THINKK again: getting the facts straight on kangaroo harvesting and conservation

In Press*, *to be published in the forthcoming book* Science Under Siege*, edited by P. Banks, D. Lunney, and C. Dickman, Royal Zoological Society, Mosman, NSW*

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Abstract

A recent publication from the Think Tank for Kangaroos (THINKK) in the Institute of Sustainable Futures at the University of Technology Sydney evaluates the idea that eating wild harvested kangaroo meat is environmentally beneficial, compared to other meats produced on rangelands (Ben-Ami *et al.* 2010). It finds in the negative. The report purports to be a reasoned and objective analysis based on the science surrounding kangaroo harvesting. Here we examine this document with reference to available literature, and demonstrate that it is neither well-reasoned nor accurate. It contains multiple errors of fact, inaccurately represents published research, and makes several invalid and seriously misleading comparisons. In our view, this report makes an inaccurate and potentially misleading contribution to the scientific, legal and social debate on kangaroo management. In the light of these findings we discuss the challenges to academic objectivity and rigour posed by funding of university research by interest groups.

Key words: kangaroo harvest, conservation through sustainable use, research funding, scientific inaccuracy, animal rights

Introduction

Management of kangaroos in some areas of some states in Australia involves a commercial wild harvest of some common species for meat and leather. Annual harvest quotas are set by state conservation agencies and are generally limited to around 15% of the estimated population in the harvested areas (Department of Sustainability, Environment, Water, Population and Communities 2011). The harvest is based on a large and increasing body of scientific research and has proved demonstrably sustainable over several decades (Lindenmayer 2007)(see Figure 1). Indeed, the commercially harvested species of kangaroo are among the best-researched of our native wildlife, due partly to their commercial importance. However, the harvest

involves the killing of wildlife, which does not rest easily with the values that some people and organisations attribute to selected species of animals.

The stated mission of the Think Tank for Kangaroos (THINKK), based at the Institute of Sustainable Futures within the University of Technology Sydney (UTS), is to critically review the scientific evidence underpinning kangaroo management and to explore non-lethal management options (UTS 2011). A recent publication by THINKK (Ben-Ami *et al.* 2010) seeks, according to the authors, to provide an 'exposé' of the idea that choosing to eat kangaroo is an environmentally beneficial choice. In doing so, the authors operate from the initial premise that the public buys kangaroo because they believe kangaroos are replacing sheep in the rangelands (Ben-Ami *et al.* 2010, p3). Ben-Ami *et al.* attack the environmental credentials of kangaroo meat by challenging what they perceive to be four key assumptions underpinning them:

a) That increased consumption of kangaroo meat by humans will lead to an increased value of kangaroo meat;
b) That an increased value in kangaroo meat will lead to sheep replacement;
c) That destocking will lead to a sufficient increase in numbers of kangaroos to service demand for red meat currently supplied from sheep; and
d) That the proper regulatory mechanisms are in place to counter an increased market demand for kangaroo products.

Here we examine the challenge raised by Ben-Ami *et al.* (2010) in three parts. The first explores some of the fundamental underpinnings of Ben-Ami *et al.*'s argument. The second assesses their criticisms of these four specific assumptions, and the third draws conclusions on the scientific value of their analysis. The focus of our paper is the identification and correction of what, in our view, are major flaws and inaccuracies of fact and reasoning, rather than debating an alternative vision for kangaroo management. Despite simplification and conflation in the THINKK paper, published proposals for kangaroo management are varied and detailed, and cannot be adequately distilled here (see e.g. Grigg 1987; Grigg 1989; Grigg *et al.* 1995; Archer 2002; Grigg 2002; Archer and Beale 2004; Wilson and Mitchell 2005; Ampt and Baumber 2006; Wilson and Edwards 2008; Cooney *et al.* 2009; Ampt and Baumber 2010).

1. Fundamental underpinnings of the THINKK argument

Does the commercial harvest of kangaroos threaten them with extinction?
Ben-Ami *et al.* (2010) repeatedly imply that the sustainability of commercially harvested kangaroos is in question — that is, that the commercial harvest may pose some sort of threat of extinction to harvested kangaroos (Ben-Ami *et al.* 2010). They present no population data to support this point. The government-published data indicate that harvested kangaroo populations within the commercial zones remain robust and abundant (Fig 1), comprising around 25 million animals in 2010 (Department of Sustainability, Environment, Water, Population and Communities 2011). Sound sustainable management has been consistently confirmed by multiple kangaroo management reviews, carried out by independent scientists (Olsen and Braysher 2001; Olsen and Low 2006; Lindenmayer 2007; and see Lunney 2010). Kangaroo populations clearly fluctuate quite independently of the harvest (see Fig 1). This not surprising, as commercial harvest levels in every state are set on the basis of the results of recent population surveys (Department of the Environment, Water, Heritage and the Arts

2010), thereby ensuring that when populations decline, as they clearly do in drought, the maximum permitted harvest level also declines. Harvested kangaroos remain, after over four decades of commercial harvest, among the most abundant large wild vertebrates on earth.

