2012 KANGAROO QUOTA REPORT

NEW SOUTH WALES

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New South Wales Office of Environment and Heritage (OEH) (and its predecessor agencies) has been researching, monitoring and managing the "NSW Kangaroo Management Program" (KMP) since the 1970's. Throughout this time adjustments have been made to the survey design, population estimation and determination of the commercial quota.

This report details the Kangaroo Management Program quotas for the 2012 kangaroo take in accordance with NSW Commercial Kangaroo Harvest Management Plan 2012-2016 (the Plan), pending approval from the Commonwealth Government for commencement on 1 January 2012. The report includes:

- Current population estimates for 2011 and quotas for 2012; and

- Details of trends in:
  - population estimates;
  - quotas; and
  - commercial take data

for red kangaroos, eastern and western grey kangaroos and wallaroos.

A: SUMMARY

1. Quotas 2011 and 2012

	2012†		2011	
	Quota	Maximum Special Quota	Quota	Maximum Special Quota
Red kangaroo	675,329	59,588	512,364	45,209
Eastern grey kangaroo	782,349	78,872	684,278	71,352
Western grey kangaroo *	48,435	7,441	78,851	9,945
Wallaroo	12,515	1,326	11,017	1,326
Totals	1,518,628	147,227	1,286,510	127,832

2. Population estimates 2011 and quotas 2012

	Population Estimate 2011	Quota – 2012	Quota – Per cent of Population
Red kangaroo	3,972,522	675,329	17.0
Eastern grey kangaroo - (Western Plains)	2,998,004	443,334	14.8
Eastern grey kangaroo - (Central and Northern Tablelands & Southeast NSW)	2,260,100	339,015	15.0
Western grey kangaroo *	496,059	48,435	9.8
Wallaroo – (Northern Tablelands)	88,430	12,515	14.2
TOTAL	9,815,115	1,518,628	

* There is a small population (650) 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.

† Quotas have been reduced to 10% of the population estimate of western grey kangaroos in the Tibooburra, Broken Hill, Cobar, Bourke and Griffith zones, and is suspended in the Lower Darling zone. Quotas for eastern grey kangaroos have been set at 10% of the population in the Broken Hill and Bourke zones. The quota for wallaroos in the Upper Hunter zone is set at 10% of the population.

3. Actual Take To 30 September 2011

1. %q – commercial take as percentage of approved quota

2. %p – commercial take as percentage of population estimate

Zone Name	No.	E/Grey				Red				W/Grey				Wallaroo			
		Quota	Take	%q	%p	Quota	Take	%q	%p	Quota	Take	%q	%p	Quota	Take	%q	%p
Tibooburra	1					108,126	13,864	13%	2%								
Broken Hill	2	12,794	2,203	17%	3%	145,413	27,853	19%	3%	23,481	5,815	25%	4%				
Lower Darling	4	11,615	1,141	10%	1%	32,968	6,762	21%	3%	23,123	3,531	15%	2%				
Cobar	6	16,338	2,072	13%	2%	25,190	3,113	12%	2%	22,077	2,127	10%	1%				
Bourke	7	16,508	3,920	24%	4%	42,703	10,369	24%	4%								
Narrabri	8	112,851	33,733	30%	4%	73,672	10,123	14%	2%								
Armidale	9	29,880	13,826	46%	7%									6,188	2,057	33%	5%
Coonabarabran	10	125,045	39,345	31%	5%	42,606	13,303	31%	5%	10,170	210	2%	0%				
Griffith	11	50,019	12,148	24%	2%	41,685	4,017	10%	2%								
Glen Innes	13	40,425	10,954	27%	4%									4,829	1,877	39%	6%
Upper Hunter	14	25,125	8,218	33%	5%												
SE NSW	16	98,385	27,052	27%	4%												
Central Tablelands N	48	64,955	15,863	24%	4%												
Central Tabelands S	49	80,340	14,163	18%	3%												
Totals		**684,278**	**184,638**	**27%**	**4%**	**512,365**	**89,404**	**17%**	**3%**	**78,851**	**11,683**	**15%**	**2%**	**11,017**	**3,934**	**36%**	**4%**

B: POPULATION ESTIMATES AND METHOD OF SURVEY USED

Full details of the aerial survey methodology used by the Kangaroo Management Program are contained in a separate document entitled "Population Monitoring for the NSW Kangaroo Management Program", and in individual survey reports for Northern Tablelands, South-east NSW and Central Tablelands. Reports are all available from the Kangaroo Management Program's web page:
www.environment.nsw.gov.au/wildlifemanagement/KangarooManagementProgram.htm

A brief outline is provided here.

1. Western Plains

The 2011 survey of the Western Plains commenced on 30 May and was completed on 12 August. The Western Plains covers an area of approximately 531,000 square kilometres, and includes Kangaroo Management Zones 1-8, 10 and 12.

The survey was conducted using well-established techniques. This methodology has been refined on the basis of additional research, but has remained largely the same since the early 1980s. It involves flying at a pre-determined speed and height, with trained observers counting animals within a strip equivalent to 100 meters on the ground. This method provides an observed density which is then multiplied by species- and habitat-specific correction factors to give a corrected density. The corrected density is then multiplied by the area of each habitat type in each zone to provide population estimates.

Correction Factors are described in detail in "Population Monitoring for the NSW Kangaroo Management Program". In essence, correction factors are used to account for the fact that not every kangaroo present will be seen by the observers. The proportion of kangaroos observed will depend on the species (because of different behaviours between species) and the nature of the habitat (a higher proportion of animals will be observed on open grasslands than in woodland habitats). These correction factors have been derived after several years of research using both helicopter and fixed-wing surveys.

The survey schedule was interrupted by storm damage to the aircraft, and was therefore completed later than usual. A further difficulty arose in that the resumed survey of the Lower Darling and Griffith zones occurred during a period of unseasonably warm conditions, and required adjustment to the standard correction factors to account for the warmer temperatures, using the formula developed by Caughley (1998). As a result, the precision of these population estimates is poorer than usual.

Throughout this document two sets of correction factors have been used in calculating population estimates. Where data is presented for the years prior to 2001, correction factors for 200 meter wide survey strips from Cairns and Gilroy (2001) have been applied. For 2001, 2002 and 2003 data (and future years), the most recent correction factors (September 2003) for 100 metre survey strips have been applied. In the tables and figures throughout this document, dark shading has been used to show where the most recent 100 metre correction factors have been used, and light shading where 200 metre correction factors have been applied.

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

Table A. Red and grey kangaroo population estimates for the Western Plains.

Management Zone	Red Kangaroo Population Estimate	Grey Kangaroo Population Estimate
Tibooburra	621,124 ± 117,629	51,214 ± 12,570
Broken Hill	1,079,052 ± 105,713	179,320 ± 28,419
Lower Darling	186,473 ± 49,447	231,585 ± 40,214
Cobar	210,921 ± 75,256	176,060 ± 34,533
Bourke	251,196 ± 69,224	128,018 ± 23,367
Narrabri	530,367 ± 166,782	1,229,345 ± 290,192
Coonabarabran	343,239 ± 100,707	1,089,829 ± 294,360
Griffith	556,415 ± 302,156	541,306 ± 179,770
Total	3,972,522 ± 407,542	3,494,063 ± 454,972

Note – Table A uses the final correction factors (ie September 2003)

The estimated numbers and densities of red and grey kangaroos in each management zone from 1989 onwards are given in Tables 1 to 8. The population trends for each species are shown in Figures 1 and 2 and Tables 16-18 (Appendix 1).

Combined red and grey kangaroo population estimates, authorised quotas and actual take (from 1982 onwards) are shown in graphical form in Figure 3, and tabular form from 1973 in Table 16 (Appendix 1). Note that the combined grey kangaroo data in Figure 3 and Table 18 includes eastern grey kangaroos in Northern Tablelands, Central Tablelands and SE NSW.

2. Northern Tablelands

The Northern Tablelands commercial harvest area covers some 51,000 square kilometres and comprises Kangaroo Management Zones 9, 13 and 14. Prior to 2001, the commercial quota was set on the basis of ground (walked) surveys conducted in 1989-90, which 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 6 and 13 September 2010, according to a design developed with the assistance of the DISTANCE© software. As helicopter survey techniques are relatively new and still evolving, each survey is redesigned 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 will be available on the Kangaroo Management Program's web page shortly.

The population estimates and commercial take of wallaroos are detailed in Table 19 and Figure 7 (Appendix 1). Wallaroo population estimates and quotas for each zone are shown in Tables 9 to 11.

The population estimates and commercial take of eastern grey kangaroos in all zones are detailed in Table 17 and Figures 3 and 5. Eastern grey population

estimates and quotas for each of the Northern Tablelands zones are shown in Tables 9 to 11.

Table B shows the current estimated density and population of kangaroos in each of the Northern Tablelands management zones, based on aerial surveys conducted in 2010.

Table B. 2010 population estimates for the Northern Tablelands

Management Zone	Zone Area (km^2)*	Eastern Grey Kangaroo			Wallaroo		
		Density	Population Estimate	Quota	Density**	Population Estimate	Quota
Glen Innes	18,449	14.6	269,500	40,425	1.5	32,190	4,828
Armidale	15,809	12.6	206,780	31,017	2.6	41,255	6,188
Upper Hunter	14,004	12.0	167,500	25,125	1.1	14,985	1,499
TOTAL	**48,262**		**643,780**	**96,567**		**88,430**	**12,515**

*Zone Area in this table refers only to the high and medium density strata, excluding National Park's estate, Forests and Reserves where harvesting is prohibited. Low density strata are not surveyed.
**Densities above have been multiplied by 1.85 as suggested in Cairns (2003).

3. South-east NSW

South-east NSW (Kangaroo Management Zone 16), with the addition of the former Young Rural Lands Protection Board, was surveyed in September 2009. About 23% of the total area of the zone is not available for commercial harvest either because it is reserved for conservation or State Forest, or the terrain is too difficult. These areas are excluded from the survey, which covers approximately 38,500 square kilometres. The population estimate gained from the survey of the zone in September 2009 will remain current until the next survey in 2012. The consultant's report on the results of the survey is available on the KMP web page (Cairns *et al* 2010):
www.environment.nsw.gov.au/resources/nature/kmp/SENSWFinalReport2009.pdf

The study area was originally surveyed in 2003 in accordance with a design developed by consultants based on latest methodologies (Pople, Cairns & Menke 2003). Due to the nature of the terrain, survey using fixed-wing aircraft was not possible and a helicopter was used as for the Northern Tablelands zones. The consultant's report on the results of the survey was presented with the 2005 Quota Submission and is available from the Kangaroo Management Section (kangaroo.management@environment.nsw.gov.au).

In accordance with the approval, a second aerial survey was conducted in September 2006 to provide updated population estimates. The 2006 survey was designed after consideration of the results of the original survey and harvest data, and advances in survey design software. As a result of the re-design, the 2006 survey included greater overall length of survey lines, and shorter individual lines, leading to more appropriate coverage of the total area and greater statistical precision. A full report of the 2006 survey (Cairns 2007b) is available from the Kangaroo Management Section (kangaroo.management@environment.nsw.gov.au).

