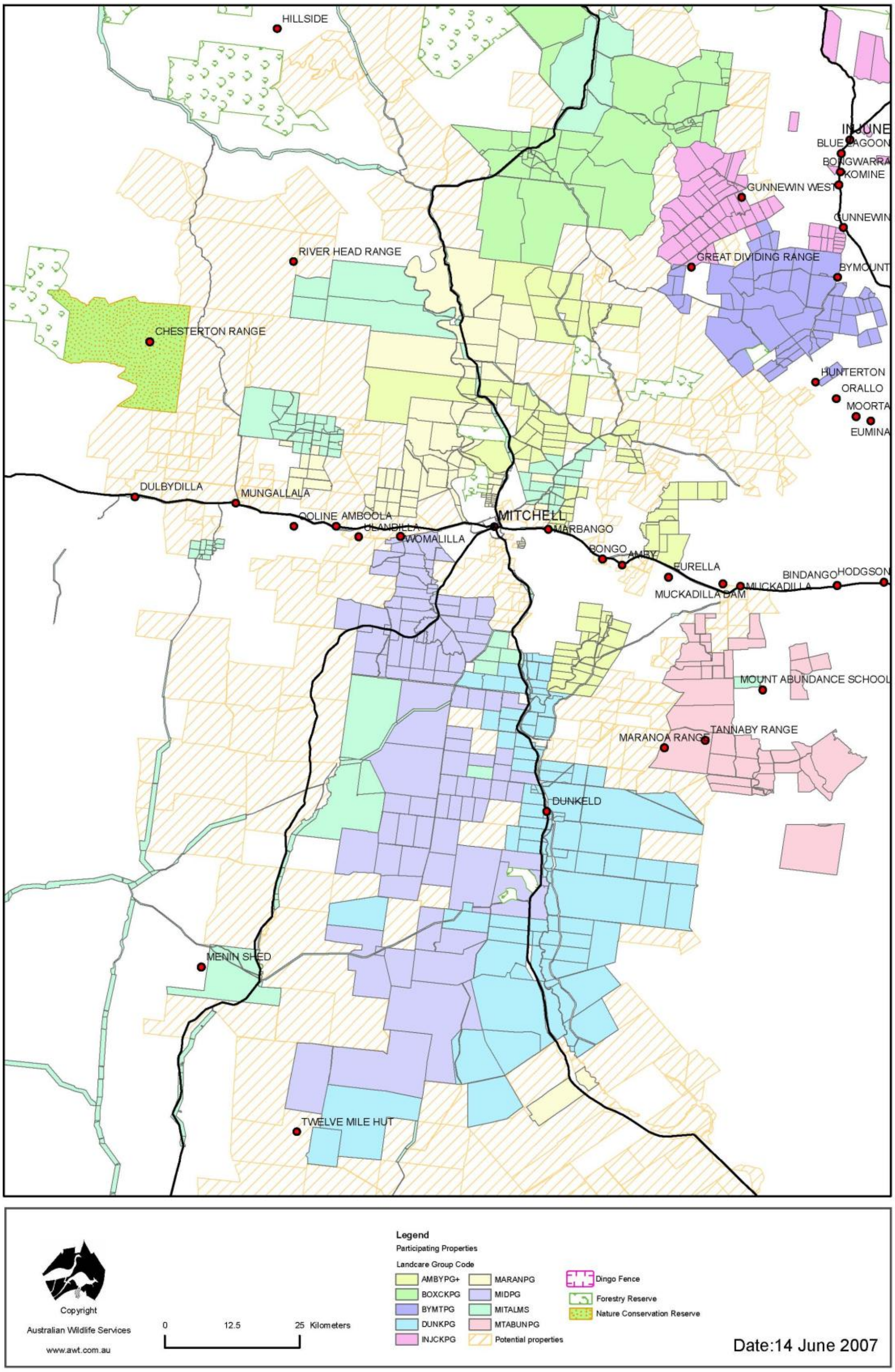

Figure 2 Map of Maranoa Landcare groups

Table 2 Statistics of the Landcare groups comprising the Maranoa WMC

	Current Membership		Expressed interest joining	
Landcare Group	Maranoa River Landcare Group	Box Creek Landcare Group	Dunkeld Landcare Group	Middle Landcare Group
Location	North of Mitchell, approx. 70km stretch of the Maranoa River	56km west of Injune and 85km north of Mitchell	South of Mitchell, approx. 150km stretch of the Maranoa River	South-west of Mitchell, approximately 150km.
Subcatchment	Maranoa River	Maranoa River	Dunkeld	Middle Road
No. businesses/ landholders	12	10	15	21
Total Area	100 000ha	203 908ha	174,468 ha	188, 997 ha
Range of property sizes	1092ha – 25 000ha	2634ha – 85 830ha	n.a.	n.a.
Enterprises	Beef production dominates, some grain production	Beef production dominates, small scale sheep and goat production, forestry	Beef production dominates, sheep production	Beef production dominates, small scale sheep and goat production, forestry

Objectives and Milestones of Maranoa SWE

The aim of the research, consistent with the overall project, was to evaluate opportunities for landholder involvement in kangaroo management.

The Maranoa WMC trial focused on establishing the SWE on-ground, but also worked closely with project researchers to help achieve the following milestones for the project:

- Initiation of framework for landholders to share proceeds of harvested wildlife
- Estimation of kangaroo populations on WMCs and rates of sustainable use
- Identification of size of markets for produce from WMC enterprises that are badged as leading to a net conservation gain
- Communications and workshops involving WMC members in order to exchange experiences and clarify expectations and opportunities.

The project enabled the Maranoa WMC principal investigator and Landcare coordinator to:

- Negotiate with landholders and kangaroo harvesters to identify their needs while testing innovative procedures for sharing the proceeds of harvested wildlife
- Participate in surveys, liaison with indigenous communities, plus on the ground support by WMC project offices and coordinators of the surveys to estimate kangaroo populations in the WMC's. Utilisation of the broadscale survey results collated earlier. Work with landholders and wildlife agencies to ensure the accuracy of estimates of distribution and abundance of wildlife populations
- Liaise with WMC members to pass on the results of the expert marketing adviser, obtain their feedback on products from WMC enterprises and priorities in the trial

- Participate and enable effective sharing of information and experiences during the conduct of the trials.

Results and emerging challenges for the Maranoa WMC

The Maranoa WMC faced a number of challenges trialling ways of increasing landholder involvement in kangaroo management.

Landholder membership

While the Conservancy has many members committed to the initiative and eager to trial new ways of diversifying rural income whilst maintaining conservation, some landholders simply cannot see past kangaroos as a pest. Many are hesitant to become involved as generally it is seen as time consuming, and many simply to not understand the concept being proposed.

Nevertheless conservancy membership expanded over the last year, with 35 additional landholders expressing a commitment to participate in the trials.

Harvester and processor resistance

Since its inception the Maranoa WMC's the trial has received its fair share negative feedback and scepticism by harvesters and processors, particularly about the possibility for landholders to be involved in kangaroo management.

Three harvesters have made a commitment to work with the group, with an additional 10 having expressed interest. However, despite increasing numbers of members, it has been difficult to maintain commitment and enthusiasm about the project.

While there are some harvesters that clearly see the benefits of landholders and harvesters working collaboratively, harvesters in the Mitchell area generally do not see the opportunity for landholder involvement in the kangaroo industry. Several reasons have been identified at various meetings to explain harvesters' reluctance to want to see landholders involved including:

- there is a general view shared by many that landholders do not deserve to receive money from kangaroos harvested when it is the harvesters that do all the work

- some harvesters are concerned that if they become involved in such an initiative they will be bound to some sort of contract or other legally binding commitment

- some are concerned that if they became members or involved in such an initiative and it failed, processors would refuse to purchase harvest from them.

As with the landholders, most harvesters simply do not understand the concept being proposed and what the benefits might be.

Processors have indicated eagerness to work with the Conservancy during meetings and negotiations; however it appears that they are also reluctant to support landholder involvement in the kangaroo industry.

The future

The WMC acknowledges the controversy associated with this novel concept. There are always going to be those who are hesitant to trial new things, especially when there is so much controversy involved. Changing attitudes is a difficult task and members of the Maranoa WMC have known from the very beginning that establishing landholder involvement in kangaroo management was never going to be an easy task. However, as the project has progressed, more and more landholders and harvesters have become involved and are beginning to understand the benefits that could be gained from a collaborative approach. The members also worked closely with the researchers to help derive approaches to managing the business and marketing the products. As a result, the Maranoa WMC is achieving its goals and is at a critical point for making the project work.

Defining a framework that enables landholders to share the proceeds of harvested wildlife

So, despite the challenges outlined above, the Maranoa WMC has successfully set up a functional SWE establishing landholder involvement in kangaroo management. Based on the Cooperative model proposed by Cooney (2008), a framework that enables landholders to share proceeds of harvested wildlife has been developed, and an informal cooperative established. Section 4 outlines the cooperative model and briefly explains how it offers potential benefits for both landholders and harvesters.

The trading cooperative, known as the Maranoa Kangaroo Harvesters & Growers Cooperative, is still in its initial stages. An agreed set of obligations of membership of the informal Cooperative is attached in Plate 1 in Attachments. The primary activities or business of the Cooperative is kangaroo management, chiller operation and marketing.

Ownership of chiller and its management

With support from the Mitchell & District Landcare Association's Management Committee, in December 2007, the Maranoa WMC purchased two kangaroo chillers from an existing private box owner in the District. This was seen as an important step for the group; to establish something tangible, demonstrating to landholders, harvesters, processors and other stakeholders that something was happening on ground that works.

Both chillers are currently operational and are located in Mitchell. All relevant QPWS licensing arrangements and Safefood accreditation were acquired, a book keeping system has been put into place for the effective operation of the business and arrangements for day-to-day box operation have been organised. Purchasing two chillers was seen as an opportunity to be able to diversify the Conservancy product over time as opportunities arise. The decision to buy an existing business, as opposed to purchasing new chillers, was based on the Conservancy's reluctance to put an additional box in town, which may be seen as creating unnecessary competition.

Figure 3 One of the two chillers owned by Maranoa WMC and forming the basis of the Coop.

After negotiations with several kangaroo processors, Giuseppe Chisari, Cobar NSW; John Burey, United Game Processors, Charleville QLD and; Ray Borda, Macro Meats, SA, the group resolved to sell carcasses to Macro Meats – Gourmet Game based in South Australia. This company is seen to offer the most potential in the immediate future. A margin on top of the standard price per kg paid to independent box owners has been negotiated in exchange for committed from Conservancy or Co-op members to refrain from applying for damage mitigation permits and ensure a consistent supply of high quality product.

In the longer term, the Maranoa WMC anticipates a higher and more consistent quality of kangaroo meat to be produced from changed harvesting and handling processes through systems proposed by the group. These include:

- More efficient standards of chiller management through implementation of best practice safe food measures. This may involve some education and training for participating harvesters and landholders

- Implementation of improved feedback and traceback system. An improved traceback system is currently being developed for the Conservancy, including GPS and data logging on a paddock and property basis.

The project has not reached a point where implementation of these systems has been feasible. However this is something that the group will implement as the cooperative progresses.

Since purchasing the chillers the Maranoa WMC kangaroo carcasses have been purchased from harvesters who have agreed to become members of the cooperative. Kangaroos were harvested from landholder's properties who have also agreed to become members of the cooperative. The harvest is currently sold on to Macro Meats. However, only a few animals have been traded between January 2008 and June 2008 due to organisational problems and staff changes.

As a result, the harvest required to maintain a viable business, which is generating enough income to be able to share any proceeds over and above the normal operation of chiller operation, is not yet being met. In these early stages, it is unlikely that landholders will derive any proceeds from kangaroo management. However landholders participating in the trial see the potential and are committed to persisting with the initiative, with a long term vision of one day earning enough of a margin to distribute back to landholders.

Landholders although committed do not understand that harvesting of kangaroos in a controlled manner for profit means the same principles apply as in any business. The solution is to appoint a manager to apply business principles for the cooperative and who has the authority to make things happen.

In line with recommendations made by Cooney (2008) the following need to happen to ensure the effective function the Kangaroo Harvesters & Growers Cooperative in the initial stages:

- appoint a Project Manager, to oversee the overall business management of the Cooperative

- appoint a Box operator – to manage the chiller boxes in Mitchell, which entails: general cleaning and maintenance; weighing in harvest each day; payment to kangaroo harvesters; loading out carcasses and passing on harvest data when processing company does a pick-up, and; pass on relevant information to Project manager to ensure effected dissemination of information to relevant parties involved in the Coop

- implement a book keeping system – put in place to ensure administration of the Cooperative is managed effectively. This includes a data base to manage all data obtained from harvested wildlife (e.g. weight, sex, species, location of harvest) and a system to create all relevant manage accounting invoicing to relevant parties. It is important that this data base is accessible to all relevant parties involved with the cooperative and is set up to create relevant reports.

In the future the group aims to set up a formal cooperative, independent of the Mitchell & District Landcare Association, as outlined in Cooney (2008). To achieve this, the group has recognised the need to receive further assistance and support from people with a good understanding and knowledge of cooperatives such as these.

The group recognises that implementing this trial and model will involve substantial inputs of time and some money, and will require the establishment of trust and cooperation between landholders and harvesters. Despite the hurdles, the group is confident that once the Cooperative approach can be demonstrated to work, more landholders and harvesters will get on board.

Estimation of kangaroo numbers that enable landholders to more effectively manage populations

With support from the University of Queensland, New South Wales Department of Primary Industry and Queensland, Department of Natural Resources and Water, an aerial survey with trained observers was conducted to estimate kangaroo populations and distribution for the Maranoa WMC. Surveys were conducted using a Cessna 180 aircraft flown at the standard 76m (250 ft) above ground level and flown at 185 kph (100 knots). Two observers were positioned on each side of the aircraft and each scanned a 100 m strip. X lines were flown by a standard sweep of east-west transects placed at intervals of 0.8° apart (X km). For the northern part of the survey above the dingo proof fence the lines were 1.2° apart. See Figure 4 for the survey flight lines. The transects were broken into units and number of animals counted in 5 km lengths we used to obtain a figure of kangaroos per square kilometre for that unit. E.g. the counts of all observers were multiplied by visibility correction factors.

The results show that in the survey area there were an estimated grey kangaroo population of 1 241 500 ± 109 378 (estimate ± standard error) at an average density of 64.7 ± 5.7 / km2. There were 73 341 ± 12 255 red kangaroos at an overall density of 3.82 ± 0.64 / km2. Survey area was 19 200km2 area. This is very high density.

The dingo fence which runs through the survey area gives rise to marked differences in kangaroo densities.   It excludes the movement of dingoes from the Carnarvon Ranges to the north into the majority of the survey area. It appears to affect kangaroo densities

On the south side of the fence the number of kangaroos was particularly high, with 1120 083 ± 105 778 eastern grey kangaroos at an overall density of 82.36 ± 7.78 / km2 and 60 501 ± 10 407 red kangaroos at an overall density of 4.45 ± 0.77 / km2 (Table 1).There were lower kangaroo densities on the north side of the fence with 121 676 ± 27 828 grey kangaroos at an overall density of 21.73 ± 4.97 / km2 and 12 840 ± 6 470 red kangaroos at an overall density of 2.29 ± 1.16 / km2. GIS maps that overlay kangaroo density with the properties which form the Maranoa WMC are shown in Figure 5 for eastern grey kangaroos and Figure 6 for red kangaroos. Wallaroo and Wallaby densities were less significant than those of the kangaroos with 0.53 ± 0.12 / km2 and 0.08 ± 0.02 / km2 on the south side of the fence and 0.83 ± 0.09 / km2 and 0.16 ± 0.11 / km2 on the north side, respectively.

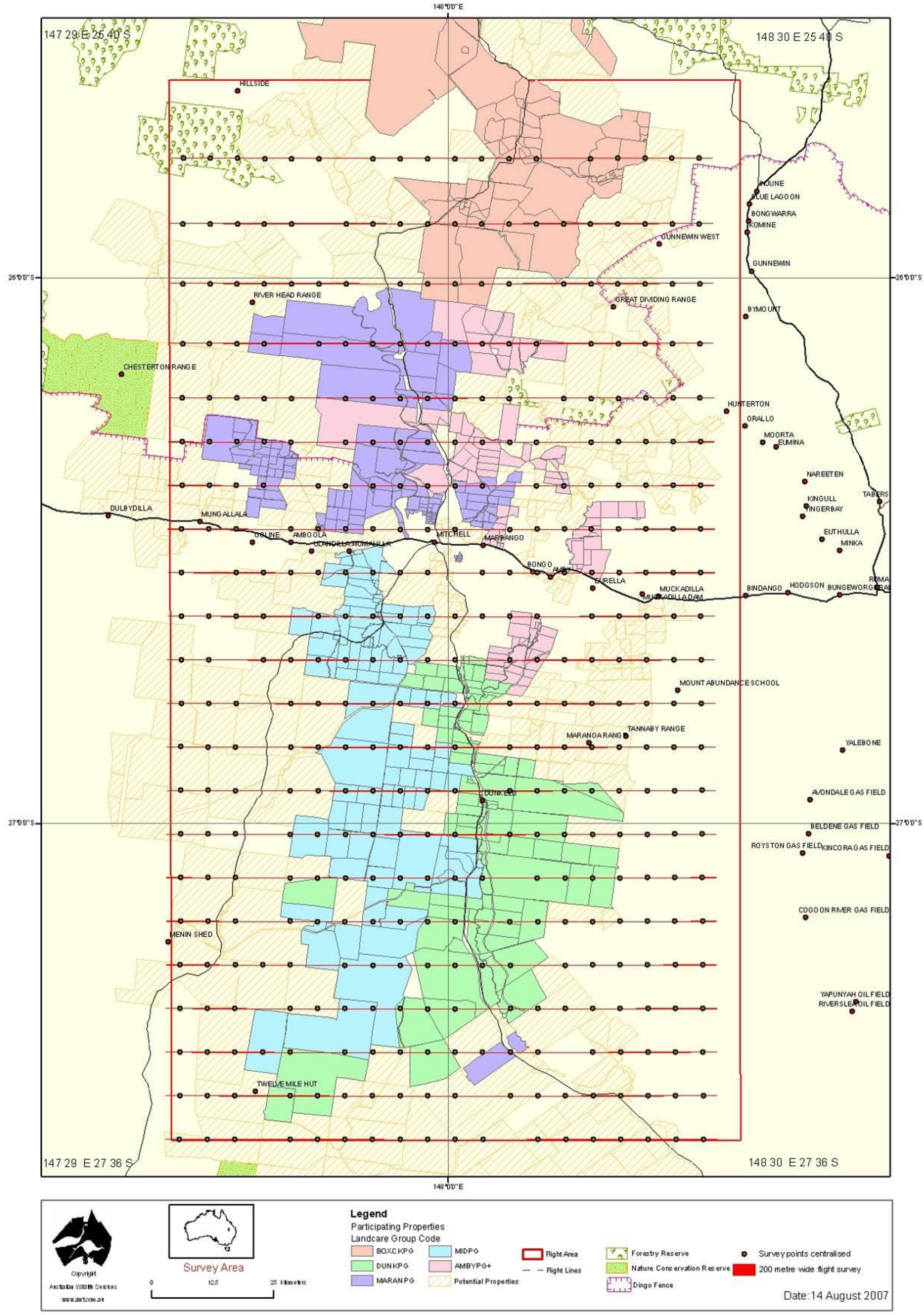

Figure 4 Flight lines for the Maranoa aerial survey

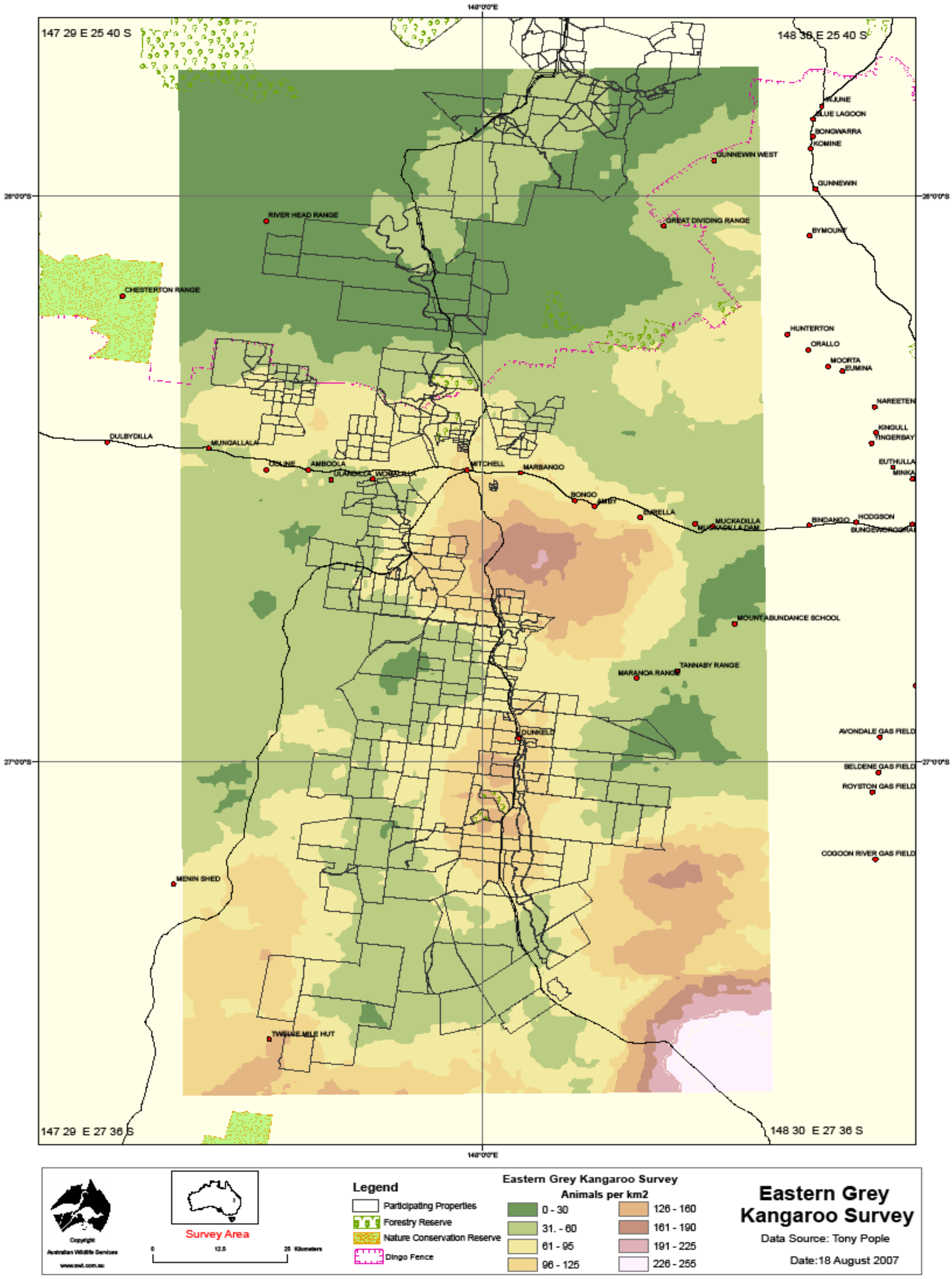

Figure 5 The density and distribution of eastern grey kangaroos in the Maranoa WMCs

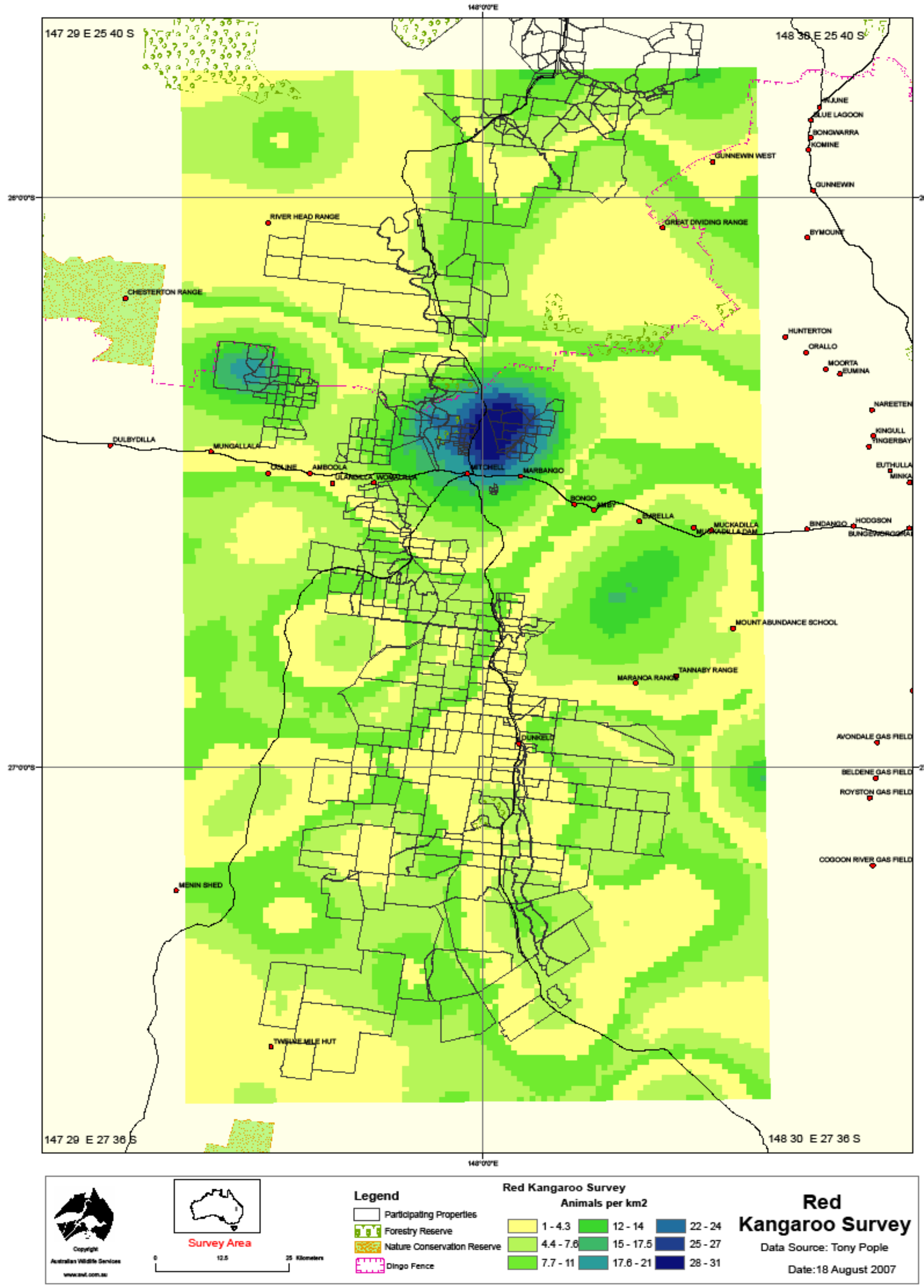

Figure 6 The density and distribution of red kangaroos in Maranoa WMCs

The number of eastern grey kangaroos is quite significant when compared to the average density of Queensland’s central kangaroo harvest zone with 11.73 eastern grey kangaroos / km2. While the average density of red kangaroos in Queensland’s central kangaroo harvest zone is 8.24 kangaroos / km2 (Figure 7). Current quotas for Queensland allow a commercial harvest of kangaroos at about 15 -

20% of the population. Although Caughley (1987a) suggested an instantaneous harvest rate of 10 - 15% for red kangaroos subjected to an unselective harvest and a lower harvest rate for greys and wallaroos. Using a quota setting at 15 %, the annual maximum sustainable yield (MSY) that could be achieved from the Maranoa WMC is 0.66 red kangaroos / km^2 and 12.35 grey kangaroos / km^2 on the south side of the dingo fence and 0.34 red kangaroos / km^2 and 3.25 grey kangaroos / km^2 on the north side of the dingo fence. This is quite substantial for eastern grey kangaroos as the average annual harvest rate is approximately 1.76 / km^2, while the average annual harvest rate for red kangaroos is 1.24 / km^2 (Table 3 and Figure).

Table 3 The numbers, densities and Maximum Sustainable Yield (MSY) of kangaroos in the Maranoa WMC and the central zone of Queensland

		South of fence	North of fence	Maranoa Total	Central harvesting zone
Eastern grey	Number	1 120 083	121 676	1 241 759	5 863 973
kangaroos	Density (km^2)	82.36	21.73	64.67	11.73
	MSY (km^2)	12.35	3.25	9.70	1.76
Red kangaroo	Number	60 501	12 840	73,341	4 122 687
	Density (km^2)	4.45	2.29	3.82	8.24
	MSY (km^2)	0.66	0.34	0.57	1.24

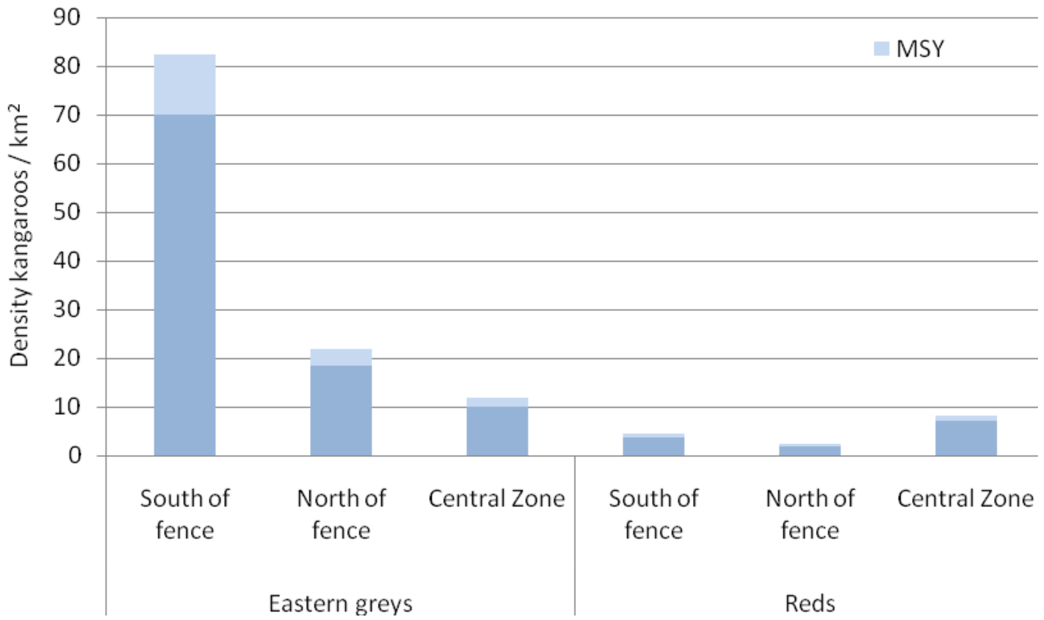

Figure 7 The density of eastern grey and red kangaroos / km^2 and MSY for the north and south side of the dingo fence in the Maranoa WMC. The figure also shows the density of kangaroos in the central harvesting zone in Queensland.

The high population densities, particularly for eastern grey kangaroos indicate that the Maranoa WMC is well placed to establish a suitable quota for sustainably harvesting kangaroos. The GIS maps that overlay kangaroo density with the Maranoa properties indicate areas where landholders could better target and manage large aggregations of kangaroo numbers to relieve TGP.

Next Steps for the Maranoa WMC

The next steps involve getting information on population numbers, impact of harvesting and the development of data collection and management systems. The potential exists to use Global Positioning Systems (GPS), Geographic Information Systems (GIS), and various data collection techniques and data analysis to combine temporal and spatial data and provide benefits to harvesters, land owners, processors and industry regulators such as EPA. The collection of data by a harvester on type of animal harvested, location and time can be integrated with information on land, pasture, weather and seasonal conditions, information on land and stock management, population dynamics and animal health to produce information which could be used to simplify harvesting and enhance landscape and animal management. This has been trialled in the Maranoa WMC, but no equipment is in place for implementing traceback because not enough kangaroos are currently being traded. Hardware is available and must link to the cooperative's data base to be effective. The industry association, the Qld Macropod and Wild Game Harvesters Association, has an operating software system that can be adapted to the Mitchell and District Landcare data base. Permission has been sought and received for this to happen as soon as the cooperative is fully staffed and operational.

Landholders may use the information to manage numbers and grazing patterns of stock to attract kangaroos to specific areas, manage total grazing pressure and to facilitate harvesting. The data will also be used to help manage and ensure kangaroo quality and supply to processors.

Integrate wildlife with their property and natural resource management plans

Landholders within the Maranoa WMC manage similar land types, conduct similar enterprises and have a long history of involvement in Landcare activities and sub-catchment planning.

Sub-catchment planning involves the Mitchell & District Landcare Association working in collaboration with QMDC to take a collaborative and coordinated approach to NRM.

The goals and priorities for the region are set out in the Regional Natural Resource Management Plan prepared by the Queensland Murray Darling Committee Inc. (QMDC) in partnership with South West NRM Group Inc. and the Border Rivers, Maranoa-Balonne, and Bulloo Catchment Coordinating Committee.

There are two types of links or common interests between the SWE and the NRM Plans. The first is a direct connection between more effective management of macropods and control over total grazing pressure as an NRM objective. The other is a broader contribution to biodiversity conservation and sustainability through the establishment of other sustainable wildlife enterprises.

Macropod management

Significantly, the South West NRM Plan lists macropods as a pest animal species 'of importance', recognises lost productivity due to increasing numbers of kangaroos and specifies the following actions be undertaken to help manage the populations:

- Conduct an impact study on lost productivity due to an increase in macropod populations
- Support the continuation of existing projects that focus on lost productivity and high macropod populations and ensure that results from these projects are extended to the broader community
- Promote the continuation of a macropod population monitoring programme
- Determine conservation requirements which may affect the management of pest macropods.

As a way of gaining recognition for their hard work in environmental management, as well as ensuring continual improvement of their natural resources, some landholders within the Mitchell & District area have implemented ALMS. This concept is gaining momentum in the area with three Landcare groups keen to learn more about it.

Share information of experiences from the trial sites and encourage regional collaboration in natural resource management and wildlife

Communication between the project teams (Maranoa WMC members and coordinator, other trial sites, researchers and the project manager) has been vital to achievements made to date. Several workshops have been organised which enabled the sharing of information and experiences from the trial sites and encouraged regional collaboration. The various communications maintained throughout the duration of the project and workshops have motivated project participants to persist with the initiative.

The group carried out a range of information sharing activities, including

- information and awareness-raising activities such as newsletters and letters among landholders and harvesters to lay a basis for collaboration
- workshops to explore issues surrounding collaboration, and
- initial negotiations with processors
- two landholders, 2 harvesters, the principal investigator and the Mitchell & District Landcare Coordinator attended the Broken Hill, NSW 14 and 15 February
- a follow up meeting was held in Mitchell, where participants from the Broken Hill meeting gave an overview of the meeting and discussed similarities between the SWE WMCs. The Maranoa WMC group felt that working together and sharing experiences with other groups trialling similar approaches to increased landholder involvement in the kangaroo industry to be a real advantage and support the idea to continue sharing these experiences.

The Mitchell & District Landcare Association Inc works in close collaboration with the regional Queensland Murray Darling Committee (MDC), assuring regional collaboration in natural resource management. All Landcare activities happening within the Mitchell & District Landcare area are in line with regional NRM targets. Regional NRM bodies in surrounding areas are interested in the concept of sustainable wildlife enterprises and have supported the Maranoa Wildlife Management Conservancy in its efforts.

A meeting was held in Brisbane in April 2008 to discuss the broader matter of landholder involvement in the kangaroo industry, the opportunity for regional bodies' involvement and the future of the SWE trials. .Tom Garrett the project officer in the Maranoa has since sought support from Department of Sustainable Development (DSD) in Queensland for them to assist with aspects of business management for the co-operative and prepare a cabinet submission for better management of kangaroo harvests using the cooperative principals identified in the SWE MLC project. A think tank will be organised by SW NRM Ltd and DSD to progress this initiative

Recommendations from the Maranoa WMC SWE trial experience

For the Maranoa Wildlife Management Conservancy to achieve its goals, the cooperative model presented in Chapter 6 should be fully implemented. This model involves establishing a harvest management, processing and marketing cooperative with both landholders and harvesters as members. While implementing this model will involve substantial inputs of time, effort, and some money, and will require the establishment of a relationship of trust and cooperation between landholders and harvesters, it offers the potential for both landholders and harvesters to benefit through:

- collective bargaining to gain best market terms for the product they both play a role in producing

- more effective kangaroo management at a cross-property level, both to meet production objectives and for better management of TGP
- more cooperative relationships between landholders and harvesters, including harvester participation in feral animals control and weed management
- more secure and exclusive access to country for harvesters
- reduced use of shoot and let lie tags (non-commercial damage mitigation culling), and
- equitable sharing of profits.

For Landcare groups and regional/catchment natural resource management bodies, the model recommended here offers them a potential option to meet objectives of better management of total grazing pressure, improved diversification of landholder incomes and better socio-economic resilience, and better management of feral animals and weeds at the local level.

For processors, collaboration between landholders and harvesters in kangaroo management, according to the recommended model, could offer real benefits to them as well. Establishment of a cooperative involving landholders and harvesters opens the way to:

- assuring an exclusive, consistent source of supply from the properties involved
- improved quality management from field to fork, through development and implementation of best-practice quality assurance programs
- harvest management measures that allow improvements to meat quality, such as selection of specific age/sex/species combinations
- implementation of sophisticated, GPS-based traceback systems
- Environmental branding based on conservation-friendly land management practices of landholders.

For relevant regulators and policymakers, particularly managers of state kangaroo management programs, the implications of this work are that landholder involvement in kangaroo management is feasible and potentially beneficial in meeting a suite of land management and industry development objectives. Government support for such initiatives would greatly assist their implementation and empower landholders to take a more active role in kangaroo management, in cooperation with relevant government entities. Recommended support includes:

- providing advice and technical and scientific support to groups seeking to collaborate on kangaroo management
- providing funding for such initiatives
- supporting the allocation of quota to collaborating landholder/harvester groups, subject to certain conditions such as adequate procedures to ensure chain of custody of tags
- exploring other approaches to conditionally devolve more kangaroo management rights to collaborating groups, in return for these groups taking on a larger role in sustainable management.

Murray Darling Rangeland Conservancy

Location and membership

The Murray Darling Rangelands SWE trial originally formed as the Barkindji Biosphere WMC, consisting of 11 landholders belonging to the Barkindji Biosphere. The ongoing drought and resulting lack of time available to landholders, plus staff changes in the field, led to the contract being continued to Rangeland Management Action Programme (RMAP) 30 August 2007. The new Murray Darling Rangelands Conservancy (MDRC) group consists of a small core group of landholders in the region around Wentworth in Western New South Wales, in the Lower Murray Darling Catchment Management Authority. The owners of 3 properties, Moorna, Aston and Wyndham Stations, with support from RMAP, form the basis of the Murray Darling Rangelands Conservancy.

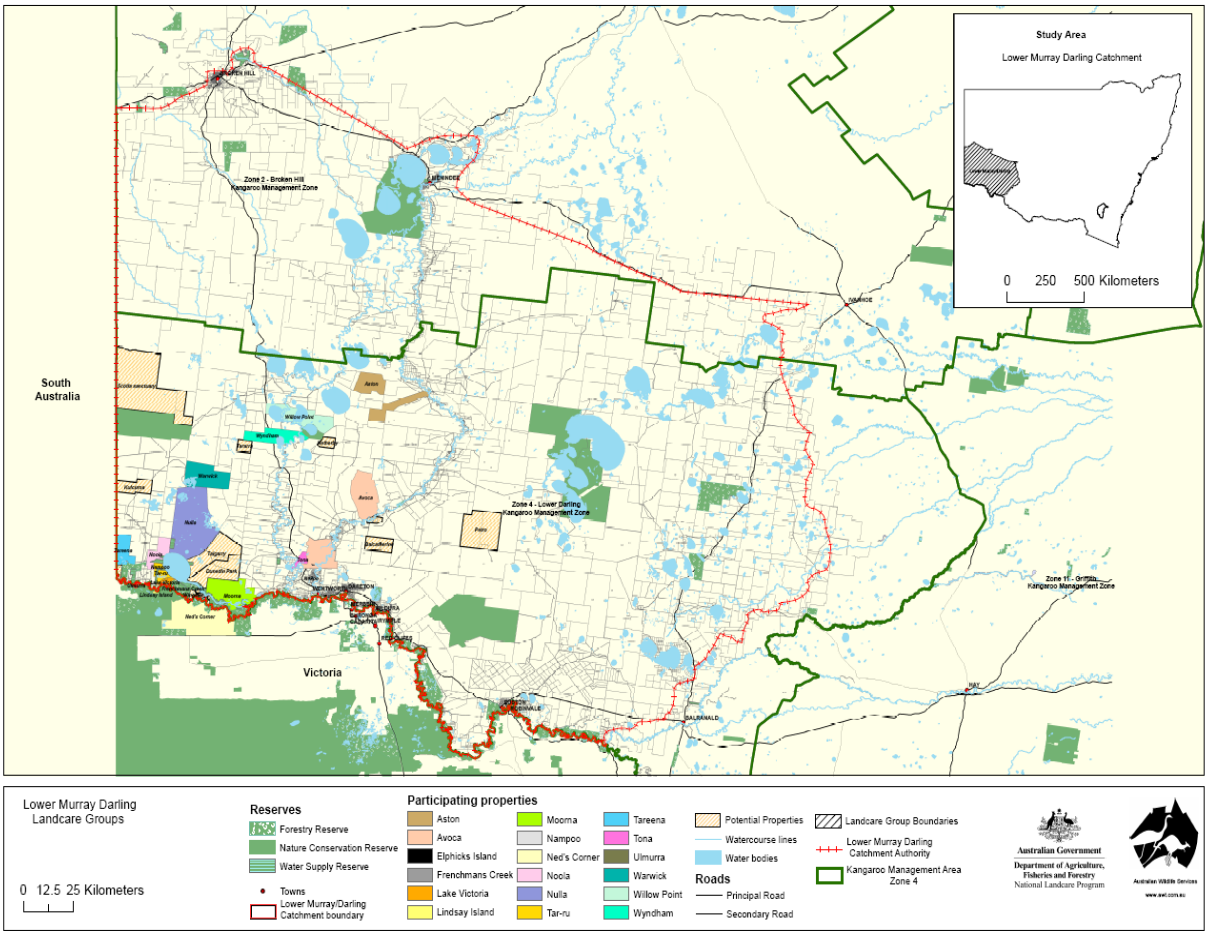

Figure 8 Properties participating in the SWE trial under the banner of Murray Darling Rangeland Conservancy.

The Barkindji group enterprises were low input rangeland grazing systems including sheep, (approximately 7ha/DSE), wheat, tourism, conservation and some irrigated agriculture, predominantly lucerne. Due to the extended drought conditions experienced within the Biosphere area, many of these enterprises were struggling to remain viable, and in some areas, landscape health had suffered a significant decline.

