

2011 Quota Submission for Commercially Harvested Macropods in Queensland

#29602

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Background

The commercial macropod harvest in Queensland is focused on three species:

- red kangaroo (*Macropus rufus*)
- eastern grey kangaroo (*M. giganteus*)
- common wallaroo (*M. robustus*).

The harvest is divided into four zones in Queensland—the non-harvest zone (quota zero), eastern harvest zone, central harvest zone and western harvest zone.

The harvest is administered through a quota, and a quota submission is released annually that outlines proposed quotas for each species in each zone for the following calendar year.

Quotas are set between 10 and 20 per cent 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 2010 and proposed sustainable use quotas for the 2011 commercial harvest can be found in Table 1.

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
- the proportion of the population not subject to harvesting
- non-harvest mortality and its significance
- rainfall trends.

This quota submission outlines in detail the aspects of these criteria that pertain to the 2011 proposed quota.

In 2010 aerial surveys were conducted at all 22 monitor blocks across the state. Population estimates derived from the surveys have decreased when compared to 2009 for each species in each zone, with the exception of eastern grey kangaroos in the western zone and common wallaroos in the eastern zone that have increased. Consequently, quotas have decreased for each species in each zone, except for common wallaroos in the eastern zone. Despite the increase in populations of eastern grey kangaroos in the western zone, no quota will be issued for take of this species in this zone as population size still remains small.

Examination of long-term trends in population and block density estimates indicates that the 2010 estimates are within the realm of fluctuations in previous years and above the low of the mid 1990s. All three commercially harvested species consistently number over 1 000 000 in Queensland.

In the 2009 harvest period 55 per cent of the commercial harvest quota was utilised, with the highest percentage of quota used being 69 per cent for common wallaroos in the central zone. The overall harvest was male biased, with females comprising 11 per cent of the overall harvest.

All tags for 2010 have been issued for red kangaroos in the eastern zone, with less than 40 per cent of the quota issued in tags for red kangaroos in the western and central zones. For eastern grey kangaroos, less than 50 per cent of the quota has been issued in tags for all three harvestable zones. For common wallaroos, the highest percentage of quota issued is 64 per cent in the central zone, whilst only 11 per cent of the quota has been issued in tags in the western zone. Given these figures, it is unlikely that quotas will be met for each species in each zone in 2010, with the exception of red kangaroos in the eastern zone.

Non-commercial take under Damage Mitigation Permits were below quota for the 2009 harvest period. In 2010, the highest percentage of quota utilised has been for common wallaroos in the central zone at 45 per cent.

The three commercially harvested macropod species continue to be protected from harvesting within the harvest area in national parks and state forests. The protected areas equate to between four to five per cent of their total distribution.

While some mortality in macropods was recorded in the 2010 harvest period, investigation and surveillance demonstrated that this was a small and isolated occurrence.

Rainfall increased in the second half of 2009 and through the 2010 harvest period, with many areas receiving above average rainfall. This rainfall may result in increased numbers of macropods in the 2011 aerial surveys if it continues. However, it is probable that it did not arrive early enough for an observed increase in the mature macropod population that was surveyed in 2010.

Introduction

The Department of Environment and Resource Management (DERM) administers the harvest of macropods in Queensland in accordance with the following overarching goal, 'to provide sustainable use, conservation of the species and their habitats in accordance with the principles of ecologically sustainable development' (Anon 2008).

The harvesting of the three species of macropods—the red kangaroo (*Macropus rufus*), eastern grey kangaroo (*M. giganteus*) and common wallaroo (*M. robustus*)—is regulated through the:

- *Environment Protection and Biodiversity Conservation Act 1999*
- Queensland Wildlife Trade Management Plan for Export – Commercially Harvested Macropods – 2008-2012
- *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.*

Management of the harvest is facilitated via a quota that sets the number of animals that can be taken. Quotas are established based largely on aerial surveys of the commercially harvested species and have been utilised in Queensland since 1975. The Director-General of DERM declares a harvest period open annually via the harvest period notice and sets quotas for this period according to the Queensland Wildlife Trade Management Plan for Export – Commercially Harvested Macropods – 2008-2012. Quotas are provided to the Commonwealth Minister for Sustainability, Environment, Water, Population and Communities for endorsement.

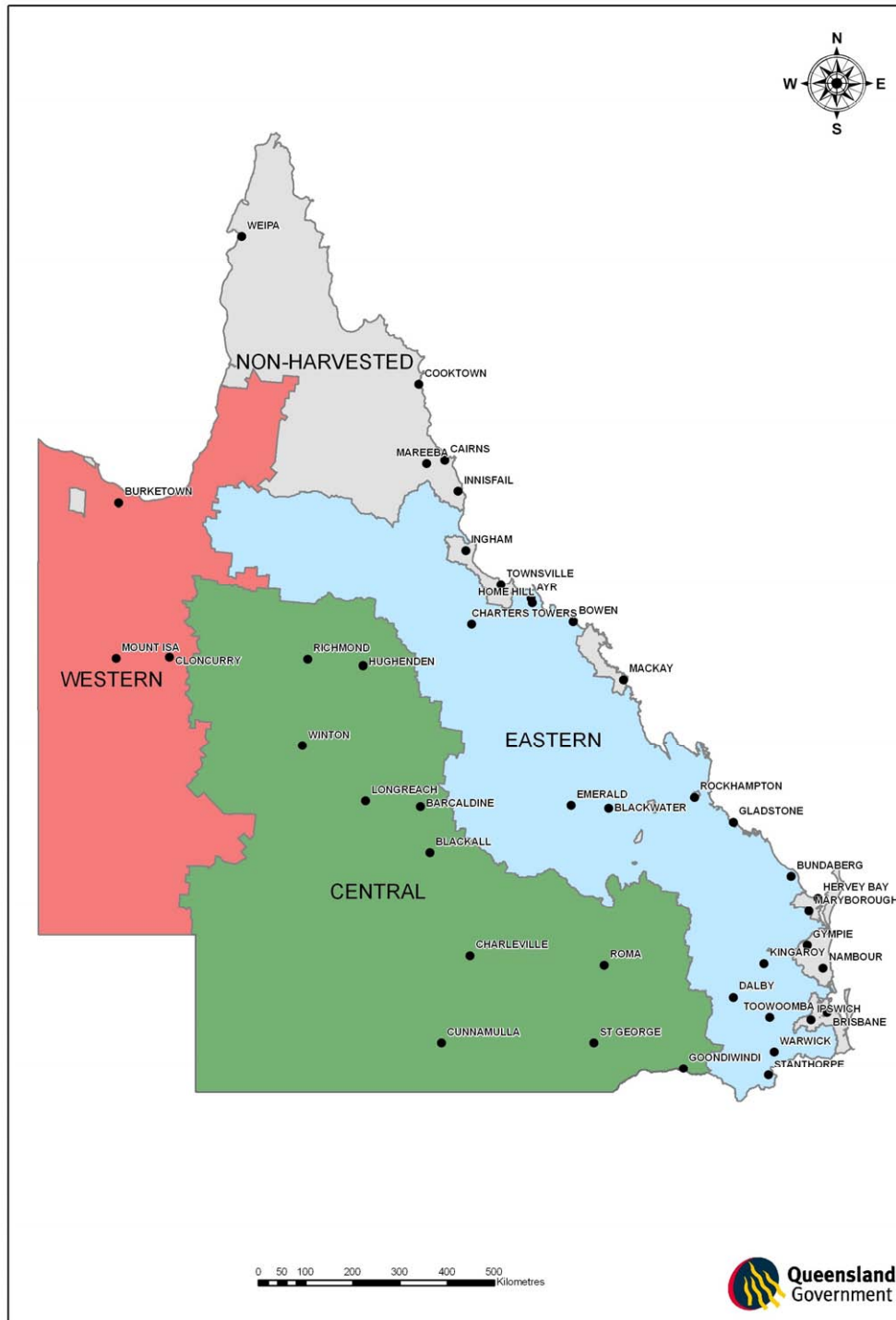
Quotas in Queensland are set between 10 and 20 per cent of the estimated population for each species in each zone. Harvesting at these levels will ensure a sustainable yield and long-term conservation of macropod populations.

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).

This quota submission contains a summary of the recommended quotas for each of the species in each of the harvest zones for 2011. Additionally, the submission outlines the basis of how these quotas were determined.

The Nature Conservation (Macropod Harvest Period 2011) Notice 2010 was released in December 2010. The release of this notice will allow the harvest period to be declared open on 1 January 2011. The notice will outline specific conditions for the 2011 harvest period including, but not limited to, harvest zone boundaries and weights.

Figure 1. Queensland harvest zones



Proposed quotas

The 2010 estimated population sizes and proposed sustainable use quotas for 2011 for the commercially harvested species in each zone are outlined in Table 1.

Species	Harvest zone	2010 estimated population	2011 Sustainable use quota (rounded to the nearest 50)	Proportion of population (% rounded to the nearest whole number)
Red kangaroo	central	3 352 823	620 700	19
	eastern	85 548	8 550	10
	western	165 138	16 500	10
	combined	3 603 509	645 750	18
Eastern grey kangaroo	central	5 160 736	772 000	15
	eastern	1 483 247	148 350	10
	western	8 460	n/a	0
	combined	6 652 443	920 350	14
Common wallaroo	central	1 433 632	212 850	15
	eastern	358 640	35 850	10
	western	124 582	12 450	10
	combined	1 916 855	261 150	14

Table 1. 2010 estimated populations and 2011 proposed quotas for each species in each zone

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 per cent of the populations for eastern grey kangaroos and common wallaroos and 20 per cent 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 per cent 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, DERM and the federal Department of Sustainability, Environment, Water, Population and Communities (DSWEPC) for determining state quota limits.

Criteria considered in quota determination

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

- population trends
- review of previous harvests
- the extent of non-commercial harvest
- the proportion of the population not subject to harvesting
- non-harvest mortality and its significance
- rainfall trends.

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

Long-term population trends

Population estimates

Since 1991 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 used to obtain population estimates that inform the quota. The methodology of the surveys is outlined in detail in Appendix 1. Please note that all 22 monitor blocks across the state were surveyed in 2010. Every five years all survey blocks must be monitored. In the intervening years a subset is monitored.

Current harvesting rates (quotas ranging from 10 to 20 per cent of population estimates) are considered sustainable. None of the three commercially harvested species has shown a consistent decline in abundance since 1992 (Figures 2 and 3), 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. Macropod population estimates have decreased in 2010, however they remain above the low of the mid 1990s.

At the close of the 20th century and commencement of the 21st there was a succession of high rainfall seasons (resulting in increased pasture biomass) following drought that contributed to a peak in population numbers for the three macropod species (Figures 2, 4 and 5). This was coupled with depressed industry economics, resulting in a decrease in harvest pressure (Anon 2002). Anecdotal evidence suggested that wet periods and high pasture biomass over this period may have caused difficulty in accessing kangaroos, and consequently added to the decrease in harvest pressure (Anon 2002).

Density estimates

To help ensure 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 eastern and western zones, with the central zone divided into three regions, central zone north (Mitchell Grass dominant), central zone south (Mulga Lands dominant) and central zone east (Brigalow belt dominant) (Figures 6-8).

This data is monitored for any significant decreases in densities. This approach is possible for all data collected since regionalisation of the macropod commercial harvest management in 2003. Examination of trends in density for the three commercially harvested macropod species in the areas outlined above for the period 2003-2010 demonstrates densities do fluctuate over time (Figures 6-8)

For red kangaroos densities are greatest in the central zone north and central zone south, with densities lowest in the eastern zone (Figure 6). Low densities in the eastern zone are expected as this area incorporates the edge of the distributional range for this species (Figure 6).

For eastern grey kangaroos highest densities are recorded in the central zone east (Figure 7). eastern grey kangaroos occur in consistently low densities in the western zone at the edge of their distributional range (Figure 7). 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 and lowest densities in the western zone (Figure 8). Densities have increased in recent years by small amounts in all areas except for the central zone north where numbers have decreased in the last three years. Since regionalisation in 2003 numbers have fluctuated for this species in this area.

Although population estimates have decreased in 2010 for each species in each zone, with the exception of common wallaroos in the eastern zone and eastern grey kangaroos in the western zone, the block density estimates for 2010 are consistent with the fluctuations in densities observed through time (Appendix 2).

