



# **2020 Quota Report**

New South Wales Commercial  
Kangaroo Harvest Management Plan  
2017–2021

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## Introduction

The New South Wales Department of Planning, Industry and Environment and its predecessor agencies have been researching, monitoring and managing the NSW Kangaroo Management Program (KMP) since the 1970s. During this time, adjustments have been made to the survey design, population estimation and method of determining the commercial quota.

This *2020 Quota Report: New South Wales Commercial Kangaroo Harvest Management Plan 2017–2021* gives details of the KMP quotas for the 2020 kangaroo harvest in accordance with NSW Commercial Kangaroo Harvest Management Plan 2017–2021 (the Plan).

The report includes the population estimates for 2019 for red kangaroos, eastern and western grey kangaroos, and wallaroos and sets the quotas for 2020.

The report also provides details of trends in population estimates, quotas and commercial take data.

All historical data for trends in kangaroo management can be found in the appendices.

## Summary

Table 1 lists the quotas for 2019 and 2020, Table 2 compares the 2020 quotas against the 2019 population estimates and gives the quotas as percentages of those estimates.

Table 3 lists the details of the 2019 harvest to 30 September. ‘%q’ is the commercial take as a percentage of the approved quota. ‘%p’ is the commercial take as a percentage of the population estimate.

**Table 1 Quotas for 2020 and 2019**

	2020		2019	
	Quota	Maximum special quota	Quota	Maximum special quota
Red kangaroo	564,137	53,110	432,198	43,975
Eastern grey	1,408,964	141,560	1,324,413	132,950
Western grey kangaroo*	129,030	13,258	117,465	12,547
Wallaroo	24,045	2,405	30,135	3,013
<b>Total</b>	<b>2,126,176</b>	<b>210,332</b>	<b>1,838,646</b>	<b>185,928</b>

\*There is a small population (5575) of western grey kangaroos in the Narrabri zone. This is included in the population estimate, but no quota is set for this species in this zone.



**Table 2 Population estimates for 2019 and quotas for 2020**

	Population estimate 2019	Quota 2020	Quota as per cent of population
Red kangaroo	3,540,644	564,137	15.9
Eastern grey kangaroo (Western Plains)	3,920,261	581,399	14.8
Eastern grey kangaroo (Central and Northern Tablelands and Southeast NSW)	5,517,100	827,565	15.0
Western grey kangaroo	883,845	129,030	14.6
Wallaroo (Northern Tablelands)	160,300	24,045	15.0
<b>Total</b>	<b>14,022,150</b>	<b>2,126,176</b>	<b>15.2</b>

**Table 3 Actual take to 9 October 2019**

Management zone	No.	Eastern grey				Red				Western grey				Wallaroo			
		Quota	Take	%q	%p	Quota	Take	%q	%p	Quota	Take	%q	%p	Quota	Take	%q	%p
Tibooburra	1	21,990		0%	0%				0%	5,610		0%	0%				
Broken Hill	2	24,734	908	4%	1%	192,699	48,590	25%	4%	34,570	4,179	12%	2%				
Lower Darling	4	13,194	4,451	34%	5%	52,295	12,216	23%	4%	28,961	3,924	14%	2%				
Cobar	6				0%				0%				0%				
Bourke	7	17,061	1,586	9%	1%	41,597	9,225	22%	4%	10,531	178	2%	0%				
Narrabri	8	108,501	34,451	32%	5%	60,069	13,618	23%	4%			0%	0%				
Armidale	9	63,120	22,599	36%	5%									10,890	2,489	23%	3%
Coonabarabran	10	176,907	76,950	43%	7%	37,113	16,503	44%	8%	9,486	837	9%	1%				
Griffith	11	114,330	51,499	45%	7%	48,425	18,492	38%	6%	23,563	3,447	15%	2%				
Glen Innes	13	88,110	18,223	21%	3%									8,235	3,583	44%	7%
Upper Hunter	14	38,940	18,837	48%	7%									11,010	4,067	37%	6%
Southeast NSW	16	258,210	20,443	8%	1%												
Central Tablelands North	48	259,230	28,746	11%	2%												
Central Tablelands South	49	140,085	16,031	11%	2%												
<b>Total</b>		<b>1,324,412</b>	<b>294,724</b>	22%	3%	<b>432,198</b>	<b>118,644</b>	27%	4%	<b>112,721</b>	<b>12,565</b>	11%	2%	<b>30,135</b>	<b>10,139</b>	34%	5%

# Population estimates and survey method used

## How surveys are conducted

The methods vary slightly across the state owing to differences in terrain and species habitat preferences. However, the general underlying principles are essentially similar:

1. The aircraft flies at known specified speed and height, and the sighting distance on the ground is delineated by streamers or a boom.
2. Trained observers record kangaroos seen from the aircraft within delineated distances from a transect. The 'detection area' is calculated mathematically from the data. The result is an estimated density of kangaroos.
3. For each region of interest (e.g. a single commercial harvest zone), the total area of the region is known.
4. The estimated density (e.g. the number of animals per square kilometre) is multiplied by the area of the region to calculate the population estimate.

## Surveys and Mark-Recapture Distance Sampling

The commercial harvest zones that occur in the rangelands of New South Wales cover an area of about 530,000 km<sup>2</sup>. Aerial surveys allow these areas to be surveyed quickly. The speed, however, and height the plane must travel limits the time available for observers to detect, identify and record observations.

In keeping with advances statistical analyses and in survey methods, mark-recapture distance sampling (MRDS) is used to estimate the abundance of kangaroos in the rangelands of New South Wales. This method accounts for kangaroos that are present during surveys but not counted. This approach, in particular, allows for statistical consideration of the differences in detection between surveys, observers, species, group size, vegetation and other factors that may influence detection.

Mark-recapture distance sampling permits statistically reliable estimates of kangaroo abundance. MRDS combines two methods of surveying wildlife populations, line transect sampling and mark-recapture. On its own, conventional line transect sampling by aerial survey is likely to overestimate detection probability and therefore underestimate kangaroo density.

Mark-recapture estimates derived from the aerial survey, where two observers independently count animals along the same transect on both sides of the aircraft, is used to account for the bias in detection probability between observers.

The combination of mark-recapture and line transect sampling combines the strengths of both methods while reducing the influence of their potential biases.

## Western Plains

Table 4 shows the current estimated density and population of kangaroos in each of the Western Plains management zones.

**Table 4 Red and grey kangaroo population estimates for 2019 for the Western Plains**

Management zone	Red kangaroo population estimate	Grey kangaroo population estimate
Tibooburra	79,346	48,502
Broken Hill	1,124,115	326,644
Lower Darling	691,119	378,718
Cobar	36,058	7,317
Bourke	497,085	51,735
Narrabri	346,451	765,632
Coonabarabran	500,137	1,536,291
Griffith North	159,545	1,029,202
Griffith South	106,788	38,643
<b>Total</b>	<b>3,540,644</b>	<b>4,182,684</b>

The estimated numbers and densities of red and grey kangaroos in each management zone from 1990 onwards are given in Tables A1 to A8. The population trends for each species are shown in Figures A1 and A2 and Tables A16 to A18 (Appendix A).

Combined red and grey kangaroo population estimates, authorised quotas and actual takes (from 1982 onwards) are shown in graphical form in Figure A3 and in tabular form from 1975 onward in Table A15 (Appendix A). Note that the combined grey kangaroo data in Figure A3 and Table A5 include eastern grey kangaroos in the Northern Tablelands, Central Tablelands and Southeast NSW.

## Northern Tablelands

The Northern Tablelands commercial harvest area covers some 40,000 square kilometres and comprises kangaroo management zones 9, 13 and 14. Before 2001, the commercial quota was set on the basis of ground (walked) surveys conducted in 1989–90, and the quotas were adjusted annually based on seasonal changes and results from the surveys of neighbouring zones.

The Northern Tablelands was first surveyed by helicopter in 2001, with additional surveys in 2002, then again in 2004 (Cairns 2004). The most recent survey was conducted between 12 September and 24 September 2016, according to a design developed with the help of Distance<sup>®</sup> software.

As helicopter survey techniques are relatively new and still evolving, each survey is redesigned by using information gained from previous surveys and advances in software capability. A full report outlining the design of the survey and analysis of the results is available on the [Kangaroo Management Program web page](#).

Details of the population estimates and commercial take of wallaroos are given in Table A19 and Figure A7 (Appendix A). Wallaroo population estimates and quotas for each zone are shown in Tables A9a to A11a.

Details of the population estimates and commercial takes of eastern grey kangaroos in all zones are given in Table A17 and Figure A5. Eastern grey kangaroo population estimates and quotas for each of the Northern Tablelands zones are shown in Tables A9b to A11b.

Table 5 shows the current estimated densities and populations of kangaroos in each of the Northern Tablelands management zones; this data is based on aerial surveys conducted in 2019.

**Table 5 Population estimates for 2019 for the Northern Tablelands**

Management zone	Zone area (km <sup>2</sup> ) *	Eastern grey kangaroo			Wallaroo		
		Density (km <sup>-2</sup> )	Population estimate	Quota	Density** (km <sup>-2</sup> )	Population estimate	Quota
Glen Innes	17,241	31.6	545,200	81,780	3.2	72,900	10,935
Armidale	15,023	28.1	421,900	63,285	4.8	63,400	9,510
Upper Hunter	7,983	20.9	166,500	24,975	9.2	24,000	3,600
<b>Total</b>	<b>40,247</b>		<b>1,133,600</b>	<b>170,040</b>		<b>160,300</b>	<b>24,045</b>

\* 'Zone area' in this table refers only to high- and medium-density strata, excluding the National Park estate, Forests and Reserves, where harvesting is prohibited. Low-density strata were not surveyed.

\*\* Densities have been multiplied by 1.85, as suggested by Cairns (2004).

## Southeast NSW

In 2018, the Government announced some changes to kangaroo management in NSW. For the commercial program, this meant an expansion of the Southeast Commercial zone. The 2018 survey was extended to incorporate the Bombala area to the south east of the zone.

Southeast NSW (kangaroo management zone 16) was surveyed in September 2018. About 25% of the total area of the zone is not available for commercial harvest, either it is reserved for conservation or state forest, or because the terrain is too difficult. These areas are excluded from the survey, which covers approximately 41,211 square kilometres including the Bombala area (2720 km<sup>2</sup>) addition. The population estimate from this survey will remain current until the next survey in 2021.

Table 6 shows the current estimated density and population of kangaroos in the Southeast NSW management zone.

**Table 6 Population estimates for 2018 for eastern grey kangaroos comprising the Southeast NSW management zone**

Management zone	Area (km <sup>2</sup> )	Survey effort (km)	Density (km <sup>-2</sup> )	Population estimate
Southeast NSW (includes Bombala)	<b>41,211</b>	<b>1,980</b>	<b>(41.9)</b>	<b>1,721,400</b>

Details of the population estimates and commercial takes of eastern grey kangaroos in all zones are given in Table A17 and Figure A5. Eastern grey kangaroo population estimates and quotas for the Southeast NSW zone are shown in Table A12.

## Central Tablelands

The initial helicopter survey of the Central Tablelands management zone was completed in 2008. It was designed to provide separate population estimates for the Hunter–Mudgee–Merriwa and Central Tablelands areas, allowing the Central Tablelands zone to be managed as either one or two zones. Since its commencement on 1 June 2009, the area has been managed as two zones (Central Tablelands North and Central Tablelands South).

These two zones were surveyed again in September 2011, 2014 and 2017. The survey design incorporated the information gained from the initial survey in the delineation of low-, medium-, and high-population density strata, allowing for improved precision in the population estimates. The population estimates and densities derived from 2017 helicopter survey are shown in Table 7.

**Table 7 Population estimates for 2017 for eastern grey kangaroos in each of the new Central Tablelands commercial harvest zones.**

Zone	Area (km <sup>2</sup> )	Density (km <sup>-2</sup> )	Population estimate
Hunter–Mudgee (Central Tablelands North)	23,185	74.5	1,728,200
Central Tablelands South	18,892	49.4	933,900
<b>Total or (Average)</b>	<b>42,077</b>	<b>62.0</b>	<b>2,662,100</b>

Details of the population estimates and commercial takes of eastern grey kangaroos in all zones are given in Table A17 and Figure A5. Eastern grey kangaroo population estimates and quotas for the Central Tablelands zone are shown in Tables A13 and A14.

## Determination of quotas

### Commercial quotas

Annual commercial quotas are set at a proportion of the estimated macropod populations.

For the Western Plains, quotas are set at 17% of the estimated red kangaroo population and 15% of the estimated population of eastern grey and western grey kangaroos.

For the Northern Tablelands, quotas have been set at 15% for both eastern grey kangaroos and wallaroos.

Eastern grey kangaroo quotas for the Southeast NSW and Central Tablelands zones have also been set at 15%.

These proportions are specified in the Plan, and any proposal to set a commercial harvest quota above these rates requires specific approval from the Commonwealth.

Population dynamics of red and grey kangaroos and wallaroos and the male bias of the commercial take have seen conservative quotas set, and support viable kangaroo populations for conservation. More than 30 years of available data indicate kangaroo populations harvested at these rates continue to fluctuate primarily in response to seasonal conditions.

The quota is based on harvesting a proportion of the estimated population, and changes in populations are reflected in the quotas. The quotas for 2020 are still considered to be conservative with low impact on kangaroo populations in the long-term.

Low kangaroo populations are further protected by the incorporation of harvest thresholds in the Plan. The Department is required to either reduce or suspend the commercial harvest quotas if the population of a species falls below the threshold in that zone, as determined by aerial surveys.

Thresholds are set on the basis of standard deviations relative to the long-term average population (*c.f.* Appendix B-Table B1).

Using statistical measures rather than arbitrary population size allows for variation between species and climatic zones, e.g. red kangaroo populations in the Far West change more rapidly and deviate more from the average than do eastern grey kangaroo populations in the Northern Tablelands. This variation is reflected in the standard deviation, and in the population change that is allowable before harvest reductions or suspensions are implemented.

## Special quotas

A special quota for 2020 has been calculated in accordance with the provisions of the Plan and will potentially be available to minimise the number of kangaroos culled under non-commercial licences. The special quota will be used only when the commercial quota for a particular kangaroo management zone has been fully issued. This is not a commercial quota; its sole purpose is to provide for commercial utilisation of kangaroos that would be culled and left in the field under the normal non-commercial licensing system. As specified in the Plan, the use of this quota will depend on one or more of the following:

- consideration of local conditions, including extended periods of rainfall well below average
- Western Lands destocking orders
- kangaroo population trends (based on the 2019 survey).

Special quotas will not be considered for zones where the commercial quota has been reduced or suspended because the populations are low.

The maximum number of animals that may be taken under special quota provisions in any commercial harvest zone is 5% of the population estimate for that species in that zone. Across the combined commercial zones, the special quota used must not exceed 1.5% of the population estimate for that species. It is not necessarily intended to fully utilise the special quota unless circumstances justify such action. The special quota was last used in 2003.

Non-commercial culling is available to landholders throughout New South Wales and occurs even where commercial harvesting is available.

Each application must be assessed by an authorised officer from the Department before a licence is issued. In the commercial zone, non-commercial licenses are generally requested only when:

- it is not economically viable to take kangaroos commercially
- the commercial kangaroo industry is unable to fulfil the landholder's needs
- management zone commercial quotas are fully utilised
- kangaroo populations are causing extensive damage and competing with livestock for food, water and other resources.

## Trends in populations, quotas and commercial takes

### Populations

In May 2018, just prior to the aerial surveys being conducted across the western plains, New South Wales was experiencing widespread agronomic drought conditions. As of 31 May 2018, 99% of the State was covered by one of the three drought categories, with 39% of the State in drought watch, 44% in drought onset and 16% in drought. (DPI 2018).

These seasonal conditions have resulted in a slight increase in populations of eastern grey and slight decrease in western grey and a large decrease in red kangaroos across the Western Plains. For both eastern grey and western grey kangaroos, there is 22.1% and - 5.7% change (about 708,256 and 47,349 respectively). Increase in red kangaroo populations 20.8% (about 608,951).

## Red kangaroo

The 2019 red kangaroo population estimate and trends in abundance since 1997 are shown in Table 8. Refer to Figure A1 for trends in red kangaroo abundance on the Western Plains since 1984.

