



Welfare implications of commercial kangaroo killing: Do the ends justify the means?

THINKK 

**THINKK, the Kangaroo
Think Tank
University of Technology
Sydney**



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The mission of THINKK is to foster understanding among Australians about kangaroos in a sustainable landscape, through critically reviewing the scientific evidence underpinning kangaroo management practices and exploring non-lethal management options that are consistent with ecology, animal welfare, human health and ethics.

THINKK SCIENCE AND POLICY

The Think Tank is governed by a Research Advisory Committee comprising of macropod experts, Dr Dror Ben-Ami, Dr Daniel Ramp and Dr David Croft, ISF sustainability expert Professor Stuart White and ISF animal and environmental law expert Keely Boom. ISF sustainability expert Louise Boronyak is THINKK's project manager. Other expert advisors include pioneering animal welfare expert Christine Townend and Indigenous elder Uncle Max Dulumunmun Harrison, inform and refine THINKK's research priorities and content.

Welfare implications of commercial kangaroo harvesting: Do the ends justify the means?

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EXECUTIVE SUMMARY

Background

Debate on the pros and cons of kangaroo management in Australia has recently centred on the awareness that commercial killing (commonly referred to as harvesting), a by-product of management, is difficult to regulate and that there are animal welfare costs that the current regulatory framework is yet to resolve. Moreover, public interest in animal welfare is at an unprecedented height and is expected to increase over time. At the core of animal welfare law and policy is a question of ends and means. Animal welfare laws have existed for around 200 years, and presently attempt to prevent 'unnecessary' or 'unreasonable' suffering by animals. Yet at the same time, large scale animal industries have developed that often involve high levels of harm and suffering being inflicted upon a great number of animals in order to produce food and other products for human use. From a policy perspective, industrial suffering of animals is 'necessary' or 'reasonable' where there is both legitimacy of purpose and legitimacy of means. As a fairly recent animal industry to evolve, Australia's kangaroo industry provides meat, leather and other products from the killing of about three million adult kangaroos each year. This report provides an analysis of the kangaroo industry and seeks to answer the question: 'do the ends justify the means?'

The methodology adopted in this report is to clearly define the ends of the kangaroo industry followed by a review of the means using the available scientific information within the framework of animal welfare law and policy. We also provide case studies of similar wildlife based industries in developed countries to provide an international perspective on the kangaroo industry. Finally, we assess whether the ends do justify the means.

THE ENDS

- 1) **Damage mitigation:** Although kangaroos are largely perceived as pests in the rangelands current research does not indicate that they are overabundant in the landscape. The estimated annual costs incurred by farmers due to kangaroos is placed at AUS \$44 Million (M) or \$1.67 per kangaroo/year. This is markedly lower than previously estimated at over \$200 M due to long-term research showing that there is minimal loss in pastoral property productivity due to competition between livestock and kangaroos for resources.
- 2) **Commercial value:** The kangaroo industry estimated its worth to the Australian economy in 2005 at \$200 M, providing approximately 4000 jobs. Recent low revenues of \$50 M for 2008/2009 (for meat, pet food and skins) and reports of financial hardship to shooters due primarily to quality control issues and extreme climatic fluctuations suggest that industry worth is over-valued.
- 3) **Environmental value:** In recent years the commercial killing of kangaroos has been considered to be environmentally friendly due to the perception that there are too many kangaroos and that they can replace livestock in the landscape. There is no convincing data to support claims of overabundance. Moreover, kangaroos are mostly shot by shooters in a separate activity to the livestock industry, and we have not observed convincing evidence that replacement is likely to occur in the future. Finally, consideration of the full environmental/ecological costs of the industry has not been properly canvassed.

THE MEANS

- 1) **Young:** Every year over a million dependent young die as collateral damage to the commercial kill (approximately 300,000 young at foot and 841,000 pouch young per year). This would be unacceptable in the livestock industry. There is currently no routine field auditing of compliance with the National Code of Practice for the Humane Shooting of Kangaroos (Commercial Purposes and termed the “Code”) into the manner of killing of pouch young or to the fate of dependent young. Ecological data suggests the young are highly unlikely to survive without their mothers and will die of starvation, dehydration, exposure or predation.

- 2) Adults: Field data suggests that anywhere from 120,000 to over a million kangaroos are miss-shot annually. There is virtually no monitoring of killing in the field and given the field conditions of the killing it impossible to do so.
- 3) Evolutionary potential of individuals and genetic integrity: The social structure of kangaroo groups is likely to have evolutionary significance in maximising the ability of individuals and ultimately populations to persist. Research is necessary on the impact of the kills on the various species' social systems and their long term genetic integrity.
- 4) Compliance: There is increasing awareness that the Code is both impossible to regulate and unsatisfactory in its provisions. It is within the gap between what the Code says and what occurs in practice that the strongest welfare concerns emerge. The Code provides that kangaroos are to be brain shot, yet it would appear that kangaroos shot in the neck are regularly processed. The Code provides that injured kangaroos are to be euthanized quickly and humanely, yet shooters are permitted to shoot more than one kangaroo in a group before retrieving the carcass. Furthermore, although the Code prescribes methods of killing joeys, there is considerable doubt about the humaneness of these methods and the capability and/or willingness of shooters to perform them.
- 5) Public attitudes: The comparative study of commercial kangaroo killing with the killing of other wildlife such as Harp Seals, whales and White-Tailed Deer has revealed that three key drivers are found in public attitudes to wildlife kills: commercial value, 'pest' status and ecological concerns. The parallels between these industries and increasing awareness to animal welfare indicates that without a resolution of the outstanding welfare issues of the kangaroo industry, an Australian moratorium and/or international trade ban on commercial kangaroo killing may eventuate.

DO THE ENDS JUSTIFY THE MEANS?

The legitimacy of the ends of the kangaroo industry is questionable, particularly the much inflated perceptions of kangaroos as pests (damage caused to farmers and the landscape) and as a panacea for Australia's land degradation and green house gas emissions. The 'means' by which kangaroos are killed carry a high welfare cost to both adult kangaroos and dependent young that is below the mandated welfare standards in the Codes. Therefore the ends of the kangaroo industry do not justify its current means.

CONCLUSIONS

- 1) The need for the commercial harvest on the landscape level should be re-evaluated on the grounds of both necessity and ethical considerations.
 - a. At the same time we note that kangaroo management on the property level needs to be reassessed and/or redesigned given the apparent low costs incurred.
- 2) In light of shifting public sentiment, both locally and internationally, mechanisms for improving welfare standards should be found. Previous efforts to reconcile stakeholder interests in the commercial killing of kangaroos have led to a detailed consultation process and report about how to best manage the kangaroo industry in the Murray-Darling Basin that encompasses three key states – QLD, NSW and SA (Hacker et al. 2004). We recommend that a similar project should be undertaken to resolve the serious welfare concerns that are apparent in the kangaroo industry.
- 3) We propose a number of policy changes to close the gap between the aims of the Code and its welfare outcomes. Two recommendations that would be more practical to implement and would address substantial welfare concerns include:
 - a. Amending the Code to clearly provide that neck shots are not compliant with the Code, that shooters retain the heads on carcasses and that only brain shot kangaroo are accepted for processing.
 - b. Mandating a male only kill would ensure that the welfare of young is not compromised.

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INTRODUCTION

At the core of animal welfare law and policy is a question of ends and means. Animal welfare laws have existed for around 200 years, and presently attempt to prevent ‘unnecessary’ or ‘unreasonable’ suffering by animals. Yet at the same time, large scale animal industries have developed that often involve high levels of harm and suffering being inflicted upon a great number of animals in order to produce food and other products for human use. From a policy perspective, industrial suffering of animals is ‘necessary’ or ‘reasonable’ where there is both legitimacy of purpose and legitimacy of means. As a fairly recent animal industry to evolve, Australia’s kangaroo industry provides meat, leather and other products from the killing of about three million adult kangaroos each year (Kelly 2005). This report provides an analysis of the kangaroo industry and seeks to answer the question: ‘do the ends justify the means?’

Public and scientific interest in animal welfare is ‘at an all-time high’ and is expected to increase over time (Littin 2010). The Hon Michael Kirby, retired judge of the High Court of Australia, has said that ‘concerns about animal welfare are clearly legitimate matters of public debate across the nation’ (Kirby 2001). Indeed, recent research suggests that consumers perceive animal welfare as an indicator of how a particular product may affect themselves, such as healthiness and food safety (Harper and Henson 2001). There is a strong body of evidence to indicate that animal cruelty is associated with other undesirable behaviour, including domestic violence, child abuse and other violence (Wilson and Norris 2003). Collectively, this myriad of drivers has created an unprecedented public interest in the welfare of animals used for commercial purposes.

Scientifically, animal welfare refers to ‘a state of body and mind as the sentient animal attempts to cope with its environment’ (Fraser and Broom 1990). The national Australian Animal Welfare Strategy (AAWS), which provides direction for future animal welfare policies, defines animal welfare as ‘a human responsibility towards animals in Australia and encompasses all aspects of animal health and well being, including proper housing, management, population control and habitat management, nutrition, disease prevention and treatment, responsible care, humane handling, and, when necessary, humane killing’ (Department of Agriculture Fisheries and Forestry Australian Animal Welfare Strategy 2006). In this report we adopt this broader definition of animal welfare provided by the AAWS, to the extent that it is applicable to wild animals. However, the pain and distress suffered by

animals cannot be easily evaluated and it is necessary to ‘assume that animals experience these in a manner similar to humans unless there is evidence to the contrary’ (National Health and Medical Research Council 2004). On this basis and emerging science, we also view the social wellbeing of animals to be a component of animal welfare (Storz 1999; East et al. 2009).

