MANAGING THE IMPACTS OF FERAL CAMELS ACROSS REMOTE AUSTRALIA:

Final Report of the Australian Feral Camel Management Project

NINTI ONE · AUSTRALIAN FERAL CAMEL MANAGEMENT PROJECT

Australian Government

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Shortened forms

ACRIS	Australian Collaborative Rangeland Information System
AFCMP	Australian Feral Camel Management Project
APY Lands	Anangu Pitjantjatjara Yankunytjatjara Lands
BTEC	Brucellosis and Tuberculosis Eradication Campaign
COP	code of practice
DAFWA	Western Australia Government Department of Agriculture and Food
DEC	Western Australia Government Department of Environment and Conservation (DEC) (replaced July 2013 by Department of Parks and Wildlife and the Department of Environment Regulation)
DKCRC	Desert Knowledge Cooperative Research Centre
DLRM	Northern Territory Department of Land Resource Management
DSS	decision support system
HCB	height to canopy base
IACRC	Invasive Animal CRC
KJ	Kanyirninpa Jukurrpa
MERI	Monitoring, Evaluation, Reporting and Improvement
NFCAP	National Feral Camel Action Plan
NOG	National Operations Group
NRM	natural resource management
NTCA	Northern Territory Cattlemen's Association
OH&S	occupational health and safety
SOG	State Operations Group
SOP	standard operating procedure
VPC	Vertebrate Pests Committee

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Andrew Bubb – Executive Officer

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Key messages and recommendations

Key messages and recommendations

The Australian Feral Camel Management Project (AFCMP) was a partnership of 20 organisations, supported by the Australian Government, that was contracted in 2010 to reduce the density of feral camels, with the primary aim of decreasing the threat to the ecological and biodiversity value at 18 sites in remote Australia and a secondary objective to protect vegetation, and therefore soils, on pastoral lands. The project largely achieved its feral camel density targets around the 18 environmental sites and exceeded the target number and area of pastoral properties on which feral camels were managed.

The feral camel population is estimated to be around 300,000 and there is now a real opportunity to maintain the low-density populations that have been achieved in the Simpson Desert and Pilbara regions. There is more work to be done in the Surveyor Generals Corner region to achieve and maintain lower densities, with major landholders in this region having a strong preference for commercial use as their form of feral camel management. The project has helped build the commercial and non-commercial feral camel removal capacity to achieve feral camel management objectives into the future.

The project has demonstrated the potential that well-coordinated, cross-tenure collaborations have to manage landscape-scale natural resource management (NRM) issues. It has developed a range of capacities, systems and collaborations that will benefit future large feral herbivore and other NRM projects in the rangelands.

The key messages and outcomes from the project are:

- Large NRM projects require substantial supporting evidence about likely outcomes, and therefore require a solid scientific basis before projects begin, in addition to monitoring and evaluation throughout the project.
- The scale and complexity of problems such as feral camel management (cross-jurisdictional, cross-cultural, cross-disciplinary, cross-institutional) require new institutional structures and appropriate levels of funding to ensure that enduring partnerships can be formed.
- The project brought together, for the first time in feral camel management, the Australian Government with state and territory governments; Aboriginal organisations; NRM organisations; the pastoral industry; commercial, animal welfare and conservation interests; and research organisations.
- The negotiation of landholder consents over 1.3 million km^2 for feral camel management in the highest priority areas means that, whenever there is a compelling case to manage feral camels, this can begin on-ground almost immediately. These consents should also assist with management of other large feral herbivores and engagement on other NRM issues.
- The key objective of the project was to reduce feral camel densities at 18 targeted environmental assets to between fewer than 0.1 feral camels per km^2 to 1.0 feral camel per km^2, depending on the asset. These density targets have largely been met.

Key messages and recommendations

- No single management method is likely to reduce the feral camel density to a level where their impact is acceptable to all stakeholders. Aerial culling is the most effective management method for rapid population knockdown in remote areas, but mustering and ground culling can also assist with population management in certain situations.
- The AFCMP has demonstrated that large herbivores such as feral camels continue to pose a significant threat to the environmental and cultural integrity of wetlands and biodiversity in arid Australia. The project's monitoring, evaluation, reporting and improvement (MERI) program has produced huge datasets from repeated samplings of waterholes and vegetation. Some feral camel impacts (e.g. vegetation community survival) involve complex interactions with other factors (e.g. other feral herbivores, drought, fire) and require many years to study effectively. Other impacts (e.g. trashing wetlands, damaging infrastructure) are dramatic and can be effectively observed within weeks or even days.
- Maintenance of the world's oldest living culture is an ethical imperative and of great benefit to all Australians. The 3.3 million km^2 over which feral camels roam contain some of the most significant cultural assets for Aboriginal people, which they have maintained for thousands of years. AFCMP monitoring has shown that reducing the density of feral camels on key environmental assets has improved the condition of those assets, with flow-on cultural and economic benefits to Aboriginal people, the pastoral industry, the commercial camel industry and the Australian people.
- The project has developed comprehensive animal welfare audit protocols against the standard operating procedures (SOP), and independent verification has indicated a high level of animal welfare.
- The AFCMP has assisted with the development of a niche camel meat industry, and approximately 25,000 feral camels were used for commercial use over the period of the project. Commercial use can contribute to feral camel management programs and provides new income and employment opportunities for Aboriginal communities. Transport costs are a major barrier, as are the logistics of mustering in remote locations. A sustainable industry will require camels to be farmed.
- 'Removal assistance' payments were shown to have some potential to contribute to feral camel management; however, the use of market-based instruments in general needs to be considered carefully, as their administration requirements can outweigh the theoretical benefits of a competitive tendering process, particularly where there is only a small number of potential tender proposals.
- Focused training has meant that an improved ground-culling capability has been developed on Aboriginal lands. This should be maintained and enhanced to allow Aboriginal rangers and other community members to effectively manage small numbers of animals that are causing problems at places such as waterholes, roads, airstrips and communities.

Key messages and recommendations

Recommendations

The AFCMP has provided the opportunity to learn from the governance and operational issues of a project that has succeeded in overcoming the challenges of: operating on a large scale across all land tenures; not having the same legislative basis for land access as programs such as the Brucellosis and Tuberculosis Eradication Campaign (BTEC); and, involving a wide range of potentially conflicting stakeholder views. Some of the below recommendations are specific to feral camel management, but most have implications for the management of other large feral herbivores and NRM projects in general.

THE NEED FOR CONTINUED FERAL CAMEL MANAGEMENT

RECOMMENDATION 1.

That the Australian Government, in partnership with the Queensland, South Australian, Western Australian state and Northern Territory governments, maintain a coordinated approach to the management of large feral herbivores in arid Australia. This approach needs to account for the experience of the AFCMP, including:

- The annual level of AFCMP resources (around $4 million per year of Australian Government funding) was appropriate and allowed the required level of engagement of a diverse range of stakeholders through a necessarily comprehensive governance and consultation structure.
- Large-scale projects such as the AFCMP are likely to require more than a four-year timeframe to account for the establishment phase and seasonal conditions.
- There are benefits in such projects being coordinated by an independent non-government agency that does not have direct land management interests and operates nationally rather than in a particular jurisdiction.

COLLABORATION FOR EFFECTIVE FERAL CAMEL MANAGEMENT

RECOMMENDATION 2.

That Governments and land managers maintain AFCMP collaborations at inter- and intra-jurisdictional levels to maintain a coordinated management approach that is appropriately resourced.

RECOMMENDATION 3.

That future Federal/State government support for feral camel management ensures that there is significant collaboration between agencies with potentially conflicting objectives (e.g. environmental protection versus commercial industry development).

RECOMMENDATION 4.

That large NRM projects have regular formalised contact with funding agencies, and, preferably, continuity of project coordinator positions and funding agency contacts.

Key messages and recommendations

RECOMMENDATION 5.
That land managers be recognised as key partners in management projects that impact on the land that they own/manage. Recognition involves providing them with the information upon which to make informed decisions as well as including them actively in the decision-making process.

PROJECT OBJECTIVES AND SCALE

RECOMMENDATION 6.
That large NRM projects have specific, quantifiable project objectives (e.g. pest animal density targets) based on solid research, with enough flexibility to alter the management approach as the project is rolled out. The AFCMP was based on a three-year research program and involved an adaptive management approach whereby annual plans were developed to account for improved knowledge and changing conditions.

RECOMMENDATION 7.
That regional density targets continue to be the main quantifiable performance measure for feral camel management, with the assumption being that at an average regional density of <0.1 camels per km^2, the frequency and severity of feral camel congregations will be substantially reduced. Although local density is more relevant than regional density in relation to feral camel impacts, for such a mobile species, local density is a transitory notion.

RECOMMENDATION 8.
That the landscape-scale approach should be considered for other mobile pest species with the option of adopting distinct operational regions (as per the three used in the AFCMP of Simpson, Surveyor Generals Corner and Pilbara) where there are distinct high-density areas and/or differences in seasonal patterns, preferred form of removal etc.

RECOMMENDATION 9.
That resourcing of feral camel management is flexible to account for the variable opportunities provided by seasonal conditions – i.e. to ensure that removal operations can be undertaken at short notice to manage developing feral camel congregations and emergency events.

RECOMMENDATION 10.
That future feral camel management employs an integrated management approach which acknowledges the role of commercial use where it is able to contribute to sustained high levels of off-take in conjunction with other removal approaches; and that there will always be a key role for aerial culling to achieve rapid population knockdown and where feral camels are too remote or in too poor a condition for commercial use.

COMMERCIAL USE

RECOMMENDATION 11.
That the commercial use industry reduces its reliance on feral harvest and builds captive herds. This will improve the reliability and quality of supply to abattoirs and also reduce potential conflicts between commercial use and impact reduction objectives.

Key messages and recommendations

KEY OPERATIONAL ISSUES

RECOMMENDATION 12.

That, although legislative differences between jurisdictions have not been a major impediment to the rollout of the AFCMP, feral camel management agencies continue to look for opportunities to address the issues identified in the Desert Knowledge CRC review as well as the legislation/policy review undertaken by the SA Government during the AFCMP.

RECOMMENDATION 13.

That future large pest animal management programs consider the process for setting and assessing the humaneness of removal operations developed under the AFCMP.

RECOMMENDATION 14.

That neighbouring jurisdictions keep each other informed about feral camel densities/movements and removal operations, to improve ongoing national coordination of feral camel management.

RECOMMENDATION 15.

That remote area operations involve at least two helicopters for OH&S reasons.

RECOMMENDATION 16.

That the size of 'no go' areas (e.g. communities, waterholes and cultural sites where culling cannot take place) for aerial culling be reduced as much as possible to reduce the distance that feral camels need to be moved before culling.

RECOMMENDATION 17.

That the 'Judas' technique (using satellite-collared individual animals to guide removal of associated groups of animals) be considered where feral camel populations have been reduced to very low densities (e.g. in the Simpson Desert).

RECOMMENDATION 18.

That the improved ground culling capability that has been developed on Aboriginal lands under the AFCMP be maintained and enhanced to allow Aboriginal rangers and other community members to effectively manage small numbers of animals that are causing problems at waterholes, roads, airstrips, communities etc.

RECOMMENDATION 19.

That exclusion be considered a relatively minor component of effective feral camel management due to the cost-effectiveness of construction and maintenance relative to other management approaches.

RECOMMENDATION 20.

That the 'removal assistance' payments made under the AFCMP be maintained for a limited time period to continue to encourage the commercial removal of female camels and to ensure that mustering operations comply with the SOP.

Key messages and recommendations

RECOMMENDATION 21.
That, although 'removal assistance' payments have some potential to contribute to feral camel management, the use of 'Market-Based Instruments' in general is considered carefully as their administration requirements can outweigh the theoretical benefits of a competitive tendering process, particularly where there is only a small number of potential tender proposals.

FUTURE INFORMATION NEEDS

RECOMMENDATION 22.
That the environmental monitoring framework and sites established through the AFCMP be maintained and involve Aboriginal rangers. Wherever possible, this work should be linked to national data collection processes for the rangelands.

RECOMMENDATION 23.
That population surveys be continued at a frequency of 8-10 years to improve population modelling and therefore help to refine the management approaches. Ongoing investigation of more automated aerial survey approaches is required to allow increased survey frequency and/or area.

RECOMMENDATION 24.
That intelligence networks for obtaining and collating information on feral camel congregations be maintained to provide early warning to support more proactive operational responses. These networks can be combined with monitoring weather and fire information to locate potential feral camel congregations.

1. From science to solutions

This chapter establishes how an evidence base developed through high quality research led to the implementation of the Australian Feral Camel Management Project (AFCMP). It describes the timelines and key findings and how the research developed principles that have guided the establishment of policy and subsequent implementation of a management plan to improve management of feral camels.

The one-humped dromedary camel (*Camelus dromedarius*) was first introduced into Australia in 1840, and a further 20,000 were imported between 1880 and 1907. They were well suited to the arid conditions found in remote Australia and were used for riding, and as pack and draught animals. Camels played an important part in the development of remote Australia, but with the advent of the motor vehicle they became redundant and were released into the wild. Since then, their numbers have increased, as has their range. The damage that feral camels were doing was known to people living and working in remote areas of Australia for a long time, but to the bulk of the Australian population it was not a problem – it was 'out of sight, out of mind' and not in their 'backyard'.

In response to a request from natural resource management (NRM) groups in remote Australia, the Desert Knowledge Cooperative Research Centre (DKCRC) submitted, in February 2005, a project funding proposal titled 'Cross-jurisdictional management of feral camels to protect NRM and cultural values' to the Australian Government's Natural Heritage Trust. In June of the same year the funding was announced, and a contract between the DKCRC and the Australian Government was signed in February 2006. The research was undertaken by a multidisciplinary group of scientists, led by Dr Glenn Edwards (of the then NT Department of Natural Resources, Environment, the Arts and Sport), and drawn from state and territory government departments, universities, NRM groups, with a private anthropologist. It was overseen by a steering group that included representatives from government (Australian, NT, SA, WA and Qld) and stakeholder groups (Aboriginal communities, pastoral industry, camel industry, and NRM organisations). The key findings from this research are outlined below, and links are made to the AFCMP.

1.1 KEY FINDINGS FROM 'CROSS-JURISDICTIONAL MANAGEMENT OF FERAL CAMELS TO PROTECT NRM AND CULTURAL VALUES'

1.1.1 DISTRIBUTION, ABUNDANCE AND POPULATION DYNAMICS

The DKCRC research estimated that in 2008 there were approximately 1 million feral camels in arid Australia distributed over an area of 3.3 million km^2 (Figure 1) and they were utilising the entire available habitat. The highest population and density of feral camels was found on Aboriginal land (Table 1). There were a number of caveats placed on this population estimate, particularly associated with the fact that it was based on a limited survey area and surveys in different areas were conducted in different years.

A detailed model of population dynamics, undertaken as part of the research, found that the population was expected to double every nine years based on data for the southern Northern Territory. It was noted that population growth was likely to be restricted by water availability in dry periods.

From science to solutions

The final report recommended that further aerial surveying was required, especially in areas not previously surveyed, and efforts were needed to better understand the factors influencing the movement patterns and population distribution of feral camels at a local to regional scale.

Figure 1: Density distribution (2008) of feral camels across their range in Australia (Source: Edwards et al. 2008[1] p. 3)

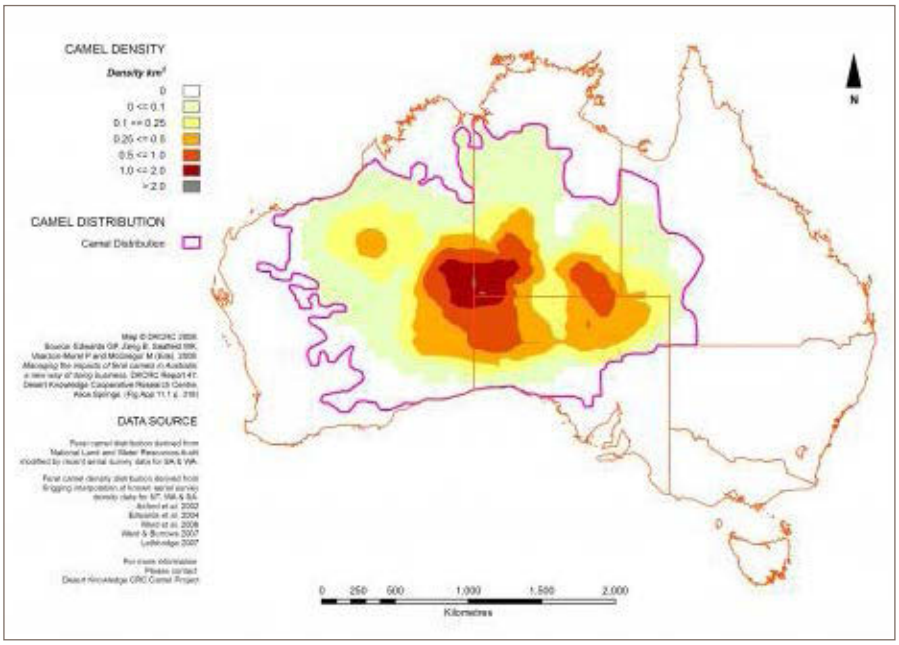


Table 1: Estimated 2008 Feral camel population abundance and density for each major tenure classification (Source: Edwards et. al. 2008[2] p. 13)

TENURE CLASSIFICATION	AREA (KM^2)	POPULATION (%)	DENSITY (ANIMALS/KM^2)
Aboriginal	783,000	415,000 (43%)	0.53
Pastoral	1,399,000	210,000 (22%)	0.15
Vacant Crown Land	813,000	236,000 (25%)	0.29
Conservation/Other	335,000	94,000 (10%)	0.28
Total	3,330,000	955,000 (100%)	0.29

1.1.2 KEY STAKEHOLDER PERCEPTIONS

The research identified that understanding the views of the key stakeholders was a necessary prerequisite to developing an effective framework for the cross-jurisdictional management of feral camels. Three groups – Aboriginal communities, pastoralists and conservation organisations – were approached about their views on the impacts of feral camels and a range of possible management strategies.

Aboriginal people were identified as key stakeholders in the management of feral camels and, as noted in Table 1, approximately 43% of the estimated feral camel population was on land managed by Aboriginal people. The research found that Aboriginal people held a range of views about feral camels. Communities located in high density areas saw a need to harvest

1 The exponential rate of increase of camels in the southern Northern Territory ranged from 0.074 to 0.079.
2 Edwards G, McGregor M, Zeng B, Saalfeld W, Vaarzon-Morel P and Duffy M. 2008. Overview of the project Cross-jurisdictional management of feral camels to protect NRM and cultural values. DKCRC Research Report 54. Desert Knowledge CRC. Alice Springs. http://nintione.com.au/publication/dkcrc-0395

From science to solutions

"I understand camel not belonging to Australia. They are a good animal but too many is too many, and it's hard to control and they move all over the place. It upset me and sometimes it makes me sorry to do what we're planning to do but it is getting out of hand now these days ... They're breeding more than the dogs I think."

Butler Landy,
Senior Martu traditional owner,
October 2010

Full interview: http://www.youtube.com/watch?v=IGcJmh1-9CA

"You know it's good if we can highlight the damage feral camels are doing, and it's not just to the pastoralists – the pastoralists are on the edge of it – it's the impact on the whole ecology out there that we got to get people to understand. That's why we must make such a fight to reduce the numbers."

Robin Mills,
Pastoralist, Warrawagine Station,
October 2010

Full interview: http://www.youtube.com/watch?v=bDLyrlS35Ag

and control feral camels and expressed a growing frustration with the impacts on both physical and cultural assets (see 2.1.1). Most Aboriginal people consulted were not comfortable with killing to waste, and there was a desire to take advantage of any commercial opportunities. A key finding was that there was a lack of detailed and accessible information for people to make decisions with, and when such information was made available they were able to make informed decisions about the need for, and best ways of, managing feral camels. Aboriginal people expressed a desire to be engaged in control methods to protect their cultural assets, pass on knowledge and provide employment for young people.

The survey of pastoralists and conservation land managers found that they supported the need to manage feral camels and were comfortable with using the full range of control methods. They already played an active role in feral camel management and were willing to engage in collaborative control methods in the future.

The research identified the need to develop a two-way communications strategy to disseminate information in culturally appropriate formats to all land managers on feral camels, their impacts and management.

1.1.3 ECONOMIC, ENVIRONMENTAL, SOCIAL AND CULTURAL IMPACTS

The research was able to estimate the economic impacts of feral camels. The economic benefit was estimated at $0.62 million per year (meat and live sales), whereas the costs were estimated to be $11.5 million per year (direct control and management: $2.5m, livestock production losses: $3.5m, infrastructure: $5.5m). A number of non-market impacts were also identified. On the positive side, these included tourism, woody weed control when co-grazing with cattle, and the fact that camels were historically an iconic species. On the negative side, feral camels damaged the environment (damage to vegetation and wetlands and competition with native animals for food and shelter) and social cultural values of Aboriginal people, including causing damage to important waterholes, destroying bush tucker, reducing people's enjoyment of natural areas, and creating danger for driving and when they invaded communities. It was also noted that impacts varied dramatically from year to year, based on seasonal conditions.

1.1.4 EVALUATION OF COMMERCIAL USES

There was recognition that feral camels are a potential source of income; internationally, there is a significant camel industry based on live animals, meat, milk and by-products, leading a number of people to believe that feral camels were a resource rather than a pest. In particular, Aboriginal people saw the utilisation of feral camels as an opportunity for local economic development, employment and empowerment.

In Australia, a camel industry had been emerging for about 20 years, based on export of live animals, meat for consumption by humans and pets, and sales of live animals for co-grazing with cattle for woody weed control in Queensland. The industry was found to be very small; lacking organisation and the suitable capital infrastructure for harvesting, transport and processing; and lacking effective dialogue and consultation with land managers. The costs of harvesting and consolidating animals in remote areas was found to be prohibitive in relation to the value that a market was

prepared to pay and for an industry to be sustainable. Strategic investment in processing facilities was required, as was a move to farming of camels to ensure continuity of supply. Pet-meating was found to be an attractive option because of the low capital infrastructure costs for establishment. The research concluded that commercial uses were a potential adjunct to reducing the impacts of feral camels in targeted areas rather than across their whole range.

1.1.5 EVALUATION OF NON-COMMERCIAL MANAGEMENT APPROACHES, INCLUDING AERIAL AND GROUND CULLING; EXCLUSION DEVICES; AND EXPLORATION OF CHEMICAL, BIOLOGICAL AND FERTILITY CONTROL OPTIONS

The research investigated the following four approaches to reduce feral camel numbers:

a. Aerial culling was the most applicable method for broadscale reduction of feral camel numbers.
b. Ground culling had limited applicability where there was a need to remove a large number of feral camels in areas where access is difficult, but had a role when combined with other management activities and for maintaining low population densities where there were high levels of road access.
c. Exclusion devices were not seen as a broadscale control method, but were applicable to protect sites of high cultural or environmental value, such as waterholes.
d. Chemical, biological and fertility control options (currently available) were not found to have potential.

The need for detailed SOPs, codes of practice (COPs) and animal welfare audits were also highlighted.

1.1.6 REVIEW OF LEGISLATION TO IDENTIFY BARRIERS TO CROSS-JURISDICTIONAL MANAGEMENT

A review of the legislative environment across the Australian and state and territory governments found a range of inconsistencies and 'grey areas' that could have impeded any cross-jurisdictional approach to managing feral camels. The key areas identified were the ownership of feral camels, the legal obligation to control, access to land for control, movement of firearms across jurisdictional borders, fencing of waterholes, and the legal classification of camels (as game or stock). The report recommended the harmonisation of legislation across jurisdictions.

1.1.7 ECONOMIC ANALYSIS OF CAMEL CONTROL IN THE CENTRAL REGION OF THE NORTHERN TERRITORY

This study found that while control costs were high the potential benefits were significant, and a control strategy based on annual removals, rather than periodic removals, was preferred.

1.1.8 DEVELOPMENT OF A FRAMEWORK FOR THE CROSS-JURISDICTIONAL MANAGEMENT OF FERAL CAMELS

This framework, including the development of a multiple-criteria decision-support system to support management decision-making, is discussed in the following section.

From science to solutions

1.2 MANAGING THE IMPACTS OF FERAL CAMELS IN AUSTRALIA: A NEW WAY OF DOING BUSINESS

The key conclusion from the research was that the management approaches being used at the time were largely ad hoc and failed to meet the key criteria outlined in the *2007 Australian Pest Animal Strategy*[3], which focused on adopting a strategic risk management approach coordinated by all levels of government in partnership with industry, land managers and the community. The final report for the project concluded that, ultimately, effective management of feral camels and their impacts will integrate all available control methods, both non-commercial and commercial, and develop a strategic and integrated management framework that works across jurisdictions, tenures, boundaries, and industry sectors and prescribes clear management targets. With this background, the research proposed a 'new way of doing business' based on the following principles:

a. The management of feral camels should focus on the mitigation of negative impacts and not on the reduction of numbers. It was recommended that feral camels should be managed to a long-term target density of 0.1–0.2 camels per km^2 at property to regional scales (10,000 to 100,000 km^2).

b. One size does not fit all situations; in particular, a management program needs to recognise the needs of landowners and communities.

c. Collaboration is required across jurisdictions, tenures, boundaries and sectors.

d. Engage stakeholders in a participatory way so that they take ownership of issues and solutions.

e. Communication is fundamental for success; a communications strategy that encompasses two-way communication and disseminated information in culturally appropriate formats to all relevant stakeholders is required.

f. Address multiple threats.

g. Livelihood development is a legitimate and desirable outcome of managing feral camels. Both commercial and non-commercial management options should look to maximise opportunities for economic development, employment, capacity building and empowerment.

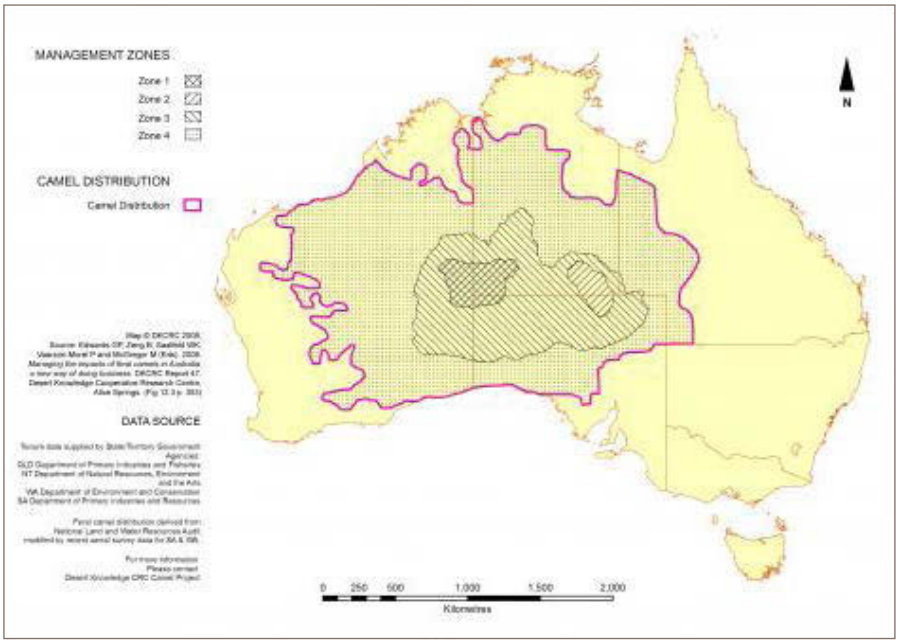
h. A sustained investment model is needed, based on a strategy of annual removals.

These principles were used to develop a framework for the management of feral camel impacts based on four management zones (Figure 2) defined on the basis of feral camel density, assets (biological and physical) under threat, land tenure, and suitable population reduction methods. Zone 1 represented the zone of highest priority. It is worth noting that the DKCRC research identified that there were high densities of camels in the Pilbara (WA) region, but because of poorer data on the area it was included in Zone 4. In the final contract for the AFCMP this area was specifically included because of the high-value refugia found in the Rudall River, De Grey River, and Mandora Salt Marsh areas.

3 Vertebrate Pests Committee. 2007. *Australian Pest Animal Strategy: a national strategy for the management of vertebrate pest animals in Australia.* Natural Resource Management Ministerial Council, Canberra.

From science to solutions

Figure 2: Map showing the distribution of feral camels and the proposed management zones (Source: Edwards et al. 2008[4] p. 19)



1.3 CARING FOR OUR COUNTRY BUSINESS PLAN 2009–10

In March 2009, just after the DKCRC research results had been published, the Australian Government released the 2009–10 Caring for our Country Business Plan[5], including a specific feral camel density target of fewer than 0.1 animals per km^2 at nominated biodiversity refuges. In April 2009, an initial expression of interest was submitted by Ninti One (with 19 initial partners) for an eight-year $56 million project to achieve the density target. In June of the same year, the Australian Government announced an allocation of $19 million of funds to the Ninti One–led partnership. The high levels of collaboration and the national management focus were identified as the reasons for the project being funded. The final contract was signed between the Australian Government and Ninti One in February 2010 for a period of four years and $19 million, in addition to contributions from partners. Due to delayed operations (and therefore expenditure) in 2010–11 due to rainfall, the Australian Government funding requirement was reduced to $15 million (subject to acquittals), despite the project being extended by six months to 31 December 2013.

The focus of the project was to reduce feral camel densities at 18 nominated 'biodiversity refuges' selected because of their high environmental value, particularly during dry periods. The project had a secondary objective: to assist feral camel management on pastoral properties. The density target selected was fewer than 0.1 camels per km^2, which had been defined in the DKCRC research. The priority areas to be targeted were (Figure 3):

- 61,000 km^2 of SA/NT/Qld Simpson Desert region that includes the following refugia: Dalhousie Springs, Goyder Lagoon, Lake Eyre, Lake Eyre Mound Springs, Hay River, and Queensland Channel country

4 Edwards G, McGregor M, Zeng B, Saalfeld W, Vaarzon-Morel P and Duffy M. 2008. *Overview of the project Cross-jurisdictional management of feral camels to protect NRM and cultural values.* DKCRC Research Report 54. Desert Knowledge CRC. Alice Springs. http://nintione.com.au/publication/dkcrc-0395

5 Australian Government Land and Coasts. 2008. Caring for our Country business plan 2009–2010. Department of Sustainability, Environment, Water, Population and Communities, Canberra, ACT; Department of Agriculture, Fisheries and Forestry, Canberra. http://www.nrm.gov.au/funding/previous/business-plan/previous-plans.html

From science to solutions

- 116,000 km^2 of SA/NT/WA tri-state border region that includes the following refugia: Western MacDonnell Ranges, George Gill Ranges, Uluru and Kata Tjuta, Petermann Ranges and Serpentine Lakes.
- 103,500 km^2 of Pilbara region that includes the following refugia: Rudall River, De Grey River, and Mandora Salt Marsh.