**Table 8 Population estimates and trends in abundance for red kangaroo, 1997–2019**

Year	Population estimate (millions)	Density (km <sup>-2</sup> )	Trends in abundance (% change from previous year)
2019	3.54	6.4	20.8
2018	2.93 ± 0.21	5.16	-42.9
2017	5.13 ± 0.57	9.76	-19.4
2016	6.36 ± 0.49	12.64	8.1
2015	5.89 ± 0.41	10.89	-8.3
2014	6.42 ± 0.50	11.62	43.4
2013	4.50 ± 0.36	8.47	8.0
2012	4.15 ± 0.31	8.01	4.0
2011	3.97 ± 0.41	7.39	32.0
2010	3.01 ± 0.24	5.73	23.0
2009	2.46 ± 0.17	4.58	-14.0
2008	2.87 ± 0.21	5.26	14.0
2007	2.52 ± 0.21	4.44	16.0
2006	2.18 ± 0.16	4.05	-3.0
2005	2.24 ± 0.22	4.32	-11.0
2004	2.51 ± 0.24	4.66	12.0
2003	2.24 ± 0.16	4.22	-53.0
2002	4.80 ± 0.39	9.35	-6.0
2001	5.12 ± 0.34	9.74	*17.0
2000	4.39 ± 0.40	8.49	-7.0
1999	4.71 ± 0.44	8.82	-19.0
1998	5.81 ± 0.61	11.36	10.0
1997	5.29 ± 0.40	10.01	40.0

Note: Dark shading has been used to indicate the use of the September 2003 100-m correction factor (CF); light shading indicates the use of a 200-m CF. No shading for 2016 indicates new survey method MRDS.

\* Invalid comparison due to a change in correction factors and survey strip width.

## Eastern grey kangaroo

The 2019 grey kangaroo (eastern and western) estimate for the area surveyed by fixed-wing aircraft is 4.80 million (density 8.65 km<sup>-2</sup>). Refer to Figure A2 for trends in grey kangaroo abundance on the Western Plains since 1984. The relative proportions of eastern and western grey kangaroos in the area surveyed were re-analysed in 2000. Application of these



proportions to the 2019 survey gives an eastern grey kangaroo population estimate for the area surveyed by air of 3.92 million (density 7.06 km<sup>-2</sup>).

The 2019 eastern grey kangaroo population estimate and trends in abundance on the Western Plains since 1997 are shown in Table 9.

**Table 9 Population estimates and trends in abundance for eastern grey kangaroo on the Western Plains, 1997–2019**

Year	Population estimate (millions)	Density (km <sup>-2</sup> )	Trend in abundance (% change from previous year)
2019	3.92	7.06	22.1
2018	3.21 ± 0.28	5.78	9.3
2017	2.94 ± 0.28	5.06	-38.0
2016	4.74 ± 0.56	8.75	-0.5
2015	4.76 ± 0.64	8.84	-13.2
2014	5.50 ± 0.71	10.36	-13.0
2013	6.31 ± 0.64	11.74	65.0
2012	3.83 ± 0.48	7.36	28.0
2011	3.00 ± 0.44	5.64	20.0
2010	2.50 ± 0.31	4.70	38.0
2009	1.81 ± 0.19	3.49	-16.0
2008	2.15 ± 0.21	3.97	0.0
2007	2.15 ± 0.27	3.99	0.0
2006	2.14 ± 0.32	3.92	7.0
2005	2.00 ± 0.33	3.65	-25.0
2004	2.66 ± 0.32	5.03	-31.0
2003	3.83 ± 0.58	7.42	-51.0
2002	7.80 ± 1.02	15.07	24.0
2001	6.29 ± 0.72	12.48	*22.0
2000	5.17 ± 0.57	9.86	6.0
1999	4.87 ± 0.42	9.43	-6.0
1998	5.19 ± 0.54	9.91	17.0
1997	4.43 ± 0.63	8.53	12.0

Note: Dark shading has been used to indicate the use of the September 2003 100-m correction factor (CF); light shading indicates the use of a 200-m CF. No shading for 2016 indicates new survey method MRDS.

\* Invalid comparison due to a change in correction factors and survey strip width.

The Northern Tablelands management zones were surveyed in September 2019. Based on this survey, the number of eastern grey kangaroos estimated to be in the Northern Tablelands region is 1,133,600 (Table 10). The Northern Tablelands region will be surveyed again in 2022.

**Table 10 Population estimates and trends in abundance for eastern grey kangaroo in the Northern Tablelands zones, 2001–19**

Zone	Armidale			Glen Innes			Upper Hunter			Total Population
	Population Estimate	Density	Trend	Population Estimate	Density	Trend	Population Estimate	Density	Trend	
2019	421,900	28.1	-7.2	545,200	31.6	0.3	166,500	20.9	-35.9	1,133,600
2016	420,800	28	60	587,400	34.1	57	259,600	32.5	105	1,267,800
2013	263,300	16.6	27	374,300	20.3	39	126,800	9.05	-24	764,400
2010	206,780	13.1	46	269,500	12.9	14	167,500	11.5	82	643,780
2007	141,610	8.7	-12	236,600	11.3	58	92,016	6.3	36	470,226
2004	161,726	10.2	4	149,621	8.1	-35	67,499	4.8	-28	378,846
2001	173,109	10.6	N/A	221,975	10.6	N/A	95,273	6.5	N/A	490,357

In Appendix A, tables A11a, A12a and A13a show population estimates and quotas for eastern grey kangaroos in the Northern Tablelands management zones from 1993 to 2019.

An increase of this magnitude is likely to be the result of immigration from neighbouring areas in addition to natural increase. Survey redesign may also have contributed.

**Table 11 Population estimates and trends in abundance for eastern grey kangaroo in Southeast NSW, 2003–18**

Year	Population estimate	Density (km <sup>-2</sup> )	Trend in abundance (% change from previous survey)
2018	1,721,400	41.9	34
2015	1,284,300	33.4	49.5
2012	858,900	22.4	31.0
2009*	655,900	17.1	0.0
2006	415,271	14.07	42.0
2003	292,455	11.95	0.0

\* The 2009 population estimate is for a larger area than in the previous two surveys, as it includes part of Riverina Local Land Services (LLS). It is therefore inappropriate to consider the difference between the 2006 and 2009 surveys as a trend.

Central Tablelands North and South management zones were surveyed for the first time in 2008 and started operation on 1 June 2009. The next survey was conducted in September 2011 and then 2014 and in 2017, providing some trend information (Table 12). The apparent trends should be viewed with caution because of the short survey history in these zones.

**Table 12 Population estimates and trends in abundance for eastern grey kangaroo on the Central Tablelands North and South, 2008–17**

Zone	Population estimate (millions)		Density (km <sup>-2</sup> )		Trend in abundance (% change from previous survey)		Total population
	CT North	CT South	CT North	CT South	CT North	CT South	
2017	1,728,200	933,900	74.5	49.4	44.8	15	2,662,100
2014	1,193,600	811,800	47.1	35.9	94.9	133.4	2,005,400
2011	612,590	347,830	20.9	15.1	41.5	-35.1	960,420
2008	433,030	535,600	14.7	23.2	0	0	968,630

CT, Central Tablelands

### Western grey kangaroo

As previously stated, the relative proportions of eastern and western grey kangaroos in the area surveyed were examined in 2000. Application of these proportions to the 2019 survey gives a western grey kangaroo population estimate for the area surveyed by air of 0.88 million (average density 1.59 km<sup>-2</sup>).

The 2019 western grey kangaroo population estimate and trends in abundance for the Western Plains since 1997 are shown in Table 13.

**Table 13 Population estimates and trends in abundance for western grey kangaroo on the Western Plains, 1997–2019**

Year	Population estimate (millions)	Density (km <sup>-2</sup> )	Trend in abundance (% change from previous year)
2019	0.88	1.59	5.7
2018	0.84 ± 0.58	1.52	-8.7
2017	0.92 ± 0.15	1.68	-42.5
2016	1.59 ± 0.25	3.18	7.2
2015	1.49 ± 0.18	3.02	-2.6
2014	1.53 ± 0.24	3.16	-17.5
2013	1.82 ± 0.20	3.83	116.0
2012	0.86 ± 0.11	1.83	73.0
2011	0.50 ± 0.07	1.02	-25.0
2010	0.66 ± 0.08	1.39	-8.0
2009	0.72 ± 0.08	1.49	-27.0
2008	0.99 ± 0.10	2.07	36.0
2007	0.73 ± 0.09	1.55	11.0

Year	Population estimate (millions)	Density (km <sup>-2</sup> )	Trend in abundance (% change from previous year)
2006	0.65 ± 0.11	1.35	9.0
2005	0.60 ± 0.09	1.31	-33.0
2004	0.89 ± 0.11	1.89	-29.0
2003	1.27 ± 0.26	2.72	-47.0
2002	2.39 ± 0.30	5.02	18.0
2001	2.03 ± 0.22	4.53	*13.0
2000	1.79 ± 0.24	3.86	-14.0
1999	2.09 ± 0.19	4.50	11.0
1998	1.88 ± 0.18	3.97	-11.0
1997	2.11 ± 0.27	4.33	22.0

Note: Dark shading has been used to indicate the use of the September 2003 100-m correction factor (CF); light shading indicates the use of a 200-m CF. No shading for 2016 indicates new survey method MRDS.

\* Invalid comparison due to a change in correction factors and survey strip width.

## Wallaroo

The 2019 wallaroo population estimate and trends in abundance for the Northern Tablelands management zones since 2001 are shown in Table 14.

In Appendix A, tables A11b, A12b and A13b show population estimates and quotas from 1993 to 2019.

**Table 14 Population estimates and trends in abundance for wallaroo on the Northern Tablelands, 2001–16.**

Zone	Armidale			Glen Innes			Upper Hunter			Total Population
	Population Estimate	Density	Trend	Population Estimate	Density	Trend	Population Estimate	Density	Trend	
2019	63,400	4.2	-12.7	72,900	4.2	32.8	24,000	3	-67.3	160,300
2016	72,600	4.8	61	54,900	3.2	94	73,400	9.2	168	<b>200,900</b>
2013	45,140	2.8	9	28,305	1.5	-12	27,380	1.9	83	<b>100,825</b>
2010	41,255	2.5	9.0	32,190	1.5	0	14,985	1	-67	<b>88,430</b>
2007	37,859	2.3	-58	32,184	1.5	-43	44,923	3.1	-27	<b>114,966</b>
2004	89,787	5.7	158	56,657	3.1	-56	61,660	4.4	7	<b>208,104</b>
2001	34,744	2.1	N/A	128,323	6.1	N/A	57,762	4	N/A	<b>220,829</b>

## Quotas

Quotas have been set at the same percentages of population estimates for several years. These proportions are specified in the Plan. Based on the population dynamics of the species and the selectivity of kangaroo harvesters for male kangaroos, these quotas are considered conservative with low impact on kangaroo populations.

The Plan includes low population thresholds below which the commercial quota is either reduced or suspended, depending on the magnitude of the decline relative to historical fluctuations. The thresholds are based on standard deviations, which are statistical measures that indicate how much a population varies from its average over time.

For the purposes of setting quotas, quotas on populations that are between 1.5 and 2 standard deviations below their long-term averages are calculated at a reduced rate of 10%. Quotas on populations that are two or more standard deviations below their averages are suspended.

This contrasts with the previous plan, which specified one threshold for each species in each zone and was based on recent historical low populations, without any consideration of natural fluctuations. For populations that fell below their respective thresholds, the commercial harvest quotas were suspended.

## Red kangaroo

The quota for 2020 of 564,137 represents 15.9% of the population estimated by aerial survey, as specified in the Plan (Quota for Cobar and Tibooburra are removed). Cobar and Tibooburra zone populations of red kangaroos is below the threshold at which the quota is suspended.

## Eastern grey kangaroo

The quota for 2020 of 581,399 for the Western Plains represents 14.8% of the population estimated by aerial survey — the maximum commercial quota specified in the Plan (Note that quota for Cobar and Bourke is removed). The quota for 2020 of 170,040 for the Northern Tablelands region represents 15% of the estimated population of 1,133,600 derived from aerial surveys in 2019. The Southeast NSW quota is 258,210 which represents 15% of the population estimate of 1,721,400 derived from aerial surveys in 2018. The quotas for Central Tablelands North and Central Tablelands South are 259,230 and 140,085 respectively, which represent 15% of the population estimates derived from aerial surveys in 2017. The combined 2020 eastern grey quota is 1,408,964.

## Western grey kangaroo

The quota for 2020 of 129,030 represents 14.6% for six zones. The quota for Cobar, Bourke and Narrabri zones are removed from the population estimated by aerial survey. The quota for Tibooburra zone (986 animals) has been reduced to 10% of the estimated population (9,859 animals) because the population of western grey kangaroos is below the threshold at which the quota is reduced from 15% to 10%.

## Wallaroo

In 2004, the quotas for wallaroos in the Northern Tablelands were changed from 5% to 15% of the population estimate because of the more rigorous scientific basis to survey and estimation methods. For the 2020 quota, this value will remain at 15% for the Armidale, Glen Innes and Upper Hunter zones, in accordance with the Plan.

The 2020 quota is 24,045 for the Northern Tablelands.

## Commercial takes

Species:	Red Kangaroo ( <i>Macropus rufus</i> )
	Eastern grey kangaroo ( <i>Macropus giganteus</i> )
	Western grey kangaroo ( <i>Macropus fuliginosus</i> )
	Wallaroo ( <i>Macropus robustus</i> )
Extent:	Commercial zone
Frequency:	Continuous
Methodology:	Collection and compilation of returns from licensed Harvesters, Registered Premises and Wholesalers
Data:	Species, sex, group weight and location taken (property)

In 2008 the minimum carcass weight requirement increased from 12 to 14 kilograms for carcasses dressed for pet food processing, and from 13 to 15 kilograms for carcasses dressed for human consumption processing. The size difference between male and female wallaroos almost eliminates females from the harvest, as they are generally too small to meet the carcass weight requirement.

The impact on the other harvested species is less pronounced. In all cases, the average carcass weights for the period 1 January 2019 to 30 September 2019 was 26.08 kilograms and for 2018 it was 27.6 kilograms, well above the long-term average of 22.5 kilograms (1999–2017).

### Red kangaroo

Harvester returns for 2018 indicated that 93.5% of red kangaroos taken were males. For the year to 30 September 2019, harvester returns reported a male bias of 90.2%, which is well above the long-term average (1999–2017) of 75.1%.

The actual takes of red kangaroos are shown against the authorised quotas in Table A16 and Figure A4.

The average take as a proportion of the authorised quota from 2000 to 2017 was 44.9%.

### Eastern grey kangaroo

Harvester returns for 2018 indicate that 89.5% of eastern grey kangaroos taken were males. For the year to 30 September 2019, harvester returns reported a male bias of 86.1%, higher than the long-term average (1999–2017) of 73.9%.

The actual takes of eastern grey kangaroos are shown against the authorised quotas in Table A17 and Figure A5.

The average take as a proportion of the authorised quota from 2000 to 2017 was 51.1%.

### Western grey kangaroo

Harvester returns for 2018 indicate that 88.4% of western grey kangaroos taken were males. For the year to 30 September 2019, harvester returns recorded a male bias of 76.9%, well above the long-term average (1999–2017) of 70.6%.

The actual takes of western grey kangaroos are shown against the authorised quotas in Table A18 and Figure A6.

The average take as a proportion of the authorised quota from 2000 to 2017 was 40.1%.

## Wallaroo

Harvester returns for 2018 indicate that 99.7% of wallaroos taken were males. For the year to 30 September 2019, harvester returns again showed a male bias of 99.7%, well above the long-term average (1999–2017) of 90.9%.

The actual takes of wallaroos are shown against the authorised quotas in Table A19 and Figure A7.

The average take as a proportion of the authorised quota from 2000 to 2017 was 48.3%.

## New commercial harvest zones

No new zones have been added to the 2020 harvest area, two existing zones were recently expanded and changed.

In 2020, the Griffith commercial harvest zone (Zone 11 and 12) has been expanded to absorb the non-commercial zone surrounding Wagga Wagga. As this created an extra-large zone, Griffith zone has been split into Griffith North (Zone 17) and Griffith South (Zone 18) zones to manage quota and tag allocations. The expanded area was incorporated into the aerial survey in 2019 to establish population estimates, thresholds and to allocate quota. This is an addition of 24,480km<sup>2</sup> for commercial harvesting, supported by the NSW Government Drought Relief Package announced in 2018.

As a reminder, the South East Tablelands zone (Zone 16) was expanded in January 2019. The addition of the Bombala area includes an approximate 2720 km<sup>2</sup> available for commercial harvesting.

Increasing the area for commercial harvesting by licensed, professional, qualified commercial kangaroo harvesters is expected to reduce reliance by landholders on non-commercial damage mitigation licences. The total area added to the commercial harvest zones is 27,200km<sup>2</sup>.

## Proposed changes to quotas

For 2020, the Department does not propose to set quotas that are higher than those specified in the Plan.

