Pasture management for growing kangaroos

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Abstract

The focus of this presentation is to discuss the issues surrounding management of quality pasture for orphaned kangaroos prior to release. Coverage of stocking density, suitable grasses, weed control and prevention of diseases such as gastrointestinal worms and coccidia will be addressed in the talk. Kangaroos are large herbivores in the Australian landscape. Orphaned kangaroos are reared for release. Pre-release pens need to be managed to ensure that they can provide some of the nutrition needed for growing kangaroo. The 11kg Eastern grey kangaroo consumes as much energy per kg as a 50kg sheep and thus calculation of the stocking density provides a tool to ensure adequate pasture is present for optimal growth. Kangaroos have a preference for short grass due to its higher water and energy content. Thus choosing a grass that tolerates high traffic, grows quickly and tolerates being eaten to a short level is important. Non-edible weeds can proliferate on pasture and safe techniques to manage weeds is discussed. Ideally pens require rotation to prevent the build-up of faecal pathogens that can affect kangaroos under growing stress. Some discussion of pen designs is covered in terms of providing shelter, minimum flight distance, exercise as well as skills training for release. The management of pasture to prevent the incidence of coccidiosis and reduce harmful worm burdens in young kangaroos in pre-release is also covered. This includes the reduction of faecal load on pasture, and ideas for pen design to minimise the harmful effects of faecal parasites.

Introduction

An understanding of pasture management of growing kangaroos is required to meet the five animal welfare freedoms. As grazing animal that spend 8-10 hours daily grazing, it is important to provide the opportunity for natural grazing during pre-release. The size of the enclosure should be large enough to permit normal behaviour of hopping and foraging. Disease is prevented by understanding the likely parasites and using control measures to prevent contamination of the pasture.

As a general statement, not many wildlife rehabilitators have a background in farming or agriculture. There has been limited work done on the nutritional requirements of the growing kangaroo. Much of the land used for pre-release enclosures is chosen, not for its suitability to grow herbivores, but based on the cost of land and proximity to other services (jobs, schooling). In country areas, the hostility of the farming community to kangaroos as a pest on pasture has limited the opportunity for rehabilitators to take advantage of pasture management education programs (e.g. Prograze, Beef-cheque, Meat & Livestock Association).

Unfortunately, there is a high cost of establishing a pre-release pen for kangaroos that is safe from predators and prevents escape. The consequence is a pen that is too small to teach predator avoidance, and too small to provide sufficient grass to be used to meet the nutritional needs of young kangaroos. However, if yards could be made of adequate size, then the ongoing cost of feeding concentrates would be reduced over the longer term.

Why talk about pasture management?

Young kangaroos have a high daily energy requirement: it is 1.8 x that of an adult. In other words, an 11kg roo has the same energy requirement as its 24kg mother. They eat half of the amount of food as an adult at ¼ of the weight (Dawson). Young kangaroos are not able to obtain sufficient nutrients for growth on low quality forage as they are limited by gut fill

(Power et al, 2005). So, in the interests of maximising growth, wildlife rehabilitators need to understand how pasture is involved in growing the kangaroo.
As growth when young has an impact on reproductive success, particularly in males, it would be desirable that we give these orphaned animals the best opportunity for a normal life. Small, runted animals will be slower and thus their risk of successful predation is increased. As rearing orphaned kangaroos continues to become more popular, there is increasing demand for space in pre-release enclosures. This contributes to overstocking with resulting epidemics of death due to the parasites of overcrowding and poor nutrition – coccidiosis. The enclosures themselves are expensive to build, and land expensive to purchase. So it is important to wildlife carers financially, to manage these enclosures to ensure their continued safe and productive use.

Stocking density

The issue with high stocking densities is the damage to pasture that results. High densities result in pasture grasses being grazed heavily, which prevents the regrowth of the plant. The goal is to have a stocking rate that sustainably balances consumption with enough plant sward left to protect the soil and regrow (Malcolm et al). Kangaroos have been identified as contributing to the loss of native grass species, such as Kangaroo grass (*Themeda triandra*), in native pasture of semi-arid regions, due to naturally high stocking rates preventing regrowth and persistence of this species. Thus the stocking rate needs to be related back to the amount of pasture present and when it is able to grow, and also its nutritional quality. Stocking rate is also greatly influenced by rainfall and soil type. Therefore, the stocking rate will vary with each property (and each pen), even when there are rehabilitators in the same region or town. How the pasture is managed will impact on stocking density.

