Submission No 249

INQUIRY INTO HEALTH AND WELLBEING OF KANGAROOS AND OTHER MACROPODS IN NEW SOUTH WALES

Organisation: Kangaroo Management Taskforce

Date Received: 26 April 2021

working together for healthy, sustainable landscapes and kangaroos

Kangaroo Management Taskforce

26 April 2021

Chair of the NSW Upper House Portfolio Committee 7 - Planning and Environment
Via: Parliament of NSW Committees website

Dear Ms Faehrmann MLC,

Submission to the inquiry into the health and wellbeing of kangaroos and other macropods in New South Wales

The Kangaroo Management Taskforce (KMT) has been working towards improving kangaroo management in NSW since its formation in 2016. The KMT welcomes the inquiry into the health and wellbeing of kangaroos and other macropods in New South Wales (NSW) and appreciates the opportunity to make a submission.

The KMT includes broad representation from all key stakeholder groups in NSW including three veterinarians with different career backgrounds relating to kangaroos, representatives from Aboriginal Communities, animal welfare, landholders and the kangaroo industry in addition to relevant NSW Government agencies involved in the delivery of kangaroo management in NSW. In 2020 the KMT published a website which includes an overview of the group's vision, goals and journey so far, in addition to an extensive range of relevant literature and resources.

Please note that this submission represents the views and perspectives of the landholders, animal welfare and Aboriginal Communities members of the KMT. We are aware that the NSW government and kangaroo industry will be making separate submissions addressing perspectives relevant to their role in kangaroo management in NSW. Throughout the five years the KMT has been active, relevant NSW Government agency personnel have been active members of the KMT and integrally involved in all our deliberations, however they have not been asked to comment on or endorse this submission. This is a principle I have maintained, ensuring agency staff who are also members of the KMT are not drawn into commenting on government policy

The KMT welcomes a fair and transparent exploration of scientific research, regulatory approaches, industry expertise, landscape and agricultural impacts and animal welfare elements of kangaroo management to better understand the issues. Our submission focuses on explaining how kangaroos exist within an intertwined system of social, agricultural and ecological landscapes in NSW and that kangaroo welfare cannot be considered in isolation from these. We must consider the context within which kangaroos exist, and the ways in which all these systems interact and impact upon each other, particularly in western NSW where the KMT was formed, and where a majority of the state's harvestable kangaroos reside.

If the parliamentary inquiry identifies issues within the current approaches, the KMT is willing and eager to work with Inquiry members to identify practical ways in which governments, regulators, the kangaroo industry and landholders can work together towards improving approaches to ensure the best possible outcomes for the health and wellbeing of kangaroos, and the ecosystems and social and agricultural landscapes they share. We recommend that such an approach builds on existing work and platforms including the Kangaroo Management Taskforce and the NSW Government Interagency Kangaroo Working Group established in 2018.

To assist in the development of solutions for this complex issue, the KMT will be developing a number of recommendations for improving kangaroo management in NSW which we will provide to the Inquiry Committee, but these will not be finalized in time to accompany the inquiry submission on 26 April, 2021.

Non-government agency members of the KMT will also welcome the opportunity to speak to, and expand on, our submission with the Inquiry Committee and look forward to open, honest discussions aimed at improving kangaroo management in NSW.

Your sincerely,

Geoff Wise
Independent Chair
Kangaroo Management Taskforce

Inquiry into the health and wellbeing of kangaroos and other macropods in New South Wales

KANGAROO MANAGEMENT TASKFORCE RESPONSE

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The Kangaroo Management Taskforce (KMT) welcomes the opportunity to respond to the Terms of Reference of the Parliamentary Inquiry into the Health and Well-being of Kangaroos and Other Macropods in New South Wales

1. Key Points

The Taskforce seeks to make the following points to the Inquiry:

- Kangaroo management requires a big picture approach that prioritises welfare but also recognises the underlying issue of an ecological crisis of overgrazing by irruptive kangaroo populations. This overgrazing is affecting over one third of continental Australia, mainly the southern rangelands of NSW, South Australia, Western Australia and parts of Queensland. Individual issues such as harvest quotas, joey welfare and the use of exclusion fencing are components of the broader challenge to find acceptable solutions to the big picture.
- The Western Region of NSW has a kangaroo overpopulation issue that needs effective, humane management. The population of large kangaroos in the region's rangelands is fully protected from dingo predation. The population far exceeds levels in those areas of adjacent states where predation suppresses growth of numbers. Consequently, the regional population behaves in an irruptive manner, solely driven by season, increasing exponentially in good or moderate seasons then crashing with the inevitable onset of drought. Landscapes are significantly degraded in the process.
- The rapid population crashes, driven by starvation and thirst, are a kangaroo welfare catastrophe far exceeding the impact of the well-publicised but regulated commercial harvest activity. Unfortunately, by default, the NSW community accepts this death by privation as the predominant mechanism by which over-abundant kangaroo populations are moderated and stabilised. The KMT does not accept that this is an acceptable welfare outcome and calls for improved public education and awareness of the reality facing kangaroo populations.
- The commercial harvest industry is an important contributor to managing and stabilising the kangaroo population, ensuring that a valuable resource is not wasted. However, land managers recognise that with consistently below-quota takes and male-biased harvesting that the industry will only provide a partial solution to kangaroo management. The commercial harvest lacks scale to address the management of large populations threatened by declining forage with the onset of drought.
- The KMT believes that an adaptive, integrated management approach is necessary, implemented at the property-level rather than harvest zone. Proactive integrated management to moderate the extremes of population is the most humane basis to address the issue, for the benefit of kangaroo populations, the rangeland environment and pastoral enterprises. Integrated management should include population targets based on carrying capacity, a code-based harvest and non-commercial cull as well as a range of other practices appropriate to the spatial scale of rangeland management and implemented in manner to ensure kangaroo welfare. The Kangaroo Management Taskforce proposes a number of principles for integrated management as outlined in Appendix 1.
- A broad-based proactive NSW kangaroo management strategy is required to address the conservation, welfare, environmental, agricultural and social impacts of this issue, beyond the specific requirements of the existing harvest operational plan.

2. Kangaroo Management Taskforce

The Kangaroo Management Taskforce (KMT) was formed at a public kangaroo management workshop in Cobar in 2016 and includes stakeholders representing landholder, conservation, welfare, harvest industry, Aboriginal, agency and landscape ecology interests. The vision of the group is:

- Healthy and sustainable kangaroo populations
- Healthy and sustainable landscapes
- Sustainable and productive agricultural industries
- A strong commercial kangaroo industry.

The KMT Strategic Plan provides an overview of the group's interests and position (KMT, 2020). The group's focus lies in the Local Land Services Western Region of New South Wales (see Figure 1) but the vision, issues and opportunities identified have commonality across the southern rangelands of Australia and to some degree with the NSW wheat-sheep belt.

This submission has been developed by the KMT to highlight Western Region issues in relation to the health and well-being of kangaroos and other macropods. We request thoughtful consideration of the information presented and can provide further advice and evidence as required.

Figure 1 Western Region of NSW. Source: Local Land Services

3. The Western Region Context

Owing to a sparse voter population, remoteness and a declining institutional and government presence, the issues and interests of the Western Region of NSW are often poorly considered or documented in a strategic context. Policy and interest group commentaries generally lack awareness and insight into the natural resource management issues of the region, if indeed these are considered at all. Major concerns such as Darling River fish deaths and drought receive brief publicity, but attention quickly wanes and reverts to the regions where most people live.

In the case of this Parliamentary Inquiry, however, the Western Region should attract significant consideration as it supports the greatest population of macropods in New South Wales. Successful kangaroo management in this region is critical from welfare, ecological and agricultural perspectives.

a. Environment and rangeland condition

The Western Region is characterised by semi-arid rangelands, terrain unsuited to intensive agriculture due to climate or other factors, therefore retaining natural landscape processes and vegetation cover. Low-intensity pastoralism is the predominant land use, having a comparatively light footprint on the landscape. In terms of kangaroo management, key features which differentiate the region from other areas of New South Wales include:

- Spatial scale and distance parameters. The region comprises 40% of New South Wales but is mostly managed by only 1000 private landholders. Property sizes range from 5,000 to 150,000 hectares. Management interventions must be pragmatic in relation to the landscape and operational scale.
- High seasonal variability dominates the responses of the environment. There is no long-term certainty of access to forage and water resources by kangaroos or other grazing animals.
- The Western Region has avoided the widespread fragmentation of native vegetation through clearing that is evident elsewhere in NSW. The native vegetation is largely intact but in poor ecological condition. While historic land-use is a factor, most NSW rangelands remain in poor to fair condition due to chronic overgrazing.
- Chronic grazing pressure limits groundcover, plant diversity and effective landscape function, especially as seasonal growth declines with the onset of drought. Landholders can manage domestic stock grazing use but not the unmanaged herbivores that access land. Up to 50% of grazing pressure arises from kangaroos, feral goats and rabbits.
- The region has high biodiversity values. However, this biodiversity is poorly documented and widely suppressed by the low condition of the native vegetation. Recovery is significant when the environmental stress of overgrazing is relieved.
- Dual outcomes are possible. Well-managed pastoralism in rangelands can coexist with the maintenance of high biodiversity values as natural resource objectives coincide. This contrasts with other land uses where areas of agricultural production or intensive development are intrinsically segregated from intact native vegetation and biodiversity values.

