A broad scale aerial survey of the feral camel population in the South Kimberley region of WA

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ABSTRACT

A broad scale aerial survey of feral camels was conducted in the north-eastern portion of the Great Sandy Desert and western portion of the Tanami Desert in the south Kimberley region of Western Australia over the period 12th to 20th May 2009. The area surveyed covered approximately 42,700 km^2 in transects 270km long and 9.3km apart. About 44% of the area surveyed was over pastoral land and the remainder was unallocated crown land and Aboriginal reserve. The number of camels in the survey area was estimated to be 3772 at an overall density of 0.088camels/km^2 (corrected). The pastoral lands contained a significantly lower camel density than other land uses with densities being 0.02camels/km^2 and 0.12camels/km^2 respectively. The lower density in the pastoral lands is most likely due to harassment by humans and other livestock and programmed or frequent opportunistic shooting. Vegetation deemed highly suitable for camel habitat appeared to have had little or no camel activity suggesting camel density was naturally low in this area for other reasons, perhaps related to environmental factors.

INTRODUCTION

Broad scale aerial survey techniques which have been developed to monitor kangaroo and other wildlife populations remains the only practical method for large scale surveys in remote areas. The aerial survey method adopted from Edwards et al (2004), Axford et al (2002), Ward et al (2005) and others has become the established way to assess the abundance of feral camels and utilizes a double count method. Previous surveys in other parts of central Australia have indicated a dramatic increase in feral camel numbers in recent decades prompting various state and federal government agencies, NRM, pastoral and Aboriginal groups to come together to find a ways of managing this emerging environmental issue. The major concern with increasing numbers is that at high densities feral camels can cause detrimental impacts on native vegetation and other biodiversity values as well as causing damage to infrastructure on pastoral leases and remote communities. Understanding patterns of density and distribution is necessary to quantify the magnitude and extent of the problem and to assist with developing control measures and with assessing management effectiveness.

The Department of Environment and Conservation (DEC), assisted by the Department of Agriculture and Food (DAFWA), Newcrest Mining (Telfer operation) and AngloGold Ashanti, have conducted a series of strategic broad area aerial surveys of feral camels across the major bioregions of central Western Australia (Burrows 2008). These surveys primarily targeted the area beyond the pastoral zone where a gap in knowledge was apparent, and were designed to build an understanding of patterns in camel density, distribution and habitat utilization. These surveys showed that camels are unevenly distributed, or clumped in the landscape, an important finding that will help in designing control programs and identifying ecosystems most at risk. This current survey is the sixth in the series to sample the arid interior and specifically aimed to determine camel density and distribution for the north-eastern Great Sandy Desert and western portion of the Tanami Desert in the south Kimberley.

METHOD

The Great Sandy Desert bioregion covers an area totaling 405, 200 kms^2 within Western Australia and Northern Territory, with approximately 75% of the bioregion within Western Australia. The bioregion includes extensive sand plains, dune fields, lakes and remnant rocky outcrops. The climate in the north of the bioregion is arid tropical and grades into a temperate-tropical zone in the south. Rainfall is influenced by summer monsoonal patterns of the tropics in the north. Seasonal and annual rains are extremely unpredictable. There is a general pattern where a particular year may have above average rainfall alternating with longer drought periods. The annual average rainfall is generally between 200-240 mm across the bioregion. Average daytime temperature ranges between 20° C and 40.6° C (Bureau of Meteorology website 2009). The Great Sandy Desert bioregion lies within the Eremaean Botanical Province (Beard, 1990) and is predominately desert hummock grassland, low woodland and shrubs.

The first survey line (line 1) commenced at latitude 19^{o}10’S; longitude 125^o 30’E, and proceeded due east for 270km to longitude 128^o 09’E. Eighteen parallel lines were flown at a spacing of 5’ (9.3km), giving a survey area of 42,700 km^2. In addition to the main survey, a survey was undertaken to the west, following a paleo-drainage system that extends from Lake Gregory to the coast near Mandora (Sandfire flat). It was thought that this drainage system could provide a habitat corridor that would allow camels access to the coast. A distance of 480km was traversed to the coast and apart from some scattered clay pans associated with the drainage system the country was mostly inhospitable, low quality camel habitat comprising spinifex-covered sand ridges and sand plains.

