

# **2020 Quota Submission for Commercially Harvested Macropods in Queensland**

Prepared by: Macropod Management Program, Queensland Parks and Wildlife Services and Partnerships, Department of Environment and Science

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September 2019

## Executive summary

The commercial macropod harvest in Queensland is focused on three species (red kangaroo *Macropus rufus*, eastern grey kangaroo *Macropus giganteus*, and common wallaroo *Macropus robustus*) located in four zones: no harvest zone, eastern harvest zone, central harvest zone and western harvest zone.

The harvest is administered through a quota submission which is released annually and outlines proposed quotas for each species in each zone for the following calendar year. Quotas are set up to 20% of the estimated population for each species in each zone, depending on survey intensity and the standard error associated with population estimates.

This quota submission outlines the following factors that relate to macropod populations:

- population trends (estimates obtained through aerial surveys)
- review of previous harvests
- the extent of non-commercial harvest mortality
- the extent of areas not subject to any harvest
- rainfall trends.

For 2019, aerial surveys were conducted at 15 monitor blocks across Queensland. Since regionalisation of the Queensland commercial macropod harvest was introduced in 2003, an estimate of macropod population size in the eastern and western zones has been made. The model used to estimate these populations is based on a small sample area and the reduced sampling effort is reflected in a conservative quota. This model was updated in 2012 to incorporate almost a decade of survey data and to generate trigger points for the commercial quota allocation.

Overall combined population estimate totals for red kangaroo and common wallaroo declined marginally across the state whilst they increased for eastern grey kangaroos. Population estimates have decreased marginally for eastern grey kangaroos in the central zone but increased significantly in the eastern zone since 2019. In the central zone north and central zone south the eastern grey population estimates are below a predetermined trigger point and there is no quota for these regions for 2020.

The red kangaroo population estimate for the central zone decreased slightly overall but increased in the eastern zone since the 2018 surveys. In the central south the estimated population for red kangaroos was below a predetermined trigger point and the quota has been halved for this region in 2020. Common wallaroo population estimates decreased for the entire central zone but increased slightly in the eastern zone. The population estimates for common wallaroos in the central north and south were also below predetermined trigger points. There is no quota allocation for this species in the central south and the quota has been halved in the central north region in 2020. No aerial surveys were conducted in the western zone in 2019 and the estimated populations and harvest quotas have not changed since 2018.

Examination of long-term trends in population and block density estimates indicates that the 2019 estimates are comparable to fluctuations of previous years. Population estimates for all three commercially harvested species consistently number more than 1 million in Queensland.

In the 2018 harvest period, only 24% of the commercial harvest quota was utilised, with the highest percentage of quota used being 31.9% for eastern grey kangaroos and 27.3% common wallaroo both in the central zone. The overall harvest was male biased, with females comprising 11% of the overall harvest.

Figures available as at 31 August 2019 indicate that the harvest will be well below quotas for each species in each zone in 2019. Non-commercial take under damage mitigation permits (DMPs) were also below the maximum available quota for the 2018 harvest period a trend that is likely to be repeated in 2019.

The three commercially harvested macropod species continue to be protected from harvesting within the harvest zones in national parks and state forests. The protected area within the harvest zones is 80,027km<sup>2</sup>. Macropods are further protected from harvest in Queensland within the non-harvest zones.

Drought continues to be the overriding factor affecting macropod numbers throughout much of the harvest zones particularly in the central north and south. This is reflected in the reduced quotas in these regions for the 2020 harvest period. The eastern harvest zone is the exception to this trend with no effect on commercial harvest quotas reported in this quota submission.

**Population estimates for 2019 and proposed sustainable use quotas for the 2020 commercial harvest. Note estimates in red signify a trigger point has been reached.**

Species	Population estimate region	2019 estimated population (rounded to the nearest 50)	2020 sustainable use quota (rounded to the nearest 50)	Proportion of population (% rounded to the nearest whole number)
Red kangaroo	Central north	3,243,700	648,750	20%
	Central south	580,100	58,000	10%
	Central east	517,650	103,550	20%
	Central total	4,341,450	810,300	18.7%
	Eastern	211,250	21,150	10%
	Western	434,400	43,450	10%
	Combined	4,987,100	874,900	17.5%
Eastern grey kangaroo	Central north	754,400	0	NA
	Central south	342,000	0	NA
	Central east	7,045,100	1,056,750	15%
	Central total	8,141,500	1,056,750	13%
	Eastern	6,397,900	639,800	10%
	Western	13,800	NA	NA
	Combined	14,553,200	1,696,550	11.7%
Common wallaroo	Central north	603,300	45,250	7.5%
	Central south	89,950	0	NA
	Central east	61,300	9,200	15%
	Central total	754,550	54,450	7.2%
	Eastern	1,670,800	167,100	10%
	Western	321,350	32,150	10%
	Combined	2,746,700	253,700	9.2%

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## Introduction

The commercial harvesting in Queensland of three macropod species—red kangaroo *Macropus rufus*, eastern grey kangaroo *Macropus giganteus* and common wallaroo *Macropus robustus*—is regulated through:

- *Environment Protection and Biodiversity Conservation Act 1999*
- Queensland Wildlife Trade Management Plan for Export—Commercially Harvested Macropods 2018–2022
- *Nature Conservation Act 1992*
  - Nature Conservation (Administration) Regulation 2017
  - Nature Conservation (Wildlife Management) Regulation 2006
  - Nature Conservation (Wildlife) Regulation 2006
  - Nature Conservation (Macropod) Conservation Plan 2017
  - Nature Conservation (Macropod Harvest Period) Notice
- *Animal Care and Protection Act 2001*
- *Food Production (Safety) Act 2000*.

The Department of Environment and Science (DES) administers the harvest of macropods in Queensland in accordance with the International Union for Conservation of Nature (IUCN) Recommendation 18.24, ‘the ethical, wise and sustainable use of some wildlife can provide an alternative or supplementary means of productive land-use, and can be consistent with and encourage conservation, where such use is in accordance with appropriate safeguards’ (IUCN 1990) and the Wildlife Trade Management Plan for Export—Commercially Harvested Macropods 2018–22, ‘to provide for the sustainable use of macropod species covered by the plan, in accordance with the principles of ecologically sustainable development’ (Anon 2017).

Management of the harvest is facilitated via a quota that sets the number of animals that can be taken. Quotas are established largely based on aerial surveys of the commercially harvested species and have been used in Queensland since 1975. The Director-General of DES declares a harvest period open annually via the harvest period notice and sets quotas for this period having regard to the Queensland Wildlife Trade Management Plan for Export—Commercially Harvested Macropods 2018–22. Quotas are provided to the Commonwealth Minister for The Environment for endorsement.

Quotas in Queensland are set up to 20% of the estimated population for each species in each zone. Harvesting at these levels will ensure a sustainable yield and long-term conservation of macropod populations.

Since 2003, quotas have been set for each species for four harvest zones to ensure that harvest pressure is distributed across the range of the species (figure 1):

- no harvest zone (quota zero)
- eastern harvest zone
- central harvest zone
- western harvest zone.

This quota submission contains a summary of the recommended quotas for each of the species in each of the harvest zones for 2020. Additionally, the submission outlines the basis of how these quotas were determined.

The Nature Conservation (Macropod Harvest Period 2020) Notice 2019 is due for release in December 2019. The release of this notice will allow the harvest period to be declared open on 1 January 2020. The notice will outline specific conditions for the 2020 harvest period including, but not limited to, harvest zone boundaries and minimum allowable weights.

The proposed quotas were calculated using a fixed proportion of the estimated macropod populations within the Queensland harvest areas. Proportions were adjusted for each species across the harvest zones in relation to the margins of error present in population estimates derived from aerial surveys. The maximum proportions used for each species were 15% of the populations for eastern grey kangaroos and common wallaroos and 20% of the population for red kangaroos for the central zone. For the eastern and western zones, where survey effort is less extensive when compared to the central zone, the more conservative maximum proportion of 10% was applied for all three species.

These sustainable-use harvest proportions are based on research and modelling undertaken by Caughley et al. (1987) and Hacker et al. (2002) and are currently accepted by the scientific community, DES and the Commonwealth Department of the Environment and Energy for determining state quota limits.

The quota submission also outlines the following factors that relate to macropod populations:

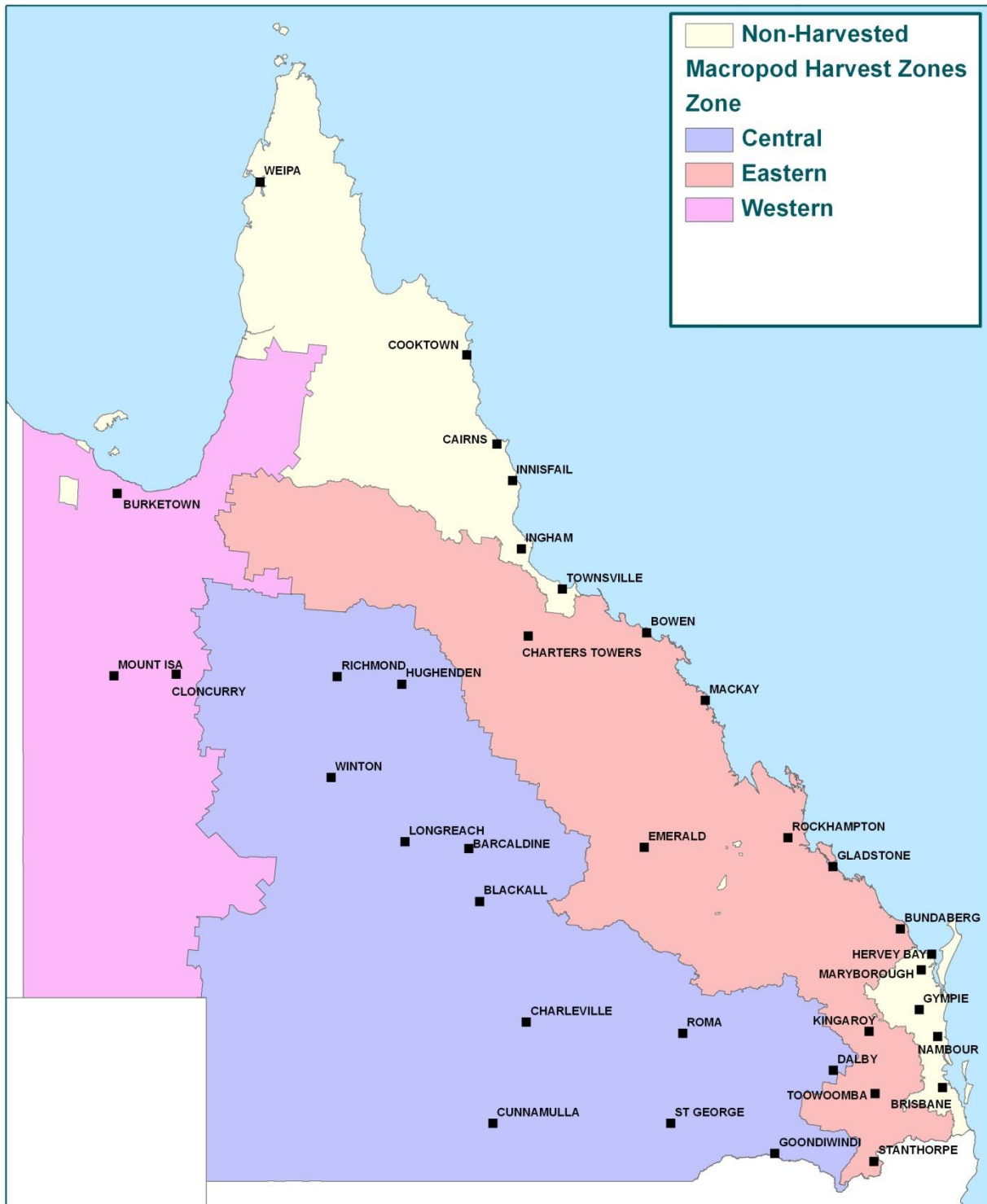
- population trends (estimates obtained through aerial surveys)
- review of previous harvests
- the extent of non-commercial harvest mortality
- the extent of areas not subject to any harvest
- rainfall trends.

## Proposed quotas

**Table 1. 2019 estimated populations and 2020 proposed quotas for each macropod species in each harvest zone. Note estimates in red signify a trigger point has been reached.**

Species	Population estimate region	2019 estimated population (rounded to the nearest 50)	2020 sustainable use quota (rounded to the nearest 50)	Proportion of population (% rounded to the nearest whole number)
Red kangaroo	Central north	3,243,700	648,750	20%
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	Central south	342,000	0	NA
	Central east	7,045,100	1,056,750	15%
	Central total	8,141,500	1,056,750	13%
	Eastern	6,397,900	639,800	10%
	Western	13,800	NA	NA
	Combined	14,553,200	1,696,550	11.7%
Common wallaroo	Central north	603,300	45,250	7.5%
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	Western	321,350	32,150	10%
	Combined	2,746,700	253,700	9.2%

Figure 1. Queensland macropod harvest zones





The central harvest zone is further divided into three regions for the purposes of estimating the populations of commercially harvested macropods. They are the central north, central south, and central east as displayed in figure 6.

The shires in the central north population estimate region are Barcaldine, Barcoo, Blackall-Tambo, Flinders, Longreach, McKinlay, Richmond and Winton.

The shires in the central south population estimate region are Bulloo, Murweh, Paroo and Quilpie.

The shires in the central east population estimate region are Balonne, Goondiwindi, Maranoa and Western Downs.

The eastern harvest zone consists of Banana, Bundaberg, Burdekin, Central Highlands, Charters Towers, Croydon, Etheridge, Gladstone, Isaac, Livingstone, Lockyer Valley, Mackay, North Burnett, Rockhampton, Scenic Rim, Somerset, South Burnett, Southern Downs, Toowoomba and Whitsunday shires.

The western harvest zone consists of Boulia, Burke, Carpentaria, Cloncurry, Diamantina and Mount Isa shires.