In other states and globally, rangeland condition is a key parameter for assessing the health of rangelands. This refers to ecological condition in terms of vegetation structure, function and composition, assessing the impact of grazing animals on the natural plant community. The assessment of rangeland condition is now neglected in NSW, but informed opinion suggests that western NSW is in poor ecological condition compared with other Australian rangelands and rangelands in the developed world globally.

Poor land condition is evidenced by factors such as:

- Groundcover levels consistently below the minimum thresholds of 50% groundcover to prevent wind erosion and 60% groundcover to minimise water erosion.

- Decreased native plant diversity, especially the loss of selectively grazed perennial grasses and sub-shrubs.
- A shift from perennial to ephemeral groundcover cover species and the increasing domination by exotic annual weeds such as Ward's weed.
- Decreased resilience to drought, as ephemeral groundcover rapidly breaks down with the onset of dry conditions. This results in reduced forage resources for native species and pastoral enterprises as well as an increased incidence of erosion including dust storms affecting urban areas.

b. Kangaroo species

The Western Region supports four widespread and common species of kangaroos:

- Red kangaroo (*Osphranter rufus*)
- Western grey kangaroo (*Macropus fuliginosus*)
- Eastern grey kangaroo (*Macropus giganteus*)
- Euro (*Osphranter robustus infrasp. erubescens*)

These species are common, widespread and have resilient populations within their preferred habitats and unless otherwise specified, all references to kangaroos in this submission refer to these species.

Other, less common macropod species in Western NSW include Swamp wallabies (*Wallabia bicolor*) which can occur in the eastern margins of the region. Yellow-footed rock-wallabies (*Petrogale xanthopus*) were once widespread in rocky areas of the West Darling but are now endangered and the focus of conservation management. Brush-tailed rock wallabies (*Petrogale penicillata*) have been recorded in the eastern part of the region but are endangered or extinct. Bridled nail-tail wallabies (*Onychogalea fraenata*) were recorded in the region during the nineteenth century but are now presumed extinct.

c. Kangaroo Population Dynamics

The dynamics of kangaroo populations across the Western Region are well-documented through the NSW Commercial Harvest Plan and Quota Reports (DPIE, 2020). The trends in Western Plains red and grey kangaroo populations for the period 1984-2020 are presented in Figures 2 and 3. To provide a seasonal context to these trends, the annual rainfalls for Cobar and Broken Hill are provided in Figure 4. These figures demonstrate:

- That kangaroo populations increased following good seasons in the late 1990's, crashed in 2003 then gradually rose again until 2010.
- Favourable seasons in 2010-11 initiated a rapid growth in numbers again crashing with the onset of dry conditions especially after 2016.

These survey-based trends are validated by the first-hand observations of the residents of the Western Region.

Populations of large kangaroos in the region's rangelands are fully protected from dingo predation. Populations far exceed levels in adjacent states where predation suppresses growth of numbers (Caughley et al, 1980). Consequently, the regional population behaves in a way solely driven by season, increasing exponentially in good or moderate seasons then crashing with the inevitable onset of drought. The Western Region has a kangaroo overpopulation issue that needs effective, humane management.

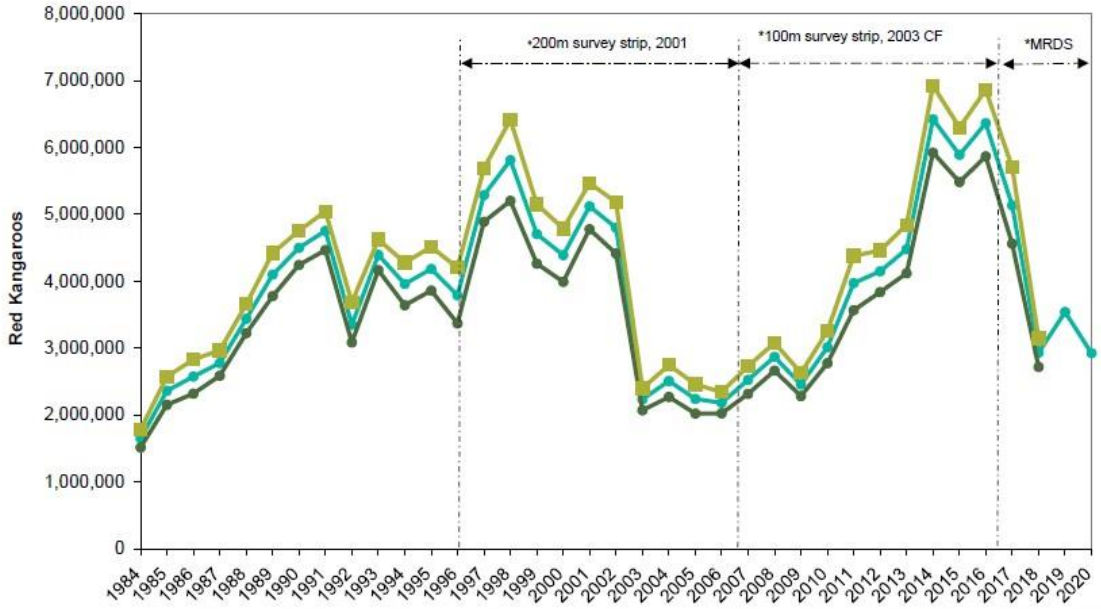

Figure 2 Trends in estimated numbers of red kangaroos (inc. standard errors), Western Plains zone, 1984-2020. Source: 2021 Quota Report New South Wales Commercial Kangaroo Harvest Management Plan 2017–2021© State of New South Wales and Department of Planning, Industry and Environment 2020.

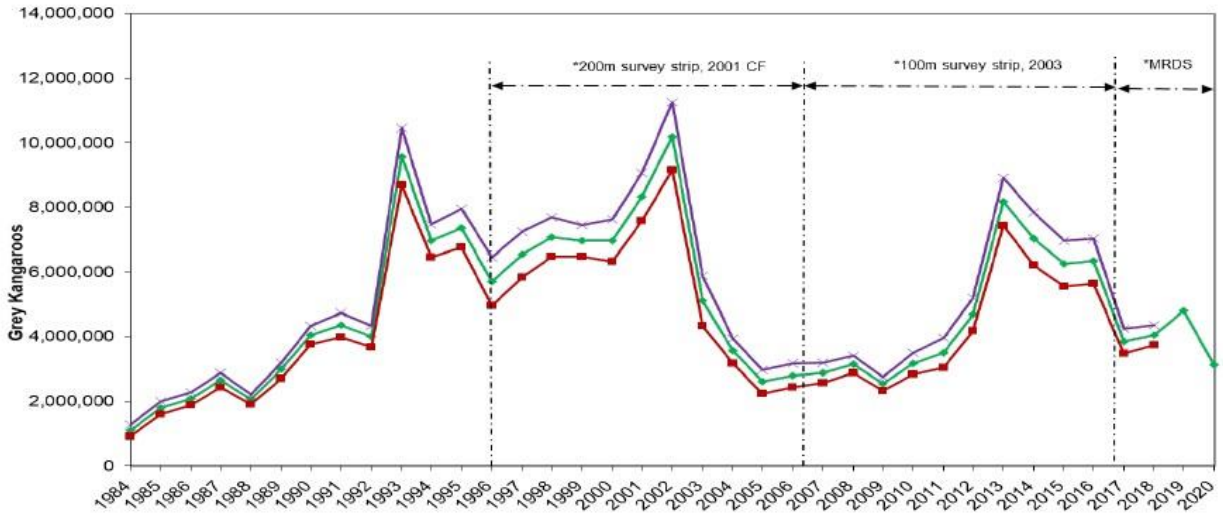

Figure 3 Trends in estimated numbers of grey kangaroos (inc. standard errors), Western Plains zone, 1984-2020. Source: 2021 Quota Report New South Wales Commercial Kangaroo Harvest Management Plan 2017–2021© State of New South Wales and Department of Planning, Industry and Environment 2020.