Figure 2. Macropod population trends - 1992 to 2010

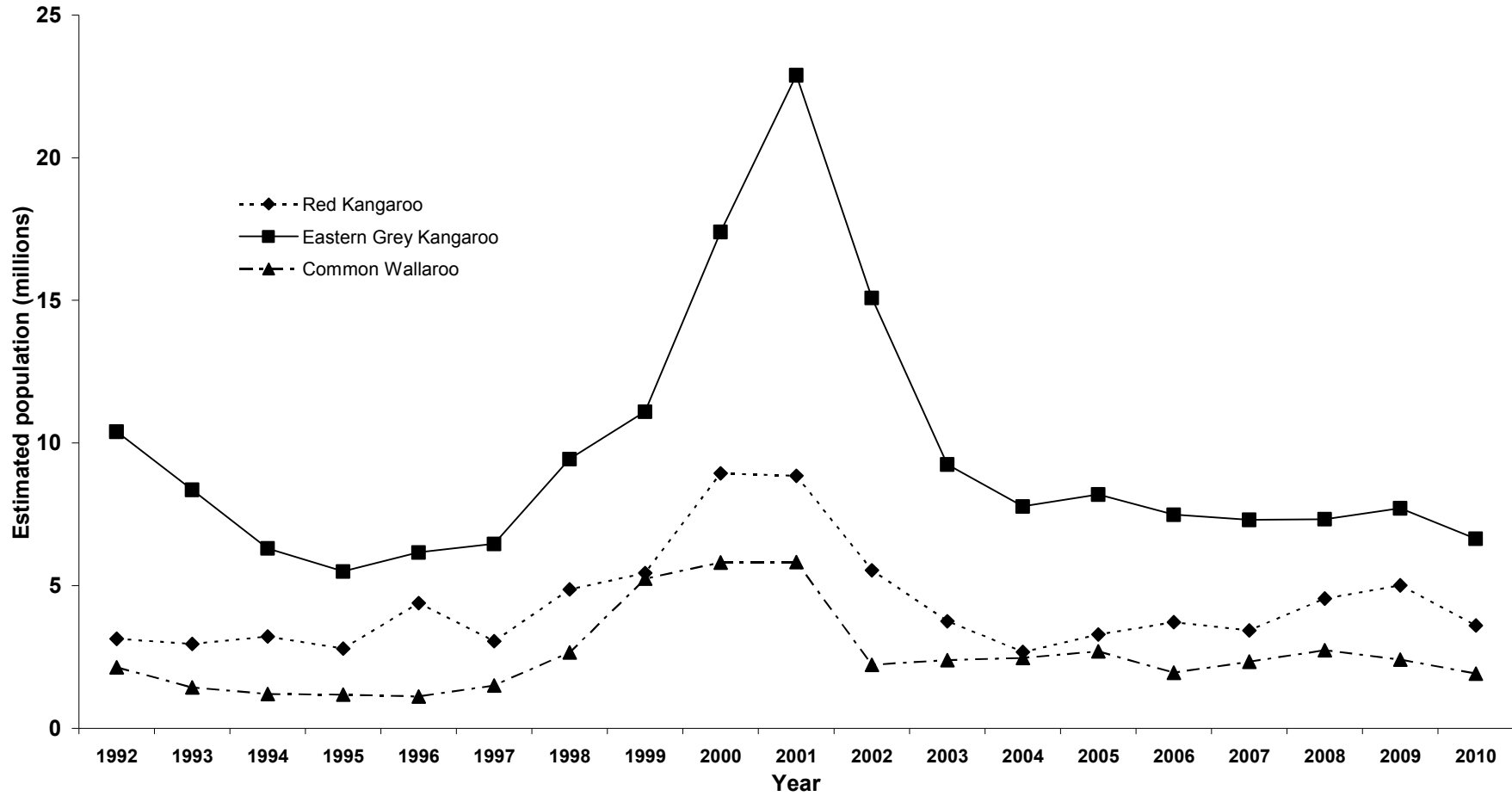


Figure 3. Macropod population estimates since 2003 regionalisation

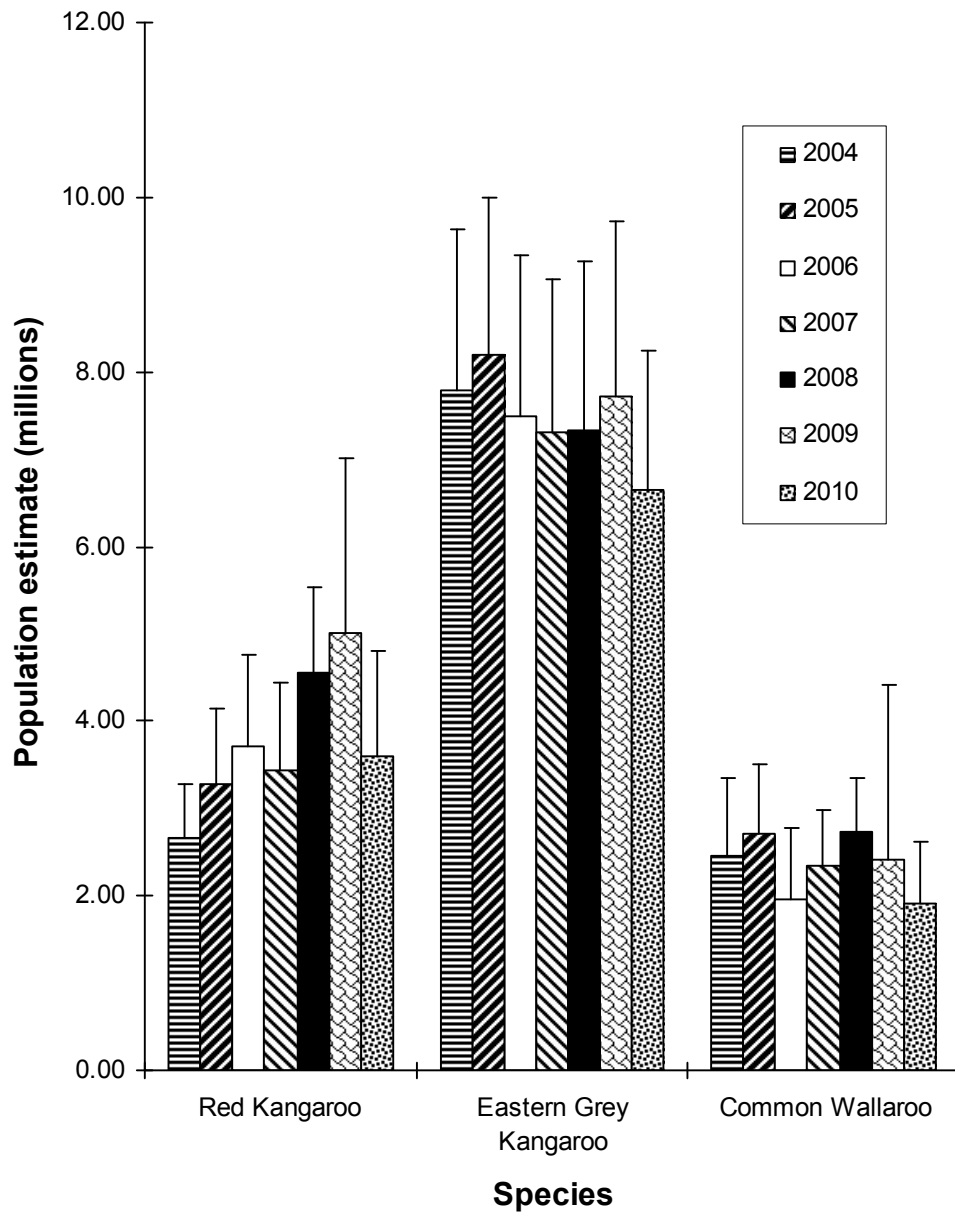


Figure 4. Australian rainfall deciles, 1 June 1999 to 31 May 2000 (Anon 2002)

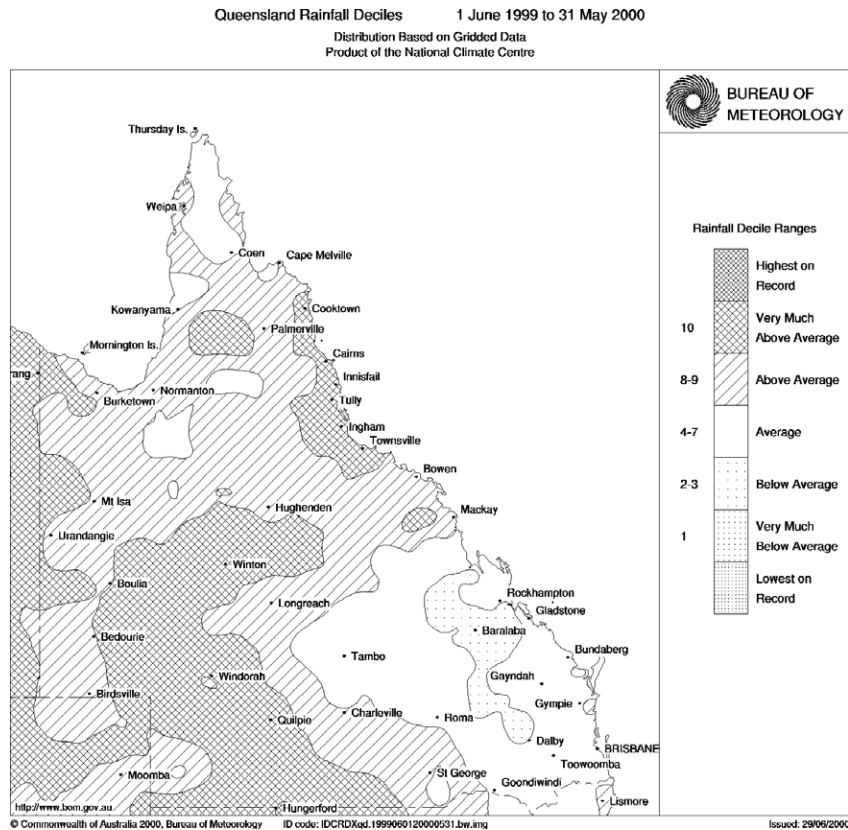


Figure 5. Australian rainfall deciles, 1 June 2000 to 31 May 2001 (Anon 2002)

