Camel Populations in Central Western Australia Determined from Aerial Surveys

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ABSTRACT

Standard aerial survey techniques were used to conduct a broad scale camel survey of a portion of central Western Australia between 3 August and 9 August 2005. The area surveyed covered an approximate 67,000 km^2 in transects 400km long and 11km apart. One third of the area surveyed was over pastoral land north east of Wiluna and the remainder was undisturbed desert. Total camel numbers were extrapolated to 238,000 for Western Australia at a density of 0.17/ km^2 after being corrected for survey operator perception bias. The pastoral leasehold area surveyed contained about 10% of the camel numbers with densities in the pastoral zone of 0.05/km^2 and desert area of 0.23/km^2. The variation in these figures is most likely due to a combined effect of camel culling by pastoralists in the preceding couple of years and the possibility that parts of the pastoral area are no longer suitable habitat. Glenayle station in the middle of the survey area reported culling 1287 camels in the previous three years (about 400/year). Dry summers leading up to the survey had driven camels out of the desert onto pastoral lands. Pastoralists were able to capitalise by culling camels for the pet meat industry. As a result of culled numbers extrapolating data from this survey is likely to result in an underestimate of the camel population for Western Australia.

Introduction

The Arabian camel (*Camelus dromedarius*) was introduced into Australia in the 1840s to assist with transport and for exploration of inland Australia (Pest Animal Control CRC 2005). Between 10,000 and 20,000 were imported from India until 1907. It is likely that some escaped and others were released into the wild once they were no longer needed. The early population of feral camels remained small and scattered until the wholesale abandonment of domesticated camels in the 1920s and 1930s (Edwards et al 2004). Early surveys conducted across the Northern Territory, South Australia and Western Australia set base line populations for Camels (Short et al 1988). More recent surveys in the Northern Territory used the earlier survey results to show growth trends in camel populations and set a minimum figure of 300,000 camels for Australia in 2001 (Edwards et al 2004). Current estimates are indicating feral camel numbers as high as 600,000 for Australia (Jackson 2005).

Camels are highly suited to the dry remote areas of central Australia and they have adapted well. Camels are free ranging, non-territorial and are able to travel up to 70km per day. They are essentially browsers and can feed on more than 80% of the available plant species (Dorges and Heucke 2003, Edwards et al 2004). The populations are relatively disease free, have no natural predators and an adequate food supply suggesting that there have been few limiting factors for growth of camel populations in Australia (Dorges and Heucke 2003). Caughley and Sinclair (1994) in their work on feral camel population dynamics reported that during the period 1966-2001 camels appeared to have been following an active growth trajectory typical of an establishing population. The rate of population increase reported by Edwards et al (2004) show that the camel population is increasing at about 10% per year with a doubling of the population every 8 years. This is of major concern given that once camel densities exceed about 2 per km^{-2} serious damage to vegetation can occur (Dorges and Heucke 2003). Much of his study area in the Northern Territory had camel densities equivalent or greater than this level.

This pilot camel survey aimed to determine:

- A baseline number for camels for the surveyed region of Western Australia
- A comparison of population levels between pastoral leases and undisturbed desert areas.
- The distribution of camels within the study area

Methods

Survey Area

The survey area was selected to utilise Lorna Glen station in the Northern Goldfields as the centre of operations as this had a good airstrip and adequate facilities. The study area covered 67,700 km^2 and extended from longitude 120^o.00E to 124^o.00E with transects placed east-west and 6 degrees latitude apart (See figure 1). Transects were 400km in length and the survey area was split in half for logistical and operational reasons. This was split on longitude 121.30^o making the west portion of each transect 150km long and the eastern portion 250km. Lorna Glen was located on the southern boundary of the survey area requiring increasing lengths of ferry flights to reach the start of each new transect. Counting was done between the hours of 9:00am and 3:00pm and flights were timed such that ferry flights could be done prior to or after these times to maximise the days activities. To compare camel densities between pastoral land and desert areas one third of the survey transects were located across pastoral land and the rest was over natural undisturbed desert.

Aerial Survey

The aerial survey methods developed for surveying kangaroos and other wildlife populations (Eg Caughley and Grigg 1982, Pople et al 1998) has been adopted and used as a standard method for Camel census (Edwards et al 2004). A Cessna 210 high wing aircraft was used and fitted with radar altimeter and GPS (Global Positioning System). The survey was conducted at a height of 250 ft (76m) at a ground speed of 100kts (185 km/hr). Transects of 200m width on each side of the aircraft were delineated by a rope attached to specially fitted wire struts. The position of the rope was calibrated on the ground for each observer from tables and functions constructed for the purpose. The marker ropes were checked to confirm accuracy once airborne against two markers set 200m apart on the airstrip.