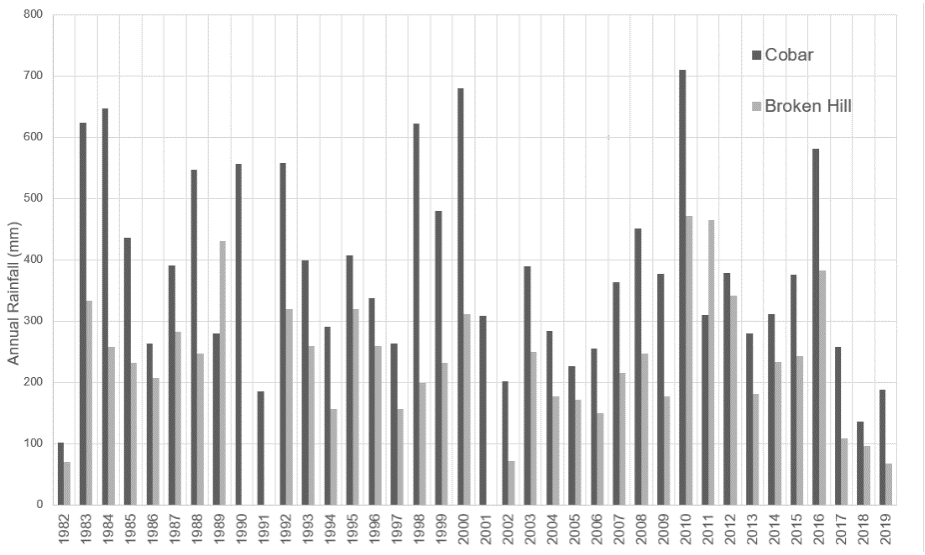

Figure 4 Annual rainfall for Broken Hill and Cobar, 1982-2019. Source: Bureau of Meteorology Climate Data Online

This process, whereby herbivore populations freed from control measures such as predation tend to increase exponentially, then crash through starvation, has been termed "irruption". Irruption has been recognised globally, in other species such as deer (Takeshita, 2018; TMS, 2010). This effect is demonstrated in South Australia where the State wild dog fence provides for clear benchmarking between the predator-free kangaroo populations existing to the south and the naturally regulated populations to the north of the barrier. In the latter case, kangaroo densities are significantly lower than in the predator-free sheep-grazing rangelands which have periodic overpopulation (Caughley et al, 1980; DEWNR, 2017; Pople et al, 2000).

- Where dingos are present, kangaroo densities are of the same order that existed pre-settlement whereas in areas of predator control, they are one to two orders of magnitude higher (Caughley et al, 1980).
- While dingoes stabilise low density populations, they generally predate rabbits and other small species during good seasons and only take kangaroos when these are weaker during drought (Caughley et al, 1980).
- Consequently, dingo reintroduction, as advocated by some interest groups, may not necessarily address high population densities, as predator-prey relationships can be complex. Regardless, reintroduction of dingoes would decimate primary production in the Western Region.

The KMT recognises that the periodic population crash events represent the death of millions of kangaroos within relatively short timeframes primarily from starvation and thirst. Land managers are first-hand witnesses to this catastrophe (McMurtrie and Kerle, in press, Robertson, 1986). The deaths are protracted and occur under the most severe environmental conditions:

- Between 2016 and 2018, approximately 7.1 million red and grey kangaroos disappeared across the NSW harvest zones, but only 1.8 million (25%) of this can be attributed to harvest. In the Western Region, the population fell by 4.2 million (Office of Environment and Heritage, 2018).
- Red kangaroo populations across the Western Plains declined by 42.9% (2,200,961 kangaroos) of which only 199,059 animals (9%) were taken by commercial harvest (Office of Environment and Heritage, 2018). An unspecified but low number would also have been culled by permit.

Rapid population crashes, largely driven by starvation and thirst, are a kangaroo welfare catastrophe far exceeding the impact of the well-publicised but regulated commercial harvest activity. Associated trauma and mortality occur with increasing road deaths associated with concentrated feeding activity

along roadsides as well as bogging in dwindling surface water supplies. Existing policy neglects these issues (Hacker, R.B., Sinclair, K., and Pahl, L., 2019b) and, by default, the NSW community accepts death by privation as the predominant mechanism by which over-abundant kangaroo populations are moderated and stabilised.

Photo 1 Kangaroo death in a drying stock watering point, 2018 drought. Bogged animals seeking moisture are too weak to escape the mud. Where possible landholders rescue living animals

Photo 2 Kangaroo death by starvation, 2018 drought

Photo 3 Red kangaroo in poor condition seeking roadside green pick, 2018 drought. Roadsides attract kangaroos during drought as runoff after light rains promotes green growth. Vehicle accidents increase in these circumstances.

d. Who is Responsible for Kangaroo Welfare during Drought?

Under the *Prevention of Cruelty to Animals Act 1979 No 200, Section 8, Animals to be provided with food, drink or shelter:*

> *(1) A person in charge of an animal shall not fail to provide the animal with food, drink or shelter, or any of them, which, in each case, is proper and sufficient and which it is reasonably practicable in the circumstances for the person to provide.*

Western Region landholders are therefore required to ensure that the livestock that they have charge of are fed and watered during drought, either by supplementary feeding or removal to areas that have adequate forage. Many feel conflicted when also seeing kangaroos suffering the privations of drought and assist where possible within their resources.

But who is responsible for the suffering of kangaroos during drought? Kangaroos, as protected native animals, are legislated property of the Crown (under the *Biodiversity Conservation Act 2016 No 63, Division 4*). There is a general community expectation that owners of animals are responsible for their welfare, and their impact on the environment and other people. That the Crown is obliged to manage the welfare and impact of kangaroos is a natural progression associated with legislated ownership but the KMT feels the Crown is failing in this regard and by default it is left to individual land managers to deal with the reality of kangaroo welfare.

While the public expresses concern over the plight of dying animals, there is no broad government strategy to manage kangaroo welfare before or during these critical periods. The kangaroo welfare catastrophe is foreseeable in terms of peak populations being at imminent risk to seasonal downturns.

The KMT believes that a long-term NSW kangaroo management strategy is necessary to moderate irruptive population cycles and implement proactive control measures when the risk of catastrophic decline is imminent. Private landholders should not be the de-facto managers of this community welfare issue but due to the lack of an effective overall strategy, they are forced to take on this responsibility with no recompense or recognition for doing so.

e. The Other Impacts of Kangaroo Overpopulation

Other impacts of kangaroo overpopulation in the Western Region are summarised in the following section. These stated impacts are often contested by interest groups that oppose kangaroo management, but understanding the local context is important in drawing valid conclusions from available data.

i. Landscape

Landscape function and stability in the Western Region is significantly affected by the level of groundcover. In general, 50% groundcover (i.e. 50% bare ground) is accepted as a crucial threshold for the occurrence of wind erosion, with higher levels required to limit water erosion (Cork et al, 2012). In paddocks where unmanaged grazing animals (kangaroos and feral goats) are present landholders have difficulty in controlling grazing pressures to maintain the minimum of 50% vegetative cover let alone higher levels. Controlling the grazing pressure of unmanaged goats and kangaroos by fencing improved perennial groundcover levels by 10 - 30% and increased total groundcover by 20 - 40% (Waters et al, 2017).

ii. Biodiversity

The impact of high densities of kangaroos on biodiversity has been well-studied in the Australian Capital Territory and similar responses are likely in the Western Region. In general, research has found that high kangaroo densities impact grassland structure, which significantly affects the abundance, species diversity and occurrence of reptiles, birds and certain insects as well as some plants (Howland et al, 2014; TMS, 2010). Recent research in the Western Region reinforces the need for kangaroo management to achieve conservation outcomes (Mills et al, 2020).

iii. Production

On average, kangaroos consume about 45% of the forage produced on Australia's southern rangelands (Hacker, R.B., Sinclair, K., and Pahl, L. 2019b). As the grazing of these animals cannot be controlled by traditional means, landholders are constrained in managing forage utilisation in relation to groundcover thresholds and are unable to spell pastures (Waters et al, 2018; Atkinson et al, 2019). Spelling is desirable to maintain the vigour of selectively grazed plants such as palatable native perennial grasses.