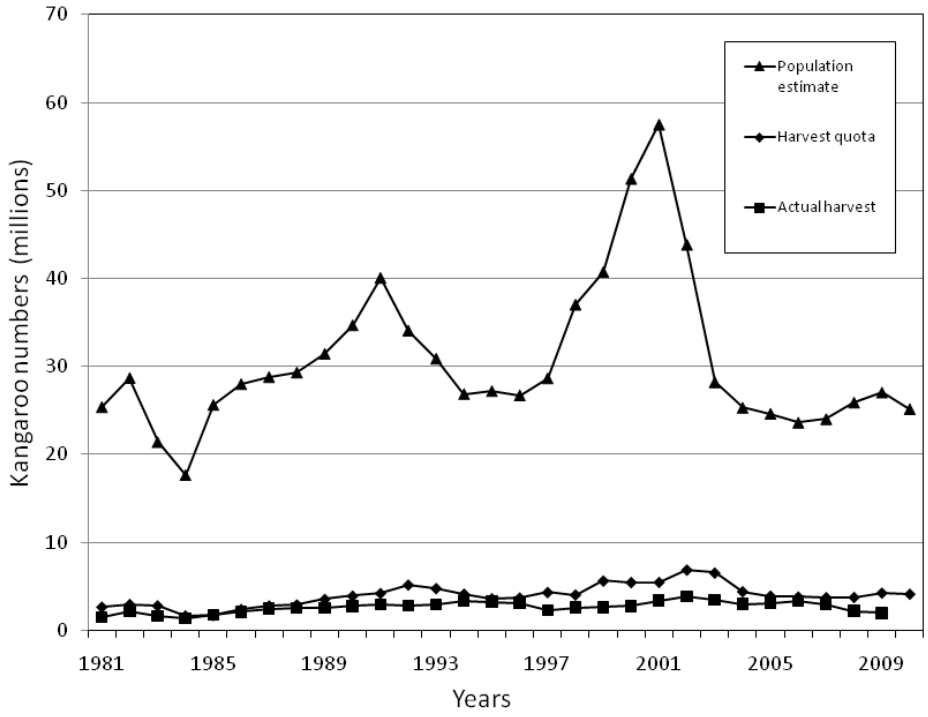

Fig 1. Population estimates, annual harvest quotas, and actual harvest levels 1982 to 2010 of the four major commercially harvested kangaroo species (*Macropus robustus, M. fuliginosis, M. giganteus, M. robustus*) in the mainland commercial harvest zones. On the mainland kangaroos are harvested in NSW, SA, Qld and SA. Source data: Department of Sustainability, Environment, Water, Population and Communities 2011.

Why is kangaroo a good environmental choice?

The analysis of Ben-Ami *et al.* (2010) rests on an unsubstantiated basic premise, expressed in its first line, that Australian consumers believe eating kangaroo is encouraging destocking in the rangelands (p3). From this they argue that sheep are not in fact currently being replaced by kangaroos, and therefore consumers are mistaken in their beliefs that kangaroo is a good environmental choice. In reality, kangaroo meat is currently an excellent environmental choice compared to other red meat alternatives because in producing that meat, kangaroos do far less damage to our fragile rangelands than sheep and cattle. Kangaroos have lower water and energy requirements per kg of body weight than sheep and cattle (Munn *et al.* 2009), and digestive processes that produce less methane (Kempton *et al.* 1976; von Engelhardt *et al.* 1978; Hume 1999; Ouwerkerk *et al.* 2007). A range of researchers has proposed changes to the current management system based on the idea of conservation through sustainable use (CSU) — we refer to the researchers here as the "CSU researchers" (see more detail below). While the CSU researchers have all proposed changes to the current policy and

management systems in order to maximise conservation benefits from kangaroo harvest, even under current arrangements consumers buying kangaroo are buying an environmentally friendly red meat compared to alternatives.

Sheep replacement therapy for rangelands: fundamentally flawed, or fundamentally misrepresented?

In the framing of their basic premise and the formulation of their four "assumptions" described above, Ben-Ami *et al.* (2010) misrepresent a number of suggestions and concepts proposed by CSU researchers. The first of these is the idea of "sheep replacement therapy for rangelands", a proposal first put forward by Gordon Grigg (Grigg 1987). Grigg proposed that investment in marketing kangaroo products would increase their price, allowing graziers to maintain their income while decreasing sheep numbers, which would in turn reduce Total Grazing Pressure (TGP) and the impact of hard-hooved animals on the land. More recent proposals have suggested other ways that kangaroo harvesting could improve the sustainability of land management. Ampt and Baumber (2006, 2010) argue that increasing the value of kangaroos to landholders could encourage a more optimal allocation of pasture resources between sheep and kangaroos, improve the responsiveness of kangaroo harvesting at times of high grazing pressure and create incentives to protect habitats that are favoured by kangaroos and other native species. A decrease in sheep and cattle with a commensurate increase in kangaroos is a further potential outcome, but not central to their arguments. Cooney *et al.* (2009) and Cooney (2009) put forward a model for collaboration between landholders and harvesters that could increase landholder involvement in the industry, and increase the value of kangaroos to landholders. Finally, Wilson and Edwards (2008) outline a case for kangaroo harvesting on the basis of their far lower contribution to climate change in comparison to domestic stock (both sheep and cattle). They argue that removal of a proportion of stock would be compensated for (in terms of landholder income) by an increase in kangaroo numbers and by the impending carbon price, with landholders potentially earning income from both kangaroo harvesting and carbon credits.

