

Guest Editorial: Managing the impacts of feral camels

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Overview

One-humped dromedary camels (*Camelus dromedarius*) were first introduced to Australia in 1840 from the Canary Islands. Thereafter the majority came from the Indian subcontinent (McKnight 1969) and were used to open up the arid interior for European settlement (McKnight 1969). Camels were well suited to working in remote dry areas and were used as a means of transport, for freight and as draught animals (McKnight 1969). It is thought that over a 27-year period between 1880 and 1907 approximately 20 000 camels were imported. It was at least 40 years after the first importation that quarantine regulations were developed and enforced; it is probably simply fortuitous that the common camel diseases found in the Middle East and south Asia are not present in Australian camels today. The replacement of the camel by the motor vehicle as a mode of transport in the early 20th century resulted in large numbers of camels being released into the wild and the subsequent establishment of a feral population. Records show that the number of captive camels registered in 1941 was 2300, compared with 12 649 in 1920 (McKnight 1969). There is no reliable estimate of the number of camels that were released into the wild, although it is thought that it may have been between 5000 and 10 000 camels (Edwards *et al.* 2004).

Although there had been several attempts to estimate the number of camels in Australia between the mid 1960s and 2000, it was not until 2001 that it became apparent that camels were an emerging pest animal problem in Australia. Survey work undertaken in the Northern Territory in 2001 indicated that there were possibly as many as 300 000 feral camels in Australia spread across WA, SA, the NT and Queensland and that the population was doubling about every 8 years (Edwards *et al.* 2004).

For the best part of 75 years, the significant damage that feral camels were doing to the fragile ecosystems, cultural sites, isolated communities and pastoral enterprises of desert Australia were largely 'out of sight – out of mind' for most Australians because it occurred in sparsely populated areas a long way from the coast. They were only noticed when their activities intersected with remote Aboriginal people, pastoralists and the tourism and mining industries. Recent incursions into remote Aboriginal communities (in 2007 and 2009) are possibly the first indication that feral camels have reached a population that is causing them stress in their natural environment.

In June 2005 the Desert Knowledge Cooperative Research Centre (DKCRC) obtained funding from the Australian Government's Natural Heritage Trust Fund for the research project 'Cross-jurisdictional management of feral camels to protect NRM and cultural values'. The overarching aim of the research was to develop a national management framework that would lead to a reduction in camel numbers to a level that reversed their population growth trajectory and reduced their impacts on natural resource management (NRM), economic and social-cultural values. This was a first attempt to develop an integrated management approach for a large herbivorous pest animal species at such a large scale in Australia.

A key starting point for the development of a national management framework was the recognition that the management of the impacts of pest animals should be guided by a risk management approach and be strategic in determining where management should occur, at what time and what techniques should be used (Australian Pest Animal Strategy 2007). The then current management of feral camels was largely *ad hoc* (Edwards *et al.* 2004) and failed to adequately meet any of these criteria. The research project recognised the complexity of the problem by bringing together a collaboration among a cross-disciplinary group of researchers (ecology, toxicology, anthropology, sociology, economics, business management, law and systems modelling) and stakeholder groups which included government agencies, Aboriginal organisations and communities, individual pastoralists and conservation land managers across three States (WA, SA, Qld) and the NT.

This research has resulted in the papers in this Special Issue which have been arranged around three themes: (i) demography and distribution; (ii) impacts and attitudes of land managers; and (iii) management and decision support.

Demography and distribution

The first four papers focus on the demographics of feral camels and their distribution across Australia's deserts. Saalfeld and Edwards (2010) estimate the 2008 feral camel population at approximately one million animals occupying ~3.3 million km² of desert Australia. The population is growing at an estimated 8% per annum with little evidence that the population is nearing carrying capacity (Pople and McLeod 2010) or that habitat is a limiting factor (McLeod and Pople 2010). The final paper by

Lethbridge *et al.* (2010) gives some preliminary insights into the movement of feral camels across the landscape. The combined results from these four papers provide land managers with valuable information that will allow them to design strategies to reduce the impacts of feral camels. For instance, Pople and McLeod (2010) note that adult survival is a major contributor to population growth and that the current survival rate of 96% would need to be reduced by at least 9% to halt that growth. They also concluded that fertility control is likely to be a highly inefficient form of population control. Saalfeld and Edwards (2010) found that although the average population density was 0.29 feral camels/km² across their range, they also identified two high density areas in the eastern part of the Great Sandy Desert (range 0.5–>2.0 animals/km²) and the Simpson Desert (0.5–1.0 animals/km²). If the negative impacts of feral camels are to be reduced, the insights that McLeod and Pople (2010) and Lethbridge *et al.* (2010) provide on habitat and movement are crucial to the design of control and impact reduction strategies.

