Anim. Prod. Aust. 2002 Vol. 24: 425-434

THE McCLYMONT LECTURE FOR 2002

THE IMPACT OF ANIMALS ON THE ENVIRONMENT: SHOULD WE BE SWITCHING TO KANGAROOS AND, IF SO, HOW COULD WE? A PAPER TO STIMULATE DISCUSSION

G. GRIGG

Zoology and Entomology, School of Life Sciences, The University of Queensland, Qld 4072

SUMMARY

The long-term ecological and economic sustainability of what we now call the sheep rangelands probably depends upon finding a less damaging alternative to sheep. If you were to design the perfect grazing animal for our semi-arid rangelands, it would be one that returns a good profit at stocking rates that are ecologically benign. Neither sheep nor goats qualify but, with better marketing, I believe that kangaroos are not far from that perfection. In this paper I describe in some detail how a new generation of kangaroo growers might operate, not farming them, but taking a selective, regulated, harvest from the free range populations. I identify current problems and suggest solutions, and provide suggestions about how the increase in price for the product could be achieved.

Keywords: rangelands, kangaroos, ecological and economic sustainability, harvesting, marketing

INTRODUCTION

If the land we now call the sheep rangelands has any significant economic future, it will probably not be in sheep. The environmental costs of land degradation will be intruding increasingly into the balance sheet and it is hard to see wool prices ever becoming sufficiently high to swing the 'triple bottom line' balance sheet positive. The present trend in NSW and Queensland towards replacing sheep with goats is unlikely to provide an ecologically sustainable answer, and much more likely to precipitate a quantum increase in land degradation, pushing the rangelands finally to desert as happened to much of the Mediterranean lands. Rangelands grazing enterprises would have a much better chance of long-term economic viability if there were a herbivore that could be sold for sufficiently high prices to enable profitable operations at densities which are ecologically benign. This is clearly not the case for either sheep or goats, but kangaroos seem to have the potential to reach prices at which they may be that herbivore. This paper explores that possibility.

Australia has 50 species of macropod marsupials — the kangaroos, wallabies and rat kangaroos — of which many have suffered serious declines or become extinct since colonisation by Europeans, particularly as a result of habitat modification associated with grazing by introduced stock (see review by Calaby and Grigg 1989). However, a small number of species of large kangaroos — the Red Kangaroo *Macropus rufus*, Eastern Grey Kangaroo *M. giganteus* and Western Grey Kangaroo *M. fuliginosus* in particular — have increased markedly in abundance. They are present in vast numbers in many parts of Australia's arid and semi-arid rangelands, a mostly degraded area occupying about 40% of the continent, where they coexist with about 15% of the nation's sheep flock. The initial degradation was caused by the wool industry, with sheep numbers driven by the 19th century English wool market without regard for the impact of overgrazing on the land (Lunney 2001), which was exacerbated by the rabbit plague. Total grazing pressure remains an issue today and the long term ecological and economic future of the degraded rangelands probably depends upon finding an ecologically benign alternative to sheep.

PRESENT SITUATION

Most of Australia's sheep, about 85%, are not in that semi-arid 40% or so of Australia that is called the sheep rangelands, but in the wheat-sheep belt. In the semi-arid lands wool productivity per hectare is low, and only large properties are viable in the sense that they provide a family with a good living. Land degradation throughout the sheep rangelands is severe in many places and, when wool prices are low, economics encourages overstocking and further degradation. Many woolgrowers in the rangelands lack

faith in the long-term capacity of wool to sustain them and their families, and many are looking for other alternatives. Hence we see the growth of farmstays and other forms of ecotourism, and other uses for land such as switching from sheep to cattle and the planting of traditional and novel crops. In some areas, landholders are switching from sheep to goats.