The Barkindji WMC landholders saw the potential for SWE initiatives to complement, or potentially replace, existing conventional agricultural enterprises, and contribute to the long-term sustainability and viability of the region. They identified the following enterprise development opportunities as suitable for establishment under the WMC:

- tourism/ecotourism and hospitality focusing on river and land based tours and cultural tours

- sustainable productions systems (traditional productions systems incorporating alternative support systems) grazing production systems, e.g. grazing

- kangaroo and other native or feral animal (rabbit) harvesting

- bush food production

- aquaculture incorporating commercial markets and conservation restocking

- reintroductions of endemic wildlife to conservation / ecotourism and pastoral enterprises

As for the other SWE trial sites, the Barkindji WMC decided to trial commercial kangaroo harvesting as it showed the most immediate potential both to gain an economic return for landholders and as a conservation incentive. Unfortunately the very reasons they saw potential with the project, the pressures associated with ongoing drought, led to them being unable to continue the project.

The MDRC landholders have an interest in sustainable use of natural resources, and conservation management of the environment. The region is predominantly sheep and cattle grazing, whilst landholders are also interested in enhancing and developing their wetlands and riverine systems. Landholders within the group identified kangaroo management as a key area of focus and have continued to see the need to have kangaroos viewed as a resource not a pest. They believe there is potential for landholders to get an economic return from kangaroos without taking money from the shooters.

The project involved landholders working together with shooters and processors to identify opportunities for vertical integration of industry opportunities, improving trace back and differentiating WMC product. The Murray Darling Rangelands Conservancy set out to build on the ideas and aspirations established within the Barkindji WMC.

Objectives

The SWE trial activities in the project aimed to contribute to the following objectives:

- Integration of property level management plans with regional natural resource management plans

- Provide a framework for landholders to share proceeds of harvested wildlife

- Estimation of kangaroo populations on WMC properties the wider sub -Catchment and rates of sustainable use

- Identification of size of markets for produce from WMC enterprises that are badged as leading to a net conservation gain

- Communication of experiences, expectations and opportunities among WMC members, and communication of project results to the broader rural community.

Integration of property level plans with regional natural resource management plans

The trial has worked to integrate kangaroo management with property management plans (PMPS) developed previously as part of natural resource management and wildlife management planning. Moorna, Aston and Wyndham Stations already had property management plans and holistic and rotational grazing practices in place.

The plans reflect the objectives of the Lower Murray Darling Catchment Management Authority Board, which has five objectives reflecting the community vision of how the catchment should be managed for the future. The five objectives are of equal importance and listed alphabetically:

- Biodiversity
- Community Values
- Salinity
- Soils and Vegetation
- Water Quality and Quantity

Within the MDRC, natural resource and environmental management issues faced by the landholders include:

- Grazing Pressure - stock and non-domestic animals notably macropods.
  - The management of total grazing pressure is seen as a key component to sustainable development with impacts including loss of ground cover having a significant impact on landscape health and enterprise viability
- Groundwater and salinity impacts
- Loss of biodiversity
- Water use and water availability
- Water quality
- Feral animals (goats, rabbits, pigs, foxes, cats)
- Pest plants (noxious and woody weeds), including African boxthorn (Lycium ferocissimum), Cockle burrs (Xanthium spp.), Dodder (Cuscuta campestris), Galvanized burr (Sclerolaena birchii), Hardhead thistle (Acroptilon repens), Harrisia cactus, (Harrisia spp.) and Johnson grass (Sorghum halepense).

The trial for the commercial harvest of kangaroos included the use of PMP's and management incorporating rotational grazing.

Aston Station

Aston Station is located on the Darling River, 60km from Pooncarie. Aston is a family run business running merino sheep on just over 21,230 ha. Aston focuses on managing the natural resource base on their property through a holistic approach and rotational grazing system.

Moorna Station

Moorna is 10,117 hectares in area and is bounded by the Murray River to the south and is also a historically significant property, established in 1850. The property is rich in Indigenous heritage significance and boasts some significant wetlands including Purda Billabong. Conservation planning and revegetation programs have been implemented over recent years. There is a closely monitored rotational grazing system in place on Moorna.

Wyndham Station

Angus, Kelly and Mitchell Whyte, the owners of Wyndham Station, 80km north of Wentworth run a 12,740 ha property dominated by chenopod shrubland. Angus and Kelly Whyte have been implementing a rotation grazing system on the property for several years now and manage their business with an aim to "graze our land with a system that will increase perennial grass species, biodiversity and pasture production, while delivering us a high enough net profit to allow for lots of lifestyle choices".

Emerging challenges for the MDRC

In particular, the MDRC trial was hampered by indecision over responsibility and changing management structures. It also faced similar challenges to the Maranoa WMC trialling ways of increasing landholder involvement in kangaroo management. It faced the same difficulties around developing cooperation and trust between landholders, harvesters and processors; of landholders breaking into an existing industry that has relatively small profit margins.

The MDRC found that existing kangaroo management regulations in NSW, which allocates tags to a shooter for use on one property, are not conducive to involvement by a group of landholders wanting to better manage the free ranging kangaroo. As part of the outcomes from the project the group hopes to get a group allocation of quota and tags to overcome this. The BARG SWE trial, described in the next section of this report, has negotiated with the NSW Department of Environment and Climate Change (DECC) to trial such a group tag system. The licence would make it possible for a group of properties to function as one, with tags issued to the group usable on all group-licensed properties.

Application of a resource sharing framework

Based on the work developed by Dr Rosie Cooney Chapter 4 looking at the "Basic model for collaborative landholder involvement in macropod harvest management", recommendations for the operational framework of the group were taken on board. In reference to work completed by Rosie Cooney, information provided to the group took into consideration the need to delivery high-quality product to processors. To adequately do this would require cooperation of landholders and harvesters, and it is assumed here that both these groups are members of the Wildlife Management Conservancy (WMC). Processors too could potentially be members of this organisation, but this is not currently being contemplated.

The proposed function of the WMC ranged from a coordinating/facilitating role to direct involvement in value-adding. More specifically functions included:

- negotiating as a single voice on behalf of landholders/shooters with processors to secure terms and conditions for contracts
- negotiating with shooters on behalf of landholders on issues such as safety, standards and NRM activities (such as weed/feral control)
- establishing best-practice standards for harvesting and field processing
- establishing guidelines for harvester selection of kangaroos for prime quality product
- establishing best-practice standards for chiller operation to produce premium product
- facilitating development of, and establishing standards or terms for, contracts between the various parties

- Assisting landholders in integrating commercial macropod harvest into property management planning.

Returns to landholders and harvesters for improved quality are the key driver in the program. For landholders and harvesters to derive an economic return from contributing to producing a product of assured high quality is dependent on processors being willing to pay a premium price for assured/exclusive access to members' kangaroos, of specified quality standards.

A return to the members of the WMC would be negotiated between the WMC and the processors. This return would be paid to the WMC by processors, and from the return, the group would be able to pay operating costs, and distribute it as agreed by its governance structures, in this instance as conservation bonuses to landholders.

Liaison with the kangaroo processing industry

Working to develop close working relationships with the processors involved project members of the MDRC along with George Wilson on the 14th March 2008 meeting with Macro Meats Owner Ray Borda and General Manager Doug Jobson at their processing plant in Athol Park SA. They discussed innovations by the company to enable quality monitoring and management of product from paddock to the supermarket outlets. The meeting outlined a picture of where the SWE project was heading, highlighting the points that as groups working towards this common goal they need to enhance the image of the whole process from harvesting to the healthy advantages of consuming Kangaroo meat.

Macro Meats explained that it was a tough industry to manage and that they needed total control or at least to be clearly informed in any public announcement or comments on harvesting methods. They had spent a long time establishing the industry and did not need a hick-up in the chain due to adverse publicity. They had achieved a very warm reception at the world meat trade fair, which cost over $100,000 in 2007 and were returning to do an even better job at the 2008 fair.

Currently Macro Meats have established a stable market into France and Germany with prime cuts and the inferior cuts going to Russia. It is hoped to break into the Chinese market but they have had a few problems achieving this. The domestic market has increased over the last few years with the development of different cuts and selections of small goods.

Continuity of supply

A problem faced by the landholders also poses problems for the processors. One of their biggest problems is a continuous supply of product, when the tags run out Macro Meats have to carry their labour and last year it cost $1.2 Million to keep their trained staff on during these periods. A benefit that could be offered to a processor, who has close contact with a group such as the MDRC, is a commitment to maintain a continuous supply of product flowing through the processing plant. A group tag allocation system, which is the focus of recommendations from the project, will maintain continuity of supply to processors. It is anticipated that with a system such as group tag allocations in place, groups will be able to help out the processors by this action, but may also be able to use this as a bargaining tool to be able to attract some money back from the processors for the landholders who are able to participate in this program.

The group is proceeding to implement a plan developed under the sustainable wildlife enterprises process. A letter was prepared and sent from the group to kangaroo processors. A strong liaison with shooters and processors will be put in place to develop a model for operation of the conservancy.

Participation in National Kangaroo Growers and Harvesters Association

The Murray Darling Rangelands Conservancy group have identified their commitment to supporting and becoming involved in a National Kangaroo Growers and Harvesters Association. A united front working in collaboration with the shooters and the processors is the way forward for landholders to have an opportunity to gain an economic return from the harvest of kangaroos. Joining forces and forming the National Kangaroo Growers and Harvesters Association landholders will have collective bargaining power to negotiate with processors.

Kangaroo population estimates

Surveys were conducted in order to estimate kangaroo numbers so as to enable landholders to more effectively manage populations and integrate wildlife with their property and natural resource management plans. Initial densities for the Murray Darling WMC were determined using survey data from the NSW Department of Environment and Conservation. Species observed were classed as red kangaroos or grey kangaroos (as eastern grey kangaroos and western grey kangaroos are not distinguishable from the air). Surveys were conducted using a fixed-wing aircraft with 100 m wide survey strips (fixed strip-width survey methodologies with correction factors based on helicopter line transect sampling (see DEC NSW 2007).

Figure 8 Properties participating in the SWE trial under the banner of Murray Darling Rangeland Conservancy.Kangaroo population estimates are provided for within the Lower Darling Kangaroo Management Zone 4 (green border) and the Lower Murray Darling Catchment The results show high numbers of kangaroos in the Lower Darling Management Zone (LMDZ), with 226 569 grey kangaroos at an overall density of 3.6 / km2 and 118 018 red kangaroos at an overall density of 1.9 / km2 in a 63 000 km2 area. The survey determined kangaroo densities using a one degree block scale shows the density of kangaroos in the Murray Darling WMC at a finer scale.

Ground surveys utilising the line transect survey methodology are used to establish a ratio between the eastern and western grey kangaroos. At Aston the density of kangaroos were 0.63 eastern grey kangaroos / km^2, 2.54 western grey kangaroos / km^2 and 4.82 / km^2 red kangaroos. The densities of eastern grey kangaroos and western grey kangaroos at Moorna and Wyndham did not differ markedly from those at Aston with 0.67 / km^2 and 2.67 / km^2, respectively. However, the density of red kangaroos at Moorna and Wyndham (2.07 / km^2) was almost half the number at Aston.

In contrast to the density of kangaroos in the Maranoa WMCs, the density of red kangaroos and eastern grey kangaroos in the Murray Darling WMCs was not considerably higher than that of the average densities for the Western Plains harvest zone (3.92 / km^2 for eastern grey kangaroos and 4.05 / km^2 for red kangaroos; DEC NSW 2007). However, the density for western grey kangaroos in the Murray Darling WMCs was higher than the average density for the average in the Western Plains harvesting zones (1.35 western grey kangaroos / km2).

Current quotas for red kangaroos and grey kangaroos are set at 13 and 15 %. The average MSY for the Western Plains NSW harvesting zone is 0.59 grey kangaroos / km^2 and 0.55 red kangaroos / km^2. Using these quota settings the annual MSY that could be achieved from the following properties are:

Aston – 0.09 eastern grey kangaroos / km^2 or 20 on property, 0.35 western grey kangaroos / km^2 or 81on property, and 0.63 red kangaroos / km^2 or 133 on property,

Moorna – 0.10 eastern grey kangaroos / km^2 or 10 on property, 0.40 western grey kangaroos / km^2 or 40 on property, and 0.27 red kangaroos / km^2 or 27 on property, and

Wyndham – 0.10 eastern grey kangaroos / km^2 or 12.75 on property, 0.40 western grey kangaroos / km^2 or 51 on property, and 0.27 red kangaroos / km^2 or 40 on property.

Table 4 and Figure 9 show these kangaroo density comparisons. The figure also shows the density of kangaroos and the MSY for the Western Plains harvesting zone.

While the NSW DEC provides indicative densities of kangaroos, aerial surveys of the properties and their surrounds will promote the accuracy of the results for determining densities in the Murray Darling WMC. An aerial survey of the Murray Darling WMC was scheduled in 2007; however it was delayed due to a late start to the project combined with the early arrival of hot weather, which is not suitable for aerial kangaroo surveys. The survey was re-scheduled for March / April 2008. But again, the survey had to be postponed as the aircraft and pilot scheduled to do the survey became unavailable. The proposed flight lines for the Murray Darling WMC aerial kangaroo survey are shown in Figure 10. The work will be completed later in 2008.

Each property involved had a property map updated to include information indicating the low, medium and high densities of kangaroo numbers as an estimate in relation to the land system types. The information for each property was developed in an attempt to gain an understanding of whether the kangaroos are favouring certain vegetation communities within the region. The details shown in the property maps are an indication only from information provided by the landholders working with their shooters. See Figure 11, Figure 12 and Figure 13 for these indicative property maps.

Table 4 The numbers, densities and Maximum Sustainable Yield (MSY) of kangaroos in the Mildura WMC and the Western Plains harvesting zone in NSW.

		Aston	**Moorna (M) & Wyndham (W)**	**Western Plains harvesting zone**
Eastern grey kangaroos	Number	134	68 (M), 85 (W)	2 140 000
	Density (km^2)	0.63	0.67	3.92
	MSY (km^2)	0.09	0.10	0.59
Western grey kangaroos	Number	539	270 (M), 340(W)	65 000
	Density (km^2)	2.54	2.67	1.35
	MSY (km^2)	0.35	0.40	0.59
Red kangaroo	Number	1023	209 (M), 264 (W)	2 180 000
	Density (km^2)	4.82	2.07	4.05
	MSY (km^2)	0.63	0.27	0.55

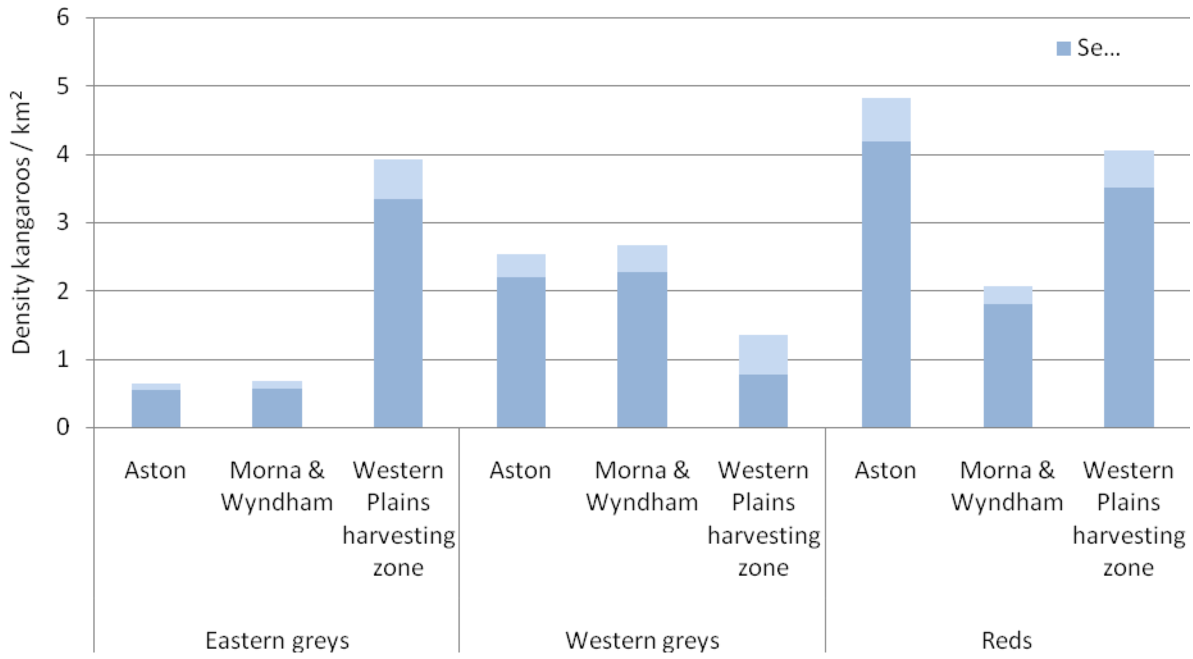

Figure 9 The density of eastern grey, western grey and red kangaroos / km2 and the MSY for the properties at the Murray Darling WMC.

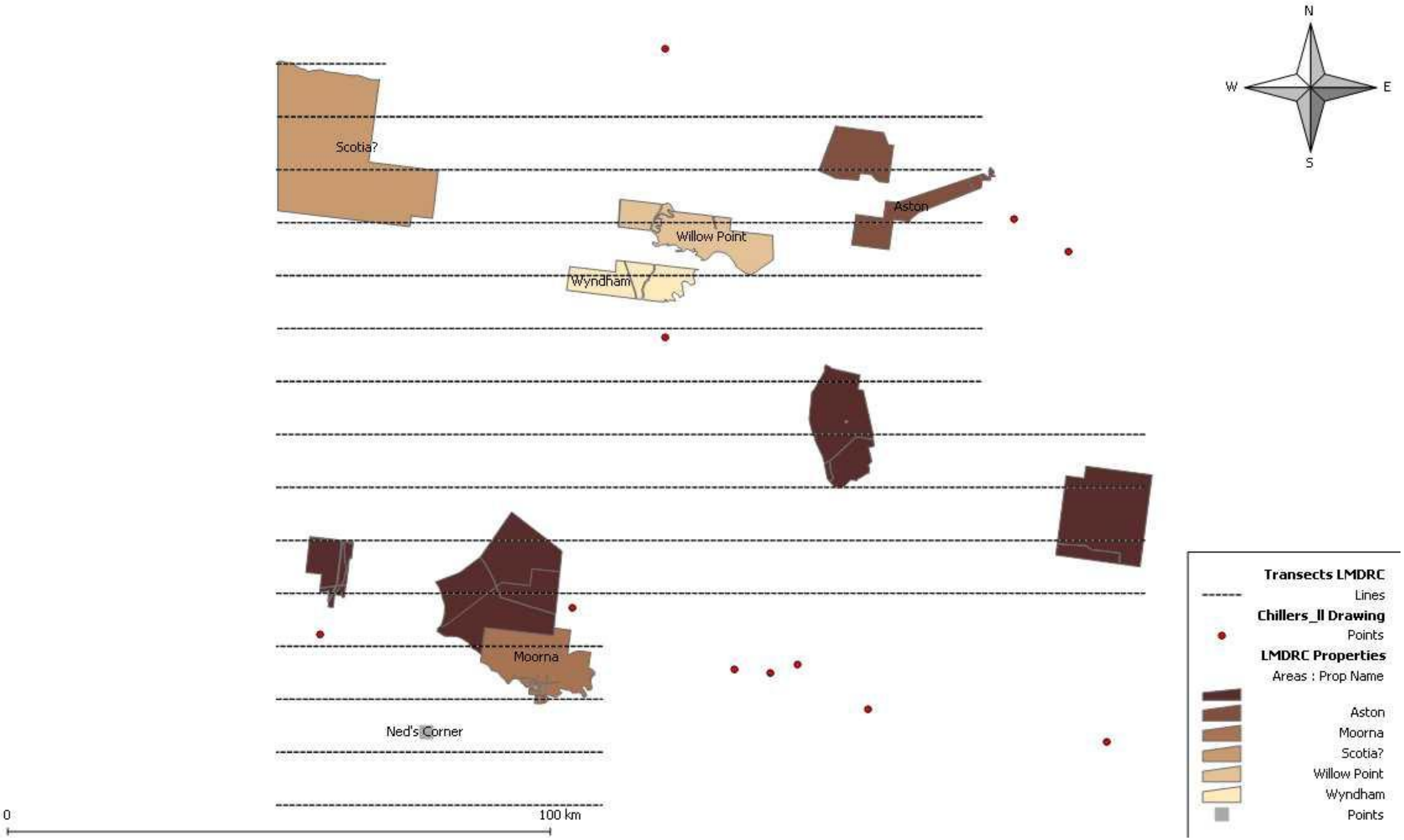

Figure 10 Proposed flight lines for the aerial survey to be carried out at Murray Darling WM

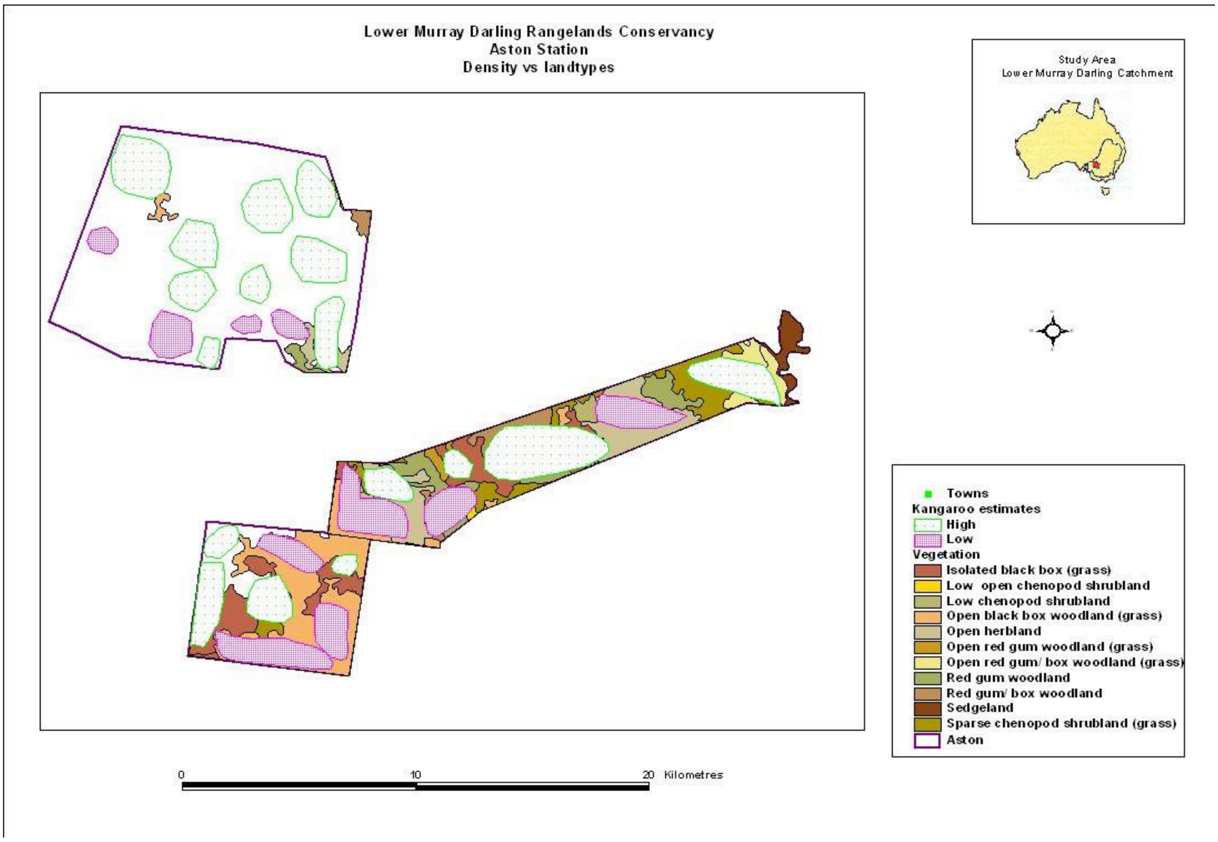

Figure 11 Map of Aston kangaroo density estimates 2007 over land types

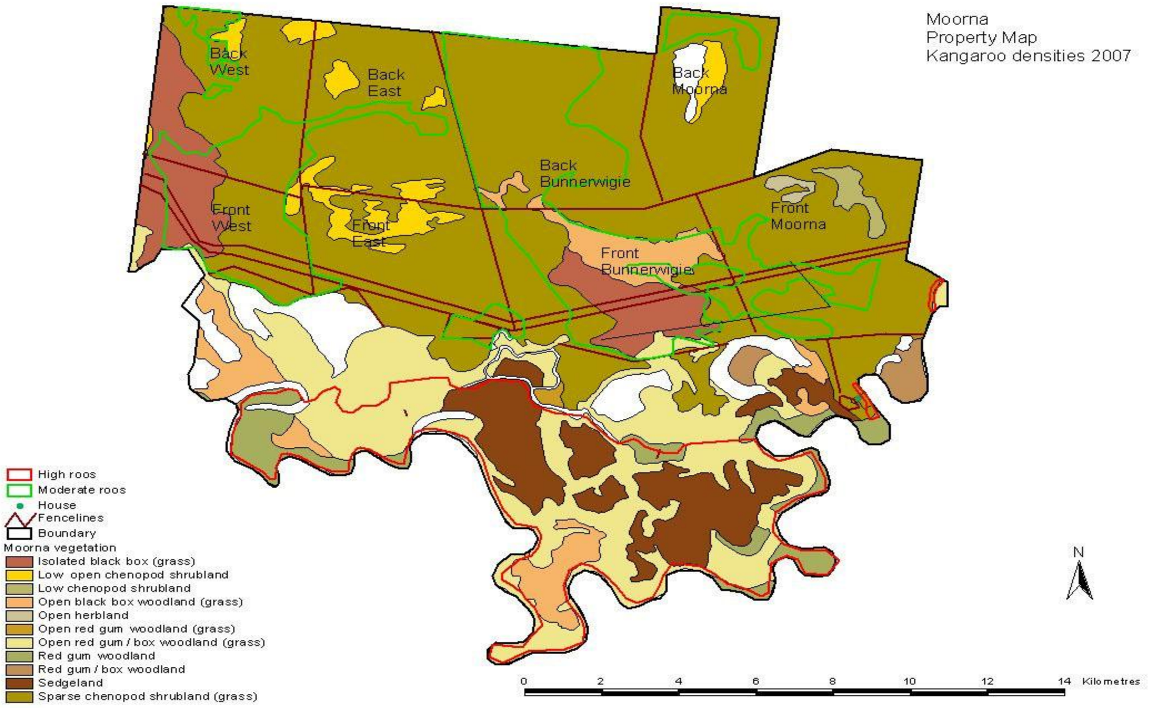

Figure 12 Moorna station kangaroo density estimates 2007 over land types

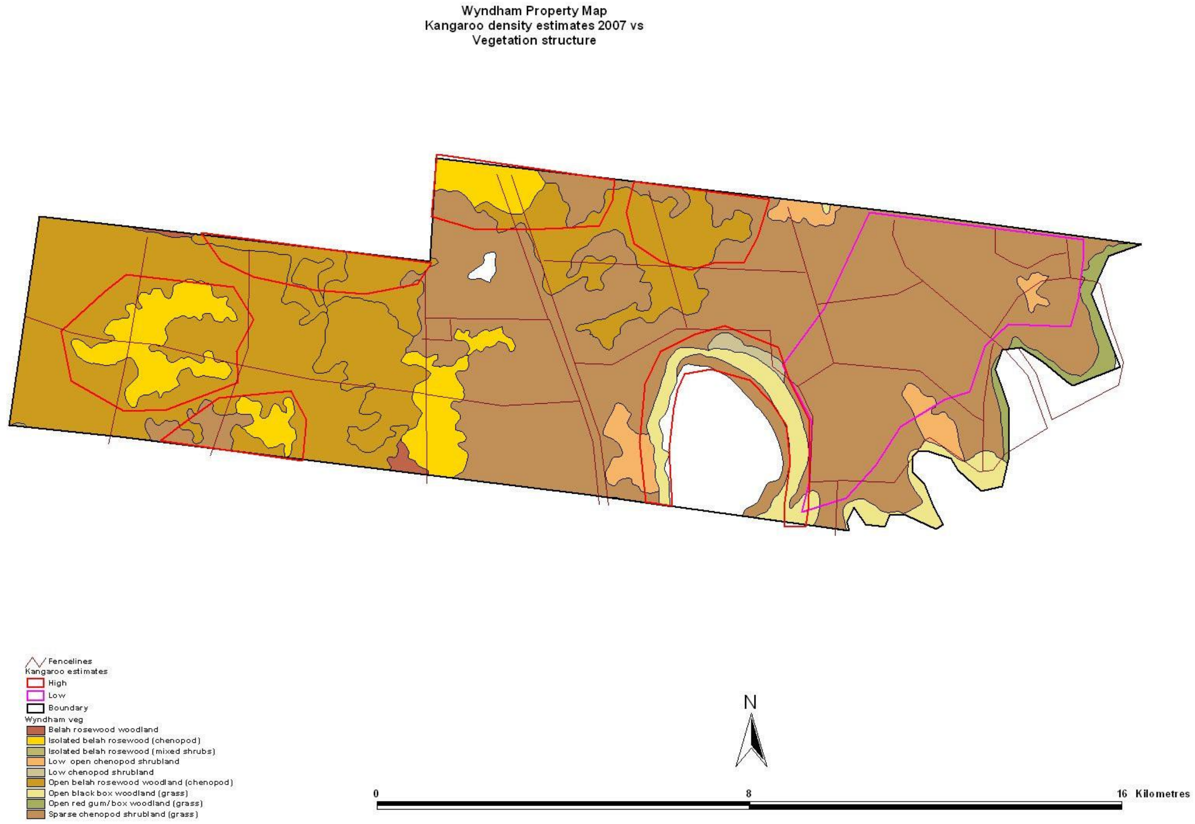

Figure 13 Wyndham station k**angaroo** density **estimates 2007** over land types

Regional resource management

An Environmental Management System (EMS) property-planning tool (prepared by AEMS and funded by RIRDC) was developed for the WMC properties. The tool sought to enable the integration of traditional agricultural production where it is compatible with existing production certification schemes, (such as organic produce status), and provides a reporting platform for reporting conservation outcomes to regulatory authorities, as well as reporting against other certification schemes such as ecotourism sustainability schemes. The tool will also enable the WMC to apply its own certification schemes to production systems. Roll out of the system has not been successful and the company's products are being 'redeveloped'.

Once land management issues within each property and the WMC have been integrated into the EMS with the assistance of the NSW DPI, the identification and integration of relevant NRM priorities and targets will also be undertaken to ensure that environmental outcomes at the property and WMC level contribute to the achievement of catchment based NRM targets.

Many landholders are currently practicing sustainable land management, however are unable to quantify environmental outcomes or incorporate outcomes into a marketable brand for goods and services produced. There is considerable opportunity to refine current 'traditional' rangeland production systems (i.e. grazing enterprise) through the incorporation of EMS, and so achieve associated marketing opportunities for 'sustainable produce'.

The WMC supports the establishment of a group quota and tag allocation system under NPWS, and removing the regularity requirement for pre-allocation of tags to shooters for use on one property would allow for ease in operation. The group tag allocation will put an end to the current situation of tags running out by August or September of each year. A flexible tag allocation system to the groups would eliminate this issue.

Identification of size of markets for produce from WMC enterprises that are badged as leading to a net conservation gain

The MDRC was required to communicate the results of marketing studies to members. This was done via a newsletter and at the forum held in Broken Hill. The information was also made readily available for shooters involved in the program.

The WMC believes the level of information-sharing, transparency, accountability and unity in the kangaroo industry is less than for other primary production industries. Understanding the business needs of each stakeholder and the ways in which decisions taken by one player impact on the others, particularly through business arrangements involving processors, harvesters and landholders, may help to resolve some of these issues.

As a continuation of the work the group has already undertaken, the Project Coordinator will work with NSW DPI Project Officer Jessica Gibson to undertake surveys of landholders in the region to ascertain the production benefits possible from a sustainable commercial harvest of goats and kangaroos. The data collated from the research will be valuable in the Groups progress. The Murray Darling Rangelands Conservancy group will work to progress the structure of its organisation and work on developing the conservancy further.

Communication of experiences, expectations and opportunities among WMC members, and communication of project results to the broader rural community

As the trial consisted of a small group of landholders, communication between members occurred on a regular basis with phone calls, emails and newsletters. The members attended the key workshop held in Broken Hill 14 and 15 February 2008, which brought together members of the three SWE trial sites, associated research and departmental personnel.

Additional activities which were undertaken by the Murray Darling Rangelands Conservancy trial included a Landscape Function workshop with Peter Andrews, which looked at the fundamentals of Peter's teaching and how the principles could be applied across the landscape. All participants in the project attended the workshop along with other interested landholders from the region.

Conclusions

As a result of the project the Murray Darling Rangelands Conservancy is seeking:

- Greater regulatory ease to be built into the system
- To improve relationships with all stakeholders involved in the process – including landholders, shooters and processors
- More transparency and understanding each others' (shooters, processor, and landholders) interests
- To support greater accountability for the product along the entire supply chain maintain quality control and trace back along the entire kangaroo supply chain
- Clearer product recognition to consumers and the broader community of the animal form the bush to the food on the plate

Barrier Area Rangecare Group - BARG1,

The third SWE trial site consists of a collaborating group of landholders in the Barrier Ranges north of Broken Hill, New South Wales. The trial is being conducted by the Future of Australia's Threatened Ecosystems (FATE) Program at University of New South Wales (UNSW) in collaboration with the Barrier Ranges Rangecare Group (BARG). The FATE group were commissioned to run the workshop that was Milestone 4.

The trial continues until June 2009 with RIRDC support. Although not funded under this DAFF project, the progress to date is reported here. It highlights that:

- a large group of landholders across a wide area can collaborate to help manage kangaroos and total grazing pressure (TGP) in a region
- harvesters are willing to collaborative with landholders
- implementing SWE is not a simple task:
  - getting agreement takes time and effort both because of the diverse groups involved in the project and current practice in commercial kangaroo regulation and management
  - external factors such as drought hinder progress.

Membership

The BARG trial involves a group of 25-30 landholders of large pastoral properties that form the Barrier Area Rangecare Group (BARG) in north-western New South Wales, covering over 1 million hectares in total. These properties, which run sheep and cattle (and also depend on a significant amount of off-farm income), have been collaborating for some time on NRM activities such as feral animal control; weed control and sustainable grazing management. The partnership between BARG and the FATE Program aims to expand this collaboration by managing free-ranging kangaroos as a common property resource, with associated monitoring and management of TGP across the BARG

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[1] Note: The Barrier Ranges SWE is funded by RIRDC Rangelands and Wildlife Program and the University of NSW

properties - to develop a role for BARG in the kangaroo harvest process that is beneficial to landholders, shooters and processors alike.

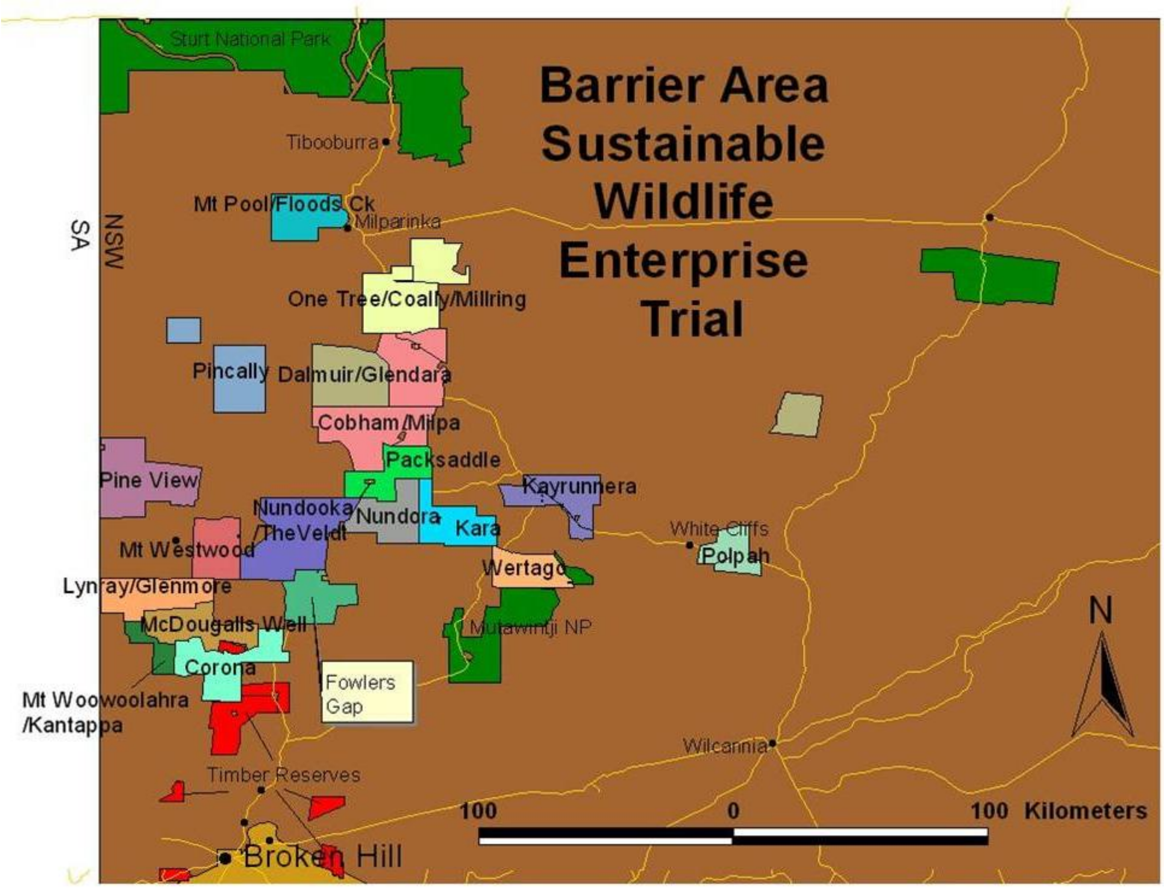

Figure 14 Properties in the Barrier Area SWE operated by UNSW

A steering committee, consisting of BARG landholders, FATE researchers, local kangaroo harvesters and Western Catchment Management Authority representatives, oversees the trial.

BARG found that existing kangaroo management regulations in NSW are not conducive to involvement by a group of landholders wanting to better manage the free ranging kangaroo. They identified a lack of security over annual harvest quotas (with landholders limited to tags with a 4-month expiry) and the requirement to obtain property- specific harvest tags (which cannot be transferred to neighbouring properties even if the kangaroos move) as the major barriers to a group of landholders working together and entering into supply deals with processors.

Landholders and harvesters involved in the project would generally prefer a group licence to be issued. The licence would make it possible for a group of properties to function as one, with tags issued to the group usable on all group-licensed properties.

To test this concept, the BARG recently negotiated with the NSW Department of Environment and Climate Change (DECC), which oversees the kangaroo harvest in NSW, a trial arrangement that might alleviate these barriers to doing business.

NSW DECC agreed to a group licence trial from 1 May 2008 for BARG members and harvesters that will make it possible for a group of properties to function as one, with tags issued to the group usable on all group- licensed properties. The idea is that this more flexible licensing and tagging system will allow the harvest to be more strategic. Kangaroo mobs can be followed as they move across properties and harvesting efforts can focus on areas of greatest kangaroo density in order to maximise harvest efficiency as well as relieve grazing pressure where it is most acute.

Trial group licence/quota

The trial group licence includes about 15 landholders and 17 shooters, with 8000 tags on the first licence (May-Aug) and another 7000 or so pencilled in for the four months after that. It operates by the:

- licence issued to the group of properties not just one
- licence lists group of shooters not just one
- licence provides a quota for the group calculated based on the area of properties participating and their past harvest level
- tags issued to group can be used on any property and by any shooter
- Steering committee overseeing the distribution of tags to shooters.

Next Steps

At this stage, kangaroos can still be sold to any chiller where they are currently sold.

Negotiations with processors have accelerated in recent months, with landholders, harvesters and processors realising the mutual advantages for consistency of kangaroo supply and meat quality that may arise from secure arrangements between a group of properties and a single processor. Deals with processors will come down the track once the group has processes in place to be able to ensure quality and supply and a trading structure from which to negotiate using their joint quota.

An aerial survey of kangaroos will be conducted in August 2008 on the following flight lines.

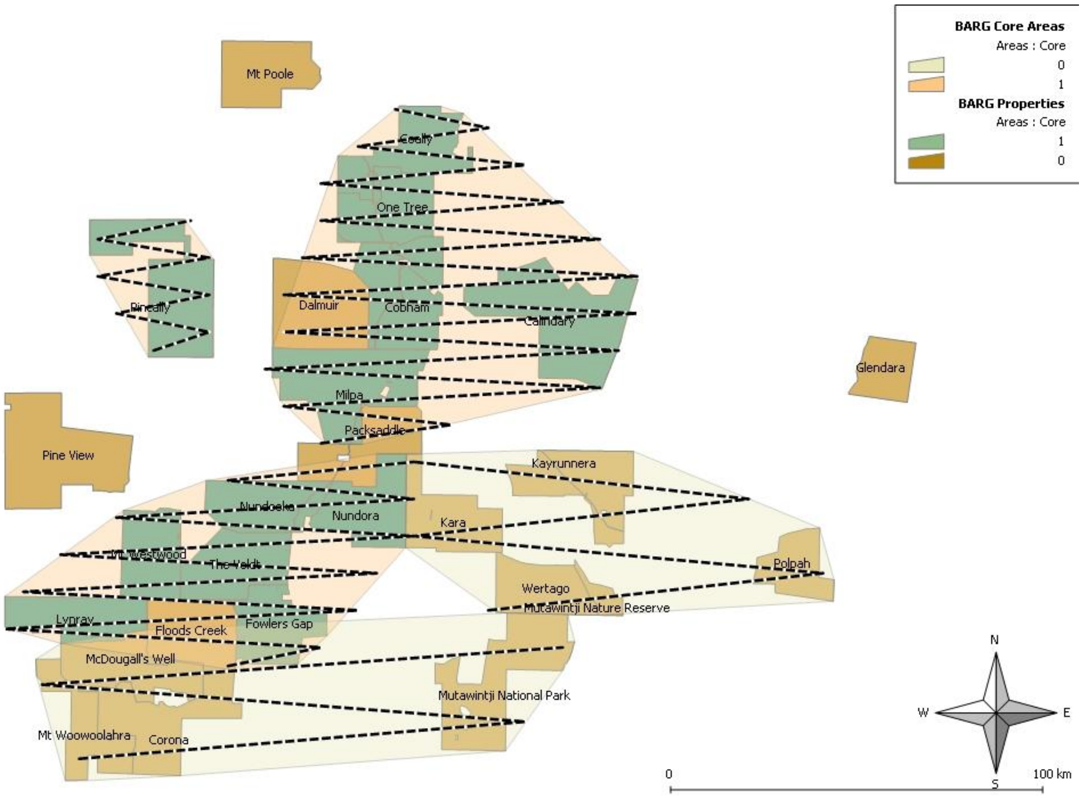

Figure 15 Flight lines for aerial survey of BARG properties

3. Wildlife Stewardship Scheme

One aim of the trials is to provide site specific and demonstrable information about: methods for integrating enterprises with existing performance management frameworks such as EMS.

