Threatened Species Nomination Form

for amending the list of threatened species under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act)

2012 Assessment Period

The purpose of this form is to provide a nomination to the Threatened Species Scientific Committee for assessment of a non EPBC Act listed species for inclusion on the list of threatened species or to nominate a species for reassessment for consideration for listing in another category of threat.

For a non EPBC Act listed species to be eligible for listing as a threatened species it must be assessed as meeting at least one of the five criteria for listing. For a species already listed as threatened under the EPBC Act to be eligible for listing in a higher or lower category of threat it must be assessed as meeting at least one of the five criteria for a particular indicative threshold. For example, for a species listed as endangered to be found eligible for listing as critically endangered, it must meet the critically endangered indicative thresholds for at least one of the listing criteria.

If there is insufficient information to enable details to be provided because of a lack of scientific data or analysis please include any information that is available or provide a statement next to the relevant question identifying that the data or analysis is not available. Please provide references in your nomination to support information provided.

If you are nominating a species for delisting (removal from the list) please complete the nomination form to delist a species.

Note – Further detail to help you complete this form is provided at Attachment A.
If using this form in Microsoft Word, you can jump to this information by Ctrl+clicking the hyperlinks (in blue text).

Eligibility for Listing

1. NAME OF NOMINATED SPECIES (OR SUBSPECIES)

The Large Macropods:

Scientific name: *Macropus fuliginosus*
Common name: Western Grey Kangaroo

Scientific name: *Macropus giganteus*
Common name: Eastern Grey Kangaroo

Scientific name: *Macropus robustus* (ssp *robustus* and ssp *erubescens*)
Common name: Wallaroo / Euro

Scientific name: *Macropus rufus*
Common name: Red Kangaroo

2. NOMINATED CATEGORY

CRITICALLY ENDANGERED

From the evidence it is clear that these four macropod species have undergone a **very severe** reduction in numbers in the 200 years since white settlement (likely that >80% lost, processes affecting them continue to operate).

Projected continued decline, particularly at the rate of exploitation the species are presently subject to, and in train with continued habitat loss and degradation and other processes (roads, fences, disease, drought, bushfire, flood, climate change etc), places them at extreme risk, particularly in the medium-term (100 years). While this may seem a long time, the actions which will need to be taken to recover the large macropods present formidable obstacles to their conservation.

3. CRITERIA UNDER WHICH THE SPECIES IS ELIGIBLE FOR LISTING

Please mark the boxes that apply by clicking them with your mouse.

All 4 Species:

■ Criterion 1	☐ A1 (specify at least one of the following) ☐a) ☐b) ☐c) ☐d) ☐e); **AND/OR** ■ A2 (specify at least one of the following) ■ a) ■ b) ■ c) ■ d) ■ e); **AND/OR** ■ A3 (specify at least one of the following) ■ b) ■ c) ■ d) ■ e); **AND/OR** ■ A4 (specify at least one of the following) ■ a) ■ b) ■ c) ■ d) ■ e)
■ Criterion 2	☐ A1 (specify at least two of the following) ☐a) ☐b) ☐c); **AND/OR** ■ A2 (specify at least two of the following) ■ a) ■ b) ■ c)
☐ Criterion 3	☐ A1; **AND/OR** ☐ A2 (specify at least two of the following) ☐a) ☐b) ☐c)
☐ Criterion 4	N/A
■ Criterion 5	10% chance of extinction in the wild in the medium-term future (100 years)
For conservation dependent nominations only:	☐ Criterion 1 ☐ Criterion 2

4. CURRENT LISTING CATEGORY

If the nomination is for a currently listed species to transfer to another category please indicate which category the species is currently listed in. If you are nominating the species for delisting (deleting from the list) please complete the nomination form for delisting.

What category is the species currently listed in under the EPBC Act?

☐ Extinct	☐ Extinct in the wild	☐ Critically Endangered
☐ Endangered	☐ Vulnerable	☐ Conservation dependent

5. 2012 CONSERVATION THEME: Corridors and connecting habitats (including freshwater habitats)

Is the current conservation theme relevant to this species? If so, explain how.

The Large Macropods and their conservation is relevant to the corridors / connecting habitats theme for the 2012 nomination period.

Active management with conservation of the kangaroo as an objective would require **landscape scale reform** in terms of reclaiming and re-connecting habitat in a meaningful and effective way. Large-scale corridor projects including multiple-kilometre-wide habitat enhancement programs, regional fauna friendly fencing initiatives etc, ie: programs with a focus on improving conditions for kangaroos, will be required. This type of large-scale and necessarily strategic corridor program (actively linking the largest areas of remnant vegetation, in which the most viable populations of kangaroos remain) would co-benefit *all* species.

6. CONSERVATION STATUS

What is the species' current conservation status under State/Territory Government legislation? Does the species have specific protection under other legislation or inter-governmental arrangements?

Western Grey Kangaroo	**Legislation**	**Status**	**Shoot Under (Harvest)**
QLD	NC(W)R 2006	Protected	r. 12(a) NC(A)R 2006
NSW	NPWA 1974	Protected	s. 121 & s. 123 (H)
ACT	N/A		
Vic	WA 1975	Protected	s. 22
Tas	N/A		
NT	N/A		
SA	NPWA 1972	Protected	s. 60J (H) & s. 68A(5)(b)
WA	WCA 1950	Protected	r. 6 WCR 1970 (H)

Western Grey Kangaroos do not form part of the commercial harvest in Queensland (too few).

Eastern Grey Kangaroo	**Legislation**	**Status**	**Shoot Under (Harvest)**
QLD	NC(W)R 2006	Protected	r. 11(e) NC(A)R 2006 (H)
NSW	NPWA 1974	Protected	s. 121 & s. 123 (H)
ACT	NCA 1980	Protected	s. 44(1) & ACT KMP 2010
Vic	WA 1975	Protected	s. 22
Tas	NCA 2002	Protected	s. 26
NT	N/A		
SA	NPWA 1972	Protected	s. 68A(5)(b)
WA	N/A		

Identified as in severe decline (only 10% left) and at-risk in Tasmania in the 1970's, the Forester (Tasmania's subspecies of the Eastern Grey Kangaroo) is considered to have recovered, and is reported to be stable at around 26,000 animals, after conservations areas (138 km2) were gazetted to conserve the species. Permits to destroy the Forester can be obtained today; DPIPWE licences the shooting of about 660 per annum, however management plans allow that tag allocations can go as high as 10% of the population (Tanner & Hocking 2001).

Tasmania is not having much luck with wildlife conservation! Their Coat-of-Arms sporting two Tasmanian Tigers is rarely seen now, just like the thylacine itself. The Tasmanian Devil looks like it might be next. Let's hope Australia does not follow Tasmania down this path, of having an extinct species bearing the national Coat-of-Arms.

Wallaroo	**Legislation**	**Status**	**Shoot Under (Harvest)**
QLD	NC(W)R 2006	Protected	r. 11(e) NC(A)R 2006 (H)
NSW	NPWA 1974	Protected	s. 121 & s. 123 (H)
ACT	NCA 1980	Protected	s. 44(1)
Vic	WA 1975	Protected	s. 22
Tas	N/A		
NT	N/A		
SA	N/A		
WA	N/A		

Euro	**Legislation**	**Status**	**Shoot Under (Harvest)**
QLD	NC(W)R 2006	Protected	r. 11(e) NC(A)R 2006 (H)
NSW	NPWA 1974	Protected	s. 121
ACT	N/A		
Vic	N/A		
Tas	N/A		
NT	TPWCA 2006	Protected	s. 45 & s. 122
SA	NPWA 1972	Protected	s. 60J (H) & s. 68A(5)(b)
WA	WCA 1950	Protected	r. 6 WCR 1970 (H)

Euro do not form part of the harvest in western NSW, they have not been monitored in NSW since 2002, when their population within the harvest zones was estimated to be only 12,000 (OEH NSW KMP 2012-2016). *M. robustus erubescens* was harvested until then, however.

Quota reports for NSW (commercial take) are only available on-line as far back as 2001, when 4,294 Euro were shot in the Bourke KMZ; 1,120 were shot in the Narribri KMZ; 1,195 were shot in the Coonabarabran KMZ (this total may have included some Wallaroos, too). In 2002 4,617 Euro were shot in the Bourke KMZ; 1,760 were shot in the Narrabri KMZ; 1,905 were shot in the Coonabarabran KMZ (this total may have included some Wallaroos, too). Incredibly with only 12,000 Euro left (as reported) 2002 saw the slaughter of more than 40% of the population. In 2003 another 1,977 were shot in the Narrabri KMZ and 2,015 were shot in the Coonabarabran KMZ. This represented 4000 of the remaining 7,200, over 55% of the population. This is the last year data was submitted for M. robustus shot in any of the western zones.

From 2001 shooting of the Wallaroo accelerated in the Armidale, Glenn Innes and Upper Hunter KMZs until "take" for Wallaroos peaked in 2006; has anyone noticed or discussed the facts around the subspecies being subject to harvest in NSW haing changed? Since 2006 Wallaroo take has crashed; the 2010 harvest was only 37% of the take in 2006, following the steeply declining populations down (see Mjadwesch 2011).

NSW commercial take back to 1989 needs to be reviewed, when M. robustus first entered the data set (illustrated in the OEH 2011, Figure 7 pp 44). Has the Euro dropped out of others of the western harvest zones?

Harvest of the Euro may re-commence in western NSW, after aerial survey of the Barrier Ranges has been conducted, according to the OEH 2011 (Action 7 pp 22).

Red Kangaroo	**Legislation**	**Status**	**Shoot Under (Harvest)**
QLD	NC(W)R 2006	Protected	r. 11(e) NC(A)R 2006 (H)
NSW	NPWA 1974	Protected	s. 121 & s. 123
ACT	N/A		
Vic	WA 1975	Protected	s. 22
Tas	N/A		
NT	TPWCA 2006	Protected	s. 45 & s. 122
SA	NPWA 1972	Protected	60J (H) & s. 68A(5)(b)
WA	WCA 1950	Protected	r. 6 WCR 1970 (H)

Numerous other Acts and Regulations direct the shooting of kangaroos across Australia. For example in Queensland there is the NCA (1992), the NC(M)R 2006 and the NC(M)CP 2005, as well as a wildlife trade management plan for export, and animal care and protection legislation and policies. This is all supposed to ensure that the harvest industry remains sustainable, and that shooting of kangaroos is done in a humane way.

The Commonwealth EPBCA 1999 provides protection for the species where States seek to export kangaroo for meat, leather, fur, testicles etc (the Commonwealth DSEWPC approves State Kangaroo Harvest Management Plans). The OEH NSW NPWS Kangaroo Harvest Management Plan (s. 2.1 pp 2) (2011) provides an overview of how the EPBCA 1999 sits over and regulates State harvest activities.

In NSW on the 29th August 2011, the DSEWPC approved the OEH DRAFT NSW CKHMP 2012-2016 (2011), on the same day public submissions closed. It is a concern that the Commonwealth body responsible for administration of the EPBCA 1999 and export approvals, approved the NSW DRAFT Plan without considering public submissions, or the changes that may have been incorporated into the FINAL report on account of submissions. The FINAL report was only released in December 2011.

Apart from NSW, other states with approved kangaroo harvest plans include Queensland, South Australia and Western Australia. These and the kangaroo management plans for Victoria and the ACT all contain the same errors described in the NSW CKHMP (discussed in Mjadwesch 2011): biologically impossible population growth rates; excessive harvest rates (up to 20%); repeated misconceptions (for example clearing improves habitat conditions for kangaroos, improved conditions with more water points etc); harvest is sustainable, etc.

Only the Northern Territory has a kangaroo management plan which seems to accurately reflect the conditions and status of kangaroos (low to very low density and abundance; populations severely affected by drought). All other states and territories either participate and facilitate "harvest", or otherwise destroy or allow the destruction of kangaroos through their regulatory systems. This is particularly the case where kangaroos are deemed to be in conflict with agriculture ("damage mitigation" permits, or simply allowing farmers to shoot kangaroos when they are on crops, as is the case in South Australia), or where they are considered to be "over-abundant" (even in conservation reserves).

Nominator's Details

Note: Your details are subject to the provisions of the *Privacy Act 1988* and will not be divulged to third parties if advice regarding the nomination is sought from such parties.

7. TITLE

Mr

8. FULL NAME

Raymond Mjadwesch

9. ORGANISATION OR COMPANY NAME (IF APPLICABLE)

N/A

10. CONTACT DETAILS

Email: [redacted]
Phone: [redacted]
Fax: N/A

Postal address: [redacted]

Important notes for completing this form

- Please complete the form as comprehensively as possible – it is important for the Threatened Species Scientific Committee to have as much information as possible, and the best case on which to judge a species' eligibility against the EPBC Act criteria for listing.
- Reference all information and facts, both in the text and in a reference list at the end of the form.
- The opinion of appropriate scientific experts may be cited as personal communication, with their approval, in support of your nomination. Please provide the name of the experts, their qualifications and contact details (including employment in a state agency, if relevant) in the reference list at the end of the form.
- Keep in mind the relevance of your answers to the listing criteria (Attachment B; Part B1).
- If the species is considered to be affected by climate change, please refer to the Guidelines for assessing climate change as a threat to native species (Attachment B; Part B2).
- Identify any confidential material and explain the sensitivity.
- Figures, tables and maps can be included at the end of the form or prepared as separate electronic or hardcopy documents (referred to as appendices or attachments in your nomination).
- Cross-reference relevant areas of the nomination form where needed.
- Nominations that do not meet the EPBC Regulations will not proceed – see Division 7.2 of the *EPBC Regulations 2000* (www.environment.gov.au/epbc/about/index.html). As noted under sub-regulation 7.04(3), if information is ***not*** available for a particular question please state this in your answer.

Species Information

11. TAXONOMY

Provide detail on the species' taxonomy, including whether or not it is conventionally accepted.

4 described species (including 2 of the 4 recognised subspecies of *M. robustus*); all taxonomic conventions are accepted, other than some discussion about the differentiation between *M. robustus* subspecies *robustus* and *erubescens*, which intergrade along a cline through NSW and Queensland (Pople & Grigg 1999 cited in DNREA 2008).

MARSUPIALIA: MACROPODIDAE

Western Grey Kangaroo *Macropus fuliginosus* (Desmarest 1817)
Eastern Grey Kangaroo *Macropus giganteus* (Shaw 1790)
Wallaroo *Macropus robustus robustus* (Gould 1840)
Euro *Macropus robustus erubescens* (Sclater 1870)
Red Kangaroo *Macropus rufus* (Desmarest 1822)

12. DESCRIPTION

Describe the species, including size and/or weight, social structure and dispersion (e.g. solitary/ clumped/ flocks), and give a brief description of its ecological role (e.g. is it a 'keystone' or 'foundation' species, or does it play a role in ecological processes such as seed dispersal or pollination).

Kangaroos are the most well known and familiar Australian marsupial (see Menkhorst & Knight 2001 and Strahan (Ed) 1995). The largest males can weigh as much as 85kg (Red Kangaroo), though more typically males of all species reach a maximum of around 65kg. Sub-dominant males and females are generally between 25 and 35kg.

Western and Eastern Grey Kangaroos and Red Kangaroos mostly occur in small family groups (2-12-20 individuals), though mobs of dozens can accumulate / aggregate when they are undisturbed, where populations become enclosed, or where they come to favourite places to feed (for example the edge of a woodland). Dawson (1995) describes group sizes:

Kangaroos are social animals but usually associate in small groups of less than half a dozen individuals.

Wallaroos and Euros tend to occur as even smaller groups (rarely more than 4 in close association – a buck, a doe, a yearling and an at-foot – *pers obs*).

Dispersal in all species tends to be young males. Despite common perceptions of hundreds of kangaroos bounding across the landscape, mature animals tend to be sedentary. Home range studies suggest surprisingly small movements, even over the lifetime of many individuals, however animals may move in response to conditions (forced migration due to drought, for example).

The kangaroo's function in the landscape was described by Mitchell (1847), cited in Gammage (2011):

Fire, grass, kangaroos, and human inhabitants, seem all dependent on each other for existence in Australia; for any one of these being wanting, the others could no longer continue.

The kangaroo's primary role in this system historically (herbage consumption, fertilise the landscape, seed dispersal etc) has been largely replaced across most of the kangaroos previous range by stock animals, which don't do quite as good a job (on account of over stocking, hard hooves, high water consumption etc).