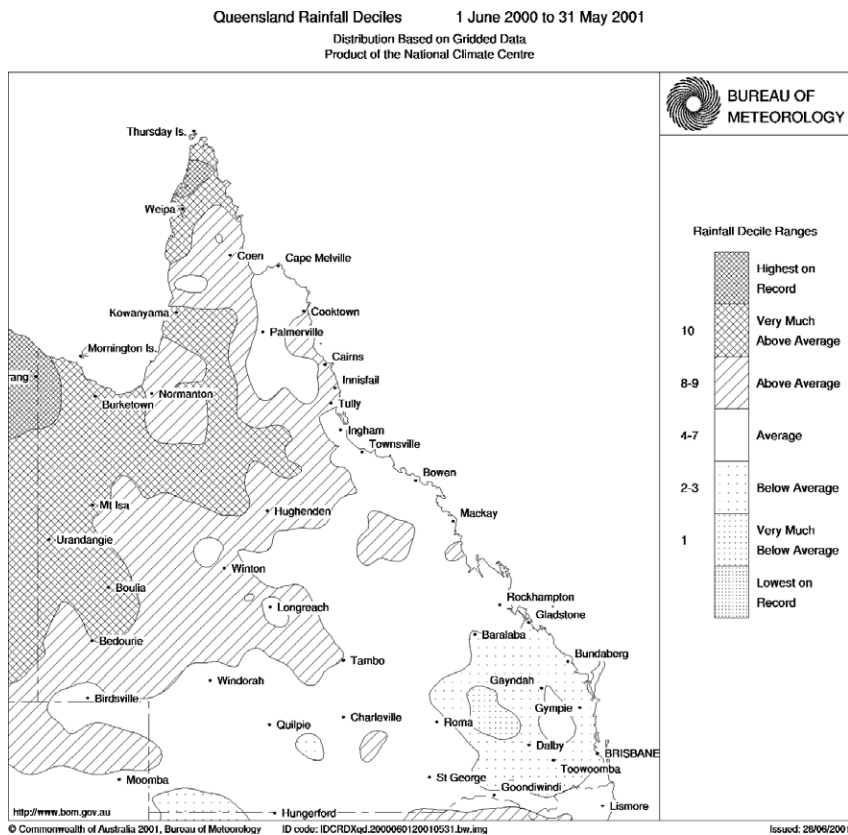


Figure 6. Density of the red kangaroo (per km²), 2003-2010

Red Kangaroo Distribution and Density Trends

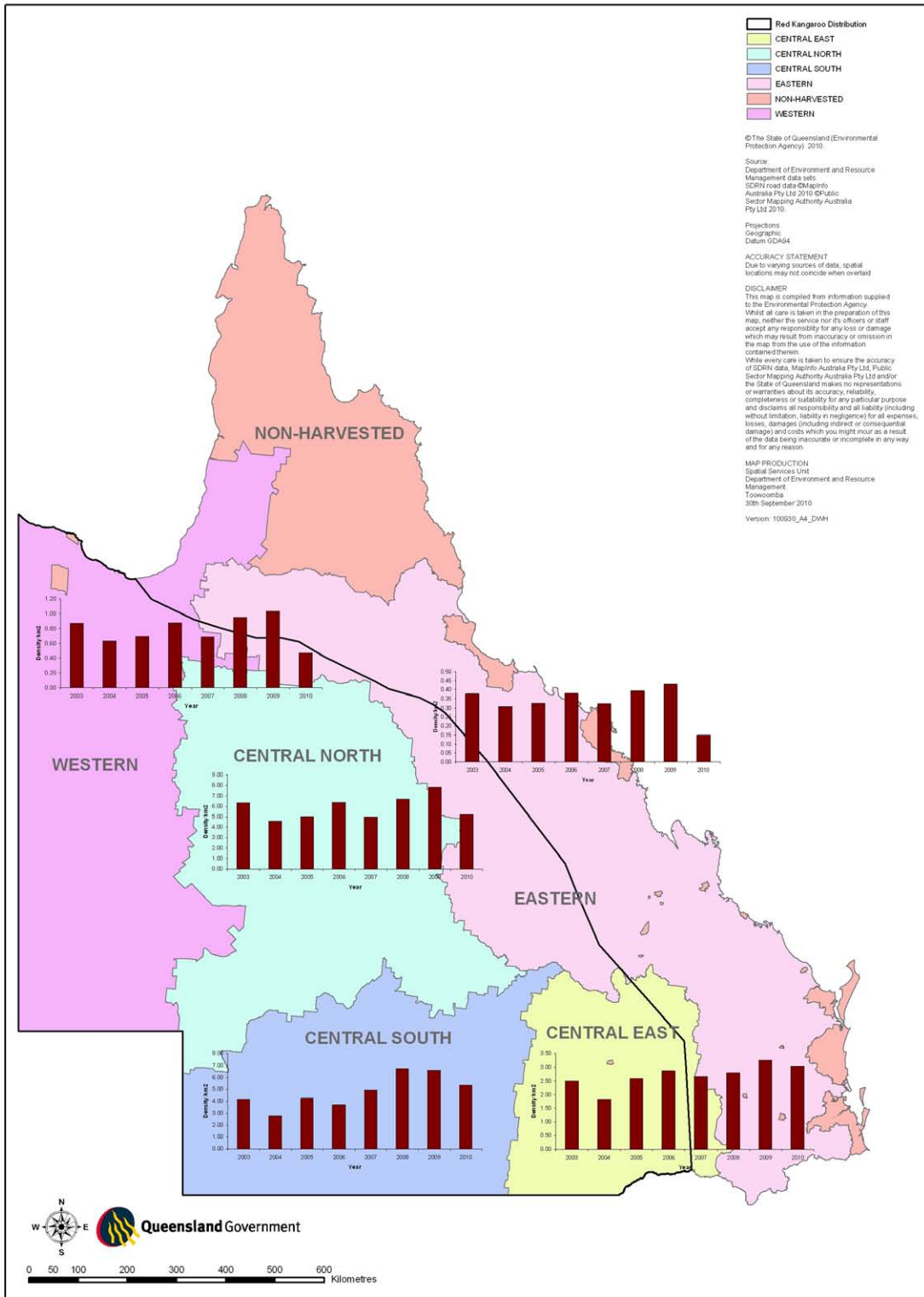


Figure 7. Density of the eastern grey kangaroo (per km²), 2003-2010

Eastern Grey Kangaroo Distribution and Density Trends

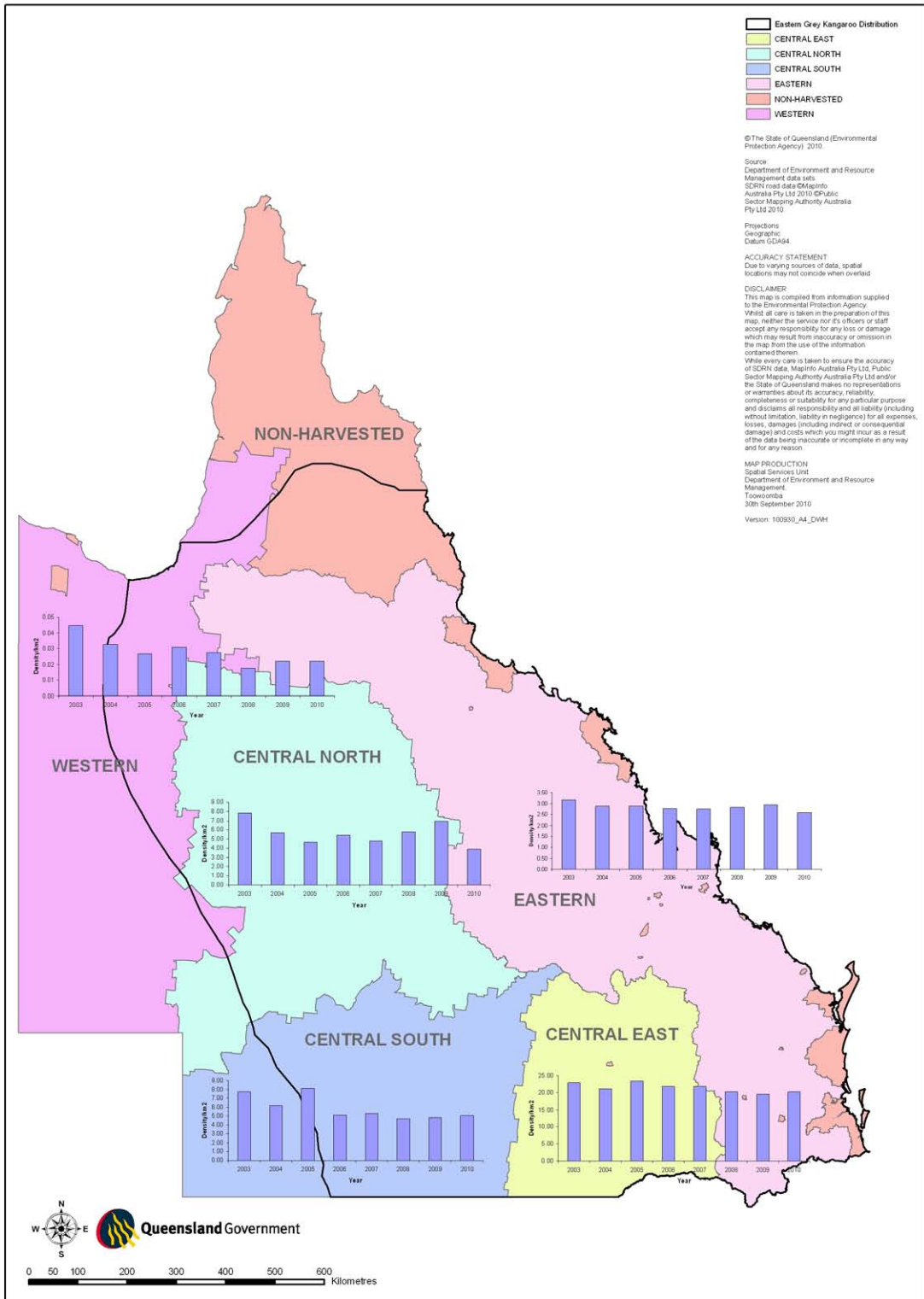
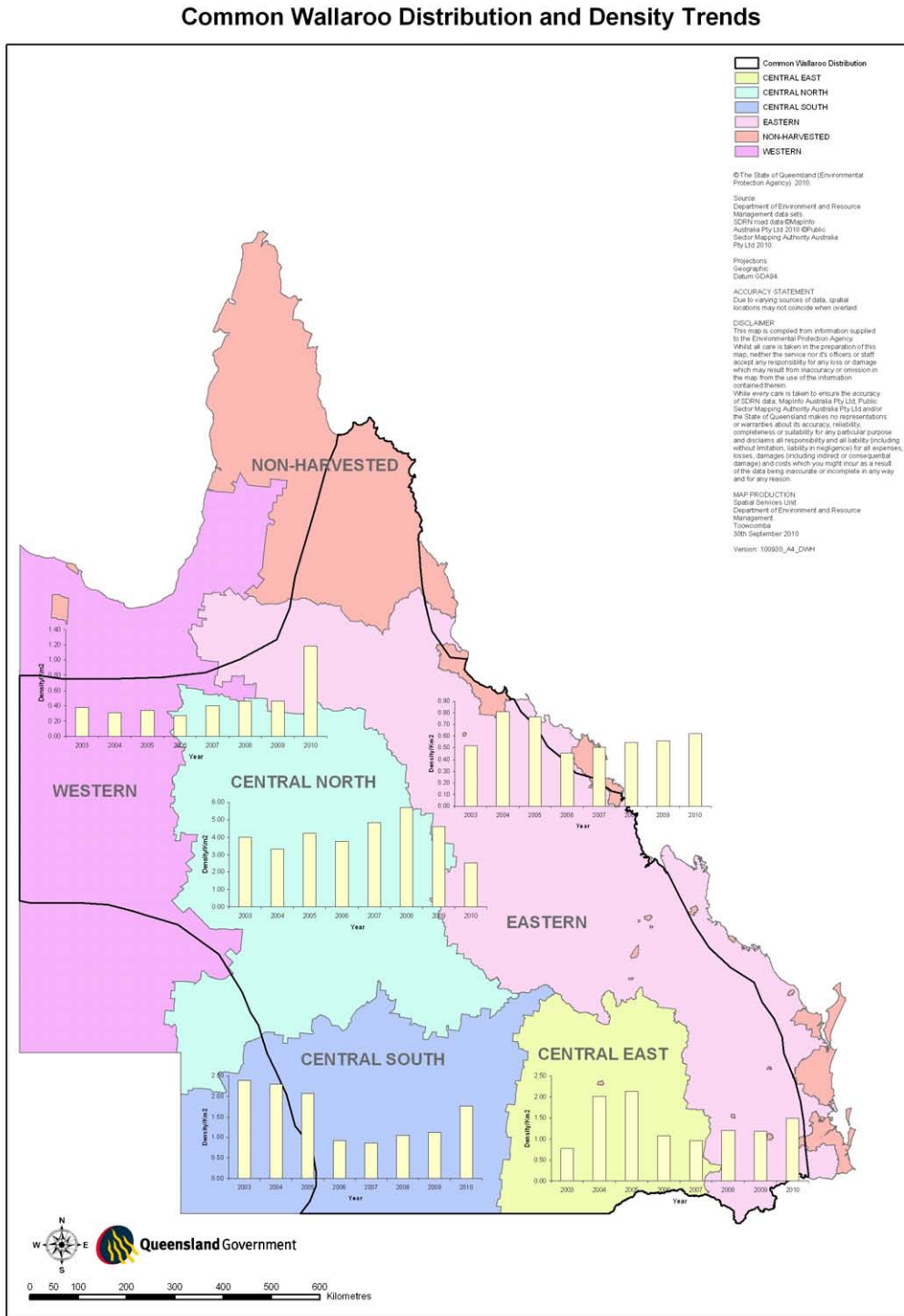


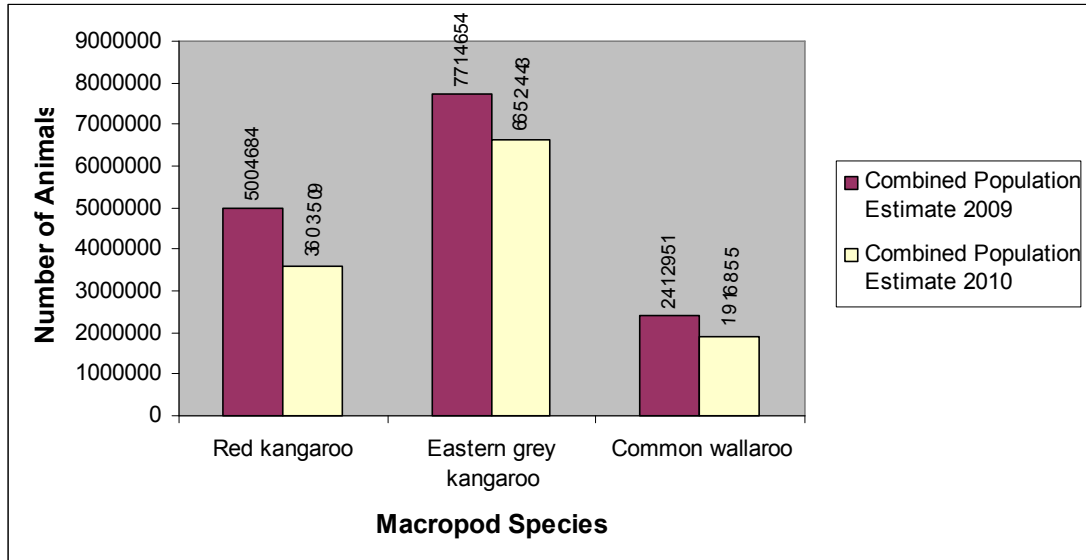
Figure 8. Density of the common wallaroo (per km²), 2003-2010



Comparison between 2009 and 2010 population estimates

Overall populations of eastern grey kangaroos, red kangaroos and common wallaroos declined in 2010 when compared to 2009 (Figure 9). Eastern grey kangaroos decreased by 13.77 per cent whilst red kangaroos decreased by 28 per cent (Table 2). Common wallaroos decreased by 20.56 per cent.

