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Can dingoes increase graziers' profits and help maintain Australia's rangelands?

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ABSTRACT

Australia's largest land carnivore, the dingo, has been targeted by control programs in many agricultural landscapes since European settlement because of the judgement that dingoes cause costs to producers through the killing of livestock. As Australian pastoralists, we challenge the assumption that dingoes will only cause costs to producers. Based on our personal experiences and from research, we provide an alternative view, namely that in certain circumstances, there are major economic and ecological benefits of maintaining dingoes in grazing landscapes by controlling the unmanaged grazing pressure. As cattle producers, we have obtained significant financial gains for our family businesses, and environmental benefits on our properties by maintaining dingoes. Dingoes greatly reduce high-density populations of larger kangaroo species and some feral animals, especially goats. Such unmanaged grazing is persistently identified as a major factor in landscape degradation across large areas of Australian rangelands. The Australian pastoral industry as a whole, and the government departments that support it, need to evaluate, consider and discuss the economic and ecological benefits as well as the costs of maintaining dingoes in Australian pastoral landscapes.

Keywords: commercial beef cattle enterprises, dingo ecology, dingoes, ecological benefits, economic benefits, feral goats, grazing pressure, herbivores, kangaroos, land management, overgrazing, pastoral enterprises, profits, profitability, rangeland management.

Introduction

Since European settlement, Australia's largest land carnivore, the dingo, has been persistently targeted by control programs by many agricultural enterprises and government agencies because of its threat to livestock, especially to the sheep and goat industry (Corbett 2001; van Eeden *et al.* 2021). This mirrors the experience of other continents, where all species of large terrestrial predators have been targeted to some level in agricultural landscapes, and many of them have been eradicated over extensive areas (Estes *et al.* 2011).

The scale of the issue is large. Rangeland pastoral enterprises occupy ~40% of Australia (~300 million ha). Dingoes are present in most of these landscapes and are widely targeted, mostly by dropping of poison baits on the ground and from the air, and trapping (Reddiex *et al.* 2006; Australian Wool Innovation 2020).

This continued lethal control of dingoes in Australia has, at its foundation, a view that dingoes are a significant predator of all types of domestic livestock, and dingoes will therefore always reduce the profitability of grazing enterprises (e.g. Australian Wool Innovation 2020; Meat & Livestock Australia 2022).

We offer an alternative view, on the basis of both personal experience and from available research. From our personal experience as pastoralists, we consider that there are substantial economic and ecological benefits of maintaining dingoes in many Australian grazing landscapes, in particular to control the unmanaged grazing of kangaroos and some feral animals.

The key question is whether the costs of dingo predation on livestock outweigh their potential benefits. Dingoes are smallish canids; adults are ~15 kg in weight

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(Corbett 2001), and are generally not effective predators of adult cattle (*Bos taurus/B. indicus*), although they can kill calves (see, for example, Wallach *et al.* 2017). In some circumstances, cows appear to provide complete or near-complete protection of their calves from dingo attack (Allen 2016). Conversely, dingoes are certainly a major threat to sheep (*Ovis aries*) and goats (*Capra hircus*) of all breeds and age classes (Corbett 2001). This is reinforced by our personal experience, and that of our neighbours and the grazing industry as a whole, that neither sheep nor goats can co-exist with dingoes without some level of protection. However, our experience and the available evidence is that the risks and costs for cattle producers who occupy the majority of Australian rangelands are different from those confronting sheep and goat producers.

We provide observations and results from beef enterprises owned and managed by three of the authors, and also briefly review the evidence from published research, on the benefits that can be obtained from maintaining dingoes in the landscape.

Dingoes or dogs?