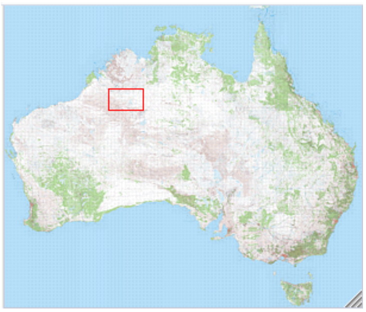

Figure 1: Survey location

A standard aerial survey technique that has been developed to assess camel density and distribution was used on this and all previous surveys. The survey used two assessment methods; a double count method (Edwards *et al* 2004) and distance sampling (Buckland et al 1993 and Lethbridge 2007). A Cessna 210 aircraft fitted with radar altimeter and GPS (Global Positioning System) was used for the survey, which was conducted at an altitude of 250’ (76m) above ground and at a ground speed of 100 kts (185 km/hr).

Although two methods were used, only the results of the double count method are reported here and the distance sample analysis will be used to compare both procedures at a later date. Strips 200 m either side of the aircraft were used for the double count method and were delineated by cord attached to specially fitted wire struts. The 200 m strip was “zone 1” in the distance sample method. Distance sampling used 4 zones (figure 2) being; zone1 (200m), zone 2 (300m), zone 3 (400m) and zone 4 (from zone 4 to as far as observers could see to the horizon). The width of the zones was adjusted following a previous survey and analysis of results which suggested that zone 1 should be further out from the aircraft and all zones should be wider (Ward 2007).

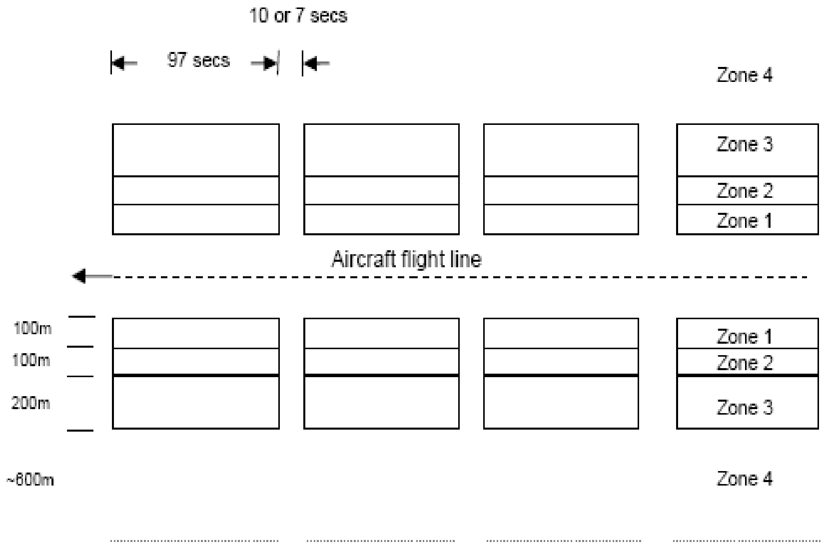

Figure 2: *Viewing zones utilized for camel density assessment with zone 1 used in the double count method and zones 1 to 4 in the distance sampling method. Source Lethbridge (2007)*

The position of the cords were calibrated on the ground from functions determined by Lethbridge (2007) and were checked for accuracy once airborne against markers set at 200m, 300m and 400m along the airstrip.

The flight crew consisted of a 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*), horses (*Equus caballus*), donkeys (*Equus asinus*), dingo (*Canis lupis dingo*) and cats (*Felis catus*), which were recorded onto data sheets designed for the purpose and camel data were captured using GPS linked electronic keypads. Notes on flight path direction, ambient temperature (^oC) and visibility were taken at the time of sampling. The protocol for this technique requires counters to count for 97.5 seconds followed by a 7 seconds gap when backup data were recorded onto prepared data forms. Each counting period is equivalent to 1 km^2 sampling area for the double count method. A timer was used so that an audible buzz signalled the end of the count period and was continuous for the 7 seconds gap. The 7 seconds recording time gave a 360m gap between sample cells where no counting was done. For camels, individual numbers and group sizes were recorded.

Data Analysis

The data analysis follows that of Edwards (2004) and uses data from groups of camels recorded from the front and rear right hand observations to develop correction factors for perception bias. The tandem counts of groups of camels were classified as;
S_f = seen by the front observer and missed by the rear.
S_r = seen by the rear observer, missed by the front.
b = seen by both observers

The steps to determine population estimates and their precision were;
1. Calculate the mean group size with its precision (V_g = standard error/mean)
2. In each transect calculate the total number of camel groups sighted by both the left and the combined right hand team.
3. From (1) and (2) above calculate the camel numbers for left and right sides for each line.
4 Calculate the correction factors for perception bias for combined right observations pooled across transects for the entire survey and its approximate precision.
5. Calculate the correction factor for left observations.
6. Apply correction factors to (3) above to obtain number of animals.
7. Sum the corrected number of animals from each transect
8. Apply the ratio method to obtain an estimate of population.
9. Calculate the precision of the population estimate

See Edwards *et al* (2004) for a detailed description of the analysis procedure.