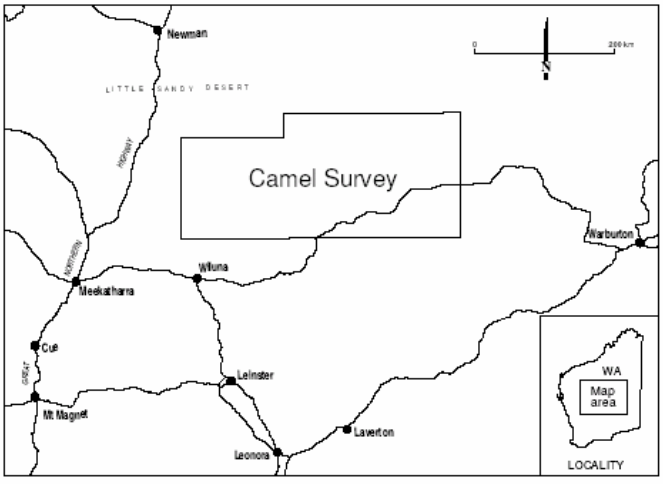


Figure 1: Map of survey area

The flight crew consisted of pilot and three observers seated in the front right, rear right and rear left positions. The observers were rotated each flight and the tandem right observers counted the same transect independently. Species counted included camels (*Camelus dromedarius*), goats (*Capra hircus*), red kangaroos (*Macropus rufus*), horses (*Equus caballus*), donkeys (*Equus asinus*), emus (*Dromaius novaehollandiae*), bustard (*Ardeotis australis*), dingo (*Canis lupis dingo*) and cats (*Felis catus*), which were recorded onto data sheets designed for the purpose. Notes on flight path direction, temperature (^{o}C) and visibility were taken at the time of measurement. The protocol for this technique requires counters to count for 97.5 seconds followed by a 7 seconds gap where data was recorded onto prepared data forms. A timing device was used and set so that an audible buzz marked the end of the count period and was continuous for the 7 seconds gap. The 7 seconds recording time gave a 360m gap between cells where no recording was done. In the 16 transects a total of 2196 cells were measured (1098 each side). Each counting period is equivalent to 1km^2. For camels, individual numbers and group size was recorded.

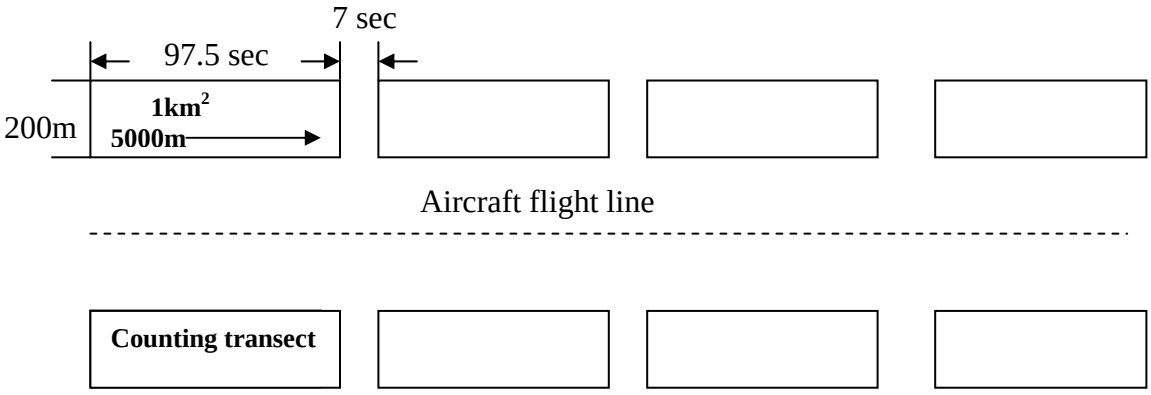


Figure 2: Schematic diagram of aerial strip-transects

Results

The aerial survey data collected for camels was analysed using the procedure set out by Edwards *et al* (2004) and the data were corrected for operator perception bias (that is for animals that were there but missed by the observer). This was done through correction factors calculated from tandem counts done on the right hand side. The mean group size was 4.71 (± 0.98 s.e.) camels and correction factors 1.23 for right transect and 2.45 for the left. The combined data gave a corrected camel density of 0.17/km^2 (pastoral zone 0.05/km^2 and desert area 0.23/km^2).

