Eastern Grey Kangaroos in Canberra Nature Park

Population estimates and culling history 2009 – 2022

A citizen science project

Jane Robinson and John Grace - May 2022

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Dedication:
This report is dedicated to wildlife carers and supporting volunteers who devote their lives to saving precious injured and orphaned wildlife. Their efforts are extraordinary and admirable. The report is also dedicated to Canberrans and others who have fought for the lives of eastern grey kangaroos over many years. Their unfailing dedication to our beloved kangaroos must, one day, be rewarded.

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Executive Summary

Culling of kangaroos in Canberra Nature Park has taken place on an annual basis for the past thirteen years. The reason for the culls, cited by the ACT Environment, Planning and Sustainable Development Directorate (the Directorate) has been to protect the habitat – specifically the grassy layer – of several threatened species of the box-gum grassy woodlands and natural temperate grasslands which comprise much of the environment in the nature reserves which comprise Canberra Nature Park.

Following the cull of 2021, when another 1,505 kangaroos and 621 pouch joeys were killed, the authors decided to undertake extensive field studies to ascertain the population densities of kangaroos in the nature reserves. Canberrans have been advised over many years that there is an overabundance of kangaroos in the nature reserves and that culling is the most humane method of controlling their population. The Directorate has stated that their preferred density of kangaroos in box-gum grassy woodland and natural temperate grassland is *one kangaroo per hectare* and that this ratio will preserve the grassy layer.

We also undertook an analysis of the Directorate's methodologies, population estimates and their culling data from 2009 until 2021.

Approximately 27,950 kangaroos have been shot and killed in Canberra nature reserves (and Googong Foreshores) since 2009. An estimated 7,000-9,000 pouch joeys have been bludgeoned to death or decapitated. It is unknown how many at-foot joeys have died, but death resulting from starvation, dehydration, hypothermia or predation is likely once joeys lose the protection of their mothers.

Over the past eight months, after an extensive, systematic search of all 37 accessible nature parks on multiple occasions, we directly observed 4,074 kangaroos remaining in Canberra nature reserves.

On May 20th 2022, the ACT Minister for the Environment announced a further cull of 1,650 kangaroos, to commence on 23rd May, despite admitting on 13 April 2022, that the Directorate *'did not know'* what the population of kangaroos actually is.

We recommend that a fully independent review of kangaroo culling in Canberra nature reserves be undertaken prior to any further culling.

After hours of searching a vast nature reserve in Canberra's south, we encountered a lone walker. 'Seen any wildlife?' we asked. 'Just kangaroos' was the response. 'Where?' we enquired, having seen only two that day, we were keen to find more. 'They're everywhere' he emphatically responded.

Is this exchange somewhat illustrative of the problems kangaroos face? It seems that some, or many Australians think kangaroos are ubiquitous, even though most rarely see them and even on a remote bush track, a walker claims to see them everywhere, when clearly, they were not.

Is this part of the thinking that enables a government department to make extraordinary claims about kangaroo populations to support claims that a culling program is necessary?

Background

Since August 2021, we have systematically searched for kangaroos in all of Canberra's nature reserves except for two, which are closed to the public. We have observed, counted and recorded the kangaroo populations in each of these reserves, carrying out 112 field studies to date.

This was never intended to be a census of all kangaroos. The citizen science project was intended to be, what is sometimes described as a methodical 'ground truthing' exercise.

Our exploration was primarily intended to evaluate what we have been encouraged to believe - the 'overabundance' of kangaroos in the reserves (based on the Directorate's preferred densities of kangaroos needed to ensure the habitat of some threatened species.) Given the size and vegetation cover of most of the reserves we reasoned that if there were hundreds, if not thousands of kangaroos on acreages of these sizes, then they would undoubtedly be highly visible.

After extensive grid-searches of the reserves we discovered that this was not the case. If there ever were hundreds, even thousands of kangaroos in some nature reserves, as claimed by the Directorate's counting methodologies, they are no longer there, ***including in reserves which have not yet been culled.***

Testimonial:
My family and I have been walking on Isaacs Ridge for 30 years and the population of kangaroos had been stable. They have been coming into our suburb all those years, grazing our lawns, they were our 'kangaroo friends'.

They are the perfect lawnmower, never eating too low, nor up-rooting grasses and their soft feet never break the ground, unlike horses, cattle, sheep.

Those of us who have walked upon the ridge several times each week for 30 years can testify that kangaroos are not over populating Isaacs Ridge or causing stress to the grasslands nor to themselves.

An observer will notice a vast difference in the grasslands of Isaacs Ridge and those of the horse agistment properties abutting the northern end of the ridge which are quite denuded compared to the grasslands which are grazed by kangaroos only.

But then the shooters came. A cull is brutal to kangaroos who are herd creatures. They also shot wallaroos and red-necked wallabies which also inhabited Isaacs Ridge.

Many neighbours suffer each night of a cull at the thought of the trauma inflicted on these endearing creatures.

Christine,
Isaacs, ACT

Findings based on our field work

We have observed and counted a total of 4,074 kangaroos, to date, in 37 nature reserves. The land area of all 39 reserves is 11,400 hectares. Even if we subtracted the reserves which are dry forests

such as Bruce Ridge, Black Mountain, or O'Connor Ridge where comparatively few kangaroos are found, kangaroos are not present at a ratio of one per hectare. Indeed, it is quite evident that the overall kangaroo population is well below this ratio, as is the case in the great majority of individual reserves. This was observed in reserves where regular culling has occurred over several years but, interestingly, also in most reserves which have never been culled.

We found that in the 20 percent of reserves where kangaroos are in marginally higher densities than this ratio, there was no evidence of grazing pressure. No doubt, growth of grass, other native plants, weeds and invasive plants reflects two years of above average rainfall. The greatest damage to the grassy layer evident was in places where invasive weeds had spread across large sections of some reserves, or in places where 'hard pan' had been created by previous poor farming practices. Undoubtedly, during extended drought, grazing pressure could occur in some reserves and measures could be undertaken to alleviate this situation.

The annual kangaroo cull is largely based on the population size of kangaroos within various nature reserves and other factors such as populations of threatened creatures and height of grasses. Our citizen science project was based on testing – or ground truthing – the kangaroo population estimates as claimed by the Directorate.

Our findings, based on over eight months of conducting Direct Observational Counts of kangaroos in Canberra nature reserves are at odds with what the Directorate claims and do not support the contention that kangaroos are 'overabundant' in the reserves or are having a deleterious effect on the grassy layer of the reserves.

Analysis of the ACT Environment Directorate's evidence for kangaroo culling

The ACT kangaroo cull is described as a 'conservation cull'. Eastern grey kangaroos, a keystone species in this region, are allegedly impacting on grassland conservation values of some of Canberra's nature reserves, threatening the habitat of certain threatened or endangered creatures: the pink tailed worm lizard, the striped legless lizard, the golden sun moth, the perunga grasshopper and the grassland earless dragon. These creatures all have 'Threatened Species Action Plans' in place, published by the Environment Directorate in 2017.

The predominant threats to these species, as listed in the Action Plans, include:

- loss of habitat and fragmentation of habitat,
- urbanisation, industrialisation and infrastructure,
- agricultural practices (use of fertilisers and pesticides), cultivation and pasture improvement, overgrazing of livestock, weed invasion,
- predation by feral animals (cats, foxes) and native animals (snakes, raptors)
- climate change.

Kangaroos are not mentioned as the primary threat in any of these action plans.

Kangaroos *are* mentioned in the plan for the grassland earless dragon, in the context of over-grazing at Canberra Airport during drought, and in instances of either over- or under-grazing. Fencing to prevent over-grazing by kangaroos in particular areas has been used in some reserves during drought. This plan goes on to state 'moderate levels of grazing by kangaroos is required to maintain structural heterogeneity by preventing a few grass species from dominating…' and that 'protecting intact native ecosystems is generally preferable to protecting areas solely for a single threatened species. Priority should be given to protecting habitat that results in broader conservation gains, such as conserving other threatened, declining or rare species, or conserving native grasslands with component native fauna.'

***'99% of natural temperate grasslands has been destroyed or drastically altered since European settlement'* (Threatened Species Action Plans, Environment Directorate, 2017).**

Loss of habitat - not kangaroo grazing - is clearly the primary threat to any native species trying to survive the onslaught of human development.

The kangaroo cull, in effect, makes kangaroos the scapegoats for the decline of these species, while achieving very little in addressing the threats listed in the Threatened Species Action Plans.

There is an Action Plan for each of the five threatened species. Not one of them states that the removal or reduction of kangaroos in the nature reserves will ensure their survival. The Action Plan for the Golden Sun Moth for example states 'Most grassland sites containing (golden sun moth) will require some management of herbage mass to maintain habitat in good condition. The preferred management of managing grass structure and biomass is grazing by native herbivores (kangaroos) which are a natural fauna component of native grasslands.'

The action plan also states, 'kangaroo numbers will need to be managed on some sites, especially during droughts, to avoid over-grazing and loss of tussock structure.' This is hardly a justification for a large-scale cull, killing thousands of kangaroos on an annual basis across many nature reserves.

In 2015, a major project to re-instate habitat of the pink tailed worm lizard was undertaken in the Molonglo Valley following development of the new suburb of Coombs. The aim of the restoration project, funded by the ACT Government, was to ensure that 'the nationally recognised threatened species will survive *regardless of urban development*.'

A report on ABC News by Alkira Reinfrank on 9 May 2015 stated, 'the shy reptile can be a developer's nightmare, with the protected species forcing urban development to snake around protected habitats'. A key threat listed in the threatened species action plans is *'urban development'*. The impacts of land-use development in the ACT have been massively destructive to the habitats of the pink tailed worm lizard and other endangered species.

Nowhere in this news report, which included interviews with two ecologists engaged on the project, were kangaroos mentioned as a threat to the pink tailed worm lizard.

The science for the kangaroo cull is contested and has been since annual culling first began in 2009.

Kangaroo culling has been criticised by scientists who have closely studied eastern grey kangaroos – their breeding patterns and reproduction rates, their feeding habits and habitat.

Plant biologists have stated that there is no evidence that grazing by kangaroos alongside species which have evolved with them for millions of years causes damage to the intact grassy layer or plant biodiversity of Canberra's nature reserves (or in other lowland temperate grassy woodlands).

An analysis of the ACT Directorate's data conducted by CSIRO in 2014 (funded by ACT Government), *Relationships between vegetation condition and kangaroo density in lowland grassy ecosystems of the northern ACT* (Analysis of data 2009, 2012 and 2013), found that **there was no deleterious effect of kangaroos grazing at a density of one kangaroo per hectare or any higher density of kangaroos found in the nature reserves.**

The CSIRO researchers attempted to identify loss of botanical diversity or richness to the grassy layer at higher densities of kangaroo habitation. Their findings showed **no justification for culling kangaroos on this basis. They found no nature reserve where kangaroos were present in a density of three (or more) per hectare.**

Kangaroo culling continued despite the findings of the CSIRO report.

All science should be subject to scrutiny. This principle clearly applies to the 'scientific' assertions made by the ACT Environment Directorate.

Testimonial:
'We've had a little mob of 'roos living on a vacant block in North Watson… for 22 years I've enjoyed their company. Although the numbers have changed throughout the seasons, with the instinctive urge for males to leave, and in response to previously vacant land being developed, the fluctuations disappear over time leaving a mob of just a dozen or so permanently.

This mob are a family, with 3 babies this year, and yesterday there were forcibly removed to Mt Majura to be culled.

Just breaks my heart and the thought of unborn joeys being so inhumanely treated and destroyed brings me to tears. They've been left alone for 22 years and managed to keep their population growth to a size the block could support without needing culling.'

ABC Facebook – response to article on kangaroo culling.
From 'Injustice', Maria Taylor, published 2021.

History of kangaroo culling in the ACT

Between 2009 (when annual culling of Eastern Grey Kangaroos in Canberra nature reserves began) and 2016, the ACT Environment Directorate reported in the Kangaroo Management Plan 2017, that 14,335 kangaroos were killed (including over 2,000 pouch joeys). Approximately one third again of this number can be added to include pouch joeys also killed during culling, but which have been recorded and published in only three of these seven years.

In 2017, eastern grey kangaroos were declared a 'controlled native species' in the ACT. From 2017 to 2021, it was reported that 13,343 kangaroos have been killed, plus pouch joeys. The kangaroo industry standard allows for joeys to be killed by blunt force trauma to the head or decapitation.

The total number of kangaroos killed in Canberra's nature reserves and Googong Foreshores since 2009 is approximately 27,950 plus an estimated 7,000 – 9,000 in-pouch joeys, not already included in this count. An unknown number of at-foot joeys have died of starvation, dehydration, hypothermia or predation as a result of losing the protection of their mothers.

The statistics for each year's cull have been published by the Environment, Planning and Sustainable Development Directorate and were also reported in the ACT media.

The stated reason for the annual culls is that kangaroos are jeopardising the survival of threatened species listed previously. These species inhabit the box-gum grassy woodlands and natural temperate grasslands, which characterise much of the landscape of the Canberra nature reserves. At an ACT Civil and Administrative Tribunal (ACAT) hearing in 2013, a senior ecologist employed by the Directorate, speaking on behalf of the government, stated that this list of species allegedly impacted by kangaroo grazing was "PR".

It has been claimed that most of these species require intact grassy layers and that kangaroo grazing threatens this habitat. It has also been stated by the Directorate that an ideal density of kangaroos living on their preferred habitat – box-gum grassy woodlands – is 'one kangaroo per hectare'. At most,

this is a guideline and a generalisation since the landscapes in question vary from heavily wooded steep slopes (few kangaroos) to open grasslands (preferred habitat). No independently verified, scientific basis for this figure has ever been explained. At ACAT 2013, the senior ecologist employed by the Directorate described it as "a guess" and "wrong". With no further research to support it, this figure has somehow been accepted as "current knowledge".

Population counts of kangaroos began in 2009, using a variety of methods, which also varied among reserves. To date, 18 nature parks have experienced at least one cull of kangaroos. Some parks have been culled many times.

As far as can be determined, 19 reserves have not been included in the culling program.

Testimonial:
I've been walking in the Farrer Ridge Nature Park for over 30 years. Last year, in 2021, it was decided to cull the kangaroos. They claimed that there were 450 of them and that they were going to shoot 350. Their population has been stable for 30 years except for during drought when their population reduced – I knew there were only about 250 in the park.

I know the native plant species in the park, and I have never seen any damage caused to plants by kangaroos. Any damage caused is by uncontrolled weeds. They went ahead with the cull despite my protests. Following the cull, I was distressed to find spattered blood on rocks and gravel, possibly that of a joey battered to death after its mother had been shot. There are only 30 kangaroos there now.

The money spent on kangaroo culls would be better spent on caring for the reserves by tackling weed infestations before they spiral out of control and replacing them with native grasses.

And why kill kangaroos when pests such as rabbits, foxes and cats are left to multiply, and have been for many years.
Julie
Farrer, ACT

Citizen science project methodology

Our citizen-science project began on the 12 August 2021. The project has comprised a field study and desk-top research to analyse the Environment Directorate's own publications. The aim was to search for kangaroos in 37 nature reserves (two are closed to the public) and record numbers of kangaroos and where they were found in each reserve. We recorded the details of all explorations. To date we have undertaken 112 field surveys and spent a combined 406 hours, walking over 1,348 kilometres in 37 of the nature reserves.

