

# Professional kangaroo population control leads to better animal welfare, conservation outcomes and avoids waste

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ABSTRACT

Millions of kangaroos are dying in 2018 but without good conservation outcomes. Populations are crashing in drought and contributing to land degradation. Non-commercial culling is increasing because landholders seek to stop kangaroos from competing with their conventional livestock.

The kangaroo harvesting industry is declining and has been ineffective in reducing populations, partly due to animal rights campaigns. In recent years less than half the annual quota has been taken, and is currently only 20 %. Consequently, graziers are erecting kangaroo-proof fences around groups of properties and lowering numbers through various other means.

Non-commercial kill leads to poor animal welfare outcomes and considerable wastage. Regulators cannot monitor the number of kangaroos killed by amateurs, nor ensure high standards of dispatch of animals. To improve kangaroo welfare, professional population control should increase not decrease.

Landholders need to get involved in professional population control and regard kangaroos as assets not pests. If kangaroos were as valuable as wild goats or deer, landholders would have an incentive to co-produce kangaroos alongside conventional livestock and take advantage of kangaroo's adaptations. Doing so could help address the falling sustainability of many rangeland production systems.

Governments currently set harvesting quotas as a proportion of existing (variable) populations. An alternative would be to set population targets based on total grazing pressure that takes account of densities of other herbivores. It would reverse the situation where landholders are expected to carry an unstated number of animals that has no relationship to the carrying capacity of their properties, seasonal conditions or competing land uses.

Landholders should have a form of proprietorship over kangaroos on their properties. It could even lead to fewer methane producing livestock and more kangaroos producing low emission meat. Higher value kangaroos would enhance sustainability and bring other benefits to both Indigenous and other landholders on whose properties they occur.

Such changes are paradigm shifting but necessary to improve kangaroo welfare and reduce current wastage. Conventional livestock agencies such as Meat and Livestock Australia (MLA) should support the kangaroo industry as part of co-production and diversification options and its strategy to be carbon neutral by 2030. In 2017 Australia's 40 million kangaroos were almost exclusively on the properties of MLA and wool industry ratepayers.

This paper discusses the benefits of sustainable use of kangaroos and asserts a need for them to be realised. Changing the status of kangaroos is a complex undertaking that involves not only activities which farmers can control, but also product management, marketing and public attitudes. Transitioning to sustainable use begins with the importance of animal welfare and greater respect for kangaroos.

**Key words:** Macropod; land-use; drought; greenhouse gas emissions; livestock; red-meat; rangelands; cluster fences; pests; commercial harvest; sustainable use; total grazing pressure; kangaroo industry; kangaroo management; carbon offsets

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## Introduction

Most of Australia's 40 million kangaroos are on pastoral land and in good seasons their numbers increase dramatically. They are a cost to landowners by limiting livestock numbers that might otherwise be carried,

reducing livestock carcass weights and wool production, encroaching on paddocks being spelled, damaging existing fences and increasing the cost of other fences. With the right incentives and rewards, this situation

would be reversed, and landholders would regard kangaroos as assets not pests.

Although the kangaroo industry is only small, it is currently contracting further. As a result, non-commercial kill is increasing which leads to considerable wastage and, increasingly, poor animal welfare outcomes. Lifting the value of products, and ensuring take of kangaroos by professionals is sustainable, will help grow the kangaroo industry (Wilson 2018b). It should be supported more strongly by government and other meat industries, then benefits could accrue to landholders, including Indigenous owners, on whose properties kangaroos occur.

This paper reviews current kangaroo management in a changing social, economic and physical environment and indicates options for improvement. It argues that better kangaroo welfare and conservation depends on managed killing by professionals.

### Problems with current kangaroo management

Both the Australian Government and state governments have a role in the conservation of kangaroo populations.

The states have responsibilities for regulating the harvest and processing industry, while the Australian Government controls the export of kangaroo products through the approval of kangaroo management programs and the granting of export permits. New South Wales, Queensland, South Australia, and Western Australia all permit commercial harvesting of kangaroos under nationally coordinated wildlife trade management plans that support sustainable use. The established commercial harvest zones in those states in 2017 are shown in Figure 1 plus the regions of Victoria in which a developmental wildlife trade plan operates. (Department of the Environment and Energy 2018a). Other macropod species are harvested in Tasmania but they are not part of the national program and are not exported. The Australian Capital Territory and the Northern Territory do not have a commercial industry

Aerial surveys to determine kangaroo populations are conducted across the commercial zones. Figure 2 shows population total estimates for 36 years, from 1981 to 2017, for the most abundant, commercially harvested macropod species in Australia; including Eastern Grey Kangaroo *Macropus giganteus*, Red Kangaroo *M. rufus*, and Western Grey Kangaroo *M. fuliginosus*. In 2017, a state-wide survey of Victoria was

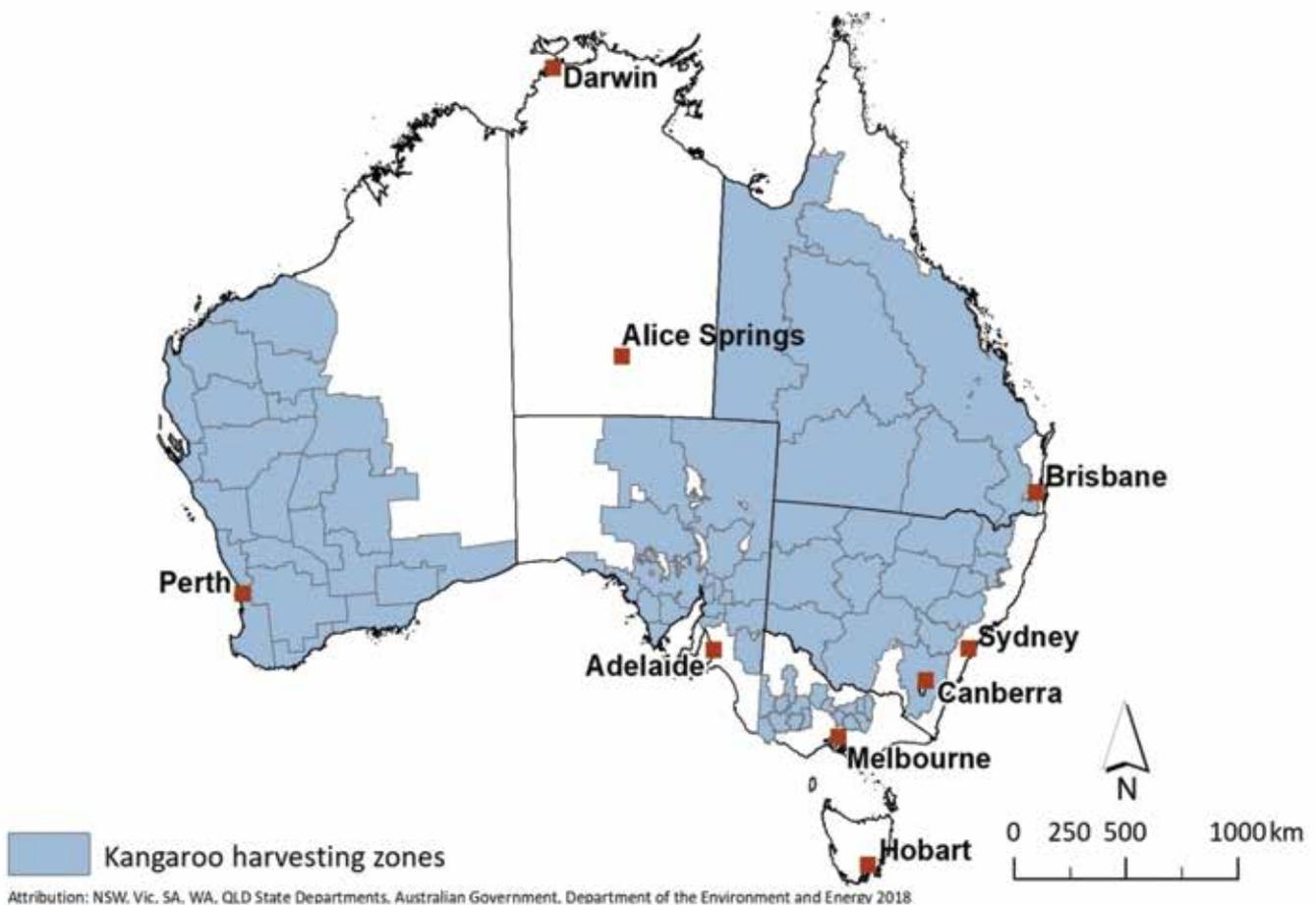
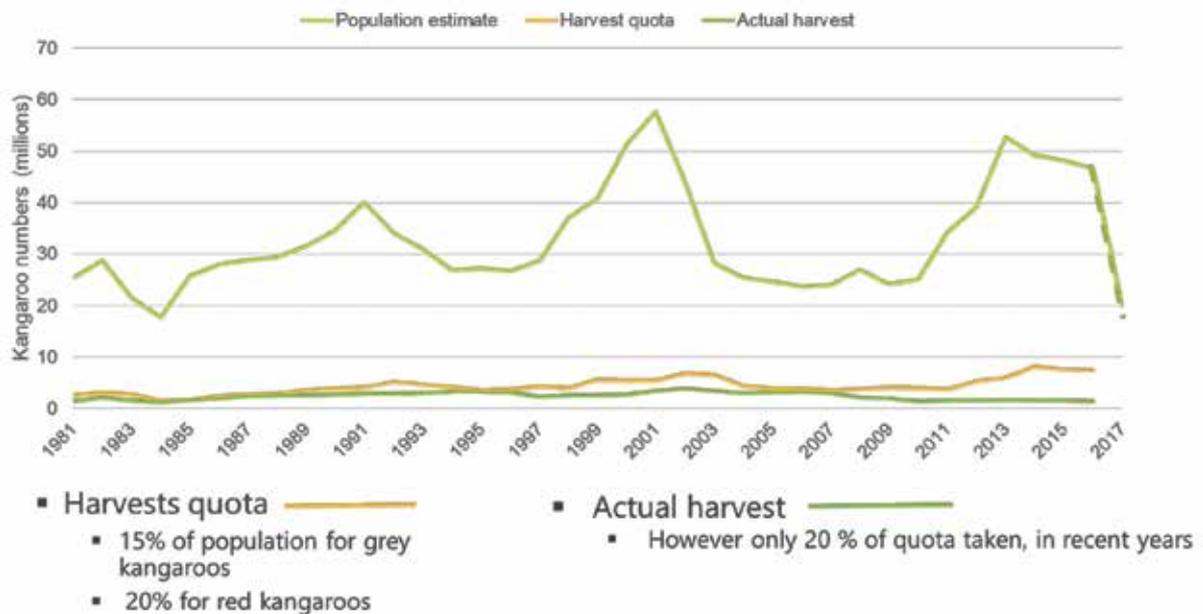