13. BIOLOGY

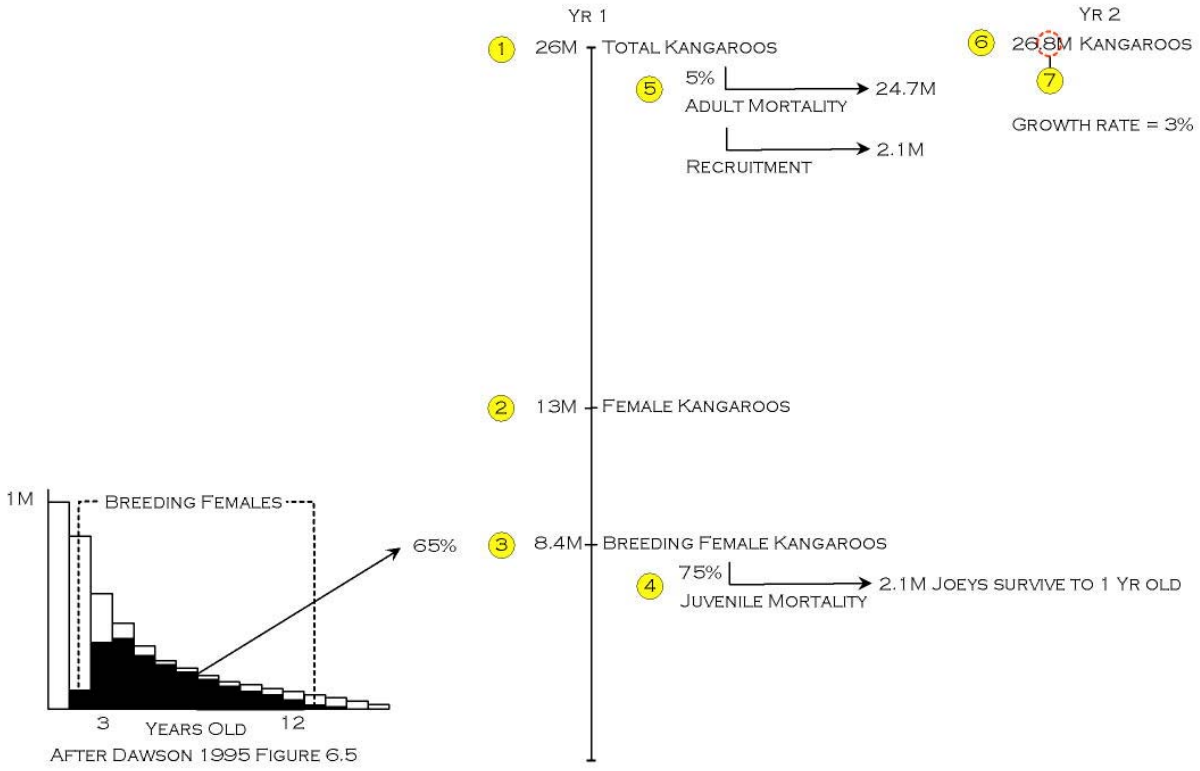
Provide information on the species' biology, including its life cycle, generation length, reproductive and feeding characteristics and behaviours.

Kangaroo biology and behaviour is well studied (eg: Dawson 1995, Caughley *et al* 1987, Coulson & Eldridge 2010); Mjadwesch (2011) provides a summary of the factors addressed in Attachment A: Further information for completing this form (see s. 2 pp 19-24), which is summarised below.

Age to Sexual Maturity (F)	c. 2 years, though rarely produce first young before 3 years, and may not have bred even at 4 or 5 years of age, if conditions poor (drought)
Life Expectancy	15 years (18 years maximum); females breed mainly between 3 and 12 years old
Natural Mortality Rates	Juveniles: 73% in WGK (Arnold *et al* 1991); minimum 60% in RK according to Bilton (2004) Adult mortality in Wallaroos: 5-25% per annum
Generation Length	5 years (average age of breeding females in the figure below)
Reproduction	"populations explode" "plague proportions" "30-45% per annum under good conditions" Monitoring data shows extremely high rates of increase year to year (up to and over 100%) Mjadwesch (2011) discusses reproduction rates, and suggests 9-14% as maximum rates Bilton & Croft (2004) has a growth rate of 8% for RK

A simple diagram, based on the discussion in Mjadwesch (2011), illustrates the kangaroo's reproductive capacity below.

1. Year 1: Assume a population of 26M kangaroos.
2. Half of them are female (assuming M:F parity).
3. Based on standard population age distribution, around 65% of the females are breeding.
4. Juvenile mortality typically runs at around 75%, though up to 90% or even 100% during drought; minimum reported 60% mortality in Red Kangaroo during good conditions (Bilton 2004).
5. Adult mortality around 5% per annum (may be much higher during drought)
6. Calculate Yr 2 total (subtract adult mortality, add recruitment)
7. Calculate the Population Growth Rate



This is all based on what happens under pretty standard conditions, at one joey / year. Obviously parameters can be tweaked – preferentially shooting males may have created a female bias in the sex ratio of some populations; more than 65% of females may be breeding in some instances; production of joeys may exceed 1 / year in Red Kangaroos & Euro (pouch exit at 8 months).

However conversely drought puts a stop to breeding, and increases juvenile and adult mortality.

Breaking drought (rainfall) and good conditions trigger breeding; young are more likely to survive during good years (when feed is abundant).

Loading the numbers in the calculations above can show how high the growth rate can be forced. Compare this with the population data being reported under various state harvest management plans. 30-50% growth rates are commonly reported, however these are obviously biologically impossibe; figures of 75% growth, or 100% or more, are absurd (see Mjadwesch 2011 for an analysis and discussion of the NSW data).

In summary, under "standard" conditions we can expect a kangaroo population to increase at about 3% per annum. Bilton (2004) found on the basis of detailed field observations an 8% growth rate in Red Kangaroos – even this is hardly an "explosion". To achieve this using the figure and calculations above, allocate 60% to juvenile mortality (Bilton found a minimum 60% juvenile mortality). Arnold (1991) reported a 9% growth rate in the Western Grey Kangaroo, after shoting half of the Wandoo Woodland population.

Approved harvest quota: of 15-17-20% (and up to 30%). Although though commercial "take" generally only runs at around 10% of the reported population (eg: DECCW 2010), a reproductive rate of between 3% and 9%, and given other factors (other legal and illegal shooting, roads, fences, disease, drought (up to 100% juvenile mortality), fire, flood, predation, habitat destruction etc), it is hardly surprising that significant declines are evident in the population monitoring data being reported by the shooting states. Using 90% juvenile mortality in the figure above (for example during drought), the population starts to decline at 0.5M animals / annum, without even increasing adult mortality. Increasing rates of adult mortality during drought (assume 25%) causes numbers to decline by more than 6.5M animals per annum.

In terms of how the large macropods reproductive cycle and life history may make them susceptible to threatening processes, a protracted period of dependency of at-foot young (weaning and independence between 12 months and 18 months) is a high risk strategy - if the mother is shot, or killed in a fence, or is run over, at-foot joeys will rarely survive. A low reproductive rate, coupled with high rates of human induced mortality, is unfolding as another story of wildlife over-exploitation, mismanagement and neglect.

Behaviour	Crepuscular; shelters during the day in timber, moving to grazing sites in late afternoon and evening – this exposes them to shooting, when they may normally rest in a national park (for example) during the day, but moving to adjacent farmland to feed or water during the night. Sedentary; mature animals may follow storms and green pick, particularly during drought, however when drought breaks, animals have been observed to return to their original home range; site fidelity has been discussed in Dawson (1995).

14. HABITAT

Describe the species' habitats and what role this plays in the species' life cycle. Include whether or not the species is associated with, or if it relies on, a listed threatened ecological community or listed threatened species?

The four species habitats are described in Mjadwesch (2011), as well as numerous other sources (for example Menkhorst and Knight 2001, Strahan (Ed) 1995, Dawson 1995 and Caughley *et al* 1987).

In summary the Western Grey Kangaroo occupies the woodlands of southern Australia (western NSW to southern WA); the Eastern Grey Kangaroo occupies the woodlands and forests of eastern Australia; the Wallaroo / Euro resides in timbered hill and ridge country across Australia (excluding the south of WA and south-west SA, Victoria and Cape York); the Red Kangaroo occupies mulga-lands, open plains and floodplains from the interior to the west coast.

In all instances tree-cover is a critical habitat element (providing shelter during the day), and grassy grazing land is required to provide feeding opportunities. The distribution of shelter and preferred grazing sites determines the placement of kangaroos in the landscape, rather than the distribution of water points (according to Montague-Drake & Croft 2004).

Where the range of any or all of the large macropods overlaps with the distribution of endangered ecological communities (such as the various Box-Gum associations of western NSW, or Brigalow or Buloke Woodlands, to name just a few examples), or where an EEC provides a critical ecosystem

service (such as water provided by the Artesian Mound Springs), then the species subject to this nomination are associated with and/or rely on Commonwealth EPBCA 1999 listed EEC's.

Transfer Information

Note: If the nomination is to transfer a species between categories please complete questions 15, 16 and 17. If the nomination is for a new listing please proceed to question 18.

15. REASON FOR THE NOMINATION FOR CATEGORY CHANGE

Please mark the boxes that apply by clicking them with your mouse.

What is the reason for the nomination:

☐ Genuine change of status ☐ Knowledge ☐ Mistake ☐ Other

Taxonomy ☐ newly split ☐ newly described ☐ newly lumped

16. INITIAL LISTING

Describe the reasons for the species' initial listing and if available the criteria under which it was formerly considered eligible

17. CHANGES IN SITUATION

With regard for the listing criteria, how have circumstances changed since the species was listed now makes it eligible for listing in another category?

Population Size

18. NUMBERS

a. What is the total number of mature individuals? How was this figure derived?
b. Identify important populations necessary for the species' long-term survival and recovery.

a. Surprisingly there has never been a National audit of the species subject to this nomination, despite 3M of them being shot annually as part of the "harvest". Neither have any of the states attempted to make an accurate assessment of numbers, other than as part of their monitoring (which supports the harvest).

Mjadwesch (2011) provides a rough calculation for numbers of each species in NSW, based on allocating various densities of macropods to regions, defined by their suitability as habitat for the various species (see s. 4.1-4.9, pp 86-99). This provides orders of magnitude only; fine scale mapping of occurrence and urban / residential and agricultural (no-kangaroo) regions would be required to make an accurate estimate macropod numbers in NSW (see Mjadwesch 2011 s. 4.8 pp 94-95).

In summary, estimated totals for NSW in 2011 were given as:

Western Grey Kangaroo	2.8M
Eastern Grey Kangaroo	14.6M
Wallaroo / Euro	1.2M
Red Kangaroo	5.2M

There are serious limitations to these estimates, not least the uncertainty around the figures provided by the NSW population monitoring data. For example kangaroo researcher Cairns (2009) allocated "high" densities to regions like the Bathurst basin, an area of 450 km2 where there are nearly no kangaroos at all. This has necessarily inflated figures in the central tablelands by tens-of-thousands of animals. Application of "high" densities to regions across NSW where there are no kangaroos (around major population centres and agricultural zones, for example), is likely to have inflated totals by hundreds-of-thousands, if not millions of animals, in population estimates.

Otherwise the calculations used to obtain the totals above tended to be based on generous and optimistic macropod densities for the conservation reserves and non-harvest zones of NSW. The

hope is that this many animals may persist, however knowing that sections of NSW are more likely to have no kangaroos, rather than many (for example the Wagga Wagga region), these numbers are considered likely to have a significantly positive bias.

For the purposes of this nomination, totals from QLD, SA and WA surveys in 2010 summarised at: http://www.environment.gov.au/biodiversity/wildlife-trade/wild-harvest/kangaroo/population.html have been used in the Table below. Density calculations according to Grigg (2002) were applied to areas not covered by the harvest data (for example Western Grey Kangaroos in Queensland). Note when Grigg cited these densities, the data was already 20 years old (from 1980-1982), so he "corrected" it (applied the "most recent" correction factors), effectively doubling population totals, and thereby doubling population densities. These and other limitations to population "data" are discussed below, in describing how these totals were calculated.

	QLD	NSW	ACT	Vic	Tas	NT	SA	WA	Total
WGK	340K	2.8M	-	700K	-	-	2.34M	2.8M	**9M**
EGK	17.4M	14.6M	373K	6M	26K	-	NS	-	**38.4M**
Wal	1.575M	600K	60K	NS	-	-	-	-	**2.2M**
Euro	1.4M	600K	-	-	-	5.175M	4M	10.4M	**21.6M**
RK	7M	5.2M	-	3K	-	459,402	10M	3.6M	**26.3M**

In NSW and QLD the **Wallaroo / Euro split** in the table above was made 50/50, to account for the smaller area of occupancy of the Wallaroo having habitat in a general sense better conserved (higher ranges of GDR and hilly country often remains timbered), and less arid than those habitats in which the Euro occurs (western NSW). This has been assumed to provide conditions which are better suited to supporting higher populations and higher population densities of Wallaroo, compared to the Euro.

A population of Western Grey Kangaroos has been estimated for **Queensland**, based on an extent of occurrence of approximately 140,000 km2, and assumed densities corresponding to Grigg (2002) density distribution maps. An assumed density of 66/ km2 has been applied to conservation areas, based on Arnold (1991), however it is accepted that this northern extent of their distribution may occur at a lower density than found through more habitat-optimal sections of their range. For the purposes of this nomination, the Western Grey is assumed to occur at Lake Bindegolly (104 km2, including 15 km2 of open water), Currawinya (1,513 km2), Culgoa (429 km2) and Thrushton (250 km2) national parks (total: 2,296 km2). Total estimated Western Grey Kangaroos in conservation areas in QLD: 150,000.

The Eastern Grey Kangaroo is protected within the harvest zones in QLD in 60,236 km2 of conservation reserve and state forest (4.8% of their range here). The density "gradient" hypothesis put forward by Mjadwesch (2011) is shown by Grigg (2002) to be true through QLD and NSW (lower densities in the west of their distribution, in farmland). The same ratios as used in Mjadwesch (2011) for calculation in NSW of Eastern Grey populations in national parks and reserves, has been applied to national parks in Queensland (74 / km2 in western half of their range; 233 / km2 in 40% of their remaining range and ; 510 / km2 in remaining 10% optimal habitats). Total estimated Eastern Grey Kangaroos in conservation areas in QLD: 10.8M.

The section of the Eastern Grey Kangaroo population in the Cape York region designated "non-harvest zone" (in the state harvest report) has been shown to actually support very few kangaroos – Grigg (2002) maps them here at only 0.2-2 / km2 and <0.2 / km2, not really adding any significant numbers to the total.

The Common Wallaroo discussed in the QLD kangaroo harvest reports (presumably including the Wallaroo and the Euro) is protected within the harvest zones in QLD in 53,988 km2 of conservation reserve and state forest (4.4% of their range). No maps of Wallaroo / Euro density could be found for the purposes of this nomination. Croft (1981) and Lundie-Jenkins (undated) reported densities up to 44 / km2 and 45 / km2 respectively (in optimal habitat); this has been applied across 1/3 of the area covered by the national parks of QLD, intervening "poor" habitat has been calculated at 2.23 / km2 (as in Mjadwesch 2011). Total estimated Wallaroos / Euros in conservation areas in QLD: 890K The section of the Wallaroo population occurring in the Cape York non-harvest zone represents approximately 1/8th of the range of the species across QLD (175K added to total).

In QLD the Red Kangaroo is harvested across its entire range, being "protected" only in national parks, state forests etc, being approximately 44,254km2 (4% of their range) in Queensland. A density

of 78 / km2 has been applied to these areas (according to Short & Bayliss (1985), reported for Kinchega NP). Total Red Kangaroos in conservation areas in QLD: 3.45M.
Note that in a general sense throughout this section, red and grey kangaroos tend to occur in complementary habitats where they are sympatric – the calculations here do not reflect this. Density totals have been applied for these species across all areas of occupancy, rather than applying Red Kangaroo densities to the correct proportion of national parks which is suitable habitat for them, and grey kangaroo densities only to the proportion of national parks which is suitable habitat for them. It may be safer to assume that for conservation areas, habitat is present in equal amounts for both species, and populations in conservation areas above (and below) should perhaps be halved. Resources being applied to these sort of questions would allow multi-variate population scenarios to be developed.

New South Wales totals are based on Mjadwesch 2011.

An alternative Euro population could be calculated, based on a starting point of 12,000 Euros in western NSW (according to the NPWS 2001 survey; DECCW 2011). An optimistic (but possibly unrealistic) 8% per annum population growth rate would bring this figure to 24,000 Euro in the harvest zones of NSW by 2010. If 6.3% of the western zones of NSW are conserved, applying the 1/3 hilly proportion from Mjadwesch (2011) provides an area of suitable habitat of 12,000 km2; densities of 44 / km2 (Croft 1981) or 45 / km2 (Lundie-Jenkins (undated) give a Euro population of 534K in conservation areas. Addition of these totals is close enough to the 600,000 in the table above to make no difference.

Eastern Grey Kangaroo numbers in the **Australia's Capital Territory** were calculated in Mjadwesch (2011) based on areas and densities described by ACT Parks & Conservation Service (1996), which may be a bit out of date. Area and density data was 15 years old; "urban land" would certainly have increased in area during this time, densities in rural land may have decreased with ongoing persecution and other process (loss of habitat, roads, fences etc), and bushfire is likely to have reduced kangaroo densities in the conservation reserves.

Interestingly Kangaroo Mob (aired on ABC TV on 21st February 2012) shows the ACT authorities justifying the shooting of kangaroos, and indeed their senior ecologist says shooting will be needed for many years to come, to "manage" them. Apparently kangaroos have an impact on threatened grassland ecosystems and species, and kangaroo populations are rapidly increasing, even though fully ¼ of the males in their study died on roads during the course of their study (1 year). That is, there is 25% adult mortality just from roads around Canberra (if the same proportion of females are hit by cars – Lee *et al* 2004 did not find a sex bias in roadkill). This population can only be declining, as recruitment (at 3-10%) cannot possibly replace animals being killed at such a high rate.

Looking at the background scenery in the documentary clearly shows Patterson's Curse dominating vast sections of the countryside. Weeds such as this species have a severe impact on native grassland values, while the municipality does little to reclaim land as habitat for the Earless Dragon. The program also discussed urban sprawl gobbling up land. What is the answer to grasslands in the ACT being destroyed and degraded? Shoot the kangaroos.

Wallaroo totals in the ACT have been estimated simply on the basis of the ACT's size in comparison to the size of the Wallaroos distribution in NSW (approximately 1/100th), and a proportional allocation of Wallaroos, multiplied by 10 (reflecting the higher proportion of national park (67%) to rural land in the ACT compared to around 9% in NSW, and no harvest in the ACT). This is just to provide a number, for the sake of discussion; it is not supposed to have any rigour.

In **Victoria** Short & Grigg (1982) described extremely low densities of kangaroos in the agricultural regions; Google Earth illustrates the patchwork of development which covers most of the state - try to imagine kangaroos persisting in this landscape after 30 more years of persecution.