Dingoes have an unusual history and a somewhat debated status in Australia. Dingoes probably arrived in Australia ~4000 years ago, moving from islands to the north of Australia (Corbett 2001), although debate exists as to whether dingoes should be classified as an 'alien' or 'native' species (Banks 2021). Dingoes have a distinct morphology and behaviour, and, like domestic dogs, are descendants of grey wolves. However, their status as a full species, subspecies or breed remains debated (Crowther *et al.* 2014; Jackson *et al.* 2017). Although some interbreeding with domestic dogs does occur, recent genetic assessments have shown that the great majority of wild canids killed in Australia are totally or largely from dingo genetic stock (Cairns *et al.* 2021). Unlike cats and many other domesticated species, domestic dog breeds do not establish breeding feral populations in Australia (Cairns *et al.* 2021). Industry and some government bodies have in recent years deliberately stopped calling the animals that are killed 'dingoes', instead labelling them as 'wild dogs' (Meat & Livestock Australia 2022; Kreplins *et al.* 2019). This label incorrectly suggests to many graziers and to the general public that dingoes are not being killed, but only domestic dogs that have formed feral populations, or hybrids between dingoes and dogs, are targeted (van Eeden *et al.* 2021).

In this paper, we follow the latest published genetic research in naming the distinctive canids that breed in the wild in Australia as 'dingoes' (Cairns *et al.* 2021). Even if individual animals have some domestic dog genes, we assume that their ecological and economic benefits and risks are the same as those of 'pure' dingoes.

The view from cattle properties with dingoes

Three of the four authors of this paper own and manage commercial beef properties. These properties have different business models, are widely separated geographically, and also vary in their landscape ecology. All three independently made the decision to cease dingo control, an activity previously conducted on all three properties for over a century.

Wooleen Station, Murchison River district, Western Australia

David Pollock and Frances Jones own and manage Wooleen Station, a 152 000 ha property in the Murchison district in the southern rangelands of Western Australian. The property is dominated by uncleared native vegetation, mostly mulga (*Acacia aneura*) woodland, with chenopod shrublands along the Murchison and Roderick rivers, and some grasslands on ephemeral wetlands. Annual rainfall is 210 mm.

David and Frances run cattle. The property formerly ran sheep, but shifted to cattle in 2006. David and Frances took over ownership and management in 2007. In an apparent coincidence of timing, dingoes were first seen on Wooleen in 2007, appearing to slowly increase in numbers from 2007 to 2010. Dingoes had been completely or near completely absent from Woolleen for over 100 years, owing to lethal control. David and Frances did not kill dingoes on Wooleen after their arrival in 2007. Anecdotally, this arrival of dingoes and increase in numbers was part of a much larger pattern of dingoes apparently expanding from refuges in desert regions to the east at this time, re-establishing themselves over large areas of the southern rangelands of Western Australia. This change appeared to have been associated with reduced lethal control of dingoes, possibly the result of more landholders in the broader region shifting from sheep to cattle, and an increasing number of partially absentee landholders. (Western Australian Wild Dog Action Group 2016; David Pollock, pers. obs.).

When dingoes re-established, Wooleen had large populations of feral goats and red kangaroos (*Osphranter rufus*). In the early 2000s, approximately 2000 feral goats were annually sold from Wooleen, but an estimated minimum of 1000 were always present to re-breed. Red kangaroos were at times super-abundant, with an estimated 20 000 observed on one floodplain in 2010 following rain. In 1 month in 2010, David shot 3434 kangaroos, and a professional kangaroo shooter also shot an estimated 1500.

Despite such significant efforts at controlling the numbers of wild herbivores, David believed that uncontrolled grazing from goats and kangaroos was precluding all attempts to regenerate pasture that was in poor condition because of previous over-grazing.

The consequences of the increase in dingoes at Wooleen were dramatic. David and Frances made numerous observations

of dingo predation on feral goats and kangaroos. Feral goat numbers rapidly started to decline, with the last commercial feral goat muster conducted in 2010. The last sighting of a feral goat on Wooleen was in 2014. Kangaroo numbers were slower to decline, but David estimated that the numbers of red kangaroos declined 90% from their peak within 7 years of dingoes returning, and red kangaroo numbers have remained consistently low since then, with minor seasonal fluctuations.