Figure 9. Comparison of overall macropod populations 2009 and 2010



Species	Harvest zone	2009 population estimate	2010 population estimate	Population change (%) 2009-2010
Red kangaroo	Central	4 532 104	3 352 823	-26.02%
	Eastern	110 397	85 548	-22.51%
	Western	362 183	165 138	-54.40%
	Combined	5 004 684	3 603 509	-28.00%
Eastern grey kangaroo	Central	6 015 263	5 160 736	-14.21%
	Eastern	1 694 031	1 483 247	-12.44%
	Western	5 360	8 460	57.84%
	Combined	7 714 654	6 652 443	-13.77%
Common wallaroo	Central	1 928 879	1 433 632	-25.68%
	Eastern	321 221	358 640	11.65%
	Western	162 851	124 582	-23.50%
	Combined	2 412 951	1 916 855	-20.56%

Table 2. Comparison between 2009 and 2010 macropod population estimates

The populations of red kangaroos decreased in each of the zones, including by 26.02 per cent in the central zone, 22.51 per cent in the eastern zone and 54.40 per cent in the western zone in 2010. Subsequently there is a decrease in the proposed quota for red kangaroos in each of the zones (Table 2 and Figures 10-11).

Eastern grey kangaroo populations decreased in the central and eastern zones by 14.21 per cent and 12.44 per cent respectively (Table 2 and Figure 10). However, there was an increase in numbers in the western zone by 57.84 per cent (Table 2 and Figure 10). As was the case for the 2009 quota, 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 (Figures 10 and 11).

Common wallaroos decreased in the central and western zones by 25.68 per cent and 23.50 per cent respectively (Table 2 and Figure 10). However, they increased by 11.65 per cent in the eastern zone. Thus, the quota for common wallaroos in the eastern zone has increased when compared to 2010 but decreased in the central and western zones (Figure 11).

Figure 10. Comparison of macropod populations 2009-2010 by species and zone

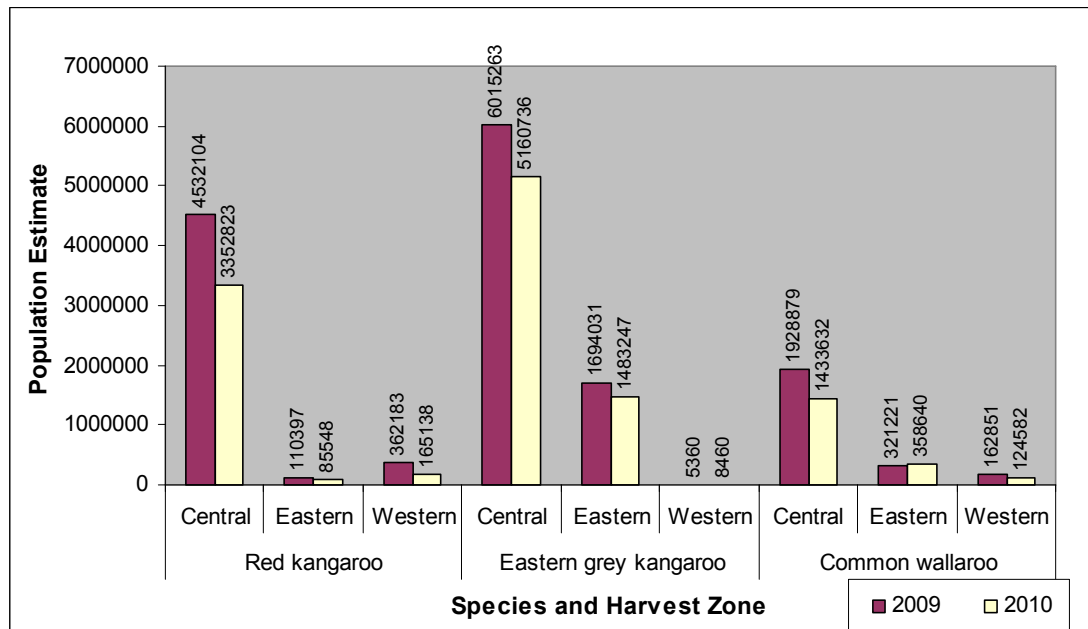
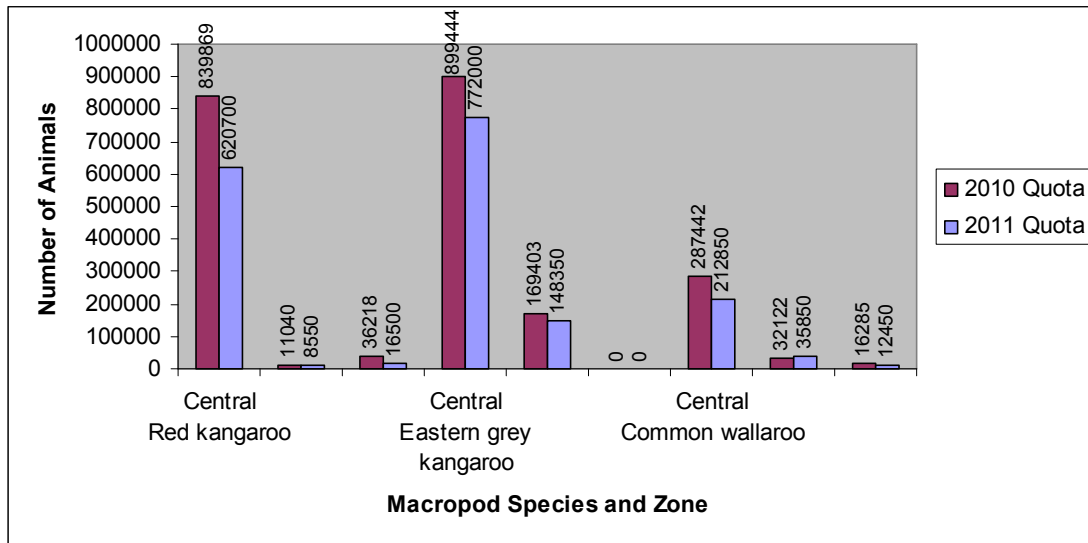


Figure 11. Comparison of 2009-2010 actual and proposed quotas



Long-term quota and harvest trends

Figures 12-14 outline data on the three commercially harvested macropod species pertaining to population, quota and harvest for the years 1993-2011, as available in September 2010. 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 to enable comparison with data collated prior to this period.

Figure 12. Long-term population, quota and harvest data for the red kangaroo

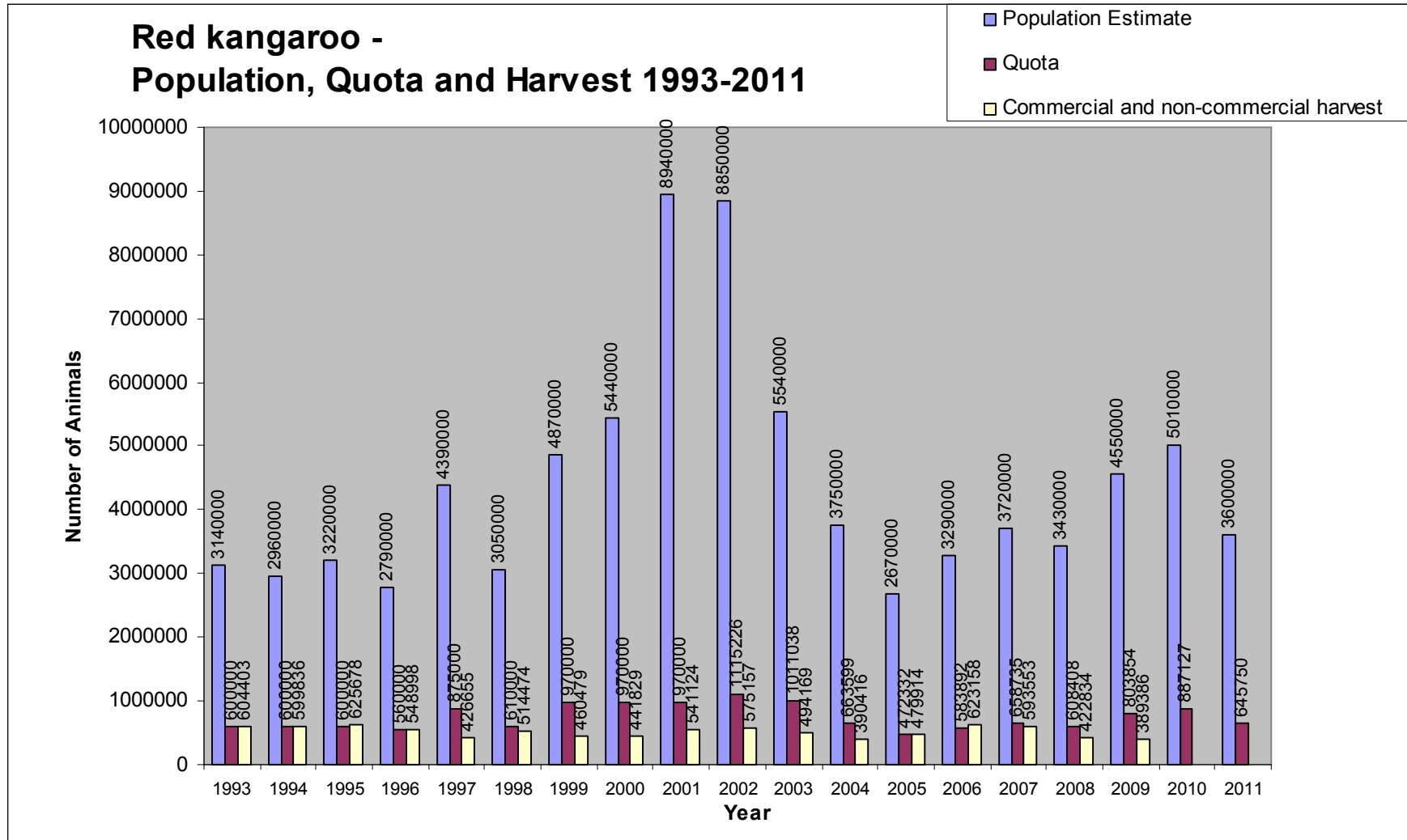


Figure 13. Long-term population, quota and harvest data for the eastern grey kangaroo