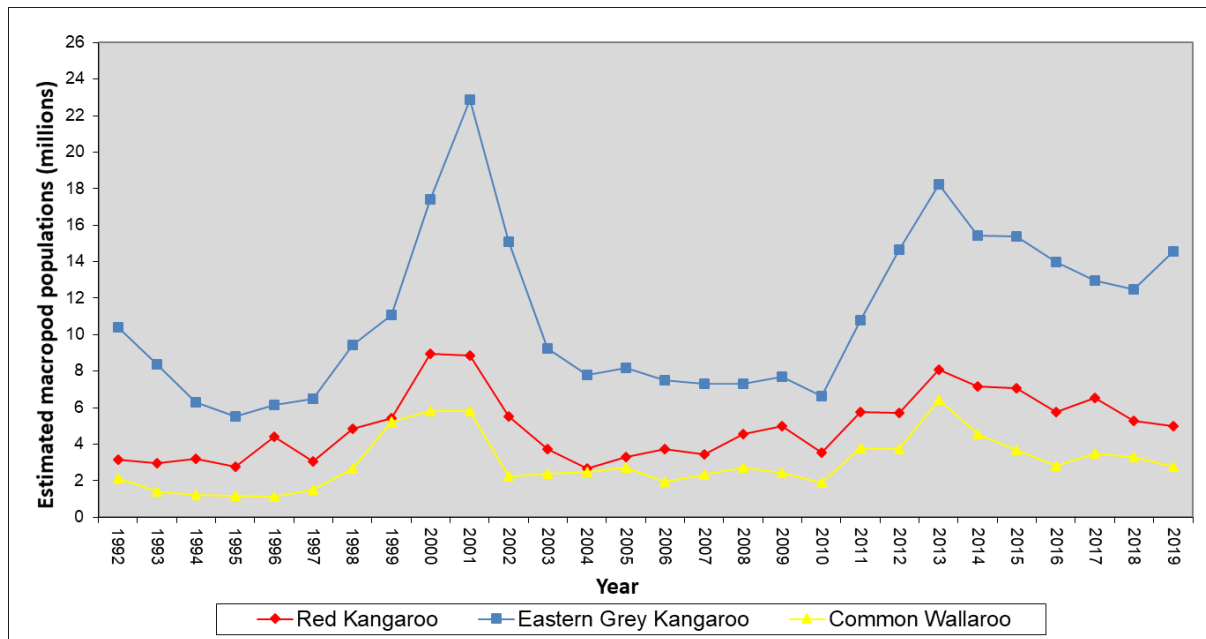
## Long-term population trends

### Population estimates

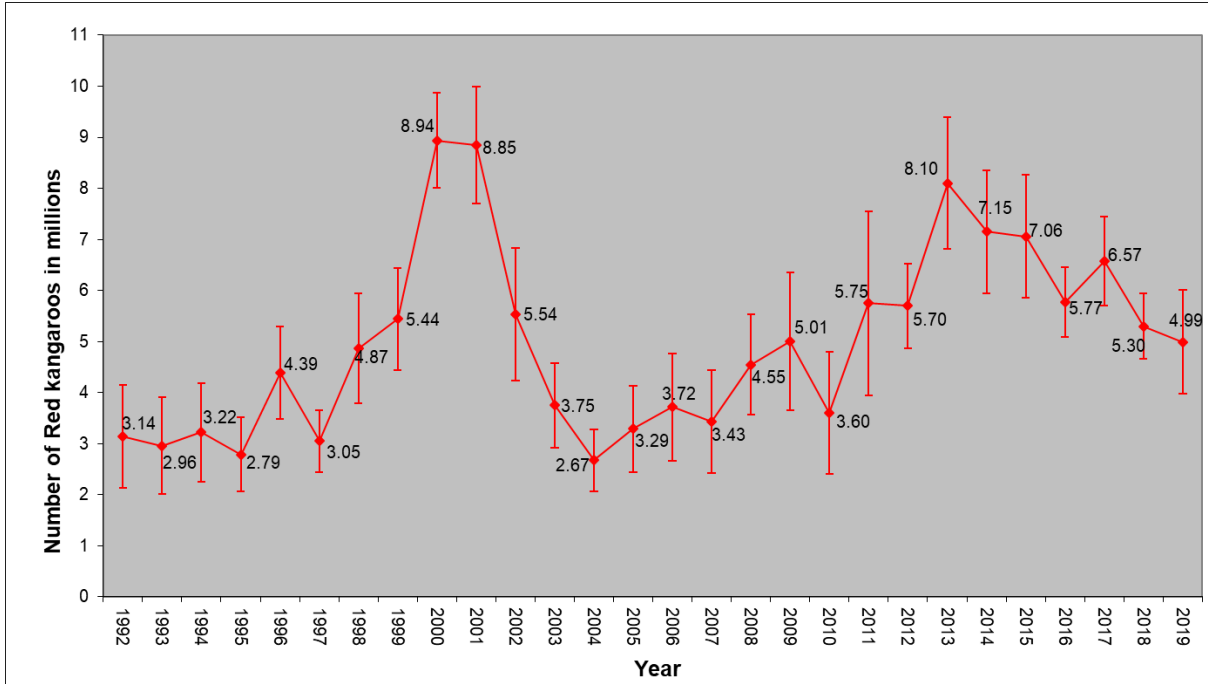
Since 1992, the Queensland Government has coordinated an annual program of aerial surveys to directly monitor populations of the three commercially harvested macropod species. These surveys occur over 22 representative monitor blocks across the state and are utilised to obtain population estimates that inform the quota. The methodology of the surveys is outlined in detail in Appendix 1. Since 2011 a correction factor of 1.85 has been applied to population estimates for common wallaroo in Queensland. Prior to this a correction factor of 1.2 was applied.

Current harvesting rates (quotas up to 20% of population estimates) are considered sustainable. None of the three commercially harvested species has shown a consistent decline in abundance since 1992 (figures 2, 3, 4 and 5), which would necessitate a reassessment of the harvest take and species conservation status. Whilst no consistent declines have been observed, the macropod populations in Queensland have fluctuated over time.

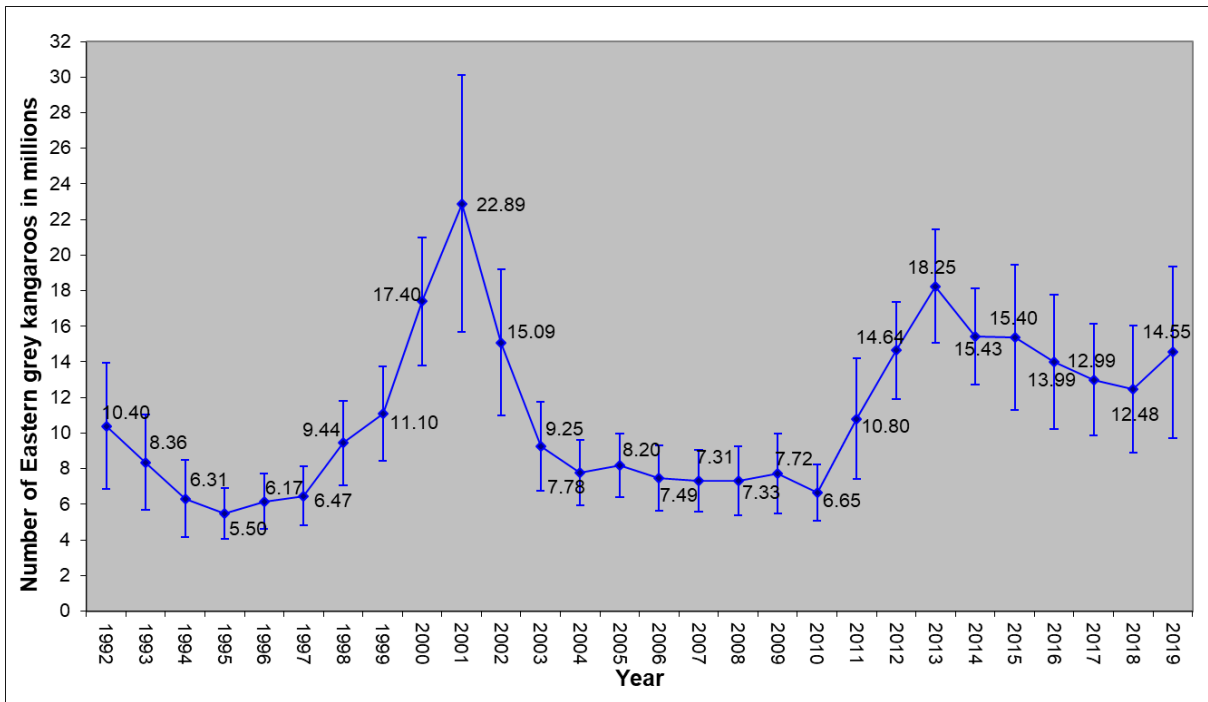
Figure 2. Macropod population trends—1992–2019



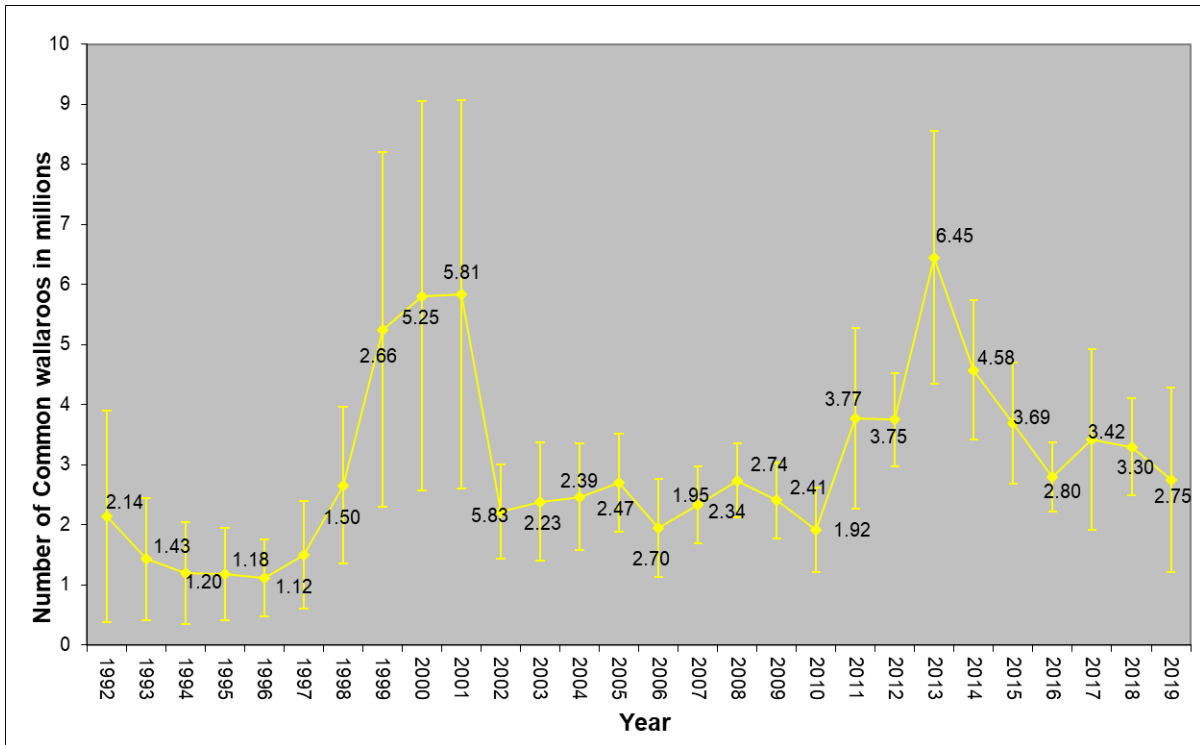
**Figure 3. Red kangaroo population estimates (with one standard error) since 1992**



**Figure 4. Eastern grey kangaroo population estimates (with one standard error) since 1992**



**Figure 5. Common wallaroo population estimates (with one standard error) since 1992. Estimates include a 1.85 correction factor for 2011 to 2019 and a 1.2 correction factor all other years**



**Density estimates**

To contribute to ensuring commercially harvested macropod species are maintained across their distributions, density estimates are calculated for representative survey blocks as part of the aerial surveys (Appendix 2). For the purposes of interpreting this data in an easily understood manner, the density estimates for each species have been grouped into the eastern and western harvest zones, with the central harvest zone divided into three regions, central zone north (Mitchell Grass dominant), central zone south (Mulga Lands dominant) and central zone east (Brigalow Belt dominant) (figure 6).

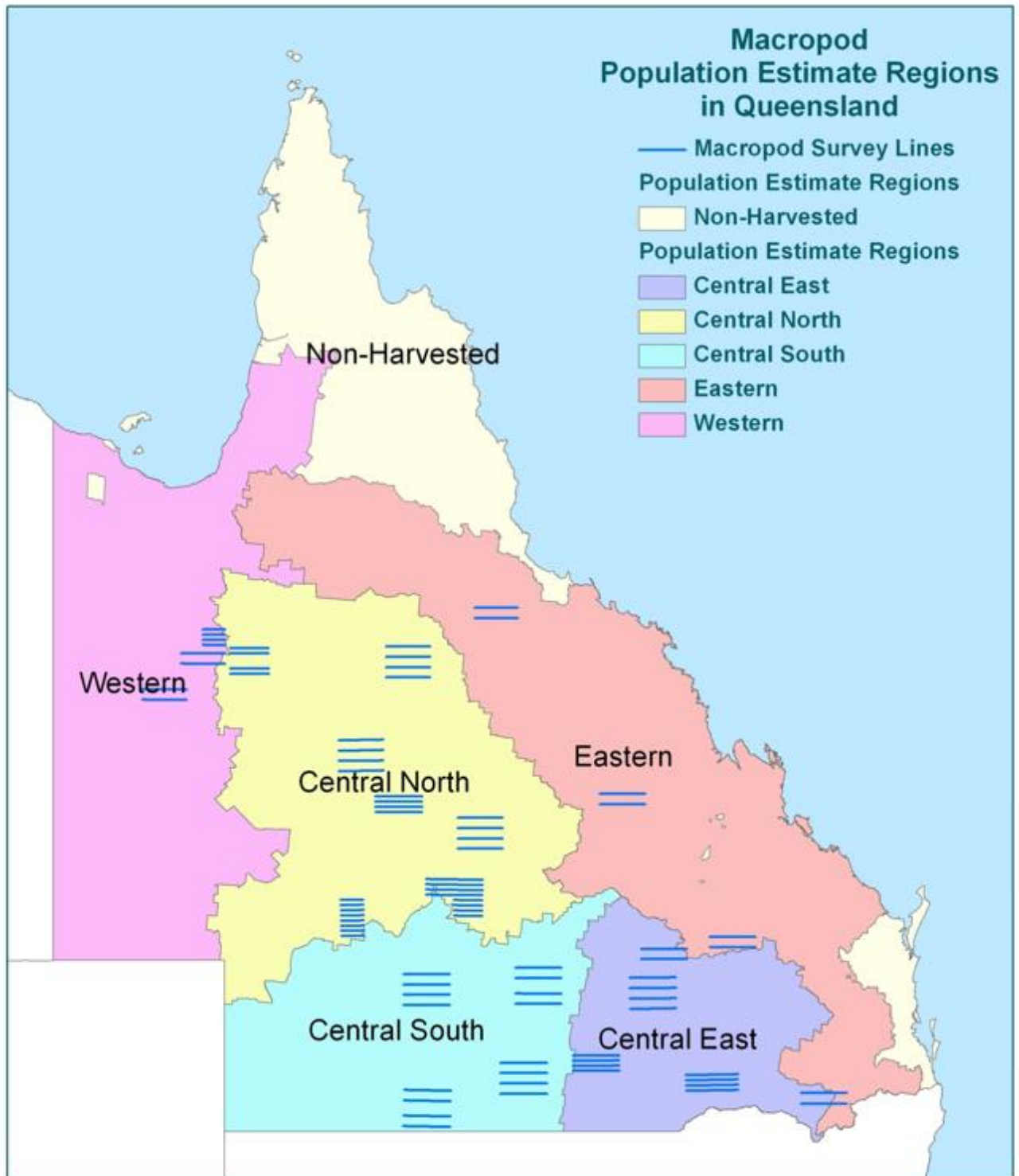
This data is monitored for any significant decreases in densities which is possible for all data collected since 2005. Examination of trends in density for the three commercially harvested macropod species in the areas outlined above for the period 2005–2019 demonstrates densities fluctuate over time (figures 7–11).

For red kangaroos densities are greatest in the central zone north and central zone south, with densities lowest in the eastern zone (figure 10). Low densities in the eastern zone are expected as this area incorporates the edge of the distributional range for this species.

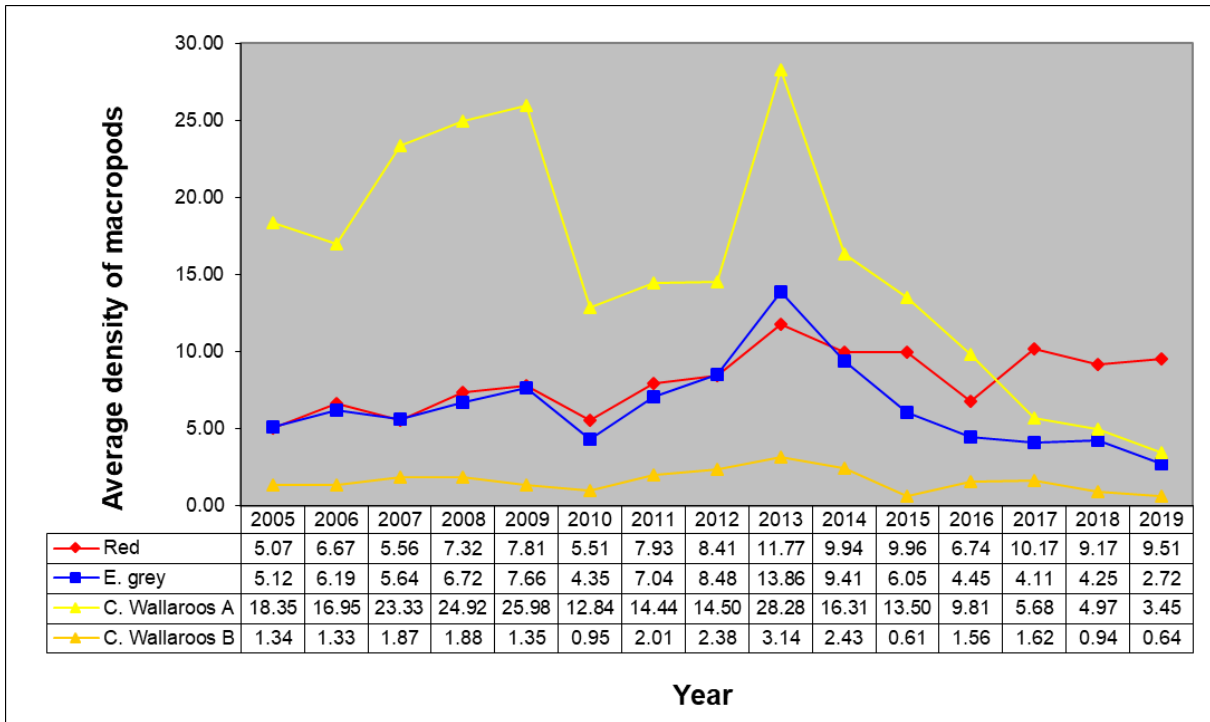
For eastern grey kangaroos highest densities are recorded in the central zone east (figure 9). Eastern grey kangaroos occur in consistently low densities in the western zone at the edge of their distributional range. As such, there is no quota for eastern grey kangaroos in this zone (table 1).