In the search for an alternate industry, it is worth noting that most of Australia's kangaroos live in the sheep rangelands. I think it strange that landholders overlook kangaroos as they seek alternate uses for their land and supplementary sources of income. Most woolgrowers see kangaroos only as a pest, competing with sheep, drinking their water, damaging their fences and colliding with their cars. Accordingly, most wool growers are apparently content to allow kangaroo shooters onto their land to harvest kangaroos, free of charge, presumably seeing a benefit in having the numbers reduced at no cost to them.

There may be another approach. Kangaroos seem to have a lot of potential to provide significant extra income for woolgrowers and to improve property viabilities at lowered total grazing pressures. For reasons that are not immediately apparent, however, graziers seem to be disinterested in pursuing this potential. Why they ignore kangaroos (except as perceived pests) yet seem happy to switch to goats (which probably really are pests) is not clear. The present low price of kangaroos is undoubtedly a hindrance, but maybe that could be changed with good marketing. Also, the iconic status of wool growing in Australia (riding on the sheep's back) and the low esteem in which kangaroo shooters were once held (or still are?) may have a lot to do with the current financial disinterest in kangaroos by most landholders.

Whatever the reason, I think that woolgrowers and their organizations are missing out on an opportunity. For one thing, the present kangaroo industry has all the nuts and bolts in place for significant expansion. The only thing missing, really, is a high price for the products. If the price of kangaroo meat at the farm gate were to double, the situation could be very different. And if woolgrowers and their organizations were to put the same imagination and political grunt into marketing and getting behind kangaroo products the way they have for wool, I think they would be on a winner.

Let us explore the present kangaroo industry, and why I say that it already has just about all the nuts and bolts in place for expansion.

The kangaroo industry is now well established. There is a large annual harvest, proven by many years of experience to be sustainable in the long term, with most of the legislation, regulations, biological knowledge and industry infrastructure already in place. Kangaroos in fact already provide a spectacularly successful example of an ecologically sustainable wildlife harvest (Pople and Grigg 1998, Grigg and Pople 2001).

A lot has changed on the kangaroo front in the last 20 years. In the 1970s exports of kangaroo products were closed down because of concerns about the effects of harvesting on the populations and the lack of good monitoring protocols. This stimulated a large amount of research, including aerial surveys and population ecology, particularly by Graeme Caughley (see Caughley *et al.* 1987). A lot of wild claims had been made about how the kangaroo industry was threatening kangaroo populations with extinction, but the research refuted that entirely and convincingly. It showed that the large species of kangaroos were abundant, their numbers being dictated by rainfall and subsequent growth rather than by harvesting. When the restrictions were lifted, harvest quotas based on regular population monitoring were set annually, state-by-state, and the industry has grown considerably since then. Most of the focus earlier was on hides and pet food, and in the 1970s only South Australia the ACT and the NT permitted the sale of kangaroo meat for human consumption. This prohibition was partly a reflection of the conservatism of the times and partly because of lobbying by producers of traditional red meats. However, kangaroo meat is now available in all States and the proportion of the harvest that goes for human consumption is increasing strongly. There are guidelines to ensure hygienic handling of the meat in the field and a Code of Practice to ensure humane slaughter. Kangaroo is on the menu at many restaurants. Both local sales and the export of kangaroo meat for human consumption are rising. Its export has risen dramatically from 2.8

million kg in 1995 to 5.8 million kg in 2000 (Kangaroo Industry Association of Australia [KIAA] April 2001 Newsletter, view at http://www.kangaroo-industry.asn.au). This is only 20% of the total weight of kangaroo meat sold, so there is a huge capacity to increase the sale of meat at a better financial return, without increasing the number shot. With BSE and similar diseases affecting sales of beef, the trend towards alternate meats such as kangaroo is logical. Some landholders have instituted kangaroo harvesting and others have profited from charging for access to kangaroos on their properties. Importantly, there has been a growing awareness of the potential to gain conservation benefits from the sustainable use of wildlife (see Grigg, Hale and Lunney 1995), as well as a formal endorsement of the concept by the International Union for the Conservation of Nature in Resolutions 18.24 (Perth 1990) and 2.16 (Amman 2000). Moreover, most Australian governments have adopted policies which support the sustainable use of wildlife (see, for example www.dlwc.nsw.gov.au/care/land/wlr). So we have come a long way. Despite this, woolgrowers, on whose properties most kangaroos grow, still seem to have their backs turned, except to focus on 'pest' control.