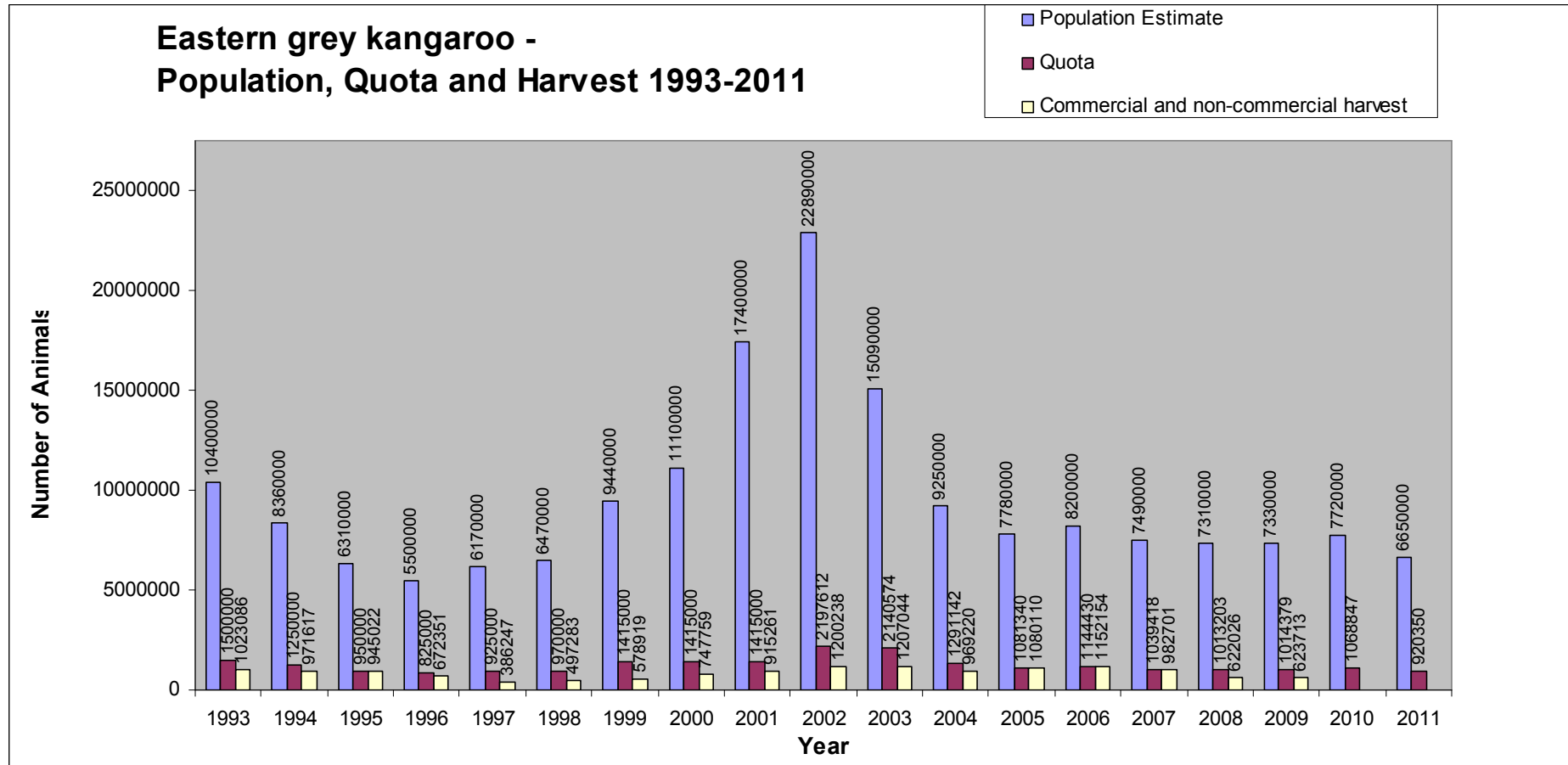
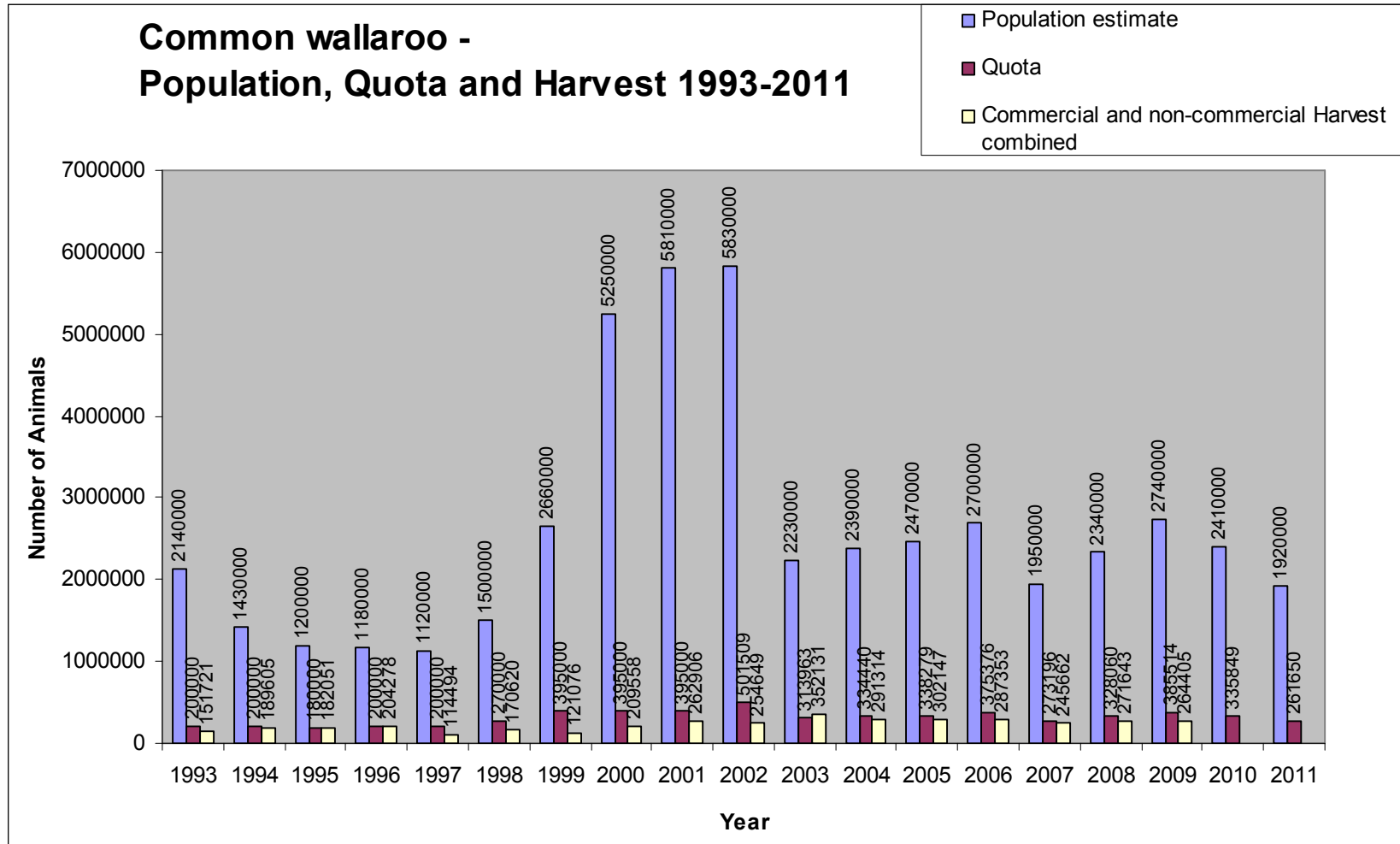


Figure 14. Long-term population, quota and harvest data for the common wallaroo



As previously outlined, there has been no consistent decline in the populations of the three commercially harvested species since 1993 (Figures 12-14). 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. All three species occur in numbers of over 1 000 000 across the harvest zones.

Quotas are set as a constant proportion of the population and will vary in accordance with fluctuations in the populations (Figures 12-14). 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 1993.

Since 1993 for red kangaroos, quotas have fluctuated between 472 332 and 1 115 226, while harvest take (commercial and non-commercial combined) has fluctuated between 390 416 and 625 678. For eastern grey kangaroos quotas have fluctuated between 825 000 and 2 197 612 and harvests have varied between the range of 386 947 and 1 207 044. For common wallaroos quotas have ranged between 180 000 and 501 509 and harvests have fluctuated between 114 494 and 352 131.

Review of the 2009 harvest

Dealer returns for the year 2009 indicate that there were 1 206 346 macropods taken in Queensland, which represents 55 per cent of the overall combined quota. Of the 1 206 346 animals taken there were 369 708 red kangaroos, 591 878 eastern grey kangaroos and 244 760 common wallaroos (table 3).

Quotas for individual species in each harvest zone were not exceeded in 2009, the maximum commercial take as a percentage of the approved quota of 69 per cent being for the common wallaroo in the central zone (Tables 4-6).

Species	Population estimate	Quota	Harvest take	% Q	% P	% Male	% Female
Red kangaroo	4 551 999	803 854	369 708	46	8	86	14
Eastern grey kangaroo	7 327 250	1 014 379	591 878	58	8	87	13
Common wallaroo	2 740 993	385 515	244 760	64	9	99.9	0.7
Total	14 620 242	2 203 748	1 206 346	55	8	89	11

Table 3: Total harvest in 2009 *Note: Population estimates are based on the aerial surveys conducted in 2008, which were used to set the 2009 quota. % Q = commercial take as percentage of approved quota; % P = commercial take as percentage of population estimate.*

Zone	Population estimate	Quota 2009	Harvest take	% Q	% P	% Male	% Female
Central	4 119 488	760 603	354 754	47	9	86	14
Eastern	99 918	9 992	6 526	65	7	82	18
Western	332 593	33 259	8 428	25	3	72	28
Total	4 551 999	803 854	369 708	46	8	86	14

Table 4. Harvest of red kangaroos by zone in 2009 *Note: Population estimates are based on the aerial surveys conducted in 2008, which were used to set the 2009 quota. % Q = commercial take as percentage of approved quota, % P = commercial take as percentage of population estimate.*

Zone	Population estimate	Quota 2009	Harvest take	% Q	% P	% Male	% Female
Central	5 694 505	851 669	517 738	61	9	89	11
Eastern	1 627 097	162 710	74 140	46	5	77	23
Western	5 647	n/a	n/a	n/a	n/a	n/a	n/a
Total	7 327 250	1 014 379	591 878	58	8	87	13

Table 5. Harvest of eastern grey kangaroos by zone in 2009 *Note: Population estimates are based on the aerial surveys conducted in 2008, which were used to set the 2009 quota. % Q = commercial take as percentage of approved quota, % P = commercial take as percentage of population estimate.*

Zone	Population estimate	Quota 2009	Harvest take	% Q	% P	% Male	% Female
Central	2 264 234	337 839	234 294	69	10	99.9	0.1
Eastern	315 985	31 598	9 699	31	3	99.5	0.5
Western	160 775	16 077	767	5	0.5	99.9	0.1
Total	2 740 993	385 515	244 760	64	9	99.9	0.1

Table 6. Harvest of common wallaroos by zone in 2009 *Note: Population estimates are based on the aerial surveys conducted in 2008, which were used to set the 2009 quota. % Q = commercial take as percentage of approved quota, % P = commercial take as percentage of population estimate.*

Sex ratio by species and zone

Commercial harvest is typically biased towards males, as they are often larger and heavier than females. In 2009, the total harvest for each species comprised between approximately 86 and 99.9 per cent males (Figure 15). Data gathered throughout 2009 indicates 11 per cent of the overall harvest was female (Figure 15), which is below the previous three years (Figure 16).

Figure 15. Sex ratio by species in 2009

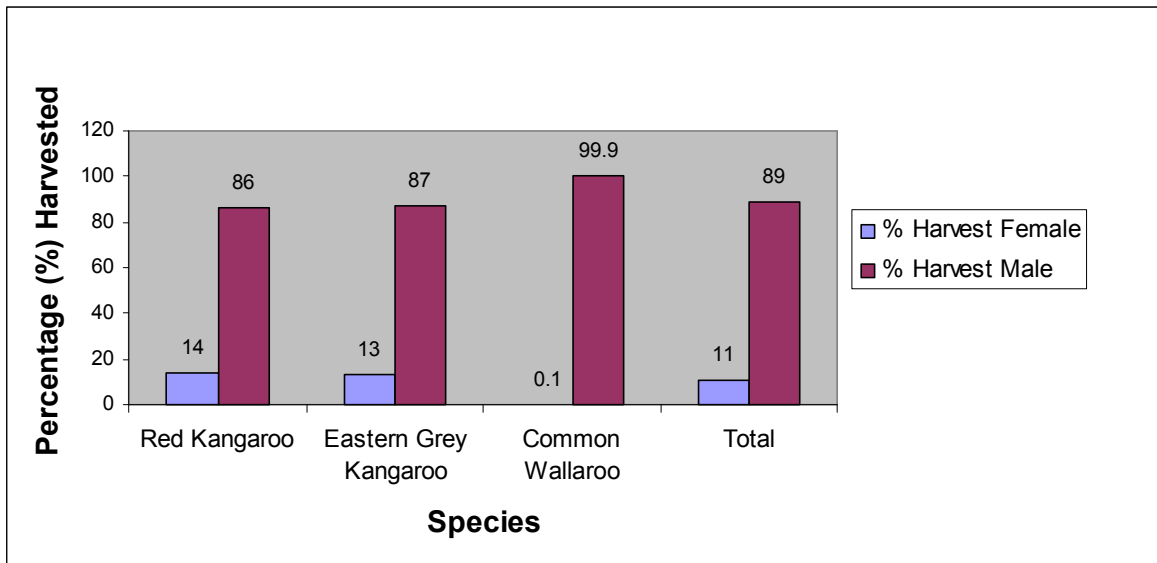
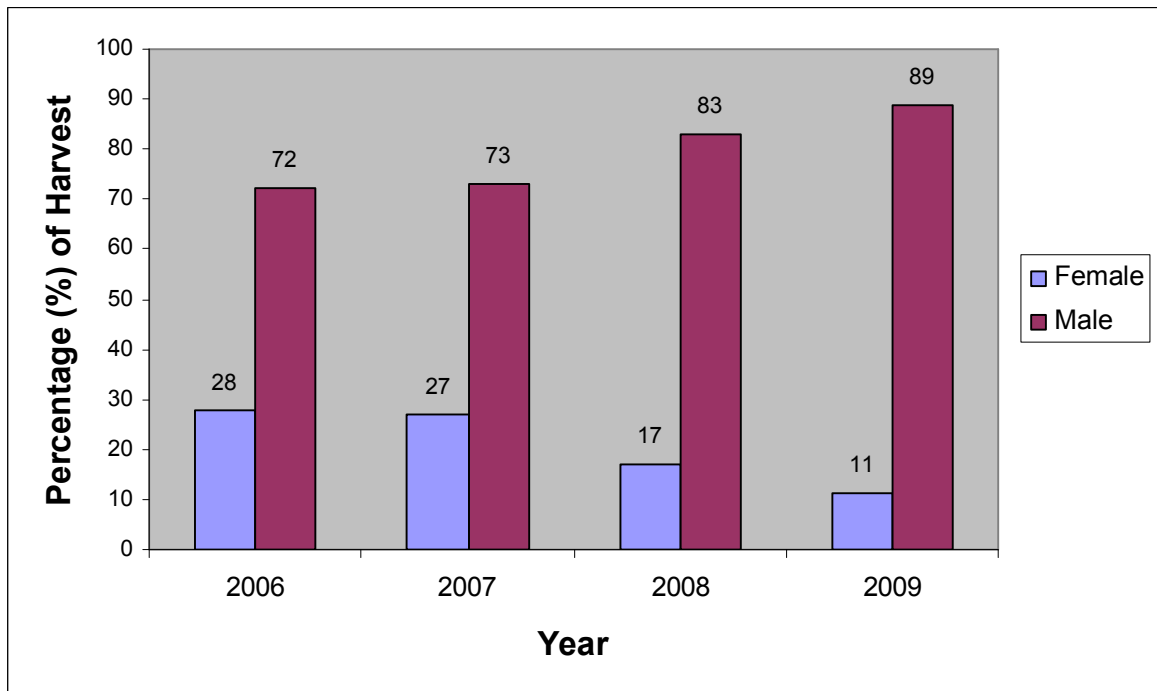