Following the approval of additional commercial harvest zones in the Central Tablelands area, the former Young Rural Lands Protection Board has been incorporated into the South-east NSW commercial harvest zone, adding an additional 8,884 square kilometres.

Table C shows the current estimated density and population of kangaroos in each of the Rural Lands Protection Boards in the South-east NSW management zone.

Table C. 2009 population estimates for eastern grey kangaroos in each of the five Rural Lands Protection Board areas comprising the SE NSW zone.

RPLB	Area (km^2)	Survey effort (km)	Density (km^{-2})	Population Est.
Goulburn	6,028	232	12.0	71,800
Braidwood	4,284	163	18.4	78,800
Gundagai	6,342	359	10.8	69,100
Yass	5,615	540	17.9	100,300
Cooma	7,271	352	34.8	252,800
Young	8,884	183	9.4	83,100
Total / (Average)	**38,424**	**1,829**	**(17.2)**	**655,900**

The population estimates and commercial take of eastern grey kangaroos in all zones are detailed in Table 17 and Figures 3 and 5. Eastern grey population estimates and quotas for this zone are shown in Table 12.

4. Central Tablelands

The initial helicopter survey of the new Central Tablelands management zone was conducted in 2008. It was designed to provide separate population estimates for the Hunter/Mudgee-Merriwa and Central Tablelands areas, allowing the area 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. 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 this helicopter survey are shown in Table D.

Table D. 2011 population estimates for eastern grey kangaroos in each of the new Central Tablelands commercial harvest zones.

Zone	Area (km^2)	Density (km^{-2})	Population Est.
Hunter-Mudgee (Central Tablelands North)	29,379	20.9	612,590
Central Tablelands South	23,105	15.1	347,830
Total / (Average)	**52,484**	**18.3**	**960,420**

It is likely that much of the change in populations in these zones is an artefact of the survey design – that is, when the initial survey was conducted, there was little existing information about relative densities of kangaroos to assist in the design of the survey. The survey area has received slightly above average rainfall over the three years since the initial survey, which would be expected to result in increased kangaroo populations. The apparent decline in populations in the Central Tablelands South zone is not consistent with the rainfall pattern. However, harvest pressure has been low with only about 30,000 animals harvested since the commencement of the zone in 2009 (from an available quota of 241,000, equivalent to 12 percent of the quota or less than two percent of the population).

The estimated density of kangaroos in this zone is still more than 15 animals per square kilometre, and the apparent decline does not indicate that the eastern grey kangaroo population is at any risk as a result of the commercial harvest.

The population estimates and commercial take of eastern grey kangaroos in all zones are detailed in Table 17 and Figures 3 and 5. Eastern grey population estimates and quotas for this zone are shown in Tables 13 and 14.

C: DETERMINATION OF THE QUOTAS

1. Commercial quotas

Annual commercial quotas are set at a proportion of the estimated macropod populations. For the Western Plains, quotas are set at 17 per cent of the estimated red kangaroo population, and 15 per cent of the estimated population for eastern grey and western grey kangaroos. For the Northern Tablelands, quotas have been set at 15 per cent for both eastern grey kangaroos and wallaroos. Eastern grey kangaroo quotas for the South-east NSW and Central Tablelands zones have also been set at 15 per cent. 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.

Based on the population dynamics of red and grey kangaroos and wallaroos, and the male bias of the commercial take, quotas set at these levels are considered sustainable in the long-term for kangaroo populations. More than 20 years of available data indicates that kangaroo populations harvested at these rates continue to fluctuate primarily in response to seasonal conditions.

As the quota is based on harvesting a proportion of the estimated population, changes in populations are reflected in the quotas. As such, the quotas for 2012 are still considered to be sustainable in the long term.

Low kangaroo populations are further protected by the incorporation of harvest thresholds into the Plan. OEH is required to either reduce or suspend the commercial harvest quotas if the population of a species falls below the threshold in that zone, based on aerial surveys. Thresholds have been set on the basis of standard deviations relative to the long-term average population. Using statistical measures rather than arbitrary population size allows for variation between species and climatic zones – for example, red kangaroo populations in the Far West change more rapidly and deviate more from the average than do eastern grey populations in

the Northern Tablelands. This variation is reflected in the standard deviation, and hence in the population change that is allowable before harvest reductions or suspensions are implemented.

The 2011 aerial survey indicated that populations of western grey kangaroos in the Tibooburra, Broken Hill, Cobar, Bourke and Griffith zones have fallen below the long-term average by between 1.5 and 2 standard deviations. Consequently, commercial quotas for these species in these zones will be set at a reduced rate, ten percent of the population rather than 15 percent. In the Lower Darling zone, western grey kangaroo populations are below the long term average by more than 2 standard deviations, and no quota is set for 2012.

The populations of eastern grey kangaroos in the Lower Darling and Bourke zones are below the average by between 1.5 and 2 standard deviations, and the quota for 2012 is set at ten percent of the population.

The wallaroo population in the Upper Hunter zone was suspended in 2011 following a significant decline between the last two surveys. Under the new threshold calculations, the commercial harvest quota is set at 10% of the population for 2012.

Quotas will be reviewed following the 2012 aerial surveys, and may be further amended. In this case, an addendum to this Quota Report will be prepared and submitted to the Commonwealth Government for information.

2. Special quota

A special quota for 2012 has been calculated in accordance with the provisions of the Plan and will potentially be available to minimise the number of kangaroos shot under non-commercial licences. The special quota will only be used when the commercial quota for a particular kangaroo management zone has been fully issued. This is not a pseudo commercial quota, its sole purpose is to provide for commercial utilisation of kangaroos that would be shot 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 well below average rainfall;
- Western Lands de-stocking orders; and
- kangaroo population trends (based on 2012 survey if completed). Special quota will not be considered for zones where the commercial quota has been reduced or suspended due to low populations.

The maximum number of animals that may be taken under Special Quota provisions in any commercial harvest zone is five per cent of the population estimate for that species in that zone. However, across the combined commercial zones, the Special Quota utilised must not exceed 1.5 per cent of the population estimate for that species. It is not necessarily intended to fully utilise the special quota, unless criteria justify such action. Special Quota was last utilised in 2003.

Non-commercial culling is available to landholders throughout NSW, and occurs even where commercial harvesting is available. Each application must be assessed by an authorised OEH officer before the licence is issued. In the commercial zone, non-commercial licenses are generally only requested when:

- it is not economically viable to take kangaroos commercially;
- the commercial kangaroo industry is unable to fulfil the landholders needs; or
- management zone commercial quotas are fully utilised.

D: TRENDS IN POPULATIONS, QUOTAS AND COMMERCIAL TAKE

1. Populations

The majority of commercial harvest areas in New South Wales have received above average rainfall during the last 12 months, particularly in the far west of the state. However, the last six months have been drier than average. As at October 2011, approximately 12 percent of the state is drought-declared (Department of Primary Industries NSW 2011), corresponding approximately with the Narrabri, Coonabarabran and Upper Hunter management zones. A further 29 percent is considered marginal, covering parts of Bourke, Cobar, Central Tablelands North and the northern parts of the Griffith zones.

The improved seasonal conditions have resulted in overall population increases across the Western Plains for both eastern grey and red kangaroos of 32 and 20 per cent respectively (about 965,000 and 500,000 respectively), however significant regional variation is apparent. Western grey kangaroos declined by about 25 per cent (about 165,000).

Over the past three years, the commercial harvest areas have received slightly above average rainfall (Bureau of Meteorology 2011). Kangaroo populations are known to respond to changes in seasonal conditions, and the observed increases in populations of red and eastern grey kangaroos is consistent with this rainfall pattern.

However, the cause of the decline in western grey kangaroo populations is not clear. The actual harvest of this species in 2010 was equivalent to only four percent of the population, so harvest pressure is unlikely to be a significant contributing factor. To 30 September 2011, only 3.4 percent of the population (23 percent of the quota) has been harvested. South Australia has also recorded a decline in western grey kangaroos, without any apparent cause (P Stokes, Dept Environment & Natural Resources, SA *pers. comm*.). In both South Australia and southwest NSW, the survey data indicates a very patchy distribution of western grey kangaroos. In the process of statistical analysis, a patchy distribution results in less certain population estimates.

- Red kangaroo populations have declined marginally in the Tibooburra and Lower Darling management zones, but increased significantly in all other zones. The increase of 131 percent in the Griffith zone is likely to be due to a

combination of factors, including movement of animals from neighbouring zones, population growth, and survey artefact.

- Western grey kangaroo populations increased by between three and 11 percent in the north and east of its range but declined by between 30 and 57 percent elsewhere. This pattern of change is essentially the reverse of that recorded in 2010.

- Eastern grey kangaroo populations increased by 17 percent in the Coonabarabran zone and 63 percent in the Narrabri zone. Tibooburra zone, at the edge of the distribution of this species, recorded an increase of 44 percent, but densities remain low relative to those at the core of its distribution. Other zones recorded decreases of between five and 59 percent. The largest declines are in zones approaching the edge of the range for eastern grey kangaroos, where they occur in relatively low densities.

The Central Tablelands management zones (North and South) were surveyed in September 2011. Since the previous survey in 2008, the populations of eastern grey kangaroos have remained static over the whole area. However, there has been an apparent increase of about 41 percent (approximately 180,000) in the Central Tablelands North, and an apparent decrease of about 35 percent (approximately 188,000) in the Central Tablelands South zone.

Over the three year period since the last survey, the Central Tablelands area has received slightly above average rainfall. Kangaroo populations would be expected to increase in response to improved seasonal conditions. The apparent increase in Central Tablelands North is consistent with the rainfall pattern, but the decline in the south is not. It is possible that there has been some movement northward, but the most likely explanation is the re-design of the survey using the baseline information gathered in the initial survey in 2008.

RED KANGAROO

The 2011 red kangaroo population estimate and trends in abundance are shown in Table E. Refer to Figure 1 for trends in red kangaroo abundance since 1984.

Table E. 2011 red kangaroo population estimates and trends in abundance

Year	Population Estimate (millions)	Density (reds km^{-2})	Trends in Abundance (% change from previous year)
2011	3.97 ± 0.41	7.39	32
2010	3.01 ± 0.24	5.73	23
2009	2.46 ± 0.17	4.58	-14
2008	2.87 ± 0.21	5.26	14
2007	2.52 ± 0.21	4.44	16
2006	2.18 ± 0.16	4.05	-3
2005	2.24 ± 0.22	4.32	-11
2004	2.51 ± 0.24	4.66	12
2003	2.24 ± 0.16	4.22	-53
2002	4.80 ± 0.39	9.35	-6
2001	5.12 ± 0.34	9.74	*17
2000	4.39 ± 0.40	8.49	-7
1999	4.71 ± 0.44	8.82	-19
1998	5.81 ± 0.61	11.36	10
1997	5.29 ± 0.40	10.01	40

1. Note: dark shading has been used to indicate the use of September 2003 100m CF; light shading indicates the use of 200m CF.
2. *Invalid comparison due to a change in correction factors and survey strip width.

