Dingoes and Nature Conservation

POLICY STATEMENT

JULY 2026

invasive species council

About this document

Invasive Species Council 2026.
Policy Statement: Dingoes and Nature Conservation.
ISBN: 978-0-6488809-9-8

This policy was developed in consultation with the staff and Conservation and Science Committee of the Invasive Species Council, and other independent experts.

Text: Dr Carol Booth, Policy Director
Design: Heidi Fin, Individual Giving and Support Engagement Manager.

About the Invasive Species Council

The Invasive Species Council is an independent donor-funded environmental NGO.

Formed in 2002, we are at the forefront of efforts to better safeguard the Australian environment from invasive plants, animals, pathogens and other organisms. We strive for a future in which invasive species are no longer a major cause of environmental decline and extinctions.

Contact

Invasive Species Council
PO Box 818, Katoomba NSW 2780
ABN: 27 101 522 829
W: invasives.org.au
E: isc@invasives.org.au

Intellectual Property Rights

invasive species council

Cover photos clockwise from top left: (1) Martin Harvey, (2) Bill Bachman and (3) Jean-Paul Ferrero/AUSCAPE.

Table of Contents

Introduction 4
Policy statement: Dingoes and nature conservation 6
References 14
Appendix A. Summary of some research on dingo predation of large herbivores and trophic cascades 18
Appendix B. Summary of some research on mesopredator release 21
Appendix C. Summary of some research on the impact of dingoes on threatened native species 26
Appendix D. Summary of some research on protecting livestock 29

Above: Australia's dingo fence stretches more than 5,000 kilometres, from the Darling Downs in Queensland to the Great Australian Bight. While its purpose is to protect sheep from dingo attacks, this long wildlife barrier has major ecological consequences. Photo: Merlyn Cantwell.

The Invasive Species Council's dingo policy

This is a high-level statement addressing only the issues most relevant to our mission of seeking better ways to protect Australia's wildlife and ecosystems from invasive species. The focus is not dingo conservation per se. The 5 positions align with our values as advocates for nature, respectful of First Australians and committed to science.

Australians hold many different values and concerns about dingoes, some in conflict. We do not provide a template for addressing these conflicts, nor attempt to resolve all tensions between the 5 positions.

1. Dingoes should be protected for their potential to (a) regulate invasive or overabundant herbivore populations and (b) possibly also suppress invasive meso-predators – subject to precaution where threatened species are at risk from dingoes.
2. Research to resolve important ecological questions about dingoes should be prioritised.
3. Dingoes should be managed where this is needed to protect native species populations.
4. Dingoes should be valued and protected for their cultural significance to many First Australians.
5. The aim for managing the impacts of dingoes on livestock should be coexistence.

Dingoes regulate the size of kangaroo populations. Where dingoes are excluded or heavily controlled, kangaroos tend to become overabundant, leading to degradation. Photo: GISTEL Cezary Wojtkowski

Introduction

Dingo ancestors probably originated in southern China, where human and dog populations expanded with the development of agriculture. Dingoes diverged from their most recent common ancestor about 6,800 years ago[1], and a bone in a cave on the Nullarbor Plain, the oldest reliably dated subfossil, indicates they were widespread in Australia by 3,300 years ago.[2] They may have been brought here by the sea-faring Tolean people from southern Sulawesi (one of several hypotheses),[3] and are likely to have spread rapidly in association with First Australians.[4]

The arrival of a new predator in Australia was ecologically momentous. Dingoes likely caused or contributed to the extinction of at least 3 species on the mainland soon after their arrival – the thylacine, Tasmanian devil and Tasmanian native hen.[5] As an apex predator similar in size to the thylacine, the dingo became an ecological force – able to 'shape ecological assemblages via a multitude of interaction pathways'.[6]

The arrival of dingoes was also momentous for people. Variably across Australia, dingoes became companions, protectors, hunting assistants and occasional food, and a prominent feature of art, ritual, songlines and creation stories.[7] 'Aborigines come from dingoes,' say Yarralin people of the Northern Territory.[8] 'Dingoes are our brothers and sisters,' say the Bundjalung, Yuin Walbunja, and Southern Yuin people of New South Wales. 'We have that family, that connection to them.'[9]

But soon after European colonisation, dingoes also became something else – a reviled killer of livestock. To aid the elimination of dingoes from sheep-grazing areas, fences were built (including the world's longest – initially more than 8,600 km, now 5,500 km); laws required landholders to cull dingoes and bounties were offered; and baits, initially with strychnine then 1080, have been regularly laid across millions of hectares.[10]

Even more recently, since the 1970s, dingoes have become a focus of conservation concern.[11] This has arisen mainly from the hope that, as an apex predator in a land that has lost all its large native terrestrial predators – 'one of the most depleted predator guilds in the world' – the dingo offers the potential for large-scale restoration of ecosystem health.[12]

[1] Zhang et al. (2020a). This date (with a range of 8,048–5,609 years ago) was based on a comparison of the complete mitochondrial DNA genomes of 27 ancient canids from the Yellow River and Yangtze River basins in China and 10 dingo genomes.
[2] Balme et al. (2018). Although genetic studies raise the possibility of an earlier dingo arrival, there are many sites in Australia with fossils older than 3,300 years, including of thylacines, but not of dingoes. The absence of dingo fossils prior to 3,300 years ago is hard to explain if the earlier proposed dates for arrival are correct.
[3] Fillios and Taçon (2016)
[4] Balme et al. (2018). The dispersal of cats across Australia, also aided by humans, took just 70 years, although with introductions at several locations.
[5] Dickman et al. (2021); White et al. (2018); Letnic et al. (2014); Baird (1991). Although the synchronicity between these extinctions (estimated by White et al. at about 3,200 years BP for devils and thylacines) and the arrival of dingoes is highly suggestive, an intensification of human hunting may also have been influential (Prowse et al. 2014). Climate change, also proposed as a factor, is unlikely to have caused range-wide extinction (Morris et al. 2022).
[6] Moseby et al. (2019)
[7] Cahir and Clark (2013); Rose (2011); Smith and Litchfield (2009); Fleming et al. (2001)
[8] Rose (2011)
[9] Costello et al. (2021)
[10] Dickman et al. (2021); Philip (2021); Fleming et al. (2001). It was roughly calculated that 10,000 to 20,000 dingoes are killed each year of an adult population of 26,000 to 52,000 (Allen and Hampton 2020).
[11] Fleming et al. (2001); Downward and Bromell (1990); Breckwoldt (1988)
[12] Ritchie et al. (2012)

The reality and scale of this potential, and whether there are also conservation risks, depend on the answers to the following questions, none yet fully settled:

- the extent to which, as a predator of certain medium-sized-to-large herbivores, dingoes regulate their populations and thereby prevent the loss of rare plants, depletion of plant biomass and the degradation caused by overgrazing – as predicted by the trophic cascade theory[13] (see Appendix A for summaries of research)

- whether, as a predator and competitor, dingoes suppress the populations or compromise the hunting effectiveness of foxes and cats, and thereby prevent or limit the declines of animals threatened by these mesopredators – as predicted by the mesopredator release hypothesis[14] (see Appendix B for summaries of research)

- whether native animals have evolved the ability to recognise and react defensively to dingoes as predators,[15] and the extent to which, as a generalist opportunistic predator, dingoes threaten rare native animal species at risk of extinction[16] (see Appendix C for summaries of research).

Valued as kin and cultural icon by First Australians, championed as an ecological benefactor, distrusted as a threat to wildlife, condemned as a plunderer of livestock – the dingo is Australia's most controversial animal. Debates also swirl about its taxonomic status and whether it should count as native or not native (Box 1).

As a conservation organisation seeking better ways to protect Australian wildlife and ecosystems from invasive species, the Invasive Species Council is vitally interested in the potential for dingoes to help in that endeavour. The following policy position is aligned with our organisational values as advocates for nature, respectful of First Australians and committed to science.

This is a high-level policy statement, not intended to reconcile all tensions between the ecological, cultural and socio-economic concerns addressed across the 5 policy positions. To date, governments have largely neglected the ecological and cultural values of dingoes in favour of industry concerns. To alter this balance will require a strong focus on developing solutions for sheep grazing enterprises that do not entail large-scale dingo killing or other environmentally detrimental measures.

We refer here only to 'dingoes', for recent research has shown that most wild dogs are dingoes, and hybrids are uncommon.[17] It is mostly not feasible in the field to distinguish between dingoes and dingo hybrids.[18]

[13] Morris and Letnic (2017). The trophic cascade theory predicts that suppression of an apex predator will result in irruption of herbivore populations, leading to depletion of plant biomass.
[14] Dickman et al. (2009); Ritchie and Johnson (2009); Letnic et al. (2012). The mesopredator release hypothesis predicts that reduced abundance of an apex predator will result in increased abundance or activity of smaller predators due to a reduction of direct killing, interference competition or fear, which in turn can lead to declines in the abundance of animals hunted by the mesopredators.
[15] Banks (2021)
[16] Ward et al. (2021); Kearney et al. (2018); Woinarski et al. (2014)
[17] Cairns et al. (2023): An analysis of 307 putative dingoes from across Australia found that 70% were pure dingoes, 15% were historical dingo backcrosses, and 15% were recent dingo backcrosses. Recent dingo backcrosses were most common in Queensland (26%) and New South Wales (20%).
[18] Tatler et al. (2021)

Policy statement: Dingoes and nature conservation

1. Dingoes should be protected for their potential to (a) regulate invasive or overabundant herbivore populations and (b) possibly also suppress invasive meso-predators – subject to precaution where threatened species are at risk from dingoes.

Dingoes offer the potential for improving ecosystem health by regulating populations of invasive ungulates and overabundant macropods. The benefits of this alone warrant dingo protection in many settings. Without predators, burgeoning populations of kangaroos, goats and deer have depleted vegetation, leading to the loss of rare plants, lower productivity, landscape degradation and probably also declines in seed-eating birds and small mammals.[19] There is strong evidence that dingoes regulate populations of macropods and goats – for example, kangaroos are common on the sheep-grazing side of the dingo fence (where dingoes are rare), and less common on the cattle-grazing side of the fence;[20] and goats are scarce where dingoes are common in semiarid and arid regions.[21] The spread of some feral deer species may be facilitated where dingoes are rare.[22]

Although sambar have become a prominent part of dingo diets in alpine areas,[23] the extent to which they and other ungulates are hunted, rather than scavenged, and their populations regulated by dingoes, needs more research (Box 2).[24] See Appendix A for summaries of research.

Although the evidence is contested, dingoes may also offer the potential for protecting threatened wildlife by suppressing fox and cat populations – through 'direct killing, interference competition, competition for food and shelter, and fear-mediated changes in habitat use and activity patterns'.[25] For example, studies across the dingo fence have found that foxes are less active and small native rodents and dasyurid marsupials are more abundant in the presence of dingoes than where dingoes are absent.[26]

The evidence of mesopredator release is strongest for foxes, with a recent meta-analysis finding their abundance 'tends' to increase when dingoes are removed.[27] This meta-analysis also found a tendency for cat numbers to increase where foxes are removed but, on average, no significant effect on cats when dingoes are removed. And while fox removal consistently benefits ground-dwelling and arboreal mammals, the effect of dingo removal on native animal species susceptible to predation by cats and foxes has not been consistent.[28]

[19] Morris and Letnic (2017); Rees et al. (2017); Allen et al. (2013); Letnic et al. (2009); Parkes et al. (1996). Overgrazing by macropods has been rated a medium or high impact threat to 62 threatened taxa and goats as a medium or high impact threat to 37 threatened taxa (Ward et al. 2021).
[20] Letnic et al. (2012)
[21] Forsyth et al. (2018); Letnic et al. (2012)
[22] Forsyth et al. (2018)
[23] Thompson et al. (2022)
[24] Forsyth et al. (2018)
[25] Letnic et al. (2012)
[26] Letnic et al. (2009)
[27] Hunter et al. (2018). The meta-analysis was of 34 papers published between 1980 and 2017 investigating the impacts of dingo and fox control on introduced predators and native mammal species. Their findings 'that removal of dingoes did not have a significant effect on fox or cat abundance, but did have a positive effect on kangaroo abundance, lend support to the hypothesis that negative effects of dingo control on small mammal populations are due more to indirect effects arising from increased abundance of large herbivores than to mesopredator release.'
[28] Hunter et al. (2018). The meta-analysis found that while dingo removal results in declines in the abundance of small mammals (below critical weight range) there is, on average, no effect on mammals in the critical weight range.