The response from vegetation during this period was rapid. Streamside tree species, including river red gum (*Eucalyptus camalduensis*), swamp she-oak (*Casuarina obesa*) and lesser bottlebrush (*Callistemon phoeniceus*), regenerated along the Murchison and Roderick rivers. Prior to the increase in dingo numbers, there had been virtually no regeneration of these species for a century because of grazing by feral goats, kangaroos and sheep. In non-riverine areas, a discernible improvement in regeneration was noted, especially species favoured by herbivores such as perennial grasses, saltbushes (*Atriplex* spp.) and bluebushes (*Maireana* spp.). Although sheep were removed in 2006, substantial regeneration was noted only following the later eradication of goats and reduction in kangaroo numbers. Resting paddocks from the high levels of uncontrolled grazing became possible, such that more appropriate grazing systems such as rotational grazing could be successfully implemented.

Close monitoring of Wooleen's cattle indicated no losses or damage from dingo attacks.

Claravale Station, Mitchell, Queensland

Since 1890, the Campbell family have owned and managed the 13 000 ha Claravale Station, north of Mitchell in Queensland. Gill Campbell has managed Claravale station since 1983. The property has valleys dissected by sandstone ridges with substantial basalt capping. Poplar box (*Eucalyptus populnea*) is the dominant tree within the valleys, with some brigalow (*Acacia harpophylla*) present. All valleys are cleared with substantial tree strips left for better-quality pasture. The ridges are mostly forested with lancewood (*Acacia shirleyi*, ironbarks (*Eucalyptus* spp.), native cypress (*Callistris* spp.) and other *Acacia's*. Average rainfall is 840 mm.

Claravale runs a self-replacing breeding herd of ~500 cows selected and educated for strong mothering and protective instincts. Dingoes were routinely controlled at Claravale until 1995, with ~20 dingoes being killed annually, although an estimated 10% of calves were killed or injured. From the 1970s, 1080 poison was used in the district. Dingo populations collapsed at that time before later recovering, presumably because some dingoes learnt to avoid baits. During the time of dingo decline, Gill observed a resulting rapid expansion in numbers of large kangaroos and a previously established population of feral pigs (eastern grey kangaroo, *Macropus giganteus*, euro *Osphranter robustus*, red-necked wallaby, *Notamacropus rufogriseus*) and pig (*Sus domesticus*). Feral goats, previously absent on Claravale Station, also established.

These trends reversed after dingo control ceased in 1995. Feral goats disappeared from the property, whereas feral pigs remain at low numbers. Kangaroo numbers are now low regardless of seasonal conditions. From remains of carcases examined, young pigs and very young and very old kangaroos appear to be the main dingo food source. Calf losses from dingoes have declined to 1–2%. The lower numbers of kangaroos and feral animals means that pasture can be fully rested when the cattle are rotated around paddocks.

On the basis of this, Gill concluded that there is a causal connection between the stabilisation of dingo numbers in what appear to be stable family groups, and durable reductions in the populations of native and feral herbivores.

Noonbah Station, Channel Country, Queensland

Angus and Karen Emmott own and manage Noonbah Station, a 52 000 ha property, 130 km south-west of Longreach in western Queensland. Its lands include extensive treed and grassland floodplains on black soils of the Thomson River and Vergemont Creek (major tributaries of Cooper's, now Cooper, Creek), and mulga, gidyea (*A. cambadgei*) and other woodlands and shrublands on red-earths and laterites. The climate is semi-arid, with a nominal average of 300 mm of rain annually, but with highly variable rainfall and erratic beneficial flooding events along the rivers.

Noonbah runs beef cattle, with stocking levels varying substantially from close to zero to 3000 head, depending on rainfall and stock prices. Previously running sheep for wool production, changing terms of trade and a preference for managing cattle meant that the Emmotts converted to cattle in 2001.

The Emmotts stopped controlling dingoes on Noonbah in 2001. As observed in the different landscapes at Claravale and Wooleen Stations, apparently stable dingo family groups quickly established, and there were significant reductions in uncontrolled grazing pressure by native and feral herbivores. At Noonbah, a feral goat population of ~100 animals had become established from escapees from a neighbouring property. These goats subsequently disappeared. Feral pig populations noticeably decreased. Feral pigs had been observed in mobs of over 100 on floodplains at Noonbah in the 1990s, and at that time recreational hunters could shoot up to 100 pigs a day. Feral pigs are now observed only in groups of fewer than 10 animals, and recreational shooters can obtain only a few kills a day. Populations of large kangaroo species, such as eastern grey kangaroos, red kangaroos, and euros, have markedly declined, and since 2001 kangaroo populations have been consistently low through a range of seasonal conditions.

