2016 Quota Submissions for Commercially Harvested Macropods in Queensland

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Executive summary

The commercial macropod harvest in Queensland is focused on three species (red kangaroo *Macropus rufus*, eastern grey kangaroo *Macropus giganteus*, 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 and 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 between 10% and 20% of the estimated population for each species in each zone, depending on survey intensity and the standard error associated with population estimates.

Population estimates for 2015 and proposed sustainable use quotas for the 2016 commercial harvest

Species	Harvest zone	2015 estimated population (rounded to the nearest 50)	2016 sustainable use quota (rounded to the nearest 50)	Proportion of population (% rounded to the nearest whole number)
Red kangaroo	Central	6,298,150	1,259,650	20
	Eastern	171,500	17,150	10
	Western	591,550	59,150	10
	Combined	7,061,200	1,335,950	19
Eastern grey kangaroo	Central	10,291,600	1,543,750	15
	Eastern	5,115,100	511,500	10
	Western	0	0	0
	Combined	15,406,700	2,055,250	13
Common wallaroo	Central	3,130,200	469,550	15
	Eastern	559,400	55,950	10
	Western	4,500	0	0
	Combined	3,694,100	525,500	14

The formation of quotas is informed by criteria including:

- 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.

This quota submission outlines in detail the aspects of these criteria that pertain to the 2016 proposed quota.

For 2015, aerial surveys were conducted at 21 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. Population estimates have increased marginally for red kangaroos in the central and eastern zones and decreased in the western zone. The eastern grey kangaroo population estimate for the central zone decreased but increased for the eastern zone. No eastern grey kangaroos were recorded in 2015 in the western zone which lies outside the established range of eastern grey kangaroos. Common wallaroo population estimates decreased in all zones. A significant decrease was observed in the western zone and no quota for this species in this zone is proposed for 2016. Overall combined totals for all three species declined marginally across the state.

Examination of long-term trends in population and block density estimates indicates that the 2015 estimates are within the realm of fluctuations in previous years. Estimates for all three commercially harvested species consistently number over 1,000,000 in Queensland.

In the 2014 harvest period, 20.8% of the commercial harvest quota was utilised, with the highest percentage of quota used being 24.8% for eastern grey kangaroos in the central zone. The overall harvest was male biased, with females comprising less than 4% of the overall harvest.

Figures available on 31 July 2015 show that 1% of the available quota for red kangaroos in the western zone had been harvested with 4% and 12% of the quota harvested in the eastern and central zones respectively. For eastern grey kangaroos, 15% and 5% of the quota was harvested in the central and eastern zones respectively. For common wallaroos, the highest percentage of quota harvested was 9% in the central zone, whilst only 3% of the quota was harvested in the eastern zone and 2% in the western zone. Given these figures, it is unlikely that quotas will be met for each species in each zone in 2015.

Non-commercial take under damage mitigation permits (DMPs) were below quota for the 2014 harvest period. This trend is likely to be repeated in 2015 although there has been a significant increase in the uptake of DMPs by landholders.

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 77,412km². Macropods are further protected from harvest in Queensland within the non-harvest zones. The total area of the non-harvest zones is 236,408km².

Annual rainfall across Queensland was drier than average during 2014 with many parts of the state drought declared throughout the year. Most of the eastern harvest zone is still drought declared whilst the entire central and western harvest zones are drought declared at 31 July 2015.

Contents

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 2013–2017
- *Nature Conservation Act 1992*
  - Nature Conservation (Administration) Regulation 2006
  - Nature Conservation (Wildlife Management) Regulation 2006
  - Nature Conservation (Wildlife) Regulation 2006
  - Nature Conservation (Macropod) Conservation Plan 2005
  - Nature Conservation (Macropod Harvest Period) Notice
- *Animal Care and Protection Act 2001*
- *Food Production (Safety) Act 2000.*

The Department of Environment and Heritage Protection (EHP) 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 2013–17, 'to provide for the sustainable use of macropod species covered by the plan, in accordance with the principles of ecologically sustainable development' (Anon 2012).

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 EHP 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 2013–17. Quotas are provided to the Commonwealth Minister for The Environment for endorsement.

Quotas in Queensland are set between 10% and 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 2016. Additionally, the submission outlines the basis of how these quotas were determined.

The Nature Conservation (Macropod Harvest Period 2016) Notice 2015 is due for release in December 2015. The release of this notice will allow the harvest period to be declared open on 1 January 2016. The notice will outline specific conditions for the 2016 harvest period including, but not limited to, harvest zone boundaries, weights and more.

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, EHP and the Department of the Environment for determining state quota limits.

Proposed quotas

Table 1 2015 estimated populations and 2016 proposed quotas for each macropod species in each harvest zone

Species	Harvest zone	2015 estimated population	2016 sustainable use quota (rounded to the nearest 50)	Proportion of population (% rounded to the nearest whole number)
Red kangaroo	Central	6,298,150	1,259,650	20
	Eastern	171,500	17,150	10
	Western	591,550	59,150	10
	Combined	7,061,200	1,335,950	19
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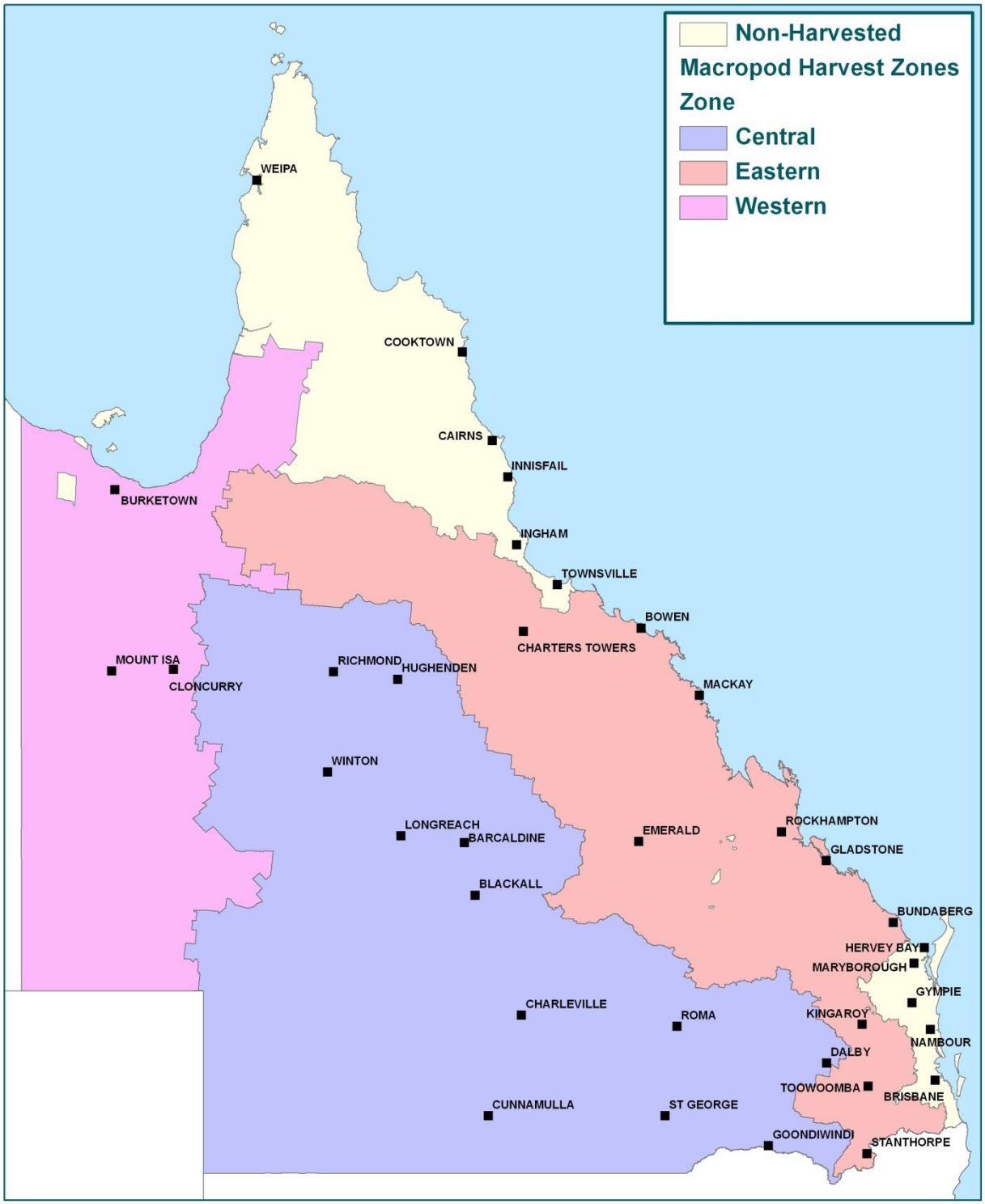
	Combined	3,694,100	525,500	14

Figure 1 Queensland macropod harvest zones



Criteria considered in quota determination

The following criteria were considered in determining the quotas for each macropod species:

- 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.

Each of these criteria will be outlined in detail in this quota submission.

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 ranging from 10% 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.

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).

Figure 2 Macropod population trends—1992–2015

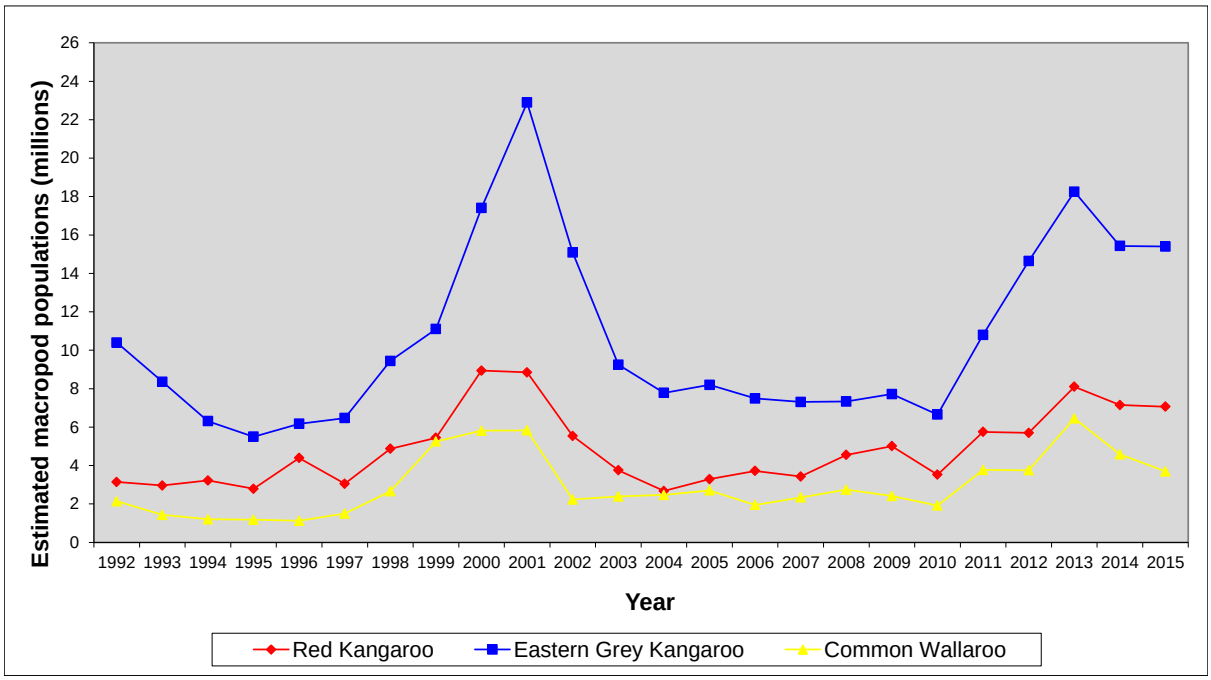


Figure 3 Red kangaroo population estimates (with one standard error) since 1992

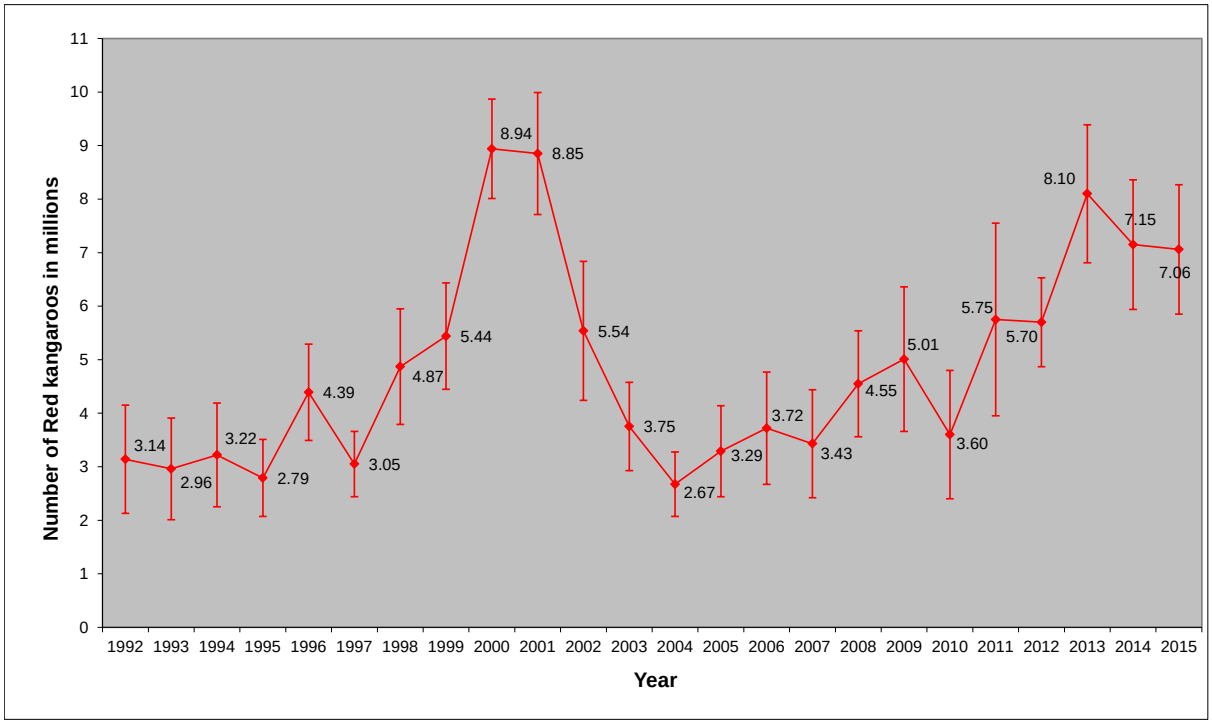


Figure 4 Eastern grey kangaroo population estimates (with one standard error) since 1992