The terms surrounding the killing of kangaroos may be seen as highly subjective. Proponents of the industry may describe the killing as ‘harvesting’ kangaroos, while animal protection activists often describe the killing as ‘slaughter’. In this paper, the term ‘commercial killing’ has been adopted on the basis that this term is neutral and objective (see Boom and Ben-Ami 2010). Currently, some three million kangaroos are commercially killed annually (not including young which are collateral deaths). Four species are commercially killed on the mainland (Figs. 1&2): *Macropus rufus* (Red Kangaroo), *M. giganteus* (Eastern Grey Kangaroo), *M. fuliginosus* (Western Grey Kangaroo) and *M. robustus* (Common Wallaroo). Their meat is used for pet food or human consumption and their hides for leather products. Commercial killing occurs in four states on the mainland, including Queensland (QLD), New South Wales (NSW), South Australia (SA) and Western Australia (WA). In Tasmania, the commercial kill is primarily for skins and includes *M. rufogriseus* (Bennetts Wallaby) and *Thylogale billardierii* (Tasmanian Pademelon). Each state has its own kangaroo management program, however, conditions set out in the National Code of Practice for the Humane Shooting of Kangaroos (Commercial Purposes) provide the national standards for kangaroo welfare in the commercial industry.

Figure 1: The four species of kangaroo in the mainland commercial kill



Macropus fuliginosus
(Western Grey Kangaroo)



M. giganteus
(Eastern Grey Kangaroo)

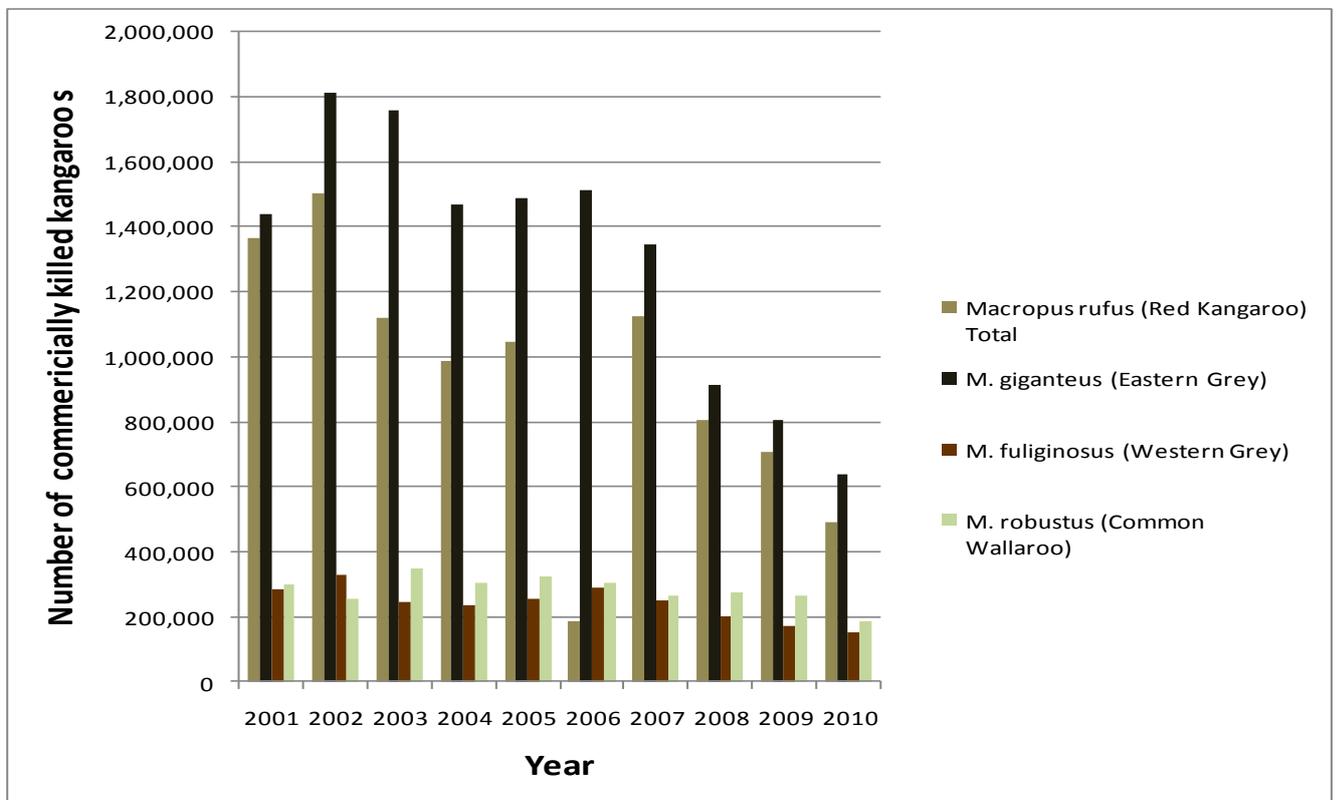


M. robustus
(Common Wallaroo)



M. rufus
(Red Kangaroo)

Figure 2: Number of commercially killed kangaroos 2001 to 2010 (Department of Environment Water Heritage and Climate Change 2011)



The approach taken in this report is to assess both the ends and the means of the kangaroo industry. This framework of analysis is adopted due to its potential significance for government policy. In determining whether a particular human activity that causes suffering to animals is necessary, both the purpose and means of the activity must be legitimate (Sankoff and Steven 2009: 458). It is necessary for there to be some reason for the relevant activity, and that reason must conform to societal values (Francione 2000; Weldon 2008). This paper identifies three potential purposes for the kangaroo industry. Firstly, the 'end' of managing kangaroos as agricultural 'pests' on the landscape; secondly, the 'end' of obtaining profit or commercial gain from kangaroo products; and finally, the 'end' of obtaining ecological and conservation value from the commercial use of kangaroos. We examine the legitimacy of each of these 'ends' within the context of current scientific understanding.

The second part of our analysis is to examine whether there is 'legitimacy of means'. Even if there is a legitimate purpose to cause harm to animals, the suffering imposed by such activity may not be justified by the means utilised, particularly if there are less harmful procedures available at a comparable cost (Sankoff and Steven 2009: 25). The means taken to obtain a particular end must be appropriate considering the purpose in question. However, it is important to note that once a legitimate purpose is found for a particular activity, it becomes very difficult to question the means employed. In this report we assess the means employed by the kangaroo industry to identify whether less harmful means are available and to provide some assessment as to the cost of these means.

The third component of this report provides a comparative analysis of similar wildlife industries, specifically, the industries around whales, Harp Seals and White-Tailed Deer. This comparative study focuses upon the means and the ends of each of these industries and compares and contrasts these components with the kangaroo industry. This comparative study provides insight into the contentious societal dimensions of commercial wildlife industries and the potential for public opinion to oppose such use.

The methodology adopted in this report is to review the available scientific literature within the framework of animal welfare law and policy. Through reviewing the literature we seek to clearly identify the welfare issues associated with the kangaroo industry by examining documented information and assessing the behavioural ecology of kangaroos as it relates to welfare. Our assessment of behavioural ecology provides a novel insight into the impact of the kangaroo industry upon the complex societal structures found in kangaroo populations. A comprehensive assessment of this nature has never been previously undertaken. Thus, this report seeks to provide a unique and critical assessment into the ends and the means of the kangaroo industry and lead the debate about this controversial industry.

THE ENDS

DAMAGE MITIGATION

Historically, free-ranging wild kangaroos in Australia have been labelled as pests: considered to be overabundant (i.e. at density levels that adversely impact on human livelihood, themselves or their ecosystems (Caughley 1981)) and competitive with livestock causing damage (i.e. to crops and fences) on farm properties. The conflict between kangaroos and farmers (of crops) and graziers (farmers of predominantly sheep, cattle and/or goats) can be traced back some 100 years. By the 1880's bounties were placed on kangaroos to decrease population numbers (Morris 1978: 46). A trade in kangaroo meat had developed by the 1950's (Lunney 2010), when conservation and welfare regulatory mechanisms were non-existent. By 1974, concern by ecologists about the persistence of kangaroos populations resulted in the cessation of kangaroo exports (Croft 2005). However, in 1975 commercial killing quota systems were established to regulate the industry and exports resumed (Jackson and Vernes 2010: 171). By 1993, the kangaroo industry had matured into its current form of deriving products from free-ranging kangaroos in the form of both meat and hides which are sold both locally and internationally (Lunney 2010).

Concern about the commercial utilisation of Australian wildlife led to a Senate Select Inquiry on the matter in 1988. While noting that the kangaroo industry institutionalised the suffering of kangaroos, the Inquiry determined that commercial killing was necessary due to the impact of kangaroos on farming income (Senate Rural and Regional Affairs and Transport Committee 1998). However, in 2006 a government commissioned review of the relationship of kangaroos to their environment concluded that kangaroos should not be considered pests due to the findings of numerous studies (see Olsen and Low 2006). Evidence was drawn from scientific studies that have shown that competition with livestock typically occurs only during drought (Edwards et al. 1995; Dawson and Ellis 1996; Edwards et al. 1996) and that artificial watering points in the arid interior (for livestock) have little impact on the distribution and densities of kangaroos (Montague-Drake and Croft 2004; Croft et al. 2007; Fukuda et al. 2010), despite frequent misconceptions to the contrary. Some scientists have argued that kangaroos are much more abundant today relative to pre-European times; in part due to land-use alterations and diminishing dingo populations (Hornadge 1972; Caughley et al. 1983; Pople et al. 2000), but a growing body of scientists dispute such arguments (Newsome et al. 2001; Auty 2005; Croft 2005). The view that

kangaroos have not been shown to be overabundant at the landscape level is reflected in the recent revising of management aims of three state government management programmes, where there has been a shift from promoting the killing of kangaroos as a pest management strategy, to promoting the killing of them primarily for commercial benefit and only for pest management where necessary (Department for Environment and Heritage 2007; Department of Environment and Climate Change 2007; Environment and Resource Management 2007).