The relationships are not straightforward – dingo densities may need to exceed a certain threshold to suppress fox populations;[29] the suppression of mesopredators is likely influenced by habitat structure[30] and productivity;[31] and the effect of dingo removal on small mammals can be mediated by the impacts on vegetation of more abundant kangaroos.[32] With much of the evidence for and against the mesopredator release hypothesis equivocal or disputed,[33] researchers have proposed a new experimental approach – assessing the effects of dingo reintroduction rather than dingo removal.[34] See Appendix B for summaries of research.

2. Research to resolve important ecological questions about dingoes should be prioritised.

Research to resolve whether and where dingoes can 'help halt Australia's biodiversity collapse' and 'restore degraded rangeland environments' should be a high national priority.[35] Much disagreement has focused on the adequacy of research design and methods[36] – most studies are observational or correlative, which means their conclusions are subject to competing explanations[37] and it is difficult to measure animal abundance, particularly predators with low densities.[38] To resolve outstanding questions, it has been proposed that 'proponents and protagonists' agree on a research agenda, research methods and benchmarks for accepting results.[39] One jointly proposed large-scale experiment is to realign the dingo fence bordering Sturt National Park to allow the reintroduction of dingoes and comprehensively test the effects over several years.[40] See Box 2 for other priority research questions.

3. Dingoes should be managed where this is needed to protect native species populations.

Australia's mainland wildlife have coexisted with dingoes for at least 3,300 years, suggesting that dingoes are unlikely to threaten native species under 'natural' conditions. But the rarity of some species due to other threats makes them vulnerable to any level of predation, and dingoes sometimes, and in some locations, exert high predation pressure.[41] For example, bilby remains were detected in 13–85% of dingo scats In Astrebla National Park (Queensland) over a 7-year period, suggesting occasional 'hyperpredation', but dingoes are likely to benefit bilbies where they suppress foxes.

[29] Hunter et al. (2018); Johnson and VanDerWal (2009)

[30] Stobo-Wilson et al. (2020); Hunter et al. (2018); Moseby et al. (2012). Where vegetation is denser, foxes and cats are better able to elude dingoes.

[31] Greenville et al. (2015): Dingo suppression of mesopredators appears to be strongest during prolonged periods of low rather than high productivity.

[32] Rees et al. (2017): A reduction of grass seeds by kangaroo grazing may explain the relative rarity of small granivorous birds and mammals in areas where dingoes are functionally extinct. Hunter et al. (2018): 'the negative effects of dingo control on small mammal populations [may be] due more to indirect effects arising from increased abundance of large herbivores than to mesopredator release'.

[33] Castle et al. (2023): 'the strength or quality of the literature on dingo-mesopredator relationships is typically weak'; 'the vast majority of studies continue to be designed and implemented in such a way that they do not permit making causal inferences for these mechanisms'.
Dickman et al. (2021): 'questions about the effects of dingoes on contemporary biota and ecosystems .. will need new thinking to achieve any resolution. More research has focused on these latter questions in the last 20 years than over the previous two centuries, yet disagreements remain intense.'
Letnic et al (2012): 'unequivocal evidence for an inverse relationship between dingo and fox numbers is lacking'; studies 'investigating the numerical relationship between dingoes and feral cats generally have produced equivocal results'.

[34] Newsome (2021); Newsome et al. (2015)

[35] Newsome et al. (2015)

[36] Newsome (2021)

[37] Allen et al. (2013)

[38] Fancourt et al. (2019); Johnson et al. 2014; Allen et al. (2013); Letnic et al. (2012); Kennedy et al. (2012). For example, Fancourt et al. (2019) say that some indices of cat activity such as track plot indices, raw camera detection rates and spotlight counts rely on unsupported assumptions to infer numerical relationships between dingoes and cats and that they are often not related to abundance.

[39] Dickman et al. (2021)

[40] Newsome et al. (2015)

[41] Letnic et al. (2012)

Northern hairy-nosed wombats were saved from likely extinction by a fence to exclude dingoes.[42] In Kakadu National Park, dingoes prey on some declining species and may limit their potential for recovery.[43] The simplification of habitats in northern Australia, due to fire regimes and overgrazing, is likely to have increased native species' susceptibility to predation by both cats and dingoes.[44] A recent assessment by the Threatened Species Recovery Hub rated dingoes/wild dogs as a medium- or high-impact threat to 12 taxa listed under the EPBC Act as threatened, particularly macropods (e.g. rock wallabies) and bandicoots.[45] See Appendix C for summaries of relevant research.

4. Dingoes should be valued and protected for their cultural significance to many First Australians.

Most management of dingoes has ignored their cultural and spiritual significance for First Australians.[46] A recent declaration signed by more than 20 Indigenous groups says dingoes are 'deeply sacred' and a 'cultural icon representing a vital connection to Country'.[47] Killing dingoes is 'killing family'. The declaration calls for lethal dingo control to cease – 'We do not, and have never, approved the killing of dingoes. ... We demand an immediate stop... – and for Traditional Custodians to be involved in decision-making for all legislation and management actions impacting dingoes.'

One option to recognise the cultural value of dingoes is to designate them as a 'culturally significant species'. This is a proposed new protection category under national environmental law advocated by the Indigenous Reference Group of the National Environmental Science Program's Threatened Species Recovery Hub for species of 'exceptional spiritual or cultural significance to Indigenous Australians' – such as totems, sources of bush food, tucker, meat or medicines and indicators of the health of Country.[49]

5. The aim for managing the impacts of dingoes on livestock should be coexistence.

For graziers, dingo attacks on sheep and sometimes young cattle can cause financial loss (an estimated $89 million in 2013–14[50]) and emotional distress, due to the welfare impacts on livestock.[51] The response of governments in many areas has been to support graziers to exclude, suppress or eliminate dingo populations, by exclusion fencing and lethal control, including in national parks.[52] This has been detrimental for nature conservation, distressing for First Australians for whom dingoes have cultural significance, costly to taxpayers, and the cause of considerable social conflict. Furthermore, lethal dingo control often does not achieve its purpose.[53] It can lead to perverse outcomes, with exacerbated attacks on livestock by destabilised dingo packs[54] and more-abundant kangaroos competing for pastures.

[42] Martin and Carver (2020)
[43] Stokeld et al. (2018)
[44] Stobo-Wilson et al. (2020)
[45] Ward et al. (2021)
[46] Van Eeden et al. (2019)
[47] National First Nations' Dingo Declaration (2023)
[49] Gore-Birch (2020); Goolmeer et al. (2022)
[50] McLeod (2016). The estimated cost of production losses ranged from $64 million to $110 million.
[51] Allen and Hampton (2020); van Bommel and Johnson (2017); Ecker et al. (2015)
[52] Queensland Audit Office (2023); Dickman et al. (2021); Brink et al. (2019).
[53] Allen (2015); Campbell et al. (2019)
[54] For example, a study on 2 large Queensland properties by Allen (2013) found more calf losses where dingoes/dogs were controlled than on control sites where they were not. Below-average rainfall was significantly associated with calf loss but only where dingoes/dogs were controlled.

It can be particularly counter-productive for cattle enterprises – graziers' experiences and economic modelling indicate that dingoes increase net profits by the improved cattle growth, survival and fertility rates resulting from fewer macropods.[55] For that reason, many cattle graziers tolerate or value dingoes. See Appendix D for summaries of relevant research.

In contrast to many millions of dollars of public funding each year for dingo culling and exclusion,[56] governments have invested little in investigating options to enable coexistence of dingoes and sheep grazing enterprises.[57] In some countries, guardian animals have been used for centuries to protect sheep and goats from predators such as wolves, coyotes and jackals.[58] Farmers using guardian dogs in Australia have reported high effectiveness,[59] but there are no government programs to support their use. The establishment of guardian animal training centres could help overcome impediments.

For the benefit of all parties, Australia's governments should concertedly and collaboratively seek coexistence solutions that respect the ecological and cultural values of dingoes and sustain sheep grazing.[60] Coexistence is unlikely to be feasible in all circumstances, but any measures supported by public funding should be subject to transparent analysis of their social, cultural, economic and ecological costs and benefits. The adverse ecological impacts of cluster fencing (not a form of coexistence) are likely to be significant (by restricting wildlife movement) but have not been evaluated.[61]

As an apex predator, dingoes are ecologically valuable for their ability to reduce populations of invasive species such as feral goats, which rarely survive where there are dingoes. But also as a predator, dingoes can threaten populations of rare species, such as the endangered bridled nailtail wallaby. Photos (from left): Ken Griffiths and Ozflash.

[55] Campbell et al. (2022); Prowse et al. (2015)

[56] There is little transparency on government funding of dingo culling and exclusion for the benefit of livestock enterprises. Brink et al. (2019) estimated that landowners and governments collectively spent >$30million a year. A recent audit found that three-quarters of Queensland Government funding from 2016 to 2021 for invasive species management under its Feral Pest Initiative went to sheep farmers to manage dingoes, most of it to subsidise cluster fencing (Queensland Audit Office 2023).

[57] Smith et al. (2021)

[58] Allen et al. (2016)

[59] van Bommel and Johnson (2023); van Bommel and Johnson (2012)

[60] Governments overseas have sought to ease conflict when predators are reintroduced by providing compensation to farmers for livestock losses. But this has apparently not been successful in easing conflict or stopping poaching, indicating that opposition to livestock predators is not just due to economic losses (Boitani et al. 2010; Firlein 2018; Muhly and Musiani 2009).

[61] Smith et al. (2021)

Box 1. What is a dingo?

The status of the dingo – whether it is a species and whether it is native – is contested. Our policy positions do not depend on how the dingo is classified. We believe the dingo warrants stronger protection for the ecological and cultural reasons set out in statements 1 and 4.

Nonetheless, its status matters. The Invasive Species Council is often asked to address this, because classifications shape how people understand nature and perceive particular wildlife. For an organisation with our mission, whether an organism colonises a new region by natural means or due to humans is a fundamental distinction. It is not a mere technicality – for human-mediated introductions are among the most consequential human acts and often detrimental.

Is the dingo a species?

Dingoes have evolved in Australia since their first arrival, and are genetically, ecologically and behaviourally distinct from other dogs. Although dingoes are recognised as an 'evolutionarily significant unit'[62] – and can legitimately be distinguished and legally protected as such – we defer to the advice of the Australasian Mammal Taxonomic Consortium that this distinctiveness does not justify classification as a separate species: [63]

> Taxonomists overwhelmingly agree that the dingo is an ancient type of domestic dog that has the scientific name *Canis familiaris*. ...
>
> Modern techniques allow all dog breeds / populations to be genetically distinguishable; however, that does not mean that they are different enough to be recognised and named as separate species. ... Dingoes are genetically distinguishable from Australian dogs of European origin. However, genetic or morphological distinction does not necessarily mean that a group is different at the species level. ... The difference between Australian dogs of European origin and dingoes is at the population level, consistent with the accepted time that the dingo arrived in Australia, 3000–3500 years ago (dates on dingo bones[64]). Speciation in vertebrates typically takes more than a million years, and rarely tens of thousands to hundreds of thousands of years.