Ben-Ami *et al.* (2010) conflate these overlapping but diverse concepts, each of which presents specific policy proposals, into an amorphous idea they attack under the label of "sheep replacement". The first misrepresentation of these CSU concepts is that they assume the wholesale substitution of Australia's sheep flock with kangaroos. For example, Ben-Ami *et al.* (2010) state: "Whether eating kangaroo meat is a proactive environmental action depends on whether sheep can be replaced by kangaroos as a *primary* source of income to graziers" (p5, italics added). Likewise, they conclude: "the number of kangaroos necessary to *supplant* meat production from sheep for an environmentally meaningful benefit is ecologically unfeasible" (p16, italics added).

However, the notion that complete substitution of sheep by kangaroos underpins so-called "sheep replacement" concepts is fanciful and wrong. CSU researchers have never proposed complete replacement of sheep or cattle, but have typically suggested a modest supplementation of graziers' incomes with income from kangaroos, which would allow stock numbers to be reduced. Wilson & Edwards (2008) suggested a much larger-scale replacement of livestock with kangaroos than other authors, but their analysis considered only those cattle and sheep on the rangelands (30% of the national herd), and only a proportion of those. A further problem with the reasoning of Ben-Ami

et al. (2010) here is that Grigg (1987, 2002) has always been specific in targeting the sheep rangelands, where sheep are grown primarily for wool, not meat, and this has been the case for almost all CSU researchers.

A second distortion relates to Ben-Ami *et al.* 's central argument that "sheep replacement" has failed as a concept, on the basis that it has not yet happened. For example, "while kangaroo harvesting for meat has been conducted for over 20 years there is no evidence of sheep replacement" (Ben-Ami *et al.* 2010, p3). This is a rather peculiar argument. None of the CSU researchers mentioned above has ever suggested that kangaroo harvesting for meat *per se*, without some significant changes of practice, would lead to sheep replacement. Rather, they have all advocated specific (and diverse) policy proposals to increase the value of kangaroos to landholders, motivated by concerns about sustainability of the land on which the rural sector relies, the reduction of greenhouse gas emissions, and conservation of biodiversity. But few of the specific recommendations proposed by any of these authors have been implemented on any significant scale — the 'macro' policy position remains largely unchanged since Grigg wrote his seminal paper in 1987 (Grigg 1987). So it is not clear why Ben-Ami *et al.* (2010) expect to have seen sheep replacement happen. This error is compounded by the fact that several of the proposals they attack have been put forward only in the last few years — it would indeed be surprising if they had yet been translated into continental-scale action. More generally, the argument that a policy proposal is flawed because it has not been translated into action after 20 years would have negated arguments for votes for women, the end of slavery, and currently, reductions in greenhouse gas emissions. Beneficial change is often a long time coming.

Ben-Ami *et al.* (2010) go on to make the more specific claim that in the period 1990-2007 sheep numbers declined dramatically, the markets for kangaroo meat increased, and that kangaroo numbers declined (p5). On this basis they argue that: "if sheep replacement [*sic*] was a reliable environmental and economic concept, then destocking should have resulted in population increases of kangaroo". This argument entirely ignores the drivers of decreased sheep numbers over this period. The decrease in sheep numbers has been accompanied by drought across wide areas of grazing land (Levantis *et al.* 2007), and an increase in market factors favouring cattle and cropping (particularly the fall in the wool price (ABARE 2003; ABARE 2006; Curtis 2009; Nicholls 2009)). Drought affects both stock and kangaroo numbers in tandem – where resources are scarce, both kangaroos and stock are likely to decrease (Jonzen *et al.* 2005). Where seasonal conditions have been suitable, in recent years landholders have typically substituted sheep for wool for other enterprises such as cattle or cropping (see e.g. Nicholls 2009), freeing up no resources for kangaroos. CSU researchers have suggested that kangaroo numbers would be encouraged by decreasing stock numbers, thereby making more resources available to encourage kangaroo abundance. This is a quite different proposition from the proposition that every time sheep numbers decrease, for whatever reason, kangaroo numbers will increase.

2. Assumptions chosen and "exposed" by THINKK

We turn now to analysis of the four specific assumptions that Ben-Ami *et al.* (2010) argue are inherent within the "sheep replacement" concept. These four assumptions are all selected by Ben-Ami *et al.* (2010) themselves. Only the last of these four, and to a

limited extent the first, can be considered as accurately representing the published arguments and proposals of advocates of what Ben-Ami *et al.* call "sheep replacement". The other "assumptions" are, in our view, spurious, misrepresenting the positions of those who argue for the actual and potential benefits of kangaroo harvesting.

"Assumption" one: Increased consumption of kangaroo meat by humans will lead to an increased economic value of kangaroo meat

Ben-Ami *et al.* (2010) claim that "sheep replacement" arguments assume that increased consumption of kangaroo meat by humans will lead to an increased economic value of kangaroo meat. We generally support this assumption, although with significant caveats. Increased demand for kangaroo meat for human consumption is far more likely to increase prices for kangaroo meat than decreased demand, and thus far more likely to open new opportunities for landholders to benefit from kangaroos. However, the relationship between demand and price is unlikely to be simple or linear. Supply and demand over short-term and long-term, locally and nationally, will interact in determining price with other important factors including regulatory arrangements, logistics, the relationships between harvesters, processors and retailers, product development, certification, and marketing. Ben-Ami *et al.*'s major argument against this assumption is that while the market for kangaroo meat has increased both locally and internationally in recent years, this has not resulted in increases in value.