Figure 1 Areas of Australia in which commercial kangaroo harvesting is practised.

## Kangaroo populations fluctuate widely



**Figure 2** Commercial harvest of Red Kangaroos, Western Grey Kangaroos and Eastern Grey Kangaroos is a tiny proportion of the kangaroo population, and 20 % of the authorised quota (note 2018 population is a projected decline).

conducted for the first time using aerial and ground survey techniques. It leads to a conservative estimate of 1.4 million Eastern and Western Grey Kangaroos for the State (Moloney *et al.* 2017).

On average Australia has more than 40 million kangaroos. They are predominantly on pastoral lands used for livestock production. National Parks within the commercial harvest areas are ‘refuges’ where commercial harvesting does not take place.

Quotas are set by government regulators based on these population surveys, and seek to ensure that harvests are sustainable. Harvest quotas are set at 15 % of estimated populations based on recommendations of field investigations (Caughley 1987). This figure has subsequently been modified in the management plans to 20 % for *M. rufus* (Hacker *et al.* 2004; McLeod *et al.* 2004). Each State in the commercial industry produces an annual quota report, an annual harvest report and longer term management plans. While these quotas ensure that the harvest is a sustainable proportion of the populations, they are set independently of consideration of other land uses and total grazing pressure. They are a percentage of the existing population and so assume that the surveyed population is the desired one. This may or may not be the case; see subsequent discussion.

The actual harvest is an even smaller proportion of the population. From 2001 to 2006, harvests took 6 to 13 % of the population or 51 to 81 % of the available quota (Department of the Environment and Energy

2018b). In 2017 the commercial harvest was 3 % of the population (*M. giganteus*, *M. fuliginosus* and *M. rufus*), i.e. 20 % of the quota and it is declining (Figure 2).

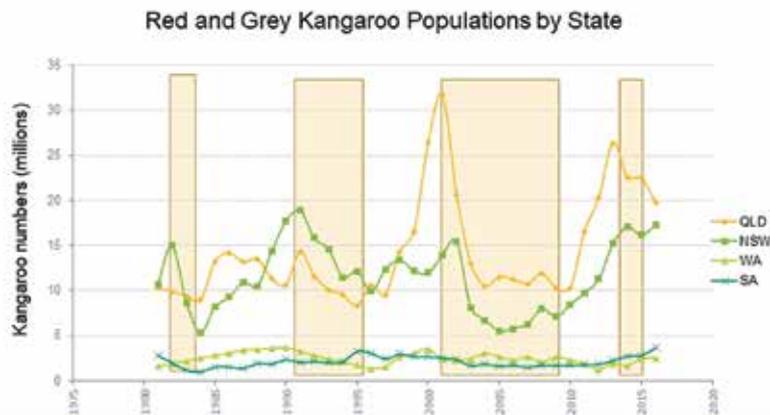
Kangaroo population estimates, quotas and harvests for commercial zones from 1982 to 2017 show that populations can grow rapidly in years that are favourable for breeding and survival; for example, 1996 to 2001 (Figure 3). Droughts can depress populations equally rapidly (Bayliss 1987; Pople and Grigg 1999). Figure 3 shows fluctuations, which particularly occur in Queensland and New South Wales, and declines in drought years (Deo *et al.* 2017).

With very dry seasonal conditions in 2018, the next aerial population estimates will show another substantial decline due to drought. These declines are completely independent of harvesting (killing) by the kangaroo industry (see Figure 2). They represent the deaths of millions of kangaroos due to starvation (Caughley *et al.* 1985; Robertson 1986), which is of considerable animal welfare concern. Overpopulation of kangaroos during drought also aggravates land degradation and leads to a substantial reduction in the quality of kangaroo meat products.

### Shortcomings in management processes

Kangaroos taken on private lands for commercial use are shot in the field at night using high-powered spotlights and rifles by certified and licensed shooters (Figure 4). The steps in the production from paddock to retailer are shown in Figure 5. Kangaroo carcasses

## Exponential growth has unacceptable consequences



Crash during droughts – causing animal welfare issues  
and land degradation

**Figure 3** Kangaroo numbers in states which commercially harvest kangaroos showing wide fluctuations in numbers between 1982 and 2017. The population of kangaroos is increasing despite these seasonal fluctuations.

are processed to human-consumption standard and meat is currently exported and sold in Australia to the food service industry, retail outlets and also as pet food. Kangaroo skins are valued for their high strength to weight ratio.

The National Code of Practice for the Humane Shooting of Kangaroos and Wallabies for Commercial Purposes (The Code) outlines a minimum standard of humane conduct in regard to the shooting of kangaroos and wallabies. It mandates head shots and instantaneous death (Natural Resource Management Ministerial Council 2008). The Code was developed after a long process of consultation involving industry, government, animal welfare groups, the scientific community and the public. In 2018, it is being reviewed through a project led by AgriFutures Australia. The review is being informed through a reference group of representatives from the Australian Veterinary Association, the Royal Society for the Prevention of Cruelty to Animals (RSPCA), industry and relevant government agencies.

Harvesters are currently price-takers and have no opportunity to receive an improved margin for higher quality, or a more accurately described product. Harvester profit margins are slim; especially when coupled with their fixed cost base and fluctuating demand and supply. They currently receive a little more than AUD\$0.60 per kilogram for carcasses.

Even at current low prices, the kangaroo industry is nevertheless an important financial contributor to rural communities, exports and the economy. Some skin and meat is used domestically, with the large proportion of the

remainder exported at human consumption standards to more than 60 countries (Department of Agriculture and Water Resources 2018b). The gross value of production in 2014 was AUD\$174 million and represented a harvest of 3 % of the total kangaroo population (Kangaroo Industry Association of Australia 2018). Once ancillary benefits such as reduced agricultural damage, reduced road accidents and broader benefits to the community are added, the industry currently contributes well over AUD\$200 million per year to the economy (Kangaroo Industry Association of Australia 2018).

### Comparative values

In the rangelands where commercial kangaroo harvesting takes place, the longer term average kangaroo population is approximately 40 million. On current values to the shooter of AUD\$0.60 per kilogram, an average kangaroo carcass (23 kg) is worth AUD\$13.80 so that the population is worth AUD\$550 million, which is a large sum but paltry compared with the value of the cattle herd and sheep flock in the same area (Figure 6).

