Conservation benefit from harvesting kangaroos: status report at the start of a new millennium

A Paper to stimulate discussion and research

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ABSTRACT

Over the last twenty years, kangaroo harvesting has gained much greater public acceptance and risen in monetary value. However, most landholders still regard kangaroos mainly as pests, and are a long way from making enough money from kangaroos to encourage any shift away from their focus on sheep. Yet kangaroo meat is now sold legally for human consumption in all Australian States and is common on restaurant menus, while its export is rising steadily. Extensive aerial surveys have established the abundance of the three large kangaroo species and their resilience to harvesting. A small number of landholders are benefiting from kangaroos, either by selling access to shooters/processors or through direct involvement as licensed operators. The International Union for the Conservation of Nature has supported the concept of achieving conservation benefits from the sustainable use of wildlife, and this has been incorporated into kangaroo management programs (for leather and meat) by most Australian governments. Despite all these positives, the low price of kangaroo meat, which has still not found the place it deserves on the international game meat market, is a major impediment to implementing "sheep replacement therapy for rangelands", and only when prices rise significantly will landholders choose to reduce sheep numbers and invest their hopes in kangaroos. Meanwhile, land degradation continues unabated and low prices for coarse fibre wool, while encouraging woolgrowers in the sheep rangelands to overstock, also provide a stimulus to landholders to diversify. Alarmingly, many landholders are choosing to diversify into goats which, though profitable in the short term, will extend the damage done by sheep.

Low prices for wool from the sheep rangelands also amplify the clamour for kangaroo control, and governments are responding by researching or implementing programs designed to significantly reduce kangaroo numbers. South Australia now has a program which, if implemented fully, would reduce kangaroos by 60%. In Queensland and NSW, research projects are examining more effective ways to reduce kangaroo numbers. These goals reflect an acceptance of the folklore that competition from kangaroos compromises wool production and markedly reduces sheep carrying capacity, even though scientific evidence for this is lacking.

But reducing kangaroos will not bring the anticipated benefits to woolgrowers, because kangaroos at typical densities are a much smaller component of the total grazing pressure (TGP) than is generally assumed. This is because the factor of 0.7 DSE (dry sheep equivalent), by which kangaroo numbers are translated into forage lost to sheep, is an over-estimate. Taking body weights into account the factor should be about 0.4

Pages 53 - 76 in *A Zoological Revolution. Using native fauna to assist in its own survival.* Edited by Daniel Lunney and Chris Dickman, 2002. Royal Zoological Society of New South Wales, Mosman 2088 and Australian Museum.

and, taking measurements of field metabolic rate into account, may be as low as 0.15-0.2. Hence, even if the desired reductions in kangaroos could be achieved, there would be little or no difference to the economic viability of woolgrowers in the sheep rangelands. Furthermore, if governments decide to institute significant reductions in kangaroos without data to confirm the conservation and economic benefits of doing so, there will probably be strong criticism from conservation and animal rights organisations as well as from Australians at large, and this approach may have to be abandoned.

For these reasons, the focus of kangaroo management as pest control aimed at improving wool productivity is doomed to failure. I still support the alternative view that the best way to reduce grazing pressure on the rangelands is by reducing sheep, and that the best way to achieve this is to develop a market for a high-value kangaroo industry and to sell its monopoly product on the world market for game meat. A significant increase in the value of kangaroo meat could make the harvest of free-range kangaroos for skins and meat a profitable and ecologically desirable enterprise for landholders. This would harness economic incentives in the service of ecological sustainability and rangeland rehabilitation and thus provide another example of achieving conservation goals through the sustainable use of wildlife. Furthermore, the development of a high value, sustainable kangaroo industry stands in sharp contrast to the fatalism of some ecological commentators who can only prescribe mass closure of Australian rural communities and essentially evacuating marginal country. What is needed to achieve these desirable social, economic and conservation goals is a strong marketing effort and I provide some suggestions about the attributes of kangaroo meat and the benefits of kangaroo harvesting which could feature in a marketing campaign.

Sheep replacement therapy for the rangelands: 20 years on

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 sheep rangelands, a mostly degraded area occupying about 40% of the continent, where they coexist with about 15% of the nation's sheep flock (Figure 1). 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. This paper reviews the case for an ecologically sustainable kangaroo industry to help restore the degraded rangelands.

For nearly 20 years I have been promoting the major conservation benefits to Australia's sheep rangelands that could be gained from expanding the export market for kangaroo products. This could enable landholders to derive significant income from kangaroos, while reducing sheep numbers in the marginal lands and avoiding further land degradation. I have referred to this idea as "sheep replacement therapy for rangelands". Its first formal, published exposition was published by the Royal Zoological Society of NSW (Grigg 1987), with a subsequent all-day RZS Symposium in Sydney in May 1988 when the idea was scrutinised by a range of biologists and other interested parties (Lunney and Grigg 1988, Grigg 1988). Since then I have advocated the idea at scores of meetings of pastoralists, conservationists and scientists from Perth and Adelaide to Longreach, and Brisbane to Dubbo, Blinman and Wagga Wagga, as well as publishing more than 20 papers and articles on the subject (Appendix 1).

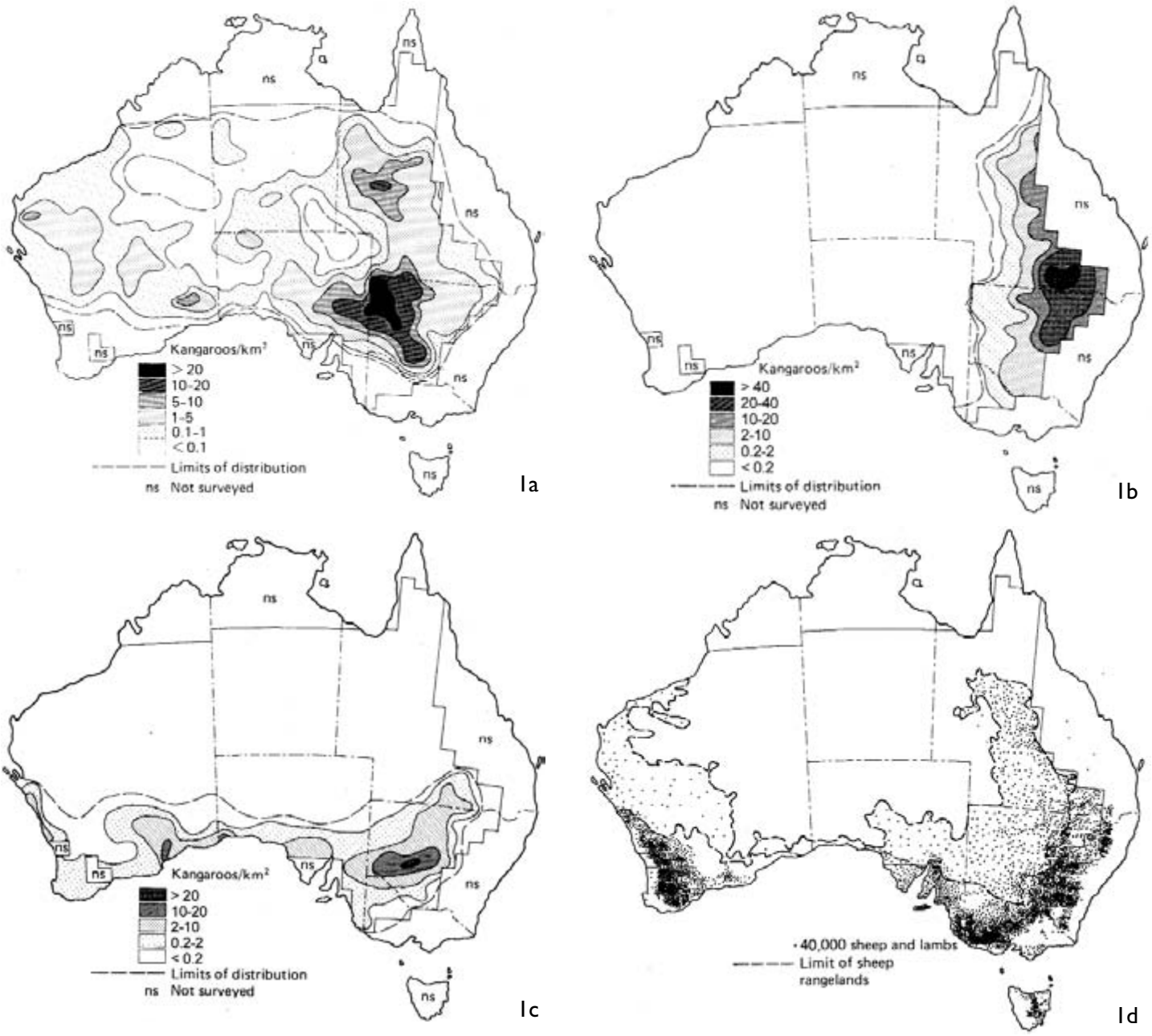

Figure 1. Density and distribution of a. Red Kangaroos, b. Eastern Grey Kangaroos, c. Western Grey Kangaroos, determined from aerial surveys over 1980-82 (modified from Caughley 1987b to take into account the most recent correction factors for aerial surveys of grey kangaroos) and (d) sheep. Ground surveys of much of the eastern part of the eastern grey kangaroo range over 1987-92 estimated a density of 10 kangaroos/km2 (Southwell *et al.* 1997).