We agree with the taxonomy consortium that the taxonomic status of the dingo does not diminish its ecological and cultural importance:

> Naming the dingo as a separate species should not be necessary to protect it and recognise its value to Australians, and to species and ecosystem conservation.

[62] https://www.canids.org/dingo-working-group. An 'evolutionarily significant unit' can be defined as a lineage following its own evolutionary trajectory, 'demonstrating highly restricted gene flow from other such lineages' (Geue et al. 2025).
[63] Australasian Mammal Taxonomy Consortium (2024). The consortium is affiliated with the Australian Mammal Society and its role is to generate, oversee and update approved mammal species lists.
[64] [Added to the AMTC text]: The oldest archaeological evidence for the presence of dingoes is 3,100–3,300- year-old bones in southern Australia (Balme et al. 2018).

Is the dingo native to Australia?

Whether the dingo is considered native depends on how 'native' is defined. Under most Australian environmental laws, dingoes have native status, some without defining 'native' and others based on arrival before a time threshold (1770 for the Northern Territory and 1400 for the Commonwealth).

But according to the definitions used by the Biodiversity Convention and the International Union for Conservation of Nature, dingoes are not native, because they were introduced by humans. The Biodiversity Convention defines an alien (non-native) species as one 'introduced to areas outside their natural range by human activities'.[65]

The Invasive Species Council accepts this definition and considers it important to maintain the distinction between:

(a) species that evolved or arrived in Australia by natural processes
(b) those introduced by humans, whether deliberately or accidentally.

The distinction matters – not because every human-mediated introduction is consequential, but because many are, with consequences often arising from the lack of a shared evolutionary history with native species or benefits gained by separation from species in the native range. Native species in their new range may lack defences against a novel predator, pathogen or competitor, or the introduced species may escape 'natural enemies' from its native range.

The dingo has been one of the most consequential introductions to Australia, and to call it native obscures something important. Even when an introduced species is ecologically benign, or eventually becomes that way as native species adapt, the distinction remains meaningful. It reflects a species' evolutionary and biogeographical history – a perspective many people consider fundamental to understanding nature.

The distinction also highlights a stark conservation reality: human-facilitated colonisations are now much more frequent than natural ones and have caused great ecological damage.[66] In Australia, this has been the leading cause of native animal extinctions.[67]

Recognising an ancient introduction

The dingo is the earliest known human introduction to Australia, and while it is likely to have contributed to at least 3 mainland extinctions,[68] other heavily impacted species would have adapted and become less vulnerable over time to population decline from dingo predation and competition.

[65] CBD Secretariat (2024)
[66] Human-mediated colonisations are often 'qualitatively and quantitatively different from natural colonisation' Wilson et al. 2016) – and are now orders of magnitude more frequent.
[67] Woinarski et al. (2019), Low and Booth (2024)
[68] Dickman et al. (2021); White et al. (2018); Letnic et al. (2014); Baird (1991).

Some biologists argue that the evolution of the dingo in Australia and its integration into Australian ecosystems should qualify the dingo as native.[69] But accepting that reasoning would imply that cats, cane toads, rabbits and most other introduced species are on a path towards nativeness. Evolution and adaptation commonly occur in both introduced and interacting native species. Cane toads leading their northern expansion have rapidly evolved longer legs, and some native species have learned to eat them without being poisoned.[70] Under this approach, some introduced plants used as food or shelter by native animals would probably already qualify as native if they were benign and had evolved (e.g. herbicide resistance or hybridisation between cultivars).

The Invasive Species Council considers it more valid and meaningful to instead distinguish the dingo as an ancient introduction – as 'archaeofauna'. Europe has taken this approach for plants introduced prior to 1500, with 'archaeophytes' deemed worthy of protection. England, for example, includes them with native plants in the Vascular Plant Red List for England.[71]

Ecological harm as the basis for intervention

The Invasive Species Council is often asked whether the dingo qualifies as 'invasive'. Under the Biodiversity Convention, an 'invasive alien' taxon is defined as one 'whose introduction and/or spread threatens biological diversity.'[72] But the term 'invasive' should not be interpreted to mean that a species is always or everywhere harmful. Invasiveness is a population-level and context-dependent phenomenon[73] – a species may be invasive in some areas or under certain conditions, but not in others.

Dingoes were likely highly invasive when introduced to Australia, but today are generally considered benign or beneficial (and therefore not invasive in most circumstances). Nonetheless, they are a threat or potential threat to a few threatened species or populations (Appendix C), and proposals for reintroduction should be evaluated on a site-by-site basis.[74]

Acknowledging the dingo's potential to cause harm in some circumstances – consistent with it being a large predator in a continent with many threatened species – does not contradict support for its conservation. After all, many native species can also be harmful, especially in ecosystems heavily disrupted since European colonisation. In such cases, targeted management – not demonisation or species-wide control – is the appropriate response.

[69] Banks (2021)
[70] Rollins et al. (2016); Shine and Baeckens (2023)
[71] Stroh et al. (2014)
[72] CBD Secretariat (2024)
[73] Haubrock et al. (2024)
[74] Fancourt et al. (2019)

Box 2. Priority research topics

The following are some priority research topics, mostly identified by others,[75] regarding the ecological effects of dingoes and the potential to mitigate dingo impacts on livestock grazing enterprises and reduce social conflict about dingoes.

Invasive ungulate control: While there is good evidence that dingoes regulate (and mostly eliminate) goat populations, research is needed to understand population-level interactions between dingoes and other ungulates. One high priority is to investigate whether dingoes kill healthy adult fallow deer, chital deer, rusa deer, red deer or sambar deer, and whether this can reduce deer populations to low densities.

Mesopredator control: A high priority is to resolve outstanding and controversial questions about the potential for dingoes to control mesopredators (particularly cats) – where and under what circumstances, and whether this moderates their impacts on prey species. It will require a collaboratively developed research agenda and agreement on best-practice research methods. One widely supported research proposal is to shift the dingo fence bordering Sturt National Park (NSW) or fence the park to test the effects of dingo reintroduction (rather than the effects of dingo control) over an ecologically relevant timeframe and spatial scale using a 'before-after-control-impact' design.

Livestock grazing (cattle): In recognition that dingo impacts on cattle enterprises are different from those on sheep enterprises, it is important to gain a comprehensive industry-specific understanding of the costs and benefits (economic, social, ecological) of different management regimes for dingoes, and the impediments, whether practical, economic or social, to coexistence with dingoes.

Livestock grazing (sheep): Essential for resolving conflicts about dingoes is thorough investigation, in collaboration with graziers, of the effectiveness of options for minimising dingo impacts on sheep enterprises that enable coexistence. A clear accounting of all costs and benefits – economic, social, cultural, ecological – is needed to inform government policy and landholder decision-making. Given the potential benefits of guardian animals, there should be a strong focus on resolving impediments to their deployment (e.g. training). Also needed is an investigation of the ecological consequences of cluster fencing.

Community attitudes and conflict: The often-intense conflicts about the status of dingoes in Australia is emblematic of many social conflicts perpetuated by narrow, sector/industry-specific public policy. We need a much better understanding, informed by social science research, of the many dimensions of the conflict about dingoes and the measures that may be effective to reduce conflict and enable a more collaborative, solutions-focused approach.

[75] The proposed topics are based in part on the following sources. Invasive ungulate control: Forsyth et al. (2018). Mesopredator control: Dickman et al. (2021); Newsome et al. (2015). Livestock grazing: Department of Climate Change, Energy, the Environment and Water (2023); Smith et al. (2021).

References

Allen LR. (2013) Wild dog control impacts on calf wastage in extensive beef cattle enterprises. Animal Production Science 54(2): 214–20

Allen LR (2015) Demographic and functional responses of wild dogs to poison baiting. Ecological Management & Restoration 16: 58–66

Allen BL, Allen LR, Graham M, Buckman M (2021) Elucidating dingo's ecological roles: contributions from the Pelorus Island feral goat biocontrol project. Australian Zoologist 41:374–387

Allen BL, Fleming PJ, Allen LR, et al. (2013) As clear as mud: a critical review of evidence for the ecological roles of Australian dingoes. Biological Conservation 159:158–174

Allen BL, Hampton JO (2020) Minimizing animal welfare harms associated with predation management in agro-ecosystems. Biological Reviews 95: 1097–1108

Alvares F, Bogdanowicz W, Campbell LA, et al. (2019) Old World Canis spp. with taxonomic ambiguity. In: Workshop conclusions and recommendations, Vairão, Portugal, 28th - 30th May 2019

Augusteyn J, Rich M, Story G, Nolan B (2020) Canids potentially threaten bilbies at Astrebla Downs National Park. Australian Mammalogy 43:300–310

Australasian Mammal Taxonomy Consortium (2024) AMTC position statement on the taxonomy of the dingo. Australian Mammal Society. Available: https://www.publish.csiro.au/zo/acc/ZO24008/ZO24008_AC.pdf

Baird RF (1991) The dingo as a possible factor in the disappearance of Gallinula mortierii from the Australian mainland. Emu 91: 121–122

Balme J, O'Connor S, Fallon S (2018) New dates on dingo bones from Madura Cave provide oldest firm evidence for arrival of the species in Australia. Scientific Reports 8:1–6

Banks PB (2021) An eco-evolutionary rationale to distinguish alien and native status: why the dingo is a native species on mainland Australia. Australian Zoologist 41:358–366

Boitani L, Ciucci P, Raganella-Pelliccioni E (2010) Ex-post compensation payments for wolf predation on livestock in Italy: a tool for conservation? Wildlife Research 37: 722–730

Breckwoldt R (1988) A Very Elegant Animal: The Dingo. Angus and Robertson

Brink H, Purcell BV, Letnic M, et al (2019) Pets and pests: a review of the contrasting economics and fortunes of dingoes and domestic dogs in Australia, and a proposed new funding scheme for non-lethal dingo management. Wildlife Research 46: 365–377.

Brüniche–Olsen A, Jones ME, Burridge CP, et al. (2018) Ancient DNA tracks the mainland extinction and island survival of the Tasmanian devil. Journal of Biogeography 45:963–976

Cahir F, Clark I (2013) The historic importance of the dingo in Aboriginal society in Victoria (Australia): A reconsideration of the archival record. Anthrozoös. 26: 185–198

Cairns KM, Crowther MS, Parker HG, Ostrander EA, Letnic M (2023) Genome-wide variant analyses reveal new patterns of admixture and population structure in Australian dingoes. Molecular Ecology 32: 4133–4150

Cairns KM, Crowther MS, Nesbitt B, Letnic M (2021) The myth of wild dogs in Australia: are there any out there? Australian Mammalogy 44: 67–75

Campbell G, Emmott A, Pollock D, Traill B (2022) Can dingoes increase graziers' profits and help maintain Australia's rangelands? The Rangeland Journal 44: 129–135

Castle G, Kennedy MS, Allen BL (2023) Stuck in the mud: Persistent failure of 'the science' to provide reliable information on the ecological roles of Australian dingoes. Biological Conservation 285: 110234

CBD Secretariat (2024) What are Invasive Alien Species? In: Convention on Biological Diversity [Internet]. Secretariat of the Convention on Biological Diversity. Available: https://www.cbd.int/invasive/WhatareIAS

Costello O, Webster N, Morgan D (2021) A statement on the cultural importance of the dingo. Australian Zoologist 41: 296–297

Crowther MS, Cairns KM, Van Eeden LM, Letnic M (2021) Introgression does not influence the positive ecological and functional role of dingo populations. Australian Zoologist 41:338–346

Department of Climate Change, Energy, the Environment and Water (2023) Threat abatement plan for predation by feral cats. Australian Government

Dickman CR, Glen AS, Letnic M (2009) Reintroducing the dingo: can Australia's conservation wastelands be restored?" In Reintroduction of Top-order Predators, 238–69. Blackwell Publishing