Western Grey Kangaroo has been illustrated as occupying the western half of the state (eg: Grigg 2002). Short and Grigg (1982) describe densities as low as 0.01 / km2 across 32% of their range, and 85% of the range of grey kangaroos in Victoria supports <1 / km2 (quasi-extinct, according to Hacker *et al* 2004).

Let's work with the 15% of land remaining, largely corresponding to the national parks of western Victoria. Larger conservation areas within the range of Western Greys in Victoria include Murray Sunset (6,330 km2), Hattah-Kulkyne (480 km2), Annuello Flora & Fauna Reserve (360 km2), Wyperfeld

(3,568 km2), Big Desert (1,423 km2), Little Desert (1,320 km2) and Grampians (1,672 km2) national parks. Note the Grampians represents the extreme southern limit of distribution for the species. Densities of Western Grey Kangaroos in reserves were highest at 47 / kms2 at Murray Sunset in 1994 (Morgan 1994b) with mean densities of 46 / km2 at Hattah-Kulkyne in 1990 (Coulson 1990) and Wyperfeld in 1993 (Morgan 1994a).

Victoria's management plans for the western reserves (eg: Mallee Parks: Hattah-Kulkyne etc DNRE 1996) include provisions for the destruction of kangaroos within the reserves, to reduce total grazing pressure and improve vegetation conservation values of the reserves (restore perennial cover). The DNRE (now DSE) were able to reduce Western Grey densities to only 5 / km2 in some areas (according to Morgan 1995), and Sluiter *et al* (1992) subsequently demonstrated an improvement in a suite of perennial herbs, possibly including rare and threatened species. The culling program was extended to the rest of Hattah-Kulkyne National Park in 1996.

Since then the DSE may have prepared kangaroo management plans for the Mallee Parks - this action was identified as a "management strategy" for the parks. Kangaroo management plans for the Mallee Parks do not appear to be available on-line, nor could the author find any data or information detailing outcomes of kangaroo shooting programs in the western reserves. The Grampians PoM (DSE 2003) makes no mention of shooting kangaroos, recommending only that populations and possible impacts be monitored.

The numbers in the table above are optimistically based on the hope that suppressing kangaroos across a landscape as large as the conservation reserves of western Victoria (exceeding 15,153 km2), to densities of only 5 / km2, is uneconomical and unfeasible, particularly over a timeframe of 15 years. 46 / km2 has therefore been applied to conservation areas as a presumed existing density, just to provide a figure for discussion.

While Eastern Grey Kangaroos are mapped as occurring right across Victoria by Strahan (1995), excluding only the far north-west, however Strahan's maps are based on voucher specimens, not actual and up-to-date maps of occurrence. Google Earth and Short & Grigg (1982) clearly shows much of the former range of the species as being now devoid of animals (patchwork of farmland): again across 85% of their range in western Victoria, this species is considered to be "quasi-extinct" (<1 / km2 30 years ago). In other sections of their range, where pockets persist, landholders can readily obtain permits to shoot them (for example NMIT – see Mjadwesch 2011), and densities are presumed to be very low across Victoria, other than in national parks and other conservation areas.

For the purposes of this nomination, the Eastern Grey Kangaroo has been allocated a 0 / km2 density in farmland and urban areas; any residual numbers in these zones will be insignificant in a national population numbering in the millions. Calculations have been applied to conservation reserves across the state (totalling 39,273 km2) based on a density of 233 / km2 in the eastern half of their range (4.5M), and 74 / kms2 in the western half of their range (1.5M).

The Wallaroo and Euro are deemed to be absent from Victoria. Consider that maps such as Strahan (1995) are often based on the location of collections (voucher specimens held by museums etc), rather than on the existing range of a species. Given reducing density distributions of species towards the edges of populations (see Grigg 2002), and fragmenting and declining populations of all of the large macropods (see Mjadwesch 2011), the tiny portion of Victoria mapped as within the distribution of the Wallaroo is expected to have a vanishingly small number of individuals of this species (NS = not significant).

Red Kangaroo was given as 3,000 (+/- 1,000) left in Victoria according to Short & Grigg (1982), being generally undetectable. The north-west of Victoria is at the extreme edge of the Red Kangaroos range, and even with 30 years between the data set and this nomination, numbers for this section of their range are not going to be significant if the species numbers in the millions nationally. Given processes (legal and illegal shooting, closing of artificial water points, roads, fences, fire, flood, drought etc) and a brutal approach to wildlife management by Victoria's DSE (permit system completely arbitrary and not evidence based – see Mjadwesch (2011) Attachment 1 - NMIT Review; shooting in western reserves etc), it is not thought likely that Red Kangaroos will have increased much lately, in Victoria.

Of the four macropods included in this nomination, **Tasmania** is home to a single species, the Eastern Grey Kangaroo or "Forester", *M. giganteus tasmaniensis*. The population estimate above is based on DSEWPC advice to the Minister re: not listing the Forester as a threatened species (2005).

There have been no attempts to systematically survey the distribution and abundance of *M. robustus* across the **Northern Territory** (DNREA 2008). The estimate above is based on application of 46 Euro / km2 to 1/3 of the 53,505 km2 reserved sections of the territory (optimal hilly habitat), totalling 820K, and 2.3 / km2 to the rest of the protected areas (low densities between optimal hilly country) totalling 82K. Total Euro in conservation areas of the NT may be 900K; *M. r. woodwardii* (Kimberley subspecies) has been attributed one quarter of this total.

The rest of the NT is sparsely populated and in considerably better condition than much of the rest of Australia (*pers obs*). The NT could be expected to contain reasonable numbers of Euro in suitable habitat, which is widespread. For the purposes of this nomination the remaining area of the NT (1,295,624 km2) has been designated 10% unsuitable (urban etc), 40% poor (at 2.3 / km2), 40% sub-optimal (at 20 / km2 after Clancy & Croft 1992) and 10% optimal habitat (at 45 / km2 according to Croft 1981 and Lundie-Jenkins undated). Again *M. r. woodwardii* (Kimberley subspecies) has been attributed one quarter of this total.

WA's DEC are reported to be working out how to count Euro properly in the top end, the NT intend to apply this methodology, when it is developed (DNREA 2008). It may be that WA will seek to increase their harvest area for Euro into the far north, to offset their decreasing take (Euro has fallen out of the WA quota in recent years - see Appendix).

Grigg (2002) mapped Red Kangaroos across the NT at extremely low densities; DNREA (2008) confirmed RK absent from 55% of mapped cells, and very low densities (0.1-1 / km2) across 82% of the remainder of their study area (the Barkly Tableland, Alice Springs and Burt Plain bioregions). Page 17 of DNREA 2008 very helpfully provides an Extrapolated Population Estimate for RK in the NT.

In **South Australia** the Western Grey Kangaroo was mapped across the south of the state at very low densities (0.2-2 / km2 or less) across most of its range (Grigg 2002). Within conservation areas in the east of its range in SA (totalling at least 8,625 km2, including Ngarkat (2,700), Chowchilla (934), Danggali (2,512), Murray River (136), Flinders Ranges (913), Mt Remarkable (183) and Vulkathunha-Gammon Ranges (1,247)), a density of 46 / km2 was applied, being proximate to parks with this density in western Victoria (400K).

In central SA Yellabinna, Yumbarra and Pureba conservation areas occupy 30,000 km2; a sub-optimal density of 23 / km2 has been applied here, to reflect decreasing densities as you head west (690K).

The Nullarbor regional reserve (28,730 km2) occupies much of the western third of the Western Greys range in SA, however the harvest does not occur here, and neither does monitoring (see DEH 2009). Grigg (2002) maps the species at very low densities across the region, dominated by the Nullarbor Desert; this nomination calculates kangaroos in this section of their distribution of SA at 1 / km2 (30K).

The Eastern Grey Kangaroos range extends to the south-east corner of SA, however Grigg (2002) maps their density at <0.2 / km2 here. For a species which may occur in populations of some millions, the SA portion of the population is not likely to represent a significant number of individuals (NS).

On top of the harvest area total, the Euro in South Australia probably occupies most of the conservation reserves and protected areas in the state (totalling around 200,000 km2). For the purposes of this nomination, 1/3 of these areas has been assumed to represent optimal habitat (72,000 km2) calculated at 45 / km2 (3.24M) after Lundie-Jenkins (undated); the remainder was allocated 2.3 / km2 (330K) after Clancy & Croft (1992).

The Red Kangaroo has also been mapped at very low densities across SA (Grigg 2002), apart from higher densities in the central eastern portion, where densities reach 10-20 / km2. In addition to those animals subject to harvest, the species is presumed to occur in non-harvest zones in the conservation reserves (in suitable habitat) and in negligible numbers elsewhere.

For the purposes of this nomination, protected areas totalling 115,934 km2 (including the Nullarbor regional reserve (28,730), Yellabinna / Yumbarra / Pureba (30,000), Tallaringa (12,688), Coongie Lakes (267), Innaminka (13,541), Lake Ayre (13,488), Wabma Springs (120) Witjira (7,711), Strzelecki (8,142) and Vulkathunha-Gammon Ranges (1,247)) have been allocated 78 / km2, corresponding to densities used elsewhere to estimate numbers in conservation areas (based on Short & Bayliss

1985) giving 9M animals.

This seems a trifle optimistic given what DNREA 2008 showed in the NT, where only 8% of potential habitat was shown to support a density of up to 5 / km2. Using these figures, Red Kangaroos in the conservation reserves of SA would only total 50K (reduced by a factor of 180).

The Red Kangaroo is mapped as generally absent from the Simpson Desert (36,143 km2) according to Grigg (2002).

In **Western Australia** Short *et al* (1983) mapped population densities of Red kangaroo and Western Grey Kangaroo, and provided totals of 980K RK and 436K WGK. Since then the WA population monitoring reports have suggested a fairly stable Red Kangaroo population (850K in 2010), with an increased Western Grey population (1.4M in 2010). Given revelations about kangaroo population growth rates (low in Mjadwesch 2011) and processes operating against the large macropods across their range in WA (habitat loss, shooting, roads, fences, disease, fire, flood, drought etc); and given uniform errors across the various state kangaroo harvest management plans, this nomination suggests that in fact populations are likely to have decreased in Western Australia since 1983.

For example for the Western Grey Kangaroo in the harvest zones of **WA**, the numbers rose from 666,900 in **2003**, to 1,433,900 in **2004**. This is a biologically impossible **population growth rate of 115%** for the year (during drought?), which is nowhere discussed or explained. This singular aberration invalidates the WA data set. It seems reasonable to assume that this reported population increase may be connected with a revision of the states methodologies and correction factors - possibly a switch back to CF100 perhaps, as happened in NSW around the same time (after Cairns & Gilroy 2001).

Otherwise high population estimates could possibly be on account of researchers applying population densities across the entire range of the species (most of the state for Red Kangaroos, according to the 2010 harvest report), instead of applying population densities only to their area of actual occupancy (isolated pockets).

Regardless of whatever fudging may be going on with the WA data, this nomination uses their harvest zone estimates as a base, and adds kangaroos from the larger conservation reserves to the total. Reserves within the range occupied by the Western Grey are given here as including (but not necessarily limited to) Nuytsland (6,253), Dundas (7,800), Fitzgerald River (3,290), Lake Magenta (780), Dunn Rock (250), Stirling Range (1,159), No 64 State Forest (400), D'Entrecasteaux (1,187), Mount Frankland (373), Lane Poole (550), Lol Gray (320), Helena (80), Mundaring / Wandoo (1,740), Boonanaming (95), Moore River (220), Nambung (175), South Enneaba (130), Alexander-Morrison (85), Watheroo (445), Yeal (110), Badgingarra (131), Beekeepers (1,200), Wandana (710), Kalbarri (1,830), Toolonga (4,000), and Zuytdorp (650) – total 30,844 km2. At a rate of 46 / km2 (as per densities found in the Mallee Parks in the east of their range) there are 1.4M Western Grey Kangaroos in the conservation reserves of south-west WA.

Incredibly no totals are provided for the Euro in Western Australia (too hard to count, according to DEC (2007)), while "take" has crashed (see Appendix). In recent years this species has been allocated a "0" take, however DEC are developing a methodology to count them in northern Australia (DNREA 2008), presumably to get them into the quota again.

The species is mapped as occurring across most of the state (excluding southern coastal WA), however the harvest has been suspended ("0" allocation). This nomination simplistically assumes that the Euro has likely been extirpated across 2/3 of their range (0 / km2 – see Google Earth), with remaining intact habitats comprised of 1/3 optimal hilly country at 45 / km2 (9.4M) and 2/3 sub-optimal habitat at 2.3 / km2 (1M).

For the Red Kangaroo, a density of 78 / km2 has been applied to conservation reserves within the range of the species. These include (but are not necessarily limited to) Kennedy Range (1,419), Barlee Range (1,048), Collier range (2,349), Millstream Chichester (2,378), Mungaroona Range (1,057), Toolonga (4,043), Kalbarri (1,927), Karroun Hill (3,096), Mount Manning (1,702), Jibadji (2,069), Dundas (7,800), Goongarrie (602), Queen Victoria Spring (2,719) and Plumridge Lakes (3,084) totalling 35,293 km2. Red kangaroos in conservation reserves of WA: 2.75M.

Note the "range of the species" for this calculation is based on Grigg (2002), which maps the north-

east quadrant of WA as RK absent, as well as being absent / very low density (<0.1 / km2) in Great Victoria Desert, Neale Junction, Gibson Desert and Rudall River, while the state harvest plan (DEC 2007) maps the north-east quadrant and these reserves as RK present.

The numbers in the table above may be perceived as "high" for species which have been nominated as CRITICALLY ENDANGERED, however consider the following.

For all species the totals in the table above are limited by the accuracy of each states monitoring data. If the poor standard of survey and analysis in NSW (see Mjadwesch 2011) is reflective of the standard of survey and analysis in the other states and territories (with the exception of the Northern Territory), then the harvest zone totals are likely to be inflated, perhaps significantly so.

A brief reading of the harvest plans for Queensland, South Australia and Western Australia shows the same methodologies and assumptions in analysis and conclusion (kangaroos are doing better under agriculture than pre-European; shooting up to 20% of populations per annum is sustainable, etc). It is considered the most likely scenario that the totals from harvest zones will be on the high side; the numbers the states have provided are considered by the author to be the most optimistic figures possible.

Further, for animals which probably occurred in their hundreds of millions nationally prior to European settlement and development (which transformed the landscape (see Auty 2004 and Mjadwesch 2011), populations now totalling only tens of millions (at most) represent losses of up to or over 90%. For Western Grey and Red Kangaroo in NSW for example, up to 98% have been lost in the harvest zones; ie across 93% of their range in NSW only 2% remain. With processes operating against them contributing to ongoing and severe declines, the proclaimed "sustainable" harvest industry can more properly be described as an impending train-wreck, for kangaroos.

Consider also populations in a highly fractured landscape; much smaller totals would come from calculations using accurate distribution and density data, where the "spaces in between" (farmland) are ascribed a "0" density value. For example DNREA 2008 Figure 3 (pp18) shows Red Kangaroo occurrence in only 40 of the 89 mapped cells, and very low densities (0.1-1 / km2) in 33 of the cells in which they did occur. Only 8% of their mapped RK distribution (including the "best" bit (highest mapped density) according to Grigg (2002)), contained densities of 1-5 / km2.

In addition, calculating totals for grey and red kangaroos on the basis of Grigg's (2002) mapped densities, instead of using optimal densities in conservation areas, would also provide significantly lower totals. For example using 78 Red Kangaroos / km2 instead of 1, or 5, or 15 / km2 in the conservation areas of Queensland, may have inflated conservation area totals by up to 15 times. If millions of square kilometres of potential habitat have an "error" density applied uniformly (as in the calculations for the estimates in the table above), then the number of animals over-estimated may be very large (millions).

Indeed the numbers discussed above as occurring in the conservation reserves of QLD may be double counting –survey blocks in QLD appear to overfly national parks; this would also significantly positively skew the numbers indicated as within the harvest zone. Then again the calculations above did not include numbers in state forests, or indigenous protected areas or private nature conserves (Bush Heritage Trust for example), so positive and negative errors may all even out.

The actual area of occupancy of species will be critically important in determining population sizes. It cannot reasonably be suggested that areas of exclusion or quasi-extinction – up to 75 or 85% of their available habitat in WA and Vic (according to numerous sources), or up to 92% of Red Kangaroo habitat in the Burt Plain bioregion in the NT (DNREA 2008), are insignificant.

Taking the DNREA (2008) rate of 8% occupancy as an example of how kangaroos may be positioned across the landscape, the author is assuming an accuracy in the above "totals" of about +/- one order of magnitude (apart from the NT for Red Kangaroos, which total may be accurate).

Close mapping and competent survey of populations is likely to provide that there are a great many fewer kangaroos than indicated above. Commitment of time and resources to making accurate population estimates, based on (but not limited to) consideration of the many factors touched on above, is required.

Even if totals in the table above are roughly right however, allowing totals of (possibly) millions of

animals to deflect a conservation effort would still be reckless, for species which occur today in scattered fragments across their former range, and in severely depleted numbers.

The large macropods have little capacity to recover (on account of a low reproductive rate, and numerous processes operating against them). Early intervention – implementing an active conservation management program while there are still millions of animals, will be necessary to turn around the massive momentum of decline. Otherwise we risk a scenario, like with the Fairy Penguins at Manly, trying (and failing) to save a last few little pockets.

b. In a general sense kangaroos of all species still reside within many of the conservation reserves across Australia. These will be important populations if intervening land can be rendered habitable again (restore forests / woodlands, remove fences, stop shooting, reduce stock numbers, address issues with roadkill, fence-kill, community perceptions etc).

