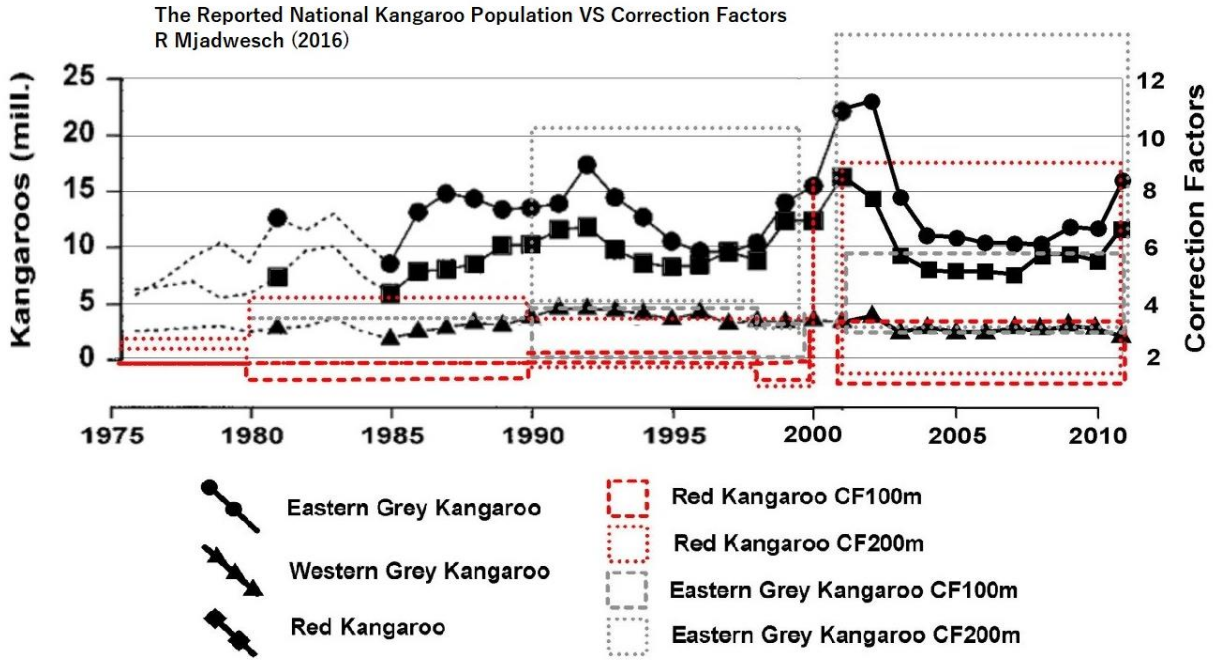
Inquiry into the Health & Wellbeing of Kangaroos and other Macropods in NSW

MJADWESCH: 27 SUPPLEMENTARY QUESTIONS

1. *Mr Brill stated that correction factors have not been changed. Can you please provide whatever information you may have relating to your assertion that correction factors have been increased?*

Correction Factors (CFs) have been progressively increased since their inception in the 1960s-70s according to the following graph, which is based on CF tables in Pople (2004) and Cairns & Gilroy (2001); national kangaroo population data is from Grigg (2002) and (after 2001) the Commonwealth Department of Agriculture, Water & the Environment website[1].



A graphical representation of correction factors from Pople (2004) and Cairns & Gilroy (2001)

The established pro-industry narrative, using graphs like the one above, is that kangaroo populations are stable. With reference to the reported national kangaroo population Grigg (2002) wrote "*collectively… …Australia-wide surveys showed conclusively that kangaroo populations were healthy, that is, not in decline at all, and were in fact flourishing…"*. In 2013 the then manager of the Kangaroo Management Unit Ms Nicole Payne, in response to being questioned about the threatened species nomination[2], said that "*…while roo numbers fluctuate due to drought, the long-term trend pointed to healthy populations"*[3].

However if CFs (which are simply multipliers used in analysis) have been increased by a factor of up to six times (from 1.8 to over 12) in some habitats between the 1960s-70s and 2001 (when the last corrections were adopted), while the reported populations have remained relatively stable (as illustrated in the graph

[1] https://www.environment.gov.au/biodiversity/wildlife-trade/natives/wild-harvest/kangaroo-wallaby-statistics/kangaroo-population

[2] https://www.farmonline.com.au/story/3595069/hoo-roo-kangaroos-in-decline/

[3] …according to the KMAP minutes #20 this finding was attributed to a statistical review of the data done by Dr Jim Hone which found "*no declining trends*", however the Hone report has not been provided to me (on request to the department and directly to Dr Hone), nor does it seem to have been released publicly.

above), then it follows that the population had probably declined by 2001 to perhaps one sixth of the former numbers in some districts.

Dr Allen acknowledged in his verbal evidence that kangaroo survey methodologies have been changed and "*improved*" as time has gone on, and that he thought survey methods *should* be changed. It is my contention that methodologies have been changed and correction factors have been incrementally increased since they started being used in the 1970s in an attempt to mask population decline, which periodically becomes apparent in the official population estimates[4]. For Dr Allen's position to be valid then old data-sets need to be re-analysed using the newly devised constants, and this has not occurred. This revision may never occur as according to Pople (2005) "*…in New South Wales, raw data prior to 1993 had been lost in a fire*"[5].

Note that Cairns (2004a) was the first time that a 1.85 correction was incorporated into the Wallaroo population estimates in the Northern Tablelands Kangaroo Management Zone (KMZ hereafter), so whatever graphs the industry, their supporting scientists and the Department present depicting so-called "*long-term*" Wallaroo numbers presumably also has a ~doubling factor for the period ~2004-present, compared to earlier estimates.

Therefore contrary to Mr Brill's spoken evidence that correction factors have not been changed, not only have new corrections used in analysis been introduced over the years, and not only have correction factors been periodically reviewed (increased) over the years, but the methodology chosen by the experts who service the survey contracts deliberately *chose* to introduce the highest suite of correction factors (proportionally) which were available to them when the methodology was "*re-appraised*" in 2001[6].

Finally, after this flaw in how population estimates have been generated (using periodically increased CFs) was pointed out in the threatened species nomination in 2011, and after the NSW Scientific Committee backed the surveys and analysis as rigorous and scientific and rejected the nomination in 2015, the use of CFs in western NSW was abandoned in 2016, when the survey design team decided to change to the MRDS methodology (which was confirmed by Mr Brill's testimony – see below).

[4] Decline in official estimates had again become apparent in 2009-11, when I wrote the threatened species nominations.
[5] It may be that some of the data survived the fire, as Lunney (2010) refers to having found data from the 1980s in "*files 17-24*", however these files have not been made available to me.
[6] The ADDITIONAL INFORMATION file included with this Q&A provides some detail on the derivation of CFs, to illustrate this point.

2. Please provide particulars of why you consider the program to have been in breach of legislation as it pertains to the protection of wildlife in NSW, as stated in your submission?

This is a very serious allegation, so I have gone to some trouble and into some detail below, to provide evidence to support my views.

It is a requirement of the Biodiversity Conservation Act 2016 (s. 13.10) to provide information that is not "*misleading in a material particular*". That is, **when information is significant in influencing someone and the consequence is neither trivial nor inconsequential – it must not be misleading**.

POPULATION ESTIMATES

The significance of the population estimates in influencing decision-makers, media, science and the public at large is near total. The estimates underwrite the social and political licence for the industrial-scale commercial (and indeed non-commercial) killing of native wildlife that would otherwise be protected.

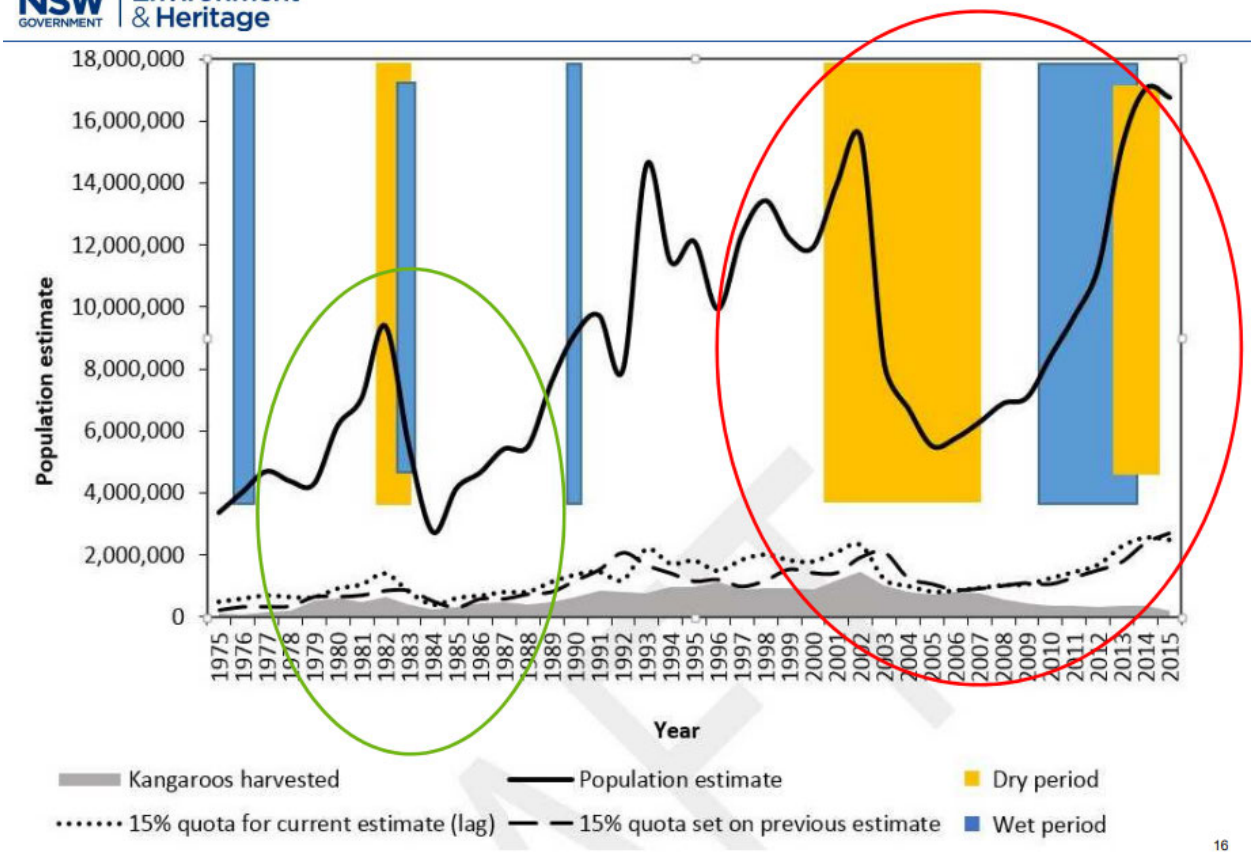
The estimates do this by asserting widespread abundance and recovery/increase after (and sometimes during) drought, and by reiterating the notion of a non-existent 'uber-fecundity' and biologically impossible population "explosions".

It is little understood and generally unexamined how the official population estimates are arrived at. That these estimates deviate to such a marked degree from what is known about kangaroo reproductive biology, their ecology and behavior, has not been generally noticed.

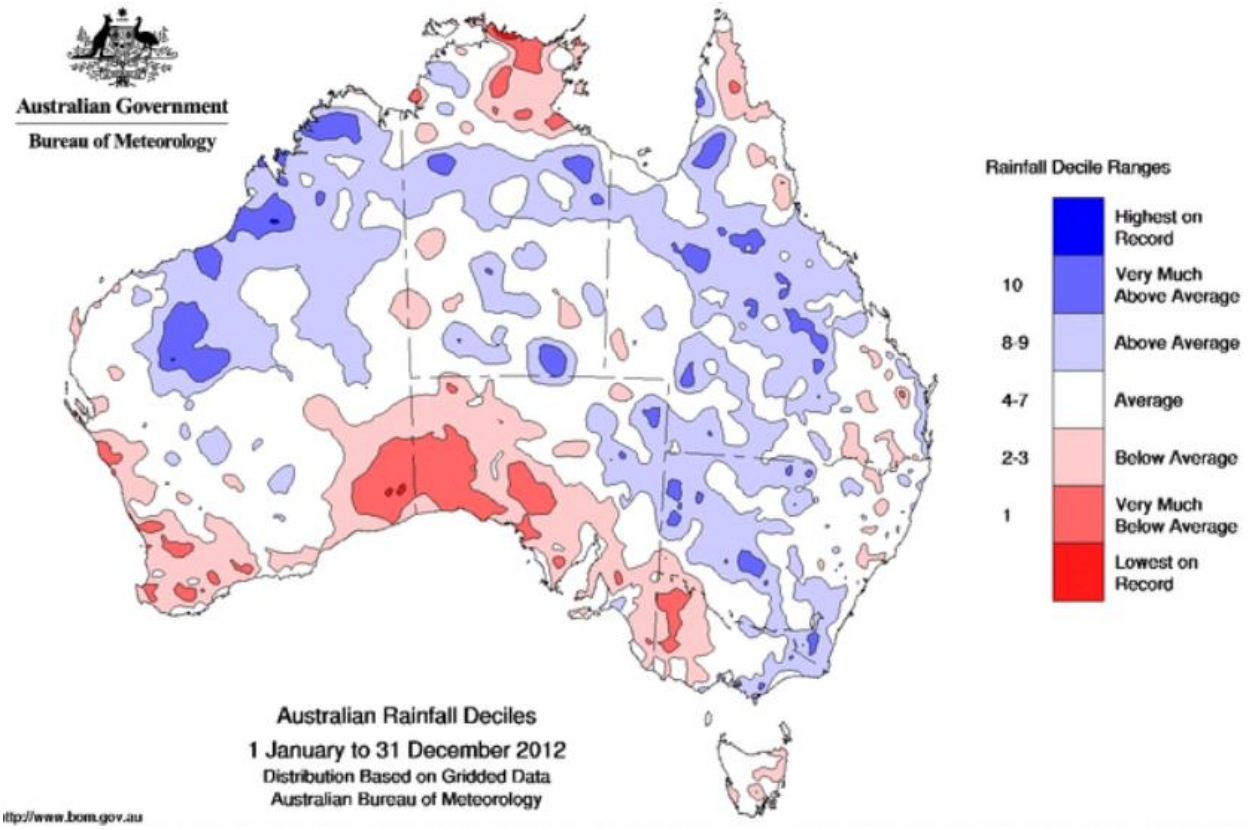
The estimates do *not* describe what the actual survey data is telling us, which is that kangaroo populations are in serious decline and that increasingly zero-counted landscapes are disguised by the application of "corrections" and are then extrapolated to assert densities and abundance across landscapes where the counts themselves indicates there are few if any kangaroos remaining. The official estimates and the kangaroo management program management plans and quota reports do not explain that reported "increases" are obtained by adding new zones or changing survey and extrapolation methodologies, in fact they imply the opposite.