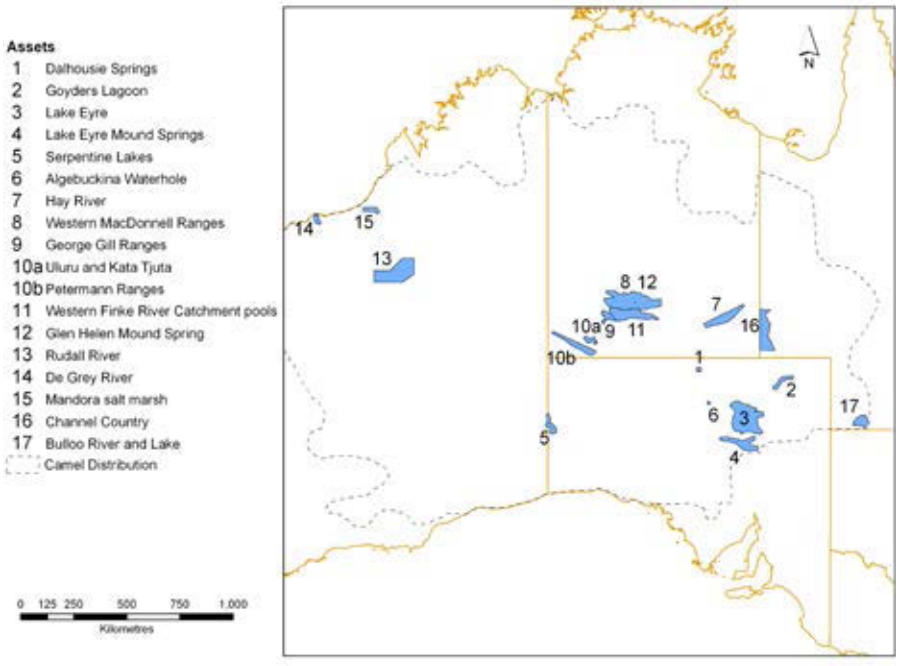
Plus the following four priority inland high conservation value aquatic ecosystems:

- Algebuckina Waterhole
- Western Finke River Catchment pools
- Glen Helen Mound Spring
- Bulloo River and Lake.

There was therefore provision in the contract to modify targets during the project based on improved feral camel density information provided by the project's Annual Works Plans. A broad range of management activities were described, including aerial and ground-based culling, exclusion fencing, trap yards and mustering for commercial utilisation.

The contract required the partnership to engage with land managers to increase their awareness of the impacts of feral camels, but, more importantly, to help them develop ongoing management strategies. There was also a requirement for an active communications plan and a Monitoring, Evaluation, Reporting and Improvement (MERI) plan. The focus of the communications plan was on improving community awareness about the numbers and impacts of feral camels and the costs and benefits of control. The focus of the MERI plan was on effective resource allocation and capturing the project outcomes and achievements.

Figure 3: The 18 environmental sites that were identified for protection from unacceptable levels of feral camel damage under the AFCMP



2. Building the partnership

One of the fundamental principles described in the DKCRC research was that collaboration was required across jurisdictions, tenures, boundaries and sectors. The key to the success of the AFCMP was the high levels of collaboration on a scale and across an area (3.3 million km^2 of rangeland) that has never been previously attempted without the comprehensive legislative support of a program such as the Brucellosis and Tuberculosis Eradication Campaign (BTEC). The project brought together, for the first time in feral camel management, the Australian Government with state and territory governments; Aboriginal organisations; NRM organisations; the pastoral industry; commercial, animal welfare and conservation interests; and research organisations.

AUSTRALIAN FERAL CAMEL MANAGEMENT PROJECT COLLABORATORS

Governments of Australia, Western Australia, South Australia, Northern Territory and Queensland; Central Land Council, Anangu Pitjantjatjara Yankunytjatjara Lands, Ngaanyatjarra Council Inc., Kanyirninpa Jukurrpa, Pila Nguru Aboriginal Corporation, Kimberley Land Council and Western Desert Lands Aboriginal Corporation; South Australian Arid Lands NRM, Alinytjara Wilurara NRM Board, Natural Resource Management Board NT Inc. and Rangelands NRM WA; Northern Territory Cattlemen's Association; Australian Camel Industry Association; RSPCA; Australian Wildlife Conservancy; CSIRO; and Flinders University.

2.1 PROJECT GOVERNANCE

2.1.1 GOVERNANCE STRUCTURE

The scale of the project meant that a strong governance structure was able to be established and full-time staff appointed. It also meant that the project had high-level involvement from the Australian Government. Ninti One, in association with its 19 original partner organisations, signed the Heads of Agreement contract with the Australian Government to manage the AFCMP, thereby making the Board of Ninti One responsible for the management and delivery of the contracted outputs. The project also had access to the expertise of the wider Ninti One management team.

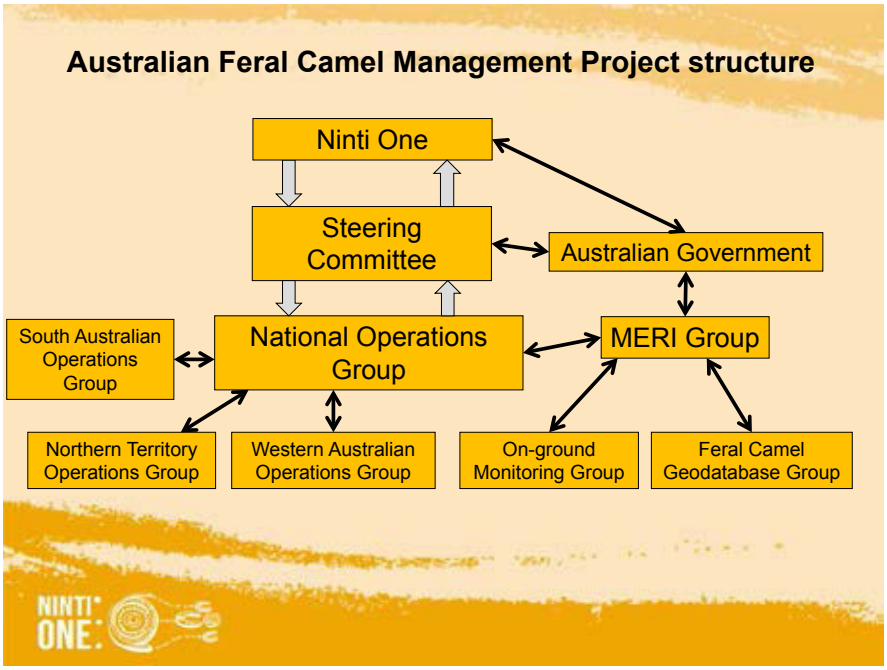
In the contract, the Australian Government stipulated that a steering committee was to be established for the project. This committee was to include 'representatives from relevant State and Northern Territory agencies; the engagement partners, including Aboriginal partners; and a representative of the Vertebrate Pests Committee (VPC). The role of the committee was to provide input into the general project direction, including management/removal methodologies, project planning and implementation and other technical matters; and monitor the complementary activities by States and the Northern Territory'. By the time of the first Steering Committee meeting in March 2010, the membership of the committee had been broadened to include the RSPCA and a representative from the commercial use industry. At the face-to-face meeting in March 2013, there were five participants from the commercial use industry.

The role of the Steering Committee was to review information from the National Operations Group (NOG) and the MERI Group and advise and/or make recommendations to the Ninti One Board on these matters and

Building the partnership

provide advice on position papers and other documents provided directly from Ninti One. Steering Committee members represented project partner issues at meetings and played an important role in disseminating AFCMP information and policy to their respective organisations. The committee was chaired by an independent chairperson with strong governance, management and broad NRM experience. This was important, as it ensured a clear separation between Ninti One and the Steering Committee.

Figure 4: Australian Feral Camel Management Project governance structure



The requirement for a NOG and regional operations groups was identified at the March 2010 Steering Committee meeting, in order to ensure adequate consultation and coordination of operational activities within and between jurisdictions. At the second Steering Committee meeting in June 2010, there was a discussion about whether regional operations groups (e.g. Simpson, Surveyor Generals Corner and the Pilbara) were required instead of, or in addition to, State Operations Groups (SOGs). The conclusion was that it was too unwieldy to have both sets of groups, so SOGs were established to ensure adequate consultation (between government, land managers, commercial use industry and animal welfare interests) within jurisdictions, and there would be a representative from each SOG on the NOG to ensure adequate cross-border collaboration.

The NOG was responsible for quality control of state and territory annual operating plans and their onward transmission to the Steering Committee. NOG members were also on the Steering Committee, and this ensured regular exchange of information between these levels and had an important role in ensuring a consistent approach between SOGs, particularly in relation to annual operating plans and MERI requirements.

The SOGs were responsible for the detailed planning and consultation associated with developing annual operating plans. They also had an important role in disseminating AFCMP information and policy within their

Building the partnership

jurisdictions and in coordinating the reporting requirements associated with the AFCMP progress reports and MERI processes.

The MERI group provided advice on the development and implementation of the AFCMP MERI Plan, and on the research and analysis activities that were not directly supported under the AFCMP but benefited the project. Two technical subgroups were formed to coordinate the feral camel geodatabase (to oversee collection and analysis of data on feral camel population movements and density) and on-ground monitoring activities (to oversee collection and analysis of data on feral camel impacts on water, native animals and vegetation).

The following guiding principles underpinned decisions about the implementation of the AFCMP:

- How and where feral camels are managed is ultimately a landholder decision.
- The focus is on reducing impacts at key environmental sites, rather than on total feral camel population size.
- Collaboration occurs at jurisdiction and land-tenure levels.
- Free and informed landowner (and manager) consents are fundamental to the success of the project.
- 'One size does not fit all'; a tailored feral camel management approach is required at each site.
- Communication is with a broad range of stakeholders to explain the project rationale.
- Animal welfare is paramount.
- The aim is to build capacity for long-term feral camel management.

2.1.2 RISK MANAGEMENT AND COMMUNICATIONS

Given the size and complexity of this project, it was important that comprehensive risk management and communications strategies were developed. The Steering Committee had oversight of both strategies, and the risk management strategy was reviewed at each committee meeting to determine if risk levels had changed and if existing mitigation strategies were adequate. The NOG and SOGs cross-referenced their activities against these strategies.

The comprehensive risk management plan identified, and developed mitigation strategies for, 39 risks associated with governance, removal activities, resources and communication. The overarching risk was the ability of the project to achieve project outcomes in a four-year period, particularly with the first year being a pilot year to test different management approaches. As it transpired, the second year of the project was largely washed out with high rainfall, which resulted in dispersed feral camel populations as well as a lack of ground access for commercial use, and even ground support for aerial culling was hampered. This meant that the bulk of the removal occurred in the last two years of the project. Nonetheless, feral camel density targets have been achieved at most sites, and there is now much greater capacity to reduce these densities further into the future.

Building the partnership

Other key risks identified and managed by the project include:

- the need to maintain a large, diverse and geographically spread collaboration of project partners, participating landholders, governments and industry[6]
- public perceptions about culling of feral animals and animal welfare
- operator and public safety associated with mustering and culling operations
- uncertainty about feral camel movements and population dynamics under different seasonal conditions and in response to removal activities
- capacity issues, ranging from skilled personnel to fuel availability
- costs of sourcing supplies and operating in remote areas.

Communication, both within the project (with partners) and with external key stakeholders, including the broader public, was identified as a key component for mitigation of risk and the overall success of the project. Annual communications plan were developed for the project and overseen by the Steering Committee. The key communication areas were:

- to raise and maintain community understanding and support by increasing the public's awareness of the impacts feral camels cause; this was achieved through a high-quality website presence (now archived), interviews that show key stakeholder perspectives (http://www.youtube.com/user/NintiOne) and 'Camelscan' (http://www.feralscan.org.au/camelscan/)
- effective day-to-day media management, including a critical incident management strategy; regular media updates; and provision of photos, videos and other materials requested by media
- internal (and external) stakeholder relations.

2.1.3 DEVELOPMENT OF INVESTMENT GUIDELINES AND OPERATING PROCEDURES

Following discussions at the second Steering Committee meeting in June 2010, a formal set of 'investment guidelines' was developed to obtain agreement between project partners about the priorities for AFCMP funding support (e.g. proximity of proposed feral camel removal to environmental assets, feral camel density, timeliness and cost-effectiveness of operations, opportunities for long-term capacity building) and the form of removal activities that the AFCMP would support. This was necessary to ensure that funding decisions were made in a transparent way. For instance, early on in the project there was perceived conflict between commercial use versus culling. The AFCMP has supported both, with the ultimate decision about feral camel management in each particular instance being made by the landholder, rather than by the AFCMP. In all cases, a key determinant for the approval of a particular removal activity that the project would support was the ability to verify the effectiveness and humaneness of that removal.

The feral camel removal budget was split into two components: 'proactive', for planned operations as determined in annual work plans; and 'opportunistic', to ensure that some contingency funds were available for unexpected feral camel congregations and/or emergency events.

6 The loss of AFCMP support with a change or potential change of government was a managed risk. The Australian, Northern Territory and Queensland governments changed during the project, with no significant loss of support.

Building the partnership

This was done to recognise the uncertainty about feral camel locations and densities under different seasonal conditions, particularly dry seasons such as those experienced in the summer of 2007/08 and late 2009.

The risk management plan also noted the risks associated with public perceptions about culling and animal welfare and about operator and public safety associated with culling and mustering. The adoption, and contractual enforcement, of a set of SOPs and an overarching COP for the humane control of feral camels was put in place to reduce these risks. While the national VPC had developed SOPs for feral camel removal methods, these were strengthened by the AFCMP with a number of the 'should' statements, being changed to 'must' statements. The project SOPs were used in conjunction with individual state/territory OH&S requirements to specify the way that aerial culling, ground culling and mustering operations were to be conducted to minimise risks to operators and to maximise the humaneness of the operations. Compliance with these SOPs was a contractual obligation under the AFCMP.

An integral part of the SOP process was the establishment of a rigorous training, auditing and verification process against the SOPs to ensure compliance. The project's assessment of aerial culling and mustering operations by feral camel experts and independent veterinarians is the most comprehensive assessment ever conducted for feral camel (and probably all feral herbivore) removal in Australia. This process was overseen by the RSPCA and has been promoted as a model for other feral herbivore removal operations. A number of training materials were produced, such as the Best Practice Camel Book by Rural Solutions South Australia which uses cartoons, drawings, diagrams and photographs (Figure 5) to describe the COP for the humane control of feral camels and the SOPs for mustering and ground-culling of feral camels. These have been used extensively in Aboriginal communities as a reference point and training aid.

Figure 5: Extract from the Best Practice Camel Book (Source: Feldmuller et al. 2012[7])

7 Feldmuller M, Gee P, Pitt J and Feuerherdt L (Eds.). 2012. *Best practice camel book. An illustrated guide to the 2012 Australian Standard, Model code of practice and Standard Operating Procedures relevant to the humane control of feral camels*. Edition 1. Prepared for the South Australian State Feral Camel Management Project. Rural Solutions South Australia, Adelaide. Available as pdf download in two parts: http://solutions.pir.sa.gov.au/__data/assets/pdf_file/0014/172040/Final_May_22_Bes_Practice_Camel_Book_web_part1.pdf; http://solutions.pir.sa.gov.au/__data/assets/pdf_file/0015/172041/Final_May_22_Bes_Practice_Camel_Book_web_part2.pdf.

Building the partnership

It is important to highlight an important link between the AFCMP and the national VPC. The Australian Government required a member of the VPC to be a member of the Steering Committee (see section 2.1.1). This allowed open sharing of information between the groups and provided a further benefit, as Dr Glenn Edwards, the NT Government representative on the VPC and the AFCMP Steering Committee, was also tasked with tracking progress against the National Feral Camel Action Plan (NFCAP) on behalf of the VPC. Such partnerships are important to successfully managing established pest animals of national significance across land tenures and jurisdiction borders. The AFCMP has demonstrated to the VPC that it is possible to establish and manage large-scale cross-jurisdictional projects and link their SOPs and COPs to a sound contracting and verification process.

2.2 ENGAGEMENT OF LANDOWNERS AND MANAGERS

The engagement of landowners and managers was fundamental to being able to undertake feral camel removal operations. Without their support, there would not have been a management program, and a truly regional and cross-border approach to NRM would not have been possible. Extensive landholder and Aboriginal community consultation was undertaken by the project, and, while this may have taken time, it ensured that feral camel removal operations had a solid foundation and will continue to into the future.

2.2.1 TRADITIONAL OWNERS

Aboriginal people were identified by the DKCRC research as key stakeholders in the management of feral camels because approximately 43% of the feral camel population was estimated to be on Aboriginal managed land at the time. The research also highlighted that 'one size does not fit all' in terms of acceptable management options, and that there was a lack of detailed and accessible information available for communities to make decisions.

The AFCMP has undertaken extensive consultation with Aboriginal Traditional Owners and communities across the feral camel range, explaining and establishing the impact of feral camels on the community and cultural assets as well as on biodiversity in general. A full understanding of the impacts of feral camels is necessary, as well as an understanding of the options available to manage feral camels. A key to the process was the engagement of the Aboriginal representative bodies as partners in the project but also as facilitators of the consultation, planning and implementation of management actions. Three examples of the consultation processes are highlighted in the three boxed case studies below:

- **Case study 1: Martu consultations**
- **Case study 2: Anangu Pitjantjatjara Yankunytjatjara consultations**
- **Case study 3: Central Land Council consultations**

Building the partnership

Each of the cases describes the particular approach that was most suitable for each situation. There are, however, some key themes that are common across all approaches:

- The process takes time to enable true consultation.
- It is important to give Traditional Owners and community members information about the population and population dynamics of feral camels. The Martu (Case study 1) and Central Land Council (Case study 3) cases describe the use of rice to explain this dynamic.
- One size does not fit all. The three case studies show that the Martu had few, if any, options for commercial use, but the APY communities had a policy of 'no shoot-to-leave' and were interested in developing the commercial use of feral camels to satisfy employment and income objectives. Proximity to an abattoir meant that commercial use was feasible for them. In the Central Land Council case, both aerial culling and commercial uses were undertaken.
- Although not documented in the case studies, an important consultation tool was taking Traditional Owners to country, either by vehicle or helicopter (on 'look around' flights). Getting Aboriginal people up into helicopters served a number of purposes: it provided them with access to remote sites (often inaccessible by road), which in many cases they had not visited for a considerable time, to show them what the impact of feral camels had been on waterholes in particular; and a second major benefit was that it allowed the accurate identification and mapping of 'no go' areas for aerial culling operations, so that animals were not culled in places of social or cultural significance.
- Employment was identified as a key objective for communities; to this end, the AFCMP worked closely with communities to identify local employment opportunities and implemented training and mentoring activities to maximise opportunities. Strong links were made with ranger groups, and they were contracted to undertake monitoring as part of the project's MERI program. The monitoring, ground culling, butchering and mustering skills are an enduring benefit from the project and will be important for ongoing local management of feral camels post-AFCMP.

Case study 1

"I understand camel not belonging to Australia. They are a good animal but too many is too many, and it's hard to control and they move all over the place. It upset me and sometimes it makes me sorry to do what we're planning to do but it is getting out of hand now these days ... They're breeding more than the dogs I think."

Butler Landy,
Senior Martu traditional owner

Full Interview: http://www.youtube.com/watch?v=IGcJmh1-9CA

Case study 1: Martu consultations

Source: Peter See, Chief Executive Officer, Kanyirninpa Jukurrpa

Over an 18-month period from early 2008 to late 2009, Kanyirninpa Jukurrpa (KJ) began their own discussions with the Martu people about dealing with feral camels, independent of the AFCMP. The discussions were prompted by a number of events, including:

- concerns by Martu elders that country, and in particular waterholes, were being heavily impacted by feral camels
- concerns about infrastructure impacts being expressed by neighbouring pastoralists to the Western Australia Government Department of Agriculture and Food (DAFWA)
- subsequent draft proposals by DAFWA to cull on Martu lands
- representations by the then Western Australia Government Department of Environment and Conservation (DEC) to KJ about the issue.

Martu concerns resulted in many informal discussions with KJ about feral camels and the cultural sensitivities of culling animals without using them for some benefit, for example, for food or as a source of revenue. Martu preference was to, where possible, make money from the many feral camels they were increasingly seeing on their country.

At the same time, KJ was successful in seeking funds to develop a feral camel management strategy, as part of other land management activities, through the first round of Caring for our Country.

Following discussions with DEC and DAFWA, KJ developed a formal consultation process, which involved an initial information session with a broad range of stakeholders followed by individual meetings in each Martu community.

The information session was held in Newman and included KJ, DEC, DAFWA, pastoral representatives and Martu from each community. This one-day session exceeded everyone's expectations, with discussion flowing about feral camels, the impacts they were having on different stakeholders, the ways of managing them, and the costs and removal rates of various options. The session also provided an opportunity to collect information and trial workshop techniques that would be used later, including the innovative use of rice to represent feral camels and removal numbers on a map of the Martu native title determination.

Case study 1

Attendees at the information session in Newman

What was equally important was that the initial information session provided a strong foundation for ongoing partnerships between the stakeholders that exist to this day.

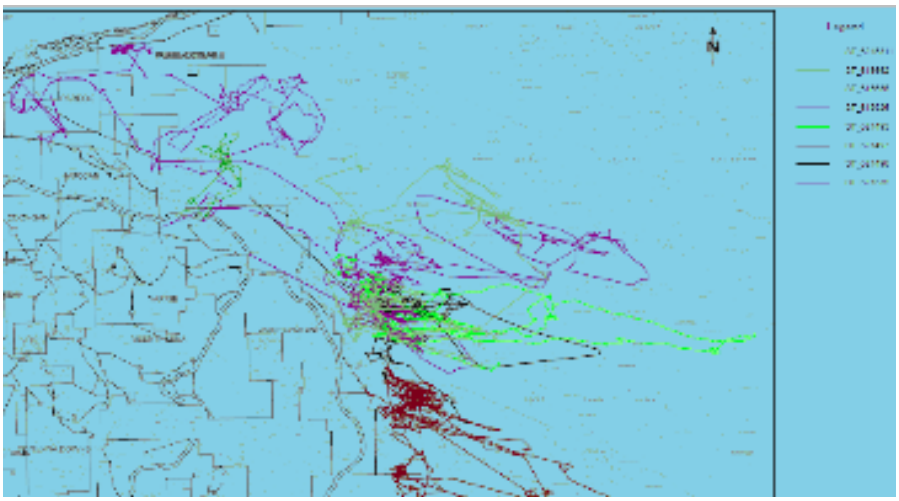
The community meetings were attended by representatives from DEC and DAFWA and were facilitated by KJ. There were variable attendances at each meeting, but all engaged well with the Martu and used a range of techniques to promote discussion. These included:

- asking people to guess how much water feral camels can drink and then showing the actual amount as a number of jerry cans
- showing photos of waterholes, destroyed vegetation and damage in communities as examples of what feral camels do and how bad it can get
- using the Tangentyere Landcare Camel Book (http://www.schools.nt.edu.au/tlcland/publications/Camel%20Book.pdf) to show pictures of how widespread feral camels are and making the connection between feral camels and the loss of bush tucker of interest to Martu
- distributing satellite tracking maps showing how far feral camels can travel
- putting a map on the ground and emptying half a bag of rice on the Martu lands then explaining that in eight years time, if nothing is done, the number of camels will double – and then emptying the rest of the bag on the map
- removing piles of rice (in varying sizes) as the different options for managing feral camels were discussed
- comparing the small piles of rice with a pile representing all the new feral camels expected to be born each year.

What became clear to people was that they had to choose between looking after feral camels or looking after their country, and that around the Martu determination, the most effective way of managing feral camels was with aerial culling.

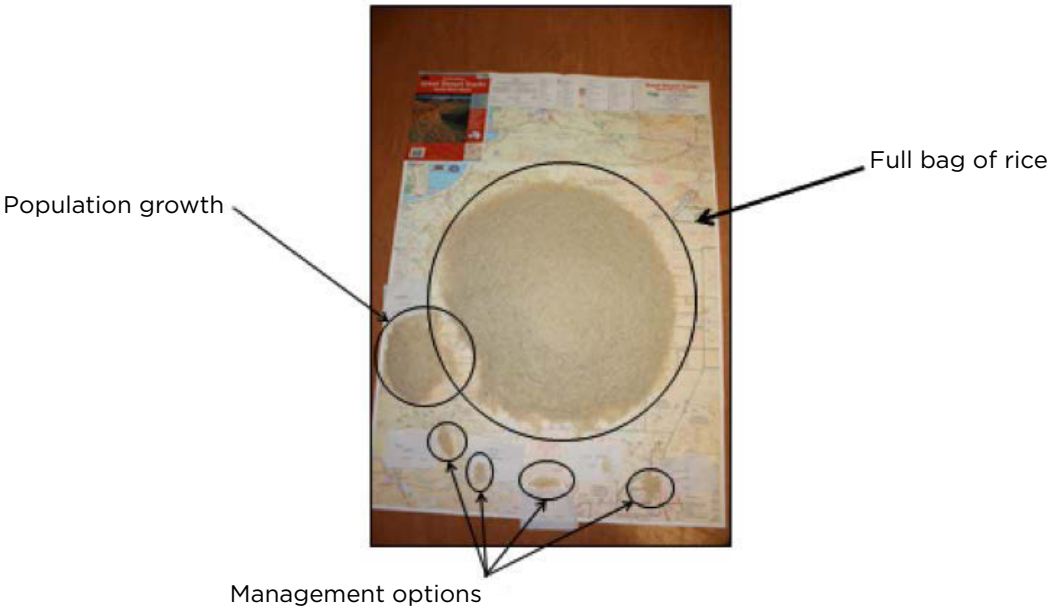
Case study 1

Prompts for the discussion about how much feral camels drink



Satellite tracking of feral camels in the north of the Martu determination

Due to the distance from abattoirs, minimal roads, accessibility issues and general remoteness, other options were dismissed as not being financially viable or effective in quickly reducing the numbers of feral camels. The potential exception to this was around communities and the main roads through the Martu determination. The consensus was to focus the aerial culling effort on the remote areas, unless there was a specific request to operate closer to communities.



The community meetings were followed by another meeting in Newman, of only Martu representatives, that prepared a number of recommendations to be considered at the Western Desert Lands Aboriginal Corporation (WDLAC) Annual General Meeting in September 2009. WDLAC is the prescribed body corporate for the Martu determination.

Following more discussion at the 2009 AGM it was resolved that:

- Martu will decide on how to manage feral camels and donkeys on their country.

Case study 1

- If Martu do nothing, then the country will get sicker and sicker.
- Martu should look after feral camels around communities, for example, by rangers shooting them and bringing food back to the elders; pet-meating operations, or other business opportunities.
- In remote country away from roads, Martu will work with governments to use helicopters to shoot feral camels and donkeys.
- Shooting by government mobs should not be near communities, roads, water sources or Jukurrpa (cultural) sites unless Martu agree.

At the same time that KJ was progressing the feral camel consultations with Martu, it was approached by Ninti One to be involved with an application to Caring for our Country for what was to be known as the Australian Feral Camel Management Project (AFCMP). Due to Martu sensitivity towards culling, KJ declined to be a partner with the initial application until the consultation process had been finalised.

Once Martu had resolved that aerial culling was an option they were prepared to pursue, a representative of WDLAC, with support from KJ, joined the national Steering Committee of the AFCMP. Negotiations with DAFWA, DEC and the AFCMP also occurred for the first aerial cull to be conducted in late 2009. The rangers and other Martu representatives were involved with fly-overs to determine go/no-go areas for culling, using a light plane and GPS technology. The no-go zones extended standard buffer areas around communities, waterholes and roads.

In the following years, KJ and the Martu rangers were also involved in other activities such as:

- assisting with the satellite collaring of feral camels to aid tracking
- searching for and retrieving stationary satellite collars
- increasing capacity to locally manage feral camels by acquiring appropriate calibre firearms and gun safes, and obtaining a corporate licence and training in the use of firearms to humanely destroy large herbivores such as feral camels
- on-ground culling of feral camels along roads for local food consumption or to generally reduce numbers closer to communities
- facilitating and/or participating in the monitoring of the impact of feral camels on vegetation and water in and around Karlamilyi National Park.

Since the commencement of the AFCMP there have been approximately 25,000 feral camels removed from in and around the Karlamilyi National Park, which is located in the middle of the Martu determination.

The impact on the general health of Martu country as a result of the feral camel management activities has been significant and has been noticed by the rangers and Martu generally: waterholes are staying cleaner and fresher for longer; there are now few, if any, vegetation impacts, even on species preferred by feral camels; and the general number of feral camels seen on the Martu determination is noticeably less than prior to the AFCMP.

With the finalisation of the AFCMP in December 2013, KJ intends to continue to control feral camels by contracting DAFWA to undertake annual aerial culling. However, the extent and range of the culling may be less than that available under the AFCMP.

Case study 2

Case study 2: Anangu Pitjantjatjara Yankunytjatjara consultations

Source: Phil Gee, Rural Solutions South Australia

Parts of the APY Lands were identified by the DKCRC and other research as having high densities of feral camels. Feral camels were known to migrate and congregate near permanent waters in the ranges that extended east–west across the north of the APY Lands, causing significant damage to culturally and environmentally important sites. There had also been a continuing problem of feral camels invading communities and threatening significant infrastructure, such as sewerage ponds, swimming pools, bores, tanks and water reticulation systems. When feral camels entered communities, they often caused fear and stress for the people as well as causing damage to home air conditioners and fences and spoiling the settlements with faeces and urine. They were also known to force the closure of airstrips, which are essential for emergency services.