A recent review of dietary requirements concluded that a 50 kg kangaroo will consume one dry sheep equivalent (DSE, 50 kg wether equivalent) of forage when grazing on heterogeneous rangeland pastures. This assessment of consumption conflicts with previous estimates of about 0.45 DSE as it recognises that the dry matter intake of kangaroos will be greater than that of ruminants in the case of low-quality forage (Pahl, 2019a). Significant overlap in diet and foraging areas in rangeland environments is also evident, especially when livestock and kangaroos are feeding on green annual grasses, perennial grasses and forbs. However, patterns of consumption do not always overlap as preferences for feed sources differ between stock and kangaroos as forage dries off. There is significant overlap in the use of perennial grasses (Pahl, 2019b).

In cropping situations, substantial losses in production have been recorded in situations where farming adjoins natural habitat areas (KMT, 2019).

iv. Mental health

The difficult kangaroo welfare issues that occur with the onset of drought create anguish for property owners witnessing the struggles of individual kangaroos and a significant workload in dealing with problems such as removing animals caught in the mud of drying water supplies.

v. Drought

After a long history of land degradation episodes and high levels of total grazing pressure, the pastures of the Western Region are in relatively poor condition. Pastures have transitioned from being composed of mainly perennial forbs and grasses to a dominance of ephemeral species such as barley grass, Ward's weed and wild turnip. These species provide quick flushes of green feed that deteriorate quickly with the first warm weather and fail to support grazing or protect soils in drought.

Kangaroos have the capacity to detect and travel widely to find feed as drought develops. Their movement is unconstrained by traditional fence designs. This constrains landholder drought preparedness in several ways:

- Removing domestic stock early fails to protect pastures as mobile kangaroos can over-utilise remaining growth.
- Spelling pastures to rebuild the perennial forage component is ineffective as kangaroos can often still access these areas and selectively graze perennials.

Maintaining drought reserve paddocks is ineffective as kangaroos can access these areas and utilise them fully before they are of use to stock, diminishing incentives for landholders to rest and conserve pastures for agricultural and ecological benefit.

f. Total Grazing Pressure

The key element to managing semi-arid rangelands is the control and manipulation of grazing pressure:

- Pastures should be managed to attain a level of at least 50% groundcover, the threshold level the protection of soils from wind erosion (Cork et al, 2012).
- Higher aspirations may involve getting sufficient control of grazing to be able to spell paddocks to improve landscape condition to increase productivity, benefit biodiversity and improve resilience to drought.

Since 1901, Western Lands lease administration under the *Crown Land Management Act 2016 No 58* (formerly the *Western Lands Act*) has included strong authority to order domestic stock numbers to be reduced or removed from a Western Lands Lease if it is assessed that the property is overgrazed. The *Prevention of Cruelty to Animals Act 1979 No 200* also oversees landholder response to overgrazing. Both Acts overlook the grazing pressure of kangaroos and other unmanaged herbivores.

The term "total grazing pressure" acknowledges that managed domestic animals exert only a component of the grazing pressure imposed on rangeland vegetation if unmanaged herbivores are present. Across Australia's southern rangelands, unmanaged kangaroos and goats exert up to 50% of the grazing pressure on pastures (Hacker, Sinclair and Waters, 2019). These herbivores are mobile as they cannot be controlled by conventional fencing practices, so they are unrestrained from accessing and potentially over-utilising native pastures including areas occupied by managed domestic stock or spelled by livestock removal.

Drought places a spotlight on overgrazing issues. However, pastures can be chronically overgrazed even in good seasons, resulting in declining groundcover, increasing erosion, a loss of plant diversity and a shift to unpalatable or ephemeral species dominance. Over-utilisation is exacerbated by the

selective grazing behaviours exhibited by all herbivores, whereby the most palatable plants are preferentially consumed until they disappear. As previously indicated, Western Region rangelands are in poor condition as landholders (and National Park rangers) are unable to control grazing pressure and landscapes are chronically overgrazed. An overabundant kangaroo population exacerbates the overgrazing, especially as pastures are declining in transition to drought periods.

The mobile, non-domestic component of total grazing pressure transcends property boundaries and public/private infrastructure. It is a landscape-scale challenge and impacts Australian producers across many landscape and enterprise types. No single entity or individual has landscape-scale management influence. Primary producers as a collective need tools that help them understand both the supply and demand aspects of this complex issue and support decision making in managing available and future resources.

Effective management of total grazing pressure results in numerous intertwined benefits for landscape, biodiversity and pastoral production, largely stemming from the simple maintenance and increase of vegetative groundcover (Waters et al, 2020).

The KMT contends that kangaroo well-being cannot be segregated from the health and resilience of the ecosystems within which they exist. The management of rangelands to achieve a higher condition state is a win for long-term kangaroo populations, biodiversity and other native species as well as pastoral enterprises.

Photo 4 Exclusion cage utilising four gates to assess grazing impact of kangaroos, Chowilla Reserve, South Australia. Credit: Alison Stokes (SA Dept. of Environment and Water)

g. Aboriginal Perspectives

Aboriginal people comprise 13% of Western Region communities and many retain a connection to Country. The KMT recognises the considerable cultural significance to Aboriginal people of all kangaroos within the region in the context of both spiritual importance and value as a resource for dietary and other purposes. Beyond respecting the spiritual value of kangaroos in the landscape, the KMT recognises that kangaroo management provides a potential avenue for Aboriginal people to be engaged in activities that align cultural aspirations with vocational opportunities. The KMT has engaged with Aboriginal Communities in the Western Region who have indicated that access to kangaroo products is a priority for cultural practices and community health and they would like to see

"cultural tags" for the commercial kangaroo harvest industry to provide culturally appropriate kangaroo products to communities.

h. Integrated Kangaroo Management

Kangaroo management policy has for some time relied on the commercial harvest quota to meet the needs of species conservation and industry sustainability, accommodating additional landholder requirements through the licence to harm native animals. This approach may prevent kangaroo populations from decreasing, but increasingly there is recognition that it does not effectively meet the needs of land managers in maintaining the environment.

The KMT is supportive of an adaptive, integrated approach to kangaroo management, including codified commercial harvesting and non-commercial culling as well as other practices including the manipulation of access to artificial watering points and appropriate fencing. Rather than being alternative approaches, these practices work best if considered as integrated components of an overall management plan. For instance:

- Harvesting or culling work best within a fenced perimeter that limits immigration.
- Fencing provides a perimeter but requires harvesting and/or humane culling to manage internal populations to desired density levels consistent with carrying capacity.
- Water point closure is a supplementary control to reduce impact on spelled areas even if kangaroo management fencing is in place.

The reintroduction of dingoes is sometimes cited as a measure to reduce kangaroo numbers. However, the KMT recognises that this would significantly impact the pastoral industry, most likely resulting in a change from grazing sheep and goats to cattle, to which the region is arguably less suited. In addition, predator-prey dynamics may not produce favourable results anyway as dingoes stabilise low-density populations of kangaroos where alternative prey is abundant but may be less capable of controlling irruptive numbers (Caughley et al, 1980). KMT does not believe that a situation where kangaroos die a slow and painful death through mauling by dingoes is a better outcome in terms of animal welfare.

The KMT has developed a series of principles for kangaroo management that provide a framework for responsible kangaroo management at the property-level, highlighting community expectations and suitable process. These guidelines are presented as Appendix 1.

4. Response to Terms of Reference

a. Historical and long-term health and well-being indicators of kangaroos, and other macropods, at the local, bioregional and state levels, including the risk of localised extinction in New South Wales,

The key long-term health and well-being indicators for kangaroos and other macropods in the Western Region are:

- Seasonal growth patterns, which drive irruptive population dynamics in the absence of a predator
- Land condition, which determines the resilience of habitat to seasonal change.

As indicated in Section 3 (c), the greatest impact on kangaroo health is the irruptive behaviour of populations. In particular, a critical period exists when high kangaroo numbers arising from a series of favourable seasons experience the onset of dry conditions. In the months or years following, grazing

pressures far exceed the capacity of native pastures to produce forage that can be used by kangaroos and water resources dwindle. Historically large numbers of kangaroos rapidly die of starvation or thirst in these tragic circumstances.

Is this situation a result of pastoral use of the land and excessive grazing pressures from domestic stock?

- Possibly in some circumstances, but financial imperatives demand that landholders destock before pastures are critically depleted.
- Unmanaged feral goats can also significantly compete with kangaroos and have specific impacts in hilly terrain, in certain circumstances competing with yellow-footed rock wallabies. However, in recent years increased export market acceptance of goats has increased offtake and reduced numbers.

Recent published research undertaken in conservation reserves clearly demonstrates that the overgrazing of native pastures by kangaroos occurs in the absence of domestic livestock. Mills et al (2020) found that across three reserves in the Western Region and one in South Australia, kangaroos were specifically the cause of overgrazing, decreasing the complexity of understorey vegetation, decreasing grass cover, decreasing species richness of grass, forbs and shrubs, depleting soil carbon and phosphorous and increasing soil bulk density.