This is misleading in the extreme.

[7] The nomination to list the large macropds as threatened species in NSW (Mjadwesch (2011-2013)) illustrated declines in the order of ~80-90% in many of the harvest zones of NSW in the period 2000-2010.

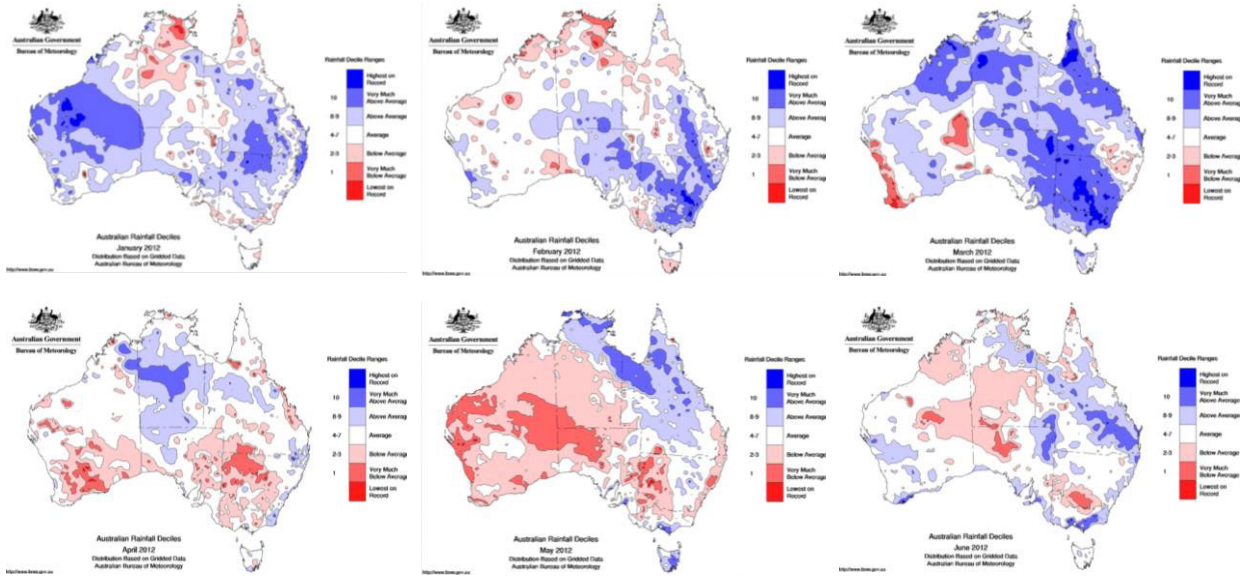


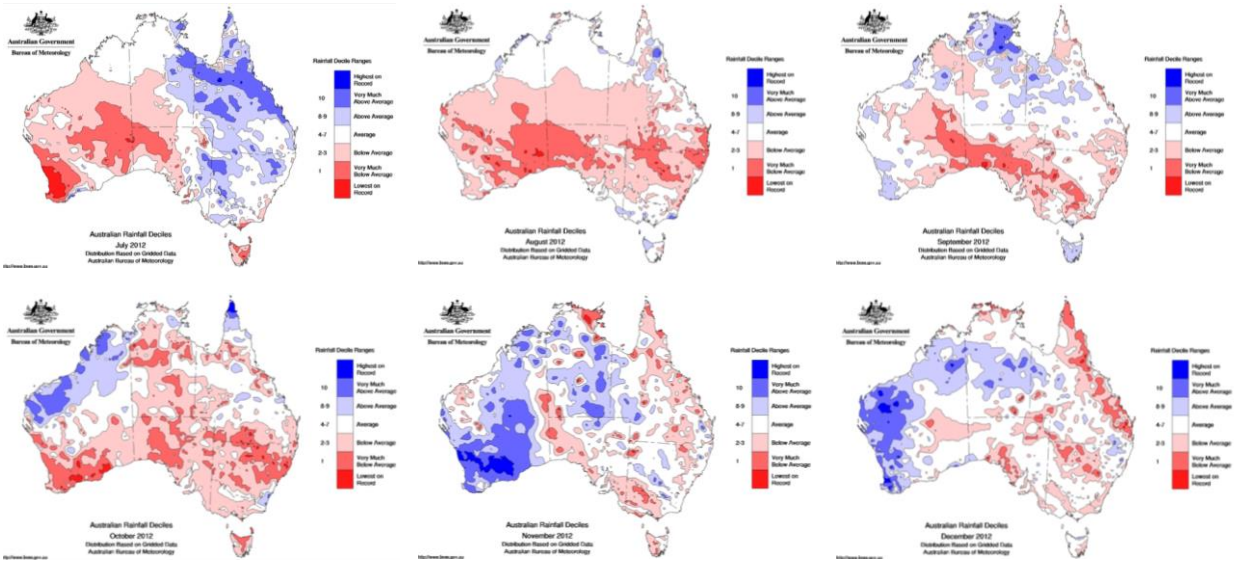
The wet period illustrated in 2010 and 2011 is an agreed fact. The "*wet period*" for 2012 may have been based on the 12 month rainfall decile map (produced by the BOM), which indicated that perhaps half of NSW experienced above average rainfall in 2012, however the other half of NSW only experienced average rainfall for the year, according to the illustration below.



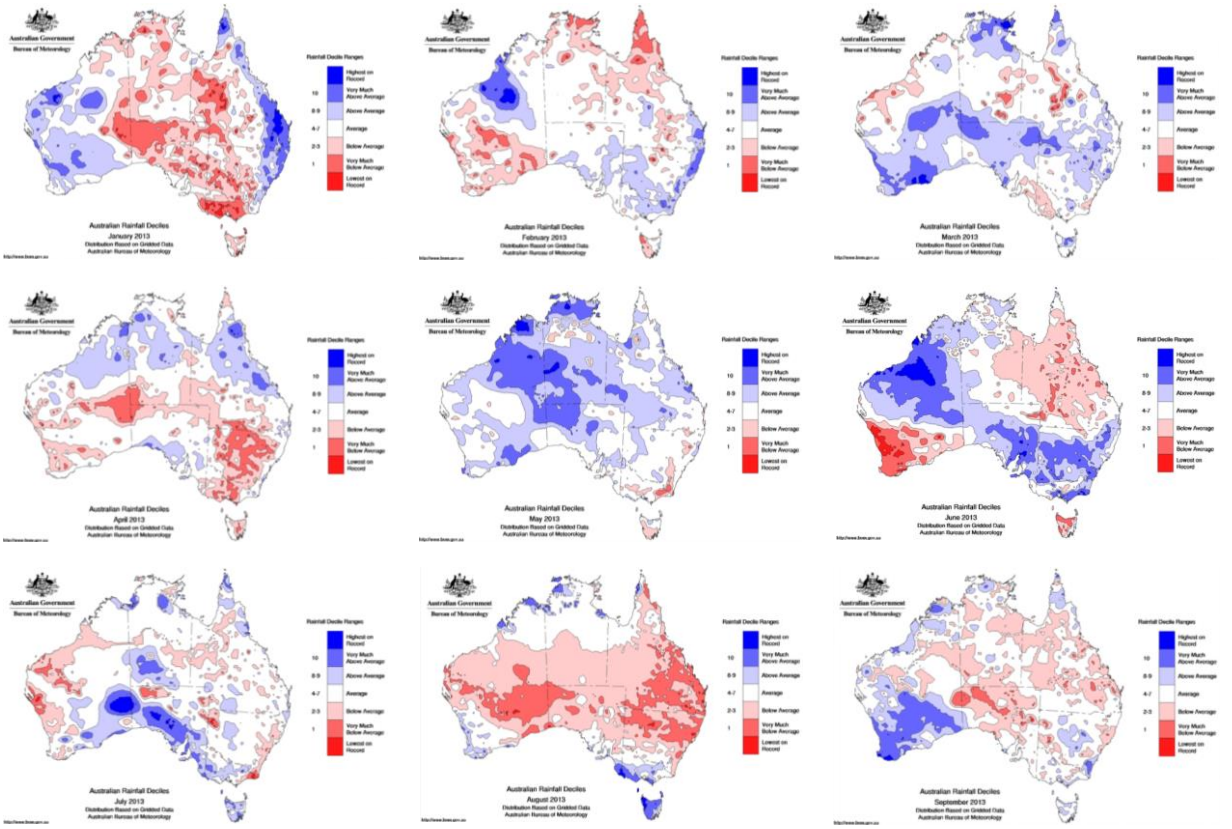
Some parts of the Northern and Central Tablelands KMZs experienced below average rainfall, however neither of these zones were surveyed in 2012, so the impact of this dry period in the north-east cannot be compared to any trend reported in the official population estimates.

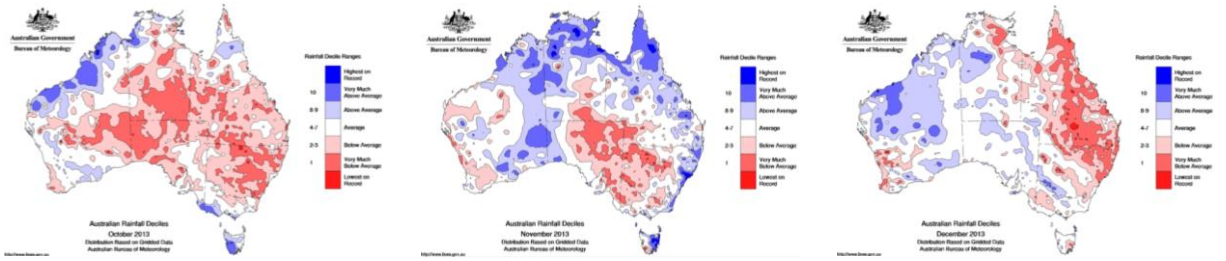
Interestingly, the above average rainfall for the 12 months to December 2012 mostly fell in the first three months of 2012, particularly in March – the rest of the year was mostly dry across most of NSW, except for July. April, May, August, September and October were the driest they had ever been in many districts, and December wasn't great either.