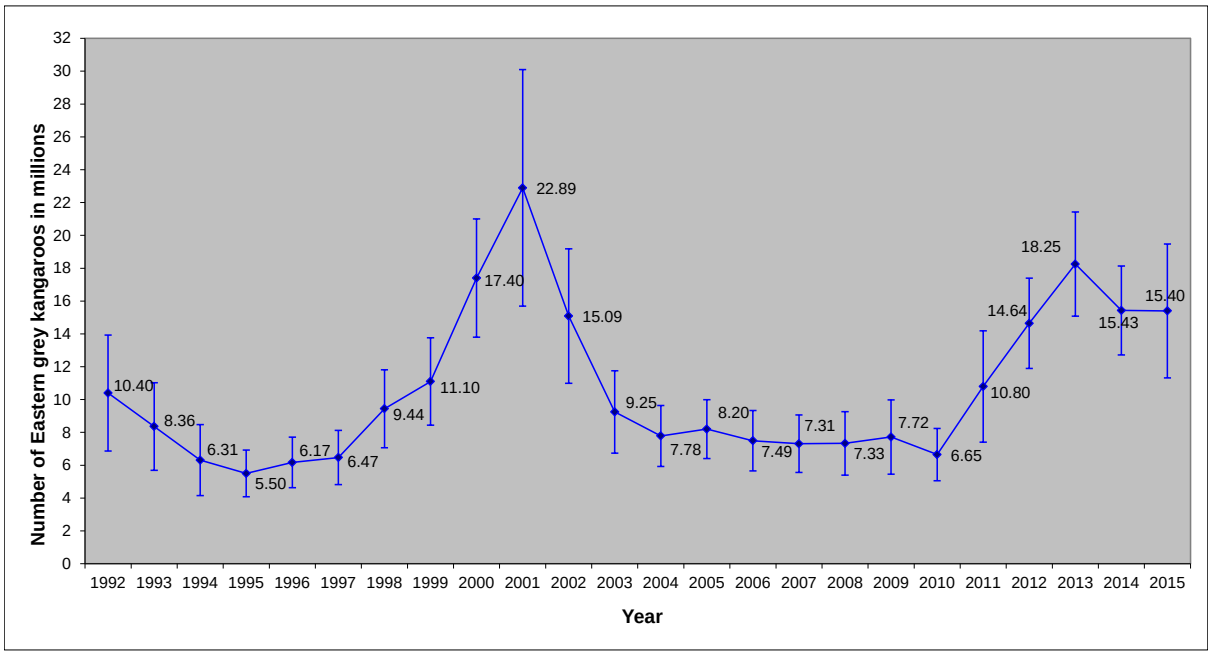
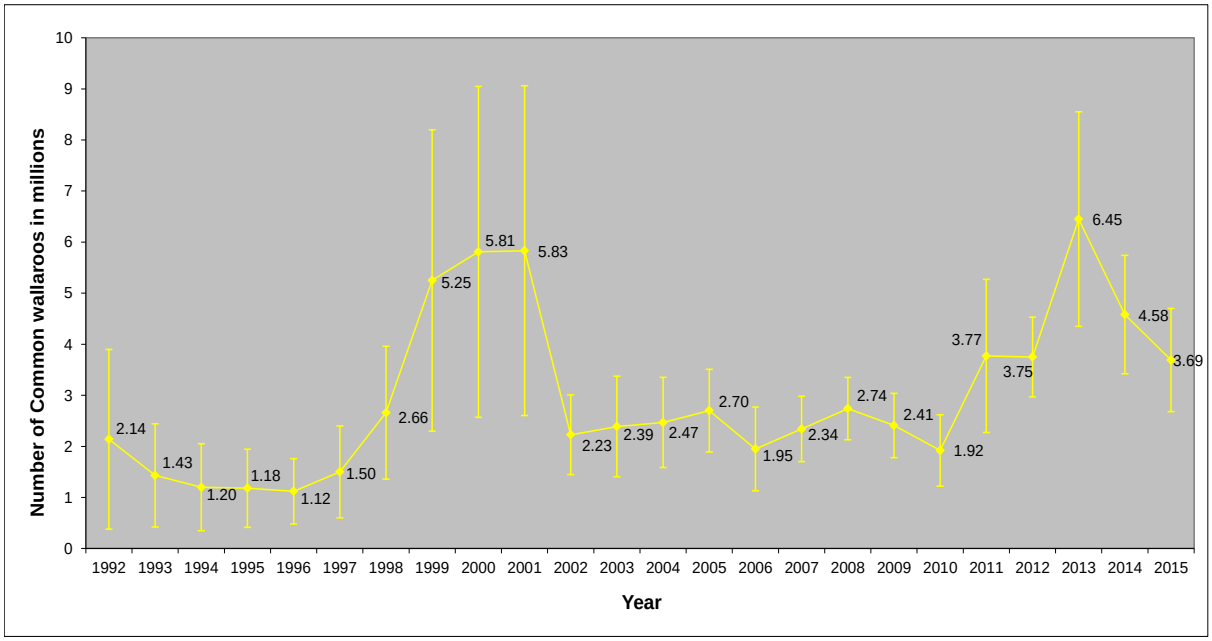


Figure 5 Common wallaroo population estimates (with one standard error) since 1992. Estimates include a 1.85 correction factor for 2011 to 2015 and a 1.2 correction factor all other years



This data is monitored for any significant decreases in densities. This approach 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 2005–2015 demonstrates densities do 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 1). 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

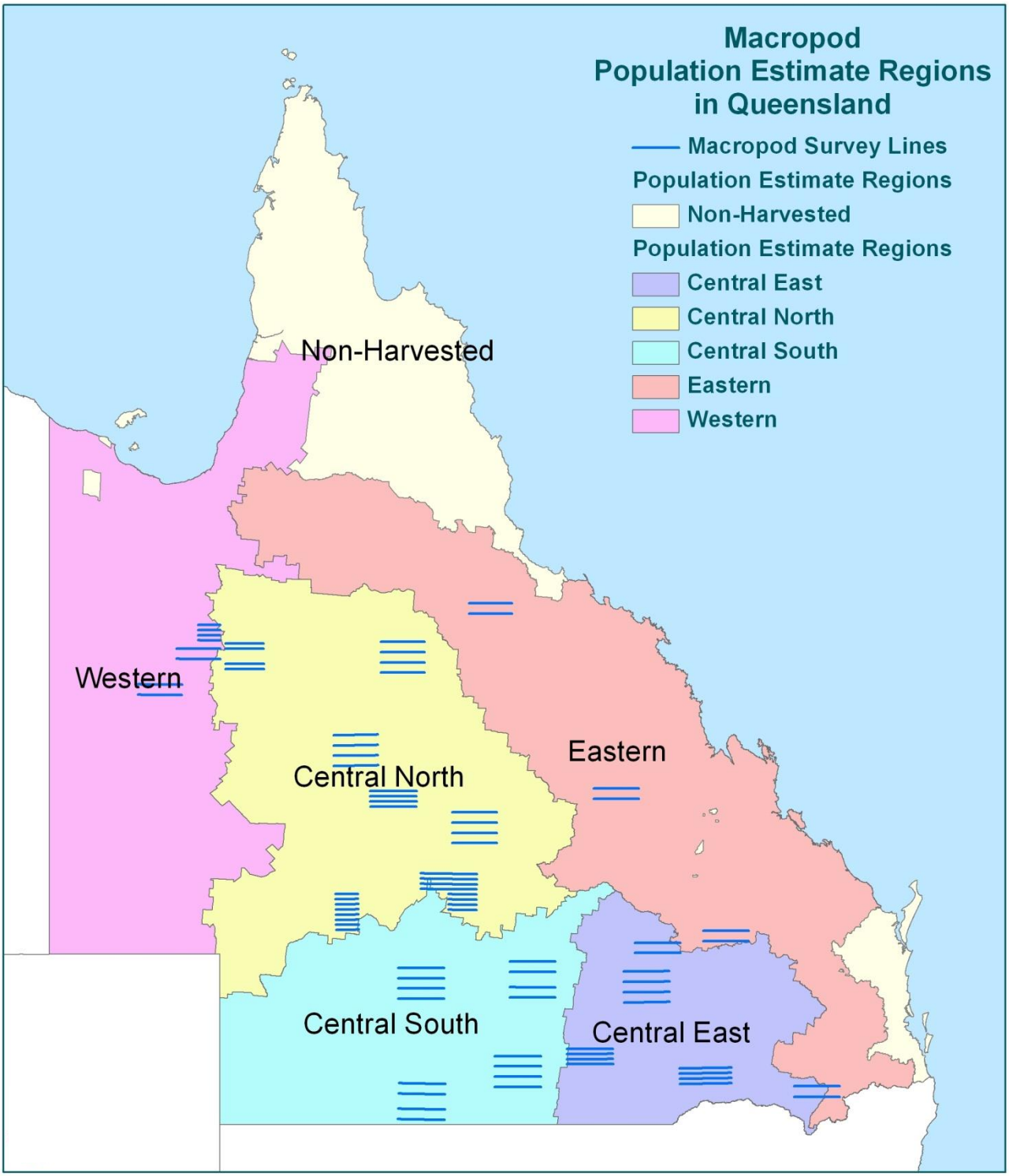
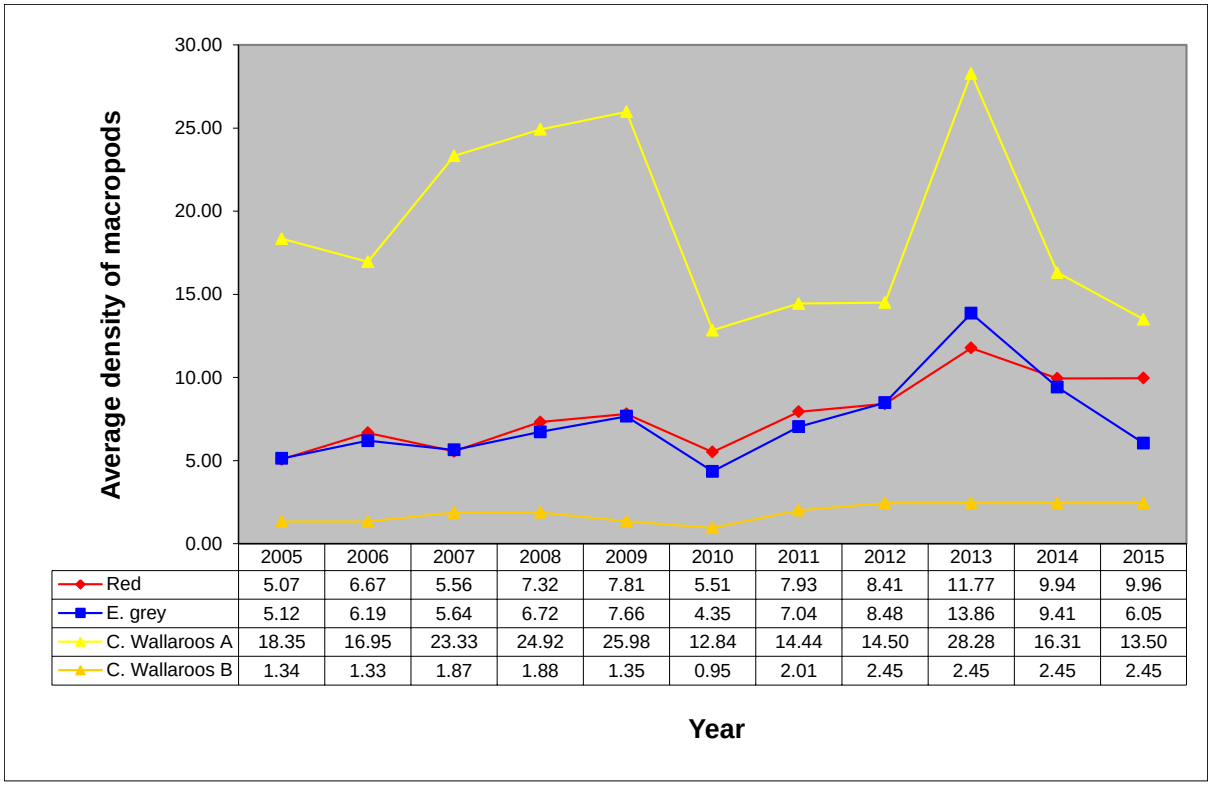
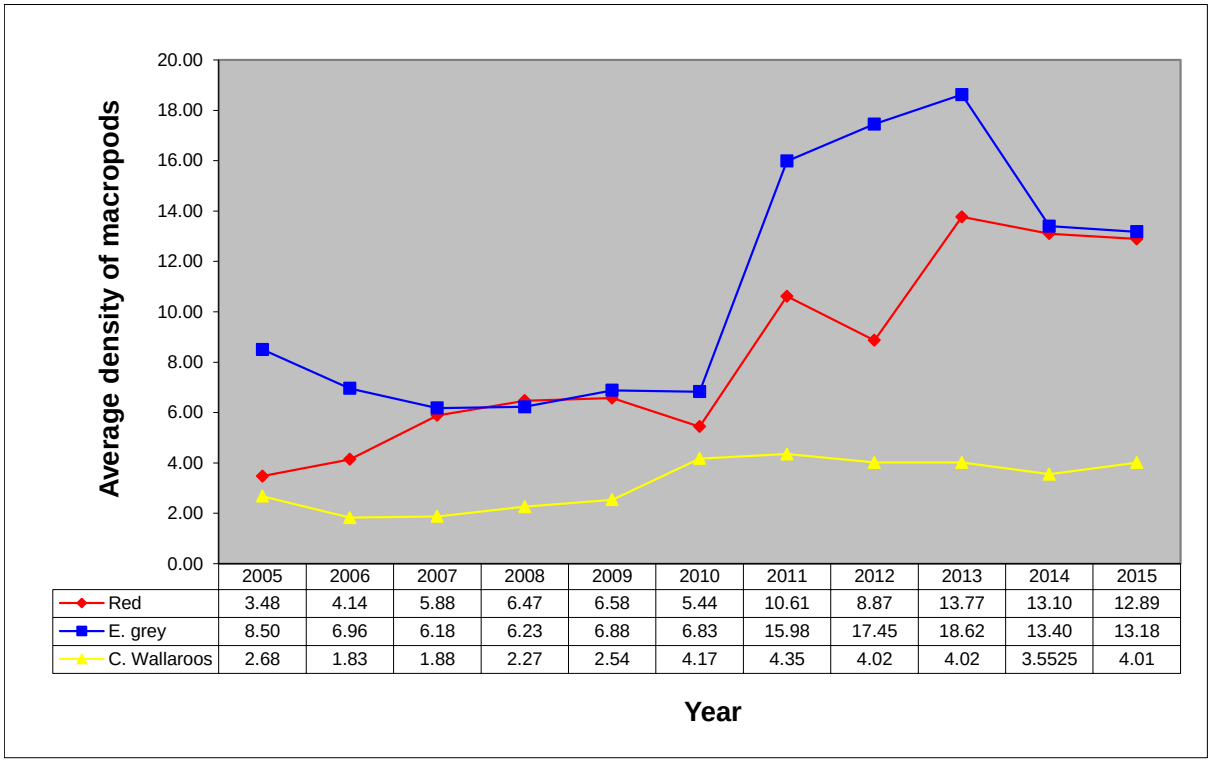


Figure 7 Average density km^2 of commercially harvested macropods in the Central North population estimate region 2005–2015 (Common wallaroos are represented by two areas in the Central North zone).