The *Anangu Pitjantjatjara Yankunytjatjara Land Rights Act (1981)* includes a statutory obligation for the APY Executive Board to consult with its member communities on major decisions associated with land management. There is an established Land Management Unit which has a stated role of 'creating opportunities for employment in natural resource management and enabling the sustainable use of the natural resources for economic development – in both the traditional and contemporary sense' (http://www.anangu.com.au/land-management.html). A key decision made by the APY Executive Board was a 'no shoot-to-leave' policy for the Lands. As part of the employment and income generation objectives, there has been a history of the APY communities mustering and selling feral camels to be processed at the abattoir in Peterborough in mid-north South Australia (and previously Strathalbyn, south of Adelaide).

When there has been significant movement of camels into the Lands threatening pastoral and community assets, such as 2007/08 and 2009, the APY Executive Board has sought funding to manage the situation but found that the only funding available before the AFCMP was for shooting to waste, which was against their 'no shoot-to-leave' policy. In 2007/08, the combination of APY Land Management workers (supported by community members) and the assistance of rain were able to turn back the tens of thousands of feral camels threatening to damage pastoral and community assets.

In late 2009, feral camels again posed a problem and the APY Executive Board, in an emergency meeting, made a decision to provide watering points near communities and then to muster, drive and habituate the feral camels to the new water. At that meeting they reaffirmed their 'no shoot-to-leave' policy. Discussions between the APY Executive Board and the AFCMP had commenced at the time of the 2009 emergency and it was clear from the start that the removal of feral camels from the APY lands needed to be based on the provision of employment and income-generation activities and linked training.

Case study 2

With this background, the AFCMP, through the then Primary Industries and Resources South Australia (PIRSA), negotiated a package that included a 'removal assistance' payment of $52 per head for all feral camels transported to the abattoir (later changed to $78 per cow), verified by trucking records and random audits of trucks travelling to the abattoir and abattoir receipts. The shift to a 'per cow' payment reflected the need to target removal of females from the herd in order to have a greater impact on the feral camel population. The engagement of AFCMP in APY commercial use activities provided the opportunity to build capacity through training programs in improved mustering, holding and loading practices; and to improve the safety, humaneness and efficiency of operations based on the COP and SOPs of the AFCMP. This has established a platform for the ongoing responsible engagement with commercial removal in the APY Lands.

This model has been successful in removing around 15,000 feral camels from the APY lands, reducing both the environmental and social impacts and providing employment and income for the communities of the APY lands. It has been estimated that over the life of the AFCMP, the removal of feral camels has contributed $12 million in meat sales and $1.24 million in gross returns to communities in the APY lands and 11 full-time equivalent jobs[8] over the four years of the project. In addition, a further $1.8 million has been contributed to the South Australian stock transport industry. Of equal importance are the many social benefits that have resulted.

8 Estimate based on five teams of five people, each working 100 days to muster 15,000 camels.

Case study 3

Case study 3: Central Land Council consultations

Source: Jude Prichard, Feral Animal [Camel] Education Officer, Central Land Council

In January 2009, before the commencement of the AFCMP, the Central Land Council (CLC) appointed a Feral Animal (Camel) Education Officer who had begun to investigate, with Traditional Owners, the impacts of feral camels on country. This work dovetailed well with the DKCRC feral camel research released in 2008, and the Indigenous Protected Area (IPA) development work being conducted in the Southern Tanami and Katiti/Petermann Aboriginal Land Trusts. Survey work with Traditional Owners, their families and rangers on country revealed that feral camels were responsible for considerable environmental impacts, but the CLC had very little capacity or budget to respond to the scale of the problem.

To give some context, it is important to note that the ease with which most Australian freehold landowners can make decisions and exercise autonomy over their property is not shared by Traditional Aboriginal Owners of freehold land in the Northern Territory (408,000 km^2), where land is collectively owned. The *Aboriginal Land Rights Act (Northern Territory) 1976* sets out the function and responsibilities of the CLC to (among other things) consult Traditional Aboriginal landowners, protect their interests, and get consent before taking action affecting land. Additional legislation applies to the protection of sacred sites and the issuing of clearance certificates that ensure Traditional Owners have been consulted and have given consent to the proposed work, and that sacred sites will be protected during that work.

The process to get consent is familiar to many Traditional Owners. It involves taking a proposal to the identified Traditional Owners of the affected country, outlining what is proposed, what is known and what is unknown about the proposal, and facilitating discussions and decision-making.

With the success of the Ninti One bid for the AFCMP, the CLC was able to invest the resources necessary to begin the consent and clearance processes necessary for broadscale feral camel management. The following process was described by one exhausted anthropologist as 'bigger than that applied to the Alice Springs to Darwin railway line'.

Over 30 meetings for consent to manage feral camels were held between June 2009 and May 2012. Nearly all these meetings occurred on country and, where possible, were aligned with mining meetings to get the greatest attendance. The presentation at these meetings discussed concepts of feral animals, populations, densities, projected increases and known impacts. Rice was used to model feral camel numbers – an idea borrowed from Peter See and the Martu (see Case study 1) – and it worked well, much better than the pellets of camel manure first used!

These presentations were well received. Often they produced anger or sadness, and the telling of personal stories. One lady described her first experience of feral camels, and her father being led away in a chain

Case study 3

of men with handcuffs on. Some meetings had hilarious and insightful commentary. When a man referred to his concerns regarding the biblical relationship of camels to the wise men, a woman responded that 'in those days they didn't have cars. Camels: they were like V8s'. Another man said that he had first travelled with camels between missions and had shown them all his waterholes and they were still coming back.

These meetings agreed that:

- Feral camel numbers were growing.
- Feral camel damage was getting worse and was present at more sites. In particular, people were seeing some plants eaten out; there were more car accidents; and there was increasing damage to outstations and fences.
- Feral camels needed to be stopped from spreading out and finding new country and water places.
- CLC should work with government to bring the number of feral camels down and stop the number growing.
- Feral camel management was not short term – it will go on forever.
- Aboriginal people should take part in feral camel management on their country.

A large three-colour poster (see page 23) was used to describe the known methods and timeframes of removing feral camels from country: harvesting (commercial companies); aerial shooting (government); and community management methods (rangers and owners, mustering, shooting, fencing and trapping). Community members strongly stated that feral camel management would need to be perpetual and that they were the best placed people to continue this work.

The hopes expressed by Traditional Owners were that by managing feral camels:

- People would feel safer on country.
- There would be no more car accidents with feral camels.
- Water sites would retain water over summer.
- Waterholes would show more native animals visiting them, like kulaya (emu), waru (rock wallaby) and malu (kangaroo).
- There would be no more dead feral camels and horses at waterholes and in communities.
- People could swim safely in waterholes.
- There would be more 'kuka' (game species) on country and more camel meat will be eaten on communities.

WITH CONSENT TO MANAGE FERAL CAMELS

With AFCMP support, the CLC negotiated five individual harvest agreements and undertook extensive sacred site clearance work with Traditional Owners to identify where activities could occur and what areas needed to be avoided. Frustratingly, none of these agreements were enacted by commercial industry contacts. The reasons given were 'too many feral camels'; 'not enough feral camels'; 'no equipment'; 'not enough

Case study 3

-Planning ways to bring camel numbers down

We have 4 to 8 years to bring numbers down. There are quick ways, and slow ways depending on how many camels are on your country.
But camels will be here forever- so even when we bring the numbers down, we need to find ways of removing some, every year, forever.

Timeline	now	1 year	2 years	3 years	4 years	5 years	6years	7	8	forever
Phase 1										
Phase 2										
Phase 3										
Phase 4	do nothing =	More Animals that belong here, many of them kuka may disappear. There may be more car accidents with camels. Communities infrastructure and outstations with water supplies may be damaged.								

This meeting is about asking consent for different ways of removing camels, some might be managed by Land Council, some by outside companies.
Land Council will get sacred site/work area clearances to identify where people can work on the ground.
Land Council will check that the idea for removing camels is reasonable and the company honest. Anyone removing camels will still need a permit.
If you give consent Land Council will not come back to check with everyone about different peoples proposals, but we will send notices around about what's going on. At all times Land Council will try to negotiate maximum local employment and benefits.

	Proposals		Consent √	Consent x	Notes
Phase 1 Harvesting Give licences to take camels for meat	**i. Aerial muster** using portable yards, butchery, fridge trucks, burial of waste, local jobs . part of proposal. ? per head- up to $3,200 per week. Maybe only 1 year in region. Mobile camps. High end operation- very risky.	  			
	ii. Small operators might be a few teams - car based shooting and boning out on country, ? per head. Waste left on country. Ngaanyatjarra Council are working like this.				
	iii. Live removal using vehicle or aerial muster. 3 written proposals so far- Arnhem Meats and Donald Fraser, Dennis Orr	 			
Government Lands and Pastoral Lands are going to be culling over the next 1 – 8 years, as part of the Caring for Country Program. Next year Land Council will be asking all Land Trusts to support culling/killing so that we all help reduce the camel problem across Australia. When numbers are high-aerial culling -away from communities and roads is most suitable –as camel numbers come down ground based shooting might be the only way we can remove camels, fast enough to stop them breeding up again.					
Phase 2 Planned Culling - Killing ***Shooting without consent on Aboriginal Land is illegal. This is on permits.***	**i. Aerial culling** This is fast and accurate. The shooter is highly trained. Conditions would be- away from roads , water places and communities . Camels are left on country. This method might be used to muster camels out of the community –if their numbers build up enough.	 			
	ii. Ground based culling/ shooting Semi automatic shooter with driver/TO -while numbers are high. -when numbers build up at known places. - when animals are dying Rangers and local teams can be trained for this work.	 			
Phase 3 Ongoing camel removal plans	**i. Camel patrol** Trial program where each region has 4 people trained to humanely shoot camels. Carcasses would be pulled away from roads. If there are more than one, they would be pulled together. About 6 weeks work each year working to a land management plan and responding to emergencies. Nyirripi and Tennant?	 			
	ii.. Water based trap yards- Up to 5 in the south west region. CLC would own traps. The community could operate them or rent them out. Any camels caught can be used for meat, pet meat, live removal. Camels are a PEST animal, If you cant find a buyer you may kill them.	 			
	iii.. Community killing and butchering camels -Butchery training for young people - Using a .308 to safely kill camels. Other feral Animals				**Who is not at this meeting who we should talk to?**

Case study 3

Left to right: Byron Ratara, Randal Butler, Dennis Minor, Walter Jugadai and Malcolm Kenny

money'; 'not enough transport'; 'not enough time'. A large agreement to harvest feral camels for dog food was abandoned when it was suggested that a plant camels might eat, called *Indigofera linnaei*, could make the meat poisonous to dogs.

Permission was given to aerial cull in most areas, with cull exclusion zones around roads, communities, sacred sites and outstations. Maps to guide culling were produced by anthropologists through field trips with Traditional Owners. These trips were an opportunity for families to locate and look after cultural sites that were hard to access without vehicle or aerial support.

Skills development, employment and asset building for feral camel management were high priorities for Traditional Owners. The CLC negotiated support from the AFCMP for three strategies for local camel management: installation of waterpoints; development of a pilot ground-based shooting and butchery program; and development of Aboriginal people's capacity to engage in feral camel mustering.

An additional Feral Camel Management Officer (Chris McGrath), two Tjuwanpa Rangers (Byron Ratara and Malcolm Kenny) and a Mentor (Dennis Orr), with extensive experience mustering feral camels, were engaged to support and mentor sixteen Aboriginal rangers in mustering skills. Three sets of portable yards were purchased and regionally located to reduce the costs and time of carting equipment from town. Five musters and one trapping event were conducted during the program, removing a total of 819 feral camels. A lot was learned about the effort, costs and limitations of this work.

Eighteen rangers were trained in firearm use to attain their Employee Firearms Licenses as part of the ground-based shooting training program. Four rangers were identified from this training and mentored as marksmen.

Five waterpoints were set up in strategic places to take the pressure off communities and culturally important waterholes and increase the ability of local people to trap or muster camels. Remote cameras were set up to see how these waterpoints altered camel behaviour.

The CLC continues to learn and adapt these strategies and circulate that information back to Traditional Owners via meetings, newsletters and ranger engagement.

CLC rangers have also worked with the AFCMP MERI scientists, undertaking monitoring to build a better understanding about the impacts of feral camels on country and the ecological benefits derived from reducing feral camel numbers. Some of the monitoring activities undertaken were:

- the study of plants to see how much browsing they can survive
- the taking of water samples to see what lives in the water, if it is healthy, and how quickly it gets polluted, evaporated and drunk by feral camels
- setting up cameras on waterholes to see what uses the water.

Case study 3

Looking to the future, the CLC priorities can be summarised as:

- Continue to work with Traditional Owners to maintain an understanding of feral camel impacts and optimise the efficiency of feral camel management methods.
- Prevent the feral camel numbers building up again by setting regional targets to remove feral camels through mustering, trapping and shooting.
- Continue to develop and further refine the feral camel management methods established during the AFCMP.
- Monitor newly established alternative waterpoints to see how they can be used to influence the behaviour of feral camels.
- Prevent populations developing in new areas.
- Prepare for potential feral camel incursions at Docker River (in south-west NT, near the WA border) each summer.
- Extend the feral camel management work to engage Aboriginal communities with the conceptualising and management of other feral animals, such as bullocks and horses.

Building the partnership

Liz Bird and her husband David run 3,000 head of cattle on the 3,000 km² Indiana station, located just north of the Simpson Desert in the Northern Territory, where feral camels are a big issue.

"The Australian Feral Camel Management Project allowed landholders to take back some control over their lands. Millions of dollars in damage to infrastructure and much time have been spent trying to manage these animals; this has been very costly and heartbreaking in the past 20 years. An approach across all lands and states was needed to really make some impact in reducing the numbers to a manageable level."

2.2.2 PASTORALISTS

The DKCRC research identified pastoralists as key stakeholders in the management of feral camels, because approximately 22% of the feral camel population was thought to be on pastoral properties. The average density of feral camels on this land tenure was assessed to be approximately 0.15 per km², the lowest of the four landholding classifications. The lower densities are due to pastoral properties being on the periphery of the feral camel range and more intensive management of feral camels by pastoralists. The research found that there was strong support for a project to manage feral camels because of the significant damage they were doing to property infrastructure and competition for feed with cattle.

The southern Northern Territory was a focal area because there were substantial numbers of feral camels coming onto pastoral properties during prolonged dry periods, causing significant damage to infrastructure and competing with cattle for feed. The AFCMP worked closely with the Northern Territory Cattlemen's Association (NTCA), a partner in the AFCMP, to develop an engagement strategy for the project. A key component in the relationship was the appointment of a pastoralist (Liz Bird) to represent the NTCA on the Steering Committee and the Northern Territory Operations Group. In addition, this role acted as a direct liaison position actively managing information flows between the AFCMP and the pastoral community (mainly NT). This link was important in developing an understanding of the project by pastoralists but also in providing the project with accurate and timely intelligence on the presence (or absence) of feral camels and current levels of damage on pastoral properties.

Case study 4

Case study 4: Emergency cull highlights improved capacity under the Australian Feral Camel Management Project

Source: Lyndee Severin, Curtin Springs Station; Donna Digby, NT Dept of Land Resource Management

Curtin Springs Station encompasses over 4,040 km^2 and is located on the Lasseter Highway, approximately 85 km east of the entrance to Uluru–Kata Tjuta National Park and 360 km south-west of Alice Springs in the Northern Territory. The station has been owned and operated by the Severin family since 1956. The station borders the Petermann Aboriginal Land Trust (to the west), Katiti Aboriginal Land Trust (to the north), Mulga Park Station (to the south) and Angas Downs and Lyndavale stations (to the east).

At a landscape scale, this area supported the highest density of feral camels in the NT at the commencement of the AFCMP (1–2 feral camels per km^2). Curtin Springs Station has no western boundary fence, and, even where boundary fences are in place, they are often breached by feral camels. Hence all neighbours need to work cooperatively to drive regional feral camel densities down, and a key purpose of the AFCMP has been to achieve an enduring collaborative approach.

Over the last decade, the continuing presence and associated impacts of feral camels on Curtin Springs Station has been a strong consideration in the decision-making process with respect to management of the station. The Severins are committed to meeting their legal obligation to control feral animals on their property and actively control feral camels on their station at every opportunity. During 2011/2012, approximately 27,000 camels had been culled during aerial operations under the AFCMP on the Petermann ALT, the Katiti ALT and Curtin Springs Station (as of September 2013, this figure had increased to over 45,000 camels).

The Severin family has always kept meticulous records of the location, number and demographics of feral camels controlled on their property. In early December 2012, there were increased sightings of feral camels and camel tracks on Curtin Springs Station. There was a commensurate increase in damage to fence lines. Throughout December, the station provided weekly updates, to both the AFCMP and the NT Government, on feral camel group size, demographics and movements (see map below provided on 9 December 2012), as well as damage to fence infrastructure. Images from two Bushnell remote sensor cameras (see photo on page 28), which were set up at key sites on the station, were used to help document feral camel mob sizes at this time.

Ground-based reconnaissance confirmed that there was a steady increase in the number of feral camels on Curtin Springs Station during the final weeks of 2012. They were concentrated on green pick that had developed following rainfall across a very narrow strip (10 km wide) on the edge of burnt country in the south of the station. Ground-based attempts to reduce the number of feral camels were having little impact on the developing population (245 feral camels were ground-culled by Curtin Springs staff in the last week of December).

Case study 4

ASSESSING THE COMMERCIAL USE OPTION

Commercial use was investigated; however, very few of the animals met the buyer specifications of large animals or yearlings, and it would be approximately four weeks before any mustered camels could be transported, which meant holding animals for a long period in extreme temperatures with feed not readily available. The situation was considered urgent by the end of December, with damage to fences occurring daily and remaining pasture under threat.

THE EMERGENCY CULL RESPONSE

On 1 January 2013, the Severins contacted the NT Government and the AFCMP to inform them that the feral camel situation on Curtin Springs Station was serious, with major damage being caused to both infrastructure and scant pasture resources. Following further clarification of the situation by phone, the NT Government decided that an emergency aerial cull was warranted.

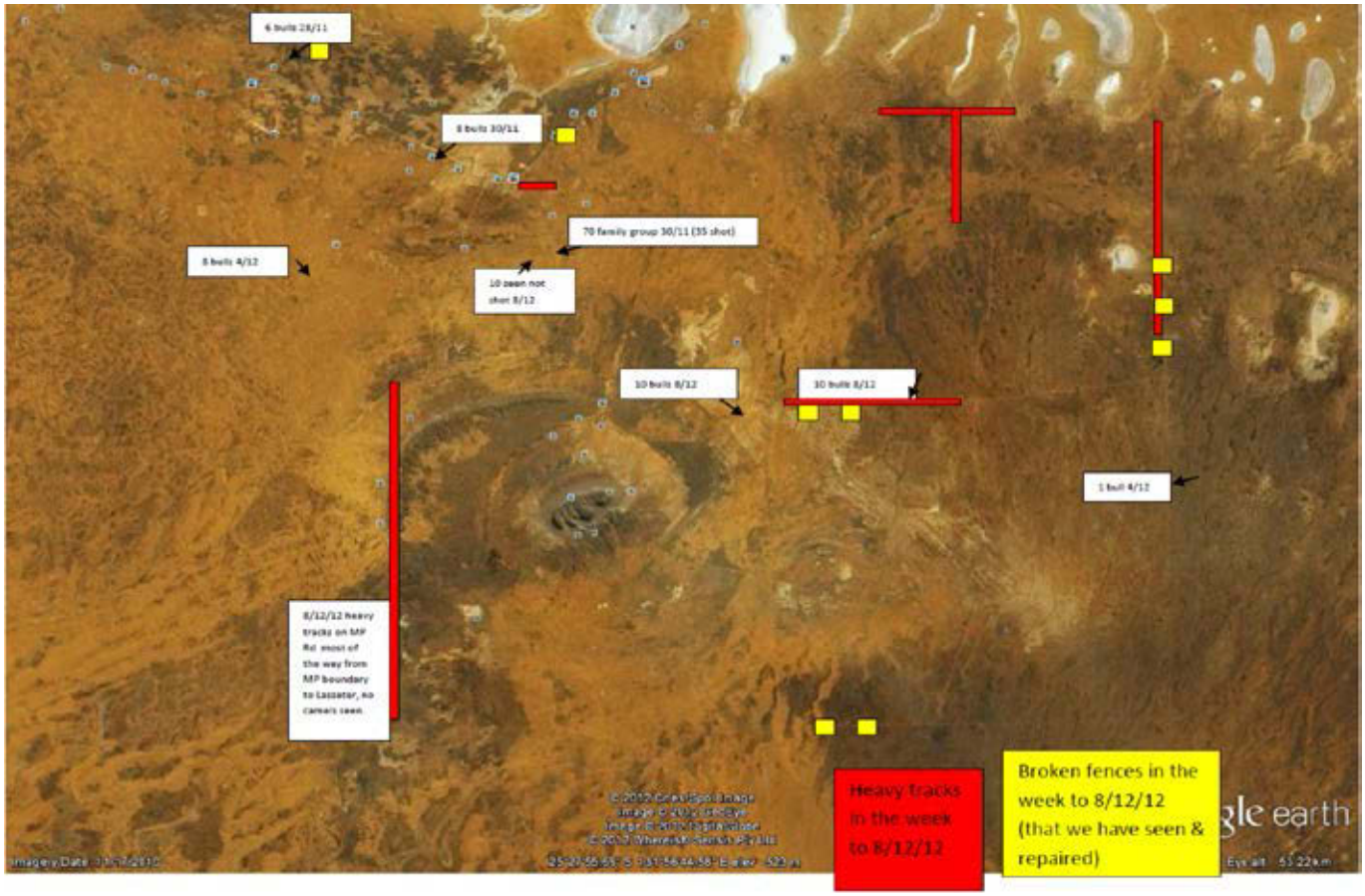
Staff from the NT Government Department of Land Resource Management and the Parks and Wildlife Commission organised the necessary resources and were in place on Curtin Springs Station to begin culling operations on 3 January, less than 48 hours after the initial email was sent from the station. Station staff provided ground support for the operation.

During the aerial cull, weather conditions were less than ideal, with hot, strong winds and very hot midday temperatures (>45°C). This meant that the single cull aircraft could only operate in the mornings (6 am – 12 pm). Nevertheless, around 1,700 animals were culled over four mornings.

This operation highlights how quickly major feral camel problems can develop in response to localised rainfall in dry periods and the responsiveness of AFCMP project partners in managing such problems. Lyndee and Ashley Severin were very appreciative of the assistance they received during this emergency situation, and the operational staff were similarly appreciative of the hospitality and accommodation provided by the Severin family.

An important footnote to the success of the aerial cull response is that Curtin Springs Station staff needed to ground cull a further 200 feral camels that moved onto their property a week after the aerial cull. This highlights that, although aerial culling is the best way to achieve a rapid reduction in feral camel densities, ground culling by landholders continues to be an important component of ongoing ‘maintenance’ management.

Case study 4


6 bulls 28/11
8 bulls 30/11
70 family group 30/11 (35 shot)
5 bulls 4/12
10 seen not shot 8/12
10 bulls 8/12
10 bulls 8/12
1 bull 4/12
8/12/12 heavy tracks on MP Rd most of the way from MP boundary to Lassater, no camels seen
Heavy tracks in the week to 8/12/12
Broken fences in the week to 8/12/12 (that we have seen & repaired)
gle earth


Bushnell
079°F
12-28-2012 02:23:22

Building the partnership

In South Australia, there was also a close link between government feral camel management agencies and pastoralists, with regular contact between these groups. The benefit of this information flow was shown in the summer of 2012/13 in the southern Simpson Desert, where satellite collaring and on-ground information helped to locate and show the extent of a congregation of feral camels, which led to 'opportunistic' funds from the project being allocated for over 2,200 feral camels to be removed in less than a week.

Relatively few pastoralists are affected by feral camels in Western Australia, and DAFWA maintained regular contact with these pastoralists through the AFCMP removal operation planning process.

2.2.3 INFORMAL PARTNERSHIPS

It is worth noting that the formal collaborations in the governance structure have fostered a number of informal collaborations. These have been important in the successful operation of the project but also in building relationships for future activities in remote Australia. Some examples are:

- The Steering Committee has provided an opportunity for the commercial use industry to forge closer relationships with landholders and the RSPCA.
- The NOG has been the main mechanism to encourage jurisdictions to coordinate management activities with neighbouring jurisdictions. It has been important for this group to share information on feral camel densities and movements (e.g. sharing aerial survey and satellite tracking information) and management activities. These relationships will be crucial for coordinated feral camel management beyond the life of the AFCMP.
- The individual SOGs have brought stakeholders within jurisdictions closer together. These groups typically have government, landholder and commercial use representatives. The relationships that have been developed through these groups are very likely to be maintained beyond the life of the AFCMP and have already led to collaborations on other NRM activities.
- The two MERI technical groups (Camel geodatabase group and On-ground monitoring group) have also been important collaborations in getting scientists across Australia to agree on methods associated with conducting and analysing aerial survey and environmental monitoring work. There has already been a spin-off from this work in the form of a collaboration that is seeking funding for further arid zone water monitoring work based on what has been learned through the AFCMP.
- In August 2010, Ninti One sponsored a workshop to bring commercial use proponents and landholders together to discuss a range of options for expanding the scope and volume of the industry. This workshop put a number of potential 'suppliers' of feral camels (i.e. landholders) in touch with potential buyers. Relationships established at this workshop have continued throughout the life of the AFCMP, with the most tangible example being the supply of feral camels from central Australia to the Caboolture abattoir.

Building the partnership

"This project has been beneficial because it has enabled the meat industry to work closely with the other partners in the AFCMP to achieve a greater supply of camels. But it's essential we keep going – because sound feral camel management will fail without camel processing."

Mike Eathorne is the General Manager of Meramist Pty Ltd, which operates the Caboolture abattoir. He has been exporting camel meat to the US, Canada and Europe for 12 years.

- In November 2012, Ninti One organised a workshop to bring a dozen representatives from aerial cull teams together from around Australia to share information about the way they plan and conduct aerial cull operations. The attendees included aerial cull planners, shooters and helicopter pilots. This workshop strengthened the connections between these cull teams, which will be of benefit to future large feral herbivore management.
- The AFCMP has facilitated discussions between the RSPCA, commercial use industry and aerial cull teams. The project contracted a vet to develop the most comprehensive verification process to assess the humaneness of aerial culling ever conducted in Australia. The project also contracted a mustering expert to audit commercial use activities. The RSPCA has assessed both the verification and audit processes and the results of these processes will be used to update the national humaneness matrix for feral camel management.
- Several scientists and over 300 Aboriginal rangers and other community members have been trained in monitoring feral camel signs (tracks, dung) and impacts to vegetation and waterbodies. Detailed methods have been developed for this assessment through the AFCMP, and these approaches have been promoted through government and private scientist networks.
- The AFCMP has sourced highly professional training providers to build capacity for commercial use and ground culling on Aboriginal lands. The feedback about this training has been universally positive and is likely to lead to some Aboriginal organisations directly contracting these providers in the future.
- Relationships have been developed between government agencies and a number of service providers, including aerial survey teams, aerial cull helicopters and pilots, fuel distributors and firearm and ammunition suppliers. These connections will facilitate the responsiveness of future large feral herbivore management.

2.3 WHY DID IT WORK?

It was noted at the start of this section that, from the outset, the AFCMP was required to generate high levels of collaboration on a scale and across an area that has never been previously attempted in Australia. Why did it work? The following have been identified as major contributors to the successful implementation of the AFCMP:

- A clear and transparent governance structure was a foundation stone for the project. The structure adopted provided clear roles for each of the functional groups while fully engaging the 20 project partners (and others) in the management, implementation and monitoring of the project. For example, separating the Steering Committee from the operational component of the project was successful, as it left the decisions about the technical aspects of the project to the experts, while allowing Steering Committee input into overall strategy.

Building the partnership

- Transparency was pivotal in developing an environment of respect and trust among partners and collaborators. The development of the investment guidelines and the requirement that all activities must adhere to the SOPs and COP ensured that all partners were clear about the allocation of funding and the implementation process required.
- The combination of strong leadership and effective communication provided an atmosphere for true collaboration to occur.
- The project managed the expectations of partners and collaborators outside the partnership. For example, the inclusion of all management methods (including commercial use) was not the starting position of all partners; significant consultation and negotiation were required to develop protocols around commercial use and ground-culling support.
- Where there were variations in the capacity of partners to participate, the subsequent planning, administration and operational activities took this into account.
- The project recognised jurisdictional differences. The ideal model was that there were no borders, but this was not possible due to different state and territory regulations. This required a move to a more pragmatic approach of state/territory operations groups rather than regional (cross-border) operations groups. There was, however, significant cross-jurisdictional sharing of information and experiences as well as coordination of activities such as culling and aerial surveys across borders.
- The project maintained a clear focus on feral camel management and did not allow other issues between partners to be brought to the table.
- Having the Australian Government representative on the Steering Committee and MERI group allowed partners (and the Australian Government) to directly engage with departmental staff and helped to reduce the time required in clarifying issues. The fact that the day-to-day Australian Government contact was the same person all the way through the project gave them a deeper understanding of the project.

3. Monitoring, Evaluation, Reporting and Improvement

In the first year of the project, the AFCMP established a Monitoring, Evaluation, Reporting and Improvement (MERI) group to develop and implement the MERI plan for the project. This group was also charged with providing advice on any research activities being conducted outside of the AFCMP which could be relevant to feral camel management. A detailed MERI plan was developed and implemented, and two technical subgroups were formed to coordinate the feral camel geodatabase (to oversee collection and analysis of data on feral camel population movements and density) and on-ground monitoring activities (to oversee collection and analysis of data on feral camel impacts on water, native animals and vegetation).

The focus of the MERI activities was to develop an understanding of the impacts of feral camels and to attempt to track reductions in impact as their densities were reduced as a result of the project – as much as this is possible in a highly variable rangelands environment in the three-year period that environment monitoring was conducted.