In accordance with the provisions of the plan, the Department has:

- suspended the harvest quota for red, eastern and western grey kangaroos in Cobar zone
- suspended the harvest quota for eastern and western grey kangaroos in the Bourke zone
- suspended the quota for red kangaroos in the Tibooburra and the Griffith South zones
- reduced the harvest quota for western grey kangaroos in the Tibooburra zone.

**Table 15 Zones with suspended or reduced quotas in 2020.**

Zone	Species	Status
<b>Cobar</b> – Zone 06	Eastern Grey	Closed
	Western Grey	Closed
	Red Kangaroo	Closed
<b>Bourke</b> – Zone 07	Eastern Grey	Closed
	Western Grey	Closed
	Red kangaroo	Open
<b>Tibooburra</b> – Zone 01	Red Kangaroo	Closed
	Eastern Grey	Open
	Western Grey	Reduced (10% quota)
<b>Griffith South</b> – Zone 18	Red Kangaroo	Closed
	Eastern Grey	Open
	Western Grey	Open

<sup>§</sup>This table does not include all zones with quotas set as per summary table



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## Appendix A. Tables and Figures

**Notes** to the tables that follow:

- Dark shading indicates the use of 100 metre correction factors from September 2003; light shading indicates 200 metre correction factors for surveys of the Western Plains zones using fixed-wing aircraft, as described in the section on 'Population estimates, and survey method used'.
- From 2017 the rows will be clear (no shading) indicating MRDS method of surveying and only for the Western Plains.
- Note that a new survey and analysis method (MRDS) is used from 2016. Within each zone, variation between population size estimates in 2015 and 2016 are due to a combination of the new method, climatic conditions and movement of kangaroo between zones.
- '% Population' refers to the actual take as a proportion of the *previous year's* population estimate, on which the quota is set.
- Where a quota has been set for only one of the two species of grey kangaroo, the population given includes both species.
- Where quota adjustments have been implemented during 2019, these are *not* reflected in the following tables. Full details of adjustments will be given in the Annual Report for 2019.
- Management zones that are surveyed by helicopter are surveyed on a three-yearly cycle. Population estimates remain the same for the intervening period. Correctional factors do not apply to helicopter surveys.

## Kangaroo management zone no. 1: Tibooburra

Table A1a Red kangaroo temporal variation – Tibooburra

Average density (kangaroos/km <sup>2</sup> )		16.49			
Area in km <sup>2</sup>		54,848			
Standard deviation		7.53			
Year	Population	Density	% Change	Quota	% Population
1990	1,004,500	18.3	-10.6	161,900	14.4
1991	1,468,600	26.8	46.2	149,200	14.9
1992	845,000	15.4	-42.5	337,800	23.0
1993	1,230,319	22.4	45.6	135,200	16.0
1994	1,103,648	20.1	-10.3	221,457	18.0
1995	1,078,399	19.7	-2.3	139,300	12.6
1996	1,009,295	18.4	-6.4	141,100	13.1
1997	1,673,668	30.5	65.8	132,800	13.2
1998	1,576,827	28.7	-5.8	190,900	11.4
1999	925,897	16.9	-41.3	104,570	6.6
2000	927,889	16.9	0.2	107,300	11.6
2001	1,389,398	25.3	49.7	106,200	11.4
2002	754,013	13.7	-45.7	229,200	16.5
2003	420,721	7.7	-44.2	124,700	16.5
2004	487,004	8.9	15.8	71,523	17.0
2005	629,502	11.5	29.3	82,791	17.0
2006	361,586	6.6	-42.6	107,015	17.0
2007	432,096	7.9	19.5	61,470	17.0
2008	606,518	11.1	40.4	73,456	17.0
2009	560,706	10.2	-7.6	103,108	17.0
2010	636,038	11.6	13.4	95,320	17.0
2011	621,124	11.3	-2.3	108,126	17.0
2012	937,643	17.1	51.0	105,591	17.0
2013	903,279	17.1	-3.7	159,399	17.0
2014	1,256,418	22.9	39.1	153,557	17.0
2015	1,061,784	19.4	-15.5	213,591	17.0
2016	1,567,598	30.2	47.6	180,503	17.0
2017	1,135,531	20.6	-27.6	266,492	17.0
2018	344,619	6.26	-69.7	193,040	17.0
2019	79,346	1.4	-77.0	0	0.0
2020				0	0.0

**Table A1b Grey kangaroo temporal variation – Tibooburra**

<b>Average density (kangaroos/km<sup>2</sup>)</b>		<b>2.53</b>			
<b>Area in km<sup>2</sup></b>		<b>54,848</b>			
<b>Standard deviation</b>		<b>1.69</b>			
<b>Year</b>	<b>Population</b>	<b>Density</b>	<b>% Change</b>	<b>Quota</b>	<b>% Population</b>
1990	83,400	1.5	48.7	7,400	13.2
1991	55,500	1.0	-33.5	11,000	13.2
1992	45,900	0.8	-17.3	8,900	16.0
1993	136,489	2.5	197.4	7,803	17.0
1994	162,375	3.0	19.0	34,122	25.0
1995	150,510	2.7	-7.3	8,653	5.3
1996	151,515	2.8	0.7	10,460	6.9
1997	274,399	5.0	81.1	7,185	4.7
1998	356,751	6.5	30.0	12,410	4.5
1999	212,896	3.9	-40.3	36,300	10.2
2000	209,231	3.8	-1.7	16,350	7.7
2001	242,312	4.4	15.8	18,100	8.7
2002	184,093	3.4	-24.0	41,700	17.2
2003	73,098	1.3	-60.3	31,000	16.8
2004	72,890	1.3	-0.3	10,965	15.0
2005	52,605	1.0	-27.8	10,933	15.0
2006	59,034	1.1	12.2	7,891	15.0
2007	64,222	1.2	8.8	8,855	15.0
2008	93,058	1.7	44.9	9,633	15.0
2009	92,905	1.7	-0.2	13,959	15.0
2010	37,781	0.7	-59.3	951	1.0
2011	51,214	0.9	35.6	0	0.0
2012	73,882	1.4	44.3	7,153	14.0
2013	163,392	3.0	121.2	11,082	15.0
2014	44,669	0.8	-72.7	24,509	15.0
2015	234,927	4.3	426.0	4,467	10.0
2016	451,594	6.8	92.2	35,239	15.0
2017	176,058	3.2	-61.0	67,739	15.0
2018	184,002	3.3	4.5	26,409	15.0
2019	48,502	0.9	-73.6	27,600	3.7
2020				6,782	14.0

## Kangaroo management zone no. 2: Broken Hill

**Table A2a Red kangaroo temporal variation – Broken Hill**

Average density (kangaroos/km <sup>2</sup> )		13.21			
Area in km <sup>2</sup>		90,845			
Standard deviation		4.34			
Year	Population	Density	% Change	Quota	% Population
1991	1,480,900	16.3	-10.5	252,600	15.3
1992	1,031,700	11.4	-30.3	263,900	17.8
1993	1,205,576	13.3	16.9	160,785	15.6
1994	1,059,378	11.7	-12.1	148,568	12.3
1995	1,477,215	16.3	39.4	125,732	11.9
1996	1,100,017	12.1	-25.5	174,059	11.8
1997	1,785,627	19.7	62.3	120,768	11.0
1998	1,437,241	15.8	-19.5	223,480	12.5
1999	1,358,991	15.0	-5.4	203,800	14.2
2000	959,482	10.6	-29.4	191,175	14.1
2001	1,487,845	16.4	55.1	143,000	14.9
2002	1,121,294	12.3	-24.6	220,200	14.8
2003	584,448	6.4	-47.9	166,950	14.9
2004	925,845	10.2	58.4	99,356	17.0
2005	538,956	5.9	-41.8	157,394	17.0
2006	725,035	8.0	34.5	91,622	17.0
2007	1,092,982	12.0	50.7	123,256	17.0
2008	1,190,299	13.1	8.9	185,807	17.0
2009	809,665	8.9	-32.0	202,351	17.0
2010	855,368	9.4	5.6	137,643	17.0
2011	1,079,052	11.9	26.2	145,413	17.0
2012	1,138,627	12.5	5.5	183,439	17.0
2013	1,219,455	13.4	7.1	193,567	17.0
2014	2,192,347	24.1	79.8	207,307	17.0
2015	2,168,733	23.9	-1.1	372,699	17.0
2016	1,206,597	13.6	-44.4	368,685	17.0
2017	823,210	9.0	-31.8	205,121	17.0
2018	1,133,523	12.41	37.7	139,946	17.0
2019	1,124,115	12.3	-0.8	192,699	17.0
2020				191,100	17.0

**Table A2b Grey kangaroo temporal variation – Broken Hill**

Average density (kangaroos/km <sup>2</sup> )		5.80			
Area in km <sup>2</sup>		90,845			
Standard deviation		3.05			
Year	Population	Density	% Change	Quota	% Population
1990	465,100	5.1	87.7	37,100	15.0
1991	449,700	5.0	-3.3	81,600	17.5
1992	457,500	5.0	1.7	102,900	22.9
1993	1,071,541	11.8	134.2	106,642	23.3
1994	660,124	7.3	-38.4	81,954	7.6
1995	1,291,048	14.2	95.6	50,450	7.6
1996	704,719	7.8	-45.4	118,800	9.2
1997	840,578	9.3	19.3	59,687	8.5
1998	711,846	7.8	-15.3	62,650	7.5
1999	645,471	7.1	-9.3	79,160	11.1
2000	730,421	8.0	13.2	71,650	11.1
2001	723,937	8.0	-0.9	71,600	9.8
2002	982,041	10.8	35.7	101,000	14.0
2003	263,796	2.9	-73.1	138,000	14.1
2004	251,867	2.8	-4.5	39,569	15.0
2005	174,358	1.9	-30.8	37,780	15.0
2006	216,474	2.4	24.2	26,154	15.0
2007	281,904	3.1	30.2	32,471	15.0
2008	439,369	4.8	55.9	42,286	15.0
2009	366,677	4.0	-16.5	65,905	15.0
2010	241,831	2.7	-34.0	55,002	15.0
2011	179,320	2.0	-25.8	36,275	15.0
2012	221,803	2.4	23.7	21,382	11.9
2013	586,534	6.5	164.4	26,702	12.0
2014	444,547	4.9	-24.2	87,980	15.0
2015	564,083	6.2	26.9	66,682	15.0
2016	672,187	7.4	19.2	84,612	15.0
2017	438,131	4.8	-34.8	100,828	15.0
2018	395,360	4.3	-9.8	65,720	15.0
2019	326,644	3.6	-17.4	59,304	15.0
2020				48,977	15.0

## Kangaroo management zone no. 4: Lower Darling

**Table A3a Red kangaroo temporal variation – Lower Darling**

Average density (kangaroos/km <sup>2</sup> )		5.77			
Area in km <sup>2</sup>		56,460			
Standard deviation		2.51			
Year	Population	Density	% Change	Quota	% Population
1991	377,600	6.7	8.1	49,700	14.2
1992	399,200	7.1	5.7	86,800	23.0
1993	268,066	4.7	-32.8	95,808	24.0
1994	555,979	9.8	107.4	42,890	16.0
1995	402,592	7.1	-27.6	75,768	13.6
1996	385,844	6.8	-4.2	55,900	13.9
1997	493,302	8.7	27.9	73,117	18.9
1998	315,945	5.6	-36.0	75,000	15.2
1999	364,651	6.5	15.4	39,910	12.6
2000	221,468	3.9	-39.3	54,300	14.9
2001	279,185	4.9	26.1	36,820	16.6
2002	468,072	8.3	67.7	40,900	14.6
2003	197,864	3.5	-57.7	69,200	14.8
2004	166,340	2.9	-15.9	33,637	17.0
2005	124,665	2.2	-25.1	28,278	17.0
2006	113,119	2.0	-9.3	21,193	17.0
2007	188,018	3.3	66.2	19,230	17.0
2008	251,731	4.5	33.9	31,963	17.0
2009	185,450	3.3	-26.3	42,794	17.0
2010	193,931	3.4	4.6	31,527	17.0
2011	186,473	3.3	-3.8	32,968	17.0
2012	295,180	5.2	58.3	31,700	17.0
2013	423,518	7.5	43.5	50,181	17.0
2014	289,106	5.1	-31.7	71,998	17.0
2015	387,272	6.9	34.0	49,148	17.0
2016	619,113	11.0	59.9	65,836	17.0
2017	289,385	5.1	-53.3	105,249	17.0
2018	307,619	5.4	6.3	49,195	17.0
2019	1,124,115	12.2	124.7	52,295	17.0
2020				117,490	17.0

**Table A3b Grey kangaroo temporal variation – Lower Darling**

<b>Average density (kangaroos/km<sup>2</sup>)</b>		<b>7.99</b>			
<b>Area in km<sup>2</sup></b>		<b>56,460</b>			
<b>Standard deviation</b>		<b>4.42</b>			
<b>Year</b>	<b>Population</b>	<b>Density</b>	<b>% Change</b>	<b>Quota</b>	<b>% Population</b>
1990	445,800	7.9	79.6	39,700	16.0
1991	696,900	12.3	56.3	75,800	17.0
1992	573,900	10.2	-17.6	188,163	27.0
1993	1,091,834	19.3	90.2	134,293	23.4
1994	1,050,128	18.6	-3.8	207,448	19.0
1995	880,562	15.6	-16.1	88,660	8.4
1996	609,376	10.8	-30.8	91,124	10.3
1997	620,029	11.0	1.7	59,340	9.7
1998	497,977	8.8	-19.7	54,150	8.7
1999	663,487	11.8	33.2	59,100	11.9
2000	362,692	6.4	-45.3	70,750	10.7
2001	454,782	8.1	25.4	44,600	12.3
2002	512,465	9.1	12.7	69,300	15.2
2003	336,387	6.0	-34.4	78,300	15.3
2004	306,466	5.4	-8.9	50,458	15.0
2005	110,876	2.0	-63.8	45,970	15.0
2006	220,666	3.9	99.0	16,631	15.0
2007	226,569	4.0	2.7	33,100	15.0
2008	367,220	6.5	62.1	33,985	15.0
2009	215,420	3.8	-41.3	55,083	15.0
2010	231,585	4.1	7.5	32,313	15.0
2011	98,973	1.8	-57.3	34,738	15.0
2012	232,187	4.1	134.6	3,259	3.3
2013	486,859	8.6	109.7	34,828	15.0
2014	397,584	7.0	-18.3	73,029	15.0
2015	360,959	6.4	-9.2	59,638	15.0
2016	566,970	10.7	57.1	54,144	15.0
2017	212,474	3.7	-62.5	85,046	15.0
2018	281,035	5.0	32.3	31,871	15.0
2019	378,718	6.7	34.8	42,155	15.0
2020				56,808	15.0



## Kangaroo management zone no. 6: Cobar

**Table A4a Red kangaroo temporal variation – Cobar**

Average density (kangaroos/km <sup>2</sup> )		4.76				
Area in km <sup>2</sup>		40,339				
Standard deviation		2.20				
Year	Population	Density	% Change	Quota	% Population	
1990	264,300	6.6	26.3	38,300	18.3	
1991	238,600	5.9	-9.7	48,500	18.4	
1992	170,700	4.2	-28.5	45,300	19.0	
1993	127,658	3.2	-25.2	27,312	16.0	
1994	201,113	5.0	57.5	12,766	10.0	
1995	151,314	3.8	-24.8	28,116	14.0	
1996	170,917	4.2	13.0	31,441	20.8	
1997	163,624	4.1	-4.3	19,780	11.6	
1998	312,413	7.7	90.9	25,580	15.6	
1999	228,367	5.7	-26.9	41,640	13.3	
2000	231,400	5.7	1.3	29,375	12.9	
2001	196,029	4.9	-15.3	29,700	12.8	
2002	258,662	6.4	32.0	29,200	14.9	
2003	121,756	3.0	-52.9	38,600	14.9	
2004	146,292	3.6	20.2	20,699	17.0	
2005	117,137	2.9	-19.9	24,870	17.0	
2006	107,825	2.7	-7.9	19,913	17.0	
2007	85,913	2.1	-20.3	18,330	17.0	
2008	156,639	3.9	82.3	14,605	17.0	
2009	97,823	2.4	-37.5	26,629	17.0	
2010	148,177	3.7	51.5	16,630	17.0	
2011	210,921	5.2	42.3	25,190	17.0	
2012	252,750	6.3	19.8	35,857	17.0	
2013	193,738	4.8	-23.3	42,968	17.0	
2014	298,459	7.4	54.1	32,935	17.0	
2015	357,287	8.9	19.7	50,738	17.0	
2016	437,129	10.8	22.3	60,739	17.0	
2017	229,495	5.7	-47.5	74,312	17.0	
2018	44,733	1.1	-80.5	39,014	17.0	
2019	36,058	0.9	-19.4	0	0	
2020				0	0	