In the Western Region, the four large species of kangaroos are not at risk of extinction and have considerable resilience, as demonstrated by aerial survey data which document recoveries after drought events (see Section 3 (c)). The Commercial Harvest Management Plan underpins the control of offtake, such as exists currently in the Cobar Zone which was closed for harvesting in 2019 and 2020 due to populations approaching low thresholds. Other than overgrazing issues, the main episodic issue to affect red and grey kangaroos is choroid blindness, a viral infection spread by midges under certain conditions. During outbreaks, infection is widespread but only severely affected kangaroos become blind and subject to misadventure (AWHN, 2010).

No information is available on the health of yellow-footed rock wallabies and swamp wallabies in the region. Rock wallabies primarily exist within reserve areas and are not secure despite conservation management interventions. Landholders express concern that the viability of rock wallabies is compromised by the competition with euros and feral goats, especially during drought.

i. *Impact on Other Native Species*

Interest group commentary and the focus of this inquiry is focused on a group of relatively common but high-profile species. The KMT considers that the sustainable management of landscapes and biodiversity across the Western Region is poorly served by a focus on a single group of species. In this region, high total grazing pressure strongly influenced by irruptive kangaroo populations has a major adverse effect on the long-term health and persistence of a wide range of grassland-dependent native fauna species as well as other macropods and native flora. Many native mammals, birds, reptiles and invertebrates require grassy or rocky habitats and diverse plant communities for both forage and shelter.

These species are suppressed by total grazing pressure, but the impact is poorly documented due to the low level of survey and research in semi-arid areas. Anecdotal reports, however, suggest that measures such as the installation of TGP and exclusion fencing together with improved grazing management results in a significant rebound of species, initially in terms of plant diversity and abundance of perennials, then subsequently in the presence of resident fauna populations.

The impact affects a wide range of species of the semi-arid environments, but in the Western Region includes threatened and endangered wildlife such as:

- Plains wanderer
- Kultarr
- Southern hairy-nosed wombat
- Dusky hopping mouse
- Bolam's mouse
- Desert mouse (LLS, 2019)
- Sandy inland mouse
- Stripe-faced dunnart
- Grass wrens, several species
- Bittern
- Bush stone-curlew

b. The accuracy with which kangaroo, and other macropod, numbers are calculated when determining population size, and the means by which the health and well-being of populations is assessed,

The KMT has faith that the information provided by current population survey techniques give a valid regional-scale estimation of kangaroo numbers and trends. While the group does not specifically possess expertise in population monitoring and modelling, it regularly consults with scientists who do and are active in this field. We are aware that the methods are rigorously evaluated and supported by world-class science.

Members of the group receive information from a wide cross-section of regional landholders who report on trends in local kangaroo populations. Overall trends are in accord with the survey data underpinning quota estimations. However, group members do see several operational issues with the current survey approach:

- Populations are only counted on pastoral or agricultural lands, not on conservation estate. Consequently, the understanding of population levels is incomplete in both assessing the health of kangaroo numbers and the potential level of commercial harvest. Landholders report significant daily movements of macropods across the 4,120 kilometres of National Park boundary within the region to forage on adjacent pastoral lands and understandably feel that the numbers impacting their properties are under-represented.
- While euros are common and widespread, especially in the Barrier Ranges area, surveys do not address this species as they are not considered in the harvest plan over the Western Region. Landholder observation suggests that euro populations are increasing and expanding in range across suitable habitats and warrant formal monitoring and modelling. The group recognises that surveys of this species entail the additional costs of helicopter traverses.

While aerial survey data supports harvest quota deliberations, it is unable to support decisions at the property level, where kangaroo management is implemented. At the property-level, population dynamics may be more complex due to the diverse response of vegetation depending on type of country, the timing and distribution of rainfall, as well as the local movement of kangaroos seeking green growth. Landholders need property-level information to adequately plan grazing and control measures. Western Local Land Services and the KMT have recently gained funding to partly address this issue through the development of a predictive modelling approach.

c. Threats to kangaroo, and other macropod, habitat, including the impact of:

i. Climate change, drought and diversion and depletion of surface water sources,

Kangaroo populations in the Western Region are driven by season and their well-being is dependent on favourable conditions. When high populations enter a period of declining seasonal growth, demand for feed rapidly exceeds landscape-scale carrying capacity and high mortality from starvation eventuates. At these times kangaroo grazing pressure can have a critical impact on habitat, other species and land condition. Declining land condition initiates a cascade of reduced resilience to drought and the increased vulnerability of kangaroo populations.

Western Region wildlife has greater access to water than the pre-settlement situation through the development of catchment dams and pipeline reticulation systems. Although kangaroos use water frugally, competition for surface water also affects other species and can affect pastoral enterprises and the living conditions of resident landholders.

The outlook for climate change in the Western Region is for increased seasonal variability, more extreme events and the effects of increased temperature such as higher evapotranspiration and heat stress for wildlife and stock. Potential habitat effects may include:

- Extreme summer temperatures that will critically stress wildlife. General heat stress may have subtle outcomes such as changes in reproductive performance.
- Increased importance of natural surface waters as refuges for biodiversity with progressing climate change. The depletion of flows such is presently occurring in the Darling River will be critical in limiting species ability to move across the region in response to changing conditions and will ultimately compromise survival.
- Drought periods will likely occur more often, further compromising land condition through reductions in groundcover and increasingly ephemeral plant community

The overall impact on kangaroos will potentially be an intensification of the irruptive cycle of population growth, with periods of plenty followed by a crash in numbers and harm to the landscape. The KMT believes that a climate change response should be consistent with existing priorities:

- Humanely moderating changes in population through an active adaptive management strategy.
- Ensuring that rangeland landscapes are managed within their carrying capacities through management of kangaroo density
- Conservative management of inland waterways and wetlands so that their role as refugia and wildlife corridors is maintained

ii. Bushfires

The 2019-20 bushfires did not affect the Western Region or its kangaroo population (see Figure 5).

Western Region rangelands are most affected by bushfires in years following high rainfall events when fuel loads are high, such as in 1974 and 1984. This contrasts with higher rainfall areas where bushfires are more associated with drought. Regional-scale rangeland bushfires are uncommon but relatively slow-moving in comparison with forest fires, so potentially have a lesser impact on wildlife.

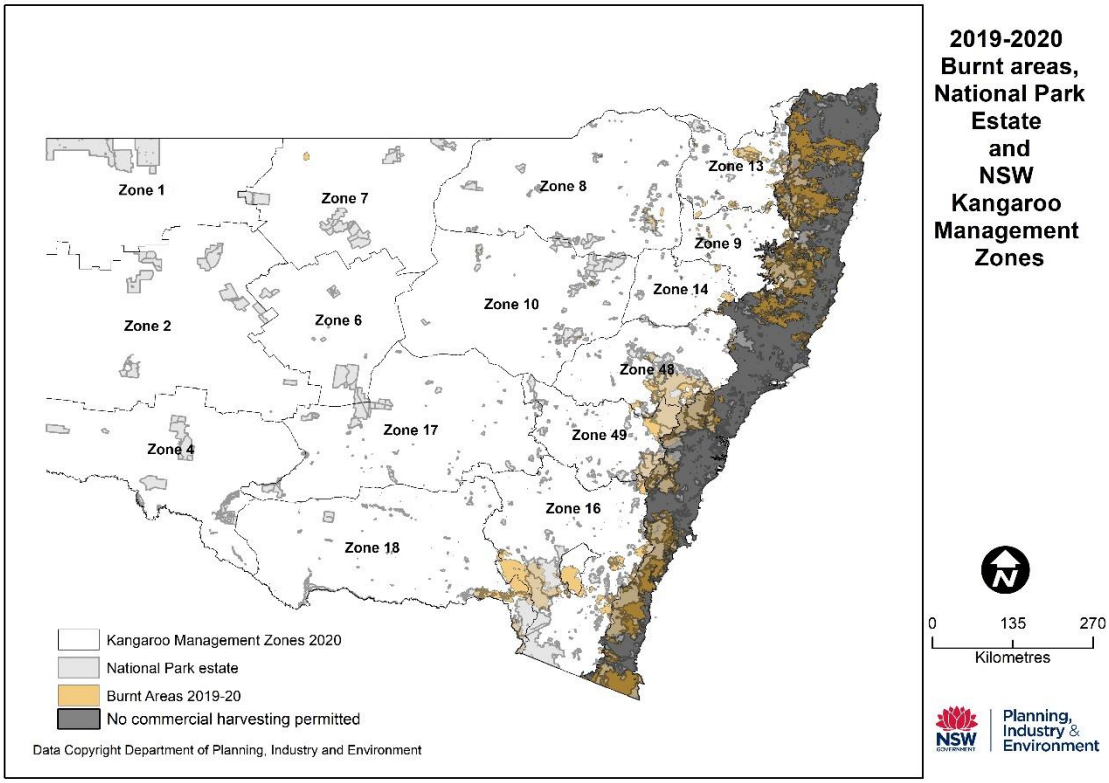

Figure 5 Areas burnt by 2019-20 fires in relation to kangaroo harvest zones

iii. Land clearing for agriculture, mining and urban development

Approximately 95% of the Western Region is uncleared and retains a matrix of native vegetation. While some vegetation management is undertaken to control invasive native species, clearing associated with land use change is not evident and does not affect kangaroo habitat.