Kangaroos are a fine resource, well adapted to the Australian environment and their value should be higher. If kangaroos were worth AUD\$70.00 per head, the same as feral goats, the population would be worth AUD\$2.8 billion, more than 10 times the value of the goat population.

In reality the value of kangaroo products is going in the reverse direction and demand is falling. Skins have become worthless with the collapse of the market in California due to a successful 2016 campaign to ban the import of skins to that State (California Penal Code 2016). The impact on demand in Australia has



**Figure 4** Field shooting is animal welfare friendly meat production – instantaneous death from head shots.

been profound. Skins from a kangaroo processing plant at Broken Hill, for example, are discarded as town waste. The number of professional kangaroo shooters is declining (Figure 7) and those still operating fear ‘the end of the roo industry’ with considerable impact on the smaller rural townships in which they live. Recent new participants in the kangaroo industry such as Cool Off Pty Lt and Keith Engineering are giving some hope to harvesters by paying AUD\$0.75 per

kilogram for carcasses to be rendered to meat-meal to supply pet food manufacturers. However, we regard this as maintaining kangaroos as a source of cheap bulk protein and a by-product of pest control.

### Populations rising

For a number of reasons including predator control, provision of water, good seasons and the decline in hunting pressure, kangaroo numbers have been steadily increasing

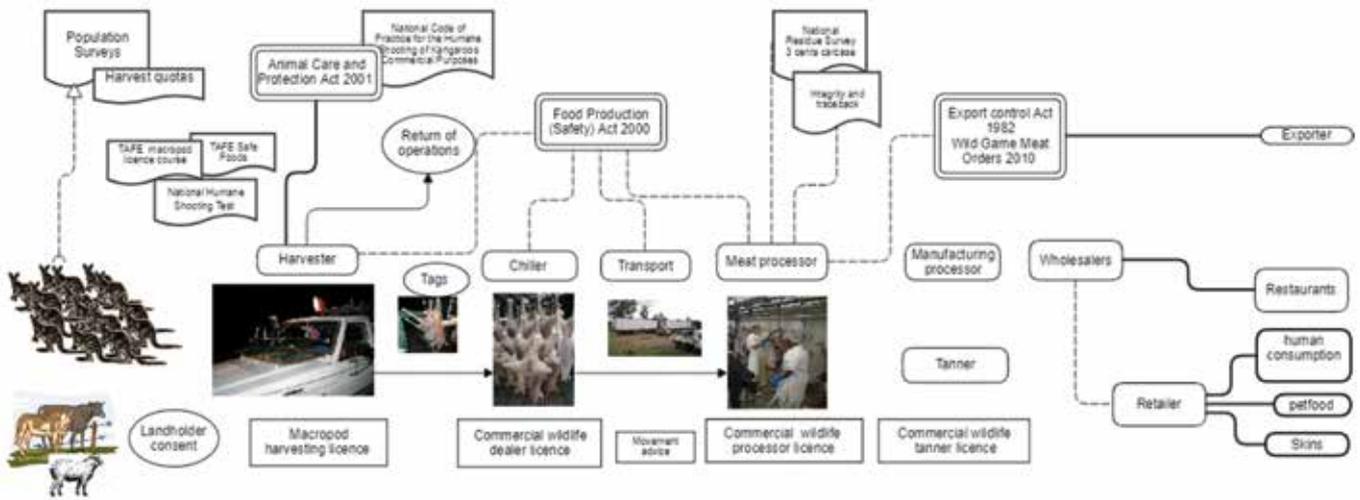


Figure 5 Steps in the kangaroo production process from paddock to retailer and regulatory requirements.

## Comparative value of kangaroos in the rangelands

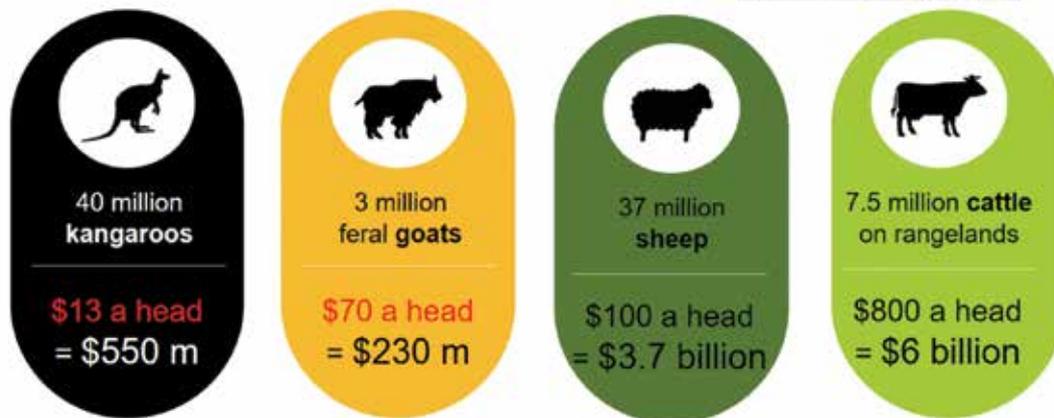


Figure 6 Comparative values in 2018 of conventional livestock, feral goats and kangaroos on the Australian rangelands.

in New South Wales and Queensland, notwithstanding fluctuations due to seasonal variation (Figure 3). In the face of harvesting and in good seasons between 1996 and 2001 the harvested population increased with a rate of increase of 0.16, and between 1984 and 1991 with a rate of increase of 0.09. The long term rate of increase prior to the 2018 drought, from 1991 to 2017, was 0.08.

These increases in population lead to a number of outcomes. Some are human responses such as more amateur shooting and the construction of kangaroo exclusion fences. Others are increases in motor vehicle collision and outbreaks of density dependent diseases. We suggest that all outcomes are unwelcome and that they would be less frequent with a stronger kangaroo industry and a well-managed commercial harvest in which land holders were more closely engaged and benefitted.

### Grazier and landholder response to ‘overpopulation’

To enable more income-earning stock to be carried, many graziers are seeking other means to lower kangaroo numbers. In New South Wales non-commercial culling figures are increasing (Table 1). Revised procedures in August 2018 make it easier for landholders to obtain pest control permits (Department of Primary Industries 2018).

In Queensland the number of damage mitigation permits (DMPs) has also been increasing (Table 2). DMPs are issued by the Queensland Department of Environment and Heritage Protection, where macropods are causing demonstrable damage to primary production. On one corporate enterprise near Cunnamulla permits for the culling of 20 000 macropods were issued.

### Number of licensed field harvesters

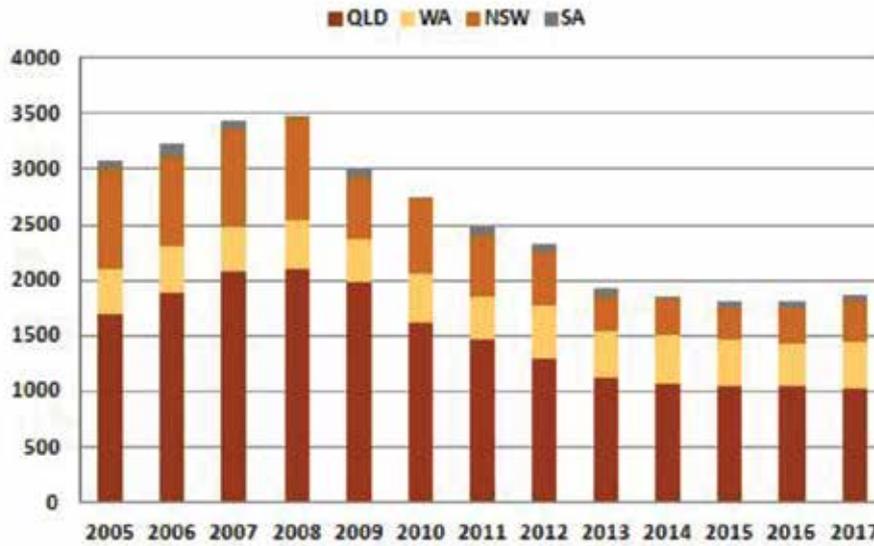


Figure 7 Declining numbers of licenced professional harvesters.

Table I. The number of kangaroos to be culled on non-commercial licenses in New South Wales.

Year	Kangaroos to be culled on NSW non-commercial licenses
2013	77 630
2014	89 830
2016	71 796
2017	217 308

Such amateur, non-commercial kangaroo control has poor management outcomes. “Shoot and let lie” means that regulators cannot assess how many kangaroos are taken. They also cannot monitor either shooter accuracy and skill, or compliance with welfare codes because carcasses are left in the paddock.