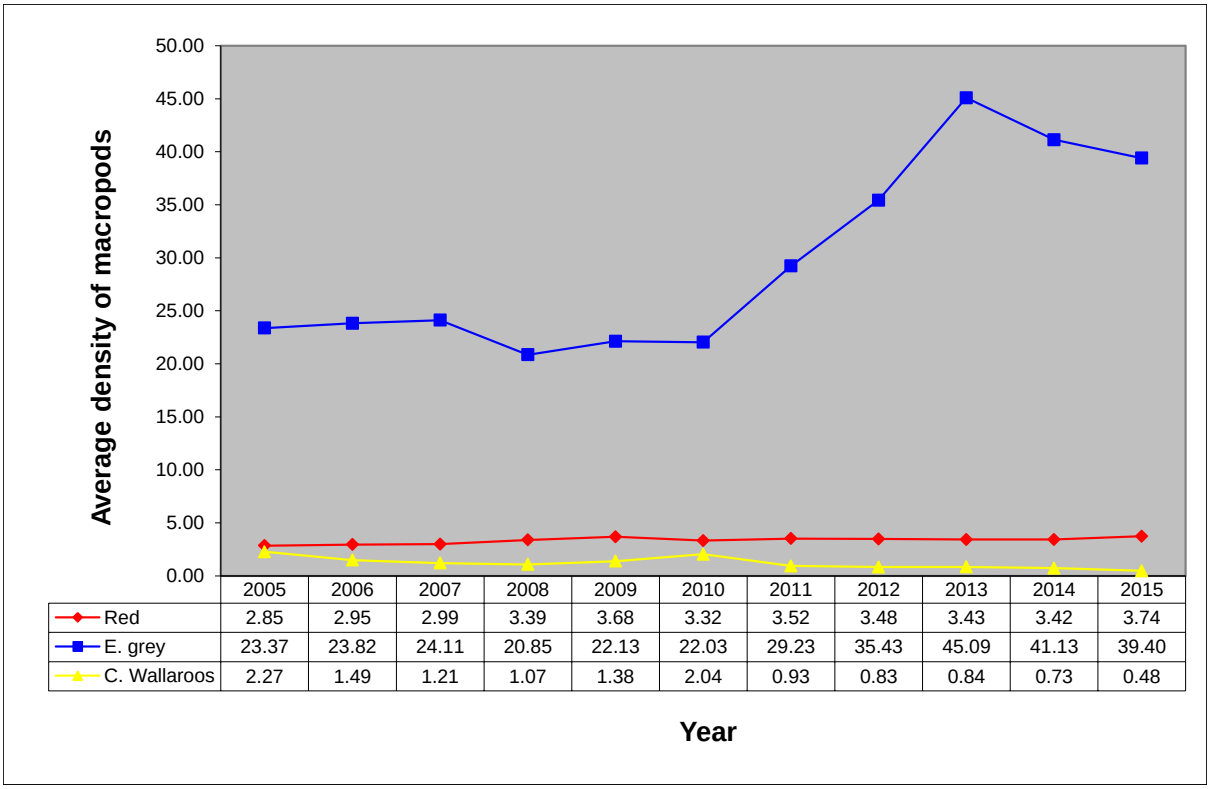
	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Red	5.07	6.67	5.56	7.32	7.81	5.51	7.93	8.41	11.77	9.94	9.96
E. grey	5.12	6.19	5.64	6.72	7.66	4.35	7.04	8.48	13.86	9.41	6.05
C. Wallaroos A	18.35	16.95	23.33	24.92	25.98	12.84	14.44	14.50	28.28	16.31	13.50
C. Wallaroos B	1.34	1.33	1.87	1.88	1.35	0.95	2.01	2.45	2.45	2.45	2.45

Figure 8 Average density km^2 of commercially harvested macropods in the Central South population estimate region 2005–2015



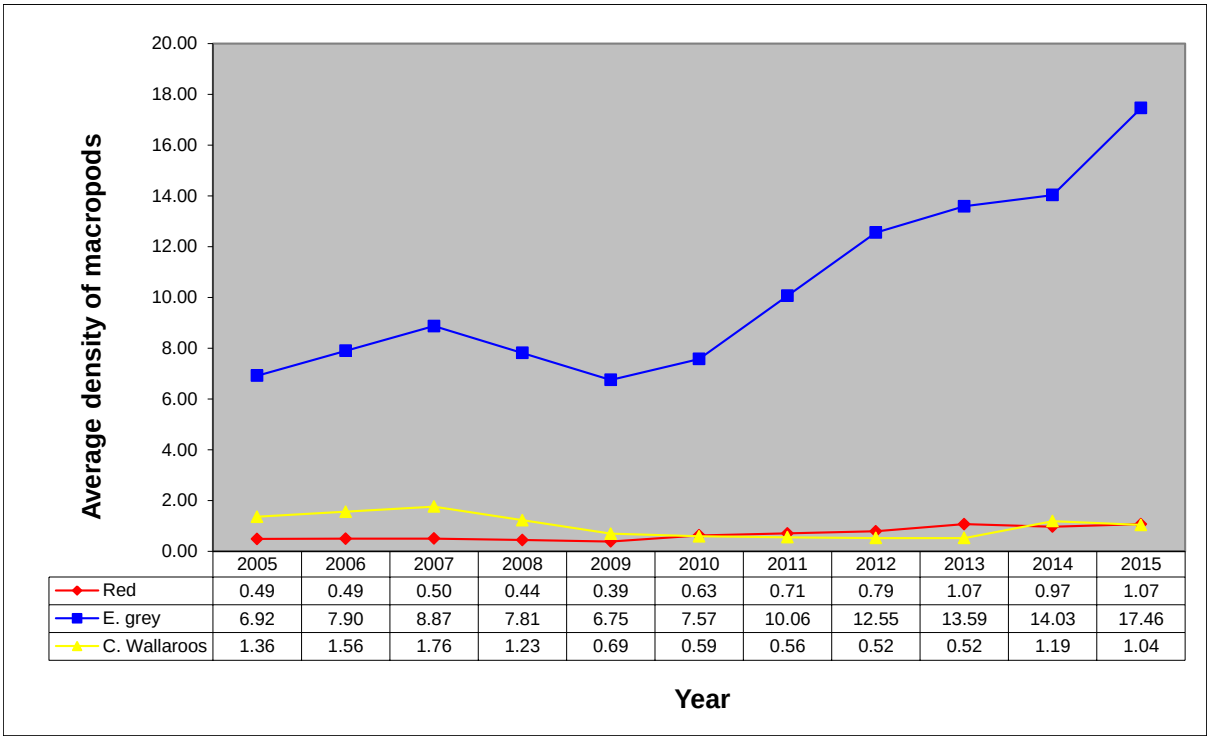
	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Red	3.48	4.14	5.88	6.47	6.58	5.44	10.61	8.87	13.77	13.10	12.89
E. grey	8.50	6.96	6.18	6.23	6.88	6.83	15.98	17.45	18.62	13.40	13.18
C. Wallaroos	2.68	1.83	1.88	2.27	2.54	4.17	4.35	4.02	4.02	3.5525	4.01

Figure 9 Average density km^2 of commercially harvested macropods in the Central East population estimate region 2005–2015



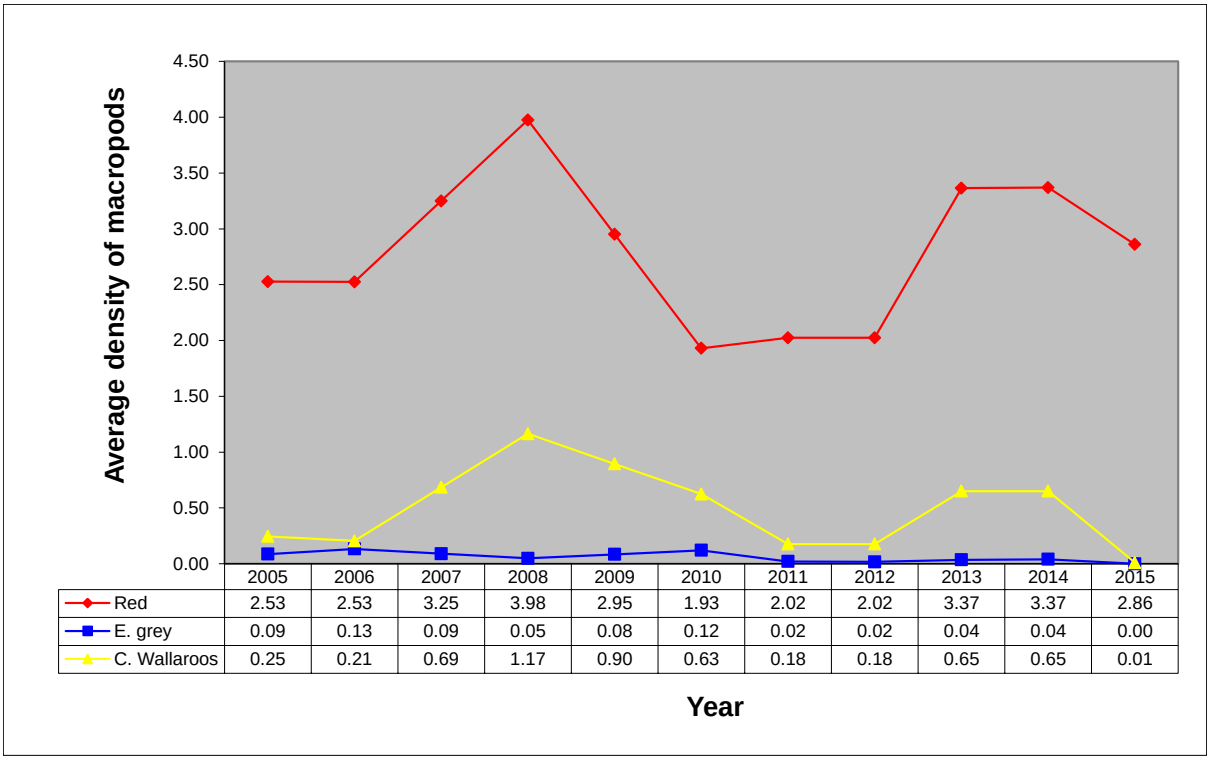
	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Red	2.85	2.95	2.99	3.39	3.68	3.32	3.52	3.48	3.43	3.42	3.74
E. grey	23.37	23.82	24.11	20.85	22.13	22.03	29.23	35.43	45.09	41.13	39.40
C. Wallaroos	2.27	1.49	1.21	1.07	1.38	2.04	0.93	0.83	0.84	0.73	0.48

Figure 10 Average density km^2 of commercially harvested macropods in the Eastern population estimate region 2005–2015



	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Red	0.49	0.49	0.50	0.44	0.39	0.63	0.71	0.79	1.07	0.97	1.07
E. grey	6.92	7.90	8.87	7.81	6.75	7.57	10.06	12.55	13.59	14.03	17.46
C. Wallaroos	1.36	1.56	1.76	1.23	0.69	0.59	0.56	0.52	0.52	1.19	1.04

Figure 11 Average density km^2 of commercially harvested macropods in the Western population estimate region 2005–2015



	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Red	2.53	2.53	3.25	3.98	2.95	1.93	2.02	2.02	3.37	3.37	2.86
E. grey	0.09	0.13	0.09	0.05	0.08	0.12	0.02	0.02	0.04	0.04	0.00
C. Wallaroos	0.25	0.21	0.69	1.17	0.90	0.63	0.18	0.18	0.65	0.65	0.01

Trigger points

2013 marked the beginning of a new Queensland Wildlife Trade Management Plan for Export (Commercially Harvested Macropods 2013–17). Incorporated into this new plan are pre-determined trigger points for each of the commercial harvest quotas. 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 two 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 2016 for each species in each zone compared with the population estimates for those regions. The estimated population for each species and zone is above the calculated trigger points for 2016 except for wallaroos in the western zone. The estimated population for common wallaroos in 2015 in the western harvest zone is below 2 SD therefore no quota is proposed for this species in the zone. As the western zone is on the very limit of the eastern grey kangaroo range no quota is set for this species in this zone. Consequently there are no trigger points calculated for this species in this zone.

Table 2 Calculated trigger points for 2016 and estimated populations of commercially harvested macropod species in each region for 2015

Note: There is no quota set for eastern grey kangaroos in the western region. No quota will be set for common wallaroos in the western zone in 2015 as the estimated population is below 2 SD.

Species	Population estimate region	2015 estimated population	2016 1.5 SD trigger point	2016 2 SD trigger point
Red kangaroo	Central North	3,401,250	1,793,569	1,575,678
	Central South	2,422,350	668,762	541,140
	Central East	474,500	92,520	70,422
	Eastern	171,500	71,600	62,450
	Western	591,550	165,750	129,450
Eastern grey kangaroo	Central North	1,787,300	1,323,178	1,099,699
	Central South	2,340,500	836,630	664,731
	Central East	6,163,850	2,375,437	1,994,077
	Eastern	5,115,100	1,115,350	881,800
	Western	0	NA	NA
Common wallaroo	Central North	2,417,750	459,735	349,413
	Central South	680,100	89,207	63,897
	Central East	32,350	15,538	11,791
	Eastern	559,400	237,000	202,400
	Western	4,500	21,250	12,600

Comparison between 2014 and 2015 population estimates

The total population estimates combined across all three harvest zones has decreased for all three species in 2015 compared with 2014 (Figure 12). However whilst some population estimates have decreased for specific zones others have increased (Table 3). Red kangaroo population estimates increased in the central and eastern zones and the eastern grey population estimate increased in the eastern zone. All three species decreased in the western zone with no eastern grey kangaroos observed during the 2015 surveys (Figure 13). As this zone lies at the edge of this species natural distribution and are only ever seen in low densities this result is not unusual.

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 (Table 3).