RESULTS

The survey of 42,700km^2 contained an estimated 3772 camels at a mean density of 0.088camels/km^2 corrected for perception bias and with a precision value of 3.3%. This is a relatively low density and is consistent with other camel populations on the extremes of the distribution range. The camel group mean size was 4.12camels ±0.142 with groups varying in size from 1-21 camels, however there were only few large groups, one of 10 another 12 and one at 21 with the remainder between 1 and 5. Correction factors to account for perception bias were determined to be 1.4 for the starboard observers and 2.12 for the port observer. The correction factors had a precision of 6.4%. Camels were sparsely scattered through out the survey area with around a 6 fold reduction in density in the pastoral lands.

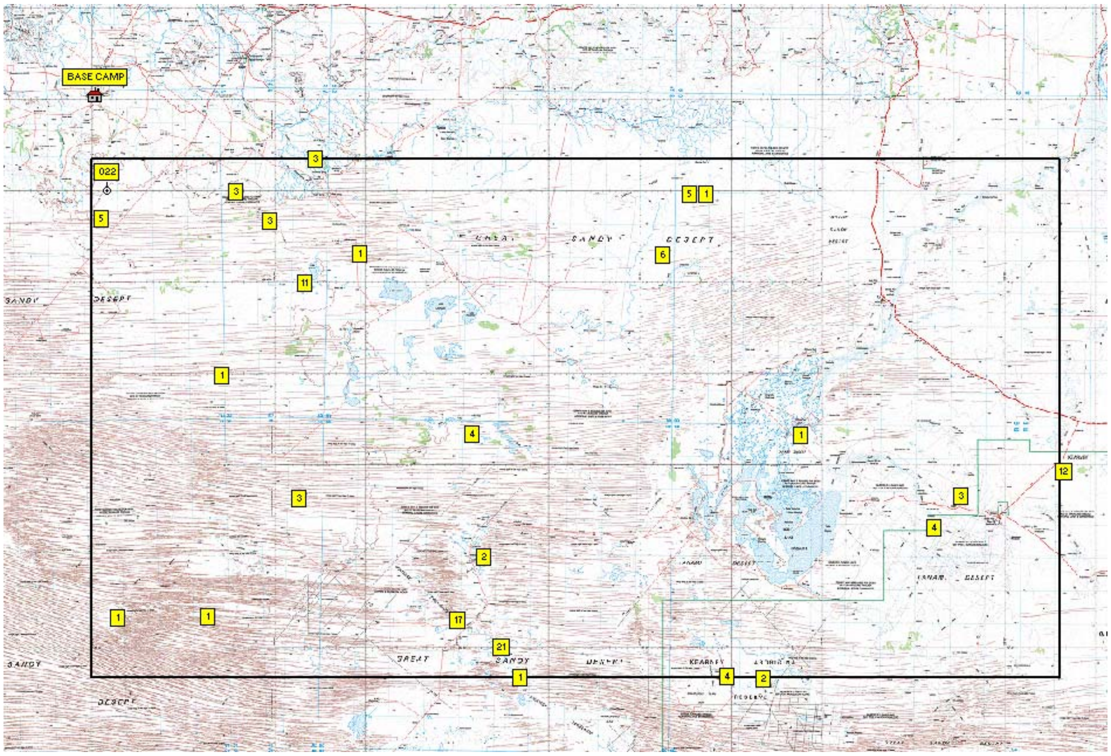

Figure 3: Camel distribution within the survey area. Numbers within the boxes indicate camel group size

An additional transect line to the coast utilized an extension of line 7 directly west which cut the paleo-drainage line twice - once at Dragon soak and the other on the northern edge of the marsh at Sandfire flat. Most of this line was well away from the drainage line (up to 20km) and resulted in a low camel density of 0.18camels/km^2. The return transect followed the drainage line and returned a much higher density of 0.65 camels/km^2. Camel density reduced with distance from the coast until it matched the survey density.