Impacts and attitudes of land managers

The next group of four papers explores the cultural, economic, environmental and social impacts of feral camels and associated this with the attitudes of key land management groups. Edwards *et al.* (2010) have found that feral camels impose an annual net cost of ~\$10.67 million on the Australian economy and note that the non-market impacts are likely to be significantly higher. Vaarzon-Morel (2010) notes the impacts on natural and cultural resources which are important to Aboriginal people. In a study of a small rock hole on the Petermann Aboriginal Land Trust, Brim Box *et al.* (2010) measured the negative physical impacts that camels had on water availability and quality as well as the consequential impacts of heavy browsing in the vicinity of an important Aboriginal cultural site. Edwards *et al.* (2008) found that the highest average densities of camels were found on Aboriginal-managed lands (0.53 camels/km²), followed by vacant Crown land (0.29 camels/km²), areas managed for conservation values (0.28 camels/km²) and pastoral lands (0.15 camels/km²). Understanding the attitudes of each of these land management groups to management strategies will be important to the success of any management actions to reduce the impacts of camels. Zeng and Edwards (2010) found that although pastoralists and conservation land managers were comfortable with using all available management methods, pastoralists indicated that culling and commercial use were their favoured management options. Vaarzon-Morel (2010) noted that there was a diverse range of perspectives among Aboriginal land managers. She found that many Aboriginal people see a need to harvest or cull feral camels and control their impacts. However, she observed that there was a particular sensitivity to culling, which was seen as wasteful, thus, there exists a desire to see the development of commercial opportunities that create livelihood opportunities.

Management and decision support

The final four papers start with a paper that addresses the question ‘who owns feral camels?’ (Garnett *et al.* 2010). Garnett *et al.* (2010) note that there is no consistency or certainty in legislation surrounding the question of ownership and propose that

legislation be amended to explicitly vest ownership in the Crown. This has implications for the long-term management of feral camel impacts. At present, feral camel impacts are predominantly controlled by aerial or ground culling or with exclusion fencing for highly valuable sites. Lapidge *et al.* (2010) undertook a comprehensive analysis of a range of chemical, biological and fertility control methods but note that little research has been undertaken internationally into the use of such methods to control camels, as Australia has the only feral camel herd in the world. They do, however, identify some potential avenues for further research including some novel camel-specific delivery methods. Drucker *et al.* (2010) used a bio-economic model to explore the cost-effective analysis of two aerial control strategies. They found that, although the costs of control under the two strategies were considerable, they were far outweighed by the present benefits to the livestock industry and society as a whole through lost production and reduced greenhouse emissions. Overall, a strategy of annual removal of camels was favoured over one where camels are removed only when a threshold density is reached. The decision making space in which management decisions are made about camel management is complex and is characterised by multiple decision makers each having a specific set of criteria by which they judge any management plan. All this takes place in an environment characterised by space and time. Lamb *et al.* (2010) describe the development of a GIS-based multi-criteria model which can be used to explore the trade-offs between a range of management options.

Research impact

The research reported here was brought together to develop the structure for a national feral camel management plan entitled ‘Managing the impacts of feral camels in Australia: a new way of doing business’ (Edwards *et al.* 2008), which proposed a framework for the cross-jurisdictional management of feral camels which would lead

‘to a reduction of camel numbers to a level that reverses their current population growth trajectory and reduces their impacts on natural resource management, economic, and socio-cultural values’.

Based on a set of guiding principles, a recommended strategy for a staged rollout of management activities to mitigate the negative impacts of feral camels across four zones over a period of <5 years was proposed. This required coordination between all levels of government in partnership with industry, land managers and local communities. A key recommendation was that, in order to reduce the impacts of feral camels, the population density should be reduced to <0.2 camels/km². The report’s findings were incorporated into the 2008–09 Caring for our Country Business Plan (Commonwealth of Australia 2008) and Ninti One (the DKCRC management company) and a group of 19 partners were successful in their bid for \$19 million to undertake the management of feral camel impacts. This work is on-going.