Common wallaroos occur in highest densities in the central zone north. This area is further divided into two regions for the purposes of estimating populations due to the considerably higher densities recorded around Blackall, Tambo and Longreach when compared to the rest of the zone (figure 7 and Appendix 2). Lowest densities for this species occur in the western zone (figure 11). Density fluctuations for this species do not follow the same patterns as those exhibited by red and eastern grey kangaroos (figures 7–11).

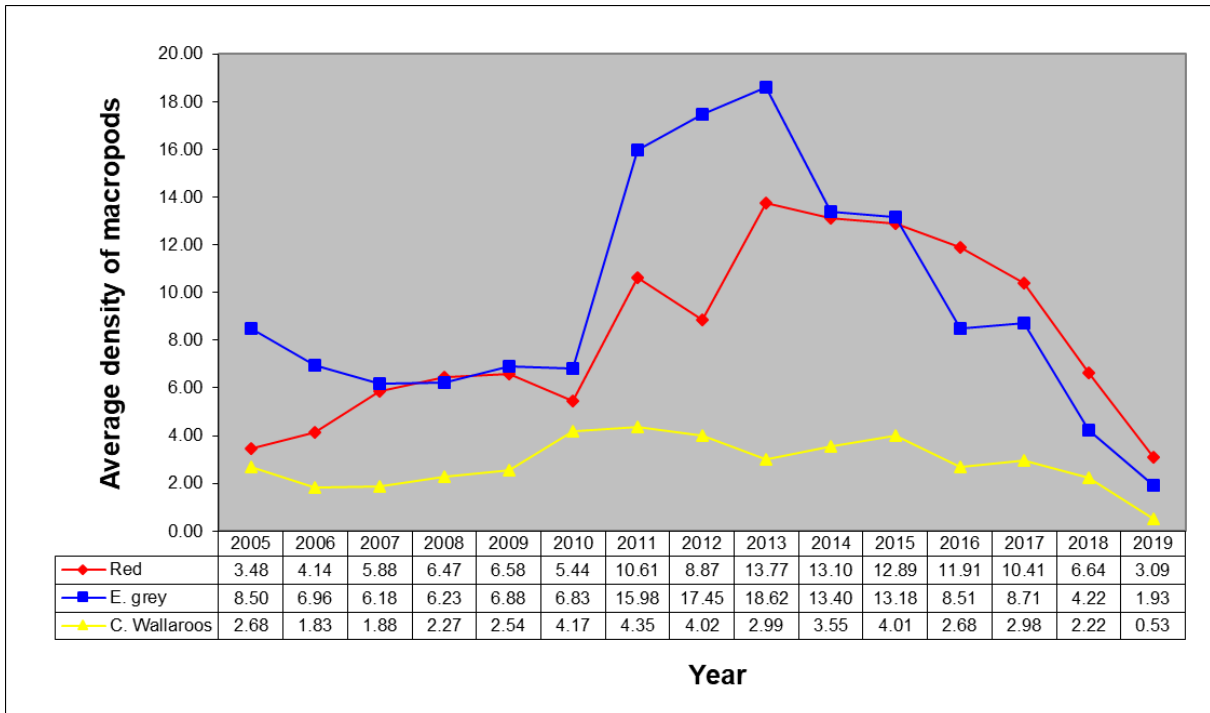
Figure 6. Regions used to calculate population estimates of commercially harvested macropods



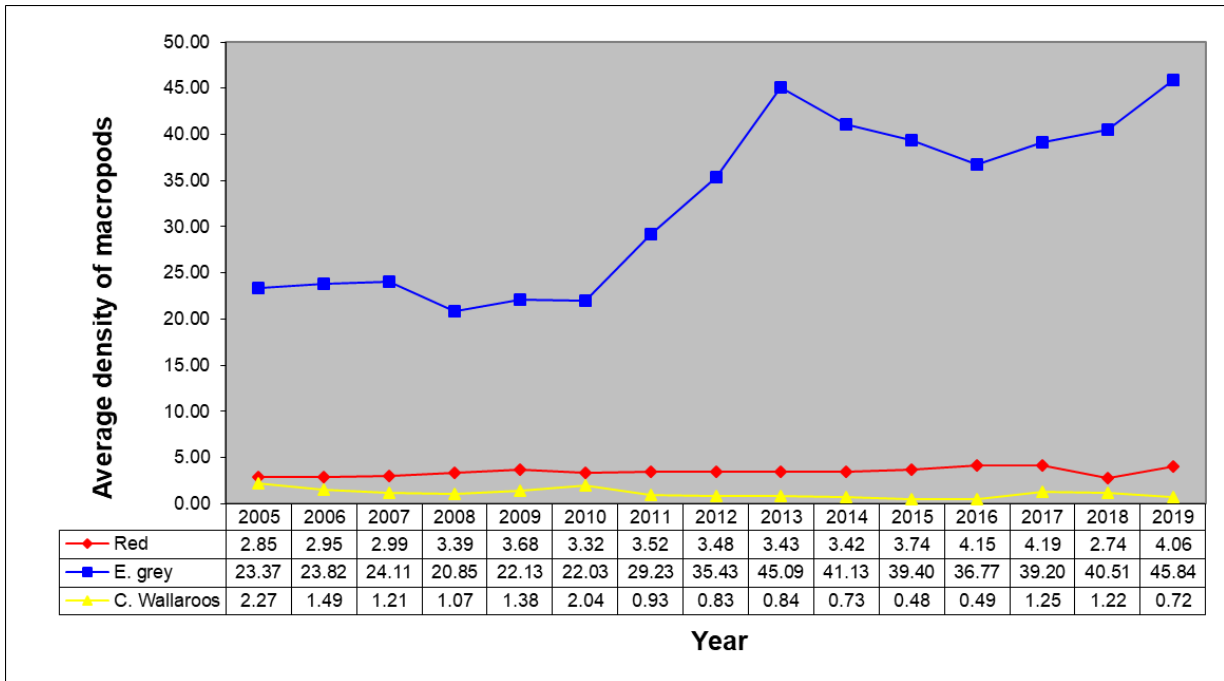
**Figure 7. Average density per km<sup>2</sup> of commercially harvested macropods in the Central North population estimate region from 2005 to 2019 (Common wallaroos are represented by two areas in the Central North zone)**



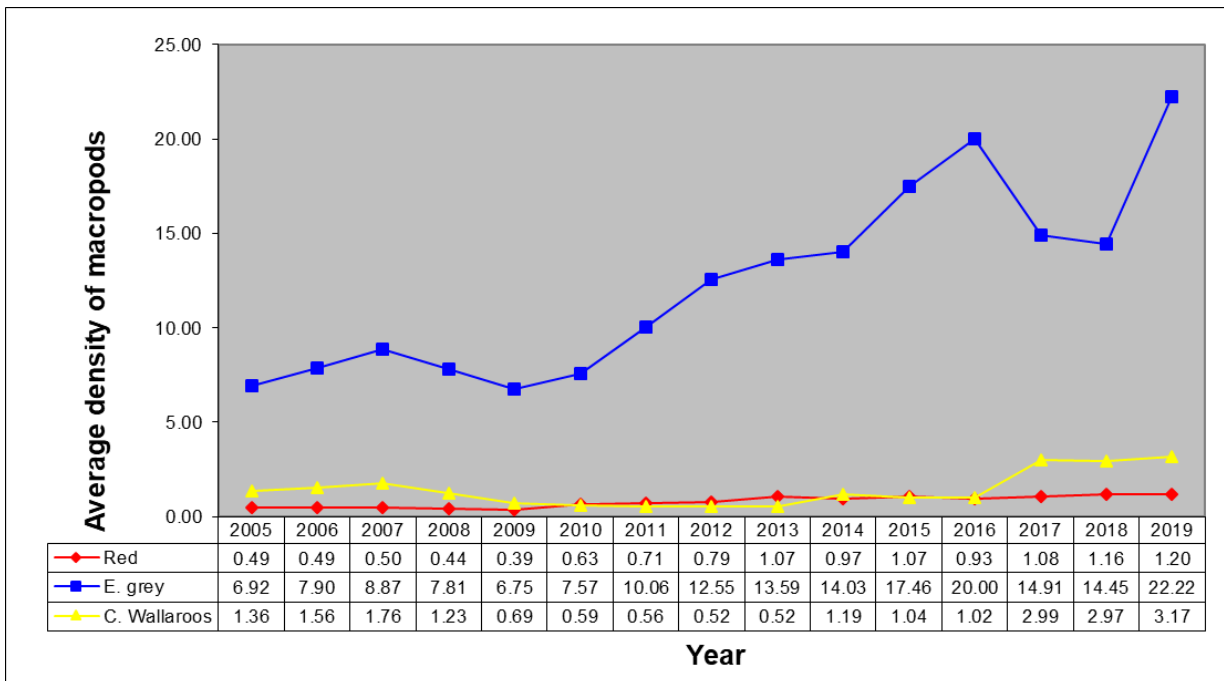
**Figure 8. Average density per km<sup>2</sup> of commercially harvested macropods in the Central South population estimate region from 2005 to 2019**



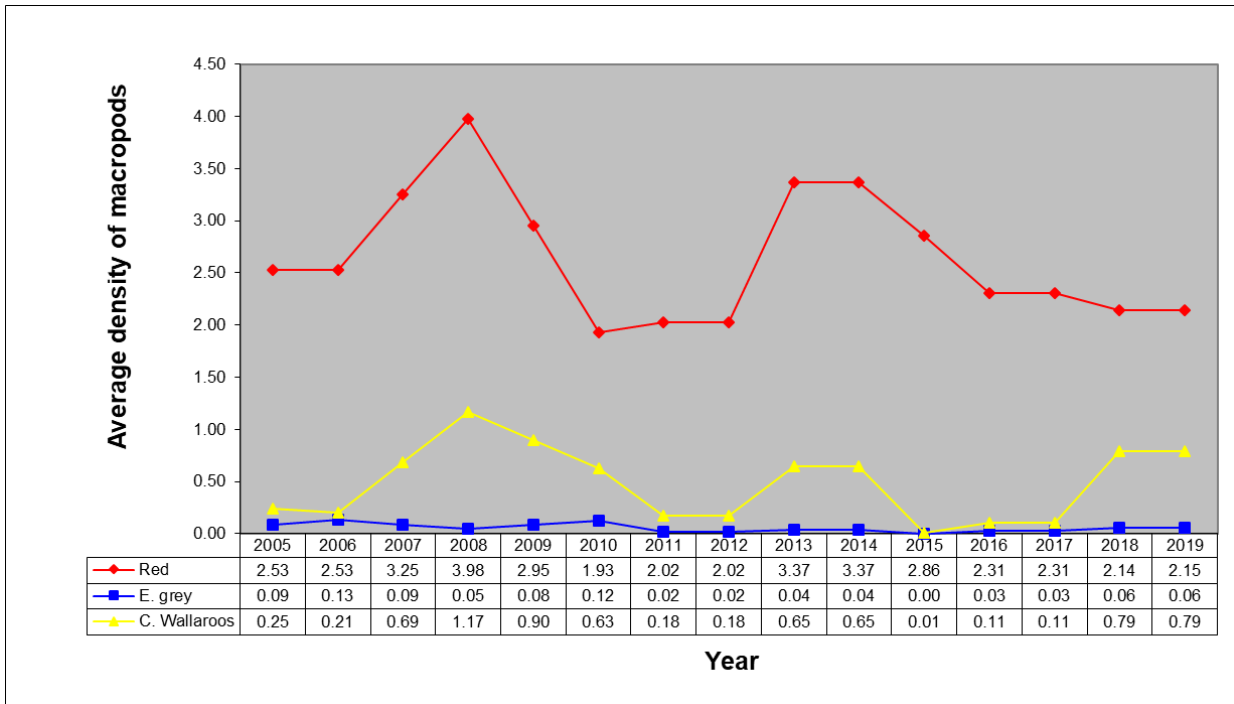
**Figure 9. Average density per km<sup>2</sup> of commercially harvested macropods in the Central East population estimate region from 2005 to 2019**



**Figure 10. Average density per km<sup>2</sup> of commercially harvested macropods in the Eastern population estimate region from 2005 to 2019**



**Figure 11. Average density per km<sup>2</sup> of commercially harvested macropods in the Western population estimate region from 2005 to 2019**



## Trigger points

Pre-determined trigger points for each of the commercial harvest quotas were introduced to the Queensland Wildlife Trade Management Plan for Export (Commercially Harvested Macropods 2013–17) and are also incorporated in to the Queensland Wildlife Trade Management Plan for Export (Commercially Harvested Macropods 2018–22). Each trigger point represents a threshold level based on analysis of the long-term population estimate for each harvested species in each population estimate region.

Where an estimated population for a region falls below a trigger point of 1.5 standard deviations (SD) below the long-term average for that region then the harvest quota will be halved for that region in the next calendar year. If a population estimate falls below 2 SDs below the long-term average for that species in that region then there will be no quota for the following year.

Table 2 shows the calculated trigger points for 2020 for each species in each region compared with the 2019 population estimates for those regions. The estimated population for red kangaroos in the central south and common wallaroos in the central north are below the 1.5 SD trigger point. Consistent with the Wildlife Trade Management Plan for Export—Commercially Harvested Macropods 2018–22 the harvest quotas for these species in these regions have been halved for 2020 (figure 12).

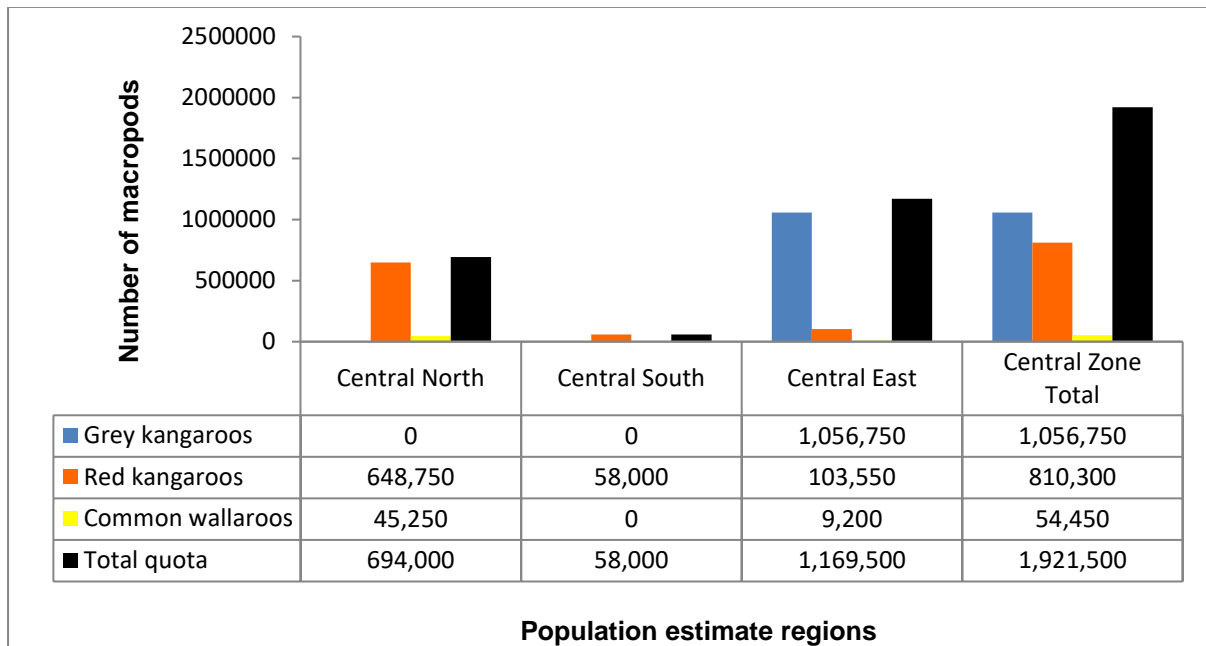
The estimated populations for eastern grey kangaroos in 2019 for the central north and south is below 2 SDs as is the estimated population for common wallaroos in the central south. Consistent with the Wildlife Trade Management Plan for Export—Commercially Harvested Macropods 2018–22 there will be no harvest quotas for these species in these regions in 2020 (figure 12).