While the nature of an EMS provides scope to include wildlife management and biodiversity, wildlife is not one of the key elements identified in most EMS plans. This could be because:

- The benefits created by wildlife are not as obvious to the immediate benefits generated by the effects of improved soil and water quality
- Wildlife may be considered a pest
- Landholders are unsure about how to include wildlife in an EMS
- Landholders already meet legal obligations and do not identify how wildlife could be included in an EMS
- Landholders are unsure of the effort and benefits involved
- For landholders that are undertaking an EMS, the significance of an impact that affects wildlife is not high priority
- Wildlife is difficult to measure and mitigate against

In the following paragraphs we consider how biodiversity loss and wildlife management can be addressed through an Environmental Management System (EMS). In particular, we identify a Wildlife Stewardship Scheme that sets out how protecting and enhancing wildlife can be used as an environmental focus point to increase natural resource management and environmental improvement - one of the key drivers of EMS.

Attributes of an EMS

The key objectives of EMS reflect elements of the broader environmental concerns of the community. These can be generally grouped into three key drivers for EMS:

- Natural resource management and environmental improvement such as conservation of soil, water, vegetation, and biodiversity
- Competitiveness objectives (such as input–output efficiencies, better prices, lower costs, more efficient production)
- Social objectives (landholder and community values such as cultural heritage and occupational health and safety matters)

While EMS aims to improve environmental management, this is not the only benefit. EMS can have additional benefits such as:

- Landholders improve the environmental impacts of the main farm activities
- Landholders may obtain recognition for environmental land management efforts. EMS can be used to gain internationally accepted management standards so customers overseas as well as locally know that products that come from certified land holdings have been managed in an environmentally responsible way
- Landholders can improve their market access from being able to use environmental attributes to differentiate products.
- May provide landholders with a basis for ‘green’ claims. Currently there is no widely adopted system that provides a basis for ‘green’ claims made by industry organisations and government representatives on behalf of Australian farmers – this places all Australian farmers at high risk.

- Landholders can document their achievements and progress which can then be recognised by markets and the community
- Landholders may improve their productivity from better use of natural and other resources
- Landholders may improve their land value

To achieve the objectives listed above, EMS provides a management framework based on a simple: plan, do, check, and act cycle that achieve continual improvement. A manager uses the system to identify likely environmental impacts and legal responsibilities, then implements and reviews changes and improvements in a structured way. The EMS process generally involves:

- Initial environmental review
- Develop an environmental policy
- Develop an environmental management program
- Define roles and responsibilities
- Carry out appropriate training and communication
- Operational control and document control

Australian Landcare Management System

There is much that landholders can achieve to increase environmental performance and quality assurance in agriculture. Agricultural industries in Australia currently operate under a range of legislative requirements from all tiers of government, product safety and quality systems, and marketing and branding schemes. In most cases, established groups exist to assist landholders undertake an EMS. While the groups usually have a different focus, they all aim to protect and enhance an aspect of the environment. In this report we look at the Australian Landcare Management System (ALMS) and discuss how it can be used to assist landholders implement an EMS with a focus on biodiversity.

ALMS is an EMS with a focus on land management and it has the great advantage of being able to be used for the management of both agricultural and non agricultural land. It is designed for Australian land managers and incorporates a whole-of-farm, catchment- linked national certification land management system that can be used for all enterprises and activities on the farm (Australian Landcare Management Systems 2008).

ALMS are based on a cycle of planning, action and reviewing. When a landholder joins the ALMS Group the first thing they will do is develop a plan, which will be their guide to improving environmental outcomes. Most landholders develop their ALMS action plan over two to four days, usually in a group and with the help of an ALMS trainer. The plan is then checked to ensure it complies with ALMS requirements.

External auditors ensure that the plans are being implemented and are meeting the targets established by landholders with the help of the ALMS trainer. Audits are done by auditors accredited by ALMS (i.e. auditors meet eligibility criteria, including relevant agricultural and environmental management experience).

There are three categories of membership within ALMS which allow members to contribute as much or as little as they can:

- **Eucalyptus members** have participated in an ALMS Training Clinic, have had their ALMS plan certified by an ALMS accredited auditor and have paid their ALMS Eucalyptus membership fee.
- **Banksia members** have met all the system requirements applying to ALMS Eucalyptus membership and are exchanging information with the catchment authority in the region. They have also passed an ALMS Banksia audit and paid the ALMS Banksia membership fee.

- **Grevillea members** have met all the requirements of ALMS Banksia membership, are ISO 14001 certified and have paid the ALMS Grevillea membership fee.

Aims of a proposed Wildlife Stewardship Scheme

Currently, wildlife and biodiversity are not a significant component of ALMS. Following the above, we examine how biodiversity conservation and wildlife can be included as a key module. This would give landholders the opportunity to protect and enhance wildlife on their land and be part of a broader ALMS process under which they can achieve ISO 14001 certification. The steps that are required to carry out an ALMS EMS are provided in a detailed paper in preparation. In short, for this report we identify the steps and processes required to establish an EMS. We then identify where modifications can be incorporated to put a focus on wildlife and biodiversity

ALMS employ a number of tools to help landholder's establish an EMS. MyEMS is an internet based program which presents a series of interconnected frames to guide landholders through the ISO 14001 steps to arrive at documented action plans and operational procedures. We identify the default data that could be incorporated into the ALMS MyEMS database in Table 6.

Table 5 The steps and processes required to carry out an ALMS EMS and areas which require modification to include wildlife and biodiversity.

Step	ALMS Process	WSS Process
Account details	MyEMS	No modifications required
Policy	Landholder, ALMS trainer (and MyEMS)	**Modification required**
Legislation	MyEMS default questions	No Modification required
Environmental review	MyEMS default questions	**Modification required**
Activities, aspects and impacts	MyEMS default data	**Modification required**
Risks and significant impacts	Likelihood and severity selected by landholder	No modification required
Objectives and targets	Set by ALMS trainer and landholder	No modification required
Management plans	Set by ALMS trainer and landholder	** Modification required**
Operational control	Set by ALMS trainer and landholder	**Modification required**
Staff management, capability and training	Set by ALMS trainer and landholder	No modification required
Emergency response management plans	Set by ALMS trainer and landholder	No modification required
Audit	Landholder, ALMS auditor or external auditor	No modification required
Review	Landholder	No modification required

Table 6 A comparison of the activities and aspects in a current ALMS EMS and how it could be expanded by the WSS

Current ALMS default data			**Proposed WSS in ALMS default data**		
Category	Activity	Aspect	Category	Activity	Aspect
Special conservation, biodiversity and ecosystem health	Maintaining ecosystem health	Inadequate enabling of revegetation	Special conservation, biodiversity and ecosystem health	Restore and/or maintain the physical component of an ecosystem	Construction on land, in/on water and in the atmosphere
		Preventing endemic (existing) biological activity to control weeds and pests			Removal of land or water
		Inadequate protection of riparian vegetation			Alteration of land or water
		Inadequate protection or creation of wetlands		Restore and/or maintain the chemical component of an ecosystem	Use of chemicals on land, in water or in the atmosphere
		Inadequate protection of native pastures			Chemicals used for livestock
		Inadequate protection of native flora and fauna			Storage of chemicals
		Preventing endemic (existing) biological activity to control weeds and pests			Chemicals or pollution produce by livestock
				Restore and/or maintain the biological component of an ecosystem	Removal of native species from land, water or atmosphere
					Introduction of species on the land, water and atmosphere
					Introduction of pathogens on the land, water and atmosphere
					Hunting/ trapping/ baiting/ shooting on the land, water and atmosphere

4. Models for landholders to share benefits from wildlife harvesting

A major component for the SWE trials has been considering models of how landholders could become involved in regional collaboration in natural resource management and wildlife planning with a view to sharing the benefits of the wildlife on their lands.

Dr Rosie Cooney from the FATE Program, University of New South Wales undertook a contract that examined organisational structures that would enable collaboration in wildlife management. There is a range of structures and processes through which this can occur. The research tested options for structures and local organisation that are most appropriate for coordinating resources to facilitate the use of native wildlife, while also contributing to enhanced biodiversity conservation, increased numbers of native species, restoration of landscapes and increased farm productivity. The results are outlined below and detailed in the companion publication, *Landholder collaboration in wildlife management: Framework for Landholders to Share Proceeds of Harvested Wildlife 2008*.

The specific focus of the study was the group of landholders that established the Maranoa Wildlife Management Conservancy, under the auspices of the Mitchell and District Landcare Association Inc, in Mitchell, Qld. As the major current option for wildlife-based enterprise for this group involves kangaroo harvesting, the study focused on kangaroos.

The work proceeded through desk-based literature research and analysis, and discussion and dialogue with key stakeholders including SWE participants, harvesters, box operators, landholders and processors. It proceeded through examining current practice in regulation and management of commercial kangaroo harvest in Australia, drawing out key weaknesses from the perspectives of environmental sustainability and various stakeholders. Overseas examples of landholder involvement in wildlife management were examined, in order to seek lessons relevant to the Australian context. A series of broad options were developed and evaluation. Based on these analyses, a detailed model was developed and presented to the SWE for implementation based on collaboration and benefit-sharing between harvesters and landholders.

Issues identified

As highlighted in chapter 1 above, current practice in commercial kangaroo regulation and management has a number of weaknesses. Landholders gain no benefits from the kangaroos on their land, and their ability to manage the kangaroo component of total grazing pressure is limited. Relationships between landholders and harvesters are often poor, and potential for cooperation on issues such as feral animal control is not realised. Harvesters have little security of access to country for harvesting and little ability to bargain on price with processors. The processing industry as a whole relies for supply of their resource on landholders, who would seek to reduce populations as far as feasible if means became available. Individual processors cannot ensure reliable and consistent supply, as this would require guaranteed access to country.

Examination of overseas examples of collaborative landholder involvement in wildlife management revealed no clear analogues for kangaroo management. In particular, the commercial rather than recreational nature of the harvest, and the particularly tight government control of wildlife in Australia, strongly suggest that Australia must develop unique models for kangaroo management. However, three examples presented and discussed in the report illustrate several useful lessons:

- where landholders benefit from sustainable use and management of wildlife, this can dramatically shape how they manage that land and the wildlife on it
- that collaboration among neighbouring landholders in management of wildlife populations can be effective and beneficial

- good management can be fostered through a cooperative, supportive stance of government agencies toward landholder involvement in collaborative wildlife use and management.

Landholders in Australia have a range of possible options for gaining a stake in kangaroo management and harvest. They could require payment from shooters in return for access to their properties. They could become licensed harvesters themselves. They could employ kangaroo managers on their properties, either individually if feasible or in a group. Or they could collaborate with each other and with kangaroo harvesters. Evaluation of these models indicates only the last has the benefits of fostering better relationships with harvesters, gaining the negotiating power of a group, involving landholders in management of harvest (rather than simply gaining benefits), and promoting management at the cross-property scale required for populations that move regularly across property borders. The proposed detailed model is therefore based on this latter option.

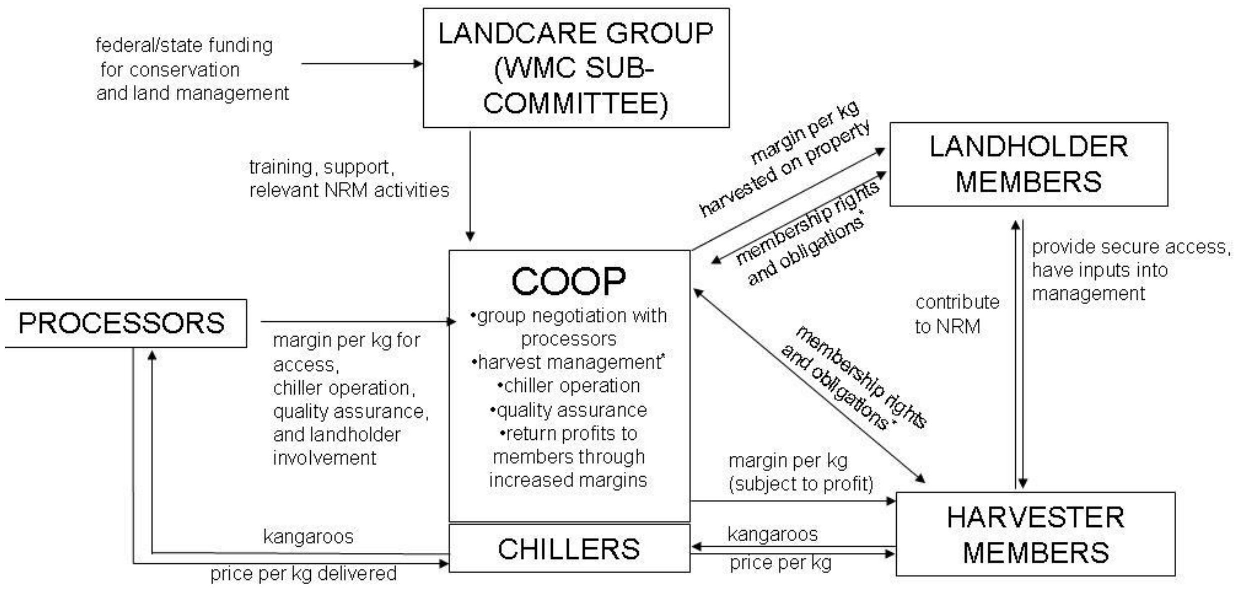

Figure 16 Visual representation of the relationship between the participants in Cooperative

The study proposed a model based on the establishment of a trading cooperative ("the Coop") for kangaroo management, processing and marketing. Landholders and shooters would be equal members of the Coop and share equitably in its benefits. All members benefit from the greater negotiating power of the Coop in relation to processors, the establishment of cooperative, long-term relationships between the groups, and the potential for development of high-value niche products reliant on landholder involvement. Activities of the Coop would initially focus on collective bargaining with processors on behalf of its members; chilling and holding of kangaroo products produced by its members; and quality assurance. In the future, the aim would be to expand into development of premium products, badged on the basis of environmental standards (land management, biodiversity), regional identity, and/or landholder involvement; and potentially into processing and marketing to buyers further toward the consumer end of the chain.

The major obligation for landholder members is that they provide exclusive access to Coop harvester members to their properties for harvest. A further obligation for landholders is that landholders do not use damage mitigation permits on their properties. The major obligation for harvester members is that kangaroos harvested on Coop member properties are supplied exclusively to the Coop chiller box, up until its capacity is reached. They further commit to implement any quality assurance schemes developed by the Coop.

A cooperative business structure appears appropriate for a number of reasons. The most salient reasons are that its limited membership, user-controlled and democratic structure are well suited to an enterprise where encouraging cooperation is a key objective. The model developed drew on some of the features that have contributed to the success of “new generation cooperatives” in recent years for producers in the USA and Canada. Development of a Coop could be substantially assisted by cooperation and support from government agencies through such mechanisms as allocation of a group quota to the Coop, for it to manage and allocate among its members.

Implications and recommendations for relevant stakeholders

The recommended collaborative management model for SWE involves establishing a harvest management, processing and marketing cooperative with both landholders and harvesters as members. While implementing this model will involve substantial inputs of time, effort, and some money, and will require the establishment of a relationship of trust and cooperation between landholders and harvesters, it offers the potential for both landholders and harvesters to benefit through:

- collective bargaining to gain best market terms for the product they both play a role in producing
- more effective kangaroo management at a cross-property level, both to meet production objectives and for better management of TGP
- more cooperative relationships between landholders and harvesters, including harvester participation in feral animal control and weed management
- more secure and exclusive access to country for harvesters
- reduced use of shoot and let lie tags (non-commercial damage mitigation culling), and
- equitable sharing of profits.

For Landcare groups and regional/catchment management bodies, the model recommended offers them a potential option to meet objectives of better management of total grazing pressure, improved diversification of landholder incomes and better socio-economic resilience, and better management of feral animals and weeds at the local level.

3. For processors, collaboration between landholders and harvesters in kangaroo management, according to the recommended model, could offer real benefits to them as well. Establishment of a cooperative involving landholders and harvesters opens the way to:

- assuring an exclusive, consistent source of supply from the properties involved
- improved quality management from field to fork, through development and implementation of best-practice quality assurance programs
- harvest management measures that allow improvements to meat quality, such as selection of specific age/sex/species combinations
- implementation of sophisticated, GPS-based traceback systems
- environmental branding based on conservation-friendly land management practices of landholders.

For relevant regulators and policymakers, particularly managers of state kangaroo management programs, the implications of this work are that landholder involvement in kangaroo management is feasible and potentially beneficial in meeting a suite of land management and industry development objectives. Government support for such initiatives would greatly assist their implementation and empower landholders to take a more active role in kangaroo management, in cooperation with relevant government entities. Recommended support includes:

- providing advice and technical and scientific support to groups seeking to collaborate on kangaroo management
- providing funding for such initiatives
- supporting the allocation of quota to collaborating landholder/harvester groups, subject to certain conditions such as adequate procedures to ensure chain of custody of tags
- exploring other approaches to conditionally devolve more kangaroo management rights to collaborating groups, in return for these groups taking on a larger role in sustainable management.

Trial of the Cooperative model with the Maranoa WMC

The recommended Cooperative model was trialled with its major target group, the Maranoa WMC. It was presented to a meeting of involved landholders, harvesters and box operators in early February 2008. It was discussed at some length and an in-principle decision was taken by the group to further examine this model with a view to its implementation. A Working Group was established for this purpose. The model was then presented and discussed at the February 2008 meeting in Broken Hill involving participants from all three SWEs, which is summarised in the chapter 6 of this report. The model received widespread support from many participants. Some long established industry participants stated that it was the first model they had seen throughout their involvement with the kangaroo industry that they believed could work. The Maranoa SWE Working Group met again in early March. At this meeting, as an initial step toward establishing a formal Coop, they agreed a set of obligations of membership of an informal Coop (see Plate 1 in Attachments) and further actions toward securing membership were agreed.

By joining the informal *Maranoa Kangaroo Harvesters and Growers Coop*, members committed to the following:

- Each landholder will provide exclusive access to their property to one individual Coop member harvester at any one time
- Harvesters will sell kangaroos from Coop member properties exclusively to the Coop chiller boxes. However, if the Coop box operator indicates the Coop boxes are full, they are free to sell elsewhere
- Landholders will not apply for or use damage mitigation permits
- Harvesters will implement any Quality Assurance schemes developed by the Coop.

Members have the following rights:

- the Coop will collectively bargain on their behalf to secure the best market price for their product
- they receive an equitable share of any profits made by the Coop.

These rights and obligations will be reviewed with member input as they establish a formal Cooperative.

5. Marketing Kangaroo Products

A key component of the SWE strategy is to increase the value of the wildlife products thereby creating a margin which can flow to the landholder. However commercial business enterprises based on Australian wildlife usually are associated with tight profit margins. Also, demand for some products can be limited by perceptions of unsustainable yields and exploitative and inhumane systems of production. These issues and perceptions led to a commissioning of a contract to examine the size of the demand and other options and requirements to market the products from WMCs.

Marketing Kangaroo Meat from the WMCs – *Chudleigh et al*

Peter Chudleigh's supporting research *Marketing Kangaroo Meat from the Sustainable Wildlife Enterprises2008*, explored whether using the concepts of sustainable yields within a conservancy and wildlife conservation gains from management of the conservancy may result in a higher acceptability of products and enhanced marketing effectiveness and margins for kangaroo products. The research focused on kangaroo marketing because the project was directly targeted at meeting the needs of the Mitchell and District Landcare Association who are pursuing the Conservancy concept and who had already purchased two chillers to enter the kangaroo marketing chain

The research provided information on the kangaroo meat market in Australia with regard to strategies for market development of conservancy produced kangaroo meat and in particular an assessment of the potential badging of products with some form of environmental accreditation.

The investigation focused on the markets for products labelled as originating from sustainable enterprises where biodiversity has been enhanced. In particular, market research was carried out within the study in order to assess and facilitate the development of a marketing strategy for kangaroo meat emanating from land and wildlife that are managed in a sustainable manner.

The approach was believed necessary, the current marketing arrangements have evolved over a number of years using the kangaroo resource without much regard to its interaction with land management. Second, a key question in the minds of the Conservancy representatives was whether environmental badging could be applied in the market place to attract increased demand for kangaroo products. Thirdly, this increased demand would in turn assist the rural sector to diversify, especially in the rangeland areas where new production options are limited.

While other market research activities on kangaroo meat have been undertaken in the past, information on the potential for differentiation of the market through environmental management associated with the kangaroo production and harvesting system and its interaction with traditional grazing enterprise was lacking.

The specific objectives of the research were:

- Identify the size and location of markets for produce from Wildlife Management Conservancy enterprises that are badged as leading to a net conservation gain
- Support the establishment of processes for supplying those markets.

The first activity concentrated on describing the characteristics of the Conservancy properties, the potential supply of kangaroo meat, and features of the Conservancy properties that were thought would be of interest to current and potential kangaroo meat consumers. This guided the second activity, appropriate market research with consumers and other participants in the kangaroo marketing chain (e.g. marketeers, restauranteurs, caterers etc). The information attained on the market was expected to lead to options for market development and in particular alternative forms of potential badging of products, for example, using some form of accreditation or chain of custody associated with environmental and wildlife management systems.

The market research was conducted through:

- Twenty one interviews with representatives of various segments of the market to provide feedback on opportunities for the Conservancy product. This covered food service suppliers, gourmet retailers, supermarket representatives, restaurants, catering organisations, hotels, and processors
- Two focus groups including one focus group of 10 people that had eaten kangaroo four or more times in the last 12 months; and one group of 9 people that included 4 that had eaten kangaroo at least once and 5 people that had never eaten kangaroo.

Key findings

The key findings have been developed from market research activities undertaken with existing and potential kangaroo meat processors, distributors and consumers in Queensland.

Sustainability

There are many activities that could be undertaken on Conservancy properties to improve the sustainability of traditional livestock management systems. Some of these activities interact with kangaroo harvesting. The Maranoa Conservancy is already progressed to the stage where a number of landholders have been accredited under the Australian Land Management System (ALMS). Various types of improvement to wildlife management are possible on Conservancy properties. One method would be integrating current kangaroo harvesting more closely with property management of both wildlife and traditional grazing management of sheep and cattle. There may need to be a financial incentive to enhance this integration and this incentive could be attracted in various forms. One avenue by which this may come about is through improved quality of kangaroo meat production, and marketing the Conservancy product as a conservation gain product.

Conservancy supply and continuity

An estimate of harvest numbers from Conservancy properties is 7,000 to 10,000 head per annum. While this is only a rough estimate, it is a very small number compared to the whole of Queensland or the Australian annual supply of kangaroo meat, with 4 to 7 million harvested each year. Consistency and continuity of supply from the Conservancy may therefore be key issues in market development.

There may be a need to take kangaroo carcasses from other conservancies with similar credentials (if they exist), or from non–conservancy properties with potential credentials. The main reason that the Maranoa Conservancy was established was because of the “Landcare ethic” of the landholders involved and the catchment planning they were doing focusing on other values and threats in their region. Since that time two other groups in the Mitchell area have commenced similar discussions, so it is possible that they could also be included in the Conservancy if they undertake subcatchment planning with their neighbours.

It is likely that more properties in the area would supply if it could be demonstrated there was a price premium to be captured, for example, if a processor could pay a premium for Conservancy kangaroos.

Apart from total quantity available, continuity and the variability of supply may be key issues in marketing a Conservancy badged product. Strategies for maintaining a continuous supply or at least reducing supply variability may include one or more of the following:

- Managing the kangaroo population on a whole area of Conservancy basis
- Reducing sheep, cattle (and in some cases goat) numbers in drought periods
- Utilising smaller kangaroos (and possibly wallabies) and supporting the meat price to processors/marketers through a reduced price for larger carcasses
- Limiting the meat sold under the Conservancy brand in periods of ample supply so that expectations for supply continuity were not high, and with surplus kangaroo meat sold generically

- Form marketing alliances with other like-minded Conservancies, preferably in other regions so that some form of spatial diversification were in play that may reduce variability.

Attitudes of wholesale purchasers

The potentially small volume of the Conservancy branded product and any problems with stability of supply will affect opportunities to supply the product into some firms and some segments. The hotels and supermarkets contacted confirmed that lack of continuous supply would be a barrier to using the product. Some of the firms in other segments would not be interested in the product if supply is not reliable or consistent.

Sixteen of the 19 firms surveyed were interested in trialling the product or in receiving more information on the product but the final decision to use the product would be based on a range of factors including quality, price and perceived demand. Two firms were not interested in the new product and one could not comment until they received more information.

When asked to rate the strength of the opportunity for the Conservancy product in the market (on a scale of 1 to 5 where 1 is poor and 5 is very good), food service companies gave the highest rating (3.5) followed by hotels (3.3) and supermarkets (2.9).

Food service companies (including game meat suppliers to high quality restaurants and gourmet butcher shops) felt that there is potential interest in the product. Demand for game meat is 'fashion' influenced. For this reason, the new product would need to be supported by a concerted promotional campaign targeting chefs (e.g. chef workshops such as G'day Chef and targeted marketing) to encourage trial of the product. Consumer demand is seen as a key driver and promotion to consumers is also needed.

Restaurants gave a rating of 2.0 out of 5 to the market opportunity. While some were interested, others were not interested in the product. Significant differentiation on quality and presentation would be needed. Successful branded products used by restaurants include Meat Standards Australia (MSA) and other high quality branded meat. Junee Lamb has developed high quality packaging for restaurants and this approach has lifted demand. Kangaroo is currently supplied to restaurants in clear plastic, bloody bags and can be much less appealing. Overall, the current presentation of kangaroo product to restaurants and food service outlets was considered fairly basic and sends the message kangaroo is just a commodity product. Information from other sources suggests there could be room for expansion into the domestic restaurant trade.

Hotel interests felt that there is potential demand for a high quality, environmental branded product (rating of 3.3 out of 5). As with the restaurant segment, promotion to chefs and marketing the product as a gourmet product is important.

For some firms, the environmental focus is valuable due to the positioning of the business or because of increased interest from consumers. However, the Conservancy product would need to be positioned primarily as gourmet and secondly as an environmental brand. Those who did not see value in the environmental branding believed that the current supply of kangaroo already has good environmental credentials. Others felt it would be too difficult to differentiate the new product from the existing supply of kangaroo.

Clear messages are needed about the differences the new product offers. To achieve wider levels of interest and support, the quality and gourmet positioning will be the main drivers. Few are interested in a product that is differentiated only by the conservancy approach. Also, the environmentally branded product must be demonstrated to be superior in quality and packaging. Regarding quality, tenderness and food safety were considered paramount.

Of the 19 firms surveyed 18 indicated that they would be willing to pay a higher price for the environmentally branded product. However, the actual price of the product would be determined by the quality of the kangaroo meat. All segments reported that the Conservancy product initially should have a similar pricing to existing kangaroo and, once the product is established and successful, the price could be gradually increased.

Businesses purchasing environmentally branded kangaroo want information on how sustainable harvesting is managed, credentials of the supplying organisation, firm ownership, food quality and system capabilities – a full profile on the operation, its capabilities and the benefits it can deliver. These firms felt that consumers would want information on the origin of the product, nutrition and health information (confirmation that it is a healthy product), information that kangaroo is tender and of good quality.

Attitudes of Consumers

Focus groups were presented with the proposition that landholders will carry out enhanced habitat protection and control of invasive species that diminish biodiversity or reduce damage to land as a result of better management of the kangaroos and traditional grazing enterprises with sheep.

The Focus Group discussions revealed some difficulties in understanding the Conservancy concept as perhaps there were too many messages involved and not one issue that could be driven home. Some of the simple conservation /environmental concepts that appeared important were the maintenance of sustainable populations of kangaroos, sheep/cattle versus kangaroos, greenhouse gas production, and some concerns about shooting females and joeys in the pouch.

However, regular buyers of kangaroo meat are generally interested in the concept of an environmentally branded kangaroo product. For the majority of this group, a gourmet product positioning is essential. A few people in this regular user focus group purchase kangaroo meat because it is a cheaper meat option. Overall this group would accept a slightly higher price if they knew the product was delivering positive results for the environment and was a gourmet product. Consumers are interested in the 'environmental story', particularly the fact that the product is produced in Queensland by Queensland based companies.

Thus it appears important to provide an effective, succinct and positive environmental story to accompany the product. Although consumers understand concepts such as 'organic' and 'free range', consumers felt that the conservancy concept would need a simple, easy to understand definition. People did not find the concept or the benefits easy to understand. Some saw the fact that cattle and sheep production was continuing, along with possible land clearing on properties, was in conflict with the concept of a net gain to the environment. There was strong interest in the low greenhouse gas emissions from kangaroos.

The market research showed that for most consumers any animal welfare and harvesting considerations were not major and these issues are probably best left alone. However, the market research demonstrated some concern about the residual population if females were harvested, the harvesting of females with pouch joeys and any genetic implications in the longer term of harvesting the larger animals. Above all, they want to be assured of quality and food safety. The perception that kangaroo meat is dog food or pet food is not a positive association for promotion as gourmet product.

Both regular and infrequent users of kangaroo are interested in information on cooking methods for the best eating result and recipes using kangaroo. Consumers identified opportunities for use of 'bush tucker' complementary spices and food products (e.g. marinades, sauces) that could be sold with the Conservancy kangaroo.

Implications for marketing

Positioning

The Conservancy product would best be promoted as a gourmet and environmentally branded high quality product; use of all three themes would be vital in the positioning of the product. The environmental brand would need to be simply communicated.

Establishing a niche product within a niche market (existing kangaroo supply) was seen as a difficult task. Some firms felt that there was still limited demand for kangaroo at the present time and that considerable marketing effort would be required to create consumer demand (considered essential for long term success) and market the new product to different market segments.

Distribution

Gaining market access and providing the necessary support and customer service backup required was identified as a challenge. Assuming a high quality product is produced, there would be a number of options for distribution and marketing. The business model chosen would depend on the extent of product differentiation envisaged, resources available to the Conservancy and the attitude to risk. Forming a marketing relationship with one processor would have the advantage in the short term in that there would be an established market for the product while matters of harvesting organisation and chiller management are developed. The Conservancy could gain knowledge about the market and the potential market positioning of its product. Also, a single processor is more likely to commit to a new product with appropriate promotional and educational support.

On the other hand a single processor may be more interested in securing access to a high quality product for existing markets rather than developing the market for a new product. While a small premium may be paid for quality in the first instance, this premium may never attain a high level if the Conservancy product is not well differentiated in the market place. The Conservancy product would then most likely be sold into the mass market for kangaroo meat (e.g. supermarkets). Some processors may be more concerned about maintaining throughput in the processing facility in order to cover fixed costs, rather than developing a premium price in the market place through packaging or promotion. The possibility remains of a joint market development effort by the Conservancy and the processor.

A second option may be to make the product available to more than one processor, with preferences given to processors or marketers with ideas for promotion as coming from a conservation gain production system.

Depending upon the availability of product, and once some security of supply and quality has been obtained, it may be then viable for the venture to target smaller volume, high value markets. However these market segments are 'unforgiving' in terms of their expectations of quality, consistency and availability of supplies. One option may be to pay for carcasses to be processed under contract and then market the processed cuts directly to an up-market food service firm that may supply restaurants or a game meat specialist distributor. Exclusive supply arrangements to game meat suppliers in some states could also be considered.

In all of these options, it may be possible to obtain a government grant to help develop the packaging, promotional material, and implement promotional activities, possibly in conjunction with the existing distributor.

Quality

A very high quality product was considered essential to penetrate all markets, but particularly the restaurant market, gourmet butchers and game meat specialist distributors.

The Conservancy could improve the arrangements around product integrity. Currently, it is understood there are no formal supply chain agreements within the kangaroo marketing chain. It is possible that product quality could be improved from the shooting and field harvesting, handling to the chiller, chiller management and then transport to the processor. This may involve for example, use of bar codes and temperature scanning devices. There is currently a code of practice for chiller management but some industry opinions are that this area of the supply chain could be significantly improved.

An issue associated with improved chain management is whether improved quality means a higher cost of supply (e.g. harvesting or chiller costs) and whether there are low cost areas of improvement that can be made. Stacking and spacing in chillers appear to be an important issue as there is a need to cool carcasses down quickly but this is not possible when chillers are full. Choices need to be made therefore between smaller or larger chillers and their number and location, regularity of emptying, single or double hanging etc. The cost implications of all such changes require estimation. Also, it would be important to assess how quality could be improved by implementing changes in terms of less wastage or improved eating quality.

Pricing

The strategy of developing the market for the Conservancy product at existing prices and then gradually increasing prices once a market niche has been developed is favoured. The potential for increasing prices to domestic consumers and to the export market is presumed to be limited in the short term. The Conservancy product has first to be differentiated and proven in terms of quality, food safety and environmental credentials. Only then would significant price premiums be likely to be extracted from processors or other distributors.

Supply variability

Maintaining stability of supply was generally important for consumers and for each of the market segments. A seasonal downturn would be understood by consumers; however patchy supply would result in consumers not consistently coming back to the product.

Promotion

Consumer acceptance of kangaroo is growing. However it is regarded as a niche product and consumers do not have a great deal of understanding of this product, particularly as a high quality gourmet product. Consumer education, in store demonstrations and promotion or endorsements of the product by chefs needs to be undertaken to appropriately position the product.

Developing effective packaging and a recognisable, attractive branding for the product would be recommended. It will be important to provide leaflets for recipes when targeting consumers and provide the necessary information on the product when targeting key market segments, e.g. quality, food safety and the Conservancy message.

Conclusions

There are four major conclusions relevant to the Conservancy pursuing any market development through a branding and promotional strategy:

- Environmental management as a concept in kangaroo meat marketing has some potential but the conservation gain concept is difficult to address in a manner that can easily be understood and believed. This remains a challenge for the SWE trials.
- Environmental credentials are not sufficient on their own to develop a market niche for the Conservancy product. Meat quality and integrity are very important and there need to be reasons provided as to why the Conservancy product is higher quality than the rest of the kangaroo meat in the market.
- Given the likely Conservancy supply, the product would need to be positioned as a gourmet product at the top end of the market including such market targets as restaurants and gourmet butchers. One distribution channel to facilitate this would be through game meat specialist distributors.

Significant promotion and packaging innovation would most likely be required to develop a niche market. The difficulties and risks, time and costs for development of a niche market should be recognised. It is questionable whether the Conservancy could raise the resources required (in the hundreds of thousands of dollars) for this market development unless there was some partnering with existing players.

Supply variability will be a constraint in market development, mainly in gaining the required support from within the distribution system. Potential multiple strategies to overcome some of this variability have been identified.

It will be important to identify where improved quality and/or cost savings/increases to the total system are likely to occur from the Conservancy operating its own chillers. There is a need to avoid pursuing a system that increases costs without net benefits. Demonstrating profitability to the overall system from changes should be given precedence.

It is recognised that the current marketing chain has evolved over a number of years. Changing it will lead to more competition which may not be in the interests of current participants. Distrust and opposition to change has been demonstrated already.

Consumer attitudes to kangaroo meat products – *Ampt and Owen*

A project commissioned by the RIRDC New Animal Products Program and conducted by the UNSW FATE Program was relevant to the SWE trials. Domestic consumers' current beliefs and attitudes towards kangaroo meat were surveyed (Ampt and Owen 2008). The information complemented the study by Peter Chudleigh with its focus on wholesalers and restaurant trade for a niche conservation-badged product

Ampt and Owen found potential for further increasing consumption of kangaroo amongst Australians if the kangaroo industry takes pro-active steps to make the product more visible. This should be achieved with a consistent message that emphasises that there is no risk of harm to the kangaroo population as a whole, that the harvest process is humane and hygienic, and that the harvest results in benefits to source communities and environments.

Finding and recommendations

The report recommends that the kangaroo industry needs to take a proactive approach to promoting kangaroo as a gourmet alternative that carries health benefits and has a wide variety of uses. To make kangaroo meat and meat products more visible to consumers as an easy to prepare, inviting alternative to mainstream meats, the industry should work with manufacturers and retailers to develop and test sample products. The biggest impact is likely to be education about its use in a wide range of meals that reflect Australia's ethnic diversity and the growing interest in gourmet foods.

Of the three kangaroo products investigated, small goods, pies and mince products, kangaroo mince presents the greatest potential increase in volume of kangaroo manufactured meat as a substitute for mainstream products (for example trim beef mince). The industry should work with retailers to further experiment with the key factors emerging from this study in relation to mince:

- price differential (that is how much lower than substitutes it needs to cost)
- location in store (that is near to substitute to allow direct choice comparison) and
- package size (that is potential demand for smaller 500g packages allowing experimentation).

In terms of its profile, the industry needs to generate consistent messages to all stakeholders of a uniquely Australian resource that is managed through careful harvesting, is humane and sustainable, and is good for the environment. It needs to separate itself from the culling for pest management that often attracts strong emotional responses from the community and creates images of poor quality control. They recommended that the kangaroo industry:

- Investigate chain of custody management to improve consistency of industry practice
- Investigate the impact of stronger involvement by landholders in harvest management on quality and stakeholder perceptions of kangaroo meat
- Develop and test different approaches to achieving consistent industry messages and branding.

6. SWE Workshop – February 2008

The final undertaking of the current contract for the SWE project was to share information and experiences from the trial sites and encourage regional collaboration in natural resource management and wildlife planning. Apart from ongoing collaboration between the various groups involved in the project, to meet this objective, a SWE workshop was run 14 -15th February 2008 at Broken Hill.

The workshop was advertised in the three SWE areas to raise awareness about the project and encourage broad participation in the meeting at Broken Hill. A media release on the workshop was issued and picked up by the Broken Hill ABC radio station, which interviewed landholders and Dr George Wilson about the SWE project and outcomes of the meeting. The interview was very positive, noting the challenges the project faced, but that the meeting had discussed ways that these issues could be addressed. (See Plate 2 in Attachments for the media release). ABC TV Landline interviewed participants at the meeting

The meeting brought together members of the three Wildlife Management Conservancies (Mitchell and District Landcare Association, Rangeland Management Action Plan-RMAP[2]) and Barrier Area Rangecare Group - BARG[3], who have been working on projects under the SWE research program funded by National Landcare Program, RIRDC, and others.

The workshop also featured invited speakers addressing specific issues affecting kangaroo management and SWEs, mostly funded by RIRDC. Representatives of the kangaroo industry, various state and federal government agencies, regional NRM bodies and landholder groups also participated in the workshop, which culminated in a panel discussion featuring representatives of the different stakeholder groups present on the topic of "the role of landholders in the kangaroo industry" (See Plate 3 in Attachments for the meeting agenda). Covering the themes explored the barriers confronting the project and addressed a number of ways to overcome the barriers. The key outcomes of the meeting are reported below.

The key themes explored through the workshop were:

- Managing risk as individuals or as a group of harvesters and landholders
- Commercial models for landholders and harvesters
- Aligning regulatory structures with landholder and harvester interests
- Capitalising on new marketing opportunities
- Issues in the kangaroo supply chain; and
- Information exchange and transparency.

Workshop presentations

The issue of risk in the kangaroo industry was revisited a number of times. Paul Moloney of RMIT University looked at rangeland landholders managing risk by diversifying incomes into different livestock as well as kangaroos and Alex Baumber of the FATE Program looked at the risks posed to landholders by high variability in kangaroo numbers. Individual landholders are exposed to risks from large and unpredictable numbers of kangaroos coming onto their properties and consuming resources and also, if they are looking to invest in a kangaroo enterprise, they face business risks in trying to provide a stable supply of kangaroos to market. Data from the Barrier Ranges indicates that individual

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[2] Generally referred to as the Murray Darling Rangelands Conservancy (MDRC)

[3] The Barrier Ranges SWE is funded by RIRDC and the University of NSW

properties had much higher harvest variability than if the properties are grouped and treated as one. This indicates that landholders can reduce risk due to harvest variability by grouping together.

Commercial models for landholders and harvesters. Dr Rosie Cooney's (Cooney 2008) model for setting up cooperatives involving landholders and harvesters as members generated a large amount of discussion at the workshop. The cooperative model allows landholders and harvesters to set standards for hygiene and quality, invest in chillers and other equipment, negotiate collective supply arrangements with kangaroo processors and potentially market a specific line of kangaroo products sourced from their group.

The model received mostly positive comments from landholders, harvesters and even processors, although key questions also arose about the costs of managing a coop, the balance of power between landholders and harvesters and the need for good communication. Overall, there was a strong interest in learning more about the model as it develops. The Mitchell and District Landcare Association and their associated harvesters will be exploring this model in further detail and Dr Cooney will be working on developing a version of the model for BARG to explore.

The issue of how well regulatory structures work in with the interests of landholders and harvesters was discussed at length. Margaret Chapman from the University of Queensland, demonstrated that landholders in Queensland saw government controls over kangaroos as a disincentive to get involved in the kangaroo industry, although greater discussion overall was dedicated to the regulatory issues in NSW and South Australia. Dana Thomsen Department of Environment and Heritage, South Australia, outlined a number of ideas on how legislative and policy frameworks could be amended to create incentives for landholders and harvesters to revitalize the industry in SA. Harvester numbers in SA are in decline and the harvest rarely exceeds 50% of the available quota, yet around 200,000 carcasses are imported from interstate by SA processors annually. Many reasons were suggested for this at the workshop, including the remoteness of the SA rangelands and competition for young workers with the mining industry, however, Ms Thomsen argued that policy changes such as greater tag flexibility, group 3 licensing, reduced barriers to new harvesters and incentives for major harvesters could all make a difference.

Alex Baumber summarised the experiences of FATE and BARG in developing a group licensing system under the adaptive management provisions of the Department of Environment and Climate Change's (DECC) NSW Kangaroo Management Program. While this process has been a long and challenging one, significant progress was made at side meetings during and after the workshop. The group licence for BARG members and harvesters will make it possible for a group of properties to function as one, with tags issued to the group usable on all group‐licensed properties. It was also stressed by people involved with the trial that the group's motivation is as much about developing a more flexible system of licensing and tagging for better land management as it is about generating economic returns from kangaroos.

The challenges posed by a single property licensing system, as exists in NSW and SA (where tags can only be used on one property and not transferred), were debated at the workshop. Whilst FATE argued that such a system makes collaboration more difficult, Nicole Payne of DECC argued that the current system has a lot of flexibility for landholders, but many aren't aware of how it can be used. Dana Thomsen also argued that tying tags to a specific property works against harvesters' interests by preventing them from focusing their harvest effort where kangaroo numbers are greatest at a given point in time. Her research reported that harvesters were under pressure to work around the single property regulations to stay viable and that as a result, considerable tag swapping took place. This left harvesters open to penalties and meant that harvest data received by the regulatory agencies was not always accurate.

A number of examples were cited in the workshop of where regulators make decisions based on ensuring the economic viability of the kangaroo processing industry (e.g. limiting the number of fauna dealers in NSW, setting minimum carcase weights for economic rather than conservation reasons and banning skin‐only shooting). This indicates that regulators are clearly prepared to step beyond the species‐protection role emphasised in their management plans. Harvesters and landholders can therefore reasonably expect their economic interests to figure in decision‐making too ‐ provided that they express those interests clearly and lobby for them.