Dickman C, Newsome T, van Eeden L (2021) The dingo dilemma: a brief history of debate. Australian Zoologist 41:298–321

Downward R, Bromell J (1990) The development of a policy for the management of dingo populations in South Australia. Proceedings of the Fourteenth Vertebrate Pest Conference

Ecker S, Aslin H, Zobel-Zubrzycka H, Binks B (2015) Participatory wild dog management: Views and practices of Australian wild dog management groups. Australian Bureau of Agricultural and Resource Economics and Sciences

Fancourt BA, Cremasco P, Wilson C, Gentle MN (2019) Do introduced apex predators suppress introduced mesopredators? A multiscale spatiotemporal study of dingoes and feral cats in Australia suggests not. Journal of Applied Ecology 56:2584–2595

Fillios MA, Taçon PS (2016) Who let the dogs in? A review of the recent genetic evidence for the introduction of the dingo to Australia and implications for the movement of people. Journal of Archaeological Science: Reports 7:782–792

Firlein H (2018) Continental divides: How wolf conservation in the United States and Europe impacts rural attitudes. Ecology Law Quarterly 45: 327–352

Fleming P, Corbett L, Harden R, Thomson P (2001) Managing the Impacts of Dingoes and Other Wild Dogs. Bureau of Rural Sciences

Fleming PA, Stobo-Wilson AM, Crawford HM, Dawson SJ, Dickman CR, Doherty TS, et al. (2022) Distinctive diets of eutherian predators in Australia. Royal Society Open Science 9: 220792

Forsyth DM, Latham ADM, Davis NE, et al. (2018) Interactions between dingoes and introduced wild ungulates: concepts, evidence and knowledge gaps. Australian Mammalogy 41:12–26

Geue JC, Bertola L, Paulette B, Brüniche-Olsen A, da Silva J, DeWoody JA, et al. (2025) Practical genetic diversity protection: an accessible framework for IUCN subpopulation and Evolutionarily Significant Unit identification. Preprint. Available: https://ecoevorxiv.org/repository/view/9129/

Goolmeer T, Skroblin A, Grant C, van Leeuwen S, et al. (2022) Recognizing culturally significant species and Indigenous-led management is key to meeting international biodiversity obligations. Conservation Letters 15: e12899

Gore-Birch C (2020) Submission to the 2020 independent review of the Environment Protection and Biodiversity Conservation Act 1999. Indigenous Working Group Threatened Species Recovery Hub, Threatened Species Recovery Hub, National Environmental Science Program

Greenville AC, Wardle GM, Tamayo B, Dickman CR (2014) Bottom-up and top-down processes interact to modify intraguild interactions in resource-pulse environments. Oecologia 175: 1349–1358.

Haubrock PJ, Soto I, Ahmed DA, Ansari AR, Tarkan AS, Kurtul I, et al. (2024) Biological invasions are a population-level rather than a species-level phenomenon. Global Change Biology 30: e17312

Hunter DO, Lagisz M, Leo V, et al. (2018) Not all predators are equal: a continent-scale analysis of the effects of predator control on Australian mammals. Mammal Review 48:108–122

Invasive Species Specialist Group (2001) IUCN Guidelines for the Prevention of Biodiversity Loss Caused by Alien Invasive Species. Approved by the 51st Meeting of the IUCN Council, Gland Switzerland, February 2000. IUCN

Jackson SM, Fleming PJ, Eldridge MD, et al. (2019) The Dogma of Dingoes—Taxonomic status of the dingo: A reply to Smith et al. Zootaxa 4564:198–212

Jackson SM, Groves CP, Fleming PJ, et al. (2017) The wayward dog: is the Australian native dog or dingo a distinct species? Zootaxa 4317:201–224

Johnson CN, VanDerWal J (2009) Evidence that dingoes limit abundance of a mesopredator in eastern Australian forests. Journal of Applied Ecology 46:641–646

Johnson CN, Crowther MS, Dickman CR, et al. (2014) Experiments in no-impact control of dingoes: comment on Allen et al. 2013. Frontiers in Zoology 11: 1–3

Kearney SG, Carwardine J, Reside AE, et al. (2018) The threats to Australia's imperilled species and implications for a national conservation response. Pacific Conservation Biology 25: 231–244

Kennedy M, Phillips BL, Legge S, et al. (2012) Do dingoes suppress the activity of feral cats in northern Australia? Austral Ecology 37:134–139

Krofel M, Hatlauf J, Bogdanowicz W, et al (2022) Towards resolving taxonomic uncertainties in wolf, dog and jackal lineages of Africa, Eurasia and Australasia. Journal of Zoology 316: 155–168

Letnic M, Koch F, Gordon C, et al. (2009) Keystone effects of an alien top-predator stem extinctions of native mammals. Proceedings of the Royal Society B: Biological Sciences 276(1671):3249–3256

Letnic M, Fillios M, Crowther MS (2014) The arrival and impacts of the dingo. Carnivores of Australia: past, present and future 53–67

Letnic M, Ritchie EG, Dickman CR (2012) Top predators as biodiversity regulators: the dingo Canis lupus dingo as a case study. Biological Reviews 87:390–413

Low T, Booth C (2024) GONE: Australian animals extinct since 1960. Invasive Species Council. Available: https://invasives.org.au/wp-content/uploads/2024/11/Gone-Report-Updated-2024.pdf

Martin AM, Carver S (2020) Ecology and conservation of the critically endangered northern hairy-nosed wombat (Lasiorhinus krefftii): past, present and future. Australian Mammalogy 43: 10–21

McLeod R (2016) Cost of Pest Animals in NSW and Australia, 2013-14. eSYS Development Pty Ltd. Report prepared for the NSW Natural Resources Commission

Morris T, Letnic M (2017) Removal of an apex predator initiates a trophic cascade that extends from herbivores to vegetation and the soil nutrient pool. Proceedings of the Royal Society B: Biological Sciences 284:20170111

Morris SD, Kearney MR, Johnson CN, Brook BW (2022) Too hot for the devil? Did climate change cause the mid-Holocene extinction of the Tasmanian devil Sarcophilus harrisii from mainland Australia? Ecography, 2022(2).

Moseby K, Crowther M, Letnic M (2019) Ecological role of an apex predator revealed by a reintroduction experiment and Bayesian statistics. Ecosystems 22:283–295

Moseby KE, Neilly H, Read JL, Crisp HA (2012) Interactions between a top order predator and exotic mesopredators in the Australian rangelands. International Journal of Ecology 2012:250352

Muhly TB, Musiani M (2009) Livestock depredation by wolves and the ranching economy in the Northwestern US. Ecological Economics 68: 2439–2450

National First Nations' Dingo Declaration (2023) First Nations Dingo Forum, Cairns. Available: https://hsi.org.au/wp-content/uploads/2023/10/dingo-declaration-FINAL-A3.pdf

Newsome T (2021) Looking to the future: what next for the dingo? Australian Zoologist 41: 643–653

Newsome TM, Ballard G, Crowther MS, Dellinger JA, et al. (2015) Resolving the value of the dingo in ecological restoration. Restoration Ecology 23: 201–208

Nyakatura K, Bininda-Emonds OR (2012) Updating the evolutionary history of Carnivora (Mammalia): a new species-level supertree complete with divergence time estimates. BMC Biology 10:1–31

Philip J (2021) A historical review of Australian aerial vertebrate pest control, targeting dingoes and wild dogs 1946–2019. Australian Zoologist 41: 580–592

Prowse TA, Johnson CN, Cassey P, Bradshaw CJ, Brook BW. (2015) Ecological and economic benefits to cattle rangelands of restoring an apex predator. Journal of Applied Ecology 52: 455–466

Queensland Audit Office (2023) Managing invasive species (Report 1: 2023–24). Queensland Government

Rees JD, Kingsford RT, Letnic M (2017) In the absence of an apex predator, irruptive herbivores suppress grass seed production: implications for small granivores. Biological Conservation 213: 13–18

Ritchie EG, Elmhagen B, Glen AS, et al. (2012) Ecosystem restoration with teeth: what role for predators? Trends in Ecology & Evolution 27:265–271

Ritchie EG, Johnson CN (2009) Predator interactions, mesopredator release and biodiversity conservation. Ecology Letters 12:982–998

Rollins LA, Richardson MF, Shine R (2016) A genetic perspective on rapid evolution in cane toads (Rhinella marina). In: Invasion Genetics. Wiley, pp. 313–327

Rose DB (2011) Wild Dog Dreaming: Love and Extinction. University of Virginia Press

Shine R, Baeckens S (2023). Rapidly evolved traits enable new conservation tools: perspectives from the cane toad invasion of Australia. Evolution 77: 1744–55

Smith BP, Appleby RG (2018) Promoting human–dingo co-existence in Australia: moving towards more innovative methods of protecting livestock rather than killing dingoes (Canis dingo). Wildlife Research 45: 1–15

Smith BP, Cairns KM, Adams JW, et al. (2019) Taxonomic status of the Australian dingo: the case for Canis dingo Meyer, 1793. Zootaxa 4564:173–197

Smith BP, Litchfield CA (2009) A review of the relationship between indigenous Australians, dingoes (Canis dingo) and domestic dogs (Canis familiaris). Anthrozoös 22: 111–128

Southgate R, Paltridge R, Masters P, Carthew S (2007) Bilby distribution and fire: a test of alternative models of habitat suitability in the Tanami Desert, Australia. Ecography 30: 759–776

Steindler L, Letnic M (2021) Not so naïve: endangered mammal responds to olfactory cues of an introduced predator after less than 150 years of coexistence. Behavioral Ecology and Sociobiology 75:1–10

Stobo-Wilson AM, Stokeld D, Einoder LD, et al. (2020) Habitat structural complexity explains patterns of feral cat and dingo occurrence in monsoonal Australia. Diversity and Distributions 26:832–842

Stokeld D, Fisher A, Gentles T, et al. (2018) What do predator diets tell us about mammal declines in Kakadu National Park? Wildlife Research 45:92–101

Stroh P, Leach S, August T, et al. (2014) A Vascular Plant Red List for England. Botanical Society of Britain and Ireland

Surbakti S, Parker HG, McIntyre JK, et al. (2020) New Guinea highland wild dogs are the original New Guinea singing dogs. Proceedings of the National Academy of Sciences 117(39): 24369–76

Tatler J, Prowse TA, Roshier DA, Cairns KM, Cassey P (2021) Phenotypic variation and promiscuity in a wild population of pure dingoes (Canis dingo). Journal of Zoological Systematics and Evolutionary Research 59: 311–322

Thompson ER, Driscoll DA, Venn SE, et al. (2022) Interspecific variation in the diet of a native apex predator and invasive mesopredator in an alpine ecosystem. Austral Ecology 47(6): 1260–70

van Bommel L, Johnson CN (2012) Good dog! Using livestock guardian dogs to protect livestock from predators in Australia's extensive grazing systems. Wildlife Research 39: 220–229

van Bommel L, Johnson CN (2017) Predation control. Advances in Sheep Welfare. Elsevier; pp. 177–196

van Bommel L, Johnson CN (2023) Still a good dog! Long-term use and effectiveness of livestock guardian dogs to protect livestock from predators in Australia's extensive grazing systems. Wildlife Research 51: WR23008

van Eeden LM, Dickman CR, Newsome TM, Crowther MS (2019) What should we do with wild dogs? Taxonomic tangles and the management of dingo-dog hybridisation. Australian Zoologist 40: 92–101

Vonholdt BM, Pollinger JP, Lohmueller KE, et al. (2010) Genome-wide SNP and haplotype analyses reveal a rich history underlying dog domestication. Nature 464:898–902

Ward M, Carwardine J, Yong CJ, et al. (2021) A national-scale dataset for threats impacting Australia's imperiled flora and fauna. Ecology and Evolution 11:11749–11761

White LC, Saltré F, Bradshaw CJ, Austin JJ (2018) High-quality fossil dates support a synchronous, Late Holocene extinction of devils and thylacines in mainland Australia. Biology Letters 14:20170642

Wilson JR, García-Díaz P, Cassey P, Richardson DM, Pyšek P, Blackburn TM (2016). Biological invasions and natural colonisations are different–the need for invasion science. NeoBiota 31: 87–98

Woinarski J, Burbidge A, Harrison P (2014) The Action Plan for Australian Mammals 2012. CSIRO Publishing

Woinarski J, Braby M, Burbidge A, Coates D, Garnett S, Fensham R, et al. (2019) Reading the black book: The number, timing, distribution and causes of listed extinctions in Australia. Biological Conservation 239: 108261.