**Table 2. Calculated trigger points for 2020 and the estimated populations of commercially harvested macropod species in each region for 2019. Note estimates in red signify a trigger point has been reached**

Species	Population estimate region	2019 estimated population	2020 1.5 SD trigger point	2020 2 SD trigger point
Red kangaroo	Central North	3,243,700	1,842,640	1,627,374
	Central South	580,100	665,524	536,585
	Central East	517,650	98,962	74,656
	Eastern	211,250	74,411	63,037
	Western	434,400	192,156	154,052
Eastern grey kangaroo	Central North	754,400	1,113,681	898,800
	Central South	342,000	723,087	560,441
	Central East	7,045,100	2,490,492	2,097,913
	Eastern	6,397,900	1,209,964	918,436
	Western	13,800	NA	NA
Common wallaroo	Central North	603,300	718,661	528,619
	Central South	89,950	150,565	107,056
	Central East	61,300	29,715	22,773
	Eastern	1,670,800	196,359	142,836
	Western	321,350	22,892	13,686

Note: There is no quota set for eastern grey kangaroos in the western region.

**Figure 12. Detail of the calculated harvest quotas for 2020 in the central zone including reductions due to population estimates being below trigger points**





## Comparison between 2018 and 2019 population estimates

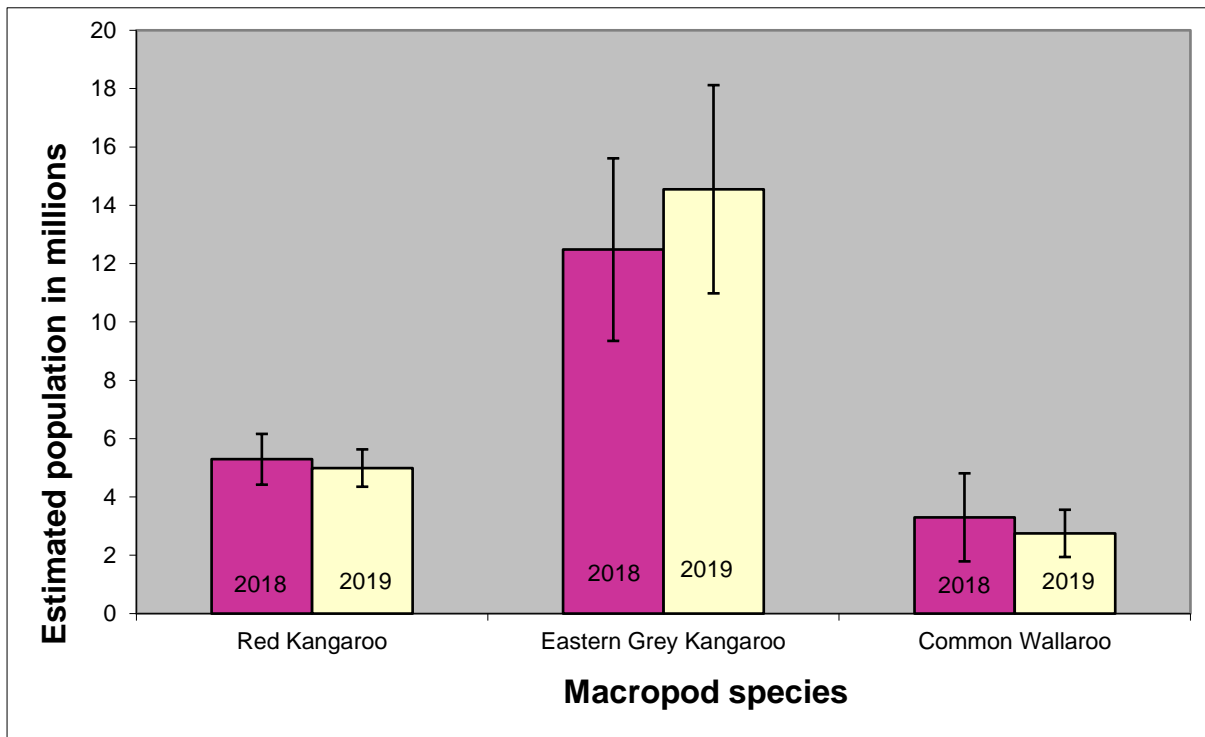
The total population estimates, combined across all three harvest zones, for red kangaroos and common wallaroos have declined in 2019 compared to 2018. By contrast the total population estimate for eastern grey kangaroos has increased over the same period (figure 13). However the total population estimates across all harvest zones does not reflect the regional variation that was pronounced in 2019 (table 3).

Since regionalisation of the Queensland commercial macropod harvest was introduced in 2003 an estimate of macropod population size in the eastern and western zones has been made. The model used to estimate these populations is based on a small sample area and the reduced sampling effort is reflected in a conservative quota (figure 16). This model was updated in 2012 to incorporate almost a decade of survey data and to generate trigger points for the commercial quota allocation.

All three harvest species decreased in the central harvest zone in 2019 whilst all species increased in the eastern harvest zone (figure 14). The aerial survey blocks in the western harvest zone were not surveyed in 2019 and this is reflected in no change to the population estimates for this region.

No quota will be proposed for eastern grey kangaroos in the western zone because the population size in this harvest zone, despite the observed recent increase, remains small and at the geographic edge of this species distribution (figure 15 and figure 16).

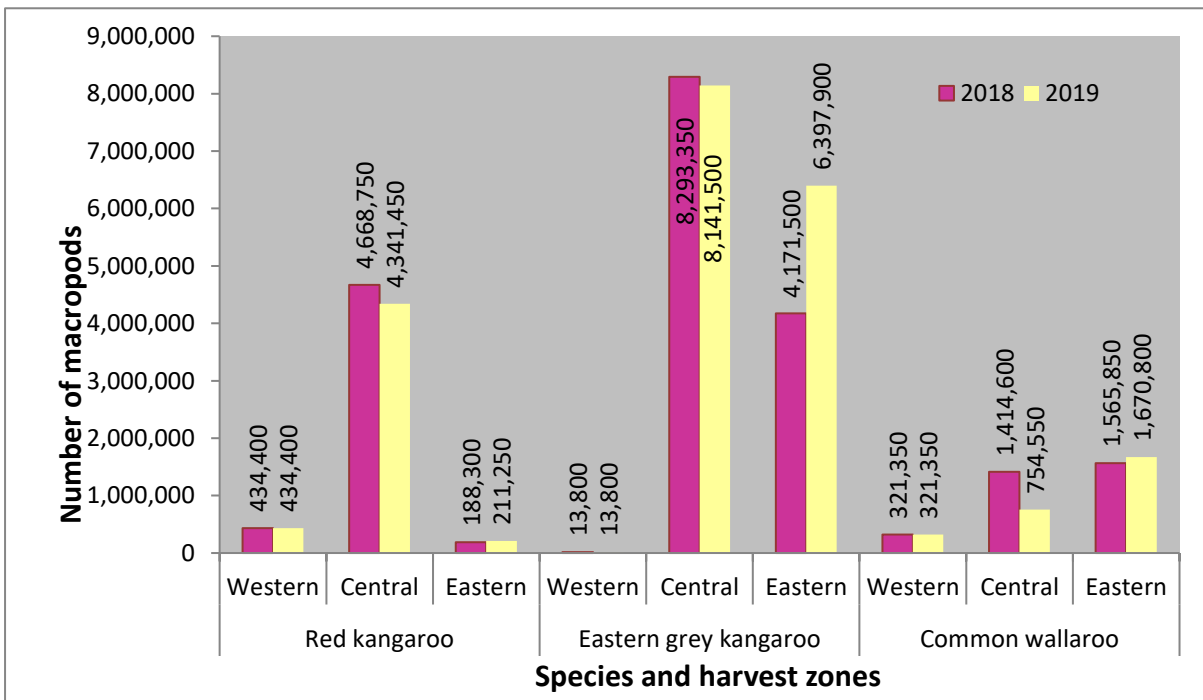
**Figure 13. Comparison of overall macropod populations in the commercial harvest zones 2018 and 2019 (with one standard error)**



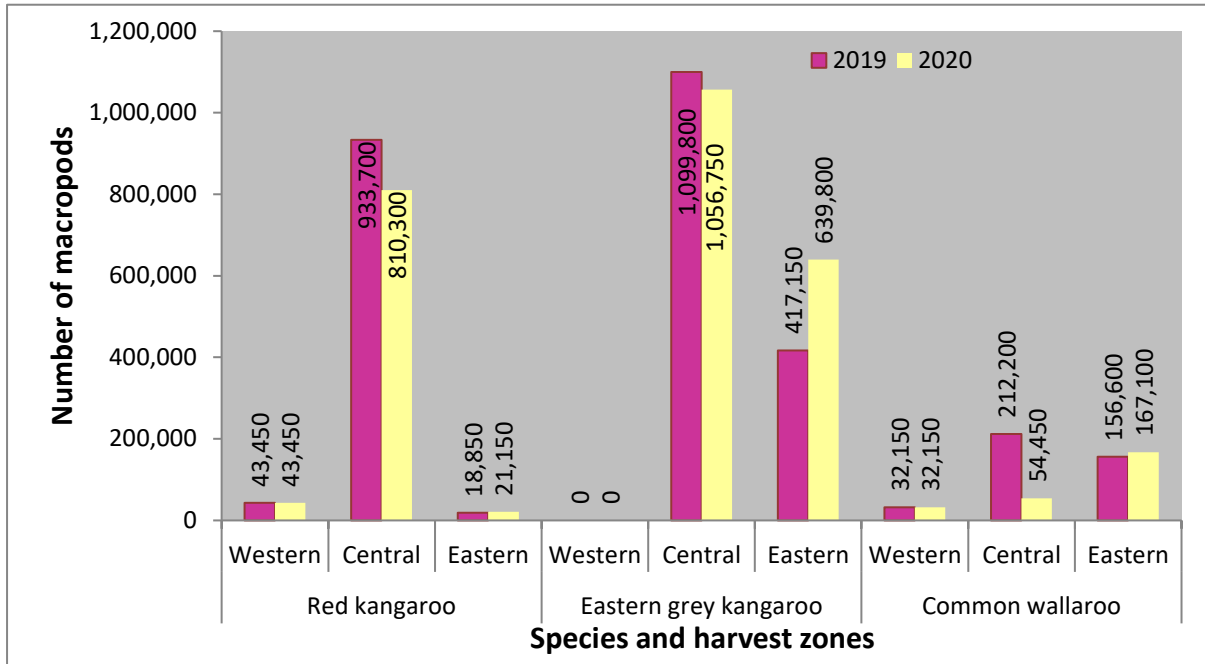
**Table 3. Comparison between 2018 and 2019 macropod population estimates**

Species	Harvest zone	2018 population estimate (rounded to the nearest 50)	2019 population estimate (rounded to the nearest 50)
Red kangaroo	Central north	3,061,850	3,243,700
	Central south	1,256,850	580,100
	Central east	350,050	517,650
	Eastern	188,300	211,250
	Western	434,400	434,400
	Combined	5,291,450	4,987,100
Eastern grey kangaroo	Central north	1,169,410	754,400
	Central south	753,159	342,000
	Central east	6,370,804	7,045,100
	Eastern	4,171,500	6,397,900
	Western	13,800	13,800
	Combined	12,478,650	14,553,200
Common wallaroo	Central north	928,400	603,300
	Central south	383,400	89,950
	Central east	102,750	61,300
	Eastern	1,565,850	1,670,800
	Western	321,350	321,350
	Combined	3,301,800	2,746,700

**Figure 14. Comparison of macropod populations from 2018 to 2019 by species and zone**



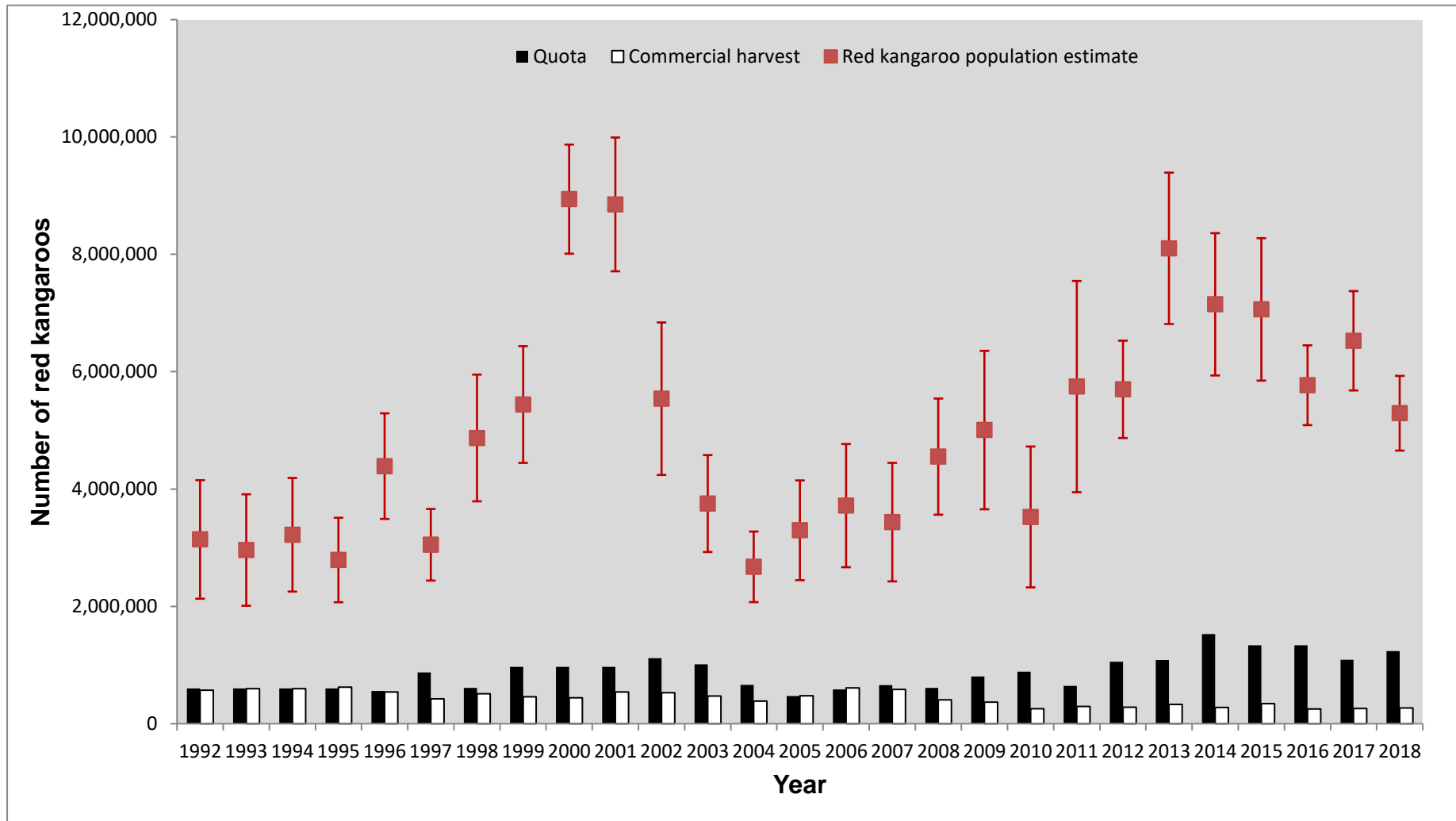
**Figure 15. Comparison of 2018 actual and 2019 proposed harvest quotas**



**Long-term quota and harvest trends**

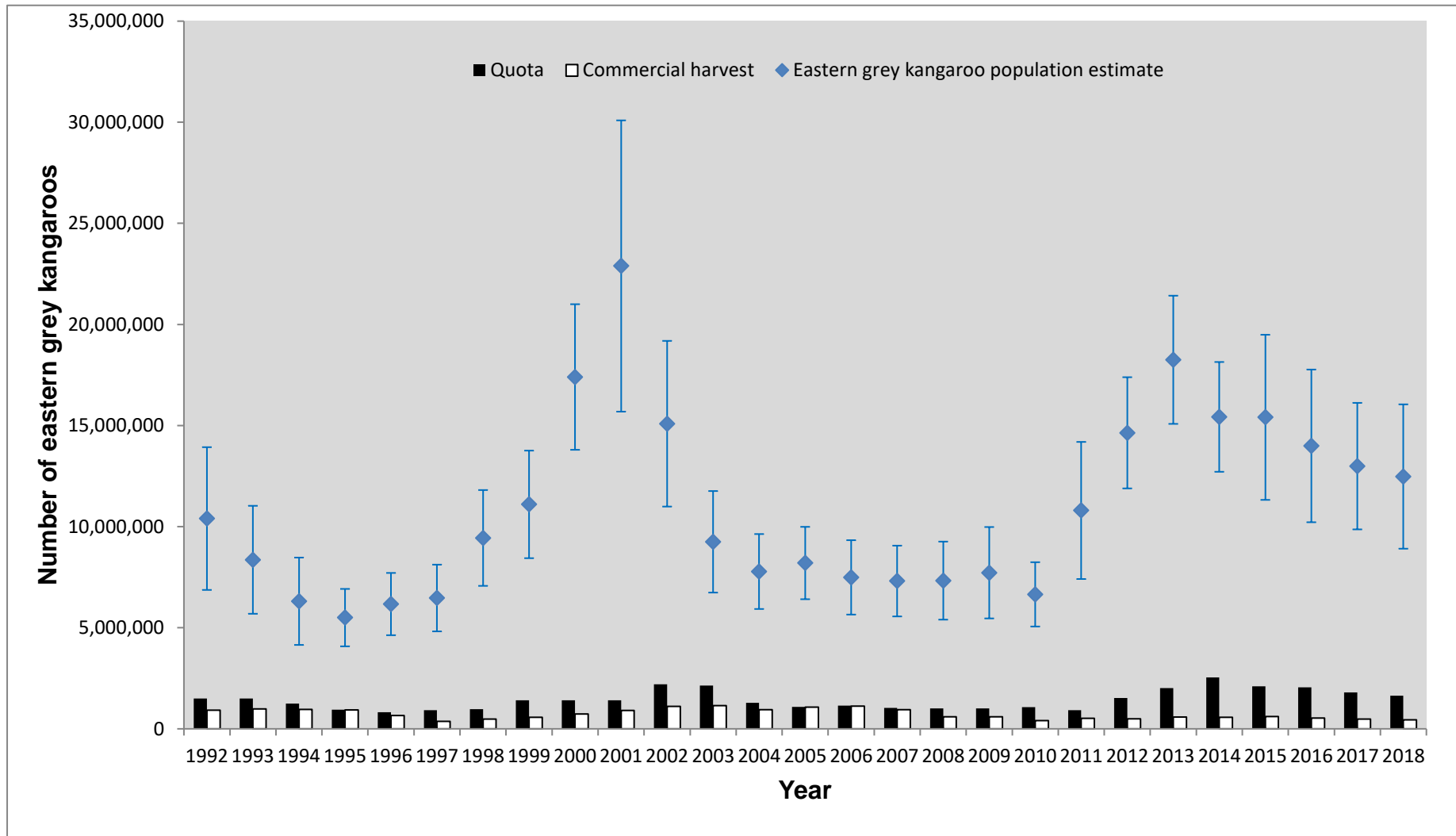
Figures 16 - 18 outline data on the three commercially harvested macropod species pertaining to estimated population, quota and harvest for the years 1992 to 2018. Please note that population estimates are based on aerial surveys conducted in the previous year to the quota and harvest. Combined population estimates, quota and harvest data have been used for the period post-regionalisation in 2003, to enable comparison with data collated prior to this period.