The start of this new millennium is a good time to review progress. The promised benefit has yet to be realised. Two to three million kangaroos are harvested every year. Their skins provide the mainstay of the industry, but meat is mostly sold at low prices, for pet food, and kangaroos are still regarded by landholders as a pest rather than a resource.

Nevertheless, a lot has changed on the kangaroo front in the last 20 years. Kangaroo meat can now be sold legally for human consumption in all States. 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 is rising. Its export has risen dramatically from 2.8 million kg in 1995 to 5.8 million 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. 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.

But kangaroos are still far from providing a significant source of income to landholders in the sheep rangelands. Is the idea flawed? Is it just that change comes slowly? Is the product not good enough? Or is the product good enough but not yet recognised? I think it is the last of these, and that the best hope of addressing land degradation in the sheep rangelands is to find ecologically as well as economically acceptable alternatives to sheep. Kangaroos at high value would provide a significant alternative. This paper reviews some of the main historic and current issues relevant to this idea, and suggests a way forward.

Land degradation in the sheep rangelands: a huge issue in need of a solution

Sheep grazing in the last 160 years has brought the sheep rangelands to their ecological knees. This trend must be halted and reversed if we are to avoid even more serious desertification. The solution will be to find activities that are both financially profitable and ecologically benign to set the stage for rehabilitation and restoration. Replacing sheep with goats, which is happening particularly in Queensland, is an unacceptable strategy because it continues to take the land down the path of degradation. Other uses for the rangelands need to be sought. Many woolgrowers in these marginal lands are turning to cattle, but this is unlikely to halt land degradation. Dryland agriculture (that is, growing crops in dry areas using irrigation rather than rainfall) is increasing, but this is far from ecologically benign. Ecotourism will become increasingly important, as discussed by Croft (2000), and it is entirely compatible with harvesting, but it is also likely to benefit tour operators in towns rather than the landholders. Removing the imperative to run too many sheep is an important priority because sheep in high densities damage vegetation by overgrazing and degrade the land with their hard feet. Prices for coarse fibre wool are simply too low for most properties to be economically viable at stocking rates low enough to contain, let alone reverse, the damage. Many alternative land uses, such as cotton growing, result in even greater deterioration of the land.

So, if the economics were better, kangaroo harvesting could become an ecologically sound alternative to sheep in the fragile semi-arid rangelands. This would be compatible with the restoration of land and the recovery of other wildlife. Kangaroos provide an existing large 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). What is lacking is a good price for the products at the "farm gate", and a big enough market for demand to exceed supply and, thus, stimulate higher prices.

Kangaroo issues then and now: how the issues have changed in 20 years

My concern about all of this arose when first flying aerial surveys of kangaroos with Graeme Caughley in 1975. This gave me a good look (from 250 feet/76 m) at the huge extent of land degradation and the vast numbers of sheep and kangaroos in the rangelands. At that time the hot issues about kangaroos were:

- claims by some conservationists/preservationists/humane societies that kangaroo populations were threatened by harvesting (and, indeed, Senator Lionel Murphy as Whitlam's Attorney General and Minister for Customs and Excise closed the export of kangaroo products in 1973 in response to concerns raised at the time, leaving only local markets for the kangaroo industry);
- opposition to kangaroo harvesting from some animal welfare lobbyists (e.g Rawlinson 1988, Arnold 1988);
- the perception by woolgrowers that kangaroos were a pest and compromised wool production (Gibson and Young 1988);

- a major Commonwealth enquiry (the House of Representatives Select Committee on Wildlife Conservation) which found in favour of "the principle that there is no reason why some animals cannot be harvested provided the operation is based on sound biological principles" (summarized in Lunney 1995), and which is what I call ecological common sense.

The claim that harvesting threatens kangaroos with extinction is now rarely heard, and never heard from well-informed people. Opposition to the industry on animal welfare/rights grounds is still there and always will be. The third issue, the notion of kangaroos as pests, is still firmly held in the rural sector. It will be significantly challenged in this paper.

A fourth issue, the role of kangaroos in land degradation, has emerged forcibly since the 1970s. In fact there was little said about land degradation in the 70s, although it was well recognised by 1901 as having occurred in the Western Division of NSW (Lunney *et al.* 1994). In recent years it has become common for landholders and some rangeland ecologists to regard kangaroos as a significant causative agent in land degradation, even though comparisons with sheep are lacking.

1. The growth of our understanding about kangaroo populations

Extensive aerial surveys have put an end to speculation that kangaroo populations were being harvested towards extinction. Partly as a response to Murphy's ban, partly because wildlife management in the 1970s was becoming more quantitative in approach, and partly because Graeme Caughley (then at the University of Sydney, later at the CSIRO) was developing improved methodology, State and Federal agencies funded significant aerial survey activities. Led by Caughley, broad-scale surveys were conducted in NSW (NSWAKS, first survey in 1975), Queensland (QAKS, 1979) and South Australia (SAKS, 1978, see Grigg *et al.* 1999 and Pople and Grigg 1998). The Australian National Parks and Wildlife Service (now Environment Australia) formed a Kangaroo Population Monitoring Unit under the direction of Gerry Maynes and Colin Southwell which organized a survey of Western Australia (a huge undertaking) and Queensland. In 1982 our team surveyed most of the rest of the range of the Red and Western Grey Kangaroos in what we called a Remote Areas Kangaroo Survey (RAKS) in the Gibson and Great Victoria Deserts, using a Cessna 206 with long-range fuel tanks. This filled in the gaps and enabled the first complete population assessments (Caughley *et al.* 1983). A second, slightly less comprehensive national survey was compiled again in 1984 (Grigg *et al.* 1985) and another in 1987 (Fletcher *et al.* 1990).

Collectively, these Australia-wide surveys showed conclusively that kangaroo populations were healthy, that is, not in decline at all, and were in fact flourishing, and that the supposed threat from harvesting was exaggerated or misguided (Grigg 1984). At the time of the first Australia-wide estimate in 1982 there were at least 30 million Red, Eastern Grey and Western Grey Kangaroos, mostly in the sheep rangelands, alongside about 30 million (15%) of Australia's total of nearly 200 million sheep (figures have been modified from the originally-published figures by the application of modern aerial survey correction factors).

Since then, comprehensive surveys in fixed-wing aircraft have been conducted annually in New South Wales, South Australia and Western Australia (1/3 of State each year, by rotation) and, since 1991, there have been annual helicopter surveys of representative monitor blocks in Queensland. The results of all of these surveys are used, together with other information such as a knowledge of rainfall, to set annual harvest quotas. These surveys were conducted through good times and in severe droughts, with significant kangaroo harvesting throughout, and we now have a huge amount of information about the population trends of kangaroos and their responses to rainfall (or drought) and to harvesting (see review by Pople and Grigg 1998, at http://www.environment.gov.au/bg/plants/wildlife/roo/roobg.htm) and Figures 2 and 3.