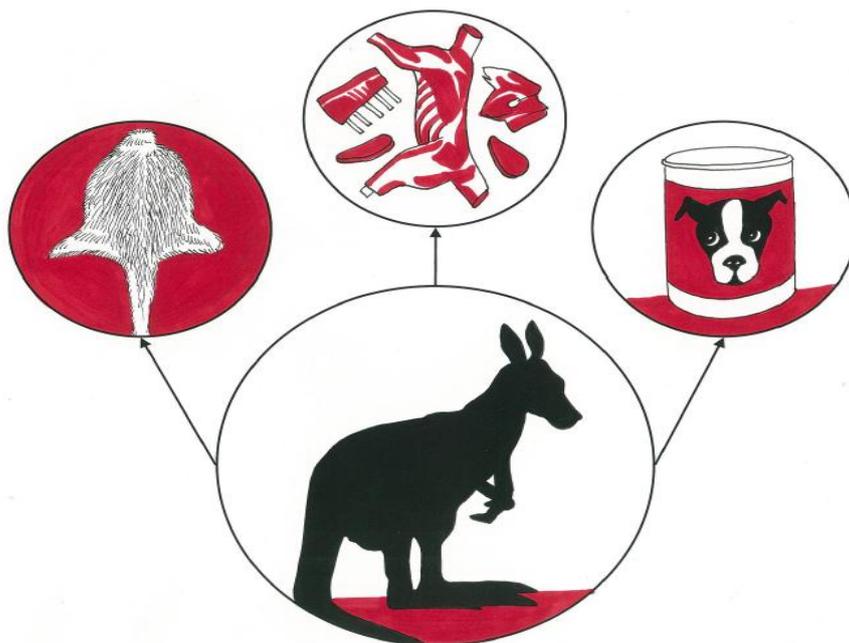
In spite of the Olsen and Lowe (2006) review, there is still considerable debate about the actual need to reduce kangaroo numbers today, leading to polemic discourse amongst scientists, governments, industry and the community; much like the debate around climate change and water allocation rights. Primary motivations for managing kangaroo populations stems from the historical perceptions of kangaroos and their perceived impact on farmers' and graziers' incomes. A series of reports have attempted to quantify the commercial impact of kangaroos on farmers and graziers (Young 1984; Gibson and Young 1987; Sloane Cook and King Pty Ltd 1988; McLeod 2004). The latest assessment by McLeod (2004) downgrades the annual cost to graziers significantly from a previously estimated (Australian dollars used throughout) \$200 Million (Sloane Cook and King Pty Ltd 1988) to \$15.5 M, reflecting the accumulation of reliable data detailing competition between kangaroos and livestock. The cost to crop farmers was estimated at \$11.9 M, while fencing damage across all agricultural sectors was estimated at \$16.7 M. Interestingly, the combined cost of \$44.1 M divided by the long-term (30 year) average of about 27 M kangaroos in the commercial killing areas of the rangelands indicates a mean cost of \$1.63 per kangaroo per year or three cents per week. To most graziers the costs are actually lower because the average costs are inflated by high values for rangelands where competition is inferred by Wilson (1991), but which is disputed and contrary to other studies (Pople and McLeod 2000). These costs do not account for the benefits of having kangaroos on the landscape, e.g. fertilising the soils and indicators of soil productivity (Tyndale-Biscoe 2005), which may yet further decrease the perceived costs. Clearly, further cost-benefit research is needed to provide graziers and farmers with management alternatives for their properties.

COMMERCIAL VALUE

There are a number of commercial incentives for the commercial killing of kangaroos including pet meat, meat for human consumption and hides (Fig 3). According to the Kangaroo Industry Strategic Plan 2005-2010, in 2005 the industry estimated its own worth at \$200 M employing some 4,000 people and projected to reach \$270 M by 2010 (Kelly 2005). These jobs include primarily the shooters, and the workers in the meat processing plants. However, a more current analysis of the industry sectors suggests different values.

According to the Australian Bureau of Agricultural and Resource Economics (ABARE) in 2010 kangaroo meat (for human consumption) was worth \$11.7 M in exports (Siegel 2011), down from \$29 M in the period of 2008/09 (ABARE 2009) and \$36 M in the period 2007/2008 due the Russian ban on kangaroo meat (Siegel 2011). In 2008/9 approximately 5,941 tonnes of kangaroo meat was produced for pet food, a sharp decline from 20,848 tonnes in 2004/5. If a generous \$2/kg return on low grade meat to the industry is considered (pet food companies can access equally cheap cattle trimmings), then the trade worth would have been about \$12 M. It is likely that this drop primarily represents a local shift from low value pet meat to high value meat for human consumption as Australian consumption of kangaroo meat increased from 4,290 to 14,008 tonnes in the same period (ABARE 2009). In 2008/9 the value of the kangaroo skins industry was approximately \$20 M, a sharp drop from about \$29 M in 2004/5 (ABARE 2009); but recent legislative change in the US may herald a revitalisation of the skins industry (Kelly 2011).

Figure 3: Key kangaroo derived products



On the basis of these figures it seems that the revenue generated by the three industry sectors is around \$50 M. Moreover, during the last three years there have been consistent reports of job loss and financial hardship for kangaroo shooters, due primarily to quality control issues (Ben-Ami 2009; Durut 2009; Ampt and Baumber 2010) and extreme climatic fluctuations from extended drought to flooding (Myers 2009; Volkofsky 2010), the industry sector which makes the most significant contribution to the economy. Thus, as demand for kangaroo products has decreased and climatic conditions have been unsympathetic; the data suggests that the industry may be worth much less than previously reported (and projected). Furthermore, the revenue presently generated by the kangaroo industry should not be interpreted as the loss to the Australian economy that would occur were the kangaroo industry to close as at least some of the resources used in the kangaroo industry have other potential uses. Clearly, more independent and detailed research is needed to assess the true value of the kangaroo industry and its contribution to the economy.

ENVIRONMENTAL BENEFIT

Finally, there is a perceived environmental imperative commonly used to justify the commercial kill as environmentally friendly. Land degradation in Australia's rangelands (where most kangaroos are commercially killed) has primarily resulted from land clearance and livestock grazing, collectively with introduced species causing unprecedented biodiversity loss (Fisher et al. 2003). In addition, concerns about climate change have highlighted the high levels of greenhouse gas emissions produced by Australia's numerous livestock (Garnaut 2007). At least partial replacement of livestock by free-ranging kangaroos as a product of choice for graziers is touted as a panacea for these significant environmental issues in Australia (Grigg 1989; Wilson and Edwards 2008). The merit of sheep replacement efforts has been the cause of heated debate as some ecologists question the commercial feasibility of replacing domesticated livestock (Croft 2000; Ben-Ami et al. 2010); in spite of ongoing efforts the vast majority of kangaroos are shot by licensed shooters and perceived as pests, not a resource, by graziers (Grigg 2002; Chapman 2003; Thomsen and Davies 2007; Baumber et al. 2009). As such, the likelihood of environmental benefits materialising are questionable. Furthermore, to our knowledge, the environmental costs, beyond population persistence, have not been adequately canvassed. On the whole there is concern that the commercial kangaroo kill has matured from pest control industry to a commercial one without an adequate environmental impacts and risk assessment study being undertaken (beyond the issues of maximum sustainable yield and population persistence for which there have been numerous studies). We recommend that such investigations be undertaken to assess long-term impacts of the commercial harvest to the rangeland ecosystems.

THE MEANS

AN ASSESSMENT OF THE AVAILABLE LITERATURE

Literature that documents welfare issues in the kangaroo industry is varied in its assessment of the severity and type of welfare concerns, to the point of being contradictory in some cases. At one end of the spectrum are assertions that not managing kangaroo populations has welfare ramifications. As grazing pressure can increase on the rangelands during drought conditions (Grigg 1997), resident herbivores can become nutritionally deprived: part of the natural cyclic population fluxes that kangaroos have evolved to survive as a species (Dawson 1995). However, the necessity of taking lethal measures to alleviate the distress of free-ranging wildlife in response to natural environmental conditions remains scientifically and ethically questionable. Grigg (1995, 2002) also argues that kangaroos might impact on the welfare of other biota dependent in the same habitats. Furthermore, relative to other domesticated animals that are part of Australia's factory farming systems or live exports, kangaroos are free-ranging throughout their life and experience instantaneous death from a shot to the head (Grigg 2002). However, kangaroos are not considered overabundant in the landscape, and as this report will show there are numerous welfare concerns that are unique to the shooting of free-ranging kangaroos.

Others argue that any commercial killing related death of dependent young is considered to be a surrogate of natural mortality (Kelly in Sheehan 2009). Under this logic, adults would die anyway from natural causes as would their young; the reduction of kangaroos therefore frees up resources and improves the survival and reproductive rates of remaining kangaroos (Pople et al. 2010). However, commercial killing pressures are much more likely to have an additive effect to mortality, particularly during drought. The greatest mortality in drought affected kangaroo populations is likely to include dependent young, juvenile and weak adult kangaroos (Shepherd 1987); but commercial killing clearly targets the larger healthier kangaroos of both sexes (Pople 1996; 2006). For example, demographic data obtained from a commercial killed Red Kangaroo population indicates that less than 15% of males are over two years old compared to over 40% of a non-commercial killed population and less than 30% compared to over 60% for females (Pople et al. 2010). Furthermore, kangaroo shooters naturally avoid emaciated individuals in favour of those providing the maximum meat yield. Thus, the commercial killing of kangaroos is likely to either kill those individuals that are most likely to survive drought events or other adverse conditions.

On the other side of the spectrum for kangaroo welfare advocacy RSPCA Australia (2002) stated that it may be that the only way of avoiding cruelty to pouch young would be to not commercially kill females altogether. It further recommended that the shooting of females should cease until the fate of young-at-foot is better understood (discussed below). RSPCA Australia's recommendations have not been implemented to date as stated by McLeod (2010: 19):

“There is currently no routine field auditing of compliance with the national Code of Practice for either commercial or non-commercial shooting. Field auditing of Code of Practice compliance would provide a more accurate picture of the extent of animal suffering.

The fate of orphaned young-at-foot remains an open question. The number of dependent young that escape euthanasia is unknown. The fate of these young also remains unknown. At present there is simply no reliable evidence of their fate or the extent to which their welfare is compromised. This issue cannot go on being ignored and remains, arguably, the highest priority.”