Our collective experience

We are struck by the overall uniformity of our observations in widely varying landscapes. We independently found similar outcomes, namely, feral goats being completely eradicated, larger kangaroo species being greatly reduced in numbers, and feral pig numbers (present on two of the properties) being reduced. These changes did not correlate with rainfall or other climatic conditions, and all three properties had years of above- and below-average rainfall during the observation periods.

It would be difficult to precisely quantify the business benefits of maintaining dingoes on our properties, but we all assess that we have obtained major benefit in improved profit. On each of these properties, there are thousands fewer native and feral herbivores competing for fodder. There is substantially more livestock feed, and reduced herbivore numbers mean that grazing levels can be controlled to a much higher degree and paddocks be rested to allow re-growth. Important for us is that our landscapes appear visibly healthier through having major reductions in uncontrolled grazing pressure.

The national story

These are our collective observations. The key questions that flow from them is whether they are applicable to other grazing businesses and in what circumstances do the costs of having dingoes on a grazing property outweigh these benefits?

First, is there evidence that dingoes significantly reduce the level of unmanaged grazing by feral and native herbivores? On this point, the evidence and observations from our properties seem to be supported by available research.

Dingoes have been predicted to reduce feral goat numbers (Forsyth *et al.* (2018), and dingoes introduced to islands have been shown to eradicate goats (Allen *et al.* 2020). Previously dense feral goat populations were reported to have disappeared over large regions of the southern rangelands of Western Australia since the return of dingoes (Pople and Froese 2012), with estimated reductions from 1 million in 2005 to 150 000 in 2011 (Western Australian Wild Dog Action Group 2016). The re-arrival of significant dingo populations in these regions came immediately prior to the collapse of feral goat populations, and dingoes are the sole cause reported for the reduction in goat numbers in the region by the pastoral industry (first-hand reports to the authors from multiple graziers in the Goldfields, Murchison and Gascoyne regions of Western Australia; Western Australian Wild Dog Action Group 2016). In landscapes divided by dingo-proof fences, feral goats are in significant numbers only on the side from which dingoes have been eradicated or nearly eradicated (Caughley *et al.* 1980; Newsome *et al.* 2001). At a continental scale, feral goats are largely restricted to sheep-growing areas, and this has been assumed because dingoes eradicate them elsewhere (Parkes *et al.* 1996).

Second, dingoes can control the populations of larger species of kangaroos. Problematically high populations of larger kangaroos that cause consistent over-grazing of native vegetation occurs only in the absence of dingoes. As with feral goats, this is most easily observed in districts divided by extended dingo barrier fences. Dense populations of kangaroos consistently occur on the side of such fences from where dingoes are eradicated or greatly reduced in numbers, with much sparser populations on the side where dingoes occur (Caughley *et al.* 1980; Pople *et al.* 2000; Letnic *et al.* 2009; although also see Newsome *et al.* 2001). There is now considerable research and first-hand observation, documenting the economic and environmental problems caused throughout southern and eastern Australia by over-abundant kangaroo populations (Atkinson *et al.* 2019; Prowse *et al.* 2019; Read *et al.* 2021).

None of this is original thinking. There is abundant research and observations globally that in many situations carnivorous animals can reduce and limit the populations of herbivores (e.g. Ritchie and Johnson 2009; Estes *et al.* 2011).

Is the uncontrolled grazing of feral and native herbivores significant economically? We were not in a position to make detailed assessments of the amount of forage taken by goats and kangaroos that could have been utilised by our livestock. However, on our properties feral goats have been eradicated, and there are, as a minimum, thousands fewer kangaroos present. Our conservative assessment is that we have all therefore achieved increases in the ability to carry domestic livestock on our properties because of this. Additionally, we can now effectively rest paddocks from grazing to promote regeneration and regrowth of desirable pasture species, as well as the regeneration of tree and shrub species that are important for maintaining ecological functions, such as protecting river-banks. Recent reviews confirmed our own experience that over-grazing in Australian rangelands by feral goats and over-abundant kangaroos have significant impacts financially and environmentally (Atkinson *et al.* 2019; Read *et al.* 2021). Atkinson *et al.* (2019) noted that 'Land managers and service providers agreed that, on average, 40 to 50% of the total demand for forage is due to non-domestic animals, that a reduction in this component is required, and that current levels are at least double the desirable level' (p 461).