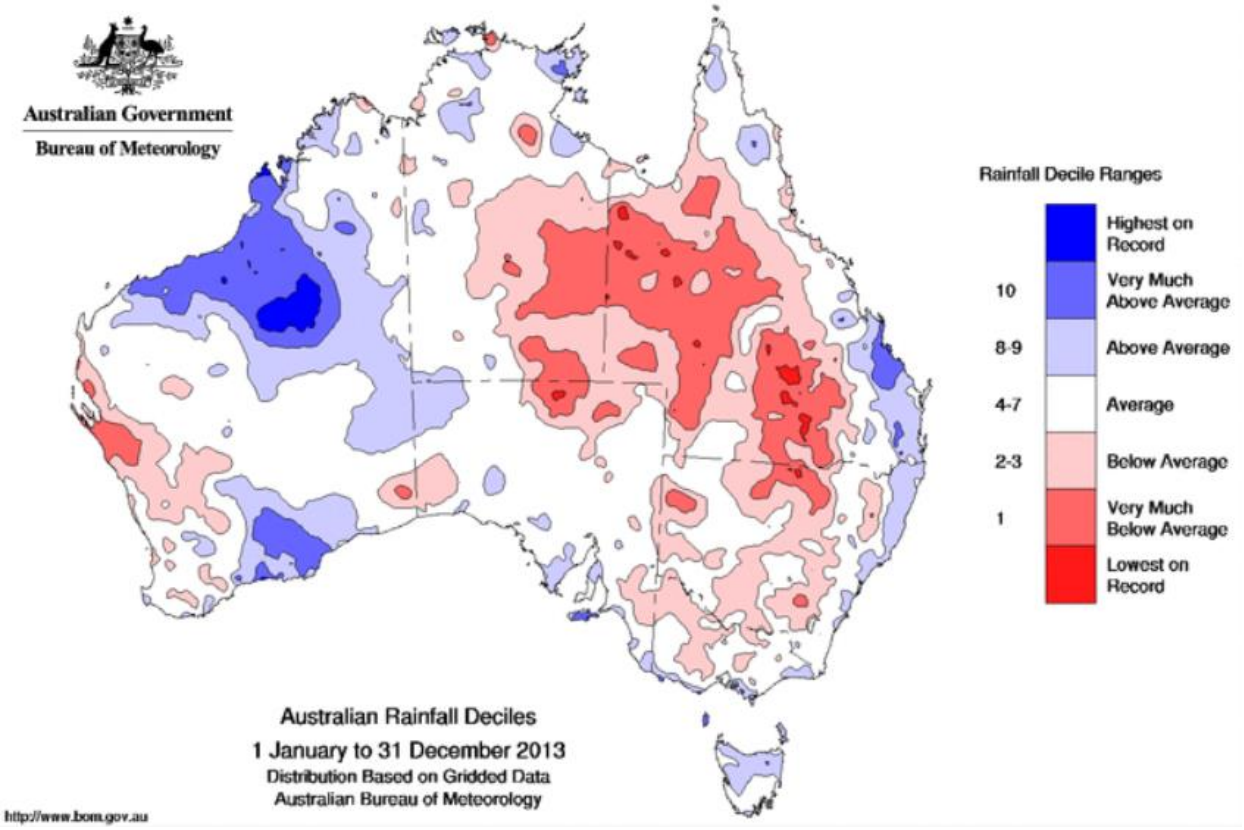


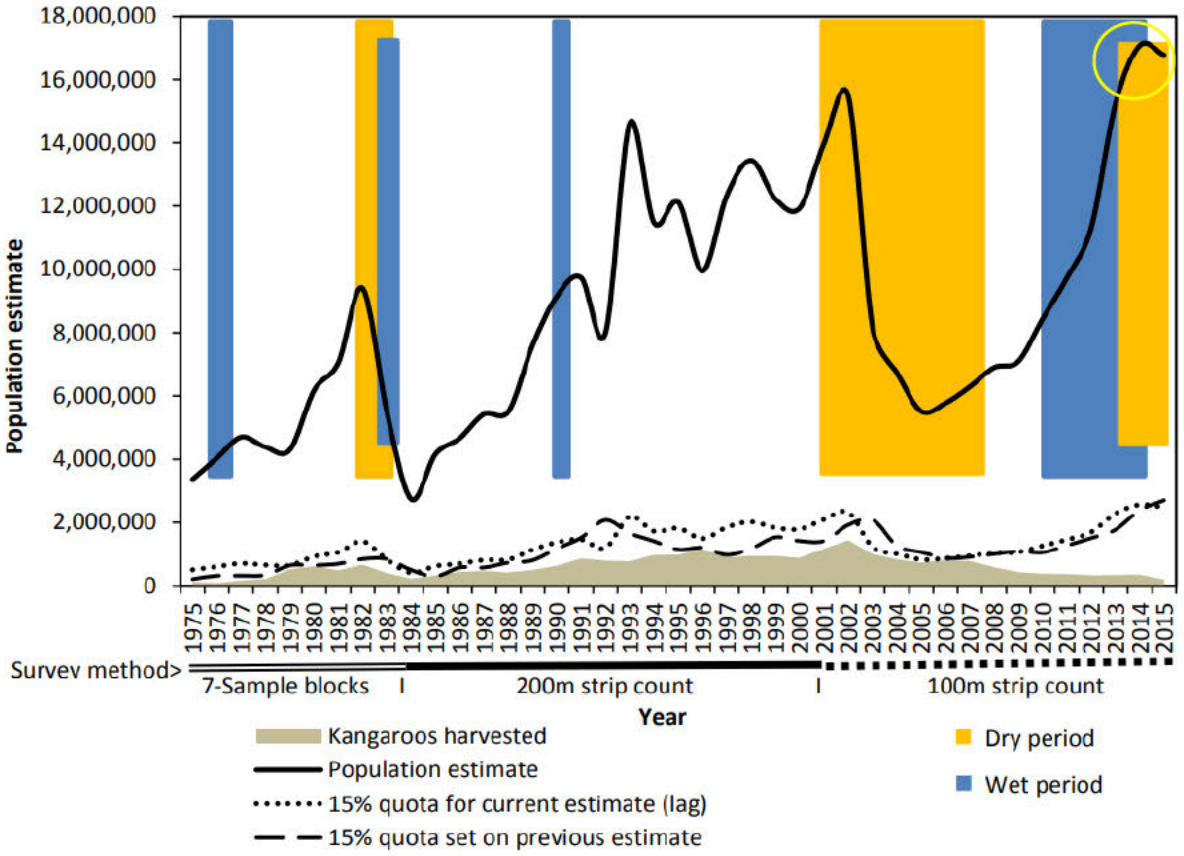


The dry trend continued into 2013; by the end of January it had not really rained for 6 months across most of NSW. There was a little bit of rain in the south-west in February, and then more widespread rain in March, followed by the driest April on record, followed by the wettest June on record. The rest of 2013 was mostly dry; August, October and November were terrible; the Northern Tablelands continued terrible through December.

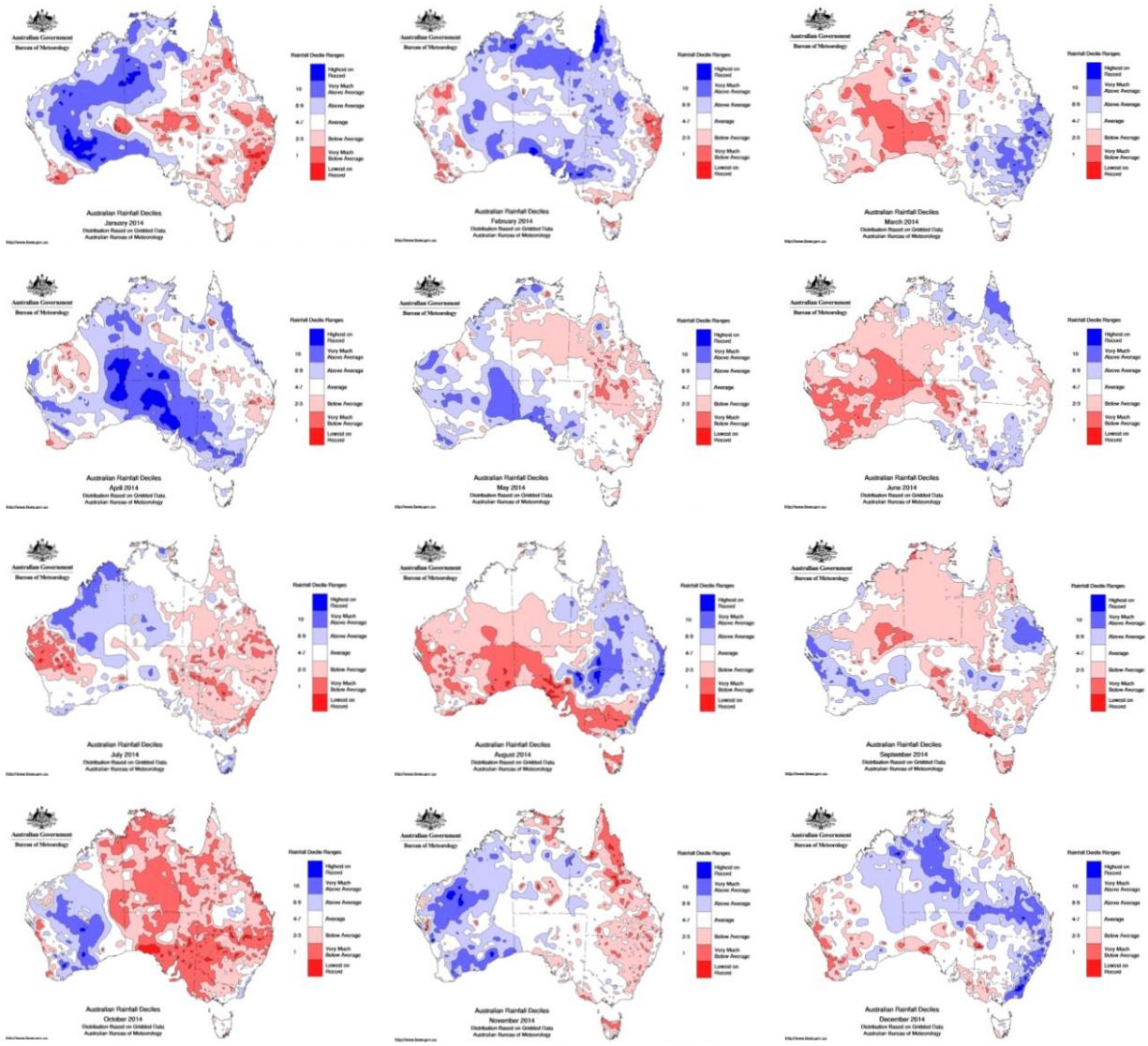




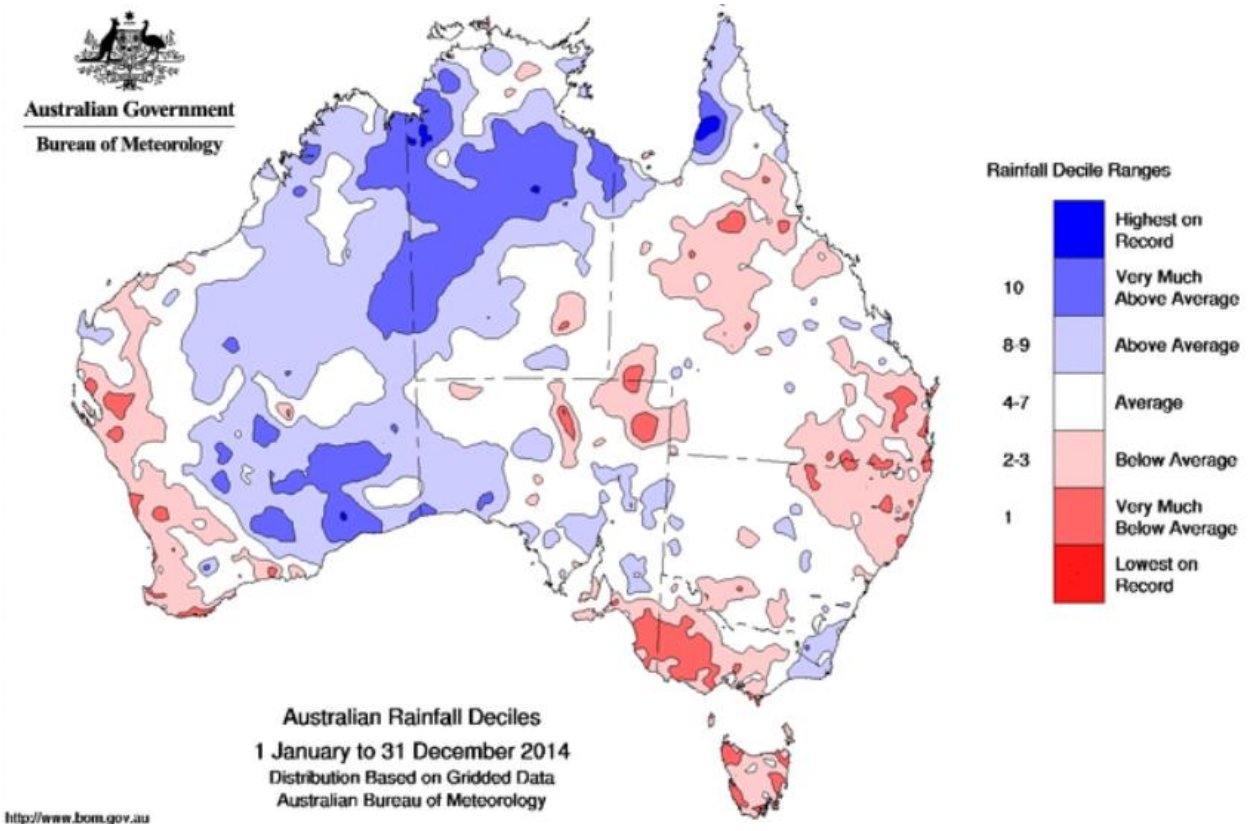

Australian Government
Bureau of Meteorology
Rainfall Decile Ranges
Highest on Record
10
Very Much Above Average
8-9
Above Average
4-7
Average
2-3
Below Average
1
Very Much Below Average
Lowest on Record
Australian Rainfall Deciles
1 January to 31 December 2013
Distribution Based on Gridded Data
Australian Bureau of Meteorology
http://www.bom.gov.au



This graph from the 2017-2021 KMP indicated the "wet period" included 2014



an average (see below). On what basis then did the OEH (2017a) categorize 2014 as a "*wet period*"?