Ben-Ami *et al.* (2010) argue against a relationship between demand and price for kangaroo products on the basis that an expanding market has not increased prices to shooters. However, first and most importantly, increased demand for kangaroo is only likely to drive price rises if and when supply becomes limiting. The demand for kangaroo meat has certainly expanded in recent years, with proportionally more being used for human consumption, but the quotas have rarely been taken fully (see Fig 1). The real reason that the price of kangaroo meat has remained low is that demand remains considerably less than supply. Second, it is unclear why Ben-Ami *et al.* use payments at the chiller door to shooters as a measure of "economic value", rather than returns to the processors who largely control the operation of the industry. Third, Ben-Ami *et al.* attempt to prove that higher demand does not mean higher prices by stating that increases in the domestic and international market for kangaroo meat have only resulted in "variable" prices being paid to harvesters, with a range of 80–150c/kg (cited from Thomsen and Davies (2007) and Ampt and Baumber (2010)). However, they do not recognise the fact that demand over that period has also been variable, particularly with the rise and fall of the Russian market. Discussions with harvesters and processors in western NSW and Qld suggest that the "variable" prices paid to harvesters are heavily influenced by changes in demand, particularly from the Russian market, with other key factors being supply (e.g. low densities during drought or wet conditions preventing harvest) and processing costs (e.g. labour, transport) (P. Ampt and A. Baumber (University of Sydney), pers. obs.).

Ben-Ami *et al.* (2010) go on to argue that the absence of an increase in prices gained by shooters is due to kangaroo meat being of inherently low value. They argue that kangaroo carcases are worth a lot less than sheep on a cents/kg basis, citing values of 80–150c/kg for kangaroos compared to 356–473c/kg for various sheep meats. However, for kangaroos the prices provided are those paid to harvesters at the chiller

door for a full carcase, with skin on, and including the liver, lung and kidneys. Carcases still include many unusable parts at this point, and have yet to travel considerable distances under refrigeration and have several layers of fees and costs added on to their price. The sheep prices, by contrast, are "hot standard carcase weights" with skin off, offal out, and fully dressed, and include the embedded costs of equipment, labour and expense involved in refrigeration, processing and storing. (In the normal supply chain kangaroo carcases are not sold in this form.) Ben-Ami *et al.* here make a clearly invalid and misleading comparison.

Ben-Ami *et al.* (2010) suggest that kangaroo produce only a small amount of meat of appropriate quality for human consumption. They state that "60–80% of kangaroo meat is low value meat sold for pet food" raising the need for "improved meat processing to produce high value kangaroo meat for human consumption" (p7). No reference is provided for the figure of 60-80%. Figures sourced from the Department of Foreign Affairs and Trade indicate that average annual kangaroo meat exports for human consumption were approximately 12,000t over 2005-2008, falling to around 6,000t in 2009, while exports for pet food constitute around 1000t annually (Payne 2010). In the domestic market, around 1,500 t is sold for human consumption and 3,000-5,000t for pet food (Payne 2010). In total, therefore, until recently around 73% (13500t/18500t) of kangaroo meat met human consumption standards and was sold for human consumption. In the current market around 60% (7500t/12500t) is used for human consumption. The rest is processed in separate, dedicated pet meat facilities and sold for pet food.

Ben-Ami *et al.* (2010) suggest that there are hygiene problems associated with kangaroo meat (p8). However, available data on the hygiene and disease status of kangaroo meat indicate that it compares favourably with domestic stock. A large study carried out in the late 1980s found that only 0.7% of 202,052 kangaroo carcases inspected for export were not passed as fit for human consumption (Andrew 1988), comparing very favourably with typical rates of rejection for sheep carcases of 2–3% (Hopwood and Martin 1991). The major diseases and conditions associated with domestic meat animals such as cattle, sheep and pigs are absent in kangaroos (Andrew 1988). A recent study of kangaroos in Queensland processing plants found microbiological quality similar to beef (Eglezos *et al.* 2007). Ben-Ami *et al.* (2010) cite none of these studies, nor any other credible, peer-reviewed research to support their contention.

Ben-Ami *et al.* (2010) further claim that "the kangaroo industry is constrained by the low quality meat that is derived from the older and larger kangaroos", citing Ampt and Baumber (2010). However, Ampt and Baumber (2010) argue that the industry could benefit from the development of a premium, differentiated line of kangaroo products, but do not suggest that poor meat quality constrains the growth of the industry. They are misrepresented here by Ben-Ami *et al.*.

"Assumption" 2: Increased value in kangaroo meat will lead to sheep replacement

Ben-Ami *et al.* (2010) claim that supporters of kangaroo harvesting assume that increased value of kangaroo meat will lead to sheep replacement. Rather than rebut this "assumption", however, Ben-Ami *et al.* (2010) simply point out that even if the value of kangaroo meat did increase, a number of other factors could pose barriers to sheep replacement. The CSU researchers would agree, and the argument Ben-Ami *et al.* seek to

disprove is one that no writer on kangaroo management (to our knowledge) has made — that increased kangaroo value *alone* will result in sheep replacement. The CSU researchers have put forward considerable reasoned argument that highlights factors other than price that would need to be addressed for kangaroos to be become a viable enterprise option for landholders, including cross-property collaboration, reform of licensing arrangements and changes in social values. Again, the "assumption" attacked by THINKK appears to be a spurious "straw man".