Effective dispersal between presently isolated populations (centred on the conservation reserves) will be critical to the long-term survival of the species in the wild, however this will be difficult to re-establish. Securing intervening land with large units of intact remnant vegetation and persisting pockets of kangaroos will be critical in restoring the genetic function of the species across their range.

Importantly isolated populations will need to be protected from random catastrophic events; the capacity for the species to recolonise areas is extremely limited (females rarely disperse), and local extinctions are likely to be permanent without intervention (active re-introduction).

On a species by species basis:

1. The Western Grey Kangaroo is harvested (NSW, SA and WA) or quasi-extinct (QLD and Victoria) across most of its range. Populations within conservation areas are likely to be the only populations with densities approaching viable levels, and these populations will be critical sources for re-populating the surrounding and wider landscape.

2. The Eastern Grey Kangaroo still retains a stronghold along the Great Dividing Range, from Victoria to Queensland and including the ACT, where numbers are persistent, with the harvest industry only relatively newly arrived (NSW Central Tablelands and South-east KMZ's) or absent (Victoria and ACT).

Habitat through this region is fragmented, but in comparison to western NSW, Victoria and Queensland, it retains a comparatively high degree of connectivity, and the population probably still functions in a limited sense as a meta-population (with effective genetic mixing and dispersal).

Securing this species within this landscape is achievable, and thus this section of the population will be critical to conservation / recovery efforts for the species. Re-establishing connectivity between populations occupying the conservation reserves through the western reaches of the species range will be more difficult.

3. The Wallaroo still retains a stronghold along the Great Dividing Range, from southern NSW to Queensland and including the ACT, where numbers are persistent, and only being harvested in the northern parts of it's range (northern tablelands including Armidale, Glenn Innes and Upper Hunter KMZ's in NSW, and Queensland).

Habitat through this region is fragmented, but often remains largely intact, as hilly country more frequently remains uncleared. A comparatively high degree of connectivity remains, when compared to fragments left behind by the broad-scale clearing that went on through agricultural regions in Queensland, western NSW and Victoria, and Western Australia. Populations probably still retain limited function here, in terms of effective genetic mixing and dispersal.

Securing this species across their former range will need to rely on re-establishing connectivity between presently isolated populations occupying outlying hills and ranges, particularly in the west of their range (for example the population on Mount Panorama is likely to be effectively isolated, being enclosed by the city precinct and agriculture).

4. For the Euro DNREA (2008) provides that "*the distribution of M. robustus is patchy within its range based on the availability of suitable habitat*". It is likely that isolated hilly country retains

populous pockets of this species throughout the Euro's range, however it is equally likely that these populations struggle to intermix with other populations. Intervening land-use is often dominated by agriculture, with clearing, shooting, roads and fences rendering dispersal difficult and dangerous, or even impossible, once critical limits in distance are exceeded.

Securing existing populations in isolated ranges will be critical to conserving the species in the wild; establishing links between these sub-populations will require active engagement by communities, to ensure continued genetic mixing and long term viability of presently disjunct populations.

5. The highest densities of Red Kangaroo were mapped by Grigg (2002) in far-west NSW and Queensland; large conservations areas are going to be important for the conservation of this species in the wild, across its range.

Short *et al* (1983) illustrates the RK's density distribution across Western Australia; obviously the Gascoyne River Basin and the Nullarbor will be critical populations for conservation of the species in the west of its range. Ensuring genetic exchange between presently isolated sub-populations in WA, and between populations in WA, SA, NT and NSW / QLD, will need to rely on intervening communities engaging in conservation of the species.

For all species the pattern of development of agricultural land has fragmented the distribution of remnants and natural areas (conservation reserves etc), which continue to support the large macropods. This has resulted in the formerly massive and widespread meta-populations being broken into many (uncounted) smaller populations, effectively separated where intervening distances exceed the capacity of animals to disperse and mix in a genetically meaningful way. It may be that natural mixing across the former range of the nominated species will be impossible to re-establish.

The nature of fragmentation often shows very large geographic separations between populations, particularly in regions dominated by agriculture. It is well beyond the scope of this nomination to identify and discuss each of the sub-populations of the species which have derived from the meta-populations originally inhabiting the continent. A casual investigation of landscapes using Google Earth gives an impression of the scale and complexity of this task.

In combination with clearing, there are human behaviours which effectively suppress or destroy animals between sub-populations (farmers shoot them), and processes which perhaps unintentionally reinforce this separation (roads and fences etc).

Suffice to say that many sub-populations now exist; they are likely to be in decline, and are likely to be heavily "predated" (shot) around their edges. Harvest states should be able to supply year-by-year maps of licensed harvest / shooting activities on a property-by-property basis; these would be expected over time to concentrate around existing populations inhabiting conservation reserves and larger remnants on private land.

19. POPULATION TREND

a. What is the population trend (**PAST to CURRENT**) for the entire species? Is the population trended increasing or decreasing, or is the population static? Provide relevant data sources.
b. Is this trend likely to continue, or are there any data which indicate **FUTURE** changes in population size? Provide relevant data sources.
c. Does the species undergo extreme fluctuations in the number of mature individuals?

a. Mjadwesch (2011) describes populations historically and at-present in NSW for all species (*M. robustus robustus* and *M. robustus erubescens* were discussed together), as well as graphing populations in all Kangaroo Management Zones in NSW across 3 time scales (30yrs, 20yrs and 10 yrs), and the harvest "take" in each KMZ.

In combination and individually, and with few exceptions, there is a uniform **downward trend** for all species in NSW, across all time scales, and this trend is a very strong trend. When we consider "take" (animals shot as part of the harvest), downward trends are again obvious and steep. This is not examined by the harvest industry or the regulators in any publicly available reports or research.

Mjadwesch (2011) s. 4.10 pp 99-101 discusses some aspects of what is going on with kangaroos in other states. Consider also the following.

QLD, SA and WA have harvests which are chasing the same or even higher harvest rates than in NSW (20% for Red Kangaroo on the recommendation of Hacker 2004), and identical processes otherwise operate against all species in these states. This includes: clearing of habitat (Queensland broad-scale clearing has been widespread, second only to Brazil globally; descriptions of "burning mallee and piles of kangaroo carcasses"; WA sheep / wheat belt, representing 73% of the Red Kangaroos range, had less than 1 kangaroo / km2, and 75% of the WGKs range had less than 1 kangaroo / km2, according to Short *et al* in 1983); other shooting and illegal shooting; roads; fences; urbanisation / encroaching humans; disease; drought; fire; flood; predation etc. It seems likely that similar declines will be occurring in macropod populations in QLD, SA and WA.
"Take" in these states has been used as a proxy for trends in populations, as population data is unreliable (100% and even greater annual increases, etc) – graphs and further discussion are included in the Appendix. These graphs uniformly indicate that declines are indeed under way in the other shooting states.

And what has happened to the Euro being part of the harvest in Western Australia? Over 74,000 of them were shot in WA between 1991 and 2002, however the WA 2008-2012 harvest management plan talks about only 2 species comprising the harvest, the Red and Western Grey Kangaroo. Nonetheless reviewing the Commonwealth harvest statistics shows that 3,565 Euros were shot in 2008 in Western Australia, and 3,031 were shot in 2009, despite them not being included in the 2008-2012 management plan (DEC 2007). If the industry was sustainable, they would still be shooting up to 10,000 per annum like they were in 1994.

In Victoria, ACT and Tasmania, where harvesting does not occur, the processes operating against the large macropods have still caused massive and continuing declines.

Mjadwesch (2011) discusses the ACT – down to only 56% remaining even without harvest, and with a large percentage of the territory given to conservation (67% reserved). Kangaroo Mob (ABC TV) illustrates that habitat continues to be lost to urban development around Canberra; habitats are degraded; roads and fences take a continuous toll and; manager" shoot them when there is deemed to be conflict with the urban environment, and where there are supposed impacts on other "higher value" conservation assets.

Much of Victoria – no kangaroos at all (intensive farming districts, see Google Earth, Short & Grigg 1982 etc). Habitat loss; shooting (for example NMIT); roads; fences; flood; fire etc.

Tasmania – Forester formerly threatened, with an estimated 90% population reduction by the late 1960's on account of shooting and habitat loss (Tanner & Hocking 2001). In 1974 the Forester was rated as second highest priority in a list of 13 declining species (Burbridge 1977). Now recovered in 6 populations (numbering 26,000 animals), after a massive conservation effort including a translocation / reintroduction program involving over 2,000 animals in the 1970's. Populations again subject to shooting (neighbours don't like them – damage to crops / fences is cited, and culling in "over-abundant" populations), and impossible to disperse / mix between populations.

The Northern Territory is the stand out. Even with the lowest human population density of all Australian states and territories, the NT do not consider that they have enough kangaroos to support a harvest industry (however the KIAA has been lobbying for it). The NT reported a 70% decline in Red Kangaroo numbers between 1999/2001 and 2006 (DNREA 2008); it takes a long time to recoup these sort of losses at a 3% growth rate; it even takes a long time for recovery from these sort of declines at 8% or 10% growth.

This nomination includes population estimates for each species (s. 18) as well as the extent of occupancy prior to the arrival of white man (s. 22). These values have been used to calculate present day densities, with numbers spread across their former range. The table below allows comparisons with 1788 densities, based on descriptions of "great herds", "forest abounding with wildlife", "300lb / week at Parramatta", "kangaroo at any time" etc, and densities reported for populations in unharvested areas (national parks etc) as discussed in Mjadwesch (2011).

Species	Average density across range 2012	Average density across range 1788	Decline
WGK	4.6 / km2	66 / km2 (Arnold *et al* 1991)	**93%**
EGK	16.7 / km2	74-**233**-510 / km2 (ACT PCS 1996)	**92.8%**
Wal	2.8 / km2	20 / km2 (up to 45 / km2)	**86%**
Euro	4.4 / km2	20 / km2 (up to 45 / km2)	**78%**
RK	4.8 / km2	78 / km2 (Short & Bayliss 1985)	**93.8%**

For EGK the average density decline has been calculated assuming a "medium" density of 233 / km2 in 1788. For Wallaroo and Euro 1788 densities of 20 / km2 have been applied (based on Clancy & Croft 1992), providing a conservative figure for decline; Lundie-Jenkins (undated) 45 / km2 would push declines up to 93.8% and 90.2%, for the Wallaroo and Euro respectively.

b. Downward trends are likely to continue, particularly if harvesting continues. Harvest rates up to 15%, or 17%, or 20%, can only push a species with population growth rates of only 3-10% toward extinction.

Even with the discontinuation of harvesting, a lesser rate of decline is likely. Other negative processes will continue to cause attrition, leading in time to local extinctions (habitat loss and degradation, other legal and illegal shooting, roadkill, fencekill, disease, drought, fire, flood, climate change etc).

c. Populations are reported to go through extreme fluctuations (see the various state monitoring / harvest management reports). Kangaroo populations are frequently described as "exploding" or "increasing to plague proportions", despite the reproductive capacity of the species being very modest (summarised above, and discussed in Mjadwesch 2011 in some detail).

Further, including additional kangaroos from new harvest zones in totals (as is done in some reports describing the harvest industry as sustainable – eg Cooney *et al* 2011; see their "Figure 1"), creates misleading spikes and apparent population "increases", even though kangaroo populations in original harvest zones have plummeted to historic low numbers and densities (see Mjadwesch 2011).

The NT report of a 70% reduction in Red Kangaroos in the Burt Plain bioregion during drought between 1999/2001 and 2006 (DNREA 2008) certainly illustrates a "bust"; wildfire, flood and disease are other mechanisms by which a severe reduction could occur. However a population growth rate of 3% (possibly up to 8% or 9% under ideal conditions), can *never* provide "rapid" growth in a population. Populations are not subject to "extreme fluctuations", despite the evidence presented in the population monitoring data; **the population trend for all species must be towards extinction**.

20. PROBABILITY OF EXTINCTION IN THE WILD

Identify and explain any quantitative measures or models that address the probability of the species' extinction in the wild over a particular timeframe.

Mjadwesch (2011) illustrates trends for the large macropods in NSW over the last 200 years (pp 96-97). Given data and conditions in other states (shooting, habitat degradation, roads, fences etc), similar trends are considered the most likely scenario for kangaroos across the range of landscapes where kangaroos interact with humans, or where they are affected by human activity and development.

With as little as or less than 10% left across much of their range after only 200 years, another 100 years of human occupation of the continental mainland is almost certainly going to push kangaroos to the brink of extinction in the wild (restricted to within large conservation areas), particularly if exploitation (harvest) continues.

Further, stochastic events, such as regional bushfire, or widespread drought or flooding, will put individual populations at risk of extinction. Constant attrition of small populations will lead to local extinctions, and a lack of capacity to disperse across landscapes (because of their naturally sedentary habits, not to mention roads, shooting, fences, habitat loss etc) is likely to contribute over time to regional declines and extinctions.

Mjadwesch (2011) suggests kangaroos are at risk from climate change on account of juvenile physiology and the effect of changing (more intense) extremes (s. 5.10 pp123-124); Ritchie & Bolitho (2008) suggest range reductions of up to 48% for some macropod species under a +2˚ warming scenario, and up to 96% range reductions for some species under a +6˚ scenario. Flannery (2005) describes Red Kangaroo male fertility as decreasing with increasing temperature.

A 2˚ global temperature increase is now locked in, there is continuing inaction on the part of government to curb greenhouse gas emissions (indeed the opposite, with coal mine after coal

mine being approved, and ongoing investment in rail and export infrastructure). It seems likely that conditions will become increasingly difficult for wildlife to cope with; extinction in the wild may be inevitable for the large macropods on account of factors now beyond human control.

Geographic Distribution

21. GLOBAL DISTRIBUTION

Describe the species' known or estimated current and past global distribution (include a map if available). Does the species exist in an EPBC Act listed ecological community?

All species are endemic to Australia, however they are commonly found in parks and zoos globally.

Menkhorst & Knight (2001) and Strahan (Ed) 1995 provide maps of species distribution based on their historic distribution (their data points were often based on voucher specimens). Grigg (2002) provides density distribution maps for Red Kangaroo, Eastern Grey Kangaroo and Western Grey Kangaroo showing a more limited distribution across their range (large areas with density <1 / km2). DNREA (2008) provides a map of Red Kangaroo density across the Burt Plain Bioregion of the NT, showing a very patchy distribution within a region mapped by Grigg (2002) as having the highest density in the territory. No-one has actually mapped the fragmented distribution of each species subject to this nomination (showing absence from regions from which they are now absent), either at a local, state-wide or national level.

All species occur within EPBCA 1999 listed EEC's.

22. EXTENT OF OCCURRENCE within Australia

NOTE: The distribution of the species within Australia is assessed in two ways, the EXTENT OF OCCURRENCE and the AREA OF OCCUPANCY. The two concepts are closely related, and often confused. Therefore, before you answer this question, please see the definitions and explanatory material in Attachment A.

a. What is the **CURRENT** extent of occurrence (in km^2)? Explain how it was calculated and provide relevant data sources.
b. Has the extent of occurrence changed over time (**PAST to CURRENT**)? If so, provide evidence.
c. Is the extent of occurrence expected to decline in **FUTURE**? If so, provide evidence.
d. Does the species undergo extreme fluctuations in the extent of occurrence? If so, provide evidence.

a. Based on areas provided in various state harvest plans, Grigg (2002) and Strahan (1995) distribution maps, Mjadwesch (2011) and very approximate scaling and estimates, the following table provides the approximate total "extent of occurrence" for each species and subspecies (in km2). There has been no attempt to calculate "discontinuities or disjunctions", however these are discussed below ("kangaroo-excluded" areas informed the calculations for Area of Occupancy, which follow in Q. 23).

	QLD	NSW	ACT	Vic	Tas	NT	SA	WA	Total
WGK	140K	459,357	-	100K	-	-	500K	750K	**1.95M**
EGK	1.254M	802K	2,280	200K	20K	-	20K	-	**2.3M**
Wal	496K	267K	2,280	-	-	-	-	-	**765K**
Euro	744K	400K	-	-	-	1M	875K	1.9M	**4.9M**
RK	1.106M	523,045	-	20K	-	I M	920K	1.9M	**5.5M**

The Wallaroo / Euro split in QLD and NSW was arbitrarily made 40/60, to provide a figure. GIS could readily be used to calculate the distribution of sub-species more accurately.

Errors within the extent of occurrence figures provided above become apparent when we look at the WA harvest plan (DEC 2007), which describes the Red Kangaroo as occurring across 1.9M km2 of the state, and maps most of WA as its distribution (Figure 3, pp 11). Strahan (1995) also includes the interior as occupied by the species. Short *et al* (1983) however provides a density distribution map, showing the species as absent from much of the state (including much of the Great Sandy Desert, the Gibson Desert and the Great Victoria Desert) and at very low density (<1 / km2) across

73% of it's range (discontinuities). This could indicate that the extent of occurrence for the Red Kangaroo in Western Australia (just as an example) could be only (and actually) 384,750 km2 - only 20% of the extent of occurrence in WA indicated above.

Certainly in the case of the DEC applying density calculations across the area mapped in the harvest plan (1.9M km2) is one way to get a total in 2010 of 850K Red Kangaroos (stable after 30 years of harvest and development), instead of considering actual distribution, across only 20% of the mapped area. The author is unsure how the DEC managed to get a Western Grey population of 1.4M in Western Australia in 2010 (a three-fold increase in the nearly 30 years since 1983).

An interesting and misleading strategy in the QLD (EPA 2007), WA (DEC 2007) and SA (DEH 2007) harvest management plans are their "non-harvest zones" (NHZ). In Queensland the NHZ's are restricted to Cape York and the major coastal cities (NHZ's are spreading with the major population centres of Townsville, Mackay and Brisbane / Gold Coast).

