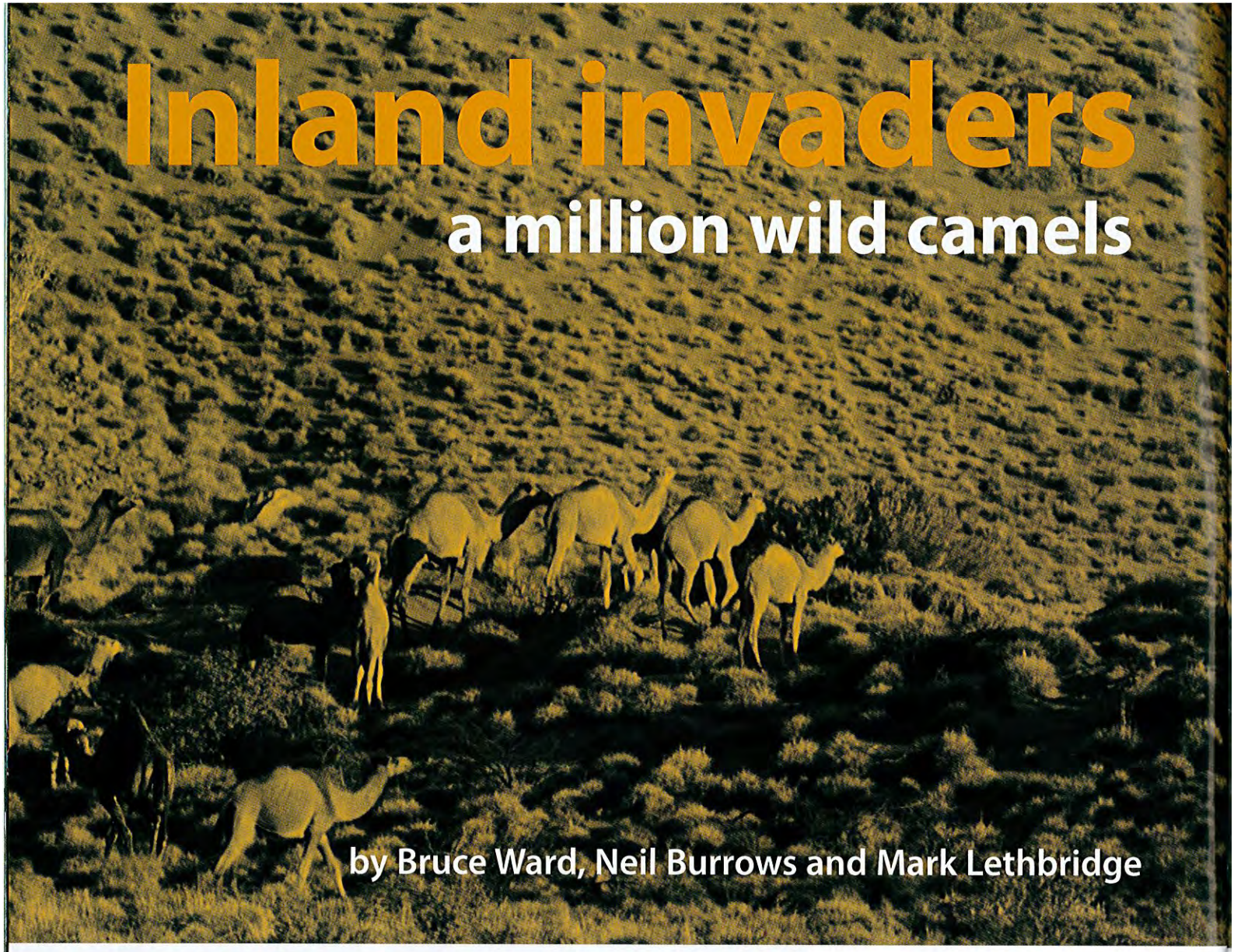
Inland invaders
a million wild camels



by Bruce Ward, Neil Burrows and Mark Lethbridge

Who would have thought that the noble, iconic camel—the animal said to have carried the 'Three Wise Men'—would become a pest? The fact is the camel has joined the ranks of some 37 pest mammal species introduced into Australia since European settlement.