Larger reserves such as Mt Ainslie and Mt Majura, which have experienced numerous kangaroo culls, were searched eight times. Large reserves were divided by us into segments so that we could ensure greater coverage of most terrain in the reserve. Very few kangaroos were found in elevated, densely timbered sites such as near the summits of hills such as Mt Majura, Mt Taylor and Black Mountain. While many densely wooded sites were searched, most kangaroos were found on lower slopes, on grassy hillsides or in valleys in lightly wooded areas. We have carried out at least two field studies, obtaining population counts on at least two separate dates, in all 37 reserves.

Our method is best described as a Direct Observational Count.

- We have recorded every kangaroo directly observed.
- Kangaroos seen on neighbouring land (such as rural leases) where migration was obviously possible were included in the count if they were nearby and likely to be a part of a mob living on the nature reserve.
- We did not extrapolate or make assumptions about the *possible* presence of kangaroos.
- We observed that kangaroos are never found evenly distributed across a landscape.

- We found that kangaroos have a connection to their home ranges, although they do move to other areas periodically, they tend to return to their home range.
- Our return field trips often (on subsequent days, but also up to 2 months apart) confirmed that mobs occupied the same general locality within a reserve, but also that they do move on/move back if there is scope to do so (such as adjoining rural lands, another reserve or mountain ranges, rather than suburbia).

We began all surveys on tracks in the reserves but deviated to follow kangaroo trails. We also used tracks created by other walkers and cyclists. In many reserves there are no tracks. We used hard copy topographic maps of each reserve and recorded sightings with the aid of GPS mapping. Wherever possible we endeavoured to complete a grid search of each reserve segment.

Binoculars were used to assist in counting, particularly in grasslands and across grassy hillsides. Photographs were taken during each field survey. Detailed records have been kept of all field trips.

Desk-based analysis of data published by the ACT Environment, Planning and Sustainable Development Directorate

The data in the tables below was sourced from the Environment, Planning and Sustainable Development Directorate, Kangaroo Management Plan 2017, 'Management Plan for Controlled Native Species 2017' and Eastern Grey Kangaroos Conservation Culling Advice 2018, 2019, 2020.

Definitions used in the tables below:

Counting method is the method used by the Directorate to assess the population each year of a particular nature reserve. (pellet count, sweep count, walked line transect, direct count, driven line transect).

During our consultation with both a biostatistician and a scientist, about the Directorate's range of counting methods they stated that:

'In order to change methods, it has to be shown statistically that the new method is equivalent or better, otherwise it can't be used' and

'Changing methods of counting invalidates the data if different results are being obtained.'

Population estimate is the result of the counting methods used by the Directorate. In numerous instances the population estimates vary widely in the same reserve and in the same year.

Undoubtedly this information is a matter of considerable interest, given that the size of population estimate resulted in culling recommendations, with the lives of kangaroos being at stake.

Kangaroos culled is the number culled that year from a particular reserve according to the Directorate's published data. The Directorate has not made public culling data for each reserve from 2017, 2018, 2019 and 2020.

Post-cull target is the desired number of kangaroos remaining in the reserve following culling, according to the Directorate.

Other data relating to kangaroo populations has been obtained by our field study which began in August 2021 and is an ongoing project. This data is headed **'Our Field Study Data 2021/2022'**.

1
The Pinnacle

Desk-based analysis of Kangaroo Management Reports by the ACT Environment Directorate.

Year	Counting method	Population Estimate	Kangaroos culled
2011	Pellet count	1,141	
2011	Sweep count (average of 2)	773	
2012	Driven line transect	462	104
2012	Sweep count	677	
2013	Sweep count (average of 2)	650	200
2013	Walked line transect	449	
2014	Sweep count (average of 2)	772	266 + 117 pouch joeys
2015	Sweep count (average of 2)	613	399 + 160 pouch joeys
2016			52 + 19 pouch joeys.
2017	Sweep count	297	127
2018			
2019	Walked line transect	191	
2020	Walked line transect	136	

There is no explanation for the widely varying population estimates in 2011 and 2012. Three different methods have been used (which may explain the extraordinary variance) and a cull of 104 occurred in 2012 but it is unclear how this number of kangaroos to be culled was calculated. Nor is it explained how the next population estimate in 2012 is 215 more kangaroos higher than the previous estimate (319 higher if this estimate took place after the cull.)

In 2013/2014 the two population estimates once again vary considerably (449 and 772). It seems that an extraordinary increase in population occurred following the cull of 200 in 2013, from 449 (post cull) to 772 to following year. Nevertheless, the culling of 717 kangaroos and 296 pouch joeys was carried out from 2014-2016 based on these estimates.

Total culled = 1,148 kangaroos and over 296 pouch joeys (recorded only in 2014/5/6).

Our Field Study data 2021/2022

This reserve, 154 ha in size, is largely cleared hillside with extensive grasslands. Remnant forest is found at various localities in the park and extensive tree planting since the 1980s has taken place. The reserve has been searched by this project on six occasions to date, as follows. The only kangaroos found, on the first four occasions, were in the same locality within the reserve, near the summit of the Pinnacle itself. The fifth field study in the reserve included an additional search area – the south-eastern area, where 55 kangaroos were observed, just outside the boundary.

Dates	Time and locality in park	Population observed
12 August	1 hour 15 minutes. Open grassland over much of the reserve with forested area. Kangaroos seen in central area.	12
1 October	2 hours in the central and western areas of the reserve.	15 (3 added to previous tally)
11 November	1 hour – kangaroos found in same area on each of these three field studies.	16 (1 added to tally)
23 November	2 hours – eastern area – grassland and forested areas	7 (not added to tally, previously seen), seen in vicinity of previous sightings.
24 November	1 hour – SE area. Kangaroos sighted on boundary of agistment area.	55
7 January	1 hour – NE and central area. The park was hit by a severe storm (thunder/lightening/heavy rain) only days before and many large trees were knocked over.	1 (on neighbouring rural land. Other members of this mob may have also been there, following the storm). Not added to tally.
	8 hours 15 minutes x 2 researchers	**71 kangaroos**

The Directorate's post-cull target was 79 in 2017, 94 in 2018, and 80 in 2019 and 142 in 2020.
Our 2021 population count for this park is 71.

2 Goorooyarroo including:

Dunnarts Flat

Forest Exclosure

Desk-based analysis

Year	Counting method	Population estimate	Kangaroos culled
2011	Pellet count	1,488	843
2012	Pellet count	2,055	629
2012	Driven line transect	1,149	
2013	Walked line transect	1,145	
2013	Sweep count	189	725
2014	Pellet count	32	663 + 231 joeys
2014	Sweep count	93	
2014	Sweep count	111	
2015	Sweep count	87	93 + 36 joeys
2016			19 + 9 joeys
2017	Walked line transect	796	147
2018		761	97 (recommended to cull)

Combined exclosures

2019		1,137	680 (high priority to cull)
2020		715	450 (high priority to cull)
2014	Walked line transect	616	
2013	Walked line transect	1,642	
2013	Walked line transect	1,200	
2015	Walked line transect	817	
2021			59 + 21 joeys

Goorooyarroo was first culled in 2010, combined with the adjacent reserve, Mulligans Flat, when 1,208 kangaroos were shot. The population estimates from year to year vary enormously.

Kangaroos were culled every year from 2011 until 2017. The total number culled was 3,119 (excluding the 1,208 culled in 2010 when both reserves were culled of this number. A proportion of the 1,208 could reasonably be added to this total). In three years (2014, 2015 and 2016, the culling of pouch joeys was recorded, totalling 276.
In 2018, in 2019 and in 2020, 97, 680 and 450 Kangaroos were 'recommended for culling.
If culling numbers reached the total recommended for culling, then this adds 1,227 to the previous count of 3,119 (plus a proportion of the 2010 cull).

This reserve was culled in 2021 with 59 kangaroos being killed plus 21 pouch joeys.

This would result in 4,405 kangaroos (plus joeys) having been culled from Goorooyarroo plus a proportion of 1,208 kangaroos culled from both Mulligans Flat and Goorooyarroo in 2010.

Our Field study data 2021/2022

Goorooyarroo is an 829ha reserve bordering NSW in the far north of the ACT, adjacent to the Federal Highway on one side. It also shares a boundary with Mulligan's Flat. Goorooyarroo is lightly timbered with extensive grasslands, an undulating landscape featuring several large hills including Gecko Hills, Burnt Stump and Old Joe Hill.

Date	Time and locality in park	Population observed
20 September	1 hour, along western edge of Dunnarts Flat and north of Throsby.	NIL
23 September	1 hour 45 minutes. Foothills and summit of Sammy's Hill. No sightings on Sammy's Hill, but a mob was found at the base of the hill.	44
1 December	3 hours along/near Goorooyarroo track, throughout centre of park, S to N and return.	12
7 December	2 hours summit and foothills of Gecko Hills	94 including 25 in Euro Valley and 5 on Burnt Stump.
8 January 2022	2 hours summit and foothills of Burnt Stump and Euro Valley towards Old Joe Hill	10 (including 5 previously seen and not added to tally)
13 January 2022	2 hours north of Burnt Stump, to foothills north of Old Joe Hill	27
9 April 2022	2 hours in far north of the reserve and western edge along Dunnarts Flat	27
	13 hours 45 minutes x 2 researchers	**209 kangaroos**

Goorooyarroo was searched on 7 occasions to date. By far the greatest number of kangaroos – like Mulligan's Flat – have been located **outside** the exclusion fences, including on the steep hillside of Gecko Hills. On this vast landscape, kangaroos could not be described as 'overabundant'.

The Directorate's post-cull targets for 2017 were 648, 664 in 2018, 457 in 2019 and 265 in 2020.

Our 2021/2022 population count to date for this park is 209 to date.

3
Mt Painter

Desk-based analysis

Year	Counting method	Population estimate	Kangaroos culled
2010	Sector count	556	221
2010	Sector count	478	
2011	NIL	NIL	106
2012	Sweep count	492	18

(Aranda added to Mt Painter program in 2019)

2013	Sweep count	432	
2013	Sweep count	475	
2014	Sweep count	477	135 + 44 joeys
2014	Sweep count	303	
2015	Sweep count	382	110 + 51 joeys
2016			58 + 19 joeys
2017			99
2018	Sweep count	319	72 (medium priority to cull)
2019		419 (including Aranda)	159 (medium priority to cull)
2020	Walked line transect	519	218 (recommended for culling)

Total kangaroos culled = 747 and over 114 pouch joeys (recorded only in 2014/5/6). There were 449 recommended to cull from 2018 to 2020.

Our Field study data 2021/2022

Mt Painter is a 93ha reserve in Cook, bordered by William Hovell Drive and Coulter Drive. It is largely cleared of vegetation (other than grass and paddock trees) and can be easily viewed from many vantage points. It is also bordered by horse paddocks and rural leases.

Date	Time and locality in park	Population observed
15 August	1 hour 30 minutes – partial foothills and summit	84
20 November	2 hours 30 minutes around foothills and also summit.	162 (*78 added to previous tally).*
	4 hours x 2 researchers	**162 kangaroos**

The Directorate's target post-cull population for Aranda/Painter in 2019 was 116 and, in 2020, 122 kangaroos to remain in the reserve.

This is one of the eight reserves researched during this project that exceeded the '1 kangaroo per hectare' ratio cited as the highest number (of kangaroos) desirable for maintaining ecosystems in grassy woodlands. Despite this, there is no evidence of damage to the intact grassy layer. Livestock are usually seen grazing on the lower slopes.

Our 2021 population count for kangaroos in this park is 162.

Mt Painter was combined with Aranda Bushlands for the purposes of 'kangaroo management' in 2020. Population estimates for 2020 and recommendations to cull were included in the statistics for Aranda.

4 Percival Hill

Our Field study data 2021/2022

Percival Hill, an 81ha reserve, has never formally been included in the culling program. The reserve consists of low-lying grasslands along Ginninderra Creek, and both forested and cleared hillsides. The reserve borders the suburb of Nicholls. Barton Highway and Gundaroo Drive also border the reserve.

Date	Time and locality in park	Population observed
16 August	1 hour – throughout forested area, hillsides and summit	23
3 October	1 hour 15 minutes – throughout forested area, hillsides and summit	22 (*previously seen in same locality, in forested area, not added to tally*)
30 March 2022	2 hours – along northern edge of park from east to west and return via Ginninderra Creek.	120 (23 previously seen in same patch of bushland and not added to tally). 97 added to tally).
	4 hours 15 minutes x 2 researchers	**120 kangaroos**

In the past (prior to this project) up to 100 kangaroos were observed in this reserve on a few occasions. They have also been seen grazing on the nearby Gold Creek Golf course. The field trip on 30 March sought to confirm these sightings.

The 2021/2022 population count for kangaroos for this reserve is 120.

5 Gungaderra Grasslands

Desk-based analysis

Date	Counting method	Population estimate	Kangaroos culled
2013	Sweep count	645	
2014	Sweep count	747	
2014	Walked line transect	888	
2014	Pellet count	742	
2015	Sweep count	765	486 + 208 joeys
2016			108 + 48 joeys
2017		335	
2018	Sweep count	431	Post cull target 591 (no cull)*
2019	Sweep count	580/610 both numbers cited	280 (high priority to cull, with 300 to remain)
2020	Sweep count	373	164 (high priority to cull, with 209 to remain)

A total of 594 kangaroos were culled in the years 2015-6 and 256 joeys were also culled. In 2019 and 2020, the grasslands were a high priority for culling, and 444 were recommended to be culled.

If the culls in the latter years resulted in 444 kangaroos being culled, the total culled will be 1,038.

Our Field study data 2021/2022

Gungaderra Grasslands is a 297ha reserve located between Barton Highway and Gungahlin Drive and bordered by Palmerston on the northern side. Although it is predominantly a grasslands park, there is a substantial area of forest adjacent to the suburb of Crace. Most kangaroos found in this reserve inhabit this area and the grasslands adjacent to the suburbs of Crace and Palmerston.

Date	Time and locality in park	Population observed
21 August	1 hour 30 minutes – NW of park	27
30 August	1 hour – grasslands near Crace	33
11 September	1 hour – bushlands near Crace	8
18 September	1 hour 15 minutes -grasslands near Crace	68 (previously seen)
28 September	1 hour – Gungahlin Hill	70 (previously seen, plus 2 added to tally)
7 October	1 hour – NE side near Palmerston	NIL
	6 hours 45 minutes x 2 researchers	**70 kangaroos**

Field studies of the NW of the reserve, across grasslands and through light forest have resulted in an observation of 'strong fidelity' to a home range. Seventy kangaroos were seen in this area over several occasions (the first three field studies adding to a total which equals the numbers observed on the last two field studies.)

***The Directorate's post-cull target – in 2018 was 591. No cull took place perhaps because there were less than that number in the reserve. Post-cull target for this park in 2019 was 300 and in 2020 was 209.**

To date our 2021 population count of kangaroos in this reserve is 70. Further exploration will include other segments of the reserve. An initial survey of the NE segment of the park revealed no kangaroos.