The DKCRC research illustrated the breadth of the impacts of feral camels, ranging from damage to infrastructure, such as fences and water supplies, through to destroying vegetation and other habitat across their 3.3 million km^2 range[9]. The central question asked of the MERI activities was: 'What impact are feral camels having, and what improves as the feral camels are removed?' The MERI data discussed in this section includes:

Feral camels

- number of feral camels removed
- area of feral camel removal (ha)
- density of feral camels – broadscale (measured and extrapolated)
- feral camel movements (satellite tracking)

Environmental impacts and potential effects of feral camel management on the environment

- condition of vegetation / biodiversity refugia surrounding wetlands (e.g. plot sampling, photo points)
- wetland condition at nominated assets (e.g. water quality, aquatic fauna)
- monitoring of indicator flora and fauna
- monitoring of feral camel carcasses for rate of breakdown and predator activity

Pastoral land management

- number of land managers adopting new conservation measures (feral camel management and/or exclusion)
- area of land (ha) managed by landholders adopting new conservation measures (feral camel management and/or exclusion)

9 Edwards G, Zeng B and Saalfeld W. 2008. Chapter 7: Evaluation of the impacts of feral camels. In *Cross-jurisdictional management of feral camels to protect NRM and cultural values*. Eds. Edwards G, McGregor M, Zeng B, Vaarzon-Morel P and Saalfeld W. pp.133–182. Desert Knowledge CRC. Alice Springs.

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Capacity building and public support

- improved long-term capacity to remove feral camels
- views of landholders about feral camel impact and management
- media coverage of feral camel issues over the life of the AFCMP

Developing a MERI program on such a broad spatial scale raised a number of challenges, including:

- **Seasonality:** Are the plants not growing because it is dry, or because they have been browsed by feral camels, or both? Will there be a boom (high rainfall) or bust (drought) during the monitoring period, and can feral camel impacts be separated from this? How has fire impacted on vegetation prior to the establishment of the vegetation monitoring program?
- **Data collection methodologies:** Technology, such as motion-activated cameras, was used to collect data. A total of 150 motion-activated cameras were set up across sites in the NT, SA, Qld and WA to confirm the destructive impacts of feral camels at waterholes. The cameras are a cost-effective way to collect huge amounts of data, but the challenge then becomes the ability to analyse all of the data; the cameras used in the MERI program produced more than a million images.
- **Site isolation:** Many of the sites monitored were a long way from major settlements and scientists, which meant new approaches had to be explored. Involving local Aboriginal people to monitor sites reduced the isolation problem. More than 500 Aboriginal people from 11 ranger groups have now been trained in assessing the impact of feral camels on the desert environment, particularly around sacred waterholes. They are helping to monitor around vegetation sites, including important watering holes in remote areas.
- **Understanding the results:** Aboriginal people helped the scientific team understand how water places were traditionally used and what types of management regimes were used to maintain good quality water for sustaining life in the desert. This gave a more holistic understanding of the waterhole, as the variability in arid environments can be extremely high. After prolonged drought, waterholes can be heavily used by humans, native birds and animals, which can also reduce their quality.
- **Which species has caused the observed negative impact?** Is the observed impact caused by feral camels, other feral animals, native wildlife or a combination of all of these?
- **Density:** damage relationships: Longer time periods (greater than 10 years) are required to establish feral camel density:damage relationships, because the major driver of asset condition in the rangelands is the significant change in seasonal conditions. Also, small localised numbers of animals can destroy valuable sites, which can make it less meaningful to try to develop a density:damage relationship based on average regional densities. The monitoring sites established for the AFCMP have increased the understanding of feral

camel impacts on natural ecosystems and have established baseline data that can be fed into longer-term monitoring studies such as the Terrestrial Ecosystem Research Network (TERN) Rangelands Reference Site Network and the Australian Collaborative Rangelands Information System (ACRIS).

A key component of MERI activities was the interaction between Traditional Owners and Aboriginal ranger groups with the MERI teams. From the outset, it was clear that Traditional Owners were keen to be involved in monitoring and collecting scientific data as well as giving permission to access traditional lands. The relationships and trust that were built up meant that the Traditional Owners identified culturally important waterholes known only to them. They allowed government workers to travel with them to these points so they could be taught how to monitor and collect environmental data for assessment.

The training was based around a methodology developed by Dr Jayne Brim-Box, an aquatic ecologist with the NT Government, and others and published in *Central Australian Wetlands Monitoring Framework: water quality and aquatic fauna sampling*[10]. Aboriginal people were trained to measure, in a western scientific sense, the condition of a waterhole using measures such as turbidity, dissolved oxygen and pH levels. In addition, Aboriginal people have been monitoring the impact of animal activity at the waterholes through the installation of 150 motion-activated cameras set up across sites in the NT, Qld, SA and WA.

3.1 ENVIRONMENTAL ASSET CONDITION

Five biodiversity refugia assets across four jurisdictions (NT, Qld, SA, WA) were selected for intensive environmental condition monitoring over the life of the project. Four were selected from the 18 priority environmental assets that Ninti One was contracted to protect: Hay River and Petermann Ranges in the Northern Territory; Dalhousie Springs/Purnie Bore in South Australia; and Karlamilyi (Rudall River) National Park in Western Australia. Sites on Aṉangu Pitjantjatjara Yankunytjatjara (APY) Lands in South Australia were also monitored, recognising the relatively high densities of feral camels in this area.

3.2 VEGETATION MONITORING

Source: Jayne Brim-Box, Catherine Nano, Glenis McBurnie and Kathy McConnell, NT; Alison McGilvray and Chris Brock, WA; and Rachel Paltridge, SA

3.2.1 BACKGROUND

Measuring the extent of damage that feral camels cause to woody vegetation is complex. Because the only wild camels in the world are found in Australia, there were significant knowledge gaps to contend with before the impacts of feral camels on vegetation could be investigated. Some of the issues are:

- It is well documented for other systems that as the density of large herbivores increases, browsing impacts on vegetation increase. It

10 Brim-Box J, Barker P, Hengstler J and Sada D. 2010. *Central Australian Wetlands Monitoring Framework: Water Quality and Aquatic Fauna Sampling*. Greening Australia (NT) Ltd. Darwin. http://www.greeningaustralia.org.au/uploads/General%20pdfs/NT_GREENINGWETLANDS_WEB2.pdf

follows that a decrease in feral camel densities in central Australia should decrease browsing pressure there. So far though, no one has attempted to quantify this relationship, and the extent to which localised factors (e.g. palatability) influence consumption rates is still very poorly understood.

- Relationships between feral camel densities and exactly how feral camels damage plants are not well known, nor are they necessarily easy to measure.
- Central Australia is a complex desert environment, with significant variability in rainfall and wildfire occurrence. This complexity makes understanding the relationship between feral camel densities and vegetation damage difficult to quantify, given that these other landscape drivers can potentially overwhelm any impacts of browsing.
- It is possible that drought, fire and browsing interact to strongly limit the growth and survival of woody plant species (the 'death by a thousand cuts' concept). However, there is currently little understanding of the cumulative/interactive effects of multiple factors, and are unsure of the extent to which one driver influences another.

Because so little was known at the beginning of this project about feral camel impacts on Australian desert plants, monitoring methodologies used in the AFCMP were developed specifically for the project, and were based on Australian and international research. Over 100 scientific journal papers on browsing impacts were examined, across a wide range of browser species (e.g. deer, elk and elephants). Australian and international experts (e.g. Don Waller, University of Wisconsin, who visited some of the study sites in 2012) were also consulted in the development of the methodologies used in this MERI evaluation.

3.2.2 BACKGROUND CONCEPTS AND OUR APPROACH TO MEASURING CAMEL IMPACTS ON WOODY SPECIES

As mentioned above, much work has been done in other parts of the world on large herbivore impacts on vegetation. This body of existing information and ideas was used as a guide to determining exactly how feral camels may be damaging vegetation and how severe the consequences of this damage might be. Five focal issues were defined for this monitoring project to address:

a. **Dominant feeding mode:** Camels are classified as 'mixed feeders', meaning they can graze on grasses and browse on trees and shrubs, but it is not clear when or why they might switch between the two modes. This was not addressed in any formal way, but feeding behaviour was noted whenever observation opportunities arose in the field.

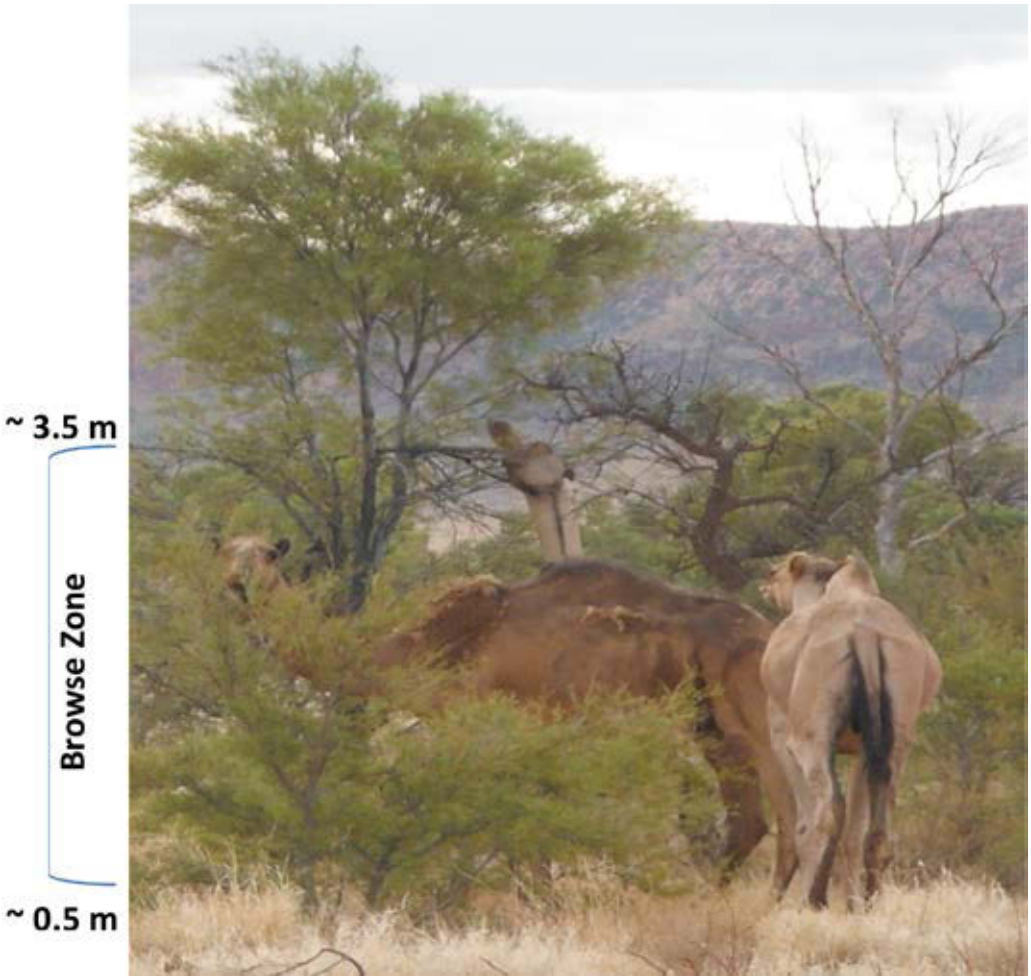
b. **Target woody plants:** Feral camels seem to prefer eating certain woody species over others. In turn, certain plant species are likely to be better able to cope with, or indeed avoid, browsing impacts from feral camels. To address this issue, the project monitored shrub and tree growth forms and species that are able to sprout back after disturbance (resprouters) as well as those that usually die if they lose a lot of their biomass from disturbance (disturbance-sensitive species).

c. **Density:** In African systems, elephants at high densities have been known to kill trees and shrubs outright. Field observations in the project showed that feral camel damage can be severe, but there were no data to indicate whether or not feral camels are actually capable of killing woody vegetation in the central Australian context. Plant death rates from feral camel browsing over the three-year period were established by numbering and mapping individual trees and shrubs in a series of permanent plots.

d. **Vertical browsing zone:** Feral camels are known to consume a considerable amount of woody biomass. Existing observations showed that camels target trees as well as shrubs. With the height differences between trees and shrubs, the extent and effect of feral camel browsing may be different according to growth form. This ties in with the concept of a 'browse zone' (Figure 6) – the vertical area between the upper and lower reach of a herbivore – which necessarily differs depending on the particular animal involved. For camels, this should fall somewhere between 0.5 m and 3.5 m. Thus, it was expected that shrubs would be shortened by camel browsing but that trees that can grow taller than 3.5 m would not be impacted. When plants become stunted from top-down pressures, such as browsing, they become more vulnerable to fire and browsing impacts because their ability to grow tall and escape these disturbances is hampered (Figure 7). Saplings of tree species might show this effect, but established adult trees should not (Figure 8). Trees instead would be more likely to lose biomass from their mid-canopy region, so browsed trees might have narrower canopies, and they might be missing the lower-hanging parts of their canopy, resulting in a distinct browse-line. To test these ideas, measurements were taken of canopy height and width, stem diameter, and the height to canopy base in browsed and non-browsed individual trees and shrubs.

e. **Combined effects of fire and browsing on central Australian woody vegetation:** The combined impacts of fire and browsing on desert woody plants may be severe but are poorly understood. Although there is some anecdotal evidence, the extent to which feral camels are attracted to burnt areas, hence whether or not they influence woody vegetation recovery after fire, is unknown. It is possible though, that where they target post-fire reshoots, feral camels may thwart fire recovery and increase the overall mortality rate of woody plants. Alternatively, feral camels may avoid areas recovering from fire and instead focus more heavily on unburnt vegetation. The fire events that occurred across central Australia in the last two years of the study (the summers of 2011/12 and 2012/13) provided some opportunity to look at this issue.

Figure 6: Example of the camel 'browse zone', the area in which camels are able to reach woody vegetation



The lower limit is not clear-cut and probably varies according to what palatable resources are on offer at any one time. AFCMP data suggest that 0.5 m is a reasonable ball-park figure for the lower height threshold.

Figure 7: Example of a shrub that is stunted from repeated camel browsing

Figure 8: Different impacts of camel browsing on mulga life classes

Adults are tall enough to avoid stunting, but saplings are not.

3.2.3 VEGETATION METHODOLOGY

A total of 24 plant species were initially monitored within the MERI process. These species were selected based on the work of Dörges and Heucke[11], who spent many years observing feral camels and what they ate[11] in central Australia. All 24 species were thought to be vulnerable to feral camel browsing, and two species (whitewoods and acacia bush) were chosen because feral camels are known to have heavily browsed these species in parts of central Australia (Paltridge and Latz 2010).[12]

A subset of widespread shrub (multi-stemmed and less than 2 m tall) and tree (single-stemmed, with maximum height over 2 m) species were selected that were known to be palatable to feral camels. Height data from non-browsed trees of 12 of the focal species (Table 3) illustrate that five of the six monitored trees were on average taller than the upper limit of the browse zone (> 3.5 m), while all shrub species were not. This supported the expectation that shrubs and trees would be affected in different ways by feral camel browsing. The tree species *Atalaya hemiglauca* was one notable exception, and thus, due to the concentration of its canopy at lower heights, it would be expected to display severe browsing impacts relative to the other focal tree species.

In the initial stages of the AFCMP, the monitoring teams from the NT, SA, WA and Qld gathered to review the methodology and align it as closely as possible between monitoring sites. In most instances data were collected for 40 individuals of a species at a site, over the three-year monitoring timeframe. Data were analysed using standard statistical methods (e.g. ANOVA, t-tests) to compare the effects of factors such as browsing across sites, height groups, trees versus shrubs and fire history. Further information about the methodology is described in Brim-Box & Edwards 2012[13].

11 Dörges B and Heucke J. 1995. *Ecology, Social Organization & Behaviour of the Feral Dromedary Camelus dromedarius (L. 1758) in Central Australia.* Translated Conclusion of 2 Ph.D. Studies, University of Braunschweig, Germany.
12 Paltridge R and Latz P. 2010. *Natural Resources of the Numery Grazing Lease Area.* Report produced for the Central Land Council, Alice Springs.
13 Brim-Box J and Edwards G. 2012. *Proposal to monitor the environmental impacts of camels on waterbodies, vegetation, and carbon sequestration in the Northern Territory.* Internal report, Northern Territory Department of Land Resource Management. Darwin.

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Table 2: List of all trees and shrubs initially measured during the project

A subset of these species (*) were used to examine the overall impacts of browsing.

COMMON NAME	SPECIES	COMMON NAME	SPECIES
Mulga*	*Acacia aneura*	Bladder saltbush	*Atriplex vesicaria*
Ironwood*	*Acacia estrophiolata*	Desert kurrajong*	*Brachychiton gregorii*
Umbrella bush	*Acacia ligulata*	Northern bluebush	*Chenopodium auricomum*
Colony wattle*	*Acacia murrayana*	Bluebush	*Chenopodium nitrariaceum*
Umbrella wattle*	*Acacia oswaldii*	Desert poplar	*Codonocarpus cotinifolius*
Weeping mulga*	*Acacia paraneura*	Sticky hopbush	*Dodonaea viscosa*
Black gidgee*	*Acacia pruinocarpa*	Long-leaf emubush*	*Eremophila longifolia*
Horse mulga	*Acacia ramulosa*	Native apricot*	*Pittosporum angustifolium*
Dead finish*	*Acacia tetragonophylla*	Thorny saltbush	*Rhagodia eremaea*
Acacia bush*	*Acacia victoriae*	Creeping saltbush	*Rhagodia spinescens*
Whitewood*	*Atalaya hemiglauca*	Quandong	*Santalum acuminatum*
Old man saltbush	*Atriplex nummularia*	Plumbush*	*Santalum lanceolatum*

Table 3: List of tree and shrub species used to determine differences in browsing effects due to growth form

GROWTH FORM	FIRE RESPONSE	SPECIES	MEAN MAX HEIGHT WITHIN THE CAMEL BROWSE ZONE?
Tree	Fire-killed*	*Acacia aneura*	No
		Acacia oswaldii	No
	Resprouters	*Acacia pruinocarpa*	No
		Brachychiton gregorii	No
		Acacia estrophiolata	No
		Atalaya hemiglauca	Yes
Shrub	Resprouters	*Acacia murrayana*	Yes
		Pittosporum angustifolium	Yes
		Acacia tetragonophylla	Yes
		Acacia victoriae	Yes
		Santalum lanceolatum	Yes
		Eremophila longifolia	Yes

*Denotes tree is often killed by fire and therefore categorised as disturbance-sensitive. If the tree's above-ground biomass is consumed by fire/herbivores, it has to come back from seed. In comparison, many shrub species are able to resprout basally or laterally after fire/browsing.

When the vegetation surveys started in 2010, central Australia experienced above-normal rainfalls (Figure 10). In latter 2011 and the beginning of 2012, in contrast, some of the driest conditions ever recorded occurred in central Australia. In 2011 and 2012, multiple fires burned across central Australia, including through many of our vegetation survey sites (Figure 11).

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Figure 9:* Acacia victoriae *from a control site (top) where there are no feral camels, and a site (bottom) where feral camels occur

3.2.4 FINDINGS

a. **Dominant feeding mode:** Observations of feral camel feeding behaviour confirmed that they are mixed-feeders: feral camels consumed large amounts of herbage as well as trees and shrubs. This ability to utilise both food sources and switch from one to the other depending on seasonal conditions, explains – at least in part – why this feral animal has been so successful in this new environment. Unlike horses and donkeys, feral camels are less likely to be strongly limited by low food availability in drought times, due to their ability to switch from grasses to shrubs and trees. Feral camel populations are therefore far less likely to crash when productivity is low.

b. **Target woody plants:** All of the plant species selected for monitoring were known, from previous work, to be palatable to feral camels. It was expected that there would be a certain degree of variability in terms of browsing intensity among the study species, in line with the idea that certain species are highly targeted by feral camels, while others were less preferentially utilised. Further, the list included both shrubs and trees, allowing a test of whether or not differences in browsing severity could be linked to differing growth forms.

The findings were that there was little variability in browsing severity among the species monitored, with the majority of species being very heavily impacted across all of the populations (Figure 12). The exception was *Acacia murrayana*, a shrub previously suspected to be unpalatable to camels.

Figure 10: Timeline of vegetation sample dates, major weather events, and fires that occurred during the three-year study period (Source: Rainfall and weather information from the Bureau of Meteorology)

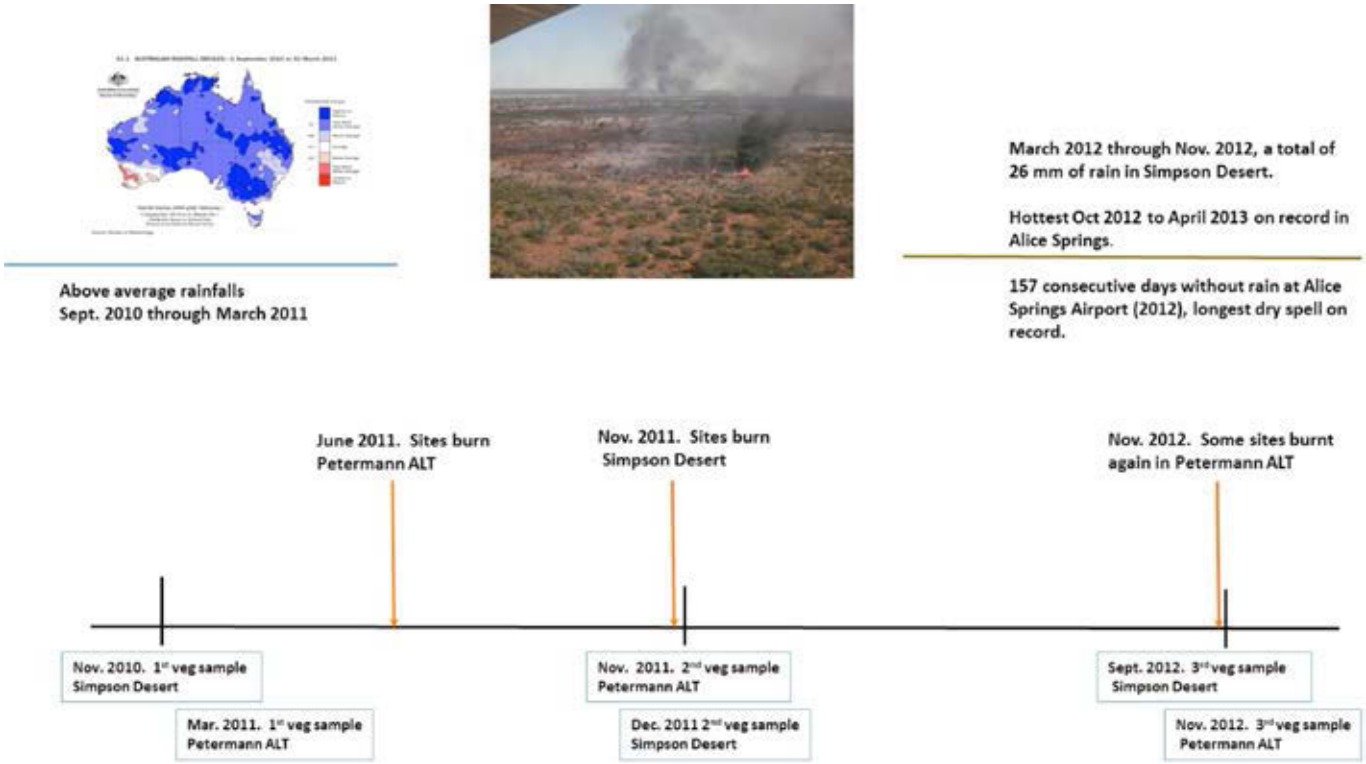

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Figure 11: Fire scars from 2010 through 2012. Fires occurred across a wide area of central Australia between 2010 and 2012. At some sites, fires occurred twice during the study period. (Source: NAFI[14])

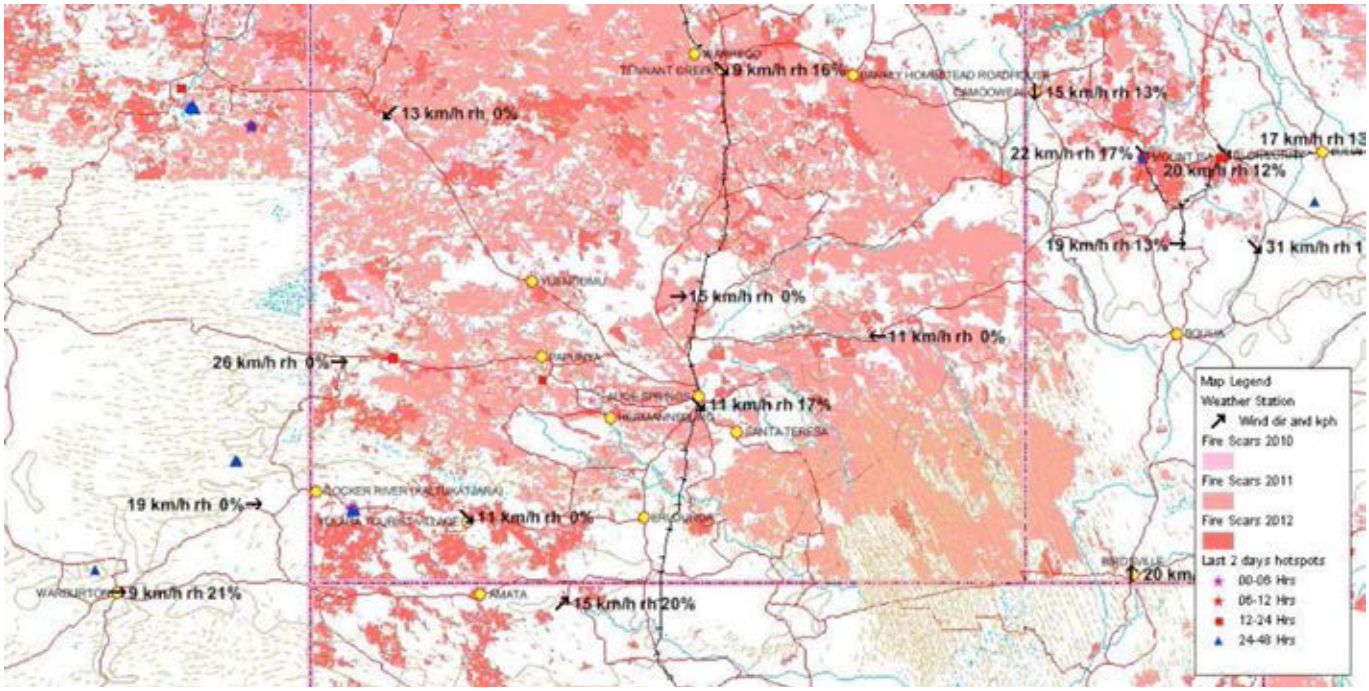
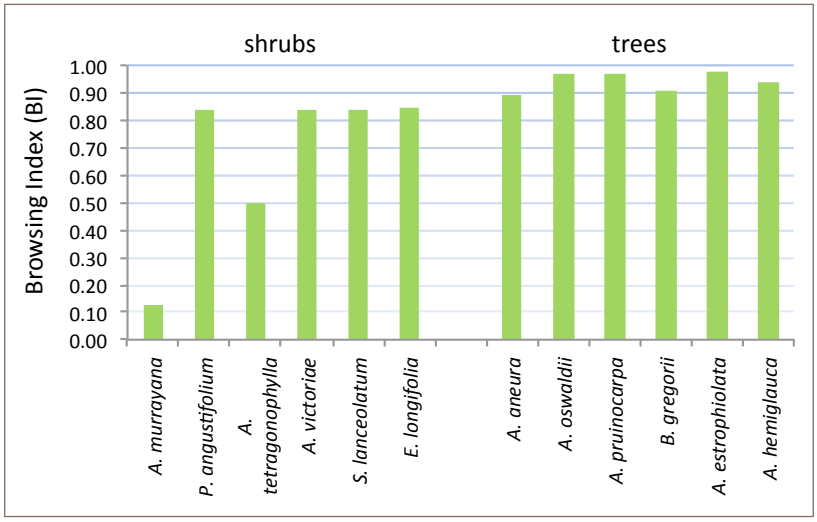


Figure 12: Browsing severity for individual species of trees or shrubs at beginning of study period

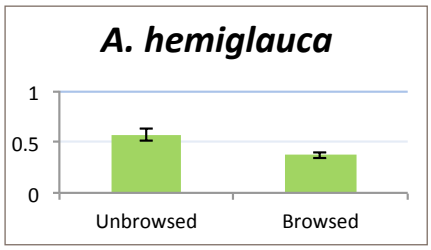


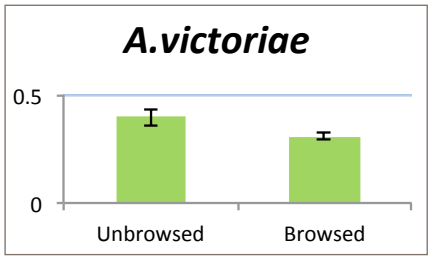
The browsing index (BI) ranges from 0 to 1 and increases as browsing severity increases. Across both shrubs and trees, initial feral camel browsing for the majority of plant species was very high.

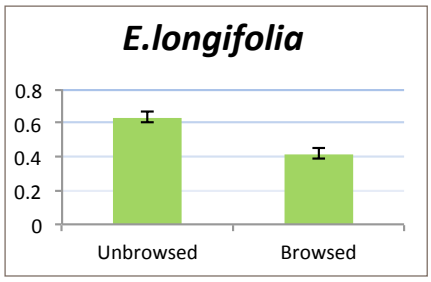
c. **Density:** Unlike in African systems where elephants are known to kill trees and shrubs outright, there was very little evidence that feral camels caused widespread plant mortality in Australia. Over all three study years, mortality due to feral camels was less than 3% across all plant species. In contrast, fires accounted for over 7% of the documented mortality in 2011, when feral camels killed less than 0.2% of the plants monitored.

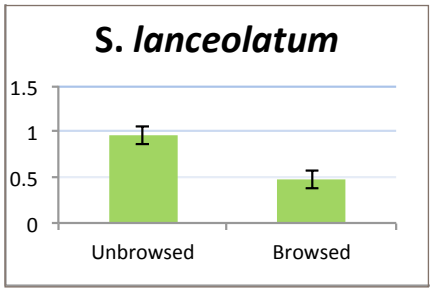
14 North Australian Fire Information. n.d. Website Fire map regions. http://www.firenorth.org.au/nafi2/

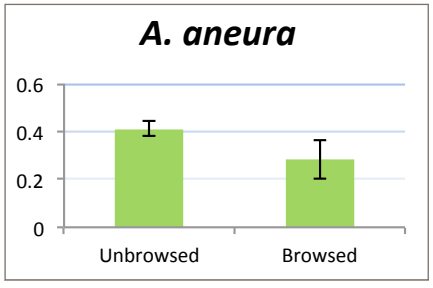
Figure 13. Mean diameter ground height (dgh) over tree height for unbrowsed (0) vs. browsed trees (1). In all five species, significant differences (two sample t-test assuming unequal variances) were found between browsed and unbrowsed trees.