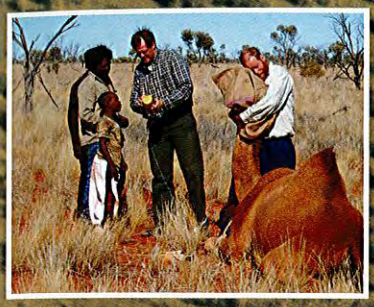
The dromedary or one-humped camel that has invaded the Australian inland is a mix of various breeds that mostly originated in India. These breeds include the pedigreed Bikaneri war camel of Rajasthan, the powerful, freight-carrying Indian camel, capable of moving loads of up to 800 kilograms, and the elite Bishari riding camel of North Africa and Arabia.

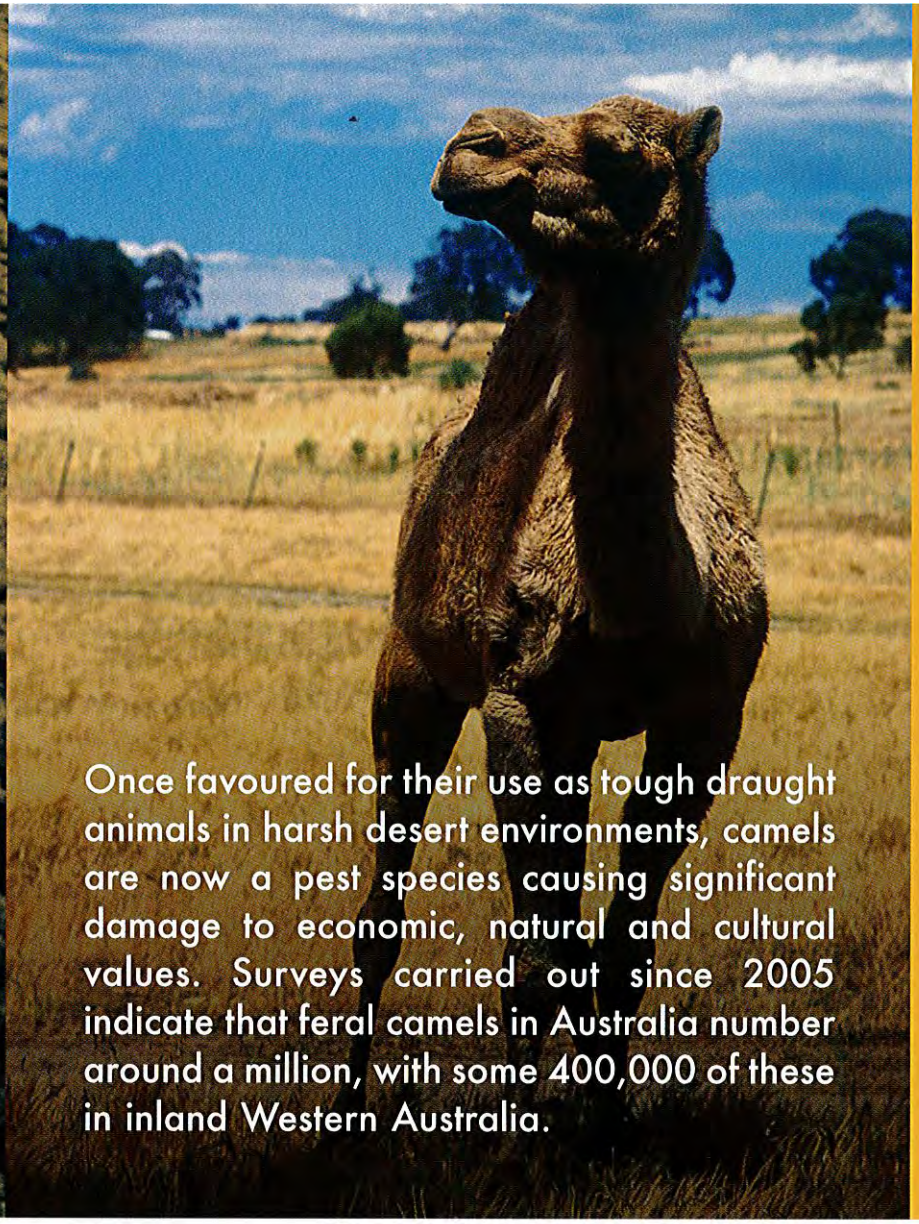
Camels were first introduced into Australia in the 1840s for transport and for exploration of the country's inland regions, although it was not until the 1860s that camels were recognised as a better draught animal than either horses or bullocks (see 'Desert Bigfoot', *LANDSCOPE*, Summer 1989–90). They are highly suited to the dry remote areas of central Australia and have adapted well. Until about 1907, thousands of camels were imported into Australia, mostly from India, together with 'Afghan' camel drivers who were actually from the drier parts of India. Goldrushes, exploration and the building of a nation all contributed to the need for camels and about 6,600 camels were imported into Western Australia alone.