Unfortunately, the legislation covering the pre-release enclosure size for young kangaroos does not appear to consider the enclosure to have the ability to provide for natural grazing. The size of the enclosures appears to house kangaroos intensively, similar to feedlots for cattle, making it unsurprising that diseases of overcrowding, such as coccidiosis occur.

Based on the energy requirements and dry matter intake, if the young at foot joey has a similar energy requirement as its mother, it too is equivalent to 0.5 Dry Sheep Equivalent (DSE), which the amount of pasture needed to feed a 50kg wether (Dawson). As a hectare is 100 x 100m in size, this translates to 50 x 100m is the area required for 0.5 DSE. This allows comparison between the kangaroo requirements and a system used to calculate stocking rate across a range of locations. For example, in low quality pasture in NSW, only 0.5 – 2 DSE/ha can be sustained. With improved and fertilised pasture, this can increase to 10 DSE/ha, which is the recommended stocking rate overall in the state codes of practice as shown below.

If we look at information that a young at foot large macropod joey of 11kg needs 1DSE equivalent, this relates to one hectare of unimproved, unfertilised pasture needed to raise this animal to a release weight of 18kg. Below the state recommendations for pre-release enclosure size are shown. A comparison is made in the table, where known, to zoo institution requirements for space per kangaroo. In all cases, rearing orphans appears to be legislated to need 1/10 of the space of an exhibited kangaroo. Yet, the orphaned kangaroo needs a space large enough to become fit. Like the exhibited kangaroo, a pre-release yard for kangaroos is unlikely to ever be empty for resting, and thus both pieces of land are under the same grazing pressure. In light of this, the reason for the small size for pre-release pens in rehabilitation is not apparent. It is expected that a kangaroo will spend eight months in pre-release to reach sexual maturity (assuming entry to pre-release at full pouch emergence) and as animals are often held back to create ‘mobs’ for release, the likelihood is that the time in these small pastures is extended. It is not surprising that pasture is becoming degraded and unable to sustain good quality grass.

Table 1: State Code of Practice recommendations for pre-release enclosure size in relation to space per kangaroo.

State	Size of macropod	Enclosure size	Total size m^2	Number of animals *	M^2/joey (require 5000)
Queensland	Wallaby < 10kg	n/a	100	1	100
	Wallaby > 10kg	n/a	300	1	300
	Kangaroo	n/a	1000	1	1000
Western Australia	Wallaby	20 x 30	600	7-10	60
	Small macropod		15	15	1
	Kangaroo	20 x 30	600	7-10	60
NSW	Kangaroo	40 x 20	800	10	80
	Small macropod (pademelon)	10 x 10	100	5	20 (4x5m)
NSW exhibition	Kangaroo	n/a	200	2	100
	Large wallaby	n/a	60	2	30
Victoria	Wallaby > 5kg		20	1	20
	Kangaroo < 20kg		50	1	50
	Kangaroo > 20kg		100	1	100
Victoria - exhibition	Wallaby < 10kg	n/a	100	1	100
	Kangaroo >20kg	n/a	1000	1	1000
South Australia	No pre-release enclosure size listed for either captive or wild macropods				
Northern Territory	No pre-release enclosure size listed for captive or wild macropods				

*Where states have listed 1 animal for the enclosure, the second animal requires 50% increase, not 100% increase in the total space – in other words, each animal receives less space, the more animals in the enclosure.

If we consider the area for each animal, the stocking density is at least ten times higher than what would be recommended for livestock. It is no surprise then, with these guidelines, that pasture is providing at best, 10-20% of the nutritional requirements of orphaned kangaroos. It is more likely that the pasture will simply be trampled to death due to the density of animals on it. Kangaroos avoid areas of grass of faecal contamination (Garnick et al), and thus, with high stocking rates and failure to remove faeces daily, the true amount of pasture available for use is often reduced even further.

Are these figures approaching those of feedlot intensive farming? From the chart above, in WA, 15 quokkas can be housed in 15m². This is equivalent to 1m²/head. Even intensive sheep farming requires 1.5m² a head!