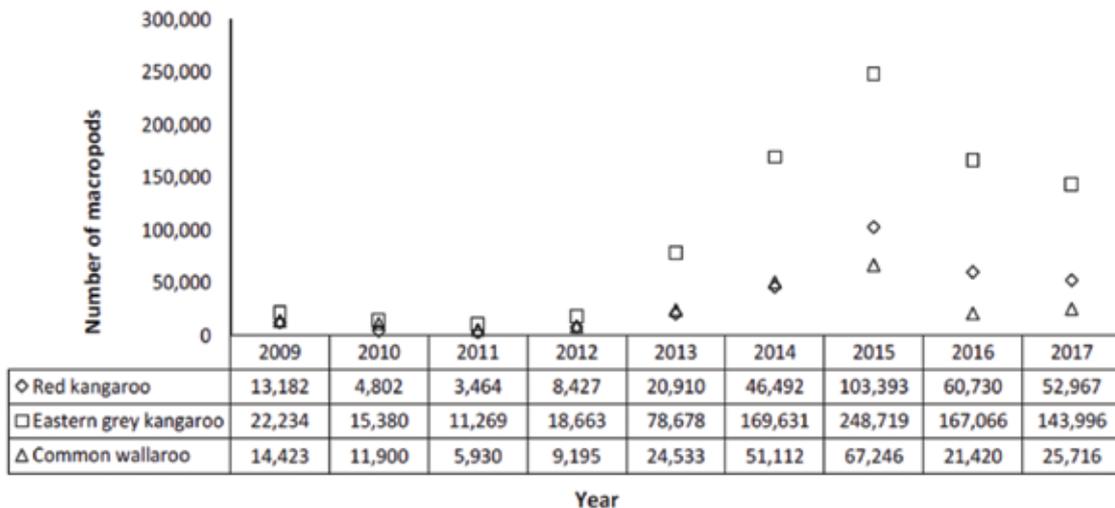
To address these shortcomings efforts are being made to improve the skill and efficacy of amateur control including collaboration with the Sporting Shooters Association and a program known as Farmer Assist ([www.farmerassist.com.au](http://www.farmerassist.com.au)).

Damage mitigation is also a significant waste. For example, the estimate of 270 000 kangaroos culled in Queensland in 2014 represents wastage of AUD\$22.9 million in meat production sales; an opportunity lost by the harvesters and the processors and savings for the landholder.

#### Kangaroo exclusion or cluster fences

Graziers unable to either incorporate effective kangaroo management into their pastoral operations or reduce kangaroo numbers efficiently, are erecting kangaroo

Table 2. Increase in Damage Mitigation Permits across Queensland 2012 to 2017 (Department of Environment and Heritage Protection 2017).



exclusion fences around clusters of properties and lowering numbers through various other means. Most have poor animal welfare and biodiversity outcomes (Bradby *et al.* 2014).

Much of the non-commercial kangaroo culling in western Queensland is occurring within these clusters of pest-proof fences. The scale is extensive and government support for fence construction, complemented by private investment, runs to the tens of millions of dollars. The Queensland Feral Pest Initiative has subsidised fence construction to the amount of \$2500 per kilometre. Landholders contributed to the balance by approximately 69 %. Private fences which are not part of the program are also being erected. Figure 8 shows the extent of fencing in the Collaborative Area Management cluster program in South West Natural Resource Management (NRM) area, and the location of the wild dog barrier fence.

Cluster fences in western Queensland are achieving the first of their aims; to eradicate wild dogs so as to enable sheep numbers to rise. Lambing rates have increased from 20 to 90 % since fences were installed (South West NRM Ltd 2017). However, increases in profitability of enterprises do not take into account that the removal of wild dogs lifts rates of increase of kangaroos and therefore could compromise the second objective which is to reduce unmanaged grazing pressure from pest animals.

### **Negative impacts of cluster fences and a few potential positives**

Cluster fences have by definition, the objective of enabling closer management of total grazing pressure of all unwanted herbivores, and in particular a reduction in kangaroo numbers. Thus their impact on kangaroo populations and on their welfare is adverse. Kangaroos are unable to move in response to changing seasonal conditions and the impact on movement of other biodiversity is also detrimental (Bradby *et al.* 2014). Kangaroos have been observed as emaciated and stressed as they are prevented from moving on. They are herded along fences and shot by amateurs, resulting in wounding and muscle stress myopathy in those carcasses that do subsequently enter the commercial harvesting industry. The kangaroo industry reports an increase in metal detections in carcasses of commercially harvested (i.e. eventually head shot) kangaroos that is rendering some areas as non-viable to operate in due to the risk of metal contamination of meat (D. Jobson, pers. comm. 2018, Kangaroo Industries Association of Australia).

On the other hand, while the impact of fences on kangaroos and other biodiversity is generally poor, barrier fences could open other more positive opportunities. It might be possible to manage kangaroos sustainably within very large cluster fence complexes. This could facilitate proprietorship, which is discussed

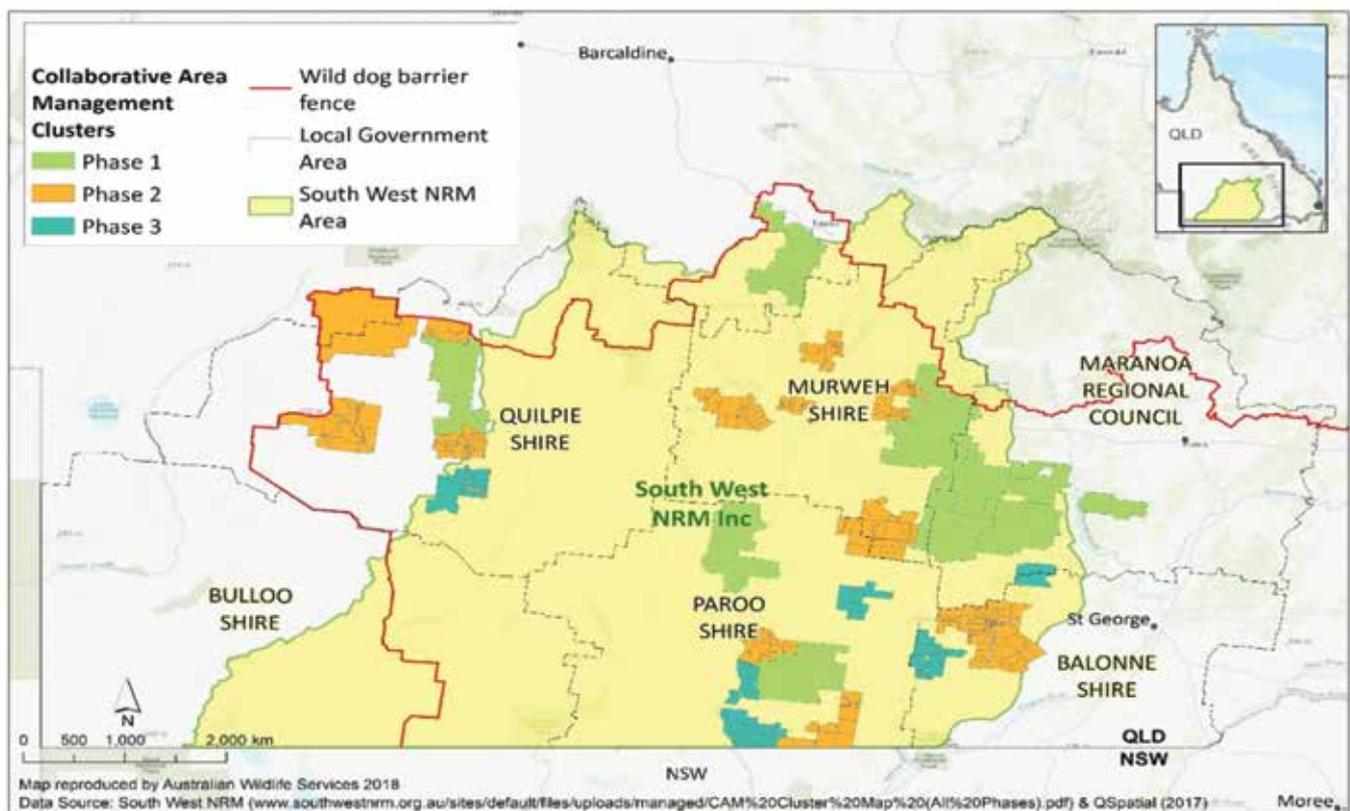


Figure 8 Cluster fences in the South West Natural Resource Management Area.

in more detail below. At the moment there is imperfect information on their location especially those being erected privately, i.e. without government support.