Figure 16. Long-term population estimates ( $\pm$  one standard error), quota and harvest data for the red kangaroo in Queensland



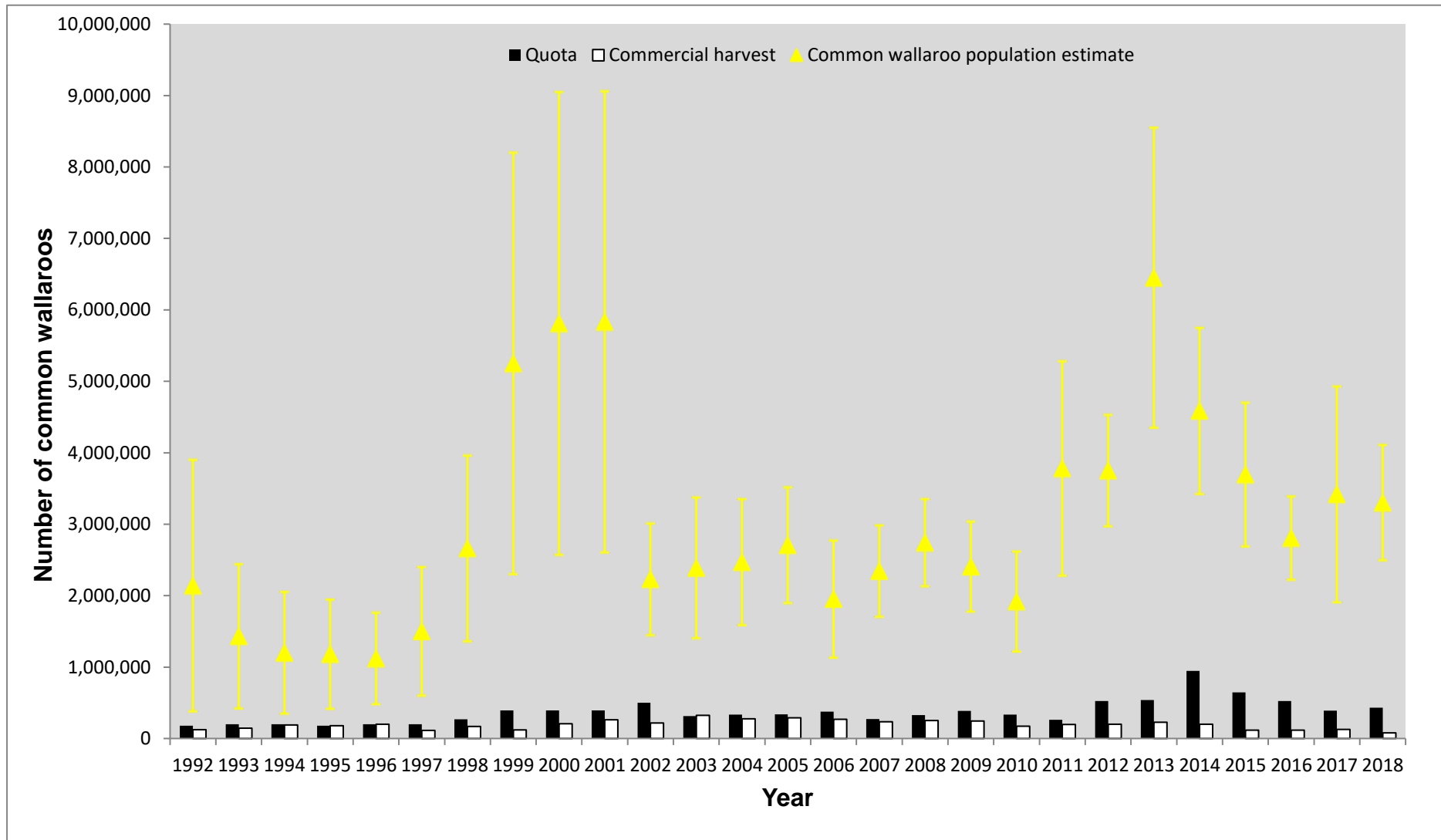
Note: population estimates are based on aerial surveys conducted the year before the harvest was taken.

Figure 17. Long-term population estimates ( $\pm$  one standard error), quota and harvest data for the eastern grey kangaroo in Queensland



Note: population estimates are based on aerial surveys conducted the year before the harvest was taken.

Figure 18. Long-term population estimates ( $\pm$  one standard error), quota and harvest data for the common wallaroo in Queensland



Note: population estimates are based on aerial surveys conducted the year before the harvest was taken.

As previously outlined, there has been no consistent decline in the populations of the three commercially harvested species since 1992 (figures 16 to 18). Of these species, the eastern grey kangaroo is consistently most abundant across the harvest zones, followed by the red kangaroo. Common wallaroos are the least numerous. Population estimates for all three species are in excess of one million across the harvest zones.

As quotas are set as a constant proportion of the populations, they fluctuate as population estimates fluctuate (figures 16 to 18). However, numerous factors influence harvest rates for commercial macropods. These include population levels, market forces, environmental conditions and access by harvesters. As a consequence, there is no clear pattern or trend in the proportion of the quota harvested since 1992.

## Review of the 2018 harvest

Dealer returns for the year 2018 (entered up to 11 February 2019) indicate that there were 795,747 macropods taken in Queensland, which represents 24% of the overall combined quota. Of the animals harvested, there were 268,571 red kangaroos, 447,936 eastern grey kangaroos and 79,240 common wallaroos harvested (table 4). Quotas for individual species in each harvest zone were not exceeded in 2018. The maximum commercial take as a percentage of the approved quotas was 31.9% for eastern grey kangaroos and 27.3% for common wallaroos both in the central zone (tables 4 to 7).

**Table 4. Total harvest in 2018**

Species	Population estimate 2017	Quota 2018	Harvest take 2018	% quota used 2018	% population harvested 2018
Red kangaroo	6,526,700	1,239,350	268,571	21.7%	4.1%
Eastern grey kangaroo	12,992,150	1,643,400	447,936	27.3%	3.4%
Common wallaroo	3,417,100	431,250	79,240	18.4%	2.3%
Total	22,935,950	3,314,000	795,747	24%	3.5%

*Note: population estimates are based on aerial surveys conducted in 2017, which were used to set the 2018 quota.*

**Table 5. Harvest of red kangaroos in 2018**

Zone	Population estimate 2017	Quota 2018	Harvest take 2018	% quota utilised 2018	% population harvested 2018
Central	5,866,450	1,173,300	253,577	21.6%	4.3%
Eastern	174,400	17,450	2,352	13.5%	1.3%
Western	485,850	48,600	12,642	26%	2.6%
Total	6,526,700	1,239,350	268,571	21.7%	4.1%

*Note: population estimates are based on aerial surveys conducted in 2017, which were used to set the 2018 quota.*

**Table 6. Harvest of eastern grey kangaroos in 2018**

Zone	Population estimate 2017	Quota 2018	Harvest take 2018	% quota utilised 2018	% population harvested 2018
Central	8,681,600	1,213,050	386,970	31.9%	4.5%
Eastern	4,303,300	430,350	60,966	14.2%	1.4%
Western	7,250	NA	NA	NA	NA
Total	12,992,150	1,643,400	447,936	27.3%	3.4%

*Note: population estimates are based on aerial surveys conducted in 2017, which were used to set the 2018 quota.*

**Table 7. Harvest of common wallaroos in 2018**

Zone	Population estimate 2017	Quota 2018	Harvest take 2018	% quota utilised 2018	% population harvested 2018
Central	1,790,200	268,550	73,407	27.3%	4.1%
Eastern	1,579,850	158,000	4,901	3.1%	0.3%
Western	47,050	4,700	932	19.8%	2%
Total	3,417,100	431,250	79,240	18.4%	2.3%

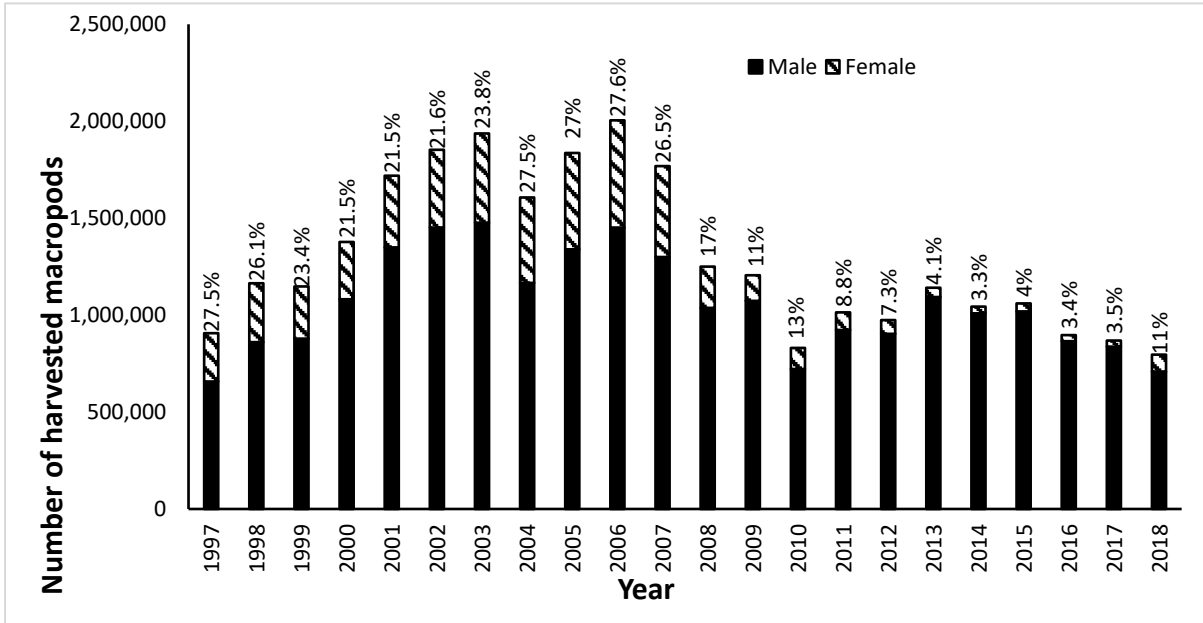
*Note: population estimates are based on aerial surveys conducted in 2017, which were used to set the 2018 quota.*

## Sex ratio by species and zone

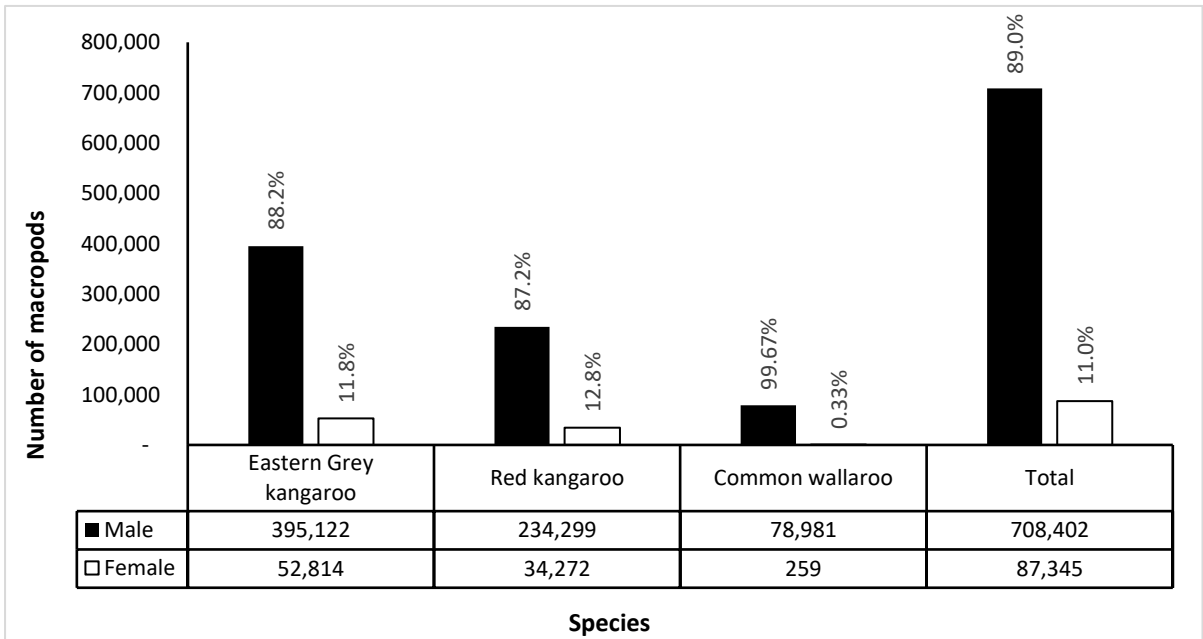
The commercial harvest of macropods is typically biased towards males (figure 19) as they are usually larger and heavier than females. In 2018, the total harvest for each species was biased towards males by 87% or greater. Data gathered throughout 2018 indicates 11% of the overall harvest was female (figure 20).



**Figure 19. Overall sex ratio from 2006 to 2018 (percentages rounded to the nearest whole number)**



**Figure 20. Proportion of 2018 harvest, male and female by species**



## Harvest update for 2019

The total number of tags issued as at 31 August 2019 was 685,100. A comparison of tag sales and harvest returns in relation to quotas in each zone is provided in table 8. The number of tags sold does not exceed the maximum quota for each species in each zone therefore it is not possible for the commercial harvest quotas to be over allocated. Given the low percentage of the quota that has currently been issued in tags, it is unlikely quotas will be met for any species in any zone during 2019. The 2019 harvest will be comprehensively reported on in the Queensland Commercial Macropod Management Program Annual Report 2019, due for release in March 2020.