EASTERN GREY KANGAROO

The 2011 grey kangaroo (eastern and western) estimate for the area surveyed by fixed-wing aircraft is 3.49 million (density 6.66 km^{-2}). Refer to Figure 2 for trends in grey kangaroo abundance since 1984. The relative proportions of eastern and western grey kangaroos in the area surveyed were examined in 2000. Application of these proportions to the 2011 survey gives an eastern grey kangaroo population estimate for the area surveyed by air of 3.00 million (5.64 km^{-2}).

The 2011 eastern grey kangaroo population estimate and trends in abundance for the Western Plains are shown in Table F.

Table F. 2011 eastern grey kangaroo population estimates and trends in abundance for the Western Plains.

Year	Population Estimate (millions)	Density (eastern greys km^{-2})	Trend in Abundance (% change from previous year)
2011	3.00 ± 0.44	5.64	38
2010	2.50 ± 0.31	4.70	38
2009	1.81 ± 0.19	3.49	-16
2008	2.15 ± 0.21	3.97	0
2007	2.15 ± 0.27	3.99	7
2006	2.14 ± 0.32	3.92	7
2005	2.00 ± 0.33	3.65	-25
2004	2.66 ± 0.32	5.03	-31
2003	3.83 ± 0.58	7.42	-51
2002	7.80 ± 1.02	15.07	24
2001	6.29 ± 0.72	12.48	*22
2000	5.17 ± 0.57	9.86	6
1999	4.87 ± 0.42	9.43	-6
1998	5.19 ± 0.54	9.91	17
1997	4.43 ± 0.63	8.53	12

1. Note: dark shading has been used to indicate the use of September 2003 100m CF; light shading indicates the use of 200m CF.
2. *Invalid comparison due to a change in correction factors and survey strip width.

The **Northern Tablelands** management zones were surveyed in September 2010. Based on this survey, the number of eastern grey kangaroos estimated to be in the Northern Tablelands region is 636,200 (Table G). The Northern Tablelands region will be surveyed again in 2013.

Table G. 2010 eastern grey kangaroo population estimates and trends in abundance for the Northern Tablelands zones.

Year	Zone	Population Estimate	Density (km^{-2})	Trend in Abundance (% change from previous survey)
2010	Armidale	206,780	13.1	46
	Glen Innes	269,500	12.9	14
	Upper Hunter	167,500	11.5	82
	Total	643,780		
2007	Armidale	141,610	8.7	-12
	Glen Innes	236,600	11.3	58
	Upper Hunter	92,016	6.3	36
	Total	470,226		24
2004	Armidale	161,726	10.2	4
	Glen Innes	149,621	8.1	-35
	Upper Hunter	67,499	4.8	-28
	Total	378,846		-23
2001/2	Armidale	173,109	10.6	N/A
	Glen Innes	221,975	10.6	N/A
	Upper Hunter	95,273	6.5	N/A
	Total	490,357		N/A

Tables 9b, 10b and 11b show population estimates and quotas for the Northern Tablelands management zones from 1992 to 2011.

Prior to approval of the commercial harvest zone in **SE NSW**, a baseline population estimate was established using helicopter survey methodology developed in the Northern Tablelands. A second survey was conducted in September 2006 in accordance with the approval, and indicated an increase of 42 per cent in the population since the 2003 survey. The area was surveyed again in 2009, with the addition of the former Young Rural Lands Protection Board (Table H). Trend in abundance is not shown in Table H, as the areas surveyed in 2006 and 2009 are different.

The increase in population within the original zone area is due mainly to a significant increase of 138 per cent in the Cooma RLPB over the last three years. The magnitude of this change suggests a combination of increases in local populations, immigration from adjacent drier areas, and possibly also improvements in the survey design based on information gathered in the previous two surveys.

Populations also increased by between 20 and 38 per cent in the Braidwood, Gundagai and Yass boards, but declined by 37 per cent in the Goulburn area.

There has also been a decline of about 17 per cent in the Young board since it was first surveyed in 2008. Improved survey design as a result of information obtained in the initial survey is likely to be the major contributing factor to this change.

Table H. 2009 eastern grey kangaroo population estimates and trends in abundance for South-east NSW.

Year	Population Estimate	Density (km^{-2})	Trend in Abundance (% change from previous survey)
2009*	655,900	17.1	N/A
2006	415,271	14.07	42
2003	292,455	11.95	N/A

* the 2009 population estimate is for a larger area than the previous two surveys, as it includes the former Young RLPB. It is therefore inappropriate to consider the difference between 2006 and 2009 surveys as a trend.

Table 12 shows population estimates and quotas for the South-east NSW management zone.

Central Tablelands North and South zones were surveyed for the first time in 2008, and commenced operation on 1 June 2009. A second survey was conducted in September 2011, providing some trend information (Table I). However, the apparent trends should be viewed with caution as a result of the short survey history in these zones.

Table I. 2011 eastern grey kangaroo population estimates and trends in abundance for Central Tablelands North and South.

Year	Zone	Population Estimate	Density (km^{-2})	Trend in Abundance (% change from previous survey)
2011	CT North	612,590	20.9	41.5
	CT South	347,830	15.1	-35.1
	Total	960,420		
2008	CT North	433,030	14.7	N/A
	CT South	535,600	23.2	N/A
	Total	968,630		

WESTERN GREY KANGAROO

The 2011 grey kangaroo (eastern and western) estimate for the area surveyed by fixed-wing aircraft is 3.49 million (density 6.66 km^{-2}). Refer to Figure 2 for trends in grey kangaroo abundance since 1984. The relative proportions of eastern and western grey kangaroos in the area surveyed were examined in 2000. Application of these proportions to the 2011 survey gives a western grey kangaroo population estimate for the area surveyed by air of 496,059 (1.02 km^{-2}).

The 2011 western grey kangaroo population estimate and trends in abundance for the Western Plains are shown in Table J.

Table J. 2011 western grey kangaroo population estimates and trends in abundance.

Year	Population Estimate (millions)	Density (western greys km^{-2})	Trend in Abundance (% change from previous year)
2011	0.50 ± 0.07	1.02	-25
2010	0.66 ± 0.08	1.39	-8
2009	0.72 ± 0.08	1.49	-27
2008	0.99 ± 0.10	2.07	36
2007	0.73 ± 0.09	1.55	11
2006	0.65 ± 0.11	1.35	9
2005	0.60 ± 0.09	1.31	-33
2004	0.89 ± 0.11	1.89	-29
2003	1.27 ± 0.26	2.72	-47
2002	2.39 ± 0.30	5.02	18
2001	2.03 ± 0.22	4.53	*13
2000	1.79 ± 0.24	3.86	-14
1999	2.09 ± 0.19	4.50	11
1998	1.88 ± 0.18	3.97	-11
1997	2.11 ± 0.27	4.33	22

1. Note: dark shading has been used to indicate the use of September 2003 100m CF; light shading indicates the use of 200m CF.
2. *Invalid comparison due to a change in correction factors and survey strip width.

WALLAROO

The 2010 wallaroo population estimate and trends in abundance for the Northern Tablelands management zones are shown in Table K.

Tables 9a, 10a and 11a show population estimates and quotas from 1992 to 2012.

Table K. 2010 wallaroo population estimates and trends in abundance for the Northern Tablelands.

Year	Zone	Population Estimate	Density (km^{-2})	Trend in Abundance (% change from previous survey)
2010	Armidale	41,255	2.5	9
	Glen Innes	32,190	1.5	0
	Upper Hunter	14,985	1.0	-67
	Total	88,430		
2007	Armidale	37,859	2.3	-58
	Glen Innes	32,184	1.5	-43
	Upper Hunter	44,923	3.1	-27
	Total	114,966		-44.8
2004	Armidale	89,787	5.7	158
	Glen Innes	56,657	3.1	-56
	Upper Hunter	61,660	4.4	7
	Total	208,104		-5.8
2001/2	Armidale	34,744	2.1	N/A
	Glen Innes	128,323	6.1	N/A
	Upper Hunter	57,762	4.0	N/A
	Total	220,829		N/A

2. Quotas

Quotas have been set at the same percentage of the population estimate for several years. These proportions are specified in the Plan, and are considered to be sustainable in the long term, based on the population dynamics of the species and the selectivity of kangaroo harvesters for male kangaroos.

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, a statistical measure that indicates how much a population varies from its average over time. For the purposes of setting quotas, populations that are between 1.5 and two standard deviations below their long-term average are calculated at a reduced rate of ten percent, while populations that are two or more standard deviations below their average 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 quota was suspended.

RED KANGAROO

The quota for 2012 of 675,329 represents 17 per cent of the population estimated by aerial survey, as specified in the Plan. None of the zone populations of red kangaroos are below the thresholds at which the quota must be reduced or suspended.

EASTERN GREY KANGAROO

The quota for 2012 of 443,334 for the Western Plains represents 14.8 per cent of the population estimated by aerial survey. The Plan specifies a maximum harvest rate of 15 per cent of the population estimate. However, the Lower Darling and Bourke zone populations are below their respective thresholds, and have been calculated at ten percent. This represents in a reduction of approximately 6,360 in the potential maximum commercial quota for this species.

The quota for 2012 of 96,567 for the Northern Tablelands region represents 15 per cent of the estimated population of 643,780 derived from aerial surveys in 2010.

The South-east NSW quota is 98,385 which represents 15 per cent of the population estimate of 655,900 derived from aerial surveys in 2009. This includes the former Young Rural Lands Protection Board.

The quotas for Central Tablelands North and Central Tablelands South are 91,889 and 52,175 respectively, which represent 15 per cent of the population estimates derived from aerial surveys in 2011.

The combined 2012 eastern grey quota is 782,349.

WESTERN GREY KANGAROO

The quota for 2012 of 48,435 represents 9.8 per cent of the population estimated by aerial survey. The Plan specifies a maximum commercial quota of 15 per cent of the population estimate. However, several zone populations are below their respective thresholds, and quota calculations have been modified as follows:

1. Quota suspended for 2012:
- Lower Darling zone.

2. Quota calculated at 10 percent for 2012:
- Tibooburra
- Broken Hill
- Cobar
- Bourke
- Griffith

This represents a reduction of approximately 25,970 in the potential maximum commercial quota for this species.

WALLAROO

For 2004, the quotas for wallaroos in the Northern Tablelands were changed from five per cent to 15 per cent of the population estimate as a result of the more rigorous scientific basis to survey and estimation methodologies. For the 2012 quota, this proportion will remain at 15 per cent for the Armidale and Glen Innes zones, which is in accordance with the Plan. However, the quota has been set at ten percent for the Upper Hunter zone, as the population estimate at the last survey had fallen significantly and is now between the threshold levels.

The 2012 quota is 12,515 for the Northern Tablelands.

3. Commercial take

Species: Red Kangaroo *(Macropus rufus)*
Eastern Grey Kangaroo *(Macropus giganteus)*
Western Grey Kangaroo *(Macropus fuliginosus)*
Wallaroo *(Macropus robustus robustus)*

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)

For 2008 the minimum carcase weight requirement increased from 12 to 14 kilograms for carcases dressed as for pet food processing, and from 13 to 15 kilograms for carcases dressed for human consumption processing. Due to the size difference between male and female wallaroos in particular, this requirement almost eliminates females from the harvest as they are generally too small to meet the carcase weight requirement. The impact is less pronounced on the other harvested species. In all cases the carcase weights for the period to 30 September 2011 are similar to those reported for 2010 and well above average for the period 1999-2009 (the long term average).