Ben-Ami *et al.* (2010) argue against the "assumption" that higher kangaroo prices will lead to sheep replacement, citing economic modeling of a mixed sheep-kangaroo enterprise (Ampt and Baumber 2010). However, Ampt and Baumber (2010) did not explore the impact of higher kangaroo prices, using only a conservative price of 80c/kg paid to harvesters. Further, Ben-Ami *et al.* (2010) state that the modeled scenarios showing returns of $1250–$2707 *included* carbon payments of $23/t as well as a $20,000 stewardship payment, making these figures appear very low in comparison to returns from stock. In fact, the figures presented in Ampt and Baumber (2010) are landholder profits from kangaroo harvesting *alone,* and would be in addition to any carbon payment and/or stewardship payment. Ben-Ami *et al.* again clearly misrepresent the research of Ampt and Baumber (2010).

Ben-Ami *et al.* (2010) repeatedly stress that there is no evidence that kangaroos compete with sheep, (and therefore no reason to think that numbers of kangaroos will increase if sheep grazing pressure is relaxed). We agree that the degree of competition between sheep and kangaroos has often been overstated, but it is wrong to suggest that they do not compete, or that there is no evidence that removing sheep can increase kangaroo abundance. Competition between sheep and kangaroos for available plant biomass occurs principally during droughts, when plant biomass is low (Dawson and Munn 2007) and ecosystems are at their most fragile. Modeling based on data from around Menindee in far western NSW suggests that competition between sheep and kangaroos occurs only at total biomass levels below 300 kg/ha (Caughley 1987), while Edwards *et al.* (1996) found evidence on Fowler's Gap of such competition when biomass levels dropped below 500 kg/ha.

Ben-Ami *et al.* (2010) contend that destocking does not lead to increases in kangaroo numbers. In pursuing this claim, Ben-Ami *et al.* are highly selective in their choice of research results, overlooking important long-term studies that have reported a significant increase in kangaroo populations after the removal of sheep (Cheal 1986; Caughley 1987; Sluiter *et al.* 1997; Pople 2006; Morgan and Pegler 2010). Further, for support for this claim they rely on a Fowler's Gap study (considered "long-term" although apparently covering only three years) focused on behavioural interactions between sheep and kangaroos (Witte 2002). However, many factors other than sheep-kangaroo interactions affect population fluctuations in destocked paddocks, including vegetation dynamics, seasonal/drought conditions, kangaroo harvesting outside the project areas and access to water. The fact that Witte (2002) shows numbers of red kangaroos in the destocked paddock were 400% more than in the stocked paddock at one stage, but below 100% two months later, strongly indicates abundance was responding to factors other than behavioural interactions. Finally, their discussion of data from Sturt National Park (NSW) is very confusing. They suggest that the removal of sheep in Sturt National Park (NSW) led to an initial increase in kangaroo abundance

under good rainfall conditions, but that unpublished data from the 1980s show that this later decreased. Because kangaroo populations show very large fluctuations over time (see Fig 1), the significance of this observation is unclear. Ben-Ami *et al.* then make a comparison between kangaroo densities in Sturt National Park and the adjoining Tibooburra block (based on Croft *et al.* 2007) concluding that densities in the destocked National Park were "generally lower" than the adjoining area. However, the Sturt National Park data were collected to assess kangaroo proximity to water, not the Park's kangaroo population density, so little can be reliably concluded from these observations. Pople (2006) found the opposite pattern at Currawinya National Park (Qld), where destocking under drought in 1990 did not stem the decline in kangaroo populations, but that once rainfall improved from 1994–2000, kangaroo densities rose to levels significantly higher than surrounding properties.

Finally, Ben-Ami *et al.* (2010) cite Chapman (2003) to support their proposition that graziers prefer to harvest feral goats rather than kangaroos because "harvesting at night time is prohibitive, resulting in a strong preference for augmenting income by harvesting feral goats instead" (p9). However, Chapman (2003) found that the three primary reasons given by graziers for preferring to harvest goats rather than kangaroos were government control of kangaroo management, the prices of kangaroo products, and kangaroo industry opposition to landholder entry to the industry. The difficulty of harvesting at night was never described as "prohibitive", although it was one of several factors raised by graziers as to why they prefer kangaroo shooting to be done by professional harvesters rather than to do it themselves. Most CSU researchers' proposals for kangaroo management assume that the shooting would be done by professionals, so the point made here by Ben-Ami *et al.* appears largely irrelevant, as well as inaccurate.

"*Assumption" 3: Destocking will lead to a sufficient increase in numbers of kangaroos to service demand for red meat currently supplied from sheep*

Like the previous "assumption", this one has never (to our knowledge) been made by any of the published proponents of achieving conservation benefits through kangaroo harvesting. As discussed above, it would be fanciful to imagine that sufficient meat could be available from kangaroos to meet Australia's demand for lamb and mutton.