Australian Government
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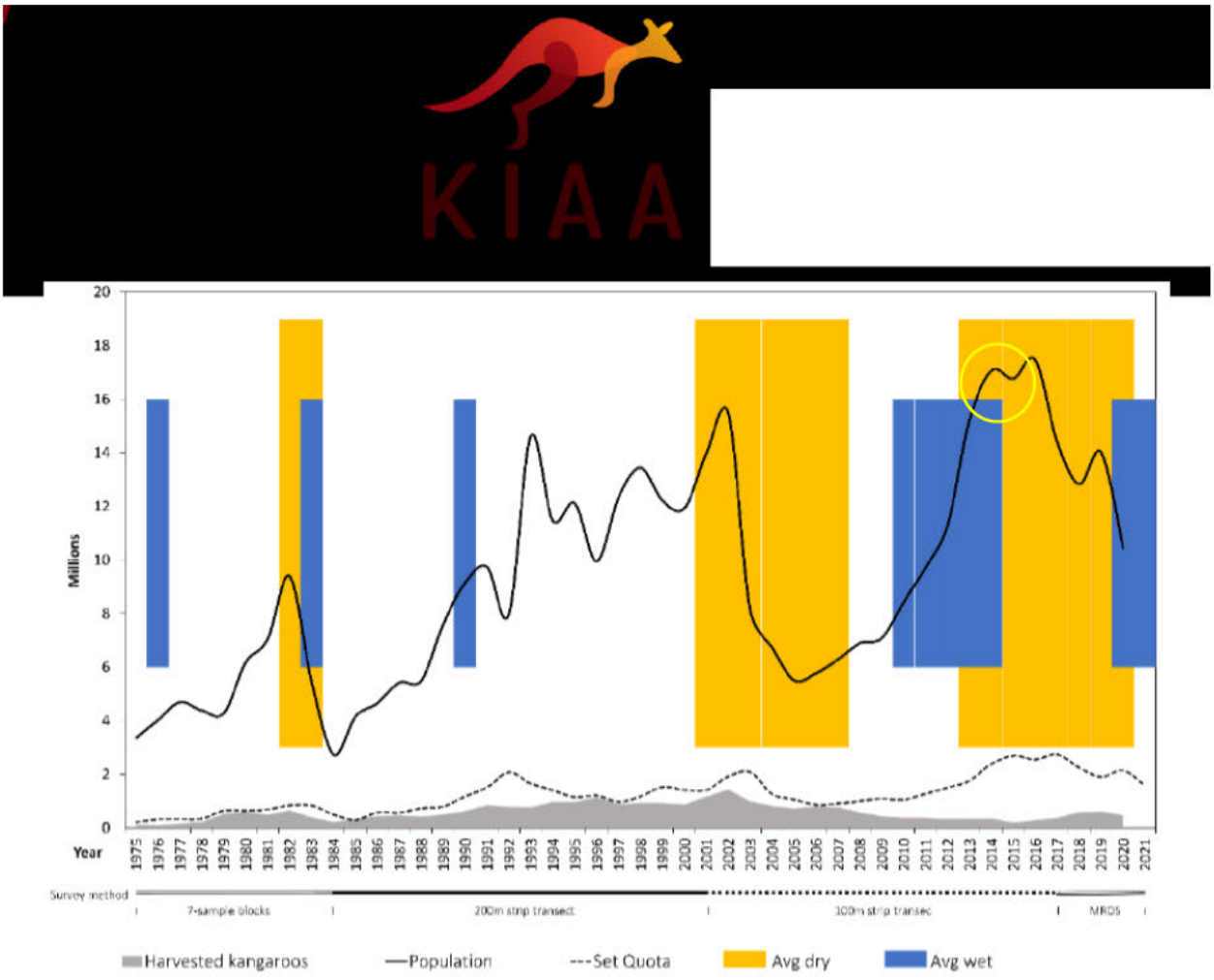
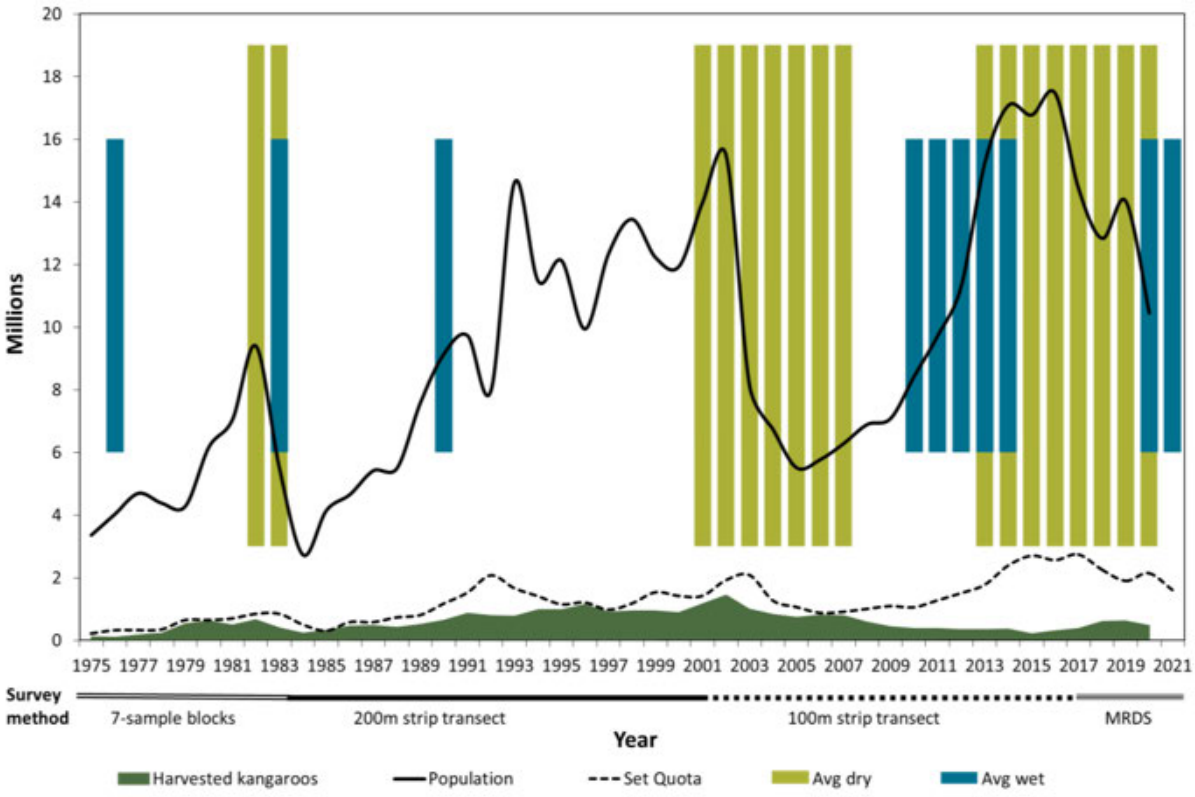


The population / wet / dry graph from the KIAA submission


Millions
20
18
16
14
12
10
8
6
4
2
0
1975 1977 1979 1981 1983 1985 1987 1989 1991 1993 1995 1997 1999 2001 2003 2005 2007 2009 2011 2013 2015 2017 2019 2021
Survey method
7-sample blocks
200m strip transect
100m strip transect
MRDS
Year
Harvested kangaroos
Population
Set Quota
Avg dry
Avg wet

3. Mr Letnic suggested in his evidence that decline in the Tibooburra region was due to a mass starvation event in the region. However your evidence dismissed the large numbers reported in the zone in 2016 as a fiction on account of the biologically impossible rates of increase that were reported in the official population estimates between 2014 and 2015. Please explain why you think this?

I note Dr Letnic suggested that the kangaroos at Tibooburra were all dying of starvation by "*the middle of 2018*". It is an incontrovertible fact that affected kangaroo populations suffer major declines during drought, and that intense drought grew steadily worse through much of NSW from 2017 to 2018, and into 2019 and 2020.

The table below indicates how many kangaroos were reported in the Tibooburra zone in 2016 and in 2020, and how many were taken commercially. Unfortunately it is unknown how many were shot under damage mitigation permits, as this data does not seem to be readily available.

	Reported Pop 2016	No. Reported Shot	Reported Pop 2020
Red Kangaroos	1,567,598	84,334	200,465
Grey Kangaroos	451,594	3,573	6,859

If we do the simple maths, and assume that non-commercial killing might have accounted for an equivalent number to those shot commercially, then Dr Letnic is claiming that in the order of 1.5M kangaroos starved in the district at the time. That is a lot of starving kangaroos!

One of the projects I am doing related to kangaroos is to collect kangaroo news items, including contemporary media stories and searches of historic databases like Trove; I have literally thousands of items in this collection. During the drought period there were a lot of stories about drought, many of them including film and/or pictures, however there was very little footage and very few pictures of kangaroos, let alone starving kangaroos. I would have thought that if ~1.5M kangaroos died in the Tibooburra region, then every single news item and every tourists' blog, would have been full of footage and pictures of starving and dying kangaroos, but this was not the case. It is true that there are a few pictures of kangaroos from this period in our recent history – incredibly some of them looked OK! Others were bogged in dams, some of them didn't look great or were dead (but there was no evidence of how they died), and it is even possible that some situations may have been contrived to sustain the "*poor starving kangaroos*" narrative.

What seems to be absent from the media reports is the avalanche of evidence (film and photographs), from hundreds of corroborating and independent sources, that would prove Dr Letnics' assertion of mass starvation.

My contention is that the "peak" of 2,019,192 kangaroos reported in the Tibooburra zone in 2016 did not exist in the first place. This is on the basis of the biologically impossible rates of increase reported between 2014 and 2016 (which exceeded 400% *per annum* in some instances), and the fact that survey methodologies changed in 2016 to the extremely inaccurate 300m MRDS methodology.

In my opinion a major contribution to magnifying the natural decline during this period of drought was shooting, with commercial activities and landholder shooting continuing right through the drought, and even intensifying from 2018. The 2016 introduction of the so-called farmer assist program, rolled out by the Sporting Shooters' Association of Australia with the support of the NSW government, saw recreational shooter members of the SSAA not only permitted but actively recruited by government agencies such as the Local Land Services "*to enjoy shooting kangaroos as pest-control*" on farming land. With further relaxation of the regulations in 2018, the result was an overwhelming avalanche of shooters social pages, forums and websites like Gumtree organising to go out west to kill kangaroos, aided by the outrageous population "explosions" asserted by the estimates.

The Hon. Ms Cusack indicated there are no kangaroos left in Sturt National Park. Red Kangaroos which leave these refuges (national parks and conservation reserves) during drought to follow storms, as they have done for millennia, would have been shot when they entered surrounding farmland, and they would not have returned to their home ranges after the break of drought, as they would have done historically.

Grey kangaroos are sedentary, occupying a small home range, and are not known to move during drought. If NPWS turned off all of the water points in the park, they probably died there. Dawson (2012) inferred evidence for their sedentary habits based on the fact that "*they died in large numbers around water holes in drought affected areas, while good feed and water was only a few kilometers away".* The reported westward expansion of grey kangaroos into the arid zone (according to Dawson *et al* (2005)) does not seem to have worked out for the species in the longer term (refer to the observed density / distribution map included on page 3 of my submission to the Inquiry).

Now even the farmers' verbal evidence (as presented on 11 June) suggests that there are not many kangaroos left in western NSW[22]. Yet supporting scientists (for example Dr Allen and Dr Letnic) and the department seem to hold no concern whatsoever for declines in a slow-breeding marsupial species, in the order of up to 98% even in just the last few years, on the basis that the species are considered "*boom and bust*" species. I wonder how the experts and bureaucrats would react to a 98% decline in a population of bettongs, bandicoots, quolls or bilbies? They would probably blame the kangaroos (this is not me being funny, as this has actually happened).

Unfortunately the supporting scientists understanding of the reproductive biology of the large macropods must be extremely poor to hold the views they hold. Kangaroo populations "*crash*" during drought, then rebuild "*albeit slowly*" during good time (Grigg *pers comm*); there is no "*boom*".

[22] Mr ZANKER: "*Right now, our overall kangaroo numbers are probably the lowest they have been for a long, long time…*"

4. You gave evidence that the reported Grey Kangaroo population increase between 2015 and 2016 in the Tibooburra zone corresponded to a change in the survey methodology. However Mr Letnic's evidence suggested that "as they have gradually refined it [the survey methodology] there have been no big shifts in the numbers…" Apart from the Tibooburra example, are there other examples of changing survey methodologies corresponding to changes in reported kangaroo populations?

It is incorrect to suggest that there have been no discernible increases in reported populations whenever changes in methodologies / correction factors have occurred.

2015-2016

As I indicated in my evidence the official population estimates for grey kangaroos in the Tibooburra KMZ ~doubled (92.2% increase) between 2015 and 2016, which corresponded to the change in the survey methodology (as per Mr Brill's evidence, that the survey in western NSW changed to MRDS in 2016).

In the same period Red Kangaroos were reported to have increased by 47.6% in KMZ1, 59.9% in KMZ4, 22.3% in KMZ6, 44.7% in KMZ7, and (as a rather extreme case) **147.5% in KMZ8**. Grey kangaroos were reported to have increased by 57.1% in KMZ4 and 76.4% in KMZ8.

This was obvious to managers of the program at the time, with the KMAP minutes #27 (15 November 2016) stating "*The big population increase in the Western Plain surveys are due to the **change in methods** plus the favourable climate conditions"* and "*the Panel feel there should be a foot note to explain the increase in population counts, ie: seasonal factors + **methods** + **difference in correctional factors**"*. Later the DoPIE (2020) *2021 Quota Report* (and possibly other Quota reports) stated "***variation*** [increase] ***between population size estimates in 2015 and 2016 are due to** a combination of **the new method**, climatic conditions and movement of kangaroos between zones*".

With regard to "*climatic conditions*" Pople *et al* (2010a) and Pople *et al* (2010b) discussed how rainfall has actually been found to be a poor predictor for population growth; the relationship between climate and its effect on kangaroo populations is complex.

With regard to the supposed movement of animals between zones, if it occurred then in simple mathematical terms there should have been corresponding / proportional increases and decreases in adjacent zones. However when grey kangaroos were reported to have increased by 426% in the Tibooburra zone, they were also reported to have increased by 26.9% in the adjacent Broken Hill Zone, and they were reported to have increased by 0.5% in the adjacent Bourke zone; there was no proportional decrease in adjoining zones. Note that this migration theory was first posited by Gordon Grigg in the 1980s, when he was attempting to explain a reported 84% increase in South Australia to the Senate Select Committee on Animal Welfare (1988).

Later Cairns *et al* (2015) suggested this had happened in the Central Tablelands districts between 2008 and 2011 attempting to explain a 40% increase in grey kangaroo numbers in the northern zone when there was a corresponding 35% decrease in their population estimate for the southern zone. However grey kangaroos are sedentary; only Red Kangaroos have been reported to follow storm pick. Any suggestion that migration of grey kangaroos might have occurred demonstrates only a poor knowledge of the species behavioral ecology. Refer to the Dawson (2012) quote cited in Q3 above, which may also describe what happened to the grey kangaroos in the Tibooburra zone in 2018, which Dr Lentic and Professor Kingsford might like to confirm with photographs.

2000-2001

The reported increase between 2000 and 2001 in the graph which opens my response to Q1 (and in other graphs elsewhere in this submission) also corresponded to the changed survey methodology / increased correction factors that were applied in 2001.

Specifically Red Kangaroos were reported to have increased by 49.7% in KMZ1, 55.1% in KMZ2, 26.1% in KMZ4, 11.2% in KMZ7 and 13.9% in KMZ11.

Grey kangaroos were reported to have increased by 15.8% in KMZ1, 25.4% in KMZ4, 39.3% in KMZ6, 47.3% in KMZ7 and 45.2% in KMZ10.