### Road accidents

High numbers of unmanaged kangaroos are a cause of road accidents and public concern, especially in rural areas. During dry times they are attracted to roadsides to graze on grass irrigated by road run-off.

The National Roads and Motorist's Association (NRMA) recorded more than 18 000 claims nationally for crashes involving collisions with animals, mostly attributed to kangaroos. The cost of these collision was AUD\$15.3 million in 2006, with an average claim amount of AUD\$2 260 (Rowden *et al.* 2008). These costs are the direct costs of vehicle damage and do not take into account the impacts of injury and even death to humans from collisions with kangaroos, nor the welfare of kangaroos themselves. More recently, Dunne (2017) conservatively estimated that over \$10 million dollars in insurance claims were made in the Australian Capital Territory in only 15 months. Better information is needed to provide insight for the National Transport Commission and insurance companies on kangaroo road safety and to inform population management objectives. In the ACT, one response to high numbers of kangaroos is to erect movement control fences on main roads. They convert roads through the Canberra Nature Park into canyons of wire (Figure 9). They leave open questions of responsibility for kangaroo numbers and whether these fencing resources might have been better spent by government on other wildlife conservation activity if populations had been better managed.



**Figure 9** Kangaroo proof fences between Canberra Nature Park and main road.

### Disease outbreaks

Mass mortality events in large macropod species have been reported in many areas of Australia (Wildlife Health Australia 2018). Kangaroos in high numbers appear more likely to succumb to disease. The extent of mortalities is difficult to quantify or even estimate with any accuracy, particularly in remote areas. Anecdotal reports range from hundreds to more than 50 000 animals dead. In some cases, aetiology has been determined, in others, causes remain unknown or unconfirmed (Curran 2011). It is likely that there are multiple causal factors. Some events appear to be associated with heavier than average rainfall and flooding, and concurrent increased insect (possible vectors) populations. Individual events also occur in relatively confined geographical areas. Ongoing investigation is required to better understand the drivers and proximate causes of mortality events in large macropod species in Australia. As with road incidents, it is expected that managed kangaroo populations will have lower incidence of disease. In addition, if proposed proprietorship proposals come in to effect, landholders would have an interest in healthy populations and management to alleviate disease outbreaks just as they currently do for conventional livestock.

### Suggested strategies for improving kangaroo management

Management of kangaroos is controversial because there are so many stakeholders. Kangaroos are concurrently a national icon, a natural resource and a pest, particularly to farmers and road users. They are protected species under State conservation wildlife laws. Animal welfare and meat production standards are regulated by primary production agencies and other legislation. National coordination and export controls are the responsibility of the Federal Government, but again split across conservation and agricultural production agencies.

### Current plans

Although most states that have a commercial kangaroo industry and export kangaroos do support sustainable use and comply with the principles of ecological sustainable development under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC ACT), none have plans that refer to a desirable kangaroo population or recognises that kangaroos are a component of total grazing pressure on the pastoral lands on which they occur.

The New South Wales Commercial Kangaroo Harvest Management Plan 2017 to 2021 has the objective of ensuring kangaroo populations in New South Wales remain ecologically sustainable; and of ensuring the methods of harvesting kangaroos for commercial use are humane.

The Queensland Wildlife Trade Management Plan Commercially Harvested Macropods 2013 to 2017 has the goal of providing sustainable use of macropod species

covered in accordance with the principles of ecologically sustainable development.

Similarly, the approved South Australian Kangaroo Management Plan 2018 to 2022 and the Western Australia Management Plan for the Commercial Harvest of Kangaroos 2014 to 2018 provide for the sustainable commercial harvest of kangaroos in accordance with the principles of ecologically sustainable development.

In 2010, Victoria commenced a program to allow the use of kangaroo carcasses resulting from authorised control activities to be processed for pet food. (Victoria Department of Environment Land Water and Planning 2018). Under provisions of the Wildlife Act 1975 (Vic) *M. fuliginosus*, *M. giganteus* and *Osphranter rufus*<sup>1</sup> can be culled in Victoria for damage mitigation purposes provided doing so is ecologically sustainable. Similar to other commercial plans, the Victorian program neither sets a desirable kangaroo population nor recognises that kangaroos are a component of total grazing on pastoral properties.

Ecological sustainability is defined under the program as ‘the maximum culling or harvesting rate that can be sustained in the long-term, while still ensuring conservation of the kangaroo population’ without saying what that is. Participating landholders must demonstrate that kangaroos are causing property damage and that non-lethal wildlife management options have been attempted before lethal control, so the program is more pest control than sustainable use. In 2018, the Victorian trial was approved as a developmental wildlife trade operation under the EPBC Act 1999, enabling participating pet meat processors to export kangaroo skins.

The Australian Capital Territory Kangaroo Management Plan 2010 does not permit commercial use of kangaroos, but unlike the others does require “particular consideration be given to managing kangaroo grazing pressure on native grassy ecosystems in the context of grazing pressure from all herbivores”. While it does not set a desirable kangaroo density on pastoral lands, in major contrast to interstate plans, it does set a target density for grassland of approximately 1 kangaroo per hectare. The program hires skilled marksmen annually to strive to attain that density (ACT Parliamentary Counsel 2017).

### **Sustainable harvests**

Once a preferred kangaroo density has been established, an estimate of sustainable harvest for an area will vary depending on seasonal conditions. Quotas that are set at 15 to 20 % of current populations, contain within them the underlying assumption that current populations are those that are desirable in the long-term.

<sup>1</sup> *Osphranter rufus* is the new Genus and species name for Red kangaroos. Its adoption in all State and Commonwealth legislation will take time.

The current commercial production represents a harvest of 3 % of the total kangaroo population. There are thus substantial opportunities for increasing the size of the harvest and generating additional sources of income for landholders and rural communities. Field studies show that rates of increase for an unharvested population can be much higher, 0.5 and above in favourable seasons (Bayliss 1987) so a harvest rate of 30 % is well within the biological capacity of kangaroos to sustain. Higher harvesting rates during good seasons will prevent peaks developing and therefore subsequent troughs (Figure 2 and Figure 3) and lead to better animal welfare outcomes.

### **Clarify and make kangaroo management objectives measurable**

#### ***Set target populations for regions***

Commercial use of kangaroos is currently permitted after governments have set harvesting quotas which are a proportion of existing (variable) populations. An alternative would be not to set harvest quotas but to set population targets based on total grazing pressure that took into account densities of other herbivores.

Setting target populations would reverse the current situation where landholders are expected to carry an unstated number of animals that has no relationship to either the carrying capacity of their properties or other livestock and competing land uses.

Under this concept individual landholders would agree to carry a nominated minimum number of animals and would be free to manage populations, including excess above those minima, in accord with their own management objectives. Management Plans would describe this process. It has been established that kangaroo populations in western New South Wales increase when pasture biomass is above 200 kg per hectare and decrease when it is below that level (Bayliss 1987).

Under the proposals outlined in this paper, survey data would be used as input to an assessment of total grazing pressure along with sheep, cattle and goat densities. Details of survey techniques are set out in state kangaroo management programs. While they do vary across Australia owing to state-based innovations and differences in terrain and species habitat preferences; the general underlying principles are essentially similar:

- Aircraft, either fixed wing or helicopters, fly at known specified speed and height, and the sighting distance on the ground is delineated by streamers or booms.
- Trained observers record kangaroos seen from the aircraft within delineated bands.
- Line-transect distance sampling (Buckland *et al.* 1993)

is used to estimate kangaroo densities.

- For each region of interest (e.g. a single commercial harvest zone), the total area of the region is known.
- The estimated density, that is the number of animals per square kilometre, is multiplied by the area of the region to calculate the population estimate.

### **Integrate kangaroo management strategies with pastoral industries**

Many graziers on the rangelands are under financial stress. A recent situation analysis of the Australian beef industry found that many beef enterprises under current management regimes were economically unsustainable (Holmes 2015).

While graziers are prepared to carry a token non-productive kangaroo population, large kangaroo populations compromise their production of more meat and wool. Graziers seek to grow more grass, while also clearing trees, removing wild dogs to increase lambing percentages and lowering kangaroo numbers because they receive no income from them (Wilson 2018a).

#### *Create incentives for co-production on pastoral lands*

The alternative is that if kangaroos were worth more money, pastoralists would regard the kangaroo industry as a co-production activity alongside conventional livestock. Co-production on pastoral lands and an expansion of the kangaroo industry could be an innovative rural development with relatively low costs. The resource is already there and the industry is operating, albeit in a constrained form. Sheep replacement therapy was advocated by Grigg (1987) for many years and the role of commercial harvest reviewed by Lunney (2010). See also Grigg (2018) and Lunney (2018). Archer and Beale (2004) also proposed that sustainable wild-harvesting of kangaroos is very much in the long-term interests of the kangaroos and the environment, as well as human health and that of Australian rural communities. Wilson and Mitchell (2005) developed plans for regional management of kangaroos and Wilson (2018b) reported on impediments to implementing them. We believe nevertheless that the concept warrants further investment.