RED KANGAROO

Harvester returns indicate that during 2010, 76.1 per cent of red kangaroos taken were males. For the year to 30 September 2011, harvester returns reported a male bias of 79.9 per cent, which is well above than the long-term average (1999-2009) of 70.3 per cent.

The actual take of red kangaroos is shown against the authorised quota in Table 16 and Figure 4.

The *average* take as a proportion of the authorised quota from 2000 to 2010 is 60.9 per cent.

EASTERN GREY KANGAROO

Harvester returns indicate that during 2010, 74.0 per cent of eastern grey kangaroos taken were males. For the year to 30 September 2011, harvester returns report a male bias of 74.8 per cent, higher than the long-term average (1999-2009) of 70.4 per cent.

The actual take of eastern grey kangaroos is shown against the authorised quota in Table 17 and Figure 5.

The *average* take as a proportion of the authorised quota from 2000 to 2010 is 68.6 per cent.

WESTERN GREY KANGAROO

Harvester returns indicate that during 2010, 82.3 per cent of western grey kangaroos taken were males. For the year to 30 September 2011, harvester returns record a male bias of 75.8 per cent, well above than the long-term average (1999-2009) of 67.8 per cent.

The actual take of western grey kangaroos is shown against the authorised quota in Table 18 and Figure 6.

The *average* take as a proportion of the authorised quota from 2000 to 2010 is 54.9 per cent.

WALLAROO

Harvester returns indicate that during 2010, 97.0 per cent of wallaroos taken were males. For the year to 30 September 2011, harvester returns record a male bias of 97.3 per cent, well above than the long-term average (1999-2009) of 88.7 per cent.

The actual take of wallaroos is shown against the authorised quota in Table 19 and Figure 7.

The *average* take as a proportion of the authorised quota from 2000 to 2010 is 58.9 per cent.

E: PROPOSED CHANGES TO QUOTAS

OEH does not propose to set quotas for 2012 that are at higher levels than specified in the Plan.

However, in accordance with the provisions of the Plan, OEH proposes to suspend the harvest of western grey kangaroos in the Lower Darling management zones, and reduce the quota for both western and eastern grey kangaroos in several other zones as specified in Section D2.

No adjustments are proposed to quotas for red kangaroos in any of the management zones.

F: NEW COMMERCIAL ZONES

No new commercial harvest zones are proposed for commencement in 2012.

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Appendix 1- Tables and Figures

In the tables following:

1. Dark shading indicates the use of September 2003 100m Correction Factors; light shading indicates 200m Correction Factors for surveys of the Western Plains zones using fixed-wing aircraft, as described in Section B. Correction Factors do not apply to helicopter surveys.

2. % Population refers to the actual take as a proportion of the *previous* year's population estimate, on which the quota is set.

3. Where quota has been set for only one of the two species of grey kangaroo, the population given includes both species.

4. Where quota adjustments have been implemented during 2011, these are *not* reflected in the following tables. Adjustments will be fully detailed in the Annual Report for 2011.

5. Management zones that are surveyed by helicopter are surveyed on a three-yearly cycle. Population estimates remain the same for the intervening period.

6. The eastern grey kangaroo population estimate in the Armidale zone has increased slightly from 2010 to 2011 due to the detection of a data entry error in the original survey analysis. No additional survey has been conducted.

Kangaroo Management Zone No. 1- TIBOOBURRA

Table 1a. RED KANGAROO

AVERAGE DENSITY	16.54
AREA : Km., sq.	54,848
STANDARD DEVIATION	6.98

YEAR	POPULATION	DENSITY	%CHANGE	QUOTA	%POPULATION
1989	1,123,200	20.5	4.1	147,800	13.7
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				105,591	17.0

Table 1b. GREY KANGAROO

AVERAGE DENSITY	2.31
AREA : Km., sq.	54,848
STANDARD DEVIATION	1.57

YEAR	POPULATION	DENSITY	%CHANGE	QUOTA	%POPULATION
1989	56,100	1	20.1	4,500	9.6
1990	83,400	1.5	48.7	7,400	13.2
1991	55,500	1	-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	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	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	-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				7,153	14.0

KANGAROO MANAGEMENT ZONE No. 2- BROKEN HILL

Table 2a. RED KANGAROO

AVERAGE DENSITY		12.61			
AREA : Km., sq.		90,845			
STANDARD DEVIATION		3.62			
YEAR	POPULATION	DENSITY	%CHANGE	QUOTA	%POPULATION
1989	1,381,500	15.2	14.9	169,000	14.1
1990	1,654,100	18.2	19.7	203,700	14.7
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	-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	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				183,439	17.0

Table 2b. GREY KANGAROO

AVERAGE DENSITY		5.93			
AREA : Km., sq.		90,845			
STANDARD DEVIATION		3.41			
YEAR	POPULATION	DENSITY	%CHANGE	QUOTA	%POPULATION
1989	247,800	2.7	-5.8	38,600	14.7
1990	465,100	5.1	87.7	37,100	15.0
1991	449,700	5	-3.3	81,600	17.5
1992	457,500	5	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	13.2	71,650	11.1
2001	723,937	8	-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				21,382	11.9

KANGAROO MANAGEMENT ZONE No. 4- LOWER DARLING

Table 3a. RED KANGAROO

AVERAGE DENSITY		5.19			
AREA : Km., sq.		56,460			
STANDARD DEVIATION		2.15			
YEAR	POPULATION	DENSITY	%CHANGE	QUOTA	%POPULATION
1989	260,300	4.6	-15.5	26,700	8.7
1990	349,400	6.2	34.2	34,800	13.4
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	-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				31,700	17.0

Table 3b. GREY KANGAROO

AVERAGE DENSITY		8.34			
AREA : Km., sq.		56,460			
STANDARD DEVIATION		4.86			
YEAR	POPULATION	DENSITY	%CHANGE	QUOTA	%POPULATION
1989	248,200	4.4	34.7	19,100	10.4
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	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	-34.4	78,300	15.3
2004	306,466	5.4	-8.9	50,458	15.0
2005	110,876	2	-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	3.82	-41.3	55,083	15.0
2010	231,585	4.1	7.5	32,313	15.0
2011	98,973	1.75	-57.3	34,738	15.0
2012				3,259	3.3

KANGAROO MANAGEMENT ZONE No. 6- COBAR

Table 4a. RED KANGAROO

AVERAGE DENSITY		4.44			
AREA : Km., sq.		40,339			
STANDARD DEVIATION		1.46			
YEAR	POPULATION	DENSITY	%CHANGE	QUOTA	%POPULATION
1989	209,200	5.2	27.3	27,000	16.4
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	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	-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				35,857	17.0

Table 4b. GREY KANGAROO

AVERAGE DENSITY		12.41			
AREA : Km., sq.		40,339			
STANDARD DEVIATION		6.76			
YEAR	POPULATION	DENSITY	%CHANGE	QUOTA	%POPULATION
1989	250,100	6.2	10.7	31,600	14.0
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				21,384	12.1

KANGAROO MANAGEMENT ZONE No. 7- BOURKE

Table 5a. RED KANGAROO

AVERAGE DENSITY		5.49			
AREA : Km., sq.		55,005			
STANDARD DEVIATION		2.76			
YEAR	POPULATION	DENSITY	%CHANGE	QUOTA	%POPULATION
1989	391,200	7.1	63.7	35,100	14.7
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	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	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				75,638	17.0

Table 5b. GREY KANGAROO

AVERAGE DENSITY		8.84			
AREA : Km., sq.		55,005			
STANDARD DEVIATION		6.15			
YEAR	POPULATION	DENSITY	%CHANGE	QUOTA	%POPULATION
1989	274,400	5	21.8	33,800	15.0
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	-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	-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				12,802	10.0

KANGAROO MANAGEMENT ZONE No. 8-NARRABRI

Table 6a. RED KANGAROO

AVERAGE DENSITY		5.45			
AREA : Km., sq.		65,787			
STANDARD DEVIATION		3.83			
YEAR	POPULATION	DENSITY	%CHANGE	QUOTA	%POPULATION
1989	272,300	4.1	62.0	26,900	16.0
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	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	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				90,162	17.0

Table 6b. GREY KANGAROO

AVERAGE DENSITY		14.17			
AREA : Km., sq.		65,787			
STANDARD DEVIATION		7.07			
YEAR	POPULATION	DENSITY	%CHANGE	QUOTA	%POPULATION
1989	808,200	12.3	87.1	71,200	16.5
1990	1,005,900	15.3	24.5	142,700	17.7
1991	987,000	15	-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				184,304	15.0

KANGAROO MANAGEMENT ZONE No. 10-COONABARABRAN

Table 7a. RED KANGAROO

AVERAGE DENSITY		4.09			
AREA : Km., sq.		61,590			
STANDARD DEVIATION		1.76			
YEAR	POPULATION	DENSITY	%CHANGE	QUOTA	%POPULATION
1989	213,200	3.5	57.0	19,900	14.7
1990	186,000	3	-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				58,351	17.0

Table 7b. GREY KANGAROO

AVERAGE DENSITY		21.08			
AREA : Km., sq.		61,590			
STANDARD DEVIATION		10.64			
YEAR	POPULATION	DENSITY	%CHANGE	QUOTA	%POPULATION
1989	706,400	11.5	54.9	74,500	16.3
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				163,474	15.0

KANGAROO MANAGEMENT ZONE No. 11- GRIFFITH

Table 8a. RED KANGAROO

AVERAGE DENSITY		3.58			
AREA : Km., sq.		98,171			
STANDARD DEVIATION		1.22			
YEAR	POPULATION	DENSITY	%CHANGE	QUOTA	%POPULATION
1989	249,900	2.5	38.6	29,200	16.2
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	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	-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	-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				94,591	17.0

Table 8b. GREY KANGAROO

AVERAGE DENSITY		8.93			
AREA : Km., sq.		98,171			
STANDARD DEVIATION		3.44			
YEAR	POPULATION	DENSITY	%CHANGE	QUOTA	%POPULATION
1989	401,000	4.1	56.5	43,500	17.0
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				78,012	14.4

KANGAROO MANAGEMENT ZONE No. 9-ARMIDALE

Table 9a. WALLAROO

AVERAGE DENSITY	5.9
AREA : Km., sq.	16,331
STANDARD DEVIATION	2.14

YEAR	POPULATION	DENSITY	%CHANGE	QUOTA	%POPULATION
1992	127,680	7.8	5	6,160	5.1
1993	127,680	7.8	-	6,160	4.8
1994	121,296	7.4	-5	6,432	5
1995	126,148	7.7	4	6,118	5
1996	98,396	6	-22	6,308	5
1997	111,187	6.8	13	4,920	5
1998	120,860	7.4	9	5,559	5
1999	119,651	7.3	-1	6,043	5
2000	125,600	7.7	5	5,975	5
2001	125,600	7.7	-	6,250	5
2002	125,600	7.7	-	6,250	5
2003	34,744	2.1	-72	6,250	5
2004	89,787	5.7	158	5,212	15
2005	89,787	5.7	-	13,468	15
2006	89,787	5.7	-	13,468	15
2007	37,859	2.3	-58	13,468	15
2008	37,859	2.3	-	5,679	15
2009	37,859	2.3	-	5,679	15
2010	41,255	2.5	9	5,679	15
2011	41,255	2.5	0	6,188	15
2012				6,188	15