The Red Kangaroo does not occur in the NHZs (this species is harvested throughout its range in Queensland); the NHZs "protect" (no harvesting) Grey Kangaroos and Wallaroos across only about 6% of their range in the state, in the southern end of Cape York. Other threatening processes continue to operate against them here (habitat loss, roads, fences, disease, other legal and illegal shooting, fire, flood, climate change etc).

In WA the NHZ covers most of the north east quarter of the state – exactly the land Short *et al* (1983) maps as kangaroos absent or at a vanishingly low density (<0.02 / km2), while the harvest plan describes this area as part of the range of the Red Kangaroo (see DEC 2007, pp 11). In effect the harvest zones of WA cover the entire distribution of both Red and Western Grey Kangaroos in the state; the "non-harvest" zones represent regions where kangaroos are factually and functionally absent.

In South Australia the NHZs occupy the western half of the state (Nullarbor & Great Victorian Deserts - Grigg 2002 maps species here at <1 / km2), and the south-east coast, which is dominated by human habitation and extensively modified for agriculture (see Google Earth).

b. The extent of occurrence has changed over time, as great holes and ragged edges have been chewed into meta-populations which formerly occurred almost continuously across the continental landmass. Great chunks of land must now be mapped as "kangaroos absent" corresponding to the major settlements which dent the coast. "Current" extent of occurrence will necessarily be a smaller area (edges eroded) compared to "former" (pre-European) extent of occurrence. Consider the number of points at which kangaroos populations now contact the coastline, compared to perhaps 90% of the coastline being inhabited by kangaroos 200 years ago.

c. Given coastal zone growth rates (NSCF 2005), continued growth in agriculture, increasing rates of clearing related to mining and other development (for example woodlands and forests being destroyed as part of the Duralie coal mining proposal, near Gloucester), kangaroo exclusion zones are expected to continue to expand. In Western Australia Dawson 1995 describes "*due to gross overgrazing by sheep, red kangaroos were largely eliminated from the plains...*". In time exclusion zones coalesce into increasingly larger exclusion zones, eventually isolating and enclosing sub-populations, to their ultimate detriment.

Regional catastrophes are certain with the passage of time, to cause local extinctions, where for example a small population may have been isolated from other populations, then suffering something like wildfire.

The combination of these two processes will continue to cause population edges to erode; continued contractions in the actual (present day) extent of occurrence are expected, if the existing pattern of development continues.

d. The common perceptions is that kangaroos bound across the landscape; they are nomadic; they infest farmland in plagues – this would suggest a fluctuating population "edge". The facts are otherwise, however.

Kangaroos occupy relatively small home ranges (as small as 20ha for EGK at Bargo, numerous studies – refer to Dawson 1995); dispersal is generally limited to young males; kangaroos may follow

storms and green pick during drought, however at break of drought they mostly return to their original home territory. A very strong homing instinct has been demonstrated (numerous papers, eg: Priddell *et al* 1988, Denny 1980, Dawson 1995).

If breeding females define the distribution of a population, and if mature females of the large macropods are sedentary, then populations "edges" (which correspond with the "extent of occurrence" for a species) will not fluctuate naturally more than slightly. Significant changes in the extent of occurrence will only be in decline, corresponding to habitat loss (as bushland is bulldozed to make way for new subdivisions, or industrial and mining precincts, for example), incremental attrition from roads and fences, and regional catastrophes. The largely sedentary nature of females will make it extremely unlikely that areas will naturally recolonise with kangaroos, if ever they go extinct within an isolated or disjunct remnant unit.

23. AREA OF OCCUPANCY

NOTE: The distribution of the species within Australia is assessed in two ways, the EXTENT OF OCCURRENCE and the AREA OF OCCUPANCY. The two concepts are closely related, and often confused. Therefore, before you answer this question, please see the definitions and explanatory material in Attachment A.

a. What is the **CURRENT** area of occupancy (in km^2)? Explain how it was calculated and provide relevant data sources.
b. Has the area of occupancy changed over time (**PAST to CURRENT**)? If so, provide evidence.
c. Is the area of occupancy expected to decline in **FUTURE**? If so, provide evidence.
d. Does the species undergo extreme fluctuations in its area of occupancy? If so, provide evidence.

a. The totals in the table below are based on assumptions derived from the following facts.

1. <1 / km2 is considered to be quasi- and functionally extinct, or vagrant (map as absent)
2. QLD 4.02% protected areas. QLD population monitoring over-flies some protected areas (DERM 2009), which may be distorting the perceived "sustainability" of the harvest.
3. 8.83% of NSW is conservation area (70K km2; Mjadwesch (2011) calculates WGK protected in 32,155km2; RK protected in 36,613km2).
4. 67% of the ACT is reserved land; 23% is classed as "rural", with persistent densities of kangaroos being reported (50 / km2 according to ACT PCS 1996)
5. In Victoria 17.26% is reserved land
6. Short & Grigg (1982) found less than 0.01 GK / km2 across 32% of their study area in Victoria, and only 1.0 GK / km2 across 85% of their survey area (here we are 30 years later…)
7. Forester assessed in Tasmania by TSSC 2005 (advice to Minister not to list)
8. NT (DNREA 2008) Red Kangaroo counts demonstrated functional occupancy (based on densities of 1-5 / km2) within only 8% of surveyed cells. This within the region in the Territory mapped as having the highest densities of Red Kangaroos (Grigg 2002).
9. NT Euro: DNREA (2008) conservation areas (protected km2): 115, 1139, 191, 459, 12791, 19111, 580, 2179, 12327, 1465, 2950, 1780, 2416, 1344, 1059, 2062, 20, 0.9, 54.4, 12.2, 15, 18, 6.9, 78.4, 4, 13, 6.5, 5, 24.8, 47.6, 17.7
10. NT Red Kangaroo: DNREA (2008) NT conservation areas (protected km2): 259, 1139, 191, 459, 12791, 40000, 1780, 2416, 1344, 1059, 2062, 3.4, 4, 6.5, 30.4, 5, 24.8
11. Short & Grigg (1983) found Red and Western Grey Kangaroo densities of <1 / km2 across 73% and 75% respectively in Western Australia
12. 9.8% of WA is protected (240K km2); RK does not occur in harshest deserts

In the broadest sense applying these (and other) considerations to the extent of occurrence (22 above) provides an extent of occurrence *with consideration for discontinuities and disjunctions*. If done with enough attention to detail this will define the area of occupancy.

This nomination uses roughly calculated protected areas as a measure of where populations persist. It is acknowledged that kangaroos occur through the harvest zones and elsewhere on private property, however so many studies describing kangaroos as functionally absent (<1 / km2) from farming regions (85% of Victoria, for example) are compelling. Otherwise land is generally given to mining, forestry, roads and urban or rural residential development, etc.

	QLD	NSW	ACT	Vic	Tas	NT	SA	WA	Total

WGK	2,296	32,155	-	15,153	-	-	67,355	30,844	**147,803**
EGK	60,236	70K	2,069	39,273	1,400*	-	N/S	-	**172,978**
Wal	8,000	7,780	690	-	-	-	-	-	**16,470**
Euro	12K	11,773	-	-	-	62,292	200K	209K	**495,065**
RK	44254	36,613	-	7,170	-	63,574	115,934	35,293	**302,838**

The following provides a worst case scenario, illustrating how little of their range may actually be occupied by healthy and viable populations, after only 200 years of development, and 30 years of intensifying commercial exploitation.

	QLD	**NSW**	**ACT**	**Vic**	**Tas**	**NT**	**SA**	**WA**	**National**
WGK	1.6%	7%	-	15%	-	-	13.5%	4.1%	**7.6%**
EGK	4.8%	8.7%	90.7%	19.6%	7%	-	0%	-	**7.5%**
Wal	1.6%	2.9%	30.2%	-	-	-	-	-	**2.1%**
Euro	1.6%	2.9%	-	-	-	6.2%	22.9%	11%	**10.1%**
RK	4%	7%	-	35%	-	6.4%	12.6%	1.8%	**5.5%**

Red and Western Grey Kangaroo in Western Australia may still occur across 27% and 25% of their former range, if their status from 30 years ago has remained static (a three-fold increase in reported WGK numbers suggests something is wrong with survey in WA, however).

b. The area of occupancy for all species has changed dramatically since the intervention of white man. Habitats are fragmented and populations are often isolated (see Google Earth). There are thousands of references to the extent of clearing of vegetation across the continent and the expansion of urban development and agriculture. This can only be to the exclusion and detriment of kangaroos.

c. The area of occupancy is expected to continue to decline as habitat continues to be lost to development, agriculture, mining, foresty etc. As populations become isolated, enclosed and eventually unviable (and subsequently extinct) the number of occupied territories reduce, and the area of occupancy is eroded.

d. Populations are often described as fluctuating (see above); the inference would be that the area of occupancy fluctuates as populations expand and contract, as they "boom" and "bust". Unfortunately the facts of kangaroo biology and behaviour preclude the "boom" from this cycle; they are experiencing a "bust" and "bust" cycle (shoot, flood, shoot, drought, shoot, disease, shoot etc). The capacity of females to disperse to uninhabited habitats is extremely limited by the sedentary nature of the species (particularly females). This nomination can only conclude that the area of occupancy does not fluctuate, it simply declines.

24. PRECARIOUSNESS

a. Is the species' geographic distribution severely fragmented, or known to exist at a limited number of locations?
b. Is the area, extent and/or quality of the species' habitat in continuing decline (observed / inferred / projected)?
c. Is the number of locations or subpopulations in continuing decline (observed / inferred / projected)?
d. Are there extreme fluctuations in the number of locations or subpopulations of this species?

Please ensure that you provide evidence and appropriate references.

a. The geographic distribution of all species is severely fragmented.

As already suggested, Google Earth illustrates where kangaroo populations may persist, being generally in association with large areas of remnant vegetation. Kangaroos are largely or completely absent from areas dominated by urban development and the patchwork of agriculture which occurs widely (in fact on almost all of the most fertile ground). Mjadwesch (2011) discusses this in some detail as it pertains to NSW.

Roads are a significant feature occurring across the landscape; vehicle collisions contribute to heavy losses, particularly during drought (Lee *et al* 2004). Roads fragment habitat directly (loss of habitat) as well as limiting the capacity of animals to disperse between populations, by direct mortality. It could be argued that roads should be listed as a key threatening process under the EPBCA 1999.

b. The area, extent and quality of the species various habitats are often degraded, and continuing to decline. Burgeoning lists of endangered ecological communities; many threatening processes operating across the landscape; widespread legal clearing (for example in mining and development, or clearing of "invasive native scrub" or "woody weeds") as well as illegal clearing - all are affecting the extent and quality of habitats for the large macropods across their range. Roads continue to proliferate and consolidate across the landscape.
c. On account of a. and b. and with consideration for other processes affecting the species across their range (shooting, fire, flood, drought, fences, roads etc), individual and isolated sub-populations are inferred to be undergoing local extinctions. As a consequence of ongoing high rates of attrition, and the certainty of catastrophic events affecting sub-populations over time, the number of locations at which kangaroos occur is expected to decline. The medium term projection is clearly towards extinction in the wild.

d. Populations are reported to go through extreme fluctuations (see the various state monitoring / harvest management reports). Kangaroo populations are frequently described as "exploding" or "increasing to plague proportions" – indeed the "data" shows this, despite the reproductive capacity of the species being very limited (summarised above, and discussed in Mjadwesch 2011).

The science suggesting the harvest is sustainable and populations are stable or increasing, by inference would also be suggesting that the number of populations are stable (kangaroos are everywhere), or perhaps even increasing (expanding their range on account of more grassland, proliferation of water points, cessation of aboriginal and dingo hunting etc).

However an active translocation / introduction program in Tasmania was only partially successful - at least 2 of the reintroduced populations did not survive. **The failure to re-introduce the Forester to the 168 km2 Freycinet National Park in Tasmania was on account of "the area of suitable habitat [being] too small to support a viable population"** (Tanner & Hocking 2001). This suggests kangaroos are not so good at colonising farming country, contrary to popular belief.

Taking kangaroos from a single site (Mount Williams National Park) and re-establishing them across an additional 5 sites (discussed in Tanner & Hocking 2001) is likely to be an example of a rare increase in the number of sub-populations of one of the species subject to this nomination. This came at considerable effort and expense, and involved over 2,000 animals being translocated.

Given that it is generally young males which disperse, the capacity of all species to naturally re-colonise habitats will be **limited by dispersal of females**, to suitable unoccupied habitats. Given a sedentary habit and relatively small home ranges of mature animals (of both sexes), and close ties and association until maturity with their mother, young does must be considered to be unlikely to disperse across large distances. Small and isolated island habitats are therefore unlikely to re-colonise with kangaroos, if they are caused to go locally extinct. Even active re-introduction (translocation) does not always work (see above).

The only trajectory on which the number of sub-populations of each species can possibly be headed is downward. This is not "fluctuation", it is decline.

25. **PROTECTED AREAS**

Is the species protected within the reserve system (e.g. national parks, Indigenous Protected Areas, or other conservation estates, private land covenants, etc.)? If so, which populations? Which reserves are actively managed for this species? Give details.

The large macropods subject to this nomination occur in many conservation areas, in which they are protected (generally not supposed to be shot).

Nonetheless they are shot even in conservation reserves legally (eg: Tidbinbilla NR in the ACT, Hattah-Kulkyne National park in Victoria) and illegally (*pers obs* Ledknapper NR NSW). Further shooting often occurs along the boundaries of farmland and adjacent conservation areas, so shooting can affect animals which may normally reside (shelter) within a conservation area.

No reserves are actively managed for the active conservation management of the large macropods, indeed some reserves are managed in a way with an objective to reduce their

numbers (for example the NSW NPWS and Victoria decommissioning "artificial water points" in western reserves). Other conservation areas include culling programs when populations are deemed to be "over abundant" (eg: Tidbinbilla NR ACT) or where the restoration of vegetation communities containing threatened perennial plants species is desired (Hattah-Kulkyne).

Threats

26. KNOWN THREATS

Identify any **KNOWN** threats to the species, and state clearly whether these are past, current or future threats.

If climate change is an **important** threat to the nominated species it is important that you provide **referenced** information on exactly **how** climate change might significantly increase the nominated species' vulnerability to extinction. For guidance refer to the Guidelines for assessing climate change as a threat to native species (Attachment B; Part B2).

Threats are discussed in detail in Mjadwesch (2011), particularly how these threats pertain to kangaroos in NSW. Similar processes are operating across the nation. For example using maps of land-use from Short *et al* (1983) for WA, and finding <1 kangaroo / km2 across much of the region (75% of their range) mapped as "pastoral zone", corresponds with findings in Victoria and South Australia (Short & Grigg 1982) with extremely low densities across areas given to agriculture (82% of the state, 30 years ago). This is also the situation as it appears to be unfolding in NSW.

Habitat Loss / Degradation	Habitat loss is recognised as the primary driver for loss of species globally; it should come as no surprise that Mjadwesch (2011) pp102-110 describes loss of and degradation of habitat, and discusses how this has been a critical contributor to species decline in the large macropods subject to this nomination.
Shooting	In addition to the harvest there is non-commercial shooting, and illegal shooting. The harvest rate alone far exceeds the replacement rate for each species; in addition SA (2009) provides that in 2008 1,222 Red Kangaroos, 9,012 Western Grey Kangaroos, and 1,415 Euros were shot legally on top of the harvest; NSW NPWS cannot provide an account of how many are shot on occupier (non-commercial) licences. No-one can give an account of how many kangaroos are shot illegally across Australia, or how many are mis-shot, or shot and "defected" (discarded), by the harvest. Mjadwesch (2011) discusses shooting at various tangents, summarising on pp 118-120. It seems likely that shooting is a primary driver in the decline of the large macropod species subject to this nomination, across their range.
Water Point Loss / Degradation	Mjadwesch (2011) pp 110-114 discusses loss of water points across Australia, and how this has affected the large macropods. A program of closure of "artificial watering points" in national parks in the eastern states is removing water from the only refuges in which kangaroos persist in any numbers. In addition this shutting down of water, in landscapes where previously mound springs or water holes provided ample water for the nations kangaroos (but are now often depleted or degraded by stock or feral animals (pigs, goats etc), or defunct, by over-extraction) forces kangaroos to the "active" bores and dams on neighbouring farms. This exposes them to harvest, as well as contributing to fence mortality.
Competition with Stock	Mjadwesch (2011) pp 115-117 estimated that 24M kangaroos in NSW were competing with nearly 500M kangaroo equivalents in stock, ie: 95% of available herbage in NSW is eaten by cows, sheep, goats etc. When you consider that stock animals have humans "on their side", and that pasture is aggressively defended by humans for consumption by stock. Harvest and "damage mitigation" runs hand in hand with the agricultural production sector, and very serious kangaroo exclusion is occurring in regions where there are stock.