The upshot is that we can be sure that rainfall and forage availability drive the short-term changes in population numbers and we know from experience that kangaroo populations remain viable in the long term with harvests in the vicinity of 8-10%, that is, at rates now achieved routinely. In practice, particularly given the male-biased harvest, proportional harvests even much higher than that would be sustainable, although the offtake in numbers of individuals would be smaller, because of a reduced population size. Mathematical modelling suggests that harvesting at 10-15% per annum, which occurs routinely in some areas, reduces average populations by 30-40% compared with what they would be if there were

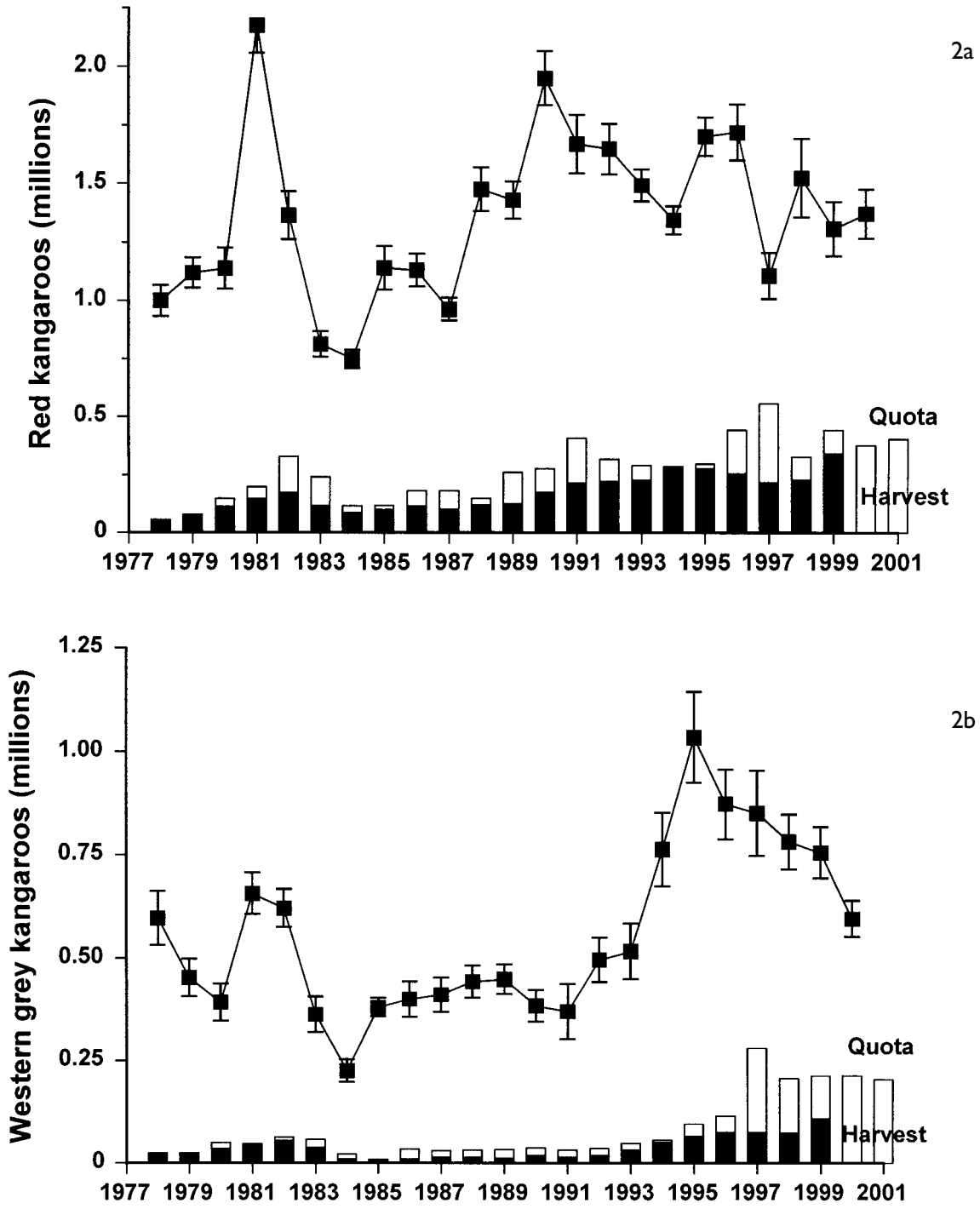

Figure 2. Population trends, quotas and harvests in the South Australian Pastoral Zone since 1978 for (a) Red Kangaroos and (b) Western Grey Kangaroos. Aerial surveys undertaken by Grigg and co-workers, funded by National Parks and Wildlife SA. Figure updated from Pople and Grigg (1998).

no harvesting (Caughley 1987a). Annual harvesting in the eastern States over the last 20 or so years has been set at 10-15%, or higher, so there has undoubtedly been a degree of success at "pest control". In the absence of significant predation from dingoes, the other major source of kangaroo mortality is starvation during droughts. If there were no harvesting, the natural weather-driven boom-bust cycles in populations would be even larger than they are (Pople 1996, Grigg and Pople 2001).

In short, the fear expressed so prevalently in the 1970s that kangaroos were being exposed to the risk of extinction by harvesting was, and is, simply non-existent. However, the raising of those concerns did have a positive outcome because a

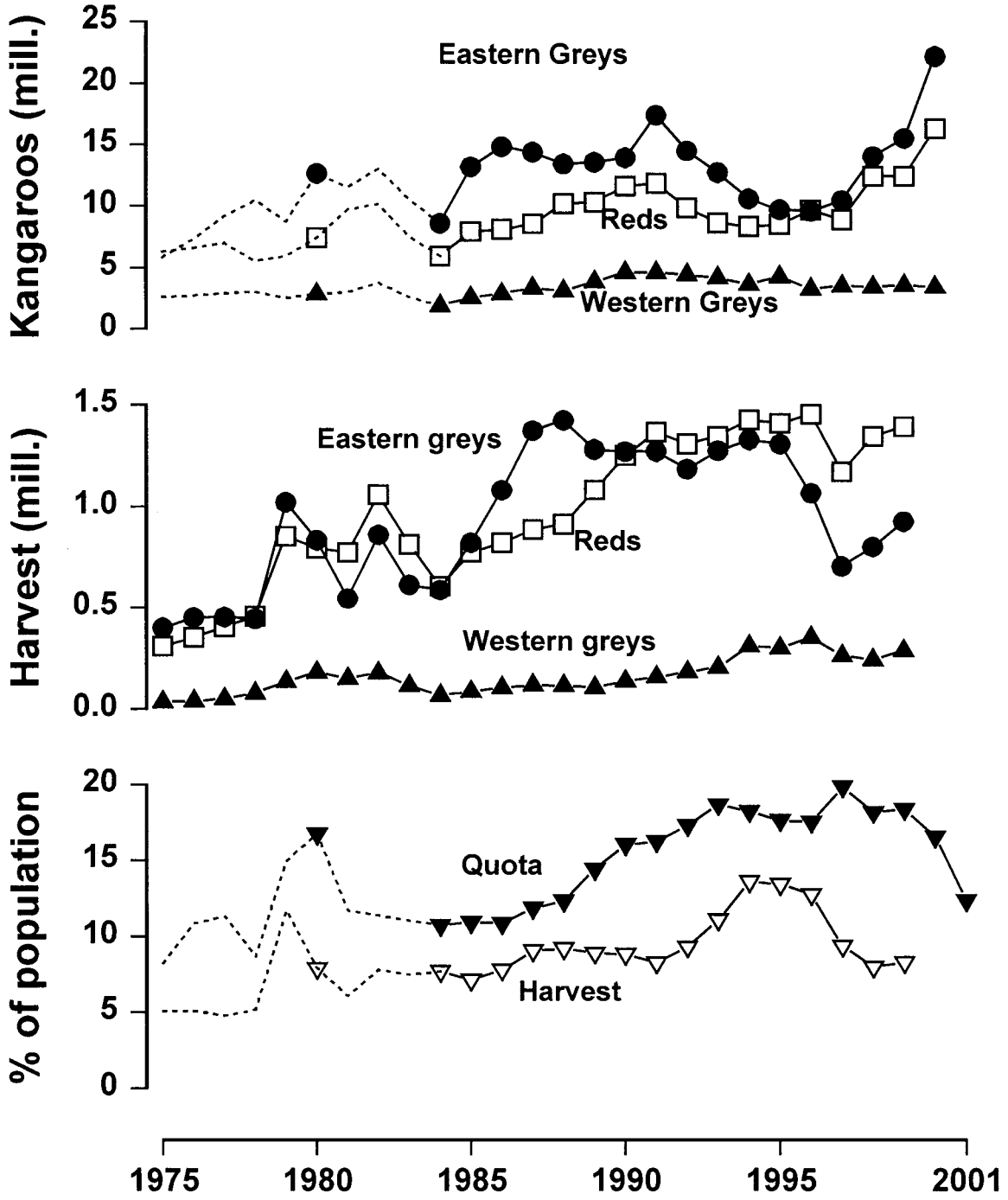

Figure 3. Trends in combined State population totals, quotas and harvest offtake (in numbers and %) of Eastern Grey Kangaroos, Red Kangaroos and Western Grey Kangaroos in the commercial areas. Extrapolations and interpolations are shown as a dotted line. Figure updated modified from Pople and Grigg (1998).

lot of research was stimulated and we now have a very significant body of hard information on which to base decisions about safe levels of utilisation of kangaroos.

2. Animal rights and welfare issues

Compassionate approaches to the use of animals for food and clothing and the control of eruptive native and animal populations are things which distinguish our civilisation. Australia faces massive problems with populations of introduced, now feral, horses, donkeys, camels, buffalo, deer, rabbits, hares, foxes and cats, quite apart from large numbers of kangaroos and some wallabies as a result of anthropogenic changes in biotic conditions. The herbivores on this list are not being controlled by predation and, if not controlled in some other way, will cause significant modification to our habitats, even beyond the massive changes which have occurred since Europeans arrived. The predators (foxes and

cats) have already modified our wildlife, and continue to do so. Seeking humane ways to effect control over abundant native and introduced species continues to be a major activity for our scientists and, even if 'magic bullets' are discovered or invented, there may be real political and legal impediments to their application. So we confront a very real dilemma in wishing to deal compassionately with animals while, at the same time, needing to prevent their presence becoming an ecosystem-threatening force.