Camel breeding stations were established by private individuals and by governments across Australia to supply the increasing demand for camels. In WA, government breeding stations were established at Londonderry (near Coolgardie), Yalgoo, Jigalong (near Newman) and Dromedary Hills (near Paynes Find). The latter two were established to support the construction and maintenance of the Number 1 Rabbit Proof Fence. By the 1920s, there were an estimated 20,000 domestic camels in Australia.

Turning feral

In the early days, the population of feral camels was small and scattered. This changed when domestic camels were abandoned in the 1920s and 1930s with the introduction of motorised transport. Motor vehicles and railways improved the speed and efficiency of travel and transport of goods, making the need for camels obsolete. Camels became virtually worthless, which led to owners disposing of their once valuable animals. Many were destroyed but most were released into the wild. The number of animals that escaped or were deliberately released in WA is not known but has been estimated at more than 5,000.





Once favoured for their use as tough draught animals in harsh desert environments, camels are now a pest species causing significant damage to economic, natural and cultural values. Surveys carried out since 2005 indicate that feral camels in Australia number around a million, with some 400,000 of these in inland Western Australia.

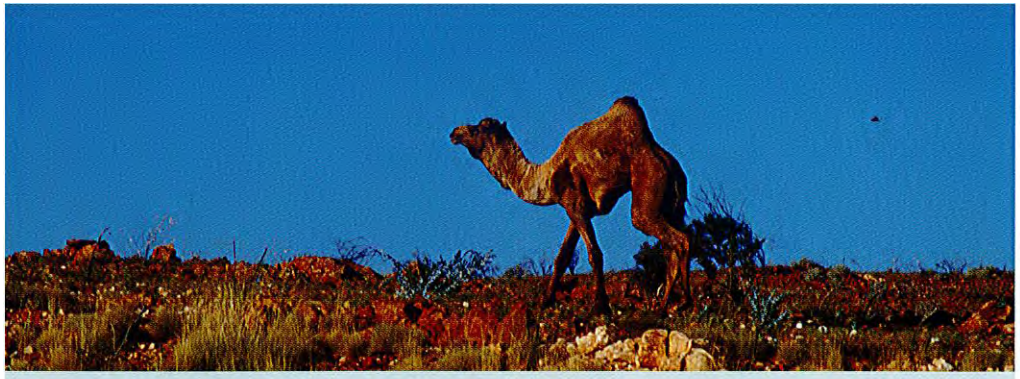
Opposite and this page
Main A camel herd in the Great Sandy Desert.
Photo – Jiri Lochman
Insets
Top left Leading Australian veterinary surgeon Wayne Boardman conducts animal health checks.
Photo – Neil Burrows/DEC
Centre left Released cow with calf.
Photo – Mark Lethbridge
Bottom left Researchers use a helicopter to locate and tranquilise camels.
Photo – Neil Burrows/DEC
Above Feral camel.
Photo – Marie Lochman

During the past 80 years, the feral camel herd has grown. Growth in numbers was slow at first, almost unnoticeable. In the mid 1960s, following an aerial survey of a portion of central Australia, the feral camel population was estimated at 15,000. Several other surveys followed over the next few decades, revealing a steady increase in camel numbers. However, during the past two decades, numbers have increased alarmingly as feral camels thrived in the Australian deserts. Today, outback travellers are almost certain to encounter camels. Increasing camel numbers and increasing tourist traffic has introduced a new hazard for motorists and camels alike—the first road fatality involving camels was in 2007 when a vehicle hit a camel on an outback road.

Pastoralists on the desert interface and Aboriginal people in remote desert communities were becoming increasingly concerned about the growing camel problem. While there were varying levels of camel control being implemented on pastoral leases, there was virtually no control of camels beyond these lands. During a drought in the interior of WA between 2001 and 2003, large herds of thirsty camels moved into remote communities and onto pastoral lands in search of water, causing damage to infrastructure and cultural values. There were also growing concerns about the impact of camels on fragile desert ecosystems.