In 1985, RSPCA Australia found that the overall proportion of head shot macropods that were processed was about 86% while in 2000/2002 this was 95.9% (RSPCA Australia 2002), meaning that the remainder were neck or body shot. In contrast, between 2005 and 2008, Animal Liberation NSW identified that an average of 40% of macropods per chiller were neck shot (Ben-Ami 2009). The apparently large difference in data of the RSPCA Australia and Animal Liberation NSW may be due to a key difference in methodology between these two studies. Animal Liberation identified neck shot macropods as ‘those whose heads were severed below the atlantal-occipital joint, a location where the cut is much more difficult to make’ (Ben-Ami 2009: 25). The argument here is that a shooter would be unlikely to engage in this difficult cut unless it was necessary to conceal a neck wound. In contrast, the RSPCA sought to identify neck shots through detecting entry bullet holes in or below the neck. Therefore, it may be that the Animal Liberation data identified neck shot macropods that were missed in the RSPCA's research.

Both the RSPCA and Animal Liberation estimates are limited by the fact that the samples were taken at processors or chillers. The Animal Liberation NSW study encompassed 24 chillers throughout New South Wales and Queensland. The RSPCA Australia study encompassed 24 processors and two tanneries across New South Wales, Queensland, Western Australia and South Australia. RSPCA Australia chose to use processors as a sampling point rather than chillers because it enabled the inspection of samples from a number of locations at a single inspection point. It should be noted that this approach does not take into account the number of dead or injured macropods left in the field (shooters are only paid if animals are cleanly head shot, so obviously miss-shot animals are left in the field). From RSPCA Australia's 2002 research, it is estimated that at least 120,000 macropods are body shot and processed each year. However, the Animal Liberation NSW data indicates that the number of non-brain shot macropods processed at chillers may be much higher, perhaps as many as 1,200,000 annually. These animals would not have experienced a 'sudden and humane death' as required by the Code (Department of Environment Water Heritage and the Arts 2011: commercial code section 2.4). To reduce the uncertainty surrounding these estimates it is imperative that further research be conducted to properly quantify the number of miss-shot animals each year. At the very least, however, they suggest that welfare concerns surrounding the killing of wild free-ranging animals are considerable and they raise doubts as to the efficacy of the current Code to prevent animal suffering. In the next section we seek to delineate from disparate studies the underlying reproductive, demographic and social factors that determine the welfare outcomes for kangaroos.

AN ECOLOGICAL PERSPECTIVE- REPRODUCTION, RECRUITMENT AND SOCIALITY

As the commercial killing of kangaroos is undertaken by shooters in remote locations it is almost impossible to enforce regulations at the kill location. Therefore there is no accounting of the fate of young: such as how many are killed or not; their survival post-abandonment by killed mothers; and the extent of stress and deprivation that they may encounter as a result of the human-caused impact. Furthermore there is a lack of information on the impact of killing individual kangaroos on their immediate social groups and even populations. This section seeks to shed light on these issues by providing details of the accumulated scientific knowledge of kangaroo reproductive and behavioural ecology.

REPRODUCTIVE BIOLOGY

Commercial killing may consist of 40-60% females (Hacker et al. 2004). A ten year average from NSW shows that 30% of shot kangaroos were female (DECC 2009). Under typical conditions 50% of female Red Kangaroos and 60% Eastern and Western Grey Kangaroo females are likely to have young-at-foot. A conservative estimate for female kangaroos with young at foot in a commercially killed population is 25%, not including young still in the pouch, as these are young that are still dependent upon their mothers for survival (Witte 2005). Lactation dependence continues after permanent pouch exit as the young at foot typically suckles every 1.5 to 2 hours throughout the day from that time until they are weaned (Russell 1989). On average 75% of females will have pouch young (Bilton and Croft 2001). On average some three million kangaroos are killed annually. All else being equal, this equates to some 300,000 young-at-foot and 841,000 pouch young being a collateral kill of the commercial kill (Table 1).

RECRUITMENT

The role of mother-young interactions in the survival of offspring in domestic and wild mammals is well acknowledged (Bradshaw and Bateson 2000; Nowak et al. 2000). Although there is a common perception in rural communities that kangaroo young become independent of maternal care at permanent pouch exit (Croft 2004), physiological and behavioural studies indicate that this is far from the case. Lactational demand on the mother peaks during the period from permanent pouch exit to weaning (Munn and Dawson 2003). The relative proportion of energy supplied by lactation to pasture declines towards weaning, which is at one year for Red Kangaroos when young typically reach 10-12 kg (Sharman and Pilton 1964), 18 months for the Eastern and Western Grey Kangaroos (Poole 1975) and over 13 months for the Euro (Dawson 1995). However, the reliance on milk would need to increase substantially for young to retain the same growth rate during drought when pasture quality decreases (Munn and Dawson 2003).

Age and gender of young at foot may play a role in their survival. High quality pasture may promote survival (Stuart-Dick and Higginbottom 1989). However, current scientific evidence of known metabolic requirements (Dawson 1989; Munn and Dawson 2003), vulnerabilities to predation (Banks et al. 2000), and low recruitment during drought (Newsome 1977; Shepherd 1987) or even during average rainfall years (Newsome 1965; Bilton and Croft 2004) suggests that the proportion of orphaned young-at-foot surviving would be negligible (Croft 2004). Croft (2004) states:

“The clear conclusion is that the shooting of adult female kangaroos will frequently leave orphaned young-at-foot to starve or die by predation in the absence of maternal care. This practice would be unacceptable in livestock industries (Standing Committee on Agriculture - Animal Health Committee 2002), unacceptable in human populations and so is clearly inhumane and unethical.”

Table 1: The estimated number of dependent young killed over 10 years due to commercial killing of kangaroos (Department of Environment Water Heritage and Climate Change 2011)

Year	<i>M. rufus</i> (Red Kangaroo)	<i>M. giganteus</i> (Eastern Grey)	<i>M. fuliginosus</i> (Western Grey)	<i>M. robustus</i> (Wallaroo)	Total	Females 40% female	Young-at-foot 25% YAF	Pouch young 70% PY
2000	1173242	1106208	227552	238439	2,745,441	1,098,176	274,544	768,723
2001	1,364,682	1,438,280	283,332	296,805	3,383,099	1,353,239	338,309	947,267
2002	1,500,588	1,810,426	330,372	257,140	3,898,526	1,559,410	389,852	1,091,587
2003	1,121,724	1,758,173	246,672	347,914	3,474,483	1,389,793	347,448	972,855
2004	988,203	1,466,325	233,496	304,047	2,992,071	1,196,828	299,207	837,780
2005	1,045,048	1,487,652	257,422	322,222	3,112,344	1,244,937	311,234	871,456
2006	1,184,554	1,510,250	288,914	305,658	3,289,376	1,315,750	328,937	921,025
2007	1,124,662	1,344,430	250,593	266,785	2,986,470	1,194,588	298,647	836,212
2008	804,278	911,815	201,199	275,915	2,193,207	877,282	219,320	614,097
2009	706,894	806,096	171,544	265,580	1,950,114	780,045	195,011	546,032
Decade total	11,013,875	13,639,655	2,491,096	2,880,505	30,025,131	12,010,048	3,002,509	8,407,034
Average	1,101,388	1,363,966	249,110	288,051	3,002,513	1,201,005	300,251	840,703

EVOLUTIONARY POTENTIAL OF INDIVIDUALS

Recent evidence suggests that the 'evolutionary potential' (development and transferral of genes) of individuals is likely to be affected by the fitness level and quality of mothers (East et al. 2009). Knowledge of mother-young and mixed-male-age-group interactions among kangaroos suggests a similar effect. Female kangaroos are generally most reproductively successful between the ages of 6-15 years (Bilton and Croft 2004). Killing these larger females not only impacts nutritionally dependent offspring but may be detrimental to other mob members due to a variety of social interactions and dependencies. Social learning from the mother is likely to be a key factor to survivorship into adulthood (Higginbottom et al. 2004), particularly as diet preferences and the ability to discriminate amongst plants are likely to be learnt from the mother (Provenza 2003). Female kangaroos also invest in training offspring to discriminate among stimuli used to assess predation risk (reviewed in Higginbottom and Croft 1999). The disruption of matrilineal (bonds between female kin-mothers, daughters and successive female offspring) and other social bonds in Eastern Grey Kangaroos could have a profound impact on reproductive success (Johnson 1986; Stuart-Dick 1987; Bilton and Croft 2004; but see Pople et al. 2010). Females that associate frequently with the same individuals are able to graze longer because they can afford to be less vigilant (Carter et al. 2009).

Learning is also facilitated between same-sex individuals as play-fights often occur between mixed age groups to assist training and to assess potential competitors (Croft and Snaith 1991). Furthermore, adult male kangaroos, particularly the more social Eastern and Western Grey kangaroos, are also thought to be important in maintaining group cohesion (Pople and Grigg 1999). Clearly, the loss of larger and older adults from a population through a size-selective commercial killing is likely to have consequences to the fitness of the remaining individuals and destabilise social structures (as already expressed by Grigg 1997; Croft 2004). Seemingly simple social systems are in fact complex and finely tuned to Australia's often harsh and unpredictable environmental conditions (Jarman 1991).

Genetic integrity

It has been argued that genetic impacts on commercially killed kangaroo populations may result from morphological (physical attributes) changes observed among individuals (Pople 2004; Pople et al. 2010). One view is that these changes are not long lasting because of kangaroo populations' continuous distribution in the landscape and refugia (areas where kangaroos are not commercially killed) that maintain the gene pool (Hale 2004; Tenhumberg et al. 2004). However, research on the evolutionary function of sociality suggests that even when sociality is characterised by more continuously distributed populations and lesser degrees of social cohesion, demographic conditions that promote skewed sex ratios, intra-sexual variance in reproductive success, natal philopatry (where animals remain close to their birthplace), and territoriality, can result in genetic drift similar to that associated with group-living sociality and a dispersed population structure (Storz 1999).

The evolutionary importance of fine-scale population structure (defined as genetic relationships among sub-groups in a population) in mammals is highlighted in cases where the level of genetic differentiation among adjacent social groups, or spatially defined breeding units, can often exceed that between more inclusive, geographically defined subdivisions of populations. This disparity between local and regional levels of genetic divergence has been documented in Black-Tailed Prairie Dogs (*Cynomys ludovicianus* - Chesser 1983; Dobson et al. 1997), California Voles (*Microtus californicus* - Bowen 1982), Vervet Monkeys (*Cercopithecus aethiops* - Dracopolni et al. 1983), Rhesus Macaques (*Macaca mulatta* - Melnick et al. 1984; Melnick et al. 1986), and Red Howler Monkeys (*Alouatta seniculus* - Pope 1992), and indicates that local genetic differentiation is an important evolutionary force in mammalian populations that a continuous population structure and refugia from commercial killing may be unable to maintain.