The time for pasture to recover depends on the degree of grazing – the more plant removed, the longer it takes for it to recover. Ideally, half of the grass height is grazed, leaving half to regrow (Macher). The challenge remains that rotating pasture does not often occur in pre-release pens of orphaned kangaroos. Continuous grazing as a concept is an inappropriate hangover from an English climate, where the regular rainfall permits continuous grass growth. In Australia, with a distinct growth season, rotation of pasture improves the use of pasture by the grazing herbivore. Too often only one roo yard is built, when preparing a space twice the size with a common fence-line would be more economical to build in the longer term. Two adjacent paddocks would permit rotational grazing and provide the opportunity for pasture to recover from grazing pressure. This would mean that the pen could provide nutrition, erosion would be slowed and weed growth controlled.

In the converse situation where there is insufficient animals on the pasture, it is possible that the pasture will grow long and thus be less likely to be consumed by the kangaroo. It is also

possible that problems such as Rye-grass staggers, where a mould grows on luscious growth of rye-grass, can occur. It is in these rare situations, that possibly the myth that kangaroos should not be fed fresh, green grass arises. It is exactly a diet of fresh green grass that is required for growth.

Suitable pasture species for kangaroo pre-release pens

Young, fresh grass is more nutritious and contains more nitrogen (protein) for growth than mature plants. It is more easily digested that woody or fibrous plants. The split upper lip of the kangaroo is an adaptation to eating short green grass, similar to sheep and deer. It has been suggested that quality, not quantity of food determines growth and survival of juvenile Red kangaroos in the wild (Munn et al). Young red kangaroos need less than 40-50% Neutral Detergent Fibre (NDF) to sustain growth – i.e.: less fibrous, green leafy plants. Thus it would appear that providing pasture that contains plants of high protein levels (around 15% protein) is ideal for growth. Which plants are suitable as pasture grasses will vary with the region and is heavily influenced by rainfall and its distribution. Soil type and salinity will also influence the choice of pasture selected. Fertilisation of the soil, based on soil analysis will assist in the optimisation of plant growth.

Legumes should be a constituent of the pasture. These plants, e.g.: clovers, act to fix nitrogen in the soil, making it available to other plants and ultimately, the kangaroo. Species that tolerate heavy grazing include sub-clover (*Trifolia subterraneum*) for rainfall 450-750mm; or white clover *(T. repens*) in areas with rainfall > 800mm.

To avoid toxicity and to cater for varied growth times, a mix of species should be used for pasture as shown below in the table. For long term pastures, the table below gives examples of suitable pasture species in Australia.

Table 2: Pasture grass species for various locations and rainfalls (DPI, NSW; DPIEW, Tas; DPI, Vic).

Location	Rainfall	Pasture options
Central tablelands	High > 600mm	Phalaris, Cocksfoot, sub-clover
	Low < 600mm	Phalaris, Cocksfoot, sub-clover
Hunter/Nepean/Manning		Phalaris, tall fescue, white clover, perennial rye, Kangaroo grass
Southern Tablelands	High	Phalaris, Fescue, clover
	Low	Phalaris, Cocksfoot, sub-clover
Northern Tablelands	High	Fescue, Cocksfoot, white clover, perennial ryegrass, Phalaris
	Low	Rhodes, sub/white clover, Bluegrass, Panic
Tweed, Richmond		Kikuyu, clovers, Bluegrass, Rhodes, Setaria
Tropical		Seteria, white clover, Paspalum, Rhode grass, Digit grass
Tasmania		Native grasses: Kangaroo, wallaby, weeping
		Introduced: Perennial rye, cocksfoot, sub-clover
Victoria	High	Introduced: Phalaris, perennial rye, cocksfoot
Western Australia	South west - high	Phalaris, cocksfoot, kikuyu, sub clover, strawberry clover

Providing browse for macropods in pre-release

The issue of providing browse is important to consider for growing kangaroos. In the wild, even species that are predominately grazers, such as Grey and Red Kangaroos will also consume bark and woody plants such as saltbush, particularly when there is reduced pasture available. Browse provides an opportunity to provide environment enrichment to captive macropods. Browse also provides nutrition in terms of protein and fibre. Three 1m long pieces for each individual can be offered every other day. Some options include cutting browse, or growing suitable species in pots which can be offered then as young saplings and removed once partly eaten. This is often how browse items are consumed in the wild. Some suitable browse species are tabled below, however this chart is not exhaustive and will vary with location.