**Table A4b Grey kangaroo temporal variation – Cobar**

Average density (kangaroos/km <sup>2</sup> )		11.53			
Area in km <sup>2</sup>		40,339			
Standard deviation		6.72			
Year	Population	Density	% Change	Quota	% Population
1990	275,100	6.8	10.0	38,800	15.5
1991	305,800	7.6	11.2	44,700	16.2
1992	313,000	7.8	2.4	73,400	24.0
1993	602,794	14.9	92.6	78,250	25.0
1994	558,152	13.8	-7.4	126,587	21.0
1995	894,671	22.2	60.3	47,542	8.5
1996	598,600	14.8	-33.1	73,738	8.2
1997	683,136	16.9	14.1	40,820	6.8
1998	775,992	19.2	13.6	40,900	6.0
1999	857,216	21.3	10.5	81,650	10.5
2000	755,493	18.7	-11.9	78,850	9.2
2001	1,052,432	26.1	39.3	67,700	9.0
2002	938,507	23.3	-10.8	131,500	12.5
2003	551,434	13.7	-41.2	114,900	12.2
2004	303,491	7.5	-45.0	82,715	15.0
2005	279,121	6.9	-8.0	45,524	15.0
2006	208,066	5.2	-25.5	41,868	15.0
2007	282,841	7.0	35.9	31,210	15.0
2008	350,925	8.7	24.1	42,426	15.0
2009	251,233	6.2	-28.4	52,639	15.0
2010	256,097	6.4	1.9	37,685	15.0
2011	176,060	4.4	-31.3	38,415	15.0
2012	311,522	7.7	76.9	21,384	12.1
2013	660,596	16.4	112.1	46,728	15.0
2014	546,338	13.5	-17.3	99,089	15.0
2015	492,207	12.2	-9.9	81,951	15.0
2016	405,079	10.0	-17.7	73,831	15.0
2017	184,069	4.5	-54.6	60,762	15.0
2018	81,391	2.0	-55.8	22,239	12.1
2019	7,317	0.2	-91.0	0	0.0
2020				0	0

## Kangaroo management zone no. 7: Bourke

**Table A5a Red kangaroo temporal variation – Bourke**

Average density (kangaroos/km <sup>2</sup> )		6.25			
Area in km <sup>2</sup>		55,005			
Standard deviation		3.02			
Year	Population	Density	% Change	Quota	% Population
1990	483,100	8.8	23.5	65,500	16.7
1991	356,600	6.5	-26.2	82,600	17.1
1992	245,300	4.5	-31.2	60,600	17.0
1993	380,260	6.9	55.0	39,248	16.0
1994	230,959	4.2	-39.3	68,447	18.0
1995	171,539	3.1	-25.7	14,920	6.5
1996	192,031	3.5	11.9	14,920	8.7
1997	208,276	3.8	8.5	19,080	9.9
1998	281,932	5.1	35.4	23,055	11.1
1999	380,435	6.9	34.9	45,950	16.3
2000	438,249	8.0	15.2	52,500	13.8
2001	487,321	8.9	11.2	59,200	13.5
2002	756,705	13.8	55.3	72,900	15.0
2003	191,581	3.5	-74.7	114,450	15.1
2004	203,764	3.7	6.4	32,569	17.0
2005	220,567	4.0	8.2	34,640	17.0
2006	258,668	2.7	17.3	37,496	17.0
2007	143,043	2.6	-44.7	43,973	17.0
2008	140,371	2.6	-1.9	24,317	17.0
2009	180,413	3.3	28.5	23,863	17.0
2010	251,196	4.6	39.2	30,670	17.0
2011	444,932	8.1	77.1	42,703	17.0
2012	429,000	7.8	-3.6	75,638	17.0
2013	460,225	8.4	7.3	72,930	17.0
2014	439,559	7.1	-4.5	78,238	17.0
2015	504,671	9.2	14.8	74,725	17.0
2016	730,140	13.3	44.7	85,794	17.0
2017	461,968	8.4	-36.7	124,124	17.0
2018	244,687	4.5	-47.0	78,535	17.0
2019	497,085	9.0	103.2	41,597	17.0
2020				84,504	17.0

**Table A5b Grey kangaroo temporal variation – Bourke**

<b>Average density (kangaroos/km<sup>2</sup>)</b>		<b>8.68</b>			
<b>Area in km<sup>2</sup></b>		<b>55,005</b>			
<b>Standard deviation</b>		<b>5.96</b>			
<b>Year</b>	<b>Population</b>	<b>Density</b>	<b>% Change</b>	<b>Quota</b>	<b>% Population</b>
1990	454,300	8.3	65.6	42,000	15.3
1991	338,200	6.1	-25.6	75,600	16.6
1992	524,400	9.5	55.1	54,100	16.0
1993	1,147,159	20.9	118.8	144,734	27.6
1994	753,367	13.7	-34.3	240,903	21.0
1995	438,500	8.0	-41.8	50,473	6.7
1996	554,855	10.1	26.5	17,500	4.0
1997	645,291	11.7	16.3	34,005	6.1
1998	616,180	11.2	-4.5	47,090	7.3
1999	751,599	13.7	22.0	65,950	10.7
2000	828,888	15.1	10.3	79,250	10.5
2001	1,220,882	22.2	47.3	88,300	10.7
2002	1,013,389	18.4	-17.0	152,200	12.5
2003	298,422	5.4	-70.6	126,700	12.5
2004	268,883	4.9	-9.9	44,763	15.0
2005	181,025	3.3	-32.7	40,332	15.0
2006	110,115	2.0	-39.2	27,154	15.0
2007	183,442	3.3	66.6	16,517	15.0
2008	152,776	2.8	-16.7	27,516	15.0
2009	147,001	2.7	-3.8	22,916	15.0
2010	140,721	2.6	-4.3	14,194	9.7
2011	128,018	2.3	-9.0	16,508	11.7
2012	446,909	8.1	249.1	12,802	10.0
2013	541,622	9.9	21.2	67,036	15.0
2014	471,812	8.6	-12.9	81,243	15.0
2015	474,326	8.6	0.5	70,772	15.0
2016	473,265	18.6	-0.2	71,149	15.0
2017	221,401	4.0	-53.2	70,990	15.0
2018	183,950	3.3	-16.9	33,210	15.0
2019	51,734	0.9	-71.9	27,592	15.0
2020				0	0

## Kangaroo management zone no. 8: Narrabri

**Table A6a Red kangaroo temporal variation – Narrabri**

Average density (kangaroos/km <sup>2</sup> )		5.93			
Area in km <sup>2</sup>		65,787			
Standard deviation		3.70			
Year	Population	Density	% Change	Quota	% Population
1990	246,100	3.7	-9.6	44,500	16.3
1991	242,600	3.7	-1.4	41,700	16.9
1992	170,100	2.6	-29.9	41,200	17.0
1993	458,957	7.0	169.8	27,216	16.0
1994	222,974	3.4	-51.4	91,791	20.0
1995	297,913	4.5	33.6	17,220	7.7
1996	124,694	1.9	-58.1	26,809	9.0
1997	283,171	4.3	127.1	11,865	9.5
1998	1,046,075	15.9	269.4	23,200	8.2
1999	506,146	7.7	-51.6	109,450	10.5
2000	924,453	14.1	82.6	52,850	10.4
2001	532,460	8.1	-42.4	98,400	10.6
2002	692,966	10.5	30.1	79,800	15.0
2003	224,010	3.4	-67.7	103,950	15.0
2004	167,484	2.5	-25.2	38,082	17.0
2005	198,190	3.0	18.3	28,472	17.0
2006	233,780	3.6	18.0	33,692	17.0
2007	121,426	1.8	-48.1	39,743	17.0
2008	124,915	1.9	2.9	20,642	17.0
2009	189,118	2.9	51.4	21,236	17.0
2010	433,366	6.6	129.2	32,150	17.0
2011	530,367	8.1	22.4	73,672	17.0
2012	371,257	5.6	-30.0	90,162	17.0
2013	369,861	5.6	-0.4	63,114	17.0
2014	406,847	6.2	10.0	62,876	17.0
2015	315,429	4.8	-22.5	69,164	17.0
2016	780,834	11.9	147.5	53,623	17.0
2017	785,211	11.9	0.6	132,742	17.0
2018	353,348	5.4	-55.0	133,486	17.0
2019	346,451	5.3	-2.0	60,069	17.0
2020				58,897	17.0

**Table A6b Grey kangaroo temporal variation – Narrabri**

Average density (kangaroos/km <sup>2</sup> )		14.82			
Area in km <sup>2</sup>		65,787			
Standard deviation		7.14			
Year	Population	Density	% Change	Quota	% Population
1990	1,005,900	15.3	24.5	142,700	17.7
1991	987,000	15.0	-1.9	186,000	18.5
1992	898,500	13.7	-9.0	187,500	19.0
1993	1,964,801	29.9	118.7	188,685	21.0
1994	1,168,552	17.8	-40.5	412,608	21.0
1995	835,633	12.7	-28.5	103,530	8.9
1996	369,992	5.6	-55.7	61,964	7.4
1997	671,027	10.2	81.4	34,931	9.4
1998	1,214,523	18.5	81.0	63,543	9.5
1999	867,516	13.2	-28.6	175,310	14.4
2000	1,491,090	22.7	71.9	119,500	13.8
2001	1,523,954	23.2	2.2	182,500	12.2
2002	1,927,959	29.3	26.5	191,200	12.5
2003	874,080	13.3	-54.7	247,300	12.8
2004	367,179	5.6	-58.0	131,112	15.0
2005	399,672	6.1	8.8	55,077	15.0
2006	398,589	6.1	-0.3	59,853	15.0
2007	697,531	10.6	75.0	59,788	15.0
2008	513,617	7.8	-26.4	104,630	15.0
2009	447,330	6.8	-12.9	77,043	15.0
2010	752,771	11.4	68.3	67,002	15.0
2011	1,229,345	18.7	63.3	112,851	15.0
2012	1,246,675	19.0	1.4	184,304	15.0
2013	1,874,886	28.5	50.4	186,514	15.0
2014	1,321,410	20.1	-29.5	280,485	15.0
2015	813,425	12.4	-38.4	197,692	15.0
2016	1,434,755	21.8	76.4	121,072	15.0
2017	445,768	6.8	-68.9	215,213	15.0
2018	728,648	11.1	63.5	66,378	14.9
2019	765,632	11.5	5.1	108,413	14.9
2020				114,009	14.9

## Kangaroo management zone no. 10: Coonabarabran

**Table A7a Red kangaroo temporal variation – Coonabarabran**

<b>Average density (kangaroos/km<sup>2</sup>)</b>	<b>4.94</b>				
<b>Area in km<sup>2</sup></b>	<b>61,590</b>				
<b>Standard deviation</b>	<b>2.30</b>				
<b>Year</b>	<b>Population</b>	<b>Density</b>	<b>% Change</b>	<b>Quota</b>	<b>% Population</b>
1990	186,000	3.0	-12.8	33,100	15.5
1991	311,600	5.1	67.5	29,900	16.1
1992	114,400	1.9	-63.3	71,700	23.0
1993	353,658	5.7	209.1	18,304	16.0
1994	95,586	1.6	-73.0	70,732	20.0
1995	254,715	4.1	166.5	9,675	10.1
1996	170,558	2.8	-33.0	23,494	9.2
1997	344,758	5.6	102.1	11,535	6.8
1998	567,057	9.2	64.5	24,015	7.0
1999	392,685	6.4	-30.8	64,100	11.3
2000	295,403	4.8	-24.8	44,000	11.2
2001	301,341	4.9	2.0	42,320	14.3
2002	345,431	5.6	14.6	45,100	15.0
2003	204,649	3.3	-40.8	51,300	14.9
2004	199,348	3.2	-2.6	34,790	17.0
2005	135,328	2.2	-32.1	33,889	17.0
2006	161,119	2.6	19.1	23,006	17.0
2007	168,001	2.7	4.3	27,390	17.0
2008	170,804	2.8	1.7	28,560	17.0
2009	202,199	3.3	18.4	29,037	17.0
2010	250,625	4.1	23.9	34,374	17.0
2011	343,239	5.6	37.0	42,606	17.0
2012	357,256	5.8	4.1	58,351	17.0
2013	373,924	6.1	4.7	60,734	17.0
2014	590,194	9.6	57.8	63,567	17.0
2015	505,429	8.2	-14.4	100,333	17.0
2016	421,498	6.8	-16.6	85,923	17.0
2017	588,404	9.5	39.6	71,655	17.0
2018	218,312	3.5	-62.9	100,029	17.0
2019	500,137	8.1	129.1	37,113	17.0
2020				85,023	17.0

**Table A7b Grey kangaroo temporal variation – Coonabarabran**

Average density (kangaroos/km <sup>2</sup> )		22.59			
Area in km <sup>2</sup>		61,590			
Standard deviation		10.11			
Year	Population	Density	% Change	Quota	% Population
1990	755,700	12.3	7.0	124,600	17.6
1991	811,410	13.2	7.4	138,100	18.3
1992	521,100	8.5	-35.8	219,100	27.0
1993	2,151,730	34.9	312.9	88,587	17.0
1994	1,497,000	24.3	-30.4	537,933	25.0
1995	1,768,625	28.7	18.1	62,007	4.1
1996	1,422,035	23.1	-19.6	83,312	4.7
1997	1,683,707	27.3	18.4	54,810	3.9
1998	1,551,195	25.2	-7.9	91,245	5.4
1999	1,717,979	27.9	10.8	130,250	8.4
2000	1,430,884	23.2	-16.7	137,600	8.0
2001	2,078,208	33.7	45.2	112,700	7.9
2002	3,195,179	51.9	53.7	245,800	11.8
2003	1,824,168	29.6	-42.9	375,000	11.7
2004	1,259,605	20.5	-30.9	273,625	15.0
2005	702,576	11.4	-44.2	188,941	15.0
2006	905,594	14.7	28.9	105,386	15.0
2007	568,378	9.2	-37.2	135,839	15.0
2008	583,873	9.5	2.7	85,257	15.0
2009	695,066	11.3	19.0	87,581	15.0
2010	935,327	15.2	34.6	98,075	14.1
2011	1,089,829	17.7	16.5	135,214	14.5
2012	1,457,381	23.7	33.7	163,474	15.0
2013	2,071,115	33.6	42.1	218,607	15.0
2014	2,417,012	39.2	16.7	310,667	15.0
2015	1,836,656	29.8	-24.0	362,552	15.0
2016	1,089,374	17.7	-40.7	275,498	15.0
2017	915,211	14.8	-16.0	163,406	15.0
2018	1,274,243	20.7	39.2	133,875	14.6
2019	1,536,291	24.9	20.6	191,136	15.0
2020				230,444	15.0



## Kangaroo management zone no. 11: Griffith\*

**Table A8a Red kangaroo temporal variation – Griffith\***

Average density (kangaroos/km <sup>2</sup> )		4.18			
Area in km <sup>2</sup>		98,171			
Standard deviation		1.82			
Year	Population	Density	% Change	Quota	% Population
1990	311,800	3.2	24.8	38,300	15.3
1991	278,900	2.8	-10.6	51,800	16.6
1992	408,500	4.2	46.5	48,800	17.5
1993	370,933	3.8	-9.2	94,895	23.2
1994	490,469	5.0	32.2	35,040	9.4
1995	351,806	3.6	-28.3	72,952	14.9
1996	633,758	6.5	80.1	38,930	11.1
1997	333,569	3.4	-47.4	76,868	12.1
1998	272,267	2.8	-18.4	33,310	10.0
1999	548,493	5.6	101.5	32,650	12.0
2000	393,042	4.0	-28.3	58,950	10.7
2001	447,833	4.6	13.9	43,110	11.0
2002	401,414	4.1	-10.4	48,600	10.9
2003	290,084	3.0	-27.7	35,200	8.8
2004	212,159	2.2	-26.9	49,314	17.0
2005	277,153	2.8	30.6	36,067	17.0
2006	221,656	2.3	-20.0	47,116	17.0
2007	292,970	3.0	32.2	37,682	17.0
2008	228,433	2.3	-22.0	49,805	17.0
2009	231,422	2.4	1.3	38,834	17.0
2010	245,208	2.5	6.0	39,342	17.0
2011	556,415	5.7	126.9	41,685	17.0
2012	366,603	3.7	-34.1	94,591	17.0
2013	536,580	5.5	46.4	62,322	17.0
2014	950,341	9.7	77.1	91,219	17.0
2015	589,282	6.0	-38.0	161,558	17.0
2016	601,325	6.1	2.0	100,178	17.0
2017	819,450	7.8	36.3	102,225	17.0
2018	284,853	2.7	-65.2	139,307	17.0
2019**	266,333	2.7	-6.5	48,425	17.0

\*Zone expanded and population now estimated for Zone 17 and Zone 18. See Tables A9a, A9b and tables A10a and A10b.