6 Molongolo River Gorge

Our Field study data 2021/2022

According to published records, this 506ha reserve has never been included in the culling program. The reserve runs along 23 kilometres of the Molonglo River.

Date	Time and locality in park	Population observed
23 August	1 hour and 15 minutes in southern area of the park.	13
7 October	1 hour – lower Molonglo near Butters Bridge	NIL
8 October	2 hours 30 minutes – near Coombs	1
	4 hours 30 minutes x 2 researchers	**14 kangaroos**

Given the nature of the reserve (its size and terrain - following the course of the river – rugged banks that are not always navigable) it is not possible with our resources to estimate the kangaroo population for this reserve. Further searches will be undertaken over time.

7
Bruce Ridge

Our Field study data 2021/2022

This 98ha reserve has never been included in the culling program.
The terrain is quite steep and rugged, with limited grassland - predominantly dry sclerophyll forest - and is largely not habitat preferred by eastern grey kangaroos. No evidence of macropod activity was sighted.

There are two wildlife-friendly underpasses suitable for a variety of fauna, including kangaroos.

Date	Time and locality in park	Population observed
25 August	1 hour 30 minutes – throughout reserve	NIL
12 December	2 hours - throughout reserve	NIL
	3 hours 30 minutes x 2 researchers	**NIL**

Our 2021 estimate of kangaroos in this reserve is NIL.

8
Aranda Bushlands

Aranda & Mt Painter (added in 2020)

Desk-based analysis

Date	Counting method	Population estimate	Kangaroos culled
2010	Sweep count	196 (bushlands)	
2013	Sweep count	184 (snowgums)	
2017	Sweep count	392	
2018		418	358 (cull may not have occurred see population estimate for 2019)
2019	Walked line transect	419	159
2020	Walked line transect	340 combined with Mt Painter	218 (medium priority to cull)

Total kangaroos culled = 735 (including those culled at Mt Painter in 2020). Records indicate the reserve was recommended for culling in 2018 (to cull 358 but this would have left only 60 kangaroos in the reserve and the following year the population is 275. However, if the cull hadn't occurred, presumably a cull of some number took place to account for the 2019 population drop to 275).
Aranda was not a culling priority in 2019 although 159 were recommended to cull.

Our Field study data 2021/2022

This reserve of 104ha, includes elevated bushland areas bordering the suburb of Aranda. The terrain and vegetation is not ideal habitat for kangaroos, although a few were seen in the lower slopes where good shelter and feeding grounds can be found. The lower slopes (and snowgums area) are grassland areas, and most kangaroos have been sighted in these areas. The reserve is also bordered by William Hovell Drive and Caswell Drive.

Dates	Time/locality	Population observed
26 August,	1 hour 30 minutes – northern bushlands area of reserve.	Nil
27 August	1 hour 30 minutes – southern bushlands and grasslands.	36
13 September	1 hour 15 minutes – bushlands eastern side	Nil
9 December	1 hour 30 minutes – lower slopes, eastern grasslands.	63 (36 previously seen on grasslands and eastern side lower slopes. 27 added to tally.
Totals	**5 hours 45 minutes x 2 researchers**	**63 kangaroos**

The Directorate's post cull target number of kangaroos was 60 in 2018, 116 in 2019 and 122 in 2020 (combined with Mt Painter).

Our 2021 population count for this park is 63.

9
Mt Ainslie/Mt Majura

Desk-based analysis

Date	Counting method	Population estimate	Kangaroos culled
2012	Pellet count	872 (Mt Ainslie)	
2012	Pellet count	781 (Mt Majura)	
2013	Pellet count	598 (Antill St)	
2015	Walked line transect	4,499	
2016			461 + 154 joeys.
2017	Walked line transect	3,109	414
2018		3,143 or 5,750 including West Majura Grasslands and Canberry Fair)	
2019	Walked line transect	2,099	1,734 (high priority to cull)
2020	Walked line transect	1,380	1,094 (high priority to cull)
2021			840 + 348 joeys

The population count for the years 2012 and 2013 indicate a kangaroo population of 2,251. Two years later, in 2015, the population of Ainslie/Majura was 4,499. A different counting method was used which may account for an extraordinary increase in population estimate.

Culling of kangaroos in these reserves began in 2016, when 461 were culled plus 154 joeys. Following this cull, in 2017, the estimated population had dropped to 3,109 but it is not made clear what had happened to the unaccounted 929 kangaroos. In 2017, a cull at Mt Ainslie (207) and Canberry Fair (207) occurred. Another 2,828 were recommended to be culled in 2019 and 2020. However, these reserves were not apparently closed for culling in these years.

These two reserves were culled in 2021, with 840 kangaroos being killed, plus 348 pouch joeys.

At least 1,715 kangaroos plus joeys have been culled in these two reserves.

Our Field study data 2021/2022

These reserves combined are 1,139 hectares in size. The terrain is varied, including the steep, densely forested mountain peak of Mt Majura where no kangaroos were observed, likewise the pine forests where none were expected to be seen.
There are extensive grasslands on the lower slopes, lightly timbered on both Mt Majura and Mt Ainslie. All the kangaroos seen in these two nature reserves were in various localities within these areas, in small – medium sized mobs.

Date	Time/locality	Population observed
27 Aug	1 hour 30 minutes – southern area Mt Ainslie	41
30 Aug	2 hours 15 minutes – NW area Mt Majura	47
1 Sept	1 hour 45 minutes – SE area Mt Ainslie	29
2 Sept	1 hour 30 minutes – vicinity Majura Pines	NIL
3 Sept	1 hour 30 minutes -western area Mt Majura	43
6 Sept	1 hour 30 minutes – SW area Mt Ainslie	27
10 Sept	1 hour 15 minutes – Mt Majura	9
21 Sept	2 hours 15minutes – summit and eastern side	NIL
	13 hours 30 minutes x 2 researchers	**196 kangaroos**

The Directorate's post-cull target population for the parks in 2018 was 423, 365 in 2019 and 286 in 2020.

Our 2021 population count for these combined parks is 196.

10
Mulligans Flat

Desk-based analysis

Date	Counting method	Population estimate	Kangaroos culled
2011	Sweep count+	1,253 (outside exclosures) + 142	942
2012	Driven line transect + Sweep count	451 + 133	191

2013	Sweep count (2) + WLT	527 + 282/254 + 90	78
2014	Walked line transect	213	249 + 90 pouch joeys
2015	Walked line transect + sweep count	531 + 89	
2016			442 + 136 pouch joeys
2017	Walked line transect + sweep counts	349	50
2018	Walked line transect + sweep counts	441	224
2019	Walked line transect + sweep counts	532	467 (high priority to cull)
2020	Walked line transect	144	84 (high priority to cull)
2021			55 + 14 pouch joeys

Mulligans Flat was culled again in 2021 with 55 kangaroos being killed plus 14 pouch joeys.

The total number of kangaroos culled is 2,231 and 240 pouch joeys counted only in 2014 and 2016 and 2021. 551 were a high recommendation to cull in 2019 and 2020 and if these culls occurred, the number culled would total 2,727. The reserve was closed for culling in 2019.

Population estimates have been done on 20 occasions since 2010. The list above has combined some of these population counts where more than one was completed in the same year. Different population estimates for different areas of the reserve were included for that year. Different geographic areas of the reserve have not been identified because the overall result and information is not affected.

The Directorate's post cull targets were 299 in 2017, then 219 in 2018, 65 in 2019 and 60 in 2020, reducing every year for 4 years.

Our Field study data 2021/2022

Mulligans Flat is a 984ha reserve with protective fencing to allow for protection of native animals against introduced predators and is the site of the bettong breeding program. The landscape is relatively flat with scattered paddock trees and remnant forest. Most kangaroos have been sighted *outside* the fenced area of the sanctuary, within different areas of the nature reserve.

Date	Time and locality in park	Population observed
13 August	2 hours / western strip of park outside sanctuary	100+ (some obscured by vegetation)
8 September	2 hours 30 minutes – southern area of park inside the sanctuary	19
12 December	3 hours – south and western strip outside and inside sanctuary	148 – 14 inside sanctuary and 134 outside sanctuary. (*100 previously counted in same locality and not added to tally, 48 added.)*
17 January 2022	2 hours 30 minutes – Little Mulligans	104
23 January 2022	2 hours – NW sector of Little Mulligans	20
5 April 2022	2 hours - northern strip – west to east-return	44
	14 hours x 2 researchers	**335 kangaroos**

Further field studies in this reserve will be carried out in future, inside the sanctuary itself where most culling has occurred. Most kangaroos counted are within the nature reserve but outside the sanctuary fence.

Our 2021/2022 population count for this reserve is 335 kangaroos.

11 Cooleman Ridge

Our Field study data 2021/2022

This 187ha reserve has never been included in the culling program.
The ridge has extensive grasslands, forested areas and includes Mt Arawang in the south which has been partly cleared.

	Date	**Time and locality in park**	**Population observed**
	15 September	2 hours 30 minutes – north and centre of park	15
	16 November	2 hours – north and centre of park	15 (6 on neighbouring rural lease, not added to tally)
	18 November	2 hours – Mt Arawang – foothills, hillsides and summit	75
		6 hours 30 minutes x 2 researchers	**90 kangaroos**

Our 2021 population count of kangaroos for this reserve is 90.

12
Mt Pleasant

Our Field study data 2021/2022

This 57ha reserve has never been included in the culling program.
This small reserve is divided in two by Northcott Drive. The reserve is overrun with a variety of well-established weeds. There were no signs of kangaroos in the reserve.

Date	**Time and locality in park**	**Population observed**
16 September	1 hour – both sides were explored.	NIL
22 April 2022	1 hour – northern side explored	NIL
	2 hours x 2 researchers	**NIL**

13
Mt Taylor

Desk-based analysis

Date	**Counting method**	**Population estimate**	**Kangaroos culled**
2010	Direct count	407	
2013	Direct count	483	
2019	Walked line transect	1,067	445 (low priority, presumably not culled)
2020	Walked line transect	564 (or 494)	335 (low priority, presumably not culled)

These population estimates vary widely; the only explanation perhaps being the two different methods of counting. The population estimate of 2019 cannot be explained by population growth when compared to the previous two counts, as this would be biologically impossible. There is no explanation for the nearly 50% drop in population from 2019 to 2020.

It appears that this reserve is being investigated for kangaroo population and has recommendations for substantial culling but hasn't been seen as a high priority at this stage.

Our Field study data 2021/2022

Mt Taylor is a 300ha park featuring foothills and the hill, Mt Taylor. The foothills are generally grasslands and lightly timbered country. Dense forest is found at the steep sides closer to the summit, less suitable kangaroo habitat.

Date	**Time and locality in park**	**Population observed**
22 September	2 hours, base to summit. Limited off-track search.	NIL
24 September	2 hours 15 minutes foothills around base and exploration off track	46
6 November	2 hours 30 minutes – western side of park.	80
	6 hours 45 minutes x 2 researchers	**126 kangaroos**

Our 2021 population count of this reserve is 126.

14
Farrer Ridge

Desk-based analysis

Date	**Counting method**	**Population estimate**	**Kangaroos culled**
2011	Sweep count	517	
2012	Driven line transect	500	

2012	Sweep count	512	
2013	Walked line transect	496	
2013	Sweep count	530	
2014	Walked line transect	451	
2014	Pellet count	549	
2014	Sweep count	514	
2015	Walked line transect	682	
2016			
2017			
2018			
2019	Walked line transect	299	169 (low priority to cull)
2020	Walked line transect	465	372 (low priority to cull)
2021	Walked line transect	409	296 + 120 joeys

Although population counts were done at this site nine times over four years, no culling during that time has been recorded in reports. There is no apparent explanation for the population estimate of 682 in 2015 and four years later a population estimate of 299. Likewise, there is no explanation for the jump in population from 2019 (299) to 2020 (465). According to records, culling (of 169) was recommended in 2019. The reserve was considered a low priority for culling of 372 kangaroos in 2020. In 2021, a cull of 296 kangaroos was caried out, plus 120 joeys.

A cull of 296 kangaroos and 120 pouch joeys took place in 2021.

Our Field study data 2021/2022

This 185ha reserve is undulating with extensive grassland and lightly forested areas. Some denser forest is found higher up the slopes to the summit of the ridge. Kangaroos in few numbers were found in lightly forested lower slopes.

Date	Time/locality in park	Population observed
26 September	2 hours – throughout most of the reserve, including foothills and summit	9
28 September	2 hours – SE eastern side	5 (4 seen previously plus 1 nearby)
17 October	1 hour 15 minutes – NW in grasslands and lightly timbered areas.	22
24 May 2022	2 hours 45 minutes – West to east across most of reserve.	28 (previously seen in same localities)
	8 hours x 2 researchers	**32 kangaroos**

The post cull target in 2020 for this reserve was 101.

Our 2021/2022 population count for this park is 32.

15
Oakey Hill

Our Field study data 2021/2022

Oakey Hill, a 66ha reserve, has never been included in the culling program.
The park features Oakey Hill and is surrounded by forested hillsides and open grasslands.

Date	Time and locality in park	Population observed
30 September	1 hour 30 minutes – northern end and summit	53
5 October	1 hour 30 minutes – including southern end and summit	79
	3 hours x 2 researchers	**79 kangaroos**

The 53 kangaroos sighted during the first field study were in much the same locality on the second field study, in two groups. A third group was found on the southern side of the reserve which hadn't been explored during previous field studies.

This is one of the eight reserves researched during this project that exceeded the '1 kangaroo per hectare' ratio cited as the highest number (of kangaroos) desirable for maintaining ecosystems in grassy woodlands. Despite this, there is no evidence of damage to the intact grassy layer.

Our 2021 population count for this reserve is 79.

16 Wanniassa Hills

Desk-based analysis

Date	Counting method	Population estimate	Kangaroos culled
2012	Driven line transects	332	112
2013	Walked line transect	1,133	
2013	Walked line transect	1,760	
2013	Walked line transect	1,803	
2014	Pellet count	784	
2014	Walked line transect	1,167	
2015	Walked line transect	1,572	202 +98 pouch joeys
2017	Walked line transect	1,154	

There is no apparent explanation for the great discrepancies in population estimates for Wanniassa Hills from year to year other than that the driven line transects used in 2012, was 'discontinued as a counting method due to unreliability'. The variation in numbers counted using the Walked Line Transect method is noted. In 2013 the results, for instance, varied from 1,133 to 1,803.

The total number of kangaroos culled in the reserve was 314 and 98+ pouch joeys (noted only in 2015).

The reserve was added to the culling program in 2012 and removed in 2015 (after culling), however 564 were recommended for culling in 2018.

Our Field study data 2021/2022

This 262ha reserve features Wanniassa Hill, largely open grasslands and forested areas on steep slopes. It supports one of the largest kangaroo populations observed during this research. It is contiguous with the Wanniassa Hills Special Reserve which is predominantly grasslands.