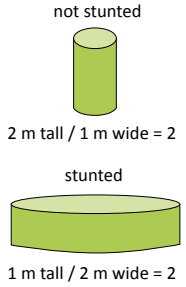












d. **Vertical browsing zone:** Little evidence was found of stunted growth due to feral camel browsing in the majority of tree species. Even when tall individuals (> 3.5 m) are excluded, there did not appear to be a significant amount of stunting in trees. There were two exceptions to this pattern. First, whitewoods (Atalaya hemiglauca) less than 2 m tall appeared stunted (Figure 13). This species is therefore possibly most at risk of being drawn into a negative browsing/fire feedback loop. Second, mulga trees < 3.5 m appeared stunted when compared to trees sampled at the sites where feral camels do not occur. Like whitewoods, this could potentially make these trees more vulnerable to browsing/fire interactions.

There was strong evidence that stunting had occurred in three of the five focal shrub species tested. Specifically, long-leaf emubush (*Eremophila longifolia*), acacia bush (*Acacia victoriae*) and plumbush (*Santalum lanceolatum*) displayed stunted growth compared to non-browsed populations at sites where feral camels do not occur. This result supports the notion that shrubs, with most of their biomass in the browsing zone, will be affected more severely than taller tree species.

It was predicted that a browse line would be visible in browsed versus non-browsed trees and tall shrubs, due to the breakage and consumption of lower branches and foliage by feral camels. Browsed populations of two (*Acacia aneura* and *Acacia pruinocarpa*) of the five focal tree species had significantly higher canopies (i.e. height to canopy base or HCB) compared to non-browsed trees. However, HCB values were equivalent in browsed and non-browsed shrub populations. This is not surprising, in that the canopy for most shrub species reaches to ground level and is below the hypothesised lower browse zone (i.e. 0.5 m).

Potential implications for canopy loss in both growth forms are myriad and include the loss of vigour/reproductive output, a reduction in carbon storage capacity at the landscape scale, and an altered woody–grass dynamic that may ultimately favour grasses, as the realised woody biomass is reduced below the climate potential; thus, grasses may be given the upper hand by browsing. This, in turn, may have implications for ground fuel loads. Finally, the loss of low-hanging branches and foliage can have an ecologically cascading impact, in that birds in the 'perch-pounce' functional group[15], whose foraging behaviour is closely associated with mature mulga stands, may be negatively impacted due to habitat loss (Figure 14). These species rely on being able to forage around vegetation that provides the predator protection of low-hanging branches.

e. **Combined effects of fire and browsing on central Australian woody vegetation:** Browsing impacts decreased over the three-year study period (Figure 15), but only for trees and shrubs that burned. For unburnt plants, browsing pressure remained high. This suggests that fire had a direct bearing on browsing, in that feral camels were less likely to browse trees or shrubs that were burnt. This is most likely because trees had either died, all above-ground foliage had been removed, or remaining leaves were scorched (Figure 16). This gives strong evidence that feral camel browsing is not independent of fire.

15 Pavey CR and Nano CEM. 2009. Bird assemblages of arid Australia. Vegetation patterns have greater effect than disturbance and resource pulses. *Journal of Arid Environments* 73, pp. 634–642.

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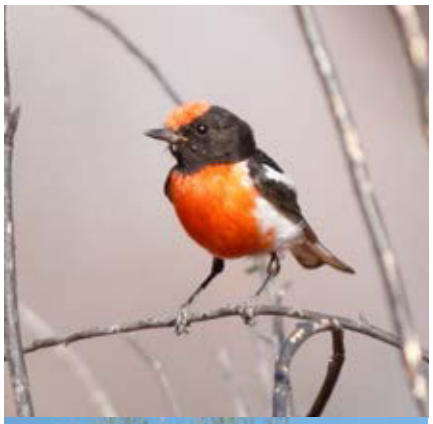
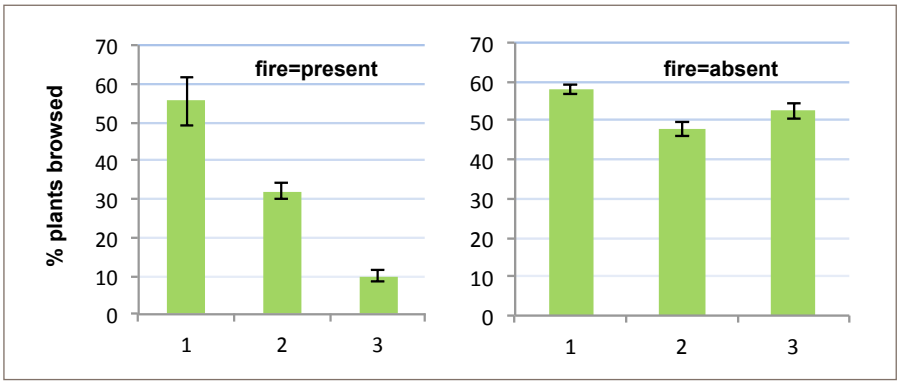
Figure 14: 'Perch-pounce' function group example. A male red-capped robin (top) is an example of the 'perch-pounce' function group that may be negatively impacted by the loss of low-hanging mulga branches (bottom).



(BELOW) Figure 16: An* Eremophila longifolia *that burned in 2011. New growth or resprout was evident at the plant's base by 2012. There was little evidence that feral camels target these small, post-fire resprouts, possibly because the resprouts were often lower (< 0.5 m) than the bottom of the proposed camel 'browse zone'.

Figure 15: Mean browsing intensity for all species and sites. Mean browsing intensity was significantly lower for burnt trees in both 2011 and 2012, compared to unburnt trees.



Most trees were not impacted by fire. Four of the focal trees largely escaped fire, while two species had close to half their population burned. For the unburnt species, browsing incidence remained extreme (i.e. > 75% of the plants measured had been browsed since the first visit). In contrast to trees, more shrubs burned per site and across sites. An astonishing 70% of all plumbush (*Santalum lanceolatum*) in this study burned between the first and second visits.

These results do not support the hypothesis that feral camels may target post-fire resprouting. In fact, many trees and shrubs resprouted basally, and these resprouts were lower (< 0.5 m) than the bottom of the proposed feral camel 'browse zone' (Figure 6). An exception to this pattern may be whitewoods (*Atalaya hemiglauca*). Whitewoods were exposed to both fire and constantly high (> 75%) browsing frequency over the first two study years. Browsing caused stunting in whitewoods that were less than 2 m tall, implying that if feral camel numbers are not kept low, there may be increasingly fewer opportunities in future years for individual trees to grow their canopies out of the browse/fire zone. Thus browsing may be causing loss of vigour in this species, both through direct consumption and by rendering it more vulnerable to fire effects (stem-kill and outright death).

The pattern of constantly high or increased browsing incidence in unburned species during the project period is consistent with the idea that feral camels did not strongly switch to a grazing foraging mode, but instead targeted shrubs and trees to the same or greater extent after the occurrence of large-scale fire.

3.2.5 CONCLUSIONS

Feral camels had heavily browsed both tree and shrub species in the study. The results also suggest negative feral camel browsing impacts (stunted growth, canopy loss or both) in a majority of the species monitored. The ecological flow-on effects for this novel 'top down' limit on woody growth for both trees and shrubs are presently not well quantified. However, various undesirable outcomes are conceivable if feral camels are not maintained at low numbers through management. Perhaps most noteworthy is the strongly negative impact of feral camel browsing on mulga (*Acacia aneura*), a species of high importance in central Australia, not just because of its widespread distribution, but also in terms of its ecological function (e.g. habitat provision and soil resource feedbacks).

Browsing conceivably has negative effects on this species in addition to those directly measured in this project. For example, the success of mulga in this drought-prone landscape is partly due to its ability to funnel rainfall to its roots by virtue of its wide-branching canopy ('stem flow'). It is possible that the removal of lateral branches by feral camel browsing may undermine the method this species uses for resource capture. Further, the distribution, demography and localised persistence of mulga can be strongly impacted by fire. Additional constraints on the growth and vigour of this species therefore have the potential to tip the balance in favour of flammable grasses. This in turn would have consequences for carbon storage and arid land biodiversity. The browsing impacts on the other five focal woody species, while undesirable, are possibly less far-reaching.

Over the study period there was likely a net loss of woody biomass from the landscape, despite the large rainfall events of 2010–11. Species either lost up to half of their biomass (at the population level) through fire, or they were subject to increased browsing frequency by feral camels. As camel numbers continue to be reduced across central Australia, it is probable that these impacts will lessen.

3.3 WATER MONITORING

Source: Jayne Brim-Box and Glenis McBurnie, NT Government Department of Land Resource Management

Waterbodies in arid areas are a precious resource because they provide reliable water for humans, livestock and native terrestrial and aquatic animals. In arid Australia, waterbodies such as rock holes, springs and waterholes are both ecological and cultural hotspots, which often contain plants and animals that are found nowhere else. Current inventories of the aquatic fauna of central Australia are very limited. The cultural value and location of many sites remain known only to Aboriginal people, for whom they have deep ceremonial, economic and social significance. Many are still managed using traditional techniques based on extensive knowledge passed down orally through many thousands of years.

Feral camels can pose a significant threat to central Australian waterbodies by trampling, fouling, muddying, destabilising, drinking, grazing and browsing. The AFCMP monitored the impacts of feral camels at 60 waterbodies in the designated key asset areas across three bioregions, ranging from the APY Lands in South Australia to the Southern Tanami Desert in the Northern Territory. As most waterholes occurred on Aboriginal land, monitoring teams worked closely with Traditional Owners and local ranger groups.

From the 60 sites, intensive monitoring (i.e. multiple visits to the same waterhole over the life of the project) occurred at eleven sites, of which six could be accessed by feral camels and the remainder could not. The waterbodies were sampled using the protocols established in the *Central Australian Wetlands Monitoring Framework: water quality and aquatic fauna sampling*.[16] The basis of the methodology is as follows:

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a. **Standard data sheet:** Standard data sheets are part of the training protocol developed by the NT Government Department of Land Resource Management for use with Aboriginal ranger groups. The data collected included macroinvertebrates and other wildlife, water quality and site condition.

b. **Evaluate impacts to macroinvertebrates:** Aquatic macroinvertebrates were chosen as indicator species as they have rapid life cycles and are a well-known indicator of aquatic health. Macroinvertebrates were monitored at least annually at sites in the Petermann Aboriginal Land Trust, in an area south of Mutitjulu to Docker River.

c. **Evaluate impacts to water quality:** Water quality was assessed at the same sites as the macroinvertebrates. Measurements were made of turbidity, dissolved oxygen, conductivity, temperature and pH.

d. **Evaluate feral camel and wildlife usage at selected waterholes:** Infrared, motion-detecting surveillance cameras were deployed for periods of at least a week (up to several months) to assess native and feral animal use of waterholes.

e. **Evaluate riparian and site condition:** Waterhole quality is influenced by the state of the surrounding land. If surrounding vegetation has been overgrazed or trampled then excessive sediment finds its way into the waterbody. Feral camel carcasses in the vicinity of waterholes also have a significant impact on water quality.

f. **Water consumption:** At a subset of intensive monitoring sites, depth loggers were deployed to determine how much water feral camels were drinking.

g. **Traditional Owner input:** The Traditional Owners were a crucial part of the evaluation team. They ensured scientists gained a holistic understanding of specific waterbodies in their home areas, including a historical perspective of characteristics such as how long waters lasted, which animals used the waterbody and water permanence. For example, Veronica Dobson, a Traditional Owner from Santa Teresa, said this about the impacts of feral animals on culturally important water places:

> *Our ancestral lands and water sites are being wrecked and ruined by feral animals.*
>
> *Grazing has been done ever since these animals were bought out here.*
>
> *Our water sites are wrecked; camels, donkeys, cattle, horse tracks and pads start to erode and erosion becomes gullies.*
>
> *The country is suffering pretty bad. The top fertile soil gets blown or washed.*
>
> *Nothing much grows there anymore.*
>
> *Veronica Do*bson, Traditional Owner

16 Brim-Box J, Barker P, Hengstler J and Sada D. 2010. *Central Australian Wetlands Monitoring Framework: Water Quality and Aquatic Fauna Sampling.* Greening Australia (NT) Ltd. Darwin. http://www.greeningaustralia.org.au/uploads/General%20pdfs/NT_GREENINGWETLANDS_WEB2.pdf

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Figure 17: Comparison of feral camel–accessed waterhole and waterhole that feral camels cannot access. *Differences in the aquatic fauna and water quality were two of several differences noted*

Feral camels present

- *Higher turbidity (muddy water)*
- *Lower species richness*
- *Fewer sensitive species*
- *Fewer predatory invertebrates*
- *Fewer species with gills*

Feral camels absent

- *Lower turbidity (clearer water)*
- *Higher species richness*
- *More sensitive species*
- *More predatory invertebrates*
- *More species with gills*

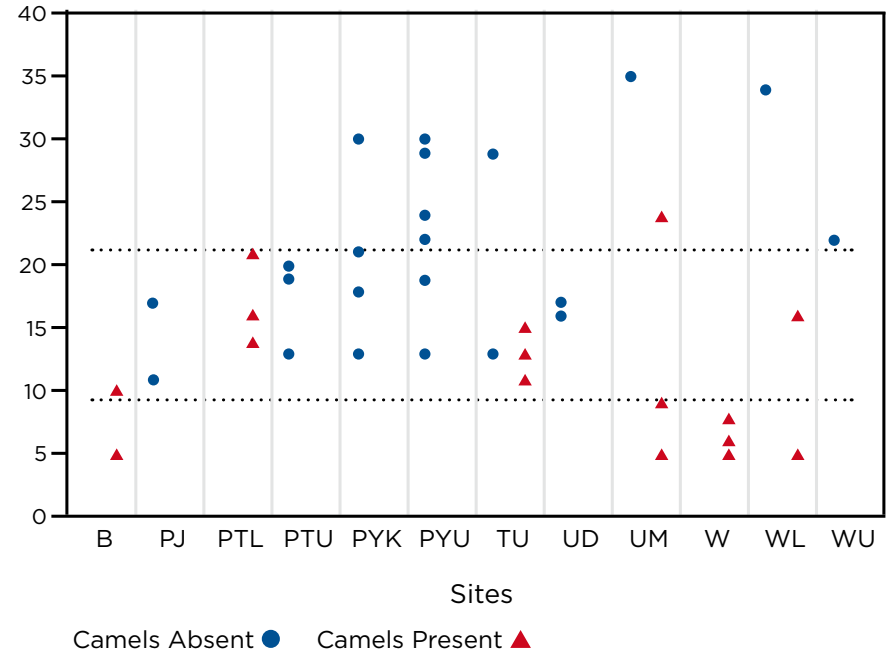
3.3.1 FINDINGS

Waterbodies that were used by feral camels were significantly different from those that feral camels could not access, as clearly shown below. The following discussion will highlight these differences.

MACROINVERTEBRATES AND WATER QUALITY

Aquatic macroinvertebrates are recognised as effective indicators of water quality and ecosystem health. It is important to note that at some sites feral camels had caused considerable damage near the time the sample was collected, but on other sample dates feral camels had not accessed the site for a long period, which influenced the number of macroinvertebrates found (Figure 18). Significant differences were found between sites that feral camels could access and those sites where feral camels were absent (Table 4 and Figure 17). Specifically the number of aquatic invertebrates was significantly higher at sites where feral camels were absent, the water was significantly less turbid or muddy when feral camels were absent, and the number of sensitive species (i.e. cannot tolerate pollution), predatory species and species with gills (i.e. rely on oxygen in the water) were also significantly higher at sites when feral camels were absent.

Figure 18: Aquatic invertebrates as an indicator of water health with feral camels absent and present



In this figure, the number of aquatic invertebrates present is three times higher (16 species) across sites when feral camels are absent compared to when feral camels are present (5 species), as indicated by the dashed lines. Within sites, species richness is higher on dates when feral camels are absent. This is important because when arid zone waterholes in Australia and elsewhere become degraded, the impacts may be irreversible (Williams et al. 1999[17]).

17 Williams, W.D., 1999. Conservation of wetlands in drylands: a key global issue. Aquatic Conservation: Marine and Freshwater Ecosystems 9, 517–522.

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Table 4: Differences in water quality and macroinvertebrates at time of sampling for aquatic sites where feral camels are absent versus sites where feral camels are present. *Results are presented as means with standard error.*

PARAMETER	FERAL CAMELS		INTERPRETATION
	ABSENT	PRESENT	
Turbidity*	24.5 (+/- 56.2)	246.3 (+/- 66.1)	Water turbidity (muddiness) was significantly higher where feral camels were present
Richness*	12.7 (+/- 1)	4.1 (+/- 1)	The number of species at a site was significantly lower where feral camels were present
'Sensitive' species*	5.2 (+/- 0.5)	1.1 (+/- 0.5)	The number of sensitive species was significantly lower where feral camels were present
'Tolerant' ratio	35.5 (+/- 6.9)	38.1 (+/- 4.7)	The ratio of tolerant species did not differ between sites where feral camels were absent versus present
'Very tolerant' ratio	28.9 (+/- 3.9)	39.7 (+/- 5.8)	The ratio of very tolerant species did not differ between sites where feral camels were absent versus present
Predators*	8.1 (+/- 0.7)	2 (+/- 0.7)	The number of predatory invertebrates decreased where feral camels were present
Species with gills*	3.6 (+/- 0.5)	0.8 (+/- 0.4)	The number of invertebrates with gills decreased where camels were present

*denotes statistical significance using the Student's t-test (p = 0.05).

Average turbidity (i.e. muddiness) was ten times higher (Figure 19) for days when feral camels were/had been present compared to days when feral camels were absent. Turbidity measurements over 150 NTU can suggest water quality is degraded. In the case of waterholes affected by feral camels, turbidity readings were almost double that amount. This has direct implications for species that are sensitive to environmental degradation, such as mayflies, which are used worldwide as indicators of aquatic health. Sites where feral camels were absent had three times as many macroinvertebrates living in the water at the time of sampling. This suggests that feral camels have caused significant degradation to these waterholes, through fouling, drinking and trampling, which impacts both the physical integrity of the sites as well as water quality.

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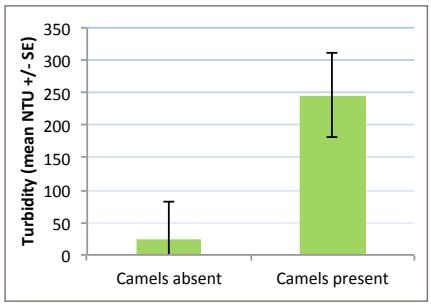
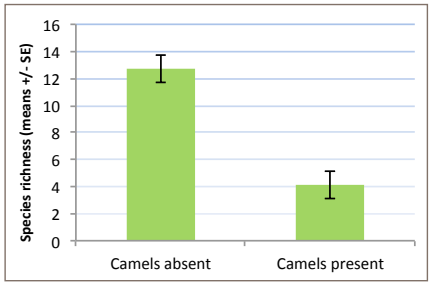
Figure 19: Comparison of turbidity and macro-invertebrate species richness at sites where feral camels are absent versus those where feral camels are present

a) Turbidity



b) Species richness



The presence of organisms that are intolerant of poor water quality (sensitive species) is a strong indicator of good biological condition and waterbody health. Significantly more sensitive aquatic invertebrates were found at sites when feral camels were absent, suggesting that feral camels can significantly impair sites when they are present (Table 4).

There was no significant difference in the number of tolerant or very tolerant species found between sites when feral camels were present (Table 4). This is not unexpected, because tolerant invertebrate species inhabit a wide variety of water types and conditions and would be expected to be found in both clean and polluted waters. In other words, as water becomes fouled, sensitive species drop out; but as water becomes cleaner, both tolerant and sensitive species will be found, leading to a net increase in species as water becomes cleaner. In general, the presence alone of tolerant taxa says little about biological condition, because tolerant groups inhabit a wide range of places and conditions.

There was a significant difference in the number of species that possess gills (Table 4) between sites/dates when feral camels were present. Significantly more invertebrates with gills were found on sites/dates when feral camels were absent. This is not surprising, in that aquatic macroinvertebrates with gills obtain oxygen from the water through direct diffusion over fragile external gills (Figure 20b and Figure 20c), and in general are very sensitive to water quality, particularly dissolved oxygen and turbidity (muddy water can clog gills). Invertebrates with gills rely on relatively stable dissolved oxygen and clear (non-turbid) water in order to live in an aquatic environment. The presence of more species with gills suggests that the water quality was better at sites where feral camels were absent.

Figure 20a: Comparison of types of macroinvertebrate species, including those that are sensitive, the numbers of predators, and those that have gills at sites where feral camels are absent versus those where feral camels are present

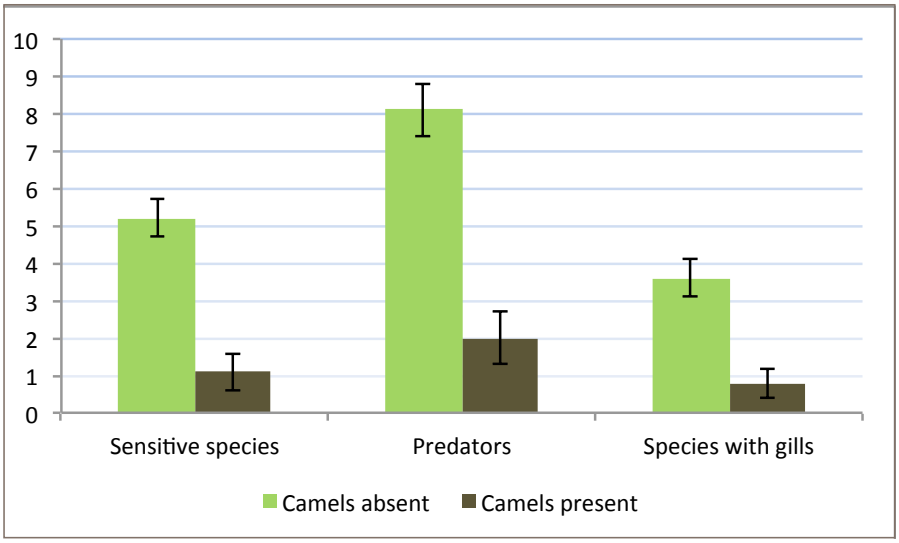


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Figure 20b: Image of a mayfly in the family Baetidae. Mayflies are a very sensitive group of invertebrates that possess gills Copyright © Malcolm Storey, 2010, www.bioimages.org.uk. Some rights reserved.

Figure 20c: Magnified image of mayfly (Baetidae) gills. Gills are very delicate and can easily be clogged with dirt in turbid water. Copyright © Malcolm Storey, 2010, www.bioimages.org.uk. Some rights reserved.

VOLUME OF WATER FERAL CAMELS CAN DRINK

The following cases from two sites, Urrurru and Tjilpuka, demonstrate the volume of water that feral camels (and other large herbivores) can drink from waterholes. Urrurru held roughly 989,000 litres of water when it was measured in October 2012 but it was dry by the end of January. After accounting for the substantial amount of pan evaporation (based on long-term monthly averages from the Bureau of Meteorology), the amount of water 'lost' from Urrurru above background evaporation was approximately 893,000 litres, and Tjilpuka was estimated to have 'lost' about 412,000 litres of water.

In hot conditions, red kangaroos and euros only need about 100 ml/day of water. In comparison, a feral camel can drink 200 L/day and horses can drink over 100 L/day in hot weather. That means feral camels can drink 2000 times more water on a hot day than a red kangaroo or euro, the largest native animals in the study areas. However, kangaroos will need to drink more often than feral camels do.

Over the 100-day period that these two waterholes dried out, theoretically 45 feral camels drinking every day could have drunk Urrurru dry, and 23 feral camels drinking every day from Tjilpuka could have caused it to dry during this same period. Camera-trap data collected during this three-month period suggest that many more feral camels and horses were in these areas actively seeking water.

Case study 5

Case study 5: Urrurru

Urrurru is a large, long-lasting rock hole that is used by the Docker River community as a swimming hole. It is one of the largest waterholes that were monitored on the Petermann Aboriginal Land Trust. It was visited in October and December 2012, and in February 2013. In October 2012, Urrurru was about half full, and was 2.5 m deep with a wetted area of 31 m by 18 m. A depth recorder was deployed, and an aquatic macroinvertebrate and water quality sample were collected. There was a surprising diversity of aquatic macroinvertebrates present in October, including mayfly larvae, an indicator species for good water quality. When Urrurru was visited in early December 2012, it still contained a lot of water, but less than in October. By the end of January 2013, it was dry, except for very small pockets of water that animals had accessed by digging through the sand (see page 51).

Urrurru in October 2012

Case study 5

A lone feral camel (in poor condition) drinks from a small soakage in Urrurru in February 2013. During this time individual feral camels sometimes spent over 12 hours at these small soakages to obtain water.

Feral camels, horses and dingoes attempt to access water during February 2013 from a small soakage in Urrurru. Over a three-month period it is estimated that feral camels and horses drank over 800,000 litres of water from this waterhole alone. The scarcity of water in the region led to large die-offs of horses and feral camels, as well as of some native animals.

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IMPACT OF FERAL CAMEL DUNG ON AQUATIC MACROINVERTEBRATES

Feral camels can cause major devastation to aquatic ecosystems by fouling the water with dung. The ongoing impact of a high nutrient load in the water in the form of dung can profoundly impact aquatic animals such as invertebrates, which are important to functioning ecosystems and provide a food source for other wildlife. An experiment was undertaken to assess the impacts of feral camel dung on the water quality and macroinvertebrate colonisation and community composition of arid zone freshwater pools.

The study involved the establishment of 18 small wading pools filled with water to imitate small arid zone waterbodies. Feral camel dung was placed in half the pools (the treatment) while the remaining pools (without dung) acted as the controls. The pools were sampled weekly over an eight-week period during summer 2012/13 for water quality, nutrients, chlorophyll a and macroinvertebrate richness and abundance.

The study found significant negative effects of feral camel dung on water quality, macroinvertebrate colonisation and community composition. Overall, macroinvertebrate abundance was higher in control pools, while pollution-tolerant animals were more common in the treatment pools. In contrast, sensitive taxa, such as larval mayflies and dragonflies, favoured the control pools. This is not surprising, in that we would expect animals with sensitive gills, such as mayflies, would be intolerant of high turbidity and low dissolved oxygen levels – conditions found in the pools that contained feral camel dung.

The presence of dragonfly larvae in the control, ‘clean’ pools and their absence from the treatment pools had a direct effect on the number of mosquito larvae in the treatment pools. Specifically, dragonfly larvae are predators and their high abundance in control pools kept the numbers of mosquito larvae under control. In dung treatment pools, where larval dragonflies were fewer, mosquito larvae and pupa were in much higher numbers.

Our results therefore suggest that feral camel dung can have a significant impact on water quality as well as the aquatic fauna present.