Table 9b. GREY KANGAROO

AVERAGE DENSITY	11.3
AREA : Km., sq.	16,331
STANDARD DEVIATION	1.62

YEAR	POPULATION	DENSITY	%CHANGE	QUOTA	%POPULATION
1992	223,650	13.7	0	33,370	14.9
1993	234,655	14.4	5	46,931	21
1994	199,474	12.2	-15	46,931	20
1995	207,462	12.7	4	43,882	22
1996	161,821	9.9	-22	45,640	22
1997	182,857	11.2	13	32,364	20
1998	198,765	12.2	9	31,085	17
1999	196,777	12	-1	33,790	17
2000	206,600	12.7	5	33,450	17
2001	173,109	10.6	-16	35,100	17
2002	173,109	10.6	0	25,966	15
2003	180,456	11	4	25,966	15
2004	161,726	10.2	-10	27,068	15
2005	161,726	10.2	0	24,259	15
2006	161,726	10.2	0	24,259	15
2007	141,610	8.7	-12	24,259	15
2008	141,610	8.7	0	21,242	15
2009	141,610	8.7	0	21,242	15
2010	199,200	12.2	41	21,242	15
2011	206,780	13.1	-	29,880	15
2012				31,017	15

KANGAROO MANAGEMENT ZONE No. 13- GLEN INNES

Table 10a. WALLAROO

AVERAGE DENSITY	5.0
AREA : Km., sq.	20,941
STANDARD DEVIATION	2.43

YEAR	POPULATION	DENSITY	%CHANGE	QUOTA	%POPULATION
1992	127,680	6.1	5	6,160	5.1
1993	127,680	6.1	0	6,160	4.8
1994	121,296	5.8	-5	6,432	5
1995	126,148	6	4	6,118	5
1996	98,396	4.7	-22	6,308	5
1997	111,187	5.3	13	4,920	5
1998	120,860	5.8	9	5,559	5
1999	119,651	5.7	-1	6,043	5
2000	125,600	6	5	5,975	5
2001	215,500	10.3	72	6,250	5
2002	215,500	10.3	0	6,250	2.9
2003	128,232	6.1	-40	6,250	2.9
2004	56,657	3.1	-56	19,235	15
2005	56,657	3.1	0	8,499	15
2006	56,657	3.1	0	8,499	15
2007	32,184	1.5	-43	8,499	15
2008	32,184	1.5	-	4,828	15
2009	32,184	1.5	-	4,828	15
2010	32,190	1.5	0	4,828	15
2011	32,190	1.5	-	4,829	15
2012				4,829	15

Table 10b. GREY KANGAROO

AVERAGE DENSITY	10.0
AREA : Km., sq.	20,941
STANDARD DEVIATION	1.32

YEAR	POPULATION	DENSITY	%CHANGE	QUOTA	%POPULATION
1992	223,650	10.7	-	33,370	14.9
1993	234,655	11.2	5	46,931	21
1994	199,474	9.5	-15	46,931	20
1995	207,462	9.9	4	43,882	22
1996	161,821	7.7	-22	45,640	22
1997	182,857	8.7	13	32,364	20
1998	198,765	9.5	9	31,085	17
1999	196,777	9.4	-1	33,790	17
2000	206,600	9.9	5	33,450	17
2001	221,975	10.6	7	35,122	17
2002	221,975	10.6	-	33,296	15
2003	229,723	11	3	33,296	15
2004	149,621	8.1	-35	34,458	15
2005	149,621	8.1	-	22,443	15
2006	149,621	8.1	-	22,443	15
2007	236,600	11.3	58	22,443	15
2008	236,600	11.3	-	35,490	15
2009	236,600	11.3	-	35,490	15
2010	269,500	12.9	14	35,490	15
2011	269,500	12.9	-	40,425	15
2012				40,425	15

KANGAROO MANAGEMENT ZONE No. 14-UPPER HUNTER

Table 11a. WALLAROO

AVERAGE DENSITY	5.7
AREA : Km., sq.	14,590
STANDARD DEVIATION	1.92

YEAR	POPULATION	DENSITY	%CHANGE	QUOTA	%POPULATION
1992	109,440	7.5	5	5,280	5.1
1993	109,440	7.5	-	5,280	4.8
1994	103,968	7.1	-5	5,512	5
1995	108,128	7.4	4	5,244	5
1996	84,340	5.8	-22	5,408	5
1997	95,304	6.5	13	4,217	5
1998	103,595	7.1	9	4,765	5
1999	102,559	7	-1	5,180	5
2000	107,650	7.4	5	5,125	5
2001	107,650	7.4	-	5,350	5
2002	107,650	7.4	-	5,350	5
2003	57,762	4	-46	5,350	5
2004	61,660	4.4	7	8,664	15
2005	61,660	4.4	-	9,249	15
2006	61,660	4.4	-	9,249	15
2007	44,923	3.1	-27	9,249	15
2008	44,923	3.1	-	6,738	15
2009	44,923	3.1	-	6,738	15
2010	14,985	1.0	-67	2,985	6.6
2011	14,985	1.0	-	0	0
2012				1,499	10

Table 11b. GREY KANGAROO

AVERAGE DENSITY	9.1
AREA : Km., sq.	14,590
STANDARD DEVIATION	2.85

YEAR	POPULATION	DENSITY	%CHANGE	QUOTA	%POPULATION
1992	182,700	12.5	-	27,260	14.9
1993	191,690	13.1	5	38,338	21
1994	162,952	11.2	-15	38,338	20
1995	169,476	11.6	4	35,848	22
1996	132,192	9.1	-22	37,283	22
1997	149,377	10.2	13	26,438	20
1998	162,372	11.1	9	25,394	17
1999	160,748	11	-1	27,600	17
2000	168,750	11.6	5	27,350	17
2001	95,273	6.5	-44	25,313	15
2002	95,273	6.5	-	14,291	15
2003	94,251	6.5	-1	14,291	15
2004	67,499	4.8	-28	14,138	15
2005	67,499	4.8	-	10,125	15
2006	67,499	4.8	-	10,125	15
2007	92,016	6.3	36	10,125	15
2008	92,016	6.3	-	13,802	15
2009	92,016	6.3	-	13,802	15
2010	167,500	11.5	82	13,802	15
2011	167,500	11.5	-	25,125	15
2012				25,125	15

KANGAROO MANAGEMENT ZONE- South-eastern NSW

Table 12. GREY KANGAROO

AVERAGE DENSITY		13.85			
AREA : Km^2		38,424			
STANDARD DEVIATION		N/A			
YEAR	**POPULATION**	**DENSITY**	**%CHANGE**	**QUOTA**	**%POPULATION**
2003	292,455	11.95	–	-	-
2004	292,455	11.95	-	43,868	15
2005	292,455	11.95	-	43,868	15
2006	415,271	14.07	42	43,868	15
2007	415,271	14.07	-	62,291	15
2008	415,271	14.07	-	62,291	15
2009	655,900	15.69	47.6	62,291	15
2010	655,900	17.07	-	98,385	15
2011	655,900	17.07	-	98,385	15
2012				98,385	15

KANGAROO MANAGEMENT ZONE- Central Tablelands North

Table 13. GREY KANGAROO

AVERAGE DENSITY		16.27			
AREA : Km^2		29,379			
STANDARD DEVIATION		N/A			
YEAR	**POPULATION**	**DENSITY**	**%CHANGE**	**QUOTA**	**%POPULATION**
2008	433,030	14.74	N/A		
2009	433,030	14.74	N/A	64,995	15
2010	433,030	14.74	N/A	64,995	15
2011	612,590	20.85	41.47	64,955	15
2012				91,889	15

KANGAROO MANAGEMENT ZONE- Central Tablelands South

Table 14. GREY KANGAROO

AVERAGE DENSITY		21.15			
AREA : Km^2		23,105			
STANDARD DEVIATION		N/A			
YEAR	**POPULATION**	**DENSITY**	**%CHANGE**	**QUOTA**	**%POPULATION**
2008	535,600	23.18	N/A		
2009	535,600	23.18	N/A	80,340	15
2010	535,600	23.18	N/A	80,340	15
2011	347,830	15.05	-35.06	80,340	15
2012				52,175	15

Table 15. 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	123,000	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	167,200	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			
5	**2012**		1,506,113	15.5			

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

Table 16. SUMMARY STATISTICS COMMERCIAL TAKE- RED KANGAROO

Year	Population Estimate	Quota	% of Population	Take	% of Population	% of Quota
1973	no survey					
1974	no survey					
1975	2,073,000					
1976	no survey	110,000	5			
1977	2,669,000	150,000				
1978	2,069,000	150,000	6			
1979	2,355,000	300,000	15			
1980	3,377,000	300,000	13			
1981	4,626,000	333,000	10			
1982	5,700,000	550,000	12	398,200	8.6	72.4
1983	3,400,000	550,000	10	264,900	4.6	48.2
1984	1,650,000	270,000	8	158,000	4.6	58.5
1985	2,363,000	190,000	12	213,300	12.9	112.3
1986	2,574,000	313,000	13	263,000	11.1	84.0
1987	2,777,000	313,000	12	270,500	10.5	86.4
1988	3,440,000	354,000	13	218,100	7.9	61.6
1989	4,101,000	487,000	14	297,000	8.6	61.0
1990	4,499,000	626,000	15	377,200	9.2	60.3
1991	4,755,000	706,000	16	496,000	11.0	70.3
1992	3,348,900	956,000	20	412,200	8.7	43.1
1993	4,395,426	598,800	18	359,820	10.7	60.1
1994	3,960,106	483,850	11	397,791	9.1	82.2
1995	4,185,494	483,680	12	431,663	10.9	89.2
1996	3,787,113	507,000	12	531,370	12.7	104.8
1997	5,285,995	450,780	12	415,395	11.0	92.2
1998	5,809,757	648,560	12	495,100	9.4	76.3
1999	4,705,664	642,070	11	450,020	7.7	70.1
2000	4,391,385	590,450	13	389,204	8.3	65.9
2001	5,121,413	558,750	13	527,521	12.0	94.4
2002	4,798,558	765,900	15	538,856	10.5	70.4
2003	2,235,114	704,350	15	274,900	5.7	39.0
2004	2,508,236	379,970	17	244,379	10.9	64.3
2005	2,241,497	426,400	17	241,503	9.6	56.6
2006	2,182,788	381,054	17	338,631	15.1	88.9
2007	2,524,448	371,074	17	304,732	14.0	82.1
2008	2,869,709	429,156	17	210,654	8.3	49.1
2009	2,456,795	487,850	17	182,858	6.4	37.5
2010	3,013,908	417,655	17	117,811	4.8	28.2
2011	3,972,522	512,364	17			
2012		675,329	17			

Note:
1. 1975-1983 population estimates based on survey of seven 1:250 000 monitor blocks
2. 1984-2000 population estimates based on survey of virtually all the Western Plains
3. 2001-2009 population estimates based on survey of virtually all the Western Plains, and incorporates revised correction factors.