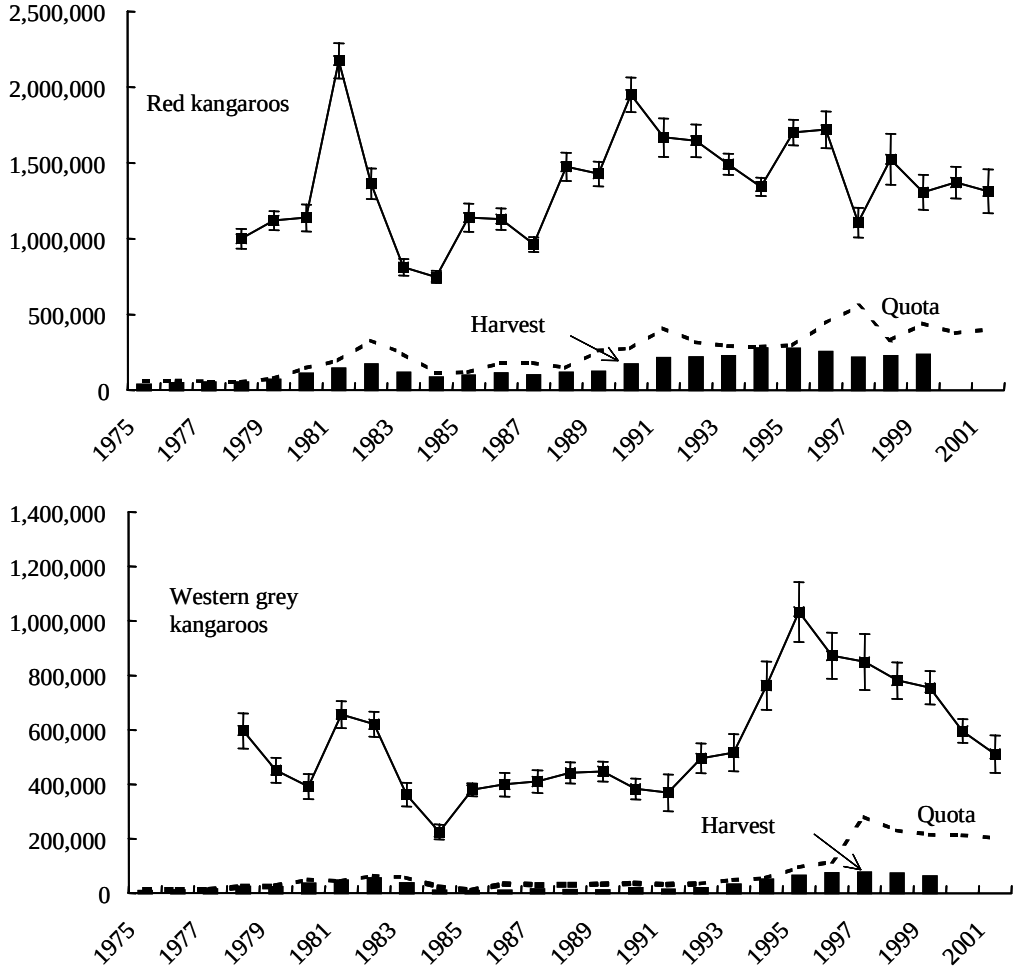

Figure 1. Population trends in Red and Grey Kangaroos, annual harvest quotas and achieved harvests in the sheep rangelands of South Australia (updated and modified from Grigg and Pople 2001)

Our semi-arid rangelands are already the location for a very large, well regulated, sustainable, and humanely carried out harvest of free-range kangaroos. In the absence of dingoes, there needs to be control of kangaroo numbers, else there will be even more widespread and pronounced starvation of kangaroos in every drought. So the artificial predation provided by a kangaroo industry is an important element in the now man-made, artificial ecosystem of the rangelands. What I am saying is, let us make the absolute most of this, and use it as a way to promote rangeland rehabilitation and economic productivity.

