Aerial Surveys of Commercially Harvested Macropods in Queensland

Aerial surveys

The first landscape scale aerial survey of macropods in Queensland was conducted by the Commonwealth Scientific and Industrial Research Organisation (CSIRO) in 1980. Annual surveys were then carried out by CSIRO/Environment Australia from 1984 until 1992. These early surveys were from fixed wing aircraft using strip transect methodology. Coverage of the pastoral zone was significant (approximately 500,000km²) but was limited to eastern grey and red kangaroos (Lundie-Jenkins et al. 1999).

Since 1991 the Queensland Government has conducted an annual program of aerial surveys by helicopter to directly monitor populations of eastern grey kangaroos, red kangaroos and common wallaroos. 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).

Originally 10 survey blocks were used in this monitoring program and were chosen to provide appropriate coverage over the core harvest area of 630,000km² (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 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.

Today annual aerial surveys are conducted over 22 fixed monitoring blocks, covering an area of 136,000km² (Figure 1). In each helicopter survey block, between two to eight east-west running 50–90km transect lines have been placed systematically 10km apart.

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 is still a close correlation 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 applied a conservative correction factor of 1.2 to the wallaroo density estimates derived from helicopter surveys. In 2011 this conservative correction factor was revised to 1.85 in line with that used in New South Wales and consistent with ground survey data collected from the Longreach area in 2010.

Frequency and coverage of aerial surveys

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

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, blocks with bioregional pairs are monitored on a rotating basis with each block being subject to surveys every two years. Linear models based on 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. 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 is completed every five years.

Table 2 summarises the current stratification, pairing and sampling frequency for all 22 of the survey monitor blocks used in the Queensland monitoring program.

Due to the significantly lower macropod harvest in the eastern and western harvest zones, they 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 the fixed-wing aerial surveys conducted over parts of these zones between 1980 and 2001.

Population estimation

Population estimates are calculated by extrapolating the mean monitor block densities within population estimate regions (Figure1) to a larger harvest area of 895,824km² for eastern grey kangaroos, 1,006,876 km² for red kangaroos and 766,613 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.

Quota derivation

Sustainable harvest quotas are calculated using a fixed proportion of the estimated macropod populations within the Queensland harvest zones. 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 Government and the Commonwealth Department of the Environment.

Figure 1. Macropod survey blocks and population estimate regions in Queensland.

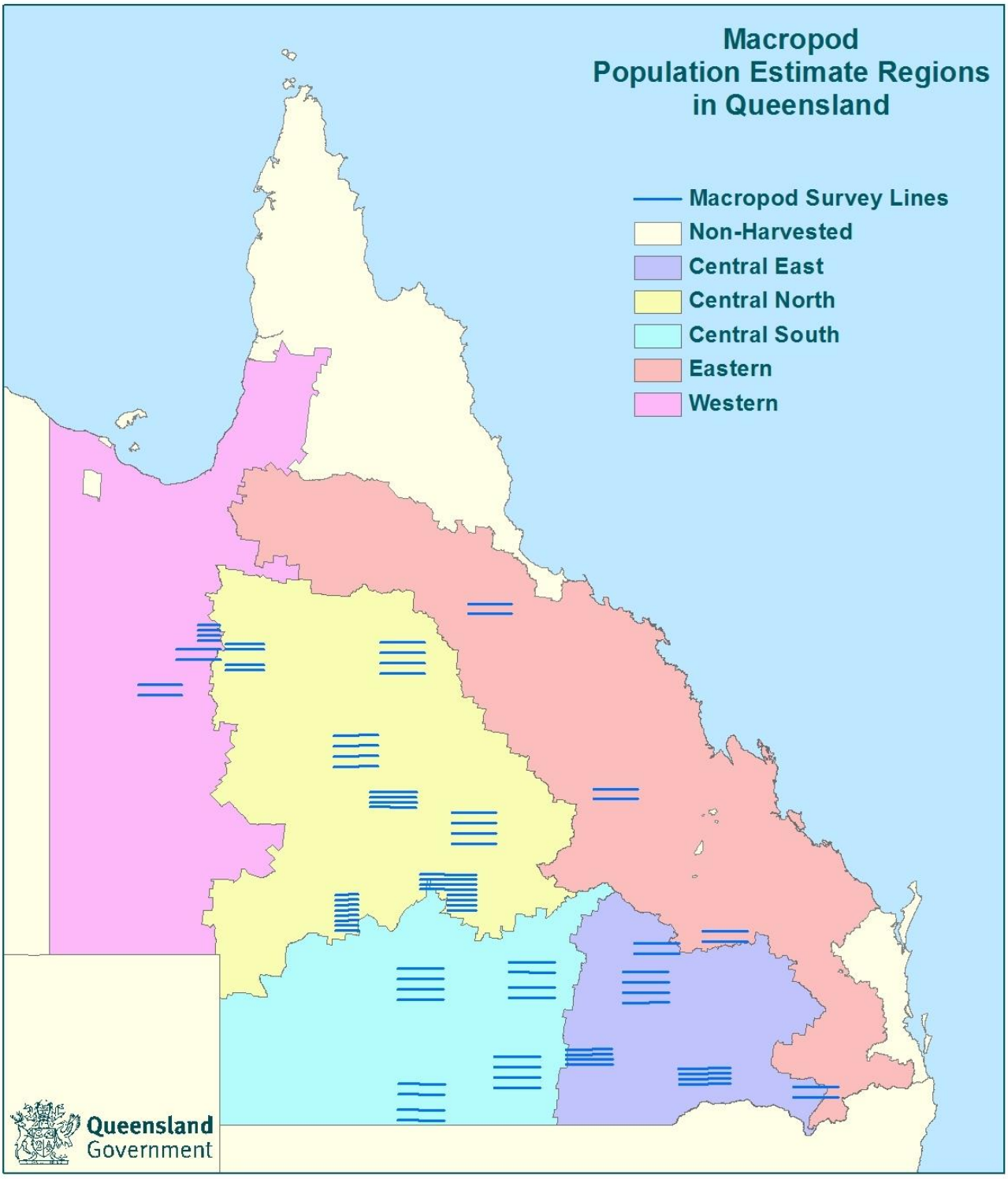

Table 1. Stratification, pairing and sampling frequency for fixed aerial survey monitor blocks in Queensland.

Harvest zone	Bioregion	Monitor block	Years 1 and 3	Years 2 and 4	Year 5
Central	Brigalow Belt South	Injune	✓		✓
		Taroom		✓	✓
		Westmar	✓		✓
		Roma		✓	✓
	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	✓		✓

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