Date	Time and locality in park	Population observed
2 October	2 hours 30 minutes-from Long Gully Rd throughout NE area of the reserve	200 plus (some partly obscured by vegetation)
29 November	2 hours – SE area of reserve	16 (including 7 seen previously along ridgeline. 9 added to tally)
15 December	2 hours – NE area (seeking to confirm 200 tally). Added strip on part of Erindale Dr, none found.	85 (previously seen and not added to tally).
	6 hours 30 minutes x 2 researchers	**209+ kangaroos**

A subsequent count was undertaken of the MacArthur Horse Paddocks and Wanniassa Hills Special Reserve where over 200 kangaroos were seen (not included in tally). Movement between the nature reserve and the special reserve/horse paddocks could account for different counts occurring on the first and third survey of the same area.

Our 2021 population count for this reserve is 209+ kangaroos (some possibly obscured by woodland).

17 Gossan Hill

Our Field study data 2021/2022

This 47ha reserve has never been included in the culling program.
There are lightly forested areas throughout most of this reserve and some areas of grassland suited to kangaroos, particularly in the western end of the reserve. The terrain in the east is largely rocky with limited open grasslands available for kangaroo grazing. The reserve borders Hayden Drive on the eastern side and the suburb of Bruce on other sides.

Date	Time and locality in park	Population observed
9 October	1 hour 30 minutes – throughout reserve	29
5 December	1 hour – throughout reserve with exception of (eastern) area near Haydon Drive where 4 kangaroos were seen on 9 October.	32 (most previously seen, 3 added to tally)
	2 hours 30 minutes x 2 researchers	**32 kangaroos**

One field study of 1.5 hours was undertaken on 9 October and a total of 29 kangaroos were observed. A second survey was undertaken on 5 December for one hour, during which time 32 kangaroos were counted. The small size of this reserve enables researchers to easily undertake a full count.

Our 2021 population count for this reserve is 32.

18
O'Çonnor Ridge

Our Field study data 2021/2022

This 57ha reserve has never been included in the culling program.
The reserve includes dry sclerophyll forest, open grasslands and a small pine forest. The few kangaroos inhabiting the reserve show fidelity to their preferred location in the forested areas and nearby grasslands.

Date	Time and locality in park	Population observed
10 October	2 hours – throughout park. Kangaroos found along NW edge of reserve.	15
8 December	2 hours – throughout reserve. Kangaroos found in same locality.	11
	4 hours x 2 researchers	**15 kangaroos**

The terrain is largely stony ground with dry sclerophyll forest, comparatively small areas of grasslands for grazing.

Our 2021 population count for this park is 15.

19
Callum Brae

Desk-based analysis

Date	Counting method	Population estimate	Kangaroos culled
2009			140
2010			200
2011	Pellet count	421	252
2012	Driven line transects	242	100
2013	Walked line transect	252	94
2014	Walked line transect	367	126 + 45 pouch joeys
2015	Walked line transect	283	284 + 103 pouch joeys
2017	Walked line transect	288	162

It appears that no baseline population data was obtained prior to the culling of 340 kangaroos in 2009 and 2010. Analysis of the population estimates, and the cull numbers reveal a curious outcome. In 2011, there was an estimate of 421 with 252 being culled, leaving 169.

In 2012, there was a population increase from 169 to 242 and 100 were culled, leaving 142. In 2013 this population increased in size to 252 and then 94 were culled, leaving 158. In 2014, there is a substantial increase in population from 158 to 367. (This *may* be due to immigration from a neighbouring reserve via a narrow access). 126 were culled leaving 241. In 2015 this population had risen to 283, and 284 were culled, leaving 'minus 1' kangaroo in the reserve. However, two years later in 2017 a WLT resulted in a count of 288 kangaroos and 162 were culled in that year.

This reserve was combined with Jerrabomberra West for the purposes of 'kangaroo management' in 2019. According to published data, the reserve was closed for culling in 2018, 2019 and 2020, but this is not reflected in the Directorate's data.

The total number of kangaroos culled in this reserve is 1,358 and over 148 pouch joeys (the latter recorded only in 2014 and 2015). The reserve was closed for culling in 2018, 2019 and 2020 and the total of 1,358 adult kangaroos does not include the kangaroos killed in those three years.

Our Field study data 2021/2022

Callum Brae is a 143ha reserve, largely undulating with open grasslands and box-gum forests. The remaining kangaroos are scattered in small numbers throughout the reserve with little obvious mob structure.

Date	Time and locality in park	Population observed
12 October	3 hours – throughout reserve which is undulating and lightly forested.	42
30 November	2 hours – throughout reserve except for northern areas where none were found on previous field study.	40
	5 hours x 2 researchers	**42 kangaroos**

Our 2021 population count for this reserve is 42.

20
Kama

Desk-based analysis

Date	Counting method	Population estimate	Kangaroos culled
2009			75
2010			57
2011	Pellet count	239	
2012	Driven line transect	94	
2013	Pellet count	106	27
2017	Walked line transect	568	
2019	Walked line transect	382 or 1,047	108
2020	Walked line transect	581	

The population estimates for this reserve appear to be completely unreliable, showing a dramatic increase from 2013 to 2017 (biologically impossible). Perhaps there was substantial immigration or perhaps the varied counting method account for the differences. The records of numbers culled on this reserve don't reflect what culls must have occurred. The reserve was closed for culling 2017 but the records state no kangaroos were targeted for culling in that year. In 2019 the reserve was again closed for culling (target 108) but the kangaroo population in 2020 does not reflect either of the population counts for 2019 (382 or 1,047), nor a cull of 108 kangaroos.

The total number of kangaroos culled in this reserve, according to available data, is 267, plus joeys.

Our Field study data 2021/2022

Like Callum Brae, and many other nature reserves, Kama, a 155ha reserve was formerly a farm. It is an undulating park-like landscape with light forest, numerous paddock trees and open grasslands, ideal kangaroo habitat. The reserve slopes towards the Molonglo Valley. It is bordered by William Hovell Drive. A kangaroo-friendly underpass between Kama and the Pinnacle would improve connectivity and could ensure wildlife well-being for kangaroos and other wildlife, especially during prolonged drought.

Date	Time and locality in park	Population observed
13 October	2 hours 15 minutes – loop walk, including some off track (track is undefined in most places)	78
2 November	2 hours – alternative loop, on and off track. Eastern side of reserve bordering rural lease was not covered during this field study.	56 (previously seen, not added to tally)
24 November	2 hours – around perimeter of the reserve and through multiple areas of remnant forest.	144 (34 previously seen)
	6 hours 15 minutes x 2 researchers	**144 kangaroos**

Our 2021 population count for this park is 144.

21
Mt Mugga Mugga/ Isaacs Ridge

Desk-based analysis

Date	Counting method	Population estimate	Kangaroos culled
2016			818 + 403 joeys
2017	Walked line transect	468	
2018		378	51
2019	Walked line transect	712 or 907	472 (high priority to cull)

No records have been cited for population estimates before the cull of 818 kangaroos and 403 joeys in 2016. It was 'added to the program' in 2016. There is no explanation as to the drop of 90 kangaroos from 2017 to 2018.

There are two records of a population count taking place. There is no obvious explanation for the almost doubling of the population from 2018 to 2019 or for the two separate estimates of population size in 2019, or the significant variation in those two estimates. The second estimate of 907 would indicate an extraordinary increase in population from a base of 378 (529 additional kangaroos).

The total number culled in Mt Mugga Mugga/Isaacs Ridge was 869 plus 403 joeys (recorded in 2016).

If the 2019 cull occurred as recommended, either in 2019 or 2020 (when the reserve was closed for culling), then this adds approximately another 472 making a total of 1,341 kangaroos culled plus joeys.

Our Field study data 2021/2022

Mt Mugga Mugga is a 148ha nature reserve, contiguous with Isaacs Ridge, of 387ha. Mt Mugga Mugga is box-gum grassy woodland with some cleared land, but mostly lightly forested. Isaacs Ridge has a pine forest (not explored), has dense vegetation in the southern areas of the reserve and overrun with weeds and very long grass. Higher elevations contain greater density of bushland, generally not preferred habitat of kangaroos, however much of the combined reserves are open grasslands. An underpass across Hindmarsh Drive connecting with Red Hill nature reserve would provide connectivity for wildlife.

Date	Time/locality	Population observed
15 October	1 hour – south and western area of reserve (Mt Mugga Mugga)	89
15 October	1 hour 30 minutes – northern area of Isaacs Ridge	44
31 October	2 hours – southern area of Isaacs Ridge – very rough terrain, weeds and long grass	17
1 November	2 hours – eastern area of Mt Mugga Mugga	73
	6 hours 30 minutes x 2 researchers	**223 kangaroos**

The Directorate's post-cull target population in 2018 was 313 and 2019 was 241.

Our 2021 count of kangaroo population is 223.

22
Urambi Hills

Our Field study data 2021/2022

Urambi Hills, a 246ha reserve has never formally been included in the culling program.
The Urambi Hills dominate the reserve. The hillsides are largely cleared of forest and are overrun with weeds, but paddock trees provide shelter. The reserve borders the Bullen Ranges and Tuggeranong Creek runs through the reserve.

Date	Time and locality in park	Population observed
18 October	3 hours – entire foothills area, western slopes adjacent Bullen Ranges, Tuggeranong Creek and suburb of Kambah	353
19 January 2022	1 hour 30 minutes – both summits and eastern hillsides, not explored on previous field trip.	113
	4 hours 30 minutes x 2 researchers	**466 kangaroos**

This is one of the eight reserves researched during this project that exceeded the '1 kangaroo per hectare' ratio cited as the highest number (of kangaroos) desirable for maintaining ecosystems in grassy woodlands. Despite this, there is no evidence of damage to the intact grassy layer, other than on the hillsides which are completely overrun with uncontrolled weeds.
Kangaroos could freely migrate between the reserve and Bullen Ranges.

Our 2021 population count for this park is 466.

23
Red Hill

Desk-based analysis

Date	Counting method	Population estimate	Kangaroos culled
2010	Sweep count	465	
2011	Sweep count	701	
2012	Sweep count	884	
2019	Walked line transect	729 (or 976)	572 (low priority to cull)
2020	Walked line transect	778 (or 1,042)	667 (medium priority to cull)

The population estimate of 2011 and 2012 includes the Federal Golf Course (approximately 100 kangaroos). Walked line transects apparently occurred in 2019 and 2020. Two differing population estimates are recorded in these two years, but no explanation is apparent for the varied results.
No culling data is available and published information indicates that culling has not occurred at Red Hill.

Our Field study data 2021/2022

This 293ha reserve is densely wooded in parts, particularly near the summit of Red Hill. These steep wooded slopes were surveyed, and few kangaroos were sighted there. The extensive grasslands on the lower slopes, the ridgeline between the two hills and more lightly wooded areas were the preferred habitat of most of the kangaroos found on Red Hill itself. Davidson Hill was populated by groups of kangaroos from base to summit and various localities. The reserve is bordered by five suburbs: Red Hill, Forrest, Deakin, Hughes and Garran, and also by Hindmarsh Drive.

Date	Time and locality in park	Population observed
20 October	2 hours 30 minutes – Davidson Hill summit and foothills	188
22 Oct	1 hour 30 minutes – NW side of Red Hill	80
16 December	1 hour 30 minutes – NW area between Deakin/Hughes	65
	5 hours 30 minutes x 2 researchers	**333 kangaroos**

This is one of the eight parks researched during this project that exceeded the '1 kangaroo per hectare' ratio cited as the highest number desirable for maintaining ecosystems in grassy woodlands.

Despite this, there is no evidence that there is damage to the intact grassy layer, other than by excessive weeds, particularly in the NW of the park. Given that the park is bordered by suburbia and the Federal Golf course, suitable underpasses would ensure kangaroos could increase their feeding range eg under Hindmarsh Drive to Mt Mugga Mugga/Isaacs Ridge.

The Directorate's post-cull target following proposed culling in 2019 was 157 and in 2020 was 111.

Our 2021 population count to date for this reserve is 333.

24 McQuoids Hill

Our Field study data 2021/2022

McQuoids Hill, a 56ha reserve has never formally been included in the culling program.
This small park is dominated by McQuoids Hill, which has partially cleared hillsides. The grasslands extend from the lower slopes to the summit. The reserve is surrounded by horse paddocks, rural leases and the suburb of Kambah.

Date	Time and locality in park	Population observed
21 October	2 hours around foothills and to summit from eastern side	73
15 November	2 hours foothills, summit and forested western slope (57 in this area, added to tally).	130
	4 hours x 2 researchers	**130 kangaroos**

This is one of the eight reserves researched during this project that exceeded the '1 kangaroo per hectare' ratio cited as the highest number desirable for maintaining ecosystems in grassy woodlands. Despite this there is no evidence of damage to the intact grassy layer.

Our 2021 population count for this park is 130.

25 Tuggeranong Hill

Our Field study data 2021/2022

Tuggeranong Hill, a 365ha reserve has never formally been included in the culling program.
The park features the very steep Tuggeranong Hill, which is rocky in places, quite well forested. Grasslands feature on the mid to lower slopes and most kangaroos were seen there.

The Eastern-most strip of the reserve is ideal kangaroo habitat, but few were found. This side of the reserve borders the Monaro Highway. The reserve is also surrounded by Tharwa Drive and the suburbs of Theodore and Conder.

Date	Time and locality in park	Population observed
23 October	2 hours – along western aspect, through steep and densely forested areas as well as open grasslands	86

6 December	2 hours – eastern-most strip alongside Monaro Highway	13
	4 hours x 2 researchers	**99 kangaroos**

Our population count for this reserve, to date is 99.

26 Justice Robert Hope Park

Our Field study data 2021/2022

This 19ha park has never formally been included in the culling program. This is a very small reserve on the edge of suburbia (Watson) in the vicinity of Mt Majura. Kangaroos could easily migrate between this reserve and Mt Majura.

Date	Time and locality in park	Population observed
25 October	1 hour throughout entire reserve	22
25 January 2022	1 hour 30 minutes throughout reserve and base of Mt Majura where kangaroos were seen, not added to tally	NIL
11 March 2022	1 hour throughout reserve	25 (most previously seen, 3 added to tally)
	3 hours 30 minutes x 2 researchers	**25 kangaroos**

This is one of the eight reserves researched during this project that exceeded the '1 kangaroo per hectare' ratio cited as the highest number desirable for maintaining ecosystems in grassy woodlands with only 6 kangaroos over the ratio. There is no evidence of damage to the intact grassy layer. Note that on the second field trip no kangaroos were in the reserve. These kangaroos have access to Mt Majura where the resident population may move freely.

Our population count for this park is 25.

27 Crace Grasslands

Desk-based analysis

Date	Counting method	Population estimate	Kangaroos culled
2009			42
2010			26
2012	Direct count	132	
2013	Direct count	146	
2013	Direct count	191	
2014	Direct count	226	
2014	Direct count	235	
2015	Direct count	249	90 + 37 joeys
2019	Direct count	271	171 (high priority to cull)
2020	Direct count	219	110 (high priority to cull)

There were 68 kangaroos shot in the first two years of culling prior to any population estimates being recorded. In 2015 there were 90 kangaroos and 37 joeys culled. In 2019, 171 were classified as high priority for culling), and in 2020, 110. Culling occurred here in these years.

If the target numbers were achieved then approximately 439 kangaroos have been culled, plus joeys (separately recorded only in 2015).