\*\*Quota calculation derived from different methods to previous year

**Table A8b Grey kangaroo temporal variation – Griffith**

Average density (kangaroos/km <sup>2</sup> )		10.07			
Area in km <sup>2</sup>		98,171			
Standard deviation		3.68			
Year	Population	Density	% Change	Quota	% Population
1990	566,000	5.8	41.1	62,800	15.7
1991	704,600	7.2	24.5	105,100	18.6
1992	669,100	6.8	-5.0	190,200	27.0
1993	1,395,898	14.2	108.6	160,584	24.0
1994	1,105,248	11.3	-20.8	108,744	7.8
1995	1,093,657	11.1	-1.0	128,016	11.6
1996	1,288,316	13.1	17.8	113,564	10.4
1997	1,121,800	11.4	-12.9	128,047	9.9
1998	1,349,050	13.7	20.3	74,650	6.7
1999	1,244,734	12.7	-7.7	154,860	11.5
2000	1,157,073	11.8	-7.0	131,050	10.5
2001	1,022,526	10.4	-11.6	147,600	12.8
2002	1,437,265	14.6	40.6	140,100	13.7
2003	874,589	8.9	-39.1	194,450	13.5
2004	722,872	7.4	-17.3	131,188	15.0
2005	701,493	7.1	-3.0	108,431	15.0
2006	677,124	6.9	-3.5	105,224	15.0
2007	571,999	5.8	-15.5	101,569	15.0
2008	638,262	6.5	11.6	85,800	15.0
2009	321,138	3.3	-49.7	95,739	15.0
2010	562,931	5.7	75.3	16,673	5.2
2011	541,306	5.5	-3.8	50,019	8.9
2012	700,388	7.1	29.4	78,012	14.4
2013	1,780,269	18.3	154.2	105,058	15.0
2014	1,376,362	14.0	-22.7	267,040	15.0
2015	1,476,232	15.0	7.3	206,454	15.0
2016	1,241,399	12.6	-15.9	221,435	15.0
2017	1,262,635	12.0	1.7	186,210	15.0
2018	919,282	8.7	-27.2	189,395	15.0
2019**	1,689,268	13.0	83.8	137,892	15.0

\*Zone expanded and population now estimated for Zone 17 and Zone 18. See Tables A9a, A9b and tables A10a and A10b

\*\*Quota calculation derived from different methods to previous year

## Kangaroo management zone no. 17: Griffith North

**Table A9a Red kangaroo temporal variation – Griffith North**

<b>Average density (kangaroos/km<sup>2</sup>)</b>	<b>2.4</b>				
<b>Area in km<sup>2</sup></b>	<b>65,748</b>				
<b>Standard deviation</b>	<b>NA</b>				
<b>Year</b>	<b>Population</b>	<b>Density</b>	<b>% Change</b>	<b>Quota</b>	<b>% Population</b>
2019	159,645	2.4	0.0	0	0
2020				27,123	17.0

**Table A9b Grey kangaroo temporal variation – Griffith North**

<b>Average density (kangaroos/km<sup>2</sup>)</b>	<b>15.65</b>				
<b>Area in km<sup>2</sup></b>	<b>65,758</b>				
<b>Standard deviation</b>	<b>NA</b>				
<b>Year</b>	<b>Population</b>	<b>Density</b>	<b>% Change</b>	<b>Quota</b>	<b>% Population</b>
2019	1,029,202	15.7	0.0	0	0
2020				154,380	15.0

## Kangaroo management zone no. 18: Griffith South

**Table A10a Red kangaroo temporal variation – Griffith South**

<b>Average density (kangaroos/km<sup>2</sup>)</b>	<b>1.70</b>				
<b>Area in km<sup>2</sup></b>	<b>64,126</b>				
<b>Standard deviation</b>	<b>NA</b>				
<b>Year</b>	<b>Population</b>	<b>Density</b>	<b>% Change</b>	<b>Quota</b>	<b>% Population</b>
2019	106,788	1.7	0.0	0	0
2020				0	0

**Table A10b Grey kangaroo temporal variation – Griffith South**

<b>Average density (kangaroos/km<sup>2</sup>)</b>	<b>10.30</b>				
<b>Area in km<sup>2</sup></b>	<b>64,126</b>				
<b>Standard deviation</b>	<b>NA</b>				
<b>Year</b>	<b>Population</b>	<b>Density</b>	<b>% Change</b>	<b>Quota</b>	<b>% Population</b>
2019	660,066	10.3	0.0	0	0
2020				99,000	15.0

## Kangaroo management zone no. 9: Armidale

Table A11a Eastern grey kangaroo temporal variation – Armidale

<b>Average density (kangaroos/km<sup>2</sup>)</b>		<b>14.3</b>			
<b>Area in km<sup>2</sup></b>		<b>15,023</b>			
<b>Standard deviation</b>		<b>5.75</b>			
<b>Year</b>	<b>Population</b>	<b>Density</b>	<b>% Change</b>	<b>Quota</b>	<b>% Population</b>
1993	234,655	14.4	5.0	46,931	21.0
1994	199,474	12.2	-15	46,931	20.0
1995	207,462	12.7	4.0	43,882	22.0
1996	161,821	9.9	-22.0	45,640	22.0
1997	182,857	11.2	13.0	32,364	20.0
1998	198,765	12.2	9.0	31,085	17.0
1999	196,777	12.0	-1.0	33,790	17.0
2000	206,600	12.7	5.0	33,450	17.0
2001	173,109	10.6	-16.0	35,100	17.0
2002	173,109	10.6	0.0	25,966	15.0
2003	180,456	11	4.0	25,966	15.0
2004	161,726	10.2	-10.0	27,068	15.0
2005	161,726	10.2	0.0	24,259	15.0
2006	161,726	10.2	0.0	24,259	15.0
2007	141,610	8.7	-12.0	24,259	15.0
2008	141,610	8.7	0.0	21,242	15.0
2009	141,610	8.7	0.0	21,242	15.0
2010	199,200	12.2	41.0	21,242	15.0
2011	206,780	13.1	4.0	29,880	15.0
2012	206,780	13.1	0.0	31,017	15.0
2013	263,300	16.1	27.0	31,017	15.0
2014	263,300	16.1	0.0	39,495	15.0
2015	263,300	16.1	0.0	39,495	15.0
2016	420,800	28.0	60.0	39,495	15.0
2017	420,800	28.0	60.0	63,120	15.0
2018	420,800	28.0	60.0	63,120	15.0
2019	421,900	28.1	0.0	63,120	15.0
2020				62,285	15.0

**Table A11b Common wallaroo temporal variation – Armidale**

<b>Average density (kangaroos/km<sup>2</sup>)</b>		<b>5.3</b>			
<b>Area in km<sup>2</sup></b>		<b>15,023</b>			
<b>Standard deviation</b>		<b>2.08</b>			
<b>Year</b>	<b>Population</b>	<b>Density</b>	<b>% Change</b>	<b>Quota</b>	<b>% Population</b>
1993	127,680	7.8	0.0	6,160	4.8
1994	121,296	7.4	-5.0	6,432	5.0
1995	126,148	7.7	4.0	6,118	5.0
1996	98,396	6.0	-22	6,308	5.0
1997	111,187	6.8	13	4,920	5.0
1998	120,860	7.4	9.0	5,559	5.0
1999	119,651	7.3	-1.0	6,043	5.0
2000	125,600	7.7	5.0	5,975	5.0
2001	125,600	7.7	0.0	6,250	5.0
2002	125,600	7.7	0.0	6,250	5.0
2003	34,744	2.1	-72	6,250	5.0
2004	89,787	5.7	158	5,212	15.0
2005	89,787	5.7	0.0	13,468	15.0
2006	89,787	5.7	0.0	13,468	15.0
2007	37,859	2.3	-58	13,468	15.0
2008	37,859	2.3	0.0	5,679	15.0
2009	37,859	2.3	0.0	5,679	15.0
2010	41,255	2.5	9.0	5,679	15.0
2011	41,255	2.5	0.0	6,188	15.0
2012	41,255	2.5	0.0	6,188	15.0
2013	45,140	2.8	9.0	6,188	15.0
2014	45,140	2.8	0.0	6,771	15.0
2015	45,140	2.8	0.0	6,771	15.0
2016	72,600	4.8	60.8	6,771	15.0
2017	72,600	4.8	60.8	10,890	15.0
2018	72,600	4.8	60.8	10,890	15.0
2019	63,400	4.2	-12.7	10,890	15.0
2020				9,510	15.0

## Kangaroo management zone no. 13: Glen Innes

**Table A12a Eastern grey kangaroo temporal variation – Glen Innes**

<b>Average density (kangaroos/km<sup>2</sup>)</b>		<b>14.7</b>			
<b>Area in km<sup>2</sup></b>		<b>17,241</b>			
<b>Standard deviation</b>		<b>8.19</b>			
<b>Year</b>	<b>Population</b>	<b>Density</b>	<b>% Change</b>	<b>Quota</b>	<b>% Population</b>
1993	234,655	11.2	5.0	46,931	21.0
1994	199,474	9.5	-15.0	46,931	20.0
1995	207,462	9.9	4.0	43,882	22.0
1996	161,821	7.7	-22.0	45,640	22.0
1997	182,857	8.7	13.0	32,364	20.0
1998	198,765	9.5	9.0	31,085	17.0
1999	196,777	9.4	-1.0	33,790	17.0
2000	206,600	9.9	5.0	33,450	17.0
2001	221,975	10.6	7.0	35,122	17.0
2002	221,975	10.6	0.0	33,296	15.0
2003	229,723	11.0	3.0	33,296	15.0
2004	149,621	8.1	-35.0	34,458	15.0
2005	149,621	8.1	0.0	22,443	15.0
2006	149,621	8.1	0.0	22,443	15.0
2007	236,600	11.3	58.0	22,443	15.0
2008	236,600	11.3	0.0	35,490	15.0
2009	236,600	11.3	0.0	35,490	15.0
2010	269,500	12.9	14.0	35,490	15.0
2011	269,500	12.9	0.0	40,425	15.0
2012	269,500	12.9	0.0	40,425	15.0
2013	374,300	17.9	39.0	40,425	15.0
2014	374,300	17.9	0.0	56,145	15.0
2015	374,300	17.9	0.0	56,145	15.0
2016	587,400	34.0	57.0	56,145	15.0
2017	587,400	34.0	57.0	88,110	15.0
2018	587,400	34.0	57.0	88,110	15.0
2019	545,200	31.6	-7.0	88,110	15.0
2020				81,780	15.0

**Table A12b Common wallaroo temporal variation – Glen Innes**

<b>Average density (kangaroos/km<sup>2</sup>)</b>	<b>4.3</b>				
<b>Area in km<sup>2</sup></b>	<b>17,241</b>				
<b>Standard deviation</b>	<b>2.36</b>				
<b>Year</b>	<b>Population</b>	<b>Density</b>	<b>% Change</b>	<b>Quota</b>	<b>% Population</b>
1993	127,680	6.1	0.0	6,160	4.8
1994	121,296	5.8	-5.0	6,432	5.0
1995	126,148	6.0	4.0	6,118	5.0
1996	98,396	4.7	-22.0	6,308	5.0
1997	111,187	5.3	13.0	4,920	5.0
1998	120,860	5.8	9.0	5,559	5.0
1999	119,651	5.7	-1.0	6,043	5.0
2000	125,600	6.0	5.0	5,975	5.0
2001	215,500	10.3	72.0	6,250	5.0
2002	215,500	10.3	0.0	6,250	2.9
2003	128,232	6.1	-40.0	6,250	2.9
2004	56,657	3.1	-56.0	19,235	15.0
2005	56,657	3.1	0.0	8,499	15.0
2006	56,657	3.1	0.0	8,499	15.0
2007	32,184	1.5	-43.0	8,499	15.0
2008	32,184	1.5	0.0	4,828	15.0
2009	32,184	1.5	0.0	4,828	15.0
2010	32,190	1.5	0.0	4,828	15.0
2011	32,190	1.5	0.0	4,829	15.0
2012	32,190	1.5	0.0	4,829	15.0
2013	28,305	1.4	-12.0	4,829	15.0
2014	28,305	1.4	0.0	4,246	15.0
2015	28,305	1.4	0.0	4,246	15.0
2016	54,900	3.2	94.0	4,246	15.0
2017	54,900	3.2	94.0	8,235	15.0
2018	54,900	3.2	94.0	8,235	15.0
2019	72,900	4.2	33.0	8,235	15.0
2020				10,935	15.0



## Kangaroo management zone no. 14: Upper Hunter

Table A13a Eastern grey kangaroo temporal variation – Upper Hunter

<b>Average density (kangaroos/km<sup>2</sup>)</b>		<b>13.6</b>			
<b>Area in km<sup>2</sup></b>		<b>7,983</b>			
<b>Standard deviation</b>		<b>7.78</b>			
<b>Year</b>	<b>Population</b>	<b>Density</b>	<b>% Change</b>	<b>Quota</b>	<b>% Population</b>
1993	191,690	13.1	5.0	38,338	21.0
1994	162,952	11.2	-15.0	38,338	20.0
1995	169,476	11.6	4.0	35,848	22.0
1996	132,192	9.1	-22.0	37,283	22.0
1997	149,377	10.2	13.0	26,438	20.0
1998	162,372	11.1	9.0	25,394	17.0
1999	160,748	11.0	-1.0	27,600	17.0
2000	168,750	11.6	5.0	27,350	17.0
2001	95,273	6.5	-44.0	25,313	15.0
2002	95,273	6.5	0.0	14,291	15.0
2003	94,251	6.5	-1.0	14,291	15.0
2004	67,499	4.8	-28.0	14,138	15.0
2005	67,499	4.8	0.0	10,125	15.0
2006	67,499	4.8	0.0	10,125	15.0
2007	92,016	6.3	36.0	10,125	15.0
2008	92,016	6.3	0.0	13,802	15.0
2009	92,016	6.3	0.0	13,802	15.0
2010	167,500	11.5	82.0	13,802	15.0
2011	167,500	11.5	0.0	25,125	15.0
2012	167,500	11.5	0.0	25,125	15.0
2013	126,800	8.7	-24.0	25,125	15.0
2014	126,800	8.7	0.0	19,020	15.0
2015	126,800	8.7	0.0	19,020	15.0
2016	259,600	32.5	105.0	19,020	15.0
2017	259,600	32.5	105.0	38,940	15.0
2018	259,600	32.5	105.0	38,940	15.0
2019	166,500	20.9	-36.0	38,940	15.0
2020				24,975	15.0

**Table A13b Common wallaroo temporal variation – Upper Hunter**

<b>Average density (kangaroos/km<sup>2</sup>)</b>		<b>5.8</b>			
<b>Area in km<sup>2</sup></b>		<b>7,983</b>			
<b>Standard deviation</b>		<b>2.15</b>			
<b>Year</b>	<b>Population</b>	<b>Density</b>	<b>% Change</b>	<b>Quota</b>	<b>% Population</b>
1993	109,440	7.5	0.0	5,280	4.8
1994	103,968	7.1	-5.0	5,512	5.0
1995	108,128	7.4	4.0	5,244	5.0
1996	84,340	5.8	-22.0	5,408	5.0
1997	95,304	6.5	13.0	4,217	5.0
1998	103,595	7.1	9.0	4,765	5.0
1999	102,559	7.0	-1.0	5,180	5.0
2000	107,650	7.4	5.0	5,125	5.0
2001	107,650	7.4	0.0	5,350	5.0
2002	107,650	7.4	0.0	5,350	5.0
2003	57,762	4.0	-46.0	5,350	5.0
2004	61,660	4.4	7.0	8,664	15.0
2005	61,660	4.4	0.0	9,249	15.0
2006	61,660	4.4	0.0	9,249	15.0
2007	44,923	3.1	-27.0	9,249	15.0
2008	44,923	3.1	0.0	6,738	15.0
2009	44,923	3.1	0.0	6,738	15.0
2010	14,985	1.0	-67.0	2,985	6.6
2011	14,985	1.0	0.0	0	0.0
2012	14,985	1.0	0.0	1,499	10.0
2013	27,380	1.9	83.0	1,499	10.0
2014	27,380	1.9	0.0	4,107	15.0
2015	27,380	1.9	0.0	4,107	15.0
2016	73,400	9.2	168.0	4,107	15.0
2017	73,400	9.2	168.0	11,010	15.0
2018	73,400	9.2	168.0	11,010	15.0
2019	24,000	3	-67.0	11,010	15.0
2020				3,600	15.0