Table 17. SUMMARY 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			
2012		782,349	14.9			

Note:
1. Quota based on a Grey Kangaroo ratio of 72:28% E/W Grey kangaroos.
2. 1987-01 populations and quotas based on aerial surveys and counts of grey kangaroos, applying species proportions determined from ground surveys for Western Plains.
3. 1975-1983 population estimates based on survey of seven 1:250 000 monitor blocks
4. 1984-2000 population estimates based on survey the Western Plains (not monitor blocks)
5. 2001-2007 population estimates based on survey of the Western Plains, and incorporates revised correction factors.
6. Helicopter surveys of the Northern Tablelands were undertaken for the first time in 2001. Prior to this, estimates were based on ground surveys conducted in the 1980s.
7. SE NSW management zone was added from 2003 population estimate.
8. Central Tablelands zones added from 2009 population estimate.

Table 18. SUMMARY 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	49.67
2009	722,255	148,434	15.0	38,675	3.9	26.06
2010	662,982	83,194	11.5	25,554	3.5	30.72
2011	496,059	78,851	11.9			
2012		48,435	9.8			

Note:

1. 1987-04 populations and quotas based on aerial survey counts of grey kangaroos, applying species proportions determined from ground surveys.
2. 1975-1983 population estimates based on survey of seven 1:250 000 monitor blocks
3. 1984-2000 population estimates based on survey of the Western Plains
4. 2001-2009 population estimates based on survey of the Western Plains, and incorporates revised correction factors.

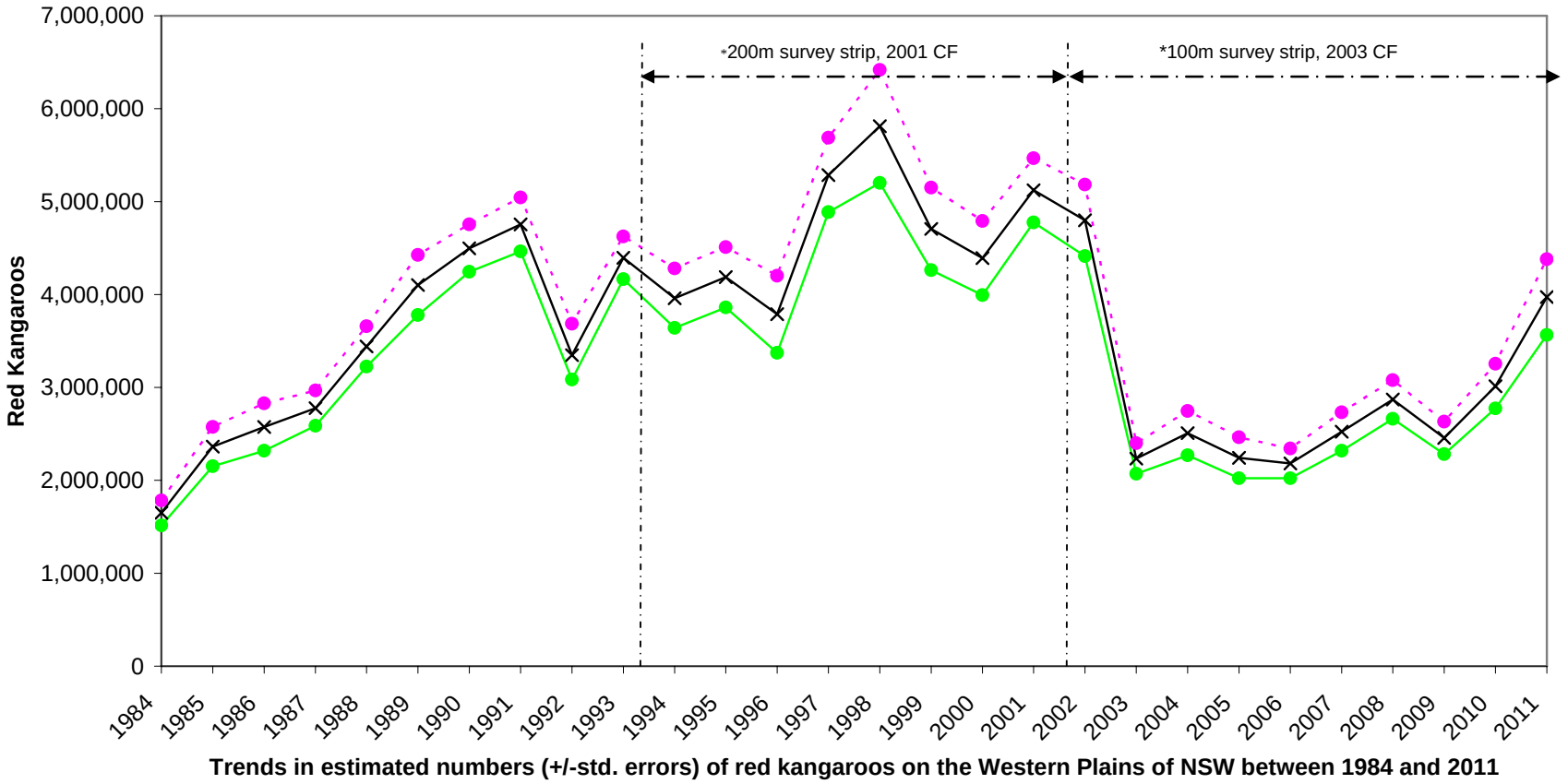
Table 19. SUMMARY COMMERCIAL TAKE- WALLAROOS (Northern Tablelands)

Year	Population Estimate	Quota	% of Population	Take	% of Population	% of Quota
1979		5,000				
1980		5,000				
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			
2012		12,515	14.2			

Note:

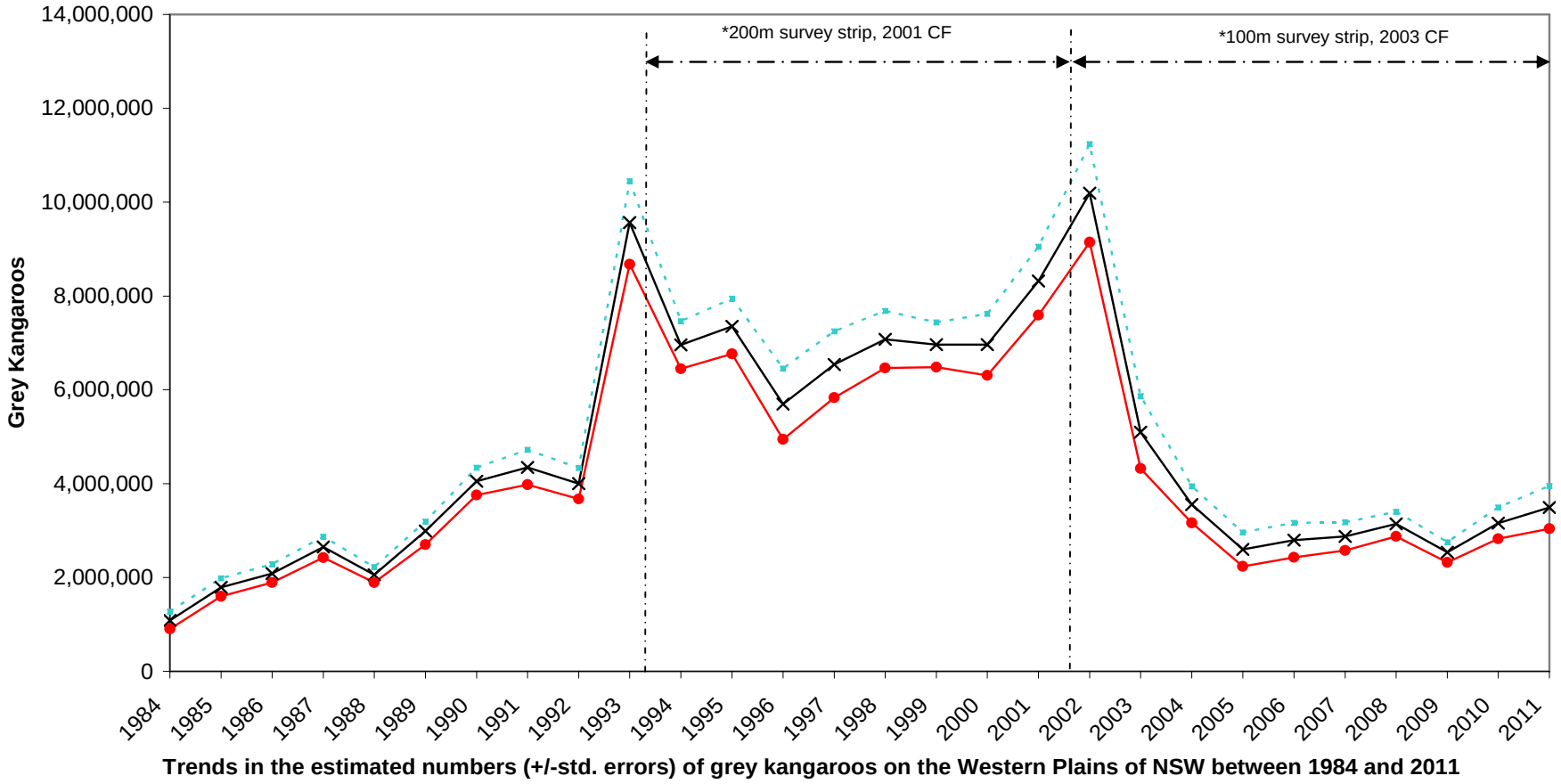
1. 1979-85, whole of commercial zone.
2. 1989-2000, Tablelands only.
3. 2001, helicopter survey of Tablelands.
4. 2004, helicopter survey of Tablelands.
5. 2007, helicopter survey of Tablelands.
6. 2004 quota changed from 5% to 15% in line with KMP 2002-2006.
7. Quota suspended for Upper Hunter zone in 2011 and calculated at 10% for 2012.