The Directorate's post-cull target for this reserve in 2018 was 244, in 2019 was 100 and in 2020 is 109.

Our Field study data 2021/2022

The Crace Grasslands form a reserve of 159ha with small pockets of remnant forest and a native tree plantation bordering the fence line. Its main feature is a rocky knoll, Crace Hill. The reserve is bordered by the Barton Highway and Gungahlin Drive as well as a rural lease.

	<table><tr><th>Date</th><th>Time and locality in park</th><th>Population observed</th></tr><tr><td>9 November</td><td>2 hours – throughout entire reserve</td><td>76</td></tr><tr><td>28 April 2022</td><td>1 hour 30 minutes – throughout entire reserve</td><td>72</td></tr><tr><td></td><td>5 hours x 2 researchers</td><td>76 kangaroos</td></tr></table> **Our 2021 population count for this reserve is 76.**
28 Black Mountain	## Our Field study data 2021/2022 This 434ha reserve has never been included in the culling program. Black Mountain is an iconic natural landmark of Canberra, heavily forested and with very steep terrain. Some grasslands on the lower slopes but very small kangaroo population is evident. Surrounded by busy roads including Caswell Drive, Parkes Way and Belconnen Way. <table><tr><th>Date</th><th>Time and locality in park</th><th>Population observed</th></tr><tr><td>17 November</td><td>2 hours – Little Black Mountain area in the northern edge of reserve</td><td>3</td></tr><tr><td>24 December</td><td>1 hour 30 minutes – SW corner</td><td>4</td></tr><tr><td>2 January</td><td>1 hour 45 minutes – western edge</td><td>2</td></tr><tr><td></td><td>5 hours 15 minutes x 2 researchers</td><td>9 kangaroos</td></tr></table> Over time, repeat field studies in different areas of the reserve will be undertaken, but an overall population estimate of this reserve cannot be estimated due to dense forest and terrain.
29 Mulanggari Grasslands	## Desk-based analysis <table><tr><th>Date</th><th>Counting method</th><th>Population estimate</th><th>Kangaroos culled</th></tr><tr><td>2017</td><td></td><td>206</td><td>NIL</td></tr><tr><td>2018</td><td>Direct count</td><td>254</td><td>NIL</td></tr><tr><td>2019</td><td>Direct count</td><td>254</td><td>154 (high priority to cull)</td></tr><tr><td>2020</td><td>Direct count</td><td>261</td><td>156 (high priority to cull)</td></tr></table> This reserve was closed for culling in both 2019 and 2020. The population estimate remained unchanged from 2018 and 2019 and had increased by only 7 in 2020. If the cull (recommending 154 for culling) occurred in 2019, leaving 100 in the reserve, then it is not possible that the population could have rebounded from 100 remaining kangaroos to 261 the following year. **If the targets for these years were met, then 310 kangaroos have been culled**. ## Our Field study data 2021/2022 This 140ha reserve is a grasslands park alongside Gungahlin Drive. The reserve is gently undulating with remnant bushland. <table><tr><th>Date</th><th>Time and locality in park</th><th>Population observed</th></tr><tr><td>27 December</td><td>3 hours throughout most of reserve</td><td>173</td></tr><tr><td>25 April 2022</td><td>1 hour 30 minutes</td><td>173 (previously seen, not added to tally)</td></tr><tr><td></td><td>4 hours 30 minutes x 2 researchers</td><td>173 kangaroos</td></tr></table> *This is one of the eight reserves researched during this project that exceeded the '1 kangaroo per hectare' ratio cited as the highest number desirable for maintaining ecosystems in grassy woodlands. Despite this, there is no evidence of damage to the intact grassy layer. In fact, the grass was over a metre in height throughout much of the park during summer.* **Our 2021/2022 population count for this reserve is 173.**
30 Dunlop Grasslands	## Our Field study data 2021/2022 This 103ha reserve has never formally been included in the culling program. The reserve comprises gently undulating grasslands with remnant bushland. Good vantage points for sighting kangaroos.

Date	Time and locality in park	Population observed
21 December	1 hour 30 minutes – throughout most of reserve	113
20 April 2022	1 hour 30 minutes – NW area of reserve	105 (previously seen in NW and mid-section of SE of reserve, not added to tally
21 April 2022	1 hour – SE area of reserve	43 southern area, 8 previously seen here, 35 added to tally
	4 hours x 2 researchers	**148 kangaroos**

This is one of the eight reserves researched during this project that exceeded the '1 kangaroo per hectare' ratio cited as the highest number desirable for maintaining ecosystems in grassland reserves. There is very strong growth and no evidence of damage to the intact grassy layer. Kangaroos can move quite freely between the reserve and the neighbouring CSIRO site and over the NSW border.

Our 2021/2022 population count for this reserve is 148 kangaroos.

31
Melrose

Our Field study data 2021/2022

This 194ha reserve has never been formally included in the culling program. The reserve is predominantly box-gum grassy woodland. There are few tracks, steep hills, cleared lower slopes and rugged bushland in deep gullies. Tuggeranong Creek runs through the southern strip of the reserve.

Date	Time and locality in park	Population observed
28 December	1 hour 30 minutes – throughout north and western areas	66
30 December	3 hours – NE area and south part way along Tuggeranong Creek, returning via NW area where kangaroos sighted during the previous field study were seen in addition to those sighted on this field survey.	41
	4 hours 30 minutes x 2 researchers	**107 kangaroos**

Our population count for this reserve is 107.

32
Jerrabomberra East

Desk-based analysis

Date	Counting method	Population estimate	Kangaroos culled
2012	Pellet count	296	
2013	Pellet count	559	
2014	Direct count	678	
2014	Pellet count	611	
2014	Sweep count	592	
2017	Walked line transect	1,933 (includes KMU)	360
2018	Sweep count	1,098	281
2019	Walked line transect	954	
2019	Sweep count	852 or 444	344
2020	Walked line transect	410 (or 712)	369 (high priority to cull)
2021			255 + 28 joeys

No explanation is apparent for the dramatic increase in population from 2012 to 2013.
The population remained relatively stable (assuming some inward/outward migration) between 2013 until 2018 (exception is 2017 when the estimate includes the entire KMU). This park was culled in 2021, with 255 kangaroos killed plus 28 pouch joeys (these are included in the overall tally).

It appears that 1,240 kangaroos plus joeys have been culled from this reserve.

Our Field study data 2022

This poorly managed 127ha reserve is predominantly grasslands, with rural lease lands beyond. The reserve features a low hill completely over-run with saffron thistle and scotch thistle. Much of the wider area of the reserve is infested with blackberry and African lovegrass. A small patch of native kangaroo grass was found.

Extensive temporary fencing has been erected to exclude kangaroos from entering the extensive grassland areas, habitat of the earless grass dragon. Some panels have been opened by the Directorate to allow free movement of kangaroos (because the grass was 'long and rank') following two wet seasons.

Date	Time and locality in park	Population observed
15 January	2 hours – foothills and summit	25
5 March 2022	1 hour 15 minutes, entire perimeter of reserve	72 (25 sighted previously, 47 added to tally
	3 hours 15 minutes x 2 researchers	**72 kangaroos**

The Directorate's post cull targets for the park are: 335 in 2017, 215 in 2018, 107 in 2019, and 53 in 2020.

The reserve is situated in extensive grasslands, and kangaroos have access to the neighbouring Queanbeyan nature reserve, a 67ha park, where we counted 145 kangaroos (on 5 March 2022), a population density of over 2 kangaroos per hectare. The kangaroos could move freely between both these reserves.

Our 2021/2022 population count for this reserve is 72.

33
Rob Roy
(2,000ha)

Our Field study data 2022

This 2,000ha reserve has never formally been included in the culling program. The reserve is a vast area of steep hills, rugged terrain, rocky gullies, dense forest and grasslands. Only a small section at the Northern end of the Rob Roy reserve is legally accessible to the public. This constrains observation of the kangaroo population. The area around the knoll explored on the first field study was completely overrun with invasive plants. Access is difficult (via a rocky creek bed and steep hills) and there are few marked trails.

Date	Time and locality in park	Population observed
19 February	2 hours – north-western area along creek track to knoll	14
14 March 2022	2 hours 30 minutes – north-eastern area of reserve	2
	4 hours 30 minutes x 2 researchers	**16 kangaroos**

Although this vast expanse contains suitable habitat for kangaroos, so far very few have been sighted. The size of the reserve means it would take many months to accurately assess kangaroo populations with our resources. These two searches have revealed a very low density of kangaroo population.

34
Jerrabomberra
West

Desk-based analysis

Date	Counting method	Population estimate	Kangaroos culled
2009			73
2010			127
2011	Pellet count	673	296
2012	Driven line transect (grasslands)	27	
2013	Walked line transect (grasslands)	392	
2013	Direct count (woodland)	5	
2014	Pellet count	809	
2017	Walked line transect	1,009	
2018		965	Cull not recommended
2019	Walked line transect	769 (or 2313)	462
2020		1,465	994 (high priority)

200 kangaroos were culled from this reserve in 2009 and 2010 prior to baseline data being obtained (or published). According to records, no apparent population estimates, or culling were carried on in the reserve in 2015 and 2016. The extraordinary variances in population estimates would lead most researchers to conclude that none of these estimates could be relied on. It is not clear how the higher population estimates were obtained from 2017 onwards.

In 2019, the reserve was combined with Callum Brae for purposes of kangaroo management. There is no explanation for how the population estimates in 2017 (1,009) and 2018 (965) with no cull taking place, could have resulted in a smaller total (769) when the park was combined with Callum Brae in 2019. However, another population estimate for 2019 for the KMU was 2313.

In 2020, the area for kangaroo management increased to 1,010ha and the estimated population dramatically increased to 1,465. The combined area of Jerrabomberra West and Callum Brae is 410ha. There appears to be no account of how the extra 600ha was included.

This set of data doesn't make any sense. Perhaps there is information not available publicly which could explain the variances in population data and land area. Combining the two reserves in 2019 for 'purposes of kangaroo management' for reasons not explained undoubtedly results in a lack of clarity about what has occurred in this reserve.

Total number of kangaroos culled in Jerrabomberra West is 958 (with an unknown proportion of these being culled from Callum Brae in 2019. **If the cull of 994 took place in 2019, then the total number culled from this park is 1,952**. The reserve was closed for culling in 2019, so presumably a proportion of this number (994) was culled.

Our Field Study data 2022

This 267ha park is largely grasslands adjoining the Monaro Highway. At some stage the grasslands have been fenced to prevent kangaroo grazing, and most kangaroos were found in the lightly forested area beyond the grasslands over the ridgeline. However, the gate was opened, presumably to allow kangaroos access to the grasslands, given the need for grazing to occur.

The grasslands in this poorly managed reserve are overrun with invasive plants including saffron thistle, scotch thistle, African lovegrass and Mullein. In these extensive, weed-infested areas, the grassy layer is largely smothered.

Date	Time and locality in park	Population observed
22 February 2022	3 hours across grasslands and throughout western edges of reserve over the ridgeline.	99
10 March 2022	3 hours throughout southernmost area including hillside, not previously explored. No kangaroos were found in this elevated area.	40 (previously seen on first field survey, not added to tally)
	6 hours x 2 researchers	**99 kangaroos**

The Directorate's post-cull target in 2019 was 307. The post-cull target in 2020 was 470.

Our 2021/2022 population count for this reserve is 99.

35 Kowen Forest Escarpment

Our Field Study Data 2022

This 466ha reserve has never been formally included in the culling program. Some of our field studies were technically outside the actual Kowen escarpment area, although within the environs of Kowen Forest. This area is dominated by pine plantations with remnant eucalypt forest in some sections of the park and extensive grasslands particularly in the vicinity of Glenburn homestead. This area is overrun with invasive plants such as African love grass, scotch thistle and saffron thistle.

Date	Time and locality in park	Population observed
21 November 2021	1 hour off Sutton Rd, area around Mt Reedy in rugged, steep and rocky terrain.	Nil
28 February 2022	3 hours, in the vicinity of Glenburn Homestead, through remnant eucalypt forests and along edges of pine forests. Kangaroos sighted in lightly planted pine forest.	10
3 March 2022	2 hours 30 minutes – from Sparrow Hill Rd, eastern precinct of park through forested areas and some pine forest.	33
5 March 2022	3 hours 45 minutes – from Orchard Rd throughout north-eastern area of park –	64

		largely pine trees some remnant eucalypt forest.	
		10 hours 15 minutes x 2 researchers	**107**

The numbers of kangaroos and joeys killed from 2009 until 2021 are considerably understated in these park-by-park 'culling' tables. The 'total number culled' totals 16,022 adult kangaroos, when published data reveals that 27,950 kangaroos (including some joeys) and thousands more joeys have been killed.

In the interests of transparency, the Directorate could consider publishing its complete park-by-park records to reveal the true picture about where the remaining 11,500 (approximately) kangaroos plus joeys were killed.

This missing data is from 2017, 2018, 2019 and 2020, following the 'Controlled Native Species' legislation being enacted. The 2021 data was obtained under the Freedom of Information Act.

Comparative observation of Queanbeyan Nature Reserve – directly adjacent to Jerrabomberra East:

Queanbeyan Nature Reserve, NSW

Our Field Study data 2022

This park of 67ha, is separated from East Jerrabomberra nature park by a railway line and is located across the border in NSW. It is essentially one and the same expanse of grasslands vegetation and habitat. It is an interesting contrast to East Jerrabomberra: there are far fewer weeds. There was almost no scotch thistle or saffron thistle, no blackberry. According to our count, this park had a higher population density than all the ACT parks, at over 2 kangaroos per hectare.

Date	Time and locality in park	Population observed
7 March 2022	2 hours – north to south throughout most of park.	145
	2 hours x 2 researchers	**145 kangaroos**

Testimonial:
In 2015, we arranged a house swap with visitors from the UK. They were in their seventies and not used to the Australian bush, not bushwalkers. They were looking forward to seeing kangaroos in their own habitat more than anything else in Canberra. We told them 'You'll see a mob of them every day as you drive along Gungahlin Drive – they're always there in the grasslands.'

After their visit they told us they did not see a single kangaroo. We were puzzled, but then we found out the Gungaderra kangaroos had been killed in the annual cull in 2015. We didn't tell our English visitors about the annual kangaroo culls here. They would have been shocked – as we were – dismayed and ashamed at this awful treatment of our wildlife…and greatly saddened by this loss.

John,
Nicholls, ACT

Analysis by Biostatistician

In its 2021 *Herbivore management* paper, the Directorate asserts that it is able to conduct more frequent population evaluations "based on evidence of kangaroo population stability and predictability between annual counts".

The out-and-out nonsense of this statement quickly becomes evident in the desk-based analysis of the Directorate's published population estimates from year to year (pages 11-29 above). In most nature reserves, the published population estimates vary so wildly that they are impossible to reconcile.

The Directorate's subsequent assertion that, based on these nonsensical estimation methods, it can develop "a simple model for estimating annual population growth rates from population density within each KMU" (Kangaroo Management Unit) is cause for grave concern.