The marketing of kangaroo products with landholder involvement was explored by Peter Chudleigh of AgTrans and Peter Ampt of FATE. Peter Chudleigh concluded that a market niche could be developed for environmentally‐badged kangaroo products but it would be challenging and would require high quality, clear environmental credentials and heavy promotion. Peter Ampt's presentation on FATE's consumer choice research showed that attractively‐priced kangaroo mince and deli meats were the most promising options for increasing the sales of manufacturing meat on the domestic market.

Peter Ampt also reported that most consumers surveyed were unaware that kangaroos were wild harvested and suggested that promoting a connection to landholders and a positive environmental message could offset any negative reaction to the idea of wild harvest. The ideas of regional and environmental badging received strong support from landholders involved with the SWE program. There wasn't much indication from processors at the workshop regarding whether they thought these ideas had commercial potential, however, there was discussion on the fact that one processor (Macro Meats) had recently introduced an environmental badge for its domestic supermarket packages, highlighting that kangaroos were softer on the environment than sheep or cattle and did not produce methane, a highly potent greenhouse gas. The issue of kangaroos versus cattle regarding the production of methane received considerable media attention in late 2007, both in Australia and overseas.

Supply chain issues in the kangaroo industry were covered in a number of workshop presentations and also generated a large amount of discussion in their own right. Meat quality, quantity and consistency of supply and skin size were three of the main areas discussed. The issue of transparency and accountability in the kangaroo industry came up a number of times and in some ways the workshop helped to bring about improvements in these areas by attempting to understand supply chain issues from the points of view of the different stakeholders.

The main issues regarding quality from processors' perspective were detailed as: how well dressed a carcase is; how quickly it enters a chiller after shooting; how it is stored in the chiller; and whether the carcase has been affected by dust or dirt. The view was expressed that these issues are less about final product quality reaching the consumer and more about yield – the better condition the carcase is in when it reaches the plant, the greater the yield of high‐value cuts and the less meat that is wasted or downgraded. Quantity issues were based around efficiency and reliability of carcase collection – if a large number of carcases can be collected reliably from fewer locations, this adds value to the industry through efficiency gains.

The issue of skin size generated considerable discussion. Processors reported a glut of small skins and a number of measures they have undertaken to address this problem, including refusing to take smaller kangaroos, encouraging regulators to lift minimum weights and implementing a two‐tied pricing structure, where kangaroos above the desired weight attract 80c/kg and those below 40c/kg. Harvesters particularly take issue with the two‐tied pricing system, as it leaves them in the difficult position where landholders who have concerns about large numbers of small kangaroos (especially in Qld) are pressuring harvesters to take them , whilst processors are pressuring harvesters not to deliver small kangaroos through pricing mechanisms which make it uneconomic.

Opportunities were identified for landholder and harvester groups working together to improve a number of these supply chain issues. The Mitchell group has been negotiating for a return from processors if certain steps are implemented, such as reducing the number of shoot‐and‐let‐lie licenses, imposing voluntary weight restrictions and applying standards that exceed regulatory requirements ‐ all of which would benefit the industry overall. The small skin issue is a clear case where a better understanding of each stakeholders' business needs could be to the benefit to all –

landholders could receive a return for accepting some of the impacts of smaller kangaroos, whilst processors could pay more to get a consistently larger - sized skin and a sustainable source of maturing kangaroos and harvesters could escape being squeezed from both ends.

National Association of Kangaroo Growers and Harvesters

A key output from the meeting that could lead to the project being extended more broadly to the rural community was the formation of the National Association of Kangaroo Growers and Harvesters.

The association has been formed to:

- Consolidate the research efforts of the SWE groups to date
- Plan for future collaboration amongst these and other groups, including on potential funding options; and to
- Provide a united voice to represent landholders and harvesters who are interested in collaborating on kangaroo management to deliver improved economic, social and environmental outcomes.

The Association is being hosted under the umbrella of the FATE Program at the University of New South Wales, which provides secretariat support. The structure for the association has been devised and initially involves interested landholder, harvester and NRM representatives from the three SWE areas, and proposes the inclusion of additional members as the project gets extended to other areas (See Figure 17 below). The next steps are for member groups to nominate (or confirm) their three representatives to the association and to establish a set of aims and proposed activities for the association.

The workshop raised the level of interest in and awareness of the concept of a Wildlife Conservancy and this project in particular. The workshop benefited immensely from having industry and relevant government representatives present to provide input. The workshop and the project also benefited enormously from having visitors from the Mildura WMC and the FATE project and the Desert Channels NRM present to share their experiences and discuss future options.

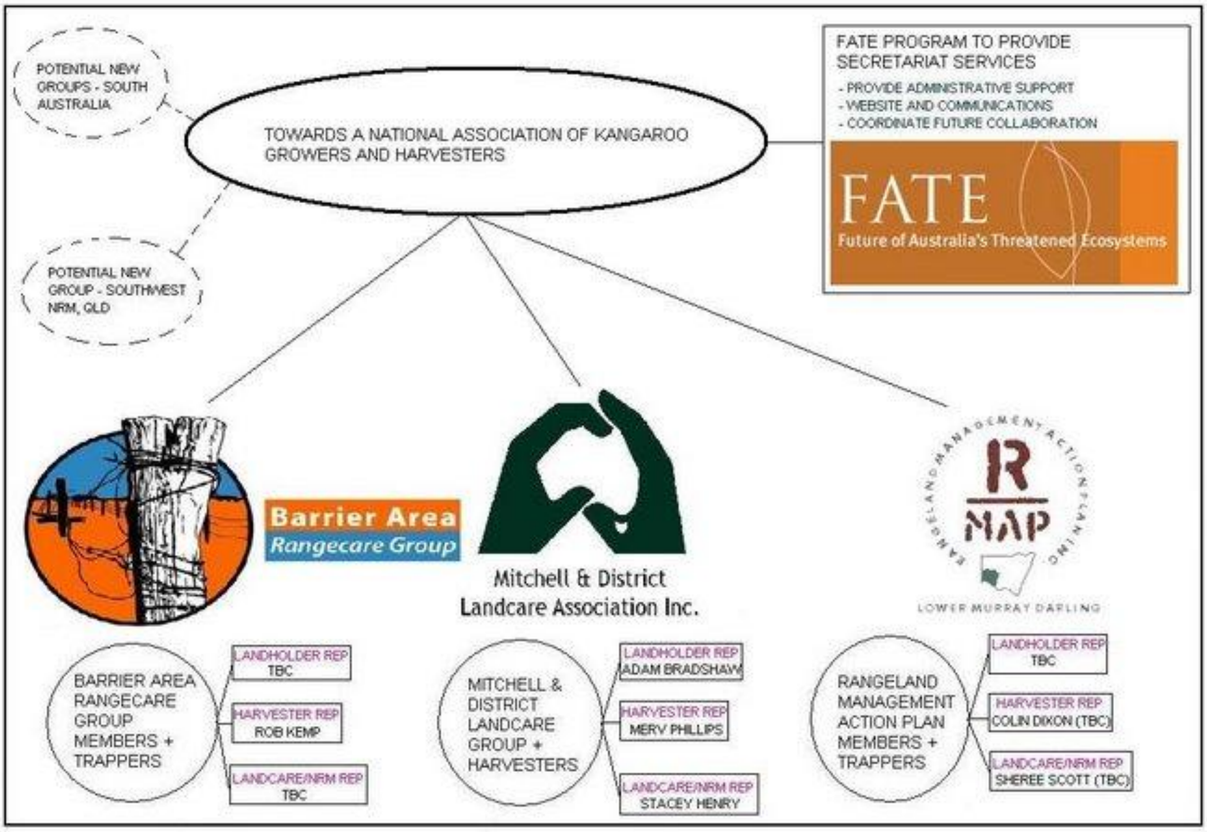

Figure 17: Structure of the National Association of Kangaroo Growers and Harvesters

A website for the association has been established to raise awareness about the association and coordinate and facilitate the association's work. See National Association of Kangaroo Growers and Harvesters

Findings

A number of clear messages came out the workshop discussions:

- Landholders and harvesters need to work together: All three of the SWE groups were initially formed around landholder organisations and sought to find economically valued roles for landholders in the kangaroo industry. However, these SWE groups have morphed over time to include strongly-motivated kangaroo harvesters, and much of the progress so far has been driven by the knowledge and interests of harvesters. These inter-linked roles were recognised with the decision to form a National Kangaroo Growers and Harvesters Association.
- Need for transparency and understanding each others' interests: A number of participants (particularly landholders and harvesters) felt that the level of information-sharing, transparency, accountability and unity in the kangaroo industry was less than for other primary production industries. Partly this was explained by the ever-present need to defend the very existence of the industry from attacks by animal rights and "wildlife protection" groups, however, many participants argued that this lack of unity and transparency was a threat to the industry in itself. Understanding the business needs of each stakeholder and the ways in which decisions taken by one player impact on the others, particularly through business arrangements involving processors, harvesters and landholders, may help to resolve some of these issues.
- Commercial and regulatory models may have broad applicability: There was strong interest amongst landholders, harvesters and other stakeholders in learning from the experiences of other groups with regard to ways of improving the commercial and regulatory models. The experiences of the Mitchell group with their processor negotiations and cooperative model and the experiences

of the Barrier Ranges group with group licensing arrangements should be shared with other interested parties. The newly formed National Kangaroo Growers and Harvesters Association should assist with this process.

- Ways to add value: The kangaroo processing industry indicated that, as a whole, it would continue to be hostile to any proposals that did not add value to the industry. A number of different ways of adding value to the industry were discussed at the workshop, generally falling into two categories - increasing the final price paid by consumers or creating efficiency gains for processors through lower costs or higher yields. If landholder/harvester groups make it clear that they are focusing their efforts in these areas rather than being seen as simply using their collective bargaining power to squeeze processors, they may be able to overcome some of this collective resistance.

7. Discussion

The SWE Implementation Plan (Wilson and Mitchell, October 2005) anticipated that the SWE trials would be a complex, bold experiment with a need for funding to run for up to six years, by which time the sites should be self-supporting.

The purpose of the SWE trials is not to seek to abandon conventional agriculture or make major change to wildlife management policy. Far from it, the intention is to learn incrementally and modify existing practice and to test these learnings and other issues. Local adaptation and ownership is critical to their success. The trials proceeded without large amounts of preliminary analysis in the spirit of adaptive management. The strategic plan identified desired outcomes but rather than go on with more detailed planning the approach was work 'back to front' so as to short-cut timelines, reduce potential costs, and lower the period from time of entry to commercial payback. The focus was to determine key routes to market; key barriers to success, then research the barriers and opportunities in detail.

Support was provided by the NLP funding to:

- Support the integration of conventional agriculture production, tourism and sustainable commercial use of wildlife
- Establish sustainable harvest rates for the WMC for species being utilised
- Develop marketing strategies for produce from enterprises that lead to a net conservation gain and integrate performance management frameworks such as EMS; and
- Enable sharing of experiences and opportunities for collaboration between trials and related programs.

It also supported the continuing activities of:

- Scoping enterprise options and identifying potential support to develop the WMCs' component projects
- Providing financial support for WMC Coordination and Management
- Enabling regional collaboration in NRM and wildlife planning
- Enhancing the capacity of land managers to effectively and efficiently plan, monitor and integrate NRM plans through use of software and GIS management packages
- Enabling easy visualisation of complex data management and attainment of standards
- Scheduling and costing conservation works, habitat improvement and wildlife threat reduction.

Critical success factors

Initial consideration in the planning process identified critical success factors as:

- Demand will be created for products from the Wildlife Management Conservancies by emphasizing their conservation benefit
- Markets for bush tucker, in particular kangaroo meat, will strengthen
- Members of the WMC will remain enthusiastic and continue to make their properties available for proposed manipulation and detailed scientific investigation
- Natural events such as drought and commodity price fluctuations over a 6 year cycle will not be so extreme as to affect the capacity and willingness of members to participate

- Government and philanthropic support will be sufficient to establish the Wildlife Management Conservancies, to underpin the research, monitoring and evaluation and to back marketing of products as conservation friendly.

Limitations and achievements

Most of these conditions have not been met. The prolonged drought impacted on all the SWE sites, but had a profound impact on the Barkindji Biosphere site where anticipated backing of the Biosphere has not eventuated leading to lack of continuity in project officers. Lack of local administrative support meant that a number of landholders could no longer participate in the trial as they were overtaken by other priorities. The Barkindji MWC reformed after some delays with a subset of eight then three of the original landholders as the Murray Darling Rangelands Conservancy.

After three years significant progress has being made at the Maranoa WMC and at the Broken Hill BARG site, thanks substantially to continuous local enthusiasm and help from the supporting research and development staff and in information exchange. The Maranoa WMC has established a cooperative trading structure, purchased two chillers and commenced trading with a processor. Progress could be better if the group had a strong manager to get the chillers fully operational and coordinate the shooters. In May 2008 the Landcare coordinator moved on – the fourth staff change in the course of the project.

The landholders realise they are unlikely to gain additional income in the short term, and in any event are proposing the income from the cooperative in the first instance should be utilised by the Landcare group to support its activities and biodiversity conservation. This is fundamental to the whole model.

Once the chain management and trace back steps are in place, the landholders will be able to move on to the steps of how to guarantee quality, and present product in such a way as to break into the niche quality market recommended by the research.

A number of the land holders are well down the track to obtaining ALMS certification. Soon they will be able to incorporate the wildlife stewardship scheme components. They will then be in a position to integrate the results of the aerial surveys and regional population estimates into natural resource management planning.

Murray Darling Rangeland Conservancy has taken steps to integrate knowledge of kangaroo movements and populations on their properties with other land uses. The next step of taking this information to the regional level has been slow. This is perhaps partly because cooperation and communication with the Lower Murray Darling Catchment Management Authority and be NPWS responsible for kangaroo management could be better.

After extensive and protracted negotiations with the kangaroo management program in the NSW NPWS the BARG group is making good progress with management of the Kangaroo resource. The group has 15 landholders and 17 shooters trialling the group tag and quota. They have been issued with 8000 tags on the first licence (May-Aug 2008) and another 7000 or so pencilled in for the four months later.

All three groups have established relationships with processors, and one company in particular Macro Meats is most interested in the project. Selling high quality, consistently is part of their marketing strategy. They have done considerable work in recent years gaining access to the three supermarket chains. Their production in recent years has been growing steadily. Reliability of supply and access to resource is a key requirement to maintaining their hard-won shelf space. The SWE model can assist in that process.

There remains considerable distrust however from the kangaroo industry as a whole. The SWE concept seeks to insert landholders in the management structures and hence the wildlife production value chain. This is a change to existing arrangements which allow the kangaroo industry free-of-charge access to the properties which produce their resource.

The SWE project seeks to professionalise the kangaroo industry and in particular kangaroo shooters. While all shooters meet the required minimum standards for marksmanship and hygiene, many are part-timers and participate in the industry as weekend operators to supplement their incomes. They too feel threatened by the SWE project and had been ready receptors of rumour and innuendo about the bona fides and aspirations of the project. The other kangaroo processing companies who have not been negotiating with the wildlife management conservancies, have seen it in their interests to inflame this discontent. Their main markets are bulk supply of undifferentiated product, particularly overseas

Threats

Surveys conducted as part of the suite project indicate that kangaroo densities can be very high, up to 250 per square kilometre. Landholders have long complained about this impact on their landscape especially during drought and their inability to manage it.

In southwest Queensland these views are held very strongly by a number of landholders and management activities are under way which the antithesis of the SWE concept. They have the specific aim of reducing kangaroo numbers substantially in many cases to zero. Landholders are so desperate to have effective management of kangaroos that they are constructing marsupial proof fences, as they did a century ago, and seeking to exclude kangaroos from their properties. This is a growing phenomenon and is a measure of the extent of powerlessness which landholders feel over the issue of kangaroo management.

With the support of the National Feral Animal Programme, the CRC for Invasive Animals and the University of Queensland have begun a trial to exclude unwanted species from gaining access to water. This can include kangaroos. Under the system known as Machine Vision, an automatically operated gate responds to the profile image of animal approaching the water point. It differentiates between cattle, sheep, kangaroos, goats, emus and pigs and can be set to exclude the unwanted, including kangaroos. Unable to drink, kangaroos will leave the property. At the regional level this will have a profound impact on kangaroo populations.

The SWE project aims to turn around this view that kangaroos are pests and ensure conservation and regional biodiversity in the process. Under the SWE scenario, the Machine Vision Project could be an asset to kangaroo management and provide indications of populations and movements. It could be an integrated part of regional kangaroo management.

Importance of integrating wildlife into production processes

Regional wildlife management plans are needed that integrate conventional agriculture production and natural resource management. Major pressures that threaten biodiversity on a national scale (not in order of significance) are total grazing pressure, weeds, invasive organisms, changed fire regimes, and habitat fragmentation. Grazing and modifications to pastures to support it have reduced the extent of native grasslands in a range of temperate Australian ecosystems to less than two per cent of that present in 1750 and have simplified the structure and quality of habitat for animals in these systems. Native species and the natural landscapes that support them perform many key functions that maintain the health of soils, water and air resources, and so provide the foundation of landscape productivity. Increasingly there is recognition by the wider community that these functions are so important that markets and payments for them are emerging.

Climate change will further compound and intensify pressures on biodiversity, especially by affecting rainfall patterns, and hence fire frequency, affecting regeneration of vegetation, and changing where plants and animals can live. The size of the problem is so large that industry and the private sector have a major role in redressing it.

Making greater use of native species adapted to the environment rather than seeking to change the environment to suit introduced species is the basis of integrating wildlife into production processes.

Opportunity to reduce Greenhouse Gases

Australian agriculture contributes 16 % of the total national greenhouse gas (GHG) emissions, mainly methane and nitrous oxide[*]. The methane comes from enteric fermentation, which is microbial fermentation during digestion of feed by ruminants, mostly domestic livestock - cattle and sheep. Enteric methane accounts for 67 % of the total agricultural emissions and 11 % of Australia's total emissions. This means that methane from livestock is equivalent to two thirds the emissions produced by the Australian transport sector. To reduce GHG emissions, the Australian Government has committed to implementing a 'cap and trade' emissions trading scheme (ETS) by 2010 and to consult with the agriculture and forestry sectors on the terms and time frame for their inclusion in the scheme. When agriculture is covered in the ETS, ruminant livestock owners or downstream service providers such as abattoirs and shipping terminals will have to account for livestock emissions.

Research projects to ameliorate the methane problem include changing diets and attempts to replace the methane-producing bacteria in the rumen by inoculating livestock with kangaroo microorganisms[***]. Modifications to rumen physiology and new feeding regimes may be useful for intensive industries such as dairying and feedlots but cost effective self sustaining options for cattle and sheep on the rangelands are not readily apparent. This raises the prospect of a decline in extensive livestock industries because they continue to produce significant quantities of GHG.

Kangaroos are non-ruminant forestomach fermenters that produce negligible amounts of methane. One of the ways being trialled by Australia's livestock industries to reduce methane emissions is to introduce kangaroo gut microorganisms to cattle but this approach has not been successful. Our study tested another option, particularly for Australia's vast rangelands, that farmers use kangaroos to produce low-emission meat.

To analyse the option of reducing methane while producing an equivalent quantity of meat, Wilson and Edwards 2008 developed a spreadsheet model (Microsoft Excel 2007). The model covered the period 2007 to 2020 and simulated changes in cattle, sheep and kangaroo populations in the kangaroo harvesting areas of the rangelands. It simulated gradually selling down the cattle and sheep whilst allowing the kangaroo population to rise.

On the rangelands where kangaroo harvesting currently occurs, increasing the kangaroo population to 175 million from 34 million while reducing the cattle and sheep by 20 % per year to 2020 would lower Australia's GHG by 16.4 megatonnes or 3 % of Australia's total emissions.

Wilson and Edwards concluded that when livestock are included in Australia's emissions trading schemes, permits for kangaroo emissions will be significantly cheaper than those for cattle and sheep, perhaps providing the incentive for farmers to switch to kangaroos. Thus increasing kangaroo production as an alternative to cattle and sheep production presents a major opportunity for Australia to reduce its greenhouse gas emissions.

The future

Native species are particularly well adapted to Australia's unique environment, allowing them to survive our climatic extremes and thrive in our soils. Landholders have an opportunity to make greater use of them than they have in the past. They also have the opportunity to manage natural resources and biodiversity on behalf of all Australians and to be paid by the wider community to do so.

The sustainable wildlife enterprises trials aim to achieve those outcomes. They seek to achieve premium prices for premium wildlife products that can be differentiated in the marketplace as contributing to net conservation and gain. They should set broad targets for total grazing pressure of kangaroos and other wildlife taking into account grazing pressure from domestic livestock.

After three years, progress is being made, but the trials are a major paradigm change in land use and continuing funding is needed. Despite the existence of a commercial kangaroo industry and a tourism industry in which wildlife is prominent, under current arrangements it is rare for landholders to benefit from the kangaroos and other wildlife on their lands or play a role in their management. SWE is trialling ways for farmers to increase the value of the kangaroo product and share in the result.

Work to date shows that farmers can collaborate with one another, support the existing kangaroo industry and build on the kangaroos' conservation and animal welfare attributes. A switch to kangaroo consumption and production might be prompted when greenhouse gas emissions from livestock are exposed to their cost and the kangaroos' low production of methane leading to "low emission meat" becomes marketable.

An expansion of the SWE trials to support production of low-emission meat production would require a significantly larger investment, including a need to monitor closely kangaroo populations and regional harvesting quotas. The free ranging behaviour of kangaroos makes establishment of cooperatives to manage them a key issue. Continuing support would enable marketing and advice on economic, ecological and social issues.

To this point the project has developed the level of interest within the community, identified a range of opportunities and barriers and taken some steps towards the development of innovative technology for data transfer and analysis in the kangaroo industry. The project has identified the scarcity of accurate, locally applicable data in the kangaroo industry and has presented a number of options to be considered in the way forward.

Cypress Pine management has been identified as an area of significant interest to landholders in the Maranoa WMC and the project to date has identified a number of future options to change the way in which this resource is managed. Landholders are engaged on the Cypress Pine issue and would welcome the opportunity to explore further management options.

The project has identified a number of possible options for future direction. The next step in this process is to further develop the options which are high priority and which will advance the project toward the successful operation of a Wildlife Management Conservancy.

A combined proposal from the natural resource management regions with the highest kangaroo populations, QMDC South West NRM and Desert Channels should be prepared as a matter of priority. In the interim, the National Association of Kangaroo Growers and Harvesters has also taken on the role of exploring future funding options.

The SWE trials have benefitted from the existence of interest; expertise and experience within the groups involved and, of course their ongoing involvement with the NRMs. The future should utilise the knowledge and skills that exist within the WMC group to develop useful information on kangaroo numbers and the impact of harvesting, economic benefits to harvesters, landholders and processors and diversification of landholder income sources.

Negotiations have been under way to continue the SWE trials beyond July 2008 with leadership, program management and coordination by the catchment management authorities. However, lack of funding and likely cuts in budgets remains an issue. The National Landcare program is a possibility for ongoing support but support would need to be initiated at the local level.

Throughout the world, wildlife plays an increasingly significant role in rural production processes and aiding conservation. Based on this overseas evidence, a significant Parliamentary Report unanimously recommended trials of landholder involvement in commercial utilisation (Rural and Regional Affairs and Transport References Committee 1998). Kangaroos are adapted to Australia's variable environment and could play a large role in the rangelands producing low-emission meat. In southern Australia, cropping and irrigation areas are likely to reduce in size as a result of climate change and be replaced by pastoralism on newly reformed rangelands.

Past conventional agriculture in Australia has contributed to biodiversity loss and environmental damage. This is being exacerbated by drought and climate change and coincides with an increased reliance on off-farm incomes. One innovative option for rural adjustment is sustainable commercial use of wildlife which produces less green house gases.

8. Recommendations

An extension of the trials is an option, especially when Australian agriculture is looking for adaptation strategies for climate change. Continued support from National Landcare Program could be used to continue the current work.

Funding

Given the size of the benefits which could be derived from greater use of native species and the prospect of contributing to significant carbon savings, a relatively large investment over three years to continue the SWE trials would seem appropriate.

Continued support will enable regional cooperative management of kangaroos and other wildlife that integrates landholders into the industry. Continuation of the trials could occur in southern QLD and western NSW through collaboration with NRM bodies - SW NRM, QMDC, Desert Channels and Western CMA.

The concepts of extending NLP support could be incorporated into the Caring for our Country (CoC) Strategic Plan. The initial carryover support could be provided in 2008/9 to the NRM bodies in the SWE trial sites pending the contracting for subsequent years under the CoC Strategic Plan.

A three year program would seek:

- $450 k in 2008/9 and
- $1 m in following three years

Additional support could come from contributions from other sources - e.g. the mining industry, and philanthropy.

Ongoing SWE trial tasks

The tasks for an extension of the trials could be grouped along the following lines:

On ground projects

Natural Resource Management

- Linking regional wildlife and conservation plans to property wildlife plans
- Coordinating the development and implementation of regional wildlife management plans
  - A key concept behind the WMCs is that members collectively manage the wildlife resource that ranges from property to property
- Estimating sustainable harvest estimates and different harvesting strategies
- Continuing surveys and population estimates, determining sustainable yield. The task will be undertaken in collaboration with the researchers below
- Assisting landholders enhance wildlife habitat and reduce threats such that ecosystems and wildlife (not only species being utilised) can thrive
- Broadening ALMS certification
  - Developing the proposed Wildlife Stewardship Scheme Cooperative management

Testing cooperative management and organisational structures

- Employing a dedicated coordinator
- Advising on legal and management advice on processes including based on overseas experiences

Improving chain management

- Defining the steps in the production chain and paths critical to maintaining quality and reliability of supply and establish partnerships with established processors and retailers
- Managing the production chain and connecting producers more effectively with the marketplace and its requirements

Branding and labelling strategies

- Differentiating products from the WMC, both wildlife and non wildlife, through regional branding that emphasises biodiversity conservation benefits, sustainability, quality and animal welfare
- Assessing the attributes of a wildlife management stewardship scheme that could form the basis for branding and eco- labelling to highlight the environmental performance of WMC produce

Marketing trials

- Undertaking a marketing trial linking regional conservation activities and initiatives by the NLP to the production and marketing of kangaroos

Research Support

Some activities below are also flagged above. The purpose here is to make provision for researchers and scientists to work with landholders in supporting monitoring and evaluation

Sustainability indicators

- Ecological monitoring
  - Integrating kangaroo density with other Total Grazing Pressure (TGP) and land management indicators
  - Refining the attributes of a wildlife management stewardship scheme
  - Identifying other ecosystem services
- Economic monitoring
  - Estimating Greenhouse gas savings through greater use of kangaroos in the WMCs in lieu of cattle and sheep and potential savings in carbon permits
  - Defining appropriate indicators to assess the impact of enterprises on farm viability and employment generation, and the impact of WMC accreditation on farm gate prices
- Sociological monitoring
  - Assessing the impact of changing enterprises on the social and cultural well-being of WMC regions and participating landholders

Certification

- Sustainability
  - Developing a framework / template/ EMS for monitoring ecological, economic and sociological performance that can be used to certify wildlife management plans, property management plans and their products
- Quality control and animal welfare

- Using quality management programs from other industries as models in promoting attention to detail in wildlife products
- Further developing protocols that apply to the harvesting of wildlife to ensure they continue to meet best practice and highest animal welfare standards

Population surveys

- Determining home ranges from movement studies to define the unity of populations being estimated and managed across property boundaries
  - Expand the Machine Vision installed on a property in SW NRM
  - Fit satellite tracking devices to confirm mobility reflecting the landscape-scale movements of kangaroos
- Conduct aerial surveys input to the population quota setting and assessments of the impact of expanding kangaroo populations

Training and education

- Employing innovative software, map displays and GIS technology that enable complex data management, rapid communication across the region and easy visualisation of outcomes to support regional and property management planning and accreditation processes
- Integrating regional Natural Resource Management plans, Property Management Plans and Environmental Management Systems with the use of landscape management tools

Communications

- Sharing information experiences from the trial sites, workshops, websites and newsletters including through the newly formed National Association of Kangaroo Growers and Harvesters

Coordination and management

- Establishing a Steering Committee to obtain input from stakeholders and funders
- Receiving innovative support and high-quality advice, input from an Adaptive Management Advisory Group that supports monitoring and evaluation

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Attachments

Table 7 Schedule 3 from the DAFF _ RIRDC contract that concluded in May 2008

OUTCOME	KEY PERFORMANCE INDICATORS	MILESTONES
Progress towards new strategic partnerships with existing wildlife resource industries, government support programs and philanthropic conservation organisations to underpin the WMC's	Accurate identification of the issues and options for resource management, licensing, ownership and tenure, royalties, and sharing of structures.	1. Initiation of framework for landholders to share proceeds of harvested wildlife.
Enhanced capacity of land managers to effectively and efficiently monitor and manage kangaroos and to integrate property, and natural resource management plans.	Acceptance by landholders and wildlife agencies of the accuracy of estimates of distribution and abundance of wildlife populations	2. Initiation of estimation of kangaroo populations on WMCs and rates of sustainable use; Initiation of marketing study for produce from WMC enterprises that are badged as leading to a net conservation gain"
Growing appreciation of the productive potential and economic value of wild resources in the WMCs	Building on the enterprise options outlined in the earlier study on market viability of products	3. Identification of size and location of markets for produce from WMC enterprises that are badged as leading to a net conservation gain and processes for supplying those markets. Conclusion of estimation of kangaroo populations on WMCs and rates of sustainable use
Development of the Maranoa and Barkindji Wildlife Management Conservancies into effective organisational structures that facilitate regional collaboration in natural resource management and wildlife planning.	Effective sharing of information and experiences during the conduct of the trials.	4. Run a workshop involving WMC members in order to exchange experiences and clarify expectations and opportunities.
Information available to inform SWE trials	Acceptance of report by DAFF	5 Finalise and submit an illustrated Final Report for the 2007-08 funding covered by this Funding Agreement. Provision of an audited report as outlined in Schedule 6.

Plate 1 Maranoa Kangaroo Harvesters and Growers Cooperative Membership declaration

THE MARANOA KANGAROO HARVESTERS AND GROWERS COOPERATIVE

MEMBERSHIP DECLARATION

By signing this statement and paying the joining fee of $11, I am joining the Maranoa Kangaroo Harvesters and Growers Coop and committing myself to the following:

Each landholder will provide exclusive access to their property to one individual Coop member harvester at any one time;

Harvesters will sell kangaroos from Coop member properties exclusively to the Coop chiller boxes. However, if the Coop box operator indicates the Coop boxes are full, they are free to sell elsewhere.

Landholders will not apply for or use damage mitigation permits;

Harvesters will implement any Quality Assurance schemes developed by the Coop.

Members will have the following rights:

the Coop will collectively bargain on their behalf to secure the best market price for their product;

they receive an equitable share of any profits made by the Coop.

This is an interim set of rights and obligations, and they will be reviewed with your input as the process towards establishing a formal Cooperative progresses.

SIGNED

WITNESS

DATE

WHEN SIGNED, PLEASE RETURN THIS FORM AND $11 (INC GST) TO:

The Landcare Coordinator

48 Cambridge St

PO Box 94

Mitchell 4465

Cheques should be made out to Mitchell and District Landcare Assoc. Inc.

Plate 2 RIRDC Media Release for SWE Workshop, 14 & 15 February 2008 at Broken Hill

Australian Government
Rural Industries Research and Development Corporation

RIRDC Shaping the future

Wednesday, 13 February 2008

Workshop to examine commercial wildlife use

The commercial use of native flora and fauna to improve bio-diversity and habitat protection will be examined at a workshop in Broken Hill on Thursday and Friday.

The workshop will review a number of trials being conducted as part of research funded by the Rural Industries Research and Development Corporation (RIRDC) and the National Landcare Program.

RIRDC's Rangeland and Wildlife Systems Research Manager, Dr George Wilson, said three projects have been underway since 2004 to see whether commercial utilisation of native wildlife, such as kangaroos, can improve bio-diversity conservation.

"The trials are based on the success of similar programs in southern Africa and elsewhere, where the commercial value of wild animals has helped in the preservation of the natural environment," Dr Wilson said.

"We are currently working with the Barrier Area Rangecare Group (BARG) north of Broken Hill, the Mitchell and District Landcare Group in Queensland and the Rangeland Management Action Plan (RMAP) group based along Murray River near Wentworth/Mildura.

"These groups are trialling different land management techniques and the development of wildlife management plans and habitat protection as part of the projects.

"The drought in many parts of Australia has seriously reduced livestock carrying capacity on the rangelands and has contributed to biodiversity loss and environmental damage.

"Under current arrangements, wildlife can be seen just as pests over which landholders have little control. Yet some wildlife produces high quality meat and leather, and appears to be softer on the environment than equivalent numbers of livestock. Similarly, some wildflowers or other vegetation could have commercial appeal if further developed.

"Wildlife is also an asset to the tourism industry and the projects aim to show there can be better ways of integrating wildlife conservation with commercial resource use and development. Giving landholders the opportunity to make money could be an incentive to restore natural systems.

"The workshop will be an opportunity to monitor and evaluate the projects based on a triple bottom line approach incorporating environmental, social and economic indicators.

The Future of Australia's Threatened Ecosystems (FATE) Program at the University of NSW has been a key institution in these Sustainable Wildlife Enterprises (SWEs) trials and has been commissioned by RIRDC to organize the workshop.

In addition to landholders and other SWEs, the workshop will also include representatives of the kangaroo industry, relevant government departments and researchers working on the sustainable commercial use of Australian native wildlife.

Media enquiries:
Danny O'Brien – RIRDC Communications Manager – 02 6271 4175 or 0438 130 445

Plate 3 Agenda for SWE Workshop, 14 & 15 February 2008 at Broken Hill

Sustainable Wildlife Enterprises Workshop
Broken Hill, 14 and 15 February, 2008 - Draft Agenda

Day One – Morning (SWE members)

- Report from each SWE on progress so far
- Discussion of future funding options and aims
- Brainstorm - what do the SWEs want to get from the workshop?

Day One - Afternoon (All participants - Starting at 1:30pm)

- Summary of SWE goals and progress
- Review of landholder experiences with kangaroos in NSW, Qld and SA
- Review of specific RIRDC-funded SWE projects
- Models for collaboration
- Business risks in landholder kangaroo enterprises
- Marketing of kangaroo and other wildlife products from SWEs
- Experiences with commercial use of wildlife overseas

Evening of Day One – Workshop Dinner in Broken Hill

Day Two –Morning (All participants – Finishing by 12:30)

- Panel Discussion - Role of landholders in kangaroo management and industry
- Next steps – Collaborative ways forward for achieving SWE goals

Day Two – Afternoon (SWE members)

- Discussion on workshop outcomes
- Refining funding applications

Australian Government

Rural Industries Research and Development Corporation

Marketing Kangaroo Meat from the Maranoa Wildlife Conservancy:

The Conservation Dimension

A report for the Rural Industries Research and Development Corporation

by Peter Chudleigh, Deborah Archbold, Sarah Simpson, and Julia Telford

January 2008

RIRDC Publication No 08/ (added by RIRDC)
RIRDC Project No AGT-13A

ISBN (…RIRDC to assign)
ISSN 1440-6845

Title of your publication
Publication No. 07/
Project No. AGT-13A

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Published in ……... 2008
Printed on environmentally friendly paper by Canprint

Foreword

The Australian rangelands are generally considered to be those land areas where the principal land use is pastoral including the grazing of sheep and cattle, and with limited cropping potential.

The Maranoa Wildlife Management Conservancy covers a group of grazing properties situated in the rangelands around Mitchell in Queensland. The Conservancy has commenced the development of a collaborative enterprise between landholders to produce kangaroo meat as a Conservancy product.

Diversifying pastoral income has always been a challenge in the rangelands. The Conservancy initiative is one attempt to not only enhance the sustainability of production of traditional grazing products from sheep and cattle but also to take advantage of a national resource where harvesting is currently controlled by the state.

Macropod numbers in Queensland are controlled through a quota system administered by the Queensland Parks and Wildlife Service (Department of Environment). The Conservancy concept fits within this regulatory context. Apart from restricting numbers and species that can be harvested, there also exists a range of animal welfare, meat hygiene and other regulations that allow kangaroo meat to be marketed and consumed in Australia as well as exported.

Commercial business enterprises based on Australian wildlife usually are associated with tight profit margins. Also, demand for some products can be limited by perceptions of unsustainable yields and exploitative and inhumane systems of production.

Exploring the potential for using the concepts of sustainable yields within a conservancy and wildlife conservation gains from management of the conservancy may result in a higher acceptability of products and enhanced marketing effectiveness and margins for kangaroo products.

This research has provided information on the kangaroo meat market in Australia with regard to strategies for market development of conservancy produced kangaroo meat and in particular an assesssment of the potential badging of products with some form of environmental accreditation.

This project was funded from a special grant to RIRDC provided by the Department of Agriculture Fisheries and Forestry and is part of a wider program on Sustainable Wildlife Enterprise Trials that enables landholders to more effectively manage wildlife populations and integrate wildlife with their property and natural resource management issues.

The key findings have been developed from market research activities undertaken with existing and potential kangaroo meat processors, distributors and consumers in Queensland.

This report, an addition to RIRDC's diverse range of over 1600 research publications, forms part of our (fill in relevant program) R&D program, which aims to (fill in program's objective).

Most of our publications are available for viewing, downloading or purchasing online through our website:

- downloads at www.rirdc.gov.au/fullreports/index.html
- purchases at www.rirdc.gov.au/eshop

Peter O'Brien
Managing Director
Rural Industries Research and Development Corporation

Acknowledgments

This report is the result of the efforts of a project team constructed to fulfil the terms of reference of the study. The team comprised personnel from Agtrans Research (Peter Chudleigh ad Sarah Simpson), a market research and marketing specialist (Deborah Archbold) from Deborah Wilson Consulting Services, and a local NRM consultant (Julia Telford) who is familiar with the conservancy concept and its history.

The authors would like to thank the following for helpful input into the project:

Peter Ampt, FATE Program Manager, University of NSW

Jeff Campbell, Mitchell Landcare

Rosie Cooney, Consultant and Research Fellow, FATE, UNSW

Tom Garrett, Coordinator, Maranoa Wildlife Conservancy

Jo Hall, Sheep & Wool Policy Director, AgForce

Stacey Henry, Mitchell and District Landcare Coordinator

Nicholas Swadling, Industry Development Officer, Queensland Department of Primary Industries and Fisheries, West Region

Noela Ward, Booringa Shire Council

George Wilson, Rural Industries R&D Corporation and Australian Wildlife Enterprises

The input from the industry personnel responding to the industry survey, as well as those consumers who participated in the Focus Groups is gratefully acknowledged.

Abbreviations

ALMS	Australian Land Management System)
DMP	Damage Mitigation Permit
EPA	Environmental Protection Agency (Queensland)
QDNRW	Queensland Department of Natural Resources and Water
QDPIF	Queensland Department of Primary Industries and Fisheries
MDLA	Mitchell & District Landcare Association

Contents

Executive Summary

What the report is about

Exploring the potential for using the concepts of sustainable yields within a conservancy and wildlife conservation gains from management of the Conservancy may result in a higher acceptability of products and enhanced marketing effectiveness and margins for kangaroo products.

This research report provides information on the kangaroo meat market in Australia with regard to strategies for market development of Conservancy produced kangaroo meat and in particular an assesssment of the potential badging of products with some form of environmental accreditation.

The research is important for two reasons. First, the current marketing chain has evolved over a number of years using the kangaroo resource without much regard to its interaction with land management. Second, a key question in the minds of the Conservancy representatives was whether environmental badging could be exploited in the market place to attract increased demand.

Who does the report target?

The report is targeted at those in the Mitchell Landcare Group who are pursuing the Conservancy concept and who have already purchased two chillers to enter the kangaroo marketing chain.

Background

The Maranoa Wildlife Conservancy has been formed by a group of pastoralists, predominantly cattle producers in central /southern Queensland. The reason behind the Maranoa Conservancy being established was because of the “Landcare ethic” of the landholders involved and the catchment planning they had been undertaking.

A key area for improved management of the Conservancy is to focus on general sustainable management within each of the properties. Maintaining an appropriate balance of traditional livestock and kangaroo populations is paramount. Conservancy members view kangaroos predominantly as a resource that can be utilised for both economic and biodiversity reasons, rather than merely as a pest for control and disposal.

Some kangaroos are harvested within the Conservancy at present (some for human consumption and some for pet food) under a regional quota system as for other areas in Queensland. Other kangaroos and wallabies are harvested under a damage mitigation permit (DMP). Kangaroos shot under a DMP are not allowed to be taken from the field after they are shot, but skins can be taken.

The objective of the Conservancy is to promote biodiversity through:

- land, vegetation and animal stewardship at both individual property and Conservancy /catchment scales
- wildlife management through protecting and enhancing the habitats of existing wildlife and potentially through re-introduction of native species
- sustainable commercial livestock management
- sustainable kangaroo management including sustainable harvesting rates and utilising sustainable harvesting practices.

While other market research activities on kangaroo meat have been undertaken in the past, information on the potential for differentiation of the market through environmental management associated with the kangaroo production and harvesting system and its interaction with traditional grazing enterprise was lacking.

Objectives

Specific objectives of the research were:

- Identify the size and location of markets for produce from Wildlife Management Conservancy enterprises that are badged as leading to a net conservation gain.
- Support the establishment of processes for supplying those markets.

The principal beneficiaries from the research are those supporting the establihsment and devlopment of the Maranoa Conservancy Group, as well as other like minded groups of landholders who may be developing similar concepts in environmental management.

Methods used

The first activity concentrated on describing the characteristics of the Conservancy properties, the potential supply of kangaroo meat, and features of the Conservancy properties that were thought would be of interest to current and potential kangaroo meat consumers. This guided appropriate market research with consumers and other participants in the marketing chain (e.g. marketers, restauranteurs, caterers etc). The information on the market was expected to lead to options for market development and in particular alternative forms of potential badging of products, for example, using some form of accreditation or chain of custody associated with environmental and wildlife management systems.

The market research consisted of two major activities:
(i) Twenty one interviews with representatives of various segments of the market to provide feedback on opportunities for the Conservancy product. This covered food service suppliers, gourmet retailers, supermarket representatives, restaurants, catering organisations, hotels, and processors.
(ii) Two focus groups including one focus group of 10 people that had eaten kangaroo four or more times in the last 12 months; and one group of 9 people that included 4 that had eaten kangaroo at least once and 5 people that had never eaten kangaroo.

Key findings

The key findings have been developed from market research activities undertaken with existing and potential kangaroo meat processors, distributors and consumers in Queensland.

Sustainability

There is a range of activities that could be undertaken on Conservancy properties to improve the sustainability of traditional livestock management systems. Many of these activities interact with macropod harvesting. The Maranoa Conservancy is already progressed to the stage where a number of landholders have been accredited under the Australian Land Management System. Various types of improvement to wildlife management are possible on Conservancy properties. One method would be by integrating current kangaroo harvesting more closely with property management of both wildlife and traditional grazing management of sheep and cattle. There may need to be a financial incentive to enhance this integration and this incentive could be attracted in various forms. This may come about through improved quality of kangaroo meat production and marketing the Conservancy product as a net conservation gain product.