Coming to terms with the use of animals for food and clothing and for controlling pest species is a matter of finding an appropriate balance. Most people come to a point of equilibrium in which they recognise the need for animals to be killed provided, however, that individual animals are treated in a humane way during their life, and killed in a way which minimises or avoids suffering.

The harvesting of kangaroos has attracted plenty of adverse criticism and there will probably always be opposition from a minority of the population. The expression of this opposition has been beneficial because it has led to much more care and attention being paid to ensuring that slaughter is carried out humanely through the implementation of the Code of Conduct. In a free and democratic society, which Australians aspire to be part of, the right to freely express a point of view is crucial. I prefer, however, that participation in public debate is conducted honestly and without personal attacks on individuals. The Australian animal rights groups do not always adhere to that philosophy, as shown by a recent publication which is not only full of untruths but is also very personal in its attack (Wilson 1999). Many people choose not to eat meat, and the freedom to choose is surely an important freedom to retain.

For me, the important issues about whether or not to harvest an animal for meat are whether the animal population is put at risk by the removal of those individuals, and whether the killing will be done humanely. Only the second consideration is relevant to domestic stock, but both are crucial for a wildlife harvest. The harvest of wildlife seems to provoke particular opposition from many people who quite happily eat meat from domestic stock. At one level I can understand this, because the cultural programming in westernised societies seems to make wildlife sacred. Rationally, however, the issues remain the same and I think what I wrote in 1984 is still applicable: *"As to cruelty, the RSPCA has no major concern regarding professional kangaroo shooters. Indeed one could argue that the slaughter of kangaroos is more humane than the slaughter of sheep and cattle, on the grounds that kangaroos lead their normal existence as wild animals until the last instant. On the other hand cattle and sheep are herded, jostled onto trucks and often transported long distances in hot conditions before eventually being killed"* (Grigg 1984).

I know people who do not eat meat from traditional domestic stock because of this treatment, and who seek out kangaroo meat instead because it represents a philosophically more defensible "free range" harvest.

3. Kangaroos as pests in competition with sheep

The third major issue from the 1970s, that kangaroos are a pest to woolgrowers, remains very much alive and is, if anything, even more entrenched today even though there has been significant research activity. Views are polarised on this issue. The main focus of controversy is the extent to which competition between kangaroos and sheep is injurious to economic production in the wool industry. Since the 1970s there has been a lot of research. A survey by Gibson and Young (1988) quantified the extent to which kangaroos are regarded as pests by NSW pastoralists, but as yet there has been no quantification of the extent of lost production. One issue that has attracted attention has been the way kangaroos move to a paddock being spelled from sheep, attracted by the green pick there, which compromises a landholder's management options. This was studied by Norbury and Norbury (1993) who examined the possibility of controlling the kangaroos by turning off water supplies.

However, the main focus of interest has been on the extent of competition by kangaroos for fodder which woolgrowers would prefer was used by sheep. Gibson and Young (1988) found that landholders' perceptions were that about $55M was lost in fodder consumed by kangaroos, and it is clear that direct competition for food is seen as a major concern. Whether the perception of major economic losses is real or not is a vexed question. McLeod (1996) and, more recently, Pople and Grigg (1998) have reviewed research on Red Kangaroos in which experimental approaches have focussed on Fowlers Gap in the chenopod shrublands of NSW and at Lake Mere in the NSW semi-arid woodlands. The Lake

Mere study (Wilson 1991) presented evidence of direct competition, but McLeod expressed scepticism about the results because of his concerns about the study's experimental design, as well as the unrealistically high stocking rates in the experimental enclosures. At Fowlers Gap, Edwards *et al.* (1995, 1996) found reduced sheep live weights in the presence of kangaroos when pasture biomasses were very low (<50-60 g/m^2), but little evidence of competition above this threshold. McLeod (1996), following on at the same Fowler's gap study site, concluded that decreased wool productivity as a consequence of competition from kangaroos occurred only in unusual circumstances, at very low pasture biomasses and high kangaroo densities and, further, that the competition was asymmetric, with sheep dominating.

One fact which needs to be remembered is that while sheep are contained behind fences, kangaroos are free to move out when conditions deteriorate. This was the case in the Fowlers Gap study, which therefore mimicked reality more closely. Indeed the capacity of kangaroos to redistribute themselves according to resource availability is a luxury denied sheep, but which has important implications for discussions about the comparative roles of kangaroos and sheep as agents of land degradation.

More work needs to be done in a range of habitats, with careful attention paid to experimental design and stocking rates, and for longer terms because vegetation response in the rangelands is notoriously slow. The slow rehabilitation of an overgrazed paddock at Koonamore in South Australia from which sheep have been excluded since 1925 (Sinclair 1996) stands as a striking example. So the comparative roles of kangaroos and sheep in rangeland systems still remains unclear, despite a lot of research on kangaroos themselves.

4. Changed attitudes to land degradation, and to the role of kangaroos in causing it

Although the extent of land degradation has not decreased in the last 20-30 years, attitudes to it and to the role of kangaroos in it have changed. People were reluctant to talk about land degradation in the late 1970s and 1980s, but there is now a wide recognition of the extent of land degradation in the sheep rangelands and a willingness to discuss it. This change in attitude came 3-4 generations after land degradation was recognised and documented as a serious problem by the Royal Commission on Western Lands (1901), of which Lunney (1994a, b) has provided a vivid preçis. In other words, it took longer to admit to the problem than to cause it. One of the benefits from the "Decade of Landcare" (the 1990s) has certainly been that this and other problems of sustainability are now the frequent focus of conferences and community activities. There has been a real cultural change, and this will probably be the biggest short-term outcome from the Landcare movement and its successor, the Natural Heritage Trust.

In contrast to the gradual acceptance of the existence of land degradation and a willingness to discuss it, there has been a shift in attitudes towards kangaroos so that kangaroos are now regarded not just as competitors of sheep but also as significant direct causative agents in land degradation. This is a view I now hear commonly. A recent example: "pastoralists generally argue that [the kangaroo management programs] have been ineffective in controlling kangaroo impacts on rangeland vegetation and pastoral production" (Hacker *et al.* 2000).

Whatever the cause, land degradation and finding ways to reverse it has always been a driving force for me. My interest in finding an economic incentive that would encourage landholders to run fewer sheep was stimulated by my early aerial survey experiences in which I saw the extent of land degradation. I wrote of those perceptions: *"Most of the grazing lands, unfortunately, show everywhere abundant signs of the foot and tooth pressure of the introduced hard-footed stock and there is simply no room for doubt that running sheep in the fragile arid inland has done a lot of damage. Graziers will argue that they obey the stocking rates recommended and many of them do, perhaps even most of them do. Maybe even all of them do, but the fact of the matter remains that the damage is everywhere evident"* (Grigg 1987).

This statement is equally applicable today. On the 24th annual aerial survey of kangaroos in South Australia in July-August 2001, I still saw high densities of sheep (and goats in many places) and, looking over the barren terrain, I still wondered what they found to eat.

A large part of the problem is that sheep in marginal country producing coarse fibre wool are worth too little to be profitable at low densities (unless the property size is very large, supporting perhaps only one family). The overall trend has been for the problem to worsen (whether or not

the present improvement of wool prices with the low Australian dollar will make a long-term impact is unknown, but doubtful). With some ups and downs (and a recent sharp rise, but for how long?), average wool price fell from 969 cents/kilo in 1990 to 550 cents in 1999 (ABARE) and they are much smaller cents if you allow for inflation. Along with this, Australia's sheep numbers have fallen from 173M to 115M (ABARE) as many growers have taken up cattle, cotton or other farming activities. [Of course, using average wool price data masks the reality that the market has several distinct segments which are moving in diametrically opposite directions. The prices for coarse fibres have essentially collapsed over the last 15 years (that is what was in the wool stockpile) but prices for fine and superfine fibres are good to excellent. In other words, good low micron fleece, grown in good conditions attracts a premium, but marginal country producing coarse fibres is less and less economic. Most of the wool produced in the sheep rangelands is coarse fibre, low value, which is being replaced increasingly by synthetics, and it is this landuse against which commercial use of kangaroos competes.]