The performance and consistency of the observers was checked to compare results of the front and rear counters of the right hand transect. These data were analysed with a two sample t-test at $p<0.05$ and showed no significant difference between counters although the variability increased with some combinations.

The calculated population for the study area, after correction factors were applied, was 11,509 camels. This was then extrapolated by taking the corrected density and applying it to the known distribution area for camels in Western Australia and for Australia, which were determined from earlier surveys and used by Edwards *et al* (2004). This calculation determined a population of 238,000 for Western Australia and for all of Australia at 476,000.

One third (34%) of the survey area was pastoral leasehold land and contained only 10% of the camels. Rainfall through the area in July (37.6mm measured at Lorna Glen station, 57.4mm at Carnegie, and 68.2mm at Glenayle) provided some surface water in remote desert areas and camels were able to disperse.

Discussion

The camel density determined by this survey (0.17/km^2) was about half that determined by Edwards et al (2004) survey for the Northern Territory (0.31/km^2). He used results of earlier surveys to determine a minimum figure of 300,000 camels for Australia, whereas this survey is the first attempt at establishing some baseline data on camel numbers for Western Australia. In this we can only draw comparisons with surveys from other states. A number of studies undertaken throughout Australia to more accurately determine feral camel populations produced a range in estimated population (Table 1). From these other surveys, Edwards et al (2004) determined camel populations to have increased at a mean annual exponential rate of r=0.093 between 1993 and 2001. If this value is applied to the 1993 population estimate (NT Conservation Commission, 1994) and adjusted for each year this returns a current population estimate of 486,000 camels, which is close to our estimate of 476,000. This however does not take into account any variation due to seasonal conditions. The study area consisted of 34% pastoral leasehold land and the remainder was natural undisturbed desert, which has no tenure and is vacant unallocated crown land. Only 10% of the camels were recorded on the pastoral area and this is likely to be due to culling by pastoralists and dispersal following rainfall across the survey area in the month prior to the survey. It is also likely that after 70-100 years of grazing by domestic stock parts of the pastoral area may now be unsuitable habitat for camels and that once water supplies are available elsewhere they will move away into undisturbed desert to more productive areas.

Table 1

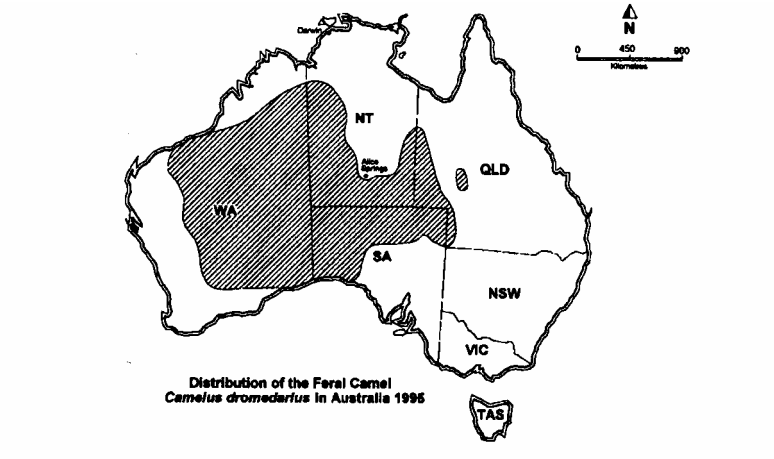
Study Area	Year	Estimated Population	Estimated Australian Population	Reference
NT, SA & WA	**1966**		**15,000 – 20,000**	**McKnight (1966)**
Western Australia	**1972**	**Distribution only**		**Long, (1988)**
Northern Territory	**1979**	**3,000 – 6,000 (NT)**		**Letts, (1979)**
Australia	**1976**	**Distribution only**		**Murray *et at* (1976)**
Northern Territory	**1986**	**31,570 (NT)**	**100,000**	**Graham *et al* (1986)**
Australia	**1988**		**> 43,000**	**Short *et al* (1988)**
Northern Territory	**!994**	**60,000**	**200,000**	**NT Conservation Commission (1994)**
Northern Territory	**2001**	**80,533**	**300,000**	**Edward *et al* (2004)**
South Australia	**2005**	**16263**	**716,900**	**Peeters *et al* (2005)**
Western Australia	**2005**	**238,000**	**476,000**	**Ward *et al* (2005)**
Western Australia	**2006**	**364,000**	**728,000**	**Ward *et al* (2006)**