Partnerships between landholders, corporate agriculture, venture capitalists, kangaroo processors, government, food marketers, research scientists and economists might be set up as regional cooperatives. They would encourage industry expansion. They would invest in plant and equipment to improve the ability of harvesters to supply higher quality products and market them accordingly. They would improve the description of product, develop the necessary infrastructure, and monitor the value chain to increase the price of the final product (Cooney *et al.* 2009; Wilson 2018b).

Kangaroo co-production would ensure that more sustainable and innovative land management practices are adopted, rather than business as usual which has seen significant erosion of natural capital. It would involve killing for conservation.

By taking advantage of the adaptations and success of kangaroos on the rangelands, co-production could provide an additional source of landholder income and help address the falling sustainability of many rangeland production systems under traditional pastoralism. Kangaroo harvesting would become a mainstream agricultural activity integrated into other on-farm operations. Market information and research support would come from organisations such as Meat and Livestock Australia (MLA) just as it does for other red meats.

#### *Devolve proprietorship and management responsibility*

Because kangaroos move from property to property, establishing a form of proprietorship over this mobile resource is a strategy that is difficult but necessary to enable coproduction. Responsibility could be passed collectively to regional cooperative bodies such as a Landcare Groups, or properties within a cluster of kangaroo and vermin control fences. Corporate agricultural bodies, cooperatives or conservancies could become the beneficiaries of proprietorship.

Wildlife conservation departments would licence devolution of responsibility as permits or leases to carry or hold. They would continue to conduct surveys and monitor populations at the regional level just as they do now. The aim would be to ensure that the national population does not fall below an agreed national minimum.

The 'permits to carry' or leases issued by conservation departments might be tradable, indeed, they could be acquired by animal rights organisations and so enable them to contribute to their objective of allowing animals to live full lives unimpeded.

Agriculture departments and food safety authorities would regulate welfare and quality standards.

The proposed changes have a similarity to those that apply for devolved responsibility for animals on game ranches in southern Africa, bison in the United States of America, deer in Scotland, and emus and crocodiles in Australia. Under these models, landholders have greater responsibility, proprietorship, tenure of animals and a capacity to benefit from stewardship of them and their habitat. The latter brings benefits to other wildlife.

Devolved responsibility would, for many landholders, encourage stewardship of the resource. It would encourage them to the take of a longer term view, maybe even a 100-

year perspective. It could lead to wider benefits such as riparian protection and vegetation diversity.

More work is needed in order to be able to nominate a preferred density on the basis of total grazing pressure. It will vary depending on whether the enterprise operates on set stocking, rotational grazing and on the mobility of kangaroos. It needs to be related to land type productivity and seasonal conditions.

Vermin control exclusion fences around clusters of properties could be an asset to better kangaroo management if they enabled a form of proprietorship. There is a need for a research project to assess the capacity of such fences to be beneficial to kangaroo management and populations as confined entities within a cluster of properties. One of the adaptations by kangaroos to Australia's erratic environment is a capacity to move with a relatively low energy costs.

### **Legal opportunities**

There would appear to be precedents for the legal and administrative processes to deliver such a change. The New South Wales *Biodiversity Conservation Act 2016* No 63 has purposes which include:

- To establish market-based conservation mechanisms through which the biodiversity impacts of development and land use change can be offset at landscape and site scales.
- To regulate human interactions with wildlife by applying a risk-based approach.
- To conserve biodiversity at bioregional and State scales.

In Division 3 of the Act, Biodiversity conservation licences may be issued in New South Wales to permit acts that would otherwise constitute an offence such as confining or holding wildlife. These licences may be granted unconditionally or subject to such conditions as are specified or referred to in the licence or as are prescribed by the regulations. Section 2.13 would appear to provide ample opportunity to issue a license to hold.

Similarly, the Queensland *Nature Conservation Act 1992* makes provision for landholders to own and farm a limited number of protected species; for example, emus, crocodiles and snakes for venom extraction. Again, in common with other states, licences permit the holding of threatened species including highly endangered species such as northern hairy nosed wombats *Lasiorhinus krefftii* and bridled nail tailed wallabies *Onychogalea fraenata*. Division 8 deals with captive breeding agreements and captive breeding conservation.

We cannot see why these legislative processes that permit holding of animals to be farmed and bred intensively

could not be used to permit a form of leasing and proprietorship at a larger scale, for example properties enclosed by a cluster fence. Landholders would have authority delegated to hold a nominated minimum number of animals. Above that number they could manage the excess as they chose, innovating and adding value, increasing the number or eliminating them.

### **Increase value of kangaroo products**

Devolved responsibility and proprietorship would encourage landholders to play a role in promoting kangaroo products, creating greater demand and raising the value. It would create an incentive to improve the quality and description of product, develop the necessary infrastructure, and monitor the value chain.

### **Strategic marketing**

Strategic alliances are needed to enable value adding and improved marketing. The proposed regional collaborators could produce quality, differentiated carcasses, vertically integrated down the supply chain. They could develop certification, branding and marketing strategies for a favourable reputation within the community and establish distribution channel relationships with markets such as specialty health and organic food stores and farmer's markets. If successful they could actually expand production and the kangaroo population earning credits as described above.

### **Emphasise valuable health and environmental attributes**

We have identified a number of production and promotional opportunities which if taken up could lead to an increase in the demand and hence value of kangaroos and their products (Figure 10). See also Grigg (2002). Young (2017) concluded making the connections between food and the land could be transformative in creating value for kangaroo meat and delivering benefits for land management.

### **Lower fat and cholesterol content**

Kangaroo meat has a lower fat and cholesterol content than lean beef and lean lamb. It provides more protein than beef, lamb, pork and chicken and has a higher iron content than lamb, pork and chicken (Food and Fogerty 1982) (Table 3). These features allow kangaroo meat to provide the health benefits of white meat, while still maintaining its red-meat status. Thus kangaroo meat appeals to the health-conscious customers, which is a growing market. Furthermore, the product is wild harvested and therefore free-range.

### **Ethical choice**

Purchasing kangaroo products should be an ethical choice for socially concerned consumers. Kangaroos

## Kangaroo attributes

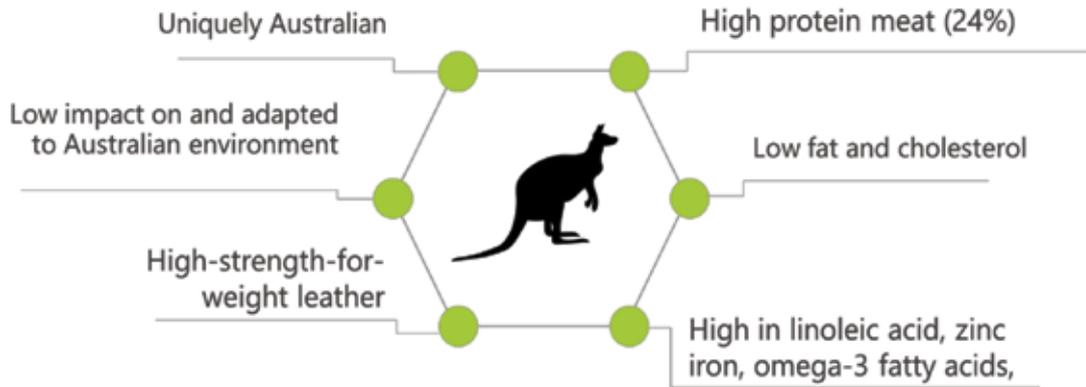


Figure 10 Positive health attributes of kangaroo meats.

Table 3. Nutritional Values of kangaroo and other meat based on raw meat trimmed of all fat (Food and Fogerty 1982).

Source	Meat Protein (%)	Fat (%)	Kilojoules (per 100 g)	Cholesterol (mg/100 g)	Iron (mg/100 g)
Kangaroo	24	1-3	500	56	2.60
Lean Lamb	22	2-7	530	66	1.80
Lean Beef	22	2-5	500	67	3.50
Lean Pork	23	1-3	440	50	1.00
Lean Chicken Breast	23	2	470	50	0.60

live free and wild on a natural diet of native vegetation. Kangaroo meat is not farmed; it is free-range. The method of killing is humane; instant kill in their natural habitat. Using kangaroos minimises waste when populations are being culled for damage mitigation purposes.