In rangelands, well-managed pastoralism can coexist with the maintenance of high biodiversity values as the natural resource objectives, such as retaining groundcover and high plant diversity, are largely coincidental (Soils for Life, 2020). This contrasts with other land uses where areas of agricultural production or intensive development are intrinsically segregated from intact native vegetation and biodiversity values as the management objectives conflict.

iv. The growing prevalence of exclusion fencing which restricts and disrupts the movement of kangaroos

The KMT believes that various types of fencing have very substantial benefits in providing landholders the opportunity to manage the grazing pressures of domestic and non-domestic herbivores to maximise benefits to biodiversity and pastoral production. The main reasons landholders fence include:

- To control several pest species including unmanaged goats, wild dogs and feral pigs as well as kangaroos. The effective containment of meat sheep breeds has also been a driver.
- To establish a paddock or property perimeter to make internal management more effective. Numbers and grazing pressure can be controlled without the inwards movement of unmanaged herbivores.
- To ensure that the utilisation of vegetation by all herbivores can be managed to preserve sufficient groundcover to prevent erosion and maintain ground-level habitat.

- To exclude all grazing animals from paddocks at times to ensure rangeland vegetation can be fully rested to promote regeneration and recovery. The selective grazing behaviour of all types of herbivores means that even low numbers can affect the regeneration of certain preferred species.
- To permit the implementation of improved practices such as rotational grazing as a means of improving vegetation condition. This practice cannot operate effectively if any herbivores have ongoing access to spelled areas.
- To allow the absolute protection of crops and horticultural plantings from unmanaged grazing.

Recent research strongly suggests that conservation management in National Parks may require similar management of kangaroo grazing pressure through fencing to ensure conservation outcomes (Mills et al, 2020).

For many decades, the commercial harvest industry has been the sole focus of kangaroo management. The wider use of prefabricated-mesh and electric fencing to control wild dogs, feral pigs, unmanaged goats and meat sheep, together with the marketing of new fencing products, has stimulated new approaches to managing total grazing pressure and consequently fencing has been increasingly adopted for kangaroo control. This has been happening at a time when the commercial kangaroo quota approach has proven much less effective in dealing with overpopulation issues (McLeod and Hacker, 2019; Hacker et al, 2019b). Accordingly, there is a clear correlation between the reduced effectiveness of commercial harvesting as a control measure and the increased adoption of fence designs that slow/stop the movement of kangaroos.

The benefits of exclusion fencing to both biodiversity and pastoral production have been robustly validated (Mills et al, 2020; Waters et al, 2017). Fences provide for the long-term management of kangaroo populations whereas lethal methods involve ongoing short-term and ad-hoc responses to fluctuating numbers. However, they are a tool to control kangaroos, but not a management system. Better production and biodiversity outcomes will only be achieved if the improved control of grazing pressure is used to strategically manage vegetation condition. In the absence of effective grazing management, fencing only results in shifting the cause of overgrazing and pasture decline from kangaroos to livestock.

Three main approaches to fencing for kangaroo management have been adopted in the Western Region:

- Total grazing pressure fencing
- Enhanced total grazing pressure fencing, also termed “density fencing”
- Exclusion fencing

1. Total Grazing Pressure Fencing

The “total grazing pressure” (TGP) style of fence is essentially standard practice over the agricultural areas of NSW, but relatively new to the pastoral zone where traditionally a low “merino” fence of only five plain wires predominated. This style of fencing is generally constructed of prefabricated mesh wire products such as Hingejoint™. Other designs based on multiple electric wires such as Weston Fencing ™ as well as multiple (eleven) plain wire fencing are also in use (LLS, 2020).

Photo 5 TGP-style fence with prefabricated mesh, constructed 1200 mm high with 50 mm ground clearance. This style of fencing is widely used throughout the wheat-sheep zone of NSW for stock control.

Total grazing pressure fencing is highly effective for controlling the movement of feral goats and Dorper sheep, but also provides partial exclusion of kangaroos. All but the larger kangaroos tend to move along TGP fences or attempt to push under, rather than risking jumping over the wire.

A preliminary assessment of the impact of this type of fence on kangaroos was undertaken near Cobar through camera monitoring of animal responses to fencing (Dohnt and Grant, 2019). Eleven motion-sensing cameras were deployed at sites along two fence lines on the boundary of a paddock fenced with Hingejoint™ as well as a plain wire fence with leaning electric offsets over a period of several weeks. The analysis of images indicated that while kangaroos continuously investigated and patrolled the fence, very few instances of jumping were recorded (see Figure 9). No kangaroos were recorded colliding with the fence.

Most activity along the fence consisted of kangaroos patrolling, seeking pre-existing holes or breaches (see Photos 6, 7 and 8). Movement through holes under the fence appeared to be a learned behaviour adopted by individual kangaroos and at certain sites only, where feral pigs had initiated the breach. Jumping events appeared to coincide with other stimuli such as nearby vehicle movements (Photo 9) (Dohnt and Grant, 2019).

The assessment reinforced the view that TGP-style fences are effective in partially controlling the movement of kangaroos, that collision with the fence seldom occurs and that animals seek to go under rather than over the fence. Further assessments are desirable to determine if measures to increase fence visibility would reduce jumping and potential entanglements, especially in high risk areas such as where a new fence crosses an established access route.

	TA	TB	TC	TD	TE	TF	TG	H	C	E
No. of movements	97	337	20	125	275	160	91	609	169	105
No. that jump fence								16	2	3
No. going under fence								17		

Figure 6 Camera records of kangaroo activity along a TGP fence. Monitoring occurred near Cobar over 38 days in August-September 2017.

Photo 6 Large red kangaroo tests fence but does not jump.

Photo 7. Red kangaroo investigates fence with trial reflectors to increase visibility. This type of visual enhancement provided little deterrent to the patrolling of the fence.

Photo 8. Red kangaroo group patrols a fence but does not breach. Only certain individuals use a hole under the fence near the gate.

Photo 9. Kangaroos infrequently jumped the fences. When jumping did occur, it often correlated with nearby vehicle movements and was probably a flight response

2. Enhanced TGP Fencing

For some time, innovative landholders have been constructing standard TGP fences with every second post a tall 180 cm picket and running two additional plain wires at low tension above the standard mesh and wires. This approach costs slightly more than a standard TGP-standard fence but less than an exclusion fence. The additional height discourages kangaroos from jumping, reducing the risk of entanglement. (Soils for Life, 2020).

3. Exclusion fencing

Exclusion fences of various designs have been constructed in western NSW since the 1880s to manage wild dogs, kangaroos and rabbits, so they are not a new innovation (Pickard, 2007). In recent years, increasing demand for predator-proof fencing to manage wild dogs has stimulated the development of new exclusion fence products from several manufacturers. Fences constructed of these materials are typically 1.5-1.8 metres in height, with progressive mesh spacing and including either an integrated folded or hinged apron at the base. The purpose of the apron is to discourage pests or fauna from digging under the fence (LLS, 2020).

Photo 10. Exclusion fence constructed with hinged apron.

4. Impacts of fencing

Interest groups commentaries have widely criticized the use of fencing to manage kangaroos based on the obstruction of free movement and potential entanglement concerns. However, the benefits of fencing are largely overlooked in this discussion.

Within the Western Region, TGP and exclusion fencing has delivered outstanding results in improving groundcover, increasing native species diversity and encouraging the recruitment of native perennial grasses across many landholdings over the past 15 years. Anecdotal observations of benefits to fauna include an improved abundance of small mammals, reptiles, invertebrates and grassland-dependent birds, as well as associated increases in the presence of small raptors such as falcons. Across the region, the only areas supporting the indicators of good rangeland condition, such as native perennial grass abundance, exist within TGP or exclusion fenced areas.