(Adapted from: Kevin Ellard, (2000) Agriculture Western Australia)

There is a likelihood that this survey may have underestimated the true potential camel density due to camel culling by pastoralists within the survey area. In the 12 months leading up to the survey harsh drought conditions forced camels out of the desert onto pastorals lands where permanent water could be obtained. Pastoralists were able to utilize the high camel numbers by culling and selling them to the pet meat industry. This commercial outlet provided a method of offsetting the cost of the culling operations, although it was dependent on the availability of commercial shooters and freezer trucks (Norma Ward, Millrose Station, 2005 personal communication). Record keeping of camel culling was quite variable amongst the stations, ranging from no records to meticulous data. Glenayle station in the middle of the survey area reported taking 1287 camels over the preceding 3 years. Survey results have most likely been affected by the combined effects of camel culling and dispersal of camels from a rainfall event prior to the survey. It may be reasonable to take the camel density from outside of the pastoral area and apply this to the known distribution area to give a number of camels for Australia. This estimates a density of 0.23/km^2 or a population of 644,000 for Australia, which is close to figures reported by Woodford (2002) and Jackson (2005). Table 1 show a survey conducted in the Victoria Desert by the Department for Environment and Heritage in South Australia, which returned a mean density for camels of 0.256/km^2 producing an estimated camel population of over 716,000 for Australia. It is likely that camel densities are going to vary greatly from place to place depending on the suitability of the land and number of permanent water sources.

Feral camel populations in Western Australia regularly move between the western deserts and the fringing pastoral properties to the west. This occurs mostly during dry periods to utilise water supplies (Ellard, 2000). The pastoral properties that line the edge of the desert takes the brunt of the camel encroachment, however, many pastoral properties further west in the shires of Wiluna, Meekatharra and Laverton also report camels. To

determine the distribution of camels for Western Australia, groups such as the Rural Industries Research and Development Corporation undertook mail out surveys of pastoral properties. Similar methods have been employed to determine camel distributions for all of Australia (Figure 3)



(Source: Peter Seidel (2000), Arid Zone Research Institute, Northern Territory)

Figure 3: Distribution of feral camels determined in 1995

A summary of camel populations from previous surveys (Table 1) show an upward trend in numbers from 15,000 in 1966 to over 700,000 in 2005. It is evident that camel populations are still increasing and following an active growth trajectory similar to that of an establishing population (Caughley and Sinclair 1994, Edwards 2004). Increasing numbers are likely to have serious impacts on vegetation, which is shown to be the case when numbers exceed about 2 per km^2 (Dorges and Heucke 2003). The group size for this survey averaged 4.71 camels and is similar to that reported by Edwards (2004) of 4.55. In some areas of camel concentrations these groups already exceed the densities recognised as causing damage to vegetation.

Camels were observed in most areas across the survey area and appeared to have a preference for wash areas that contained trees and shrubs and around clay pans. Only a few were seen on open spinifex plains that were probably being traversed between water sources and more productive feeding areas.

It is likely that camel distribution will expand with increasing numbers and may well have done so already since the 1995 mapping exercise. Factors that affect camel distribution include the physical environment and control measures by man (Ellard 2000). Camels range widely over sandy areas but avoid wet or very rocky regions. This is supported by the distribution patterns in Western Australia where camels do not extend far into the rugged regions of the Kimberley but do extend south onto the Nullarbor and as far as Esperance on the south coast (Ellard 2000).

CONCLUSIONS:

- A baseline number of camels for the surveyed region of Western Australia was calculated to be 11,509 at a density of 0.17/km^2 This may well be an underestimate due to the impact of recent culling by pastoralists and rainfall impacts.
- The data when extrapolated to the known distribution of camels in WA resulted in a WA population estimate of 238,000
- A comparison of population levels between pastoral leases (one third of the survey area) and undisturbed desert areas showed pastoral areas contained only 10% of the camels (density of 0.05/km^2).
- Camels were widely distributed over the study area with a preference for wash areas that contained trees and shrubs and areas around clay pans.

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