Zhang M, Sun G, Ren L, et al (2020a) Ancient DNA evidence from China reveals the expansion of Pacific dogs. Molecular Biology and Evolution 37: 1462–1469

Zhang S, Wang G-D, Ma P, et al. (2020b) Genomic regions under selection in the feralization of the dingoes. Nature Communications 11:1–10

Appendix A. Summary of some research on dingo predation of large herbivores and trophic cascades

Following are brief summaries of 9 papers relevant to trophic cascades, mainly focused on dingo predation of kangaroos and invasive ungulates.

Thompson et al. (2022).[76] Sambar deer make up a large proportion of the dingo diet in Victoria's alpine region: The diet of dingoes and foxes was compared in alpine and subalpine habitats across 3 different mountains by scat analysis. Dingoes mainly ate larger mammal species, including sambar deer (44%), wombats (34%), rabbit (17%) and possums (15%) while foxes typically ate smaller mammals, including native rats (58%), possums (23%), rabbit (15%) and antechinuses (12%). Whether sambar are mainly scavenged or killed by dingoes is unknown. While there are only records of dingoes killing sambar calves, it is likely they have the ability to kill adults by hunting in packs. Also unknown is whether reduced deer numbers could lead to unintended, negative impacts to native species when dingoes switch to other prey.

Allen et al. (2021).[77] Dingoes are highly efficient predators of feral goats: Two dingoes were released on Pelorus Island (near Palm Island, north Queensland). In less than a year, they had eliminated the feral goat population except for a few males (about 250 animals in all), which led to a marked increase in vegetation. This demonstrated that dingoes can be a powerful biocontrol tool against feral goats and cause trophic cascades by removing goats.

Mills et al. (2021).[78] Alternate states in shrub, mammal and bird assemblages exist either side of the dingo barrier fence (Strzelecki Desert): Drone imagery, ground-based shrub and tree counts, and camera trap footage were used to test a hypothesis that alternate states in plant, bird and mammal assemblages exist on either side of the dingo barrier fence. Shrubs and trees were twice as dense where dingoes were rare, and 28% of shrub and tree species, 78% of mammal species, and 14% of bird species recorded were significantly more likely to occur on one side of the fence than the other. Where dingoes were rare, large mammals, emus and red foxes were more likely to occur. Where dingoes were common, small mammals, medium-sized mammals and a ground-nesting bird were more likely to occur. There were no differences in populations of cats and scavenging bird species.

Forsyth et al. (2018).[79] 11 of 15 wild ungulate species in Australia have been recorded in the diet of dingoes, but little is known about whether dingoes can regulate their populations. This was a literature review to identify potential ecological interactions between dingoes and wild ungulates and synthesise evidence for interactions between dingoes and each species. 15 ungulate species have established wild populations in Australia. Of the 11 recorded in the diet of dingoes, the highest frequency has been reported for feral goats (73%).

[76] Thompson ER, Driscoll DA, Venn SE, et al. (2022) Interspecific variation in the diet of a native apex predator and invasive mesopredator in an alpine ecosystem. Austral Ecology 47(6): 1260–70.

[77] Allen BL, Allen LR, Graham M, Buckman M (2021) Elucidating dingo's ecological roles: contributions from the Pelorus Island feral goat biocontrol project. Australian Zoologist 41:374–387

[78] Mills CH, Wijas C, Gordon CE, et al. (2021) Two alternate states: shrub, bird and mammal assemblages differ on either side of the dingo barrier fence. Australian Zoologist 41(3): 534–49

[79] Forsyth DM, Latham ADM, Davis NE, et al. (2018) Interactions between dingoes and introduced wild ungulates: concepts, evidence and knowledge gaps. Australian Mammalogy 41:12–26

It is usually not possible to determine whether prey was scavenged or killed, or domestic or wild. Although cattle formed up to 60% of the dingo diet in one study, most was from scavenging carcasses rather than from predation. There is little known about how dingoes interact with wild ungulates, and how dingo group size affects these interactions. The vulnerability of particular species to dingo predation, which depends largely on their size, was summarised as follows:

- the young of all species: vulnerable, although maternal defences could mean that some species are seldom killed.
- adult goats, sheep and female pigs: vulnerable
- adult hog deer, female fallow deer, chital deer and red deer: probably vulnerable.
- healthy adult feral cattle, banteng, swamp buffalo, horses and camels: probably not vulnerable
- adult male fallow deer, male rusa deer or male red deer, or adult sambar deer: unknown vulnerability.

Feral goats have commonly been recorded in the diet of dingoes. There is little overlap between dingo and feral goat populations in semiarid and arid Australia and several case studies indicate that dingoes can regulate their populations – feral goats declined in the Kimberley in the 1970s following the removal of sheep and the cessation of dingo control; goats increased in the Flinders Ranges after dingoes were controlled to low densities in the 1940s; and at 7 central Australian sites feral goat track density was significantly negatively correlated with indices of dingo activity.

Although feral pigs were the most common item in the diet of dingoes in tropical Queensland (29%), dingo predation apparently has little limiting effect on their populations because pigs have a very high maximum annual population growth rate (they produce large litters at a young age). In wet areas pigs can avoid dingo predation by spending the day in wetlands. In arid areas, they may be more vulnerable. Some of the highest recorded densities of feral pigs have been in the absence of dingoes, so 'the possibility that dingoes limit pig populations cannot be discounted'. The reviewers predict that dingoes could limit the distribution and abundance of hog deer, fallow deer, chital deer, rusa deer and red deer.

Hunter et al. (2018).[80] Red kangaroos increase in abundance when dingoes are removed: A meta-analysis of the effects of lethal control of dingoes on other mammal species found that dingo removal is linked to a 'dramatic increase' in red kangaroo abundance – 'an unintended and perverse outcome of dingo control programmes, because these animals compete with livestock for pasture'.

Lyons et al. (2018).[81] Trophic cascades due to dingo removal may lead to changes in dune morphology (Strzelecki Desert): Removal of dingoes south of the dingo fence is associated with a higher density of shrubs likely due to reduced abundance of small mammals that eat shrub seeds and seedlings. Modelling of dunes in Sturt National Park found that dunes with more shrubs were higher, less rectangular and more varied in their height profile than dunes with fewer shrubs.

[80] Hunter DO, Lagisz M, Leo V, et al. (2018) Not all predators are equal: a continent-scale analysis of the effects of predator control on Australian mammals. Mammal Review 48:108–122

[81] Lyons MB, Mills CH, Gordon CE, Letnic M. (2018) Linking trophic cascades to changes in desert dune geomorphology using high-resolution drone data. Journal of the Royal Society Interface 15(144): 20180327.

This is probably due to the increased shrub cover altering local wind flow patterns and sediment binding potential. It may drive dunes inside the dingo fence towards a new, alternate stable state.

Rees et al. (2017).[82] Dingo absence is associated with more abundant kangaroos, and lower pasture biomass and grass seed head densities (central Australia): Kangaroos (4 species) were regularly surveyed over 4 years in matched habitats on each side of the dingo fence in the Strzelecki Desert. The abundance, reproductive output (seedheads) and total biomass of grasses and a grass-like rush were surveyed at 45 sites with dingoes and 27 sites where dingoes were functionally extinct. Exclosures and control plots were established to investigate grazing effects on ground-layer vegetation. Where dingoes were absent, kangaroos were 100 times more abundant, pasture biomass was 88–98% lower and the densities of grass seed heads were 85–97% lower. Regeneration of vegetation within the kangaroo exclosures demonstrated that kangaroo grazing was responsible for these differences. Reduction of grass seeds by kangaroo grazing likely explains the relative rarity of small granivorous birds and mammals in areas where dingoes are functionally extinct.

Morris and Letnic (2017).[83] Kangaroos were more abundant where dingoes were rare and had cascading impacts on vegetation and soil nutrients: Nocturnal spotlight transects were used to compare the abundance of dingoes and kangaroos at sites on each side of the dingo fence (in 2 conservation reserves and nearby pastoral properties). Kangaroos were more abundant where dingoes were rare. Where dingoes were rare, the effects on vegetation of experimentally excluding kangaroos were marked, which also strongly affected total carbon, total nitrogen and available phosphorus in the soil. Where dingoes were common, the effects on vegetation and soil nutrients were negligible. There is evidence 'that a trophic cascade resulting from an apex predator's top-down effects on herbivores can extend to vegetation and in turn the soil nutrient pool.' If the positive effects of dingoes on the soil nutrient pool 'translate to enhanced primary productivity, it would blur the distinction between top-down and bottom-up control of ecosystems and could be a driver of ecosystem productivity and the composition of ecological assemblages at a continental scale.'

Letnic et al. (2012).[84] Where dingoes are suppressed, kangaroos are far more abundant (summary of several studies): Studies from 1980 to 2009 comparing dingo and kangaroo populations on either side of the dingo fence across the arid zone[85] consistently showed that where dingoes were rare, kangaroos were abundant (a 1980 study reported 166 times greater abundance). The disparity occurred regardless of whether land was used for sheep or cattle grazing or conservation and even where kangaroos were commercially harvested (in the areas where dingoes are rare). There is also evidence that where dingoes were common there were few feral goats or pigs, indicating that dingoes may regulate their populations.

[82] Rees JD, Kingsford RT, Letnic M (2017) In the absence of an apex predator, irruptive herbivores suppress grass seed production: implications for small granivores. Biological Conservation 213: 13–18

[83] Morris T, Letnic M (2017) Removal of an apex predator initiates a trophic cascade that extends from herbivores to vegetation and the soil nutrient pool. Proceedings of the Royal Society B: Biological Sciences 284:20170111

[84] Letnic M, Ritchie EG, Dickman CR (2012) Top predators as biodiversity regulators: the dingo Canis lupus dingo as a case study. Biological Reviews 87:390–413

[85] These studies were by Caughley et al. 1980, Pople et al. 2000, Newsome et al. 2001, Caughley and Grigg 1982, Grice et al. 1985, Letnic et al. 2009. The reference details can be found in Letnic et al. 2012.

Appendix B. Summary of some research on mesopredator release

Following are brief summaries of 16 papers (organised in date order) testing whether dingoes suppress mesopredator populations and whether this benefits native species. These are not comprehensive of the research conducted on this question but serve to illustrate the diversity of outcomes reported.

Brawata (2021).[86] Dingoes suppressed fox activity and the abundance of fox prey species increased; cat activity was not affected (central Australia): Dingo, fox, cat and small mammal populations were compared across 5 matched sites either side of the dingo fence in the Strzelecki Desert. Dingo management was an important predictor of dingo, fox and some small mammal activity under varying levels of productivity. The strength of trophic regulation by dingoes fluctuated but occurred both prior to and post significant rainfall events. There were strong relationships between dingo management, dingo activity and fox activity – fox activity was higher (by up to 22 times) where dingoes were absent or in low numbers. Both fox and dingo activity was lower at sites where 1080 baiting was conducted. Dingo control did not appear to be an important determinant of feral cat activity, which was low at all sites (typical in arid environments) and fairly uniform between sites and years. Dingoes may provide a net benefit to small vertebrates in arid ecosystems by reducing the predatory impacts of foxes – where dingoes were retained, 'small mammals had higher baseline densities through the millennium drought and when the boom period came with the rain they really boomed'. This did not occur on the other side of the dingo fence in sites with the same inherent productivity.