Table 3: Suitable species to offer as browse (Dexter et al, Dawson et al, Jackson)

Species	Salt bush; *Atriplex sp*	Eucalypt	Wattle; Acacia sp	Native mint; *Prostanthera sp*	She-oak; Allocasurina sp	Other species
Red kangaroo	Y	Y	Y		Y	
Grey kangaroo	WGK	Y	Y (Mulga, WGK)	Y	Y	
Euro, Antilopine Wallaroo	Y	Y			Y	Bluebush
Agile	Y	Y	Y			
Red neck wallaby		Y	Y	Y	Y	
Swamp wallaby		Y, incl Mtn Ash	Y *A. implexa*	Y	Y	Pine tree Grevillea, Bitou bush, Banksia

Controlling weeds and toxic plants

Weeds are more likely to occur in a pre-release pen if the soil has low fertility (i.e., it has not been supplemented with fertilisers). Weeds also proliferate when the grass cover has been lost due to high grazing pressure. Many weeds are known to contain toxins such as liver alkaloids. If sufficient grass cover is not present, the kangaroos may be left with nothing but toxic weeds to consume.

Plants documented to be poisonous to macropods include Yew (*Taxus baccata*), Rhododendron, Lantana, Monkey rope (*Parsonia straminea*) (Ladd). These plant species are unlikely to be present on pasture.

However, kangaroos have demonstrated toxicity to plants containing pyrrolizidine alkaloids (Ladd). Plant species that contain pyrrolizidine alkaloids that could be found as common pasture weeds include: Patterson's curse (*Echium plantagineum*), *Crotaria sp*, and Fireweed (*Senecio sp*). Macropod species vary with their sensitivity to the toxin's action in the liver. Macropods have not been assessed to determine their relative sensitivity to these toxic alkaloids in relation to other species.

Phalaris staggers has been seen in captive macropods kept on Phalaris-dominated pasture (Ladd). Phalaris and rye are more common pasture species that may under specific situations such as stress by cold, dry after recent growth can harbour a fungus which contains a toxin that affects the nervous system. Fungi do grow on a range of grass species

and thus it is prudent to manage pasture to reduce the incidence of fungal growth than to blame one grass species. There is one case of a fungal toxicity from sporidesmin growth on perennial rye grass reported in the literature in an Eastern grey kangaroo (Hum, 2005).

Supplementation

Supplementation with Lucerne hay (without milk) has been demonstrated to maintain ideal growth rates (Munn & Dawson). Lower quality hays may not provide sufficient nutrition for optimal growth. However, it may be prudent to offer a variety of hays such as grass and oat with Lucerne hay. This could reduce the potential risk of the high oxalates in Lucerne causing chronic kidney disease

Provision of concentrated food is required considering there is often insufficient pasture to address the nutritional needs of the growing kangaroo. As kangaroos require 15% protein for growth, a pellet should contain this level. Macropods are thought to have higher requirements than livestock for vitamin E. Crowding increases this requirement (Hume). However, they evolved on low Selenium soils and tolerate low levels in the diet. This too should be reflected in the pellet composition. Macropods do have a requirement for fibre to promote passage of ingesta and create the correct fatty acid substrates for energy. Low fibre, high starch diets, seen in grain-based diets create favourable conditions for the growth of Clostridium bacterium in the gut and the development of lumpy jaw. Feeding fruits and root vegetables which occurs in zoological institutions as enrichment items has been translated into wildlife rehabilitation as being basic diet requirements. This is not recommended and a grazing herbivore is unlikely to find apples and sweet potatoes in the wild. If other species such as the Ringtail possum are now being reared on natural leaf diets, instead of inappropriate fruit diets, then rearing the kangaroo should also take the approach of rearing on appropriate food items: grass, hay, natural browse items and a limited amount of concentrates.

None of the pellets below presented in alphabetical order, as sourced through an internet search claim to be a complete diet, all state that hay and grass should also be fed.