Figure 12 Comparison of overall macropod populations in the commercial harvest zones 2014 and 2015 (with one standard error)

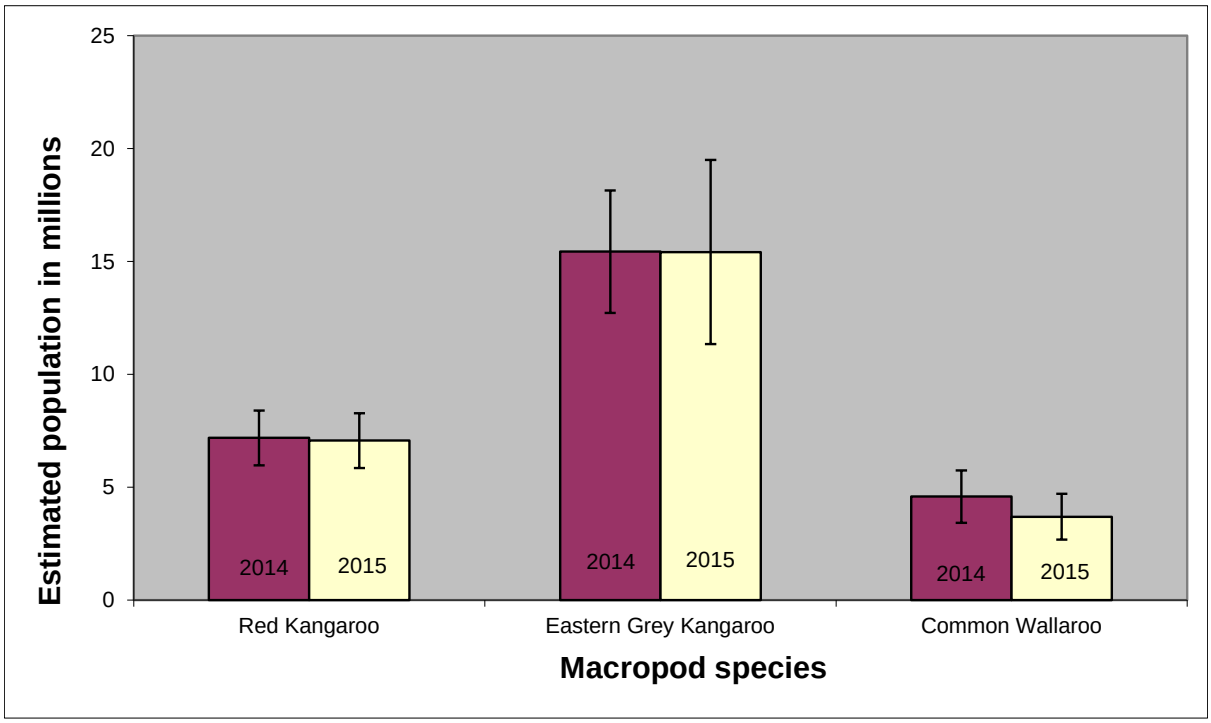


Table 3 Comparison between 2014 and 2015 macropod population estimates

Species	Harvest zone	2014 population estimate	2015 population estimate
Red kangaroo	Central	6,221,550	6,298,150
	Eastern	166,350	171,500
	Western	759,950	591,550
	Combined	7,147,850	7,061,200
Eastern grey kangaroo	Central	11,280,150	10,291,600
	Eastern	4,138,650	5,115,100
	Western	8,450	0
	Combined	15,427,250	15,406,700
Common wallaroo	Central	3,776,550	3,130,200
	Eastern	649,650	559,400
	Western	158,550	4,500
	Combined	4,584,750	3,694,100

Figure 13 Comparison of macropod populations 2014–15 by species and zone

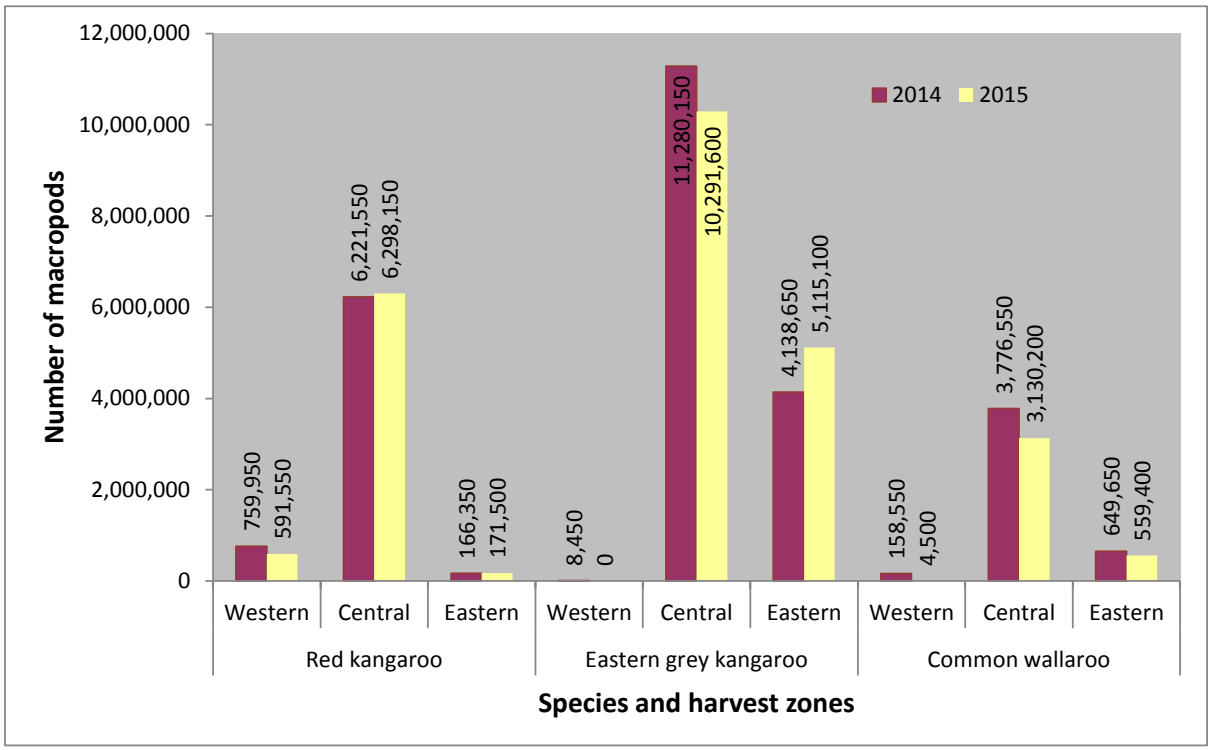
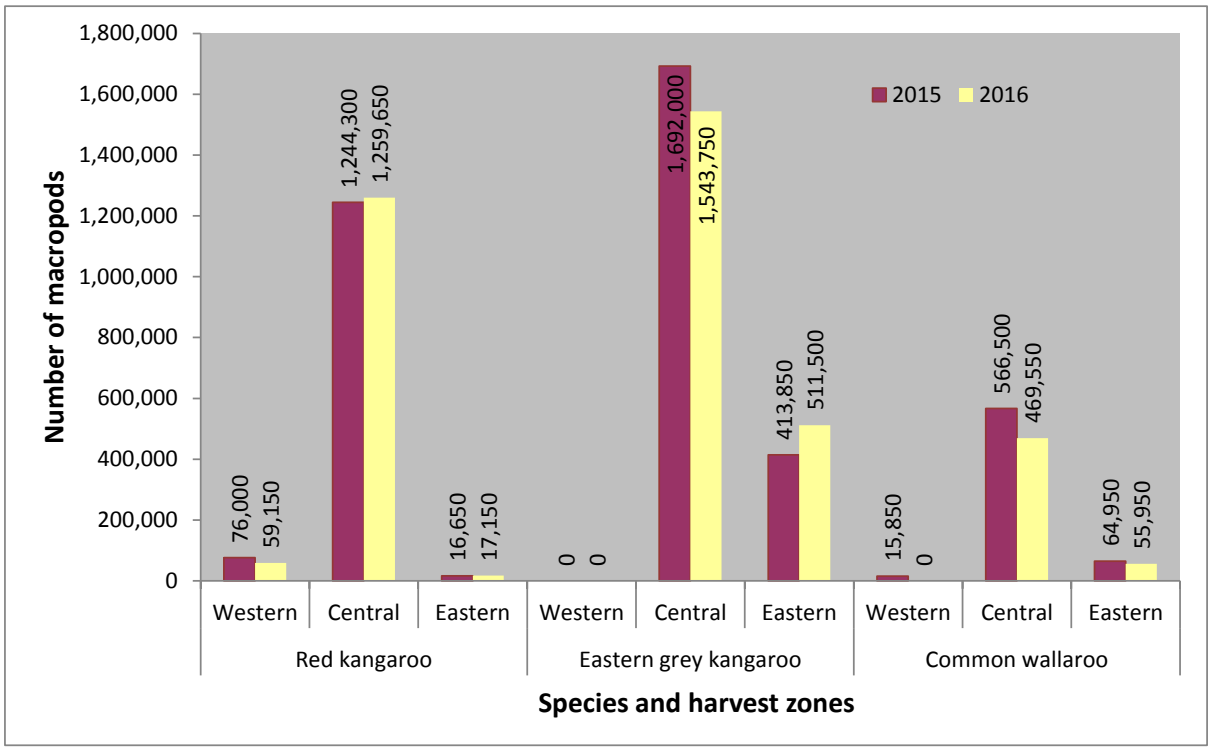


Figure 14 Comparison of 2015 actual and 2016 proposed harvest quotas



Long-term quota and harvest trends

Figures 15–17 outline data on the three commercially harvested macropod species pertaining to estimated population, quota and harvest for the years 1992–2014. 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 (2003) to enable comparison with data collated prior to this period.

Figure 15 Long-term population estimates (± one standard error), quota and harvest data (commercial harvest + damage mitigation permits) for the red kangaroo in Queensland. Note: population estimates are based on aerial surveys conducted the year before the harvest was taken.

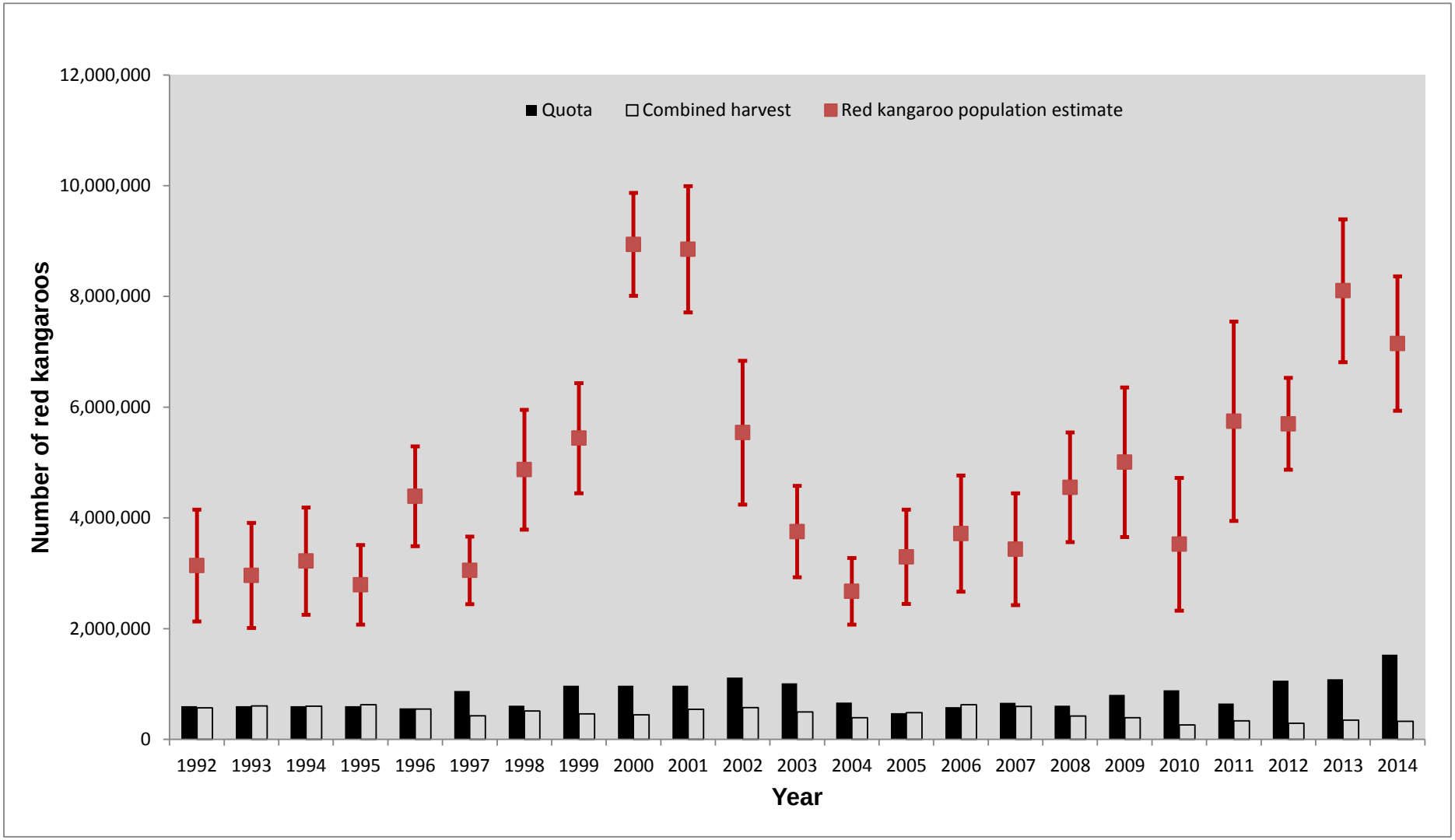


Figure 16 Long-term population estimates (± one standard error), quota and harvest data (commercial harvest + damage mitigation permits) for the eastern grey kangaroo in Queensland. Note: population estimates are based on aerial surveys conducted the year before the harvest was taken.