In the course of their rebuttal of this "straw man", Ben-Ami *et al.* (2010) argue that kangaroos are simply too small (compared to sheep) to produce viable quantities of meat. They calculate that 22 kangaroos are required to provide the amount of meat for human consumption provided by a single sheep[1] (p11). Again, this calculation is seriously flawed. Ben-Ami *et al.* (2010, p11) state that by "industry estimates there are 1.5 kg of quality meat per carcase (Kelly 2005) that constitute prime cuts from an average 12 kg dressed carcase (Hardman 1996; Hacker 2004[2])", and that "most of the meat is not premium grade and of low value for human consumption". They later state "the industry value for kangaroo meat for human consumption is 1.5 kg" (p12). There are three major errors in this calculation. First, government records show the average weight of a dressed kangaroo carcase is around 20 kg, not 12 kg (see e.g. Department of Environment, Climate Change and Water (NSW) 2009, p9). Second, the meat yield from

[1] Ben-Ami *et al.* (2010) do go on in this section to derive the comparison of 3 kangaroos to one sheep if all the meat
[2] Presumably the authors here intend to refer to Hacker *et al.* (2004).

a kangaroo carcase is around 12 kg, not 1.5 kg (Hardman 1996). The figure of 1.5 kg refers only to prime cuts suitable for pan-frying — with kangaroos as with sheep and cattle, only a small amount of the meat constitutes prime cuts such as fillets, topside and rump. Third, the full 12 kg of meat from a kangaroo is of appropriate quality for human consumption, if it has been harvested according to the relevant human consumption standard and the carcase has passed the requisite inspection (C. Sheridan and B. Pearse (AQIS), In litt.). Ben-Ami *et al.* (2010) could have validly compared prime cut yields from kangaroos and sheep, but instead seek to compare prime cut yields from kangaroo with entire meat yields from sheep.

Ben-Ami *et al.* (2010) compound these errors by comparing these underestimated figures from kangaroo with overestimated figures from sheep. They state "In contrast [to kangaroos], the mean amount of *quality meat* per sheep and cattle carcasses are estimated to be 33 kg and 274 kg (Wilson and Edwards 2008)" (italics added). However, the figure of 33 kg for sheep as calculated from Wilson and Edwards (2008) does not refer to quality meat, but refers to the carcase weight, which includes most of the sheep's skeleton The yield of bone-out meat (the appropriate comparison here) from a dressed sheep carcase generally constitutes only around 45–55% of its weight (Hopkins *et al.* 1995), or around 15–18 kg from a 33 kg sheep.

The upshot of this is that Ben-Ami *et al.* (2010) compare kangaroos providing 1.5 kg of human consumption meat to sheep providing 33 kg, deriving the startling figure of 22 kangaroos required to provide the meat of one sheep. However, examination of the evidence indicates kangaroos provide around 12 kg of meat per carcase and a 33 kg sheep around 17.5 kg. A more realistic figure, therefore, is that around 1.5 kangaroos provide as much meat for human consumption as one 33 kg sheep. But even this estimate may be weighted on the side of over-estimating sheep yields, as a 33 kg carcase weight is on the very upper end of sheep weights — official statistics from the Australian Bureau of Agricultural and Resource Economics and Sciences (ABARE), for example, report average slaughter weights in 2005–06 of 20.8 kg for lamb and 20.7 kg for mutton (ABARE 2006)). In terms of production efficiency and environmental impact, it should also be borne in mind that kangaroos require much less feed than sheep. Recent work suggests that a kangaroo requires around 0.35 as much food as a Dry Sheep Equivalent (DSE)(Munn *et al.* 2009), meaning one sheep eats the same amount of food as almost three kangaroos.

Ben-Ami *et al.* (2010) investigate the proposition of kangaroo "servicing" Australia's sheep meat requirements. While this proposition is a novel one, and seemingly irrelevant to an analysis of "'sheep replacement therapy", Ben-Ami *et al.* calculate that 22 million kangaroos would need to be harvested each year to provide every Australian one meal of kangaroo per week. Here the correct weight of boneless meat of 12 kg/kangaroo is used. However, a portion size of 250g for each person is used, twice the standard size of a lean meat portion for a healthy adult (Department of Health and Aging 2010), and taking no account of children, ill and the elderly eating less. This will result in a substantial overestimate. They compare this with the number of sheep required to give the same amount of meat, stating that "sheep carcasses yield around 68% quality meat from the 49 kg average dressed weight (Hopwood *et al.* 1976)". However, Hopwood *et al.* (1976) make no mention of average dressed weight of sheep carcases (their analysis used a range of weights of sheep kept for experimental feeding

trials), nor of the percentage of "quality meat" that can be gained from them. Regardless of origin, the figure of 49 kg for sheep carcase weight is more than twice the figure reported by ABARE (2006: 20-21 kg) and is clearly problematic. Likewise, Ben-Ami *et al.*'s figure of 68% carcase yield (yield of boneless meat as a percentage of carcase weight) is at odds with published work finding 45–55% (e.g. Hopkins *et al.* 1995).

Ben-Ami *et al.* (2010) express negative attitudes about the value of kangaroo meat for human consumption, but empirical carcase analyses have reached opposite conclusions. Hopwood *et al.* (1976) found "carcasses of kangaroos were heavier muscled than those of sheep" (p3). They concluded that the body composition of kangaroos was a highly desirable one for a meat animal, with most of the empty body weight being muscle, negligible carcass fat, and the muscle mass concentrated in the loin, rump and thigh, thereby increasing the percentage of high-value muscle (see also Hopwood and Griffiths 1984).