Figure 21a: Colonisation of mosquito larva and pupa and dragonfly larva in control pools. *The abundance of mosquito larva and pupa dropped with an increase in dragonfly larva.*

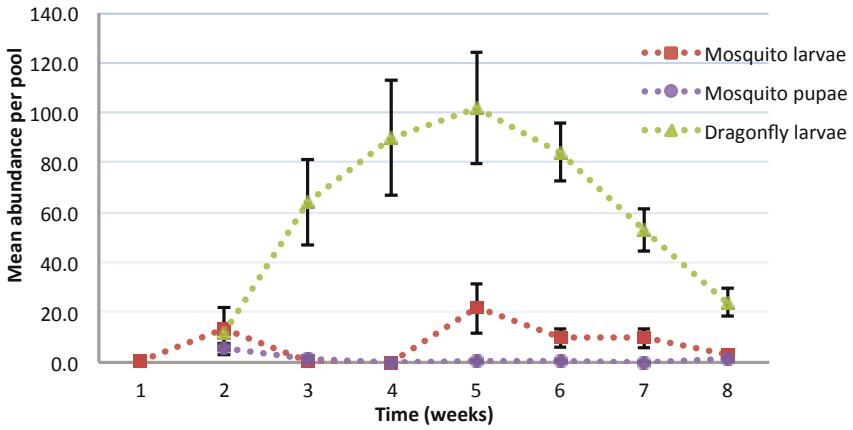
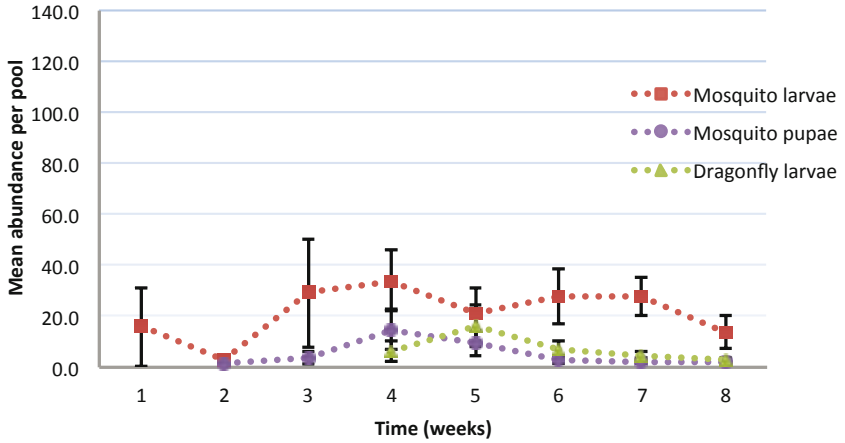


Figure 21b: Colonisation of mosquito larva and pupa and dragonfly larva in treatment pools. *The abundance of mosquito larva and pupa remained relatively consistent throughout and double that of control pools while dragonfly larva were in lower abundance.*

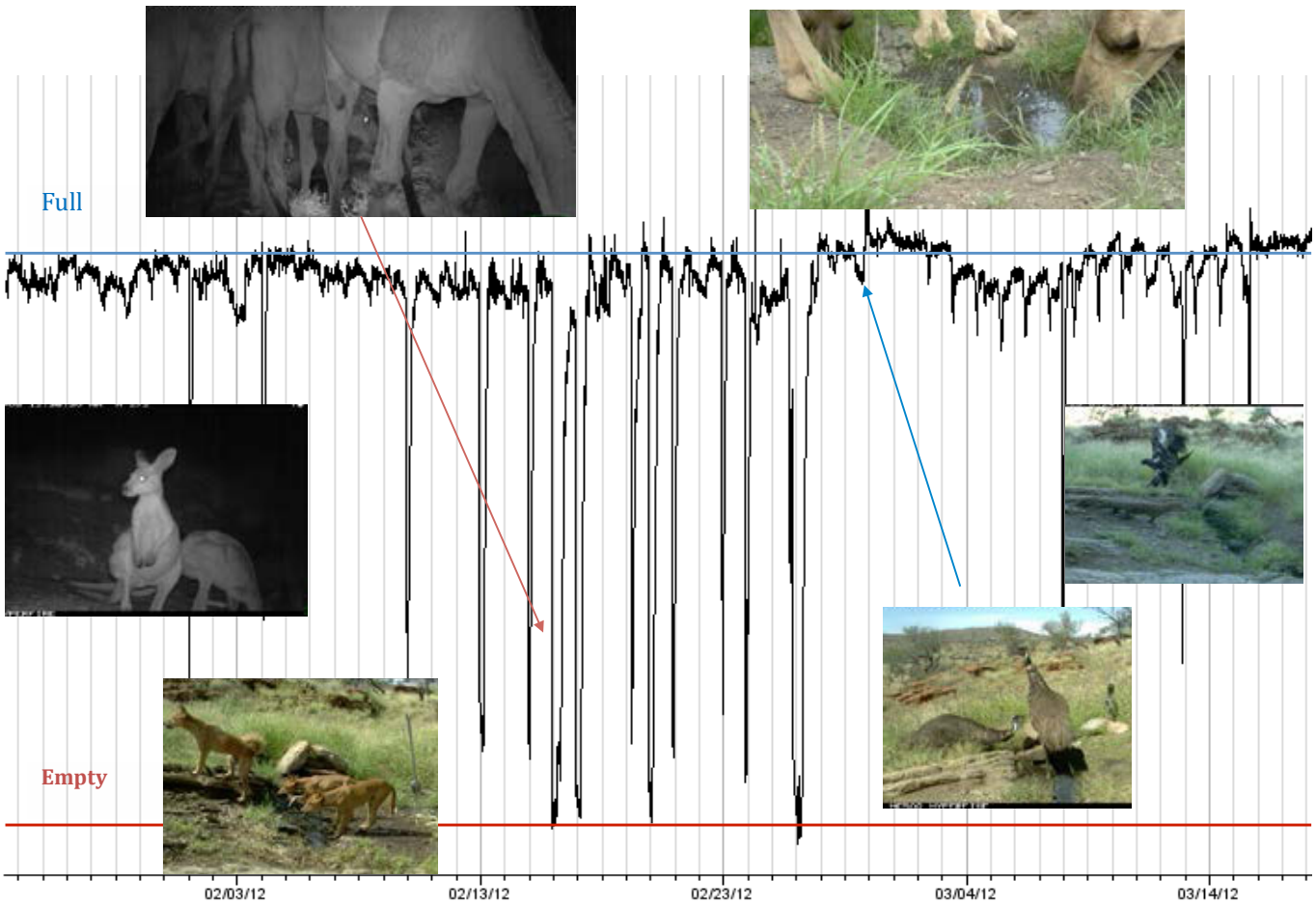


3.3.2 CONCLUSION: FERAL CAMELS NEGATIVELY IMPACT WATERBODIES IN CENTRAL AUSTRALIA

Every waterbody that feral camels had accessed during the project was degraded in some way. The monitoring clearly shows that feral camels impact water quality, the aquatic animals found in waterholes, the amount of water available to native animals (Figure 22) and the overall integrity of these sites through trampling, fouling with dung and drinking. This is not only disastrous for the ecosystems but also upsetting to Traditional Owners and land managers who care about these sites.

Fortunately, these results also suggest that degraded waterbodies can return to good condition if feral camel usage or access is decreased. This is a significant finding, in that in other arid zones severe degradation of waterbodies went past the tipping point, and waterbodies, even after they were cleaned up, did not regain their ecological integrity or functionality. Our results reinforce the need for ongoing management of Australia's feral camel population to ensure the long-term integrity of arid zone waterbodies and the freshwater biodiversity they support.

Figure 22: Changes in water levels at a small spring site in central Australia. *When native animals are present, the amount of water they drink is minimal (blue arrow). When feral camels are present, they are able to drink the small spring virtually dry, as evidenced by the dips in water level highlighted by the red arrow.*



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"We have had ground and aerial culling of feral camels on our property for a long time. We cannot attribute any change in dog populations to camel carcasses. The last few years with the increased rainfall, dog numbers have increased, but we don't think it is actually related to camel carcass numbers – rather to an overall increase in all prey. The motion-activated cameras that we have on the carcasses don't show opportunistic eating by dogs, rather 'playing' with the carcass. We would like to see the aerial culling continue."

Lyndee Severin,
Curtin Springs Station, NT

3.4 MONITORING FERAL CAMEL CARCASS BREAKDOWN

Source: Donna Digby, NT Dept of Land Resource Management

Due to the remoteness of feral camel populations, in many instances aerial culling was the most suitable method of control to reduce the feral camel population and the high levels of environmental damage that they cause. Using 21 remote-activated cameras, the project monitored the rate of camel carcass breakdown following aerial culling and the carcass use by native and feral wildlife in Qld and the NT across a range of land tenures (pastoral, conservation reserves and Aboriginal). Analysis of the images looked at the state of decomposition (Table 5).

Table 5: Stages of carcass breakdown

DECOMPOSITION STATE	STAGE NUMBER	DESCRIPTION
Fresh	1	Begins immediately after cessation of the heart and ends when the carcass inflates during the bloat stage. Odour is normal at the start of this stage. Insects can begin arriving at the carcass within minutes of death.
Bloat	2	Begins when anaerobic internal chemical reactions cause the carcass to inflate. The bloat stage provides the first clear visual sign that microbial proliferation is underway.
Active decay	3	Commences when the carcass deflates from bloat.
Advanced decay	4	Is marked by a decrease in odour and most of the carcass tissue is removed.
Dry	5	Carcasses have only small bits of tissue remaining and odour becomes faint.
Remains	6	Carcasses are largely skeletonised.

The images showed a wide range of animals and birds within the vicinity of the carcasses. Analysis of the images along with field observations indicate that there was little predation on the carcasses. A preliminary analysis based on a single carcass (out of the 12 that were monitored in the NT) found that the vast majority (>97%) of visits to the carcass were made by three species: the Torresion crow (61.6%, n = 614), red fox (27.8%, n=277) and the dingo (8.2%, n=82). The remaining 2.4% of visits were by the crimson chat (n= 5), honeyeater (n = 6), Australian magpie (n = 3), cat (n = 1), yellow-throated miner (n = 4) and sand goanna (n = 5).

While the aerial culls result in large amounts of protein being present in the landscape, they were programmed to occur less than two to three times per year in the same location. This means that fresh carcasses from aerial culling were only available to predators for a short period of time, which was unlikely to significantly influence reproduction or even immigration of predators onto pastoral properties. Anecdotal feedback from pastoralists is that the carcasses from aerial culling do not pose a problem and that predators tend to mainly visit the carcasses when they are fresh. There is also anecdotal evidence, and some remote camera evidence, that predators may inspect carcasses but not necessarily feed on them.

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Figure 23: The threatened black-footed rock wallaby. *This native animal occurs at waterholes near Docker River, but only in areas that feral camels cannot access.*

Figure 24: Dingoes at sunset at Newhaven wildlife reserve, captured on camera trap. *This salty spring is also heavily used by feral camels.*

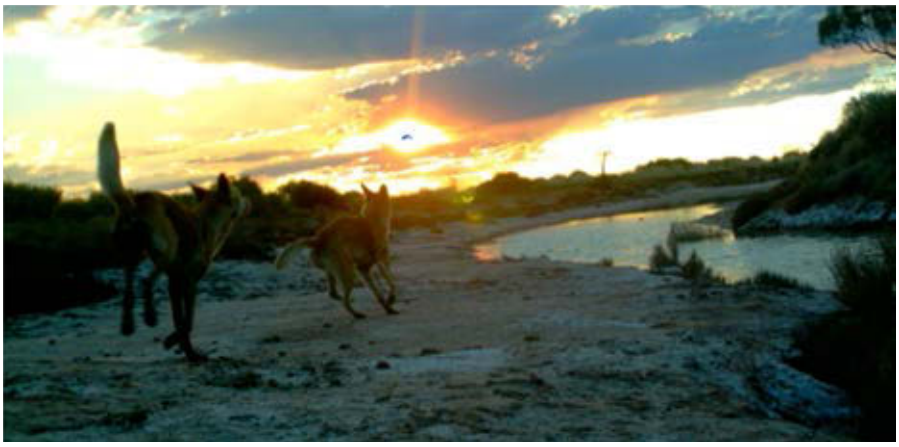

Figure 25: Camels drinking from a remote spring. *As temporary waterholes dry up, feral camels often dominate more permanent waters to the exclusion of native wildlife.*

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Figure 26: Feral camel carcasses in waterholes. *When conditions are very dry, camels can become stuck and die in remote waterholes that are both culturally and ecologically significant.*

3.5 CAMEL GEODATABASE

Source: Mark Lethbridge, Ecoknowledge; Keith Saalfeld and Glenn Edwards, NT Dept of Land Resource Management

The DKCRC feral camel research project developed a camel geodatabase, and this was adopted as the repository for all AFCMP data relating to population and density changes. The feral camel density map presented in the DKCRC project final report in 2008[18] provided the baseline for the AFCMP. The density map was overlain with key biodiversity assets and the expected buffer zones (50 km and 100 km) required around each asset to provide protection (i.e. zones around biodiversity refugia where the project is aiming to achieve various density targets per square kilometre) – see Figure 27, Figure 28 and Figure 29.

The project has built up a large database on the logistics and associated costs of aerial culling operations to help refine a decision support system (DSS) that has recently been developed for aerial culling. The DSS considers the density of feral camels in an area, the maximum operational boundaries for helicopters away from base camp and various other factors and gives an indicative cost of removal per animal. While not being the sole basis for planning operations, the information assists agencies in their planning.

The project considered ways (e.g. use of cameras rather than spotters) to improve the efficiency of aerial surveys so that these could be conducted more often and/or over a larger area for the same cost, but these alternatives were not able to be tested in any substantial way during the project.

18 Edwards G, Zeng B, Saalfeld W, Vaarzon-Morel P and McGregor M. 2008. *Managing the impacts of feral camels in Australia: a new way of doing business.* DKCRC Research Report 47. Desert Knowledge CRC. Alice Springs. http://www.desertknowledgecrc.com.au/resource/DKCRC-Report-47-Managing-the-impacts-of-feral-camels-in-Australia_A-new-way-of-doing-business.pdf.

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3.5.1 POPULATION MODELLING (AND AERIAL SURVEY)

At the start of the AFCMP there was still some uncertainty about the total population and densities of feral camels, as the estimates at that time were based on surveys of 12% on the known feral camel distribution and incorporated some data that was over five years old. These numbers were extrapolated and combined with an estimate of an average 10% yearly increase in feral camel numbers from surveys conducted in the different areas at different times (see Figure 27). Aerial survey work under the AFCMP suggests that this 10% annual increase may be an overestimate in drier years.

In 2008, the feral camel population was initially estimated at 780,000, based on aerial surveys conducted between 2001 and 2008. Based on assumptions about the average density of feral camels outside of survey areas, this initial estimate was increased to one million feral camels and reported in the 2008 DKCRC report as a reasonable estimate 'until a more accurate estimate can be devised' (Edwards et al. 2008[16], p. 28). Recent remodelling of the data used in the 2008 map has provided a better estimate of the feral camel density outside of survey areas and given a revised total population figure of around 600,000 in 2008.

The revised 2008 total population figure, combined with the likelihood that the original figure of 10% for average rate of annual increase is an overestimate, helps explain why the AFCMP has only had to remove around 160,000 feral camels to achieve its density targets. Other factors include the likely increase in natural mortality in 2012 associated with drought and fire, and the fact that most pastoralists in the feral camel range undertake ongoing ground culling and some mustering as feral camels move through their property. It's important to note that the AFCMP conducted removal operations whenever adequate densities of feral camels allowed cost-effective removal, and this was the main driver for removal rather than a target removal number per se.

Even at a population level of 600,000, there was still an imperative to undertake a large-scale management program such as the AFCMP, to drive the population towards the 0.1/km^2 target figure (equivalent to a total population of 300,000), at which level the impacts of feral camels would be more acceptable and there would be greater potential for landholders to maintain lower densities into the future.

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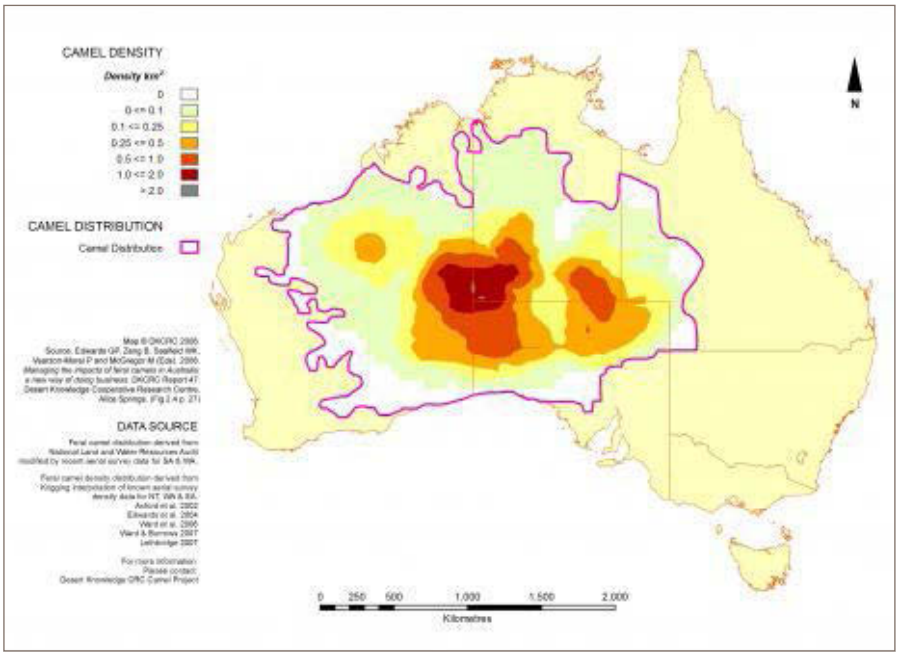
Figure 27: Density map from 2008 DKCRC report. *(Source: Edwards et al. 2008 , p. 27)*



The project has provided the resources to undertake more extensive aerial survey work, thereby improving the knowledge of feral camel densities and refining total population estimates. An updated 2011 density map put together by the AFCMP involved aerial survey coverage of around 20% of the feral camel distribution, but again, some of these data were old, from 2006. To account for these older data, it assumed an average annual rate of population increase of 8% and derived a population estimate of around 750,000 (with a range of 680,000–780,000 depending on the period of aerial survey data pulled into the analysis and the assumed average rate of population increase). This 2011 population estimate is not inconsistent with the revised 2008 population estimate of 600,000, given the lack of population removal in the first two years of the AFCMP (first year was a pilot year; the second year experienced very high rainfall) and the likely high rate of feral camel population increase in this period due to wet conditions across most of the rangelands.

Although the final 2013 AFCMP density map (Figure 28 and Figure 29) is based on aerial survey coverage of only 13% of the feral camel distribution, it has the advantage of using only recent 2013 data and not having to extrapolate from old survey information. Thirteen per cent of the feral camel distribution equates to 430,000 km^2 and the project allocated a significant amount of the MERI budget to aerial surveying. To undertake a significantly larger area of sampling across the country to obtain a more accurate density estimate would have been cost prohibitive.

The 2013 aerial survey work concentrated on areas that have traditionally had the highest feral camel densities. These tend to coincide with most of the 18 environmental assets where the AFCMP was required to reduce impacts. Considerable anecdotal and aerial spotting information over the life of the AFCMP has provided confidence that there are no inherently high-density feral camel population areas that are a significant distance

from the 2013 aerial survey areas. This gives us greater confidence in the figures in the environmental asset density table (Table 6) because the aerial surveys were either flown over or close to the buffer zones where the standard errors in the Kriging (extrapolated) map are much lower. However, the total population estimate of around 300,000 may be a slight underestimate because of the lack of aerial surveys in the low-density areas of inland Australia. Nevertheless, there has been much less extrapolation of these densities into new areas, a flaw in the original Kriging approach used to create the 2008 map.

Figure 28: Current (2013) national density map for feral camels, with aerial survey areas marked by diagonal lines. *Note: The diagonal line shading does not represent transect lines.*

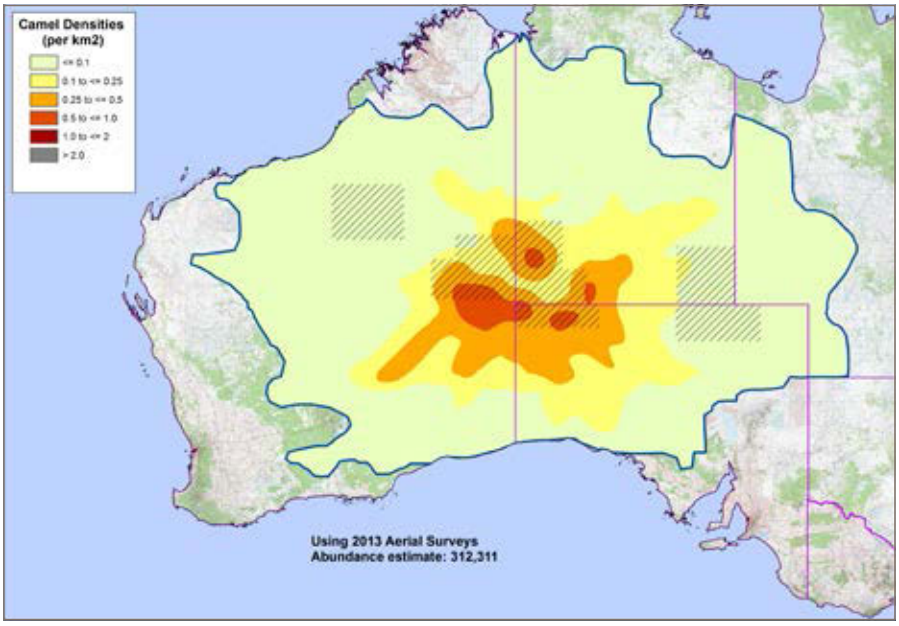


Figure 29: Current (2013) national density map for feral camels with environmental assets and association buffer zones (0–50 km and 50–100 km) shown

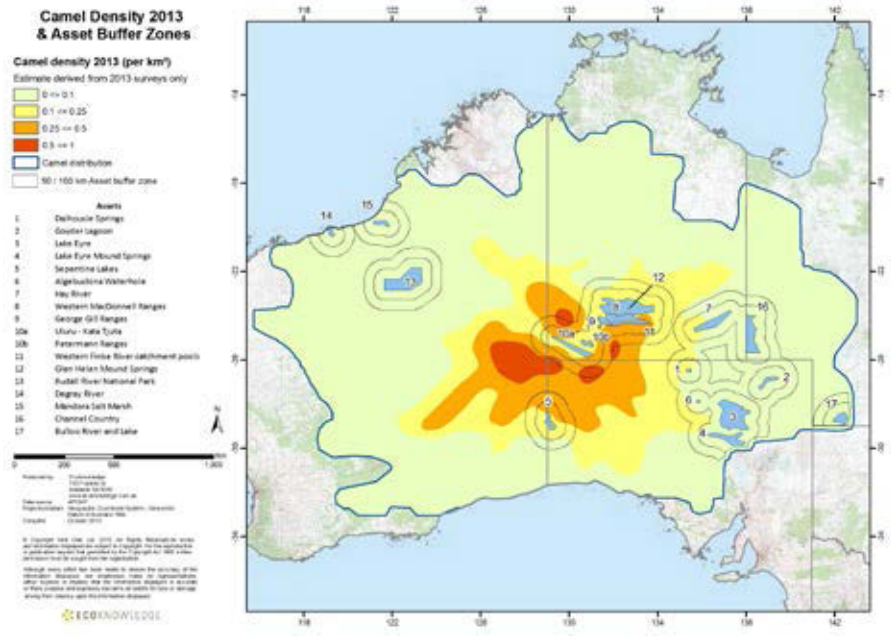


Table 6: Target and achieved feral camel densities in the buffer zones (see Figure 29) around nominated environmental assets.

Notes:

- As can be seen in Figure 28, some buffer zones encompass multiple environmental assets and there are therefore variable target densities within these large buffer zones.
- Means of achieved density ranges are presented in brackets for areas where the density standard errors are low enough for a meaningful estimate of the mean value to be made.

REGION	ENVIRONMENT ASSETS (GROUPED ACCORDING TO SHARED BUFFER ZONES)	TARGET DENSITY WITHIN BUFFER ZONE (FERAL CAMELS PER KM²)	ACHIEVED (2013) DENSITY WITHIN BUFFER ZONE (FERAL CAMELS PER KM²)
0–50 KM BUFFER ZONE			
Simpson	Dalhousie Springs, SA	<0.1	0.04–0.14 (0.1)
	Goyder Lagoon, SA	<0.1	0–0.07 (0.04)
	Lake Eyre, SA Lake Eyre Mound Springs, SA Algebuckina Waterhole, SA	<0.25	0–0.11
	Hay River, NT Channel Country, Qld	<0.1	0–0.14 (0.04)
	Bulloo River and Lake, Qld	<0.1	0
Surveyor Generals Corner	Western MacDonnell Ranges, NT George Gill Ranges, NT Uluru and Kata Tjuta, NT Petermann Ranges, NT Western Finke River Catchment pools, NT Glen Helen Mound Spring, NT	<0.1 to <0.25	0.1–0.53 (0.22)
	Serpentine Lakes, SA	<0.25	0.1–0.33 (0.21)
Pilbara	Rudall River	<0.1	0–0.07 (0.03)
	De Grey River	<0.1	0
	Mandora Salt Marsh	<0.1	0–0.01
50–100 KM BUFFER ZONE			
Simpson	Dalhousie Springs, SA Goyder Lagoon, SA Lake Eyre, SA Lake Eyre Mound Springs, SA Hay River, NT Channel Country, Qld	<0.25 to <0.5	0–0.16
	Bulloo River and Lake, Qld	<0.1	0–0.01
Surveyor Generals Corner	Western MacDonnell Ranges, NT George Gill Ranges, NT Uluru and Kata Tjuta, NT Petermann Ranges, NT Western Finke River Catchment pools, NT Glen Helen Mound Spring, NT	<0.5 to <1.0	0.08–0.6 (0.3)
	Serpentine Lakes, SA	<0.5	0.07–0.42 (0.22)
Pilbara	Rudall River	<0.25	0–0.08 (0.03)
	De Grey River	<0.1	0
	Mandora Salt Marsh	<0.1	0–0.01

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As the above maps and table show, the AFCMP density targets have been met completely in 13 of the 17 buffer zones around environmental assets, and have largely been met in the other four buffer zones, with some sections of these four zones having densities above the targets. In particular, there is now a real opportunity to maintain very low densities of feral camels in the Pilbara and Simpson regions.

Although densities in the Surveyor Generals Corner region have been reduced, they are still generally above the broad long-term target of 0.1/km^2. Within this region, there are two large areas (APY and Ngaanyatjarra lands) where the landholders have expressed a strong preference for commercial use. The AFCMP has supported commercial use in these areas in order to maximise the rate of removal through this approach, particularly in terms of encouraging removal of female camels. We hope that the increased commercial use capacity that has been facilitated by the AFCMP in these areas will allow a level of removal that drives the density down rather than just being a sustainable offtake. The aerial culling that has occurred in the non-commercial use zones of Surveyor Generals Corner has undoubtedly helped reduce the overall density of feral camels in this region over the life of the project, given the mobility of feral camels between commercial and non-commercial zones.

The AFCMP has provided improved knowledge of feral camel landscape utilisation under different seasonal conditions. While future modelling could use habitat data and co-Kriging to improve national density maps, this requires further research and was outside the scope of the project.

In order to assist improved modelling of feral camel population dynamics under different seasonal conditions, the AFCMP supported a project to take feral camel teeth samples from a population of feral camels in the Simpson Desert that was aerially culled in early 2010. Analysis of tooth cross-sections allows an individual animal to be aged and a histogram of age distribution to be conducted. Two hundred and nineteen individuals were sampled from 22 herds. The histogram for female camels showed a pronounced peak at six years of age, with very few animals over 10 years and a maximum age of 17 years. The histogram for male camels was more evenly spread with a pronounced block in the range 5–15 years, with few animals over 15 years and a maximum age of 27 years.

It is important to emphasise that the results of such an analysis will depend on a number of factors, including seasonal conditions and frequency of past removal in the lead-up to the sampled population being culled; and the seasonal conditions and time of year when the cull occurs, which will have an influence on herd structure. Therefore this type of work needs to be repeated for a range of situations to get a clearer idea of population dynamics in different regions and under different seasonal conditions and removal regimes.

3.5.2 FERAL CAMEL MOVEMENT

The extreme mobility of feral camels means that there is a need to collect information on their movements in response to seasonal conditions and control activities. The AFCMP deployed approximately 50 satellite tracking collars to obtain information on feral camel distribution and movement and help guide removal operations. The data collected has shown that feral camels are extremely mobile animals and will travel long distances in response to climatic conditions. Monitoring of feral camel movements in the Simpson Desert between August 2011 and May 2013 (see Case study 6) found that the monitored animals covered an area of 159,122 km^2.

The high level of feral camel mobility means that densities can expand or contract rapidly depending on seasonal conditions. When favourable conditions prevail, large numbers of feral camels can quickly congregate and have major impacts on those sites. The movement data is also showing trends in habitat preferences under different seasonal conditions, which will help guide future feral camel management. Predicting these movements can make for better protection of environmental assets and more efficient removal operations.

This information, when linked with observations from landholders and aerial reconnaissance, was found to be useful in designing cost-effective management strategies, particularly in lower density areas, and locating congregations of animals. Taking the time to understand feral camel movement leading up to a removal effort can ensure that resources are directed into the right place at the right time. The data has also proven to be an important community engagement tool to explain feral camel movements to people in remote communities.

Case study 6

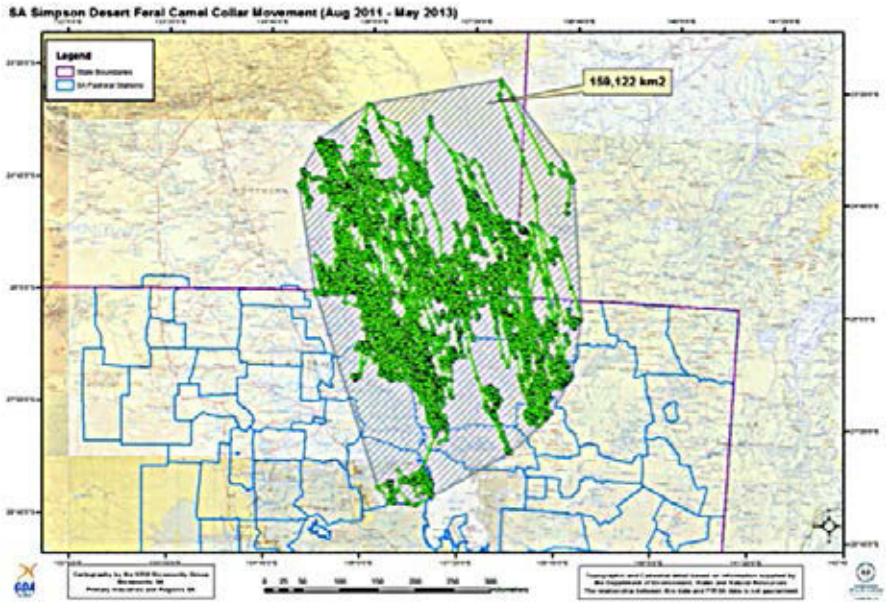
Sharon Oldfield (Cowarie Station) – "This is an example of the system working well," Sharon said. "Landholders reported an unexpected congregation of feral camels and the Feral Camel Project staff were able to check with the neighbours to respond straight away. As it turned out there were a lot more animals there than we expected. It was fantastic to take the chance to respond while we could. I'd hate to think what sort of impact we would have seen if that number of feral camels had been left there for much longer."

Nick Secomb (Primary Industries South Australia, SA Coordinator for the AFCMP at the time of the removal operation) – "In a recent exercise in the Simpson Desert we retrieved real-time satellite collaring data, landholder reports and aerial reconnaissance which showed that feral camels were congregating on diminishing natural waters along the Warburton and Kallakoopah creeks. We were able to download activity maps onto a computer tablet with mapping software to help guide the helicopter and aerial cull crew directly to the hotspots". This same software also helps ensure that operations remain on those properties which have given permission for removal to be undertaken. "By using this approach, we are also able to show the exact current location of collared animals so that the crew can not only grid out the hotspot of activity but also directly fly over collared animals. Using this method we were able to remove over 2,200 animals in less than a week with over 90% of these being removed from the anticipated hotspots."

Case study 6: The use of satellite collars to improve decision-making for feral camel management in the Simpson Desert

Source: Nick Secomb, Biosecurity SA

In August 2011, 25 satellite tracking collars were deployed in the Simpson Desert. Fourteen were still active in May 2013. Over this period the collared animals covered 159,122 km^2. The average distance covered each day by a female was 3.91 km and by a male was 3.44 km. The maximum distance travelled in a day by an individual was approximately 70 km and in a month was 557 km. The maximum distance travelled by an individual during the deployment period was 4,336 km.



Information provided by the collars is a useful planning tool. Where a number of feral camels in a local population are fitted with collars they provide information on the movement of that population, and over time the information collected helps in the understanding of behaviour in relation to changing environmental conditions. The information can be useful in determining where high concentrations are likely to be located under different seasonal conditions based on observations of whether movement is directional and/or linked to permanent water, rainfall patterns, or other factors.