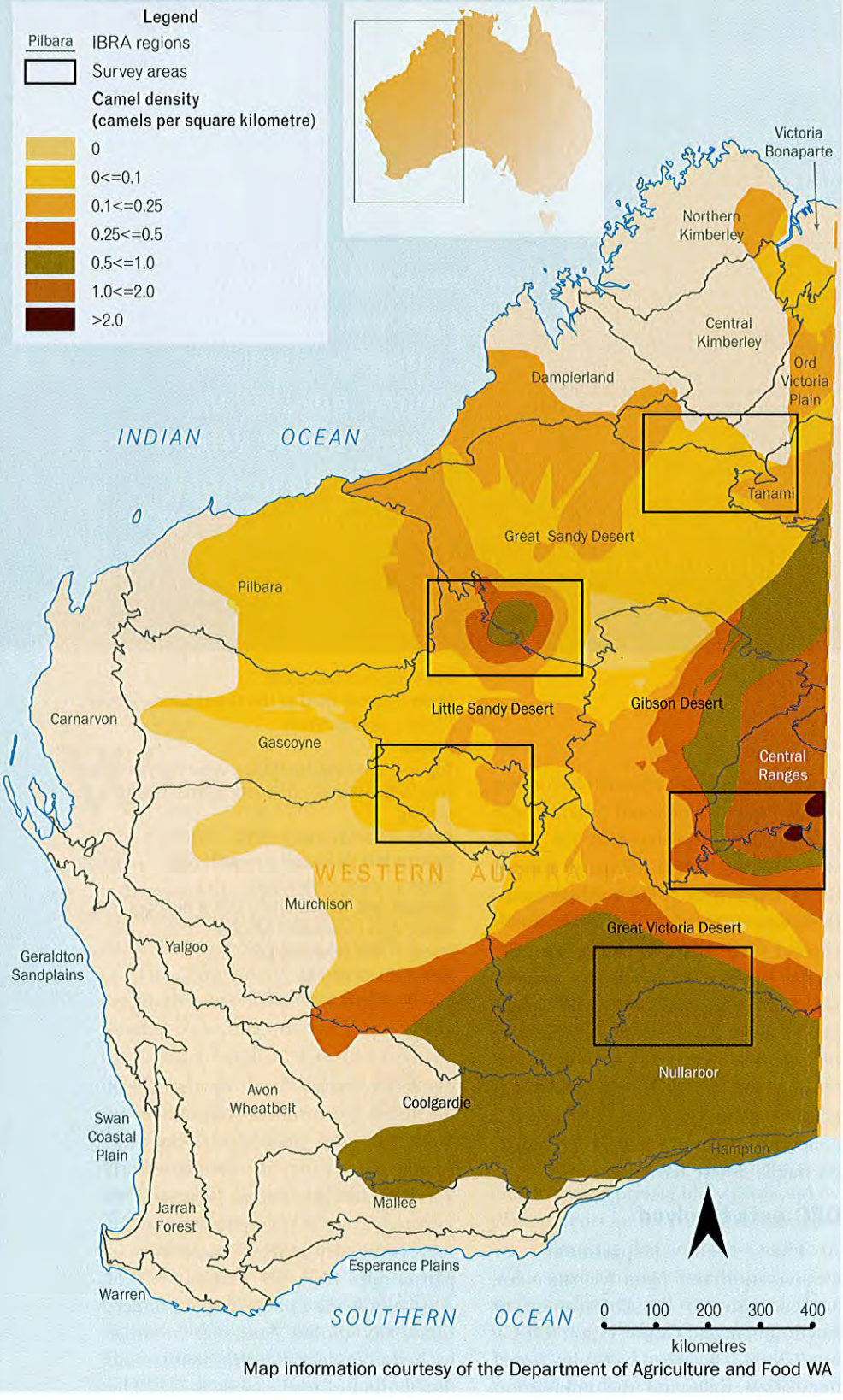
DEC gets involved

The then Department of Conservation and Land Management, a predecessor to the Department of Environment and Conservation (DEC), was alerted to the growing camel population following the publication of aerial survey data by Northern Territory Government researchers in 2004. The data showed that the feral camel population in the Northern Territory had doubled in 10 years. This initiated a series of systematic aerial surveys by department researchers in partnership with the Department of Agriculture and Food WA and Flinders University (South Australia) in order to better understand the density and distribution of feral camels in WA. The



Left Camels adapt well to the harsh desert environment.
Photo – Jiri Lochman

Camel population density



Map information courtesy of the Department of Agriculture and Food WA

first of six surveys through the remote interior of WA started in 2005.