### Low physical impact

It is often asserted that kangaroos have less physical impact on the environment compared to sheep, goats and cattle as a result of their physical attributes. Grigg (2002) reviewed the impact and concluded that kangaroos “soft feet” do less damage to land and vegetation compared to sheep and cattle at kilogram for kilogram. We note that the impact of hard-hoofed livestock is particularly profound in riparian areas and there have been major land and vegetation conservation programs to fence livestock out of creeks and rivers. We note the need for more comprehensive comparative studies to support this assertion and an extension of the work of Bennett (1999) and Noble and Tongway (1986). Many golf courses will tolerate up to 100 kangaroos whereas we doubt they would tolerate any sheep and certainly no cattle because of the damage that would be done to playing surfaces (Figure 11).

### Lowering carbon emissions and gaining offset credits

Consumers purchasing kangaroo are choosing comparatively low emission meat because kangaroos produce negligible amounts of the greenhouse gas methane (Kempton *et al.* 1976; Vendl *et al.* 2015). This attribute appeals to environmentally aware and sustainability conscious consumers. Per head cattle can produce up to 600 times more, and sheep 50 times, the amount of methane that kangaroos produce (Figure 12) (National Greenhouse Gas Inventory 2005). It means



Figure 11 Kangaroos can be found on many golf courses around Australia, where conventional livestock are not tolerated. Photo G Wilson, Federal Golf Club, Canberra.

that 1 kg of kangaroo meat generates 0.75 kg CO<sub>2</sub> equivalents per year, whereas 1 kg beef generates 25 kg CO<sub>2</sub> equivalents per year.

The difference between emissions produced per kilogram of meat creates an opportunity for landholders to earn carbon credits. There are also potentially biodiversity credits through better management of grazing pressures and reduced damage to sensitive habitats.

Landholders could supplement their income with tradeable carbon credits by reducing cattle numbers and producing the same amount of meat from the kangaroos (Wilson and Edwards 2008). In 2018 the opportunity would be restricted to the voluntary carbon market but changes could occur to the Emissions Reduction Fund (ERF). The ERF is a voluntary scheme that aims to provide incentives for a range of organisations and individuals to adopt new practices and technologies to reduce their emissions. Research is needed to assess the environmental outcomes of undertaking this business.

**Enhancing quality, reliability of delivery and product description**

Increasing the value of kangaroos could include improved field procedures that enabled better product description, quality management and differentiation by selecting preferred animals, differentiating product on basis of species, sex, age and size or condition characteristics. In many respects, lack of capacity to differentiate product ‘at the farm gate’ places the kangaroo industry in a similar position to that of the meat industry many decades ago. Back then,

farmers dispatched their livestock and had no further information on the product nor interest in its subsequent sale.

There are opportunities for innovations in harvesting, field dressing methods, reducing time to the chiller, ensuring even and quick temperature reduction of carcasses, avoiding overcrowding in the chiller and faster transport to processing.

If effective trace back through tracking technologies used by harvesters and product differentiation could be accomplished, a regional brand could be established. Branding would include the attributes listed above.

Effective trace back would also open up some other truly innovative opportunities. The elastic properties of kangaroo tendons and heart valves have caught the attention of surgeons performing replacement and restorative operations on humans. To date, pigs and calves are used because they can be inspected ante mortem and there are detailed monitoring chains to meet production and health criteria.

**Comparisons between kangaroos and conventional livestock**

Kangaroos have favourable boning percentages; a dressed carcass (carcass weight/empty body weight) is 66 % and over 50 % of the empty body weight of kangaroos is muscle. Carcass and fat is negligible (Hopwood *et al.* 1976). Muscle mass is concentrated in the region of the loin, rump and thigh. Approximately 40 % of the meat yield of kangaroo carcass is high-

# Lower carbon emissions per kg meat

Kangaroos have different digestive systems



Figure 12 Methane emissions expressed as carbon dioxide equivalents from kangaroos and conventional livestock.



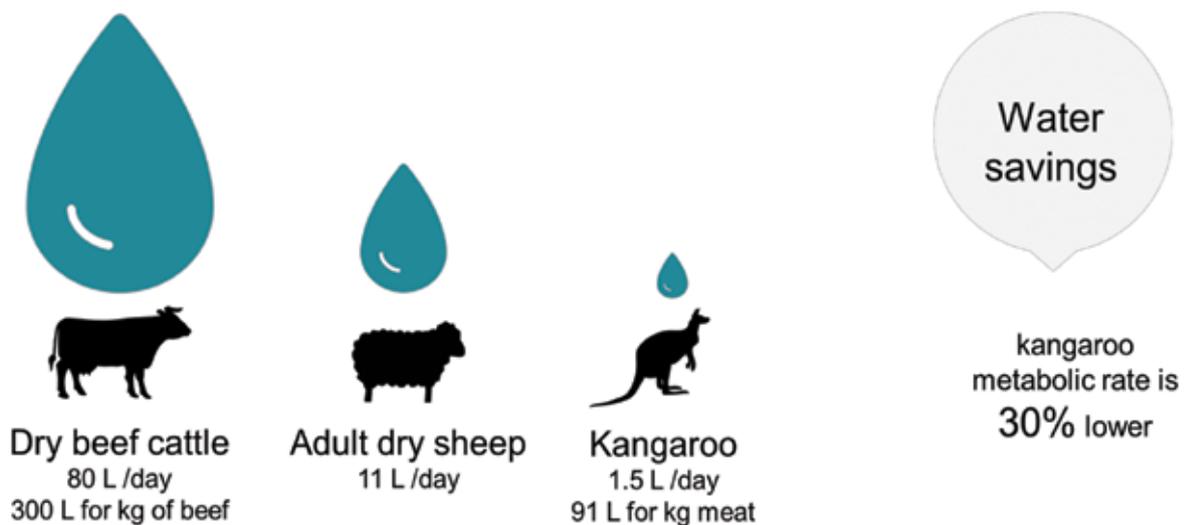
South Australian populations were 19 and 32 kg harvested and unharvested respectively and in Queensland 16 and 27 kg (Pople and Grigg 1999). For the purposes of analysis we have taken standard sheep to be 45 kg, a steer to be 500 kg and a kangaroo to be 35 kg. With these constraints on generalisations we have compared water consumption in Figure 15 (Munn *et al.* 2009; Munn *et al.* 2013; Munn *et al.* 2014; NSW Department of Primary Industries 2014) and production in Figure 16. Fourteen 35 kg kangaroos weigh the same as 500 kg steer producing 170 kg of meat compared to 200 kg from the steer.

competition between livestock and kangaroos and production efficiency. Notwithstanding earlier analyses (Dawson and Munn 2007; Grigg 2002; Milllear *et al.* 2001; Munn *et al.* 2009; Munn *et al.* 2013), there are still questions to be resolved about the appropriate Dry Sheep Equivalent (DSE) value in harvested populations. Harvesting practice has an impact on sex ratios and reduces the age of a population to one that is actively growing and which may have higher metabolic costs. Despite these uncertainties we suggest that a DSE of 0.35 per individual kangaroo is an appropriate assumption (Munn *et al.* 2009) which means kangaroos consume a diet with only a third overlap in good

There has been some debate about the extent of

## Lower water requirements

Kangaroos need less water



13

Figure 15 Comparative water consumption for kangaroos and conventional livestock.

## Weight for weight meat production

■ 14 x 35kg kangaroos weigh the same as 1 x 500kg steer

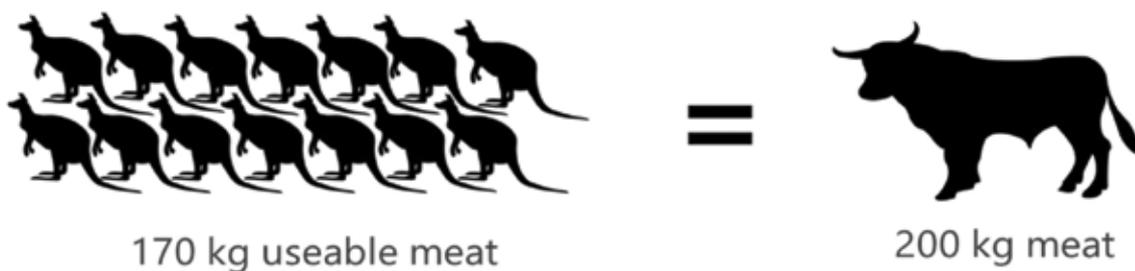


Figure 16 Comparative meat production weight for equal weight of kangaroos and cattle.

seasonal conditions. However, they do grow more slowly and further allowances need to be made to the comparison. On the basis of the comparisons in Figure 16, 40 kangaroos would have equal impact on pasture to 1 steer. They would produce 480 kg of meat compared to 200 kg from the steer.