## Kangaroo management zone no. 16: South East NSW

**Table A14 Eastern grey kangaroo temporal variation – South East NSW**

<b>Average density (kangaroos/km<sup>2</sup>)</b>		<b>21.07</b>			
<b>Area in km<sup>2</sup></b>		<b>41,211</b>			
<b>Standard deviation</b>		<b>9.19</b>			
<b>Year</b>	<b>Population</b>	<b>Density</b>	<b>% Change</b>	<b>Quota</b>	<b>% Population</b>
2003	292,455	11.95	–	–	–
2004	292,455	11.95	0.0	43,868	15.0
2005	292,455	11.95	0.0	43,868	15.0
2006	415,271	14.07	42.0	43,868	15.0
2007	415,271	14.07	42.0	62,291	15.0
2008	415,271	14.07	42.0	62,291	15.0
2009	655,900	15.69	47.6	62,291	15.0
2010	655,900	17.07	47.6	98,385	15.0
2011	655,900	17.07	47.6	98,385	15.0
2012	858,900	22.35	30.9	98,385	15.0
2013	858,900	22.35	30.9	128,835	15.0
2014	858,900	22.35	30.9	128,835	15.0
2015	1,284,300	33.04	49.5	128,835	15.0
2016	1,284,300	33.04	49.5	192,645	15.0
2017	1,284,300	33.04	49.5	192,645	15.0
2018	1,721,400	41.9	34.0	192,645	15.0
2019	1,721,400	41.9	34.0	258,210	15.0
2020				258,210	15.0

## Kangaroo management zone no. 48: Central Tablelands North

**Table A15 Eastern grey kangaroo temporal variation – Central Tablelands North**

<b>Average density (kangaroos/km<sup>2</sup>)</b>		<b>39.32</b>			
<b>Area in km<sup>2</sup></b>		<b>23,185</b>			
<b>Standard deviation</b>		<b>N/A</b>			
<b>Year</b>	<b>Population</b>	<b>Density</b>	<b>% Change</b>	<b>Quota</b>	<b>% Population</b>
2008	433,030	14.74	0.0		
2009	433,030	14.74	0.0	64,995	15.0
2010	433,030	14.74	0.0	64,995	15.0
2011	612,590	20.85	41.5	64,955	15.0
2012	612,590	20.85	41.5	91,889	15.0
2013	612,590	20.85	41.5	91,889	15.0
2014	1,193,600	47.13	95.0	91,889	15.0
2015	1,193,600	47.13	95.0	179,040	15.0
2016	1,193,600	47.13	95.0	179,040	15.0
2017	1,728,200	74.54	45.0	179,040	15.0
2018	1,728,200	74.54	45.0	259,230	15.0
2019	1,728,200	74.54	45.0	259,230	15.0
2020				259,230	15.0

## Kangaroo management zone no. 49: Central Tablelands South

**Table A16 Eastern grey kangaroo temporal variation – Central Tablelands South**

<b>Average density (kangaroos/km<sup>2</sup>)</b>		<b>30.88</b>			
<b>Area in km<sup>2</sup></b>		<b>18,892</b>			
<b>Standard deviation</b>		<b>N/A</b>			
<b>Year</b>	<b>Population</b>	<b>Density</b>	<b>% Change</b>	<b>Quota</b>	<b>% Population</b>
2008	535,600	23.18	0.0		
2009	535,600	23.18	0.0	80,340	15.0
2010	535,600	23.18	0.0	80,340	15.0
2011	347,830	15.05	-35.06	80,340	15.0
2012	347,830	15.05	-35.06	52,175	15.0
2013	347,830	15.05	-35.06	52,175	15.0
2014	811,800	35.87	133.0	52,175	15.0
2015	811,800	35.87	133.0	121,770	15.0
2016	811,800	35.87	133.0	121,770	15.0
2017	933,900	49.40	15.0	121,770	15.0
2018	933,900	49.40	15.0	140,085	15.0
2019	933,900	49.40	15.0	140,085	15.0
2020				140,085	15.0

**Table A17 Red and grey kangaroo annual population estimates: annual quotas, annual take figures and relative percentages**

Note	Year	Population	Quota	% Population	Take	% Population	% Quota
1	1975	3,365,300	212,000	0.0	123,000	0.0	58.0
1	1976	no estim.	319,400	9.49	96,000	2.85	30.1
1	1977	4,699,000	321,000	0.0	167,200	0.0	52.1
1	1978	4,383,000	345,000	7.3	220,000	4.7	63.8
1	1979	4,288,000	645,000	14.7	520,000	11.9	80.6
1	1980	6,174,000	645,000	15.0	619,023	14.4	96.0
1	1981	7,046,000	694,500	11.2	488,647	7.9	70.4
1	1982	9,400,000	843,000	12.0	664,342	9.4	78.8
1	1983	5,500,000	843,000	9.0	400,477	4.3	47.5
2	1984	2,738,000	500,000	9.1	229,484	4.2	45.9
2	1985	4,155,000	300,000	11.0	326,028	11.9	108.7
2	1986	4,662,100	577,000	13.9	444,509	10.7	77.0
2	1987	5,425,000	577,000	12.4	473,454	10.2	82.1
2	1988	5,498,000	730,000	13.5	421,200	7.8	57.7
3	1989	7,593,500	804,000	14.6	500,355	9.1	62.2
3	1990	9,150,000	1,172,000	15.4	633,000	8.3	54.0
3	1991	9,734,000	1,520,000	16.6	856,406	9.4	56.3
3	1992	7,981,900	2,074,000	21.3	796,007	8.2	38.4
3	1993	14,618,672	1,663,600	20.8	775,220	9.7	46.6
3	1994	11,476,951	1,409,100	9.6	971,694	6.6	69.0
3	1995	12,123,100	1,146,626	10.0	977,459	8.5	85.2
3	1996	9,942,520	1,206,000	9.9	1,149,917	9.5	95.3
3	1997	12,341,062	976,000	9.8	897,937	9.0	92.0
3	1998	13,443,170	1,175,140	9.5	940,789	7.6	80.1
3	1999	12,220,865	1,532,916	11.4	937,642	7.0	61.2
3	2000	11,939,107	1,416,285	11.6	883,478	7.2	62.4
3	2001	13,982,496	1,418,212	11.9	1,169,500	9.8	82.5
3	2002	15,479,854	1,920,100	13.7	1,441,276	10.3	75.1
4	2003	8,127,976	2,083,590	13.5	996,507	6.4	47.8
4	2004	6,732,789	1,263,900	15.5	827,291	10.2	65.5
4	2005	5,514,526	1,060,083	15.7	731,772	10.9	69.0
4	2006	5,772,567	871,912	15.8	810,104	14.7	92.9
4	2007	6,286,831	909,540	15.8	780,999	13.5	85.9
4	2008	6,894,305	1,001,757	15.9	584,803	9.3	58.4
4	2009	7,088,320	1,091,539	15.8	435,751	6.3	39.9
5	2010	8,433,682	1,053,753	14.9	380,403	5.4	36.1
5	2011	9,726,685	1,275,493	15.1	377,997	4.5	29.6

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Note	Year	Population	Quota	% Population	Take	% Population	% Quota
5	2012	11,302,163	1,506,113	15.5	335,967	3.5	22.3
5	2013	15,229,573	1,771,235	15.7	344,453	3.0	19.4
5	2014	17,071,705	2,374,048	15.6	355,976	2.3	15.0
5	2015	16,196,802	2,686,988	15.7	357,189	2.1	13.3
5	2016	17,256,357	2,547,318	15.7	352,464	2.2	13.8
5	2017	14,202,962	2,715,912	15.7	453,021	2.6	16.7
5	2018	12,631,495	2,223,779	15.7	467,456	3.3	21.0
5	2019	13,861,850	1,874,076	14.8			
5	2020		2,102,131	15.2			

- 1 Based on survey of seven 1:250 000 monitor blocks
- 2 Based on survey of the Western Plains of NSW
- 3 Western Plains of NSW plus Northern Tablelands
- 4 Western Plains plus Northern Tablelands and Southeast NSW
- 5 Western Plains plus Central and Northern Tablelands and Southeast NSW

**Table A18 Summary statistics of commercial take: red kangaroo**

Year	Population estimate	Quota	% of previous year's population	Take	% of previous year's population	% of quota
1976	no survey	110,000	5.0			
1977	2,669,000	150,000				
1978	2,069,000	150,000	6.0			
1979	2,355,000	300,000	15.0			
1980	3,377,000	300,000	13.0			
1981	4,626,000	333,000	10.0			
1982	5,700,000	550,000	12.0	398,200	8.6	72.4
1983	3,400,000	550,000	10.0	264,900	4.6	48.2
1984	1,650,000	270,000	8.0	158,000	4.6	58.5
1985	2,363,000	190,000	12.0	213,300	12.9	112.3
1986	2,574,000	313,000	13.0	263,000	11.1	84.0
1987	2,777,000	313,000	12.0	270,500	10.5	86.4
1988	3,440,000	354,000	13.0	218,100	7.9	61.6
1989	4,101,000	487,000	14.0	297,000	8.6	61.0
1990	4,499,000	626,000	15.0	377,200	9.2	60.3
1991	4,755,000	706,000	16.0	496,000	11.0	70.3
1992	3,348,900	956,000	20.0	412,200	8.7	43.1
1993	4,395,426	598,800	18.0	359,820	10.7	60.1
1994	3,960,106	483,850	11.0	397,791	9.1	82.2
1995	4,185,494	483,680	12.0	431,663	10.9	89.2
1996	3,787,113	507,000	12.0	531,370	12.7	104.8
1997	5,285,995	450,780	12.0	415,395	11.0	92.2
1998	5,809,757	648,560	12.0	495,100	9.4	76.3
1999	4,705,664	642,070	11.0	450,020	7.7	70.1
2000	4,391,385	590,450	13.0	389,204	8.3	65.9
2001	5,121,413	558,750	13.0	527,521	12.0	94.4
2002	4,798,558	765,900	15.0	538,856	10.5	70.4
2003	2,235,114	704,350	15.0	274,900	5.7	39.0
2004	2,508,236	379,970	17.0	244,379	10.9	64.3
2005	2,241,497	426,400	17.0	241,503	9.6	56.6
2006	2,182,788	381,054	17.0	338,631	15.1	88.9
2007	2,524,448	371,074	17.0	304,732	14.0	82.1
2008	2,869,709	429,156	17.0	210,654	8.3	49.1
2009	2,456,795	487,850	17.0	182,858	6.4	37.5
2010	3,013,908	417,655	17.0	117,811	4.8	28.2
2011	3,972,522	512,364	17.0	125,843	4.2	24.6
2012	4,148,316	675,329	17.0	134,893	3.4	20.0



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Year	Population estimate	Quota	% of previous year's population	Take	% of previous year's population	% of quota
2013	4,480,580	705,214	17.0	152,851	3.7	21.7
2014	6,423,271	761,699	17.0	149,789	3.3	19.7
2015	5,889,886	1,091,956	17.0	144,680	2.3	13.2
2016	6,364,234	1,001,281	17.0	151,059	2.6	15.1
2017	5,132,654	1,081,920	17.0	199,059	3.1	18.4
2018	2,931,693	872,551	17.0	177,359	3.5	20.3
2019	3,540,644	432,198	15.0			
2020		564,137	16.0			

Notes:

1975–1983 population estimates based on survey of seven 1:250 000 monitor blocks

1984–2000 population estimates based on survey of virtually all the Western Plains

2001–2009 population estimates based on survey of virtually all the Western Plains, and incorporates revised correction factors

**Table A19 Summary statistics of commercial take: eastern grey kangaroo**

Year	Population estimate	Quota	% of population	Take	% of population	% of quota
1989	2,535,000	444,000	–	257,300	–	58.0
1990	3,354,800	394,000	15.5	170,800	6.7	43.4
1991	3,587,300	548,000	16.3	254,800	7.6	46.5
1992	3,313,000	790,300	22.0	264,400	7.4	33.5
1993	7,738,749	757,000	22.8	284,300	8.6	37.6
1994	5,426,382	657,200	8.5	363,659	4.7	55.3
1995	5,384,828	474,177	8.7	370,757	6.8	78.2
1996	4,427,575	480,000	8.9	402,356	7.5	83.8
1997	4,947,349	391,290	8.8	333,426	7.5	85.2
1998	5,754,812	382,500	7.7	314,328	6.4	82.2
1999	5,426,433	657,641	11.4	355,845	6.2	54.1
2000	5,755,494	582,697	10.7	376,851	6.9	64.7
2001	6,829,471	628,416	10.9	527,521	9.2	83.9
2002	8,293,707	882,625	12.9	704,010	10.3	79.8
2003	4,627,831	1,065,789	12.9	616,718	7.4	57.9
2004	3,328,133	694,175	15.0	490,868	10.6	70.7
2005	2,670,822	499,220	15.0	419,220	12.6	84.0
2006	2,936,255	400,623	15.0	388,396	14.5	96.9
2007	3,036,020	440,438	15.0	394,906	13.4	89.7
2008	3,035,904	455,403	15.0	320,026	10.5	70.3
2009	3,909,270	455,386	15.0	214,218	7.1	47.0
2010	4,756,792	552,904	14.1	237,038	6.1	42.9
2011	5,258,104	684,278	14.4	235,579	5.0	34.4
2012	6,297,955	782,349	14.9	177,234	3.4	22.7
2013	8,775,664	944,693	15.0	169,263	2.7	17.9
2014	9,119,616	1,334,443	15.0	178,011	2.0	13.3
2015	8,818,588	1,366,344	15.0	185,517	2.0	13.6
2016	9,298,261	1,322,788	15.0	179,957	2.0	13.6
2017	8,153,725	1,394,739	15.0	225,679	2.4	16.2
2018	8,863,205	1,223,059	15.0	243,689	3.0	19.9
2019	9,437,361	1,324,413	14.9			
2020		1,408,964	14.9			

Quota based on a grey kangaroo ratio of 72% to 28% eastern to western grey kangaroos

1987–01 populations and quotas based on aerial surveys and counts of grey kangaroos, applying species proportions determined from ground surveys for Western Plains

1975–1983 population estimates based on survey of seven 1:250 000 monitor blocks

1984–2000 population estimates based on survey of the Western Plains (not monitor blocks)

2001–2007 population estimates based on survey of the Western Plains incorporate revised correction factors

Helicopter surveys of the Northern Tablelands were undertaken for the first time in 2001.

Southeast zone added from 2003, Central Tablelands zones added from 2014.

**Table A20 Summary of commercial take: western grey kangaroos**

Year	Population estimate*	Quota	% of previous year's population	Take	% of previous year's population	% of quota
1987	806,500	75,000		62,900		83.9
1988	626,500	105,000	13.0	72,800	9.0	69.3
1989	957,500	95,000	15.2	67,300	10.7	70.8
1990	1,296,400	152,000	15.9	83,700	8.7	55.1
1991	1,391,700	220,000	17.0	106,600	8.2	48.5
1992	1,320,000	327,700	23.5	173,600	12.5	53.0
1993	2,484,496	307,800	23.3	191,000	14.5	62.1
1994	2,090,463	268,050	10.8	210,244	8.5	78.4
1995	2,552,778	188,800	9.0	175,039	8.4	92.7
1996	1,727,832	219,000	8.6	216,191	8.5	98.7
1997	2,107,718	148,000	8.6	141,167	8.2	95.4
1998	1,878,601	151,700	7.2	123,826	5.9	81.6
1999	2,088,768	220,119	11.7	122,481	6.5	55.6
2000	1,792,228	216,553	10.4	107,902	5.2	49.8
2001	2,031,612	203,556	11.4	145,787	8.1	71.6
2002	2,387,589	271,575	13.4	183,513	9.0	67.6
2003	1,265,031	313,378	13.1	104,889	4.4	33.5
2004	896,420	189,755	15.0	92,044	7.3	48.5
2005	602,208	134,463	15.0	71,049	7.9	52.8
2006	653,524	90,331	15.0	83,077	13.8	92.0
2007	726,363	98,029	15.0	81,361	12.4	83.0
2008	989,559	108,954	15.0	54,123	7.5	49.7
2009	722,255	148,434	15.0	38,675	3.9	26.1
2010	662,982	83,194	11.5	25,554	3.5	30.7
2011	496,059	78,851	11.9	16,575	2.5	21.0
2012	855,892	48,435	9.8	18,366	3.7	37.9
2013	1,852,710	121,328	14.2	22,339	2.6	18.4
2014	1,528,818	277,906	14.9	22,757	1.2	8.2
2015	1,488,329	228,168	14.9	21,017	1.4	9.2
2016	1,595,023	222,307	15.0	21,448	1.4	9.6
2017	916,583	239,253	15.0	28,283	1.8	11.8
2018	836,496	128,169	14.0	38,166	4.2	29.8
2019	883,845	117,465	14.0			
2020		129,030	14.6			

1987–04 populations and quotas based on aerial survey counts of grey kangaroos, applying species proportions determined from ground surveys

1975–1983 population estimates based on survey of seven 1:250 000 monitor blocks

1984–2000 population estimates based on survey of the Western Plains

2001–2009 population estimates based on survey of the Western Plains and incorporates revised correction factors

\* There is a small population (3,606 in 2017) of western grey kangaroos in the Narrabri management zone. This is included in the population estimate, but no quota is set for this species in this zone.