Aerial survey is a widely used technique for reliably assessing the population of larger animals such as kangaroos and feral camels, cattle, horses and donkeys. The scientifically proven technique involves observers in an aircraft flying line transects at low altitude (76 metres or 250 feet) and counting animals that fall within a defined sample area on the ground, which is delineated by cords attached to the wing struts of the aircraft.

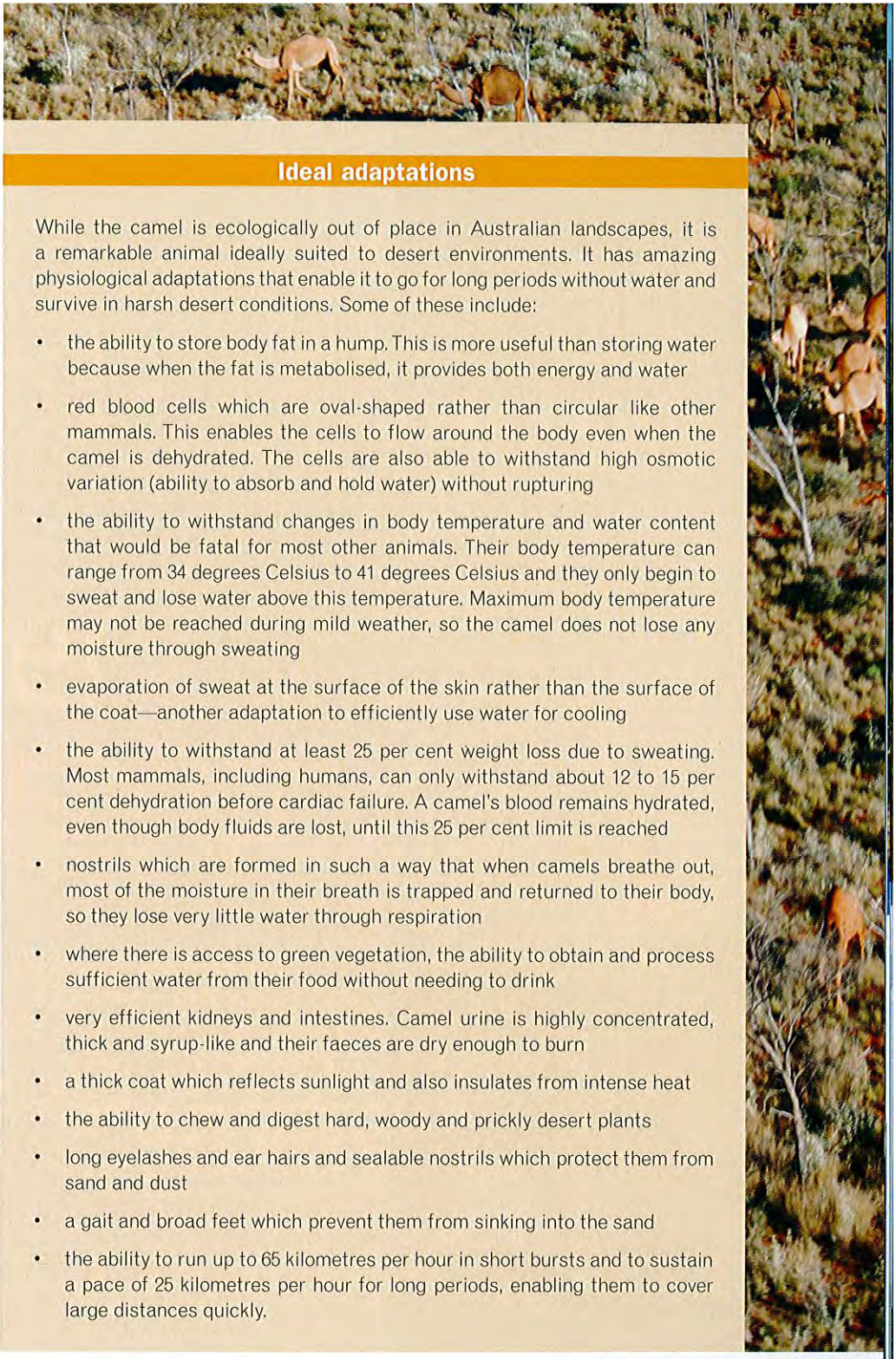
Six surveys were conducted in selected regions of the interior of WA to provide a representative sample of the areas occupied by feral camels. One site was surveyed twice—before and after a culling operation to reduce camels and other feral animals. Each survey covered an area of about 60,000 square kilometres made up of some 20 flight transects each 300 kilometres long and one kilometre apart. The total distance flown was about 40,000 kilometres and the total area surveyed was about 378,000 square kilometres—an area one-and-a-half times the size of Victoria.