Figure 1. Population trends in red kangaroos in the Western Plains of NSW



Trends in estimated numbers (+/-std. errors) of red kangaroos on the Western Plains of NSW between 1984 and 2011

Figure 2. Population trends in grey kangaroos in the Western Plains of NSW



Trends in the estimated numbers (+/-std. errors) of grey kangaroos on the Western Plains of NSW between 1984 and 2011

Figure 3. NSW combined red and grey kangaroo population estimates, authorised quota & actual take 1982-2012

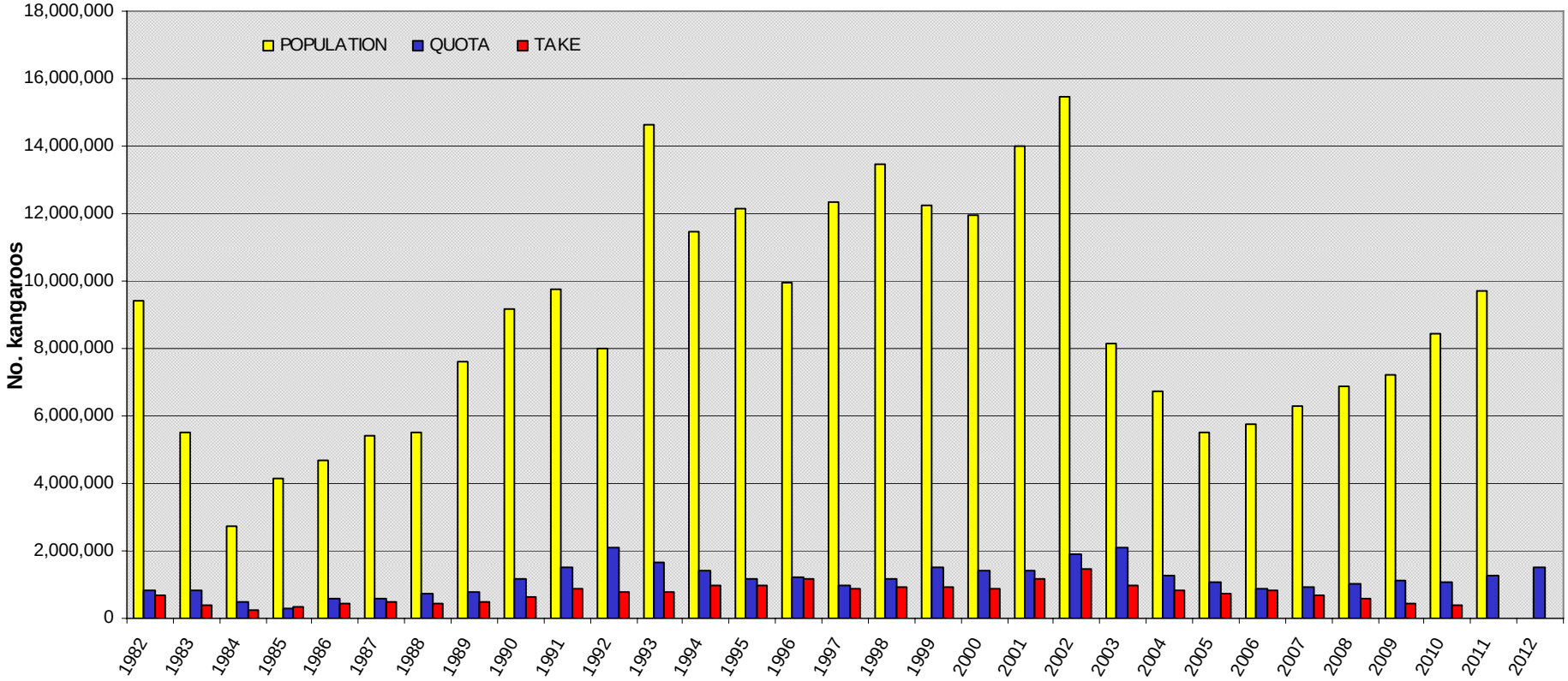


Figure 4. NSW red kangaroo quotas and take 1982-2012

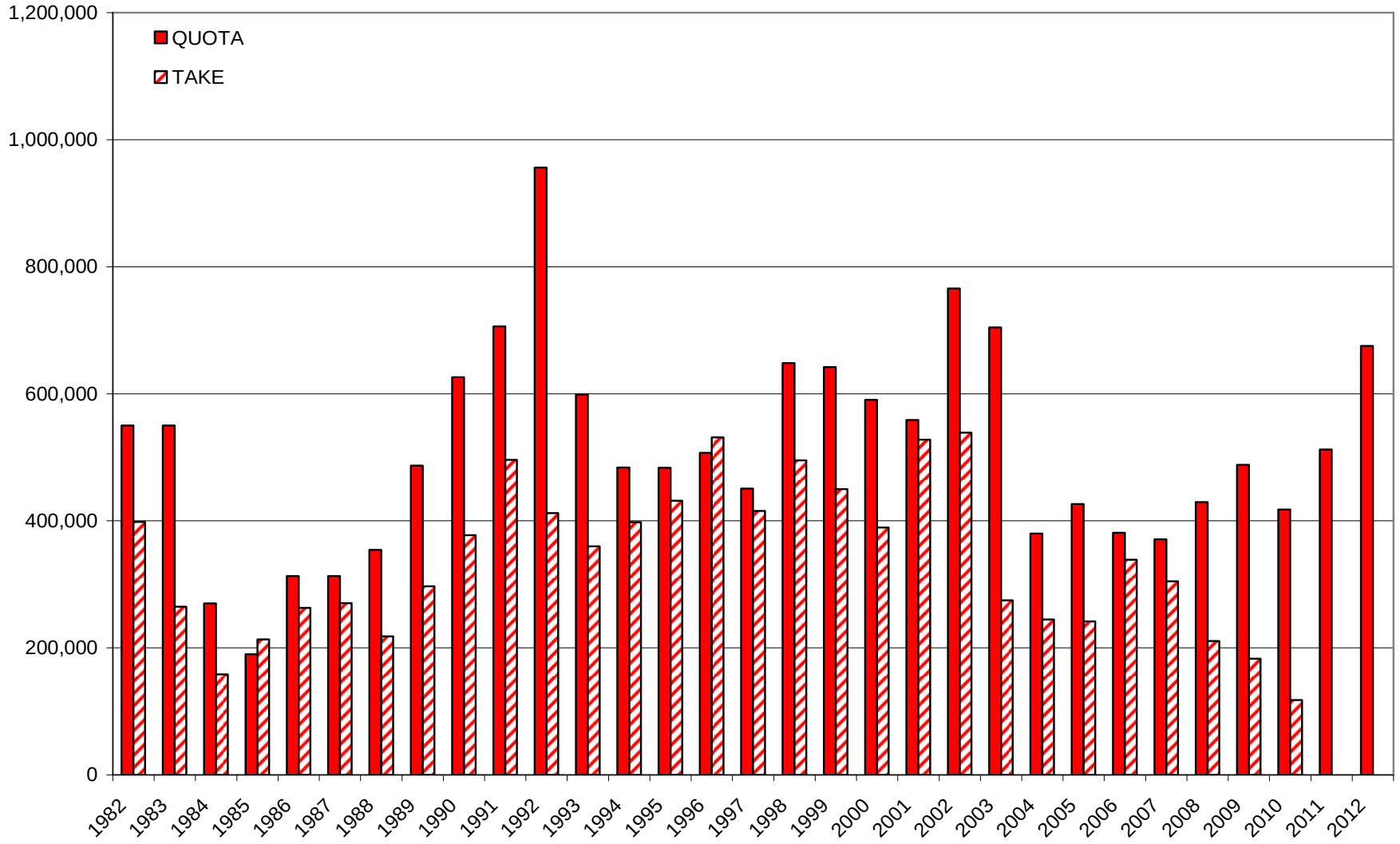


Figure 5. NSW eastern grey kangaroo quotas and take 1989-2012

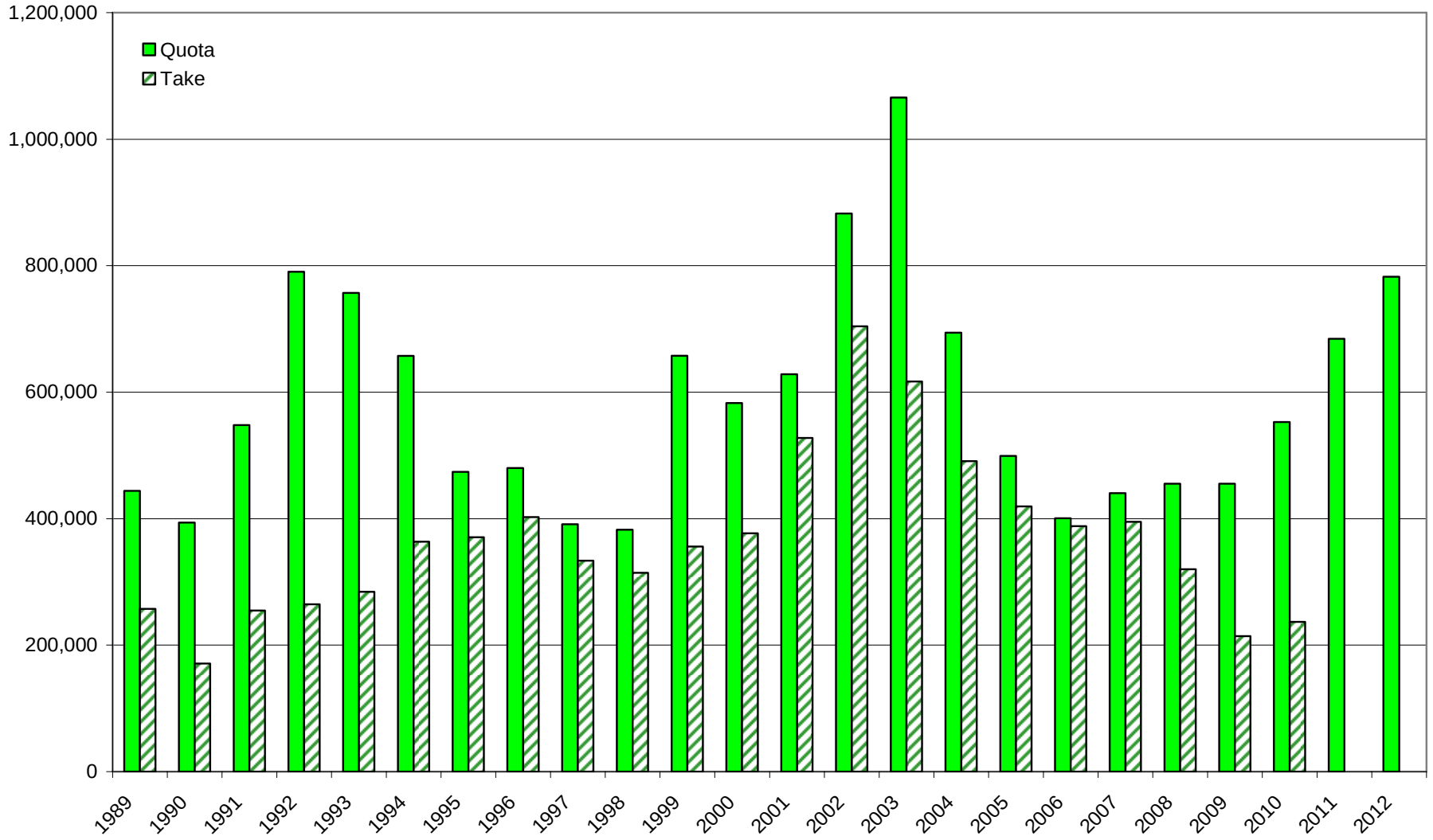


Figure 6. NSW western grey kangaroo quotas and take 1989-2012

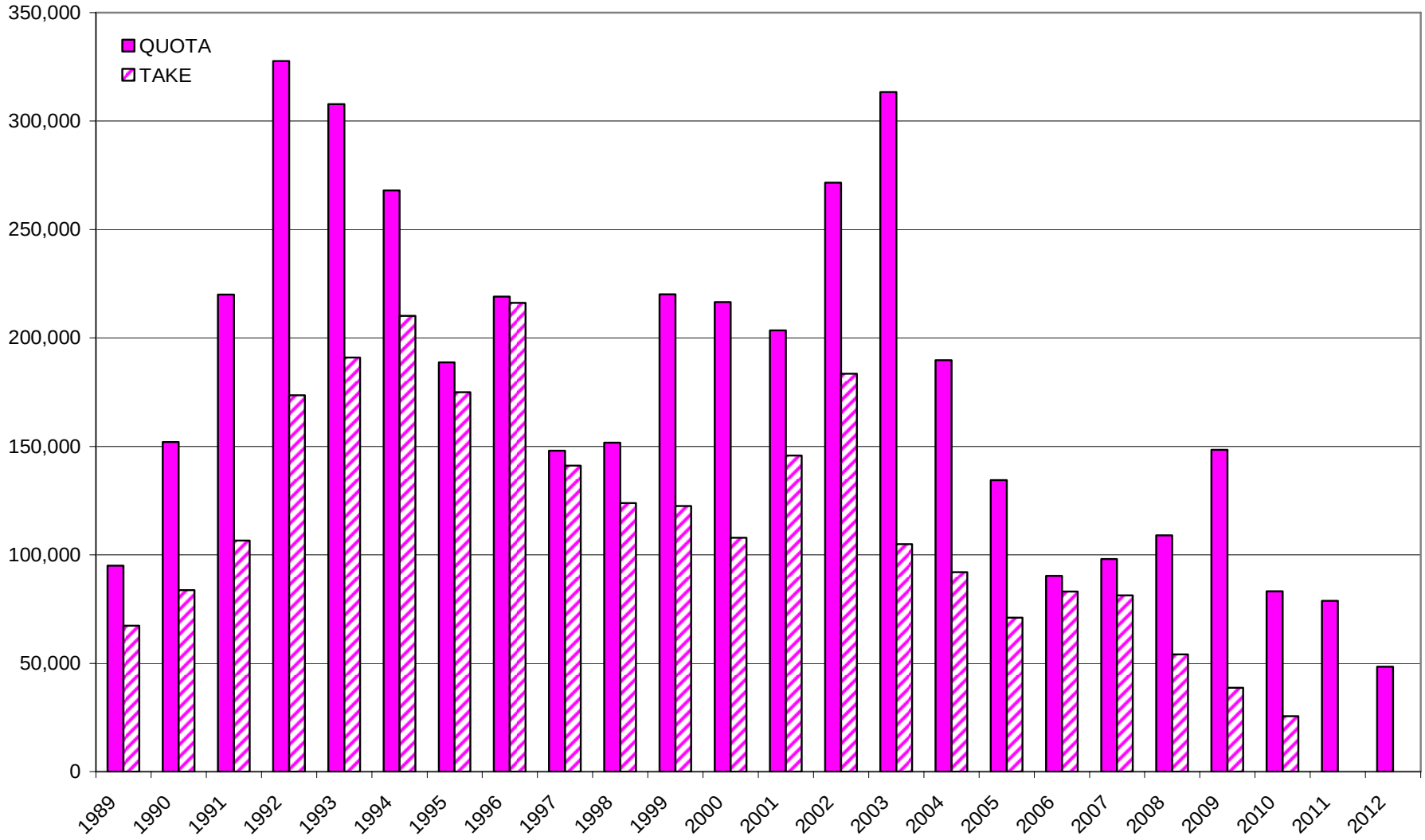
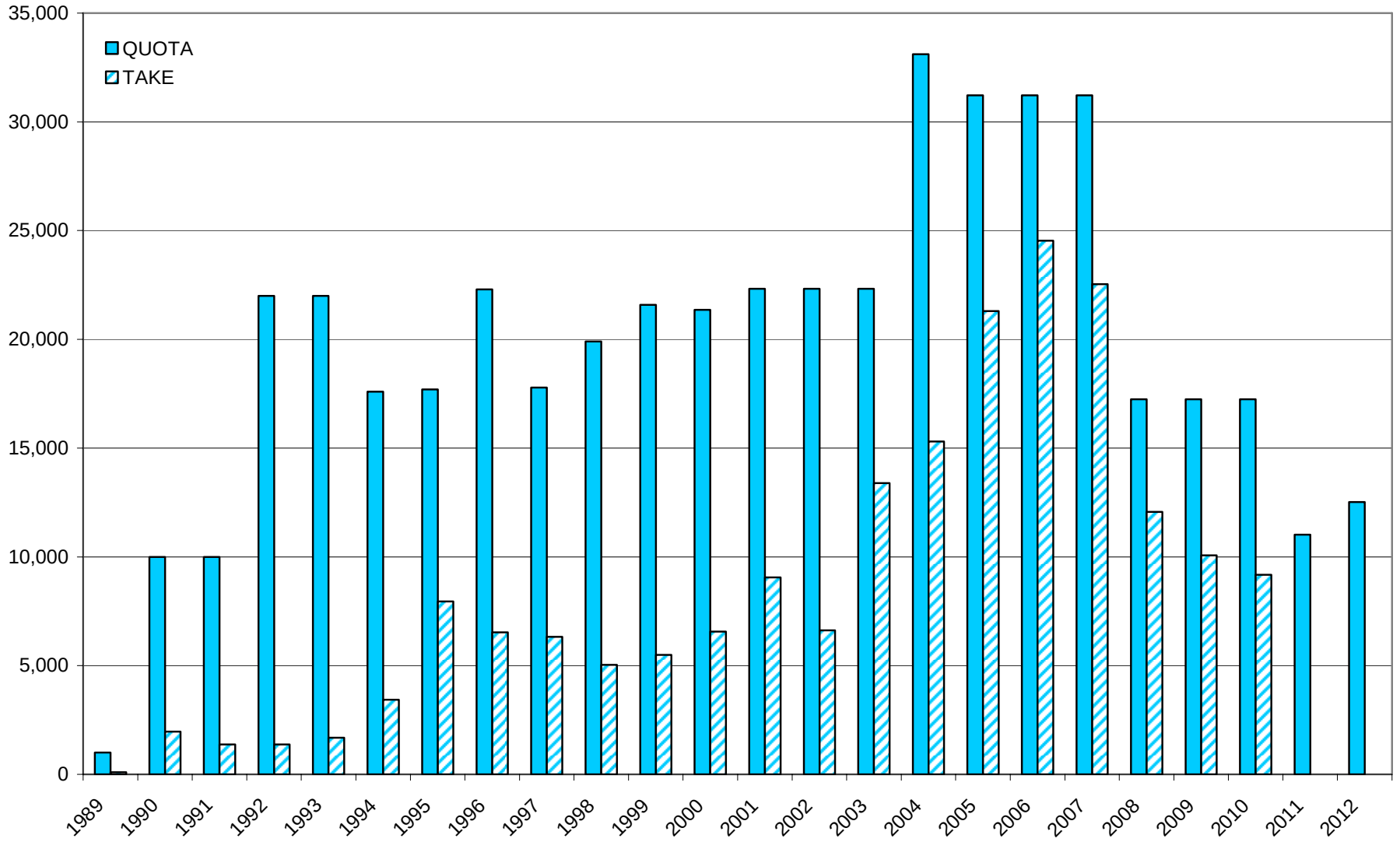


Figure 7. NSW wallaroo quotas and take 1989-2012



Appendix 2- Low population thresholds applicable for 2012

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, a statistical measure that indicates 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, while a large standard deviation indicates that the population varies more. Each species in each zone has it's 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 percent of the population rather than the usual 15 or 17 percent. Reducing the quota will assist 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.

Example 1: Reduced eastern grey kangaroo quota in the Lower Darling management zone for 2012.

The average density of eastern grey kangaroos in the Lower Darling management zone is 2.31 kangaroos per square kilometre. Threshold 1 is set 1.5 standard deviations below the average. Following the 2011 aerial surveys of the Lower Darling zone, the estimated population of eastern grey kangaroos had a density of **0.58** kangaroos per square kilometre. The density at **Threshold 1** is **0.72**, and the density at **Threshold 2** is **0.52**. The current density, 0.58, is lower than Threshold 1 but higher than Threshold 2, so the commercial quota will be set at 10 percent of the population for 2012.

Example 2: Suspended western grey kangaroo quota in the Lower Darling management zone for 2012.