Castle et al. (2021).[87] When dingo numbers were reduced, there was no increase in fox, cat or goanna populations (central Queensland): There was an attempt to eradicate dingoes inside 2 large areas on grazing properties within cluster fences (3,763 km^2 and 2,265 km^2) near Morven and Tambo and test whether this would result in mesopredator release. Populations of dingoes, foxes, cats and goannas (measured with sand plots and spotlighting) were monitored in fenced and control sites over 4–5 years. There was no evidence of fox, cat or goanna increases inside fenced areas where dingoes had declined (they didn't decline in one fenced area relative to the control site), indicating no mesopredator release.

Stobo-Wilson et al. (2020).[88] Dingoes did not spatially limit the occurrence of cats (northern Australia): Camera traps were used to survey 376 sites in the Top End for feral cats and dingoes, covering most major vegetation types and a range of land tenures, but not pastoral lands. Feral cat and dingo site occurrence were modelled to provide a broad-scale assessment of their distributional patterns and co-occurrence. Feral cat and dingo occurrence were best predicted by different indices of habitat structural complexity – cat occurrence declined with increasing productivity (increased vegetation density), although less so in areas of relatively high fire activity, and dingoes were less prevalent in rugged areas.

[86] Brawata RL (2021) Does management of a top carnivore influence the response of mesopredators and prey to rainfall in arid ecosystems? Evidence for a baseline density theory." Australian Zoologist 41 (3): 417–32

[87] Castle G, Smith D, Allen LR, Allen BL. (2021) Terrestrial mesopredators did not increase after top-predator removal in a large-scale experimental test of mesopredator release theory." Scientific Reports 11(1): 1–18.

[88] Stobo-Wilson AM, Stokeld D, Einoder LD, et al. (2020) Habitat structural complexity explains patterns of feral cat and dingo occurrence in monsoonal Australia. Diversity and Distributions 26(7): 832–42.

This supports the hypothesis that an interaction between reduced habitat structural complexity and cat predation is the primary driver of mammal decline in northern Australia. It could also indicate that the persistence of mammals in rugged areas 'may be due to the lower occurrence of dingoes in these habitats'. There is 'insufficient evidence to suggest dingoes are limiting the distribution, or constraining the habitat use, of feral cats in northern Australia'.

Moseby et al. (2019).[89] Dingoes suppressed kangaroo and red fox numbers but did not affect feral cat activity (central Australia): This study combined a before-after-control-impact-paired design (introduction of 2 dingoes into a 37 km^2 paddock with a dingo-proof fence at Roxby Downs) and a correlative study investigating differences in mammal assemblages on either side of the dingo fence (Strzelecki Desert). Dingoes suppressed kangaroo and red fox populations and benefited small mammals and rabbits. Feral cat activity was unaffected.

Leo et al. (2019).[90] Where there were fewer dingoes, there was greater activity of cats and macropods, a sparser understorey and fewer native rodents (northern Australia): This study compared predator, macropod and rodent abundances at 7 paired sites (with and without dingo control) in the Kimberley and Top End using sand plots (predators), spotlight surveys (macropods) and trapping (rodents). At baited sites, cat activity and macropod abundance were higher, native rodent abundance was less (but they were rare at most sites) and groundcover was sparser. Cattle grazing activity was unaffected. This is consistent with mesopredator release and trophic cascade theory. The researchers recommended manipulative experiments to provide more fine-scale resolution on the effects that dingo removal has on tropical savannah ecosystems.

Feit et al. (2019).[91] Cats were more abundant where dingoes were rare and their numbers correlated with the availability of prey (central Australia): Dingo and cat scats were collected and dingoes, cats and prey species were surveyed by spotlight at 2 matched sites each side of the dingo fence (Strzelecki Desert) over 6 years. Cat remains were present in 1% of dingo scats, and the dietary overlap between cats and dingoes was high (0.75–0.82), indicating the potential for competition. Even if fatal encounters between dingoes and cats are rare, this could have a 'marked effect' on local cat populations with low densities. The abundance of cats was on average higher where dingoes were rare and correlated with the abundance of their prey, but not where dingoes were common. This suggests that the top-down effects of dingoes on cats 'decoupled the population dynamics of cats and their prey and suppression of cats by dingoes remained strong irrespective of increasing prey availability'.

Fancourt et al. (2019).[92] Dingoes did not suppress cat activity (central Queensland): Camera traps were used to investigate whether dingoes suppressed the activity of feral cats in Taunton National Park and on 3 pastoral properties adjoining each other in central Queensland. There was no evidence of dingoes excluding cats or of cats avoiding dingoes.

[89] Moseby KE, Crowther MS, Letnic M. (2019) Ecological role of an apex predator revealed by a reintroduction experiment and Bayesian statistics. Ecosystems 22(2): 283–95

[90] Leo V, Reading RP, Gordon C, Letnic M (2019) Apex predator suppression is linked to restructuring of ecosystems via multiple ecological pathways. Oikos 128: 630–639

[91] Feit B, Feit A, Letnic M (2019) Apex predators decouple population dynamics between mesopredators and their prey. Ecosystems 22: 1606–1617

[92] Fancourt BA, Cremasco P, Wilson C, Gentle MN (2019) Do introduced apex predators suppress introduced mesopredators? A multiscale spatiotemporal study of dingoes and feral cats in Australia suggests not. Journal of Applied Ecology 56: 2584–2595

In the national park, the probability of detecting a cat was significantly higher in areas with dingoes than in dingo-free areas. On pastoral properties, it made no difference. Cats were 'active, abundant and widespread across both sites'.

Gordon et al. (2017).[93] Dingo suppression may lead to the encroachment of shrubs due to fewer rodents and rabbits eating seeds and seedlings (central Australia): Aerial photographs over a 51-year period were used to compare shrub cover between areas in the Strzelecki Desert where dingoes were rare and common, and contemporary patterns of shrub, shrub seedling and mammal abundances were quantified. Modelling was used to compare competing trophic cascade hypotheses to explain how dingoes could influence shrub recruitment. The fate of seedlings of an encroaching shrub (Dodonaea viscosa) were tracked to quantify removal rates of hopbush seeds by rodents from enriched seed patches. Shrub cover was 26–48% greater in areas where dingoes were rare than common. This was consistent with the hypothesis that dingo removal facilitates shrub encroachment by triggering a trophic cascade – the absence of dingoes leads to increased mesopredator abundance, which suppresses populations of rodents and rabbits (which eat shrub seeds and seedlings). Where dingoes were rare, seedling survival was 1.7 times greater and seed removal was 2.1 times lower than in areas where dingoes were common.

Colman et al. (2014).[94] Dingo baiting in forested sites in south-eastern Australia may lead to small mammal decline due to both increased fox predation and increased macropod herbivory: Mammal assemblages and understorey vegetation were compared at 7 paired sites – sites subjected to dingo control at least once a year for 5 years and control sites – in forested conservation reserves in NSW. In baited sites compared to control sites, dingo activity was lower, fox activity was higher and cat activity was not affected. Macropod, possum and glider abundances were higher, while ground-dwelling rodents and dasyurid marsupials were less abundant and bandicoots were unaffected. Understorey vegetation 0–100 cm and 100–200 cm above ground level was sparser. The differences in the relative abundances of mammals and the complexity of understorey vegetation accorded well with the trophic cascade theory and mesopredator release hypothesis.

Kennedy et al. (2012).[95] Cat activity was highest where dingo activity was low, but cat activity did not increase after reduction of dingo numbers (northern Australia): Dingo and cat abundance (measured by track plots) were assessed on 5 properties in the Top End and Kimberley subject to different degrees of dingo control (no baiting, annual road-based 1080 baiting, annual aerial 1080 baiting). Where dingo activity was very low – whether due to control or natural variation – cat activity was greatly heightened. But reduction of dingo numbers (by 55% on average due to baiting) did not result in increased cat activity in the subsequent 2–4 weeks. If dingoes do suppress cat activity, the results indicate this occurs with even low dingo numbers or it takes longer than a few weeks for cat behaviour to change in response. The tentative conclusion was that the relationship between cat and dingo activity in northern Australia 'is driven by differential habitat use' or by some degree of population-level suppression of cats. There are problems with methods for assessing cat numbers.

[93] Gordon CE, Eldridge DJ, Ripple WJ, et al. (2017) Shrub encroachment is linked to extirpation of an apex predator. Journal of Animal Ecology 86: 147–157

[94] Colman NJ, Gordon CE, Crowther MS, Letnic M. Lethal control of an apex predator has unintended cascading effects on forest mammal assemblages. Proceedings of the Royal Society B: Biological Sciences 281, no. 1782 (2014): 20133094.

[95] Kennedy M, Phillips BL, Legge S, et al. (2012). Do dingoes suppress the activity of feral cats in northern Australia? Austral Ecology 37: 134–139

Brook et al. (2012).[96] Dingoes may prevent cats hunting at optimal times (northern and central Australia): Camera traps at 9 pairs of grazing properties (control of dingos vs no control) were used to measure the effects of dingo control on dingo and feral cat activity. In uncontrolled populations dingoes were crepuscular (like their major prey). In controlled populations, dingoes were less active around dusk and more active shortly before dawn. Reduced activity by dingoes at dusk was associated with higher activity of cats at dusk and cats appeared to avoid areas where dingoes were locally common. This indicates that cats can coexist with dingoes by concentrating their use of space and time to avoid encounters. Effective dingo control may allow cats to optimise hunting behaviour by hunting at dusk, when many native animals are active.

Moseby et al. (2012).[97] Dingoes killed foxes and cats (central Australia): 7 foxes and 6 feral cats were introduced into a 37 km^2 fenced paddock at Roxby Downs inhabited by a male and female dingo. Dingoes killed all foxes within 17 days. All cats died within 103 days; dingoes killed at least 3. Dingoes did not eat any carcasses, suggesting they were killing due to interference competition rather than intraguild predation. This was the first demonstration of a direct negative interaction between dingoes and cats and foxes.

Letnic and Dworjanyn (2011).[98] Foxes were less abundant and dusky hopping mice were more abundant where there were dingoes (central Australia): Spotlight surveys were used to estimate the abundance of dingoes, foxes and dusky hopping mice (endangered) on 2 pastoral properties on either side of the dingo fence (Strzelecki Desert), one with dingoes and one without.

One of the benefits of dingoes in some places is suppression of fox populations. Foxes have been one of Australia's major drivers of extinction. Photos (from left): Slowmotiongli and Terbe Rezso.

[96] Brook LA, Johnson CN, Ritchie EG (2012) Effects of predator control on behaviour of an apex predator and indirect consequences for mesopredator suppression. Journal of Applied Ecology 49: 1278–1286

[97] Moseby KE, Neilly H, Read JL, Crisp HA. (2012) Interactions between a top order predator and exotic mesopredators in the Australian rangelands. International Journal of Ecology 2012: 250352

[98] Letnic M, Dworjanyn SA (2011) Does a top predator reduce the predatory impact of an invasive mesopredator on an endangered rodent? Ecography 34: 827–835

Foxes were less abundant in the presence of dingoes. Both predators ate dusky hopping mice, but foxes ate more, particularly in the absence of dingoes, and dusky hopping mice foraged less efficiently where dingoes were absent (perhaps indicating greater fear of foxes than dogs).