With unsatisfactory prices for coarse fibre wool, it is not surprising that resentment towards kangaroos has grown. When sheep were very profitable, as they were in the 19th century until 1890, there was encouragement to carry a lot of them, but now it is falling prices that provide an incentive to put more sheep onto the land to maintain income. Just as complaints about "plagues of kangaroos" are most common during droughts when forage is scarcest (and when kangaroos are most noticeable feeding on green pick close to roads), low prices for coarse wool also raise the level of antagonism towards kangaroos and this has expanded to include blame for land degradation as well as competition with sheep for forage.

Where are we now? On a path towards serious kangaroo control!

In 1997 I wrote that Australia was at a crossroads in kangaroo management policy:

> *"In one direction is the traditional view of kangaroos as pests, which is leading to more and better ways to 'control' them. In the other direction is the view of kangaroos as a potentially valuable resource, which leads to a focus on more and better ways to market them and to have them bring significant economic value to landholders."*

I argued then that these two directions were incompatible because significant reduction in kangaroo populations removed the potential for a significant, continuing, long-term high-value, high-volume kangaroo industry and, thereby, the potential to achieve conservation goals by replacing large numbers of sheep with high-value kangaroos. I asserted that "the only real, practical, long term direction at these crossroads is the one leading to kangaroos as a sustainable economic resource", which would "bring into alignment...the ecological and economic goals in Australia's sheep rangelands" (Grigg 1997).

I still believe this to be the case, but it is clear that the official pathway remains mainly along the other road, towards getting more effective "control" of kangaroos.

The wrong way at the crossroads

There is no doubt that, for the present anyway, the official path is more towards kangaroo control than price-boosting, with the kangaroo industry being expected to deliver that control. New South Wales, Queensland and South Australia are all looking at "more effective" kangaroo control. The Queensland Department of Primary Industries has a program, under Lester Pahl's direction, which is designed to work out better ways for woolgrowers to control kangaroos by using water traps to make pest reduction more efficient. NSW Agriculture has a Murray-Darling Basin Commission funded project, under Ron Hacker, entitled "Evaluating Alternative Management Strategies for kangaroos in the Murray-Darling basin". This includes assessing the capacity of the kangaroo industry to achieve particular harvest rates and population densities, in tune with stakeholder concerns.

South Australia is furthest along the road towards implementing policies designed to lower kangaroo numbers. The South Australian approach since 1996 has been to look towards higher proportional harvests as a tool for reducing kangaroo populations to less than half the long-term average populations. The 1999 proposal to the Commonwealth for harvest quotas in 2000 identified a range of target densities in each of the Soil Boards. If the low ends of the ranges were to be achieved, and it is clear that these are the real targets, it would result in a reduction of Red Kangaroos in South Australia from a long-term average of 1.49 million to 0.6 million, or a 60% decrease (Alexander *et al.* 1999). The target densities have been set in consultation with the Soil Boards, and

the Department of Environment and Heritage is clearly aiming to manage the populations in response to current landholder perceptions about appropriate numbers of kangaroos and their role in land degradation and in compromising the economic viability of the existing industry, namely introduced stock, and especially sheep.

The notion of shooting a larger proportion of kangaroos will be politically acceptable in the grazing community but, unfortunately, there is no quantitative information which identifies the levels at which kangaroo populations are 'acceptably benign'. I suspect that even at very low densities their capacity to concentrate on green pick in a spelled paddock will still be the cause of just as much grief for landholders as when numbers are higher. It may well be that the South Australian approach is desirable both ecologically and economically. After all, experience in the Flinders Ranges shows that there can be no doubt that grazing pressure at very high densities of macropods can have a conspicuous effect on pasture and land erosion by thwarting attempts at regeneration. However, whether reductions of this magnitude will actually make any noticeable difference at the densities typical in South Australia's sheep rangelands is unknown and, as I will show later, extremely unlikely.

South Australia is endeavouring to embark on research to try to measure the effect of reductions in kangaroo numbers in the continuing presence of sheep, with appropriate experimental controls, and it will be interesting to see whether or not there is reality in the long-held belief that kangaroos have a seriously negative influence on farm profits and land condition.

My own view is that kangaroos are often made scapegoats. I am unconvinced that it is appropriate, without good data, to adopt a policy designed to halve a State or the national kangaroo population because of a belief that they are harmful at the diversities which are typical in the sheep rangelands. Indeed, there are good reasons to suspect that even large reductions in numbers will have little or no effect. If, on the other hand, halving the kangaroo populations really does lead to measurable benefits to land conservation, then I will be a strong supporter of doing so.

It is relevant to note that all three State programs were devised in consultation with landholders and other "stakeholders" at workshops, and all are looking for ways to implement the requests of woolgrowers who regard kangaroos as pests. That is, the programs are all "perception-driven" rather than "information-driven". This direction has been encouraged by a cultural change in governments' attitudes to "extension services". We seem to have entered a phase of management in many areas in Australia where the policies of government agencies are dictated by local "knowledge" which, though accepted at a grass roots or stakeholder level, is often too shaky to satisfy a scientist. In my view, the responsibility of the scientist, government or otherwise, is to evaluate the accepted "knowledge" in a proper, evidence-based framework, and with the degree of scepticism appropriate in all scientific enquiry, to publicise the results and, if they conflict with the accepted knowledge, to say so loudly and often in the belief that management based on truth is in the long run much more likely to be appropriate than management based on misunderstanding. Further, I think it is the responsibility of governments, through senior bureaucrats, to back their scientists in these activities. Unfortunately this does not occur, and some senior bureaucrats seem to only want to, or are only able to, tell their political masters what they think their masters want to hear and, sadly, the same goes for some scientists as well. This may lead to research and policy directions which are designed to find ways to implement the wishes of the "stakeholders" whether or not the desired goals are achievable or useful. It also leads to "publication" of "results" only in internal reports which are not peer-reviewed by independent scientists and are often circulated no more widely than the audience they are designed to serve. I believe that there is a serious need for scientists to publish in appropriate journals the science on which they base their management advice so that other, independent, scientists can review it. In the case of kangaroos, this process of internal reports has led to kangaroos being made scapegoats, even at a governmental level, even though the evidence that reducing kangaroos will lead to increased wool production is equivocal at best. Existing evidence from the most realistically formulated empirical studies tends to exonerate kangaroos except in the driest times.

Uncertain results for woolgrowers

Woolgrowers will not, I believe, get the benefits they want (better economic viability at lower total grazing pressures, or the capacity to carry more sheep) by reducing the number of kangaroos.

This is an important issue because millions of dollars are being spent trying to work out how to achieve this objective. What outcomes do

woolgrowers want? Most of all, they want improved economic viability, preferably at lower total grazing pressure. Hacker *et al.* (2000) identified two separate ways in which kangaroos are believed to threaten this aim: reduced wool production per sheep and reduced carrying capacity.

It is my belief that reductions of kangaroos will not provide the outcome/s woolgrowers and land managers want. This is an opinion, but it is an informed one. It is an opinion which flies in the face of the assumptions underlying the direction that kangaroo management now appears to be taking. It is an opinion that few will want to hear. Most people in the kangaroo industry will not want to hear it because a long standing rationale for permitting this large harvest of wildlife has been the assumption that kangaroos are a pest to woolgrowers. Most woolgrowers will probably reject it as just more raving from "another one of those academics in the city". Many people in government agencies, such as agriculture and primary industries, will not want to hear it either, partly because their focus is primarily on traditional rather than potential new industries, partly because of their traditional alignment with people in the traditional industries, and partly because now that such agencies are increasingly expected to be financially self-sufficient it is difficult for them to be in any vanguard for change.

My opinion, my "working hypothesis", should be evaluated by research, not simply rejected by counter-opinion or dismissed by the production of alternative views. I have been trying without success for years to get funding for a proper research effort. Fortunately, there is a growing body of concerned biologists – both in government and in the universities – and open-minded land managers who are willing to adopt new ways of meeting the challenge of land restoration.

Why do I believe that there will not be much benefit from reducing the size of kangaroo populations? For several reasons, but I cannot yet put good science to it any more than the proponents can support their contentions. The truth of the matter is that the results of empirical studies which have striven to assess the extent of competition between kangaroos and sheep have tended to exonerate kangaroos. More work is needed, but there seems to be an unwillingness to accept that this could be true and, instead, to continue to interpret or model information in a way which leaves kangaroos as the villains.

One study which seeks to advance the state of knowledge in this area is a desktop study by Hacker *et al.* (2000), which uses the results of empirical studies combined with a number of assumptions to conclude that, in the mulga woodlands of Queensland, harvesting kangaroos at 10% per annum would lead to an increase in wool production of up to 25%. This is close to the annual harvests that have been taken from this area, so the implication is that current wool production is up to 25% higher as a consequence of the current harvests of kangaroos. Conversely, the implication is that wool production is now up to 25% lower on properties where kangaroo shooting is minimal.