There is clear evidence that the management of kangaroo grazing pressure through fencing has highly significant biodiversity benefits. Mills et al (2020) provides evidence that grazing by kangaroos will jeopardise conservation efforts in the semi-arid zone where populations are not regulated by predators. They used exclusion fenced areas to demonstrate kangaroos had marked effects on vegetation and soils that were symptomatic of overgrazing. Fenced areas had:

- Higher understorey vegetation complexity, grass cover as well as grass and forb species richness.
- Higher soil carbon and phosphorous pools, and lower soil bulk density.

Comprehensive studies by Waters et al (2017) within the Western Region also validated improvements to perennial groundcover and native plant diversity with total grazing pressure control and rotational grazing

Exclusion fencing has perceived adverse impacts on wildlife (Sinclair et al, 2019c). To date these have not been well-substantiated but have been widely promoted by specific interest groups. Potential issues include:

- Barrier effects, which could affect the long-term genetic viability of populations of fauna isolated within an exclusion fence. Kangaroos and emus are the main species likely to be affected, but these animals are abundant in the Western Region, with population densities up to 500 % of those recorded in adjacent semi-arid areas where they are subject to predation.

- Mortality due to entanglements or collisions with the fence. However, kangaroo and emu mortality associated with entanglement has not been documented and will be lower than that associated with conventional or TGP fencing as animals are unlikely to attempt to traverse the fence.
- Stress on animals, especially kangaroos and emus, where accustomed movement patterns and access to water are blocked by a new fence.
- The use of mesh fences by predators to trap prey such as mallee fowl has also been suggested. However, ground-dwelling birds may actually benefit from the containment of predators by the fence
- Bird and bat mortality through collision with exclusion fences. This is likely but not at a scale warranting remedial action (EnviroKey, 2017).

The juveniles of most small to mid-sized animals can pass through standard fence mesh sizes and the main species potentially impacted will be echidnas and large goannas (DEWNR, 2017; EnviroKey, 2017). The extent of exclusion fenced areas is a consideration in relation to the effect on wildlife movement, whether they form "islands" which species like emus can move around, or become connected, which will have a greater impact (Bradby et al, 2014).

5. Management within fenced areas

Landholders who fence have no guidelines to suggest appropriate densities to maintain within enclosed areas or recommended management protocols to promote the best outcomes for kangaroos and overall biodiversity. A positive opportunity to promote kangaroo welfare exists in the development of appropriate guidelines for enclosed areas including monitoring protocols for both vegetation condition and macropod numbers as well as benchmarks for recommended densities.

6. Design innovation

Substantial scope exists for innovation in design to improve the welfare performance of various fence configurations. Existing examples include:

- The use of horse sighter wire on TGP fences in high kangaroo traffic areas to reduce the potential for entanglement when jumping occurs (LLS, 2020).
- The use of design-specific emu gates to enable movement of this species through fences while excluding stock (LLS, 2020).
- The trial of an echidna gate, providing a specific opening to allow these animals to pass under exclusion fencing.

Many wildlife-friendly design options have been developed overseas for species such as deer, but there has been little promotion of such measures in Australian rangeland settings (Paige, 2016).

d. Current government policies and programs for kangaroo management

i. The method used for setting quotas for kangaroo culling

The KMT notes the distinction between harvesting kangaroos as a resource as opposed to culling for damage mitigation but will answer this point on the assumption that it refers to commercial harvest quotas. The quotas set for the commercial harvest and are based on values that conserve the kangaroo population at a zone level and provide a sustained yield to harvesters but incorporates no direct consideration of impact on the environment. Seasonal growth is not factored in the modelling. Landscape condition concerns are not specifically considered unless special quotas are implemented (McLeod and Hacker, 2019; DPIE, 2020). Consequently, the harvest quota fails to meet the needs of landholders in terms of moderating seasonal population fluctuations or managing grazing pressure on semi-arid rangelands.

In addition to the harvest rate or quota, the male bias of the harvest is a key consideration that determines the impact of take on population. In modelling harvest scenarios, Hacker et al (2004) found the best compromise harvest rate to be 20% (reds) or 15% (greys) with a 70% male bias to meet the needs of pastoralists, harvesters and conservation managers, but recognising that such a level of offtake was unlikely to be realised. To achieve a population density decrease as desired by most landholders, a lower male bias is desirable, targeting more females. However, in recent years harvesters have strongly selected for males, both for welfare and processing reasons. For instance, in 2018, there was a 93.5% male bias for red kangaroos, 89.5% for eastern grey kangaroos and 88.4% male bias for western grey kangaroos (OEH, 2019). A high male bias ensures that kangaroo populations are not reduced and in the longer-term may result in an increase in overall numbers and grazing pressure.

Again, the quota approach fails to engage landholder concerns in relation to moderating seasonal fluctuations in numbers. In order to address the welfare aspects of population irruption and crashes as well as the landscape-scale environmental impacts of chronic overgrazing, landholders need a bigger picture kangaroo policy that supports adaptive, integrated management.

ii. The management of licences to cull kangaroos

The KMT considers the commercial harvest as the preferred manner for the culling of kangaroos as shooting by professional harvesters to Code requirements maximises welfare (Agrifutures 2020; Wilson, G and Edwards, M 2019, KMT, 2020). The utilisation of kangaroo carcases ensures that high quality products are not wasted, and that carrion is not remaining in paddocks to attract foxes and feral pigs. Kangaroos have a low carbon footprint due to their unique metabolism that produces less methane than ruminants, so meat products have good environmental credentials for both human and pet consumption.

Regardless, non-commercial culling is necessary as the commercial harvest quota and take are inadequate to meet population management needs, especially in conjunction with a high male-only bias (McLeod, S, and Hacker, R, 2019). However, the predominance of non-professional shooters undertaking non-commercial culls presents a high social licence risk to landholders seeking to manage kangaroos responsibly. A low awareness of and compliance with the provisions of a Licence to Harm Kangaroos especially in relation to implementing the National Code of Practice for the Humane Shooting of Kangaroos and Wallabies for Non-Commercial Purposes is problematic. As compliance operations are difficult to resource at the scale of the Western Region, greater emphasis should be placed on educating licence applicants.

iii. Temporary drought relief policies and programs

In August 2018, at a time when all of NSW was declared in drought, temporary drought relief measures were instigated to simplify processes the non-commercial culling of kangaroos. At the time, the peak kangaroo populations of 2016-17 were crashing due to lack of forage and water, impacting both the environment and the survival of agricultural businesses. Given that the population peak was recognised in advance by both by survey data and landholder observations, the subsequent collision between kangaroo numbers, agricultural sustainability and the environment was foreseeable and inevitable.

The KMT view is that the management of kangaroos and their populations requires a broad-based NSW kangaroo strategy to address the conservation and impact of common kangaroos as well as addressing the needs of threatened species. An effective NSW kangaroo strategy should consider:

- Long-term population trends and the prediction of boom-bust events in advance to avoid crisis management in the event of drought

- A range of integrated measures to proactively ameliorate “boom-bust” cycling to reduce the welfare, environmental and agricultural production impacts that occur on a cyclical basis.
- Adaptive, proactive measures to ensure kangaroo numbers are in accord with landscape carrying capacity as seasonal conditions deteriorate.
- The use of seasonal outlook information to model impacts on populations and identify proactive responses.
- Support for landholders to sustainably manage kangaroo densities within carrying capacity at the property level for both landscape condition and species conservation objectives.
- Guidance for the use of measures such as exclusion fencing and water point control for the best outcomes for kangaroos and landscape.
- Adequate recognition of the impact of kangaroos on other native species and promote management accordingly.
- Support for commercial harvesting as a valid component of kangaroo management, preferred over non-commercial cull where possible.
- Clear linkage to drought policy.
- Mechanisms for emergency interventions such as the employment of commercial shooters to cull kangaroos in urgent disaster scenarios.
- Public education on kangaroo ecology, welfare, impacts and management beyond the emotive focus on the operation of the commercial cull.

The current harvest plan, which is solely an operational strategy for the commercial harvest, fails to meet these objectives. The harvest quota of 15-17% with no definition of male bias can no longer be considered an adequate policy answer to the management of kangaroos across the landscape (McLeod and Hacker, 2019).

e. Current government policies and programs in regards to 'in pouch' and 'at foot joeys' given the high infant mortality rate of joeys and the unrecorded deaths of orphaned young where females are killed

The KMT has confidence in the research-based veterinary advice underpinning the components of the commercial and non-commercial codes of practice that define practices for euthanasing pouch young and young-at-foot. The group recognises the importance of ensuring that this aspect of culling is managed in the most humane way possible.