The total number of feral camels in WA was estimated based on the number of camels counted during the aerial surveys and by making an estimate of where camels occur in WA. These data were contributed to a national database so the total number of camels in Australia could be estimated.

How many camels are there?

The number of camels in WA is estimated at about 400,000, with the Australian population estimated to be as high as one million, distributed across an area of 3.3 million square kilometres of central Australia. Based on repeated surveys, the feral camel population is estimated to be doubling every eight to 10 years.

The surveys also revealed that the distribution of camels is clumped rather than even, with, not surprisingly, the highest numbers found where there is ample water and food. Camel densities are high around areas where water



Right Camels have reached concerning levels in the desert regions.
Photo – Neil Burrows/DEC

is likely to persist for longer periods following rain, such as rivers, lakes and other drainage systems, and around low mountain ranges that contain rockholes. In other parts of the desert, such as the vast spinifex sandplains and dune fields, feral camels are sparse except after heavy rains that fill small claypans and creeks.

Effects on plants and animals

Camels are primarily browsers and can feed on more than 80 per cent of the plant species available in Australian deserts. Browsing by camels can damage trees and shrubs and severely defoliate preferred species. Camels also inhibit recruitment by suppressing flowering and fruit production and by browsing and killing juvenile plants. If unchecked, large congregations of camels have the ability to cause the local extinction of highly palatable species such as the quandong (*Santalum acuminatum*), plumbush (*S. lanceolatum*), curly pod wattle (*Acacia sessiliceps*), native apricot (*Pittosporum augustifolium*), bean tree (*Erythrina vespertilio*) and *Lawrencia* species. In central Australia, adverse effects on vegetation have been recorded where camels occur at densities of more than about two animals per square kilometre. In some areas, significant damage to native vegetation occurs at much lower densities. Camels have also been observed to concentrate their browsing on regrowth following bushfires.

Native birds and mammals are not exempt from the impact of feral camels. Impacts are most pronounced during drought, particularly when species depend on natural waterholes. These refuge areas can quickly become degraded to the point where native species may be severely disadvantaged and face local extinction.

Counting the cost

Many Aboriginal people live in areas where there are high numbers of camels and experience firsthand their impacts, which include damage to fences, water tanks, toilets, air conditioner units and standpipes. Camels also loiter on airstrips and roads, causing a hazard to traffic. Camels damage and foul-up sacred waterholes and denude the surrounding vegetation. Aboriginal people fear to camp in these areas as they are afraid of being trampled in the night.

For people who live with high camel numbers, most feel that reducing numbers is a good idea and are willing to discuss control options. However, in areas where camels are in low numbers, attitudes may be different as they are still a novelty and to cull animals goes against cultural ethics. The need to make decisions considering a wide range of views adds complexity to the camel control issue. While cost of infrastructure damage can be easily measured, what cost can be put on loss of cultural value?

Mining companies, pastoralists and the public can measure the cost of damage and losses from camels through lost production and replacement of infrastructure. The Desert Knowledge Cooperative Research Centre has calculated an annual net economic loss of $10.6 million Australia-wide from infrastructure damage and lost production alone. These costs will rise with increasing camel numbers.