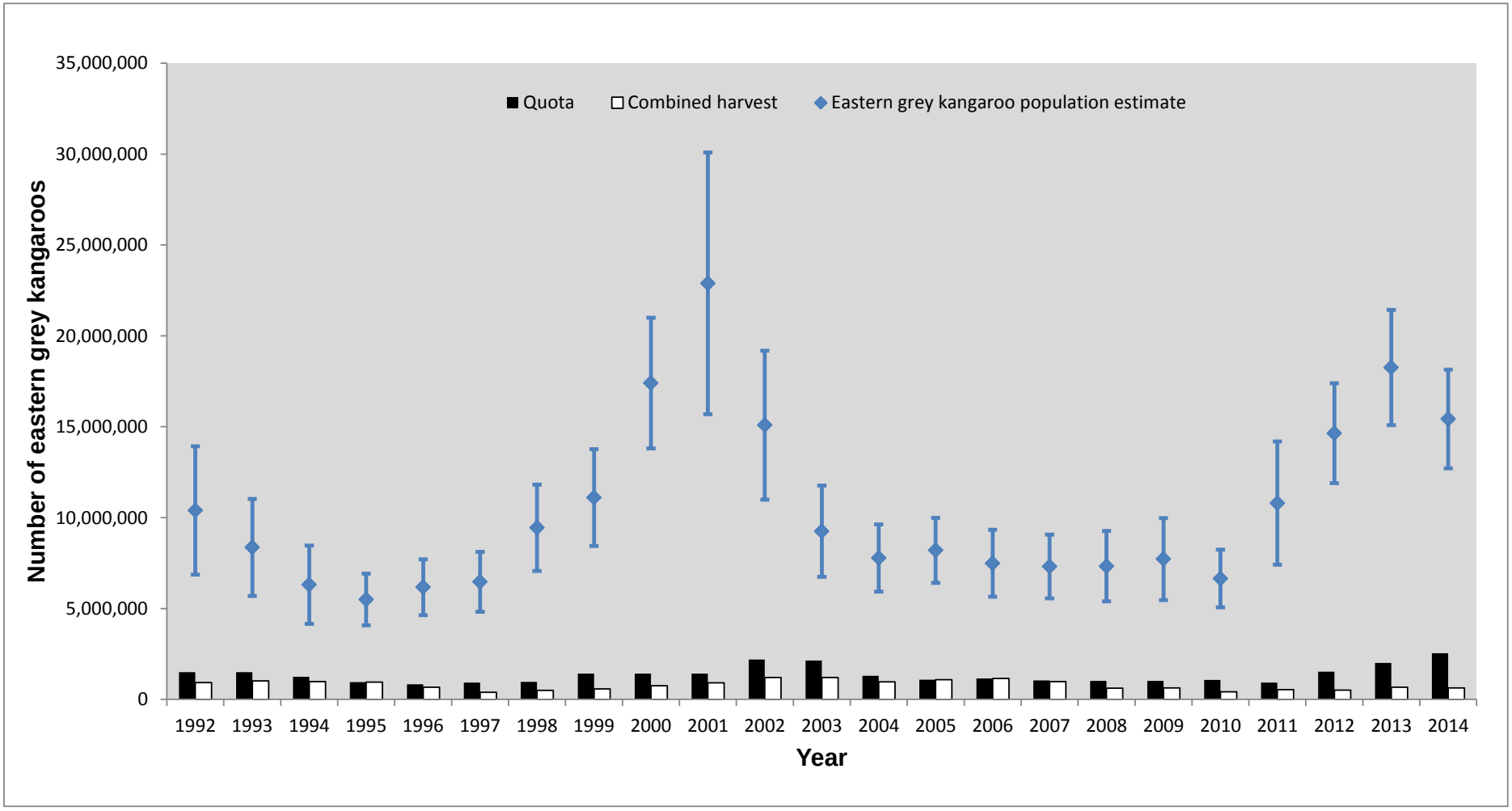
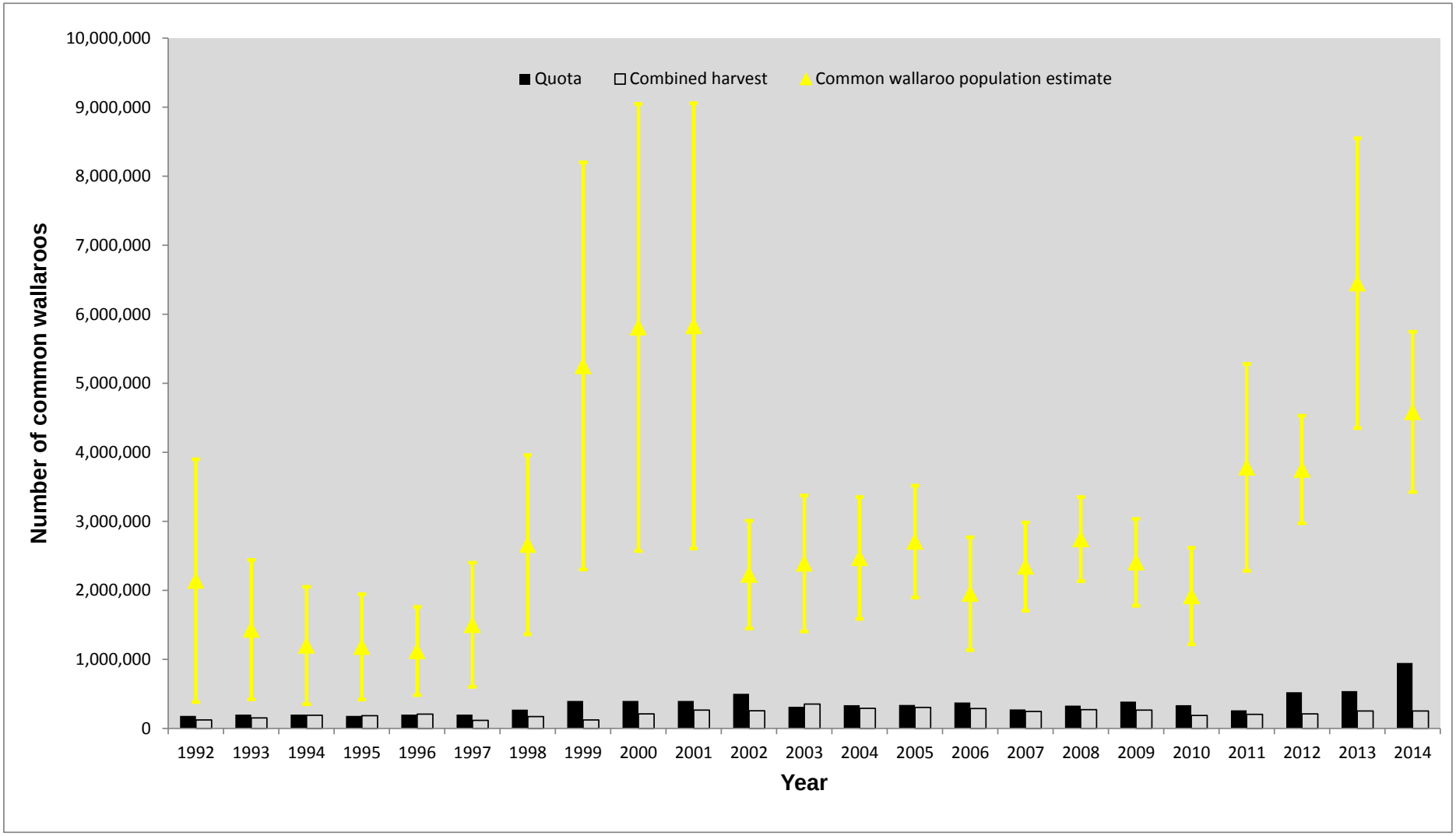


Figure 17 Long-term population estimates (± one standard error), quota and harvest data (commercial harvest + damage mitigation permits) for the common wallaroo in Queensland. Note: population estimates are based on aerial surveys conducted the year before the harvest was taken.



As previously outlined, there has been no consistent decline in the populations of the three commercially harvested species since 1992 (figures 15–17). 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 15–17). 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 2014 harvest

Dealer returns for the year 2014 indicate that there were 1,044,498 macropods taken in Queensland, which represents 20.8% of the overall combined quota. Of the 1,044,498 animals harvested, there were 277,992 red kangaroos, 566,061 eastern grey kangaroos and 200,445 common wallaroos harvested (Table 4). Quotas for individual species in each harvest zone were not exceeded in 2014, the maximum commercial take as a percentage of the approved quota of 24.8% being for eastern greys in the central zone (tables 4–7).

Table 4 Total harvest in 2014

Species	Population estimate 2013	Quota 2014	Harvest take 2014	% quota used 2014	% population harvested 2014
Red kangaroo	8,102,000	1,529,450	277,992	18.2%	3.4%
Eastern grey kangaroo	18,252,150	2,536,350	566,061	22.3%	3.1%
Common wallaroo	6,449,750	945,500	200,445	21.2%	3.1%
Total	32,803,900	5,011,300	1,044,498	20.8%	3.2%

Note: population estimates are based on aerial surveys conducted in 2013, which were used to set the 2014 quota.

Table 5 Harvest of red kangaroos in 2014

Zone	Population estimate 2013	Quota 2014	Harvest take 2014	% quota utilised 2014	% population harvested 2014
Central	7,192,400	1,438,500	269,838	18.8%	3.8%
Eastern	149,650	14,950	1,892	12.7%	1.3%
Western	759,950	76,000	6,262	8.2%	0.8%
Total	8,102,000	1,529,450	277,992	18.2%	3.4%

Note: population estimates are based on aerial surveys conducted in 2013, which were used to set the 2014 quota.

Table 6 Harvest of eastern grey kangaroos in 2014

Zone	Population estimate 2013	Quota 2014	Harvest take 2014	% quota utilised 2014	% population harvested 2014
Central	14,239,650	2,135,950	529,892	24.8%	3.7%
Eastern	4,004,050	400,400	36,169	9.0%	0.9%
Western	8,450	0	0	NA	NA
Total	18,252,150	2,536,350	566,061	22.3%	3.1%

Note: population estimates are based on aerial surveys conducted in 2013, which were used to set the 2014 quota.

Table 7 – Harvest of common wallaroos in 2014

Zone	Population estimate 2013	Quota 2014	Harvest take 2014	% quota utilised 2014	% population harvested 2014
Central	6,009,850	901,500	194,880	21.6%	3.2%
Eastern	281,350	28,150	5,162	18.3%	1.8%
Western	158,550	15,850	403	2.5%	0.3%
Total	6,449,750	945,500	200,445	21.2%	3.1%

Note: population estimates are based on aerial surveys conducted in 2013, which were used to set the 2014 quota.

Sex ratio by species and zone

Commercial harvest is typically biased towards males (Figure 19) as they are usually larger and heavier than females. In 2014, the total harvest for each species comprised between 95.1% and 99.9% males. Data gathered throughout 2014 indicates 3.3% of the overall harvest was female (Figure 18).

Figure 18 Proportion of 2014 harvest, male and female by species

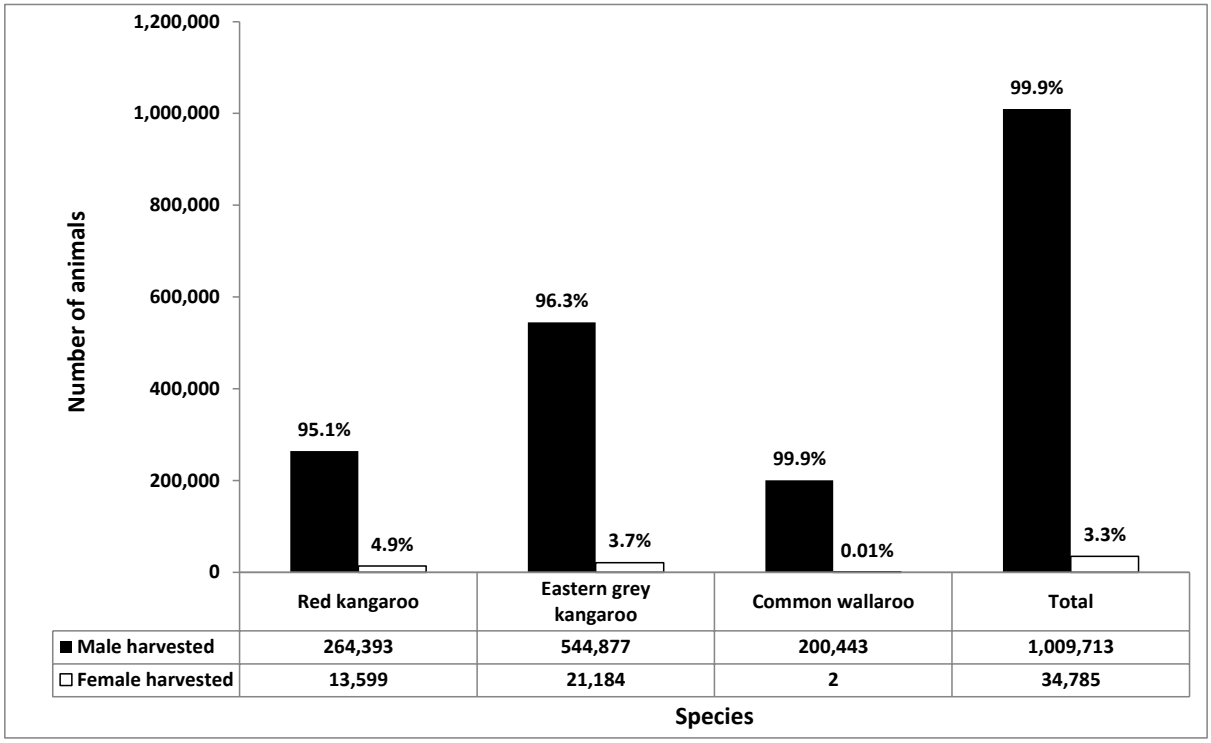
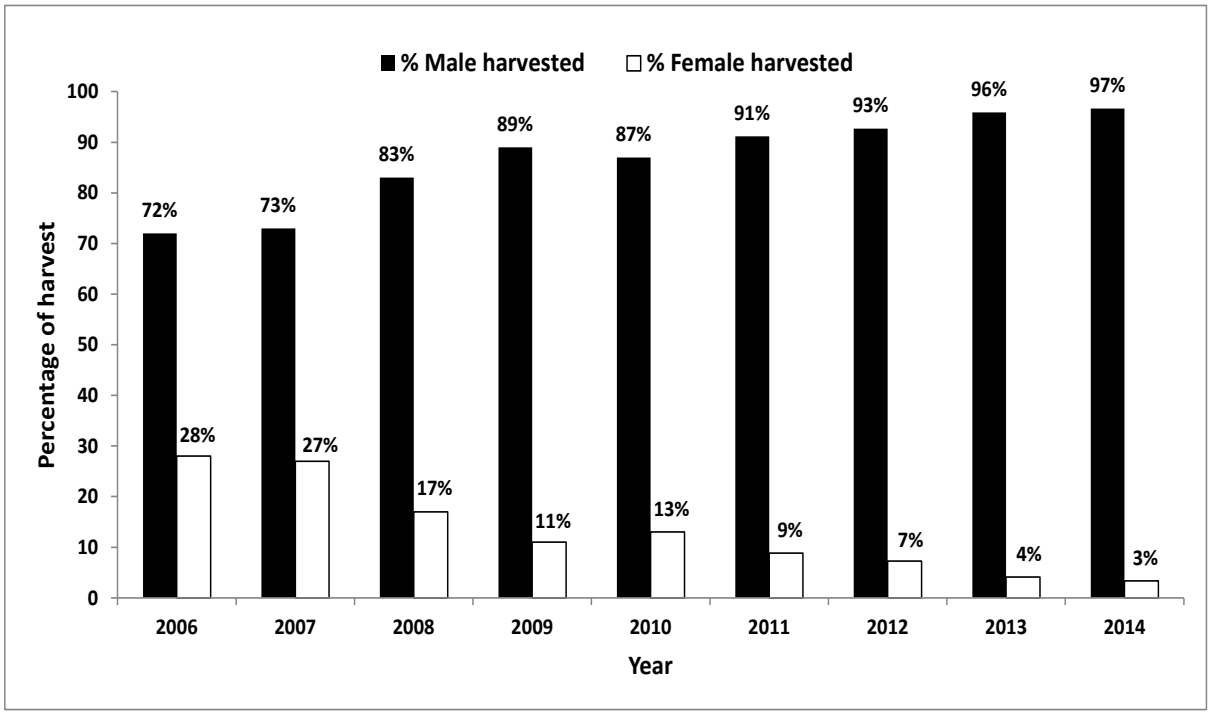


Figure 19 Overall sex ratio 2006–2014 (percentages rounded to the nearest whole number).