Figure 16. Overall sex ratio 2006-2009



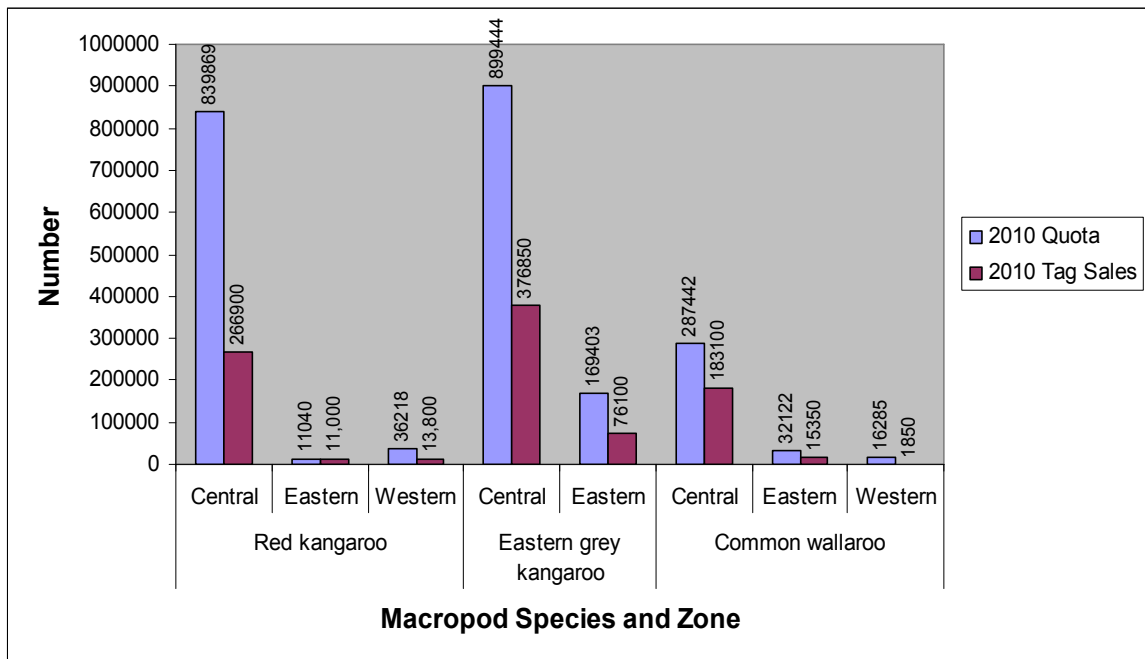
Harvest update for 2010

The total number of tags issued up to 20 September 2010 for red kangaroos was 291 700, for eastern grey kangaroos totalled 452 950 and for common wallaroos numbered 200 300 (Figure 17)

All tags have been issued for red kangaroos in the eastern zone, whilst tags issued are less than 40 per cent of quota for the central and western zones (table 7). For eastern grey kangaroos, the tags issued are for less than 50 per cent of quota for all harvestable zones (table 7). For common wallaroos the highest percentage of quota utilised in tags issued is for 64 per cent for the central zone, whilst it is only 11 per cent for the western zone (table 7). Under the new system introduced into Queensland for the 2010 harvest period, where the number of tags produced matches the maximum quota for each species in each zone, it is not possible for the commercial harvest quotas to be exceeded. Given the percentage of the quota that has currently been issued in tags, it is unlikely quotas will be met for most species in most harvest zones, with the obvious exception of red kangaroos in the eastern zone and potentially common wallaroos in the central zone.

The 2010 harvest will be comprehensively reported on in the Annual Report 2010, due for release in March 2011.

Figure 17. Harvest update for 2010 (data derived from tag sales as of 20 September 2010)



Species	Zone	Tags issued as a percentage of quota for 2010
Red kangaroo	Central	32
	Eastern	100
	Western	38
Eastern grey kangaroo	Central	42
	Eastern	45
	Western	n/a
Common wallaroo	Central	64
	Eastern	48
	Western	11

Table 7. Tags issued as a percentage of quota for 2010

Non-commercial take and damage to primary production

Damage Mitigation Permits (DMPs) are issued by DERM where macropods are causing demonstrable damage to primary production. The issuing of these permits is limited to a maximum of one per cent 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.

For comparative purposes, a summary of the macropods taken under DMPs for each species for each zone for 2006-2010 is outlined in Figure 18. Since 2006 the greatest number of macropods taken under DMPs are from the central zone, with the lowest number of DMP take recorded in the western zone.

A total of 125 DMPs were issued for macropods in Queensland in 2009. For 2010 there have been 57 permits issued as of 28 August 2010.

The current percentages of quota issued for 2010 are below the quota limit, as at 28 August 2010 (Figure 19 and Table 8). The highest percentage of quota used is for the common wallaroos in the central zone at 45 per cent

Figure 18. Macropods taken under Damage Mitigation Permits 2006-2010 *Note: 2010 figures are as recorded on 28 August 2010*

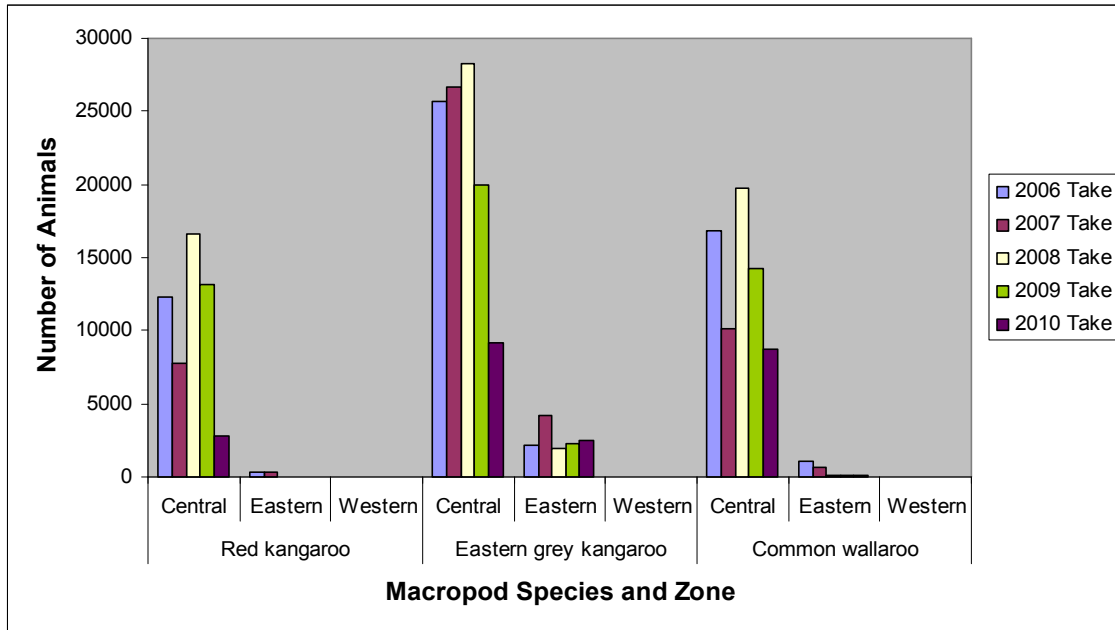
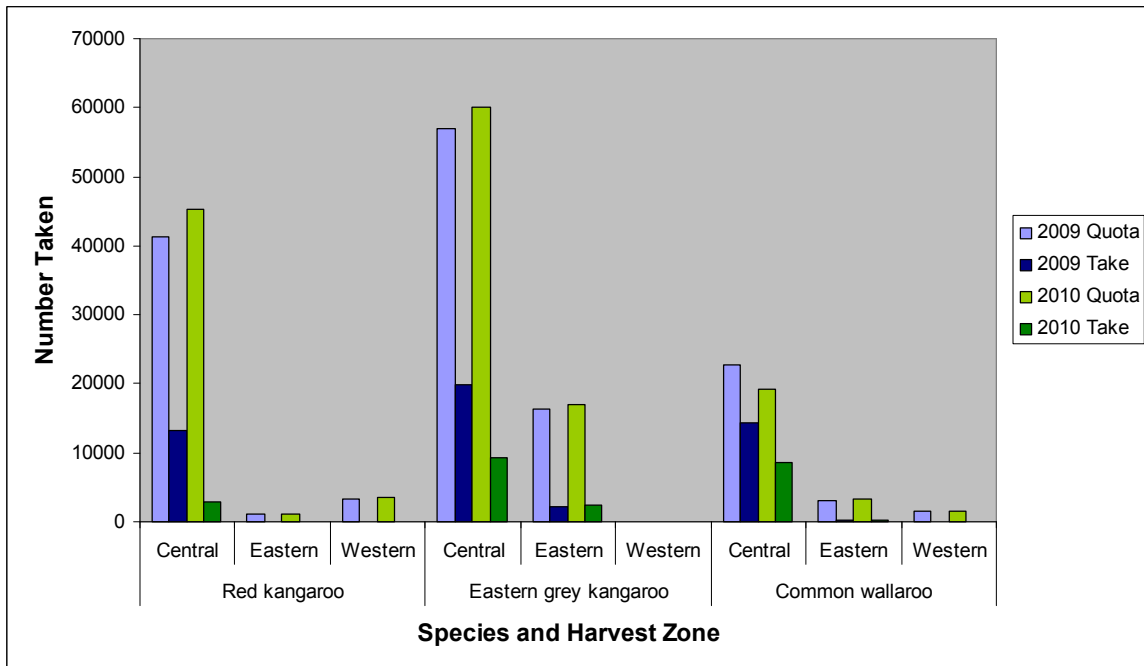


Figure 19. Macropod quota and take for Damage Mitigation Permits 2009-2010 *Note: 2010 figures are as recorded on 28 August 2010*



Harvest zone	Eastern grey kangaroo quota	% of quota used	Red kangaroo quota	% of quota used	Common wallaroo quota	% of quota used
Central zone	60 153	15	45 321	6	19217	45
Eastern zone	16 940	15	1104	0	3212	4
Western zone	54	0	3622	0	1629	0
Total	77 147	15	50 047	6	24 057	37

Table 8. Damage Mitigation Permit quota and percentage of quota utilised for macropods for 2010 *Note: 2010 figures are as recorded on 28 August 2010.*

Proportion of the population not subject to harvesting

The range of the red kangaroo in Queensland covers approximately 1 105 587 km² (Figure 20). Red kangaroos are harvested over the entirety of their Queensland distribution (Figure 20). The area within the red kangaroo range in Queensland in which they are protected within national parks and state forests is around 44 254 km², or approximately four per cent of their total distribution (Figure 20).