Assumption 4: The proper regulatory mechanisms are in place to counter an increased demand for kangaroo products

This assumption is supported by CSU researchers on kangaroo management, although their publications propose various "fine-tuning" changes to policy and management frameworks. The rigour and soundness of the Australian kangaroo management system, which requires review of the harvest for export at both state and Commonwealth levels, has received repeated endorsement from independent authorities (US Department of the Interior 1993; The Australian Mammal Society 1999; Olsen and Braysher 2001; Australasian Wildlife Management Society 2004; Olsen and Low 2006; Lindenmayer 2007; Wildlife Preservation Society Queensland 2007; Australian Veterinary Association 2009; Lunney 2010; The Ecological Society of Australia 2011; The Wildlife Preservation Society of Australia 2011). It clearly meets any credible criteria for best practice.

Ben-Ami *et al.* (2010) paint a gloomy picture of any wildlife management that involves consumptive commercial use:

> "the push for a profitable return has led to the over-exploitation and collapse of wildlife populations historically in Australia (e.g. koala skin trade) and elsewhere (e.g. American bison, rhinoceros species), with similar suggestions of a risk of localized population collapse with kangaroos (McCallum 1995)".

While Ben-Ami *et al.* (2010) provide no references for the proposition that koalas, American bison and rhinoceroses have been overexploited (McCallum (1995) makes no reference to these species), unregulated and unsustainable use of wildlife can clearly cause population declines. But this is unequivocally not the case with kangaroos (Fig. 1). Ben-Ami *et al.* (2010) at no point mention the potential of sustainable, well-managed use of species to drive wildlife population recoveries and provide incentives to conserve wildlife species. They raise bison and rhinoceroses as examples of the impact of exploitation. Bison numbers were reduced historically by uncontrolled commercial harvest, leaving fewer than 1000 in 1900. Today there are more than 220,000, the vast majority of which exist on private lands and are harvested for meat (Carter 2011). Black and southern white rhinoceroses, even under escalating pressure from illegal poaching of rhino horn, continue to increase in southern Africa due in large part to programs of well-managed, regulated sustainable use, with trophy hunting and live sales playing a major positive role (Leader-Williams *et al.* 2005; Milliken *et al.* 2009). In these cases, commercial exploitation provides important incentives for communities and private

individuals to choose wildlife ranching rather than farming as their source of income, and to maintain their land for wildlife rather than livestock or cropping.

Ben-Ami *et al.* (2010) suggest kangaroo harvesting takes place under an "open access" regime akin to the "Tragedy of Commons" (sic) (Hardin 1968). Yet in this and other statements about property rights they seem unaware of the rich literature on property rights regimes for common pool resources, and how they apply to wild kangaroos. Property rights regimes for common pool resources are generally accepted as falling into four basic types: open-access, state (government) control, private, and communal (Ostrom *et al.* 1999), with many hybrids. Scholarship on sustainable use of natural resources, from Hardin (1968) onward, is united in finding that common pool resources under open-access regimes are easily and frequently overexploited (see e.g. Ludwig *et al.* 1993). However, kangaroos in Australia are not an open access resource. They belong to the Crown, as established explicitly or implicitly in all state/territory legislation (Cooney 2008). The Crown controls all the rights generally viewed as comprising "property rights" (rights to "take", sell etc), except (on private land) the right to access. It exercises those property rights through measures such as licensing, establishing tagging systems and restricting the number of tags issued to control harvest quotas. Kangaroo management is a relatively straightforward example of state control of a common pool resource, not of open access.

Ben-Ami *et al.* (2010) go on to state that an alternative to open access is "private ownership through a common property system", citing Cooney *et al.* (2009). However, Cooney *et al.* (2009) discuss neither open access nor private ownership as potential models for kangaroo management. Rather, the models they discuss are: landholders obtaining a payment from harvesters, landholders becoming harvesters themselves, landholders employing kangaroo managers and collaboration between landholders and harvesters (including a proposed co-op model). All of these models retain state government control over licensing and quota-setting and none give landholders ownership of kangaroos on their properties (either individually or collectively). Ben-Ami *et al.* have, for unexplained reasons, chosen to focus on only two extreme property rights models (open access and private ownership), which represent neither current nor proposed arrangements.

Finally, Ben-Ami *et al.* (2010) suggest that densities of some harvested kangaroos in NSW have fallen to concerning levels, leading to the introduction of trigger points (threshold densities for reducing or ceasing harvesting). For example, they claim "[i]n a recent ruling an Administrative Appeals Tribunal concluded that the NSW Kangaroo Management Plan must adopt trigger points for the cessation of harvesting because the densities of some harvested species were of concern"(p15); and further "a court intervention was necessary to prevent over-exploitation of kangaroos under the NSW Kangaroo Management Programme (p17)." However, the AAT ruling in question was *not* responding to concern about actual kangaroo densities. The ruling in question states:

> *"It seems to us that the Plan ought provide some concrete response to an apparent or demonstrated decline in numbers such that culling will be suspended for a period of time. The first task is to determine a trigger point." (Administrative Appeals Tribunal AAT 2008)*

The AAT ruling and consequent introduction of trigger points to the Management Plan is positive fine-tuning. It establishes a mechanism to deal with a *potential* situation

where culling may need to be suspended if kangaroo numbers, at some indeterminate future point, fall below a certain level. This is a precautionary measure, not a response to any actual recorded declines in kangaroo numbers as Ben-Ami *et al.* imply.