Once again it is relevant that the OEH (2018) *2018 Quota Report* referred to the difference between the results from 2000 and 2001, stating it was an "*invalid comparison due to a change in correction factors and survey strip width*". This is a particularly interesting admission as it indicates that even the department knows that comparison of estimates using different methodologies is not valid in a scientific sense.

In comparison to reported increases elsewhere in the official population estimates the increases indicated above don't look particularly high. However consider that the Millenium Drought commenced with low rainfall conditions in late 1996 and through 1997, and worsened through particularly dry years in 2001 and 2002. Horstman (2003) reported *"…Dr James Risbey, at Monash University in Melbourne, believes the 2002 drought was the worst in recorded history…"*[23].

How were populations supposed to have been increasing during this period of intensifying drought? Increasing correction factors at this critical time (2000-2001) could be construed as a strategy to offset the declines which would have been expected, and which would have been becoming apparent in the official estimates.

The raw data from western zone surveys (which sampled over 1,500 transects) indicated that Red Kangaroos were observed along 804 transects in 2000, however they were only recorded on 651 transects in 2001. Grey kangaroos were reported from 866 transects in 2000, but they were only observed on 713 transects in 2001. Unfortunately science tells us this is not a valid comparison however, because the survey methodology was changed between these two sets of observations. It does *look* like decline (increasing absence), however in analysis the department made it look like increase, during drought.

[23] https://www.abc.net.au/science/articles/2003/09/18/946924.htm?site=adelaide&topic=enviro

8. Can you outline how you undertook your surveys and how you came to the conclusion that the number of grey kangaroos may have been reduced by as much as ~98%?

I have not undertaken surveys. My analyses and conclusions are based on an independent re-working (a spatial analysis) of the department's raw survey data, which I have obtained through freedom of information requests (GIPA), and review of the relevant literature.

When the raw data is analysed spatially it indicates there are vast areas where there are now very few kangaroos left, if any. This has been confirmed by my in-field observations as I have worked around the state delivering other environmental survey projects. I note that the Kangaroo Management Task Force confirmed my observations of very few kangaroos persisting in many landscapes of western NSW during their verbal testimony (Mr Grant: "*Presently, yes, there are very few kangaroos in the landscape*").

To quantify the magnitude of decline I have compared the spatial analysis of the raw data with records of historic abundance and theoretical maximum carrying capacities for different ecosystems, and I have compared maximum densities recorded in various studies to observed densities across the surveyed districts.

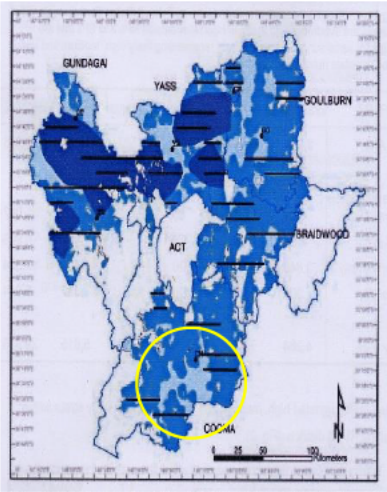
I note that Mr Quirk provided in his verbal testimony to the Inquiry that Professor Kingsford reported a 98% decline in Sturt National Park in just a few years, which I would have thought would be an issue of serious concern for anyone in charge of management of a slow-breeding marsupial. The indication that populations have also declined by up to 98% over the longer term (since settlement) is likewise met with disinterest and even contempt on the part of those responsible for the management of kangaroos in NSW.

9. In your submission you have discussed changes in survey methods over time as well as the bias in population estimates whereby kangaroos from non-shooting areas are used to derive densities which are then applied to shooting areas. Can you explain how these two factors affect population estimates?

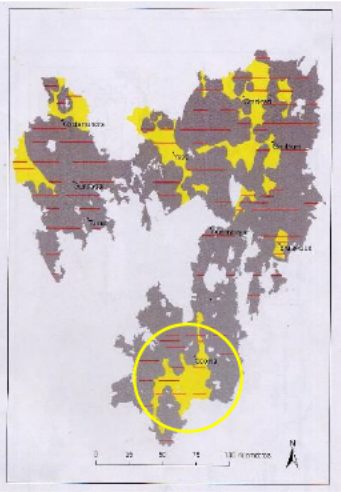
The scientific method requires a researcher to apply the same methodology, repeatedly and repetitively. This is how science generates valid long-term series of population estimates, for example. Constantly changing the survey methodology in western NSW renders any comparison of results invalid. Comparison of results from different survey methodologies are not valid – it is basically apples and oranges. In the case of kangaroo surveys in western NSW the survey methodology and analytical constants have been changed so many times that when we look at the "*long-term*" population estimates we are comparing apples with oranges, and bananas, grapes and mangoes, and (since 2018) a scotch fillet. The new surveys are not even a type of fruit, if we compare the current methodology to what was being done 40 years ago.

Any assertion of population increase across the four decades of kangaroo surveys in western NSW, or suggestions that the population estimates track the population, are simply not valid given the changes and variations in survey and extrapolation methodologies. This is particularly important when the changes in those methodologies have continually "inflated" the official population estimates, which underwrite the political, social and scientific license for the continued shooting of these native wildlife.

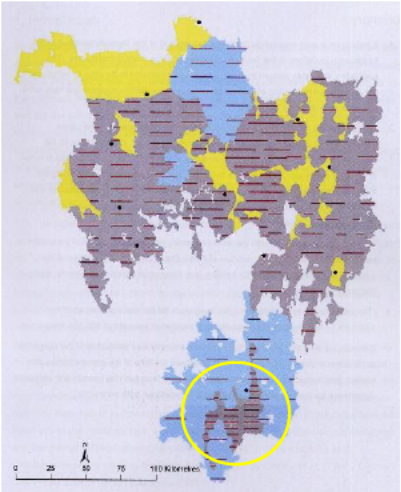
Any suggestion that surveys are the same in the eastern zones in NSW (Northern Tablelands, Central Tablelands and SE NSW) are not true either. Survey transects are constantly moved around and increased in number from one year of survey to the next, in each zone. This is illustrated for the SE Zone below. Note that the first survey (in 2003) was supposed to provide representative samples and a reliable estimate, so why these were abandoned after one survey session defies explanation. The incremental and inexorable expansion of the zone to the north and south is also illustrated, as the department extends industry access to more kangaroos by opening more districts to commercial operations.



SENSW Transects in 2003 from Cairns (2004b)

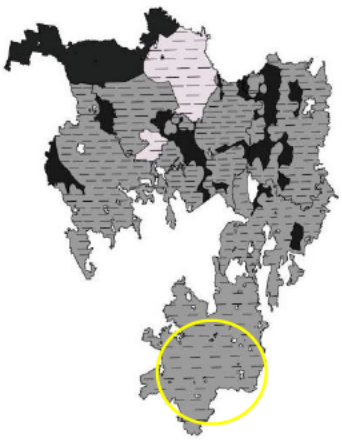


SENSW Transects in 2006 from Cairns (2007)

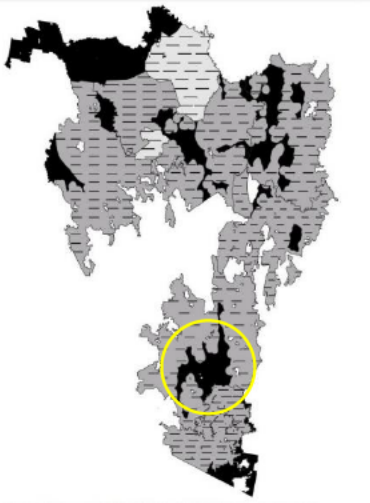


SENSW Transects in 2009 from Cairns et al (2010)

SENSW Transects in 2012 from Cairns et al (2013)



SENSW Transects in 2015 from Cairns et al (2016)



SENSW Transects in 2018 from Cairns et al (2019)

Compared to the transects prescribed for survey in 2003, by 2012 there were so many transects being flown in the SENSW KMZ it looks like they were trying to count every single kangaroo in the zone!

The on and off and on again classification of the "low" density unit in the southern district of this KMZ (circled in yellow above) also looks very strange and raises concerns about the scientific rigor of the survey program. This area was not sampled in 2003; Cairns (2004b) stated that "low" density areas were not sampled as "*density of kangaroos in the low density strata was assumed to be near zero*". However this area was increasingly sampled between 2006 and 2012, during which time (2009-2015) it became re-stratified as "medium density". The reports continued to state that "low" density strata were not sampled as "*the low density strata only supported trace numbers of kangaroos and did not warrant surveying*" (Cairns *et al* (2016)). Then the area was dropped from sampling again in 2018, and was once again re-stratified as "low" density.

We can only speculate that by 2006 it had been discovered that there were more than "*trace numbers*" of kangaroos in this area, so they were targeted for survey between 2006 and 2015. However after they were all shot the transects sampling this area in 2015 probably started returning very few observations[31], so the area was again re-stratified as a "low" density area, and the precinct was again dropped from the sample[32].

With regard to sampling national parks during survey, official kangaroo population estimates are supposed to provide an estimate of the harvestable population (this is what the quota is based on), not the total population. From DoPIE (2021) "*This Plan relates to the commercial harvest of kangaroos only on privately owned land* [and] *publicly owned land for which the primary purpose is not conservation…*".

The aim of the program has been to maintain viable populations of the harvested species across their range (including in farmland), and DoPIE (2021) claims that this has been the case "*After over 45 years of commercial harvesting in NSW… …ecologically viable populations of each species have been maintained across their range".* However a spatial analysis of the data, and the survey reports themselves, illustrate

[31] The later reports for this zone do not label transects or provide lat / logs, so it is impossible to tell where animals were observed in the KMZ in 2015.

[32] Unfortunately sampling landscapes where there are very few or no kangaroos brings the aggregated density down. Survey transects have also been dropped in western NSW when they started returning zero-count observations.

large areas of absence, particularly in farmland, so this claim in the *DRAFT NSW CKHMP 2022-26* is false. Kangaroo populations have not been maintained across their range.

Population estimates are not supposed to and no longer include counting kangaroos in national parks. The areas of national parks and reserves are subtracted from the total area of KMZs when the experts are performing the official harvestable population estimate calculations.

However in the western zones from at least 1984-2017, and in the Central Tablelands in 2008 and 2011, the surveyors flew over national parks and other non-shooting areas when they were gathering their sample data. In the case of the 2008 and 2011 surveys in the Central Tablelands, the reports even said that these areas were excluded from survey, when in fact they had been sampled. A clearer case of a sampling error does not exist in the Australian wildlife research space.

Obviously there will be more kangaroos in areas where they are not shot. By sampling areas where kangaroos are not shot – areas which do not form part of harvest zone operations, density calculations in the period 1984-2017 were inflated. As a consequence population estimates were inflated, and quota was over-allocated.

A secondary consequence of this sampling error is that decline is masked, as the non-shooting areas do not necessarily decline (unless drought conditions are prevailing), while kangaroos are suppressed or shot out completely in the operational areas (farmland). Meanwhile in western NSW surveyors continued to sample national parks, perhaps generating what looks like a stable density, while in reality most of the transects that sample farmland were increasingly returning zero observations. This is evident in the spatial analyses illustrated on pages 3, 5, 6 and 25 of my submission.

Sampling national parks and other non-shooting areas was a very basic and obvious error in the survey program which was discussed in the 2011-13 nomination to list the large macropods as threatened species in NSW (Mjadwesch (2011-13)). The department subsequently ceased this practice in 2018, allowing it to assert[33] national parks are not sampled in western NSW any more[34]. Population estimates based on using animals from national parks to generate densities applied to the harvest zone were indefensible.

By having population estimates from 1984-2017 which used kangaroos from national parks to generate densities applied to farmland in western NSW, and then abandoning the sampling of national parks in 2018, the project team acknowledged that the "*long-term*" series of population estimates was not a valid series of population estimates. If it was OK to sample national parks then presumably they would still be doing it, as the practice was defended while the NSW Scientific Committee were considering the threatened species nomination. It certainly was an effective way to increase the official population estimates, and to mask decline in the official population estimates.

[33] This assertion has been made before and has been found to be untrue. I have not yet reviewed the locations of the new survey monitor blocks.

[34] Note that other jurisdictions across Australia continue to sample national parks and other non-shooting areas in order to generate their "*rigorous and scientific*" population estimates. Unfortunately the problems with flawed kangaroo survey methodologies and bias in analysis have not just been limited to NSW.

10. You have discussed the mismanagement of the kangaroo industry where the harvest rate (15-17%) exceeds species' reproductive rates (10%) – can you outline what the impact of this will be on macropods taking into consideration that you have also stated that the breeding rate decreases during drought?

I would remind the Committee that while the maximum population growth rate for grey kangaroos is 10% (as per my verbal evidence) the maximum population growth rate for Red Kangaroos and Wallaroos is 14% on account of a faster pouch-emergence / weaning time (as per my verbal evidence) as pouch-emergence and weaning triggers the next phase of the breeding cycle.

If the harvest rate exceeds the species replacement rate, then the population will decline. Obviously if the population growth rate is negative (for example during drought), and if harvesting continues under these conditions, then the population will decline even faster.

The industry and its supporters assert that during drought commercial shooters are only shooting animals that would have died during drought anyway. However professional shooters do not target the starving / dying kangaroos – if they did these animals would likely be rejected from processing on account of their poor condition, or the shooter would reject the carcass in the field. Professional shooters shoot the healthy kangaroos, which may have survived the drought.

Early harvest model proposals recommended a cessation to shooting during drought, however this recommendation (and others) were not incorporated into the harvest model that was adopted.

It is also worth mentioning that landholder and illegal shooting is additive to commercial killing, and is not factored into quota allocations. As a consequence when commercial take was close to quota in the early days of the regulated industry in NSW, landholder and illegal shooting would have been contributing to a kill rate that exceeded the supposedly sustainable harvest rate.

11. Can you please discuss your comments regarding the management of licenses and point-of-kill monitoring and the impact these have on macropod welfare and management?