Guidelines governing the treatment of 'in pouch' and 'at foot joeys' are prescribed in the National Code of Practice for the Humane Shooting of Kangaroos and Wallabies for Non-Commercial Purposes and the National Code of Practice for the Humane Shooting of Kangaroos and Wallabies for Commercial Purposes (2020). The KMT accepts the findings of the humaneness assessments of the methods detailed by McLeod and Sharp (McLeod and Sharp, 2020) that inform those prescribed in the revised 2020 Code of Practice regarding the welfare impacts on ‘in pouch’ and ‘at foot joeys’.

As indicated elsewhere, the KMT considers that the appalling privation and death of millions of kangaroos during periodic droughts present a worse animal welfare issue and should receive due consideration in addition to the emphasis placed on joey welfare in emotive interest group publicity.

f. Regulatory and compliance mechanisms to ensure that commercial and non-commercial killing of kangaroos and other macropods is undertaken according to the Biodiversity Conservation Act 2016 and other relevant regulations and codes

The KMT considers that a robust compliance regime is essential to ensure that the public has confidence in the lethal management of kangaroos under the *Biodiversity Conservation Act 2016.* Improving awareness of and compliance with the National Code of Practice for the Humane Shooting of Kangaroos and Wallabies for Non-commercial Purposes, (DEWHA, 2008b) and obligations under the Biodiversity Conservation Act 2016 should be addressed as an overall strategic approach to kangaroo management in NSW. This could include improved greater scrutiny of the non-commercial *"occupier licence to harm native animals on private property"* in order to maintain social licence in this area.

g. The impact of commercial and non-commercial killing of kangaroos and other macropods including the difficulty of establishing numbers killed by landholders since the removal of the requirement for drop tags

The KMT considers that the commercial harvest of kangaroos in the Western Region has a very low impact on populations especially given that quotas and zone access is reviewed annually to ensure conservation of species, the take has been well below quota since about 2006 and that in recent years male-only harvest has dominated. For financial as well as welfare reasons, harvesters abide by the *National Code of Practice for the Humane Shooting of Kangaroos and Wallabies for Commercial Purposes (2020).* In fact, commercial harvesting fails to provide a level of population control consistent with protection of landscape condition (DEWHA, 2008a, McLeod and Hacker, 2019).

The KMT believes that commercial harvesting should be the preferred approach to culling as it promotes a professional approach to ensuring animal welfare, prevents waste a high-quality low-carbon products and reduces the presence of carrion in the environment (Wilson, G and Edwards, M, 2019).

However, until commercial harvest approaches can meet the needs of land managers in their efforts to preserve groundcover and maintain landscapes, non-commercial culling will continue to be utilised for damage mitigation purposes. Under the regulations, landholders are still required to apply for permits and submit reports on what numbers and species have been culled. Despite the perception that the removal of the requirement for drop tags reduces accountability, all other elements of this program remain in place other than attaching the tag to the carcases of kangaroos. The KMT recommends improved training, compliance and public awareness regarding the licence conditions of non-commercial permits and the requirements of the *National Code of Practice for the Humane Shooting of Kangaroos and Wallabies for Non-Commercial Purposes*.

h. Current and alternative measures to provide an incentive for and accelerate public and private conservation of kangaroos and other macropods

Presently NSW kangaroo management policy focuses solely on the determination of a harvest rate that maintains the population and provides a sustained yield to harvesters. The impact of kangaroos on the environment is not a mandated consideration and harvest activity is determined by market factors rather than the need for damage mitigation (Hacker et al, 2004; McLeod and Hacker, 2019).

The view of the KMT is that the public and private conservation of macropods would be best served by broadening the scope of NSW kangaroo policy to actively reduce the impact of cyclical irruptive population dynamics on the natural environment. This should involve adaptive, integrated

management programs to reduce large fluctuations in population in response to season, ensuring that kangaroo grazing pressure aligns with available forage. Such an approach would pre-empt catastrophic die-offs by ensuring that kangaroo numbers would not be peaking with the onset of drought as is currently the case. In the longer-term, better alignment of grazing pressure to landscape carrying capacity should improve landscape condition, providing greater resilience of the forage resource to seasonal change.

An adaptive integrated management plan must operate at the property level as this is where decisions are made on grazing regimes, infrastructure deployment and the need for culling if necessary. However, currently landholders have no tools or technical support to assess kangaroo numbers, grazing pressures or other impacts as a basis for making other than ad-hoc decisions on appropriate responses.

Appendix 1

Principles for Integrated Kangaroo Management

Individual landholders have the foremost role in managing the reputation of agriculture through what happens on their own property. Effective self-regulation is extremely important. The following broad principles are provided as a framework for responsible kangaroo management at the property-level in order to guide the approach landholders take on this important issue:

1. Healthy, viable kangaroo populations are a vital component of the Western Region.

Landholders in the Western Region enjoy the sight of kangaroos in their landscapes. Therefore, the intent of kangaroo management is not to fully exclude kangaroos from the landscape, but to regulate the large population fluctuations that negatively impact landscape condition and cause a large number of kangaroo deaths during drought.

2. Total grazing pressure control is necessary for sustainable pastoral production.

The key goal of managing kangaroo populations involves getting control of total grazing pressure so that pastures can be managed to attain a level of at least 50% groundcover, the threshold level for protection the protection of soils from wind erosion (Cork et al, 2012). Higher aspirations may involve getting sufficient control of grazing to be able to spell paddocks to improve vegetation condition, both to increase productivity and improve resilience to drought.

3. Best practice animal welfare is fundamental to kangaroo management.

Most landholders believe in the humane treatment of all animals and this includes kangaroos. Science-based stakeholders (e.g. Australian Veterinary Association) are supportive of kangaroo management based on robust codes to ensure that practices are humane. Management practices, whether involving shooting, fencing or other approaches, should be undertaken with due consideration for any welfare risks that may arise for kangaroos or other affected animal life.

4. Biodiversity should be enhanced, not damaged.

Overgrazing by kangaroos has been shown to adversely impact biodiversity and culling can directly address this issue (TMS, 2010). The closure of water points and exclusion fencing may have both positive and negative outcomes for native fauna and flora. For instance, exclosure can reduce the impact of feral animals such as pigs and improve habitat quality for lizards, small mammals and seed-eating birds. However, fencing may also affect the movement of species such as emus, mallee fowl and echidnas. Such changes can be hard to identify over relatively short timeframes due to variation from changing seasonal conditions. Kangaroo management should seek to maximise benefits and minimise impacts on biodiversity. For instance, fence clearing operations should avoid destroying unusual vegetation and maintain habitat trees by realignment. Adopting fence designs that minimise wildlife injury can improve animal welfare and in turn reduce ongoing infrastructure damage.

5. Sites of Aboriginal cultural value should be protected.

Aboriginal people of the Western Region value their heritage and have a strong interest in the preservation of sites across the landscape. Respecting their interests builds the positive profile of agriculture. When undertaking clearing operations and earthworks, landholders must be mindful of legalities and the Due Diligence Code of Practice for the Protection of Aboriginal Objects in New South Wales as well as maintaining awareness of the potential for sites such as hearths and marked trees (DECCW, 2010).

6. Kangaroos should be managed as a resource.

Kangaroo meat is a valuable source of nutrition in a world where protein is in increasing demand. Most landholders recognise the value of kangaroo meat and regret the wastage of this resource where non-commercial culling is necessary to reduce populations. Consequently, where possible the commercial harvest industry should be the priority avenue for the removal of kangaroos.

7. Co-benefits should be maximised where possible.

The control of kangaroo numbers can have a number of co-benefits beyond solely reduced competition with livestock for available pasture. These include reduced biosecurity risk through stock containment by exclusion fencing, increased long-term resilience to drought through regenerative pasture management, better soil stability through higher groundcover levels and improved wildlife habitat through enhanced vegetation condition. However, these co-benefits only arise if kangaroo control is undertaken in the context of a broader management plan rather than ad hoc responses.

8. All aspects of kangaroo management must comply with current regulations and be transparent.

The process of kangaroo management should be transparent, meaning that all activities are undertaken legally and in accordance with statutory codes of practice so that they can be judged as robust in the face of public or legal scrutiny. Management operations should be undertaken in a professional manner, implementing best practice approaches to minimise animal welfare issues but also addressing other areas of public interest such as food safety, biodiversity conservation and sustainable land management. Poor practice and non-compliance risk the social licence to operate of both land managers and the kangaroo harvest industry.

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