**Table A21 Summary commercial take: wallaroos (Northern Tablelands)**

Year	Population estimate	Quota	% of previous year's population	Take	% of previous year's population	% of quota
1981		5,000				
1982		5,000		2,066		41.3
1983		5,000		714		14.3
1984		1,000		632		63.2
1985		1,000		763		76.3
1986		0		0		
1987		0		0		
1988		0		0		
1989	300,000	1,000		97		9.7
1990	413,700	10,000	3.3	1,967	0.7	19.7
1991	434,000	10,000	2.4	1,378	0.3	13.8
1992	456,000	22,000	5.1	1,377	0.3	6.3
1993	456,000	22,000	4.8	1,678	0.4	7.6
1994	433,200	17,600	3.9	3,431	0.8	19.5
1995	450,528	17,700	4.1	7,949	1.8	44.9
1996	351,414	22,300	4.9	6,530	1.4	29.3
1997	397,096	17,780	5.1	6,323	1.8	35.6
1998	431,879	19,900	5.0	5,035	1.3	25.3
1999	427,559	21,586	5.0	5,490	1.3	25.4
2000	448,750	21,355	5.0	6,562	1.5	30.7
2001	448,750	22,330	5.0	9,053	2.0	40.5
2002	448,750	22,330	5.0	6,615	1.5	29.6
2003	220,738	22,330	5.0	13,388	3.0	60.0
2004	208,104	33,111	15.0	15,304	6.9	46.2
2005	208,104	31,216	15.0	21,299	10.2	68.2
2006	208,104	31,216	15.0	24,540	11.8	78.6
2007	114,966	31,216	15.0	22,532	10.8	72.2
2008	114,966	17,245	15.0	12,069	10.5	70.0
2009	114,966	17,245	15.0	10,073	8.8	58.4
2010	88,430	17,245	15.0	9,178	8.0	53.2
2011	88,430	11,017	12.5	4,940	5.6	44.8
2012	88,430	12,515	14.2	5,474	6.2	43.7

**Table A21 *continued* Summary commercial take: wallaroos (Northern Tablelands)**

Year	Population estimate	Quota	% of previous year's population	Take	% of previous year's population	% of quota
2013	100,825	12,515	14.2	4,402	5.0	35.2
2014	100,825	15,124	15.0	5,419	5.4	35.8
2015	100,825	15,124	15.0	5,962	5.9	39.4
2016	200,900	15,124	15.0	7,060	7.0	46.7
2017	200,900	30,135	15.0	4,967	2.5	16.5
2018	200,900	30,135	15.0	8,242	4.1	27.4
2019	160,300	30,135	15.0			
2020		24,045	15.0			

**Notes:**

1979–85, whole of commercial zone

1989–2000, Tablelands only

2001, helicopter survey of Tablelands

2004, helicopter survey of Tablelands

2007, helicopter survey of Tablelands

2004 quota changed from 5% to 15% in line with KMP 2002–2006



**Figure A1** Population trends for red kangaroos on the Western Plains of NSW. The olive and dark green lines indicate the standard error for the population estimate. That is, the actual population may be higher (the olive line) or lower (the dark green line) than the population estimate used to set conservative quotas, as indicated by the green line.



**Figure A2 Population trends in grey kangaroos on the Western Plains of NSW. The top and bottom lines indicate the standard error of the population estimate. That is, the actual population may be more (top line) or less (bottom line) than the estimate (middle line).**

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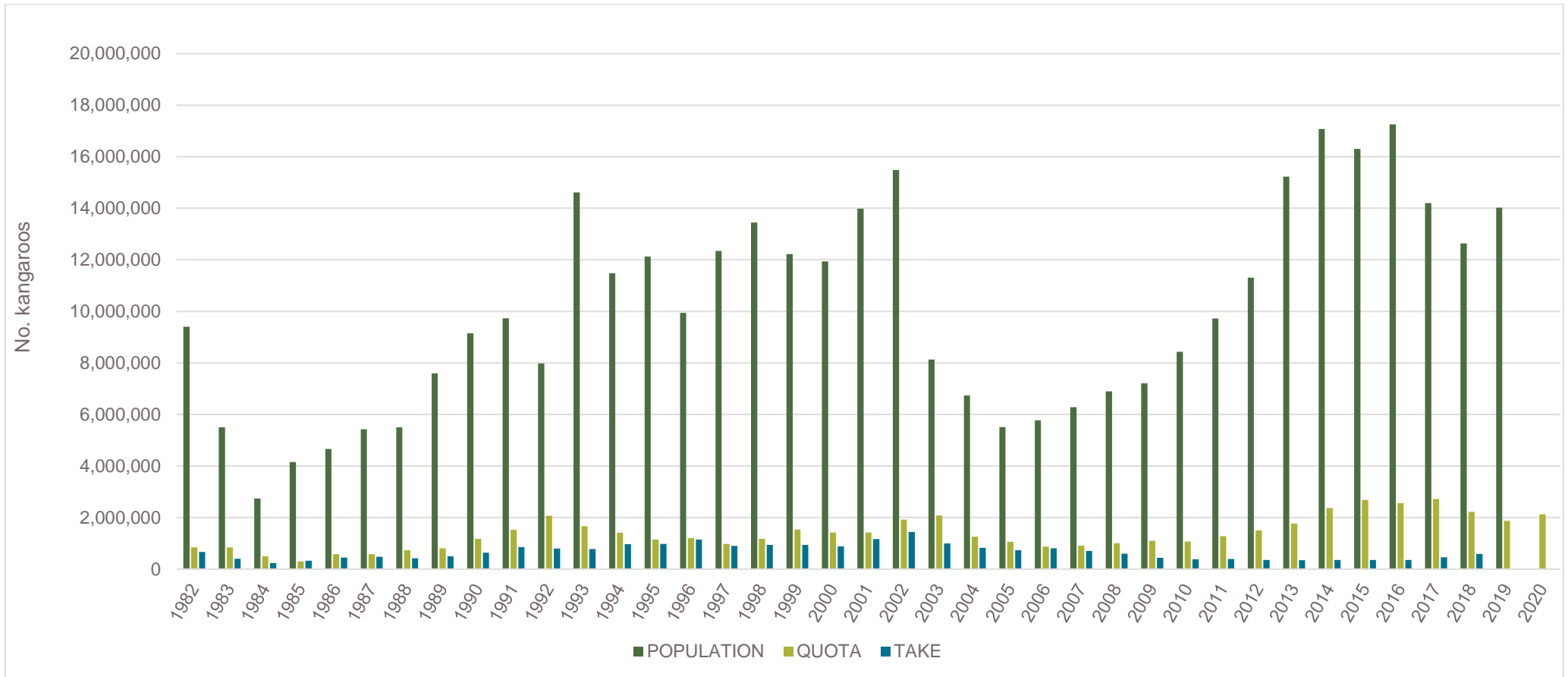


Figure A3 NSW combined red and grey kangaroo population estimates, authorised quotas and actual takes, 1982–2020