The average density of western grey kangaroos in the Lower Darling management zone is 8.00 kangaroos per square kilometre. Threshold 1 is set 1.5 standard deviations below the average. Following the 2011 aerial surveys of the Lower Darling zone, the estimated population of western grey kangaroos had a density of **1.18** kangaroos per square kilometre. The density at **Threshold 1** is **2.09**, and the density at **Threshold 2** is **1.45**. The current density, 1.18, is lower than Threshold 2, so the commercial quota will be suspended for 2012.

The current population densities and thresholds are shown in Table 20. Orange shading shows which quotas are reduced and blue shading shows quotas that are suspended as a result of applying the thresholds.

TABLE 20: Average and current density estimates, and thresholds for quota reduction and suspension

Western Plains								
Western Grey								
zone	Tibooburra	Broken Hill	Lower Darling	Cobar	Bourke	Narrabri	Coonabarabran	Griffith
Average density	0.62	4.88	8	7.99	2.97		2.23	1.84
Threshold 1: 10% quota	0.24	1.61	2.09	3.18	0.85		1.19	0.68
Threshold 2: suspension of quota	0.18	1.18	1.45	2.44	0.60		0.99	0.51
2011 density estimate (kangaroos/sq km)	**0.19**	**1.21**	**1.18**	**2.49**	**0.61**		**1.80**	**0.65**
Eastern Grey								
zone	Tibooburra	Broken Hill	Lower Darling	Cobar	Bourke	Narrabri	Coonabarabran	Griffith
Average density	1.98	1.55	2.31	5.05	7.72	15.87	27.07	7.61
Threshold 1: 10% quota	0.69	0.22	0.72	1.79	1.86	6.46	11.75	3.04
Threshold 2: suspension of quota	0.52	0.13	0.52	1.33	1.26	4.98	9.21	2.33
2011 density estimate (kangaroos/sq km)	**0.74**	**0.76**	**0.58**	**1.87**	**1.72**	**18.68**	**15.90**	**4.87**
Red								
zone	Tibooburra	Broken Hill	Lower Darling	Cobar	Bourke	Narrabri	Coonabarabran	Griffith
Average density	18.84	15.16	5.55	4.79	5.85	4.97	4.49	3.82
Threshold 1: 10% quota	7.94	7.81	2.51	2.44	2.55	1.80	2.31	2.04
Threshold 2: suspension of quota	6.18	6.41	1.99	2.00	2.01	1.36	1.90	1.69
2011 density estimate (kangaroos/sq km)	**11.32**	**11.88**	**3.30**	**5.23**	**8.09**	**8.06**	**5.57**	**5.67**

Tablelands						
Eastern Grey						
zone	Armidale	Glen Innes	Upper Hunter	SE NSW	Central Tablelands North	Central Tablelands South
Average density	10.37	10.77	7.53	14.37	14.70	23.20
Threshold 1: 10% quota	4.71	4.85	3.32	6.42	7.07	10.79
Threshold 2: suspension of quota	3.63	3.74	2.59	4.93	5.53	8.36
2011 density estimate (kangaroos/sq km)	12.20	12.90	11.50	17.10	20.90	15.10

Note: "Average" for CT North and CT South is the one previous survey, undertaken in 2008

Wallaroo			
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
2011 density estimate (wallaroos/sq km)	2.50	1.50	1.00