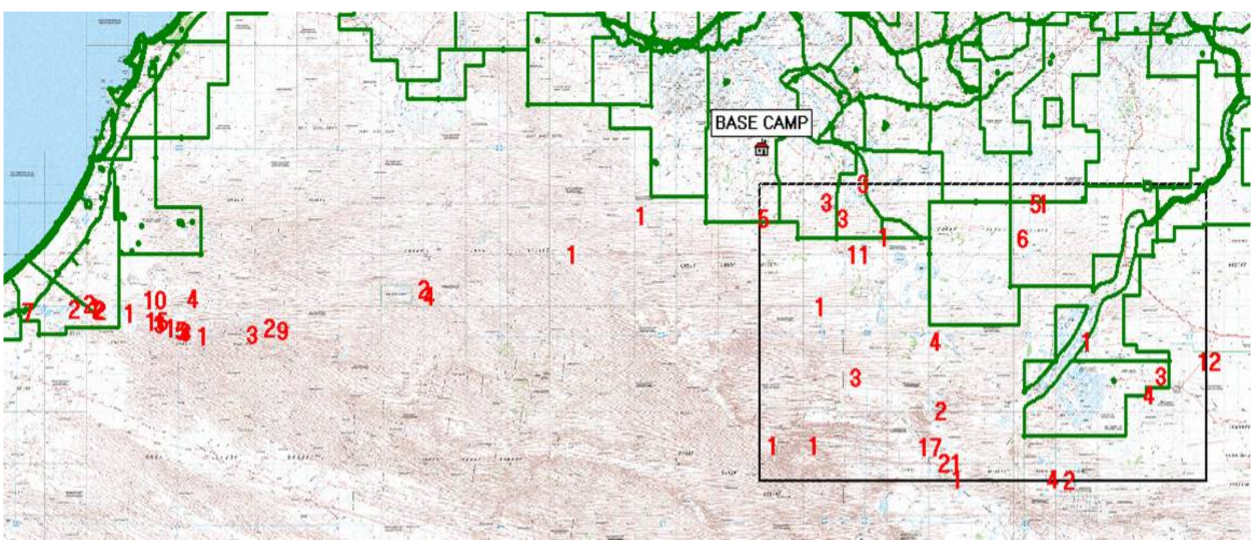

Figure 4: showing a survey line through to the coast from the survey area and the extent of pastoral land within the survey area

There was a large rainfall event in the months leading up to the survey (Figure 5) however this also corresponds with high evaporation rates which are double the rainfall. Pools of water are ephemeral however some of the lakes and water courses contained some water at the time of the survey.

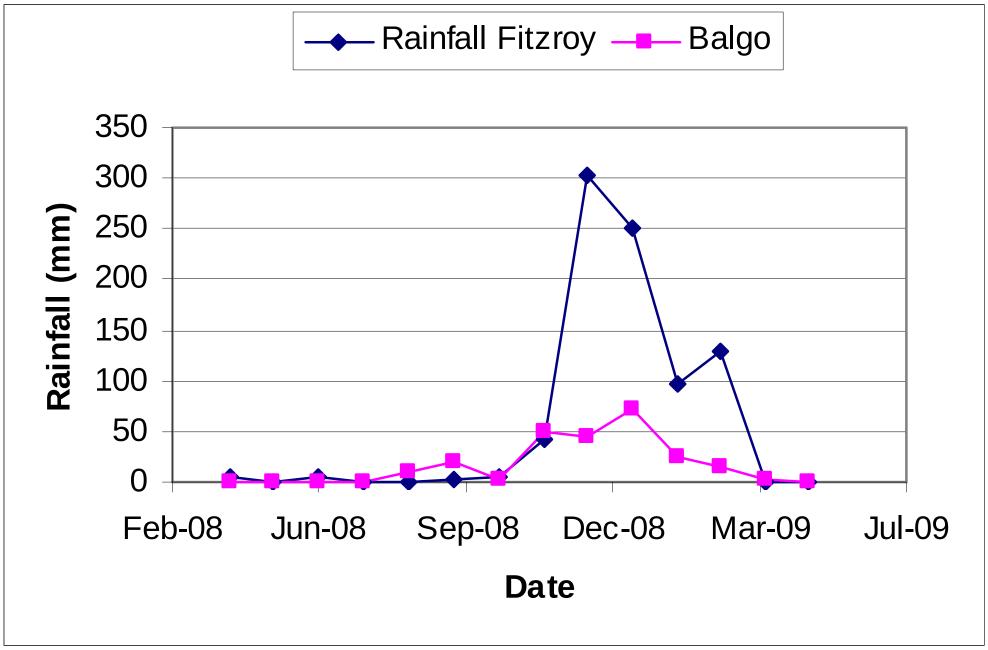

Figure 5: Rainfall for Fitzroy Crossing and Balgo Hills showing rainfall events between November and March, 2 months before the survey. Balgo Hills is within the survey area and Fitzroy Crossing is about 100 km north of the survey area.