Johnson and VanDerWal (2009).[99] Where wild dogs were abundant, foxes were rare, but the converse did not always apply (eastern Australia): The researchers reanalysed published data (using different statistical methods) from 2 previous studies on fox and wild dog abundance in eastern Australian forests (coastal NSW and Kosciuszko National Park). This revealed a triangular relationship: when wild dogs were abundant, foxes were consistently rare; when wild dogs were rare, foxes were abundant in some cases but not consistently so. 'This suggests that the abundance of wild dogs sets an upper limit on the abundance of foxes, but does not fully determine fox abundance.' Other factors limiting fox abundance would include baiting that kills both dingoes and foxes.

Southgate et al. (2007).[100] Bilbies were more likely to be present where there were dingoes (central Australia): The predicted probability of the occurrence of bilbies, feral cats, foxes, dingoes and camel was modelled based on surveys across >200 sites in the Tanami and Great Sandy desert bioregions. For the entire study area, bilby presence was associated most strongly with the probability of dingo occurrence (as well as rainfall and substrate type). This suggested they favoured similar habitats and also that dingoes benefit the bilby. There was little shared habitat use by foxes and dingoes.

Mitchell and Banks (2005).[101] Wild dogs did not exclude foxes at a landscape scale but may have influenced finer-scale habitat use (eastern Australia): The diet of foxes and dogs in the Greater Blue Mountains region was analysed by scat content. It showed almost complete overlap, with the fox niche slightly broader than the dog niche, but different prey abundances, indicating niche partitioning based on prey size that would alleviate strong competition. Habitat use was assessed using data from bait stations (species identified by tracks in sand). There was evidence of fine-scale avoidance by foxes: they had a lower likelihood of visiting a bait station that was visited by dogs during a baiting event. But there was no evidence at a larger scale: the presence or absence of wild dogs was not a significant predictive variable of fox occurrence at the landscape scale. The study area has relatively high productivity, so wild dogs may tolerate foxes due to an abundance of prey, water and cover.

[99] Johnson CN, VanDerWal J (2009) Evidence that dingoes limit abundance of a mesopredator in eastern Australian forests. Journal of Applied Ecology 46: 641–646

[100] Southgate R, Paltridge R, Masters P, Carthew S (2007) Bilby distribution and fire: a test of alternative models of habitat suitability in the Tanami Desert, Australia. Ecography 30: 759–776

[101] Mitchell BD, Banks PB (2005) Do wild dogs exclude foxes? Evidence for competition from dietary and spatial overlaps. Austral Ecology 30: 581–591

Appendix C. Summary of some research on the impact of dingoes on threatened native species

Following are brief summaries of 10 papers (organised in date order) demonstrating that in some circumstances dingoes are a threat to populations of native species. Dramatic changes since European colonisation are likely to have altered the relationship between native species and dingoes – for example, the introduction of cats, foxes and rabbits; pastoralism and the widespread installation of artificial water sources; altered fire regimes and the decline of traditional Aboriginal land management practices; and increased availability of carrion due to road kills, dead livestock etc.

Sheldon et al. (2023).[102] Foxes and dingoes selected certain prey species at a frequency negatively associated with the abundance of those species (central Australia): Foxes and dingoes have considerable dietary overlap, so dingoes can yield biodiversity benefits only if their predation risk to vulnerable species is less than their ability to reduce fox predation on the same prey. Scat analysis of prey items over 9 years was compared with the abundance of 6 prey types present in >5% of scats – hopping mice (listed as vulnerable), long-haired rats, reptiles, kangaroos, small rodents (<30 g). For dingoes, negative frequency dependent selection of prey (when predators persist in eating a preferred prey type as it becomes less abundant) was found for hopping mice, reptiles and rats. For foxes it was found for hopping mice and small rodents. But only foxes continued to preferentially select hopping mice when they were scarce, suggesting a particular vulnerability to fox predation. The ecological effects of these patterns need testing, including the potentially detrimental effects of dingo predation on reptile populations. It may be beneficial for predators to persist in searching for scarce prey because they become highly efficient at hunting particular prey.

Behrendorff et al. (2023).[103] Dingoes threaten the marine turtle rookery on K'gari: Green turtles (*Chelonia mydas*, vulnerable) and loggerhead turtles (*Caretta caretta*, endangered) nest on the beaches of northern K'gari. Surveys in 2019/2020 found that dingoes predated an estimated 840 nests (84% of about 1,000 nests, with 100 eggs eaten per nest). Only 6% of nests were confirmed to have successfully hatched. Dingoes also attack the adult turtles. Dingo predation 'may ultimately cause the collapse of the entire turtle rookery if left unmanaged'.

Fleming et al. (2022).[104] Dingo diets considerably overlap with those of cats and foxes but include more macropods/potoroids, wombats, monotremes and bandicoots/bilbies than cat or fox diets: A comparison of the diet of dingoes, cats and foxes (based on 157 dietary studies at 264 sites across Australia) found that 45% of all Australian terrestrial mammal, bird and reptile species occurred in the diets of cats, dogs and/or foxes. The overlaps in diet were 0.64 for dingoes and cats; 0.73 for dingoes and foxes; 0.79 for cats and foxes.

[102] Sheldon EL, Feit B, Feit A, Letnic M. (2023) Negative frequency dependent prey selection by two canid predators and its implications for the conservation of a threatened rodent in arid Australia. Biodiversity and Conservation 32(5): 1671–86.
[103] Behrendorff L, King R, Allen BL (2025) Trouble in paradise: When two species of conservation and cultural value clash, causing a management conundrum. Ecology and Evolution 13: e10726.
[104] Fleming PA, Stobo-Wilson AM, Crawford HM, Dawson SJ, Dickman CR, Doherty TS, et al. (2022) Distinctive diets of eutherian predators in Australia. Royal Society Open Science 9: 220792.

Cats were more likely to have eaten birds, reptiles and small mammals; dingoes tended to eat larger animals (macropods/potoroids, wombats, monotremes, bandicoots); and foxes had a more variable diet, with fewer distinctive items, suggesting there was prey switching (especially of mammals) to mitigate competition. Dingoes consume some locally rare or threatened native species including the bridled nailtail wallaby, rock wallabies, burrowing bettongs and koalas. Bandicoots and bilbies more commonly featured in fox and dingo diets than in cat diets, but were twice as frequent in the diets of dingoes than foxes.

Lavery et al. (2021).[105] Dingoes may threaten some rock-wallaby populations: This review of threats to rock-wallabies notes that dingoes are 'potentially major predators' of rock-wallabies, particularly in desert areas. Ngaanyatjarra people have identified dingoes as significant predators of warru (central Australian rock-wallaby) in the Warburton region of Western Australia. Any regulation by dingoes of cat and fox populations has been 'insufficient to prevent widespread disappearance of desert rock-wallaby populations'.

Ward et al. (2021).[106] Dingoes are a threat to some nationally listed threatened taxa: A threat and impact dataset compiled for all nationally listed threatened taxa based on assessments by taxonomic experts found that dingoes are a high- or medium-impact threat to 12 taxa (Table 1).

Table 1. Taxa listed under the EPBC Act threatened (high or medium impacts) by dingos/dogs

Threatened taxon		EPBC Act status	Threat impact
Greater bilby	*Macrotis lagotis*	VU	High
Bridled nail-tail wallaby	*Onychogalea fraenata*	EN	High
Plains rat	*Pseudomys australis*	VU	High
Smoky mouse	*Pseudomys fumeus*	EN	High
Malleefowl	*Leipoa ocellata*	VU	Medium
Nabarlek (Kimberley)	*Petrogale concinna monastria*	EN	Medium
Koala (part of range)	*Phascolarctos cinereus*	VU	Medium
Long-footed potoroo	*Potorous longipes*	EN	Medium
Long-nosed potoroo	*Potorous tridactylus tridactylus*	VU	Medium
Kowari	*Dasyuroides byrnei*	VU	Medium
Western barred bandicoot (Shark Bay)	*Perameles bougainville bougainville*	EN	Medium
Black-footed rock-wallaby (West Kimberley)	*Petrogale lateralis kimberleyensis*	VU	Medium

Notes: The assessments in Ward et al. 2021 did not distinguish between domestic dogs and dingoes.The eastern barred bandicoot (Tasmania) listing has been excluded here due to the lack of dingoes in Tasmania.

Martin and Carver (2020).[107] Dingoes were a major threat to the critically endangered northern hairy-nosed wombat: In 2000, despite regular baiting, a single predation event by a pack of dingoes is thought to have killed up to 20 northern hairy-nosed wombats (with an adult population estimated to be no more than 100).

[105] Lavery TH, Eldridge M, Legge S, et al. (2021) Threats to Australia's rock-wallabies (Petrogale spp.) with key directions for effective monitoring. Biodiversity and Conservation 30: 4137–4161

[106] Ward M, Carwardine J, Yong CJ, et al. (2021) A national-scale dataset for threats impacting Australia's imperiled flora and fauna. Ecology and Evolution 11:11749–11761

[107] Martin AM, Carver S (2020) Ecology and conservation of the critically endangered northern hairy-nosed wombat (Lasiorhinus krefftii): past, present and future. Australian Mammalogy 43: 10–21

This precipitated the building of a 20-km-long predator-proof fence, which led to slow but steady population growth.

Beyer et al. (2018).[108] Dingoes/dingo hybrids may be a major contributor to koala mortality: A radio-tracking study of about 500 koalas in urban and peri-urban habitat remnants in the eastern Moreton Bay region of Queensland from 2013 to 2017 (in association with the development of a railway line) found that predation accounted for an estimated 63% of deaths and disease for 29%. Predation deaths were caused by dingoes (85%), carpet pythons (12%) and domestic dogs (3%). A single male dingo was thought to be responsible for 75 deaths. Without control of dingoes and disease, this koala population was likely to have approached local extinction within a decade. It is unclear how representative this population is of others in the region because no other population has been studied as intensively.

Stokeld et al. (2018).[109] Predation by dingoes as well as cats is likely to be exerting pressure on declining mammal fauna in Kakadu National Park: This study evaluated the changes in dingo and feral cat diets as mammals declined over a 3-decade period in Kakadu. In sampled scats in the 1980s, small-sized native mammals were the prey item occurring at the highest frequency for both dingoes (34%) and cats (86%). In sampling from 2014 to 2015 at a site where the abundance of small- and medium-sized mammals had decreased by 95-98%, macropods were predominant in dingo scats and medium-sized native mammals in cat scats. The frequency of small native mammals declined in both dingo and cat scats while the frequency of medium-sized native mammals remained constant in dingo scats and increased in cat scats. Predation by both feral cats and dingoes should be considered in the conservation of native mammals. Dingoes may also play an important role in limiting the recovery of threatened species.

Jolly et al. (2018).[110] Dingoes likely eliminated northern quolls reintroduced to Kakadu National Park: In 2015, northern quolls from an insurance population established on Astell Island (to prevent extinction of quolls from poisoning by cane toads) were reintroduced to Kakadu National Park. For the 23 (of 29) quolls not killed by cane toads (due to aversion training) the main source of mortality was dingo predation. Predation pressure is suspected to have driven the population to extinction within weeks. Prior to the arrival of cane toads in Kakadu, dingo predation accounted for 36% of quoll mortality a year. This predatory pressure may have been exacerbated by a loss of antipredator behaviours in the quolls (within 12 generations) and intensification of fire regimes.

Moseby et al. (2011).[111] Surplus killing by dingoes may be a threat to reintroductions of some threatened native mammals: In 2008, 101 burrowing bettongs sourced from Arid Recovery Reserve (protected from predators) were released outside the reserve into an area inside the dingo fence with free-ranging cats and foxes subject to regular baiting. All bettongs were dead within 7 months, due mainly to predation by foxes, cats and dingoes. Although the area was south of the dingo fence and dingoes were rare, a single dingo killed 17 bettongs within the first 24 hours.

