

Aerial Surveys of Commercially Harvested Kangaroos and Wallaroos in Queensland

Aerial surveys

Since 1991 the Queensland government have conducted an annual program of aerial surveys by helicopter to directly monitor populations of the three large macropod species covered by the Wildlife Trade Management Plan for Export – Commercially Harvested Macropods – 2008-2012. This method employs line transect methodology (Buckland et al. 1993), which is significantly more robust to variations in sightability than standard fixed-wing methods and provides more accurate and precise population estimates (Clancy et al. 1997). A detailed description of the methodology employed in these surveys is provided in Clancy et al. (1997).

Surveys are conducted over 22 fixed monitor blocks, covering an area of 136,000 km² (Appendix 1) or 25% of the original fixed-wing survey area sampled by the Australian National Parks and Wildlife Service (ANPWS) between 1984 and 1992. In each helicopter survey block, between two to eight east-west running 50-90 km transect lines have been placed systematically 10 km apart. Sampling intensity within each block is approximately 2.5%.

The placement of the original ten of the 22 survey blocks used in this monitoring program was designed to provide appropriate coverage of representative densities of macropods over the core harvest area of 630,000 km² (Pople et al. 1998). In response to the introduction of regional management to Queensland in 2003, a further 12 survey blocks were added to provide broader coverage of the entire harvest area and to ensure all bioregions were sampled. Placement of these new survey blocks was optimised using fixed-wing survey data collected across the harvest zone during 2001. These surveys provided data to reassess the representativeness of the existing helicopter monitor blocks and to investigate alternative scenarios for future survey design. Analysis of these data in combination with harvest data has led to improved stratification of the survey area and hence increased the power to extrapolate data from survey monitor blocks to other regions in the harvest zone. These investigations were conducted in collaboration with the University of Queensland as part of the Australian Research Council (A.R.C.) funded ROOSPIRT Linkage project (Pople 2006).

No correction factors are applied to surveys of Eastern Grey Kangaroos and Red Kangaroos as comparisons of ground and aerial surveys conducted by Clancy et al. (1997) concluded that the helicopter line transect technique is both accurate and precise in determining population densities for both these species over a range of habitats, seasons and densities. Whilst the method is less accurate for Common Wallaroos, there are still close correspondences between the results of helicopter surveys and those of ground counts. Estimates derived from ground surveys for Common Wallaroo density are approximately 1.9-2.0 times that recorded for helicopter surveys. Accordingly, since 1998, the Queensland government have applied a conservative correction factor of 1.2 to the wallaroo density estimates derived from helicopter surveys.

Frequency and coverage of aerial surveys

Due to the costs and logistics associated with conducting helicopter aerial surveys over 22 monitor blocks, not all monitor blocks are surveyed on an annual basis. To ensure adequate coverage of the harvest area in Queensland and to enable accurate tracking of population trends, all blocks are surveyed at least once every 2 years. Decisions on the frequency and coverage of the aerial survey program were based on analyses completed by the University of Queensland as part of the A.R.C. funded ROOSPIRT Linkage project. This redesign of the monitoring program also sought to introduce a level of bioregional stratification to provide for improved potential to monitor populations at that scale as a possible prelude to the introduction of further harvest zones in Queensland.

The main feature of the current monitoring program is the establishment of pairs of closely correlated monitor blocks within each of the bioregions. The process of pairing monitor blocks was based on linear modelling that examined the relationships between macropod population densities, rainfall and harvest off-take for all monitoring blocks within each bioregion. The process of pairing blocks and the development and refinement of these linear models enables the frequency of monitoring of blocks to be reduced without compromising the efficacy of the monitoring program. Using this approach monitoring blocks with bioregional pairs will be monitored on a rotating basis with each block being subject to surveys every two years. Linear models utilising data on rainfall, harvest off-take and population rates of increase for the monitored block within a pair are then used to predict population changes in the unmonitored block of the pair. The models are refined annually as further data is collated and enhancements are made to the modelling process. In the situation where there is only a single monitor block within a bioregion or where a monitor block samples a unique macropod community, such as the Blackall block which contains moderate densities of all three species and particularly high densities of Common wallaroo, these blocks are sampled annually. In order to calibrate the models and to provide a benchmark of the states' macropod populations, a survey of the complete set of 22 monitor blocks will be completed every five years. Appendix 2 below summarises the current stratification, pairing and sampling frequency for all 22 of the fixed aerial survey monitor blocks used in the Queensland monitoring program.

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

Population estimation

Population estimates are calculated by extrapolating the mean monitor block densities to a larger harvest area of 795,000 km² for Eastern Grey Kangaroos, 890,000 km² for Red Kangaroos and 695,000 km² for Common Wallaroos. To improve precision and remove bias in density estimates used in the calculation of population sizes and their standard errors, the data collected since 2003 have been stratified by observer (Buckland et al. 1993) and bioregion. Helicopter surveys are conducted with two observers, which results in twice the sampling intensity as one observer. To account for differences between observers, the data is post-sampling stratified by applying 'goodness of fit' models to the data from each observer using the computer program 'Distance' (Buckland et al. 1993). 'Distance' is then used to obtain an overall macropod density estimate for the survey block. For Red and Eastern Grey Kangaroos, the survey blocks were stratified by bioregion, and their weighted (by sampling intensity) density estimates used to calculate population sizes for the harvest area according to the methods and calculations outlined in Clancy et al. 1994 and 1997. For Red and Eastern Grey Kangaroos, stratification of the data by observer and bioregion has not significantly changed the population size estimate but has reduced the standard error associated with that estimate. Common Wallaroo density is estimated for four density strata, based on historical (1986-2002) harvest density in grid squares (~2500 - 3000 sq km) within the Central Zone (Pople 2006).