Table 4: Macropod pellet nutrient analysis (Google search: macropod/roo pellet)

Product	Energy MJ/kg	Protein	Fibre	Fat	Vitamin E (mg/kg)	Selenium (mg/kg)
Barastoc macropod pellet	No longer produced					
Barastoc (Ridley) calm performer (horse pellets)	11	11	15	2.5	20	0.5
Barastoc completo (grain mix)	11	10	10	2.5	10	0.5
Cummins Milling kangaroo & wallaby pellet	11.38	14.6	7.59	2.97	Not listed	Not listed as ingredient
Lauke roo food		14	13	3	p/m	p/m
Mazuri kangaroo/wallaby pellet (not in Australia)	13.37	15	10	5	760	0.6 – 0.7
Riverina macropod pellet	10	12	6	*	25	0.1
Wombaroo macropod pellet	9	15	22	5	150	0.18

*Listed as an ingredient, no amount documented. P/M = stock vitamin premix.

Prevention of disease

Prior to arrival at the pre-release pen, a program to reduce the parasite load in the individual should be instituted. Macropods may host at least 20 species of nematode worms, and although most of these are non-pathogenic, *Strongyloides* and *Globocephaloides* are

species that can cause diarrhoea and death. Use of albendazole (Alben, Virbac) at 4mg/kg or 1ml/5kg has been demonstrated to be safe and effective against nematodes in Eastern grey kangaroos (Cripps et al).
Two vaccinations against clostridial diseases (Ultravac, 5-in-1 vaccine, Zoetis) should be implemented at least two months prior to arrival to reduce load of Clostridial bacteria returned to pasture.
A young kangaroo can produce up to 1.5kg of faeces daily (Power et al), and simple prevention of disease is to remove the faeces on a daily basis. This is particularly important for coccidiosis prevention as the oocysts require a minimum of 24 hours out of the host to become infective. Ionophore anticoccidiostats (lasalocid and monensin) are thought to be potentially toxic to macropods. Amprolium at 125ppm in dairy meal was successfully used by Taronga Park Zoo in 1968 to control coccidiosis (Finnie, 1974) but no studies on efficacy have been done since. It is effective against one of eight stages of the parasite. There is concern that continued use may lead to resistance in the coccidian. As a thiamine antagonist, it can cause necrosis of white matter in the brain at higher concentrations. Toltrazuril, (Baycox 5%, Bayer) is likely to be more effective than amprolium (Booth) in treating and preventing coccidiosis as it is effective against 7 of 8 stages of the parasite (it does not affect the stage outside the kangaroo). It has a main advantage in that it only is required to be given once by mouth. Confusion between the dose rate for chickens where it is placed in water at a lower dose rate of 7mg/kg for two days to account for refusal to drink, and a single oral dose of 20mg/kg in mammalian species has occurred in the wildlife rehabilitation literature. Toltrazuril, in mammals has a long half-life, where one dose persists in the body for up to 55h in cattle and horses. Considering that their metabolic rate may be slower than mammals, a single dose which can be repeated 5 – 7 days later is all that is required to dose marsupials.

Recommendations

- Build a bigger pre-release pen, and build a second adjacent to it. It is only with increased size of pasture that kangaroos will have the opportunity to be a grazing animal in pre-release.
- Rotation of pasture. This is a common practice that is recommended whenever rainfall is not consistent. It will assist with pasture growth and persistence.
- Aggressive disease prevention with vaccination and targeted worm and coccidian treatment prior to arrival and then regularly throughout their stay in the pre-release pen.
- Increase the amount of browse fed to improve enrichment, education and nutrition.
- Improve the soil nutrient status to maximise amount of nitrogen for muscle. Add fertiliser after soil testing and include clovers in the pasture mix to mobilise soil nitrogen.
- Control broadleaf weeds with timely application of herbicides or physical removal.
- Remove faeces daily to break the parasite life-cycle.
- Increase the size of the enclosure to permit survival of grasses and permit more natural behaviours such as predatory vigilance, natural grazing behaviours such as selection of grass and faecal contamination avoidance.

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17. www.weeds.org.au A website for weed identification relevant to all states of Australia

Pasture recommendations for each state:

- www.dpipwe.tas.gov.au/Documents/Managing-Tasmanian-Native-Pastures---Part-1.pdf
- www.dpi.nsw.gov.au/agriculture/pastures/
- ww.ccmaknowledgebase.vic.gov.au/brown_book/documents/31_Pastures/Greener_pastures_Chapter_3.pdf
- ww.agric.wa.gov.au/productive-pasture-management-small-landholders