Let me now try to paint a picture of a possible future in which a shift in focus by landholders from sheep to kangaroos allows improved property viability at reduced total grazing pressure.

A VISION FOR THE FUTURE: ECOLOGICALLY AND ECONOMICALLY SUSTAINABLE KANGAROO HARVESTING AS A REPLACEMENT FOR SHEEP

Scenario

Just imagine for the time being that kangaroos were worth a lot more money. What scenario can we imagine of how an industry might function, and what elements are missing? In my vision, I see kangaroos remaining as free-ranging wildlife, and harvested periodically and humanely by small teams that move around the country with a mobile chiller, probably in an annual cycle. The teams harvest the number of kangaroos permitted for that property by the regulatory authority, and pay a price for them negotiated in advance with the property owner. It is likely that some landholders would want to be more involved, either through financial interests in the harvesting and processing chain or, perhaps, more directly through employing harvesters and managing the sale of their own product. Both of these situations exist now, of course, in a limited way. Some landholders already charge access rights to shooters. Some landholders have taken out appropriate licenses to harvest, process and sell their own kangaroos.

Setting of quotas and future monitoring

I see a continuing and important role for government regulatory agencies in setting annual quotas. To set quotas properly at a property level, if kangaroos are more valuable and there is more pressure than at present to maximize the quota, will be a bit of a challenge and will require some developments and modification. At present, kangaroo populations are estimated by aerial surveys at sampling intensities that are good for deriving estimates at regional scales. This means that an appropriate harvest quota can be set for a region, but it is difficult to translate this to an appropriate quota for each of the properties in that region. At present this is achieved by different means in different jurisdictions, taking local knowledge into account and some information about the distribution of different habitat types within a region. Some current research work under way at The University of Queensland should enable a significant refinement in this within the next two-three years. We have an ARC Linkage grant to examine correlations between trends in numbers and satellite-gained indices of pasture growth, among other things. This work is in collaboration with partners in State and Federal agencies and the kangaroo industry and should allow two improvements. We should be able to add an element of prediction a year ahead of the likely number and distribution of kangaroos. We should also be able to provide valuable interpolations between the present survey lines, to enable better assessments of density and quota setting at a more local level, taking habitat into account.

This will, however, still be short of what will surely be required if kangaroos become a high value commodity. We can be sure that, if this were to happen, landholders would want to be sure they were getting the maximum possible offtake, set as a percentage of the number of kangaroos on their property, and so having an accurate estimate would assume a much higher importance than it now does. I can see a time, therefore, when landholders would be wanting to have an opportunity to conduct kangaroo surveys of their own properties, and paying for it. There is already an appropriate method for conducting accurate surveys of smaller areas, using the 'line transect' technique which is regarded as industry standard by wildlife managers. As applied to kangaroos, this involves flying transects across the property using a helicopter and a team of trained and experienced observers, methodology which has been thoroughly researched and validated by QPWS. Because helicopters are quite expensive, Lyn Beard, Tony Pople and I trialled the use of an ultralight aircraft as a survey platform, instead of a helicopter, and found it very satisfactory.

Figure 1. A Drifter ultralight aircraft set up for kangaroo survey of individual properties using line transect methodology. The observer sits behind the pilot and can count to the southern (better viewing) side in both E-W and W-E transects (Grigg, Pople & Beard, 1997).

Figure 2. Observer's view of transect from the Drifter ultralight. Kangaroos are recorded by species and distance from the aircraft as guided by the grid wires. At 50 knots, the ultralight emulates the use of a helicopter but at a much lower cost.