Clearly, there is significant scope for further research in this area. In particular, there is a need to examine the evolutionary biology of kangaroos, especially with regard to behaviour, through the collection of data over several decades and life histories of recognisable individuals (cf. Clutton-Brock and Sheldon 2010). Through the development of such research and new social analysis techniques (such as social networks), we may be able to answer key questions on the evolution of social organisation and the impact of commercial killing on the social structure and evolutionary processes in kangaroo populations (Krause et al. 2007).

A LEGAL PERSPECTIVE- THE COMMERCIAL CODE OF PRACTICE FOR THE HUMANE SHOOTING OF KANGAROOS AND WALLABIES

The Code is the key regulatory instrument for the killing of kangaroos that relates to animal welfare (see Appendix 1). The Code does ‘not override state or territory animal welfare legislation’ but seeks to provide technical specifications and procedures, including procedures for the euthanizing of injured kangaroos, pouch young and young at foot (Department of Environment Water Heritage and the Arts 2011). The purpose of the Code is to ‘ensure all persons intending to shoot free-living kangaroos or wallabies ... undertake the shooting so that the animal is killed in a way that minimises pain and suffering’ (1.1: Purpose of the Code). The Code was approved by the Natural Resource Management Ministerial Council (NRMMC) in 2008. The following discussion outlines and analyses the key provisions of the Code: conditions on the method of shooting; conditions on the killing of injured macropods; and conditions on the killing of dependent young. This section seeks to examine whether the standards contained in the Code are legitimate and whether there are less harmful procedures available at a comparable cost.

Conditions on the method of shooting

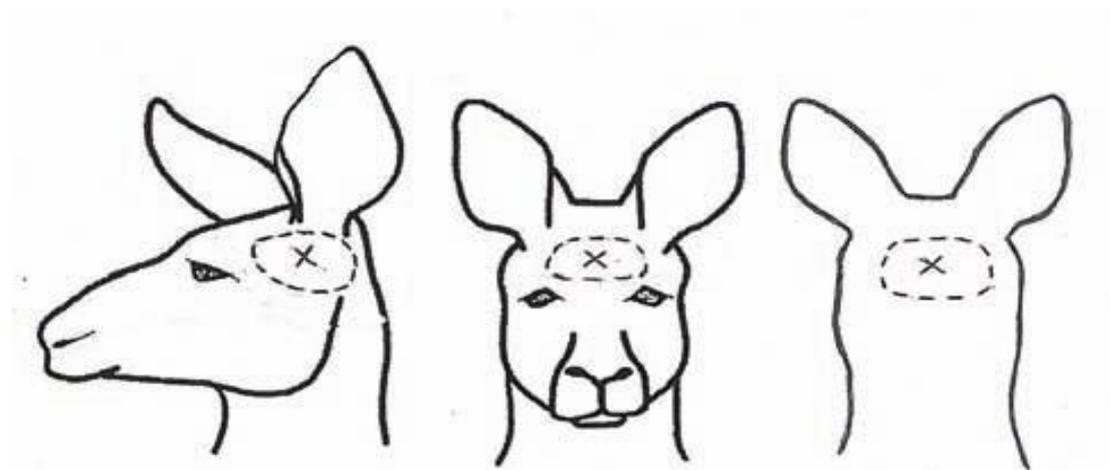
The Code provides that the primary objective for shooters ‘must be to achieve instantaneous loss of consciousness and rapid death without regaining consciousness’ (2.4 Conditions: Goal (i)). It is generally considered that shooting a kangaroo in the brain will result in a sudden and painless death for the specific animal. The Code provides that certain conditions must be met and if they cannot be met, or where there is any doubt about achieving a ‘sudden and humane death’ shooting must not be attempted (2.4 Conditions).

In relation to the method of shooting, the Code provides that shooters must use the specified firearms and ammunition and that they must not attempt to shoot a kangaroo from a moving vehicle or other moving platform (2.4 Conditions: Firearms and Ammunition; Shooting Platform). The target animal must be standing, stationary and within a range specified in Schedule 1 (2.4 Conditions: Target Animal (i)-(ii)). Shooters must avoid shooting female kangaroos where it is obvious that they have pouch young or dependent young at foot (2.4 Conditions: Target Animal (iii)). Shooters must aim to hit each kangaroo in his or her brain (2.4 Conditions: Point of Aim). A diagram is provided in Schedule 2 of the Code

(Fig. 4). Shooters must ensure that each animal shot is dead before another kangaroo is targeted (2.4 Conditions: Follow-up). Although instantaneous death for the kangaroo is the objective, this is certainly not achieved in all circumstances. As shown earlier it is possible that up to 40% of kangaroos found in chillers are neck shot and this research does not take into account the number of dead or injured kangaroos left in the field, as there is no enforcement of the Code at the point of kill.

In 2004, the NSW Young Lawyers Animal Rights Committee argued that ‘often animals are shot in the head but not in the brain.’ (NSW Young Lawyers Animal Rights Committee 2004: 13). The NSW Young Lawyers Committee called for a change in the text whereby where ever the term ‘head’ was used in the Code (in reference to shooting) that it should be replaced by the word ‘brain’. They further recommended that better diagrams should be inserted to ‘precisely indicate the size and location of the brain within the animal’s head.’ The Code has since been amended to use the term ‘brain’ rather than ‘head’. However the Animal Liberation NSW data indicates that the requirement for carcasses to be brain shot in order to be processed is not being adhered to due to the high occurrence of neck shot carcasses.

Figure 4: Point of aim (X) for a shot to the brain and location of the brain (Source: Code)



Conditions on the killing of injured macropods

The Code provides that if a kangaroo is still alive after being shot, 'every reasonable effort must be made immediately to locate and kill it before any attempt is made to shoot another animal' (2.4 Conditions: Follow-up). Injured kangaroos 'should be euthanized quickly and humanely to alleviate suffering' (4 Euthanizing Injured Kangaroos and Wallabies). Conditions are set out in Section 4.1 which provide that the preferred method for killing these animals is a shot to the brain, however where this is impractical or unsafe, a shot to the heart is permissible. Furthermore, if either a shot to the brain or heart is impractical or unsafe, the conditions state that 'a heavy blow to the base of the skull with sufficient force to destroy the brain ... is permissible.'

However, the Code also provides that shooters are permitted to shoot more than one kangaroo in a group before retrieving the carcass (2.4 Conditions: Follow-up). Although the shooter must be 'certain that each kangaroo or wallaby is dead before another is targeted', the Code provides sufficient ambiguity that shooters may continue shooting even when an animal is injured. The key ambiguity arises around the requirement that shooters make 'every reasonable effort' to locate and kill injured kangaroos before continuing to shoot others (2.4 Conditions: Follow up (ii)). It is not clear what 'every reasonable effort' refers to and what is expected of shooters. The commercial interest is to obtain as many brain shot macropods as possible as these are sellable. There is no commercial incentive to retrieve and kill injured kangaroos and the existing ambiguity in the Code compounds this problem. It is not known how many kangaroos are injured and either killed or left to die in the field. Where an instantaneous death is not achieved, and the shooter does not pursue and kill the animal, the animal is likely to experience a slow and/or painful death.

Conditions on the killing of dependent young

As stated earlier around three hundred thousand young at foot and 800,000 pouch young are either killed or left to die each year as collateral of the commercial industry. The Code provides that any target female kangaroos, including injured animals, must be 'thoroughly examined for pouch young' (2.4 Conditions: Follow-up (iv)). Where pouch young or young at foot are present, these animals must be euthanized in accordance with the methods provided. However, the Code prescribes methods of killing joeys which would be considered clear breaches of animal welfare law if committed against a range of other animals (Voiceless 2011).

The recommended methods (Table 2) of killing for furred pouch young is euthanasia by a single ‘forceful blow to the base of the skull sufficient to destroy the functional capacity of the brain’ (e.g. by a steel water pipe or the tow bar of a vehicle) (5 Euthanizing Pouch Young and Young at Foot). For small furless pouch young (fits within the palm of the hand) the method is ‘stunning, immediately followed by decapitation by rapidly severing the head from the body with a sharp blade’ or a ‘single forceful blow to the base of the skull sufficient to destroy the functional capacity of the brain.’ For young at foot the Code provides the following methods: ‘Single shot to the brain or heart where it can be delivered accurately and in safety’.

Table 2: Acceptable euthanasia methods for dependent young as prescribed by the Code (Source: Code: 14)

Description of young	Acceptable Euthanasia Method
Small furless pouch young (fits within the palm of the hand)	Single forceful blow to the base of the skull sufficient to destroy the functional capacity of the brain. OR Stunning, immediately followed by decapitation by rapidly severing the head from the body with a sharp blade.
All furred pouch young	Single forceful blow to the base of the skull sufficient to destroy the functional capacity of the brain.
Young at foot	Single shot to the brain or heart where it can be delivered accurately and in safety using the firearms and ammunition specified in Part A or B of Schedule 1.

A number of studies have shown that there is doubt as to whether the current methods of killing joeys ensure a sudden and painless death in all cases (RSPCA Australia 2002). The American Veterinary Medical Association (AVMA) Report of the AVMA Panel on Euthanasia stated ‘[p]ersonnel performing physical methods of euthanasia [such as a blow to the head or decapitation] must be well trained and monitored for each type of physical technique performed’ (AVMA Panel 2001). However, no formal training is required for the killing of joeys and these practices are virtually unmonitored.

The RSPCA’s research on the Code revealed that shooters often have difficulty catching young at foot (RSPCA Australia 2002). Many of these joeys later die from exposure, starvation or predation. The RSPCA found that even if young at foot are captured by shooters, there is difficulty in killing them. The Code provides that any dependent young must be shot as soon as possible, yet it is clear that many joeys endure death, pain and suffering each year as collateral of the kangaroo industry.