Licenses are not "*managed*"; it is a tick a box process. If a professional shooter wants tags he gets them and commercial killing is in no way limited by quota[35]. If a landholder wants to kill kangaroos approval is given over the phone or by email. There are no checks on numbers reported on applications, nor on the numbers killed. If a professional shooter mis-hits an animal he (or she) can easily leave it in the field rather than bring it to a processer; there is no post-shooting follow up or property inspections looking for mis-hit animals, so the chance of poor shooting being detected and prosecuted is close to zero.

There is minimal or no point-of-kill monitoring for commercial killing; when a researcher accompanied 14 professional shooters, she reported general non-compliance with the Code that required destruction of dependent at-foot joeys (refer to McLeod & Sharpe (2014)). Another study in this macabre suite of experiments found slow decline in the condition of joeys after "*sudden separation"* from their mother, so it must be assumed that if orphaned joeys are not predated soon after the loss of their mother, then they decline slowly from starvation and stress, until they die.

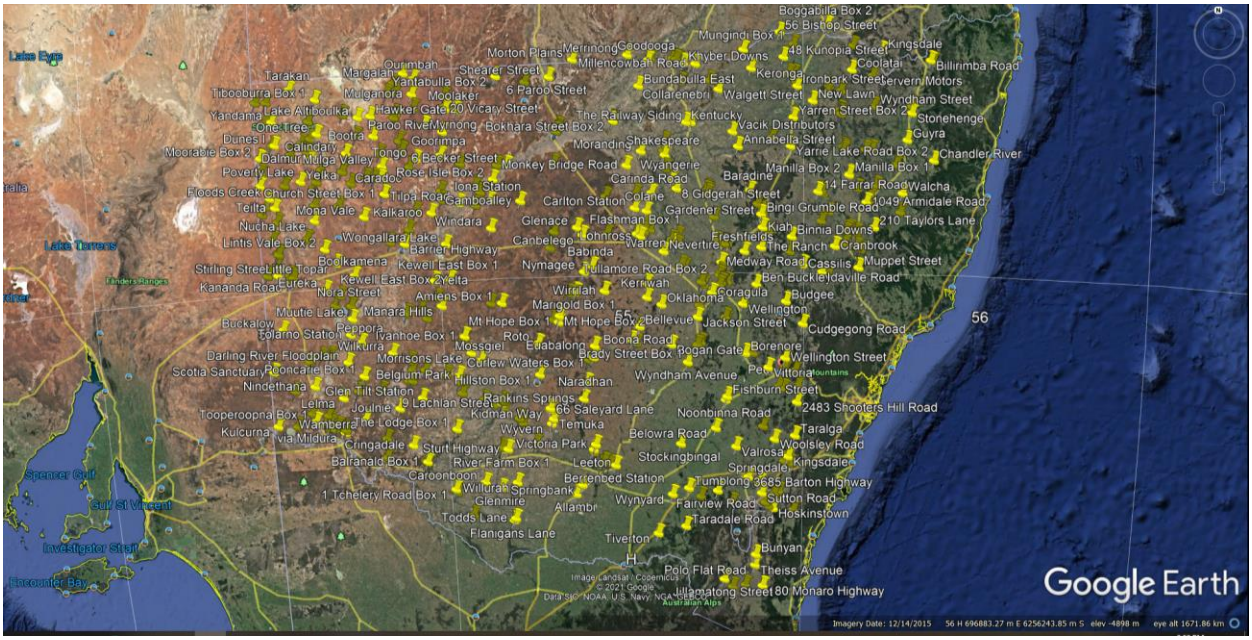
There is no competency testing or point-of-kill monitoring of damage mitigation shooting. Anecdotally it has been said that some farmers will sometimes shoot kangaroos in the stomach so they run off and die in the bush, rather than dying in a crop, as their carcasses can foul-up harvesting machinery. There is no post-shooting follow up or property inspections looking for mis-hit animals after a landholder shoots animals under a damage mitigation permit. Whatever assurances may be provided that damage mitigation shooting is done humanely cannot be proven, and in fact no-one has ever attempted to prove it.

[35] The industry boasts about how small a percentage of the available quota is taken up each year, as part of their "*the industry is sustainable"* badging.

12. Could you please outline what "chiller boxes" are, and how the declining numbers of kangaroos is evident by these?

Chiller boxes are refrigerated carcass collection points. They are generally located on remote properties or in industrial areas on the outskirts of rural and regional towns. Shooters shoot, eviscerate and "trim" the kangaroos in a paddock somewhere, they load them onto their truck and drive around shooting and butchering more animals until they have enough for the night, then they unload the carcasses into chiller boxes. When the chiller box operator has enough carcasses refrigerated trucks pick them up for transport to processing facilities.

In the period 1997-2016 there were ~600 licensed carcass collection points servicing the commercial industry across NSW.



There were ~600 carcass collection points in NSW between 1997-2016 (Mjadwesch in prep)

The weekly loading rate data ("*inward consignments*") from the NSW chiller boxes indicate there has been a decline in loading rates (take) at all spatial and temporal scales (refer to graphs on pages 22 and 23 in my submission). This is irrespective of "*market forces*" (for example the closing of the Russian market).

Studies of hunted wildlife all over the world have shown that declining take is a reliable indicator of the trajectory of populations of exploited species, indeed hunting statistics have been found to be a better proxy for population density and the trajectory of populations than actual survey of species in some cases. I would suggest that this is also true for kangaroos, given the critical sampling and method errors with surveys and bias in analysis, and the biological impossibility of reported increases in the official population estimates published in Australia. Pople *et al* (2010b) wrote of kangaroos "*because harvest data are collected continuously and throughout the harvested areas, they offer the promise of more intensive and more representative coverage of harvest areas than aerial surveys do".*

I have covered the issue of what the chiller box data (and declining take data more generally) shows in a general sense in my submission, however producing a comprehensive account of how the chiller box data evidences population decline is far beyond the scope of responding to supplementary questions to the Inquiry.

13. Has there ever been any scientifically verified attempt to calculate precise population estimates for kangaroos or any other macropod species in NSW?

There has never been any attempt to generate an accurate population estimate of any of the commercially killed kangaroo species in NSW (or elsewhere in Australia). While inaccurate (inflated) estimates have been provided for harvest zones, many districts have been excluded from surveys (such as the coastal strip of NSW) and population estimates in commercial harvest areas are based on excluding the areas of national parks within the KMZs, ironically while kangaroos from within the national parks were used to generate densities that were applied to farmland, until recently.

Likewise for other species that are thought to be secure (eg: Swamp Wallabies, Red-necked Wallabies). No-one tries to count any of the so-called abundant species unless they are worth something, and unfortunately they are only worth something when they are hanging on a hook.

There may have been attempts to quantify numbers of some of the cute and cuddly species which everyone acknowledges are in decline and/or are threatened species (Brush-tailed- and Yellow-footed Rock Wallabies, for example), however I am not across the literature and recovery plans for every macropod species in NSW.

I think it is fair to say that people only become worried about a species enough to try to count them properly when there are nearly none left.

The authorities who are in charge of the large kangaroos in NSW have not yet reached this stage in their thinking, possibly because they accept and do not question or interrogate the reported population estimates that come out of the survey program. Note that survey of the large kangaroos (in NSW and other commercial shooting jurisdictions across Australia) is only done to provide quota allocations for the commercial industry.

14. Do you think the Kangaroo Management Taskforce's assertion that NSW kangaroo populations peaked in 2016 at 17.4 million, trebling from 5.5 million in 2005, is accurate?

No I don't.

I have discussed issues with the long-term population graph used by the industry and its supporters elsewhere in this submission. The graph is misleading and omissive (it does not indicate where animals from new harvest zones have been added to totals, and it does not indicate where correction factors have been increased, nor the magnitude of these increases).

I have also discussed errors with how artificially inflated population estimates have been generated elsewhere in this submission (using kangaroos from national parks to generate densities applied to farmland, for example).

Note the KMAP minutes #27, which conceded that the 2016 population estimate had been artificially inflated (at least in part) by the application of the new MRDS survey methodology.

Note also the OEH (2018) *2018 Quota Report* which referred to the changed methodology between 2000 and 2001, making the comparison of results "*invalid… …due to a change in correction factors and survey strip width…*".

FACT: There is no long-term data series for NSW.

Suggesting that a population "*peaked*" when there is no long-term data series (ie: population estimates based on a consistent survey area, an identical survey methodology, and using uniform analytical constants) is a logical fallacy. You can't have a "*peak*" if you don't have a valid long-term data series.

The department's failure to conduct a robust survey methodology (ie: survey the same area, replicate and repeat *ad nauseam*) has deprived the commercial kangaroo management program for NSW of anything that even remotely resembles a valid long-term data series.

15. You make reference to historical records, what do they have to say about kangaroo populations in the early days of settlement?

My work in this area is not ready for sharing at this stage.

In summary however, extensive examination of early historical source documents indicates presence and abundance of kangaroos across many Australian landscapes, and then decline and loss of kangaroos on account of clearing of their habitat and ongoing and intensifying persecution, as landscapes became progressively settled. This process of displacement and eradication commenced on the day the First Fleet arrived in Sydney Cove, and it has never ceased, to the present day.

I make reference to some historical observations about kangaroos elsewhere in these responses, and to other factors that have and continue to contribute to their ongoing decline.

16. Where have kangaroos disappeared from in NSW?

Unfortunately kangaroos have disappeared from most Australian landscapes.

Understanding what has happened to kangaroos in Australia (not just NSW) requires the simple effort of *noticing absence,* including not only in your daily life (including in major cities where extirpation occurred long ago), but also when driving wherever, or even watching media footage of Australian landscapes. When your "normal" daily observations are informed by the understanding that agricultural land, city landscapes and development sites (for example), or vast districts now given to intensive agriculture, are where kangaroos occurred *historically*, then their disappearance from these spaces becomes clear.

Please take the time to drive around until you find some kangaroos, then keep driving until you find some more kangaroos. Then look at the spaces between where you found the two lots of kangaroos (urbanisation, mining precincts etc); these are the places from which kangaroos have been eliminated.

If you don't have time to drive around looking for kangaroos, watch the news every night for a few months; this will provide a very random but representative sample of landscapes that occur in Australia today. Look for kangaroos – if they are there the camera crew will usually shoot them for some flavor. If you see some kangaroos, that's great! If you see agricultural land (crops and sheep and cows), or people crowded into sports stadiums or city streets, or drone footage of urban roof-scapes, or congested highways, or piles of coal, monster trucks and open-cut mines, these are landscapes where kangaroos have disappeared.

If you examine Cairns' eastern zone survey reports you will notice that they stratify the KMZs into "high", "medium" and "low" density strata. The low density areas are not surveyed; Cairns (2004a) writes "*the low density stratum was assumed to support less than trace numbers of both eastern grey kangaroos and wallaroos"*. Payne (2008) wrote of these areas "*…densities are assumed to be zero (but are unlikely to be zero) in low density strata…".* These landscapes have often been given to intensive agriculture (for example much of the Liverpool Plains) or mining (in the Upper Hunter KMZ), or they may be proximate to population center's (for example the districts around Cowra and Lithgow), however these landscapes *were* historically home to kangaroos (and other now-absent or extinct species).

Going to the stratified analyses I have illustrated on pages 3 and 5 in my submission, the raw data from surveys also frequently indicates absence along survey transects. Modelling the species distribution based on stratification of the raw data by land-use and vegetation type would illustrate species persistence across their range, however there is precisely zero incentive (funding) to generate a comprehensive accounting of persistence (and absence), as this would not fit within the dominant narrative of "*there are more kangaroos than ever before*".

There is a phenomenon called "*change blindness*". This is when things change so slowly – over multiple generations – or where change occurred so long ago, that we can't see or even imagine what was there before. We assume that a forest or woodland which is empty of kangaroos today was always empty. However Dawson (2012) wrote "*They are animals of the forest and woodland…*", echoing the early observations of the English colonisers – the Eastern Grey Kangaroo was colloquially the "*scrub kangaroo*".

How many kangaroos were in the forests and woodlands of Australia do you think, after millions of years of no shooting? Go for a walk in your nearest forest or woodland, and count the kangaroos. This really is not rocket science, and even the experts servicing the government survey contracts have acknowledged absence from many landscapes where they previously occurred (including Cairns as per his "low density" strata mentioned above), even if it is never mentioned when they are briefing the media on how populations supposedly increased with the arrival of the British, and after the advent of agriculture.

17. Have you been surprised by the survey data that shows extensive areas where there were no kangaroos observed despite the historical evidence of kangaroos having populated those areas in significant numbers?

No I have not been surprised. When you read the histories – what was done to kangaroos *and* what was done to the land (clearing of forests / woodlands = clearing of habitat), it can *only* be expected that landscapes where they were historically abundant would be today completely devoid of kangaroos.

If you persecute a slow-breeding species relentlessly for ~200 years this will have exactly the impact that is illustrated by the data from macropod surveys when it is analysed spatially, which shows frequent zero-count transects, and a depleted and fragmented distribution where they persist (refer to the density / distribution maps I included on pages 3 and 5 of my submission to the inquiry).

If you look at the rate of killing in the chiller box returns, and the decline that is obvious in the '*inward consignment"* datasets at all spatial and temporal scales, then finding that the raw data from surveys indicates critically low densities and absence from many landscapes comes as no surprise at all.

18. You state that red kangaroos can now only be found at extremely low densities - how does that compare to historical references?

Oxley shot the first Red Kangaroo near where Wellington is today on 20 July 1817 – now the closest Red Kangaroo to Wellington is hundreds of kilometers away.

Gould used to pop over to the Liverpool Plains and kill Red Kangaroos with his dogs, and he described them as "*abounding*" along most of the inland river systems in 1838. These districts have often been taken over completely for intensive and irrigated agriculture (in the Riverina), and now these land systems have no Red Kangaroos at all.