Quota derivation

Sustainable harvest quotas are calculated using a fixed proportion of the estimated macropod populations within the Queensland harvest area. The proportions used vary between species and are adjusted across the harvest zone in relation to the margins of error present in population estimates. The maximum proportions used for each species are 15% of populations for Eastern Grey Kangaroos and Common Wallaroos and 20% of the population for Red Kangaroos. These maximum proportions are only applied to populations within the Central Harvest Zone where survey effort is greatest and hence confidence limits for population estimates are within acceptable limits. In both the Eastern and Western Harvest Zones more conservative harvest proportions of 10% for all three species are applied. These sustainable-use harvest proportions are based on research and modelling undertaken by Caughley et al. (1987) and Hacker et al. (2002) and are currently accepted by the scientific community, the Queensland Department of Environment and Resource Management and the Commonwealth Department of Environment, Water, Heritage and the Arts for determining state quota limits.

References

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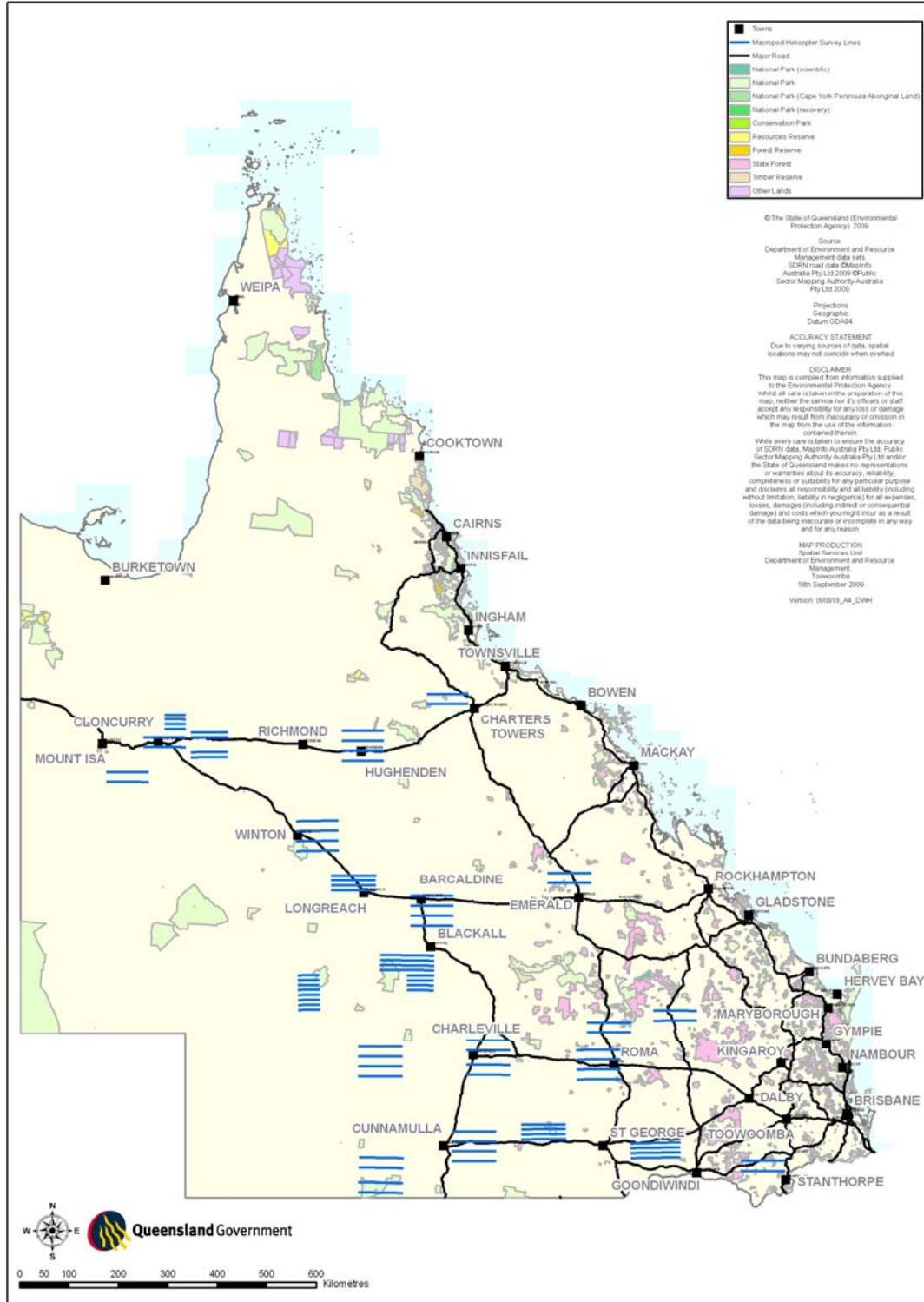
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Appendix 1. Macropod survey blocks

Queensland Macropod Survey Lines and QPWS Estate



Appendix 2. Stratification, pairing and sampling frequency for fixed aerial survey monitor blocks in Queensland.

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