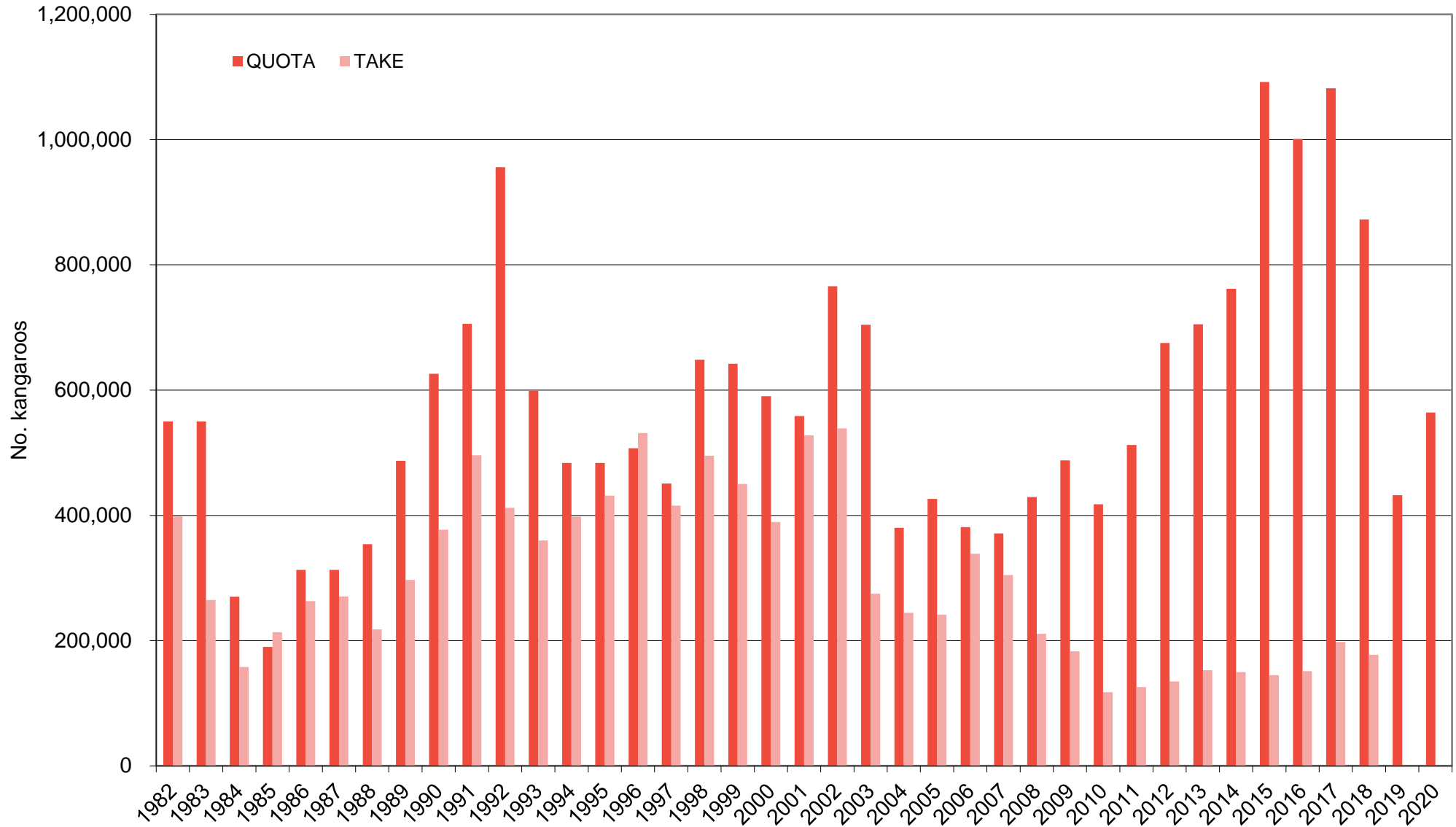


Figure A4 NSW red kangaroo quotas and takes, 1982–2020

NSW Kangaroo Management Program 2020 Quota Report

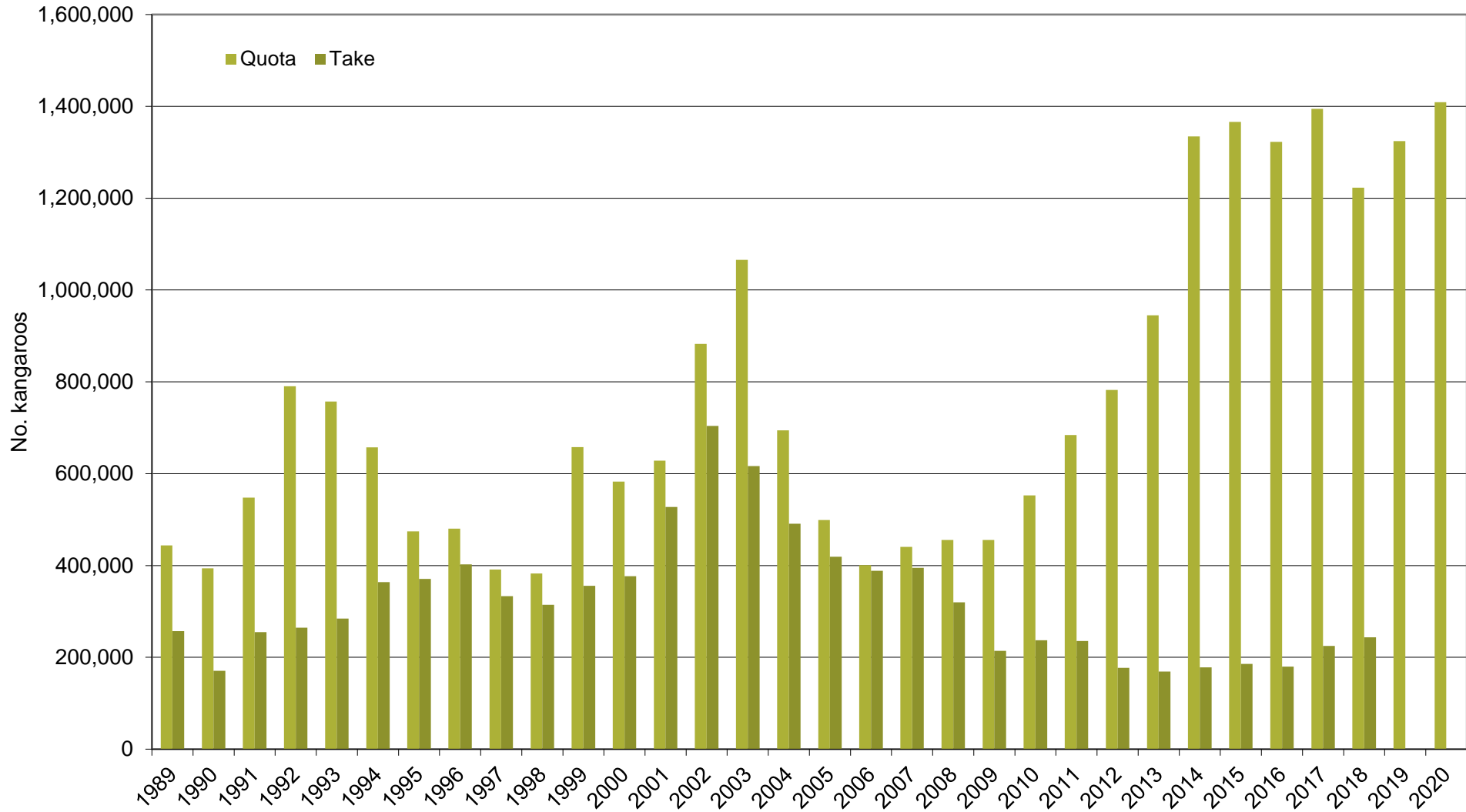


Figure A5 NSW eastern grey kangaroo quotas and takes, 1989–2020

NSW Kangaroo Management Program 2020 Quota Report

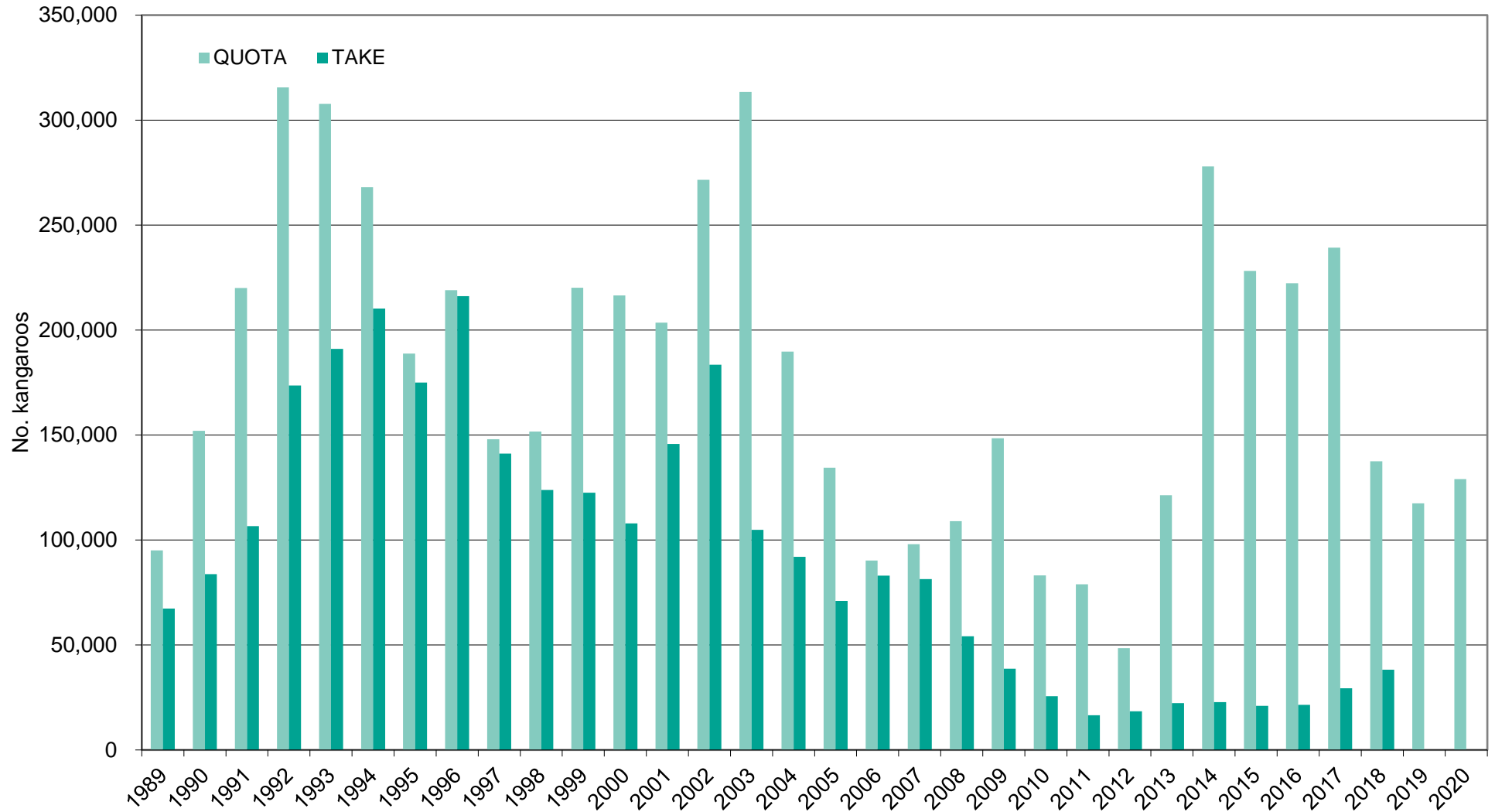


Figure A6 NSW western grey kangaroo quotas and takes, 1989–2020

NSW Kangaroo Management Program 2020 Quota Report

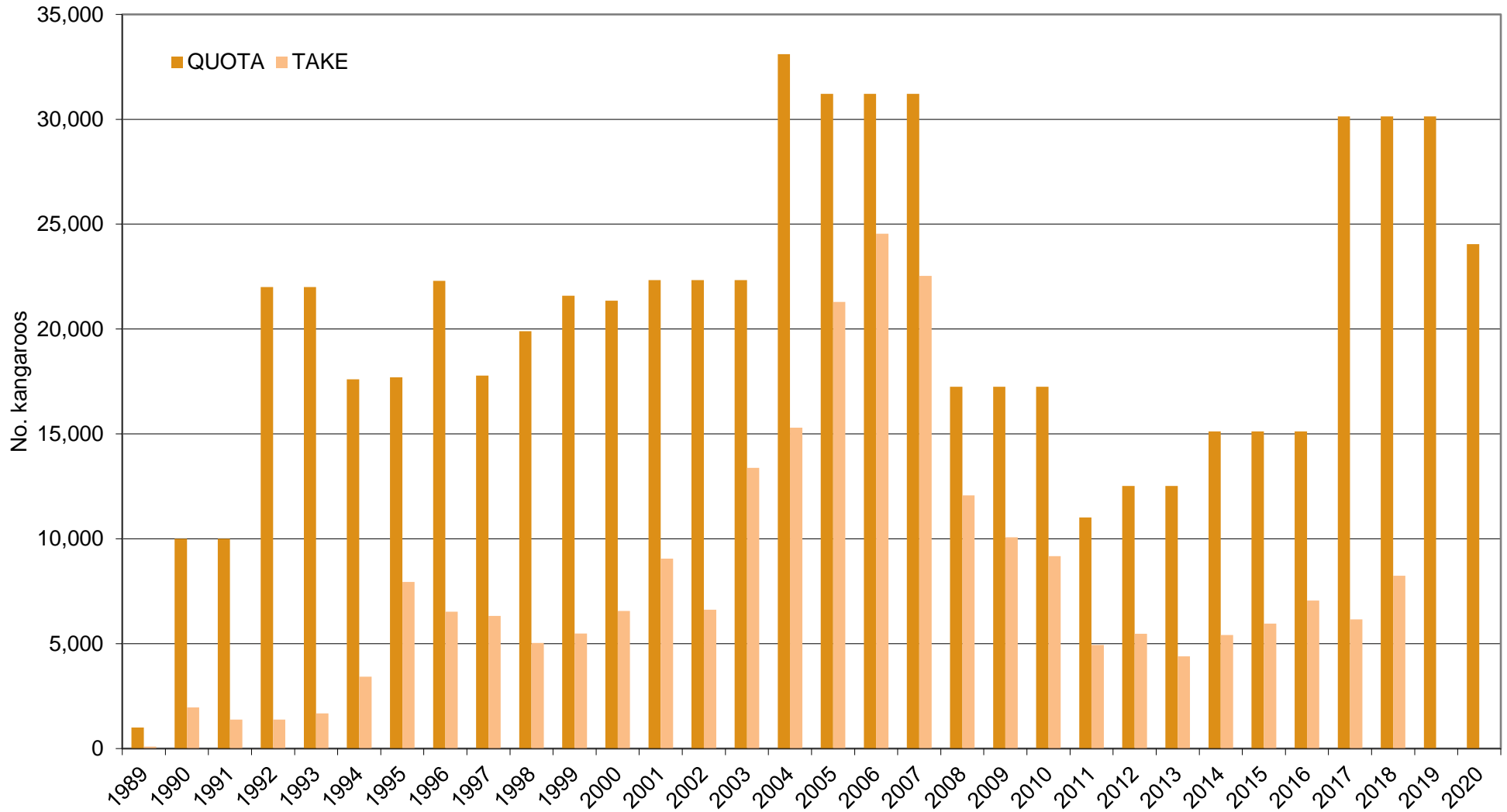


Figure A7 NSW wallaroo quotas and takes, 1989–2020

## Appendix B Low population thresholds applicable for 2020

The Plan protects low populations by requiring the commercial harvest quota to be either reduced or suspended, depending on the current population estimate relative to the mean (average) population over the time for which records are available. Thresholds have been set based on standard deviations, which are statistical measures that indicate how much a population varies from the average population. A small standard deviation indicates that the population doesn't vary by much from the average, whereas a large standard deviation indicates that the population varies more. Each species in each zone has its own thresholds.

For the purposes of managing commercial quotas, the thresholds are based on densities of kangaroos, calculated as the number of kangaroos per square kilometre at the time of the aerial survey. There are two thresholds, representing increasingly significant population declines. Threshold 1 is set at 1.5 standard deviations below the average density. Threshold 2 is set at 2.0 standard deviations below the average density.

If a population falls to below Threshold 1, but not as low as Threshold 2, the commercial quota for the following year is calculated at 10% of the population rather than the usual 15 or 17%. Reducing the quota will help the kangaroo population to recover when the decline is not sufficient to warrant complete suspension of the harvest. If a population falls below Threshold 2, no commercial quota is set for the following year.

### Reds, Eastern and Western greys Cobar zone

The average density of red kangaroos in Cobar zone is 4.97, eastern grey 4.68 and western grey 7.30 per square kilometre. Following the 2019 aerial surveys of the Cobar zone, the estimated population of red kangaroos had a density of 0.89, eastern greys 0.08 and western greys 0.11 per square kilometre. The density for each species fell below threshold 2 (refer to table B1). Therefore, the commercial quota for all species in Cobar zone will be suspended for 2020.

### Reds and Western greys Tibooburra zone

The average density of red kangaroos in Tibooburra zone is 18.13 per square kilometre. Following the 2019 aerial surveys of the Tibooburra zone, the estimated population of red kangaroos had a density of 1.45 per square kilometre. The current density of 1.45 is lower than threshold 2 (refer to table B1). Therefore the commercial quota for red kangaroos in Tibooburra zone is suspended for 2020.

The current population densities and thresholds are shown for all zones in Table B1.

### Eastern and Western greys Bourke zone

The average density of eastern grey kangaroos in Bourke zone is 6.78 per square kilometre (density 0.75 per square kilometre), and western grey 2.81 per square kilometre (density 0.19 per square kilometre). The current densities of 0.75 and 0.19 for eastern and western greys respectively, is lower than threshold 2 (refer to table B1). Therefore the commercial quota for eastern and western grey kangaroos in Bourke zone is suspended for 2020.

The current population densities and thresholds are shown for all zones in Table B1.

## Expansion of South East Tablelands and Griffith zones

In 2018 the NSW Government released the Drought Relief Package. This included increasing the area available for commercial kangaroo harvesting, being the preferred method to manage kangaroo populations and the contribution of kangaroo grazing to total grazing pressure. Two regions previously part of the non-commercial zone (no harvesting areas) in the south surrounding Wagga Wagga (Hume) and south east extending from South East Tablelands zone (Bombala), had historically been surveyed to expand the commercial harvesting area. At those times, the new areas were not incorporated as part of the commercial program.

Improvements to aerial survey methods used since 2017, changing from strip sampling along east-west transects to line transect Distance sampling and specifically mark-recapture distance sampling in survey blocks using the fixed-wing aircraft, has enabled rapid adaptation of annual aerial surveys and instant expansion of zones. For instance, Bombala was surveyed using line transect distance sampling during the 2018 helicopter surveys and was opened for commercial harvesting in 2019. In the 2019 fixed-wing surveys, survey blocks were included in the Hume non-commercial area to expand the Griffith Zone for commercial harvesting in 2020.

## Thresholds for new zones – Griffith North and Griffith South

Expanding Griffith zone meant it increased from 98,171km<sup>2</sup> to 129,884.10km<sup>2</sup>. Compared with other zones, this would have been a very large zone and challenging to manage commercial harvesting activity due to fluctuations in kangaroo densities responding to dry and wet conditions. To counteract this the expanded Griffith zone was divided into Griffith North (65758.40km<sup>2</sup>) and Griffith South (64125.70km<sup>2</sup>) zones.

Calculation of thresholds for older zones is straightforward because each kangaroo management zone (KMZ) has a long time-series of estimated abundances. No long time-series exists for the new zones, Griffith North and Griffith South, so an alternative method of estimating the thresholds in the zones must be used.

Assuming the estimated densities in the old Griffith KMZ was representative of the densities of kangaroos in the new zones then the thresholds calculated for the new zones will be identical for the old Griffith zone (Table B1).

**Table B1 Estimated thresholds for old Griffith KMZ and new Griffith North and Griffith South KMZs.**

Zone	Species	Upper threshold (kangaroos/km <sup>2</sup> )	Lower threshold (kangaroos/km <sup>2</sup> )	Density 2019
Griffith	Red kangaroo	2.05	1.66	2.05
	Eastern grey kangaroo	3.40	2.63	10.78
	Western grey kangaroo	0.73	0.56	2.22
Griffith North	Red kangaroo	2.05	1.66	2.43
	Eastern grey kangaroo	3.40	2.63	13.0
	Western grey kangaroo	0.73	0.56	2.67
Griffith South	Red kangaroo	2.05	1.66	1.66
	Eastern grey kangaroo	3.40	2.63	8.53
	Western grey kangaroo	0.73	0.56	1.76

The old Griffith KMZ would have had a reduction in harvest rate for red kangaroos for 2020. In the new zones there will be no reduction in harvest rates for any species in Griffith North KMZ, but the density of red kangaroos is equal to the lower threshold level at which harvesting for that species is suspended until the population recovers. Therefore, in Griffith South, there will be no quota allocated for red kangaroos but a full quota of 15% of the population size for eastern and western grey kangaroos.

The current population densities and thresholds are shown for all zones in Table B2.

**Table B2 NSW 2020 zone closures and available quota summary**

Zone name	Red kangaroo quota	Western grey kangaroo quota	Eastern grey kangaroo quota	Common wallaroo quota
Tibooburra	0	986	5,796	0
Broken Hill	191,100	28,562	20,435	0
Lower Darling	117,490	39,027	17,780	0
Cobar	0	0	0	0
Bourke	84,504	0	0	0
Narrabri	58,897	0	114,0	0
Coonabarabran	85,023	17,156	213,288	0
Griffith North	27,123	26,380	128,000	0
Griffith South	0	16,919	82,091	0
Northern Tablelands - Glenn Innes	0	0	81,780	10,935
Northern Tablelands - Armidale	0	0	63,285	9,510
Northern Tablelands - Upper Hunter	0	0	24,975	3,600
Central Tablelands - North	0	0	259,230	0
Central Tablelands - South	0	0	140,085	0
South East Tablelands	0	0	258,210	0
<b>Total</b>	<b>564,137</b>	<b>129,030</b>	<b>1,408,964</b>	<b>24,045</b>

**Table B3 Average and current density estimates, and thresholds for quota reduction and suspension**

<b>Western Plains</b>								
<b>Western grey</b>								
Zone	Tibooburra	Broken Hill	Lower Darling	Cobar	Bourke	Narrabri	Coonabarabran	Griffith
Average density	0.63	4.50	7.07	7.30	2.81	0.04	2.23	1.87
Threshold 1: 10% quota	0.21	1.47	1.84	1.65	0.67	0	1.16	0.73
Threshold 2: suspension of quota	0.16	1.08	1.29	1.08	0.45	0	0.96	0.56
2019 density estimate (kangaroos/km <sup>2</sup> )	<b>0.18</b>	<b>2.09</b>	<b>4.60</b>	<b>0.11</b>	<b>0.19</b>	<b>0.08</b>	<b>1.85</b>	<b>2.22</b>
<b>Eastern grey</b>								
Zone	Tibooburra	Broken Hill	Lower Darling	Cobar	Bourke	Narrabri	Coonabarabran	Griffith
Average density	2.05	1.63	2.20	4.68	6.78	16.02	26.13	8.13
Threshold 1: 10% quota	0.64	0.28	0.74	1.02	1.54	6.81	11.94	3.40
Threshold 2: suspension of quota	0.46	0.17	0.54	0.66	1.03	5.30	9.50	2.63
2019 density estimate (kangaroos/km <sup>2</sup> )	<b>0.70</b>	<b>1.50</b>	<b>2.09</b>	<b>0.08</b>	<b>0.75</b>	<b>11.60</b>	<b>23.04</b>	<b>10.76</b>
<b>Red</b>								
Zone	Tibooburra	Broken Hill	Lower Darling	Cobar	Bourke	Narrabri	Coonabarabran	Griffith
Average density	18.13	15.08	5.87	4.97	6.52	5.43	5.01	4.22
Threshold 1: 10% quota	6.07	8.00	2.69	2.03	2.86	2.00	2.44	2.05
Threshold 2: suspension of quota	4.43	6.62	2.14	1.57	2.25	1.51	1.97	1.66
2019 density estimate (kangaroos/km <sup>2</sup> )	<b>1.45</b>	<b>12.30</b>	<b>12.20</b>	<b>0.89</b>	<b>9.03</b>	<b>5.27</b>	<b>8.10</b>	<b>2.04</b>



**Table B3 continued. Average and current density estimates, and thresholds for quota reduction and suspension**

<b>Tablelands</b>						
<b>Eastern grey</b>						
Zone	Armidale	Glen Innes	Upper Hunter	Southeast NSW	Central Tablelands North	Central Tablelands South
Average density	10.37	10.77	7.53	21.07	14.70	23.20
Threshold 1: 10% quota	4.71	4.85	3.32	9.18	7.07	10.79
Threshold 2: suspension of quota	3.63	3.74	2.59	7.96	5.53	8.36
2018 density estimate (kangaroos/km <sup>2</sup> )	<b>31.6</b>	<b>28.1</b>	<b>20.9</b>	<b>41.9</b>	<b>74.5</b>	<b>49.4</b>

<b>Wallaroo</b>			
Zone	Armidale	Glen Innes	Upper Hunter
Average density	3.50	2.03	2.83
Threshold 1: 10% quota	1.47	0.88	1.13
Threshold 2: suspension of quota	1.13	0.68	0.88
2019 density estimate (wallaroos/km <sup>2</sup> )	<b>4.2</b>	<b>4.2</b>	<b>3.0</b>