Concerned about the obvious inconsistencies in the methods of calculating kangaroo populations, the extraordinarily high population estimates and the lack of consistent checking on population size of various reserves just prior to culling in any given year, we consulted Ms Claire Galea, a biostatistician who specialises in the investigation of population time trends. We provided her with a copy of our compilation of the Directorate's counting methods, population estimates and culling outcomes and asked her to analyse two combined reserves which have experienced recent culling (2021) of many kangaroos (840) – Mt Ainslie and Mt Majura. Her review is below:

Biostatistical concerns surrounding the ACT kangaroo culling program

There is insufficient data to provide any reliable population estimates or subsequent quotas for kangaroos in the ACT. Based on this review it is impossible to have any confidence in the population estimates provided or that the subsequent quotas do not pose significant threat to kangaroo populations across the ACT.

My expertise as a biostatistician lies in the investigation of population time trends. I have worked through the ACT government population documents and am extremely concerned by the methodology and subsequent population estimates / quota established. The concerns below relate to the overall program but will focus specifically on the Mt Ainslie/Mt Majura area as an example.

1. The **change in counting methodologies** over time periods with no comparison between methods.

Year	Method used
2012	Pellet count
2012	Pellet count
2013	Pellet count
2014	
2015	Walked line transect
2016	No further methodologies cited

Two different methods were used to obtain population estimates and justification that the two methods are equivalent or that the walked line transect (the last method used) is superior to the pellet count.

Concern: Time trends cannot be established when methodologies have been changed without any statistical justification for this process and therefore any population estimates are unreliable.

Concern: Time trends cannot be set over two time points a minimum of 5 to 10 time points are needed to establish reliable trends in population estimates.

Concern: If no population estimates in this zone have been undertaken since 2015, and given only four were taken originally, with two different methodologies there can be no confidence in the number of kangaroos estimated in the park area.

***Recommendation**: An immediate independent investigation / review be undertaken on the population estimates of all kangaroos in all park zones be undertaken before any more culling.*

2. The **population estimates and subsequent quotas**

Year	Population estimate	Culled
2012	1653	
2013	598 (Antill St) = 2251 both years	
2014		
2015	4499	
2016		461 adults, 154 joeys
2017	3109	
2018	3143 or 5750 (including added zone)	
2019	2099	1734 (high priority cull)
2020	1380	1094 (high priority cull)
2021		881 (actually culled 840)
2021	**1380-840 = 540 remaining**	

The above population estimates demonstrate the lack of consistency surrounding the methodology and clearly shows that no time trends have been or can be established. The consequence of this has been a population which has only approximately 40% remaining.

Concern: Had population estimates using consistent methodology been undertaken on an annual basis the population decline would have been noted.

***Recommendation**: An immediate independent investigation / review be undertaken on the population estimates of all kangaroos in all park zones be undertaken before any more culling.*

3. Adding in zones

From the above table it can be seen that in 2018 a new zone was added into the original Mt Ainslie/Mt Majura zone. This has been done in other states of Australia for kangaroo populations and led to significant fluctuations in populations estimates and subsequent quotas.

Concern: Adding zones will impact population trends over time and without consistent methodology being undertaken on an annual basis there is no possible way of knowing how many kangaroos are actually in the park.

Claire Galea,
Biostatistician.

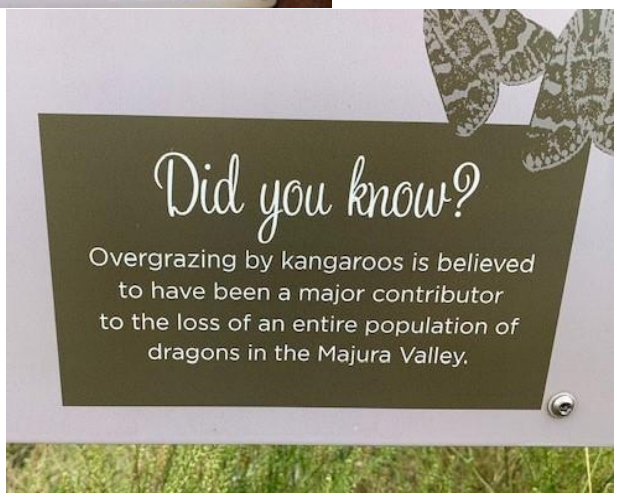
Invasive plants and weeds in Canberra Nature Park reserves

Typical signage – particularly ironic when adjacent "threatened ecosystems" are smothered by invasive plants which can threaten biodiversity. The gates are now open to allow kangaroo grazing and there *are* no tracks, as the grasslands are almost completely weed infested.

Jerrabomberra East – hill-top totally infested with weeds – common in many Canberra nature reserves

A tale of two grasslands

The photograph above depicts the weed infested East Jerrabomberra nature reserve, home to the endangered earless dragon. 72 kangaroos were found here. Culling of at least 1,240 kangaroos occurred at East Jerrabomberra over four consecutive years until 2021. Signs claim that this nature reserve is being carefully managed and monitored each summer.



Sign at East Jerrabomberra claiming the loss of an earless dragon population at Majura Valley with 'overgrazing by kangaroos believed to be a major contributor'.

The Directorate's sign, asking readers to believe that overgrazing by kangaroos may have been a major contributor to the loss of grassland earless dragons at Majura Valley, is erected at Jerrabomberra East for few observers to see. (Most walkers would be quickly deterred from walking at Jerrabomberra East because of the proliferation of very prickly weeds over a metre high.)

Whoever authorised this sign has not considered, for inclusion on this sign, other factors that may have contributed to the loss of the grassland earless dragon:

- Drought?
- Inappropriate land use incompatible with their survival?
- Poor land management?

Rather than addressing the core issues, it seems easier to blame kangaroos for eating grass, make them scapegoats for all the problems facing earless dragons, and then kill them. Problem solved (?).

The Canberra Nature Park Reserve Management Plan 2021 does attribute heavy kangaroo grazing as a threat to the grassland earless dragon during the 2006 to 2010 drought, along with the 'extreme

drought,' but the authors of this management plan do not claim that the population of lizards was totally lost as the sign above suggests.

The kangaroo population is *still* paying the ultimate price for this, some 12-15 years later. 840 kangaroos were culled from Mt Ainslie/Majura in 2021, despite the authors of the Canberra Nature Park Reserve Plan of Management 2021 stating that *'The lizard population has been recovering since the drought conditions ended but remain at risk due to factors including increased temperatures as a result of climate change'.*

Jerrabomberra East is one of the worst examples of unchecked weed growth. Extensive grasslands have been fenced off with rented fencing (at considerable cost to ratepayers).

The fencing is intended to protect the grasslands from kangaroo grazing. Some of the 72 kangaroos we observed at this reserve were clustered on the small hill completely covered by metre high saffron thistle and scotch thistle. Unchecked weed growth, smothering the grassy layer over many hectares, results in poor outcomes for native species, including the threatened species.

The gates in the fence have been opened by the Directorate to allow the kangaroos into excluded areas because the grass is now 'long and rank', making the fencing redundant, perhaps until the next drought.

Across the disused railway line is the Queanbeyan nature reserve in NSW, essentially part of the same grasslands as East Jerrabomberra. 145 kangaroos were located here, on 67ha of land, a population density that exceeds 2 per hectare. This may not be an ideal location for kangaroos; as the relatively small acreage borders busy Lanyon Drive which has no underpasses to safer locations. Nevertheless, the two reserves could hardly provide a greater contrast to illustrate different systems of management.

Weed management is obviously a priority, rather than blaming and killing kangaroos. As it happened, on the day we were there, a small team of contractors was there undertaking weed removal in the Queanbeyan reserve.

In 112 field trips to the 37 nature parks over an eight-month period, we did not see any weed management teams working in the Canberra nature parks. Nor did we encounter any Directorate staff undertaking field studies on the all-important grassy layer.

The impact of invasive plants and weeds is described below, in this instance in the southside reserves of the ACT.

Testimonial:
For several years now St John's Wort has covered much of the open grassy areas in the southside reserves, flowering in spring and summer. St John's Wort rosettes out-compete the summer flowering lilies, chocolate lily, blue grass lily, vanilla lily, yellow autumn lily, fringe lily, blue devil and several of the late flowering Australian grasses – hence a reduced amount of native grass for kangaroos and no delicate native plants.

Lost native wildlife reduces habitat for insects, reptiles and birds. Yet no resources go into eradicating and studying the devastation that weeds cause. A great deal of money is spent each year for the mass shooting of kangaroos.

We have lost all our birds-of-prey in this time, including nesting wedge tailed eagles which had lived in the area for some 30 years. The kestrels have gone as has the collared sparrow hawk, the boobook owls and the tawny frogmouths.

The reason they cannot see their prey is that the grasslands are smothered in a sea of knee-high yellow in spring and dark brown seeds all summer. From a bird's eye view, it is impossible to see or locate their prey.

The button quails have gone due to nothing being done to control foxes. Foxes should be shot, not kangaroos. We haven't seen jacky lizards, blue tongues, bearded dragons and brown snakes for over two years. They used to be common.
Julie,
Farrer, ACT

The testimonial above points to the harm caused by the obsessive focus on killing kangaroos. The belief that the kangaroo culling program solves any significant environmental problems will result in critical threats to other native species being effectively ignored.

Some reserves are very well maintained by ParkCare volunteers and others. These groups do outstanding work tending local nature reserves, controlling weeds and restoring vegetation. Sadly, some reserves appear very neglected and overrun with invasive plants which threaten biodiversity. Given the land area of the Canberra nature park, weed infestation is obviously a major ongoing challenge. The disastrous situation with noxious weeds should make this a priority, rather than culling kangaroos. Kangaroos are highly likely to play a role in controlling certain weed species before they become uncontrollable.

Kangaroo creche among the weeds

Population estimates in very large reserves or those closed to the public

Although we have conducted multiple field studies in all reserves (except two grasslands reserves, so far), we will not estimate *total* kangaroo populations in four of the nature reserves accessible to the public. The size and the terrain of these parks are too challenging to ascertain with any confidence the number of kangaroos occupying these reserves. These parks include Rob Roy (2000 ha), Kowen Forest (466 ha), Black Mountain (434ha) and Molonglo Gorge (506 ha).

Access is very limited in some reserves. For instance, Rob Roy is a 2,000ha park with the main access via a rocky creek bed surrounded by steep hillsides. Other access points would need to be available to allow proper exploration of other parts of the park.

Nevertheless, we have included details of our field trips and numbers of kangaroos observed in these four reserves.

None of these reserves have been included in the kangaroo culling program to our knowledge.

Kangaroo densities are calculated by the Directorate based on Kangaroo Management Units (KMU) which include nature reserves, adjacent rural leases, land for agistment and horse paddocks. Officially, culls only occur inside nature park reserves and so our field exploration has focussed on the nature reserves, which are accessible to the public, unlike neighbouring 'private' or restricted land. While undertaking our 112 field studies we observed almost no kangaroos on the rural land that was visible to us from the nature reserves. We observed kangaroo populations on two horse paddocks cited previously.

Testimonial:
I have lived near Gungaderra grasslands reserve for 15 years and something I have always loved about living here is the beautiful natural landscape and the wildlife, especially the kangaroos. I used to always see kangaroos grazing peacefully on my daily walk, but they have disappeared over the past few years.

I rarely see kangaroos here anymore and it makes me feel really sad, knowing that they have been killed. It's heartbreaking. When I read about how many kangaroos have been killed in the nature parks, my blood ran cold. We must stop this. It's so cruel.

Rebecca
Palmerston, ACT

Observations and analysis

It is now difficult to imagine any one of the culled nature reserves with many hundreds, let alone thousands of kangaroos inhabiting them. Despite thorough exploration, we have found only three nature reserves to date with populations over 300. Two of these reserves have not been culled as far as we can determine and yet there is no apparent over population, no 'overabundance', no irruption of population and certainly no plague.

Only eight nature reserves (or 20% of reserves) had kangaroo densities over '1 kangaroo per hectare,' and these were generally very small numbers over that ratio. Kangaroos are certainly not 'overabundant' by that measure.

The CSIRO report (2014) found that the vegetation was richer and more diverse where there were up to 3 kangaroos per hectare than where there were none. The CSIRO Report could not find a link between densities of kangaroos and the quality of the grassy layer which provides habitat for the threatened species.

Dr William Taylor, formerly plant biologist with CSIRO reviewed the findings of the CSIRO report in 2017 and stated that 'Nothing in the documents (2014 CSIRO Report) … provides compelling evidence that lethal management of a native animal is required for protection of biodiversity.'

The inherent inconsistencies and contradictions in the alleged science supporting the ACT kangaroo cull are very evident in the literature. The Directorate seems to rely on the fact that very few people manage to delve deeply enough into the reports, plans and supporting papers. *In its public documents the Directorate regularly falls back on quotes drawn from papers written by its own staff as evidence that the actions taken by its staff are justified.*

It is also clear that the Directorate is willing to regularly move the goalposts when it comes to justifying the cull. This is evidenced in the 2021 journal paper entitled *Herbivore management for biodiversity conservation: A case study of kangaroos in the Australian Capital Territory (ACT).* In this paper the authors – many employed by or directly connected to the Directorate – describe this approach of moving the goalposts as "An adaptive management framework". It seems clear in the paper that, in practical terms, this means altering the justifying arguments whenever the scientific evidence fails to support the shooting of kangaroos. This document is primarily a propaganda instrument, masquerading as a scientific paper.

Two paragraphs are very revealing when considered together.

Firstly:

> "The conservation cull of kangaroos within the Canberra Nature Park aims to maintain densities of kangaroos which allow for conservation of the grassy ecological community and habitat for grassland plant and animal species."

and then later in the paper:

> "Biodiversity in grassy ecosystems is linked directly to the ground-layer vegetation, rather than to kangaroo density per se."

So, *which is it?* Are kangaroo densities the major cause of the destruction of grassy ecological communities – or are they not? *Again*, it is indisputable that there are other, much more significant causes of the decline of Canberra's grassland species*,* such as:

- loss of habitat and fragmentation of habitat,
- urbanisation, industrialisation and infrastructure,
- agricultural practices (use of fertilisers and pesticides), cultivation and pasture improvement, overgrazing of livestock,
- weed invasion,
- predation by feral animals (cats, foxes) and native animals (snakes, raptors)
- and climate change.