We are not suggesting that dingoes are a cure-all for all uncontrolled grazing by feral herbivores in Australia. We see no research and have no observations that dingoes will have any significant impact on the populations of larger feral herbivores, such as feral cattle, horses (*Equus caballus*), Asian water-buffalo (*Bubalus bubalis*), Arabian camels (*Camelus dromedarius*) and larger deer species (Forsyth *et al.* 2018). Although we observed apparently reduced numbers of feral pigs after the re-establishment of consistently present dingo

populations, the available research indicates that dingoes do prey on pigs but do not significantly reduce populations (Forsyth *et al.* 2018). However, grazing by larger kangaroo species and feral goats comprises a large proportion of the uncontrolled grazing pressure in the Australian rangelands, and in many regions it comprises the majority (Atkinson *et al.* 2019). It is reasonable to state that uncontrolled grazing of feral goats and substantial kangaroo numbers cause major, ongoing financial losses for graziers over millions of square kilometres of lands in Australia.

There are potential and known costs and risks of course. Attacks by dingoes on cattle, especially calves, do occur. Domestic goats and sheep unprotected from resident dingoes will suffer large losses that will probably quickly cripple a business. However, our own observations are that losses for cattle are low, especially with well managed cows in good condition.

There is also the parallel question of whether lethal control efforts actually assist in reducing losses of cattle. In the majority of the Australian rangelands, in districts dominated by cattle production, eradication of dingoes has not occurred. Instead, poison-baiting and trapping programs reduce the population of dingoes periodically (Allen 2016). We could find little evidence that such control reduces dingo attacks on cattle. Of particular note is the research of Lee Allen, who detailed the available research on the costs, benefits and efficacy of attempting large-scale dingo control (summarised in Allen 2016). This included research that found that, overall, there was limited empirical evidence that baiting of dingoes reduced calf loss (as also found by Campbell *et al.* 2018). Counter-intuitively, calf losses to dingoes were sometimes *higher* where there had been dingo baiting than on properties where there had been no baiting (Allen 2014, 2015). This may occur through changes in stable social structures in the dingo population caused by lethal control (Allen 2015; Wallach *et al.* 2017). This fits the observations of one of us, Gill Campbell, that losses of calves became significantly lower, reducing from an estimated 10%, to 1–2%, *after* poison baiting was stopped at Claravale Station, and where individually identifiable dingoes forming apparently stable family groups in distinct home ranges were observed.

For cattle stations, even if low levels of cattle predation by dingoes occur, such as on Claravale Station, with an estimated 1–2% per annum, the economic impact of such losses is likely to be less than are the financial and environmental benefits from the eradication of feral goats and the maintenance of low levels of kangaroo numbers.

Unlike cattle, sheep and goats cannot co-exist unprotected with dingoes. However, we are struck by the focus on industry bodies and government departments on only providing significant support for lethal methods of protection (e.g. Australian Wool Innovation 2020; Meat & Livestock Australia 2022). Expensive exclusionary fencing has been strongly promoted, but this relies on complete eradication of dingoes inside the fenced area, and some level of ongoing control outside the fences. Non-lethal techniques that have worked on other continents have received little attention. There has been no attempt that we can observe to systematically support landholders wanting to use non-lethal techniques, such as using proven breeds of guard dogs which bond with, and live with stock in paddocks (van Bommel and Johnson 2012). Use of guard dogs, and possibly other non-lethal techniques, has the potential to effectively protect smaller stock, while also maintaining the benefits of maintaining dingoes in the landscape and reducing the uncontrolled grazing of feral and native herbivores.