In summary kangaroos use fewer resources to produce a healthier and more environmentally friendly product when compared to conventional livestock. These attributes should be the foundation of marketing and promotion.

### Promotional opportunities

Markets are always looking for a new and unique product. No other country can directly compete with Australia in this trade. For international markets there is no need to promote country of origin. The world equates kangaroo to Australia. Promotion should move away from bulk meat and pet food markets and create a demand at the high value end.

A study in 2008 found that an environmental message alone would be unlikely to attract significant market advantages, whereas a gourmet, high quality, environmentally branded product would most likely raise the value of kangaroo meat. All three would be vital to adding value. These market segments exhibit little concern that kangaroos are part of Australia's national emblem and there is general agreement that kangaroos should be used as a resource for food and leather. Consumers express concern that kangaroos should be killed humanely, a sentiment across all consumer segments except objectors (Ampt and Owen 2008).

## Developing the kangaroo industry

### Research, Development and Adoption

The current kangaroo industry research, development and adoption program is supported by levies (Box 1) and Agrifutures Australia. It focuses on meat and skin processing and market development and has five strategic areas of investment:

- Animal welfare – gathering scientific evidence to a standard sufficient to gain third-party endorsement for the industry's animal welfare practices.
- Sustainability – compiling and sharing scientific evidence.
- Nutritional value – identifying benefits of kangaroo meat.
- Trade barriers and food safety – generating scientific data to satisfy regulators that gamma irradiation is a safe treatment for kangaroo meat, and demonstrate whole-of-chain safety of kangaroo meat.

### Box 1 Current Macropod Levies

#### Kangaroo for human consumption

National Residue Survey (NRS): AUD\$0.03 per carcass.

Research and Development (R & D): AUD\$0.04 per carcass.

Total: AUD\$0.07 per carcass.

#### Other macropod for human consumption

R & D: AUD\$0.04 per carcass.

Total: AUD\$0.04 per carcass.

#### Animal consumption

R & D: AUD\$0.03 per carcass.

Total: AUD\$0.03 per carcass.

(Department of Agriculture and Water Resources 2018a)

- Product value – ensuring standards/specifications are made available to support eating quality assurance claims to consumers.

The program is thus the micro-equivalent of the Australian Meat Processing Corporation whose mandate is to provide research, development and extension services that improve the sustainability and efficiency of the processing sector.

Our proposal is that the producers, in the form of the landholders, should be more actively engaged in the commercial development of the kangaroo industry, in addition to the processors.

We propose the creation of a Kangaroo Industry Council with the key objective of extending the current research and development activities to on-farm production improvements and engagement with landholders. Kangaroo statutory levy and industry sub-accounts, showing tiny income and expenses is displayed in Table 4.

### Collaboration with the other red meat industries

While commercial kangaroo harvesting is regarded by many in the established livestock industries as solely a pest control activity, this paper argues it is time for change. The recent incorporation by MLA of the goat industry into its charter is a precedent of an animal species moving from pest to asset. Understandably, MLA appears to be wary of taking on kangaroos within its portfolio. There is a perception that doing so would expose the Corporation to the kangaroo-use controversy and could damage its image by association.

**Table 4.** Kangaroo statutory levy and industry sub-accounts (Rural Industries Research and Development Corporation 2017).

Income	2016-17 (AUD\$)	2015-16 (AUD\$)
Commonwealth contributions	12612	16008
Statutory industry levies	43754	57195
Industry levy penalties	276	131
Other income	10448	11550
Total revenue	67091	84884
<b>Expenses</b>		
Research projects	4996	20447
External research management	4757	3584
Program management fees	11131	7779
Other expenses	11082	5600
Total expenses	31966	37410
Surplus/(deficit)	35125	47474
Retained surplus at beginning of reporting period	362246	314772
Retained surplus at end of reporting period	397370	362246

### *Importance of graziers' social licence*

However, we argue that non-commercial techniques that are used by the livestock industries to lower numbers of unwanted kangaroos have such poor animal welfare outcomes that they are likely to do damage to the social licence of meat producers on the rangelands. On current trends, in our view MLA has no option but to support a stronger kangaroo industry that will benefit its members.

Concern about such criticism of its social licence has led to MLA supporting a study in 2018 which is examining the social licence of pastoral production. The project is reviewing the social acceptability of measures to manage total grazing pressure in the rangelands.

### *Industry development and product processing improvement*

As a compromise, those in MLA who are wary of the kangaroo industry might accept MLA supporting improvements in kangaroo production to reduce wastage, increase value for landholders, and improving welfare, while staying at arm's length from product promotion.

Support could come through investment and advice in improving the management of meat products so as to increase the consistency of supply, accuracy of their description, reliability of quality, and hence value. These are all things that MLA has mastered in other meat producing species.

Incorporating the production of low emission meat from kangaroos could assist MLA achieve its target of becoming carbon neutral by 2030.

### *Take the case to Red Meat Advisory Council*

An important step in advancing the proposed collaboration and co-production case would be gaining the support of the Kangaroo Industries Association of Australia and the Red Meat Advisory Council (RMAC). RMAC is an industry advocacy group of producers, lot feeders, manufacturers, retailers and livestock exporters of beef, goat meat and sheep meat. Its aim is to advance the interests of the Australian red meat and livestock supply chain from 'paddock to plate' to government, industry and the community. It seeks to create value for its industries through industry leadership and provision of advice to the Federal Minister for Agriculture. RMAC has a diverse membership including the Goat Industry Council of Australia as an Associate Member.

The creation of a Kangaroo Industry Council representing the producers of kangaroos - the landholders - as an associate member, would be modelled on, and hopefully supported by the Goat Industry Council, Cattle Council of Australia and Sheep Producers of Australia.

### **Conclusion**

Campaigns by animal preservationists to shut down the kangaroo industry are having adverse animal welfare outcomes. They would appear to be contrary to their own objectives and are increasing the suffering of kangaroos. When professional control diminishes, killing of kangaroos does not stop; amateur shooting increases. Kangaroos in drought starve through over population. Regulators cannot monitor the number of kangaroos killed nor ensure high standards of dispatch of animals.

There are parallels with noisy climate change deniers who, although in a small minority, capture the attention of the press and have a major impact on outcomes. There is a need to counter their non-science statements which were reported in 'Science under siege' - 'Getting the facts straight on kangaroo harvesting and conservation' (Cooney *et al.* 2012). Sharp *et al.* (2014) found the group that was least accepting of commercial kangaroo management had the lowest knowledge about kangaroos and their management. In the Australian Capital Territory, they have been successful in preventing the commercial use of over abundant kangaroos. As a consequence, scarce conservation dollars from the local Government are allocated to pay shooters who then bury the carcasses rather than selling them. Populations remain high so that expensive kangaroo proof fences are needed to reduce motor vehicle collisions, in the process converting highways into canyons of wire. See Figure 9.

We would like to appeal to animal preservationists not to continue their campaign because of the environmental damage and animal welfare problems you are creating. To the vegetarians amongst you, "Become kangatarians".

Killing for conservation is more sensible kangaroo management and better use of the kangaroo resource. It takes advantage of kangaroo adaptations and is an opportunity currently begging for adoption. Current wastage

needs to be minimised and the benefits of sustainable use of kangaroos realised to the benefit of both Indigenous and other landholders on whose properties they occur. Taking up the opportunity at scale is long overdue but we recognise that changing the status of kangaroos is a paradigm shifting and complex undertaking. It involves not only activities which farmers can control, but also product management, marketing and changing public attitudes. It begins with the importance of animal welfare and greater respect for kangaroo. Stories that connect food and the land - eco-gastronomy (Young 2017) could be integral to improving rangelands ecosystems.

Now is also the time to do this. There is notable push by both state and federal legislators to ensure Australian agriculture performs at its best. Kangaroo co-production should be part of this process. It would ensure that the more sustainable, innovative and improved land management practices are adopted, not business as usual, which has seen significant erosion of natural capital and often is financially unsustainable.

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APPENDIX I



Eastern Grey Kangaroos. Gungahlin, ACT. During favourable pastoral conditions kangaroo density can increase rapidly. Photo by George Wilson.



Eastern Grey Kangaroos. Mt Painter, ACT. Overabundant kangaroos in the ACT are shot by professional shooters and then buried rather than sold to offset the costs of the control program. Photo by Ed Wilson.



Red Kangaroos. Broken Hill, NSW. The Australian national icon deserves more respect, better management and care for its welfare than be left to die in millions during drought. Photo by Nicholas Walker.