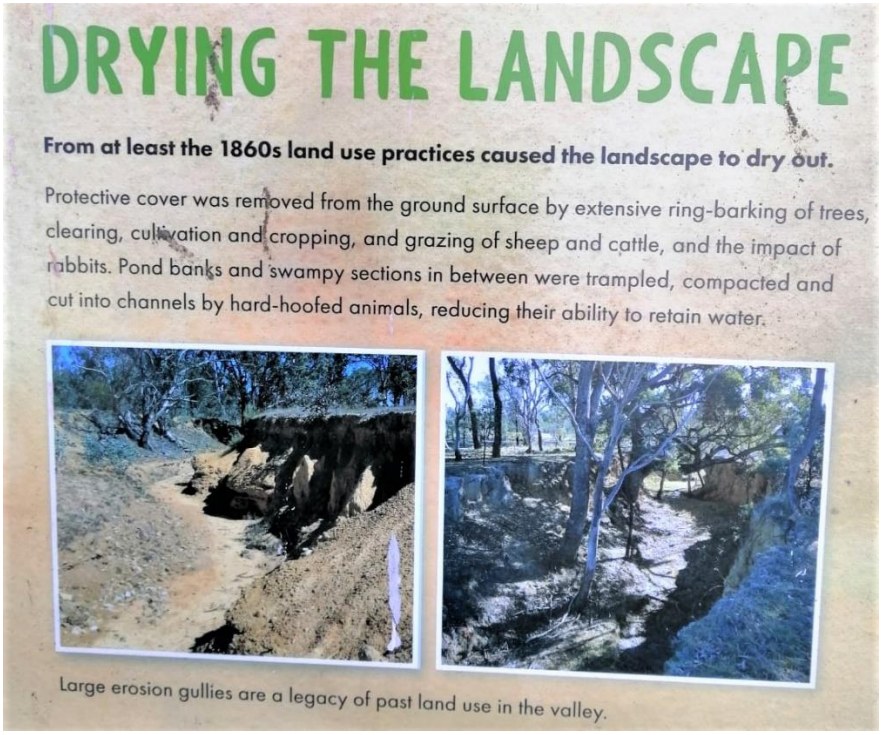
The density argument relates to the notion of "overabundance" which the Directorate touts repeatedly. Very significantly, the 2010 ACT Kangaroo Management Plan spells out, in no uncertain terms, that **"overabundance" is a social and political value judgement, and not a scientific concept**. The claimed overabundance of eastern grey kangaroos in Canberra has never been scientifically, independently verified. It is a narrative, relentlessly prosecuted by the ACT Environment Directorate as part of the long campaign to convince ACT residents that the slaughter of kangaroos is justified.

The Directorate's Culling Calculator (2018) states that 'a reserve comprising 100 hectares of forest, 100 hectares of open woodland and 100 hectares of grassland could sustain 10 (*kangaroos in forest*) +90 (*kangaroos in open woodland*) +100 (*kangaroos in grassland*) = 200 eastern grey kangaroos without threatening the habitat of small ground dwelling animals.'

The problem with this calculation is that only the Directorate appears to support the hypothesis that an average of 'one kangaroo per hectare' (considering the variations in vegetation type as described above) has any basis in science.

For those committed to the preservation of native wildlife, the culling calculator must certainly be a bitter pill when a sheep farmer, looking at a property the size of Goorooyarroo, could consider grazing 2,000 sheep (one Dry Sheep Equivalent per acre). That said, undoubtedly, this would result in a poor

outcome for every native creature and for the landscape, soil structure ad vegetation overall. Sheep have a damaging feeding habit, eat more grass, and damage the ground with hard hooves, thereby causing far more threat to the habitat of the threatened species the Directorate is trying to protect from kangaroo grazing.



One of the true, major causes of damage to grassland habitat – Directorate sign in Goorooyarroo

There are 150 rural leases in the ACT farming box-gum grassy woodlands, which threatened species may inhabit. The Directorate's post-cull population target for Goorooyarroo in 2020 was a mere 265 kangaroos. This is difficult to justify in the light of the CSIRO observation that a major influence on vegetation diversity and condition is "Land use history, such as historical grazing practices and present-day grazing pressure from other animals". CSIRO also points to rabbit grazing pressure across nature parks as a significant influence. Again, it appears, kangaroos have been made the scapegoats.

'Ecological grazing'. Or is it just livestock grazing?

A ludicrous proposition: Hard-hoofed animals saving Golden Sun Moths?

- **'Population management' or elimination?**

It seems clear that the Directorate has reduced kangaroo populations in certain reserves to a level far lower than its stated post-cull targets. Despite being warned by informed citizens that its kangaroo population estimates were highly inflated, the Directorate has insisted on setting targets according to its own formulae.

Why did the Directorate steadfastly ignore external advice? Is it possible that the unstated aim is to permanently reduce the populations of kangaroos in many nature reserves – evidently to just small token populations.

An example from the 2021 cull is that of Farrer Ridge. The Directorate, following a walked line transect in 2021, estimated a population of 409 on this 185hectare reserve. The previous year, the population estimate was 465 and in 2017, 299. At least one local resident knew the 2021 estimate was wrong. If the starting point for the estimated population is wrong (too high), then the calculation for 'recommendations to cull' will also, obviously, be wrong. Garbage in – garbage out.

The ACT Conservator has since advised that the 'culling calculator' resulted in recommendations to cull 317 kangaroos. 296 kangaroos were killed, plus 120 joeys. The 'post cull target' for Farrer Ridge plus an additional 17ha, according to the Conservator should be 101 kangaroos, allowing for a population growth rate (PGR) of 19%. (Ecologists specialising in the study of eastern grey kangaroos advise that the PGR of eastern greys is 10%).

Residents who subsequently searched this reserve following the cull have found very few kangaroos. The authors, searching the reserve for over 8 hours, have so far located only 32 kangaroos surviving in the reserve - a long way short of the 'post cull target' of 101.

The kangaroos of Callum Brae have experienced repeated culls almost every year since 2009. They were spared only in 2016. The reserve was closed for culling (according to published information) in 2018, 2019 and 2020, but no culling figures are available for these years. Despite extensive searching on this reserve for 5 hours, we could only find 42 kangaroos on this 143hectare reserve. This was not culling; these were repeated massacres committed on docile native animals living in their native habitat.

Both these examples (and there are more examples) suggest that the Directorate's ratio of 'one kangaroo per hectare' is largely irrelevant (although still repeatedly cited) when the 'culling calculator' is applied.

The Canberra Nature Park Reserve Management Plan 2021 notes a small population of pink tailed worm lizards at Farrer Ridge and a very small population of perunga grasshoppers at Callum Brae (so small that it doesn't rate a location identifier on the map.)

And *this* is a 'conservation cull'?

- **Eastern grey kangaroo population growth rate**

The numbers of kangaroos to be culled are calculated based on (up to) a 30% population growth rate (PGR). (Eastern Grey Kangaroo Conservation Culling Calculator Determination 2018). In some years, a PGR of 40% is claimed. (EGK Plan of Management 2017). PGR takes account of reproduction rate and mortality rate.

The PGR rates following numerous culls do not suggest that kangaroos are abundant breeders. Some obvious examples are the current kangaroo populations and densities at The Pinnacle, Callum Brae,

Mulligans Flat, Goorooyarroo, Mt Ainslie and Mt Majura. Following repeated culling these reserves have low kangaroo populations, well under the Directorate's 'one kangaroo per hectare'.

Dr Daniel Ramp and Ray Mjadwesch, ecologists specialising in the study of Eastern Grey Kangaroos, have found that the reproduction rate from year to year is 10%. Kangaroos are slow growing animals. Adult female kangaroos produce only one joey per year, and only when food is plentiful. Joeys are in-pouch for eleven months and can remain dependent on their mothers until they are 18 months old. Female joeys may stay with their mothers for much longer. Joeys have a high mortality rate in nature. At-foot joeys are extremely vulnerable if their mothers are killed.

Testimonial:
One of the things I liked best about my move to Canberra was that I could live in a suburban home and still have a connection right outside my door with the natural world. It was the sight of a kangaroo grazing outside the window of this property on open day that sealed the deal for me.

I bought the property without hesitation. No regrets, as I never stopped feeling delight at the sight of the kangaroos peacefully grazing in the reserve that bordered our property.

In time, I discovered the neighborhood also had grown to know and enjoy the small kangaroo family. Often, I found that people had given them names, and many had stories of seeing the joeys mature. The kangaroos seemed to give our neighborhood a common starting point for neighbourly interaction.

And then they were gone! Initially we thought that they had found a better place to feed. And then we read of the 'conservation cull' and realised the truth. We were incredulous that after the immense loss of animal life in the 2020 bush fires that a government body would be calling for a massive kill of our macropods.
Lyn
Nicholls, ACT

Humane solutions for peri-urban kangaroos during adverse conditions such as extreme drought

Why is it that for the past twelve years or more, that the first and only response to 'managing' kangaroo populations in nature reserves is to shoot them? This is not the only solution to the perceived problem of over-grazing (during drought). Humane solutions could include the following:

- **Road underpasses or overpasses**

Some reserves are surrounded by busy roads and suburbia. Given the relatively small ranges of kangaroos this is mostly not problematic, but during episodes of prolonged drought, the availability of grass would be reduced. Connecting underpasses have been built between some reserves. Some of these have been designed for use by humans and horses and are not suitable for macropods. If these underpasses were modified to allow for use by kangaroos and other wildlife, then this issue would be addressed.

Good examples of wildlife underpasses are those under Gungahlin Drive. Similar wildlife underpasses could be added to the network of nature reserves over time, where there are busy roads hindering the safe movement of kangaroos and other wildlife between nature reserves.

Before adding to any network of underpasses, research should be undertaken to ensure that they are entirely suitable for use by kangaroos. Overpasses, such as those used in Europe for wildlife may be more suitable.

- **Translocation**

Kangaroos may rarely need to be re-located from some nature reserves to larger areas during drought conditions. Some wildlife carers regularly use translocation for releasing hand-reared orphaned joeys and injured kangaroos restored to health, proving that translocation is possible and successful when the kangaroos are translocated in a mob.

There is a precedent for translocation of kangaroos in the ACT. Thirty years ago, kangaroos from Government House were successfully relocated to nearby nature parks.

Translocation is not without challenges. However, the Directorate appears not to have made any serious attempt to translocate kangaroos, preferring to slaughter animals instead.

- **Contraception**

The *GonaCon* contraceptive has been found to be an effective means of artificial population control if, in some instances, it was deemed necessary. In its frequent public relations offensives, the Directorate makes a great deal of its experimental contraceptive program. However, the use of contraceptive control has never moved beyond a small window-dressing exercise, aimed at placating concerned members of the public. Even in Minister Vassarotti's 'proud' announcement of the 2022 cull and re-announcement of the contraceptive trial in April 2022, the Directorate continues the shooting of

kangaroos as its preferred method – without showing any genuine sign of moving towards broader scale adoption of *GonaCon*.

None of these solutions require lethal means of 'kangaroo management' and are therefore more inherently humane solutions which could be adopted. Given the ability of kangaroos to manage their own reproduction rates, it would be in extreme and unusual circumstances where these methods may be necessary (such as in prolonged drought, among kangaroos living in a human-created confined environment).

RECOMMENDATION

We believe there should be a fully independent review of the annual kangaroo cull before any further culling is considered. The review published in May 2014, conducted by a private contractor to the ACT Environment Directorate, is not regarded by many stakeholders as a thorough review of the cull program. It was largely a selective, desk-based analysis of a sample of material relating to the kangaroo conservation cull, including data supplied by the directorate.

The CSIRO report: *Relationships between vegetation condition and kangaroo density in the lowland grassy ecosystems of the northern Australian Capital Territory*, was ignored, perhaps because it did not find evidence that the killing of a native animal was justified for the reasons cited by the Directorate.

All government programs committing public funds (especially ethically controversial programs) should be periodically reviewed, and findings of reviews be made public, and acted upon. A program which results in the lethal treatment of native animals should be reviewed rigorously and independently – and regularly.

Some questions that should be addressed in a review include:

- The methods of assessing kangaroo population size have been varied and give widely varying results. Can the methods used by the Directorate be relied upon? Are desk-based population estimates likely to be any more accurate than the variety of methods formerly used?
- In April 2022 the Directorate admitted it does not know the population numbers of kangaroos in the Canberra environs. Is this acceptable when large scale culling is proposed for the 13th consecutive year?
- Is there a plausible explanation for the original very large population estimates of reserves which have been culled when compared with parks that have not yet been culled of kangaroos, given the habitats are similar in most respects?
- Is there an explanation as to why it appears that both culled and unculled parks overall have similar sized populations as revealed by this project, despite twelve years of culling?
- Is there independent, peer reviewed scientific evidence that kangaroos over-graze to the extent that they could cause damage to the habitat of threatened native species?
- Have other causes of declining populations of threatened species been adequately considered? (as identified in the Directorate's Threatened Species Action Plans).
- Have the deleterious environmental impacts of reducing natural population growth in a keystone species (kangaroos) been considered?

- Is there a scientific basis for estimating the optimal 'carrying capacity' of kangaroos on box-gum grassy woodlands as one per hectare, when the CSIRO report found that up to three per hectare on ACT reserves had no adverse effects?
- If there are genuine concerns about kangaroo grazing of the box-gum grassy woodlands and affecting the habitat of threatened species, then why are hard-hooved livestock still allowed to graze on rural lands which are contiguous with nature parks and are also box-gum grassy woodlands and may include habitat for threatened species?

This review should be overseen by an independent committee made up of at least one ACT Member of the Legislative Assembly, an independent ecologist and at least one community member.

Both the organisation selected to carry out the review, and the members of the review committee should be independent of the Directorate and any organisations, including research organisations, which have a vested interest in continuing the kangaroo cull or are engaged in killing wildlife or have a history of advocating the lethal management of kangaroos. The report of the independent review should be published without amendment by Directorate.

Independence is critical to achieving genuinely transparent and balanced findings in any review of government programs. To achieve this, the organisation being reviewed cannot be in control of the review.

During the period of the independent review, no additional kangaroo culling permits should be issued to rural lease-holders.

Testimonial:
During the Covid lockdown in 2021, families at Crace used to walk over to the grasslands and watch the kangaroos grazing just before sunset – a quintessentially Australian scene, where you know you just couldn't be anywhere else. Parents would just sit there with their young children and enjoy this peaceful sight.

The kangaroos were also a family group…an alpha male, older females, young males, young mums, joeys at-foot and pouch joeys. It was a beautiful end to the day and as one mother said to me 'How lucky are we?'

Jane
Evatt, ACT

Further considerations

Apart from the evidence, revealed by the Directorate's own statistics, in addition to our population counts during 2021-2022, that culling has caused a catastrophic drop in kangaroo population numbers in the nature reserves where culling has been carried out, there are very important issues of animal welfare that must be considered.

A shot to the head of a healthy sentient animal is a violent and premature death. There is a risk that kangaroos may be mis-shot. Pouch joeys up to the age of 11 months are killed by bludgeoning or decapitation. At-foot joeys are left to their fate, vulnerable to predation, hypothermia or starvation. We would not tolerate puppies or kittens being treated this way. Why is it acceptable for a native Australian animal, a member of a species which has evolved along with other creatures on this continent for millions of years?

In 2019, the ACT Government became the first government in Australia to pass 'sentient animal legislation.' Bringing the legislation to the Assembly, Chris Steel MLA said, 'These animal welfare laws reflect the values of the Canberra community on how we should manage and care for our domestic animals, livestock and wildlife.' He went on to say, 'For the first time under law we are recognising the science, that animals are sentient, and they feel emotion and pain. The bill also recognises that animals have 'intrinsic value' and deserve a quality of life that reflects this. Further, people have a duty of care for animals 'mental welfare' along with physical wellbeing.'

Somehow, eastern grey kangaroos seem to have fallen through the cracks and are not seen by the ACT Government as being entitled to protection under this legislation. Instead, tragically they have been relegated to 'pest' status as a 'Controlled Native species.'

Another aspect of the needless nastiness inherent in the ACT Government's attitude towards eastern grey kangaroos is that under the Controlled Native Species legislation, a limit of only 35 kangaroo joeys per annum, from the ACT, may be rescued and taken to wildlife carers after their mothers have died from any cause. This is even though there are numerous wildlife carers in and around the ACT who are willing to take these joeys and raise them, rather than have them killed.