When linked to landholder information, satellite tracking data is useful in identifying, planning and implementing removal operations. At Cowarie Station, on the edge of the South Australian part of the Simpson Desert, satellite collaring helped to locate and show the extent of a congregation of feral camels in the summer of 2012/13. Hundreds of feral camels had descended upon diminishing waters along the Warburton and Kallakoopah Creeks. The collaring data helped to locate the congregation and assist in coordinating the response.

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3.5.3 FERAL CAMEL REMOVAL

As Figure 30 shows, feral camel removal under the AFCMP has been conducted over around 660,000 km^2 over the life of the project. Removal was focused on the areas that had the highest feral camel densities, which were generally also close to priority environmental assets. In most cases, removal was repeated several times in each region over the life of the project, which is essential to progressively drive the regional population down and to account for the movements of such a mobile animal.

As much as possible, removal operations are guided by various forms of intelligence gathering, including aerial surveys (flying along set transects so that density can be calculated), aerial spotting (flying to areas of most likely feral camel activity to get a general idea about higher density locations), satellite tracking collars and landholder and traveller feedback. This intelligence helps inform decisions about whether a removal operation is likely to be cost-effective and maximises the efficiency of operations.

Around 160,000 feral camels have been removed under the AFCMP, with operations still underway at the time of writing this report. This includes over 130,000 through aerial culling, 15,000 mustered and 12,000 ground culled for pet meat.

The economics of commercial use are discussed in section 5.3 (page 95) of this report. While commercial use can offset removal costs with the sale of animals, it has challenges as a form of population management in that it is not suitable for all areas and only certain animals have commercial value. In contrast, aerial culling can be conducted in the remotest of locations and all observed animals are removed. Aerial culling can also achieve more rapid population knockdown, for example, over a thousand animals per day compared with a few hundred per week for mustering.

Aerial culling operations under the AFCMP have generally been in the cost range of $25–50 per head where larger numbers of animals are removed (over 1000), typically increasing to the $75–150 per head range for smaller culls (500–1000).

The largest individual aerial cull operation under the AFCMP was conducted in mid-2012 in south-west Northern Territory. It employed three R44 helicopter cull platforms in combination with two R22 helicopter spotting/mustering platforms. It removed 11,560 feral camels in 280 operational hours over 12 days. The area covered was 45,000 km^2 and the average removal cost was around $30 per head.

As can be seen in Table 7 and the cumulative removal graph in Figure 31, commercial and non-commercial removal was relatively limited in the first two years of the project. Year 1 (2009–10) was a pilot year to test different removal approaches, and Year 2 experienced wet conditions (see Figure 32). Pet-meating ceased in January 2011 following a change in processor requirements. There was also a hiatus in mustering in the middle of the project due to a combination of wet weather and the lack of an export abattoir in reasonable proximity to central Australia. With the reopening of Peterborough abattoir in mid-north South Australia in early 2012, the AFCMP was once again able to support commercial use as a removal approach.

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One of the formal project objectives was to improve land management practices in the pastoral industry, with a measure of this objective being the number and area of pastoral properties assisted with improved feral camel management. The target was 12 properties covering 88,082 km^2 and the AFCMP exceeded this by assisting feral camel removal on 35 properties covering 162,000 km^2.

Figure 30: Map showing the areas where feral camel removal was conducted under the AFCMP, relative to the locations of priority environmental assets

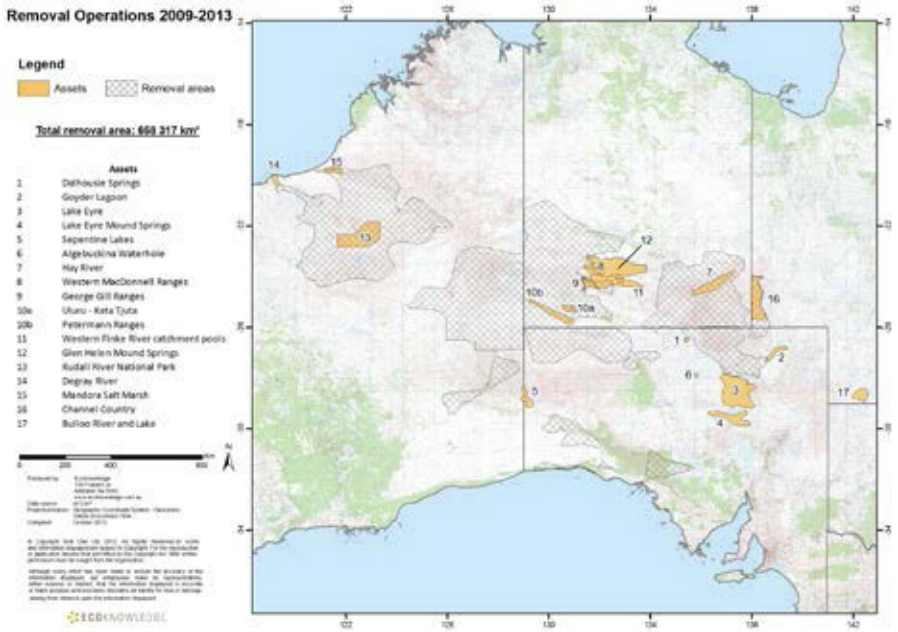

Table 7: Feral camel removal numbers by year, region and method

		REMOVAL METHOD			
YEAR	REGION	AERIAL CULL	MUSTER	PET MEAT	TOTAL REMOVED
2009/10	Simpson	5888	-	-	5888
	SG Corner	3708	3143	9699	16,550
	Pilbara	5237	-	-	5237
2010/11	Simpson	2761	-	-	2761
	SG Corner	-	-	2033	2033
	Pilbara	8308	-	-	8308
2011/12	Simpson	736	-	-	736
	SG Corner	41,056	895	-	41,951
	Pilbara	7802	-	-	7802
2012/13	Simpson	10,024	-	-	10,024
	SG Corner	34,957	8911	-	43,868
	Pilbara	2688	-	-	2688
2013/14	Simpson	1150	-	-	1150
	SG Corner	10,586	2239	-	12,825
	Pilbara	989	-	-	989
TOTALS		**135,890**	**15,188**	**11,732**	**162,810**

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Figure 31: Cumulative feral camel removal by method

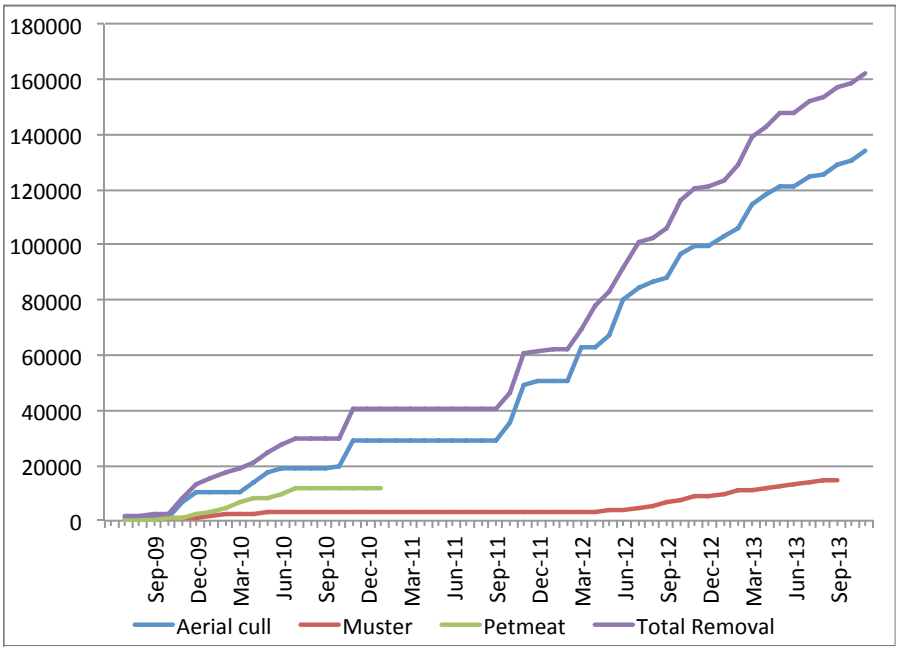
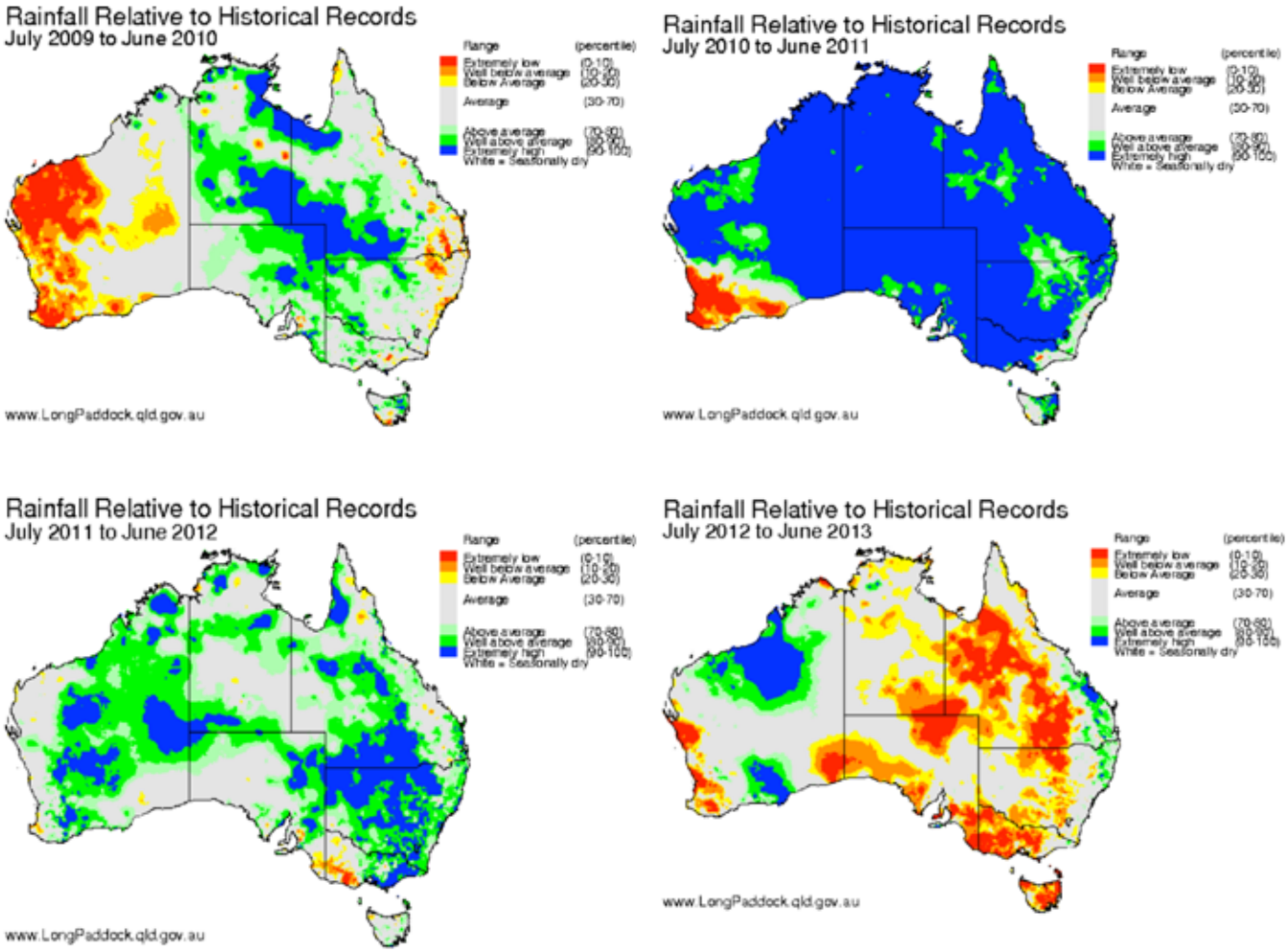


Figure 32: Rainfall patterns over the life of the AFCMP, showing the particularly wet period in Year 2



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3.6 VIEWS OF LAND MANAGERS AND THE PUBLIC ABOUT FERAL CAMEL IMPACTS AND MANAGEMENT

The MERI program included three surveys of land management groups to assess their views on feral camel impacts and management. These surveys were not as comprehensive as those undertaken in the DKCRC research, although they do provide an interesting insight into changes in opinion over time. The land management groups surveyed were Aboriginal owners, pastoralists and conservation land managers.

3.6.1 ABORIGINAL PEOPLE

The DKCRC research found that the highest densities of feral camels were on lands managed by Aboriginal people, and a community survey found that while there was a realisation that feral camel numbers (and their impacts) were increasing, there was very little knowledge within communities about range and suitability of the available management approaches.[19] The Aboriginal community survey conducted by the DKCRC was followed up by a further survey at the end of the AFCMP to determine whether there had been any change in perceptions, perspectives and attitudes towards different feral camel management options.

In total, 222 individuals were surveyed in 2013 by Ninti One Aboriginal Community Researchers. This survey found that there was a high level of awareness of feral camels (87% of respondents have some knowledge of feral camels and over 75% of respondents are seeing tracks and dung from feral camels around their community). There was a commonly held view that there were still too many camels (90% of respondents); 70% of people interviewed noted an increase in numbers of feral camels in the past four years, and 20% felt that numbers had reduced, indicating that the full impact of the AFCMP management activities are not being fully felt yet. These survey findings contrast with direct feedback received by on-ground AFCMP coordinators from many Aboriginal communities over the past year that feral camels are less obvious on roads and around communities, and that the condition of the environment and cultural sites has improved.

The presence of feral camels, and the locations where they were found (Figure 34), has the potential to impact on community member's safety and cultural activities. Over 70% of respondents indicated that feral camels were spotted when travelling on the roads, posing a serious threat to safety. While the incidence of feral camel damage to cars was identified as low compared with impacts on other infrastructure (Figure 35), motor vehicle accidents involving feral camels have resulted in serious injury and fatalities.

As Figure 35 shows, feral camels impact on traditional cultural values (rock holes, sacred sites, waterholes, native animals); contemporary culture (bush tucker, native animals and water bores); and community life (community dumps, cars, houses, buildings and airstrips). The presence of feral camels at sacred sites and waterholes can impact on the frequency and way in which Aboriginal people conduct cultural activities. Being afraid of camping in areas with high feral camel populations can lead to a significant impact on the passing on and maintenance of culture.

19 Vaarzon-Morel P. 2008. *Key stakeholder perceptions of feral camels: Aboriginal community survey.* DKCRC Research Report 49. Desert Knowledge CRC. Alice Springs. http://www.desertknowledgecrc.com.au/resource/DKCRC-Report-49-Key-stakeholder-perceptions-of-feral-camels_Aboriginal-community-survey.pdf

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Figure 33: The communities that were involved in the changing views towards feral camels survey. Note that some respondents identified with more than one community.

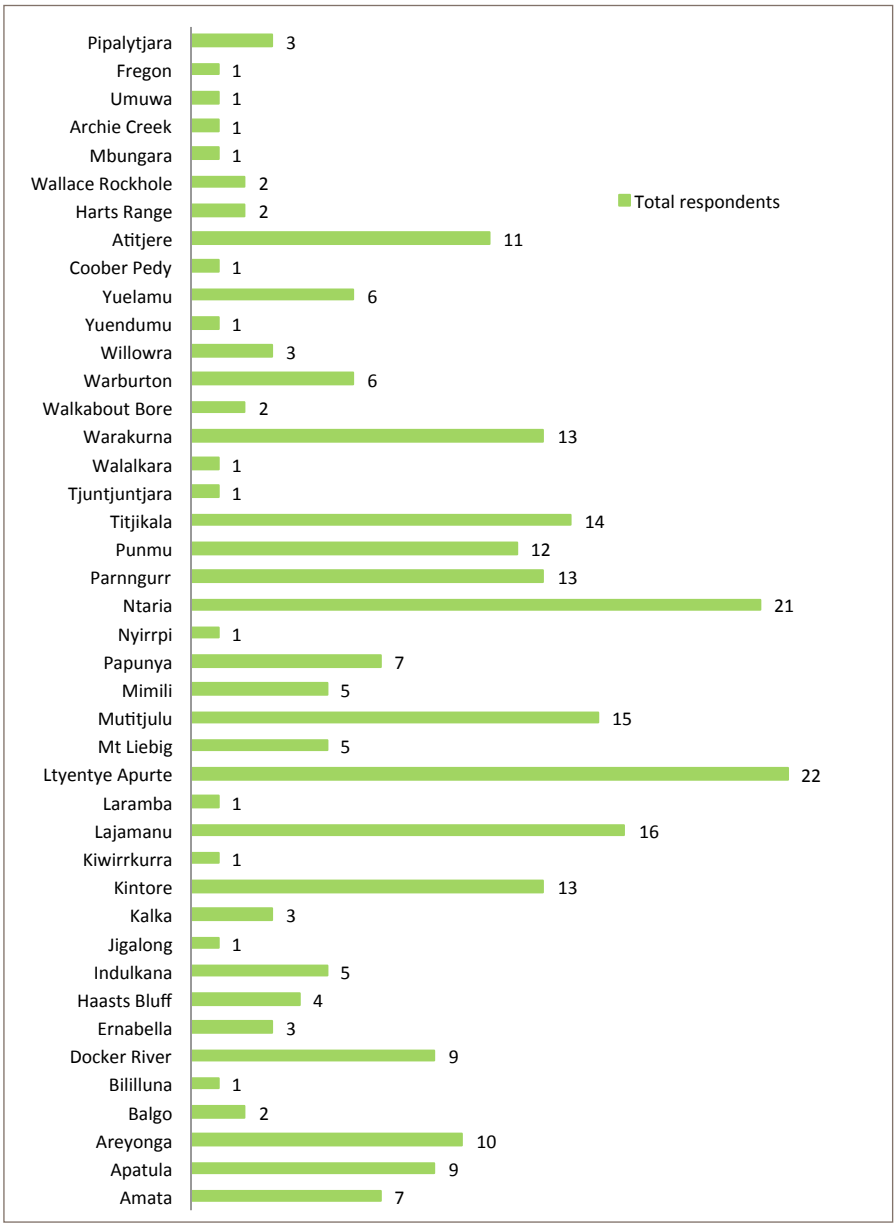
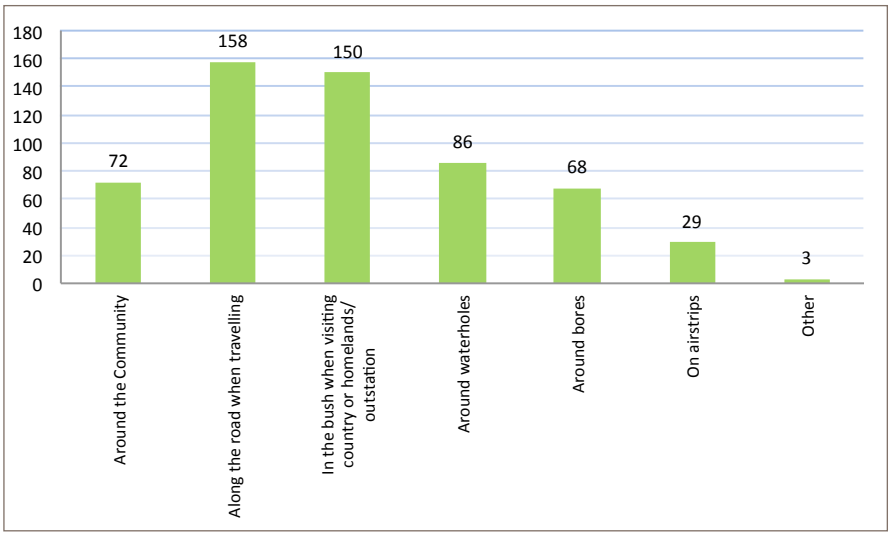


Figure 34: The locations where Aboriginal community members see feral camels



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The overall impacts are large and not passive. Impacts on buildings, water bores and airstrips can have serious impacts on health and safety of community members. Damage to airstrips can prevent The Flying Doctors planes from landing. Interference with water supply can result in communities being without their only source of potable water and isolated away from repair crews. These impacts do not usually occur in isolation; multiple impacts are likely to happen at the same time during periods of high levels of feral camel congregation in dry periods.

The survey also found that 65% of respondents believed that the impacts of feral camels had increased in the past four years, and approximately 19% of respondents reported decreasing impacts. The reported increase may relate to heightened awareness of the problem and the concentrated damage on waterholes during 2012/13 as a result of the very low rainfall across desert Australia.

A recommendation in the 2008 DKCRC report was that 'Aboriginal people and communities interested in feral camel management projects [should be provided] with support and assistance in the form of information, resources, training and capacity building' (Vaarzon-Morel 200[20], p. 4), as there was a very low level of understanding of the management options available and the implications associated with each option. By the time of the 2013 survey, 54% of people knew about the different ways of managing feral camels. While only one-third of respondents had heard of the AFCMP by name, much of this increase in knowledge can be attributed to AFCMP activities through the efforts of the partners. Respondents who knew about management options received that information from Land Council meetings (48%); from family, friends or community meetings (53%); or when working or being trained (50%), showing that people were able to access information about the project from multiple sources. The AFCMP used Land Council and community meetings to inform communities about feral camel management options.

Approximately 60% of respondents noted that their community does something to actively manage feral camels, and 90% indicated that these management activities did not cause problems for the communities. The range of management options used is shown in Figure 36. There is a low awareness of aerial culling, possibly due to these activities not directly involving the community members who were surveyed. The AFCMP has involved senior Traditional Owners and Aboriginal rangers in aerial culling in the following ways: obtaining consent for aerial culling; 'look around' flights to help plan aerial culling, including 'no go' areas; and involvement in ground support for aerial culling.

The survey found that there was a strong recognition that feral camels are an issue for the attention of all organisations and groups with land management responsibilities and therefore need to be managed at a landscape scale (Figure 38).

20 Vaarzon-Morel P. 2008. *Key stakeholder perceptions of feral camels: Aboriginal community survey.* DKCRC Research Report 49. Desert Knowledge CRC. Alice Springs. http://www.desertknowledgecrc.com.au/resource/DKCRC-Report-49-Key-stakeholder-perceptions-of-feral-camels_Aboriginal-community-survey.pdf

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Figure 35: The damage that Aboriginal community members perceive feral camels causing

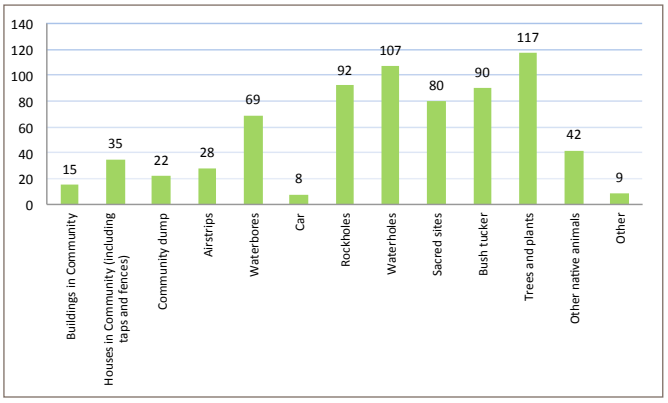


Figure 36: What does your community do to reduce the numbers of feral camels and their impact?

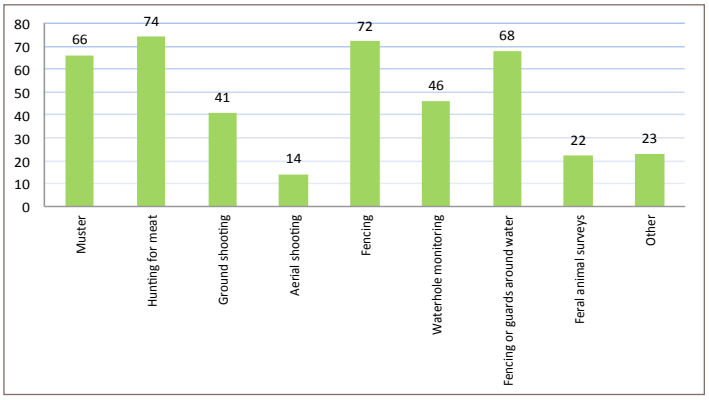


Figure 37: What should happen to feral camel management in the future?

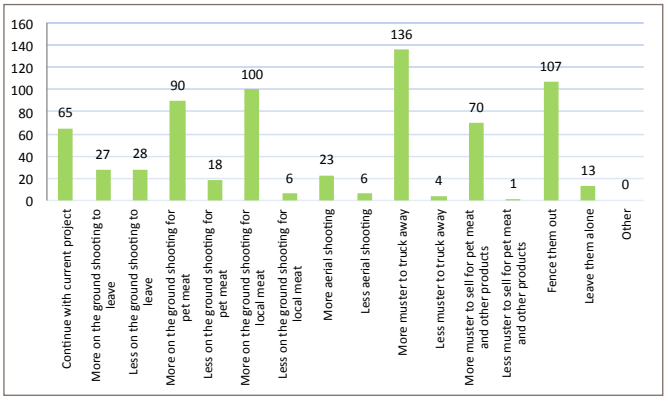
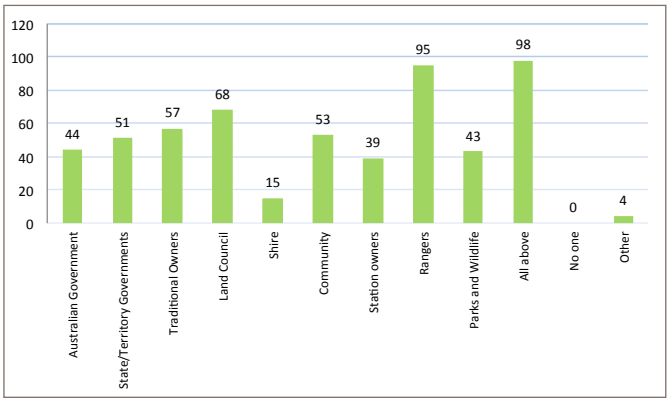


Figure 38: Who should work on managing and/or controlling feral camels?



3.6.2 PASTORALISTS

The DKCRC research found that feral camels were causing significant damage on pastoral properties, and pastoralists indicated that feral camels needed to be controlled. The most favoured control methods were shooting to waste and harvesting, although pastoralists expressed a lack of confidence in the camel industry and its long-term viability. Less than 11% of pastoralists surveyed supported strategic approaches such as the AFCMP and wanted 'immediate action rather than more talking about, planning to deal with, and monitoring of the problem' (Zeng and Edwards 2008[21], p. 39). The research also found that while most pastoralists who had feral camels on their property were engaged in control activities, most did not receive relevant information and there was a need to develop a strategy based on two-way communications.

The 2013 survey also found that feral camels were causing problems on more than half of the properties surveyed. Pastoralists identified damage to fences and waterpoint infrastructure and competition with livestock for feed and water as their main concerns. Road safety was also identified as a major impact of feral camels by more than 30% of respondents. The infrastructure damage identified by pastoralists surveyed had substantial economic impact. In 2009/10, one pastoralist quantified the impact at $60,000 while the average impact was identified at just under $20,000. In 2012/13 the average was approximately $10,000.

The majority of respondents (85%) were aware of the AFCMP and 36% had had AFCMP activities occur on their properties. A major change from the original DKCRC research was that 45% of those surveyed felt that the 'strategic' approach implemented by the AFCMP was the right approach for managing feral camels, and only 18% still had a negative view of the 'strategic' approach. A small percentage of those surveyed (15%) felt that feral camel impacts on their properties had increased over the four years of the AFCMP and one-third indicated that impacts were decreasing. The majority of respondents thought that their individual activities were only slowing the inevitable increase in the population as opposed to maintaining the population at current levels or achieving a reduction in the population.

While 43% of pastoral enterprises reported selling feral camels at some stage, there are currently very few pastoralists that are involved in commercial use on a regular basis. This is despite the fact that pastoral enterprises usually have the infrastructure required to deal with mustering and holding feral camels. The lack of widespread selling of feral camels was attributed to the low sale price that they attract and the high transport costs. There was a mixed response about whether a camel industry would replace the need for aerial or ground culling (46% yes and 38% no, with 15% unsure).

21 Zeng B and Edwards G. 2008. Chapter 3: Key stakeholder perceptions of feral camels: pastoralist survey. In *Cross-jurisdictional management of feral camels to protect NRM and cultural values.* Eds. Edwards G, McGregor M, Zeng B, Vaarzon-Morel P and Saalfeld W. pp. 35–62. Desert Knowledge CRC. Alice Springs. http://www.desertknowledgecrc.com.au/resource/DKCRC-Report-47-Ch03_Zeng-and-Edwards_Key-stakeholder-perceptions-of-feral-camels_pastoralist-survey.pdf

3.6.3 CONSERVATION LAND MANAGERS

A survey of government and private managers of conservation properties was undertaken as part of the DKCRC research[22] and the AFCMP. The results of both surveys produced similar results. Feral camels were found on over 90% (2008: 94%; 2013: 90%) of the properties surveyed and were causing damage to fences and, more importantly, were competing with native animals for food and water by browsing vegetation and drinking and fouling water sources. A range of techniques were used to control feral camels, including aerial and ground culling as well as exclusion fencing. Of interest was that 27% of the 2013 respondents noted that they had undertaken ground culling to supply food locally. The costs of their management activities were low, with 37.5% saying they had budgeted more than $15,000 per year for management options. Their expectations were that this level of investment would maintain or reduce the population of feral camels on their property. Clearly, individual landholder investment has been able to be lower while the coordinated management approach of the AFCMP has been in place. The level of required landholder investment to maintain the lower densities of feral camels achieved through the AFCMP is likely to increase beyond the AFCMP.

The DKCRC survey found that less than 24% of conservation land managers favoured strategic approaches to controlling feral camels. The 2013 survey found that 63% of those surveyed had had AFCMP management activities undertaken on their property, and they all felt that the AFCMP was the right approach and had increased their capacity to deal with feral camels. All respondents in the 2013 survey felt that feral camel numbers had remained stable (75%) or decreased (25%) in the past four years that the AFCMP had been operating.

While the majority of managers supported the development of a stronger camel industry, only 25% of those surveyed in 2013 had mustered feral camels for sale. Only 12.5% of respondents believed that a camel industry could be viable or that a stronger camel industry was capable of achieving effective feral camel control.