Case law

In 2008, a challenge to the NSW kangaroo management plan alleged that the Code allows inhumane and cruel treatment of kangaroos and joeys, noting that young at foot which are left behind are likely to die from predation, starvation or exposure. However, the Administrative Appeals Tribunal (Tribunal) rejected the arguments of the applicant and found that the Code does satisfy the legislative object of promoting the humane treatment of kangaroos. It must be noted that the Tribunal's role was not to suggest alternative policy measures but simply to determine whether the current standards 'promote the humane treatment' of kangaroos (Part 13A of the Environment Protection and Biodiversity Act 1999 (Cth)). On that basis, it appears that the Tribunal's decision is correct, yet the case does not necessarily support the conclusion that the Code's standards are humane.

Furthermore, there were problems with the logic adopted by the Tribunal. The Tribunal stated that what is required of the Code is to 'achieve as near to perfection as human frailty will permit'. Yet a result of 120,000 kangaroos (and probably significantly more) being neck or body shot and processed each year is very far from perfection. In addition, leaving over a million joeys either dead or left to die each year as collateral of the industry is no small matter. As will be discussed below, there are a number of areas of potential legal reform that could significantly raise the welfare standards of the kangaroo industry.

Legal Reform

There are many areas for reform of the current law and policy that have arisen from the analysis contained in this report. Some of these areas for legal reform are more practical than others. In relation to adult kangaroos, the Code should be amended to clearly provide that neck shots are not compliant with the Code. Furthermore, the Code should specify what 'every reasonable effort' means in the context of locating and killing injured kangaroos. This could be done through the use of examples. Alternatively, shooters should be required to retrieve each carcass immediately after shooting to ensure that the animal is dead before continuing to shoot any other animals.

Another important area for legal reform is with regard to joey welfare. The NSW Young Lawyers Animal Law Committee has proposed that all of the current prescribed methods for killing joeys be replaced with the following requirement:

Shooters must administer lethal injection to pouch young and young at foot whose mothers have been killed. After administering the injection the shooter must be certain that the animal is dead ... The shooter must not dispose of the dead pouch joey or young at foot in any manner other than: incineration by fire so that the entire carcass is destroyed or burying the carcass so that the top of the carcass is at least 30cm underground.

This suggestion is problematic for a few reasons. Administering such lethal injections would require a specific skill set on the part of the shooters to ensure that these injections are safe. If the procedure is poorly performed, the joeys may experience great pain and suffering. It hardly seems practical or safe for shooters to be supplied with large amounts of lethal poisons for use in remote locations with little or no supervision.

The NSW Young Lawyers Animal Law Committee further proposed that it 'be mandatory that a qualified veterinarian supervise all shootings and administer the legal injections.' This proposal appears to contradict the previous requirement that shooters administer the injection. Nonetheless, this proposal poses a separate set of issues. Over a million joeys are killed each year in remote locations as collateral of the commercial industry. It is unlikely that there would be enough veterinarians to supervise all shootings and administer the lethal injections. Even if there were, the costs employing veterinarians to accompany all shootings would be commercially unviable. Nonetheless, it is clear that if such a proposal was adopted, it could improve welfare outcomes for joeys.

Research is currently being undertaken to determine if spring-loaded captive-bolt guns can be used to achieve improved welfare outcomes for joeys (Aggs 2009). Although the results of this research will not be known for some time, it is doubtful that use of spring-loaded captive-bolt guns will resolve the welfare issues relating to joeys. It has been argued that captive-bolt guns only achieve 'acceptable' animal welfare outcomes if the gun is placed on the head of the animal between the base of the ears and the animal is bled dry by cutting a large artery immediately after the shooting (Hultmann 1991). It would appear that cruelty to joeys will continue unless the killing of female kangaroos ceases. The NSW Young Lawyers Animal Law Committee and other groups such as the RSPCA have called for a ban on shooting female kangaroos in order to prevent the killing of and cruelty to joeys. Research has already shown an annual commercial kill rate of 10% and male only commercial killing would achieve the best solution from a conservation perspective of non-government conservation organisations and wildlife management agencies (McLeod et al. 2004).

A separate yet critical issue is ensuring that the shooting is effectively monitored and any breaches are subject to enforcement. One method of improving such regulatory action would be to retain heads on carcasses to ensure that only brain shot kangaroos are accepted for processing. If such scrutiny and welfare outcomes cannot be achieved, there is a strong argument to be made that the shooting should be discontinued. The various legal reform options are summarised in Table 3.

Table 3: Key areas for possible legal reform to improve welfare outcomes of the kangaroo industry

Welfare Concern	Possible legal reform	Cost and practicality
Processing of neck shot kangaroos	Amendment of the Code to clearly provide that neck shots are not compliant with the Code.	No cost. This option would be consistent with the existing provisions of the Code.
	Retain the heads on carcasses to ensure that only brain shot kangaroos are accepted for processing.	Increase in cost should be negligible. This option would provide a cost-effective and simple method of ensuring that only brain shot kangaroos are processed.
Prolonged suffering of miss-shot kangaroos	Amendment of the Code to specify what ‘every reasonable effort’ means in the context of locating and killing injured kangaroos. This could be done through the use of examples.	Increase in cost could be high. Difficult to enforce.
	Shooters could be required to retrieve each carcass immediately after shooting to ensure that the animal is dead before continuing to shoot any other animals.	Increase in cost could be high. Difficult to enforce.
Suffering of joeys	<p>Replace current methods of killing joeys with the following requirement:</p> <p>Shooters must administer lethal injection to pouch young and young at foot whose mothers have been killed. After administering the injection the shooter must be certain that the animal is dead. The shooter must not dispose of the dead pouch joey or young at</p>	This option would require specific skill set to be held by shooters to ensure the injections are safe. If the procedure is poorly performed, the joeys may experience great pain and suffering. It does not seem practical or safe for shooters to be supplied with large amount of lethal poisons for use in remote locations with little or no supervision.

	<p>foot in any manner other than: incineration by fire so that the entire carcass is destroyed or burying the carcass so that the top of the carcass is at least 30cm underground.</p>	
	<p>Replace current methods of killing joeys with the following requirement: It is mandatory that a qualified veterinarian supervise all shootings and administer the lethal injections to pouch young and young at foot whose mothers have been killed.</p>	<p>It is unlikely that there would be enough veterinarians to supervise all shootings and administer the lethal injections. The costs employing veterinarians to accompany all shootings would be commercially unviable.</p>
	<p>Male only kill and a ban on the shooting of female kangaroos.</p>	<p>This option appears to be the most practical legal reform to avoid cruelty to joeys. The cost of such a ban on the industry is not known.</p>
<p>Lack of monitoring and enforcement of the Code in the field.</p>	<p>Increased regulatory and enforcement action in the field.</p>	<p>This reform would be difficult to put in place and costly due to the remote location of the killings and high number of kills.</p>

Australian Animal Welfare Strategy (AAWS)

There is a lack of animal welfare law and policy at the Commonwealth level. In response to this deficiency, the national Australian Animal Welfare Strategy (AAWS) was established under the auspices of the Commonwealth Department of Agriculture, Fisheries and Forestry (DAFF). The AAWS states that its vision of promoting animal welfare in Australia extends to the 'care, uses and direct and indirect impacts of human activity on all sentient species' (Department of Agriculture Fisheries and Forestry 2011). The AAWS process provided a review by Scott (2006) on the animal welfare arrangement for animals in the wild. The report suggested that kangaroos could be considered pests 'in some situations' but did not provide any reasoning for this view (Scott 2006: 2). Meaningful reform of the Code is unlikely to occur through the AAWS due to inherent weaknesses within the AAWS process itself. Rather it appears that the AAWS will further solidify the current welfare standards for kangaroos and other animals (Caulfield 2008: 16-17).

COMPARATIVE CASE STUDIES

Although recent academic literature indicates that there is increasing concern about the welfare of both common wildlife and pest species (see review in Littin 2010), commercial killing or non-commercial killing of native wildlife is still commonplace. The products derived from commercial killing continue to be bought and sold in both domestic and international markets. This section will consider the ends and means to three case studies of commercial wildlife industries in developed countries, including the Harp Seals in Canada, White-Tailed Deer in the United States and whales killed by hunters from Japan, Norway and Iceland. This section will provide a comparative perspective of the kangaroo industry with practices in other countries and uncover the variability in shared values towards wildlife management in these countries.

Note: The analysis is restricted to developed countries. African countries have been excluded from the case studies because there is no single commercial free-ranging wildlife industry in Africa on the scale of the kangaroo industry or our chosen case studies. Rather there is game-farming which is constructed and regulated (or potentially regulated) in a similar fashion to livestock industries, regulated low volume trophy hunting where meat is a secondary purpose and bush-meat sale which is free-range hunting and not well regulated.