**Table 8. Tags issued and reported harvest for 2019 at 31 August**

Species	Harvest zone	2019 sustainable use quota (rounded to the nearest 50)	Tags issued to 31 August 2019	Reported harvest to 31 August 2019
Red kangaroo	Central	933,700	189,950	117,735
	Eastern	18,850	4,500	1,151
	Western	43,450	8,950	5,720
Eastern grey kangaroo	Central	1,099,800	341,850	225,567
	Eastern	417,150	68,200	41,641
	Western	NA	NA	NA
Common wallaroo	Central	212,200	62,150	31,458
	Eastern	156,600	8,350	3,032
	Western	32,150	1,150	432

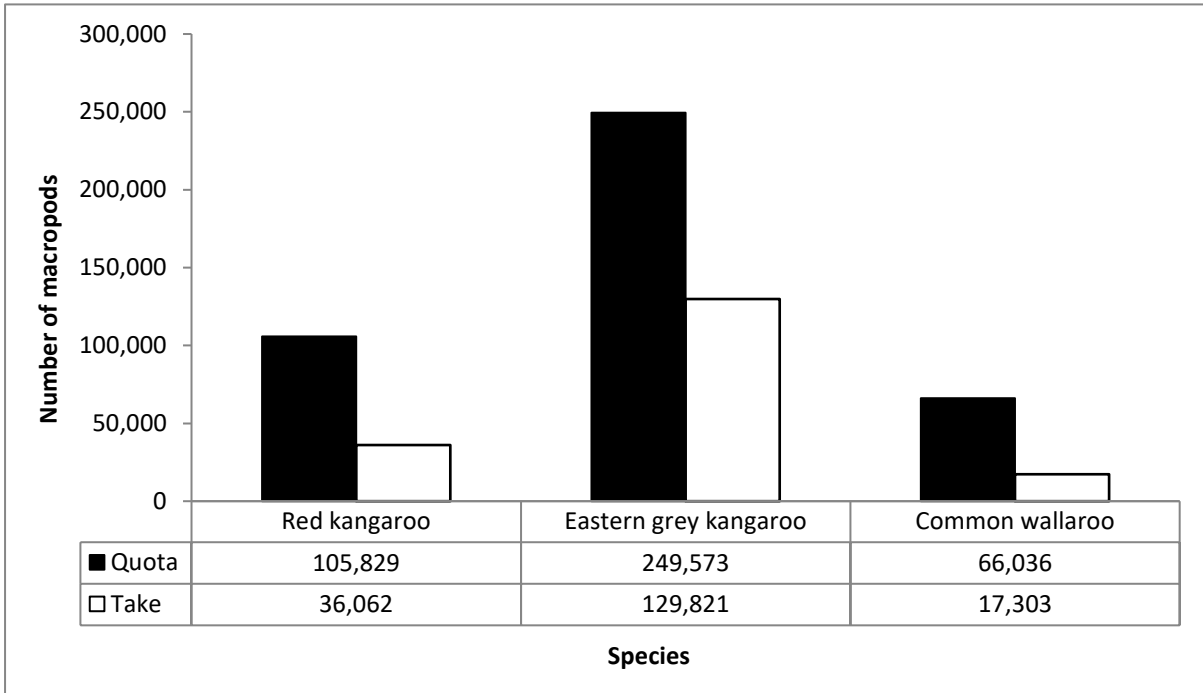
## The extent of non-commercial harvest mortality

There are many forms of macropod mortality outside of the commercial harvest. It is possible for DES to collect and report data on two forms of non-commercial harvest mortality which can be considered when determining commercial quotas. These include Damage Mitigation Permits (DMPs) and disease outbreak mortality.

### Damage mitigation permit

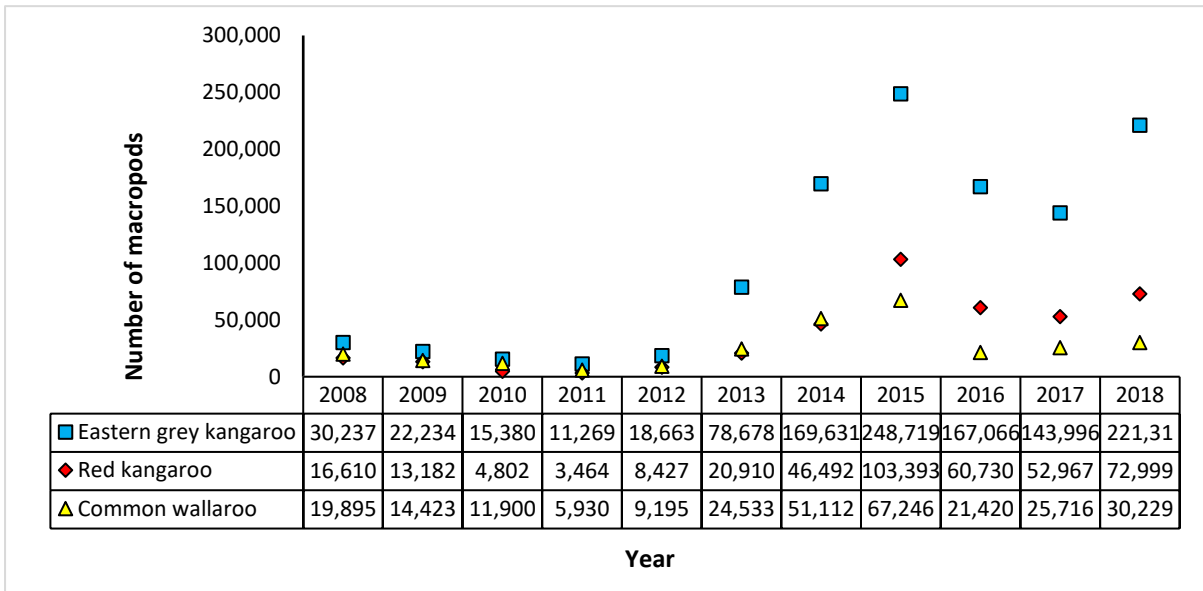
A Damage Mitigation Permit (DMP) may be granted where a protected animal (including commercially harvested macropods) is causing, or may cause, damage or loss; or represents a threat to human health or wellbeing. The total number of commercially harvested macropods allowed to be taken under these permits are limited to a maximum of 2% of the estimated population for each species. All DMP permits state that macropods must be taken in a way specified in the National Code of Practice for the Humane Shooting of Kangaroos and Wallabies for Non-commercial Purposes. Uptake of DMPs in 2019 is below the available quota (figure 21) and has fluctuated over the last 10 years (figure 22).

**Figure 21. DMP macropod quota and take for 2019 at 24 September**



Note: Figures are as recorded on 24 September 2019

**Figure 22. Macropods approved to be taken under a DMP 2008–2018**



### Disease outbreak mortality and its significance

No incidence of significant disease mortalities have been recorded for macropod populations in Queensland during 2018 or 2019. Most of the local government areas within the harvest zones have been drought declared for several years. These conditions reduce the available feed for all grazing species including macropods. The effect of prolonged drought is reflected in the decrease in estimated macropod populations in the central south and north population estimate regions.

### Proportion of the population not subject to harvesting

Commercial harvesting of macropods can only occur in three harvest zones in Queensland. Cape York Peninsula and the south east corner of Queensland are designated Non-harvest zones (figure 1). Within the three commercial harvest zones macropods cannot be harvested within National Parks, States Forests, Conservation Parks, Resources Reserves, Timber Reserves and Forest Reserves. Table 9 outlines the size of these land tenures within the commercial harvest zones.

Figures 23 to 25 show the general distribution of each of the commercially harvested macropods in relation to the population estimate regions. Red kangaroos are harvested in the western and central harvest zones and in the north of the eastern harvest zone (figure 23). Eastern grey kangaroos are only harvested in the eastern and central harvest zones (figure 24). Common wallaroos have the broadest distribution (figure 25) throughout Queensland and can be harvested in the central, eastern and western zones.

**Table 9. Area of land tenures within the Queensland commercial harvest zones where harvesting of macropods is not permitted (at 23 September 2019)**

	Western harvest zone km <sup>2</sup>	Central harvest zone km <sup>2</sup>	Eastern harvest zone km <sup>2</sup>	Total km <sup>2</sup>
National Park	21,448	11,781	16,844	50,073
State Forest	NA	10,788	16,407	27,195
Conservation Park	79	30	384	493
Resources Recserves	969	137	1,066	2,172
Forest Reserve	NA	NA	225	225
Timber Reserve	77	451	121	649
Total km <sup>2</sup>	22,573	23,187	35,047	80,807

Figure 23. Red kangaroo *Macropus rufus* distribution

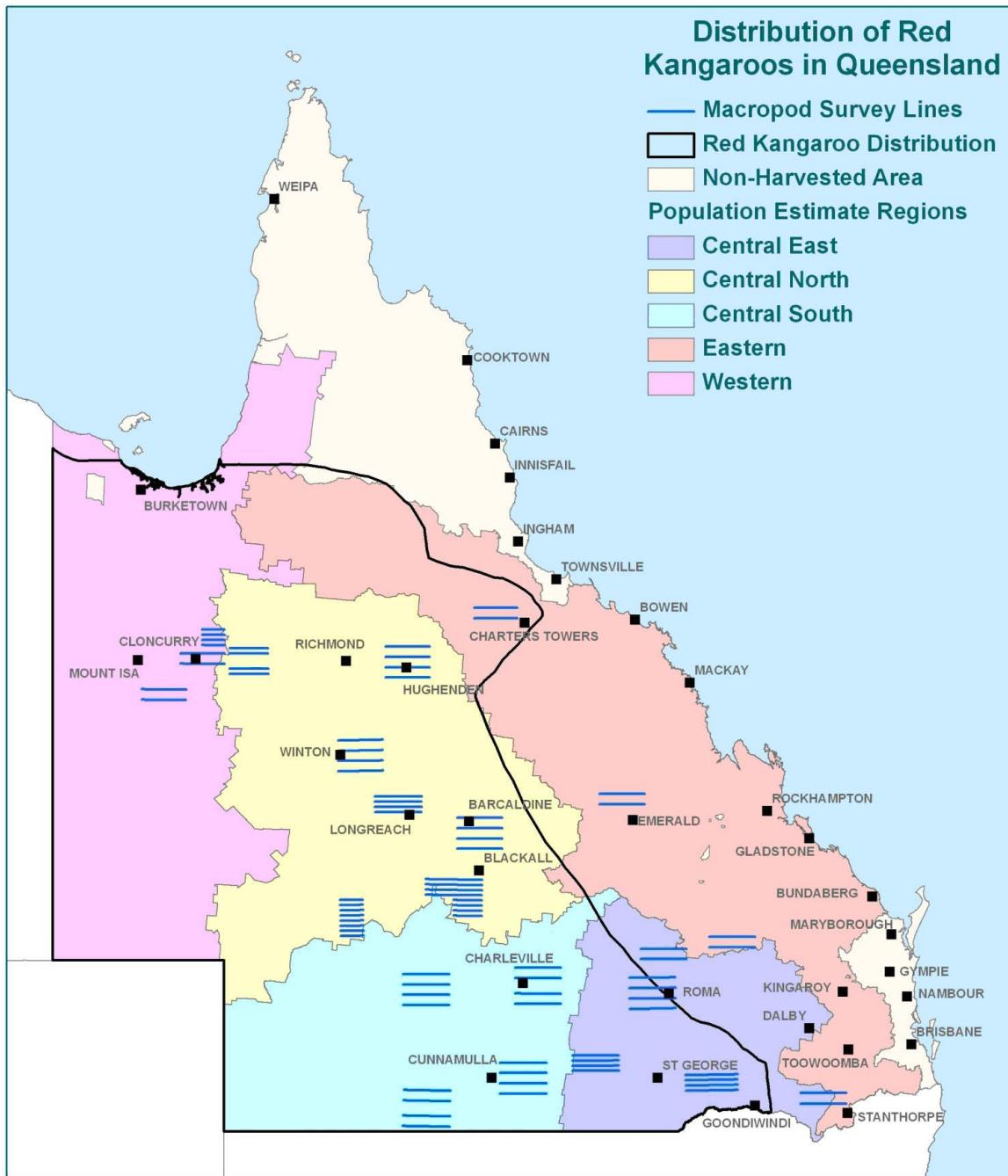


Figure 24. Eastern grey kangaroo *Macropus giganteus* distribution

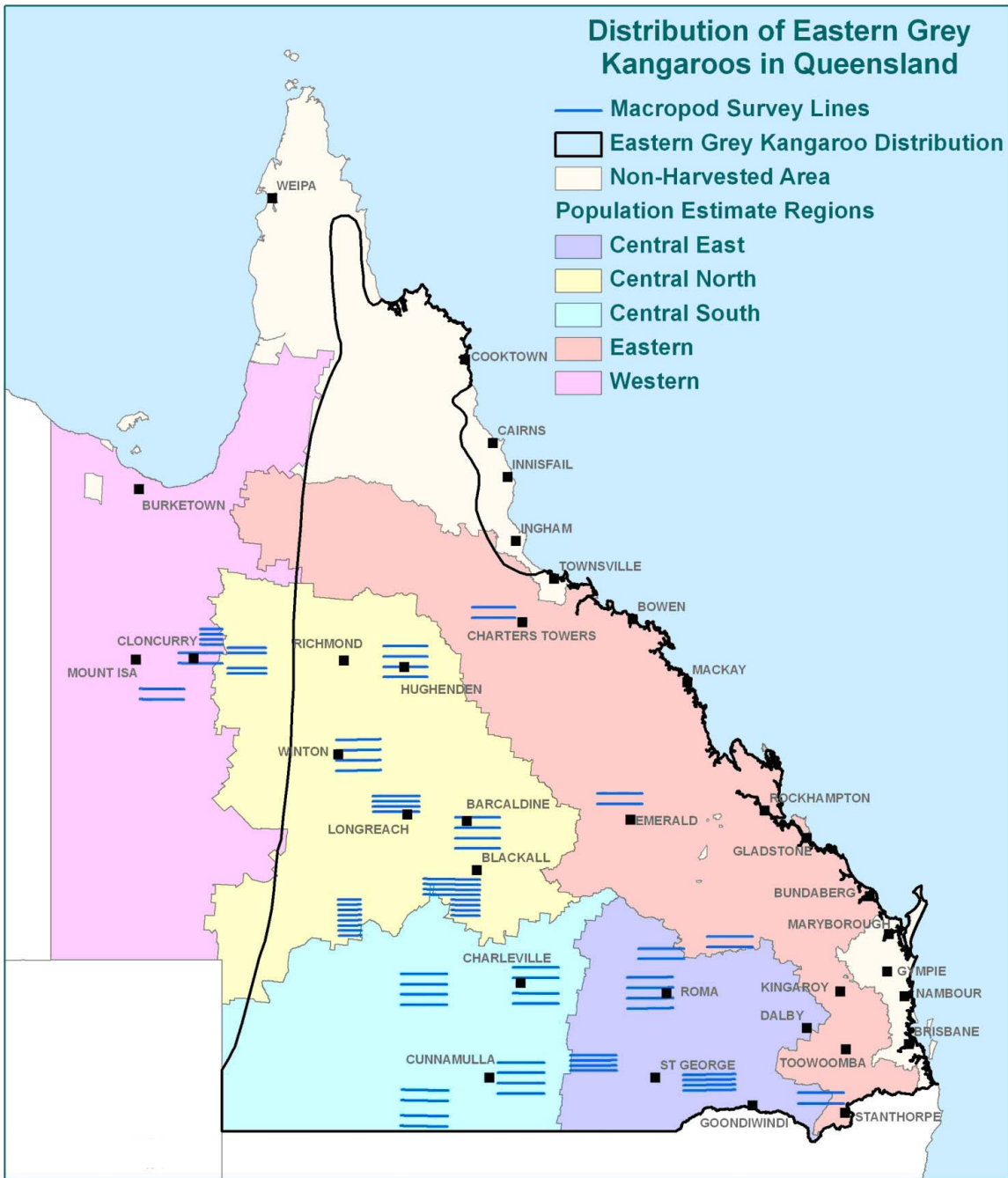
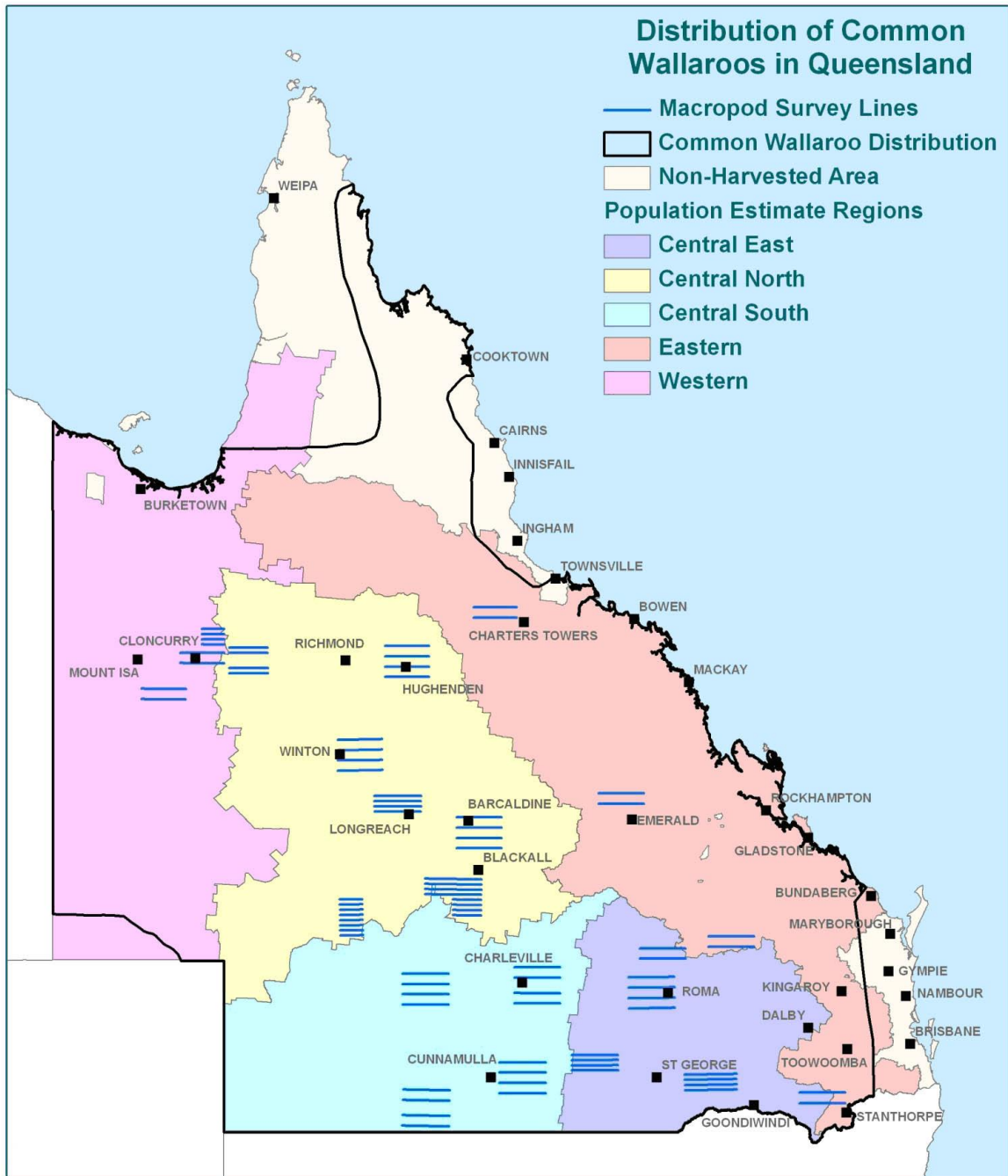