Ideal adaptations

While the camel is ecologically out of place in Australian landscapes, it is a remarkable animal ideally suited to desert environments. It has amazing physiological adaptations that enable it to go for long periods without water and survive in harsh desert conditions. Some of these include:

- the ability to store body fat in a hump. This is more useful than storing water because when the fat is metabolised, it provides both energy and water
- red blood cells which are oval-shaped rather than circular like other mammals. This enables the cells to flow around the body even when the camel is dehydrated. The cells are also able to withstand high osmotic variation (ability to absorb and hold water) without rupturing
- the ability to withstand changes in body temperature and water content that would be fatal for most other animals. Their body temperature can range from 34 degrees Celsius to 41 degrees Celsius and they only begin to sweat and lose water above this temperature. Maximum body temperature may not be reached during mild weather, so the camel does not lose any moisture through sweating
- evaporation of sweat at the surface of the skin rather than the surface of the coat—another adaptation to efficiently use water for cooling
- the ability to withstand at least 25 per cent weight loss due to sweating. Most mammals, including humans, can only withstand about 12 to 15 per cent dehydration before cardiac failure. A camel's blood remains hydrated, even though body fluids are lost, until this 25 per cent limit is reached
- nostrils which are formed in such a way that when camels breathe out, most of the moisture in their breath is trapped and returned to their body, so they lose very little water through respiration
- where there is access to green vegetation, the ability to obtain and process sufficient water from their food without needing to drink
- very efficient kidneys and intestines. Camel urine is highly concentrated, thick and syrup-like and their faeces are dry enough to burn
- a thick coat which reflects sunlight and also insulates from intense heat
- the ability to chew and digest hard, woody and prickly desert plants
- long eyelashes and ear hairs and sealable nostrils which protect them from sand and dust
- a gait and broad feet which prevent them from sinking into the sand
- the ability to run up to 65 kilometres per hour in short bursts and to sustain a pace of 25 kilometres per hour for long periods, enabling them to cover large distances quickly.

Left Camels can be a hazard to drivers in desert regions.
Photo – Jay Sarson/Lochman Transparencies

Below Field staff collar a camel before a tranquiliser reversal drug is administered and the animal is released.
Photo – Neil Burrows/DEC

However, the cost on the natural environment and cultural values can not be measured in dollars and the value in lost species and local extinctions remains unknown. Much more work is required in this area to determine the impacts on plants and native species, and this will remain a topic for further investigation.

Camel migration patterns

Research to better understand the movement patterns of camels in various seasons is currently being undertaken using GPS-satellite tracking collars. In a joint project involving scientists from Flinders University, the Royal Zoological Society of South Australia, DEC and people from the Ngaanyatjarra Aboriginal community (Warburton), eight female camels were caught, tranquilised, fitted with tracking collars and released in July 2008. The information gained from this research will improve understanding of which parts of the desert are most at risk from damage by camels, and will assist with the development of targeted, cost-effective control programs.

The animals were automatically tracked for 13 months and while data are still to be fully analysed, some interesting information is emerging. Two of the collared camels travelled interstate, crossing the WA border into the Northern Territory and South Australia. On average, the camels moved between five and 10 kilometres a day, with most camels travelling about 30 kilometres per week in search of food and water. Distances in excess of 100 kilometres per week were not uncommon at warmer times of the year. The average monthly home range of the camels varied from an area of about 12,000 hectares in February, to a massive 260,000 hectares in November. Further analysis will add new information about which parts of the landscape camels prefer and how seasonal conditions influence their movement patterns.

Where to from here?

Management of feral camels and their impacts will involve the integration of all available control methods, both non-commercial and commercial, and the development of an integrated management framework that operates across jurisdictions, tenure, boundaries and industry sectors. There are only a few studies which have tried to quantify the environmental impacts caused by camel densities. However, the level of camel impact can also vary depending on the resilience of the ecosystem. So while in some areas, significant damage to native vegetation and cultural assets occurs at much lower densities, reducing densities to well under one camel per square kilometre on average is a reasonable start-point.

Current legislation needs revision to enable cross-jurisdictional management of feral camels, and legislative instruments at both the Federal and State level show a range of inconsistencies around issues including camel ownership, legal obligation to control, right of access to property, movement of firearms across borders and fencing of waterholes.

Unlike many other introduced pest animals, the size and relatively low fecundity of these animals means that it is feasible to reduce camel numbers significantly. However, this requires broad-scale, cross-jurisdictional and cross-tenure cooperation, which can be, to say the least, a very difficult task. The alternative, more costly and often less productive option is regular targeted local control to protect high value conservation, cultural and economic assets.

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contents

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