Conservancy supply

An estimate of harvest numbers from Conservancy properties is 7,000 to 10,000 head per annum. While this is only a rough estimate, it is a very small number compared to the whole of Queensland or the Australian annual supply of kangaroo meat. Consistency and continuity of supply from the Conservancy may therefore be key issues in market development.

There may be a need to take kangaroo carcasses from other conservancies with similar credentials (if they exist), or from non–conservancy properties with potential credentials. As mentioned earlier, the main reason that the Maranoa Conservancy was established was because of the “Landcare ethic” of the landholders involved and the catchment planning they were doing focusing on other values and threats in their region. Since that time two other groups in the Mitchell area have commenced similar discussions, so it is possible that they could also be included in the Conservancy if interested and have undertaken subcatchment planning with their neighbours.

It is likely that more properties in the area would supply if it could be demonstrated there was a price premium to be captured, for example, if a processor could pay a premium for Conservancy kangaroos.

Apart from total quantity available, continuity and the variability of supply may be key issues in marketing a Conservancy badged product. Strategies for maintaining a continuous supply or at least reducing supply variability may include one or more of the following:

- Managing the kangaroo population on a whole area of Conservancy basis.
- Reducing sheep, cattle (and in some cases goat) numbers in drought periods.
- Utilising smaller kangaroos (and possibly wallabies) and subsidising the meat price to processors/marketers.
- Limiting the meat sold under the Conservancy brand in periods of ample supply so that expectations for supply continuity were not high, and with other kangaroo meat sold generically.
- Form marketing alliances with other like-minded Conservancies, preferably in other regions so that some form of spatial diversification were in play that may reduce variability except in nation wide droughts.

Findings from Survey of Firms

The potentially small volume of the Conservancy branded product and any problems with stability of supply will affect opportunities to supply the product into some firms and some segments. The hotels and supermarkets contacted confirmed that lack of continuous supply would be a barrier to using the product. Some of the firms in other segments would not be interested in the product if supply is not reliable or consistent.

Sixteen of the 19 firms surveyed were interested in trialling the product or in receiving more information on the product but the final decision to use the product would be based on a range of factors including quality, price and perceived demand. Two firms were not interested in the new product and one could not comment until they received more information.

When asked to rate the strength of the opportunity for the Conservancy product in the market (on a scale of 1 to 5 where 1 is poor and 5 is very good), food service companies gave the highest rating (3.5) followed by hotels (3.3) and supermarkets (2.9).

Food service companies (including game meat suppliers to high quality restaurants and gourmet butcher shops) felt that there is potential interest in the product. Kangaroo was more popular about 7 years ago and demand for game meat is ‘fashion’ influenced. For this reason, the new product would need to be supported by a concerted promotional campaign targeting chefs (e.g. chef workshops such as G’day Chef and targeted marketing) to encourage trial of the product. Consumer demand is seen as a key driver and promotion to consumers is also needed.

Restaurants gave a rating of 2.0 out of 5 to the market opportunity. While some were interested, others were not interested in the product. Significant differentiation on quality and presentation would be needed. Successful branded products used by restaurants include MSA and other high quality branded meat. Junee Lamb has developed high quality packaging for restaurants and this approach has lifted demand. Kangaroo is currently supplied to restaurants in clear plastic, bloody bags and can be much less appealing. Overall, the current presentation of kangaroo product to restaurants and food service outlets was considered fairly basic and sends the message kangaroo is just a commodity product.

Hotel interests felt that there is potential demand for a high quality, environmental branded product (rating of 3.3 out of 5). As with the restaurant segment, promotion to chefs and marketing the product as a gourmet product is important.

For some firms, the environmental focus is valuable due to the positioning of the business or because of increased interest from consumers. However, the Conservancy product would need to be positioned primarily as gourmet and secondly as an environmental brand. Those who did not see value in the environmental branding believed that the current supply of kangaroo already has good environmental credentials. Others felt it would be too difficult to differentiate the new product from the existing supply of kangaroo.

Clear messages are needed about the differences the new product offers. To achieve wider levels of interest and support, the quality and gourmet positioning will be the main driver. Few are interested in a product that is differentiated only by the conservancy approach. Also, the environmentally branded product must be demonstrated to be superior in quality and packaging. Regarding quality, tenderness and food safety were considered paramount.

Of the 19 firms surveyed 18 indicated that they would be willing to pay a higher price for the environmentally branded product. However, the actual price of the product would be determined by the quality of the kangaroo meat. All segments reported that the Conservancy product initially should have a similar pricing to existing kangaroo and, once the product is established and successful, the price could be gradually increased.

Businesses purchasing environmentally branded kangaroo want information on how sustainable harvesting is managed, credentials of the supplying organisation, firm ownership, food quality and system capabilities – a full profile on the operation, its capabilities and the benefits it can deliver. These firms felt that consumers would want information on the origin of the product, nutrition and health information (confirmation that it is a healthy product), information that kangaroo is tender and of good quality.

Findings from Consumer Focus Groups

The key proposition conveyed to the Focus Groups was that landholders will carry out enhanced habitat protection and control of invasive species that diminish biodiversity or reduce damage to land as a result of better management of the kangaroos and traditional grazing enterprises with sheep.

The Focus Group discussions revealed some difficulties in understanding the Conservancy concept as perhaps there were too many messages involved and not one issue that could be driven home. Some of the simple conservation /environmental concepts that appeared important were the maintenance of sustainable populations of macropods, sheep/cattle versus kangaroos, greenhouse gas production, and some concerns about shooting females and joeys in the pouch.

However, regular buyers of kangaroo meat are generally interested in the concept of an environmentally branded kangaroo product. For the majority of this group, a gourmet product positioning is essential. A few people in this regular user focus group purchase kangaroo meat because it is a cheaper meat option. Overall this group would accept a slightly higher price if they knew the product was delivering positive results for the environment and was a gourmet product. Consumers are interested in the 'environmental story', particularly the fact that the product is produced in Queensland by Queensland based companies.

It is important to provide an effective, succinct and positive environmental story to accompany the product. Although consumers understand concepts such as 'organic' and 'free range', consumers felt that the conservancy concept would need a simple, easy to understand definition. People did not find the concept or the benefits easy to understand. Some saw the fact that cattle and sheep production was continuing, along with possible land clearing on properties, was in conflict with the concept of a net gain to the environment. There was strong interest in the low greenhouse gas emissions from kangaroos.

The market research showed that for most consumers any animal welfare and harvesting considerations were not major and these issues are probably best left alone. However, the market research demonstrated some concern about the residual population if females were harvested, the harvesting of females with pouch joeys and any genetic implications in the longer term of harvesting the larger animals. Above all, they want to be assured of quality and food safety. The perception that kangaroo meat is dog food or pet food is not a positive association for promotion as gourmet product.

Both regular and infrequent users of kangaroo are interested in information on cooking methods for the best eating result and recipes using kangaroo. Consumers identified opportunities for use of 'bush tucker' complementary spices and food products (e.g. marinades, sauces) that could be sold with the Conservancy kangaroo.

Implications for marketing

Positioning

The Conservancy product would best be promoted as a gourmet and environmentally branded high quality product; use of all three themes would be vital in the positioning of the product. The environmental brand would need to be simply communicated.

Establishing a niche product within a niche market (existing kangaroo supply) was seen as a difficult task. Some firms felt that there was still limited demand for kangaroo at the present time and that considerable marketing effort would be required to create consumer demand (considered essential for long term success) and market the new product to different market segments.

Distribution

Gaining market access and providing the necessary support and customer service backup required was identified as a challenge. Assuming a high quality product is established, there would be a number of options for distribution and marketing. The business model chosen would depend on the extent of product differentiation envisaged, resources available to the Conservancy and the attitude to risk. Forming a marketing relationship with one processor would have the advantage in the short term in that there would be an established market for the product while matters of harvesting organisation and chiller management are developed and the Conservancy could gain knowledge about the market and the potential market positioning of its product. Also, a single processor is more likely to commit to a new product with appropriate promotional and educational support.

On the other hand a single processor may be more interested in securing access to a high quality product for existing markets rather than developing the market for a new product. While a small premium may be paid for quality in the first instance, this premium may never attain a high level if the Conservancy product is not well differentiated in the market place. The Conservancy product would then most likely be sold into the mass market for kangaroo meat (e.g. supermarkets). Some processors may be more concerned about maintaining throughput in the processing facility, rather than developing a premium price in the market place through packaging or promotion. The possibility remains of a joint market development effort by the Conservancy and the processor.

A second option may be to make the product available to more than one processor, with preferences given to processors or marketers with ideas for promotion as coming from a net conservation gain production system.

Depending upon the availability of product, and once some security of supply and quality has been obtained, it may be then viable for the venture to target smaller volume, high value markets. However these market segments are 'unforgiving' in terms of their expectations of quality, consistency and availability of supplies. One option may be to pay for carcasses to be processed under contract and then market the processed cuts directly to an up-market food service firm that may supply restaurants or a game meat specialist distributor. Exclusive supply arrangements to game meat suppliers in some states could also be considered.

In all of these options, it may be possible to obtain a government grant to help develop the packaging, promotional material, and implement promotional activities, possibly in conjunction with the existing distributor.

Quality
A very high quality product was considered essential to penetrate all markets, but particularly the restaurant market, gourmet butchers and game meat specialist distributors.

The Conservancy could improve the arrangements around product integrity. Currently there are no formal supply chain agreements within the kangaroo marketing chain. It is possible that product quality could be improved from the shooting and field harvesting (gutting etc), handling to the chiller, chiller management and then transport to the processor. This may involve for example, use of bar codes and temperature scanning devices. There is currently a code of practice for chiller management but some industry opinions are that this area of the supply chain could be significantly improved.

An issue associated with improved chain management is whether improved quality means a higher cost of supply (e.g. harvesting or chiller costs) and whether there are low cost areas of improvement that can be made. Stacking and spacing in chillers appear to be an important issue as there is a need to cool carcasses down quickly but this is not possible when chillers are full. Choices need to be made therefore between smaller or larger chillers and their number and location, regularity of emptying, single or double hanging etc. The cost implications of all such changes require estimation. Also, it would be important to assess how quality could be improved by implementing changes in terms of less wastage or improved eating quality.

Pricing
The strategy of developing the market for the Conservancy product at existing prices and then gradually increasing prices once a market niche has been developed is favoured. The potential for increasing prices to domestic consumers and to export market is presumed to be limited in the short term. The Conservancy product has first to be differentiated and proven in terms of quality, food safety and environmental credentials. Only then should price premiums are likely to be extracted from processors or other distributors.

Supply variability
Maintaining stability of supply was generally important for consumers and for each of the market segments. A seasonal downturn would be understood by consumers, however patchy supply would result in consumers not consistently coming back to the product.

Promotion
Consumer acceptance of kangaroo is growing. However it is regarded as a niche product and consumers do not have a great deal of understanding of this product, particularly as a high quality gourmet product. Consumer education, in store demonstrations and promotion or endorsements of the product by chefs needs to be undertaken to appropriately position the product.

Developing effective packaging and a recognisable, attractive branding for the product would be recommended. It will be important to provide leaflets for recipes when targeting consumers and provide the necessary information on the product when targeting key market segments, e.g. quality, food safety and the Conservancy message.

Conclusions and recommendations
1. There are four major conclusions relevant to the Conservancy pursuing any market development through a branding and promotional strategy:

- (i) Environmental management as a concept in kangaroo meat marketing has some potential but the net conservation gain concept is difficult to address in a manner that can easily be understood and believed. This remains a challenge for the Maranoa Conservancy Group
- (ii) Environmental credentials are not sufficient on their own to develop a market niche for the Conservancy product. Meat quality and integrity are very important and there need to be reasons provided as to why the Conservancy product is higher quality than the rest of the kangaroo meat in the market.

(iii) Given the likely Conservancy supply, the product would need to be positioned as a gourmet product at the top end of the market including such market targets as restaurants and gourmet butchers. One distribution channel to facilitate this would be through game meat specialist distributors.

(iv) Significant promotion and packaging innovation would most likely be required to develop a niche market

2. The difficulties and risks, time and costs for development of a niche market should be recognised. It is questionable whether the Conservancy could raise the resources required (in the hundreds of thousands of dollars) for this market development unless there was some partnering with existing players.

3. Supply variability will be a constraint in market development, mainly in gaining the required support from within the distribution system. Potential multiple strategies to overcome some of this variability have been identified.

4. It will be important to identify where improved quality and/or cost savings/increases to the total system are likely to occur from the Conservancy operating its own chillers. There is a need to avoid pursuing a system that increases costs without net benefits. Demonstrating profitability to the overall system from changes should be given precedence.

5. It is recognised that the current marketing chain has evolved over a number of years. There will be entrenched interests, distrust and opposition to change as has been demonstrated already.

1. Introduction

This project focuses on the markets for products labelled as originating from sustainable enterprises where biodiversity has been enhanced. In particular, market research has been carried out within the study in order to assess and facilitate the development of a marketing strategy for kangaroo meat emanating from land and wildlife that are managed in a sustainable manner.

If a viable marketing strategy, based on sound market research, develops from this project, it will represent another step in the development of sustainable wildlife enterprises. This will in turn assist the rural sector with diversification, especially in rangeland areas where new production options are minimal. It could provide RIRDC with a win-win strategy of increasing profits for rural landholders but at the same time increasing environmental sustainability and strengthening the social fabric of rural areas.

The marketing study (AGT-13A) funded within the Maranoa Wildlife Conservancy project is part of a wider RIRDC project on trialling three sustainable wildlife enterprises. The wider project has the following objectives. AGT-13A addresses the third objective:

1. Define a framework that enables landholders to share the proceeds of harvested wildlife.
2. Estimate kangaroo numbers that enable landholders to more effectively manage populations and integrate wildlife with their property and natural resource management plans.
3. Identify markets for products that are badged as leading to net conservation gain.
4. Share information of experiences from the trial sites and encourage regional collaboration in natural resource management and wildlife planning.

The focus of the present project is on the connection between environmental management and the demand for kangaroo meat. In addressing this connection, substantial preparatory investigation has been carried out in order to ensure the appropriate questions are pursued when assembling information from the marketplace.

2. Objectives and Methods

2.1 Objectives

The broad objective of the project was to contribute via marketing and market research to a more diverse rural sector, enhanced biodiversity and innovative industries based on non-traditional uses of the rangelands and their wildlife. While the project is embedded within a broader RIRDC program aimed at trialling sustainable wildlife enterprises in several Australian locations, it is specifically associated with the development of a wildlife management conservancy around Mitchell in the Maranoa region of Queensland.

Specific objectives of the project were:
- Identify the size and location of markets for produce from Wildlife Management Conservancy enterprises that are badged as leading to a net conservation gain.
- Support the establishment of processes for supplying those markets.

The key role of the study was to identify the characteristics of markets for kangaroos from the Maranoa conservancy that may be potentially penetrated by a net conservation gain interest and how marketing may best proceed to capture and expand those markets. The views of those involved in marketing and of existing and prospective consumers of kangaroo meat are of paramount interest in order to direct the Conservancy focus, particularly the attitudes towards activities and products that are associated with 'net conservation gains'. There was a need to explore the reaction to a conservancy or regional brand to promote the sustainable harvest of kangaroo meat from the Conservancy (and potentially any other products).

2.2 Methods

The project team was made up of Agtrans Research personnel (Peter Chudleigh and Sarah Simpson, agricultural economists), a market research and marketing specialist (Deborah Archbold) from Deborah Wilson Consulting Services, and a local NRM consultant with experience of the development of the conservancy and its history (Julia Telford). The project commenced in May 2007 with a team meeting to identify roles and the approach to be taken. The first activity concentrated on describing the characteristics of the Conservancy properties, the potential supply of kangaroo meat, and features of the Conservancy properties that were thought would be of interest to current and potential kangaroo meat consumers. This guided appropriate market research with consumers and other participants in the marketing chain (e.g. marketers, restauranteurs, caterers etc). The information on the market was expected to lead to options for market development and in particular alternative forms of potential badging of products, for example, using some form of accreditation or chain of custody associated with environmental and wildlife management systems.

The first part of this report (Sections 3 and 4) has been compiled from team knowledge and reading selected material (project and non-project). The report initially focuses on the potential linkages between the sustainability and environmental credentials of the Conservancy and the market-place, with emphasis on the market for kangaroo meat. Some brief attention is given to several other potential Conservancy enterprises (non- kangaroo harvesting enterprises). A brief report on these other enterprises is provided in Appendix 1.

There was some delay in the project (a two month lag) when the project was paused pending the outcome of the negotiations of the Maranoa Group with kangaroo meat processors. An initial option was that the Group would negotiate with one processor, then it changed to three and then it reverted to one. The project was delayed as it was thought the chosen processor could be consulted regarding the market strategies before the market research was carried out. However, the negotiations were ongoing for a long period and it was decided to go ahead with the market research in November 2007.

The key aims of the market research were to:

- Provide feedback on consumer interest in the Conservancy concept and the extent to which this would influence buyer behaviour.
- Determine the level of acceptance and interest in a Conservancy brand kangaroo product range amongst delicatessens, high quality food outlets, food service firms, restaurants, and supermarkets.
- Determine processor views on the Conservancy product.

The market research consisted of two major activities:
1. Twenty one interviews with representatives of various segments of the market to provide feedback on opportunities for the Conservancy product. This covered:

- 5 food service suppliers
- 4 gourmet retailers
- 4 supermarket representatives
- 2 restaurants
- 2 catering organisations
- 2 hotels
- 2 processors.

Interviews covered firms with operations in Queensland, New South Wales, Victoria, ACT and South Australia.

2. Two focus groups covering:

- One focus group of 10 people that had eaten kangaroo four or more times in the last 12 months.
- One group of 9 people that included 4 that had eaten kangaroo at least once and 5 people that had never eaten kangaroo.

Questionnaires used in interviews with market segment representatives and the focus group questionnaire are contained in Appendix 2 of this report.

Research results provided insights into key issues affecting uptake of the conservancy product in various market segments. The focus group research provided qualitative feedback on attitudes to kangaroo meat and reaction to the Maranoa Conservancy concept.

A short summary of the Conservancy approach that was used to inform those surveyed or participating in the Focus Groups is included as Appendix 3 of this report.

3.Background to the Conservancy

The Maranoa Wildlife Conservancy has been formed by a group of pastoralists, predominantly cattle producers in central /southern Queensland. The reason behind the Maranoa Conservancy being established was because of the “Landcare ethic” of the landholders involved and the catchment planning they had been undertaking.

A key area for improved management of the Conservancy is to focus on general sustainable management within each of the properties. Maintaining an appropriate balance of traditional livestock and kangaroo populations is paramount. Conservancy members view kangaroos predominantly as a resource that can be utilised for both economic and biodiversity reasons, rather than merely as a pest for control and disposal.

Some kangaroos are harvested within the Conservancy at present (some for human consumption and some for pet food) under a regional quota system as for other areas in Queensland. Other kangaroos and wallabies are harvested under a damage mitigation permit (DMP). Kangaroos shot under a DMP are not allowed to be taken from the field after they are shot, but skins can be taken.

3.1 Conservancy Objectives

The objective of the Conservancy is to promote biodiversity through:

- land, vegetation and animal stewardship at both individual property and Conservancy /catchment scales
- wildlife management through protecting and enhancing the habitats of existing wildlife and potentially through re-introduction of native species
- sustainable commercial livestock management
- sustainable kangaroo management including sustainable harvesting rates and utilising sustainable harvesting practices.

3.2 Current and Prospective Conservancy Activities

3.2.1 Grazing Management

There is the potential for changing the mix of cattle/sheep and kangaroos on the Conservancy properties. There is potential for there to be fewer sheep/cattle, watering points, fences etc. Also, harvesting kangaroos more strategically could allow pastures to regenerate more rapidly. Managing total grazing pressure especially in drought is a key aspect of kangaroo interaction and integration with property management.

3.2.2 Harvesting Strategies

Location and time of harvest information for each kangaroo could be integrated with information on land, pasture, weather and seasonal conditions. Kangaroo harvest data assembled on a Conservancy basis can be used for both livestock and kangaroo management. One idea canvassed was for the Conservancy to give priority to harvesting kangaroos on spelled regenerating paddocks, with harvesters being requested to harvest in specific locations on behalf of the Conservancy group. This does not happen under existing harvesting arrangements. Also, sharing information about location and aggregation of kangaroos may be beneficial to harvesting efficiency. A coordinated approach may allow better strategic control of large concentrations and easier shooting.

3.2.3 Invasive Species

The maintenance of native vegetation by control of weed spread could be improved with kangaroo harvesters washing down vehicles before entering another property and would be part of an overall environmental management plan.

Kangaroos are the most common native species within the Conservancy. However, the number of many other native species has been reduced by invasives such as wild dogs, foxes and cats, and feral pigs. There is some anecdotal evidence that there has been loss of native birdlife (plains turkeys, brolgas) as a result of increased numbers of feral animals. The situation may have been worsened by the DMPs whereby some kangaroos are left to rot and die in the paddock. Kangaroo harvesters working within the Conservancy may be able to assist with wildlife management by shooting feral goats, foxes or cats.

If ferals can be controlled, there may be scope for reintroduction programs for native animals like the bilby program that operated at Charleville.

3.2.4 Greenhouse Gases

It is estimated that about 16% of Australia's total net greenhouse gas emissions originate from the farm sector. Of this 16%, 71% is contributed by ruminant livestock such as cattle and sheep emitting methane gas. Methane is a product of ruminants, and kangaroos are not ruminants. Consumption of kangaroo meat instead of beef or sheepmeat is therefore very greenhouse friendly.

A recent report by Greenpeace on global warming stated that reducing beef consumption by 20 per cent and putting Skippy on the dinner plate instead would cut 15 megatonnes of greenhouses gases being emitted to the atmosphere by 2020 (Reference to be inserted).

3.2.5 Meat Quality

A higher and more consistent quality of kangaroo meat potentially may result, from changed harvesting and handling processes, a higher level of chiller management, and an improved feedback and traceback system. An improved traceback system is currently being developed for the Conservancy, including GPS and data logging on a paddock and property basis.

Also, if kangaroo harvesting within the Conservancy is organised by a combination of pastoralists and harvesters with some form of joint control of chillers, one of the benefits may be improved quality control and an improved product to market.

3.2.6 Harvesting and Chiller Management

The Mitchell & District Landcare Association (MDLA) is acting for the Conservancy and has recently purchased two chillers (one 40 foot and one 20 foot in length), both located in Mitchell. By purchasing 2 boxes it was seen as an opportunity to be able to diversify the Conservancy product over time as opportunities arise. A manager of the chillers has been appointed. MDLA took advantage of local boxes being for sale, rather than trying to purchase new boxes to be located in Mitchell. This has been seen as an easier way to enter the industry, as locally all other boxes were owned by processors.

The concept was that landholders involved in the Conservancy see the need to be able to prove itself initially and then look to growth, with the general agreement that there would be a need to increase supply for it to be successful and profitable in the long term.

MDLA will be selling product to Ray Borda of Macro Meats, based in South Australia. The MDLA & Macro Meats have agreed that the product will go through the processing plant, however MDLA can trade through another processor if it so chooses.

In early January 2008, with the Certificate of Trade issued by EPA in Charleville, MDLA had started buying kangaroos from local harvesters. However, due to administrative issues and not having the

Certificates on site, this ceased. The local harvesters have thus pulled out of shooting to the "Landcare boxes" and this has created a new round of negative feeling towards the project. As a result, MDLA is currently in a situation of having no harvesters prepared to supply the boxes. MDLA is in the process of trying to rectify this situation at least for the short term. It is another bump in the road between local landholders and harvesters since the Conservancy concept was initiated several years ago.

As a result of this latest halt to the progress of the project, there has been mixed feeling by landholders and people involved in the group. One line of thought is that landholders have a right to refuse harvesters access to their properties, unless they supply the "Landcare boxes". This is not a view supported by everyone, as this approach is seen by some to be antagonistic, and therefore creating more disharmony and negativity towards the Conservancy.

Within the kangaroo industry there is negative sentiment towards landholders being involved in the production side of the business, with harvesters feeling threatened by this involvement. This is regardless of the fact that harvesters have not been happy with the prices imposed on them by processors, and where they have little room to negotiate.

3.3 Environmental Management Systems

3.3.1 General

Past Australian experience with environmental management systems in improving access or extracting premiums in the market place has not been overly positive. For example, the Field Fresh Nature Conservation Project was established to encourage Tasmanian onion and carrot growers to develop a conservation program as part of the compliance with Natures Choice Quality Assurance program (Tesco Supermarket Chain in the UK). An analysis of the program showed that there needed to be a financial incentive apparent, not just market access, to avoid a significant drop out from such a scheme; the drop out quickly occurred due to the absence of any financial incentive.

A survey of 25 influencers of attitudes towards sustainability of Australian woolgrowing suggested that in the long term sustainable practices could impact on price but more likely on market access. In the short term (1-10 years), factors affecting price and market access were thought more likely to be in the areas of animal ethics and chemical use rather than biodiversity.

The issue with kangaroo meat is whether consumers are convinced there are likely to be net conservation gains from the Conservancy and whether they are prepared to pay a higher price for meat originating in the Conservancy. It is possible that meat quality and animal welfare issues may be stronger drivers of differentiation.

3.3.2 Environmental Management Systems in the Conservancy

Some landholders within the Conservancy have recently been audited under the ALMS process. ALMS (Australian Land Management System) is an ISO14001 accredited EMS. At this stage there are four landholders who have been audited under the ALMS accreditation, with three landholders awaiting an audit. The two differences between it and any other EMS is that it takes into consideration catchment targets/issues and it has a focus on biodiversity. No other EMS does this.

As initially anticipated there are now other landholders within the conservancy who are interested in undertaking an ALMS EMS since the first landholders began. There are three landholders at present who have said that they would like to undertake the work, with others possibly interested.

There is potential for 3rd party certification if landholders choose to become fully ISO certified. This has not been flagged as something that is of interest to landholders at present as the cost involved in getting the ISO accreditation is high, and there has been no market incentive to support this cost. To be able to say that as a result of their ALMS audit that they are ISO compliant has been sufficient.

Consumers can be confident that ISO 14001 is an internationally recognised EMS program, and that landholders who have passed the audit process are deemed to be compliant with this standard.

ALMS-accredited auditors certify that each ALMS management system complies with the internationally recognised ISO 14001 environmental management standard. ALMS members are required also to account for catchment priorities and strategies, and to provide continuous support for biodiversity conservation.

The SAGGE project represents Scenario Analysis of Grain & Graze Enterprises. One of the properties in the conservancy was used as the pilot property for this project in the Maranoa Balonne Catchment.

Some landholders further west of the Conservancy area have done a Pastoral EMS through a project with the Queensland Department of Primary Industries and Fisheries (QDPIF). However, this project has now finished and QDPIF has approached Queensland Murray Darling Committee to work with these landholders. Some landholders have been working with AgForce on property management plans, however these are not auditable. There are no organic beef producers or organic wool producers in the Conservancy to the knowledge of the authors.

3.3.3 Wildlife Management and Planning

There is no overall wildlife management plan for the Maranoa Wildlife Conservancy as a whole. Wildlife management is currently integrated into the individual property management on Conservancy properties by highlighting high value biodiversity and vegetation corridors and managing for this, along with riparian areas.

Managing total grazing pressure especially in drought is a key aspect of kangaroo interaction and integration with property management. However, the regional quota system may mean that during droughts that quota may be reduced just when greater kangaroo control may be required.
Black striped wallabies are not harvestable currently and could compensate by increasing numbers if kangaroo numbers are better controlled through harvesting, although some of the Conservancy country will not be suited to their habitat. The black striped wallabies sometimes are culled as a pest under damage mitigation permits if it can be demonstrated the wallabies are responsible for significant losses. An approximate number is that around 6,000 may be shot each year around Roma. One option is to have a small quota for them, on a sub-regional scale, to keep numbers at a manageable level.

A special case could be made for carcasses to be used rather than being left to rot in the field. However, information on the size of the cuts and the quality of the meat is not available. Any market niches that may be filled would need to be weighed up against the higher processing cost per kg of carcass and the lower value of the smaller skins.

3.3.4 Potential for Wildlife Management Changes

A key idea is whether conservation based enterprises can act as an incentive to retain and restore on-farm habitat. But from where will the incentive come? The propositions raised so far include:

- the Conservancy will gain revenue from sharing in the likelihood of domestic consumers paying more for higher quality kangaroo meat
- the Conservancy will gain revenue by selling its product to processors at a small premium price
- the demand for kangaroo meat increasing due to the promotion of conservation and environmental benefits and being produced under a net conservation gain management system
- a perceived reduction in damage to land as a result of better management of the kangaroos

- there could be a government incentive for innovative business ideas, ‘drought’ tolerant agriculture, etc
- a direct payment of consumers for kangaroo meat that is produced on the Conservancy with such payments being channeled directly for on-farm habitat restoration and conservation enhancement, not only for kangaroos but also for other native animals

There would be some data available on the current native and feral wildlife on conservancy properties apart from kangaroos, but much of this may be anecdotal. Local councils would have information on wild dogs through their baiting program and bounties on dogs. This might also be a source of information on foxes and cats, and perhaps feral pigs.

There is anecdotal evidence only of the loss of native birdlife (plain turkeys, brolgas) as a result of increased numbers of feral animals. This is potential for surveys to be done in the area to look at native species abundance. There would need to be a demand from the Conservancy for funding to be able to justify such surveys.

There is not much evidence of the impact of effectiveness of control of dingoes, cats, pigs and wild dogs on native wildlife. Wildlife management does not appear as an integrated part of property management plans within the Conservancy and this is an area that could be developed further.

There may be scope for reintroduction programs for native animals (e.g. opportunities for reintroduction of small mammals due to improved control of ferals on a Conservancy wide basis, similar to the bilby program at Charleville).

3.3.5 Harvesting Macropods and Wildlife and Pastoral Management Opportunities within a Conservancy

Harvesting kangaroos for wild dog baits has been mentioned as a tool to integrate pastoralists and harvesters, at least in the first instance. This may apply particularly using the DMP animals that are currently killed and left to rot in the paddock so encouraging populations of feral animals as has been mentioned earlier.

Kangaroo harvesters may be used to assist with wildlife management e.g. shooting feral goats, foxes or cats. This has been a thought from the beginning of Conservancy development. With regard to weeds, harvesters could wash down vehicles before entering another property. While this may increase costs, it would provide much benefit with regard to weed spread (e.g. parthenium) and could be part of an overall environmental management plan.

Other potential opportunities and benefits may include:

- low weight kangaroos are currently not targeted for harvesting, but if they were this may assist management of numbers
- harvesters may be able to purchase inputs more cheaply if part of a wider Conservancy
- kangaroo harvest data assembled on a Conservancy basis can be used for both livestock and kangaroo management. Location and time of harvest could be integrated with information on land, pasture, weather and seasonal conditions etc, population dynamics etc
- decision making tools could be developed with increased information input from kangaroo shooters for example, on the kangaroo populations to target, management of native and exotic animals including pests, state of fences, water levels, pastures etc, managing disease etc.
- Reduction of livestock numbers if the value of kangaroo meat harvested on Conservancy properties increases; this may result in improved livestock welfare, and increased land and pasture sustainability.

3.3.6 Technology to Trace Wildlife Products and Data Management for Kangaroo Harvesting

Information is assembled manually and submitted every month to regulatory authorities by kangaroo harvesters and includes where a kangaroo is shot, its species, age, sex and weight. This is effected by harvesters in submitting their harvest information to government. The chiller managers record the number and species at the point of sale, but presumably property level details are lost at this stage.

An improved traceback system is currently being developed for the Conservancy, including GPS and data logging on a paddock and property basis with chain of custody at least to the processor (and possibly further to market).

There has been much animosity about the Landcare group getting involved in the macropod industry, with the current chiller operators and processors happy with the ‘business as usual’ approach, and not supportive of any change within the industry. As such the MDLA had decided to take a ‘soft’ approach towards the harvesters, so that they are able to secure supply for the chillers. The bar coding and trace back system has been placed on hold until the local macropod industry understands that the development of the Conservancy does not impact on their livelihood. The MDLA have decided that given the delicate situation at the moment, it is important first to ensure that they are not squeezed out of the market by the processors, and to become a commercial, viable entity, then to bring in the next stage of the Conservancy strategy including the trace back and bar coding system.

3.4 Summary

There is a range of activities that could be undertaken on Conservancy properties to improve the sustainability of traditional livestock management systems. Many of these activities interact with macropod harvesting. The Maranoa Conservancy is already progressed to the stage where a number of landholders have been accredited under the Australian Land Management System. Various types of improvement to wildlife management are possible on Conservancy properties. One method would be by integrating current kangaroo harvesting more closely with property management of both wildlife and traditional grazing management of sheep and cattle. There may need to be a financial incentive to enhance this integration and this incentive could be attracted in various forms. Alternatives would be improved quality of kangaroo meat production and marketing the Conservancy product as a net conservation gain product.

4. Supply of Kangaroo Meat and Factors Affecting Demand

4.1 Quantity and Quality

Five species of macropod in four mainland states and two species of wallabies in Tasmania can be harvested commercially under the quota system administered by the Australian Government, with quotas set annually and with kangaroo management plans developed by each State. The Australian kangaroo harvestable population of the 3 most populous species is often in excess of 50 million and can be as low as 15 million; the total Australian quota is 10-20% or about 4 to 7 million harvested each year.

Kangaroo harvesting accounts for an average of about 57% of the quota set on an Australia wide basis. In 2002 the federal government announced a 25% increase in the national kangaroo cull; this was an extra 1.5 million head (total of 7 million could be culled). At that time in Queensland numbers were at their highest in 20 years and the Queensland quota was 2.4 million. The actual Queensland harvest was about only half this quota. In 2006, the mainland quota was set at 3.8 million head (15.5%) due to the drop in the kangaroo population due to the drought.

The Queensland quota is usually set between 10-20% of the estimated population for each of the 3 species that can be harvested in Queensland; the quota is set for each species within each of three regional zones. Usually at least 1 million head are harvested in Queensland with the harvest reaching over 2 million in some years.

The 2007 quotas for Queensland are:

	Central zone	**Eastern zone**	**Western zone**	**Total**
Red kangaroo	618,403	9,648	30,684	658,735
Eastern Grey Kangaroo	879,596	159,822	0	1,039,418
Wallaroo	237,503	26,210	9,483	273,196

(Source: Queensland EPA)

The Maranoa Conservancy falls into the central zone of Queensland for quota purposes. An additional number of macropods may be culled under damage mitigation permits, as discussed earlier

The total quota for the Central Zone in 2007 was 1.74 million. Up to 21 December 2007, the total number taken was 1.55 million (about 90% of quota).

Apart from regulations limiting the number of kangaroos that can be harvested, there are other regulations administered through a range of government agencies, codes of practice and standards including (Kelly, 2005):

- Code of Practice for the Humane Harvesting of Kangaroos.
- Standard for the Hygienic Production of Game Meat for Human Consumption.
- Standard for the Hygenic Production of Kangaroo Meat for Pet Food
- Standard for the Hygienic Transport of Meat
- Kangaroo Harvester accreditation requirements (each State has a TAFE course which harvesters must pass in order to gain licences).

4.2 Prospective Conservancy Supply

An estimate of harvest numbers from Conservancy properties is 7,000 to 10,000 head per annum. This is a very small number compared to the whole of Queensland or the Australian annual supply of kangaroo meat. Consistency and continuity of supply from the Conservancy may therefore be key marketing issues.

An initial aim was that that the Conservancy region would be able to have a quota allocated to itself. Investigations by the project team into State & Federal laws that impact on the success of a conservancy idea working found that not being able to have sub-regional quotas was an impediment. However, the concept of a Conservancy quota has still not been realised. To date the project team has not focused on this, as they are continuing to establish the initial stages of the project, mainly focusing on the purchasing of the boxes, and the supply into these boxes. This remains an opportunity for the Conservancy to investigate.

The often high number of DMPs sought in the Conservancy area and the fact that the animals killed under a DMP can not be harvested was another issue that the conservancy investigated initially. A change would mean that the same number of animals would be killed but all would have a chance at being harvested for consumption. The current damage mitigation permit system is either not thought to be sufficient or landholders are not familiar with them. The QDPIF has approached AgForce to help get information about damage mitigation permits out to their members, which AgForce has agreed to (pers comm., Jo Hall).

In terms of managing the Conservancy offtake it is recognised that information on the average population of macropods in the specific land care areas and the Conservancy properties in particular would be helpful. One activity taken by the Conservancy was to undertake an aerial count for the Maranoa Conservancy region.

The following information was recently provided to the Department of Agriculture, Fisheries and Forestry in a milestone report from the MDLA.

With support from the University of Queensland, New South Wales Department of Primary Industry and Queensland Department of Natural Resources and Water, an aerial survey with trained observers was conducted to estimate kangaroo populations and distribution for the Maranoa WMC. Ground surveys of the Maranoa WMC were also conducted.

GIS maps that overlay kangaroo density with the properties which form the WMC have been prepared and maps showing the densities of kangaroos (eastern grey and red kangaroos) for the Conservancy are shown in Figures 1 and 2. The data show high numbers of kangaroos, with over 1 241 500 eastern grey kangaroos and over 73 341 red kangaroos in a 19 200km^2 area. The density on the south side of the dingo fence was particularly high with 82.36 eastern grey kangaroos/km^2 and 4.45 red kangaroos/km^2. There were lower kangaroo densities on the north side of the dingo fence with 21.73 grey kangaroos/km^2 and 2.29 red kangaroos/km^2.

The number of eastern grey kangaroos is quite substantial when compared to the average densities for Queensland's harvest zone which are ~11.73 eastern grey kangaroos/km^2. Wallaroo and Wallaby densities were less significant than those of the kangaroos with 0.53km^2 and 0.08km^2 on the south side of the dingo fence and 0.83km^2 and 0.16km^2 on the north side, respectively.

Current quotas for Queensland allow a commercial harvest of kangaroos at about 15-20% of the population. Using a quota setting at 15%, the annual maximum sustainable yield (MSY) that could be achieved from the Maranoa WMC is 0.66 red kangaroos/km^2 and 12.35 grey kangaroos/km^2 on the south side of the dingo fence and 0.34 red kangaroos/km^2 and 3.25 grey kangaroos/km^2 on the north side of the dingo fence. This is quite substantial for eastern grey kangaroos as the average annual harvest rate is approximately 1.76/km^2.

Figure 1 Eastern grey kangaroo densities for Maranoa WMC

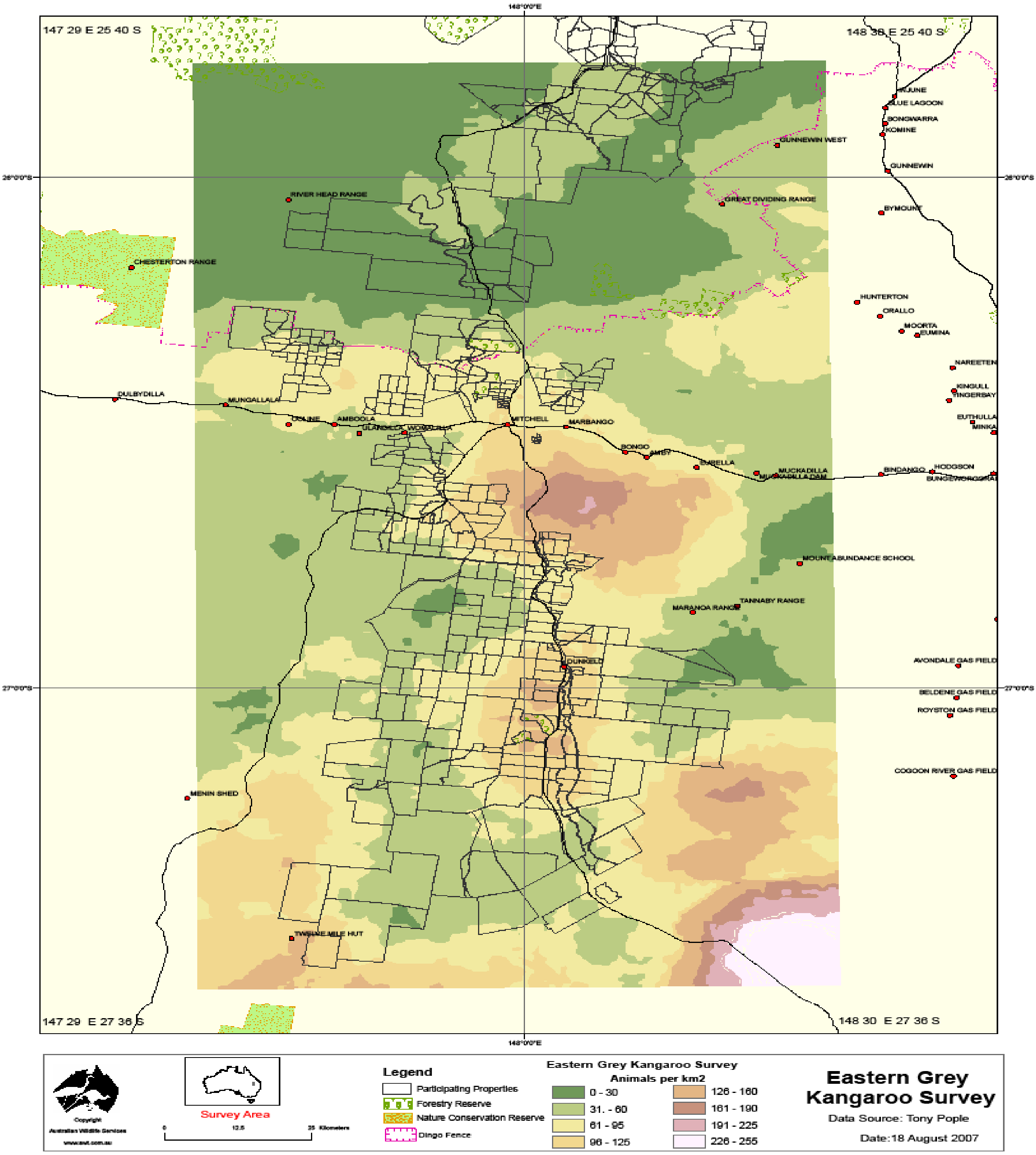
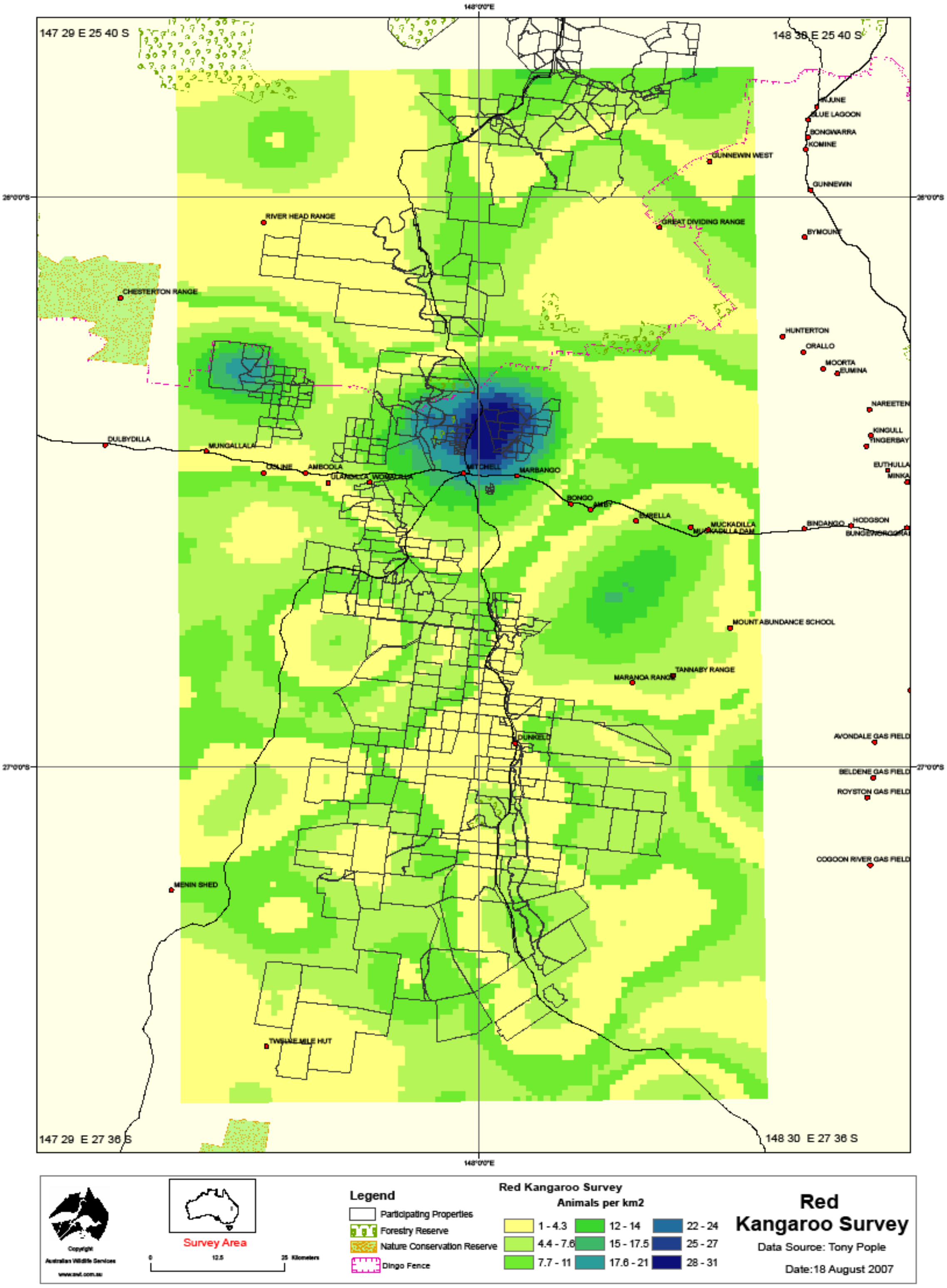


Figure 2 Red kangaroo densities for Maranoa WMC.