The range of the eastern grey kangaroo in Queensland covers approximately 1 253 710 km² (Figure 21). Eastern grey kangaroos are harvested over approximately 1 097 410 km², or 88 per cent of their Queensland distribution (Figure 21). The area within the active harvest zones within which they are protected in national parks and state forests is around 60 236 km² or approximately 4.8 per cent of their total distribution (Figure 21).

The range of the common wallaroo in Queensland covers approximately 1 239 921 km² (Figure 22). Common wallaroos are harvested over approximately 1 104 222 km², or 89 per cent of their Queensland distribution (Figure 22). The area within the active harvest zones where common wallaroos are protected within national parks is around 53 988 km² or around 4.4 per cent of their total distribution area (Figure 22).

Figure 20. Red kangaroo distribution, harvest area and protected areas in Queensland
 (distribution maps sourced from Johnson 2003)

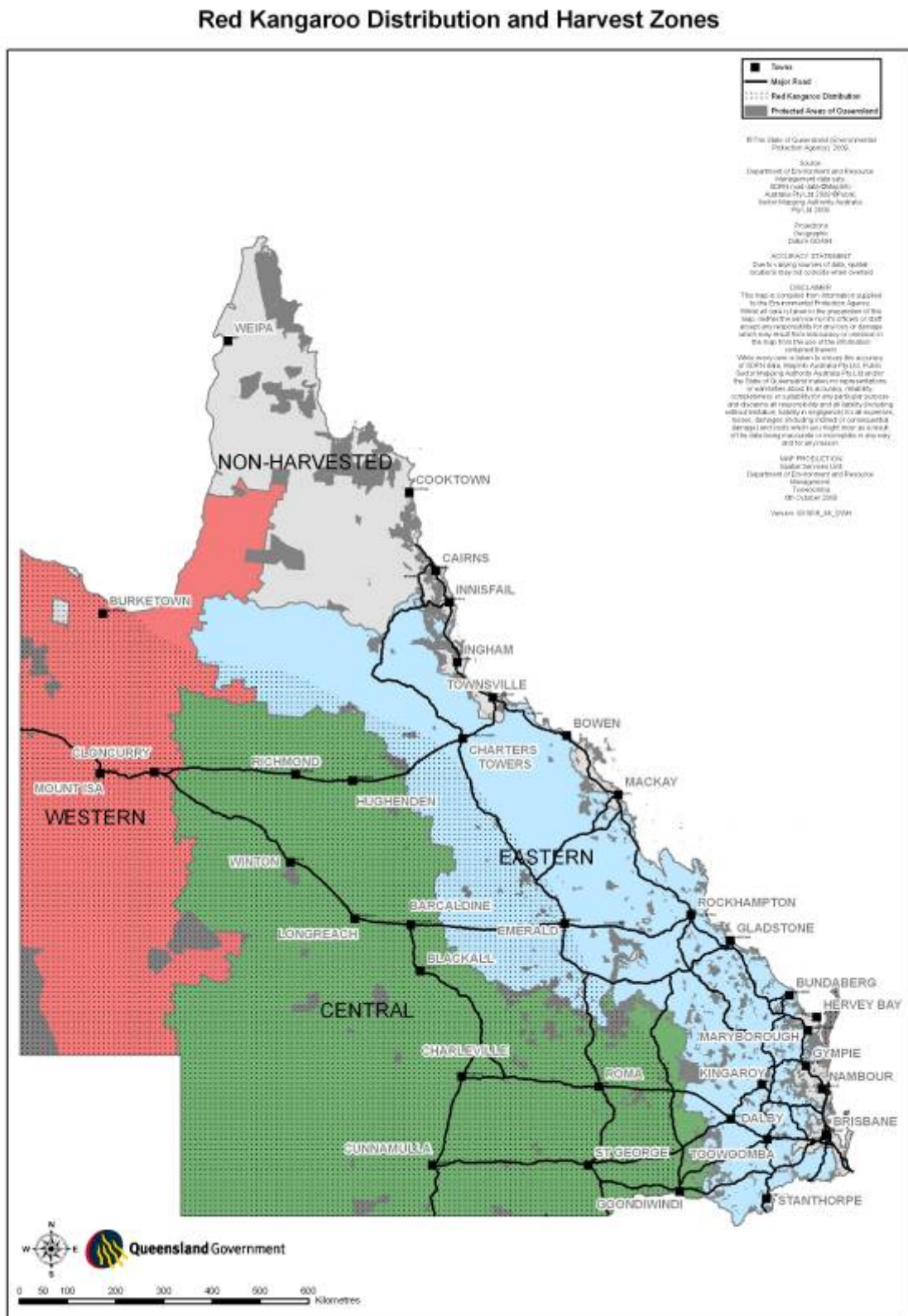
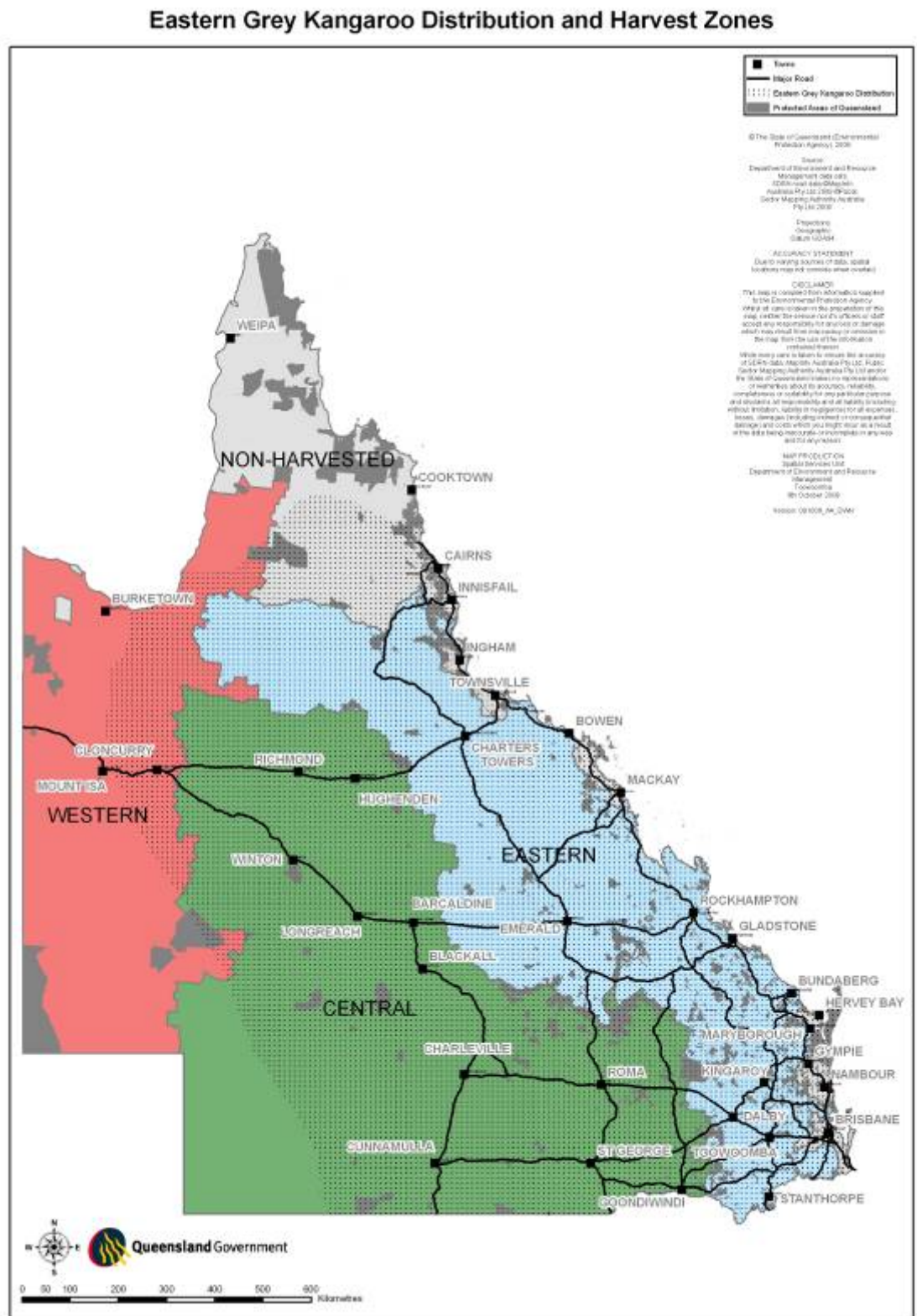


Figure 21. Eastern grey kangaroo distribution, harvest area and protected areas in Queensland (distribution maps sourced from Johnson 2003)



Non-harvest mortality

In March 2010, reports emerged of low-level mortality in macropods around Tibooburra in NSW, subsequently extending to just north of Quilpie in QLD. The NSW Department of Environment, Climate Change and Water alerted the Australian Wildlife Health Network, which liaised with DERM and the Department of Employment, Economic Development and Innovation regarding the Queensland reports that emerged subsequently.

Investigation and surveillance over the weeks following the reports established that the deaths were very limited and restricted to small areas only.

Rainfall trends

Recorded rainfall deciles for Queensland are outlined in figures 23-25 for July to December 2009 and from January to August 2010. These figures and the categorisation of deciles ranges within these figures are derived from the Australian Bureau of Meteorology <www.bom.gov.au>.

In the quota submission for 2009, it was reported that rainfall for most areas in the commercially harvested zones decreased to below average for the period July to December 2008 and January to August 2009. However, this trend did not apply for the period of rainfall reviewed for this quota submission.

For the period July to December 2009 above average rainfall was received for parts of the western and central zones with average rainfall recorded for most other parts. For much of the eastern zone rainfall remained at below average.

For the six months from January to June 2010 above average rainfall was recorded over most of the commercially harvested area, with a higher than average rainfall recorded in the southern areas of the western and central zone.

For three months from June to August 2010, above average rainfall continued in the southern parts of the central and western zone. However, average rainfall was recorded in much of the remaining area.

As the period preceding the rainfall increase in the latter part of 2009 and during 2010 was characterised by below average rainfall, it is possible that the decrease in macropod numbers observed in 2010 is reflective of these dry conditions. While rainfall increased towards the end of 2009 and into 2010, it is possible that this may have resulted in an increase in the juvenile population that is not counted during aerial surveys. If this is the case, there may be an increase in numbers observed during the 2011 aerial surveys if the rain continues.