Despite the recognised benefits of retaining dingoes in certain situations and in at least some pastoral landscapes, large-scale lethal control of dingoes remains the dominant approach of industry bodies for all types of livestock producers (e.g. Western Australian Wild Dog Action Group 2016; Australian Wool Innovation 2020), and industry bodies and associated government agencies have committed significant resources to market the value of ongoing large-scale lethal dingo control (Australian Wool Innovation 2020; Western Australian Wild Dog Action Group 2016). The National Wild Dog Action Plan claims that dingoes are a threat to biodiversity, as well as graziers' incomes, but provides no discussion of dingoes controlling kangaroo populations and eradicating feral goats (Australian Wool Innovation 2020).

There is a lack of discussion of the benefits of maintaining dingoes in the research and discussions of rangeland scientists and ecologists. For example, recent reviews on the ethical, economic and ecological problems caused by high kangaroo densities discussed a wide array of expensive or already tried solutions, including culling, harvesting and fencing off of kangaroos, but placed no emphasis on the potential for simply stopping lethal control of dingoes (Hacker and McDonald 2021; Read *et al.* 2021). This was despite a lack of dingo predation being identified by these papers as a key cause of the of very high kangaroo populations. Similarly, an approximately 85% decline in feral goat numbers between 2005 and 2011, most marked in the Murchison and Gascoyne bioregions, was recorded in Western Australia (Pople and Froese 2012; Western Australian Wild Dog Action Group 2016). But the role of dingoes in eradicating goats at such a scale, and the full environmental and economic consequences of that, has received limited discussion in the rangelands research literature.

Despite long-standing practices, and the active marketing to get graziers to control dingoes, we personally know of many graziers who have ceased control (e.g. Landholders for Dingoes 2021). This is often not made public by individual graziers because of fear of legal consequences in not controlling dingoes, as mandated by some local and state laws. The reasons we hear from graziers for not controlling dingoes vary. They include admiration for dingoes as a native animal, not observing any predation on stock, not wanting to cause protracted suffering through use of poison, the risk

of poisoning working and pet dogs, and similar reasons to ours, namely, the value of the control of kangaroos and feral herbivores by dingoes.

A new conversation

It is understandable that the early graziers in Australia saw dingoes as an enemy to eradicate (van Eeden *et al.* 2019). The interactions between landscapes, predators, livestock, and wild herbivores in Australia have taken time to understand.

However, we are now in the 21st century. Is it not realistic to move away from simplistic notions that the best method to deal with a potential predator is to lethally control it? Should not non-lethal techniques such as using guardian dog breeds, with a proven ability to protect stock, be actively investigated and better supported for graziers running sheep and goats (van Bommel and Johnson 2012; van Eeden *et al.* 2018)? In many ways, we have been blessed with fortune as graziers in Australia. The largest land predator is not a lion or a wolf, well designed to pull down adult cattle. It is a 15-kg canid, evolved to prey on smaller animals. Our operations, and an assessment of available research suggest that dingoes can be beneficial in increasing the profit of cattle businesses.

At a landscape scale, grazing pressure needs to be better managed on Australian rangelands for economic and environmental reasons. In addition, a range of studies have indicated that current approaches to lethal control may at least sometimes increase, not reduce, dingo attacks on cattle.

Underlying this approach are ethical issues that require more industry and public discussion. We can personally attest to there often being significant cultural as well as legal pressure to continue to kill dingoes on our properties. This is understandably especially strong where sheep and goat producers abut cattle producers (also see Allen 2016).

However, is it reasonable to ask cattle producers to forego financial and environmental benefits to protect the financial interests of sheep and goat producers? There is an obligation to be good neighbours, but there is also a duty to maintain a viable business and a healthy landscape. We therefore believe that cattle businesses should not be obliged to control dingoes, if they assess that it would be a significant detriment to their businesses and the environments they manage.

The Australian pastoral industry as a whole, and the government departments that support it, need to re-consider their approach to dingo control. We need to properly assess and openly discuss the economic and ecological benefits as well as the costs of maintaining dingoes in Australian landscapes.

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Data availability. The data that support this study will be shared upon reasonable request to the corresponding author.

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