[108] Beyer HL, De Villiers D, Loader J, Robbins A, Stigner M, Forbes N, et al. (2018) Management of multiple threats achieves meaningful koala conservation outcomes. Journal of Applied Ecology 55: 1966–75

[109] Stokeld D, Fisher A, Gentles T, et al. (2018) What do predator diets tell us about mammal declines in Kakadu National Park? Wildlife Research 45:92–101

[110] Jolly CJ, Kelly E, Gillespie GR, et al. (2018) Out of the frying pan: Reintroduction of toad-smart northern quolls to southern Kakadu National Park. Austral Ecology 43: 139–149

[111] Moseby K, Read J, Paton D, et al. (2011) Predation determines the outcome of 10 reintroduction attempts in arid South Australia. Biological Conservation 144: 2863–2872

Appendix D. Summary of some research on protecting livestock

Following are brief summaries of 9 papers on the effectiveness or otherwise of dingo baiting for protecting livestock and on alternative protection options.

van Bommel and Johnson (2023).[112] Livestock guardian dogs can be effective on large and small farms provided an adequate number of dogs is properly selected and managed: 112 of 150 farmers surveyed in 2008–09 about their use of guardian dogs were reinterviewed (see van Bommel and Johnson 2012 below). 56 of the 112 (50%) had ceased using guardian dogs, mainly due to a change in business (53%; decisions unrelated to predation on livestock), some due to behavioural issues with the dogs (24%), and others due to problems with neighbours (19%). The main reported advantages of using guardian dogs were the protection for livestock, property or people (65%); peace of mind due to protection (12%); the loyalty and good temperament of the dogs (12%); other improvements in livestock management (6%); and reduced need for other forms of predation control (4%). The main disadvantages were the commitment required to look after the dogs (40%); the commitment required for training and the difficulties of training (24%); unwanted behaviour in dogs (19%); complications to livestock management (4%); cost (3%); incompatibility with lethal control (3%). 100% of participants still using guardian dogs said they would recommend them to other farmers, as did 98% of participants no longer using them. Based on user-reported yearly stock losses, the effectiveness of guardian dogs remained high for 96% (53 of 55) of participants who had continued their use. Farmers generally reduced or ceased other forms of predation control. Although farmers resumed other forms of control to some extent over the longer-term, use of these methods remained below previous levels.

Guardian dogs may be ineffective for several reasons:

- Predators might adjust to the behaviour of the guard dogs and learn how to launch successful raids on livestock.
- Farmers might struggle to maintain the level of attention and interventions and gain the knowledge needed to properly manage their guard dogs and correct behavioural problems (e.g. excessive roaming).
- Guard dogs might stray outside property boundaries and generate conflict with neighbours.
- Long-term use may become impractical if mortality rates of the dogs are high, for it takes up to 2 years for a pup to become a fully functional guardian, and a considerable investment of time and effort.

[112] Van Bommel L, Johnson CN (2023) Still a good dog! Long-term use and effectiveness of livestock guardian dogs to protect livestock from predators in Australia's extensive grazing systems. Wildlife Research 50: WR23008

Campbell et al. (2022).[113] Three cattle graziers document the ways that dingoes are beneficial for their businesses: The 3 pastoralists, with commercial beef properties in Western Australia and Queensland, recount the following outcomes when dingoes were not baited:

- Woolleen (Western Australia): Uncontrolled grazing from goats and kangaroos was preventing all attempts to regenerate pasture that was in poor condition because of previous over-grazing. The return of dingoes eliminated goats and reduced kangaroo populations and resulted in regeneration of streamside vegetation and pasture species.

- Claravale Station (Queensland): The cessation of baiting led to the elimination of feral goats and low populations of feral pigs and kangaroos. Calf losses from dingoes declined to 1–2%.

- Noonbah Station (Queensland): The cessation of baiting led to the elimination of feral goats and reduced populations of feral pigs and kangaroos. They say their 'landscapes appear visibly healthier through having major reductions in uncontrolled grazing pressure'.

Ballard et al. (2020).[114] High rates of baiting are needed to reduce dingo populations (north-eastern NSW): The mortality rates of dingoes exposed to aerial baiting at 40, 10 and 0 baits per kilometre were compared by tracking the fate of 132 dingoes fitted with telemetry collars. Baiting occurred in April and May each year from 2008 to 2013 along predetermined transects on public and private lands in wet forest environments. At 40 baits/km, 91% of collared dingoes died; at 10 baits/km, 55% died. The lower baiting frequency was ineffective because 75% mortality is considered necessary to limit dingo population growth. One reason for ineffectiveness is competition for baits by foxes, pigs and birds (ravens), which can eat up to 100% of baits. Even with 90% mortality, rapid repopulation can be expected, with a return to parity between annual programs. To maintain a dingo population at low levels therefore requires additional killing.

Campbell et al. (2019).[115] Dingo baiting did not prevent calf losses (northern South Australia): Of 3,145 pregnancies tracked over 2–4 years in 3 beef herds (based on lactation at re-musters), fetal/calf losses averaged 18.6%. Although calf predation by dingoes was observed, dingo baiting did not have a significant effect on outcomes. Dingo activity indices were on average 59% lower in baited areas. The scale and timing of fetal/calf loss was not correlated with dingo activity, time of year, or activity of alternative dingo prey. Successful pregnancies may have been reduced by diseases. The occurrence of cattle hair in dingo scats was higher when seasonal conditions were poorer and alternative prey less common but was probably due mainly to carrion feeding. It is unclear whether the baiting was insufficient to protect calves, or whether confounding effects of cow age, disease or behavioural responses of baited dingoes masked any baiting effect.

van Bommel and Johnson (2017).[116] To protect sheep against predators, the use of livestock guardian animals does the most to enhance sheep welfare: Dingo attacks have severe sheep welfare consequences.

[113] Campbell G, Emmott A, Pollock D, Traill B (2022) Can dingoes increase graziers' profits and help maintain Australia's rangelands? The Rangeland Journal 44: 129–135

[114] Ballard G, Fleming PJS, Meek PD, Doak S. (2020) Aerial baiting and dingo mortality in south-eastern Australia." Wildlife Research 47(2): 99–105

[115] Campbell G, Coffey A, Miller H, et al. (2019) Dingo baiting did not reduce fetal/calf loss in beef cattle in northern South Australia. Animal Production Science 59(2): 319–30.

[116] van Bommel L, Johnson C. (2017) Predation Control. In Advances in Sheep Welfare, 177–96. Elsevier.

Reductions in livestock loss due to lethal control are typically short term – predator numbers recover rapidly through immigration and lethal control can increase predation, probably due to an influx of young males, which are more likely to attack livestock. The benefits of using livestock guardian animals – dogs, donkeys, mules, llamas and alpacas – include reduced stress in sheep. They spend less time being vigilant and more time grazing and moving. The disadvantages are mainly the time and effort needed to properly raise and manage guardian animals.

Other approaches have generally failed:

- visual and acoustic repellents such as sirens and flashing lights – predators habituate quickly to non-threatening stimuli
- chemical repellents – large-scale or long-term application is ineffective or impractical
- conditioned taste aversion (when an animal learns to associate the taste of a food with illness) – ineffective; killing of prey may be elicited by specific prey behaviours regardless of aversion.

Allen et al. (2016).[117] Maremma dogs prevent dingo attacks by guarding sheep rather than excluding dingoes: After annual predation losses of ~15% of their sheep, the owners of a large property in Queensland switched from regular poison baiting to deploying 18 to 26 guardian dogs (1–3 dogs per flock). This reduced sheep losses to ~3% within 3 years (mainly due to non-predation causes). 8 maremmas and 6 dingoes fitted with GPS collars were monitored for 7 months. Dingo territories (ranging in size from 4.5 km^2 to 22.8 km^2) did not overlap with each but dingoes made frequent incursions, often for several hours, into maremma territories (from 9.8 km^2 to 92.8 km^2). The maremmas prevented attacks by shepherding the sheep, preventing dingoes from coming into direct contact with sheep, and aggressively barking. Physical altercations between the maremmas and dingoes were rare.

Allen (2015).[118] Lethal control of dingoes on cattle properties can lead to more calf attacks: A large-scale manipulative experiment on 2 cattle properties (in central-south and north Queensland) investigated the impact of baiting programs on dingo abundance, age structures and their prey. Baiting mostly reduced dingo abundance but only for 1–12 months (75% of the 8 baiting programs resulted in dingo print track index values returning to prebaiting levels in <8 months).

The age structures of dingoes in baited areas differed from those in unbaited control areas, which is likely to change the way they interact with prey, due to a reduced efficiency at hunting kangaroos and more reliance on easy-to-catch species like possums. When preferred prey populations decline during a drought, dingo groups with fewer, younger and less experienced individuals would probably be forced to select less preferred prey (such as livestock).

[117] Allen LR, Stewart-Moore N, Byrne D, Allen BL. (2016) Guardian dogs protect sheep by guarding sheep, not by establishing territories and excluding predators. Animal Production Science 57(6): 1118–27.
[118] Allen LR. Demographic and functional responses of dingoes to poison baiting. (2015) Ecological Management & Restoration 16(1): 58–66.

Baiting on cattle properties is seldom effective because:

- predation on cattle is infrequent when preferred prey are available
- baited dingo populations numerically recover from baiting programmes before calving commences or when most calves are small and vulnerable
- baiting appears to change the age structure and group size of recolonised dingo populations likely reducing their ability to hunt kangaroos for and more prone to harass calves

Prowse et al. (2015).[119] The presence of dingoes can increase profits from cattle grazing due to higher pasture biomass resulting from fewer kangaroos: An economic model was used to examine trade-offs between cattle density, kangaroo abundance, calf losses and dingo control. At cattle stocking densities of 0.03 cattle per hectare (an intermediate stocking density), an unbaited population of dingoes reduced kangaroo density from 0.174 to 0.022 a hectare and increased standing dry matter from 333 to 383 kg a hectare. This resulted in improved cattle growth, survival and fertility rates. The live weight gain of cattle increased from 121 to 147 kg a year. These production benefits more than compensated for calf losses due to dingo predation, and increased the gross margins of cattle enterprises by $0.83 a hectare. The researchers concluded there is little evidence to support dingo control in cattle rangelands and that in contrast they are likely to increase profits from conservative stocking densities while reducing the risk of pasture over-utilisation. The benefits may not apply at high cattle densities (which restricted the kangaroo population) or when there was alternative preferred prey (such as high rabbit densities).

van Bommel and Johnson (2012).[120] Livestock guardian dogs can be effective in protecting livestock from predators when ranging freely on large properties: 150 livestock producers with guardian dogs were surveyed by telephone. 7% used them with cattle, 28% with sheep, 21% with free-range poultry, 39% with goats, 4% with other livestock types. Property sizes ranged from 3 to 125,000 ha. The number of stock ranged from 14 to 40,000. The number of guardian dogs ranged from 1 to 25. The reported effectiveness of guardian dogs was high – of 126 participants with a history of predation, 66% said predation ceased and 30% said it decreased. The main factor influencing effectiveness was the number of stock – if the number of stock per guardian exceeds 100, they may not be able to stop all predation. Guardian dogs are often kept free-ranging on large properties where wild dogs are the main predator, but restricted on smaller properties. The cost of obtaining a guardian dog is recovered within 1–3 years after it starts working. Guardian dogs 'could play a major role in securing the viability of livestock businesses and reconciling people–predator conflict in Australia'.

[119] Prowse TA, Johnson CN, Cassey P, Bradshaw CJ, Brook BW. (2015) Ecological and economic benefits to cattle rangelands of restoring an apex predator. Journal of Applied Ecology 52: 455–466

[120] van Bommel L, Johnson CN (2012) Good dog! Using livestock guardian dogs to protect livestock from predators in Australia's extensive grazing systems. Wildlife Research 39(3): 220–29

Invasive Species Council
invasives.org.au