Figure 25. Common wallaroo (*Macropus robustus*) distribution



## Climate trends

2018 was the fifth warmest year on record for Queensland with extreme weather events including cyclone, floods, bushfires, heatwaves and drought occurring throughout the state. Overall rainfall totals were below average whilst the southern harvest areas were significantly below average (figure 27). Several areas of the state recorded their lowest rainfall records ever. By contrast areas of the western and central north harvest areas received significant rainfall associated with cyclones during the beginning of 2019.

Much of the commercial harvest zones have now been drought declared for seven consecutive years (figure 28). The population estimates for commercially harvested macropod species decreased in the central north and south regions as a consequence. Five of the commercial harvest quotas for 2020 have been affected by this decrease as they were below a predetermined trigger point for the harvest season.

Despite the ongoing drought conditions sufficient rainfall occurred in some parts of the harvest zones over the last 12 months to produce feed for macropods particularly in the eastern regions. Population estimates from this area of the state accounts for the overall population total being greater than 2018. Given the continued dry conditions the potential exists for macropod densities to decrease further like they did in 2002 (figure 26) across some regions of the harvest zones.

**Figure 26. Estimated macropod populations plotted with annual rainfall totals from Queensland from 1992 to 2019**

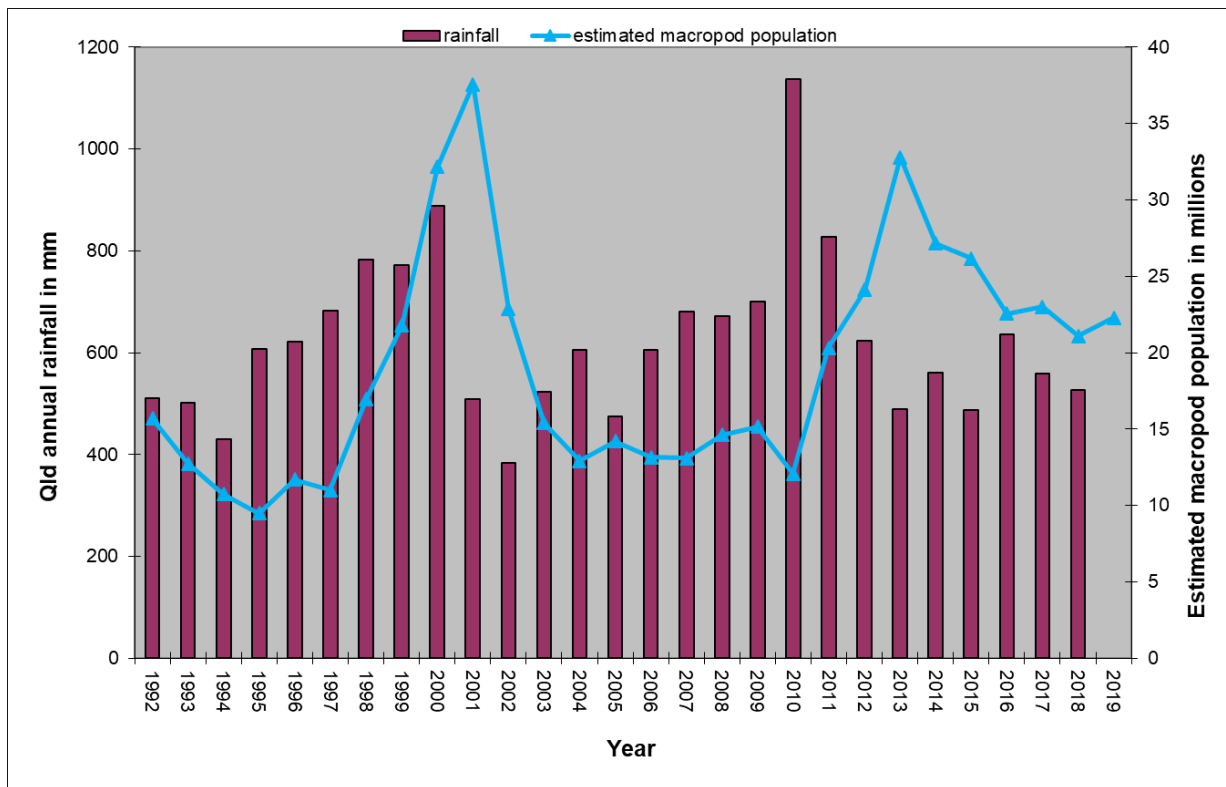




Figure 27. Queensland rainfall totals (mm) from 1 September 2018 to 31 August 2019

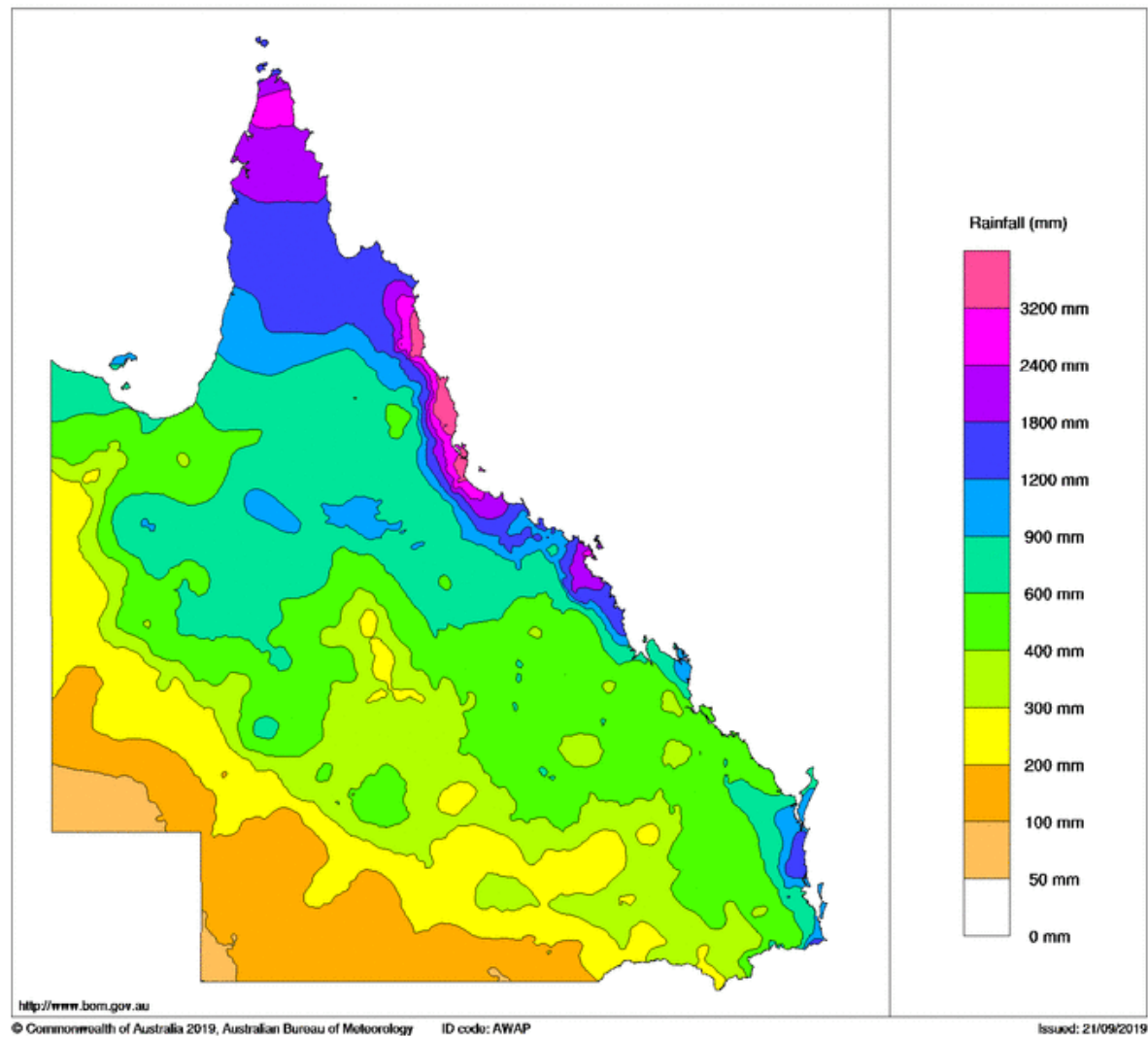
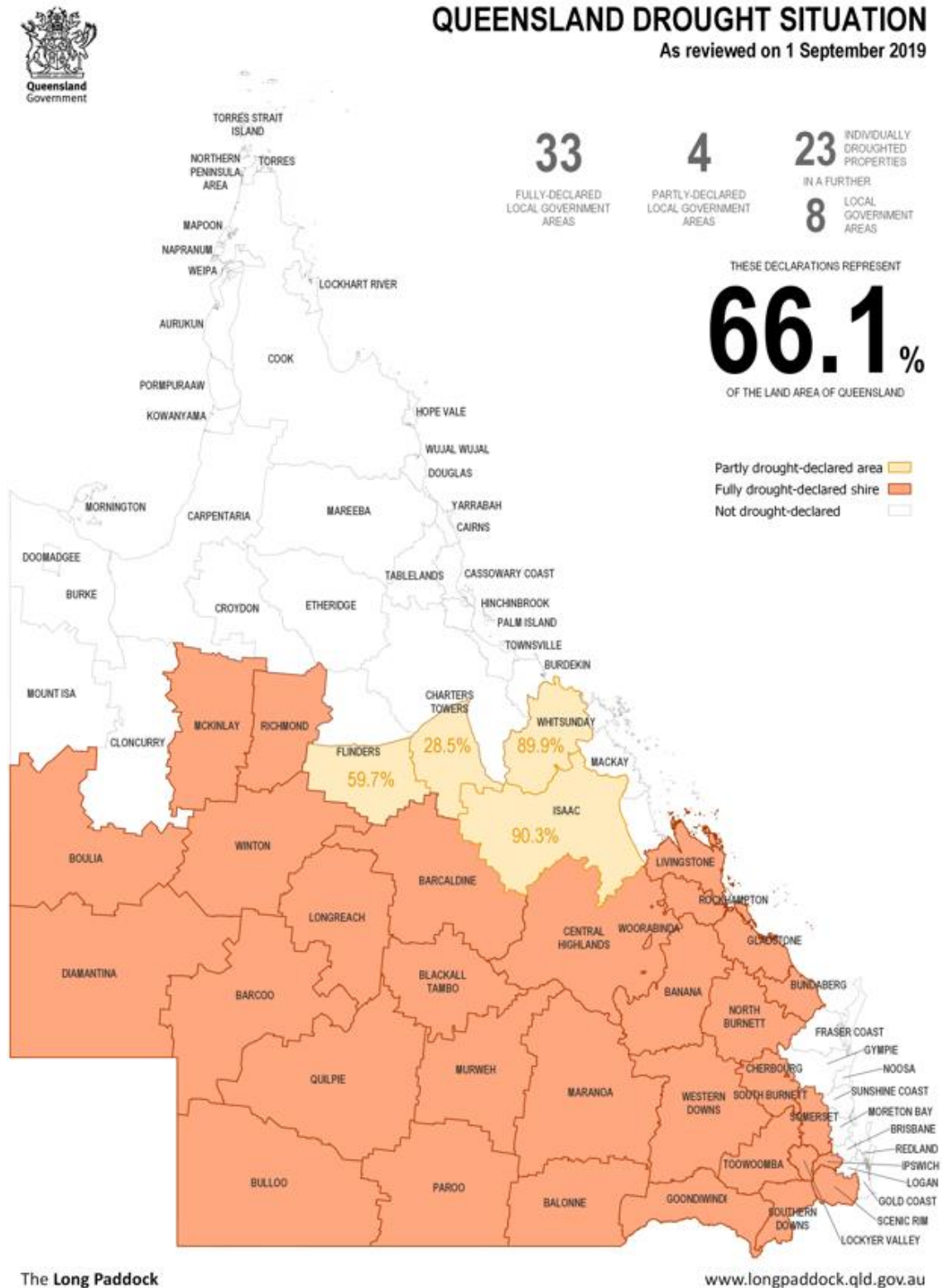


Figure 28. Queensland drought declarations at 1 September 2019



## Summary and conclusion

The proposed quotas for the 2020 commercial macropod harvest in Queensland have been formulated by following an established methodology, which is largely based on constant proportions of population estimates and monitoring of long-term population trends. Population estimates are derived from representative aerial surveys across the harvest zones that are informed by the best available science.

Long-term trend data relating to population size since 1992, when Queensland began an annual program of helicopter surveys, demonstrates there has been no consistent increase or decline in the populations of red kangaroos, eastern grey kangaroos or common wallaroos in Queensland. However, populations do fluctuate over time. Population estimates indicate that more than 1 million macropods of each species occur in the harvest areas. Thus, current harvest rates can be viewed as not having a long-term detrimental impact on populations.

Since regionalisation of the Queensland commercial macropod harvest was introduced in 2003, an estimate of macropod population size in the eastern and western zones has been made. The model used to estimate these populations is based on a small sample area and the reduced sampling effort is reflected in a conservative quota. This model was updated in 2012 to incorporate almost a decade of survey data and to generate trigger points for the commercial quota allocation. The population estimates in the eastern and western zones are a function of both the new model and the survey data for 2019. As there were no aerial surveys in the western zone in 2019 there is no change to the population estimates from 2018.

Population estimates have decreased marginally for eastern grey kangaroos in the central zone but increased in the eastern zone in 2019. In the central zone north and central zone south the eastern grey population estimate is below a predetermined trigger point and there is no quota for this species in these regions in 2020.

The red kangaroo population estimate for the central zone decreased slightly overall but significantly in the central south where it is below a predetermined trigger point and the harvest quota is halved for 2020. The population estimate increased marginally for red kangaroos in the eastern zone.

Common wallaroo population estimates decreased in the central zone but increased slightly in the eastern zone. Decreases in the central north and south population estimate regions are below predetermined trigger points. There is no quota for this species in the central south and a reduced quota in the central north regions. Overall combined quotas for all three species declined across the state.

For the 2018 commercial harvest period no quotas were exceeded, with the maximum percentage of quota utilised, being 31.9% for eastern kangaroos and 27.3% common wallaroo both in the central zone. Sex ratios from harvest data continue to be biased towards males with the overall percentage of females harvested below 12%. Thus, the last completed harvest period provides no indication of adverse pressure on populations that would influence proposed quotas.

For the 2019 harvest period as at 31 August, tag sales are well below quota for all species in all zones. It is therefore unlikely that quotas will be met for any species in any zone in 2019.