Disease	Epidemic mortality has been reported on a number of occasions. Curran *et al* 1999 reported 300,000 deaths from north-western NSW in 1998 including an estimated 72% of Red Kangaroos killed in the main outbreak area. Speare *et al* 1991 described similar circumstances from an epidemic in Queensland. The cause of these outbreaks remains unknown (KMAP 2010), and no-one seems to be interested in finding out (see Mjadwesch (2011) pp 124).
Roads	Mjadwesch (2011) discusses impacts of roads on kangaroos (and other species) on pp 122-123, and indeed concludes by nominating roads as a Key Threatening Process in NSW under the *TSCA 1995*. The author does not have the resources to prepare a nomination for roads to be considered as a KTP under the *EPBCA 1999*, however there is ample evidence of many species being affected. The TSSC should have the capacity to consider and investigate these sort of issues, and list serious processes on appropriate schedules, in their own capacity.
Fences	Mjadwesch (2011) discusses impacts of fences on kangaroos (and other species) on pp 120-122, and indeed concludes by nominating fences as a Key Threatening Process in NSW under the *TSCA 1995*. The author does not have the resources to prepare a nomination for fences to be considered as a KTP under the *EPBCA 1999*, however there is ample evidence of many species being affected. The TSSC should have the capacity to consider and investigate these sort of issues, and list serious processes on appropriate schedules, in their own capacity.
Enclosure	In addition to the fragmentation of habitat that has happened across the range of the nominated species, on occasion populations become completely genetically isolated, and then enclosed (physically impossible to move or disperse). "Management" of these sort of populations has uniformly devolved to shooting them, when the kangaroos are perceived to come into conflict with humans. An example KMP action timeline: do nothing, do nothing, do nothing, shoot the kangaroos. In Bathurst when kangaroos were identified as a risk to car-racing safety, NPWS supported the shooting as it was for the protection of the kangaroos (Ross McDonnell *pers comm*). You shoot kangaroos to protect them, according to NPWS. If the Grassland Earless Dragon is "enclosed" with them, or if some developer needs to make a few $M building a new subdivision, the easiest (and cheapest) way to manage kangaroos is to shoot them. When the last animals in an enclosed population die (local extinction), this represents the logical conclusion for kangaroos in a developing landscape.
Bad Science	The validity of much of the "science" backing the kangaroo harvest industry comes into question when you consider conflict of interest and pecuniary gain on behalf of the parties involved. Tag allocations fund the unit which manages the species at the NSW OEH. The departments contracts the scientists who monitor numbers, the same scientists also often consult to organisations such as RIRDC and the Kangaroo Industry itself. It is no surprise that their reports actively justify kangaroo shooting as a form of "management", and promote the supposed sustainability of the industry. Mjadwesch (2011) and this nomination conclude that nothing could be further from the truth. Populations are crashing and harvest rates are crashing, even as the industry brings new harvest zones on-line. Consideration of the biological (reproductive) capacity of the large macropods precludes any possibility of population "explosions", while the supposedly "reputable and peer reviewed science" (*pers comm* OEH N Payne) shows exactly this (biologically impossible growth rates). Harvest rates exceeding the reproductive capacity of the species, coupled with

	others of the threats above, are the mechanisms by which populations are declining. Pro-culling researchers are providing the kangaroo industry with the "science" it needs, both to badge itself as the green and ethical meat choice (to consumers), and to promote the industry itself as sustainable, to government offices, and domestic and international markets.
Fox Predation	Banks *et al* (2000) describes foxes as taking 50% of pouch emergent young, fox predation is obviously a serious threat, particularly for small or isolated populations.
Climate Change	Mjadwesch (2011) pp 123-124 touches on one issue (extreme weather increases juvenile mortality); Ritchie & Bolitho (2008) predicts significant range reductions for some kangaroo species under various warming scenarios; Flannery (2005) describes Red Kangaroo male fertility as decreasing with increasing temperatures. It is reasonable to assume, given the factors above, that it is likely that the large macropods will be affected by climate change.

27. POTENTIAL THREATS

Identify any **POTENTIAL** threats to the species.

The kangaroo meat industry is worth $270M.

The KIAA's aggressive pursuit of markets and its close links with state and federal offices suggests that regulatory capture may have occurred, and there may have been undue influence on the development of government policy.

The farming sector, which whole-heartedly supports the harvest industry, facilitates direct access to politicians and Ministers, who support and advocate the industry and products to overseas markets. At the same time the industry is very active in the media perpetuating the myth of (impossible) exploding populations and plague numbers of kangaroos, even while their own data shows consistently downward trends.

For example data looks like it has been manipulated to give an impression of sustainable and even increasing kangaroo populations, even during drought (see OEH 2011 and Herbert & Elzer 2011). Even in the face of the numerous impacts coming from mankinds development and modification – indeed transformation – of the landscape, and widespread destruction and exploitation of the species, populations are reported to increase at rates beyond anything that resembles a possible population growth rate.

This has never been queried by the departments charged with the conservation and protection of the species.

Instead we see the government offices doing everything they can to assist this industry with the paperwork which allows the destruction of kangaroos. Ranger's sign permits to shoot them at a local level, rarely questioning numbers and even more rarely verifying them. In Bathurst, ranger's even suggest which boxes to tick on applications to harm fauna, in order to make sure the paperwork is done correctly, while they advise shooters and land managers to target the breeding does, while they look the other way when the public reports illegal shooting (see Mjadwesch 2011). Policy development units write the legislation which allows the export of kangaroo products to international markets, possibly under the direction of the Minister of the day.

Kangaroos have been brought to this point by the actions (and inaction) of the very departments charged with their protection. Negligence and complacency on the part of the regulatory officers of government may itself be a threat to the species subject to this nomination.

28. THREAT ABATEMENT

Give an overview of recovery and threat abatement/mitigation actions that are underway and/or proposed.

No threat abatement for the decline of kangaroos is underway – mainland state authorities (NSW

NPWS, Victoria's DSE, QLD EPA, SA DEH and WA's DEC) have not realised and probably would not even accept that declines are occurring; indeed Victoria is considering joining the harvest states in commercial exploitation. Kangaroo "management" in the mainland states at this stage seems to be focussed on and facilitates the destruction of kangaroos.

Tasmania and the territories are the exception.

Tasmania is the only state or territory to have identified serious declines in Eastern Grey Kangaroo populations in contact with humans and agriculture / development. The DPIWE have alleviated the decline of the Forester (*M. giganteus tasmaniensis*) through what can only be described as a successful recovery effort, though calling it a "success" at only 6 populations and 26,000 individuals may be calling it a bit early, particularly given that shooting remains the main form of "management" (many landholders really do not like them – see Tanner & Hocking 2000).

NT have reported alarming declines during drought (70% reductions) for the Red Kangaroo. While they are not actively working to conserve them, at least they declined to join the harvest industry in decimating this icon of the outback.

The ACT are struggling to live with kangaroos (TAMS KMP 2010). Urban conflict and roads, low macropod densities in farmed regions, fences, habitat loss etc have certainly reduced their numbers across Australia's capital territory; Mjadwesch (2011) suggests possibly a 56% population reduction since 1788, based on very rough calculations. There also seems to only ever be a single and rather unimaginative solution to perceived "over abundance" in the ACT: be it a nature reserve or a military base – shoot them. The TAMS KMP 2010 seems to be little more than a very convoluted and extensively argued justification for the shooting of kangaroos, on account of their impacts on endangered ecosystems and other high conservation value assets (for example the Grassland Earless Dragon *Tympanocryptis pinguicolla*).

This nomination proposes the following strategies will need to form part of threat abatement:

1. Cessation of shooting / harvest
2. Policing and prosecution of illegal shooting
3. Detailed survey (accurate population estimates are required)
4. Community participation in species recovery (fauna friendly fencing, regional corridor projects, fox control programs etc)
5. Development of strategies addressing impacts of roads (population fragmentation and roadkill)
6. Research on the species capacity to recover from such severe population declines

Surveys and Monitoring

29. **DISTINCTIVENESS**

Give details of the distinctiveness of the species.

Is this species taxonomically distinct? Taxonomic distinctiveness is a measure of how unique a species is relative to other species.

How distinct is this species in its appearance from other species? How likely is it to be mis-identified?

All species are distinct, however some of them can be misidentified in the field, or by the layperson.

Western and Eastern Grey Kangaroo are similar: WGK was described as a separate species by Demarest in 1817. After no-one was able to tell the difference for the next 155 years, this was confirmed in 1972 by Kirsch & Poole. The Western Grey differs at a glance in having darker pelage with more marked contrast between upper- and under-parts; other differences are more subtle (black on snout, males musky odour, more slender).

Female Wallaroos are superficially similar to the Eastern Grey (tail more yellowy than black-tipped); Male Wallaroo cannot be mistaken for anything else.

Red Kangaroos are distinct, however the Euro is often red, though more shaggy-furred.

30. **DETECTABILITY**

Give details of the detectability of the species.

Provide information on how easy the species is to detect and the ease in which it has/can be surveyed.

- If relevant, provide information on when and how surveys should be conducted, for example:
  - Recommended methods
  - Season, time of day, weather conditions
  - Length, intensity and pattern of search effort
  - Limitations and whether or not the method is accepted by experts
  - Survey-effort guide
  - Methods for detecting the species.

All species subject to this nomination are highly detectable. They can be "easily and reliably" surveyed using aircraft (according to the researchers doing the monitoring – there are dozens of survey reports which describe their methodologies), however the reliability of data being reported using this methodology is highly questionable. Impossible growth rates in the State harvest reports, and unacceptable confidence intervals in the literature (Grigg & Pople 1999 cites Southwells (1989) correction factor of 23.3 for Wallaroos in "wooded" habitat for example, and their own **CF10.2 (+/- 9.14)** for Eastern Grey Kangaroo in open habitat at Longreach) provides little confidence in the existing data sets.

Terrestrial survey can also provide solid population / density data (eg Banks 2000), typically done using a transect methodology. Walters (2010) provides an example of how this result in an over-estimation of a population through numerous incorrect data inputs and mis-applicatio0n of the methodology. Nonetheless the Walters (2010) report was still used by NMIT to justify destroying animals in their hundreds, and this proposal was approved by a disinterested and complacent bureaucracy.

31. **SURVEYS**

Provide information on survey effort to date, and any ongoing/proposed monitoring programs.

States provide annual counts of most species and harvest data – there are mountains of survey reports for the TSSC to consider, all prepared by "reputable scientists and peer reviewed" (Nicole Payne, NSW NPWS Kangaroo Management *pers comm*). These monitoring programs are ongoing, representing an extraordinary amount of effort over the past 30 years, however given the data and conclusions of this nomination, this seems to have misinformed the literature on the status of the species, and the sustainability of the harvest industry.

An alternative survey methodology could be tested, still based on aircraft over-flight, however using cameras instead of "trained" observers (who still miss up to 90% of animals even in "open" habitat, according to Pople *et al* 1998). This would still need to be coupled with a comprehensive (detailed) ground-truthing program and targeted survey system.

Survey needs to define the actual area of occupancy of the species, and provide an accurate and up-to-date account of numbers nationally, on which basis recovery planning can be implemented.

Conservation Dependent Considerations

Note: Only complete this section if nominating for consideration under the conservation dependent category, or if nominating a fish (or fished marine species) with a management plan.

32. **CONSERVATION PROGRAM**

a) Give details of the conservation program for which this species is a focus.
b) Provide details of how the species would become vulnerable, endangered or critically endangered should the program cease.

33. FISH MANAGEMENT PLANS

a) Give details of the plan of management that focuses on the fish.
b) Provide details of how the plan provides for management actions necessary to stop the decline of and supports the recovery of the species, so that its chances of long term survival in nature are maximised.
c) Explain the effect on the fish if the plan of management ceased

34. MANAGEMENT PLAN'S LEGISLATIVE BASIS

Provide information on how the management plan is in force under a law of the Commonwealth or State or Territory.

Indigenous Values

35. INDIGENOUS CULTURAL SIGNIFICANCE

Is the species known to have cultural significance for Indigenous groups within Australia? If so, to which groups? Provide information on the nature of this significance if publicly available.

The kangaroo is known to have cultural heritage significance to all Aboriginal groups; there is a vast amount of literature on this. This nomination is not the place to provide an analysis of this, nor is cultural heritage an area of expertise of the author, who would respectfully defer this discussion to the indigenous people of Australia.

Fundamentally (and amongst other things) kangaroos beating the ground with their tails as they hop keeps the energy of the song-lines "activated and flowing" (Elder Max Dulumunmum Harrison quoted in Ben-Ami 2009); the kangaroo is a massive figure in Aboriginal mythology, appearing in rock art etchings, carvings and paintings stretching back at least 30,000 years, across Australia.

Reviewers and Further Information

36. REVIEWER(S)

Has this nomination been reviewed? Have relevant experts been consulted on this nomination? If so, please include their names and current professional positions.

This nomination has not been reviewed. The Nomination to List the Large Macropods as VULNERABLE in NSW (Mjadwesch 2011) was reviewed by Dr Johannes Bauer (wildlife researcher & population ecologist), who was satisfied that arguments were reasonable, indeed compelling.

Dr Bauer is semi-retired; he is presently investigating starting a community forest co-op for carbon sequestration and biodiversity conservation under the international REDD+ program. After the fallout for Dr Bauer resulting from his introduction to the NSW nomination (Mjadwesch 2011), the author decided to spare him further exposure on this controversial topic.

Other comments on the NSW paper have included:

name withheld (CSIRO researcher):
this is an excellent study and very important

name withheld (herpetologist and taxonomist):
it is one the most important conservation initiatives ever produced in this country

name withheld (Game Council of NSW):
a most interesting expose

"Relevant experts" (for example NSW NPWS and their consultants, and other "experts" who have been doing kangaroo "research" for the last 30 years) are not interested in and do not accept or acknowledge that kangaroos may be in decline (refer to papers by Grigg, Pople, Hacker, McLeod, Cairns etc, right up until the present day). The author considers that the TSSC is the body most suited to conducting a thorough and independent review of the species and issues discussed herein.

37. **FURTHER INFORMATION**

Identify relevant studies or management documentation that might relate to the species (e.g. research projects, national park management plans, recovery plans, conservation plans, threat abatement plans, etc.).

2 papers by the author in 2011 provide detailed case studies of kangaroo management (NSW and Victoria), as well as considering the kangaroos history, processes operating against them, and their trajectory.

Mjadwesch (2011) *Nomination to List the Large Macropods as VULNERABLE in NSW* discusses many of the misconceptions around kangaroos, and the anomalous data which is being used to support the harvest industries claims of "sustainability".

Mjadwesch (2011) *Review of NMIT Kangaroo Management Program* details the way in which programs facilitating and even forcing local extinctions can play out, if unopposed by a committed local community.

These papers stand pretty much by themselves in terms of critiquing management of kangaroos, and in their interpretation of how kangaroos are faring after 200 years in a developing landscape. Otherwise the literature and the scientific community fairly uniformly considers that kangaroos are plentiful and abundant, they have benefited from human development and agriculture, and that the harvest industry is sustainable. Exceptions to this include work by groups such as THINKK, and independent researchers such as Auty (2004), however these alarm bells have been ignored by the regulators to date.

The States have readily available Kangaroo Management Plans and policies, all facilitating the destruction of kangaroos if not for harvest, then for "damage mitigation". These and their quota reports make interesting reading, and provide an impression of the scale of the destruction of kangaroos across their range. 3M animals are shot annually as a "sustainable harvest", countless joeys are also destroyed or orphaned. Unknown numbers of kangaroos are also shot under occupier's licence (at least in NSW – some other states are doing better at keeping track of this), and unknown numbers are shot illegally.

The amount of literature on kangaroos and their management (and the harvest) across Australia, probably outweighs research, in terms of the number of papers written and the amount of money spent, than any other species, or group of species, in Australia.

However no-one ever seems to have seriously studied numbers of kangaroos other than in support of harvest models. There is a dearth of independent research critically testing the *status quo* assertions about the supposed abundance of kangaroos, or their response to wide-scale slaughter, in a landscape devastated by other human impacts (clearing, roads, fences etc) while global forces (drought, fire, flood, disease, climate change etc) cause multi-regional declines. While millions of dollars are rightly poured into saving the last few Hairy-nosed Wombats, Australia's foremost icon – our international image and national emblem, is treated with contempt and complacency. Kangaroos are a pest to be rid of.

Other areas that may bear investigation by the TSSC might also include (but should not necessarily be limited to) the genetic impact of mass-shooting, to whit:

Kangaroo Genetics: Impact of Harvesting, produced for the NSW NPWS by Dr Peter Hale, states that "*The effects of the commercial harvest are therefore unlikely to produce genetic changes in the population*", so that there was no negative genetic fallout from decades of killing the biggest and best kangaroos. This conclusion by Dr Hale has been challenged on several points by Dr Ian Gunn, the Director of the Animal Gene Storage Resource Centre of Australia, at Monash University Medical Centre.

38. **REFERENCE LIST**

Please list key references/documentation you have referred to in your nomination.

Mjadwesch (2011) *Nomination to List the Large Macropods as VULNERABLE in NSW* analyses the situation with kangaroos in NSW and historically – it includes an extensive reference list (blue text in this nomination), which should be used instead of again listing them all here (half the forests of Tasmania will have to be cut down to print it all). Over 160 sources informed the author's position on the status of kangaroos in NSW. Of these particularly helpful resources include:

Caughley & Short (1987) *Kangaroos: Their Ecology & Management in the Sheep Rangelands of Australia* Cambridge University Press, Cambridge

Dawson (1995) *Kangaroos: Biology of the Largest Marsupials* Cornell University Press, New York

Menkhorst P, Knight F 2001 *A Field Guide to the mammals of Australia* Oxford University Press, Melbourne

Strahan R (Ed) 1995 *The Mammals of Australia* Reed New Holland, Sydney

Work by Arnold (1991), Banks (2001), Bilton / Croft / Lee / Montague-Drake etc (eg: 2004) and Gammage (2011) (amongst others) also have adequate rigour to provide useful information on various aspects of kangaroo biology and ecology, and the function of populations, and landscapes.

Work by some sectors of the scientific community sometimes has questionable value. For example Hacker & McLeod (2004) conclude on the basis of shooting 2,755 animals and gouging their eyes out, that a 20% harvest is "sustainable" - complete rubbish; nonetheless QLD and WA went on to incorporate this recommended rate into their harvest system. However Hacker's in-pouch M:F sex ratios were useful. Many papers written by pro-harvest researchers contain gross errors, heavy bias and misleading and omissive statements, with a few grains of fact – the critical reader should be able to detect the difference.