The population taken from the region in the past could be estimated using figures from the EPA. It is understood that some data is being gathered for each property regarding the numbers harvested in the past. Annual aerial surveys, involving macropod harvesters, Hunting & Conservation Queensland, local people, and more specific requests of information from EPA can be used to obtain improved estimates of populations and current harvests in relation to the specific Conservancy region. This information was not currently available from the MDLA.

There is an estimate of harvest numbers for Booringa shire near Mitchell of about 80,000 kangaroos per year, but numbers will vary for each year.

The accuracy of the 7,000 to 10,000 estimate for Conservancy properties is unknown. The mountain range running through the Conservancy region and the Carnarvon Ranges to the north means that a number of the macropod species in the region are not harvestable, as opposed to the southern half of the Booringa Shire where the majority of macropods are harvestable and the habitat is more suited to the kangaroos (both grey and red).

There may well be a need to be able to justify a sustainable yield each year, not just to fit in with the regional zone quota, but to demonstrate responsible management of the Conservancy by carrying out its own monitoring as part of securing a marketing advantage via increased sustainability assurance.

Monitoring yield will also provide data for management purposes e.g. management of total grazing pressure. There is some monitoring of numbers for most Conservancy properties, so improved estimates may be available in future.

The implication of these numbers for marketing is that a critical mass of product may need to be available to support a marketing campaign aimed at developing a market niche. Apart from the initial supply available, continuity of supply could be a key issue, and perhaps exacerbated by quota restrictions. Hence spatial diversification of supply may be important.

It is possible that the overall variability in supply could be reduced if Conservancy properties work together more closely. This may be so if comparisons are made with current variability from the individual properties. However, variability may increase if comparisons are made with the Central region as a whole.

There may therefore be a need to take kangaroo carcasses from other conservancies with similar credentials (if they exist), or from non–conservancy properties with potential credentials. As mentioned earlier, the main reason that the Maranoa Conservancy was established was because of the "Landcare ethic" of the landholders involved and the catchment planning they were doing focusing on other values and threats in their region. Since that time two other groups in the Mitchell area have commenced similar discussions, so it is possible that they could also be included in the Conservancy if interested. That was always the idea of the Mitchell Landcare group, that they were happy to have more landholders involved, but to be involved they must have undertaken subcatchment planning with their neighbours.

It is likely that more properties in the area would supply if it could be demonstrated there was a price premium to be captured, for example, if a processor could pay a premium for Conservancy kangaroos.

Another issue is whether the black striped wallabies on Conservancy properties could be harvested. There has been some attempt to secure regulation change for commercial harvest of this species in order to increase the sustainable supply of kangaroo meat from the Conservancy and to improve property management. At the moment they can not be harvested, but they can be destroyed under a DMP. This is still under investigation.

Supply could be increased if smaller animals were shot. In drought periods, there are many smaller and lighter animals that increase grazing pressure. Smaller animals have not traditionally been shot due to their high cost of processing per kg of meat and the lower value of their skin. Processing wages are often negotiated on a per animal basis so a carcass of 20 kg is not economic to process compared with one of 60 kg. Also a significant return from a carcass is the skin. Skin buyers will allow some small skins (say 10% small) but when the proportion increases there are complaints. Skin users can do more with a large skin as it is more flexible in its end use. On the other hand cuts from smaller animals may be able to find a market niche.

4.3 Profitability and Pricing

It has been reported that the kangaroo processing industry has not been particularly profitable in the past year or so. The industry has had a tumultuous year, with adjustments in the industry, new pricing systems and tensions between industry players.

The following points are relevant to kangaroo harvesting and markets for kangaroo products over the past year:

- The higher prices paid to harvesters for most of 2007 result from increased competition responding to the increase in product demand for human consumption over the last few years, both domestically and for export, thus having a flow on effect to the pet food processors chasing product share.
- There was a depressing effect on processors returns last year as the demand for Kangaroo meat met with competition from traditional meats that were able to be sourced at comparable prices.
- The increasing value of the Australian dollar had a significant impact on comparative pricing against other protein sources.
- There were inventories of other protein meats held over in some areas due to warmer than expected winter temperatures.
- While the quota has been reducing for the past two years, it has not been able to be utilised completely by the industry due to the quota input administrative processes used by the regulator in Queensland. The number of animals taken was 100,000 short of the quota in 2006 and more than 250,000 in 2007.
- The drought has had an effect on unit processing costs as the animals presented were often of lesser weight for size.
- The small skin market has been severely depressed for a number of years, with some processors receiving invoices for the removal of 'smalls'. Small skins are being held in stockpiles in hope of a recovery, which may occur now that the Californian market has revoked anti- kangaroo skin sale legislation.

In one area, the price reached $1.45 but generally hovered between .85c and $1.20, with one human consumption processor consistently putting pressure on prices by maintaining a 20 c per kg margin over competitors.

In 2007 there was a 2 tier pricing structure set up by the processors, with animals above 16kg receiving 85 c / kg and animals under 16kg receiving 40 c /kg. The introduction of the two tiered pricing system for this year will see a higher profitability per unit cost to the processors (if there is not a propensity to harvest small animals) and a reduction of income to the harvesters. It will also probably see a reduction in harvester numbers from 2089 in 2007 to less than 1800 in 2008. If a greater accuracy in quota administration is adopted by the EPA, then the quota may be fully utilised at last year's quota levels. It will be interesting to see if the differential pricing system is able to be maintained and what its actual effect on the industry will be.

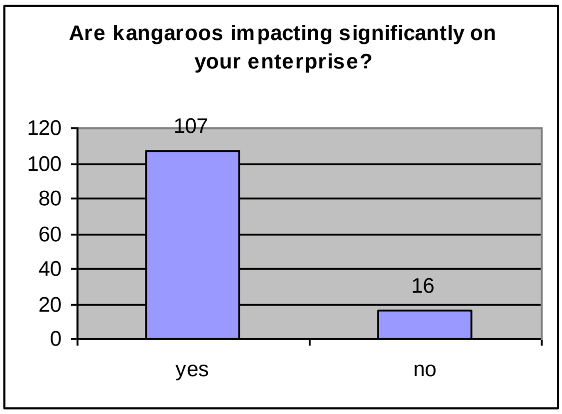
A pressure point on the macropod demographics could be the harvesting of a lot more animals below 17 kg as harvesters take what they can to cover costs for the night's harvesting. The introduction (now reversed) of the decision to restrict skin harvesting in 2008 to between May – August could have had the effect of exacerbating the situation and reducing competition to a greater degree.

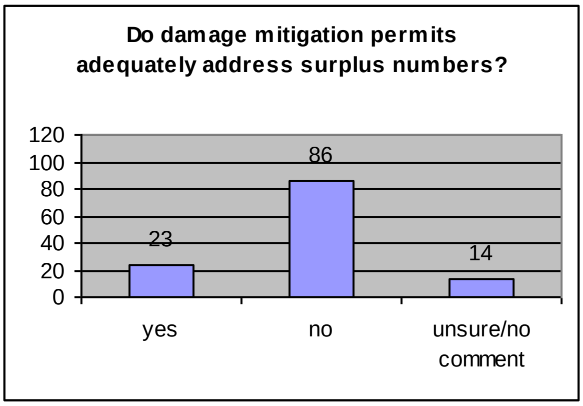
There has not been a loss of shelf presence for kangaroo meat from the retail sector, and the retail price of kangaroo meat has not dropped, so any drop in profitability in the industry has not been reflected in the retail sector (Tom Garrett, pers.comm.).

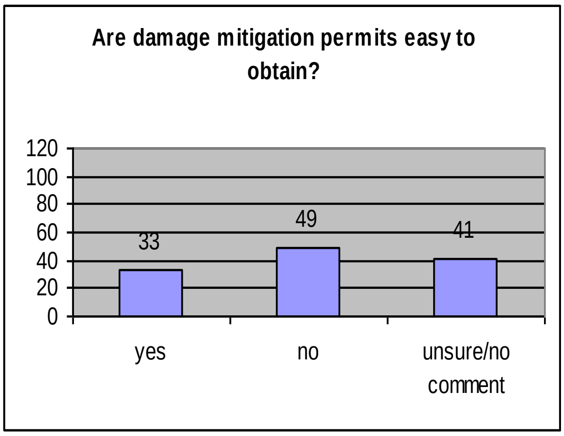
4.4 Attitudes of Landholders

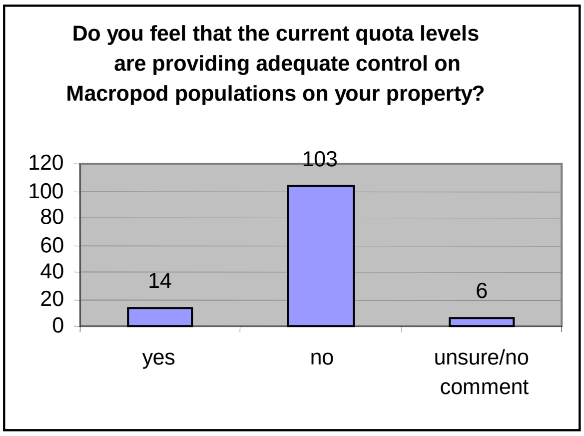
On the 21st of August 2007 around 60 key industry representatives, including seven government agencies, landholders, processors and harvesters and regulators attended a Queensland Macropod Industry Forum hosted by the Department of Primary Industries and Fisheries and the Environmental Protection Agency, at Charleville. Sustainability of resource was the number one priority for all involved.

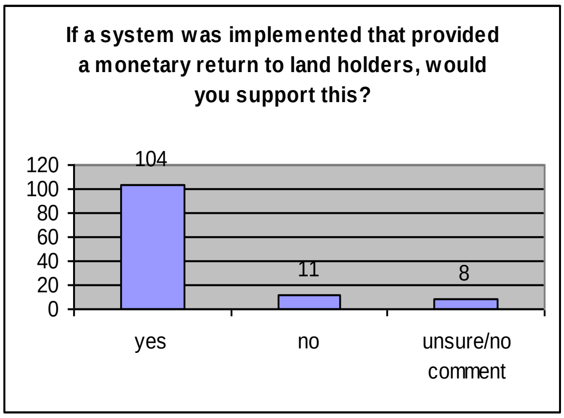
As a result of a workshop held in Charleville in August 2007, AgForce conducted an e-survey for members to gauge attitudes regarding the macropod industry. AgForce was happy with the feedback they received with over 120 responses to the survey. The results are as follows:

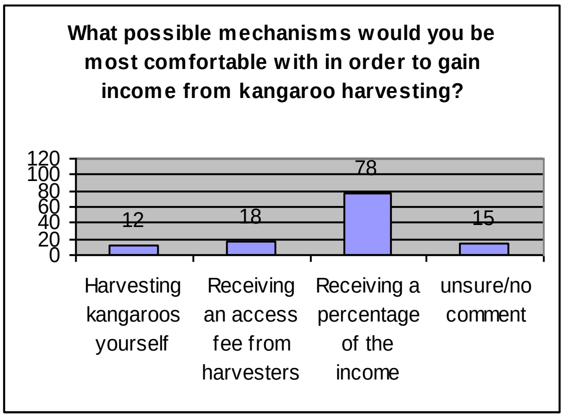


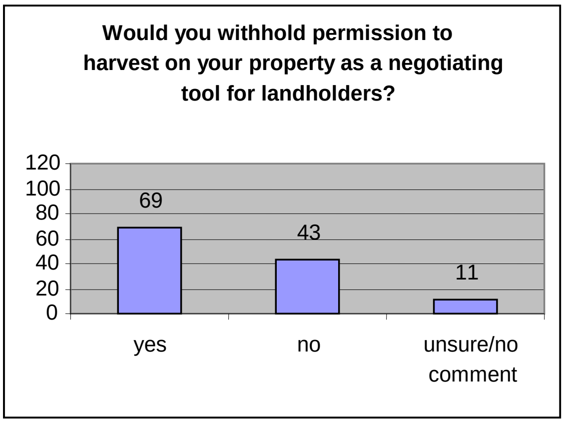


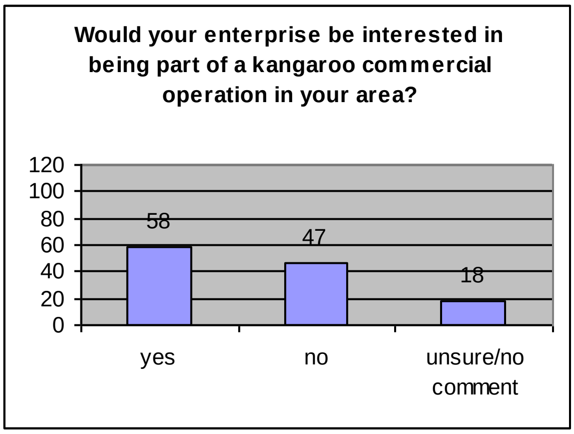












Given that around half of the respondents were interested in being involved in a commercial macropod operation in their area (although the majority asked for more details of the operations before they would commit (Jo Hall, pers.comm.)), the interest in landholder involvement across the state in the macropod industry is growing. Momentum is growing at different levels (local and state) in different states across Australia, and this is not being well received by processors (Tom Garrett, pers comm.).

4.5 Market Segments

4.5.1 End Uses

On an Australia wide basis about 60-70 % of carcasses taken are used for pet food with only 30-40% destined for human consumption. Of the human consumption segment, about 70% is exported; therefore only about 10% of total carcasses taken are destined for domestic human consumption (Kelly, 2005).

There were about 5,000-6,000 tonnes of meat exported each year in the early 2000s with 1.5 to 2 million skins also exported in those years (Kelly, 2005).

There is a rough estimate that the domestic restaurant sector could take one third of production of prime cuts but currently only take some 10% of prime cuts (Kelly, 2005). So it appears there could be room for expansion into the domestic restaurant trade.

There is a need for improved general information on the consumption of kangaroo meat for different end uses (e.g. fillets, rumps, sausages etc.), and yields and prices for different cuts and components of carcasses, and how these vary with size and sex of animal. Spreadsheets that represent such carcass yield information were not located but would be valuable in developing harvesting and marketing strategies.

One industry processor and marketer (Macro Meats) has pioneered a significant change in marketing of kangaroo meat for human consumption with distribution into supermarkets and to the food service industry. Health characteristics of kangaroo meat in term of its low fat content are being promoted by Macro Meats – Gourmet Game (www.macromeats.com/aboutmm.html).

4.5.2 Consumption

The main issues that appear to be associated with low consumption are: awareness, some negative perceptions of quality, and a lack of knowledge of how to cook.

A 1997 study (Des Purcell and Associates, 1997) reported that the number of people who had eaten kangaroo in the past 12 months was 25% (66% in restaurants and 28% at home). The main kangaroo cuts were strip loin, long fillet, and rump which are all ideally suited to pan frying, barbecuing and stir frying and all optimally served medium rare. Actual cooking methods used were panfried, grilled and barbecued. Also the majority of people cooked kangaroo medium and well-done rather than medium rare or rare. The issue of the perception of hygiene may be one reason that leads to overcooking in some instances.

Most Australians believe that kangaroos should be harvested (increased from 75% in 1995 to 85 percent in 2005) so the anti-harvest population is only minor, but its voice is loud. It is likely that consumers worry more about health /hygiene issues, control and checks, etc and that less important in their minds are the harvesting method and the 'Eating Skippy Syndrome.

It has been estimated that if all animals taken were consumed domestically, kangaroo consumption would make up only 4.5% of the domestic red meat market.

In a more recent study funded by RIRDC, Ampt and Owen (2007) investigated the potential for increasing penetration of kangaroo meat into the smallgoods and processed meat markets (e.g. pies, sausages). The research targeted manufacturers, retailers and focused groups of meat consumers. Investigations included their level of awareness and factors influencing purchasing choices including price and information provided, consumers values, concerns and preferences. Some of the main findings were:

- Kangaroo meat availability has increased and consumption has been growing slowly and steadily; the meat is now present on most domestic supermarket shelves.
- Issues remain concerning the harvesting of animals and meat hygiene.
- Many consumers are still cooking kangaroo meat medium to well done.
- Kangaroo meat should be promoted as a gourmet alternative, carries health benefits and has a wide variety of uses.
- Kangaroo meat mince has a high volume potential, deli products are likely to be received positively but kangaroo meat pies are unlikely to receive a significant market share beyond specialist pie shops.

4.6 Implications for Market Research

Given the foregoing background, the role of the ensuing market research was therefore to assess the market sensitivities and the characteristics that processors, marketers and consumers (in the wider sense) place on individual attributes or the mix of attributes such as:

- conservation of kangaroos within the Conservancy
- production systems for traditional livestock fitting within a broader environmental management system
- quality control along the marketing chain including the ability to traceback
- conservation of other valuable native species of animals through control of pest animals
- the maintenance of native vegetation with improved control of weeds.

Consumers of kangaroo meat would need to be asked what they see as the key messages/information that would influence them to purchase kangaroo meat more regularly, order more frequently in restaurants etc. For example:

- knowledge of where it can be purchased
- more information on cooking methods
- quality assurance including health and hygiene
- assurance of source and ability to trace back
- humane harvesting methods
- sustainable management of kangaroos
- sustainable management of pastures and land with a higher level of ground cover
- sustainable management of native wildlife.

Other specific questions needing some exploration included:

1. would you be inclined to try kangaroo meat, eat more, order more frequently in restaurants etc if you believed the source of the kangaroos was from a sustainably managed conservancy?
2. would monitoring of kangaroos numbers and offtake within the conservancy provide some assurance to you of sustainable management?
3. would you be willing to pay more for kangaroos meat it if were sourced from an accredited sustainably managed land production system (e.g. control of feral animals that destroy wildlife, processes for reducing the spread of weeds, development of biodiversity corridors)?
4. would you favour product that demonstrated management of an improved balance between kangaroos and sheep whereby less sheep were carried and more kangaroos were available for harvest?

5. Market Survey Findings and Implications

This section is based on the market research carried out with kangaroo meat processors and representatives of the kangaroo meat marketing chain including consumers. Results are based on a small sample of firms but the themes raised were consistent. Further details of these results are contained in Appendices 4, 5, and 6.

5.1 General Market Trends

Some key trends affecting potential demand for the Conservancy product include the following:

- The kangaroo industry at present is price competitive and over the past 12 months there has been intense competition between major processors driving prices down in the marketplace.
- Some food service firms specialising in game meat supply have reported shortages of kangaroo and were interested in the potentially new product for that reason.
- Increased sales of kangaroo product through supermarkets is raising consumer awareness of kangaroo products and increasing consumption.
- Kangaroo product is generally seen as a niche product by consumers, retailers, restaurants and food service companies.

5.2 Interest in the Conservancy Product

Supermarkets, food service companies, hotels, restaurants, caterers and gourmet food retailers provided the following feedback on their interest in the Conservancy product. It should be noted that the number of respondents in some market segments was limited and that these responses may not necessarily be representative.

- Sixteen of the 19 firms surveyed were interested in trialling the product or in receiving more information on the product but the final decision to use the product would be based on a range of factors including quality, price and perceived demand. Two firms were not interested in the new product and one could not comment until they received more information.

- When asked to rate the strength of the opportunity for the Conservancy product in the market (on a scale of 1 to 5 where 1 is poor and 5 is very good), food service companies gave the highest rating (3.5) followed by hotels (3.3) and supermarkets (2.9).

- Food service companies (including game meat suppliers to high quality restaurants and gourmet butcher shops) felt that there is potential interest in the product. Kangaroo was more popular about 7 years ago and demand for game meat is ‘fashion’ influenced. For this reason, the new product would need to be supported by a concerted promotional campaign targeting chefs (e.g. chef workshops such as G’day Chef and targeted marketing) to encourage trial of the product. Consumer demand is seen as a key driver and promotion to consumers is also needed.

- Restaurants gave a rating of 2.0 out of 5 to the market opportunity. While some were interested, others were not interested in the product. Significant differentiation on quality and presentation would be needed. Successful branded products used by restaurants include MSA and other high quality branded meat. Junee Lamb has developed high quality packaging for restaurants and this approach has lifted demand. Kangaroo is currently supplied to restaurants in clear plastic, bloody bags and can be much less appealing.

- Catering firms (rating of 2.0 out of 5) generally felt that the market was not yet ready for the new kangaroo product but that there was potential for the product in the future.

- Hotel interests felt that there is potential demand for a high quality, environmental branded product (rating of 3.3 out of 5). As with the restaurant segment, promotion to chefs and marketing the product as a gourmet product is important.

- Small gourmet retailers sold very little kangaroo prosciutto or salami and were least likely to be interested (giving a rating of only 1.5 out of 5 for the strength of the opportunity).

- Supermarkets were interested in receiving the product and gave a rating of 2.9 out of 5. Independent supermarkets were interested in the product because it would provide a point of differentiation. One major supermarket is interested in seeing the product but consumer demand from the market would be needed to support sales.

- For some firms, the environmental focus is valuable due to the positioning of the business or because of increased interest from consumers. However, the Conservancy product would need to be positioned primarily as gourmet and secondly as an environmental brand.

- Those who did not see value in the environmental branding believed that the current supply of kangaroo already has good environmental credentials. Others felt it would be too difficult to differentiate the new product from the existing supply of kangaroo.

- Consumers are interested in the environmental branding but provided feedback that the product must also be seen as gourmet and high quality to attract interest, particularly from those who currently do not buy kangaroo meat regularly.

5.3 Supply Arrangements

Key issues to emerge on supply arrangements for the Conservancy product included the following:

- The potentially small volume of the Conservancy branded product and any problems with stability of supply will affect opportunities to supply the product into some firms and some segments. The hotels and supermarkets contacted confirmed that lack of continuous supply would be a barrier to using the product. Some of the firms in other segments would not be interested in the product if supply is not reliable or consistent.

- Clear messages are needed about the differences the new product offers. To achieve wider levels of interest and support, the quality and gourmet positioning will be the main driver. Few are interested in a product that is differentiated only by the conservancy approach. Also, the environmentally branded product must be demonstrated to be superior in quality and packaging. Regarding quality, tenderness and food safety were considered paramount.

- Of the 19 firms surveyed 18 indicated that they would be willing to pay a higher price for the environmentally branded product. Firms stated they were willing to pay between 1% and 20% more for the environmental brand, but the actual price of the product would be determined by the quality of the kangaroo meat. All segments reported that the Conservancy product initially should have a similar pricing to existing kangaroo and, once the product is established and successful, the price could be gradually increased.

- High quality packaging and differentiated marketing is required. The current presentation of kangaroo product to restaurants and food service outlets was considered fairly basic and sends the message kangaroo is just a commodity product. Market feedback indicates that care and attention with packaging will help to differentiate high quality products, particularly in the restaurant segment.

- Businesses purchasing environmentally branded kangaroo want information on how sustainable harvesting is managed, credentials of the supplying organisation, firm ownership, food quality and system capabilities – a full profile on the operation, its capabilities and the benefits it can deliver. These firms felt that consumers would want information on the origin of the product, nutrition and health information (confirmation that it is a healthy product), information that kangaroo is tender and of good quality.

- Specialist game meat suppliers are interested in exclusive state supply arrangements.

- While some hotels, restaurants, food service and catering firms want a single point of contact for supply, others want to access a more sophisticated supply network to service different locations.

- Supermarkets want to see distribution support for a wide network of outlets.

5.4 Feedback from Processors

Two processors were interviewed and both felt that the best approach for the Conservancy product was to link with an existing processor that has established distribution pathways into key markets.

Processors had provided feedback that the market over the last 12 months has been extremely price competitive with major suppliers discounting prices for market share growth. This extremely competitive and price driven market can make it difficult for a new niche product to establish in the marketplace and seek improved returns.

Both processors contacted are interested in talking with the Maranoa Conservancy Group about providing a supply and distribution linkage.

5.5 Consumer Reactions

Two focus groups provided consumer feedback on the new kangaroo product.

Regular buyers of kangaroo meat are generally interested in the concept of an environmentally branded kangaroo product. For the majority of this group, a gourmet product positioning is essential. A few people in this regular user focus group purchase kangaroo meat because it is a cheaper meat option.

Overall this group would accept a slightly higher price if they knew the product was delivering positive results for the environment and was a gourmet product.

Consumers are not interested in information on harvesting processes but do want to be assured of quality and food safety.

Consumers are interested in the ‘environmental story’, particularly the fact that the product is produced in Queensland by Queensland based companies.

It is important to provide an effective, succinct and positive environmental story to accompany the product. Although consumers understand concepts such as ‘organic’ and ‘free range’, consumers felt that the conservancy concept would need a simple, easy to understand definition. People did not find the concept or the benefits easy to understand. Some saw the fact that cattle and sheep production was continuing, along with possible land clearing on properties, was in conflict with the concept of a net gain to the environment.

There was strong interest in the low greenhouse gas emissions from kangaroos.

Both regular and infrequent users of kangaroo are interested in information on cooking methods for the best eating result and recipes using kangaroo. Consumers identified opportunities for use of ‘bush tucker’ complementary spices and food products (e.g. marinades, sauces) that could be sold with the Conservancy kangaroo.

Consumers who have not purchased or eaten kangaroo in the past need to be made aware of the environmental benefits of kangaroo and that it is a high quality, gourmet product. The perception that kangaroo meat is dog food or pet food is not a positive association for promotion as gourmet product.

This group of non-users felt that the environmental branding, along with the gourmet positioning, would encourage them to try the Conservancy product.

5.6 Challenges and Opportunities

The research has identified some challenges and also some opportunities for the new Conservancy branded product. Key challenges for the new venture include:

- Gaining market access and providing the necessary support and customer service backup required was identified as a challenge.
- A very high quality product was considered essential to penetrate all markets, but particularly the restaurant market, gourmet butchers and game meat specialist distributors.
- Maintaining stability of supply was generally important for consumers and for each of the market segments. A seasonal downturn would be understood by consumers, however patchy supply would result in consumers not consistently coming back to the product.
- Although there is potential for the Conservancy branded kangaroo to increase its price compared with the standard product, the initial supply would need to be price competitive with existing supplies to build up a market following.
- Consumer acceptance of kangaroo is growing. However it is regarded as a niche product and consumers do not have a great deal of understanding of this product, particularly as a high quality gourmet product. Consumer education, in store demonstrations and promotion or endorsements of the product by chefs needs to be undertaken to appropriately position the product.
- Establishing a niche product within a niche market (existing kangaroo supply) was seen as a difficult task. Some firms felt that there was still limited demand for kangaroo at the present time and that considerable marketing effort would be required to create consumer demand (considered essential for long term success) and market the new product to different market segments.

Key recommendations based on the market research findings include:

- Establishing a partnering arrangement with one of the processors may offer the best fit for the new venture in the short term in terms of gaining knowledge about the market and its market positioning.
- Exclusive supply arrangements to game meat suppliers in some states could also be considered.
- The Conservancy product would need to be promoted as a gourmet and environmentally branded high quality product; use of all three themes would be vital in the positioning of the product.
- The environmental brand would need to be simply communicated.
- Developing effective packaging and a recognisable, attractive branding for the product would be recommended. It will be important to provide leaflets for recipes when targeting consumers and provide the necessary information on the product when targeting key market segments, e.g. quality, food safety and the Conservancy message.
- It would be highly desirable to undertake a targeted consumer promotion strategy to raise awareness of the quality of product and its environmental credentials.
- Depending upon the availability of product, and once some security of supply and quality has been obtained, it may be then viable for the venture to target smaller volume, high value markets. However these market segments are ‘unforgiving’ in terms of their expectations of quality, consistency and availability of supplies.

5.7 Summary of Main Findings from Market Research

Table 5.1 provides a summary of main findings and implications for the Maranoa Conservancy Group derived from the market research. This summary covers:

- Critical success factors.
- Best markets.
- Positioning and branding.
- Marketing and promotion.
- Distribution strategies.

Table 5.1: Summary of Key Findings and Implications

Key Findings	Implications
CRITICAL SUCCESS FACTORS	
• Raising awareness amongst buyers and consumers of the quality of the product and the environmental brand. • Establishing effective distribution arrangements. • Targeting market segments and supply volumes that suit the capacity to supply. • Focusing on establishing a premium quality and environmental brand. • Being able to supply the product for a similar price to existing kangaroo during the establishment phase of 12 to 18 months before increasing prices.	• Consistency of supply is vital. • Product must be regarded as very high quality. • High quality packaging is needed to differentiate the kangaroo product from other options in the marketplace – at present there is relatively low value packaging occurring. • Without a combined quality and environmental brand, the product will not be successful. • It is a tight market at the present time and the new product must be price competitive particularly as it establishes a place in the market.
BEST MARKETS	
• Supermarkets represent best potential for volume supply but the new product may have difficulties in terms of consistency of supply and price competitiveness. • Consumers see the new product as a gourmet product – not necessarily a supermarket product. • Processors advise that the market is still small for kangaroo but is developing. Relying only on the specialist deli and restaurant market may not be sufficient to provide viable volumes without a widely developed distribution system. • End customers expect a high level of support from distributors – it would be difficult for the Maranoa Conservancy to set up its own distribution network, given the price competitiveness of the marketplace and the limited supply of product.	• Consideration must be given to whether the Conservancy wants to work with one or more processors – exclusivity will create increased loyalty but may limit the distribution of the product, particularly if targeting specialist markets. • Undertake discussions with processors and form an alliance with one processor that has the potential to take the product into key markets. • Investigate exclusive supply arrangements with specialist game meat food service companies that distribute to restaurants and gourmet butcher shops.
POSITIONING AND BRANDING	
• Environmental branding is seen as a plus by consumers but an environmental brand alone is insufficient to gain increased interest and uptake, particularly from consumers that have higher disposable incomes. A combined quality/ gourmet/	• The Maranoa Conservancy must focus on quality cuts and quality supply. This may create issues in terms of use of the whole carcass. • Quality and gourmet branding supported by environmental branding needs to be reflected in

Key Findings	Implications
environment brand is needed. • Kangaroo meat is seen by the food service industry and restaurants as being relatively low value. These markets are driven by quality and gourmet brands – distinctive differentiation of the product is required to be able to differentiate it from the bulk supply of kangaroo meat.	packaging and marketing information regardless of the market segment. • The experience of Junee Lamb shows that the restaurant market will respond very positively to innovative packaging and high quality positioning.
MARKETING AND PROMOTION	
• For consumers, in store promotions and tastings are an important part of getting existing current consumers and potential new consumers to try the new product. • Leaflets and high quality packaging are required to concisely communicate the gourmet and environmental branding of the Maranoa Conservancy kangaroo product. • Public relations activity such as articles in gourmet magazines and endorsements by key chefs will be required to support a superior branding and marketing position for the product. • There is potential to add spices and accompaniments to the kangaroo product for consumers, e.g. lemon myrtle and other spices for marinades. Gourmet users want to have access to these options but do not necessarily want to purchase premarinated product.	• Gourmet, high quality branding will require considerable marketing resources in order to do this successfully and professionally. • A niche branding marketing strategy needs to be developed in close consultation with the processors or others with whom the Maranoa Conservancy may partner. Unless there is close collaboration between the parties, marketing work undertaken by the Maranoa Conservancy may not deliver the desired results. • Working with a respected food journalist and commentator is recommended to provide strategic advice on marketing, prepare articles and identify suitable marketing events e.g. chef's workshops. • Considerable funding may need to be provided to achieve profiling of the kangaroo product in gourmet magazines and chef endorsements. • A decision on initial target markets will dictate the range of marketing activities undertaken. • Develop recipes and point of sale/support material for these markets to explain the brand and the Conservancy 'story'.
DISTRIBUTION	
• All market segments want and expect consistency of supply in a high quality, gourmet product. Although consumers and businesses can accept seasonality, (i.e. mangoes are not available all year round), intermittent supply is very difficult to manage. Consumers and businesses will be reluctant to support a product that is sporadic in its supply arrangements. • The cost of establishing separate supply and distribution arrangements are high. The Maranoa Wildlife Conservancy needs to choose a processor or partner that offers synergies in terms of target markets for the new product and a compatible overall positioning in the marketplace – gourmet and high quality.	• Consistency of supply will be a critical issue as the product brand is developed. • Coordination and marketing support will be a priority to ensure that effective messages regarding the new product are delivered and supported through the distribution arrangements of the partner organisations. This includes the preferred processor(s) and possible exclusive state supply arrangement with specialist game meat companies.

6. Discussion

6.1 Sustainable Management

There is a need to demonstrate the value of a conservancy environmental brand that can be promoted to consumers. As mentioned earlier the concept may be difficult to promote to consumers.

The propositions identified so far by the Conservancy is that landholders will carry out enhanced habitat protection and control of invasive species that diminish biodiversity or reduce damage to land as a result of better management of the kangaroos and traditional grazing enterprises with sheep.

The focus group discussions revealed some difficulties in understanding the Conservancy concept as perhaps there were too many messages involved and not one issue that could be driven home. Some of the simple conservation /environmental concepts that appeared important were the maintenance of sustainable populations of macropods, sheep/cattle versus kangaroos, greenhouse gas production, and some concerns about shooting females and joeys in the pouch.

Possible dimensions to pursue could include:

(i) Sustainable kangaroo management in terms of numbers being able to regenerate quickly (e.g. not harvesting young females or females with joeys in the pouch) as well as in terms of improved information on kangaroo numbers and maintaining sustainable yields. For example, sending GPS/GIS data to Queensland Parks and Wildlife Service (QPWS) to bypass the current paper trail with electronic data transfer. This will allow more accurate and quicker updates of the macropod database daily with possible cost savings and a higher level of efficiency of administering the quota. This would demonstrate to government and consumers that the Conservancy is supportive of an accreditation system and influencing consumer attitudes by demonstrating the efficacy and responsiveness of management of sustainability of harvest quotas etc.

(ii) Sustainable land management including grazing pressures, and the balance between traditional livestock grazing systems and kangaroo management. Maintaining an appropriate balance of traditional livestock and kangaroo populations could be promoted. This may mean more sheep/cattle or more kangaroos. There is the potential for there to be fewer sheep/cattle, but on the other hand harvesting kangaroos more strategically will allow pastures to regenerate more rapidly overall. One option is to focus on general sustainable management within the conservancy of grass, water and animals. It could be possible for the same label to be used on cattle, sheep, etc, given that the same land management that was producing the kangaroo product was also producing other products.

(iii) Sustainable management of other native animal species within the Conservancy and highlight in general conservation management on properties (e.g. some form of wildlife stewardship certification label). Also, there is the possibility to promote the benefits of harvesting native animals given pending climate change. Native animals generally manage better during drier conditions, and given changes in climate and potential land use, there is a possibility that in years to come there may be kangaroos grazing where sheep used to graze.

(iv) The relative greenhouse gas emission implications of kangaroos and beef/sheep production could be used to promote the environmental implications of kangaroo production and harvest.

(v) The possibility of labelling carcasses to differentiate between species and sex may demonstrate sustainable management. For example, gathering information cost effectively on sex, age and weight of the harvest so that population models can be used to demonstrate sustainable populations of non-harvested animals.

(vi) It may be possible to produce an explanatory booklet emphasising the benefits to Australia including those to the environment and to consumers; this would need to be more than a simple message and may contain elements of each of the themes above

(vii) Much of the explanatory and supporting material as identified above would need to be aimed at key intermediaries in the market such as chefs and gourmet butchers rather than end consumers.

Since many of the Conservancy properties have already been certified under ALMS, the simplest strategy would be to claim that certification and provide a simple, short and easy to read explanation of what ALMS represents. In addition it would be necessary to indicate how the kangaroo management system under ALMS differs from the traditional system under which kangaroos are produced. However, only a handful of properties have been certified so far under ALMS. It would be necessary for this number to be substantially increased in order to legitimately claim some type of formal accreditation for the product.

6.2 Humane Harvesting

Currently harvesting techniques are generally considered humane by most consumers. For example, there is a harvesting best practice developed by the Game Harvesters Association, there is required training of shooters, humane disposal of pouch joeys and other ethical practices.

There is sufficient information at present to conclude that the 10% or so of people who worry about animal welfare or ethical considerations will not change their opinion anyway and therefore are not important as a potential market target. Animal welfare issues (and more specifically harvesting issues and how kangaroos are killed) may therefore not be important in any market development. An exception to this would be if the shooting of kangaroos on Conservancy properties was perceived to be more humane than that for the rest of the industry and this would be difficult to address.

The market research showed that for most consumers any animal welfare and harvesting considerations were not a major issue and these issues are probably best left alone. However, the market research demonstrated some concern about the residual population if females were harvested, the harvesting of females with pouch joeys and any genetic implications in the longer term of harvesting the larger animals.

6.3 Product Availability

The regional or Conservancy quota, and the relatively small size of the Conservancy resource, may restrict supply of kangaroo meat from the Conservancy. As indicated from the market research, this may have implications for the commitment to the product of those in many market segments (and possibly some consumers). There may well be a critical mass of kangaroo meat marketed under the Conservancy brand that would need to be made available to the market for it to be promoted effectively. Assuming there was a price premium available for the Conservancy product, there exists somewhat of a chicken and egg situation whereby a price premium may not be captured until there is sufficient supply, and that sufficient supply may not be available until a price premium is apparent.

Apart form total quantity available, continuity and the variability of supply may be key issues in marketing a Conservancy badged product. Strategies for maintaining a continuous supply or at least reducing supply variability may include one or more of the following:

- Managing the kangaroo population on a whole area of Conservancy basis.
- Reducing sheep, cattle (and in some cases goat) numbers in drought periods.
- Utilising smaller kangaroos (and possibly wallabies) and subsidising the meat price to processors/marketers.
- Limiting the meat sold under the Conservancy brand in periods of ample supply so that expectations for supply continuity were not high, and with other kangaroo meat sold generically.

- Form marketing alliances with other like-minded Conservancies, preferably in other regions so that some form of spatial diversification were in play that may reduce variability except in nation wide droughts.

6.4 Product Quality, Integrity and Traceback

It is evident from the market research that meat quality and food safety and integrity are key issues. A member of the Maranoa Conservancy has developed a system of barcoding and electronic data capture including GIS and GPS information. One benefit of this system could be to stop kangaroos being taken illegally out of the region with the quota. The new system, if implemented by the Conservancy, would demonstrate quality control back to the paddock and to the chiller level and may even extend further down the value chain if that can be organised within the distribution system. The benefits of the traceback system would be proof of the product coming from the Conservancy as well as a better ability to quickly trace product back to the source of any quality problem.

Also, the Conservancy could improve the arrangements around product integrity. Currently there are no formal supply chain agreements within the kangaroo marketing chain. It is possible that product quality could be improved from the shooting and field harvesting (gutting etc), handling to the chiller, chiller management and then transport to the processor. This may involve for example, use of bar codes and temperature scanning devices. There is currently a code of practice for chiller management but some industry opinions are that this area of the supply chain could be significantly improved.

An issue associated with improved chain management is whether improved quality means a higher cost of supply (e.g. harvesting or chiller costs) and whether there are low cost areas of improvement that can be made. Stacking and spacing in chillers appear to be an important issue as there is a need to cool carcasses down quickly but this is not possible when chillers are full. Choices need to be made therefore between smaller or larger chillers and their number and location, regularity of emptying, single or double hanging etc. The cost implications of all such changes require estimation. Also, it would be important to assess how quality could be improved by implementing changes in terms of less wastage or improved eating quality.

As mentioned earlier, harvesting smaller kangaroos may not be profitable unless there is a niche market for smaller cuts, as they have high processing costs per kg and limited skin value. Steps taken to ensure a high quality product need to be listed and communicated to those harvesting on Conservancy properties and the operator of the Conservancy chillers.

6.5 Distribution

Assuming a high quality product is established, there would be a number of options for distribution and marketing. The business model chosen would depend on the extent of product differentiation envisaged, resources available to the Conservancy and the attitude to risk.

Forming a marketing relationship with one processor would have the advantage in the short term in that there would be an established market for the product while matters of harvesting organisation and chiller management are developed. Also, a single processor is more likely to commit to a new product with appropriate promotional and educational support. On the other hand a single processor may be more interested in securing access to a high quality product for existing markets rather than developing the market for a new product. While a small premium may be paid for quality in the first instance, this premium may never attain a high level if the Conservancy product is not well differentiated in the market place. The Conservancy product would then most likely be sold into the mass market for kangaroo meat (e.g, supermarkets).