I think it extremely unlikely that this conclusion could be correct, particularly in the face of information (admittedly from a different habitat, the chenopod shrublands) gained by McLeod (1996) and Edwards *et al.* (1995, 1996). One difficulty in the analysis is that their model assumes average body weights for kangaroos, which are too high (30 kg), and the sensitivity of the outcome to this assumption was not presented. If models, rather than empiricism, are to be used as the basis of management decisions, then it is important that the models are as realistic as possible. Such models must include realistic values for the comparative forage requirements of kangaroos and sheep, which take proper account of differing body weights and metabolic requirements.

Comparative forage requirements of kangaroos and sheep

In assessing the comparative contributions of sheep and kangaroos to TGP (Total Grazing Pressure), the amount of pasture required by a kangaroo is usually assumed to be 0.7 of a DSE (dry sheep equivalent). This value (or sometimes 0.75) is applied routinely, (for example, see the Queensland DPI website at http://www2.dpi.qld.gov.au/dpinotes/animals/sheep/sw97007.html) but it is undoubtedly incorrect, perhaps even wildly so. From the QDPI website, sheep are said to require 400kg of forage per year, kangaroos 280kg (400 x 0.7). A DSE is equated as forage consumed in one year by a 45kg (Merino) wether (a "wet" Merino, one with a lamb, equates to 1.5 DSEs, and cattle 10-12). Thus, in terms of forage lost from what would have been available for domestic livestock, 1,000 kangaroos are equated to 700 "dry" sheep.

Using such a simple translation assumes that sheep and kangaroos share a common food pool and ignores any spatial differences in their foraging habits. However, leaving that completely

aside, there are two other reasons that this equation is flawed. One is to do with comparative population biomasses and the other is with the origin and meaning of the value 0.7. Nevertheless, the multiplication of estimates of kangaroo numbers by 0.7 and equating that to forage lost in terms of DSE has become firmly embedded in rangeland ecology lore. Let us explore the inadequacies of this practice.

Firstly, multiplying by 0.7 does not take into account the different sizes of sheep and kangaroos. Where sheep are being grown for wool, stock management leads to flocks of adults with a reasonably homogeneous age and size distribution, and in calculations of TGP the inputs relate to sheep with a body weight of 45kg. In contrast, many individuals in kangaroo populations will be much less than this. For example, Stuart Cairns from the University of New England is conducting a long-term study at Bulgunnia in South Australia, where male and female kangaroos are harvested in approximately similar proportions. Excluding pouch young, only about 25% of the male Red Kangaroos and 45% of the females in 1998 and 1999 were more than 3 years old (Cairns *pers. comm.*). Both sexes are approximately 8-10kg at 1 year, 17-20kg at 2 years and 21-32kg at three years. With sexual dimorphism becoming more developed in older animals, females older than three years might average 28-30kg, males 45-55kg. Therefore, in the Bulgunnia population, two thirds of the individuals would be smaller than 20kg. This is likely to be typical of a harvested population.

The range of sizes present in typical kangaroo populations clearly complicates estimation of a population's forage requirements from estimates of raw numbers. However, Tony Pople at the University of Queensland has provided some average values for the purpose of making simple, illustrative calculations. Unharvested kangaroo populations can be expected to have a mean body weight of about 32kg (South Australia) and 27kg (Queensland), and harvested populations to have means of 19kg (SA) and 16kg (Qld) respectively (Pople *pers. comm.*). We can calculate weight-corrected values for DSE using the generalisation about the way in which metabolic rate (and thus forage requirement) scales with body mass, i.e. MR a $M^{0.75}$. (This will be familiar to many readers as the famous 'mouse-elephant curve'.) Applying this to the traditional assumption that a kangaroo has a forage requirement of 70% that of a sheep leads to DSE values of 0.54 (in unharvested populations) and 0.37 (harvested populations) in South Australia, and 0.48 (unharvested) and 0.32 (harvested) in Queensland. Kangaroo populations on sheep properties tend to be harvested rather than unharvested, and these values are vastly different from 0.7.

There are some measurements of kangaroo forage intake from work done by Short (1985, 1987) with which these theoretically derived estimates can be compared. He measured the relationship between food intake and food availability in graze-down trials with Red Kangaroos and sheep (and rabbits). He compared replicated pairs of 20x20 m pens, with two individuals in each, assessing food intake by following the decline in biomass measured daily by visual estimates in quadrats, using a series of reference photographs. The kangaroos and sheep consumed 65g/$kg^{0.75}$/day and 80g/$kg^{0.75}$/day respectively when food was not limiting. Taking scaling into account, this implies that suitable DSE values would be 0.62 (in unharvested populations) and 0.42 (harvested populations) in South Australia, and 0.54 (unharvested) and 0.37 (harvested) in Queensland Tony Pople *pers. comm.)*. These values are 11-13% higher than those I calculated from theoretical considerations, averaging 0.4 in a harvested population compared to 0.35. There could be a simple explanation for this difference (see below) but, either way, it is clear that body mass considerations cannot be ignored in calculating the kangaroo component of TGP. If DSE is 0.35-0.40, it is harder to see how halving the numbers of kangaroos on the average sheep property would make much difference to wool productivity, or to reducing land degradation.

However, the failure of the assumptions behind the 0.7 figure gets worse, because there are good reasons to think that kangaroos require even less than 70% as much forage as equivalent-sized sheep. The value 0.7 comes from the resting metabolic rate of marsupials being about 70% of eutherian mammals of equivalent weight (Dawson and Hulbert 1970) and the recognition that forage requirements correlate well with metabolic needs. However, animals do not spend their lives at rest, and physiological ecologists use the term "field metabolic rate" (FMR) to refer to the overall metabolic requirements of an animal in its natural habitat, including that required for foraging and other activities. So a much more valid approach would be to use a DSE ratio which reflects the FMRs of sheep and kangaroos, rather than their

resting rates, and when this is done there is a very different result. Metabolic rates can be determined in free-ranging animals by measuring rate of turnover of doubly-labelled water, which enables the measurement of carbon dioxide excretion, which can be related via respiratory quotient (RQ) to oxygen consumption (Lifson and McClintock 1966, Nagy 1980). In this way, generalisations have been determined empirically for a large number of eutherian and marsupial mammals over a large size range, and very good correlations were found in both groups (Nagy 1987). No distinctions emerged between the groups at small sizes (<1 kg). However, large differences were found between marsupials and eutherians over a size range from 20-50kg, where the FMR of eutherians such as sheep was found to be 3-3.5 times that of marsupials such as kangaroos. This suggests that the DSE for kangaroos the same size as sheep should be of the order of 0.29-0.33 and not 0.7. Why this should be so is not obvious, but cannot be ignored.

Fanning and Dawson (1989) also measured FMR in Red Kangaroos, but using a completely different approach (radiotelemetry of heart rate as an index of oxygen requirements) and found an essentially similar result. Their measurements of three individuals free-ranging in a 100-hectare enclosure averaged slightly lower than that predicted by Nagy's generalised equation, suggesting a DSE equivalent (for animals of the same size) in the vicinity of 0.25. They too were clearly intrigued by the low result, and speculated on what it is about marsupials that apparently enables them to operate so efficiently.

These observations are thought-provoking, and it seems highly likely that the energetic requirements of free ranging kangaroos are far less than what has been accepted for sheep the same size.

Putting these two lines of thought together — comparative population biomasses and recalculated forage requirement ratios — we can propose that the "rule of thumb" for translating kangaroo numbers to DSE for the purpose of calculating the kangaroo component of TGP in a harvested population should be about 0.15-0.2; that is, an average kangaroo in a harvested population (16-19kg) requires only 15-20% of the forage of an average (45kg) sheep. This is much sharper contrast to the empirical data presented by Short (1987). However, graze-down trials on a small number of kangaroos in a pen over a short time frame cannot be said to be definitive. For one thing, food was plentiful and they may have been taking an opportunity to increase body condition. Also, perhaps in a small pen they were constrained to a pentapedal gait, their most inefficient form of locomotion (Dawson 1973). A DSE of 0.15-0.20 would seem to be unlikely. However, in the face of two completely independent studies turning up such similar answers by different techniques, that possibility cannot be dismissed. Obviously there is a need for more empirical data to be gathered, under realistic conditions.

These considerations raise the important question: by how much would kangaroo numbers need to be reduced to make a measurable difference? Apart from the real value of the equivalence between sheep and kangaroos, the relative numbers of the two herbivores on a property is a real consideration. Hacker *et al.* (2000) reported that, historically, the kangaroo population in the Western Division of NSW has ranged from 45-60% of the domestic livestock population, expressed in terms of dry sheep equivalents using a DSE of 0.75. A typical property might therefore be said to have about 2/3 as many kangaroos as sheep. Table 1 presents a comparative assessment of the contribution to

Table 1. On the basis of comparative biomasses and field metabolic rates this paper asserts that 0.7 is too large a value for DSE, and shows that there are good reasons for suggesting that a value even as low as 0.15-0.2 might be more appropriate. If this were correct, removing half the kangaroos from a property with 10,000 sheep and 6,660 kangaroos would reduce the total forage offtake by only 6% compared to the 16% benefit suggested by using a DSE of 0.7.