One such wildlife carer, located not far from the ACT writes about a joey she has raised. Her love and care for native wildlife, and that of her partner George, is evident in her dedication and in her words below.

The Story of Jynx

Quite a while ago I did a story about our wonderful Jynx-a-roo. Besides Birdie, I haven't put in the hours one-on-one with any animal as much as Jynx. She's beaten the euth needle twice now. Came within a whisker but survived with a lot of re-hab.

I'm so proud of this girl. Those of you who rode out the fires with us will remember the horrific injuries to her legs at that time and the every-second-day sedations and re-dressing. Of course, she was also paralysed at 5 kilos from a high tail break and was given a two-week reprieve while we massaged her tail relentlessly to get the blood flowing so her tail didn't die. We got her through that.

She released with her best mate Maisie a couple of years ago and they are still besties, although Maisie's life changed after her joey Mouse, and she was a responsible Mama and didn't go

adventuring with Jynx and Little Joe as much as before Mouse came along. Maisie has another joey in her pouch now.
I noticed Kandy has come home today but not Thelma Louise who has decided to stay out with the mob in this crazy weather. I was worried about her being on her own until I noticed Jynx had brought her joey home as well. Both must be needing a bit of reassurance tonight. It's bloody awful out there.
But I am sooooo proud to welcome Jynx's joey, Jester, to the mob.
You can still see the scarring on Jynx's legs but she is so healthy and beautiful. Her joey must be about to emerge more as Jynx has been hanging around the house longer than usual. It's a safe place for the tiny ones to bounce about.

Beth Nasser
Windellama, NSW

In addition to the medical care provided, wildlife carers feed joeys round-the-clock, every day and night, for months. They do this for love; the work is unpaid. Beth and George release their kangaroo, wallaby and wombat joeys – when they are old enough – on their own property. It is estimated that there are over 20,000 wildlife carers across Australia. Many are assisted with donations for marsupial milk, medications, vet visits and equipment such as humidicribs and handmade pouches by other Australians and people around the world who love Australia's wildlife.

What a stark contrast to the violence and hatred demonstrated by the ACT annual kangaroo 'cull'.

There is growing concern around Australia and the world that governments have neglected their responsibilities to properly protect our unique wildlife. Politicians legislating to allow the slaughter of wildlife should fully inform themselves of what they are condoning and facilitating.

Like the ACT Government, other Australian state governments issue licences to allow people such as farmers to kill kangaroos. Several state governments also underpin the kangaroo industry by allowing 'harvesting' of kangaroos for skins and meat (shoe leather and pet food). An estimated two million kangaroos or more are killed per annum.

The 2021 NSW Parliamentary Inquiry into the health and well-being of kangaroos and other macropods, uncovered disturbing evidence about methods of assessing kangaroo populations, biologically impossible estimates of reproduction rates, inhumane practices used by the kangaroo industry during slaughter and cruel treatment of kangaroo joeys. There is a growing political and social movement to bring about an end to kangaroo killing.

To our knowledge, the ACT Government is the only government *directly funding* kangaroo culling on an ongoing basis.

Over many decades Australian governments have promulgated policies that have resulted in the massive decline of animal species on our continent. This has often occurred with species that were considered abundant. An example is that of koalas, once inhabiting eastern and south-eastern Australia in their millions. The Australian Koala Foundation estimates there were up to 15 million koalas at the time of British settlement.

Hunting koalas for their fur was allowed by governments for over three decades. Governments even funded job creation programs to hunt and kill koalas. Their populations have never recovered and now Australian citizens, desperate to save them from extinction in the wild, are planting koala feed trees by the thousands, while state governments are still allowing destruction of their habitat.

We know what causes animal extinctions: relentless hunting and habitat loss. The Eastern Grey Kangaroo is not, broadly speaking, a threatened species but it is a unique Australian animal, a keystone species which is an essential element of our biodiversity. The annual kangaroo cull devalues and maligns kangaroos in the minds of the public, and the ongoing slaughter could potentially bring about localised extinctions in years to come. The massacre at Farrer Ridge is just one example.

Much collateral damage appears to have been done to a rarer species of macropod. During our field studies we also noted the rare presence – but mostly the absence – of wallaroos (*macropus robustus*). *We found no wallaroos in any reserve where culling had occurred.* Throughout the other reserves, we found only 4 at Cooleman Ridge and 1 at Rob Roy. It is highly likely that wallaroos were deliberately shot in the period from 2009 at least until 2017. During this time all extant macropod species were included in the Kangaroo Management Plan, including the much rarer wallaroos and wallabies. Even now, with contractors operating at night, it is almost impossible for shooters to distinguish between the large macropods - wallaroos and eastern grey kangaroos. There is no verified mechanism in place to confirm that wallaroos are not killed. The once relatively common wallaroo has now virtually disappeared from Canberra Nature Park.

Canberra, the bush capital, is unique in the world in having communities of kangaroos living in the suburbs. What a progressive and refreshing development it would be to hear a government narrative about the inherent value of our endemic species. What a great example of respect for wildlife and our biodiversity could be demonstrated in the context of a capital city.

A tragic irony in the ACT is the case of the brush-tailed rock-wallaby, once abundant throughout the ACT, hunted to extinction and last seen in the wild in 1959. Now fewer than 100 live in the protected environment of Tidbinbilla, part of an insurance population to circumvent complete extinction.

The irony is that the brush-tailed rock-wallaby was officially adopted as the mammal emblem for the ACT on 29 November 2018, while barely six months later the annual cull of eastern grey kangaroos began - resulting in 4,035 kangaroos being killed in our nature reserves – the highest death toll since culling began in 2009. Have we learnt *nothing* after two centuries of slaughtering wildlife?

The ACT Government's commitment to the culling of kangaroos in nature reserves is committing Canberrans to participating in the largest land-based slaughter of wildlife in the world. Ultimately, we will all be shown to be on the wrong side of history.

Who are the authors?

Jane Robinson and John Grace are regular Canberra citizens. They have spent many years bushwalking and observing Australian native animals in their habitats.

In the ACT, over the years, they have walked extensively in many of Canberra's nature reserves as well as many other bush locations, never encountering kangaroos in the numbers or population densities claimed by the Environment Directorate in the Kangaroo Plans of Management 2010 or 2017.

Since August 2021 they have conducted an extensive, methodical exploration of 37 Canberra Nature Park reserves with the sole aim of locating, counting and recording the locations of eastern grey kangaroos.

They have developed considerable expertise in tracking and locating eastern grey kangaroos in the box gum grassy woodland ecosystems in the Australian Capital Territory. They have also acquired a great deal of practical knowledge of eastern grey kangaroo behaviour.

Jane and John have had long, successful careers in various levels of government (local, state and federal), community and private sectors. They have both worked extensively in program design and management and have had experience in policy analysis and development.

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Lyndsey Vivian, Ecologist, CSIRO and Robert Godfree, Field Ecologist and Botanist, CSIRO

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Threatened Species Action Plans (2017) Golden Sun moth (Synemon plana walker 1854), Grassland Earless Dragon (Tympanocryptis Pinguicolla), Striped legless lizard (Delma impar), Pink-tailed worm lizard (Apraisia parapulchella), Perunga grasshopper (Perunga ochracea).
Environment, Planning and Sustainability Directorate, Canberra, ACT

Attachment A - ***Eastern Grey Kangaroos in Canberra Nature Park***

A critique of the ACT Government's kangaroo population estimates

The Canberra Times, in an article titled 'Roo defenders say count is wrong' (June 11, 2022) published a Kangaroo Cull table, supplied by the Environment, Planning and Sustainable Development Directorate (The Directorate). (See table below).

This table demands scrutiny. It lists data from the previous decade of kangaroo culling in Canberra Nature Park. The first three years are missing. It does not list the actual parks which are the focus of kangaroo counts but in the accompanying article the ACT Conservator confirms that only reserves which are subject to culling have kangaroo population estimates undertaken.

For the record, the reserves which have experienced culling include Mt Ainslie, Mt Majura, Goorooyarroo, Mulligans Flat, Mulanggari, Gungaderra, Crace, The Pinnacle, Mt Painter, Aranda, Kama, Farrer Ridge, Wanniassa Hills, Callum Brae, Mt Mugga Mugga, Isaacs Ridge, Red Hill, Jerrabomberra East, Jerrabomberra West. Nineteen reserves. Twenty reserves have not been subject to kangaroo culling.

KANGAROO CULLS

Year	Number of sites	Kangaroos counted	Target	Culled
2012	11	5333	1880	1154
2013	12	6206	1244	1149
2014	13	10,118	1606	1521
2015	11	6236	1962	1689
2016	14	13,952	1991	1989
2017	12	14,540	1200	1186
2018	15	16,341	1822	1822
2019	15	14,680	4076	4035
2020	16	11,320	1958	1931
2021	16	11,397	1568	1505
2022	15	15,456	1650	TBC

Source : Environment, Planning and Sustainable Development Directorate

Failure to use a consistent and reliable method of counting: Questions that arise are based on the population estimates reported by the Directorate throughout thirteen years of kangaroo culling. From 2009 until 2017, the Directorate used a variety of methods for counting kangaroos. These included:

- Sweep count
- Pellet count
- Walked line transect
- Driven line transect
- Direct count

At no time did the Directorate publicly admit that any of these techniques were yielding unreliable results and should therefore be discounted. They have continued to use a variety of counting methods which have provided widely varying results. These can be seen in the tables in our report 'Eastern Grey Kangaroos in Canberra Nature Park' pages 12 – 32. This data was obtained from the Directorate's own publications. Since 2017, the Directorate has predominantly relied upon the walked line transect method, only occasionally using sweep counts or direct counts.

Scientists advise that inconsistent, variable methods of counting will result in inconsistent results, both in a specified geographic area (such as one nature reserve) and in the overall result. To change counting methods, to be scientifically valid, requires evidence that a discontinued method is unreliable and that a substitute method is more accurate. At no time did such analysis take place, as the evidence is clear: a variety of counting methods is used over a seven-year period i.e. from 2010 until 2017, when the walked line transect method became preferred. It is noted that there is no record of kangaroo counting before 2010; kangaroo culling began in 2009 before any baseline data had been obtained.

The Conservator claims that the walked line transect method is 'peer-reviewed methodology and is a standard methodology for counting animals, in particular kangaroos.' A variation of this method was described and challenged in the 2021 NSW Inquiry into the Health and Well-being of Macropods, where kangaroos in the NSW rangelands are targeted for commercial harvesting. Essentially, kangaroos in a transect are counted, and that number extrapolated. It may be inferred that the profit motive in this scenario is driving the use of a method which deliberately inflates kangaroo population numbers in an environment where neither the relevant government department nor the NSW government itself have demonstrated a concern for the health and well-being of macropods.

Comparison between the Directorate's population estimates for 15 reserves and population count as described in the report 'Eastern Grey Kangaroos in Canberra Nature Park.
The ACT Conservator stated in the Canberra Times article that the ACT Environment Directorate's population estimate for 2022 in 15 reserves is 15,456. He went on to describe the method of ascertaining this figure. The ACT Parks and Conservation rangers '***walk a line through multiple sites on multiple reserves. This number is then extrapolated to the rest of the park***.'

The Conservator is describing the 'walked line transect' method. *Extrapolated* is the key word. In other words, what has been seen and counted by the rangers in a 'transect' or section of the reserve, is *multiplied* across the entire area of the reserve.

Our conclusion, after eight months of searching, observing and counting kangaroos and recording their locations on the reserves, is that kangaroos are *never spread evenly across a landscape*. Not once did we find this to be the case. This phenomenon is also well known among scientists who have intensively studied eastern grey kangaroo behaviour.

After eight months of methodical searching, using the direct observational count method, we found a population throughout 37 of the accessible nature reserves to be 4,074.

The Directorate's claim is that there is nearly **four times** this number in just half the reserves.

The mathematical formula used to estimate Canberra's kangaroo populations has massively inflated the population estimate being used to assess how many kangaroos the Directorate believes should be 'culled.' This has resulted in many thousands more kangaroos and their joeys being needlessly killed than even the Directorate intended.

Specific examples of questionable population estimates arising from the Directorate's data table. Ecologists who study eastern grey kangaroos have written that the population growth rate of kangaroos, taking both birth and mortality rates into account, is no more than 12% per annum. The survival rate of joeys is only around 25% (Brooks, D. 2022, *The Number Game: Counting Kangaroos*, Animal Studies Journal, Volume 11, Number 1, Article 2, 2022).

Kangaroos tend to have a home range which they periodically leave, if new feeding grounds are required, and then return to. Young males also leave to find new territory for breeding. The populations in Canberra Nature Park, it could be argued, are naturally more stable than most free-living kangaroos. Most reserves are bordered by suburbia, arterial roads and other infrastructure. As such, the reserves are not as conducive to immigration by kangaroos from elsewhere. The factors described above make the ACT Environment Directorate's published population data even more implausible (arguably impossible).

1) According to the Directorate, in 2013, across 12 reserves the estimated kangaroo population was 6,206. One year later, it was 10,118, an increase of 3,912 kangaroos, or 63%. Just one additional reserve was added to the population count in that time.
2) In 2015 across 11 reserves, the Directorate's population estimate was 6,236. A year later it was 13,952, including the addition of three reserves. The question must be asked; *which three reserves were added in 2016 to give rise to an additional 7,716 kangaroos or 123% increase?*
3) In 2021, the Directorate claimed there were 11,397 kangaroos in 16 of Canberra's nature reserves. In 2022, the claim is that there are 15,456 kangaroos in these nature reserves, minus one reserve – an increase of 4,059, or 35%.

While the Directorate could and should provide information about which reserves were added (and subtracted) to the count for the years 2014 and 2016 and 2022, the size of the overall population estimates of these reserves at that time should be carefully scrutinised.

During our citizen science project we searched 37 nature reserves – all box-gum grassy woodlands and natural temperate grasslands - essentially the same environment and habitat found in the majority of the reserves.

In the 20 reserves which have never been culled, not one reserve was home to kangaroos in anything like the numbers cited by the Directorate in 2014 and 2016 or 2022. An example is that of Urambi Hills – the only reserve never culled which we found had a population over 400. All other reserves which have never been culled had populations far fewer than this, ranging from nil to 126.

Based on our direct observational count, it would seem highly unlikely that the Directorate's shifting goal posts (changing the numbers of reserves counted), resulting in exponentially increased populations within a twelve-month timeframe, could be correct.

- Kangaroos cannot have achieved a biologically impossible reproductive rate.
- Inward migration at such a rate has not been observed and is highly improbable.

What is more likely is that the variety of counting methods being used are yielding both inaccurate results and greatly inflated population estimates. On both counts, the population counts are just plain wrong.

The Directorate is killing kangaroos based on incorrect population estimates, applying a mathematical formula to the population which amounts to counting hypothetical kangaroos, and then adding to this disastrous situation by applying a culling calculator based on these inaccurate estimates. It is a blatant case of “garbage-in-garbage out”.

The only responsible course of action is to stop the killing of kangaroos, and to hold an independent review or public inquiry into the management of this program as a matter of urgency.

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