Some processors may be more concerned about maintaining throughput in the processing facility, rather than developing a premium price in the market place through packaging or promotion. The possibility remains of a joint market development effort by the Conservancy and the processor.

A second option may be to make the product available to more than one processor, with preferences given to processors or marketers with ideas for promotion as coming from a net conservation gain production system.

Another option may be to pay for carcasses to be processed under contract and then market the processed cuts directly to an up-market food service firm that may supply restaurants or a game meat specialist distributor.

In all of these options, it may be possible to obtain a government grant to help develop the packaging, promotional material, and implement promotional activities.

The strategy of developing the market for the Conservancy product at existing prices and then gradually increasing prices once a market niche has been developed is favoured. The potential for increasing prices to domestic consumers and to export market is presumed to be limited in the short term. The Conservancy product has first to be differentiated and proven in terms of quality, food safety and environmental credentials. Only then should price premiums are likely to be extracted from processors or other distributors.

6.6 Cooking and Health Aspects

Several studies have suggested that there is still limited knowledge of the best methods of preparing, cooking and serving kangaroo meat in the home and this may be constraining the home consumption market.

The market research suggested that overcooking may still be quite prevalent. Specific messages regarding the integrity of the meat need to be developed that while the meat is 'game', there are no pathogens or parasites that are associated with kangaroo meat. This may be endorsed by some form of survey including analyses of randomly selected Conservancy product by an accredited laboratory. Such endorsement may reduce the overcooking tendency some of which is possibly associated with this fear.

One comment from the focus groups was that some found the gamey flavour of kangaroo very strong and suggested using marinades and spices to cut the flavour.

Kangaroo meat is endorsed by the Heart Foundation as low fat and this characteristic is currently being exploited by some involved in kangaroo marketing and by the Kangaroo Industry Association. This message is well received by consumers and any promotion of Conservancy product will need to include this message as well.

6.7 Size and Location of Markets

The sizes of the markets identified for targeting are generally sufficient to accommodate the supply of kangaroo meat from the Conservancy. The key market segment considered appropriate is the upmarket gourmet sector using highest quality cuts. This key market has a number of sub-segments that could be targeted by Conservancy marketing, for example, gourmet butchers, restaurants and hotels. These markets are potentially large but promotion will be required for them to be successfully penetrated. The location of markets will be dependent on the distribution system chosen. However, the majority of the upmarket segments are likely to be in NSW and Victoria.

7. Conclusions and Recommendations

1. There are four major conclusions relevant to any market development through a branding and promotional strategy:

(v) Environmental management as a concept in kangaroo meat marketing has some potential but the net conservation gain concept is difficult to address in a manner that can easily be understood and believed. This remains a challenge for the Maranoa Conservancy Group

(vi) Environmental credentials are not sufficient on their own to develop a market niche for the Conservancy product. Meat quality and integrity are very important and there need to be reasons provided as to why the Conservancy product is higher quality than the rest of the kangaroo meat in the market.

(vii) Given the likely Conservancy supply, the product would need to be positioned as a gourmet product at the top end of the market including such market targets as restaurants and gourmet butchers. One distribution channel to facilitate this would be through game meat specialist distributors.

(viii) Significant promotion and packaging innovation would most likely be required to develop a niche market

2. The difficulties and risks, time and costs for development of a niche market should be recognised. It is unlikely that the Conservancy could raise the resources required (in the hundreds of thousands of dollars) for this market development unless there was some partnering with existing players.

3. Supply variability will be a constraint in market development, mainly in gaining the required support from within the distribution system. Potential multiple strategies to overcome some of this variability have been identified.

4. It will be important to identify where improved quality and/or cost savings/increases to the total system are likely to occur from the Conservancy operating its own chillers. There is a need to avoid pursuing a system that increases costs without net benefits. Demonstrating profitability to the overall system from changes should be given precedence with secondary attention given to the distribution of any gains or losses, at least in the first instance.

5. It is recognised that the current marketing chain has evolved over a number of years. There will be entrenched interests, distrust and opposition to change as has been demonstrated already.

Appendix 1: Other New Enterprises for the Conservancy

Several other enterprise products and markets were outlined in the earlier study of WMC enterprises. Apart from adding value to the kangaroo resource, three other opportunities have been identified in the past for the Maranoa Conservancy. These are ecotourism, cypress pine and other vegetation management including regrowth control, and bush foods.

A1.1 Vegetation Management

Native vegetation management can be considered a part of property management. One of the more common native species within many of the Conservancy properties is cypress pine. Because the conservancy properties are leasehold the cypress pine timber is considered property of the State of Queensland. Some pastoralists perceive valuable timber is often lost to fire and age, and could be managed better than currently (via enhancement thinning, pruning). It is possible that this resource could be better managed under property management plans within an overarching Conservancy plan.

QDNRW has certification under the Australian Forestry Standard (AFS) and presumably this applies to cypress pine. Also some cypress pine mills we understand have chain of custody certification. However, individual landholders can not get certified under AFS.

One opportunity would be to assess whether the Conservancy itself could get leasehold rights changed in order to be able to manage and harvest the cypress pine on their properties. The resource could then be managed on a Conservancy basis.

Regrowth control (has an impact on pasture resource) and ecological value of the regrowth, and soil condition is controversial and interacts with the existing vegetation management laws. Regrowth of a species such as cypress pine could be incorporated into the management plans.

A1.2 Ecotourism and Eco-education

One opportunity is reintroduction of endangered mammals and marsupials due to improved feral animal control (e.g. via dog baiting). Kangaroo viewing as a feature of ecotourism is another option that could be considered.

Ecotourism requires either a central feature that is unique or a series of attractive tourist activities roughly within the same region. There would be a need to have some accredited system of wildlife management to show off; such may include control of ferals, reintroduction of species, integrated kangaroo and traditional livestock management systems etc. One constraint to ecotourism is that vehicle movements would increase so that visitor education regarding weed spread would be required.

Ecotourism could include the Nalingu Aboriginal Corporation with regard to the YUMBA and the preservation of its history. YUMBA Indigenous Cultural Education and Knowledge Sharing Centre hosts an interpretive trail and guided tour, an education centre and a plant nursery.

Booringa Shire Council is still interested in the SWE project in the Maranoa. The bird watching trail is still on the agenda and could include properties in the Maranoa Conservancy but would most likely be developed as a broader initiative to cover St George, Surat, and Injune areas. This is because the potential project was developed in the past by Booringa Shire on behalf of 4-5 other shires in the district. There were 4 ecotours involved: bird watching, fishing, 4WD tour, and cultural heritage.

The next step in the stalled bird watching project is to identify the hot spots for bird watching in the region, and carry out market research on the type of watching required, accommodation and other infrastructure needs of the potential market. Birds Australia has shown interest in the market research but funding is needed to take it to the next stage. Also required is a listing of birds in the region in combination with the scientific name, common names, and indigenous names of birds as well as the cultural significance of birds to the aboriginal communities (Noela Ward, Booringa Shire Council, pers. comm., August 2007).

Also investigated has been photography groups from the city, and an opportunity to have a wood turning weekend, something similar to what is done at Maleny & other places.

Alison Alexander has also done some work with Booringa Shire council to develop some signature dishes from the local area. There is an opportunity for kangaroo to be one of these dishes. These signature dishes are then promoted at the local shops, restaurants, pubs, etc.

A1.3 Bushfoods

Australian desert limes grow in the region and could be the basis of a bush food industry. Contacts for this idea and other bush food prospects include the Booringa Shire Council, Jock Douglas, and Nalingu Aboriginal Corporation. A key question is how could these prospects be aligned with the Conservancy.

An investigation into market for native honey could be useful, However, one or two pastoralists could start such an enterprise on their own and it would not appear to require Conservancy involvement

Appendix 2: Survey Questionnaires: Strategic Research for the Maranoa Conservancy Concept

INTRODUCTION

Good morning/afternoon, my name is …… from Deborah Wilson Consulting Services. I am following up on the earlier email about the survey we are conducting for the Maranoa Conservancy Concept. I wanted to get your feedback on the value of environmentally branded kangaroo meat.

All of the information that you provide is confidential and only summarised information is provided to the client.

Would you have 10 to 15 minutes now to undertake the survey?

Name: ____

Organisation: ____

Phone No: ____

Interviewer: ________________________________ Date: ____________________

---

1. Current Profile of Kangaroo Meat Purchases

1.1 Do you currently buy any kangaroo meat? **(Record all answers)**

Yes 1 **(go to 1.2)**
No 2 **(go to 2)**

1.2 What type of kangaroo meat do you currently sell? **(Record all answers)**

____

____

2. REACTION TO CONSERVANCY SUPPLY

2.1 I sent through an email on the planned environmentally branded kangaroo from the Maranoa Conservancy. The benefits offered by the environmentally branded kangaroo also include improved quality, food safety and humane harvesting. The environmentally branded kangaroo would represent only 2% of the total kangaroo available for human consumption. What are your initial thoughts on the concept? **(Record all answers)**

____

____

2.2 What is your reaction to environmentally branded kangaroo versus the ordinary supply of kangaroo? **(Record all answers)**

2.3 What value do you and your customers place on sourcing environmentally branded kangaroo? **(Record all)**

2.4 What benefits do you think the environmentally branded kangaroo needs to deliver to significantly differentiate this kangaroo meat from existing kangaroo product? **(Record all answers)**

2.5 What are the minimum differences you would need to see in the product to support a distinctive environmentally branded kangaroo product? **(Record all)**

2.6 What do you expect in terms of quality, consistency and price from this new brand of kangaroo meat? **(Record all answers)**

2.7 How important is the sustainable yield approach to you - harvesting to keep the environment and wildlife balance in the conservation area? **(Record all answers)**

2.8 What information would you want about an environmentally branded product? **(Record all)**

2.9 What information do you think consumers would want about the environmentally branded kangaroo product - what does the brand need to say to consumers? **(Record all)**

____

____

____

2.10 How interested are you in buying environmentally branded kangaroo product?

____

____

____

2.11 (a) Would you consider trialling environmentally branded kangaroo? Why? Why not?

____

____

(b) What types of organisations do you think would support a trial? **(Record all)**

____

____

2.12 Would you promote the environmental brand to your customers? **(Record all)**

____

____

2.13 What contact points and supply arrangements would you need from the conservancy if you bought the environmentally branded kangaroo? **(Record all)**

____

____

3. INTEREST IN ENVIRONMENTALLY BRANDED KANGAROO PRODUCT

3.1 Would you still be interested in the environmentally branded kangaroo product if the supply was limited - the conservancy represents only 2% of the total market? **(Record all)**

____

____

3.2 What is the minimum quantity of environmentally branded kangaroo that needs to be available to support you buying the product regularly? **(Record all)**

____

____

3.3 What will drive demand for environmentally branded kangaroo? **(Record all)**

____

____

3.4 What marketing support is needed to promote the environmentally branded kangaroo product? **(Record all)**

____

____

3.5 Would knowing that other customers are using the environmentally branded kangaroo product be important in your decision to buy it? **(Record all)**

____

____

3.6 What would prompt you to buy the environmentally branded kangaroo product? **(Record all)**

____

____

3.7 Would you be prepared to pay a slightly higher price for environmentally branded kangaroo? What percentage increase would be acceptable? **(Record all)**

____

____

3.8 Eating kangaroo meat can reduce greenhouse gas emissions compared to eating beef - is this an important message for you and your customers? **(Record all)**

____

____

3.9 (a) What kangaroo products and pack sizes would you want in environmentally branded kangaroo? **(Record all)**

____

____

3.10 What quantity of kangaroo meat do you sell in a week? **(Record all answers)**

____

____

3.11 What price per/kg do you pay for the kangaroo meat that you purchase? **(Record all answers)**

____

3.12 What are the most important priorities for the new product to get support from the market?

____

____

3.14 On a scale of 1 to 5 where is poor and 5 is very good, how would you rate the strength of the opportunity for the environmentally branded kangaroo in the marketplace? Why is that?

____

____

3.15 Thanks for your feedback today. Is there anything else you would like to add?

____

____

Thank you for your help with this important survey.

Just to confirm, my name is…….from Deborah Wilson Consulting Services and this research is carried out in compliance with the Privacy Act. Information you provided will only be used for research purposes.

Issues to be Covered in Consumer Focus Groups

Current Consumption and Attitude

The focus group will start with a few general questions on kangaroo consumption and awareness. Specific questions for the focus groups include the following:

- How often do you eat kangaroo?
- Why/why don't you eat kangaroo?
- What recipes and cooking approaches do you use? What it is best suited for, preferred cooking (well done, medium rare, rare)?
- What is your view on the favour, tenderness/toughness of kangaroo?
- How well does kangaroo compare with other meats?
- What are the health, nutrition and other benefits of eating kangaroo?
- Are there any disadvantages of eating kangaroo meat?
- Sources of information on kangaroo meat and cooking/recipes?
- What consumers know about how kangaroos are killed and processed?
- What do you know about how kangaroos are harvested?
- What are your thoughts on wild culling?
- Do you know the population of kangaroos and the impact of culling?
- What do you know about the processing chain and any concerns about food safety? Comparison with other meat sources – current concerns (e.g. supermarket storage of meat) and how kangaroo meat is regarded in terms of safety?

  Reaction to the message that there are no food safety risks in eating kangaroo meat?
- Any other concerns e.g., humane killing?

Reaction to Conservancy Supply

- Reaction to the conservancy concept. The conservancy represents about 2% of kangaroos culled in Australia.
- Reaction to the size and location of the conservancy (map needed) and the fact that kangaroos can roam wild over a large area.
- Did you know that eating kangaroo meat can reduce greenhouse gas emissions compared with eating beef? How important is this message to you?
- What other benefits do you expect the conservancy to deliver e.g. environmental?
- What do you think of the sustainable yield approach?
- What is your view of a conservancy brand versus an ordinary supply?

- Are you interest in the conservancy branded kangaroo?
- What benefits would the conservancy product need to offer to prompt you to trial it and buy it on an ongoing basis?
- Range of information consumers want about the conservancy brand and its role in sustainable properties, preserving the environment, sustainability of kangaroo populations.
- How conservancy product should be branded compared with other kangaroo.
- What does the brand name needs to get across to consumers?

Interest in Conservancy Kangaroo Product

- What are the best types of kangaroo products for the conservancy kangaroo e.g. fresh (mince, cuts), smallgoods, other?
- Are you interested in kangaroo smallgoods – interest in different products, positioning as an every day deli item?
- Are you interested in gourmet items/flavours as special occasion purchases?
- What factors or information would prompt you to buy conservancy branded kangaroo over other kangaroo product?
- If conservancy kangaroo product is available, would be more interesting or more attractive than other premium meats e.g. organic beef, corn feed chicken, free range chicken?
- What is your view of the conservancy or environmentally branded kangaroo product (good to buy for environmental reasons, higher quality product, gourmet product, different/better tasting)?
- What information do you want to know about conservancy kangaroo available covering:
    - Type of product available e.g. fresh mince, fresh cuts, smallgoods. What consumers think are the best product types for conservancy and why.
    - Availability – does it always need to be available or would consumers still buy it if supply was intermittent or seasonal. The conservancy may not be able to supply the same volume all the time. Whether consumers would still buy the product if it was only available occasionally.
    - Differences between conservancy product and other kangaroo product.
    - Pricing – kangaroo compared with beef and whether people would pay say 20% more for conservancy kangaroo.
- Why would you try and buy conservancy kangaroo product?

    What would prompt you to buy conservancy kangaroo meat – in store tasting/promotion, magazines, chef endorsement?

    What would encourage you to order kangaroo meat more frequently at restaurants or buy it more frequently at supermarkets?
- What are the most important messages to encourage people to order kangaroo meat more frequently at restaurants or buy it more frequently at supermarkets (unprompted discussion)?

How importance are these messages in encouraging people to order kangaroo meat more often at restaurants or buy it more frequently at supermarket:

- Where people can buy kangaroo.
- More information on how to cook kangaroo and more kangaroo recipes.
- The quality assurance systems used including health and hygiene.
- Assurance about the source and the ability to trace back (as with the beef industry).
- Humane harvesting methods – more humane that intensively reared animals.
- Sustainable management of kangaroos.
- Sustainable management of pastures and land with a higher level of ground cover as a result of harvesting kangaroos from the conservancy area.
- Sustainable management of wildlife.
- Reducing greenhouse gases by eating kangaroo.

- Would you be more inclined to try kangaroo meat, eat more or order more frequently in restaurants if you believed the source of the kangaroos was from a sustainably managed conservancy?
- Does monitoring of kangaroo numbers and numbers processed from the conservancy give some assurance to consumers of sustainable management?
- Would you be willing to pay more for kangaroo meat if it was sourced from an accredited sustainably managed land production system (e.g. control of feral animals that destroy wildlife, processes for reducing the spread of weeds, development of biodiversity corridors, etc.)?
- Is it important to have an improved balance between kangaroos and sheep whereby less sheep were carried and more kangaroos were available for harvest?
- Are there any other important messages or information that would encourage people to try and buy conservancy kangaroo product?

Appendix 3: The Conservancy Concept

A3.1 Introduction

The Maranoa Wildlife Conservancy has been formed by a group of pastoralists, predominantly cattle producers in central /southern Queensland. The reason behind the Maranoa Conservancy being established was because of the "Landcare ethic" of the landholders involved and the catchment planning they have been undertaking.

The group views kangaroos predominantly as a resource that can be utilised for both economic and biodiversity reasons, rather than as a pest for control and disposal

Some kangaroos are harvested within the Conservancy at present (some for human consumption and some for pet food) under a regional quota system as for other areas in Queensland. Other kangaroos and wallabies are harvested under a damage mitigation permit. These macropods are not allowed to be taken from the field after they are shot.

A number of landholders within the Conservancy have recently been audited under the ALMS process. ALMS (Australian Land Management System) is an ISO14001 accredited Environmental Management System or EMS The two differences between it and any other EMS is that it takes into consideration the catchment targets/ issues and it has a focus on biodiversity. No other EMS does this.

A3.2 Broad Concept

The objective of the Conservancy is to promote biodiversity through:

- Land, vegetation and animal stewardship at both individual property and Conservancy /catchment scales.
- Wildlife management through protecting and enhancing the habitats of existing wildlife and potentially through re-introduction of native species.
- Sustainable commercial livestock management.
- Sustainable kangaroo management including sustainable harvesting rates and utilising sustainable harvesting practices.

A3.3 Specific Management Practice Ideas

Grazing management and overstocking

A key area for improved management of the Conservancy is to focus on general sustainable management within the conservancy. Maintaining an appropriate balance of traditional livestock and kangaroo populations is paramount. There is potential for there to be fewer sheep/cattle, watering points, fences etc. Also, harvesting kangaroos more strategically will allow pastures to regenerate more rapidly. Managing total grazing pressure especially in drought is a key aspect of kangaroo interaction and integration with property management.

Location and time of harvest information could be integrated with information on land, pasture, weather and seasonal conditions. Kangaroo harvest data assembled on a Conservancy basis can be used for both livestock and kangaroo management. One idea that has been canvassed is for the

Conservancy to give priority to harvesting kangaroos on spelled regenerating paddocks, with harvesters being requested to harvest in specific locations on behalf of the Conservancy group. This does not happen under existing harvesting arrangements. Also, sharing information about location and aggregation of kangaroos may be beneficial to harvesting efficiency. A coordinated approach may allow better strategic control of large concentrations and easier shooting.

Invasive species

The maintenance of native vegetation by control of weed spread could be improved with kangaroo harvesters washing down vehicles before entering another property and would be part of a an overall environmental management plan.

Kangaroos are the most common native species within the Conservancy. However, the number of many other species has been reduced by wild dogs, foxes and cats, and feral pigs. There is some anecdotal evidence that there has been loss of native birdlife (plains turkeys, brolgas) as a result of increased numbers of feral animals. The situation may have been worsened by the damage mitigation permits whereby some kangaroos are left to rot and die in the paddock.

Kangaroo harvesters working within the Conservancy may be able to assist with wildlife management by shooting feral goats, foxes or cats.

If ferals can be controlled, there is scope for reintroduction programs for native animals like the bilby program at Charleville.

Greenhouse gases

It is estimated that about 16% of Australia's total net greenhouse gas emissions originate from the farm sector. Of this 16%, 71% is contributed by ruminant livestock such as cattle and sheep emitting methane gas. Methane is a product of ruminants, and kangaroos are not ruminants. Consumption of kangaroo meat instead of beef or sheepmeat is therefore very greenhouse friendly.

A recent report by Greenpeace on global warming stated that reducing beef consumption by 20 per cent and putting Skippy on the dinner plate instead would cut 15 megatonnes of greenhouses gases from the atmosphere by 2020.

Quality

A higher and more consistent quality of kangaroo meat may result, from harvesting processes, chiller management, and an improved feedback and traceback system. An improved traceback system is currently being developed for the Conservancy, including GPS and data logging on a paddock and property basis.

Also, if kangaroo harvesting within the Conservancy is organised by a combination of pastoralists and harvesters with some form of joint control of chillers, one of the benefits may be improved quality control and an improved product to market.

A3.4 The Role of this Study

The key role of the study is to identify the characteristics of markets for kangaroos from the Maranoa conservancy and to support the establishment of processes to supply those markets. We need to focus on the views of consumers to direct the Conservancy focus, particularly the attitudes towards activities and products that are associated with 'net conservation gains'. We need to explore the reaction to a conservancy or regional brand to promote the sustainable harvest of kangaroo meat from the Conservancy (and potentially any other products).

Appendix 4: Profile of Firms Interviewed in Market Research

A4.1 Key Findings

Key findings from interviews conducted with restaurants, caterers, food service firms (including game meat suppliers to restaurants and gourmet butchers), 5 star hotels, gourmet retailers and supermarkets included the following:

- Quality is the dominant driver in purchasing new food products. Firms need to be assured of quality and consistency.

- For some, the environmental focus is valuable due to the positioning of the business or because of increased interest from consumers. However, the Conservancy product would need to be positioned primarily as gourmet and secondly as an environmental brand.

- Game meat demand is fashion driven. Without consumer interest and supporting promotion, it will be very difficult to establish the new products.

- Game meat suppliers see the product as a specialist item and are seeking exclusive rights to supply in their state.

- Kangaroo is seen as a niche product already and some felt that trying to establish a new niche product in this thin market would be too difficult.

- Supply of kangaroo meat at present in unsophisticated packaging sends the message that kangaroo is a commodity product. Clear messages are needed about the differences the new product offers. To achieve wider levels of interest and support, the quality and gourmet positioning will be the main driver. Few are interested in a product that is only differentiated by the conservancy approach.

- Considerable effort and marketing resources will be needed to support the establishment of the product. This includes direct promotion to buyers and chefs as well as promotion in gourmet magazines and other media. A link to a known chef or existing gourmet brand would assist the product to establish.

- Comparative pricing with existing supplies is important in the establishment phase of the products.

- Consistent availability of supply is important for some firms (large catering firms and some supermarkets) but not for others.

- Working with a panel of chefs and businesses to trial the new product will provide valuable feedback in the product development stage. This approach can also be used very effectively to test marketing, packaging and positioning for the new product.

Feedback from interviews are summarised in Appendices 5 and 6. Results are based on a small sample of firms but themes raised are consistent.

A4.2 Current Profile of Purchasing Kangaroo Meat

Firms interviewed were asked to provide information on their current purchase profile of kangaroo meat.

Of the organisations surveyed, 15 currently buy kangaroo meat.

Volumes varied with some organisations buying/selling 8 kilos of kangaroo meat per week up to 1,000 kilos.

The prices paid for kangaroo meat purchased varied from $7.60 per kilo to $15.50 per kilo.

The type of kangaroo meat that firms currently used, purchased or sold included the following:

- Strip loin.
- Fillet.
- Rump.
- Tail.
- Forearm.
- Backstrap.
- Denuded backstrap.
- Sausages.
- Hamburgers.
- Prosciutto.

A4.3 Quantity Sold

The quantity of kangaroo meat sold or purchased by organisations surveyed varied according to size and type of operation. The largest users of kangaroo meat included one food service firm (up to 1,000 kilograms of kangaroo per week) and one supermarket selling 1,000 kilograms of kangaroo each week through supermarket outlets.

The profile of quantities used or sold on a weekly basis included the following:

Restaurants

- 8 kg to 12 kg per week.

Hotels

- 2 kg per week
- 15 kg to 20 kg per week.

Gourmet Retailers

- 20 kg per week for sale in selected affluent suburbs.

Food Service

- 10 kg per week.
- 750 kg to 1,000 kg per week.
- 10 kg per week.
- 400 kg to 500 kg per week.
- 400 kg to 500 kg per week

Supermarkets

- 100 kg per week.
- 1,000 kg per week.

A4.4 Price Profile

The price per kilo paid for kangaroo meat varied from a low of $6 to $7 per kilo through to a high of $14 to $16 per kilo.

The price per kilo that businesses reported paying included the following:

Restaurants

- $14 per/kg direct from the processor.

Hotels

- $15.99 per/kg.
- $7.60 per/kg.

Food Service

- $10.60 per/kg.
- $13 per/kg to $14 per/kg for premium cuts and $5 per/kg to $6 per/kg for lesser cuts of meat.
- $8.50 per/kg to $15.50 per/kg depending on the cut.

Supermarkets

- None of the supermarkets would disclose the price of the kangaroo that they purchase.

Appendix 5: Reaction from Retail, Food Service, Restaurant and Supermarket Firms to the Conservancy Concept

A5.1 Reaction to the Environmentally Branded Kangaroo Product from the Maranoa Conservancy

Participants in the research were provided with the following brief outline of the conservancy product:

> Deborah Wilson Consulting Services is conducting market research to assess potential market demand for niche production of high quality kangaroo meat under an environmental brand.
>
> The Maranoa Wildlife Conservancy which is west and north of Roma in Queensland has been formed by a group of pastoralists, mainly cattle producers to sustainably manage the region's kangaroo population, produce kangaroo meat and promote biodiversity among wildlife.
>
> The Conservancy product will represent approximately 2% of kangaroos culled annually within Australia and will offer these benefits over existing kangaroo meat:
>
> - **Improved Product Quality – more consistent and higher quality kangaroo product** as a result of improved harvesting processes (chiller management, improved traceback systems using GPS and data logging)
> - **Environmentally Sustainable –** the conservancy will **use an environmental management system** – managing the stock load on properties and preserving the existing environment. A number of the conservancy landholders are ISO14001 Australian Land Management System accredited.
>
>   Another benefit is that encouraging kangaroo consumption instead of beef consumption can reduce greenhouse gases.
> - **Increased Food Safety –** kangaroos will be harvested using **quality assurance systems** including health, hygiene and food safety.
> - **Humane Harvesting Methods –** the size of the region allows wild kangaroos to be harvested in the **most humane method** possible.
>
> The research will cover:
>
> - Interest in Conservancy brand kangaroo products.
> - Types of kangaroo products preferred.
> - Key factors that would encourage use of the Conservancy brand kangaroo.
> - Information needed about the Conservancy brand kangaroo.

There were varying levels of support for the concept – some organisations saw limited potential for the product while others saw considerable opportunity for the product.

> Support for the concept of environmentally branded kangaroo differs. Those who saw the concept as a positive initiative have stressed the importance of branding and supporting the brand to successfully establish and market the product.
>
> Those who do not see value believed that the current supply of kangaroo already

has good environmental credentials. Others felt it would be too difficult to differentiate the new product from the existing supply of kangaroo.

The feedback participants provided on their initial reaction to the concept included the following:

Restaurants

- The concept is 'silly'. Unless the kangaroo were farmed, the product would not be any different from the current supply.
- The restaurant supported the concept. The brand is the most important aspect for success in the marketplace.

Caterers

- The firm does not know enough about the current supply of kangaroo to make a comparison.
- The firm is unsure about the concept. There is not enough demand for the current supply of kangaroo meat.

Hotels

- The hotel has no problem with the current supply which is highly accredited. Tenderness of the meat is the most important attribute of the product.
- The current process is already well managed and approved.

Gourmet Retailers

- Kangaroo is a sideline product. The firm thought the new product would require significant investment for it to be successful.
- There will be no demand for the new supply as it will be more expensive than the current product and price is important in the kangaroo market.
- The concept is a good idea providing it is heavily promoted and well managed.

Food Service

- The concept is interesting but success would be difficult to achieve.
- Consumers do not see the current supply as being polluted or inhumanely harvested.
- The concept is valid. Having the trace back capability is important.
- The concept is not viable. The production costs involved in the concept will reduce any profit margin.
- The current volumes of kangaroo sold would not sustain the new branded concept. The inconsistency in supply of the current product has lead to a reduction in the amount the firm sells.

Supermarkets

- There is room in the market for the environmentally branded kangaroo concept. The current good publicity surrounding kangaroo means that the timing is right.

- The concept sounds good. The current supply of kangaroo can not meet the demand for kangaroo in the market.

- It is a positive initiative for industry advancement.

- The concept sounds good.

A5.2 Environmentally Branded Kangaroo versus Existing Supply

> Some felt that the existing supply of kangaroo already has an environmental brand. Others were not familiar enough with the existing supply to make a comparison.
>
> Some of the firms surveyed believed that the new brand would compare well and would find a place in the market.

Feedback on the comparison between environmentally branded kangaroo and the existing ordinary supply of kangaroo meat included the following:

Restaurants

- The ordinary kangaroo supply is environmentally branded. The current supply has the organic tag, can be exported to the EU and is considered very healthy.

- The environmental brand would need to have the backing of a face or a chef.

Caterers

- The firm is not familiar enough with the ordinary kangaroo supply to compare the two.

Hotels

- The hotel's preference for kangaroo meat would be based on the price.

- The price of the product is what matters to the hotel. The environmentally branded meat would need to be price competitive.

Gourmet Retailers

- The current kangaroo supply is good. The current supply is government regulated and there is export quality meat available.

- The environmental kangaroo meat sounds like a good concept, however the organisation is not familiar with the current supply.

- The environmental brand name of the new variety would be marketable.

- There must be a protocol attached to the environmental brand.

Food Service

- The firm would need more information to make a judgement.

- The environmental branding would be a contradiction, as the 'greenies' do not want any kangaroo harvesting to occur.

- The environmental brand would need to be significantly different from the current supply.

Supermarkets

- Any brand related to the environment would be popular with customers.

- An environmental brand would work in the marketplace.

- The firm has no issues with the current process of kangaroo supply. The industry appears well organised and controlled.

A5.3 Value of the Environmental Brand

Some felt that the current product is already environmentally managed and environmentally branded – the new product would not be sufficiently differentiated. Others felt that there is strengthening consumer interest in environmentally branded kangaroo. Some were concerned about the complexity of getting the message through to consumers – this could be difficult to do on a hotel menu.

There are differences of opinion on the value of an environmentally branded kangaroo. The key issue will be the ability to successfully differentiate the environmentally branded kangaroo from the existing supply, which many regarded as being managed on an environmental basis.

Feedback on perceived value of sourcing environmentally branded kangaroo included the following:

Restaurants

- The current product already is environmental.

Caterers

- Stability in supply and product quality assurance is more important to the firm. The organisation has a food safety system which has to be used by suppliers.

- The environmental brand would be valued by the firm and the customer.

Hotels

- The firm previously had organic products which customers did not value.

- There is not enough room on the menu to pass on information about the product to customers.

Gourmet Retailers

- The firm is yet to test whether customers value environmental branding.
- Customers would value the environmental branding to some degree. The price of the product would be very important.
- A big emphasis must be put on product quality.
- There is currently some interest from the firm's customers in environmentally branded products.

Food Service

- The firm is not sure how the environmental brand is valued by customers.
- The current supply of kangaroo is environmentally branded.
- The current product is environmentally managed and organic.
- 'Sourcing kangaroo meat environmentally would not be important to our customers'.
- The environmentally branded kangaroo should be highly regarded by the customer. Sustainable farming is very important to the firm.

Supermarkets

- The environment is a priority to the consumer.
- Customers would value environmentally branded kangaroo.
- The firm is unsure how customers value the environment. Price will be a key influence.
- The firm has confidence in the merits of the existing industry and is not looking for an improved model for kangaroo harvesting.

Benefits of an Environmental Brand

The benefits that the environmentally branded kangaroo needs to deliver to significantly differentiate this kangaroo meat from existing kangaroo product focused on quality and a clear, positive environmental 'story' to support the branding.

Feedback on these differentiating benefits included the following:

- The only way to produce a different product would be if the kangaroos were fed differently e.g. corn fed chickens.
- Improved quality and consistency.
- Tender and uniform in portion size.
- Tenderness must be the differentiator between the two brands. Kangaroo meat is too tough.
- Advertising must be the differentiator between the two types of kangaroo meat. People need to be aware of the new brand.

- The environmental brand must have a unique packaging. Customers of gourmet retailers would need to be aware that the product is different. The customers would need to be educated about the new brand.

- Information on where the new brand comes from and the full story about the new product.

- Harvested from a more environmental source, promote animal welfare and be a cleaner product.

- The product needs to be more uniform than the current supply.

- Land management is important in differentiating the products.

- The environmental brand needs to have a superior product quality and should be better promoted than the current supply.

- Improved level of quality and consumer confidence in the product's integrity.

- Product tracking and traceability will be the only difference between the two types of kangaroo meat.

- Some felt that the new brand will not be different from the current supply as the kangaroos are still wild.

Minimum Differences
The minimum differences that market representatives would need to see in the product to support a distinctive environmentally branded kangaroo were not easy for market representatives to define.

Restaurants, caterers and hotels had difficulty specifying a minimum level of differentiation needed. Others highlighted that marketing, merchandising, packaging and labelling all need to be different from the current supply.

The environmentally branded product must be demonstrated to be superior in quality and packaging.

Importance of Sustainable Yield
Views on the importance of sustainable harvesting varied – for some organisations, it is very important but for others, it is unimportant.

Supermarkets more consistently emphasised the importance of sustainable harvesting and the fact that consumers will expect this sustainability.

Feedback on sustainable yield from individual firms included the following:

Restaurants

- Very important - the current supply of kangaroo is harvested sustainably. The kangaroo quota for harvesting has never been filled.

Caterers

- Very important - sourcing products that are harvested sustainably is a company wide policy.

- Very important.

Hotels

- Not important to the firm.
- Very important.

Gourmet Retailers

- Very important.

Food Service

- A good idea.
- Conservationists would not be pleased if any kangaroo harvesting is occurring.
- Not important.
- Not important - the firm is not aware that kangaroo numbers have an impact on other wildlife.
- Very important for the future.

Supermarkets

- Extremely important and very relevant to the customers.
- The public would not know.
- Very important.

A5.4 Quality, Consistency, Price and Supply

Representatives provided feedback on:

- Expectations of product quality and consistency.
- Pricing expectations.
- Supply requirements.

The majority felt that it was important for the new environmentally branded kangaroo to be at the same pricing level as the current supply. Some felt that the price could be increased once the brand or the product had become more strongly established. In raising the price it will be important to develop a significantly differentiated product in the minds of consumers based on quality.

The market expects the product to be of consistent quality and be a tender, high quality product.

Feedback on expectations for quality, consistency and price of the new environmental brand of kangaroo meat included the following:

Restaurants

- The business would not pay any more for the new kangaroo meat. The current product is very good.

- Product quality is very important.

Caterers

- Product quality and consistency are very important.

Hotels

- Product availability is most important, followed by quality. The product must be uniform in size.

Gourmet Retailers

- The product quality must be very specific.

- The environmentally branded kangaroo meat needs to be a better quality product with a similar price to the current supply. In the past, the firm was selling a branded emu meat. When the supplier raised the price of the emu meat, the demand for the product fell significantly.

- The environmental product must be as good as or better in quality than the current supply of kangaroo meat.

- Quality, consistency and price should be the same as the current supply of kangaroo meat.

Food Service

- The new environmentally branded product can not be too expensive or it will struggle to sell.

- The new product must be uniform, consistent and tender.

- The new product will be hard to sell at a premium price and would be limited to restaurants. The product needs to have packaging, branding and history.

- The product must be consistent and uniform.

Supermarkets

- The price can not be different from the ordinary kangaroo meat.

- Quality and price go hand in hand - the market must be tested. The current product is well packaged and priced with a mark up.

- Value for money is very important when releasing a new product.

- The quality, packaging, price and consistency must be as good as the current product.

A5.5 Pricing Profile of the Environmentally Branded Kangaroo

Representatives surveyed were asked if they would be prepared to pay a slightly higher price for the environmentally branded kangaroo, and by what percentage.

Of the 19 firms surveyed 18 indicated that they would be willing to pay a higher price for the environmentally branded product. Firms were willing to pay between

1% and 20% more for the environmental brand.

For many firms the price of the product would be determined by the quality of the kangaroo meat.

Of the participants surveyed only one indicated that they would not pay any more for environmentally branded kangaroo than the current supply. Feedback on perceived value of sourcing environmentally branded kangaroo included the following:

Restaurants

- The firm would not be prepared to pay any more for the new branded kangaroo meat as the current supply is good quality meat.

- The firm would be willing to pay a slightly higher price for branded kangaroo meat.

Caterers

- Up to a 1% premium for an environmentally branded product.

Hotels

- The firm would pay more for the branded kangaroo. The premium the firm would be willing to pay would depend on the product quality. The meat must be uniform.

- A slightly higher price for the branded kangaroo meat but the price increase could not be significant.

Gourmet Retailers

- The price would be determined by the quality of the product.

- The price of kangaroo meat is cut dependent. If the current supply of kangaroo is $8 per/kg and if the branded kangaroo were $11 per/kg, the market would not sustain the new product.

- 10% more for an environmentally branded kangaroo meat.

Food Service

- No more than 15% extra for environmentally branded kangaroo meat.

- The firm would purchase the environmentally branded product if the product had a premium on the price.

- The price will be determined by the product quality.

- The price must be competitive with the current kangaroo supply.

- Quality, consistency and the strength of the brand within the market place will determine how much the firm is willing to pay for the branded kangaroo meat.

Supermarkets

- Pay slightly more for an environmentally branded product. However, an increase in price of more than $3 per/kg would be an issue.

- $4 to $5 more per kilo of the branded kangaroo.
- Up to 10% more for the branded product.
- The firm would only pay more for the environmentally branded product if it was justified and the increase could be passed on to the customers.

A5.6 Information Needs

The research covered feedback on the information requirements that gourmet retailers, hotels, caterers, restaurants, food service firms and supermarkets would need about the supplier as well as the information that consumers would want to know about environmentally branded kangaroo.

> Businesses purchasing environmentally branded kangaroo want information on how sustainable harvesting is managed, credentials of the supplying organisation, firm ownership, food quality and system capabilities – a full profile on the operation, its capabilities and the benefits it can deliver.
>
> These firms felt that consumers would want information on the origin of the product, nutrition and health information (confirmation that it is a healthy product), information that kangaroo is tender and of good quality.

The information that firms would want to know about an environmentally banded kangaroo product included the following:

- The credentials of the people behind the project.
- Company ownership.
- The branding is the most import aspect of the product if it is going to be successful in the market.
- The processes involved in producing the standard product and details on how the product is kept.
- Where the product comes from, cut information and what the animal has been fed.
- The 'where, how, what and why' of the new product.
- How kangaroos are sustainability harvested.
- All the information available that will help the firm in marketing the product.
- The product consistency and supply.
- Product accreditation.
- Product specification sheets similar to the information provided about beef and free range pork. The information would need to detail the region and age of the product.
- The differences between the environmental brand and the conventional product.
- All the relevant information available.
- Information that can deliver a commercial benefit to the firm.

The information that firms believed consumers would want to know about the environmentally branded kangaroo product – what the brand needs to say to consumers - included the following:

- Nutritional and health aspects of the product.
- Consumers already understand that the current product is lean and healthy.
- Where the product comes from, cut information and what the animal has been fed.
- The product would need a recognised brand.
- Consumers will want the ‘full story’ about the new product.
- The firm needs all the product information so that the staff can answer the questions customers have about the product.
- Information on the tenderness of the product as there is a perception that kangaroo meat is tough.
- Details of any accreditation the product has.
- Knowing that the brand is of a better quality than the current kangaroo supply.
- The consumer would require all the information to be on a label at the point of sale.
- Benefits of the product including information that the product is healthy and environmentally friendly.
- The environmentally branded product needs to be identified as significantly different from conventional kangaroo.

A5.7 Uptake of Environmentally Branded Kangaroo

Overall, 14 of the firms surveyed were interested in buying environmentally branded kangaroo.

16 of the firms surveyed were interested in trialling environmentally branded kangaroo.

The types of kangaroo products and pack sizes of greatest interest included pack sizes of up to a kilo for loin, fillet, backstrap, rump and sirloin.

Supermarkets were also interested in mince, stir fry and sausages.

Interest in Buying Environmentally Branded Kangaroo Products

Overall, 14 of the firms surveyed where interested in buying environmentally branded kangaroo. 5 firms were not interested. Feedback on their level of interest in buying environmentally branded kangaroo included the following:

Restaurants

- The firm is not interested. The current product achieves everything this product is attempting to do.

Caterers

- The firm is not interested in kangaroo meat at present but can foresee the market changing in the future.

Hotels

- The level of interest from the firm would depend on the final quality of the product.
- The hotel would be interested in the product if the quality and price were right.

Gourmet Retailers

- The firm is not interested in environmentally branded kangaroo as the current product meets all the requirements of the firm.
- There must be a demand for the product among the customers for the firm to stock the environmentally branded kangaroo meat.
- The firm would purchase the kangaroo meat as customers often discuss sustainable farming when shopping at the business.

Food Service

- The firm would purchase the branded kangaroo as upper market restaurants would have a demand for it. Restaurants are now purchasing a lot of branded lamb.
- The firm would be interested in the product.
- The firm would be interested in the kangaroo meat if the price was competitive.
- The firm is sceptical about the product. Branded beef took two years to introduce into the marketplace. Kangaroo would require a lot more time and effort.

Supermarkets

- As an independent supermarket, stocking different and new products is a point of differentiation for the firm.
- The firm is very interested in stocking the branded kangaroo meat.
- The firm is moderately interested in trialling the product.
- The supermarket would require more information on the kangaroo meat to make a decision.

Trialling Environmentally Branded Kangaroo

Sixteen of the organisations surveyed were interested in trialling environmentally branded kangaroo. The reasons why firms would trial the product included the following:

- General interest in the product.
- To test customer demand.
- To gain customer feedback.
- Trialling based on the merits of the product.

The reasons why firms were not interested in trialling the product included the following:

- Failure of a previous trial of kangaroo meat.
- The current supply of kangaroo is very good.

Perceived Targets for the Product
Firms believed that restaurants, upmarket hotels, gourmet butcher shops and supermarkets would support a trial.

One supermarket representative thought that independent supermarkets would be more likely to promote branded kangaroo than the larger chains.

Pack Sizes Required
The kangaroo products and pack sizes that firms would want in an environmentally branded kangaroo included the following:

Restaurants

- Sirloin, fillet, rump, tails, shoulder and forearm in 250g to 500g packs.

Caterers

- Quantities would vary from very small portions to bulk sizes.
- Quantities would vary depending on the purpose the firm is ordering the kangaroo meat for.

Hotels

- Loin cuts.
- 1.5 kg to 2 kg packs of kangaroo which the hotel butcher trims on site.

Gourmet Retailers

- 500g packs.