Table 4: A comparison of the ends, means and the welfare concerns arising from three case studies of commercial wildlife industries in developed countries and the kangaroo industry

Wildlife Industries/animals	The ends (justifications for the kill)	The means (how the wildlife is killed)	Welfare concerns
<p>Canadian Harp Seals (<i>Pagophilus groenlandicus</i>)</p> <p>The Commercial Industry exists in Canada and Alaska.</p>	<ul style="list-style-type: none"> • Employment; • Products (fur, oil, meat, blubber); • To control seal populations; • Improving fishing yields and reducing damage to fishing gear; • To support the sustainable use of resources (European Commission Directorate-General Environment 2008). 	<p>Harp Seals are killed by:</p> <ul style="list-style-type: none"> • a sharp blow to the head using a wooden club, or a hakapic (an iron or steel hook, sometimes with a hammer opposite, mounted on a long wooden pole); • a bullet shot; • trapping seals underwater. 	<ul style="list-style-type: none"> • A large number of seals are killed each year, representing the largest killing of marine animals on the planet averaging 281,510 seals between the years 2000 to 2006 (IFAW, 2007); • Given the conditions in which the hunt occurs, it would not be feasible to independently verify and control the hunters' compliance with animal welfare standards on every hunt; • Lack of objective data to accurately determine the number of seals hit or shot but are not killed instantly; • Monitoring of seals prior to bleeding out is not always carried out effectively. An unknown percentage of seals are still conscious while being skinned (EFSA, 2007); • The struck and loss rates, in which a seal is struck and then escapes (loss), vary between 0-21.6 per cent on ice and 5-50 per cent in the water (NAMMCO, 2007). Depending on the extent of the injuries the animal could suffer a protracted death; • Seal hunts that involve herding can cause unnecessary distress and fear and can result in suckling young being separated from nursing dams (EFSA, 2007).
<p>Whaling</p> <p>(Commercially hunted species include: <i>Balaenoptera acutorostrata</i> (Common</p>	<ul style="list-style-type: none"> • Meat for human consumption • Whale meal to feed farmed fish and livestock (WCDS, 2010); • Whale myoglobin and chondroitin has been sold in pharmaceutical products 	<ul style="list-style-type: none"> • Whales are commercially killed using a whaling cannon and harpoon; • A grenade harpoon is fired from a boat, the harpoon consists of two or four barbs and an explosive penthrite grenade (Øen 1995).; 	<ul style="list-style-type: none"> • The IWC found that whaling does not meet the standards that commonly apply in domestic slaughter situations that require that the animal be rendered instantaneously insensitive to pain prior to death, which should take no more than a few seconds; • Opponents claim that sustainable quotas are not

<p>Minke whale <i>Balaenoptera bonaerensis</i> (Antarctic Minke whale) <i>Balaenoptera borealis</i> (Sei whale) <i>Balaenoptera physalus</i> (Fin whale) <i>Physeter macrocephalus</i> (Sperm whale) and <i>Balaenoptera edeni</i> (Brydes whale)</p> <p>Commercial Industries exist in Japan, Norway and Iceland</p>	<p>(WCDS, 2010);</p> <ul style="list-style-type: none"> • Oligosaccharides derived from whales used as a food additive; • Scientific research; • To improve fishing yields; • Provide employment in remote areas. 	<ul style="list-style-type: none"> • The harpoon is designed to kill either by the trauma or laceration to vital organs or by the creation of shock waves to the brain (Environment Australia 1997: 36); • A heavy calibre rifle or cold harpoon is used by Norwegian hunters and electric lance is used by Japanese hunters (Gambell 1997) as a secondary killing method. 	<p>possible due to previous over-commercial killing- of certain species based upon poor science (Clapham et al. 2007; Illif 2010);</p> <ul style="list-style-type: none"> • Hunters underreport the numbers of whales that are struck and lost due to the harpoon line breaking or the harpoon being pulled out if the injured whale breaks loose (IWC, 2007); • Weather and the skill of the hunter are important factors in minimising strike and loss rates; • Large calibre rifles are ineffective for large whale species such as sperm and fin as a secondary killing method (IWC, 2007).
<p>White-Tailed Deer <i>Odocoileus virginianus</i></p> <p>Hunting takes place in various states across the United States.</p>	<ul style="list-style-type: none"> • Population control strategy in urban areas across a number of states in the United States; • Meat for human consumption; • Minimise human wildlife interactions; • Prevent damage to ornamental shrubbery in domestic gardens; • Reduce road fatalities from collisions with cars; • Trophy or sport hunting. 	<p>Lethal means include:</p> <ul style="list-style-type: none"> • hunting or sharpshooting by recreational or professional hunters (Messmer et al. 1997); • Trapping, relocating then killing; • The introduction of natural predators, diseases or parasites (Wildlife Agency, 1999). <p>Non lethal means include:</p> <ul style="list-style-type: none"> • Trapping and relocation; • Fertility control using immunocontraceptives (Messmer 2000; Rooney 2010); • Mitigation measures such as slowing down on roads, wildlife road crossing signs, fencing, landscape planning and 	<ul style="list-style-type: none"> • Damage to property caused by the hunters (Malcolm et al. 2010); • Concern for human health and safety due to the presence and use of firearms (Bishop et al. 1999); • Number of miss-shot and injured animals in the field; • The efficacy of hunting as a population control strategy (Pellerin et al 2010).

		chemical repellents.	
<p>Kangaroos</p> <p><i>Macropus rufus</i> (Red Kangaroo), <i>M. giganteus</i> (Eastern Grey Kangaroo), <i>M. fuliginosus</i> (Western Grey Kangaroo) and <i>M. robustus</i> (Wallaroo)</p> <p>The Commercial Industry exists in Australia</p>	<ul style="list-style-type: none"> • Population control strategy; • Limit damage to fences and crops on farmland; • Reduce grazing pressure; • Reduce competition between livestock; • Meat for human and pet food; • Skins and leather; • Sustainable use of wildlife; • Sport or recreational hunting. 	<p>Lethal means include:</p> <ul style="list-style-type: none"> • Shooting of adult kangaroos; • Furred pouch young are killed by a single forceful blow to the base of the skull (e.g. by a steel water pipe or the tow bar of a vehicle); • Furless pouch young are killed by decapitation or a single forceful blow to the base of the skull; • Young at foot are killed by a single shot to the brain or heart. (<i>National Code of Practice for the Humane Shooting of Kangaroos and Wallabies for Commercial Purposes</i>); • The introduction of natural predators, such as dingoes. 	<ul style="list-style-type: none"> • A large number of kangaroos are killed each year as targets for the commercial industry representing the largest commercial killing of land-based wildlife in the world averaging three million kangaroos per year; • Lack of objective data about the number of miss-shot kangaroos; • High number of dependent young affected by the killing (approximately 300,000 young-at-foot and 841,000 pouch young per year); • Welfare implications arising from joeys that are not killed humanely after the mothers have been shot; • Whether decapitation or bludgeoning the joeys is humane; • No formal training required for the killing of joeys; • Virtually no monitoring of killing in the field; • Shooters are permitted to shoot more than one kangaroo in a group before retrieving the carcass; • Evidence of a high rate of neck shot kangaroos being processed; • Given the conditions in which the killing occurs, it would not be feasible to independently verify and control compliance with animal welfare standards on every occasion.

Harp Seals

The commercial killing of Canadian Harp Seals (*Pagophilus groenlandicus*) is a high profile case that has drawn international condemnation. Sealing products (Table 4) account for less than 0.5 per cent of the Gross Domestic Product (GDP) of the province of Newfoundland and Labrador in Canada (Fink 2007). This is similar to the kangaroo industry, which creates commercial products (meat and leather), and is thought to improve agriculture yield through population control. Another driver in both industries is the use of lethal means as a form of population control. In Australia, the justification for commercial kangaroo killing is due to their perceived impact on farmers' and graziers' incomes from damage to crops and fences. Further investigations are required to weigh up whether reducing kangaroo populations will improve farmer's income and whether the welfare costs are justifiable.

According to the Fisheries and Oceans Canada, between 1996 to 2006 approximately 2,649,317 seals have been killed. The Canadian Veterinary Medical Association has deemed the various killing methods (Table 4) humane following a study which observed that a large proportion (around 98 percent) of the seals are killed or rendered unconscious in less than one minute (Daoust et al. 2002). According to the North Atlantic Marine Mammal Commission (2006), struck and loss rates by which a seal is struck and then escapes (loss), vary between 0-21.6 percent on ice and 5-50 percent in the water. If a conservative estimate of 5 percent of seals suffered inhumane deaths resulting from a body shot or being struck and lost this could equate to approximately 13,246 seals annually. In both industries effective killing does not always occur, but the degree to which it does not happen has often been difficult to assess due in part to the lack of objective and available data. The Australian Department of Sustainability, Environment, Water, Population and the Arts (SEWPaC) publishes figures on the yearly kangaroo quotas and the number of officially reported kangaroo deaths from the commercial killing (Department of Sustainability Environment Water Population and Communities 2011). However, data on the annual number of miss-shot kangaroos is unavailable due to a lack of regulation at the point of kill. Reports of miss-shot kangaroos being processed vary from 4.1 to 40 percent of the total kangaroos shot each year (RSPCA Australia 2002; Ben-Ami 2009).

The annual seal hunt has drawn widespread concern and condemnation within Canada and internationally. Sealing is opposed by 79 per cent of Canadians, yet the hunt is subsidised by the government which aims to promote and expand markets for the products (Fink 2007). In 2008, the European Commission received 73,153 responses to a public consultation that explored attitudes to the seal hunt and around 60 percent of the respondents stated that the seal hunt could never be acceptable (European Commission Directorate-General Environment 2008). Baby (< 3 month old) Harp Seal products are banned in Mexico, the United States, and the European Union on welfare grounds (Fink 2007). A more comprehensive ban, established by Commission Regulation (EU) No 1007/2009 of the

European Parliament and of the Council on trade in seal products, was to be implemented in August of 2010 targeting all Harp Seal products. This occurred because the conditions in which the hunt occurs make it difficult to verify and control the hunters' compliance with animal welfare standards on every hunt (European Commission 2009). A parallel between the commercial harp seal industry and kangaroo industry may easily be drawn here. The effectiveness of the kill methods for both kangaroos and seals depends on the methods used, the environmental conditions and the skill of the individual hunter. The killing occurs in remote locations and enforcement of welfare standards is often difficult in the field given that independent verification and control of shooters for every kill is impossible. The lack of reliable information makes it difficult to assess the number of animals that are not killed humanely. These welfare concerns are also mirrored in the commercial whaling industry that is still conducted by Japan, Norway and Iceland.

Whaling

Historically, Australia was involved in commercial whaling activities, however in 1978 a Senate inquiry into whaling concluded 'that Australian whaling should end, and that internationally Australia should pursue a policy of opposition to whaling (Frost 1978; Sutter 1982). This shift occurred due to a number of factors including the influence of the environmental movement, changing public attitudes towards whales, over-exploitation of certain species, decreasing demand for whale products and lack of economic viability (Bowett and Hay 2009). The Australian anti-whaling movement matured in parallel to the international movement and by 1982 the International Whaling Commission (IWC) introduced a moratorium on commercial whaling which took effect in 1986 (Environment Australia 1997). However Japan, Iceland and Norway defy the international ban for commercial, cultural and scientific reasons (Bowett and Hay 2009).