Red Kangaroos were killed during a drive at Tambar Springs in 1875, now the closest Red Kangaroo to Tambar Springs is hundreds of kilometers away.

Frith (1973) and Newsome (1975) both reported mobs numbering in the thousands even into the 1960s; the raw data from surveys doesn't show anything like these numbers any more, anywhere.

Archer *et al* (1985) included a map indicating the Red Kangaroo's historic range extending for hundreds of kilometers to the east of where modern texts indicate they occur, while the modern texts bizarrely fail to indicate any range contraction at all.

There are other examples indicating similar contractions of the species into the interior in Victoria and South Australia.

All of the evidence points to catastrophic decline and range contraction for Red Kangaroos[36], while the charlatans talk up the fabulous cloth of the Emperor's New Clothes, and everyone claps and cheers, while the Emperor strides down the street in the nude.

There are more than ever before! Eat them! It is good for them, and it is good for the environment!

There is a monumental swindle in progress.

Q: How do you make hundreds of millions of kangaroos disappear, so that no-one even notices?

A: Use "*science*" to mask the decline – everyone trusts scientists!

Think big tobacco; think climate change denial, think the Australian kangaroo industry. Vested interests are able to buy the science (and the scientists) they need.

[36] NOTE: and the Wallaroo / Euro. The Eastern and Western Grey Kangaroos still occur across most of their former range, however populations have become increasingly fragmented and depleted, instead of suffering range contractions.

19. What is your view on the fact that in 2015 the NSW Scientific Committee rejected a nomination to list the large macropods as threatened species on the basis that they considered that the harvest model and surveys were "rigorous and scientific" despite the fact that they did not review the survey methodology or the analysis that underpin the official population estimates"?

On 25 July 2014 the NSW Scientific Committee wrote to me (as the author of the threatened species nominations) "*The Scientific Committee has not undertaken a review of the Kangaroo Management Program as this is outside the responsibilities of the Committee…"* (*pers comm*).

The Committee did not review the scientific methodology of the surveys nor did they question the biologically impossible rates of increase indicated in the official population estimates. They did not review the raw data, nor did they consider my independent analysis of the raw data. Their statement that "*…the Kangaroo Management Program has been independently reviewed several times and its methods and results have been published in the peer reviewed scientific literature"* was not true. The Committee's final determination to reject the nomination failed to consider critical flaws in the program, or the critique of the reported results, which were detailed in the nomination.

The proof that the surveys were neither rigorous nor scientific lies in the fact that after the nominations were rejected, the kangaroo management project team abandoned the methodologies that had been criticized in the nomination. Simply put the methodologies (including analysis using ever increasing correction factors, flying over national parks etc) were indefensible. I note that to this day no-one has engaged with my concerns about reported but biologically impossible rates of increase in the official estimates, which have exceeded 400% *per annum*.

[37] There are professional associations whose membership and revolving office bearers indicate close associations between senior peers in the Australian wildlife management space.

20. Why do you claim that shooting - whether it be commercial or non-commercial, is the most serious threat to kangaroos?

"*The two biggest drivers of biodiversity decline are overexploitation (the harvesting of species from the wild at rates that cannot be compensated for by reproduction or regrowth*)" *and land clearing*" (Maxwell *et al* (2016)). It is no different for kangaroos.

I consider that commercial and non-commercial killing is the biggest threat to kangaroos simply because shooting has killed and continues to kill more kangaroos than anything else has ever done. Processing the chiller box data really brings this fact home – an example of an *Inward Consignments* file is illustrated below.

27975	WS181-CP042	147.874442	Quambone	24/11/2012 0:00	336
27976	WS181-CP042	147.874442	Quambone	1/12/2012 0:00	208
27977	WS181-CP042	147.874442	Quambone	8/12/2012 0:00	278
27978	WS181-CP042	147.874442	Quambone	15/12/2012 0:00	144
27979	WS181-CP042	147.874442	Quambone	29/12/2012 0:00	183
27980	WS181-CP042	147.874442	Quambone	5/01/2013 0:00	280
27981	WS181-CP042	147.874442	Quambone	12/01/2013 0:00	268
27982	WS181-CP042	147.874442	Quambone	19/01/2013 0:00	253
27983	WS181-CP042	147.874442	Quambone	26/01/2013 0:00	166
27984	WS181-CP042	147.874442	Quambone	2/02/2013 0:00	327
27985	WS181-CP042	147.874442	Quambone	9/02/2013 0:00	246
27986	WS181-CP042	147.874442	Quambone	16/02/2013 0:00	242
27987	WS181-CP042	147.874442	Quambone	23/02/2013 0:00	253
27988	WS181-CP042	147.874442	Quambone	2/03/2013 0:00	187
27989	WS181-CP042	147.874442	Quambone	9/03/2013 0:00	295
27990	WS181-CP042	147.874442	Quambone	16/03/2013 0:00	330
27991	WS181-CP042	147.874442	Quambone	23/03/2013 0:00	59
27992	WS181-CP042	147.874442	Quambone	30/03/2013 0:00	229
27993	WS181-CP042	147.874442	Quambone	6/04/2013 0:00	272
27994	WS181-CP042	147.874442	Quambone	13/04/2013 0:00	328
27995	WS181-CP042	147.874442	Quambone	20/04/2013 0:00	280
27996	WS181-CP042	147.874442	Quambone	27/04/2013 0:00	355
27997	WS181-CP042	147.874442	Quambone	4/05/2013 0:00	273
27998	WS181-CP042	147.874442	Quambone	11/05/2013 0:00	323
27999	WS181-CP042	147.874442	Quambone	18/05/2013 0:00	260
28000	WS181-CP042	147.874442	Quambone	25/05/2013 0:00	348
28001	WS181-CP042	147.874442	Quambone	1/06/2013 0:00	437
28002	WS181-CP042	147.874442	Quambone	8/06/2013 0:00	241
28003	WS181-CP042	147.874442	Quambone	15/06/2013 0:00	65
28004	WS181-CP042	147.874442	Quambone	22/06/2013 0:00	208
28005	WS181-CP042	147.874442	Quambone	29/06/2013 0:00	140
28006	WS181-CP042	147.874442	Quambone	6/07/2013 0:00	336
28007	WS181-CP042	147.874442	Quambone	13/07/2013 0:00	333
28008	WS181-CP042	147.874442	Quambone	27/07/2013 0:00	128
28009	WS181-CP042	147.874442	Quambone	10/08/2013 0:00	122

A sample of the 2013 Inward Consignments file – the last column is the weekly carcass loading rate

The files literally run to thousands of rows *per annum*. A shooter wants to shoot about 50 kangaroos per night for a full load, so the figures above probably indicate the weekly kill rate of one full-time commercial shooter, loading carcasses to a single chiller box (WS181-CP042).

Every week, at hundreds of locations all over NSW, for the last ~50 years, tens-of-thousands of kangaroos have been shot commercially. Note that these figures do not include joeys, or mis-shot animals, that lurch away into the dark with their nose shot off, or animals that are discarded because of their poor condition of other defects. These are just the animals taken in for processing.

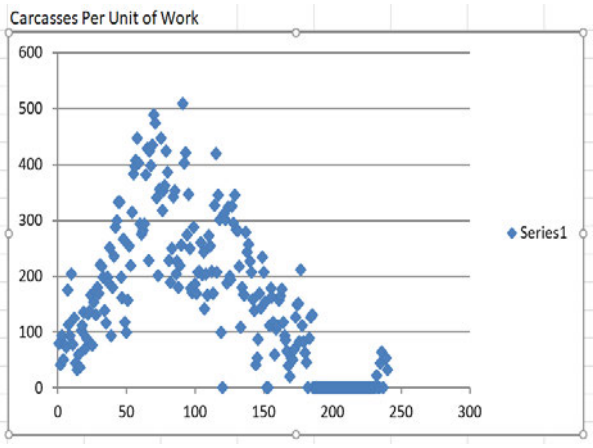
Even cases of episodic mortality that have been estimated to have killed 300,000 kangaroos at a stroke pale in comparison to the relentless rate of commercial killing.

No-one knows how many kangaroos have been killed under non-commercial permits (I understand the department will be providing these figures as a response to a question taken on notice), but so-called damage mitigation shooting has been reported to sometimes equal commercial killing. Since 2018 the department has been trying to divert damage mitigation shooting into the commercial management stream. No-one knows how many kangaroos are shot illegally, and illegal shooting is neither policed, nor investigated or prosecuted, in my experience.

Habitat loss is the second most serious threat, as it exposes kangaroos to shooting. This was the finding of Wapstra (1976) (the Forester was reduced by 96% in Tasmania by the 1970s) and Short & Grigg (1982) in Victoria. It has been acknowledged that hunting caused the extinction of the Toolache Wallaby. Yet there exists the illogical and unscientific general consensus that shooting has not and cannot ever have any impact on the commercially exploited large macropods? Given the evidence before the Inquiry it cannot be argued that commercial killing (and other killing) is well managed or regulated.

A careful examination of the chiller box data clearly shows that over time harvesters shoot kangaroos out completely. Sometimes in the last week of loading before a chiller box is closed or relocated the data shows a total of one carcass being loaded. Even if the professional shooters give a local population a rest for a few years, the next period of commercial shooting invariably forms a lesser peak in take. This suggests that ongoing damage mitigation shooting between the periods of commercial operations continues to reduce populations, even in the absence of commercial shooting.

For example the combined monthly totals from four boxes taking animals around Gunnedah (illustrated at right) built to a peak in production of ~500 carcasses per unit of work in 2004 (month 100 on the x-axis), however local take had declined to an average of only ~100 carcasses per unit of work by 2012 (month 180 on the x-axis), when the local professionals gave it up. Two boxes re-opened four years later (in 2016 – month 240 on the x-axis), by which time they were lucky to load 50 kangaroos per week of operations. This indicates that in the interim populations continued to decline locally, even in the absence of commercial killing.



21. What evidence do you have for your argument that in pre-White settlement times, kangaroos would have had access to abundant sources of water and that there is less water in the landscape today than there was prior to the occupation of landscapes for agriculture?

This issue is addressed in my response to Q6.

22. What has been the impact of broad scale agriculture on kangaroos?

This issue is addressed in my response to Q6.

23. In your experience, are there sufficient measures put in place to protect kangaroos from the effects of displacement by urban developments?

No. Kangaroos as remnant wildlife are not considered from the outset in the design of urban development.

Urbanisation is a major threat to wildlife worldwide, further fragmenting remnant habitat and safe movement, increasing predation from pet dogs, and increasing/introducing road mortality for all wildlife, including kangaroos who are often the last vestiges of remaining wildlife. This process has affected kangaroos from the first colonial settlements, and can be predicted to continue to result in local extirpations, that creep across the landscape.

If remnant kangaroos persist on land earmarked for subdivision, they flee when the bulldozers move in, and they die on the surrounding roads or in fences, or they are shot in adjacent farmland, or by Council planners / developers, with departmental support.

Members of the public, vets and wildlife rescuers such as myself bear the cost of such projects. Where kangaroos are displaced into adjacent areas they will be the victims of the all-too predictable consequences (roadkill and MVA trauma) of this type of development. Bathurst Regional Council have plans for a southern bypass that proposes to go through Boundary Road Reserve on the outskirts of Bathurst, which is home to one of the few pockets of kangaroos which persist around Bathurst.

Developers keen to support non-lethal solutions are stymied by obstructionist attitudes by councils and departments alike. Professionals like vets, ecologists and darters who volunteer substantial skills and experience to work with those developers or community are actively prohibited or threatened by government agencies from doing so, prohibitive conditions are imposed on proposals, and they are undermined and vilified by external and uninformed interference.

In my considerable professional and personal experience, there are successful non-lethal solutions that Departments and developers can help deliver, with funding and active support to optimise humane outcomes, that can be achieved with careful and expert planning and delivery lent to community work.

With regard to development planning, the protection and preservation of wildlife must be a consideration from the outset to ensure persistence. This should include greater retention of existing habitat allowing for the existing movement and use by resident wildlife (in this case kangaroos), and landscape-scale habitat connectivity connecting sub-populations; wildlife-friendly barriers to guide movement away from roads and toward designed safe wildlife crossings; careful placement of roads and effective strategies to limit traffic speed and driving habits; wildlife friendly fencing; containment of pets to reduce dog attack and spread of *T.gondii* by cats etc.

The pervasive and unquestioned myth of kangaroo abundance ensures kangaroos are ignored or excluded from conservation strategies, however. Further, in my professional experience, where strategies *are* prescribed by a consulting ecologist to a development to ensure wildlife is protected in urban development (eg koala protections including strategies listed above) as a *prerequisite* condition to minimise and/or ameliorate impacts, the approving authority does not include those requisites in consent conditions.

24. Do you agree with the conservation groups who argue that kangaroos must be killed to prevent them from becoming a major threat to biodiversity?

No.

The detailed response required to address this complex issue is beyond the scope of answering these supplementary questions, and is far beyond my capacity to respond to these questions according to the timeframe allocated.

Suffice to say that when the ACT ACAT hearing in 2013 dissected the various assertions in the media about supposed impacts of alleged "*over-abundant*" kangaroos on a host of threatened species, the finding was in the negative. Kangaroos had not been identified in the published scientific literature as a threat to a single threatened species at the time.

The senior ecologist defending the TAMS (Territory & Municipal Services) position at the time (promoting the killing of kangaroos in the parks and reserves of the ACT) stated he had not written the media releases, and claims about impacts on threatened species were departmental "*PR*". Nonetheless he thought there were "*too many*" kangaroos, and he based the projects target density (one kangaroo per hectare) on his "*gut*". I refer the Inquiry to my independent expert witness evidence to the ACAT, which was accepted in that forum (Mjadwesch (2013)).