I can envisage a time when a kangaroo grower might contract one of a small number of certified kangaroo surveyors who operate from an ultralight aircraft and, following the protocols developed already, make an accurate estimate of the kangaroo stocks he property. An issue that people often raise with me is when would you do the survey? Because the kangaroos have no respect for fences and they might be here today but on the neighbour's place tomorrow. This is partly true, because kangaroos can be quite mobile if they need to be. But most radiotracking and tagging studies have shown that kangaroos tend to remain in the same general area for most of the time, moving out mainly when conditions deteriorate. So if were up to me, I'd let a landholder choose the time that they do the survey on which the quota is then based. That should avoid arguments and, as I suggest later, if land is managed in a way which encourages kangaroos to stay, not move out, then that is a conservation benefit.

Which bring us to the question of ownership.

Ownership

I am often told that what I am talking about could not work because a kangaroo grower would never know how many kangaroos they own, could not afford to put up big enough fences to keep them in, and could not identify their value as a basis for establishing a loan from a bank. I think this is not an issue. Under what I am proposing, kangaroos can remain the property of 'the Crown', which decides what a quota for the year will be, and ownership would be taken when a kangaroo taken within the approved quota has its tag attached. So in my property of the future, the recent history of kangaroo harvest quotas would be the basis for determining property value, rather than the records of wool clips or approved sheep stocking rates. There are some similarities here to the operations of a fishing industry; fishers do not 'own' their product, but have a right to harvest it, usually within certain proscribed geographic areas and to a certain catch limit. Because kangaroos can be seen from the air and counted, we will always have a much better idea of how many kangaroos there are than we know of fish stocks.

The harvesting process

The Code of Practice requires that kangaroos be shot in the head, and the success rate at that is extraordinarily high. This 'paddock slaughter of an animal unaware of danger' is undoubtedly humane in comparison to the process by which domestic animals are transported and slaughtered. Philosophically there is an appeal, too, because of the 'free-range' element. I know people who regard eating kangaroo as more acceptable than eating pork, beef or lamb or because of the way domestic animals are handled prior to death.

This is not to say that there is no room for improvement. Most females have a joey in the pouch, embryonic in comparison to the young of placental mammals, and dependant on the mother to whose teat it is attached. So when a female is shot the joey cannot survive. The Code demands that a joey is killed quickly with a blow to the head, which is undoubtedly humane, but is unacceptable to some people because it sounds so brutal. I think there is room for exploring ways to dispatch the joeys in a less brutal sounding way. Often there is a young at foot as well. As in many species, young kangaroos often remain with the mother well past their need to suckle. Most shooters do not shoot a female with a young at foot which they judge to be still dependant on the mother, partly out of concern for the young, but also because it makes good business sense anyway.

In the more sophisticated harvest that I envisage, I can see shooters being even more selective over which kangaroos they shoot. It is worth remembering that a shooter gets a good look at the target through the telescopic sight, and skilled shooters get to be good judges of the size and probable sex. Some have likened this inspection of the target to the pre-slaughter veterinary check conducted at abattoirs for domestic stock.

Harvesting, not farming; a low cost operation

Perhaps I should re-emphasise that I am not talking about farming kangaroos, but about harvesting them from the free-range populations. Farming implies fences, traditional ownership, husbandry, and so on. It would bring a need to provide fodder in poor times, diseases, attempts to treat disease, genetic manipulations and so on. In my scenario, kangaroos remain wild, and this is a strong economic benefit because there is no need for fences or their maintenance, or for drenching or many of the other costs which drain the profitability of pastoral enterprises. Water sources would need to be maintained, but would not need to be as close together as for sheep. The free-range nature of the stock will make it more politically and philosophically acceptable to the community at large, and will probably be better for the kangaroos. The low fat content of the meat is probably related to their mobility, and their mobility allows them to take advantage of conditions where they are good and move out when they are not. This movement away, perhaps to the neighbour's place, is often seen as a drawback to what I am proposing, and I have discussed above how quotas for a property could be set in order to minimize that concern. Also, however, at lower grazing pressures after the removal of sheep, kangaroos will be much less likely to need to move. Indeed, kangaroo growers may well instigate significant conservation-positive initiatives such as rabbit control in order to provide an environment in which kangaroos will be encouraged to remain.