3. Conclusions

THINKK aims to "foster understanding among Australians about kangaroos in a sustainable landscape, through critically reviewing the scientific evidence underpinning kangaroo management practices…" (Ben-Ami *et al.* 2010, p2). This is a laudable goal. Unfortunately, however, Ben-Ami *et al.* have generated a seriously flawed and misleading analysis. The THINKK publication incorrectly describes the main idea it purports to critique and misrepresents the assumptions it rests on, in effect setting up and blowing over a series of "straw men". In the process it makes a number of false statements of fact, relies on unreferenced claims, draws invalid comparisons, and distorts published research. It omits reference to decades of data confirming the ongoing abundance of the harvested kangaroo species, and to numerous examples of successful wildlife harvesting from around the globe. It appears to have been through no peer review process – at least, none is mentioned. Taking these points together, the publication does not, in our opinion, meet even a reasonable standard for being considered an objective, scientific, evaluation of kangaroo harvesting issues. This renders the publication of little use for increasing understanding of the real management issues for kangaroos within Australia. Indeed, in our view it has the opposite effect.

If science is increasingly "under siege", and in our view it is, the front line of defence must be in ensuring the practice of science strives to meet high standards of objectivity, independence and rigour. One trend that poses challenges in this respect is the increase of funding and support for university research by interest groups such as corporations, government agencies, NGOs and industry bodies (Chapman *et al.* 2011). This is by no means necessarily a bad thing – it is arguably an important step in engaging scientists more closely in society and ensuring their work contributes to current societal priorities. Further, these interest groups often have a strong stake in the outcomes of research, and there is a legitimate argument that they should contribute to the costs of generating this information for society. However, it is well recognised that such associations between universities and external interest groups can be problematic, because they:

> "may influence the principal functions of universities (to educate, to generate knowledge and provide social benefit); may weaken the fundamental obligations that universities have to staff and their students; may distort the scientific record; may impair the integrity, independence and critical facility of teachers, researchers and students; may threaten the core values of scholarly independence in universities, and may ultimately undermine public trust in the integrity of science and research" (Chapman *et al.* 2011, p3).

In the interests of science itself as well as the credibility of their own research, individuals carrying out research in such situations will need to take particular pains to apply scrupulous standards of transparency and rigour, and do science that can withstand robust critical scrutiny. In our view, doing such "sound science" requires an objective and robust process of proposing, testing and accepting or rejecting logically drawn hypotheses, with the chain of evidence open, transparent, accurate and referenced. This does not mean that other scientists could not draw different

conclusions from the evidence so presented. Scientists often disagree over the interpretation of evidence derived by the scientific method, and pose different hypotheses to attempt to explain assembled results – this is the very stuff of science. However, interpretations, conclusions and speculation derived from evidence should be logically derived, open to testing, and be underpinned by a desire (perhaps unattainable) to reach the truth. The maxim that "scientists should strive to be infallible without claiming to be" (attributed to Nicholas Malebranche, 1638-1713) still seems a sound one.

The THINKK research group is supported by an external interest group, in the type of scenario explicitly examined by Chapman *et al.* (2011). Ben-Ami *et al.* (2010, p2) state that their research is funded by Voiceless, a non-governmental "animal protection" advocacy organisation. Two co-authors of the THINKK study are also Directors of Voiceless (Voiceless undated(a)), a point which was not disclosed in the publication, and perhaps should have been. Voiceless is a vocal public opponent of the kangaroo harvest. It urges the public to take action to end it (Voiceless undated(b)), and characterises it in the following terms: "[a]nother high priority for Voiceless is the largest massacre of land-based wildlife on the planet, also known as the Australian kangaroo industry. This lucrative multi-million dollar meat, fur and skin industry is under pinned by the demonisation of our native animal as a 'pest'. The remote slaughter of kangaroos under cover of darkness is a further example of unseen and unfathomable legalised cruelty" (Voiceless undated(c)).

While it goes without saying that Voiceless is entitled both to express its views and to fund university research, including by its Directors, it is inevitable that such research will raise concerns about academic independence and be subject to close scrutiny. We have applied such scrutiny to the analysis of Ben-Ami *et al.* (2010), and find that it is seriously compromised. In our view it fails to meet basic criteria for sound science: factual accuracy, citing published research faithfully, representing published viewpoints of other researchers accurately, ensuring comparisons are logical and reasonable, and presenting and discussing published information that counters its arguments in a balanced fashion. The pursuit of different philosophies concerning animal rights, and different codes of practice concerning animal welfare, are both areas of legitimate social debate. Science can and does play a role in in informing these debates, and sound research in these fields can make a welcome contribution to developing a better understanding of the issues. However, debate on these issues is poorly served by documents purporting to be based in science that lack scientific rigour and cannot stand up to scientific scrutiny. Indeed, this is likely only to confuse and undermine the public's confidence in science and scientists, at a time when science is indeed, "under siege".

ACKNOWLEDGEMENTS AND DECLARATIONS REGARDING CONFLICTS OF INTEREST

We are very grateful to Gordon Grigg, who provided extensive comments and input in the development of this paper, and to Robert Beale, Graeme Coulson, Tom Garrett and Nicole Payne who provided helpful comments. Four anonymous referees provided very constructive comments and suggestions.

None of the authors of this paper receive or have received in the past any funding from the kangaroo industry. P. Ampt, A. Baumber and R. Cooney have in the past received funding from the Commonwealth Government Rural Industries Research and

Development Corporation's New Animal Products Program, which is funded primarily from the Commonwealth Government with additional funding raised by industry levies on the kangaroo and other rural industries.

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