Figure 23. Queensland rainfall deciles July to December 2009

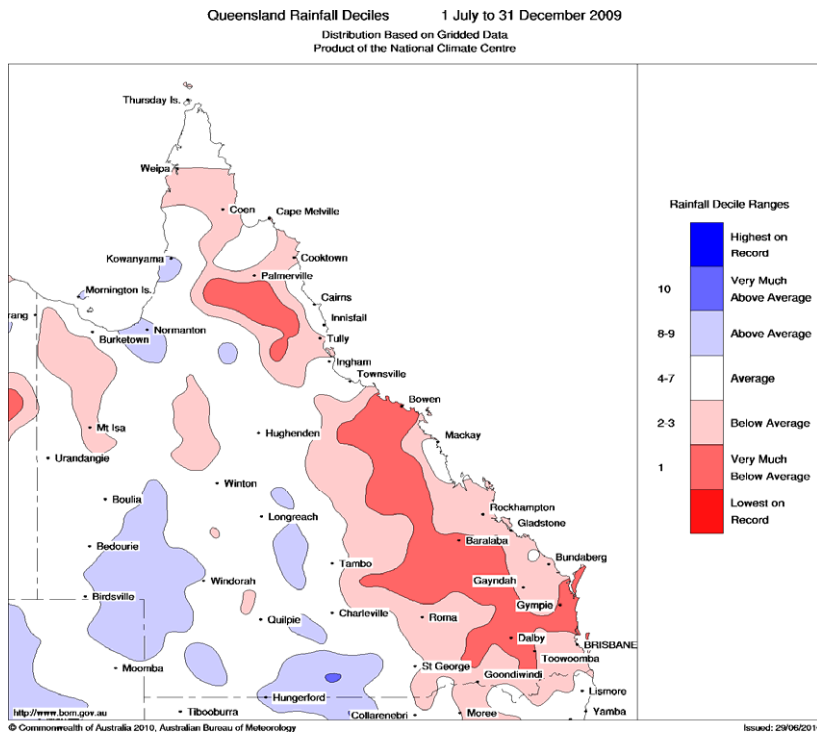


Figure 24. Queensland rainfall deciles January to June 2010

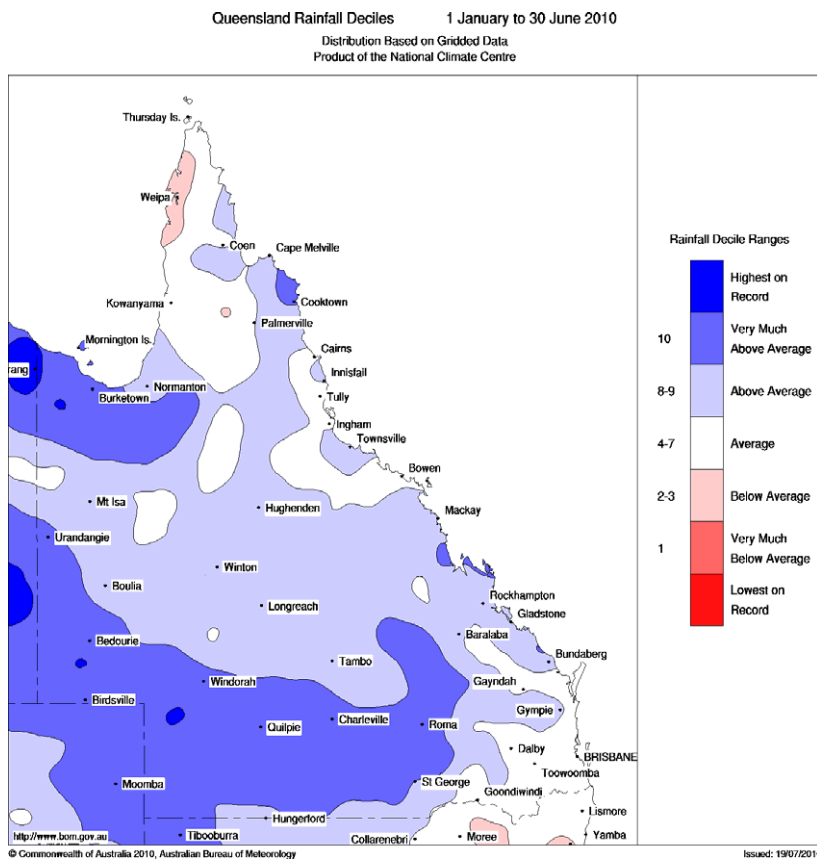
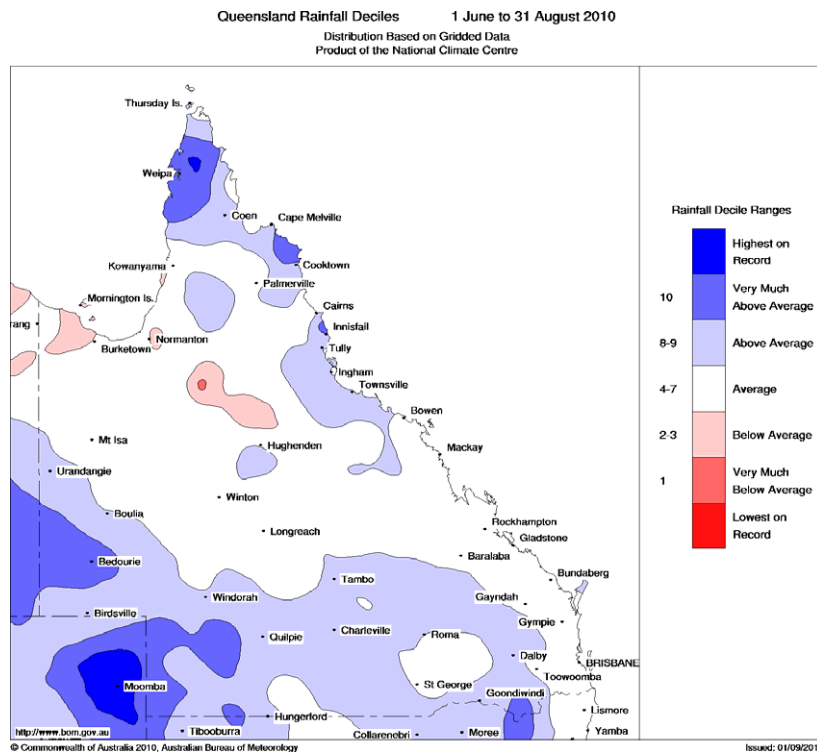


Figure 25. Queensland rainfall deciles June to August 2010

Summary and conclusion

The proposed quotas for the 2011 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. For the 2010 aerial surveys that are the basis of 2011 proposed quotas, all 22 monitor blocks across the state were surveyed.

Other factors considered in the setting of the 2011 commercial harvest quotas include a review of previous harvests, extent of non-commercial harvest, proportion of the population not subject to harvesting, non-harvest mortality and its significance, and rainfall trends.

Long-term trend data relating to population size since 1993, when Queensland began an annual program of helicopter surveys, demonstrates there has been no consistent decline in the populations of red kangaroos, eastern grey kangaroos or common wallaroos in Queensland. However, populations do fluctuate over time. All species occur in numbers 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.

Population estimates for red kangaroos, eastern grey kangaroos and common wallaroos have declined in 2010 in most harvest zones, with the exception of eastern grey kangaroos in the western zone and common wallaroos in the eastern zone. No quota will be set for 2009 for eastern grey kangaroos in the western zone, as this species continues to be recorded in low densities in this zone that is at the limit of its distributional range. Proposed quotas are inherently linked to population fluctuations by the manner in which they are determined.

For the 2009 commercial harvest no quotas were exceeded, with the maximum percentage of quota utilised being 69 per cent for common wallaroos in the central zone.

Sex ratios from harvest data continue to be biased towards males with the overall percentage of females harvested recorded at 11 per cent which is below previous years. Thus, the last completed harvest period provides no indication of adverse pressure on populations that would influence proposed quotas.

For the 2010 harvest period all tags have been issued for red kangaroos in the eastern zone, whilst tags issued are less than 40 per cent of quota for the central and western zones. For eastern grey kangaroos, the tags issued are for less than 50 per cent of quota for all harvestable zones. For common wallaroos the highest percentage of quota utilised in tags issued is for 64 per cent for the central zone, whilst it is only 11 per cent for the western zone.

Given the percentage of the quota that has currently been issued in tags for 2010, it is unlikely quotas will be met for most species in most harvest zones, with the obvious exception of red kangaroos in the eastern zone and potentially common wallaroos in the central zone.

Non-commercial quotas for DMPs for 2009 were below one per cent of the population estimate quota for all species for all zones.

The current percentages for utilisation of DMP quotas for 2010 are well below the quota limits, with the highest percentage of use recorded for common wallaroos in the central zone totalling 45 per cent DMP take will continue to be monitored to ensure adherence to quotas.

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.

While some mortality in macropods was recorded in the 2010 harvest period, investigation of the scenario demonstrated that this was a small and isolated occurrence.

Rainfall increased in the second half of 2009 and through the 2010 harvest period, with many areas receiving above average rainfall. This rainfall may result in increased numbers of macropods in the 2011 aerial surveys if it continues. However, it is probable that it did not arrive early enough for an observed increase in the mature macropod population that was surveyed in 2010.

Examination of the long-term population and density estimate trends indicates that the decrease in numbers observed in 2010 is within the realms of fluctuations in previous years and above the low of the mid 1990s.

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Appendices

Appendix 1

Summary of the methodology for population monitoring and quota derivation for Queensland

Aerial surveys

Since 1991 the Queensland government have 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 – 2008-2012. This method employs line transect methodology (Buckland et al. 1993), which is significantly more robust to variations in sight ability 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 136 000 km² (Figure 1) or 25 per cent 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 50-90 km transect lines have been placed systematically 10 km apart. Sampling intensity within each block is approximately 2.5 per cent.

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 630 000 km² (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. While 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 have applied a conservative correction factor of 1.2 to the wallaroo density estimates derived from helicopter surveys.

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 Roo Spirit 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 under Quota Derivation 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 795 000 km² for eastern grey kangaroos, 890 000 km² for red kangaroos and 695 000 km² 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 zone in relation to the margins of error present in population estimates. The maximum proportions used for each species are 15 per cent of populations for eastern grey kangaroos and common wallaroos and 20 per cent 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 per cent 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, DERM and the Commonwealth Department of Sustainability, Environment, Water, Population and Communities for determining state quota limits

Harvest zone	Bioregion	Monitor block	Years 1 & 3	Years 2 & 4	Year 5
Central	Brigalow belt south	Injune	✓		✓
		Taroom		✓	✓
		Westmar	✓		✓
		Roma		✓	✓
	Mulgaland	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	✓		✓

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

Appendix 2. Densities/km² of the commercially harvested macropod species 2004-2010

Block	Eastern grey kangaroo						
	2004	2005	2006	2007	2008	2009	2010
Barcardine	20.61	13.17	22.77	17.65	23.15	29.50	12.871
Blackall	7.57	7.10	6.22	7.51	8.28	11.19	7.082
Bollon	25.66	25.31		30.53		31.74	30.143
Charleville	17.51	19.91	15.96	12.05	11.20	12.95	12.229
Charters Towers		1.63		5.02		5.33	5.568
Cloncurry	0.01		0.16		0.02		0.214
Cunnamulla	13.20		9.97		11.44		11.642
Duchess	0.00		0.00		0.00		0
Emerald		3.95		3.41		4.05	5.035
Hughenden	0.77	0.58		1.16		0.97	0.795
Hungerford	1.16	1.10		0.77		0.94	0.651
Inglewood		8.72		18.62		9.75	12.326
Injune	13.53	18.85		18.62	6.82		16.599
Julia Creek	1.08	0.87	1.05		0.76		0.276
Longreach	9.05	8.48		6.63		6.61	6.129
Quilpie	1.86		0.97		1.42		2.795
Roma	25.05	24.98	25.46	25.12		23.43	19.298
Taroom	8.12	13.37		8.44		7.87	7.362
Westmar	25.53		23.17		21.18		22.083
Windorah	1.58	2.69	1.14	1.39	2.39	1.26	0.858
Winton	4.86	2.98	3.74		4.78		2.432

Red kangaroo							
Block	2004	2005	2006	2007	2008	2009	2010
Barcaldine	6.07	4.07	11.07	6.72	9.03	9.83	7.58
Blackall	3.99	3.29	4.55	3.78	6.45	7.24	4.701
Bollon	4.13	8.87		8.35		11.16	9.895
Charleville	4.55	5.48	7.36	9.57	7.58	8.47	6.459
Charters Towers		0.02		0.05		0.00	0.7
Cloncurry	2.14		4.18		6.17		3.013
Cunnamulla	3.54		4.59		9.02		10.646
Duchess	2.92		0.87		1.78		0.846
Emerald		0.00		0.00		0.00	0.024
Hughenden	1.97	1.59		1.59		1.29	0.922
Hungerford	1.04	2.57		3.90		4.41	2.598
Inglewood		0.00		0.00		0.00	0.496
Injune	1.02	0.14	0.05		0.72		0
Julia Creek	4.08	5.13	4.91		5.39		3.156
Longreach	9.53	11.86		11.33		14.71	12.236
Quilpie	2.19		1.39		5.13		2.056
Roma	2.19	1.62	2.54	2.66		2.37	2.261
Taroom	0.02	0.37		0.00		0.00	0
Westmar	0.97		0.59		0.55		1.139
Windorah	4.42	4.52	7.32	4.48	9.85	12.62	6.668
Winton	3.69	5.02	5.62		6.05		3.315

Common wallaroo							
Block	2004	2005	2006	2007	2008	2009	2010
Barcaldine	6.59	12.30	8.63	16.42	19.98	16.20	5.521
Blackall	18.02	21.17	22.15	34.98	39.14	49.05	23.819
Bollon	4.72	2.64		1.55		1.67	0.363
Charleville	7.21	6.20	5.79	4.66	4.70	5.36	11.803
Charters Towers		0.30		2.84		0.61	1.069
Cloncurry	0.00		0.30		0.64		0.507
Cunnamulla	1.68		0.45		0.64		1.951
Duchess	0.57		0.11		1.69		0.743
Emerald		0.02		0.00		0.78	0.024
Hughenden	1.65	1.28		2.28		0.24	0.411
Hungerford	1.19	0.36		0.24		0.48	0.254
Inglewood		3.08		4.03		0.34	1.013
Injune	0.01	2.30	1.34		0.91		4.053
Julia Creek	2.74	0.00	0.04		0.11		0.013
Longreach	17.96	21.57		18.59		12.69	9.185
Quilpie	5.41		0.78		3.36		2.686
Roma	1.35	3.74	2.49	2.08		1.16	3.447
Taroom	0.22	2.04		0.17		1.05	0.253
Westmar	0.74		0.02		0.13		0.299
Windorah	2.14	2.30	1.81	2.72	3.03	3.07	2.422
Winton	1.73	1.78	1.70		3.14		0.955