This nomination also refers to additional material listed below (red text in this nomination).

ACT Govt 1980 *Nature Conservation Act*

ACT Govt 2010 *Kangaroo Management Plan* Territory & Municipal Services, Canberra

Coulson G 1990 *Hattah-Kulkyne Kangaroo Management Plan* in *Restoring the Balance. A Kangaroo Control Program for the Hattah-Kulkyne National Park* DCE, Victoria

Croft D 1981 *Social behaviour of the Euro (Macropus robustus) in the Australian arid zone* Australian Wildlife Research 8: 13-49

Curran G, Gay E, Gilroy J 1999 *Investigations of a Major Epidemic Mortality of macropods in the Northern Part of Far Western NSW in October 1998* KMC Dubbo

Department of Conservation & Natural Resources 1996 *Mallee Parks: Management Plan* DNRE, Melbourne

Department for Environment & Heritage 2009 *2010 Commercial Kangaroo Harvest Quota Report for SA* DEH, Adelaide

Department of Environment & Conservation 2007 *Management Plan for the Commercial harvest of Kangaroos in Western Australia 2008-2012* DEC, Perth

Department of Environment & Heritage 2007 *The Kangaroo Conservation & Management Plan for South Australia 2008-2012* DEH, Adelaide

Department of Environment & Resource Management 2009 *Aerial surveys of commercially harvest kangaroos and wallaroos in Queensland* DERM, Brisbane

Department of Natural Resources, Environment & the Arts 2008 *Assessment of the conservation and management of the Red Kangaroo* Macropus rufus *and Euro* Macropus robustus *in the Northern Territory* DNREA Biodiversity Conservation Division Palmerston NT

Department of Sustainability & Environment 2003 *Grampians National Park Management Plan* DSE, Melbourne

Department of Sustainability, Environment, Water, Population and Community 2012 http://www.environment.gov.au/biodiversity/wildlife-trade/wild-harvest/kangaroo/population.html

Environment Protection Agency 2007 *Queensland Wildlife Trade Management Plan for Export – Commercially Harvested Macropods – 2008-2012* EPA, Brisbane

Flannery T 2005 *Country* Text Publishing, Australia

Kirsch JAW, Poole WE 1972 *Taxonomy and distribution of the grey kangaroos Macropus giganteus (Shaw) and M. fuliginosus (Desmarest) and their subspecies* Australian Journal of Zoology 20: 315-339

Lee E, Klocker U, Croft D, Ramp D 2004 *Kangaroo-vehicle collisions in Australia's sheep rangelands, during and following drought periods* Australian Mammalogy 26: 215-226

Mjadwesch R 2011 *Nomination to list the large macropods as VULNERABLE in NSW under the TSCA 1995* MESS, Bathurst

Morgan DG 1994a *Hattah-Kulkyne National Park and Murray-Kulkyne Park Kangaroo Populations: June 1994* University of Melbourne, Victoria (unpublished)

Morgan DG 1995 *Hattah-Kulkyne National Park Mournpall Block Kangaroo Populations: March 1995* University of Melbourne, Victoria (unpublished)

NT Govt 2006 *Territory Parks & Wildlife Conservation Act*

Office of Environment & Heritage 2011 *NSW Commercial Kangaroo Harvest Management Plan* OEH, Dubbo

Pople AR 1996 *Affects of Harvesting upon the Demography of Red Kangaroos in Western Queensland* UQ, QLD

Pople AR 2003 *Harvest Management of Kangaroos During Drought* NPWS, Dubbo

QLD Govt 2006 *Nature Conservation (Administration) Regulations*

QLD Govt 2006 *Nature Conservation (Wildlife) Regulations*

Ritchie EG, Bolitho EE 2008 *Australia's Savanna Herbivores: Bioclimatic Distributions and an Assessment of the Potential Impact of Regional Climate Change* in *Physiological and Biochemical Zoology* 81:6, JCU, Townsville

SA Govt 1972 *National Parks & Wildlife Act*

Sluiter I, Allen G, Morgan D, Walker I 1992 *Kangaroo management at Hattah-Kulkyne National Park: the vegetation response* Abstract proceedings of the fifth Australasian Wildlife Management Society symposium, Brisbane

Southwell C 1989 *Techniques for monitoring the abundance of kangaroo and wallaby populations* in *Kangaroos, Wallabies and Rat Kangaroos* (Ed Grigg G, Jarman P, Hume I) pp 659-693 Surrey Beatty & Sons Chipping North

Speare R, Johnson PM, Pullsford T 1991 *Epidemic Mortality in Large Macropods of Central Western Queensland during May 1990* Queensland NPWS

Tasmanian Govt 2002 *Nature Conservation Act*

Victoria Govt 1975 *Wildlife Act*

WA Govt 1950 *Wildlife Conservation Act*

WA Govt 1970 *Wildlife Conservation Regulations*

The author apologises if he has missed anyone.

The collation of material to inform this nomination has been a mammoth exercise. It was produced in a period of 3 weeks, after the DSEWPC (Director - Species Listing) advised that the Commonwealth Threatened Species Scientific Committee would not be able to consider the NSW nomination (Mjadwesch 2011) in a national sense. The TSSC are unable to consider threatened species issues unless a nomination has been submitted in the correct form.

This obviously places quite an obstruction in front of effective conservation in Australia. The Commonwealth TSSC are unable to consider state issues, such as NSW where subsidence is listed as a KTP (for example), and initiate their own investigation, to ensure that good policy enacted by the states is incorporated into the national legislature. This is a failing, and may be one reason why longwall mining is expanding across Queensland, to the extreme detriment of the environment.

As a consequence of a single person working on this nomination, and a period of 3 weeks for preparation, this nomination is likely to contain errors and omissions. There are a great many interesting looking papers in the literature, which were not sought by the author; the TSSC and DSEWPC are encouraged to spend some of their own considerable capacity and resources on further research into this topic.

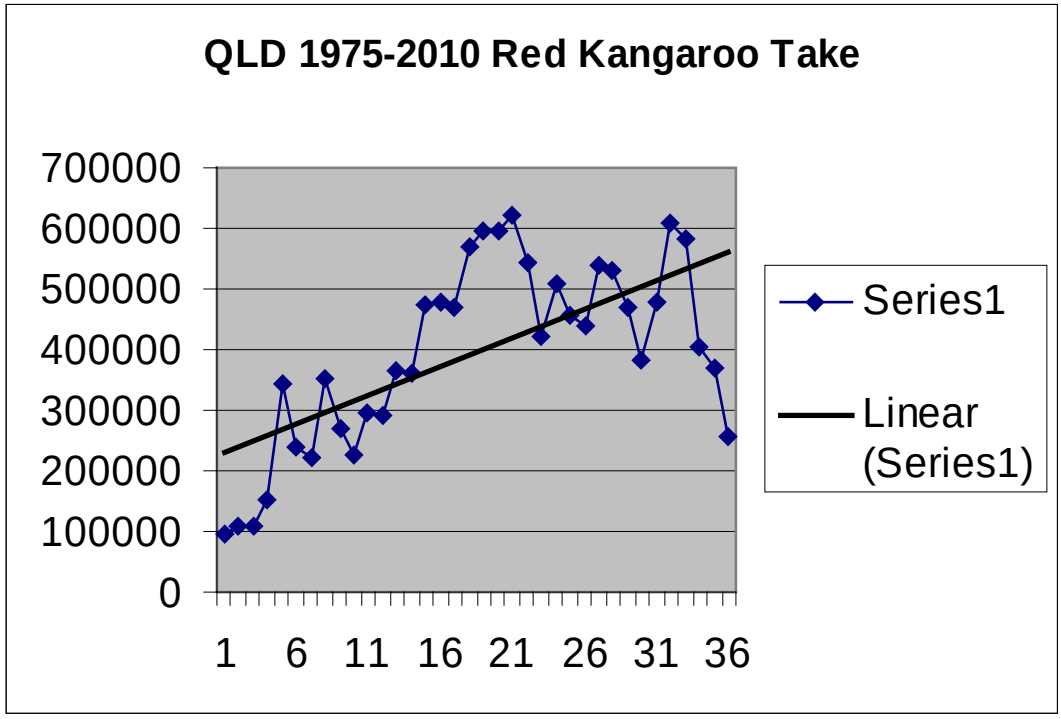
39. **APPENDIX**

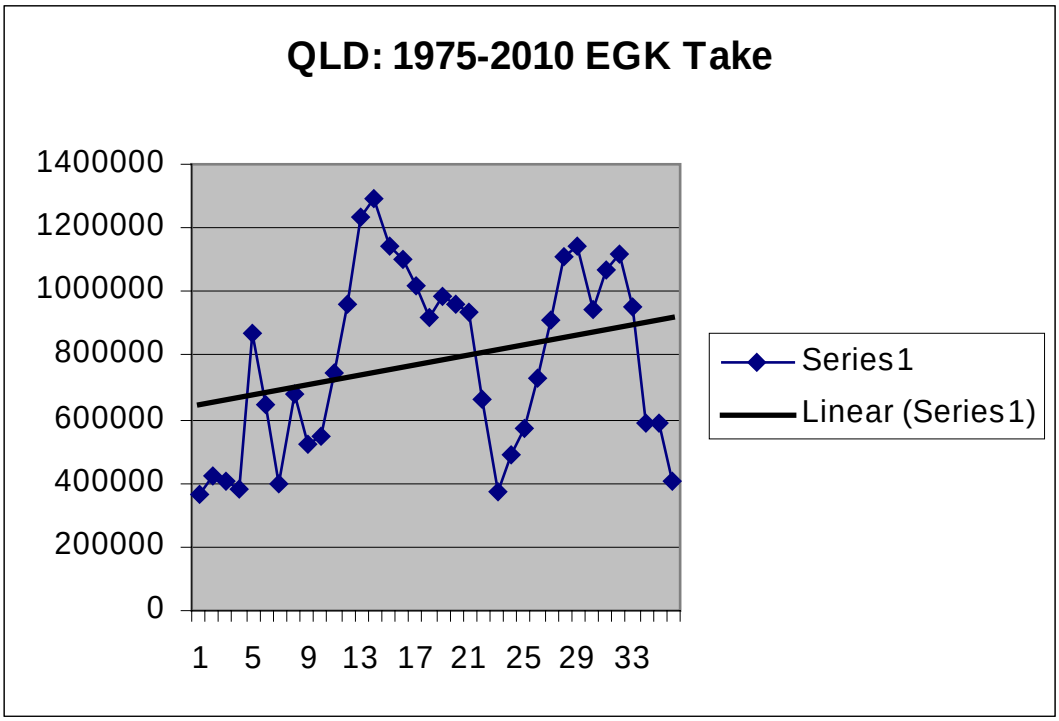
Please place here any figures, tables or maps that you have referred to within your nomination. Alternatively, you can provide them as an attachment.

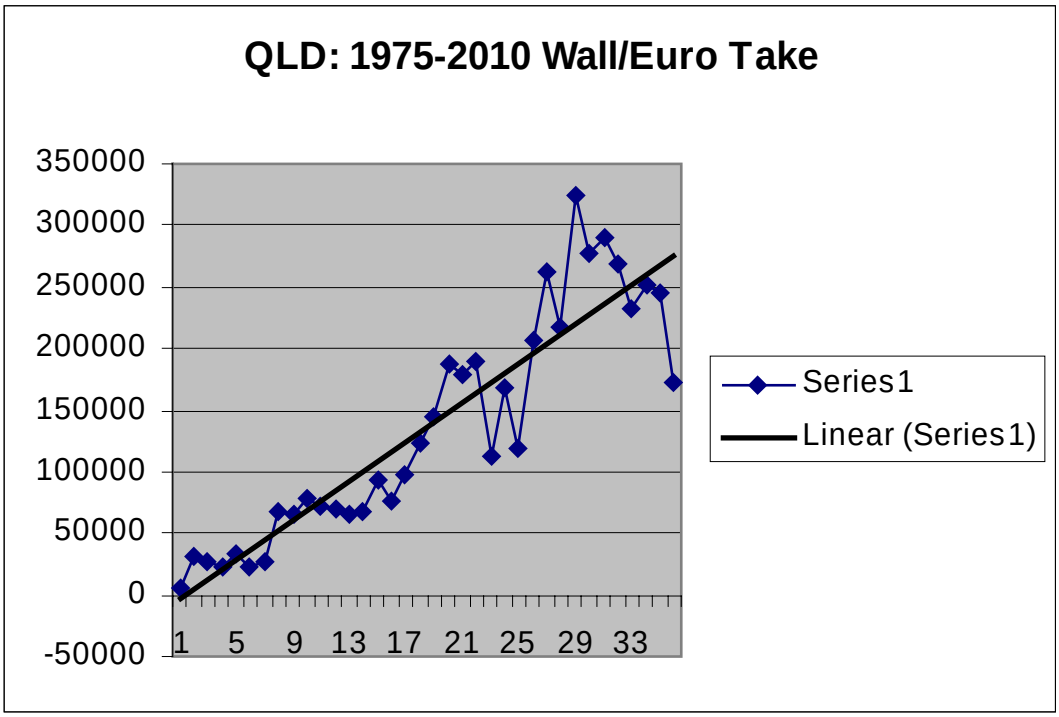
The illustration showing reproductive capacity remains in the text of this nomination, so that the reader can readily refer to it while reading the text reproductive biology.

Mjadwesch (2011) *Nomination to List the Large Macropods as VULNERABLE in NSW* and Mjadwesch (2011) *Review of NMIT Kangaroo Management Program* have been attached to this nomination.

Find below graphs of Take in QLD, WA and SA, referred to in **19. Population Trend** above. These have been used as a proxy for trends in populations (on account of unreliable population monitoring data, which uniformly shows biologically impossible increases), with some discussion.







What an interesting bunch of graphs. Do they show much, these "take" graphs? They certainly show more than population monitoring graphs for the state, which are pretty bland.

What the 3 Queensland Take graphs show with their positive trajectories is the industry building capacity, shooting more and more animals as they get shooters, properties and markets on-line and aligned. The strong growth in Red Kangaroo and Wallaroo take is not a sustainable trajectory, in fact the opposite. The only thing that an industry growing at such a fast rate can do, is crash. The last 10 years shows peak production being reached for all three species; the tailing off in all three graphs is attributed by the author to macropod numbers falling, as the quota in no way limits the harvest in QLD (or elsewhere).

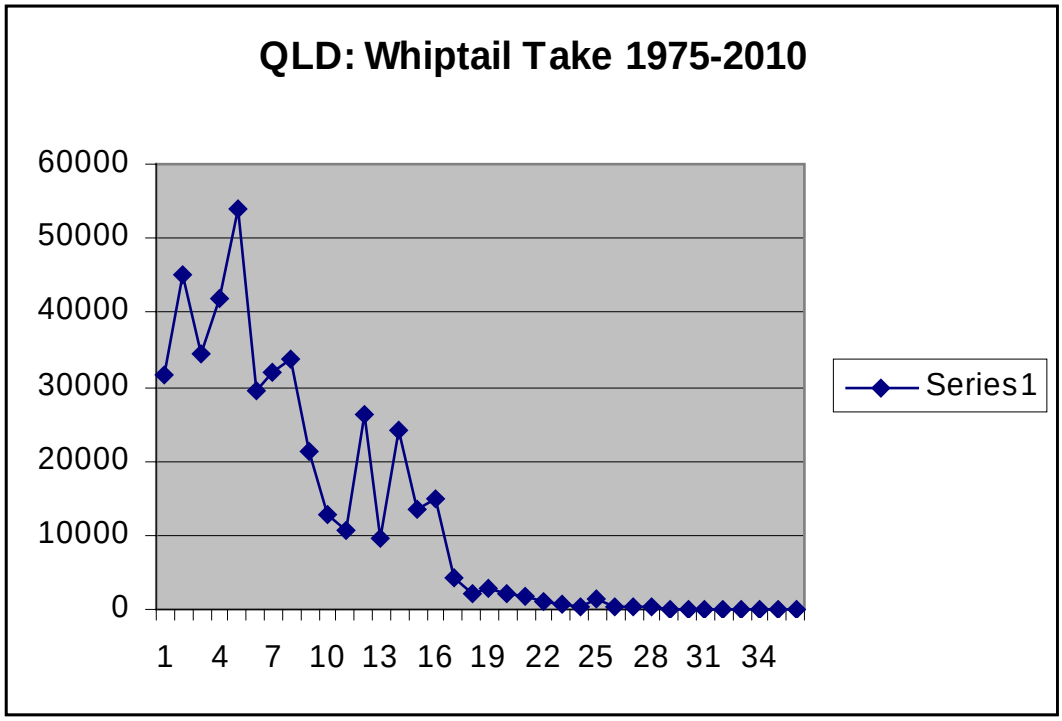
The experts, departments and the industry continue to assert that "declines in population totals in recent years are attributable to drought", however take itself is not limited by drought. Take is limited at its maximum by the quota, and at its minimum by how many animals shooters can find. The next thing in the media is that "take is down because flooding has prevented harvesters from accessing land… populations are going to explode". Whatever the reason, shooters consistently fail to meet quota allocations; ie take is not

limited by the quota. It would be worthwhile to investigate whether take is deceasing as a proportion of the quota, as well.

Simply put a deceasing take which is not limited by a quota can only indicate that there are fewer animals to find. Shooters continue to shoot as many animals as they *can* find.

The Eastern Grey Kangaroo graph is difficult to interpret. Why did take reduce from the high of nearly 1.3M animals in 1988, to only 370K in 1997? Pople (2003) suggests this was on account of a declining market. After 1997 the industry slowly rebuilt over the next 5 years, until over 1M animals were again being shot per annum, however in the last 5 years take has slumped again to 1/3.