DSE represented by each kangaroo	Contribution to "TGP" by kangaroos on a property with 10,000 sheep and 6,660 kangaroos
0.7 (traditional value)	32% 6,660 'roos = 4,662 sheep, TGP = 14,662 sheep
0.4 (comparative biomasses considered)	21% 6,660 'roos = 2,664 sheep, TGP = 12,664 sheep
0.2 (comparative free-ranging MRs considered also)	12% 6,660 'roos = 1,332 sheep, TGP = 11,332 sheep

TGP made by kangaroos on such a property according to the three different DSE values discussed above; the "traditional" 0.7; 0.4 (being conservative) derived by taking the smaller sizes of kangaroos into account; and 0.20 (still being conservative) taking the comparative FMRs into account as well.

The other side of this coin, of course, is that if kangaroos got to be seriously valuable, removing sheep would allow a larger number of kangaroos to be carried, and there would have to be good regulation and effective harvests to ensure that land degradation is not exacerbated. If nothing else, the table makes it clear that having a good estimate of an appropriate value for the DSE is important before any meaningful conclusions can be drawn about how much benefit can be expected from the reduction of kangaroo numbers.

One quite worrying potential mis-application of the "traditional" value for DSE is that, if kangaroo numbers are reduced by a known number, a wool grower might then feel it appropriate to increase sheep to accommodate that reduction, calculated using the 0.7 figure. Hacker *et al*. (2000) made it quite clear that they had in mind getting an increased carrying capacity for sheep, rather than achieving land rehabilitation from kangaroo reduction, when they point out that apart from the up to 25% gain in wool production which (they claim) flows from a 10% kangaroo harvest, "*the impact of kangaroos on resource management is potentially more important than the effect on per head production due to the greater potential to increase pastoral productivity through increased carrying capacity*".

This is breath-taking. Just imagine if a target reduction of 60% were achieved, as identified in South Australian, and landholders felt justified in increasing sheep accordingly. To make the point again about the importance of using a realistic DSE for kangaroos, if a reduction in kangaroos by 60% were achieved on a property with 10,000 sheep, at present reckoning this would be equated to forage for an additional 2,797 sheep (0.6 x 4662; DSE 0.7). If the real value were 0.2 however, adding 2,797 sheep would lead to an increase in TGP from 11,332 DSE to 13,329, a nearly 20% increase in TGP when the landholder may think he/she is level pegging!

For these reasons, we need better information about appropriate DSEs for kangaroos if the rangelands are to be managed both optimally and sustainably.

These considerations of comparative contribution to TGP by kangaroos and sheep, however, consider TGP only in terms of the actual forage requirements, that is, kg of pasture consumed. There is another aspect of TGP which rarely gets a mention and that is the pressure from the direct, physical effects of tooth and foot pressure on rangeland soils and plants.

Hard-footed v. soft-footed

The notion of comparing kangaroos with sheep on the basis of their comparative forage requirements, with a rule of thumb equivalence, is a good one. However, forage requirements are 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. These are the tooth and foot pressure components of total grazing pressure. Currently, rangeland ecologists do not take this into account and, in fact, 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.

The omission is an interesting one though, because the belief is often expressed by Australians at large that kangaroos are soft-footed and therefore do less damage to the landscape than sheep. I have heard this expressed time and time again 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 which helps in any discussion about whether sheep are harder on the land. In the past I have asserted that they are (Grigg 1987), but I was quickly reminded of the lack of data, so I stopped asserting it, but not thinking about it. Absence of evidence is not evidence of absence, and we need to know more about this question, especially if, as current official thinking seems to imply, there is going to be a national push towards further reductions in kangaroos.

There is now a small amount of data on comparative foot pressures. Noble and Tongway (1986) tabulated data which show that sheep have a somewhat higher (1.9-2.6 kg/cm^2) static foot pressure 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, 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, and 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.

Taken together, these considerations about realistic values for DSE, comparative biomasses, and kangaroos probably having lesser physical impacts than sheep on soils and vegetation allow the conclusion to be drawn strongly that woolgrowers will not get the benefits they seek from reductions in kangaroo numbers.

The medium-term and long-term future

Despite this, the current "official" thinking seems to be enshrining kangaroos as pests rather than as a resource, which looks bleak for the idea of achieving a conservation benefit from a high-value kangaroo industry to provide woolgrowers with a way to maintain their properties and lifestyles in an ecologically benign way. The drift instead seems to be to expand the use of the kangaroo industry in its traditional pest control role.

Therefore, in the medium term, we can expect to see a continuation of the expectation that reducing kangaroos, if it could be achieved, would be a big help to woolgrowers. The formal identification of kangaroo reduction as a legitimate goal seems to be much closer than it was previously, through the cultural change which now sees governments more focused on achieving politically acceptable, "stakeholder" driven goals than on achieving real, long-term sustainable outcomes. (In this context, "stakeholder" means a limited sample, too often only local graziers or catchment management boards and their allies in the government departments set up to support and regulate them, but certainly not a representative sample of interested parties with a legitimate voice in the debate.)

As the kangaroo industry will be unable to harvest enough kangaroos (at current prices) to achieve the ambitious reductions in kangaroo numbers, I fear that the blame for land degradation will now widen to include blaming the kangaroo industry. After all, the present quotas are seldom taken, so taking quotas large enough to achieve a 60% reduction in kangaroos is a pipe dream. Only if kangaroo markets expand and prices rise to the extent that the full quotas are taken will landholders probably start taking the serious interest in kangaroos that I have been advocating, and nobody will then be talking about the need for a 60% reduction.

It is interesting to speculate about the likely impact this might have on the current kangaroo industry. The industry is apparently comfortable in its present "pest control" role, and welcomes claims such as those made recently by Hacker *et al.* (2000) which reinforce the idea that kangaroos are pests. This is made clear in the following extract from a recent KIAA Newsletter (Volume 21) referring to Hacker *et al.*'s (2000) report.

"Enormous Political Importance for the Kangaroo Industry

…This is probably the first time a scientific analysis has delivered a comment on the potential long term effect of kangaroo harvesting on sheep production economics. The computer model suggests that long term harvesting at 'maximum sustainable yield' (calculated to be 10% of populations; that is, about the current quota levels) in Mulga country, may yield up to an extra 25% more wool to graziers for no extra costs. No analysis has yet been run, but such a benefit would have an enormous impact on pastoral properties' bottom lines. Nor has any physical trial confirmed that such a benefit is actually delivered.

However this computer simulated suggestion is of enormous political importance to the kangaroo industry. It suggests that kangaroo harvesting provides a direct and important (potentially huge) economic benefit to pastoralists. There are of course many assumptions in creating this model (some of which may prove not to be correct), also the estimate carries two clear caveats:

1) It probably represents the upper limit of per head productivity gains achievable, and

2) It relies on kangaroos being harvested at maximum sustainable yield, which is about 10% of the total population.

However back of envelope calculations based on these estimated gains suggest that it is possible every kangaroo harvested in the mulga woodlands, in an industry operating continually at maximum sustainable yield, could deliver a long run benefit in wool production worth more in dollar value than the actual value of the unprocessed kangaroos themselves. That is, much more than pastoralists could ever hope to be paid in any sort of 'royalty' for the animals harvested on their properties. In addition we don't as yet have an estimate of the productivity benefit from kangaroo control in areas other than the mulga woodlands. It may well be that when the benefits from increased wool productivity nationally is calculated and added to the value of kangaroo product, a kangaroo industry harvesting at maximum sustainable yields (about 10% of population) nationally would in fact be worth half a billion dollars or more per year to the economy!!!

Finally the authors of the above paper also note: "Nor does the model account for the [cost of] resource degradation that could be expected in the presence of an unharvested kangaroo population."

It appears that there are some in the kangaroo industry who may not have realised the implications of successful kangaroo reduction; the long-term survival of the industry at its present size depends upon there being plenty of kangaroos. And the socio-economic impacts of a collapsed kangaroo industry should not be underestimated. Several towns in Queensland depend very heavily on it. The outcry in Queensland in 1995, when the government refused to increase the quotas as it became anticipated that by about August the quotas would be fully taken, should not be forgotten.