Future stocking rates; realistic values of DSE

One effect of the removal of sheep would be the availability of more forage for kangaroos. The traditional view of this is that a kangaroo has a dry sheep equivalent (DSE) of 0.7. I have recently re-examined this figure (Grigg 2002) and shown that if relative body size had been taken into account, which it obviously should have been, the value would be 0.4. In the same paper, however, I raise the strong possibility that a more realistic value may be in the range of 0.15-0.2. The reason is that the value of 0.7 is derived from the resting metabolic rate of marsupials being approximately 70% that of placental mammals. It would be more reasonable, however, to compare 'field metabolic rates', that is, the energy requirements of animals not at rest but including all of their activity periods as well. Interestingly, marsupials in this size range have FMRs much lower than placentals, and when this is taken into account a DSE of 0.15-0.2 results. More work needs to be done to confirm this, but two totally independent studies using quite different techniques came up with the same answer for comparisons of FMR in marsupials and placentals, so it cannot be ignored.

The implications of this are quite striking. For one thing, it probably means that woolgrowers are chasing a mirage in hoping for any significant improvement in wool production by reducing kangaroo numbers. Kangaroos seem not to be the pest they are perceived to be. However, if we are talking about replacing sheep with kangaroos, then the lower DSE suggests that we might expect kangaroo numbers to rise very substantially unless harvesting pressure also increases substantially.

Put another way, it means that the kangaroo productivity of the semi-arid rangelands is much greater than anyone has thought. At higher prices for kangaroo meat, and added to the continuing production of hides, this means that the economic potential of the 'new' kangaroo industry is enormous.

Hard-footed versus soft-footed

Direct foraging is only part of the impact made by foraging herbivores on the pasture. They also make a physical impact on the plants in the way they feed and the way they walk over the landscape, the 'tooth and foot pressure' components of total grazing pressure. Currently, rangeland ecologists ignore it and assume that there is no difference between sheep and kangaroos in the abrasion and compaction to which the plants and soils are subjected as part of the foraging process. There is, for example, no consideration allowed for this in calculations translating kangaroos to sheep equivalents.

However, Australians at large often express the belief that kangaroos are soft-footed and therefore do less damage to the landscape than sheep. I have heard this time and time again, given as a good reason to eat kangaroo meat, from people who live in the city and have no vested interest in the matter. However, as Noble and Tongway (1986) noted, "supporting data for this folklore is deficient" and there appears to be no solid data that helps in any discussion about whether sheep are harder on the land. In the past I have asserted that they are (Grigg 1987), but have been reminded quickly about the lack of data. So I stopped saying it, but not thinking about it.

There are some data, and more recently. Noble and Tongway (1986) tabulated data that showed that sheep have a higher static foot pressure (1.9-2.6 kg/cm^2) than kangaroos (0.8-1.8 kg/cm^2). More recently, Bennett (1999) investigated "foot areas, ground reaction forces and pressures beneath the feet" of a range of 23 species of macropods and came to the conclusion that "the findings support the commonly held belief that introduced grazing animals may cause greater mechanical disruption of the soil surface, leading to increased rates of soil erosion, than Australia's indigenous grazing fauna".

However, a more comprehensive study is needed. If I had to make an assertion, which might be the working hypothesis, I would say that, based on the data on foot pressures, on what can be seen from the air, on what is known about the movements of kangaroos and sheep in paddocks, their use of water, and the way sheep flock together and are restrained in paddocks, it would be that kangaroos do less damage per head to soils and vegetation than do sheep, at similar, typical densities.

Further, if kangaroos replaced sheep as the main source of property income, it is likely that there would be less direct physical impact on the soil and the pasture, which would encourage land and biodiversity rehabilitation.