Food Service

- 1 kg pack sizes of loin and rump.
- 200g, 500g and 1 kg pack sizes of loin, back strap, fillet, tail, sausages, hamburgers and rump.
- The firm purchases kangaroo in cartons containing ten 1 kg packs to a carton.
- 650g to 1 kg packages of sirloin and fillet.
- 1 kg packs of loin fillets, back strap, denuded back strap and topside.

Supermarkets

- Smaller pack sizes of kangaroo are better - 200g to 300g packs.
- The supermarket purchases kangaroo in 300g to 500g packages of fillet steaks, sausages, stir-fry and mince.
- The firm purchases pre packaged value added kangaroo steaks.

- Pre packaged boneless leg, fillet steak, sausages and mince.

Interest in Product Given Supply Constraints
Firms surveyed were asked whether they would still be interested in environmentally branded kangaroo product if the supply was limited – the Conservancy represents only approximately 2% of the total market.

Some firms serving larger markets such as food service and supermarkets consider that availability of supply could be a limiting issue. However, other firms in these two categories did not believe that a limited supply would be an issue.

The feedback from firms on whether interest in the environmentally branded kangaroo would be affected if supply is limited, included the following:

Restaurants

- No effect – would still purchase the product.

Caterers

- Still interested in the product if supply was limited.

Hotels

- The supply must keep up with demand otherwise the firm would not stock environmentally branded kangaroo.
- Not interested if the supply was limited.

Gourmet Retailers

- Not interested if supply was limited.
- Still interested if the supply was limited.

Food Service

- Interested if supply was limited as the ordinary kangaroo supply is also limited.
- A limit on supply would be a major issue for the firm. Marketing the product would be pointless if there is no supply.
- Not interested if the supply is limited.
- The firm would need to know specifically how much kangaroo meat is available.
- Still interested if supply was limited.

Supermarkets

- Two would be interested if the supply was limited.
- Two were not interested if supply was limited.

Minimum Supply Required
The minimum quantity of environmentally branded kangaroo that needs to be available to support the firm buying the product regularly varied from a few kilograms a week up to 3 tonnes per week. Examples of requirements included the following:

- There is a large variation in supply. The firm could order $20 to $2,000 worth of kangaroo meat per week for the 150 sites that the business services (caterer).

- About 2 kg of kangaroo a week (hotel).

- 15 kg to 20 kg of kangaroo a week (hotel).

- 60 kg of trim kangaroo meat each month (gourmet retailer).

- 40 kg of kangaroo per month (food service).

- 2 and 3 tonnes of kangaroo each week. Currently there is a lot of demand for this type of product. The firm sells 1.5 tonnes of table pigeon each week (food service).

- Starting at 50 kg a week. The quantity of meat required would rise with demand from customers (food service).

- The minimum quantity of product required would be determined by the market. The quantity of meat supplied is very important. The firm promoted a branded beef which was very popular with customers. The company increased the level of supply to the firm, the meat became a commodity and the price dropped (food service).

- 5 cartons per week of kangaroo meat (supermarket).

- 100 kg of kangaroo meat each week (supermarket).

- Stores need to be able to order products regularly without having any unsupplied items (supermarket).

A5.8 Factors Prompting Purchase

> The exclusivity of the product, quality and a strong environmental brand would prompt a number of firms to purchase the product.
>
> Consumer awareness and demand for the product would also be a key driver.
>
> Product quality and, for supermarkets, price competitiveness, will be drivers of demand.
>
> A number of firms would pay slightly more for an environmentally branded kangaroo product that is also a high quality product.

The main factors that will drive demand for environmentally branded kangaroo include marketing the environmental credentials of the product, quality and successful branding. Feedback on drivers of demand for the new product included the following:

Restaurants

- Drought and the effect of climatic conditions on the supply chain will drive demand for environmentally branded kangaroo.

- Branding and quality.

Caterers

- The catering participants were unsure what would drive demand.

Hotels

- The drivers are difficult for the firm to determine. Organic meat failed in the restaurant.

- Consumer product awareness needs to drive demand.

Gourmet Retailers

- The price, novelty and current food trends.

- The product quality.

- Advertising.

Food Service

- Packaging and marketing.

- Point of sales material and brand recognition.

- Product image.

- Marketing.

Supermarkets

- Marketing the environmental aspects to consumers.

- Product quality and marketing.

- Consumer awareness of the product's benefits.

Prompts for Firms to Purchase

Consumer demand is the main factor that would prompt firms to purchase the environmentally branded kangaroo. Other factors include the quality of the product, successful branding, trialling and market acceptance.

Detailed feedback on the points that would encourage firms to buy environmentally branded kangaroo product included the following:

Restaurants

- A shortage of other kangaroo product and a convincing argument to purchase the product.

- Consumer demand.

Caterers

- Market movements and retail opportunities.

Hotels

- The fact that the kangaroo meat is rare and different.

- Knowledge of the product.

Gourmet Retailers

- Customer demand.

Food Service

- If the product looks good and is packaged well.
- Customer demand.
- Tenderness and price.
- Customer demand. A trial with 100 kg in selected butcher shops would be used to determine demand.
- Demand and price.

Supermarkets

- The product quality and price.
- A successful trial of the product.
- The organisation must be convinced of the commercial benefits of stocking the product.
- If the firm thought the product had potential.

A5.9 Marketing and Supply Support

> A signature branding, proactive and targeted marketing, point of sale leaflets and an advertising campaign were recommended marketing strategies.
>
> Market testing the product is also an important strategy.

Suggested marketing support needed to promote the environmentally branded kangaroo product included the following:

Restaurants

- The product must be marketed in health food stores, organic stores and upmarket supermarkets.
- The product must have a face – a celebrity or a chef. The company must educate each chef on the best way to cook the kangaroo meat to ensure the final product that reaches the consumer is of maximum quality.

Caterers

- The product needs to be marketed using point of sale advertising, table talk, posters, flyers and a website.

Hotels

- The supplier of the product needs to know the product in great detail and be contactable at any hour of the day.

- The branded meat must be advertised in food magazines to create awareness and demand for the product.

Gourmet Retailers

- In store promotions that educate the customer on the quality and traceability of the new brand of kangaroo meat.

- Advertising to educate the consumer on the attributes of the product.

Food Service

- Good packaging and branding will help to market the kangaroo meat. A lamb supplier from Junee has had increased sales since changing the packaging of their product.

- The packaging and presentation of the product is important. The meat should also be marketed with recipes.

- Effective packaging and flyers with cooking hints.

- Advertising campaign and table talkers. The product should be trialled with 10-15 chefs to gain feedback on the taste and quality.

Supermarkets

- Leaflets and handouts which can be passed on to the consumer.

- Effective branding and product leaflets.

- Proactive marketing is needed to create repeat sales.

- Provide information about the benefits of environmentally branded kangaroo.

Exclusivity
For 8 of the 19 firms surveyed, knowing that other firms were also using the product would have no impact on their decision.

Many firms felt that it was a positive development that other firms were using the environmentally branded kangaroo. A few firms wanted exclusivity of the brand. Of the 4 supermarkets that participated in the survey, 3 felt the knowledge that other firms are using the product would positively impact on their decision to purchase branded kangaroo meat.

The fact that other firms are using the product demonstrates a market demand.
Some felt that exclusive distribution in a region is needed as the market would be very small.

Kangaroo Meat and Greenhouse Gases
The majority of firms surveyed felt that the message that eating kangaroo reduces greenhouse gases is a positive and important message.

Three of the supermarket contacts felt that the reduced greenhouse impact of kangaroo meat is not an important message to customers.

Promoting the Environmental Brand
The majority of firms surveyed (16 out of 19) reported that they would promote the environmental brand to their customers.

One hotel currently stocks Naturoo kangaroo meat and promotes this brand.

Supply Arrangements
Some firms wanted a central or single contact point for supply arrangements.

Supermarkets were looking for a more sophisticated account management and supply arrangement to fit in with existing supply chain arrangements.

Feedback on the contact points and supply arrangements that firms would need from the Conservancy if they bought the environmentally branded kangaroo included the following:

Restaurants

- Multiple supply points would be required.

Caterers

- Distribution would need to be through the existing supply arrangements in Queensland and the Northern Territory. The firm has 6-9 butchers within this region.
- The organisation would require a number of distributors to purchase the product.

Hotels

- One contact point and an account with direct billing.
- Supply arrangements are up to the supplier. The firm uses multiple contact points in their supply arrangements.

Gourmet Retailers

- The contact points are up to the supplier to manage.
- One contact point is the preferred for simple supply arrangements.

Food Service

- Order every month and have direct contact with the supplier. Kangaroo is difficult to source at present.
- Contact from the supplier directly on a regular basis.
- The product would need to be delivered to a depot in Melbourne by refrigerated transport. The price would be determined at the point of pick up from the depot.
- Supply arrangements need to be very simple. The firm would require marketing information, product fact sheets and table talkers.

Supermarkets

- The supermarket has a distribution arrangement with a main distribution company.
- Delivery once a week in vacuum packed packages.
- An account manager, a store contact person and direct to store deliveries.

A5.10 Priorities for the New Product

Participants in the research rated the strength of the opportunity for the environmentally branded kangaroo at 2.8 out of five on a scale where one is poor and five is very good – just below average. Highest ratings were recorded for food service organisations (3.5 out of 5), hotels (3.3 out of 5) and supermarkets (2.9 out of 5).

Key issues that need to be addressed in gaining market support include high quality branding, delivering a high quality product, good promotion of the nutritional and environmental benefits of the product and raising public awareness of the benefits of the product.

Important Priorities
The important priorities for the new product to gain support in the market included the following:

Restaurants

- Convincing data on product quality.
- Branding and quality.

Caterers

- Promoting the health benefits of the product will be an important priority if the product is to gain market support.
- Product promotion.

Hotels

- Product quality.
- Education of the consumer on the environmental benefits of the product.

Gourmet Retailers

- Product quality and the promotion of environmental aspects.
- Education.

Food Service

- Packaging is important if the product is to be supported and demanded by the market place.
- Continuity of supply and clear messages on the product.
- Product quality.
- Simple eye catching branding.

- Product marketing, packaging, consistency and branding are all important if the product is to be successful in the marketplace.

Supermarkets

- Price, marketing and differentiation on packaging.
- Good branding and a clear message.
- Convincing the consumer of the benefits of the product.
- Public awareness of environmentally branded kangaroo.

Strength of the Opportunity

Firms were asked to assess the strength of the opportunity for the new product on a scale of 1 to 5 where 1 is poor and 5 is very good. Sector feedback included the following:

***Restaurants* (2.0 out of 5)**

- The environmentally branded product is not necessary as the current product is already environmentally friendly.

***Caterers* (2.0 out of 5)**

- An education process is required for kangaroo in general and not just the environmental brand to be successful.
- The product will not be successful until consumers have a good understanding of the product.

***Hotels* (3.3 out of 5)**

- The environmental aspect of the product is not a big selling point.
- The project should be undertaken to change current farming practices.

***Gourmet Retailers* (1.5 out of 5)**

- If there is currently no product like environmentally branded kangaroo on the market than the product has more chance.
- Customers discuss the environment and sustainability often in this region.

***Food Service* (3.5 out of 5)**

- The product would be popular if correctly marketed.
- The product has not been demanded by customers and the current supply of kangaroo is considered environmental.
- The environmental aspect of the product is not important - eating quality is more important to the consumer.
- There is currently a good attitude towards the environment.

- The firm does not see any demand for this product in what is already a very small market for kangaroo meat.

***Supermarkets* (2.9 out of 5)**

- The branded kangaroo meat would be difficult to sell to consumers and any uptake of the product would take time.

- The branded kangaroo could be popular among consumers. There is room in the market for another kangaroo supplier.

- The firm is not convinced that consumers would change their current purchasing habits.

- Kangaroo meat is widely accepted as an alternative protein source. The current supply only receives minor opposition.

Results show that there is some support for the product but that others are not convinced that the environmental branding will be an effective selling point for the product.

Other Feedback
Firms surveyed also provided the following feedback on the new product and opportunities for the new product:

Restaurants

- The current packaging of kangaroo lets the product down. The meat looks bloody and red puts off consumers in the domestic market. The restaurant was keen to forward its contact details to the organisation behind this research.

Caterers

- The project will require a lot of support and financial backing if the product is going to be successful.

- The chef does not think kangaroo meat is suitable for human consumption.

- Kangaroo is only used when specifically requested by clients. The firm will order kangaroo in upon request.

- The firm only uses a small quantity of kangaroo. The business thinks there is no market demand for kangaroo and would not value an organic or environmental kangaroo product. The firm would not pay more money for the product.

Hotels

- The chef has no intention of putting kangaroo on the menu of the hotel restaurant.

Gourmet Retailers

- The firm only sells 10 kg worth of kangaroo every four months so the product is not a priority.

- The business stocked kangaroo products about a year ago. Currently there is no demand for kangaroo.

- The firm does not stock any kangaroo as there is no demand for the product. This does not mean that another brand would not be successful if it had the marketing to increase demand.

- The business does not currently sell any kangaroo meat. There is a sign in the shop saying that the firm can get kangaroo and other game, however customers have never asked for kangaroo.

- The firm does not see a general demand for an environmentally branded product. There may be a demand within selected suburbs or high turnover areas. An environmental brand would not be valued. Currently export quality kangaroo is $20 per/kg to $25 per/kg. The new brand could not sell for more than the export quality kangaroo.

- The firm sells kangaroo prosciutto and chipolatas. The firm sells less than 100 kg of deli kangaroo products each year.

- The firm does not stock any kangaroo meat as the market for kangaroo in general is very small. The business thinks that consumers would be resistant to marketing of kangaroo products. The firm participated in an industry event where a cattle producer spoke of how the farmers should be changing to kangaroo. Consumers drive the market.

Food Service

- Organic products have failed in the market after 6 years. The kangaroo meat must be a simple product with good promotion and recipes.

- The firm requested that its details be forwarded to the company behind this product.

- The firm would not put any money behind this project.

- The firm does not have an opinion on kangaroo meat as the quantities sold are too small.

Supermarkets

- The representative of the firm does not wish to participate as they can not speak for the entire retail chain. If investors are interested in the project they may contact the representative from the firm directly to discuss the project. The contact does not want to influence any decisions.

Appendix 6: Consumer Focus Groups

A6.1 Key Findings

Two focus groups provide insights into consumer attitudes to kangaroo and to the new environmentally branded kangaroo. The key findings from these groups included the following:

- Regular buyers of kangaroo liked the meat and saw it as providing variety. However, people would generally buy much more beef and chicken 'as that's what we grew up eating'.
- A few people in the regular user group purchased kangaroo because it was cheaper than other meat.
- People in both groups had noticed kangaroo more because it was now more widely available in supermarkets. Some had seen kangaroo prosciutto in delicatessens.
- Some found the gamey flavour of kangaroo very strong and would use marinades and spices to cut the flavour.
- People were aware that kangaroo meat is very lean, healthy and high in iron.
- Some non users were concerned about parasites and food safety because kangaroo was 'wild like pigs and rabbit'. Others felt confident that food safety practices and supermarket standards would ensure that kangaroo is safe to eat.
- Although people knew that kangaroo is used for pet food, kangaroo is becoming more popular and is seen as a lean, healthy meat.
- People were unaware of the numbers of kangaroo in Australia.
- People in both groups were interested in more information about how to cook kangaroo to get tender meat and were interested in recipes.
- Consumers were interested in the conservancy or environmental brand but found it a difficult concept to grasp compared with existing or known categories such as 'organic' and 'free range'. The fact that cattle and sheep are still stocked and that land might also be cleared did not make it clear what the net gain would be to the environment.
- Consumers were interested in gourmet and quality products and felt that the new brand would have to have this feature to gain support.
- Consumers were interested in the 'environmental story' and wanted a clear and simple story that told them of the benefits. The fact that the product is locally produced and the company locally owned is important.
- People wanted to be assured of quality and food safety of the new product.
- Although people did not want to know about the details of how kangaroos were harvested, some women in both groups wanted to be assured that joeys were not left to die and that natural groupings of kangaroo were not adversely affected by culling.

- People would be prepared to pay a higher price for a gourmet, environmental product although some did not understand why it should cost more - kangaroos are wild and were harvested in the same way as other kangaroos.

- Strong brand marketing, promotions in gourmet magazines, in store promotions, recipes and accompanying spice/flavouring packs were suggested by consumers to encourage uptake of the new product.

A6.2 Focus Group with Regular Users of Kangaroo Meat

Current Consumption Patterns
The nine people in the focus group were asked to provide information on the meat they purchased the last time they shopped. Feedback included the following:

- Chicken and kangaroo.
- Lamb, chicken schnitzel, mince, kangaroo rump and kangaroo sausages.
- Beef, chicken, lamb and kangaroo.
- Salami, ham and chicken.
- Ingredients for possum pie and goat (this woman was preparing a special meal).
- Lamb, beef, kangaroo.
- Mince, beef and chicken.
- Ham, pork, chicken and kangaroo.
- Lamb, chicken and steak.

People were asked how often they ate kangaroo. People reported eating kangaroo:

- Once a week.
- Kangaroo is cheaper than other meat – two to three times a month.
- Twice a month.
- One person had bought kangaroo at a restaurant.
- Once a month – the deli this person went to sells smoked kangaroo prosciutto.
- Another person in the group mentioned that a South Australian company makes kangaroo biltong.
- Two people purchased kangaroo once a month.
- Once a week.

Recipes and Cooking Approaches
People were asked to comment on the recipes and cooking approaches they used when cooking kangaroo:

- Kangaroo has been affected by the drought – it is not farmed.
- One woman fried kangaroo, cooled it and put it in the fridge. She had a daughter with an iron deficiency and the family was able to cut slices from the cooled, cooked kangaroo. This family ate these kangaroo slices as a snack and in salads.

- Sausages – they are easy to cook and lean. The taste is ‘not too steaky’.
- One person commented that kangaroo can taste a bit like liver.
- Using kangaroo meat in spaghetti Bolognese.
- Using kangaroo mince in Mexican dishes such as nachos, burritos and tacos.
- One person marinated kangaroo for a few hours in wine to make the meat more tender.
- One person had eaten kangaroo at a restaurant and they served small fillets.
- One person felt that roasted kangaroo can be overpowering and a bit chewy.
- Kangaroo burgers.
- Kangaroo sausages.
- ‘Kangaroo is good on the barbecue.’
- One person’s friend has a beef burgundy recipe and kangaroo goes very well in this recipe.
- People commented that kangaroo can be cooked at a lower temperature. It is important not to cook kangaroo too long – it is important to rest it and let it bleed.
- Some felt that the odour of kangaroo was fairly strong. One person used a lemon juice and pepper dressing to cut the strong odour and taste.
- Another person used Middle Eastern spices including cumin to reduce the ‘gamey flavour’.

When commenting on the flavour, tenderness and toughness of kangaroo, people made the following comments:

- The taste can be a bit like offal.
- One person had been out in the bush and had shot and eaten kangaroos.
- One person found kangaroo tough ‘if I cook it at home’.
- Most people in the group agreed that kangaroo steaks were not too hard to cook. Sausages were also good.
- One person had tried venison ham which had been smoked and salted. She also felt that kangaroo would be good if smoked and salted.
- Some felt that kangaroo could be a pretty tough meat – based on the lifestyle of the animal.
- Kangaroo prosciutto is good.
- One person had tried kangaroo jerky and found that it had a strong flavour.
- Some people had no problem with the flavour although a few found it a strong flavour.

- One person slow cooked kangaroo with olive oil and red wine. Another person used a red wine marinade and also used kangaroo in shish kebabs.

- People agreed that kangaroo ‘does not look like regular meat’.

Five to six people in the group felt that kangaroo had a fairly strong flavour.

Comparison with Other Meats

People made the following comments when comparing kangaroo with other meats:

- It is like rabbit and venison – a game meat.

- Kangaroo meat is very lean and compares well to other meats because of its low fat content.

- Kangaroo sausages and mince are very good.

- Some people liked the dark colour of the meat.

Health, Nutrition and Other Benefits

People felt that the benefits of kangaroo included the following:

- The iron content.

- The lean meat. It slices well when cold.

- People commented that grazing animals had to be taken to an abattoir and at times there was stress involved. Kangaroos are killed on the spot and there is less stress.

- Kangaroos are not genetically modified.

- There are more trace elements in kangaroo meat.

- There are no antibiotics used in kangaroos. Some were concerned about use of antibiotics in chicken meat.

- ‘Kangaroos have a lighter footprint on the earth’ and there is no farming of kangaroos.

Disadvantages of Eating Kangaroo Meat

People felt that the disadvantages of eating kangaroo meat included the following:

- Perceptions that kangaroo is ‘pet meat’ or ‘Skippy’.

- One person sometimes cooked meals for guests and did not mention that it was kangaroo. For this person, it was a price consideration. However the guests never noticed.

- Kangaroos are on the Australian emblem.

- One person felt they were vermin like rabbits.

- A few people were concerned about the parasite issue – the meat is often still bleeding when cooked and people did not know whether parasites were an issue.

- Some are concerned that kangaroos are killed and not put in the fridge straightaway.

- A few had concerns about ‘dirty’ meat because the animals were wild and the way in which animals are harvested. Others in the group commented that all meat is covered by food safety regulations.

- One person in the group had shot kangaroos and commented that kangaroos are shot at night and refrigerated within 10 hours.

- Again a few people in the group raised the issue of parasites.

- Cole's has very high quality control on all of its food and would not sell kangaroo if it had parasites.

Sources of Information on Kangaroo Meat and Recipes
People used the following sources for information on kangaroo meat and kangaroo cooking and recipes:

- The internet – 'The Roadkill Recipe Book'.

- The CWA cookbook.

The Roma Meatworks sends kangaroos to Russia for meat supply.

Some animals are slaughtered in the halal method but some are concerned that this was not as safe as having a regular meat inspector.

Dieticians advise that kangaroo meat is healthy because of the low fat and the nutritional profile.

Knowledge of How Kangaroos are Killed and Processed
Some in the group did not know much about how kangaroos are killed and processed.

People in the group knew that kangaroos are not farmed and that they are culled.

Some people in the group knew that shooters go out and use spotlights and shoot kangaroos at night.

There is an image of a 'tough Aussie out there shooting kangaroos'.

One person commented that kangaroo shooters are professionals and use refrigerated vans – there is a mother ship to take carcasses.

Only two people in the group felt that they did not know much about how kangaroos are killed and processed.

Views on Wild Culling
People made the following comments about wild culling of kangaroos:

- Some were concerned about joeys being left in the pouch when their mothers were killed – 'cows are not pregnant when they kill them'.

- Only one young woman in the group wondered whether there was any farming of kangaroos.

- When people drive out west, they run over kangaroos.

- Most in the group had no problem with kangaroos being shot.

- Sometimes kangaroos are just shot for dog food.

Awareness of the Kangaroo Population
None of the people in the group knew the size of the kangaroo population. One person thought it was 30 million.

Concerns over Humane Killing

People in the group felt that shooting kangaroos was more humane than taking cows through a slaughterhouse. One person was concerned about shooting kangaroos in a limited area – did this affect the gene pool if large kangaroos were shot, leaving only smaller kangaroos.

Reaction to the Conservancy Concept

Participants were given an outline of the conservancy concept:

> Deborah Wilson Consulting Services is conducting market research to assess potential market demand for niche production of high quality kangaroo meat under an environmental brand.
>
> The Maranoa Wildlife Conservancy which is west and north of Roma in Queensland has been formed by a group of pastoralists, mainly cattle producers to sustainably manage the region's kangaroo population, produce kangaroo meat and promote biodiversity among wildlife.
>
> The Conservancy product will represent approximately 2% of kangaroos culled annually within Australia and will offer these benefits over existing kangaroo meat:
>
> - **Improved Product Quality – more consistent and higher quality kangaroo product** as a result of improved harvesting processes (chiller management, improved traceback systems using GPS and data logging)
> - **Environmentally Sustainable –** the conservancy will **use an environmental management system** – managing the stock load on properties and preserving the existing environment. A number of the conservancy landholders are ISO14001 Australian Land Management System accredited.
>
>   Another benefit is that encouraging kangaroo consumption instead of beef consumption can reduce greenhouse gases.
> - **Increased Food Safety –** kangaroos will be harvested using **quality assurance systems** including health, hygiene and food safety.
> - **Humane Harvesting Methods –** the size of the region allows wild kangaroos to be harvested in the **most humane method** possible.
>
> The research will cover:
>
> - Interest in Conservancy brand kangaroo products.
> - Types of kangaroo products preferred.
> - Key factors that would encourage use of the Conservancy brand kangaroo.
> - Information needed about the Conservancy brand kangaroo.

People's reaction to the conservancy concept included the following:

- Quality is an important aspect.
- Some are concerned about the impact on joeys in female kangaroo pouches – some would pay extra if they knew that joeys were taken care of when the mother was killed.
- 'It is a good spin to be ecologically sound.'
- It would be good if the meat is better – 'I always think of parasites'.
- There is more effort gone into it.

- People in the group felt that it would be a positive thing to have environmentally branded kangaroo.

- One person felt that they would pay extra to not have the same dog meat handling of kangaroo. People are prepared to pay extra in a delicatessen.

Four people in the group were interested in the conservancy branded kangaroo and were prepared to pay 10% to 20% more for this kangaroo.

Best Types of Kangaroo Product
Consumers felt that the best types of kangaroo products for the conservancy or environmental brand included:

- Prosciutto.

- Smoked kangaroo.

- Something different – perhaps adding bush tomato or lemon myrtle in sausages.

- One person questioned whether sausages were a good idea – is it supposed to be cheap?

- Smoked kangaroo and kangaroo salami.

- Environmentally branded kangaroo should offer basic cuts – like organic meat.

People in the group discussed the fact that organic meat had a similar type of positioning.

One person was interested in kangaroo tail.

The branding could tell people how it is different – people understand what free range eggs are compared to ordinary eggs but it is harder to understand what the difference is with the environmentally branded kangaroo.

People knew that kangaroos are already free ranging.

Some felt that the environmentally branded kangaroo would be close in price to the ordinary kangaroo – there is no hand feeding of the kangaroos.

People acknowledged that they pay more for wild fish.

Some people also noticed other specialist meat such as camel, crocodile and emu.

Benefits of the Conservancy Product
The benefits the conservancy product needs to offer to prompt consumers to trial it and buy it on an ongoing basis included the following:

- Reliability – being able to buy the product and have reliable quality.

- Having a very healthy product.

- Kangaroo is becoming more mainstream – it is very healthy.

- A 20% higher price is still cheaper than other types of meat.

- Perhaps it could be used in McDonald’s burgers.

- One person suggested using it in meat pies – it promotes Australian pride.

- One person knew that kangaroo meat is exported to Russia and it is 'just sold as meat'.

Pricing
People in the group reported that kangaroo meat sells for $6 to $7 or $8 per kilo.

Brand Name
The brand name needs to get across the following information to consumers:

- Local – western Queensland.
- Some thought has gone into it.
- Food safety.
- The food is fit for human consumption and is safe.
- The environmental benefits.
- That it is a gourmet treat.
- Letting people know that shooting does not stress out the kangaroos. One person commented that cows can get very stressed. The group discussed this and decided that 'they did not want to know about the killing process'.
- Let people know about the iron content.
- Information that the product stores well.
- Letting people know that the harvesting of kangaroos is not damaging Australia.
- Get the Heart Foundation Tick.

Availability
Consumers provided the following feedback on availability of the new product:

- Some want it available every day.
- People wanted to know when the product was available. People understood that fruit can be seasonal but did not associate seasonality with meat.
- One person in the group mentioned that slow food is all about choosing seasonally available food – this new product would fit in with slow food.
- Consumers wanted a frozen alternative available if fresh was not available.
- Smoking the kangaroo will give it a longer shelf life.
- Some people wanted to have that 'hunter gatherer' link and would feel that buying the product kept them 'in touch with the land'.
- People suggested including packs of lemon myrtle seasoning and recipe cards with the kangaroo.

Differentiating the Product
Consumers wanted to know who the people are that will benefit from the product, e.g. is it an Australian owned farm?

People were more interested in supporting a local group of farmers versus a multimillion dollar business.

‘Does it link in with the indigenous community?’

People wanted to know what the benefits were to the land.

Were the producers local owners?

Trying and Buying the Conservancy Kangaroo Product
People were asked when they would try and buy the conservancy or environmentally branded kangaroo:

- Some would buy it when they had visitors.
- Buy it from the deli.
- One person made the comment that kangaroo meat is very dark and can get ‘lost in the black containers’.
- Kangaroo steaks are not flat like other steaks.
- Australia Day.
- The new product could be Cryovaced.
- In store promotions encouraged people – cooking the product and giving people a taste test.
- Ethnic festivals – often at festivals there are food from all nations but no truly Australian foods – perhaps the environmentally branded kangaroo can be promoted as Australian food.
- One person had an Australian food themed dinner party. She had cooked possum and had to get it from New Zealand. Possum recipes use half possum and half beef. Perhaps there is an opportunity to use the same approach with the kangaroo – half kangaroo and half beef.
- People buy chicken from the deli department of the supermarket. Environmentally branded kangaroo could also be sold in the same way.
- It is up to the restaurant whether they offer kangaroo. Restaurants offer very high quality meat, e.g. 1824 Steak, Bangalow Sweet Pork. The environmentally branded kangaroo can be promoted to restaurants in a similar way.
- Organic restaurants in capital cities would probably be interested in the product.

Important Messages
The most important messages to encourage people to order kangaroo meat more frequently at restaurants or buy it more frequently at supermarkets included the following:

- The conservancy message.
- Health and environment are the top messages.
- Where people can buy the kangaroo.
- Information on how to cook kangaroo and providing more kangaroo recipes.

- The quality assurance systems and food safety.
- Humane harvesting methods – however some did not want to know about this information.
- Sustainable management of kangaroos was of interest to some but not to others.
- Sustainable management of pastures and land was of interest to some.
- Sustainable management of wildlife was important to some.

Trying the New Environmentally Branded Kangaroo Meat
Four of the people in the group would be more inclined to try kangaroo meat, eat more or order it more frequently in restaurants if kangaroos were from a sustainably managed conservancy.

Monitoring Numbers
People felt that the conservancy approach does show a different approach to culling kangaroos and sustainable management**.**

Paying More
The majority of the people in the group felt that they would be willing to pay more if kangaroo was sourced from a sustainably managed land production system.

Priorities
The priorities and messages to encourage people to try and buy the environmentally branded kangaroo product included the following:

- It should be easy to get – available in a supermarket.
- Provide lemon myrtle and other seasoning with the kangaroo.
- Focus on the sustainability message – aboriginal people use all of the kangaroo.
- Some crops like cotton take too much water to produce. There has been a move to replace cotton with hemp. The environmentally branded kangaroo would be a more sustainable approach for the environment than beef.
- There is more sustainability in using kangaroos as the leather, bones and other parts can all be used.
- Some felt that kangaroo had a very strong flavour and this would need to be overcome. Providing seasoning such as lemon myrtle can cut through this strong flavour and taste which is repellent to some people.
- The sausages are fairly mild. Perhaps the group can donate sausages to school fetes and then let people know that they are kangaroo sausages.
- Perhaps get the Australian Boxing Team for the Olympics to eat and endorse the kangaroo.
- People wanted the convenience and ease of being able to buy the kangaroo. It must also be easy to cook.

A6.3 Focus Group with People Who Do Not Regularly Eat Kangaroo

Current Consumption and Attitude

At the start of the group people were asked to comment on the type of meat they had purchased last time they went shopping. Feedback included the following:

- From the organic butcher, roast, steak and chops.
- Organic lamb, sausages.
- Chicken schnitzel and topside.
- Chicken thighs.
- Chicken, pork, leg ham, salami and schnitzel.
- Organic chicken breasts.
- Half a hot chicken.
- Steak, rack of lamb, chuck, sausages and roast chicken.

Consumption of Kangaroo

Four of the people in the group had eaten kangaroo at some time in the past. Feedback included the following:

- One person was at a barbecue and had been served very thin slices of kangaroo with pepper.
- One person went to a restaurant that had kangaroo, crocodile, emu, buffalo and camel on the menu.
- Another person had also tried kangaroo at a restaurant.

Feedback on kangaroo included:

- 'It's okay.'
- 'You cannot have too much of it.'
- Some had not thought about it but had tried it when it was offered.
- Some were worried about the fact that it was a wild animal. Feral animals are not healthy and perhaps there was a health risk.
- 'Eating kangaroo is like eating the bald eagle.'
- Other people in the group simply had no opportunity to try kangaroo.

Views on Kangaroo

One person who had eaten kangaroo found it more tender than he had thought. The kangaroo meat was very tender at a restaurant but this person wondered whether they could cook kangaroo well at home.

Another person felt that kangaroo was good for a change but was not a regular weekly purchase – it is more of an occasional purchase.

Kangaroo has a strong flavour – much stronger than steak.

People in the group agreed that it had a strong, gamey and rich flavour.

Comparison with Other Meats

Some felt that kangaroo did not compare well with other meats – 'I don't love it like I like chicken'.

Kangaroo does not compare as highly with other meats because it is not eaten as often.

People were 'brought up on beef and chicken'. People agreed that getting used to food early on had a big influence on what they ate today.

Australians eat Vegemite but adults who come to Australia from other countries do not necessarily like the Vegemite flavour.

One person felt that as kangaroo was a strong meat, people would use less of it because of the strong flavour.

Health and Nutrition
People made the following comments on the health, nutrition and other benefits of eating kangaroo:

- 'There are a heap of them.'
- Australia is the only country that eats its national emblem.
- Some thought of kangaroos as pests.
- Kangaroos are 'fed to dogs'.
- Kangaroo is high in iron.
- Eating kangaroos is better for the environment than eating beef. A cow has the greenhouse gas emissions equivalent to a Land Rover.
- Some did not know where to get kangaroo from.
- People discussed the fact that when animals are shot, the stress hormone can affect the condition and quality of the meat. People would want to know the conditions under which kangaroos are shot.
- People knew that kangaroo was lean meat.
- Some were not sure what part of the kangaroo was available – is it the rump?
- One person commented that 'they use all of the kangaroo for dog meat'.

Knowledge of Kangaroo Killing and Processing

One person in the group had been out shooting kangaroos.

Shooting kangaroos is a pest control issue in some areas.

Some in the group were not sure what the relationship was between kangaroo numbers and the land.

Disadvantages of Eating Kangaroo Meat

The high iron content can be a problem for some people.

There can be a perception that kangaroo is 'roadkill or pet food'.

One person in the group was an American and felt that eating kangaroos was like eating bald eagles.

Some felt sorry for the ‘poor joeys’ when mother kangaroos were shot.

Some had seen information about kangaroo and kangaroo recipes in magazines such as Gourmet Travellers – exotic magazines.

There was push on promoting kangaroo for human consumption about 10 years ago. It became more mainstream – Geoff Jansz was cooking kangaroo but then it ‘fizzled out’.

Knowledge of the Kangaroo Population

People were not sure how many kangaroos there were in Australia but felt that there were ‘many’.

Some knew that ‘farmers hate them’.

One person thought there were a million or more kangaroos.

Reaction to Conservancy Supply

People were given information on the conservancy concept.

People provided the following feedback on their initial reaction:

- Some were concerned about female kangaroos being shot.
- People felt they were more likely to buy kangaroo if they knew what was behind it e.g. the conservancy brand.
- It is important to tell people what to do with kangaroo – how to cook it. People needed recipes and advice on preparation.
- One person would not buy it from Woolworths and Coles – the meat looks ‘old or dirty’.
- The product would need to be in gourmet packaging and the low emissions message and environmental branding needs to be on the packaging.
- Butchers could provide tastings. Wine tastings are popular and butchers could recommend the environmentally branded kangaroo to people when they are serving customers.
- The kangaroo needs to be packaged – a gourmet pack.

If the meat was just on a slab, it would look ‘diseased’.

Some people will not buy caged eggs so there are already examples where consumers will make choices for more natural or environmental products.

The product needs to have an image as a delicacy. It could also be promoted to encourage young people to try the product.

Benefits the Conservancy Would Need to Deliver

The key benefits the conservancy product would need to deliver included:

- Integrity of the product.

- Good quality and consistent quality.

- Good quality – killing the animal as soon as it is caught.

- Food safety.

Range of Information Consumers Need

The range of information that consumers wanted about the conservancy brand and its role in sustainable properties, preserving the environment and sustainability of kangaroo populations included the following:

- Price – is it cheaper than (beef) meat.

- Why is the price 20% higher than other kangaroo?

- The quality and the integrity of the product.

- An Australian business – produced by Australians.

- Some were concerned about game meat – pigs and rabbits have parasites and some were concerned about the health of the animal and whether eating kangaroo could cause harm.

- Nutritional information including fat content.

- 'Why it is good for you'. The omega-3 message has been a strong one – tell people why it is good for you.

- Good packaging and the story on the pack.

- People felt that the product should be sold through butchers and consumers could be given a booklet explaining the conservancy product.

- Safe.

- Good for you.

- 'Not Skippy or Captain Kangaroo'.

- Fresh.

- Gourmet.

- Organic.

Branding Compared to Other Kangaroo

People felt that the conservancy product should have the following branding compared with other kangaroo:

- Better quality – building the reputation.

- People mentioned the 'eat red meat' TV ads. These have been very effective.

- Develop the cultural approach – kebabs with bush spices. The kangaroo product could come with sachets or pre prepared marinades or spices.

- Include an Aboriginal recipe and a recipe book.

Best Types of Products
Consumers felt the following products would be the best types of products for the new kangaroo product:

- Fillets – this is a delicacy.
- Kangaroo jerky.
- Kebabs.
- Rissoles.
- Chorizo sausage.
- One person suggested mince for tacos but others felt that mince was too down market.
- Kangaroo sausages. Stronger style sausages such as Italian or chorizo would be good as kangaroo has a strong flavour.
- Kangaroo prosciutto – this is good.

Attractiveness of the Conservancy Brand
The attractiveness of the kangaroo product compared with other premium meats such as organic beef, corn fed chicken and free range chicken would depend on the labelling and the promotion.

People would need to understand what the environmental brand actually meant.

People understood what the terms 'organic' and corn fed meant but they were not really sure what the environmental or conservancy message was.

This needs to be a clear message combined with information about safety and quality of the product.

Availability
People felt that it would be okay if the product was seasonally available, e.g. available in winter. If it is intermittent supply, some would not remain interested.

Information on the Conservancy
Some in the group pointed out that the conservancy farmers would still be producing cattle – cattle produce methane and farmers clear land. What is the difference or benefit with the conservancy kangaroo?

Farmers may be looking after the land but are they looking after the kangaroo or the cattle – these seem to be completely separate.

It will be important to have an environmental message on the cattle issue.

Trying the Conservancy Product
Eight of the people in the group would be prepared to try the new product.

People would be interested in a taste test.

People suggested television advertising, brochures and recipes in the pack to promote the product.

Perhaps the new product could have its own brand of sauce – not on the meat itself but in a pack that is separate.

The new kangaroo product could also have its own recipe book – this would be very useful.

Important Messages

Important messages included the following:

- Availability of the product is a big thing.

- What does it mean in terms of emissions? There was a lot of talk about emissions and people would want to know what impact it was having.

- Have the options for recipes and recommendations on wine.

- ‘Will the kids eat it?’

- Can it be used at a barbecue – will everyone in the family eat it? If the whole family would not eat it, some would not buy it.

- It would be something new.

- People need advice on preparation.

- Perhaps there could be a promotion – kangaroos for kids like the pasta shapes at McDonald’s.

People felt that the following messages were important:

- Where people can buy the kangaroo.

- More information on how to cook the kangaroo and more kangaroo recipes.

- Quality assurance including food safety.

- Assurance about the source and the ability to trace back – some felt that general information was okay but felt that GPS tracking was a bit too much.

- Sustainable management of kangaroos.

- Sustainable management of pastures and land with a high level of ground cover as a result of harvesting kangaroos from the conservancy area.

- Sustainable management of wildlife.

- Reducing greenhouse gases by eating kangaroo – people felt that they would do anything that will help.

Environmental Balance

People felt that it was important to have an improved balance between kangaroos and sheep but properties would still continue to carry sheep or cattle.

Top Priorities

‘If the product is a success, it will not make a dent in the 50 million kangaroos out there’.
Top priorities for the new product included the following:

- Some did not want mother kangaroos with joeys shot.

- Kangaroos are very territorial -If farmers took the fathers, kangaroos, would this affect family groupings?

- How can the suppliers guarantee the quality?

- Why is it better than beef?

References

Ampt P and Owen K (2007), 'Choosing Kangaroo: Product and Industry Attributes and Consumer Choice Behaviour", Draft Report to Rural Industries Research and Development Corporation, July

Kelly J (2005) 'Kangaroo Industry Strategic Plan 2005-2010', Report for the Rural Industries Research and Development Corporation, Lenah Consultancy, RIRDC Publication No 05/108, Canberra.

Des Purcell and Associates (1997) 'Improving Consumer Perceptions of Kangaroo Products', RIRDC Publication No 97/036, Canberra.

Rural and Regional Affairs and Transport Legislation Committee

ANSWERS TO QUESTIONS ON NOTICE

Supplementary Budget Estimates October 2016

Agriculture and Water Resources

Question: 187

Division/Agency: Rural Industries Research and Development Corporation

Topic: Kangaroos

Proof Hansard page: Written

Senator RHIANNON asked:

May I please have a copy of the following reports, preferably in digital form:

a) RIRDC project '*Kangaroo meat export market access analysis'* (by Oliver & Doam) which was due to finish on 10 July 2015.

i. May I also have a copy of the presentation and workshop documents, notes and outcomes from that project please. If not, why not?

b) Project PRJ-002302: Taking the Kangaroo Industry to the internet community: This project provided $110,000 to KIAA's John Kelly, with the aim to "research and produce and load a range of ['positive'] material to contributor generated sites such as youtube and wikipedia, industry sites and any other suitable forum" and to "ensure resources are available to counter anti industry campaigns." Please provide:

i. any report or research papers from this project

ii. a list of websites and links to materials 'loaded' onto any internet sites or forums

iii. copies of the 'resources…available to counter anti industry campaigns"

c) Sustainable Wildlife Enterprises Trial in The Murray Darling Rangelands (PRJ-000877)

d) Strategic Management of Total Grazing Pressure in Semi-Arid Environments (PRJ-000676)

e) Ongoing kangaroo industry up-imaging (2006)

Answer:

a) The report was prepared to assist the kangaroo industry to develop a meat export plan. Rural Industries Research and Development Corporation does not intend for the report to be published.

Question: 187 (continued)

b) An industry video developed from this project is available on the KIAA website and Youtube. Nine cooking demonstration videos were also developed for Youtube and the KIAA website. A range of kangaroo recipes and photos of dishes were uploaded to myspace, photobucket, kangaroomeat.net.au and the KIAA website. Kangaroo industry, kangaroo meat and kangaroo leather briefs have been loaded onto Wikipedia. Six kangaroo industry newsletter have been produced, distributed and loaded onto the KIAA website. Several blog groups were established on Facebook including, 'Eat more kangaroo - become a kangatarian' and 'kangaroo youth forum'.

c) No final report was published.

d) No final report was published.

e) This project developed newsletters that were posted to the KIAA website.