As noted above, the papers presented in this Special Issue are a summary of the research that was carried out under the Australian Government’s Natural Heritage Trust funding and interested readers who would like more detail than is included in these papers are encouraged to access the full suite of reports on

the Desert Knowledge Cooperative Research Centre website (www.desertknowledgecrc.com.au/publications). In conclusion, we would like to thank the authors for their contributions.

References

- Australian Pest Animal Strategy (2007). 'Australian Pest Animal Strategy – A National Strategy for the Management of Vertebrate Pest Animals in Australia.' (Natural Resources Ministerial Council: Canberra.)
- Brim-Box, J., Guest, T., Barker, P., Jambrecina, M., Moran, S., and Kullitja, R. (2010). Camel usage and impacts at a permanent spring in central Australia: a case study. *The Rangeland Journal* **32**, 55–62.
- Commonwealth of Australia (2008). 'Caring for our Country Business Plan: 2009–2010.' (Commonwealth of Australia: Canberra.)
- Drucker, A. G., Edwards, G. P., and Saalfeld, W. K. (2010). Economics of camel control in central Australia. *The Rangeland Journal* **32**, 117–127.
- Edwards, G. P., McGregor, M., Zeng, B., Saalfeld, W. K., Vaarzon-Morel, P., and Duffy, M. (2008). Synthesis and key recommendations. In: 'Managing the Impacts of Feral Camels in Australia: a New Way of Doing Business. DKCRC Report 47'. (Eds G. P. Edwards, B. Zeng, W. K. Saalfeld, P. Vaarzon-Morel and M. McGregor.) pp. 331–360. (Desert Knowledge Cooperative Research Centre: Alice Springs.) Available at www.desertknowledgecrc.com.au/publications/
- Edwards, G. P., Saalfeld, K., and Clifford, B. (2004). Population trend of feral camels in the Northern Territory. *Australian Wildlife Research* **31**, 509–517. doi:10.1071/WR03073
- Edwards, G. P., Zeng, B., Saalfeld, W. K., and Vaarzon-Morel, P. (2010). Evaluation of the impacts of feral camels. *The Rangeland Journal* **32**, 43–54.
- Garnett, S. T., Williams, G., Ainsworth, G. B., and O'Donnell, M. (2010). Who owns feral Camels? Implications for managers of land and resources in central Australia. *The Rangeland Journal* **32**, 87–93.
- Lamb, D. S., Saalfeld, W. K., McGregor, M. J., Edwards, G. P., Zeng, B., and Vaarzon-Morel, P. (2010). A GIS-based decision-making structure for managing the impacts of feral camels in Australia. *The Rangeland Journal* **32**, 129–143.
- Lapidge, S. J., Eason, C. T., and Humphrys, S. T. (2010). A review of chemical, biological and fertility control options for the camel in Australia. *The Rangeland Journal* **32**, 95–115.
- Lethbridge, M. R., Anderson, N., Harper, M. L., and Gee, P. (2010). Movements and landscape use of camels in central Australia revealed by GPS satellite. *The Rangeland Journal* **32**, 33–41.
- McKnight, T. L. (1969). 'The Camel in Australia.' (Melbourne University Press: Melbourne.)
- McLeod, S. R., and Pople, A. R. (2010). Modelling the distribution and relative abundance of feral camels in the Northern Territory using count data. *The Rangeland Journal* **32**, 21–32.
- Pople, A. R., and McLeod, S. R. (2010). Demography of feral camels in central Australia and its relevance to population control. *The Rangeland Journal* **32**, 11–19.
- Saalfeld, W. K., and Edwards, G. P. (2010). Distribution and abundance of the feral camel (*Camelus dromedarius*) in Australia. *The Rangeland Journal* **32**, 1–9.
- Vaarzon-Morel, P. (2010). Changes in Aboriginal perceptions of feral camels and of their impacts and management. *The Rangeland Journal* **32**, 73–85.
- Zeng, B., and Edwards, G. P. (2010). Perceptions of pastoralists and conservation reserve managers on managing feral camels and their impacts. *The Rangeland Journal* **32**, 63–72.