DISCUSSION

The total survey area of ~42,700 km^2 had an overall mean camel density of 0.088 camels per km^2 which is equivalent to 3772 camels for the survey area. Some 44% of the survey area crossed pastoral lands and this had about 6 times lower density than vacant crown land and Aboriginal lands outside the pastoral area (0.02 and 0.12camels/km^2 respectively for pastoral and lands outside). This result shows a similar trend to earlier surveys that included pastoral lands (see Ward et al 2005, 2006). The reason for this lower density is most likely due to harassment by humans and/or other livestock including some level of shooting.

The camels were shown to be in small groups of 1-5 and widely separated. This is consistent with camel distribution following rainfall events. The survey area had reasonable rainfall through the summer period of November to March (Fig 3) and surface water was observed during the survey. Much of the area flown was spinifex covered sand dunes and sand plains, which has very little capacity to hold surface water and provides relatively poor food resources. Previous surveys have shown this sand ridge/sand plain country to be poor habitat for camels with corresponding low densities. About 60-70% of the survey area contained this type of country and is a likely reason for the low densities observed.

In a previous survey of the Great Victoria Desert, (Ward and Lorkiewicz 2008) observations of camel activity appeared to be greater than the number of animals observed in the survey. It was concluded that in this case the survey area was in the grip of a drought and that the area would normally carry a higher number of camels in normal conditions. However, with this survey the scenario was different in that the country was in good condition having had reasonable rains in the months leading up to the survey and the observed activity level in areas considered prime habitat was low. This suggests that the normal camel populations in this area are naturally quite low or perhaps this is the limit of their range with climate (seasonal temperature regimes) or food resources unfavorable for camels. Also the availability of prime habitat is lower in this survey area and therefore likely to support lower densities of camels.

Some anecdotal observations made by workers on Gogo cattle station (about 100km north-west of the survey area) indicated that the first sighting of a camel on that station was made in 1978. Today some 30 years later camels are still a novelty suggesting that their numbers are still very low with incursions of camels onto the station a rare event. No attempts so far have been made to cull any camels on either Gogo or Cherrabun stations as their numbers a very low and as yet are not considered to be a threat to livestock (Sedon, pers. comm 2009).

The additional transect through to the coast along the extensive paleo-drainage system confirmed that camels were utilising the drainage system as a corridor to and from the coast. The chain of lakes that extended from the coast towards Lake Gregory tended to break up and become more widely spaced. This was reflected in the camel observations which also decreased with distance from the coast (Figure 4) and once out of the drainage system, camels were rarely seen.

CONCLUSIONS AND RECOMMENDATIONS

This is the sixth broad scale aerial survey, which completes a coverage of the major bio-regions of the arid interior of Western Australia. Camel density was low and this survey suggested that there may be a northern limit to camel distribution based on environmental and habitat factors. While the series of aerial surveys has been quite extensive and very informative, it still only provides a snap shot in time of the populations within regions. Camels are highly mobile, moving through the landscape in search of food and water. What is needed is a better understanding of the factors influencing movement patterns and population distribution at the regional scale. Radio tracking of camels set up in 2008 may help answer some of the questions on movement patterns and habitat utilisation. However to be useful the same camels need to be followed over different seasons and varying climatic conditions.

Once these patterns are determined there is the need for better vegetation mapping that can define productive landscapes. Modeling of landscape information, surveys and radio tracking would provide a tool that has the capacity to predict where camels are likely to congregate in the landscape. This is critical information needed to understand and manage impacts of camel browsing. Knowing where camels congregate and their utilization patterns will determine what vegetation communities, species and areas are most at risk. Control measures can then be more strategically targeted and more cost effective in reducing camel impacts.

Long term ex-closure experiments would help in determining camel browsing impacts and also in monitoring recovery. It would be prudent to initiate a series of ex-closures in a range of habitats as soon as possible before species are lost. Control measures targeted to reduce camel densities in strategic areas, provides an opportunity to gather information and improve methods. For example, removing a known number of camels from an area may help to strengthen survey census methods and results. In addition this provides an opportunity to run diet studies by sampling the gut content of camels to determine which vegetation species are targeted by camels in various landscapes.

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