Harvest update for 2015

The total number of tags issued up to 31 July 2015 was 826,400. A comparison of tag sales and harvest returns in relation to quotas in each zone is given in Table 8. The number of tags produced 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. The 2015 harvest will be comprehensively reported on in the 2015 annual report, due for release in March 2016.

Table 8 Tags issued and reported harvest for 2015 at 31 July

Species	Harvest zone	2015 sustainable use quota (rounded to the nearest 50)	Tags issued to 31 July 2015	Reported harvest to 31 July 2015
Red kangaroo	Central	1,244,300	264,250	154,789
	Eastern	16,650	4,600	744
	Western	76,000	6,950	800
Eastern grey kangaroo	Central	1,692,000	397,700	246,305
	Eastern	413,850	40,500	19,215
	Western	NA	NA	NA
Common wallaroo	Central	566,500	103,900	53,298
	Eastern	64,950	7,700	2,144
	Western	15,850	800	273

The extent of non-commercial harvest mortality

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

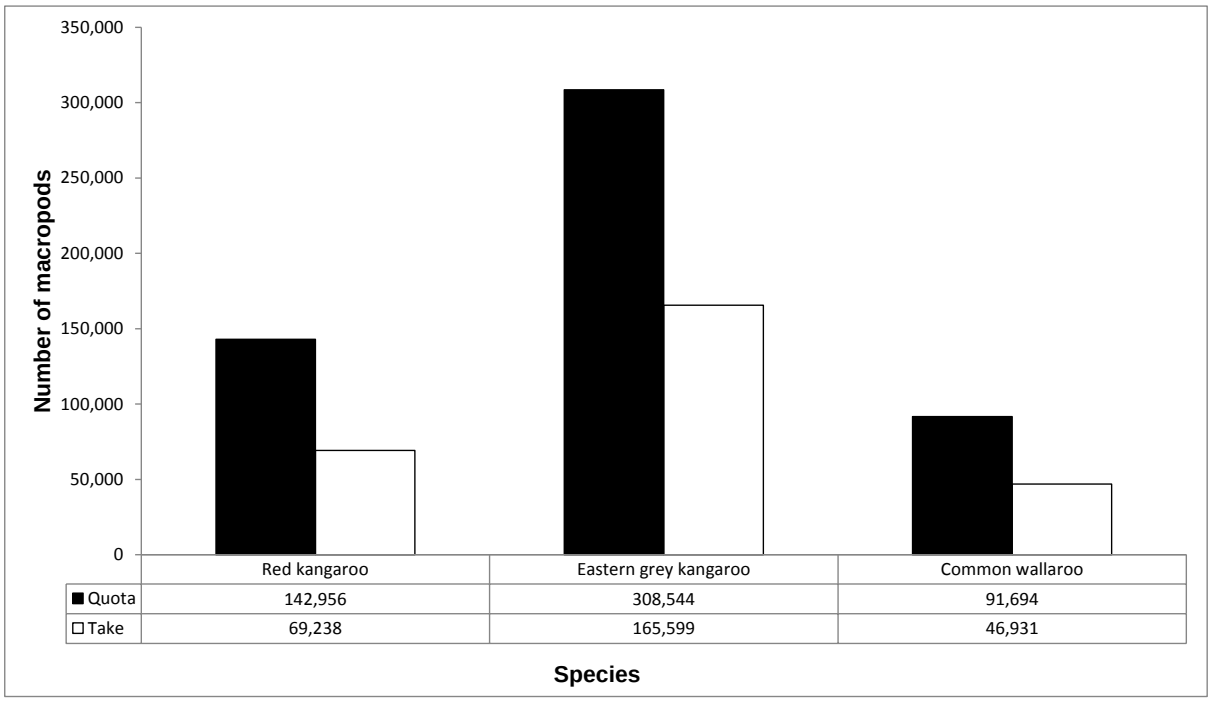
Damage to primary production

DMPs are issued by EHP where macropods are causing demonstrable damage to primary production. The issuing of these permits is limited to a maximum of 2% of the population estimate for each species in each zone. It is a condition of the permit that macropods are taken in accordance with the requirements of the National Code of Practice for the Humane Shooting of Kangaroos and Wallabies for Non-commercial Purposes. Consistent with the Queensland government's policy of reducing red tape EHP made a number of significant improvements to the DMP process in 2014 that greatly enhanced landholders' ability to manage macropods:

Uptake of DMPs has increased since these changes were instigated (Figure 21). In August 2015 changes were made to the Nature Conservation (Macropod) Conservation Plan 2005 to further assist landholders comply with legislative requirements when managing macropods for damage mitigation purposes. The quota for DMPs of commercially harvested macropods was increased from 1% to 2% of the estimated population.

Figure 20 Macropod quota and take for DMP in 2015

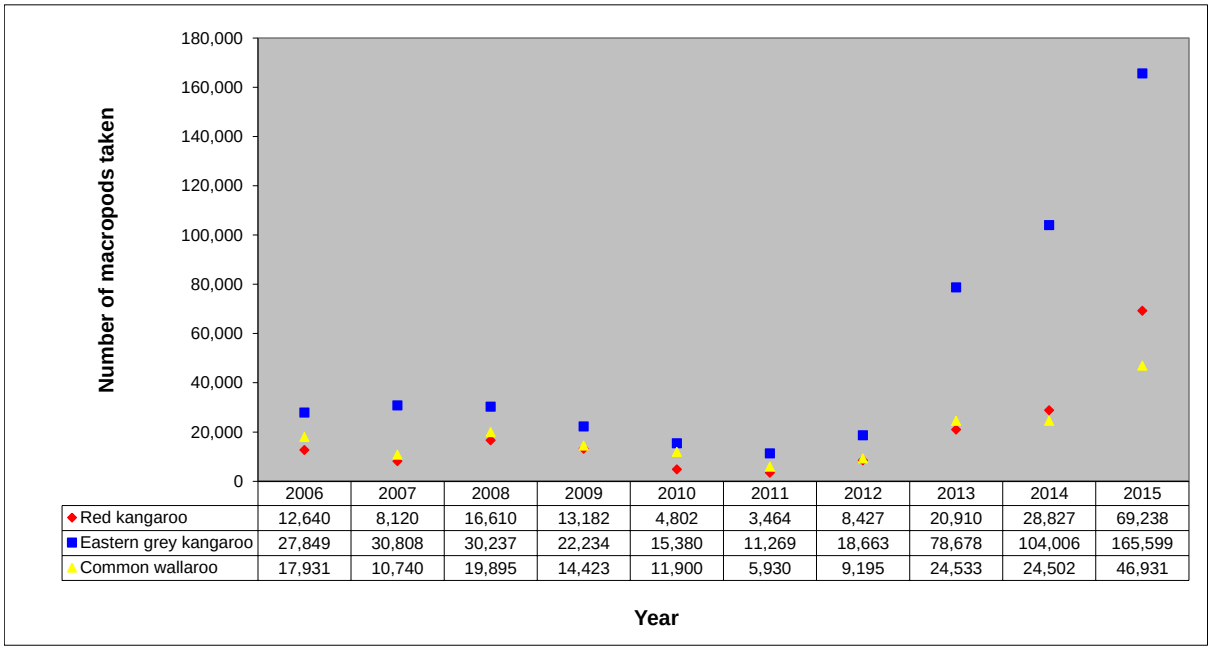
Note: Figures are as recorded on 31 August 2015



	Red kangaroo	Eastern grey kangaroo	Common wallaroo
Quota	142,956	308,544	91,694
Take	69,238	165,599	46,931

Figure 21 Macropods taken under a DMP 2006–2015

Note: 2014 figures are as recorded on 25 August 2015



	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Red kangaroo	12,640	8,120	16,610	13,182	4,802	3,464	8,427	20,910	28,827	69,238
Eastern grey kangaroo	27,849	30,808	30,237	22,234	15,380	11,269	18,663	78,678	104,006	165,599
Common wallaroo	17,931	10,740	19,895	14,423	11,900	5,930	9,195	24,533	24,502	46,931

Disease outbreak mortality and its significance

No incidence of significant disease mortalities have been recorded for macropod populations in Queensland during the past year. Above average temperatures and extremely dry conditions have continued across the majority of the commercial harvest zones in the past 12 months. Most of the local government areas within the harvest zones have been drought declared for two to three years. These conditions reduce the available feed for all grazing species including macropods. The main areas to experience a significant reduction in macropod numbers is in the west of the state. All three commercially harvested macropod species declined in the western harvest zone in 2015.

The last disease related non-harvest mortality event recorded in Queensland macropod populations was in March 2010. Localised disease related mortalities for some commercially harvested species were recorded in the south-west of the state from the New South Wales border to just north of Quilpie in the Paroo and Bulloo river systems. Investigation and surveillance over the weeks following the reports established that the deaths were very limited and restricted to small areas only. This was documented in the 2011 Quota Submission for Queensland. The aerial surveys conducted in 2011 showed that in the year following the reported mortalities, macropod populations had increased indicating that the reported mortalities in 2010 did not have a significant effect on macropod populations in the area.

Licensed recreational wildlife harvesting licence (macropods)

The recreational macropod harvest in Queensland is centred on the same three species as the commercial harvest and runs for the same harvest period. The recreational harvesting of these macropods is regulated through:

- *Environment Protection and Biodiversity Conservation Act 1999*
- *Nature Conservation Act 1992*
    - Nature Conservation (Administration) Regulation 2006
    - Nature Conservation (Wildlife Management) Regulation 2006
    - Nature Conservation (Wildlife) Regulation 2006
    - Nature Conservation (Macropod) Conservation Plan 2005
    - Nature Conservation (Macropod Harvest Period) Notice
- *Animal Care and Protection Act 2001.*

A person holding a Commercial Wildlife Harvesting Licence (macropods) cannot hold a Recreational Wildlife Harvesting Licence (macropods). The harvest is restricted to a maximum of 50 tags per licence holder during a harvest period. The recreational harvest of macropods in Queensland is small with a total of 840 tags issued in 2014. Only 24 Recreational Wildlife Harvesting Licence (macropods) had been issued by 31 August 2015 (Table 9).

Table 9 Number of Recreational Wildlife Harvesting Licences (macropods) issued per year since 2008

Note: 2015 figures are year to date at 31 August

	2008	2009	2010	2011	2012	2013	2014	2015
Total number of permits issued	19	20	25	15	27	15	25	24
Total quantity which can be taken	673	910	1220	660	1350	498	840	855

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 22). Within the three commercial harvest zones macropods cannot be harvested within National Parks, States Forests, Regional Parks or Forest Reserves. Table 10 outlines the size of these land tenures within the commercial harvest zones (current in 2015).

The range of the red kangaroo in Queensland covers approximately 1,105,587km^2 (Figure 22). Red kangaroos are harvested over the entirety of their Queensland distribution. The area within the red kangaroo range in Queensland, in which they are protected within national parks and state forests is 77,412km^2, or approximately 7% of their total distribution (Figure 22).

The range of the eastern grey kangaroo in Queensland covers approximately 1,253,710km^2 (Figure 23). Eastern grey kangaroos are harvested only in the central and eastern harvest (Figure 23). The total protected area for eastern grey kangaroos within these commercial harvest zones is 54,835km^2 (Figure 23).

The range of the common wallaroo in Queensland covers approximately 1,239,921km^2 (Figure 24). Common wallaroos are harvested over approximately 1,104,222km^2, or 89% of their Queensland distribution (Figure 24). The total protected area for common wallaroos within the commercial harvest zones is 77,412km^2 (Figure 24).

Table 10 Area of land tenures within the Queensland commercial harvest zones where harvesting of macropods is not permitted

	Western harvest zone km^2	Central harvest zone km^2	Eastern harvest zone km^2	Total km^2
National Park	21,450	11,285	14,139	**46,874**
State Forest	NA	10,789	16,400	**27,188**
Regional Park	1,048	485	888	**2,421**
Forest Reserve	78	451	400	**929**
Total km^2	**22,576**	**23,009**	**31,826**	**77,412**