MARKETING

As I see it, most of the legislative, regulatory and ecological work is already done. The major thing standing between the situation we have now and the more ecologically and economically desirable scenario that I describe is the comparatively low value of the product. I think kangaroo meat is a product that has not yet found the place it deserves. And I do not see its place as a cheap meat exported to masquerade as beef or lamb. I think its place finally will be the as a game meat, sold for high prices in those countries where there is a strong culture of eating game, particularly in Europe. But there needs to be a lot of good promotion done first. Luckily, I think there is a lot of good material to work on, mainly because of the potential conservation benefits.

How to make kangaroo meat more valuable

Important background information relevant to a marketing campaign to put kangaroo meat on the world's game meat market includes the following considerations:

- At present the main commercial value of kangaroos comes from their hides. Kangaroo leather is thin but very strong and is ideal for shoes, including soccer boots and other sports shoes. A rapid increase in the volume or price in this market is unlikely because manufacturers can turn to cheaper leathers such as calf when shortages lead to price rises.
- Australia has a monopoly on the commercialisation of kangaroo products.
- The proportion of kangaroos shot for their skins alone is trending downwards, from more than half a few years ago to less than 15% now (John Kelly, KIAA *pers. comm.*). Only Queensland has a legal skin-only take, but this now equates to less than half the total annual harvest. Most of the kangaroo meat harvested annually is used for pet food, but the proportion used for human consumption is rising steadily, approximating 20% in 2000.
- Marketing kangaroo meat is an exercise in selling a product which is already harvested but, because its value is so far largely unrecognised, is mostly wasted or sold too cheaply.
- Local and overseas demand for kangaroo meat for human consumption is rising slowly, as a result of the activities of the KIAA and the broader and growing official and public acceptance of the principles of sustainable use of wildlife for conservation.
- At present, the value of kangaroo products is not high enough to ensure that the annual quotas are fully taken, and prices cannot be expected to rise until the annual quotas are taken fully — that is, when supply exceeds demand. However, an increased demand (for skins) in 1997 led to higher skin prices and a near full take of the quotas in the eastern States.
- A way forward from this Catch 22 situation would be to generate an increase in demand by expanding the market for meat. Because of carefully set quotas, the supply is finite and demand would not have to rise much for the quotas to be reached. It would be reasonable to expect a sharp price rise when demand rises to a point where the quotas are restraining harvests on a regular basis; this would be a classic vertical supply curve that was insensitive to increased demand.
- A 15% annual quota implies the availability of about 60,000 tonnes of meat (Switala 1995), varying from year to year as kangaroo populations fluctuate in response to rainfall and pasture availability.
- Unlike most primary produce, the amount of kangaroo skins and meat that will be available in the following year will be known at the end of the previous year when the quotas are set. This allows primary producers and processors to enter into supply contracts well ahead. In 1997 we saw the beginnings of this in South Australia, where tags were allocated to individual properties, with some processors entering into contracts with landholders early in the year to ensure a supply later on.
- In my opinion the logical way to expand the market would be to sell kangaroo meat as a specialty product in those countries where there is a history of appreciating game meats, such as in parts of Europe and in the USA plus, of course, as a restaurant meat in Australia where it has already made significant penetration. I have never thought that local domestic sales would be more than a small part of the market, like duck and venison. However, health benefits for cardiac fitness, its philosophical

attraction as a free-range meat and freedom from BSE could mean that I am underestimating this market potential.
- It follows that in a future, high-value industry all harvesting would be at human consumption hygiene standards instead of the dual harvesting systems we now have with some kangaroos being shot only for pet food. Then, the best cuts from all animals could enter the human consumption food chain, with less choice cuts going for pets and other applications, as in the current domestic meat industry.
- The development of a smallgoods industry based on kangaroo meat is in its infancy, but the products already available show the promise of great potential.