Since then multiple studies, some of them funded by the ACT's TAMS, and some of these including the above senior ecologist as co-author, have established and consolidated the now widely-publicised position that kangaroos are a "*major threat*" to biodiversity. This phrase, relating to kangaroos in the bush, first appeared in the TAM's evidence to the ACT ACAT hearing in 2014. Examination of the methodologies, assumptions and biases in many of these papers however are a cause for concern, in my opinion.

This thinking seems to have infected non-government conservation agencies that otherwise have a good reputation, such as Bush Heritage Australia. I would urge such organisations to apply more rigorous and independent inquiry into these issues, instead of accepting funding, and employing agents promoting these notions, into their wildlife management teams.

25. Do you think the commercial shooting of kangaroos is subject to responsible oversight by the Department for Environment?

No.

26. ***In your experience does NPWS monitor local kangaroo populations to make sure that landholder permits to kill do not risk local extinctions?***

I need to answer this question in two parts, as both landholder and commercial killing puts local populations at risk of extinction.

In terms of landholder shooting, let us consider some hypothetical scenarios.

Imagine that a population of 1,000 kangaroos lives in a forest somewhere; the forest is 20 km^2 in area, providing a density of ~50 kangaroos per square kilometer[38]. The forest is totally surrounded by agriculture in all directions; in the evenings the kangaroos come to the forest edge in various local groupings to graze, as they have been doing for millions of years.

Farmer Brown drives down to the back of his property one day and sees what he thinks is a plague of kangaroos, being maybe 100 kangaroos grazing on a hillside in the late afternoon sun. He decides it is time to cull some, so he puts in an application to shoot 200 because there might be more, and it is coming into what might be a dry summer. There are no checks on numbers reported on applications at the local NPWS office (a ranger has described to me that the landholder approvals process is "PR"), and Farmer Brown is approved to shoot them over the phone or by email. The fact that approval can be given over the phone or by email seems to prove that there are no checks on the numbers reported on applications.

There are other farmers living around the forest remnant too, let's imagine there are six adjoining properties. Each of the other five landowners put in an application to shoot 200 kangaroos too, because Farmer Brown has told them how many there are, and everyone is worried about climate change. Each of the other farmers receives the authorization required, no questions asked. That would mean that 1,200 kangaroos could be shot, out of a population of only 1,000 kangaroos. At no point has there been a check on the numbers reported as being present, at no point would there be an inspection of operations, and at no point would anyone check on results of the program. It would be far beyond the capacity or ability of most NPWS staff to conduct a study to find out how many kangaroos were in the forest to begin with.

Consider another hypothetical situation. A small group of Eastern Grey Kangaroos, say 20 of them, live in a woodland fragment at the back of a farm that adjoins another farm; as the females in the mob have a home range of about 1km^2 their territory overlaps both properties. Farmer Green goes for a drive one afternoon, spots them and carefully counts them, and considerately decides to put in an application to shoot 10 of them – he likes kangaroos, but he can't have 20 of them running around ruining his fences and eating all the grass! Approval is provided by email, without question. The neighbor at the back does the same thing, because he likes kangaroos too. Both farmers shoot 10 kangaroos. How many kangaroos are left?

In a final hypothetical situation Farmer Black doesn't like kangaroos. His property has been almost completely cleared of native vegetation because he doesn't like trees very much either, so he doesn't actually see kangaroos very often on his rounds. However his grand-pappy told him "*they have three at a time – they breed like rabbits!!!*", so he puts in regular applications to shoot kangaroos just in case he does see any. He doesn't want to break the law, and he shoots every kangaroo he sees. Some of the animals from the first hypothetical scenario above scatter from the shooting into the surrounding agricultural land, including Farmer Black's property. Farmer Black shoots them.

The NPWS does nothing to monitor where (via a spatial analysis) and how many kangaroos are being killed (via monitoring and inspections) in any given area under damage mitigation permits, so there is no way

[38] Note that this density rarely occurs in the raw data from surveys.

that local extinctions can be prevented even if this is not the intention of a landholder. The only time that local extinction can be detected is when survey transects return nil observations, however because the department does not analyse the survey data spatially, they don't notice it then, either. The hypothetical scenarios described above are some of the mechanisms by which the absence which is obvious in the raw data from surveys increasingly creeps across the landscape.

In terms of professional shooting, this was an issue I raised in the nomination to list the large kangaroos as threatened species in 2011-13, as this seemed to me to be yet another a critical flaw in the way the harvest model has been designed, and how it is implemented.

A so-called "*sustainable*" quota of 15% or 17% is allocated across an entire harvest zone, depending on the species being shot. That is 15%, or 17%, offtake is applied to a population, calculated across an entire zone. For the sake of argument we will ignore the fact that these rates of offtake exceed the species actual replacement rate.

But taking 15% or 17% is not how the professional shooter works; their objective is to operate efficiently – the more efficient he (or she) is, the more profit he (or she) makes. Efficiency is a function of a few factors, one of which relates to the distance travelled (fuel costs, wear and tear on the vehicle etc). Another relates to the time spent shooting. The less distance travelled, the more profit there is, the less time spent shooting, the more money the shooter makes per hour.

The way this plays out in the field is that irrespective of whether a 15% or 17% off-take is sustainable or not, the percentage of the total number of animals killed on an individual property will be much higher than this. A commercial shooter does not travel 50km to a property, shoot one in seven kangaroos, and then not return for a year. If a shooter can take 50%, 80%, or 100% of a mob, they will do this in the name of efficiency, so at a local level the prescribed 15% or 17% harvest rate that is applied across a zone is meaningless. A slow-breeding species cannot withstand the sort of shooting pressure being exerted by rates of take at a local level illustrated by the portion of harvest data provided as part of my response to Q20 above.

Shooters are subject to the same embedded narrative that "*the industry is sustainable*", and the official population estimates indicate that populations always "*bounce back*", notwithstanding the fact that reported rates of recovery are often biologically impossible, or may occur in response to changes to methodologies and/or increases in correction factors. Unsurprisingly then shooters do not think there is anything wrong with how they operate, no matter how many kangaroos they shoot, regardless of the intensity of shooting in a spatial sense, and despite the necessary closing of chiller boxes when kangaroos have been shot out of a district (which is illustrated by the chiller box data).

27. How do you respond to the NSW Dept of Environment's submission stating that kangaroos are well suited for surviving within and successfully exploiting the habitat resources within the peri-urban matrix.

This an absurdity, both at an individual level and at a local population level. I will address the individual level first – and believe I speak for the many volunteers who currently deal with the reality of peri-urban kangaroo trauma.

In my experience the reason that the department holds this view may relate to the fact that they do not attend to kangaroos on the side of the road with two broken legs; they do not respond to calls about kangaroos that have been attacked by dogs; they do not pull kangaroos out of peoples' swimming pools, they do not respond to calls about kangaroos running through the streets until their feet are bleeding and they collapse from myopathy.

A long time ago when I have asked a NPWS ranger to assist with a rescue, I was told he was busy, and that as a volunteer wildlife rescuer it was my responsibility to catch kangaroos in town; I haven't asked him again. NPWS call me directly to deal with kangaroos in town, rather than attend the scene themselves.

As a consulting ecologist every rescue I attend impacts on my business. The average / straight forward euthanasia generally takes ~1hr; these probably make up 90% of cases. Rescues (including animal acquisition (darting), vet checks, transport to rehabilitation / sanctuary etc) can easily run to 6 hrs or more. This is my own unpaid time, it generally occurs several times a week, and sometimes several times a day. It incurs considerable out of pocket expense to myself, and significant costs in time lost to my business, and often contributes to failing to service paid projects according to agreed contracts. This is not what I want to be doing, however in the absence of any other person attending to the animal with the necessary skills and equipment, and an understanding of the animal's behavior, it is something I ethically *have no choice* but to respond.

Meanwhile the salaried departmental staff spend their time signing licenses to *kill* kangaroos, and people in offices in Sydney or Dubbo stand around the water cooler talking about how well kangaroos have adapted to exploiting the peri-urban environment.

On an individual level animals persisting in these environments often suffer extreme trauma, and often experience protracted and painful deaths. I apologise in advance for including below some photos from my records; documenting cases is important as on top of the trauma of bearing witness to what are often awful and obviously painful injuries, you can also expect to be questioned and/or criticized for ending the suffering of animals, by people who do not attend these type of incidents.

I have attended over 1,500 of these sort of incidents since 2008, and I think I am probably better placed to comment on how well kangaroos are doing (or otherwise) in peri-urban environments, than whoever wrote the DoPIE submission.

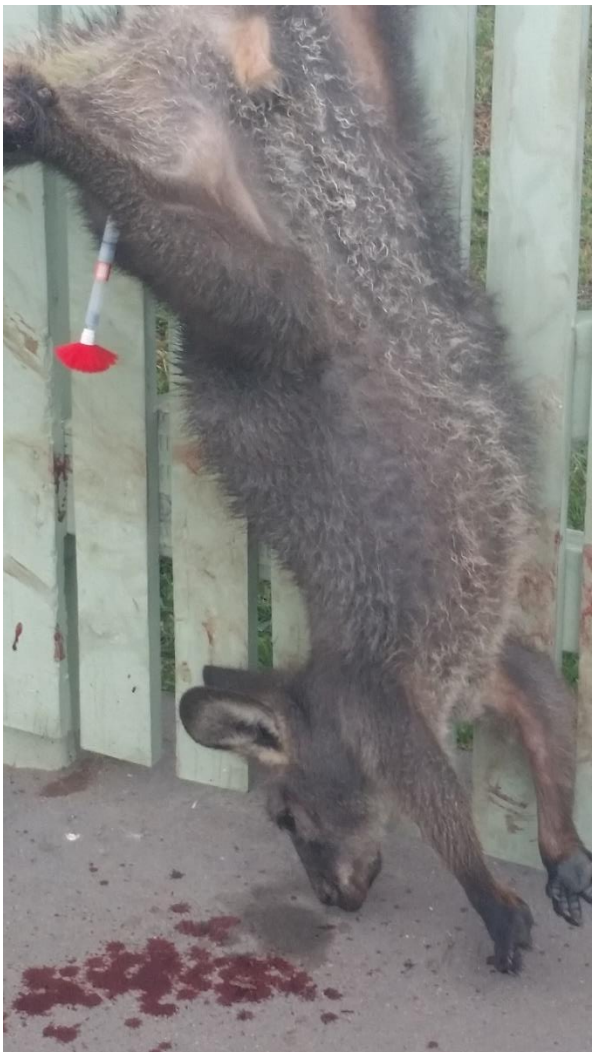
Fences break feet; these sort of injuries can take weeks to kill an animal

Sometimes animals are ensnared in loose wires…

…other times they make their getaway on one leg

When acquiring animals on Mount Panorama for a UTS post-grad research project in 2014 we found six animals with broken feet / leg injuries from fences over a three week period, in a 600 ha precinct. This suggests to me that at any given time there are probably ~six animals suffering from these sort of injuries on Mount Panorama, including right now. This issue becomes quite horrendous if it is extrapolated across landscapes wherever kangaroos persist in NSW, and more widely across Australia.

Kangaroos are frequently hit by cars if they end up in town, suffering catastrophic injuries in the process. It can be unsafe to fire a rifle (to euthanase animals) in built-up environments, and current regulations around darting (relating to the prescription and handling of S4 drugs) often makes it extremely difficult to deploy an appropriate (humane) and timely response. It is sadly incredible what these animals can do with these sort of injuries. The Wallaroo (below) had been seen hopping around Eglinton on one leg for three days before anyone bothered to call it in. If I had not been available to safely sedate and euthanase him, how long would this have continued before his inevitable death? DoPIE have no systems in place.



Sometimes they get caught in picket fences; this one died in care, despite not breaking anything.

Sometimes dogs maul them; this male had injuries to his head, neck, both arms and tail

Perhaps the nice people at DoPIE who like to write about how kangaroos are doing so fantastically at the urban interface should be called to attend these type of incidents.

Some people like to take pot shots at them with bows and arrows…

The doe above with a large joey in her pouch was shot through the arm with an arrow in Boundary Road Reserve on the outskirts of Bathurst in 2016. The police make inquiries – they consider that people who are cruel to animals are a risk to other people, however they are hard to catch. The department responsible for the protection of kangaroos in NSW have shown precisely zero interest. The arrow split the bone in her forearm, however she was able to be saved.

Other animals appear to have been mis-shot – this one and two others had their jaws shot off on the outskirts of Bathurst in September 2020

…some injuries defy explanation

Meanwhile DoPIE is generally nowhere to be seen; the department's dissociation from what is actually happening to the animals they are supposed to be protecting is total. I am sure it is much easier sitting in an office somewhere pretending to themselves that kangaroos "*are well suited for surviving within and successfully exploiting the habitat resources within the peri-urban matrix"*, than whatever it is I have to deal with.

That is how kangaroos are going on an individual level in the peri-urban matrix.

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[39] Section 14 of the POCTA Act requires… *…Injuries to animals to be reported*
The driver of a vehicle which strikes and injures an animal (other than a bird) shall not fail:
(a) where, in consequence of the injury, pain has been inflicted upon the animal-to take reasonable steps to alleviate the pain…
Maximum penalty: 50 penalty units or imprisonment for 6 months, or both.

Brunton *et al* (2018a) found decline in many peri-urban populations; Brunton *et al* (2018b) attributed most of the decline (73% of the mortality) to road kill. It seems to be the case that the trauma experienced by animals at an individual level in peri-urban environments leads to decline in populations, which must lead eventually to local extinction.

Remnant groups sometimes persist at the edges of towns, but as urbanisation and other development expands kangaroos are progressively killed and displaced until none are left. This might be why there are no kangaroos left in the CBD and urban environments of Sydney, or Bathurst, or Griffith, or Grafton, or Dubbo, or Broken Hill, for example.

The assertion by the Department that "*kangaroos are well suited for surviving within and successfully exploiting the habitat resources within the peri-urban matrix"* does not appear to be correct at either an individual or a population level.

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