Kelly (2008) cites from Pople (1996), who concluded that a 40% harvest rate in QLD was shown to have "no effect" on Red Kangaroo populations on individual properties. One can only imagine that 15 years later, if properties maintained a 40% harvest rate, that those properties will now have very few kangaroos left (given population growth rates of 3-9%), and Poples "no effect" may be shown to be no longer correct.

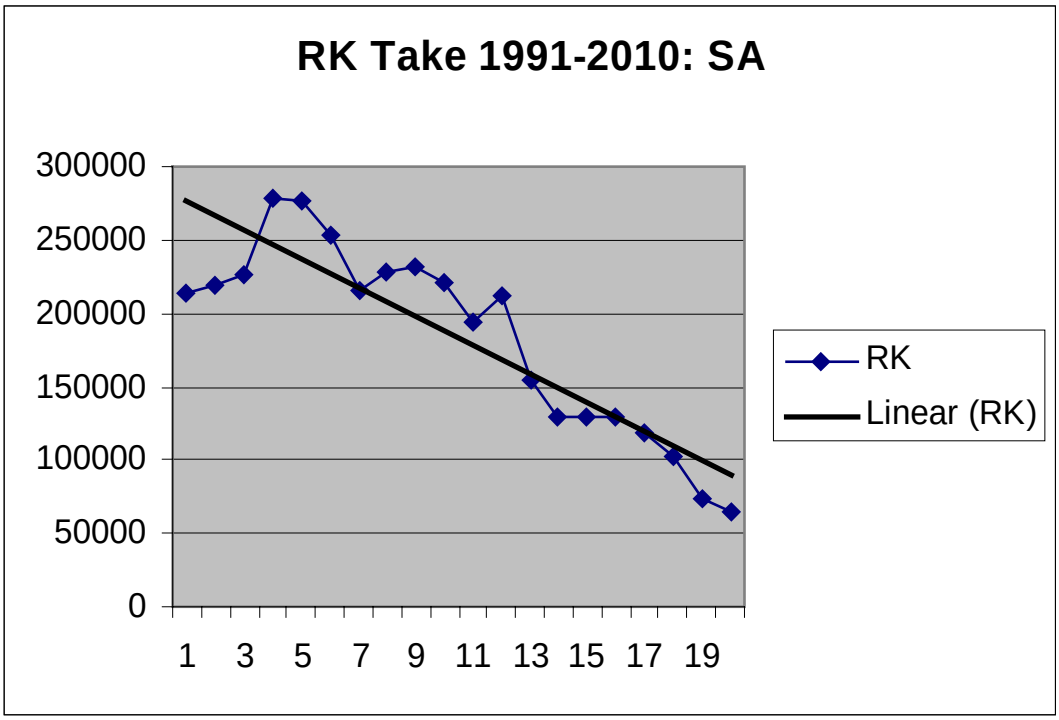


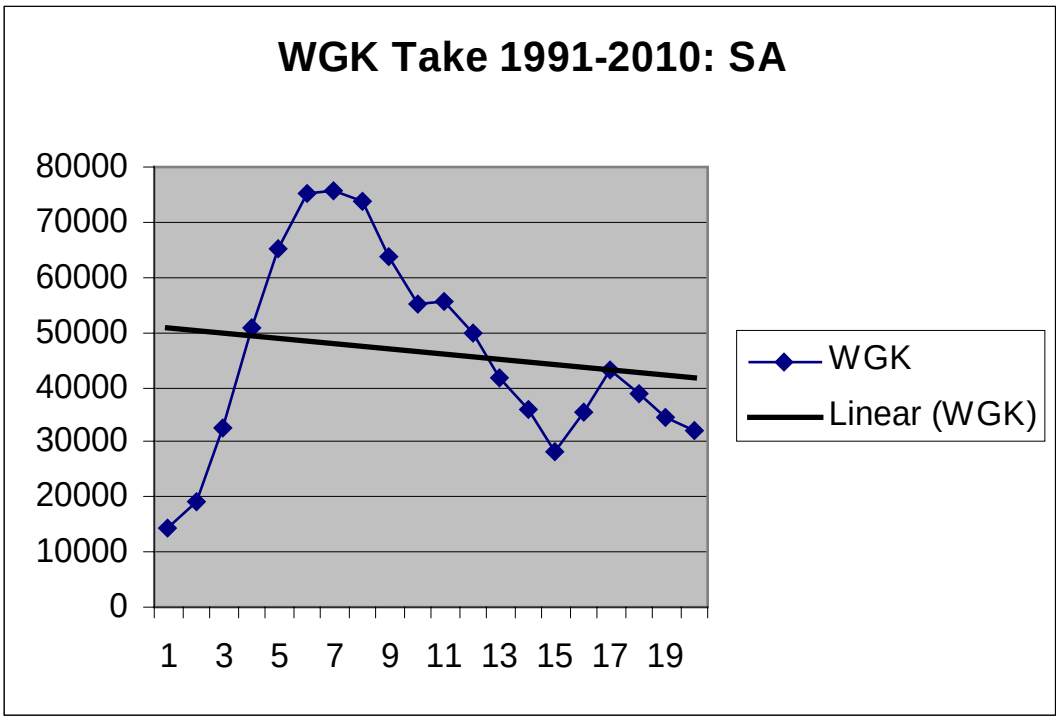
Queenslands data showing the killing of their Whiptail Wallabies tells a pretty convincing story of eradication – no trendline is required. **Quotas of 25,000 per annum were set for this species right up until the end** (2002), when they only managed to shoot 190 of them. The species no longer appears in either state or commonwealth quota reports; no-one seems to have noticed or commented on this strange fact. The species coastal distribution has left it in direct conflict with humans since then; this species is not included in this nomination, simply on account of the author not having time to include it.

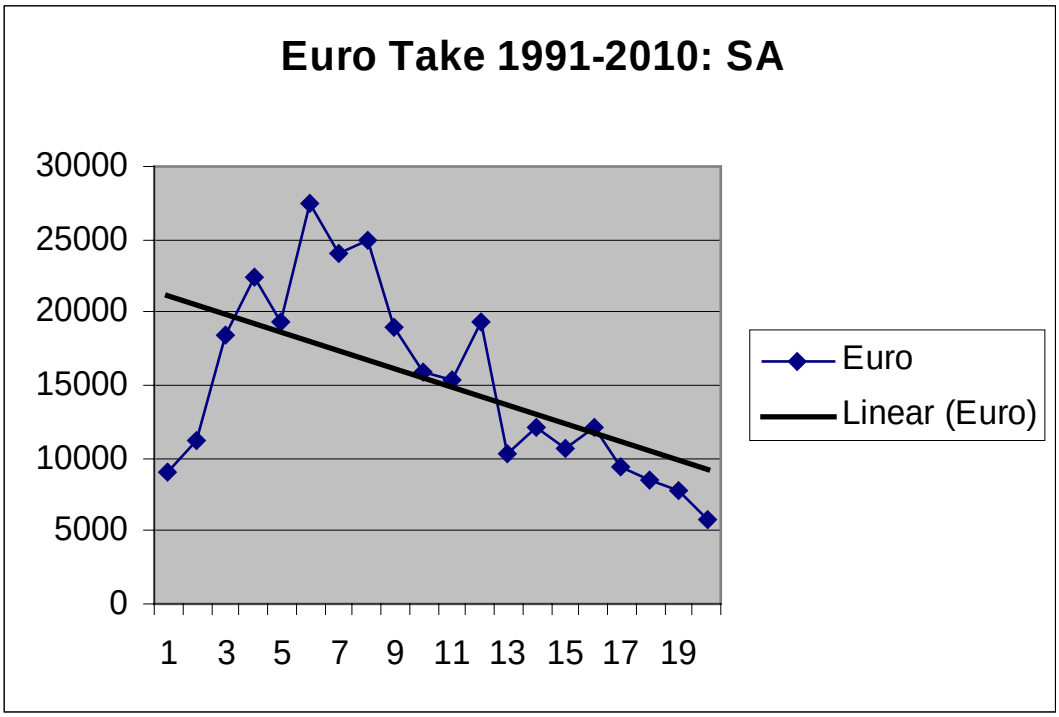
The Agile Wallaby also sounds like it has taken a pounding, with poisoning programs in WA and NT, and bounties still being paid in Queensland until at least 1995 (Strahan (Ed) 1995). Again the species coastal distribution places it in conflict with humans.

It would be appropriate for the TSSC to instigate and undertake investigations into species and issues on their own initiative. Criteria to be eligible for consideration should be required, however it should not necessarily entail a 40 point thesis on the biology and ecology of species, with consideration and discussion of issues and management.

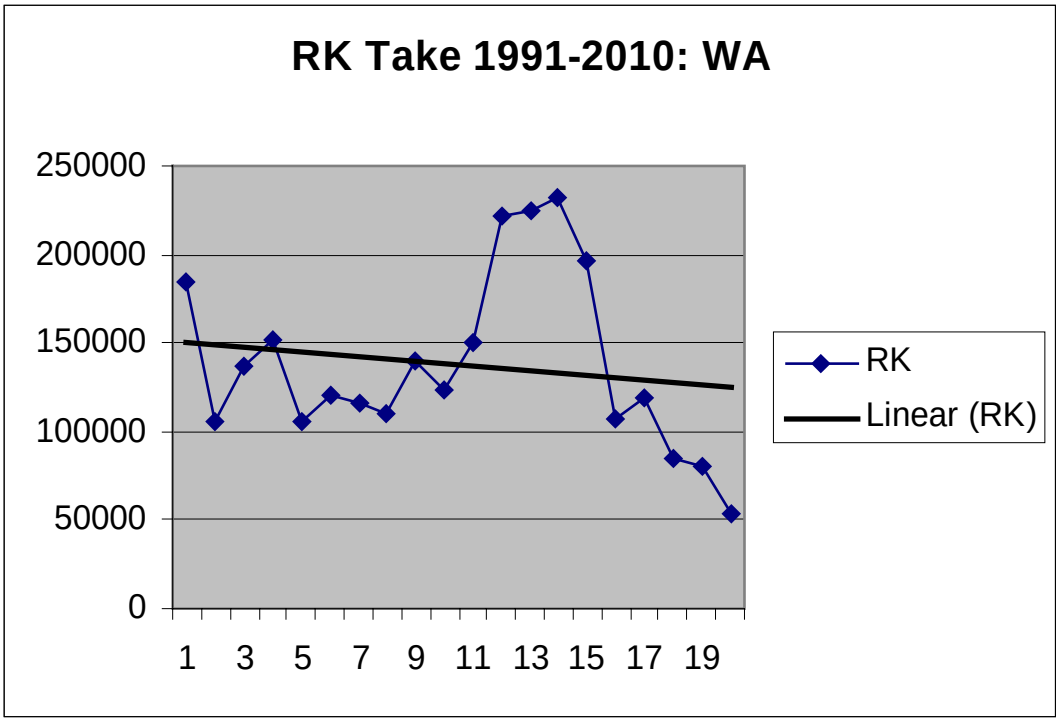
Timely intervention must take place for many species, and on many issues. Instead of action, well-funded government departments rely on the capacity, goodwill and charity of community "nominators", to identify and characterise issues relating to crown property (wildlife belongs to the crown). This should not be the role of the author, or the public.

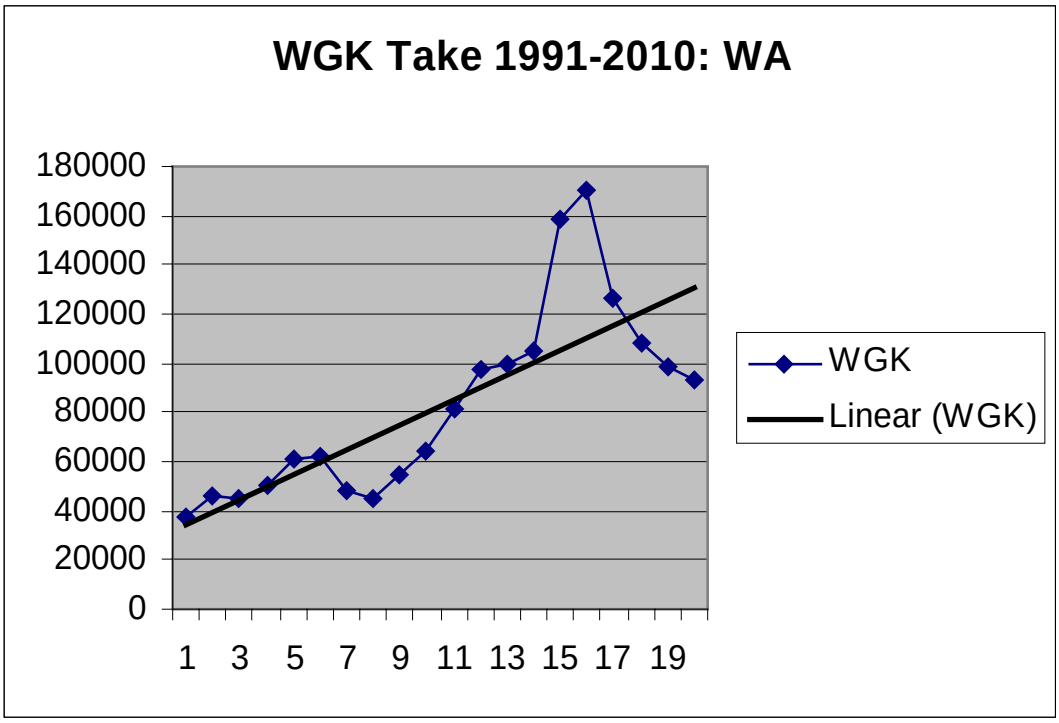

RK Take 1991-2010: SA
300000
250000
200000
150000
100000
50000
0
1 3 5 7 9 11 13 15 17 19
RK
Linear (RK)


WGK Take 1991-2010: SA
80000
70000
60000
50000
40000
30000
20000
10000
0
1 3 5 7 9 11 13 15 17 19
WGK
Linear (WGK)

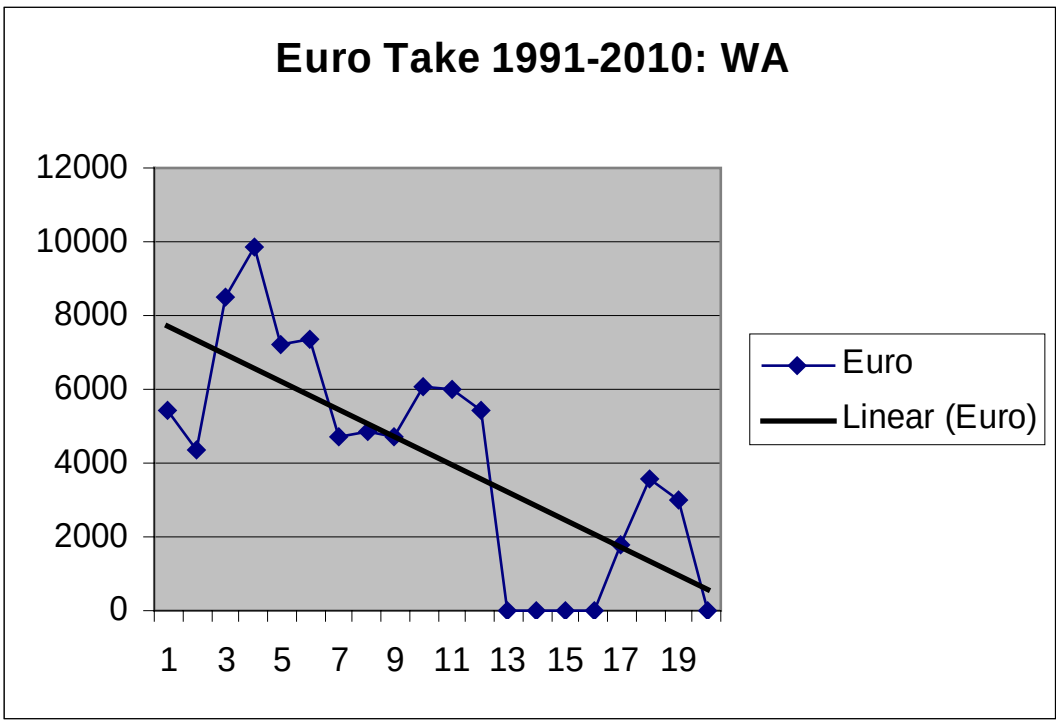


In South Australia, with records only going back to 1991, take is easier to analyse. Again capacity building is evident, peaking in 1995-1996, after which for all of the harvested species SA are reporting a steady decline in take. SA take data clearly demonstrates that the industry is unsustainable; a downward trajectory for all species is not indicative of a sustainable harvest.





This graph looks good for business, but it is hardly sustainable, in fact the opposite. An industry growing at this rate can only crash; this is coming through in the data between 2006 and 2010.

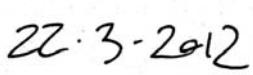


Capacity building is obvious again in the Western Australia take data, particularly for Red Kangaroo and Western Grey Kangaroo. RK has declined to only 25% of peak take (between 2004 and 2010); WGK take has declined by 45% in just 5 years (2006-2010).

The harvest of the Euro in WA is clearly unsustainable, given a fairly convincing trajectory and "0" quotas in later years. How do Western Australia regulators and the industry continue to pitch this as "sustainable" to the DSEWPC?

40. DECLARATION

I declare that, to the best of my knowledge, the information in this nomination and its attachments is true and correct. I understand that any unreferenced material within this nomination will be cited as 'personal communication' (i.e. referenced in my name) and I permit the publication of this information.

Signed:		
Date:		

** If submitting by email, please attach an electronic signature*