Figure 22 Red kangaroo *Macropus rufus* distribution

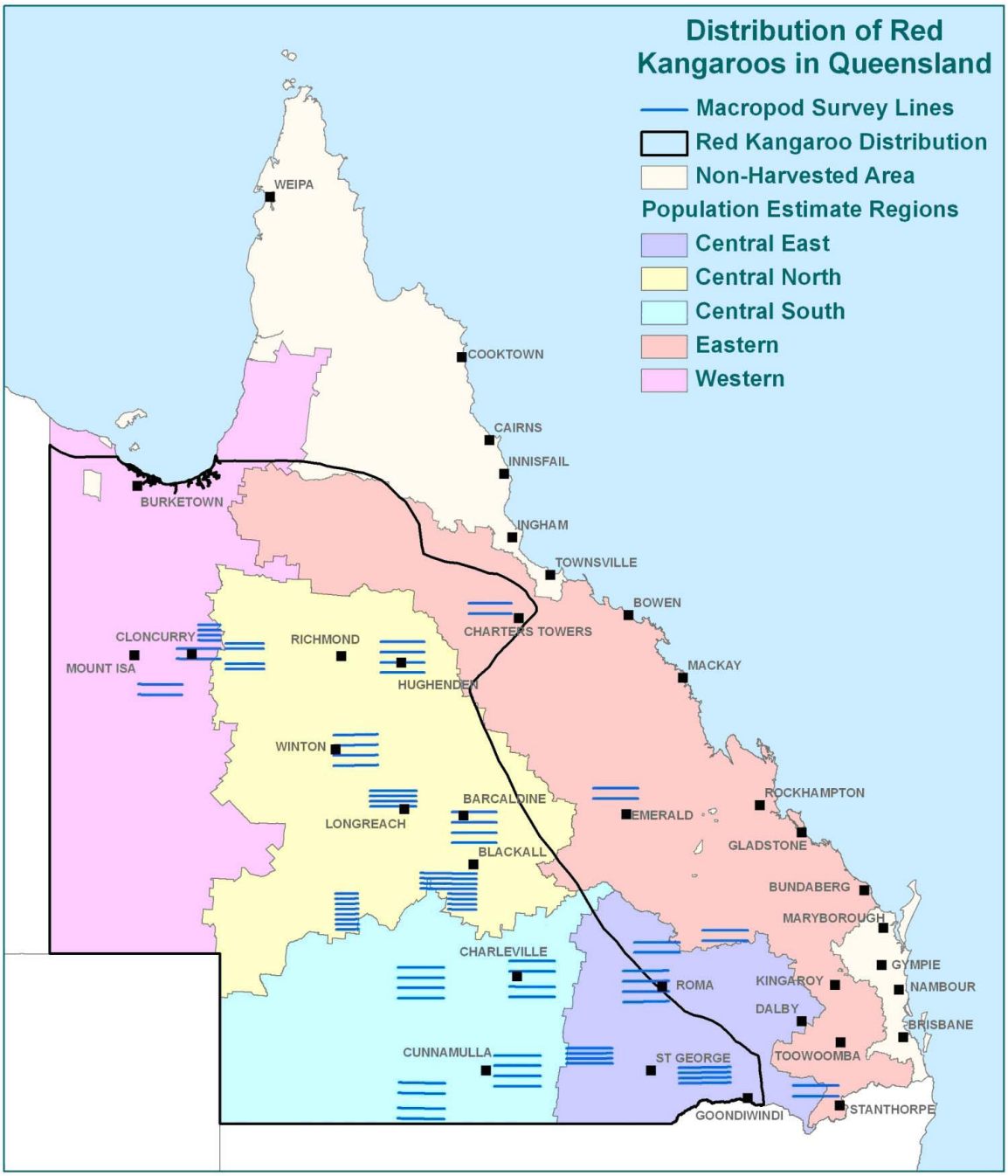


Figure 23 Eastern grey kangaroo *Macropus giganteus* distribution

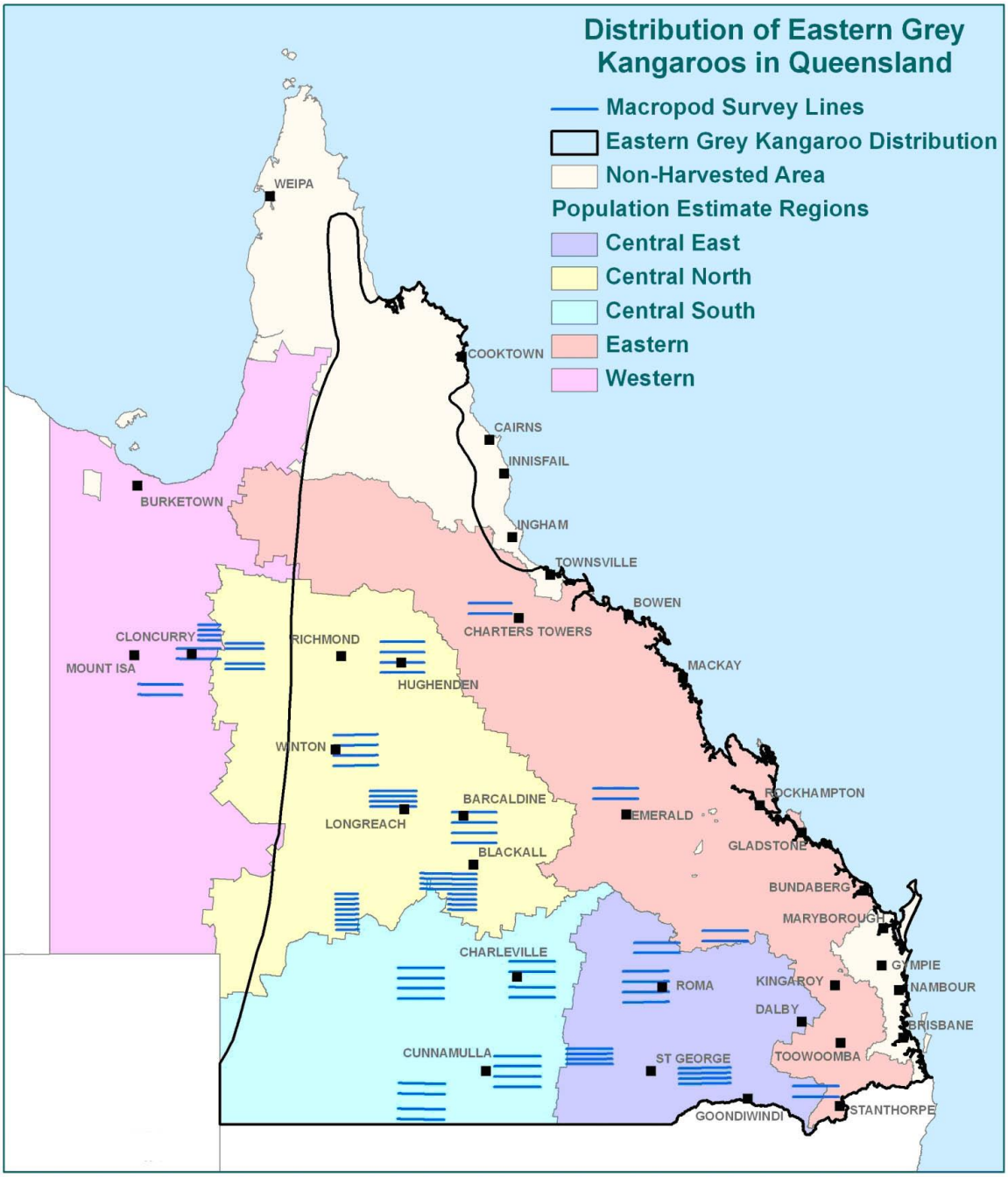
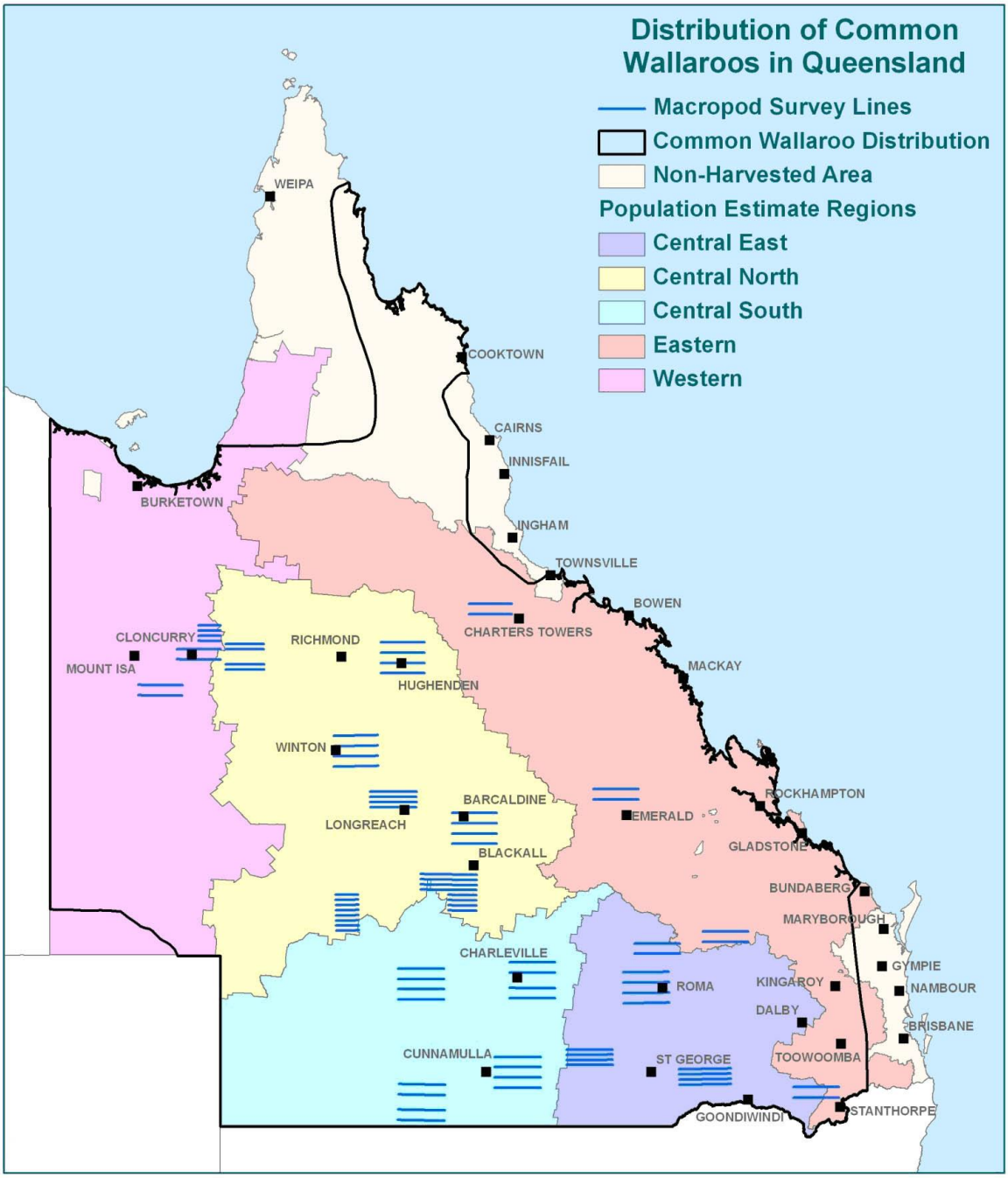


Figure 24 Common wallaroo *(Macropus robustus)* distribution



Rainfall trends

Recorded rainfall totals for Queensland are outlined in Figure 25 for 1 August 2014 to 31 July 2015 (Australian Bureau of Meteorology www.bom.gov.au). 2014 was a hot year overall for Queensland being the third hottest on record. Heatwaves across much of the harvest zones were experienced in January, May, October and November. Most of the harvest districts were dry and drought declared throughout 2014. The hot and dry conditions continued over much of the state during 2015 and can be described as severe in many areas. As at 1st August 2015 most of the macropod harvest zones were drought declared with all of the central and western zones declared (Figure 26). Much of the commercial harvest zones have been drought declared for three consecutive years.

Despite the ongoing drought conditions sufficient rainfall has occurred in some parts of the harvest zones over the last 12 months to produce feed for macropods. Whilst overall population estimates in 2015 are slightly below 2014 a dramatic decline across the entire state has not occurred. The western harvest zone has experienced the greatest decline in macropod numbers for all three commercial species. Estimated populations of red and eastern grey kangaroos have increased in the eastern zone with only common wallaroos observed declining. There is the potential for macropod densities to decrease dramatically like they did in 2002 if drought conditions continue across the harvest zones.

Figure 24 Estimated macropod populations plotted with annual rainfall totals from Queensland 1992–2015

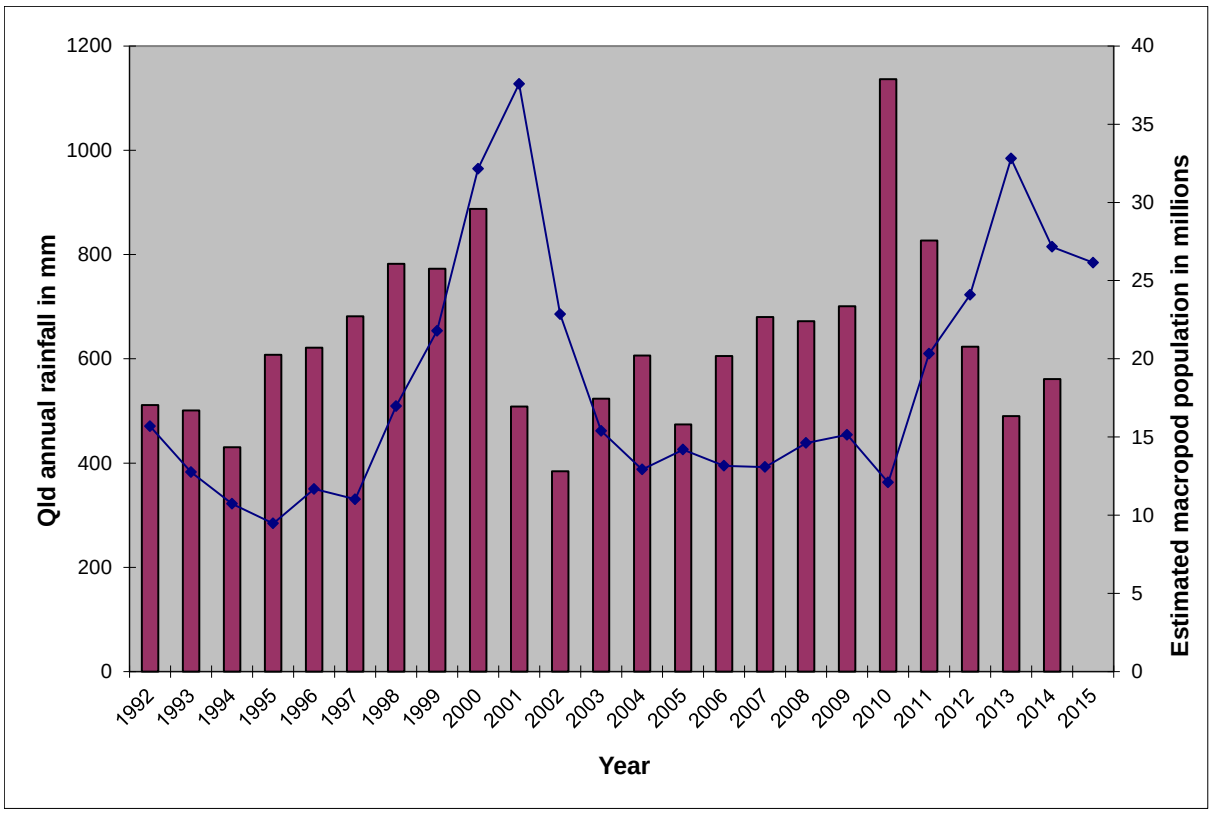


Figure 25 Queensland rainfall totals 1 August 2014 to 31 July 2015.