Current anti-whaling efforts are motivated by both welfare and conservation concerns. Opponents claim that sustainable harvest quotas are not possible due to previous over-commercial killing of certain species based upon poor science (Clapham et al. 2007; Illif 2010). While proponents claim that with uncertainty effects duly noted, sustainable whale commercial killing of some species is possible (Morishita 2006; Cooke et al. 2009). The last few meetings of the IWC saw anti-whaling countries oppose the adoption of a sustainable whale commercial killing regime proposed by the Commission (Cooke et al. 2009; Illif 2010). Similarly, legislation pertaining to kangaroos has been previously enacted due to concerns regarding the overexploitation of the Red Kangaroo. This resulted in the 1974 ban of kangaroo products being imported into the USA (Kelly 2011). With the drive by the kangaroo industry to open up new markets worldwide for kangaroo products there needs to be more independently verifiable data in order to monitor the change in commercial killed species populations.

Currently, whales are commercially killed by the use of a whaling cannon and harpoon. According to a report developed by the National taskforce on whaling “the harpoon is designed to kill either by the trauma or laceration to vital organs or by the creation of shock waves to the brain” (Environment Australia 1997: 36). The inherent cruelty of the means was recognised by the IWC who held a series of workshops in 1992 and 1995 to investigate more humane killing methods. In the 1995 meeting discussion focused on two specific issues: a comparison of whale killing with the killing of domestic stock and the hunting of terrestrial animals; and an evaluation of the efficiency of secondary killing methods. On the first issue the IWC found that whaling does not meet the standards that commonly apply in domestic slaughter situations that require that the animal be rendered instantaneously insensitive to pain prior to death, which should take no more than a few seconds. A counter argument presented by pro-whalers was that the whaling slaughter standards were similar to those practiced in other wildlife killing such as fox hunting, big game hunting and commercial kangaroo killing (Environment Australia 1997: 37).

As a result of those meetings more humane killing methods have been sought. If the use of the harpoon does not result in instant death, then a heavy calibre rifle or cold harpoon is used by Norwegian hunters and an electric lance is used by Japanese hunters (Gambell 1997). In Norway, approximately 90 per cent of the whales killed in this way die instantly (Anon 2004). However, a workshop by the North Atlantic Marine Mammal Commission on strike and loss rates for marine mammal hunting concluded that a large calibre rifle is an ineffective secondary killing method for fin and sperm whales (North Atlantic Marine Mammal Commission 2001). Despite the advancements in killing methods, many Australians perceive the whale hunt to be inhumane, a view supported by Britain’s commissioner to the IWC Mr Cowan who argued that “killing whales is inherently cruel” and that Britain’s opposition to whaling was largest due to public expectation (Anon 2004). Therefore, the debate around the whaling industry and welfare provides an important comparative point for the commercial killing of kangaroo. According to NSW Industry and Investment, “the humaneness of aspects of kangaroo harvesting, particularly the euthanasia of pouch young and young-at-foot, is the subject of new research to run until 2012” (Aggs 2009). This new research recognises the significant welfare concerns surrounding the means to kill joeys when their mother has been shot. The movement against whaling demonstrates that both in Australia and internationally, increasingly stringent welfare standards are being expected of wildlife industries. Where there is a perception of cruelty unjustified by the ends, as in the whaling and Harp Seal industries, there may be a strong call for the closing of an industry.

White-Tailed Deer

In the United States, White-Tailed Deer (*Odocoileus virginianus*) are considered overabundant in urban areas across a number of states. The wildlife agencies in each state use lethal and/or non-lethal approaches to reduce population densities (Table 4). Many community and animal welfare organisations oppose hunting which is the primary lethal management method. This may be due to philosophical reasons but also out of concern for personal safety due to the presence and use of firearms (Bishop et al. 1999). The increase in public opposition to hunting in urban areas has led to many wildlife agencies “to perceive that stakeholders are more likely to accept non-lethal than lethal techniques” to reduce human/wildlife conflicts (Messmer 1997). The effectiveness of hunting as a population control strategy has been called into question as deer populations have reached historic peaks of abundance (Pellerin et al 2010). The potential reasons include a preference for trophy hunting for large male deer (D'angelo 2009), hunting seasons outside of birthing (D'angelo 2009; Rooney 2010) and a declining hunter population (Brown et al. 2000).

A strong driver for the continued hunting of the White-Tailed Deer is as a means to control population overabundance. This is also a justification put forward in Australia for continuing the kangaroo industry. In both cases, each lethal and non-lethal method has its advantages and disadvantages which will need to be fully considered by the various stakeholders. While hunting remains the primary strategy for limiting White-Tailed Deer throughout most of their range in the United States, wildlife agencies will need to become more active in engaging different stakeholders in order to incorporate differing and competing values (Rooney 2010). In comparison, the commercial killing of kangaroos mostly occurs in remote locations and not in urban areas. In this way, concern for human health and safety are perhaps more present in the context of White-Tailed Deer hunting.

AN ASSESSMENT OF THE COMPARATIVE CASE STUDIES

On a comparative basis neither the ends nor the means for the commercial killing of kangaroos are unique. The means of shooting White-Tailed Deer and clubbing Harp Seals are particularly similar to methods utilised in the commercial killing of kangaroos, although whalers compare their kill technique to the shooting of kangaroos. Noting the similarities between wildlife industries is important because it informs us that the kangaroo industry is likely to be subject to the same attitudinal trends which are shifting in the direction of valuing welfare outcomes. These shifts have occurred as the pest status of the commercial killed species decreased (e.g. Harp Seals); as the conservation concerns increased (e.g. whales); and as awareness to the lethal, or inhumane, nature of the management actions increased (e.g. White-Tailed Deer, Harp Seals and whales). These shifting attitudes need not be localised to Australia as a significant value of the kangaroo industry is derived from

exports. As the public becomes more aware of the ecological risks and welfare costs of the commercial killing of kangaroos, it may be that these drivers will lead to an Australian moratorium on the commercial killing of kangaroos as occurred with whaling and/or international trade bans as has occurred with Harp Seal products. Interestingly, the Russian Federation has already banned kangaroo products due to concerns about hygiene (Bevan 2009).

DO THE ENDS JUSTIFY THE MEANS?

The three key ends sought by the kangaroo industry and examined in this report are the management of kangaroos as 'pests' in the landscape and on the property level, the seeking of commercial gain from kangaroo products and the seeking of environmental value from the commercial use of kangaroos. Kangaroos have not been shown to be overabundant in the landscape level and for this reason the aims of three state management programs (excluding WA) have been revised from 'culling' to 'resource' management. Moreover their cost to farmers and graziers has been highly overstated in past years and is currently estimated at \$44M or \$1.67 kangaroo/year. In relation to the seeking of profit from kangaroo products, it is likely that the industry estimate of \$200-\$270 M is an over-estimate. We also question the legitimacy of the more recent environmental ends, biodiversity restoration and greenhouse gas reduction, which are predicated on partial livestock replacement by kangaroos in the rangelands. Finally, we are concerned that the environmental costs of the industry have not been adequately canvassed.

Our analysis of the means of the kangaroo industry has highlighted a large number of significant welfare concerns. Each of these welfare concerns is relevant in assessing the legitimacy of the means of the kangaroo industry. To start with, the industry represents the largest commercial killing of land-based wildlife in the world averaging three million kangaroos per year. A high number of dependent young are impacted by the killing, approximately 300,000 young at foot and 841,000 pouch young per year (for an average yearly kill consisting of 40% females) . Young at foot have little chance of surviving on their own and it is unlikely that they are killed humanely. The welfare concern is compounded by the lack of formal training in the disposing of young, the lack of regulation in the field and the questionable humaneness of the prescribed methods of killing pouch young. As such the practice in the field falls far short of the mandated welfare standard in the Code.

There is a lack of objective data about the number of miss-shot kangaroos and there is virtually no monitoring of killing in the field. Given the conditions in which the killing occurs, it is not feasible to independently verify and control compliance with the Code on every occasion. There are indications that a high number of neck shot kangaroos are being processed, which is contrary to the existing Code requirements for brain shot kangaroos. A further concern is that shooters are permitted to shoot more than one kangaroo in a group before retrieving the carcass. The existing data from RSPCA Australia's field data and Animal Liberation NSW's chiller data suggests that many kangaroos are not brain shot per the mandated welfare standard in the Code. Finally the impact of the commercial harvest on the kangaroos' social systems and genetic integrity has not been adequately assessed.

The comparative study of kangaroo harvesting with the killing of Harp Seals, whales and White-Tailed Deer has revealed that the key drivers found in public attitudes to wildlife harvests (commercial value, 'pest' status and ecological concerns) are commonly shared. The parallels between these industries and increasing awareness to animal welfare indicates that without a resolution of the outstanding welfare issues of the kangaroo industry, an Australian moratorium and/or international trade ban on kangaroo harvesting may eventuate.

In summary, the legitimacy of the ends of the kangaroo industry is questionable. At the same time the means carry substantial welfare costs that are unacceptable per the mandated welfare standards in the National Code of Practice for the Humane Shooting of Kangaroos. Therefore, the ends of the kangaroo industry do not justify its current means.

CONCLUSIONS

- 1) This report identifies that the commercial industry as the only substantial driver for the harvesting of kangaroos. It shows that there are substantial gaps between welfare practices in the field and those mandated by the Code that is meant set the benchmark for welfare practices in the industry. We therefore conclude that both the need for the commercial harvest on the landscape level should be re-evaluated on the grounds of both necessity and ethical considerations.
 - a. At the same time we note that kangaroo management on the property level needs to be reassessed and/or redesigned given the apparent low costs incurred.
- 2) Interests in the commercial harvest of kangaroos have led to a detailed consultation process and report about how to best manage the kangaroo industry in the Murray-Darling Basin that encompasses three key states – QLD, NSW and SA (Hacker et al. 2004). We recommend that a similar project should be undertaken to resolve the serious welfare concerns that are apparent in the kangaroo industry.
- 3) We propose a number of policy changes to assist in closing the gap between the aims of the Code and its welfare outcomes. Two of the recommendations that would be more practical to implement and would address substantial welfare concerns include:
 - a. Amending the Code to clearly provide that neck shots are not compliant with the Code, that shooters retain the heads on carcasses and that only brain shot kangaroo be accepted for processing.
 - b. Mandating a male only kill would ensure that the welfare of young is not compromised.

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