Usage of DMPs in 2018 were below the 2% of the population estimate quota for all species for all zones. The current percentages for usage of DMP quotas for 2019 are also below the quota limit of 2%.

The three commercially harvested macropod species are protected from harvesting within the harvest area through national parks and state forests. These 'refuges' occur in patches throughout the distributional ranges of all three species. Macropods are further protected from harvest in Queensland within the non-harvest zones.

Overall numbers of commercially harvested macropods in Queensland harvest zones have remained relatively stable over the past 12 months although significant declines were observed in the central north and south. Much of the harvest zones remain drought declared as many of them have for the past seven years. Should the widespread dry conditions continue throughout the state it is possible that observed macropod numbers will decrease in 2020.

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## Appendixes

### Appendix 1 Summary of the methodology for population monitoring and quota derivation for Queensland

#### Aerial surveys

Since 1992, the Queensland Government has conducted an annual program of aerial surveys by helicopter to directly monitor populations of the three large macropod species covered by the Wildlife Trade Management Plan for Export—Commercially Harvested Macropods 2018–2022. This method employs line transect methodology (Buckland et al. 1993), which is significantly more robust to variations in sightability than standard fixed-wing methods and provides more accurate and precise population estimates (Clancy et al. 1997). A detailed description of the methodology employed in these surveys is provided in Clancy et al. (1997).

Surveys are conducted over 22 fixed monitor blocks, covering an area of 136,000km<sup>2</sup> (figure 1) or 25% of the original fixed-wing survey area sampled by the Australian National Parks and Wildlife Service (ANPWS) between 1984 and 1995. In each helicopter survey block, between two to eight east-west running 50–90km transect lines have been placed systematically 10km apart. Sampling intensity within each block is approximately 2.5%.

The placement of the original 10 of the 22 survey blocks used in this monitoring program was designed to provide appropriate coverage of representative densities of macropods over the core harvest area of 630,000km<sup>2</sup> (Pople et al. 1998). In response to the introduction of regional management to Queensland in 2003, a further 12 survey blocks were added to provide broader coverage of the entire harvest area and to ensure all bioregions were sampled. Placement of these new survey blocks was optimised using fixed-wing survey data collected across the harvest zone during 2001. These surveys provided data to reassess the representativeness of the existing helicopter monitor blocks and to investigate alternative scenarios for future survey design. Analysis of these data in combination with harvest data has led to improved stratification of the survey area and hence increased the power to extrapolate data from survey monitor blocks to other regions in the harvest zone. These investigations were conducted in collaboration with the University of Queensland as part of the Australian Research Council (ARC) funded ROOSPIRT Linkage project (Pople et al. 2006).

No correction factors are applied to surveys of eastern grey and red kangaroos as comparisons of ground and aerial surveys conducted by Clancy et al. (1997) concluded that the helicopter line transect technique is both accurate and precise in determining population densities for both these species over a range of habitats, seasons and densities. Whilst the method is less accurate for common wallaroos there is still a close correlation between the results of helicopter surveys and those of ground counts. Estimates derived from ground surveys for common wallaroo density are approximately 1.9–2.0 times that recorded for helicopter surveys. Accordingly, since 1998, the Queensland Government has applied a conservative correction factor of 1.2 to the wallaroo density estimates derived from helicopter surveys. In 2011, this conservative correction factor has been increased to 1.85 in line with that used in New South Wales.

#### Frequency and coverage of aerial surveys

Due to the costs and logistics associated with conducting helicopter aerial surveys over 22 monitor blocks, not all monitor blocks are surveyed on an annual basis. To ensure adequate coverage of the harvest area in Queensland and to enable accurate tracking of population trends, all blocks are surveyed at least once every two years. Decisions on the frequency and coverage of the aerial survey program were based on analyses completed by the University of Queensland as part of the ARC funded ROOSPIRT Linkage project. This redesign of the monitoring program also sought to introduce a level of bioregional stratification to provide for improved potential to monitor populations at that scale as a possible prelude to the introduction of further harvest zones in Queensland.

The main feature of the current monitoring program is the establishment of pairs of closely correlated monitor blocks within each of the bioregions. The process of pairing monitor blocks was based on linear modelling that examined the relationships between macropod population densities, rainfall and harvest off-take for all monitoring blocks within each bioregion. The process of pairing blocks and the development and refinement of these linear models enables the frequency of monitoring of blocks to

be reduced without compromising the efficacy of the monitoring program. Using this approach monitoring blocks with bioregional pairs will be monitored on a rotating basis with each block being subject to surveys every two years.

Linear models utilising data on rainfall, harvest off-take and population rates of increase for the monitored block within a pair are then used to predict population changes in the unmonitored block of the pair. The models are refined annually as further data is collated and enhancements are made to the modelling process. In the situation where there is only a single monitor block within a bioregion or where a monitor block samples a unique macropod community, such as the Blackall block which contains moderate densities of all three species and particularly high densities of common wallaroo, these blocks are sampled annually. In order to calibrate the models and to provide a benchmark of the states' macropod populations, a survey of the complete set of 22 monitor blocks will be completed every five years. The table below summarises the current stratification, pairing and sampling frequency for all 22 of the fixed aerial survey monitor blocks used in the Queensland monitoring program.

Due to the significantly lower macropod densities and associated lower harvest densities recorded historically from the eastern and western harvest zones, these two zones are not surveyed with the same intensity as the central harvest zone. Within both the eastern and western harvest zones, population density estimates are based on helicopter aerial surveys of three monitor blocks established in 2004 and monitored on a two yearly rotation. The results are used in association with data derived from fixed-wing aerial surveys conducted over parts of these zones during 2001 to adjust approximations of the population rates of increase calculated by comparing fixed-wing survey data from 1981–82, 1984 and 2001 with the most recent helicopter aerial survey data and past ground surveys completed in equivalent habitats.

### **Population estimation**

Population estimates are calculated by extrapolating the mean monitor block densities to a larger harvest area of 1,097,410km<sup>2</sup> for eastern grey kangaroos, 1,105,587km<sup>2</sup> for red kangaroos and 1,104,222km<sup>2</sup> for common wallaroos. To improve precision and remove bias in density estimates used in the calculation of population sizes and their standard errors, the data collected since 2003 have been stratified (Buckland et al. 1993) by observer and bioregion. Helicopter surveys are conducted with two observers, which results in twice the sampling intensity as one observer. To account for differences between observers, the data was post-sampling stratified by applying 'goodness of fit' models to the data from each observer using the computer program 'Distance' (Buckland et al. 1993). 'Distance' was then used to obtain an overall macropod density estimate for the survey block. The survey blocks were stratified by bioregion, and their weighted (by sampling intensity) density estimates used to calculate population sizes for the harvest area according to the methods and calculations outlined in Clancy et al. 1994 and 1997. For all species, stratification of the data by observer and bioregion has not significantly changed the population size estimate but has reduced the standard error associated with that estimate. However, with common wallaroos the standard errors associated with the population estimate remain high due to the high variability in densities across the state.

### **Quota derivation**

Sustainable harvest quotas are calculated using a fixed proportion of the estimated macropod populations within the Queensland harvest area. The proportions used vary between species and are adjusted across the harvest zones in relation to the margins of error present in population estimates. The maximum proportions used for each species are 15% of populations for eastern grey kangaroos and common wallaroos and 20% of the population for red kangaroos. These maximum proportions are only applied to populations within the central harvest zone where survey effort is greatest and hence confidence limits for population estimates are within acceptable limits. In both the eastern and western harvest zones more conservative harvest proportions of 10% for all three species are applied. These sustainable-use harvest proportions are based on research and modelling undertaken by Caughley et al. (1987) and Hacker et al. (2002) and are currently accepted by the scientific community, the Queensland Department of Environment and Science and the Commonwealth Department of Sustainability, Environment, Water, Population and Communities for determining state quota limits.

**Stratification, pairing and sampling frequency for fixed aerial survey monitor blocks in Queensland**

Harvest zone	Bioregion	Monitor block	Years 1 and 3	Years 2 and 4	Year 5
Central	Brigalow Belt South	Injune	✓		✓
		Taroom		✓	✓
		Westmar	✓		✓
		Roma		✓	✓
	Mulga Lands	Charleville	✓	✓	✓
		Cunnamulla	✓		✓
		Bollon		✓	✓
		Quilpie	✓		✓
		Hungerford		✓	✓
	Mitchell Grass Down	Blackall	✓	✓	✓
		Winton	✓		✓
		Longreach		✓	✓
		Julia Creek	✓		✓
		Hughenden		✓	✓
	Desert Uplands	Barcaldine	✓	✓	✓
	Channel Country	Windorah	✓	✓	✓
	Eastern	Not stratified	Inglewood		✓
Emerald				✓	✓
Charters Towers				✓	✓
Western	Not stratified	Duchess	✓		✓
		Cloncurry	✓		✓

**Appendix 2. Densities per km<sup>2</sup> of the commercially harvested macropod species 2004–2019**

Eastern grey kangaroo																
Block	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Barcaldine	20.61	13.17	22.77	17.65	23.15	29.50	12.87	23.92	24.09	44.10	24.96	19.31	14.71	13.65	15.19	5.03
Blackall	7.57	7.10	6.22	7.51	8.28	11.19	7.08	6.08	9.87	19.41	10.59	8.75	5.29	4.97	3.16	1.64
Bollon	25.66	25.31		30.53		31.74	30.14		47.2		32.01	24.95		27.58		29.50
Charleville	17.51	19.91	15.96	12.05	11.20	12.95	12.23	28.11	25.12	26.77	11.77	8.4	10.47	9.32	5.25	2.13
Charters		1.63		5.02		5.33	5.57		3.37		3.14	2.01		1.53		1.32
Cloncurry	0.01		0.16		0.02		0.21	0.012		0.07		0.00	0.06		0.12	
Cunnamulla	13.20		9.97		11.44		11.64	32.82		41.04		35.87	18.73		9.15	5.10
Duchess	0.00		0.00		0.00		0.00	0.00		0.00		0.00	0.00		0.00	
Emerald		3.95		3.41		4.05	5.04		2.75		7.01	5.29		7.88		7.67
Hughenden	0.77	0.58		1.16		0.97	0.79		0.53		1.17	1.41		1.01		1.43
Hungerford	1.16	1.10		0.77		0.94	0.65		2.20		4.00	3.79		3.36		0.13
Inglewood		8.72		18.62		9.75	12.33		29.10		32.73	49.88		42.02		66.87
Injune	13.53	18.85		18.62	6.82		16.60	17.75		31.32		22.52	40.62		25.97	
Julia Creek	1.08	0.87	1.05		0.76		0.28	0.28		0.84		0.84	0.2		0.49	
Longreach	9.05	8.48		6.63		6.61	6.13		18.07		20.17	5.25		3.85		4.67
Quilpie	1.86		0.97		1.42		2.79	1.57		3.61		4.65	2.66		0.87	0.34
Roma	25.05	24.98	25.46	25.12		23.43	19.30		27.16		40.56	32.23		31.74		39.34
Taroom	8.12	13.37		8.44		7.87	7.36		14.98		13.24	12.65		8.19		13.00
Westmar	25.53		23.17		21.18		22.08	37.25		62.54		77.9	66.07		82.67	
Windorah	1.58	2.69	1.14	1.39	2.39	1.26	0.86	2.68	1.24	1.80	0.79	1.02	2.13	1.34	0.29	0.10
Winton	4.86	2.98	3.74		4.78		2.43	3.57		6.61		5.79	4.46		5.11	



## 2020 Quota Submission for Commercially Harvested Macropods in Queensland

Red kangaroo																
Block	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Barcaldine	6.07	4.07	11.07	6.72	9.03	9.83	7.58	10.05	7.83	12.30	9.2	16.24	8.54	8.25	7.49	5.52
Blackall	3.99	3.29	4.55	3.78	6.45	7.24	4.70	12.37	14.17	17.47	10.35	11.58	9.69	8.52	7.89	8.78
Bollon	4.13	8.87		8.35		11.16	9.90		7.78		7.27	9.83		8.87		7.18
Charleville	4.55	5.48	7.36	9.57	7.58	8.47	6.46	14.69	5.53	7.03	4.97	5.06	6.32	3.75	4.06	3.72
Charters		0.02		0.05		0.00	0.70		0.24		0.21	0.62		0.59		0.28
Cloncurry	2.14		4.18		6.17		3.01	3.34		5.91		4.06	3.45		2.97	
Cunnamulla	3.54		4.59		9.02		10.65	18.27		28.76		27.29	16.54		6.94	5.56
Duchess	2.92		0.87		1.78		0.85	0.71		0.82		1.66	1.61		1.32	
Emerald		0.00		0.00		0.00	0.02		0.05		0.00	0.00		0.00		0.00
Hughenden	1.97	1.59		1.59		1.29	0.92		2.22		2.67	1.52		2.62		3.54
Hungerford	1.04	2.57		3.90		4.41	2.60		7.01		8.75	9.7		9.83		0.65
Inglewood		0.00		0.00		0.00	0.50		0.00		0.00	0.00		0.00		0.00
Injune	1.02	0.14	0.05		0.72		0.00	0.86		0.04		0.00	0.11		0.00	
Julia Creek	4.08	5.13	4.91		5.39		3.16	3.30		8.10		5.6	4.58		5.54	
Longreach	9.53	11.86		11.33		14.71	12.24		14.43		19.26	4.79		15.90		25.72
Quilpie	2.19		1.39		5.13		2.06	4.70		9.80		9.51	12.27		7.87	2.41
Roma	2.19	1.62	2.54	2.66		2.37	2.26		3.47		5.02	2.83		2.96		4.96
Taroom	0.02	0.37		0.00		0.00	0.00		0.00		0.00	0.00		0.00		0.00
Westmar	0.97		0.59		0.55		1.14	1.49		1.14		2.28	4.69		3.27	
Windorah	4.42	4.52	7.32	4.48	9.85	12.62	6.67	10.47	10.77	11.84	8.11	12.29	12.16	16.95	11.80	3.22
Winton	3.69	5.02	5.62		6.05		3.32	4.44		9.73		16.98	8.57		10.86	

## 2020 Quota Submission for Commercially Harvested Macropods in Queensland

Common wallaroo																
Block	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Barcaldine	6.59	12.30	8.63	16.42	19.98	16.20	5.52	8.306	5.53	9.02	4.69	6.79	4.89	3.57	3.57	0.87
Blackall	18.02	21.17	22.15	34.98	39.14	49.05	23.82	21.549	20.2	54.43	28.58	24.86	11.29	9.32	6.89	3.44
Bollon	4.72	2.64		1.55		1.67	0.36		2.44		0.7	0.31		2.38		1.01
Charleville	7.21	6.20	5.79	4.66	4.70	5.36	11.80	13.439	10.65	5.09	4.47	4.07	3.81	1.24	0.60	0.60
Charters		0.30		2.84		0.61	1.07		0.51		1.03	0.22		0.23		0.63
Cloncurry	0.00		0.30		0.64		0.51	0.260		0.14		0.02	0.21		1.32	
Cunnamulla	1.68		0.45		0.64		1.95	0.611		0.70		2.53	2.60		2.10	0.99
Duchess	0.57		0.11		1.69		0.74	0.093		1.16		0.00	0.00		0.26	
Emerald		0.02		0.00		0.78	0.02		0.33		0.19	0.32		0.25		0.25
Hughenden	1.65	1.28		2.28		0.24	0.41		0.94		0.93	0.22		1.59		0.55
Hungerford	1.19	0.36		0.24		0.48	0.25		0.47		1.27	1.93		2.33		0.08
Inglewood		3.08		4.03		0.34	1.01		1.22		3.18	3.42		11.16		11.60
Injune	0.01	2.30	1.34		0.91		4.05	0.00		0.63		0.84	0.60		0.33	
Julia Creek	2.74	0.00	0.04		0.11		0.01	0.00		0.00		0.00	0.03		0.00	
Longreach	17.96	21.57		18.59		12.69	9.18		17.77		15.67	8.84		4.17		6.05
Quilpie	5.41		0.78		3.36		2.69	3.007		5.58		7.51	3.42		3.76	0.45
Roma	1.35	3.74	2.49	2.08		1.16	3.45		0.87		1.01	0.75		1.45		1.15
Taroom	0.22	2.04		0.17		1.05	0.25		0.02		0.38	0.18		0.35		0.20
Westmar	0.74		0.02		0.13		0.30	0.00		0.01		0.00	0.28		0.54	
Windorah	2.14	2.30	1.81	2.72	3.03	3.07	2.42	3.185	3.32	5.29	2.82	1.46	4.86	4.12	2.47	0.46
Winton	1.73	1.78	1.70		3.14		0.96	4.191		6.35		0.76	1.14		1.30	