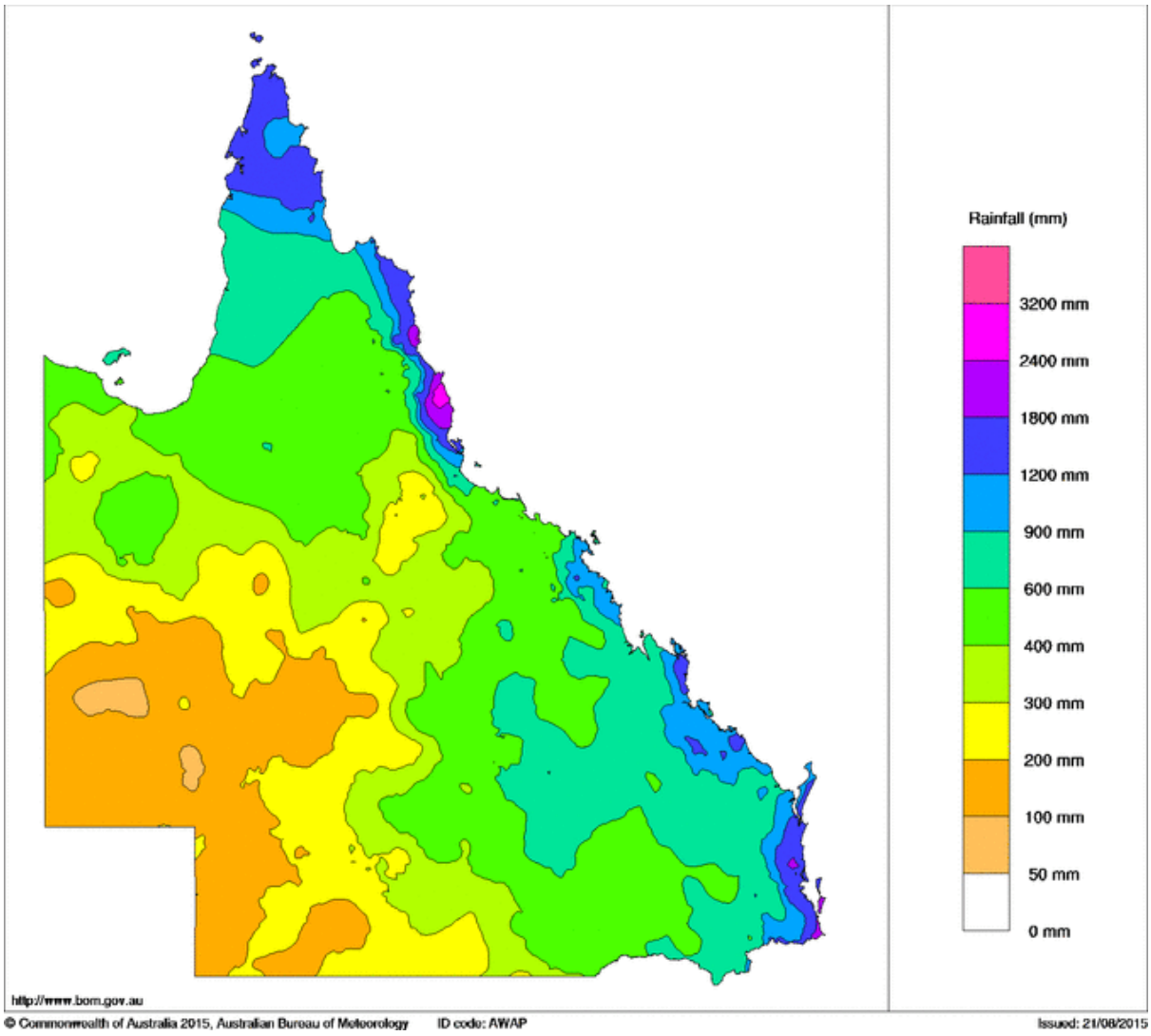
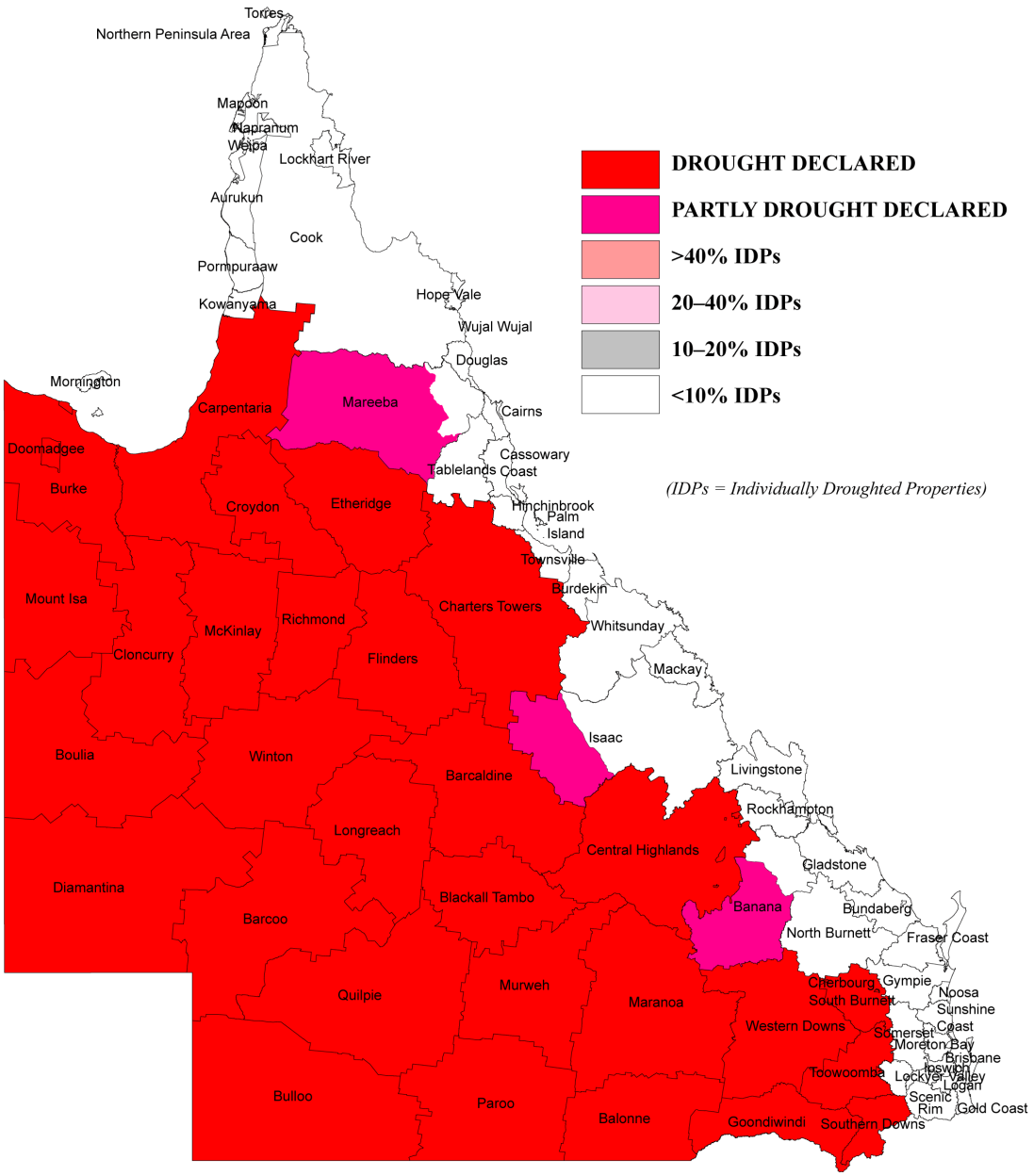


Figure 26 Queensland drought declarations at 1 August 2015.



Summary and conclusion

The proposed quotas for the 2016 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. Other factors considered in the setting of the 2016 commercial harvest quotas include a review of previous harvests, extent of non-commercial harvest, proportion of the population not subject to harvesting, non-commercial harvest mortality and its significance, and rainfall trends.

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 for all species indicate that numbers occur over 1,000,000 in the harvest area. 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 2015.

Population estimates for all three species declined in the western harvest zone in 2015. No eastern grey kangaroos were observed in this zone which lies at the edge of this species natural range. No quota is set for eastern grey kangaroos in the western zone. The population estimate for common wallaroos is below 2 Standard Deviations of the long term average for this species in this zone. Therefore no quota is proposed for this species in this zone in 2016 either. Estimates for eastern grey kangaroos and common wallaroos in the central harvest zone decreased but not significantly. In contrast population estimates increased for eastern grey and red kangaroos in the eastern harvest zone and also red kangaroos in the central harvest zone.

For the 2014 commercial harvest no quotas were exceeded, with the maximum percentage of quota utilised being 24.8% for eastern kangaroos in the central zone. Sex ratios from harvest data continue to be biased towards males with the overall percentage of females harvested below 4%. Thus, the last completed harvest period provides no indication of adverse pressure on populations that would influence proposed quotas.

For the 2015 harvest period up to 31 July, 1% of the available quota for red kangaroos in the western zone had been harvested with 4% and 12% of the quota harvested in the eastern and central zones respectively. For eastern grey kangaroos, 15% and 5% of the quota was harvested in the central and eastern zones respectively. For common wallaroos, the highest percentage of quota harvested was 9% in the central zone, with 3% harvested in the eastern zone and less than 2% in the western zone. Given these figures, it is unlikely that quotas will be met for each species in each zone in 2015.

Usage of DMPs in 2014 were below the 1% of the population estimate quota for all species for all zones. The current percentages for utilisation of DMP quotas for 2015 are well below the new 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. The total area of the non-harvest zones is 236,408km^2.

Whilst macropod numbers observed in the eastern harvest zone increased in 2015, for eastern grey and red kangaroos, they decreased for common wallaroos. The majority of the harvest zones are drought declared and macropod numbers overall have decreased slightly. Should the widespread dry conditions continue throughout the state it is possible that observed macropod numbers will decrease again in 2016.

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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 2013–2017. 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^2 (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^2 (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 are still close correspondences 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^2 for eastern grey kangaroos, 1,105,587km^2 for red kangaroos and 1,104,222km^2 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 Heritage Protection 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	✓		✓
		Cloncurry	✓		✓

Appendix 2 Densities per km^2 of the commercially harvested macropod species 2004–2015

	Eastern grey kangaroo											
Block	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**
Barcaldine	20.61	13.17	22.77	17.65	23.15	29.50	12.871	23.92	24.09	44.10	24.96	19.31
Blackall	7.57	7.10	6.22	7.51	8.28	11.19	7.082	6.08	9.87	19.41	10.59	8.75
Bollon	25.66	25.31		30.53		31.74	30.143		47.2		32.01	24.95
Charleville	17.51	19.91	15.96	12.05	11.20	12.95	12.229	28.11	25.12	26.77	11.77	8.4
Charters Towers		1.63		5.02		5.33	5.568		3.37		3.14	2.01
Cloncurry	0.01		0.16		0.02		0.214	0.012		0.07		0.00
Cunnamulla	13.20		9.97		11.44		11.642	32.82		41.04		35.87
Duchess	0.00		0.00		0.00		0.00	0.00		0.00		0.00
Emerald		3.95		3.41		4.05	5.035		2.75		7.01	5.29
Hughenden	0.77	0.58		1.16		0.97	0.795		0.53		1.17	1.41
Hungerford	1.16	1.10		0.77		0.94	0.651		2.20		4.00	3.79
Inglewood		8.72		18.62		9.75	12.326		29.10		32.73	49.88
Injune	13.53	18.85		18.62	6.82		16.599	17.75		31.32		22.52
Julia Creek	1.08	0.87	1.05		0.76		0.276	0.28		0.84		0.84
Longreach	9.05	8.48		6.63		6.61	6.129		18.07		20.17	5.25
Quilpie	1.86		0.97		1.42		2.795	1.57		3.61		4.65
Roma	25.05	24.98	25.46	25.12		23.43	19.298		27.16		40.56	32.23
Taroom	8.12	13.37		8.44		7.87	7.362		14.98		13.24	12.65
Westmar	25.53		23.17		21.18		22.083	37.25		62.54		77.9
Windorah	1.58	2.69	1.14	1.39	2.39	1.26	0.858	2.68	1.24	1.80	0.79	1.02
Winton	4.86	2.98	3.74		4.78		2.432	3.57		6.61		5.79

	Red kangaroo											
Block	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**
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
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
Bollon	4.13	8.87		8.35		11.16	9.90		7.78		7.27	9.83
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
Charters Towers		0.02		0.05		0.00	0.70		0.24		0.21	0.62
Cloncurry	2.14		4.18		6.17		3.01	3.34		5.91		4.06
Cunnamulla	3.54		4.59		9.02		10.65	18.27		28.76		27.29
Duchess	2.92		0.87		1.78		0.85	0.71		0.82		1.66
Emerald		0.00		0.00		0.00	0.02		0.05		0.00	0.00
Hughenden	1.97	1.59		1.59		1.29	0.92		2.22		2.67	1.52
Hungerford	1.04	2.57		3.90		4.41	2.60		7.01		8.75	9.7
Inglewood		0.00		0.00		0.00	0.50		0.00		0.00	0.00
Injune	1.02	0.14	0.05		0.72		0.00	0.86		0.04		0.00
Julia Creek	4.08	5.13	4.91		5.39		3.16	3.30		8.10		5.6
Longreach	9.53	11.86		11.33		14.71	12.24		14.43		19.26	4.79
Quilpie	2.19		1.39		5.13		2.06	4.70		9.80		9.51
Roma	2.19	1.62	2.54	2.66		2.37	2.26		3.47		5.02	2.83
Taroom	0.02	0.37		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
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
Winton	3.69	5.02	5.62		6.05		3.32	4.44		9.73		16.98

	Common wallaroo											
Block	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**
Barcaldine	6.59	12.30	8.63	16.42	19.98	16.20	5.521	8.306	5.53	9.02	4.69	6.79
Blackall	18.02	21.17	22.15	34.98	39.14	49.05	23.819	21.549	20.2	54.43	28.58	24.86
Bollon	4.72	2.64		1.55		1.67	0.363		2.44		0.7	0.31
Charleville	7.21	6.20	5.79	4.66	4.70	5.36	11.803	13.439	10.65	5.09	4.47	4.07
Charters Towers		0.30		2.84		0.61	1.069		0.51		1.03	0.22
Cloncurry	0.00		0.30		0.64		0.507	0.260		0.14		0.02
Cunnamulla	1.68		0.45		0.64		1.951	0.611		0.70		2.53
Duchess	0.57		0.11		1.69		0.743	0.093		1.16		0.00
Emerald		0.02		0.00		0.78	0.024		0.33		0.19	0.32
Hughenden	1.65	1.28		2.28		0.24	0.411		0.94		0.93	0.22
Hungerford	1.19	0.36		0.24		0.48	0.254		0.47		1.27	1.93
Inglewood		3.08		4.03		0.34	1.013		1.22		3.18	3.42
Injune	0.01	2.30	1.34		0.91		4.053	0.00		0.63		0.84
Julia Creek	2.74	0.00	0.04		0.11		0.013	0.00		0.00		0.00
Longreach	17.96	21.57		18.59		12.69	9.185		17.77		15.67	8.84
Quilpie	5.41		0.78		3.36		2.686	3.007		5.58		7.51
Roma	1.35	3.74	2.49	2.08		1.16	3.447		0.87		1.01	0.75
Taroom	0.22	2.04		0.17		1.05	0.253		0.02		0.38	0.18
Westmar	0.74		0.02		0.13		0.299	0.00		0.01		0.00
Windorah	2.14	2.30	1.81	2.72	3.03	3.07	2.422	3.185	3.32	5.29	2.82	1.46
Winton	1.73	1.78	1.70		3.14		0.955	4.191		6.35		0.76