With all of this in mind, I list below some of the factors useful for a marketing campaign. It is worth remembering that an advertising campaign for kangaroo meat is also a public education campaign, because the concept of harvesting wildlife for a conservation gain is not widely understood or accepted throughout the community. Getting that message across would be an important element of any advertising message. Hence the following suggestions:

- Publicise the problems Australia has with land degradation from overgrazing by sheep and the benefits of a shift to a more kangaroo-based land use, instead of reducing kangaroos in order to carry even more sheep.
- Explain the concept of receiving a conservation gain from the commercial use of kangaroos, the checks and balances in place to ensure sustainability of the populations, and that harvesting is undertaken hygienically and humanely.
- Point out that harvesting free-range kangaroos is philosophically akin to free-range eggs, poultry or bacon. I am not advocating kangaroo "farming", because neither restraint nor husbandry is envisaged. Indeed, I think that wildlife authorities should specifically prohibit farming and all it entails. Under what is proposed, a kangaroo remains as free-living wildlife in its natural habitat until harvested.
- Of the harvesting itself, explain that "the paddock slaughter of an animal unaware of danger" is more humane than the way we treat our domestic livestock. I know of people who will not eat pork, beef or lamb because of discomfort about the methods of husbandry and slaughter, but who approve of eating kangaroo, and do so.

There are also many positives to do with the meat itself:

- Taste. Similar to beef but sufficiently different to be interesting.
- It is healthy in having low fat (1-2%) and low cholesterol (O'Dea 1988, Sinclair 1988) and is sometimes recommended for cardiac patients taken off traditional red meat.
- There are no insecticide residues in the meat as kangaroos are not drenched or dipped like domestic stock.
- No possibility of BSE. This might assist sales of the meat in Europe in particular.
- It is a traditional Aboriginal food which has been a dietary mainstay throughout much of the continent for millennia.

WHERE TO NOW?

In the mid-1980s I thought that kangaroo harvesting would soon become a major source of income for landholders then relying on wool, and that with the switch to kangaroos would come conservation benefits. I was wrong about the time frame. In the 1990s I accepted this, and became more realistic. Now, in the 2000s, unless the goats win, I am still convinced about the value of the idea and optimistic about its potential for achieving good conservation, social and economic outcomes in the long term. A lot of things have changed in the area of wildlife conservation and management in the last 20 years, and most of them are in directions which makes the implementation of "sheep replacement therapy for rangelands" more likely. The proportion of kangaroos shot for human consumption is rising steadily, prices are higher, people have a much better understanding now of the potential for harnessing economic imperatives in the service of conservation and, when annual harvest quotas are taken fully, this will stimulate price rises towards the point where landholders will look towards kangaroos as a resource instead of a pest. I still

think that the impediments are not ecological, but economic, and that the whole scene will change dramatically once the market potential is recognised.

The idea is being grasped and promoted by the Australian Museum, which is embarking on a project linking the concept of sustainable use of wildlife for conservation gains to the more specific target of enhancing biodiversity. This project will initially address kangaroos, embracing the concepts outlined above, that have been through the long process of scientific and public debate. Specifically, the Museum's project aims to monitor changes in biodiversity in response to landholders shifting from sheep to native wildlife. To dramatically represent this project, it has been dubbed FATE (Future of Australia's Total Ecosystems) to demonstrate that taking a new approach to conservation is essential, not optional. Whether or not FATE is able to accelerate what I see as the natural progression now under way, in advance of higher values for kangaroo products, remains to be seen. But the fact that scientists and managers are embracing these concepts and seeking to promote them is a very healthy sign.

What can current land holders in the sheep rangelands do? I think the key will be in the pastoralist's organizations embracing these ideas and running with them, using their political clout and business acumen and marketing skills. What is missing now, mainly, is a higher price for the product. In this paper, I have tried to spell out in a very practical way the elements of what could be a very successful marketing campaign. The other significant element necessary will be for governments to get behind the idea and endorse it.

The times are changing. Land managers and rural communities are now taking the rehabilitation of land much more seriously than their forebears, and are interested in pragmatic, ecologically sustainable and locally compatible solutions. I think that the idea I have spelled out in this paper is one of them.

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Email: ggrigg@zen.uq.edu.au