Large numbers of kangaroos would be assured, however, if kangaroos were to become valuable (assuming a continuation of the present tight regulation over harvests), and instead of calls by landholders for reduction there would be an emphasis on maintaining a maximum but sustainable yield. In that event, however, it is unlikely that landholders would continue to give the kangaroos away as they (mostly) do now, and we could expect changes in industry ownership as landholders invest and become a force in a restructured kangaroo industry. This would provide the opportunity for a conservation gain, if economic considerations encouraged landholders into kangaroos, so let us turn our attention to some of the marketable attributes of kangaroos, particularly the meat.

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 the 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.

The wrong way at yet another crossroads?

There is underway in the rangelands of Western Australia, New South Wales and Queensland a quite different form of sheep replacement. This is the shift to goats. There is growing interest in and a surprising amount of governmental support for woolgrowers going into goats not just as 'money in the bank, stored in the back paddock until the price is right' but as a serious ongoing enterprise. There seems to be a serious belief that goats will not cause land degradation problems "as long as they are controlled" (like sheep, I suppose). This should be the subject of another essay, but suffice it to say that if the wool industry is replaced by an industry producing goat meat, then the further desertification and degradation of the rangelands will surely follow.

An increase in the value of kangaroo products and a consequent shift in focus from sheep (and goats) to kangaroos, the implementation of wildlife and outdoor-based tourism and every other ecologically benign diversification we can think of will not come quickly enough to save the rangelands if the emerging goat industry takes off.

The next 20 years

In the mid-1980s I thought that kangaroo harvesting as a mechanism to allow sheep reduction and the consequent conservation benefit was an idea whose time had come. I was wrong about the time frame, because I underestimated how long it takes for new ideas to become embedded, and for things to change. In the 1990s I accepted this, and became more realistic. Now, in the 2000s, unless the goats win, I am even more 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 this stimulates 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 from Cunnamulla to Canberra. 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 land managers are embracing these concepts and seeking to promote them is a very healthy sign.

Many of the people who now adhere to the paradigms which dictate our use of the sheep rangelands will not be the predominant forces in another 20 years. I sense that new generations of land managers and rural communities are going to take rehabilitation of land far more seriously, and that they will be much more interested in pragmatic, ecologically sustainable and locally compatible solutions.

The achievement of conservation goals through the sustainable use of wildlife depends on achieving an alignment of economic and ecological goals. Gaining conservation benefits from sustainable use is now a major new paradigm in wildlife management, a concept which I have been pursuing since before they were put into now-familiar words.

After nearly 25 years, and seeing countless thousands of individual kangaroos, I still get pleasure from seeing another group ahead stand up to listen quizzically to the sound of the aircraft on survey, or seeing them break into that fantastic loping gait. If we cannot do something positive about the continuing desertification in our arid and semi-arid lands, future generations will not be able to enjoy the thrill of seeing the large numbers of kangaroos we now have.

Acknowledgments

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Wilson, A.D. 1991. Forage utilization by sheep and kangaroos in a semi-arid woodland. *The Rangeland Journal* **13**: 81-90.

Wilson, M. 1999. "The kangaroo betrayed". Hill of Content Publishing, Melbourne.

APPENDIX

Appendix 1. Chronological list of publications by Grigg promoting the conservation benefits of controlled, sustainable harvesting of kangaroos, through better marketing, to achieve "sheep replacement therapy" for rangelands. The more significant papers are asterisked. Primary research and review papers are listed in Appendix 2, following.

Grigg, G.C. 1983. South Australian Kangaroo Management Forum – A Brief Review. *Koolewong* **12**(3): 4-7.

Grigg, G.C. 1984. Are kangaroos really under threat? *Australian Natural History* **21**(4): 123-9.

Archer, M., Flannery, T.F. and Grigg, G.C. 1985. "The Kangaroo" *Chapter 5. The Kangaroo in the Future*. Kevin Weldon, Sydney.

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Grigg, G.C. 1987. Australia's kangaroos: their management, the public debate, and a plan for the future. *Australian Wildlife Proceedings* 104, Post Graduate Committee in Veterinary Science, University of Sydney. Pp. 485-93.

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***Grigg, G.C. 1989**. Kangaroo harvesting and the conservation of arid and semi-arid rangelands. *Conservation Biology* **3**:194-7.

***Grigg, G.C. 1991.** Kangaroos, land care and animal welfare: a proposal for change. *Bulletin of the Ecological Society of Australia* **21**(2): 30-35.

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***Grigg, G.C. 1995.** Kangaroo harvesting for conservation of rangelands, kangaroos and graziers. In "Conservation through the sustainable use of wildlife" (Eds G.C. Grigg, P.T. Hale and D. Lunney). Pp.161-5. Centre for Conservation Biology, University of Queensland, Brisbane.

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Grigg, G.C. 1996. Counting on 'roos. (Popular account of the aerial surveys conducted from a Drifter Ultralight aircraft.) *Geo* July 1996.

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Grigg, G.C. 1997. Regulated rangeland harvesting of kangaroos – conservation and animal welfare benefits. Conference proceedings from Self-Regulation in the Kangaroo Industry, September 1996. Australian Wildlife Protection Council.

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APPENDIX

Appendix 2: Chronological list of primary research and review publications related to the population ecology of kangaroos in which Grigg is an author or co-author (one paper appears in both Tables). Review publications asterisked.

Grigg, G.C. 1979. Aeronautical aspects of aerial survey. In "Aerial surveys of fauna populations". Australian National Parks and Wildlife Service Special Publication No. 1, Canberra.

Caughley, G.J., Sinclair, R.G. and Grigg, G.C. 1979. Trend of kangaroo populations in NSW Australia. *Journal of Wildlife Management* **43**: 775-7.

Caughley, G.J., Grigg, G.C. Caughley, J.A. and Hill, G.K.E. 1980. Does dingo predation control the densities of kangaroos and emus? *Australian Wildlife Research* **7**: 1-12.

Caughley, G.J., Grigg, G.C. 1981. Surveys of the distribution and density of kangaroos in the Pastoral Zone of South Australia, and their bearing on the feasibility of aerial survey in large and remote areas. *Australian Wildlife Research* **8**: 1-11.

Caughley, G.J., Grigg, G.C. 1982. Numbers and distribution of kangaroos in the Queensland pastoral zone. *Australian Wildlife Research* **9**: 365-71.

Short, J. and Grigg, G.C. 1982. The abundance of kangaroos in suboptimal habitats wheat, intensive pastoral, mallee. *Australian Wildlife Research* **9**: 221-227.

Caughley, G.J., Short, J. and Grigg, G.C. 1983. How many kangaroos? *Search* **14**: 151-2.

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Grigg, G.C. 1989. Kangaroo harvesting and the conservation of arid and semi-arid rangelands. *Conservation Biology* **3**:194-7.

Fletcher, M, Southwell, C.J., Shepherd, N.W., Caughley, G., Grice, D., Grigg, G.C. and Beard, J.A. 1990. Kangaroo population trends in the Australian rangelands, 1980-87. *Search* **21**:28-9.

*** Grigg, G.C. Jarman, P.J. and Hume, I.D. 1990.** "Kangaroos, Wallabies and Rat Kangaroos". 835pp. Surrey Beatty and Sons, Sydney.

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Cairns, S.C., Pople, A.R. and Grigg, G.C. 1991. Distribution and habitat associations of red kangaroos (*Macropus rufus*) and western grey kangaroos (*Macropus fuliginosus*) in the pastoral zone of South Australia. *Wildlife Research* **18**: 377-402.

Cairns, S.C. and Grigg G.C. 1993. Population dynamics of red kangaroos *(Macropus rufus)* in relation to rainfall in the pastoral zone of South Australia. *Journal of Applied Ecology* **30**: 444-458.

Grigg, G.C., Pople, A.R. and Beard, L,A. 1995. Movements of feral camels in central Australia determined by satellite telemetry. *Journal of Arid Environments* **31**: 459-69.

***Grigg, G.C., Hale, P.T. and Lunney, D. 1995.** "Conservation through the sustainable use of wildlife" 362pp. Centre for Conservation Biology, University of Queensland, Brisbane.

Pople, A.R., Grigg, G.C., Cairns, S.C., Alexander, P., Beard, L.A. and Henzell, R. 1996. Trends in the numbers and changes in the distribution of feral goats (*Capra hircus*) in the South Australian Pastoral Zone. *Wildlife Research* **23**: 687-96.

Grigg, G.C., Pople, A.R and Beard, L.A. 1997. Application of an ultra-light aircraft to aerial surveys of kangaroos on grazing properties. *Wildlife Research* **24**: 359-372.

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Cairns, S.C., Grigg, G.C., Beard, L.A., Pople, A.R. and Alexander, P 2000. Western grey kangaroos (*Macropus fuliginosus*) in the South Australian pastoral zone: populations at the edge of their range. *Wildlife Research* **27**: 309-318.

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