3.6.4 OBSERVATIONS

There are a number of observations emanating from these three surveys:

- Feral camels continue to be a problem for all those surveyed. Damage to cultural and environmental assets and public and private infrastructure was noted by all groups, and concerns about road safety were highlighted by Aboriginal communities and pastoralists.
- Pastoralists and land conservation managers moved from not supporting strategic approaches in the DKCRC survey to a situation where a majority support a strategic approach such as the AFCMP.
- There was not strong support for a camel industry by conservation land managers because they saw it as not viable and as not reducing the problem. The attitude towards commercial use by pastoralists was mixed.

22 Zeng B and Edwards G. 2008. Chapter 4: Key stakeholder perceptions of feral camels: A conservation manager survey. In *Cross-jurisdictional management of feral camels to protect NRM and cultural values.* Eds. Edwards G, McGregor M, Zeng B, Vaarzon-Morel P and Saalfeld W. pp. 63–78. Desert Knowledge CRC. Alice Springs. http://www.desertknowledgecrc.com.au/resource/DKCRC-Report-47-Ch04_Zeng-and-Edwards_Key-stakeholder-perceptions-of-feral-camels_conservation-manager-survey.pdf

- Aboriginal people supported commercial uses as it supplied income and employment to communities.
- Aboriginal people's understanding and attitudes about the impacts and management of feral camels significantly changed between the DKCRC survey and the 2013 AFCMP survey. This can be attributed to the extensive AFCMP engagement activities on Aboriginal lands.

3.6.5 MEDIA AND GENERAL PUBLIC

Two approaches were used to assess media and public opinion about feral camel impacts and management. The first was to monitor media reports on feral camels and their management over an eight-year period: 2005–2013. The period was chosen as it represented the period from the commencement of the DKCRC research through to the completion of the AFCMP. The second approach was the Invasive Animals CRC monitoring program, which monitored the community's views about the management of pest animals in Australia.[23] The technique provided a 'moving picture' of the general public's attitudes to pest animals and their control.

Media analysis

While media analysis does not directly track the public's attitudes, it identifies the nature and distribution of information passing through media sources to the general public, which will in turn influence their thinking. The analysis included print and online news items, radio and television interviews, magazine stories, and editorials/opinion pieces that appeared in Australian-based media sources. A total of 283 articles/interviews were analysed (Figure 39), with the largest number occurring in 2012 when the aerial culling program was most concentrated.

The content of the media reports was focused on the management techniques being used, the impacts of feral camels, the population and the potential for commercial use (Table 8). There was a considerable amount of repeat information presented (e.g. multiple quoting of a media release), with 54% of the items analysed being straight news accounts and only 6% being presented as contentious items. The overall conclusion of the analysis was that the media coverage delivered a clear message about the numbers of feral camels and their impacts, and 71% of items discussed some form of management. On the topic of which type of management should be implemented there was some divergence, with commercial use discussed in just over half the items and slightly less than half of the items presenting aerial culling as an appropriate management option. Approximately 25% of the items were opposed to aerial culling, and the interviewees in these articles supported commercial use activities.

23 http://www.feral.org.au/community-awareness-survey/

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Figure 39: Number (and percent, shown in red) of media articles by year

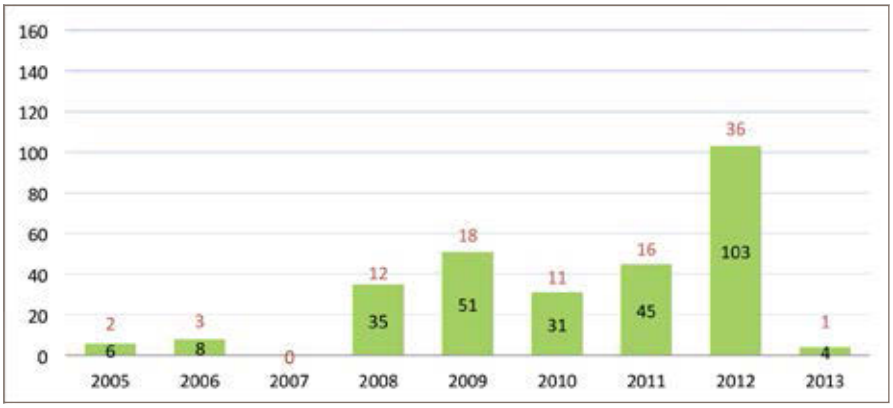

Table 8: Media item themes

CONTENT	POINTS RAISED	ITEMS MENTIONING
Feral camel population	Number of feral camels is estimated Population is rapidly growing Description of distribution of feral camels	61%
Environmental or social impact of feral camels	Degrading waterholes Damage to cultural heritage sites Competition with native species of plants and animals Greenhouse gas emissions/climate change Damage to property and infrastructure (fences, water supplies)	62%
Management techniques	Integrated approach to management is needed (no single strategy will work) Culling Fencing off high biodiversity or culturally significant sites	71% Culling positive/ neutral: 42% Culling negative: 25%
Feral camels as a resource	Mustering potential Camel industry (overseas and local markets) Abattoir and abattoir construction Meat source (for human consumption and or pets) Job creation (including Indigenous skills and employment)	51%

Moving picture

The monitoring showed that there was a very high level of concern held by the majority of Australians over the impact of pests such as cane toads, cats, rabbits, feral pigs, foxes and feral camels, especially on native fauna and flora and agriculture. The results (Figure 40) show that feral camels remained tenth throughout the period of analysis with an increase in response in late 2009 and early 2010. The rise in rating over this period is likely to be related to the high levels of media around the incursion of feral camels into Aboriginal communities and pastoral properties as a result of dry conditions at this time. An observation from the study was that the public was not well informed about which feral animals cause the most damage, and do not proportionately value the efforts made to control rabbits, foxes, pigs, feral camels and other key species.

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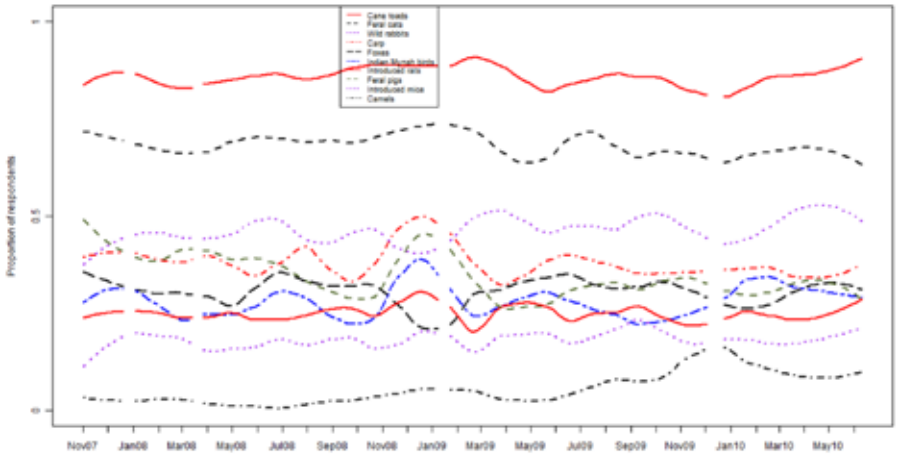
Figure 40: Comparative trends in ratings of the top ten pest animals during the lifetime of the survey. Note: breaks in the curves correspond to periods when no data were collected. (Source: Fisher et al. 2012[24]).



24 Fisher NI, Lee AJ and Cribb JHJ. 2012. *Will the community accept our science? Monitoring the community's view about managing pest animals in Australia.* Invasive Animals Cooperative Research Centre, Canberra.

4. Operational lessons

What have the management and implementation teams learned as a result of the AFCMP? The scale and nature of the project meant that at times the partners, and management and implementation teams, were dealing with unique operational problems that produced learnings of value to others considering similar projects. The following insights provide the key operational lessons and highlight some of the unexpected outcomes experienced with the AFCMP.

4.1 BUILDING AN ENDURING COLLABORATION

1. **Staffing:** Long-term and continual engagement of skilled and experienced project management staff was essential to deliver a project that encompassed a variety of social, economic and environmental issues. The continuity, expertise and dedication of Ninti One and project partner staff contributed to the success of the management and interactions between the different groups. These staff had significant skills in a variety of social and economic disciplines which complemented core NRM skills well and were essential in delivering the project.

2. **Strong and transparent governance structure:** A cohesive and professional governance structure was required to ensure that partner expectations were managed and that the project was successful. Considerable effort was put into establishing the structure, membership and Terms of Reference for the project's governance arrangements. These arrangements provided a very effective framework for the implementation of the project and serve as a potential model for other landscape-scale NRM projects.

   The governance structure worked well for the following reasons:

   - There was shared understanding of project objectives and associated activities.
   - The governance framework and roles of groups were clearly defined.
   - Effective interaction between different groups was facilitated by overlap in membership of some of the groups and the National Project Manager was a common representative on all groups.
   - The Chair of the Steering Committee had a long association with NRM projects and agri-business development and therefore had a good understanding of the issues, including commercial use.
   - Any concerns about the role of the Steering Committee, with respect to decision-making and discussing strategic issues, were addressed and resolved.
   - Effective collaboration between partners was ensured by the strong governance structure, which provided a platform for regular meetings and dialogue.

Operational lessons

3. **Bringing in industry and animal welfare representatives:** Representatives from these areas bring insights and options that would not otherwise be seen, and their involvement also meant they gained a better understanding of what the project was trying to achieve and the different views of a diverse project partnership.
4. **Building trust:** The relationship between Ninti One, AFCMP partners, industry and the Australian Government was particularly constructive, involving regular contact and sharing of information which meant that high levels of trust were built between partners.
5. **Set-up time:** Complex projects such as the AFCMP need to have a ramp-up period built in to allow in-depth discussions with project stakeholders and include time for deep consultation with Aboriginal communities. This is often at odds with the shorter government funding cycles, but when high quality consultation takes place, the benefits are seen later in the project and provide the basis for trust and efficiency in future work. The need for comprehensive land clearance and other governance processes under the AFCMP has highlighted the challenges that will be faced by the National Feral Camel Action Plan without adequate resourcing or coordination.
6. **Landholder consents:** This was a significant undertaking for a project of this scale and the time required for this foundation work needs to be explicitly accounted for in project planning and contracting.
7. **Formal and informal sharing of information:** The sharing of information between partners, both formally and informally, led to a greater understanding of both differences and similarities of views and processes. Sharing of information occurred at AFCMP meetings but also outside these meetings, based on the relationships that had been developed in the project. These relationships have helped the project achieve its objectives in a number of ways, such as new business opportunities that have been explored and developed, development of audit processes that have put the emphasis on animal welfare, identification of congregations of feral camels before they impacted on infrastructure or sites of interest, and review activities aimed at identifying new and better ways of managing feral camels (see Case study 7).

Case study 7

Case study 7: Learning by sharing – improving aerial culling operations

Source: Andrew Bubb, Ninti One

A meeting was held in November 2012 with the aerial culling teams from each of the partner jurisdictions to compare operations and develop recommendations that would improve the safety, humaneness and effectiveness of aerial culling operations.

Photo: Tim Anderson

After comparing experiences and practices, the major areas of difference found between the jurisdictions were:

Landholder consent: the process in the NT was particularly involved and was led by the Central Land Council over a two-year period (see Case study 3). The complexity of this process was not fully appreciated in the initial stages of the AFCMP, but the resulting consultation process that was established was very successful in engaging Aboriginal landholders. Recognising the differences in land tenure and adopting the most appropriate method of consultation to achieve proper and informed consent from landholders was a significant outcome of the AFMCP and offers a model for future landscape-scale NRM projects.

Operational planning: The two major areas highlighted were the procurement and distribution of fuel and the staffing of the operation. Fuel procurement and distribution was influenced by the scale of the operation and the procurement requirements of the jurisdiction conducting the operation. Fuel was sometimes sourced separately by government staff and in other cases through the 'wet hire' of aircraft (fuel supply and cost incorporated into hire rates). The distribution of the fuel to the operation site was dependent on the location of the operation and the ease of access to the site. In SA, fuel procurement and distribution was outsourced to a private supplier.

Case study 7

Operation staffing also varied and was dependent on the location and scale of the operations. Operations involving multiple aircraft had a higher level of complexity, due in part to the additional number of people involved. In the NT, an operations manager position was created following early operations and proved beneficial to subsequent operations. Previously, many of these logistical responsibilities were handled by the shooters. The NT had the highest number of culling operations under the AFCMP, with frequent large-scale removal operations involving multiple aircraft in relatively high feral camel density areas.

Aircraft number, type and use: The number of aircraft and how they were used was the most significant variation in operations between jurisdictions. The NT used up to five helicopters on large operations, with a combination of Robinson R44s (culling platforms) and Robinson R22s (spotting/mustering aircraft). This innovation of having smaller (and more manoeuvrable and lower cost) non-culling R22 platforms involved in large operations had a number of benefits for improving the efficiency of operations: R22 pilots could provide intelligence on where mobs of feral camels were and could muster small groups together or break up large mobs for more efficient culling. The R22 aircraft were particularly useful for moving feral camels out of areas where culling was not allowed (e.g. near roads, water courses and cultural sites).

In Qld, a minimum of two R44s (both used as culling platforms) were used in operations, while in SA a minimum of two aircraft (R44 culling platform and R22 or R44 support/additional culling platform aircraft) were used. In WA, operations were conducted using a single aircraft (R44 culling platform) only, as agency regulations do not allow the use of multiple aircraft.

It was generally agreed that the use of multiple helicopters provided the greatest level of safety to operational teams. The remote nature of most operations would make it logistically complex to get to an aircraft if it was required to land or became non-operational away from the camp. The use of multiple types of aircraft (helicopter and fixed-wing) together on the same operation was discussed, although the variations in speed and flexibility of movement between these different types of aircraft is a coordination challenge; fixed-wing aircraft obviously do not have the landing flexibility that helicopters have in terms of playing a support role (for tasks such as remote fuel distribution, ammunition reloading, veterinary verification and casualty evacuation).

Spatial data management: Spatial data management varied between jurisdictions as a result of varying procedures relating to mapping, data recording and the hardware in use. As many of the geographical information systems were established within agencies and partner organisations prior to the AFCMP, this is to be expected, although establishing detailed standards around these processes at the beginning of large, multi-jurisdictional projects may reduce the differences as the project progresses.

Case study 7

The following recommendations are made:

- Landholder consent processes should have a review schedule established that is appropriate for the type of tenure, and consideration should be given to seeking approvals for managing multiple species in the one process.
- Arrangements for culling near jurisdiction borders should be formalised and include conditions under which culling can occur across a border, such as for animal welfare reasons.
- All jurisdictions should be encouraged to adopt a minimum of two helicopters to be present for all operations for safety and efficiency reasons.
- The creation of a standard set of lists describing the equipment and procedures used by jurisdictions in operations should be maintained to allow for comparison and potential improvement of operations.
- Long-term contracts for the provision of services (particularly aircraft) should include a consideration for technology developments over the life of a contract.
- When establishing multi-jurisdictional projects, forums should be provided that allow operational staff to discuss/compare processes to a high level of detail and facilitate regular review of these.

Operational lessons

4.2 DEVELOPING AND IMPLEMENTING THE MANAGEMENT APPROACH

1. **Landscape focus:** Adopting a landscape focus to the project was appropriate, as the problem being addressed was nationally significant and involved a highly mobile species. While this adds to the complexity of management, feral camel impacts would only have been addressed in a piecemeal way without the wider focus.

2. **Integrated management approach:** From the start, the project had the full range of management options available to it to achieve the target densities. This meant that more than one management option could be used at each of the sites of interest, and, through ongoing project monitoring and annual work plans, the mix of options could be tailored to meet the specific requirements at a particular site. Informed landholder preferences ultimately determined the form of management at each site.

3. **Adaptive management:** The influence of seasonal conditions on NRM projects needs to be comprehensively accounted for as part of project planning and contracting, and explicitly referenced in risk management strategies. The main solution for dealing with adverse seasonal conditions is to extend project timelines, but this is not always possible – particularly for a project dependent on contributions from many partners. The project used an adaptive management approach based on information derived from the MERI work, annual reviews and informal information derived from teams in the field. Examples of this adaptive management are:

    - The project was able to adapt to changing landholder consents. In the case of the Ngaanyatjarra Council (Aboriginal Corporation) Lands, the initial consents were for pet-meating. These changed to aerial culling and finally mustering over the life of the project.
    - A market-based instrument (competitive tendering) approach for the removal of large feral herbivores using techniques other than aerial culling was tested in Western Australia but was found to be ineffective, costly, controversial, and did not offer a viable means of feral camel management.[25]
    - The use of feral camel exclusion devices became a minor component of the project due to issues associated with cost-effectiveness; cost of materials and labour, including the need for ongoing maintenance; aesthetics; and animal welfare (feral camels and other animals). Exclusion will therefore remain a relatively minor component of managing feral camel damage.
    - A contingency fund was established to allow unexpected large congregations of feral camels to be managed outside of formal work plans. This fund gave the project the ability to adapt to changing seasonal conditions within the life of an annual work plan.

25 Rose K, Martin G, Gavin J, Agnew D and Woolnough A. 2011. Assessment of a market-based instrument approach to removing large feral herbivores from the landscape in Western Australia. Proceedings of the *15th Australasian Vertebrate Pest Conferenc*e, 20–23 June, Sydney. p. 65. http://www.avpc.net.au/15th/pages/index.html.

Operational lessons

4. **Standard operating procedures and animal welfare:** Ensuring high levels of animal welfare was a key principle adopted by the AFCMP. To ensure acceptable animal welfare outcomes under the AFCMP, there was a focus on: establishing and enforcing in its contracts with subcontractors, an agreed code of practice (COP) and standard operating procedures (SOPs) for the three removal approaches (aerial and ground culling and mustering); developing extension materials with associated training against these COP/SOPs; undertaking auditing and verification of removal operations against the COP/SOPs, as well as veterinary verification of animal welfare outcomes; and inviting RSPCA oversight of this process.
5. **Building skills and knowledge:** Ensuring a consistent approach to feral camel management and leaving a solid footprint behind in terms of community, industry and individual skills and knowledge was an important part of the project. This included building community understanding of the impacts and management of feral camels, industry-based training for mustering and ground culling, training of rangers and community members in monitoring and evaluation techniques, and training additional government aerial cullers. The consistent approach meant that there was a high level of compliance with the COP/SOPs for operations, and a cohort of people now have the skills and knowledge to benefit the ongoing management of large feral herbivores in remote Australia.
6. **Subcontracting:** The initial preferred position was to have just four subcontracts with the respective lead government agencies in the relevant jurisdictions. However, it proved to be more efficient and effective for Ninti One to have some direct subcontracts with non-government organisations, such as the Central Land Council (NT) and Ngaanyatjarra Council (WA), rather than going through the relevant state/territory government agencies. The ability to change the suite of contractors to best suit administrative and feral camel removal requirements highlights the flexibility of this type of project structure.

   The overarching subcontract terms were detailed and made it clear that subcontractors were responsible for the performance of their own subcontractors, including ensuring compliance with SOPs. They also emphasised the obligations of Ninti One to the Australian Government under the overarching Funding Deed. The detailed schedule of activities in subcontracts included indicative feral camel removal numbers, in line with the jurisdictional annual operating plans that were endorsed by the Steering Committee and amalgamated into the overall yearly works plans for the project. Detailed guidance on reporting requirements against the MERI work plan were included in subcontracts.
7. **Carbon credits:** the prospect of carbon credit trading poses opportunities for increased feral camel removal, but also has the potential to hinder removal if expectations and feral camel ownership rights of landholders and governments are not carefully managed. The potential to package up ‘co-benefits’ (e.g. socio-economic benefits of involving Aboriginal people in commercial use activities) with carbon credits is being explored.

Operational lessons

4.3 MONITORING, EVALUATION, REPORTING AND IMPROVEMENT

Undertaking environmental and socio-economic monitoring in the field on such a broad spatial scale raised many challenges.

1. **Methodologies:** As noted in the MERI chapter (Chapter 3), the methodologies and analysis needed to consider seasonality, use of technology, the role of other native and feral species and the distance between monitoring sites. The use of the motion-activated cameras, for example, was important as they provided a cost-effective way of assessing, on a large scale, which animal species were using the waterholes.

2. **Aboriginal ranger groups:** A major learning from the project was that land managers such as Aboriginal ranger groups and pastoralists can play an important part in monitoring remote sites. For some, it has cultural significance as it keeps them connected to the land and their culture, while to others it means that productive assets such as grazing resources and infrastructure are protected by their involvement. The high levels of trust built up in the project, and the level of interest developed through the deep consultation with Aboriginal people, meant that Traditional Owners allowed government workers to travel with them to waterholes, which were often only known to them, so they could work together to monitor and collect environmental data for assessment.

3. **Developing predictive power:** Developing a predictive capability to reduce uncertainty was an important component of the project and was designed into the project plan from the beginning. A number of strategies were adopted including:
    - Using a range of feral camel intelligence gathering techniques, including aerial survey and spotting, direct contact with landholders, CamelScan (online reporting of feral camel sightings), and satellite tracking, usually in combination (see Case study 6), leading to cost-effective management strategies.
    - Holding monthly National Operations Group teleconferences during the peak removal periods (spring and autumn) to track cumulative feral camel removal figures closely and discuss cross-border surveillance and management issues. This allowed operational staff to respond quickly to changes in seasonal conditions and intelligence on feral camel populations.
    - Monitoring and reflecting on management strategies and making changes in practices in response to this information.

4.4 COMMUNICATION

1. **Communication strategy:** A comprehensive communications strategy was necessary because of the sensitive nature of the project. Key issues addressed by the strategy (which was updated each calendar year) included providing information on the crucial need for feral camel density reduction to protect high value biodiversity and cultural areas; and demonstrating to landholders and the general public that any feral camel removal activities were conducted according to the highest standards. The communication strategy emphasised

ongoing and targeted communication with the project's partners and supporters, Aboriginal landholders, and the commercial use industry, ensuring early engagement on issues and providing for effective consultation. The target audiences were quite diverse and required different means of communication methods.

The communication strategy focused on four key areas:

- Raising and maintaining community understanding and support: Key products were the AFCMP website (now archived); CamelScan Google mapping tool (http://www.feralscan.org.au/camelscan) and website for recording feral camel sightings; and interaction with key groups, including consultation with key animal welfare interests.
- Effective communication and stakeholder relations: Partners were kept informed through the governance structure and less formal contact as required. Other major activities were the monthly email newsletter (as part of *NintiNews*); monthly teleconferences between Ninti One and the Australian Government; updates for federal politicians and the heads of relevant state and territory government departments; establishment of a government communicators' forum; and development of case study and other audiovisual material, including a series of interviews to illustrate the views and describe first-hand experiences of a range of Australians managing the impacts of feral camels (http://www.youtube.com/user/NintiOne).
- Recognition of partners' investment – this included: ensuring that all partners were acknowledged for their involvement in the project in communication products; working in partnership with state and territory governments to develop a consistent communications plan for the AFCMP; and the development of a style manual.
- Media management – Through careful management of media enquiries (particularly having the Managing Director of Ninti One Ltd as the single point of contact) the project avoided inconsistent messages about the project.

2. **Media management:** the management of any feral animal is likely to generate some negative media; the first negative media reports were generated during the DKCRC feral camel research program and becoming more focused when the final report was launched. The key to the successful media strategy was the appointment of a part-time media manager to deal with all media enquiries, supported by an agreed media protocol signed off by project partners which directed all media enquiries to the media manager who then sought comment through the Managing Director of Ninti One. In addition, a series of proactive strategies were embarked upon, including:
   - a media information space on the AFCMP website
   - an updated media database and contact list, which included relevant state and regional media outlets
   - background information for prospective film and documentary makers
   - targeted media management in geographic regions as required.

5. Outcomes

The Australian Feral Camel Management Project (AFCMP) has achieved significant outcomes. The following discussion will deal with these under the following themes:

- project-level outcomes, including stronger collaboration between project partners, establishing and improving new protocols and monitoring of the impacts of large feral herbivores
- reduced density of feral camels at 18 targeted environmental assets, leading to improvements in the value of these and related sites
- commercial outcomes
- socio-economic outcomes.

5.1 PROJECT-LEVEL OUTCOMES

5.1.1 NEGOTIATING LANDHOLDER CONSENTS OVER 1.3 MILLION KM^2

As noted earlier in this report (Chapter 2) the key to the success of the AFCMP was the high levels of collaboration on a scale that has never been previously attempted. A legacy of the project is that a wide range of people and organisations associated with the project are now sharing information and collaborating on a scale not possible before the project. While there were high levels of collaboration between state, territory and federal government agencies before the project, these have been enhanced by having the resources for all agencies to focus on the same problem in a concerted way. The commercial use industry has forged closer relationships with landholders and the RSPCA, which should ensure that an industry that was struggling now has the possibility of developing into one that is sustainable. Ninti One believes that these relationships are so important that they are investigating ways of maintaining the collaboration focused on feral camel management, as well as opportunities for other collaborative NRM projects.[26]

The negotiation of landholder consents over 1.3 million km^2 for feral camel management means that, whenever there is a compelling case to control feral camels on these lands, this can commence on-ground almost immediately. These consents will also form the basis for the management of other large feral herbivores and other NRM issues. These consents took time to negotiate but were obtained because the project listened, provided unbiased information to landholders and was flexible enough to meet landholder needs. There was a strong desire among most Aboriginal people to do something about feral camels once they realised the damage being done to cultural sites and following the dramatic invasions of remote communities in 2009. However, most were not initially happy with the option of aerial culling. The starting position in negotiations was often commercial use, but in the areas where this was not a feasible option, there has been a high level of acceptance of aerial and ground culling (see Case study 1 and Case study 3); in the Ngaanyatjarra Lands there have been three forms of removal over the life of the project: pet-meating, then aerial culling and now mustering. Consent was also successfully negotiated with 209 pastoralists and 13 park and reserve managers within the first two years of the project.

26 A Biodiversity Fund application was submitted to the Australian Government (then) Department of Sustainability, Environment, Water, Population and Communities in May 2013 based on the collaborations and learnings from the AFCMP.

Outcomes

5.1.2 SUPPORTING THE NATIONAL FERAL CAMEL ACTION PLAN

Supporting the National Feral Camel Action Plan (NFCAP) was not a contractual obligation of the AFCMP. Nonetheless, AFCMP has supported the four goals of the NFCAP as shown in Table 9.

Table 9: Links between National Feral Camel Action Plan and the AFCMP

NFCAP GOALS	RELEVANT AFCMP ACTIVITIES
Goal 1 The Australian public and international community understand the need for and support the humane management of feral camels and their impacts	• communications strategy developed and implemented • project website developed • CamelScan website developed in conjunction with the Invasive Animals CRC to provide an interactive community engagement tool • regular meetings with stakeholders through the project governance structure as well as responding to ad hoc opportunities for stakeholder engagement • project responded to media enquiries and documentary film-makers as appropriate
Goal 2 Mitigation of the negative impacts being caused by the current overabundance of feral camels	• priority environmental assets identified for protection • MERI plan identified the aspects of feral camel populations, movements and impacts to be monitored • priority control areas identified and acceptable forms of feral camel removal determined in consultation with landholders • investment guidelines developed to guide proactive and opportunistic feral camel removal • cross-jurisdictional survey and removal work encouraged and conducted wherever feasible
Goal 3 Adoption of a platform for ongoing humane management of feral camels	• beyond scope of AFCMP to investigate new removal techniques, but the project integrated existing techniques and implemented them efficiently and humanely • model COP and SOPs adapted from existing Vertebrate Pests Committee versions • training and verification processes in place to ensure humaneness of different removal techniques • project worked closely with landholders and industry to facilitate commercial use wherever possible
Goal 4 Partnerships and social capacity for humane feral camel management are in place	• established formal partnerships between the 20 project partners and many other links with landholder, industry, animal welfare and scientific stakeholders • building the capacity of organisations and landholders was a major focus of the project and the activities undertaken in the project will benefit longer term feral camel management • informed landholder consent for feral camel removal was a fundamental aspect of the project

5.1.3 CODES OF PRACTICE, STANDARD OPERATING PROCEDURES AND AUDITING OF MANAGEMENT PRACTICES

As mentioned in section 4.2 (page 82), high levels of animal welfare were achieved by focusing on establishing, and enforcing in contracts with subcontractors, an agreed COP and SOPs for the three removal approaches, and for auditing and verifying the removal operations against the COP/SOPs.

The Vertebrate Pests Committee adopted three national model SOPs for the aerial and ground shooting and mustering of feral camels in early 2010. These were strengthened for use by the AFCMP and endorsed by the project's NOG and Steering Committee before being signed off by the Australian Government for use by the project. An important role for the

project was that it was instrumental in fast-tracking the practical adoption of these SOPs. An adaptive management approach ensured that where there were any issues with the SOPs or animal welfare requirements, these were identified and rectified early on in the project.

Training programs were developed to complement the SOPs. Considerable resources were devoted to training and assessing mustering teams on Aboriginal lands as well as ensuring that appropriate commercial use infrastructure (suitable yards, troughs and loading ramps) was in place. While aerial-based culling and commercial use were the main forms of feral camel removal under the AFCMP, it was recognised early in the project that Aboriginal rangers and communities needed to have their own capacity to manage small groups of feral camels at waterholes, roads, airstrips and in communities. The project provided rigorous ground-based culling training to approximately 50 Aboriginal people in three jurisdictions and ensured that those trained had access to the appropriate firearms and ammunition as specified in the ground-based culling SOP. Training against the SOPs provided the opportunity to assess new aerial cull team members, thereby building capacity for professional management of large feral herbivores into the future.

In order to assure the Australian Government (and the general community) that feral camel removal was being conducted humanely, the project developed and implemented, in consultation with the RSPCA, a verification process for animal welfare for commercial use and aerial culling. This is the most rigorous process of its type in Australia to date and proved to be a valuable training tool that has led to improved practice. Aerial culling was assessed on six occasions by qualified independent veterinarians. This found very high standards of animal welfare and compliance with the SOPs.

The contract with APY Land Management required provision of trucking records (via national Vendor Declaration), spot checks of trucks at Port Augusta and Alice Springs and abattoir receipt records for verification of numbers, sex and animal condition. Three on-site, government officer animal welfare audits were undertaken at yarding and loading sites during 2012 and 2013. In addition, an independent veterinarian audited a mustering operation on the APY Lands in December 2012. These audits found that mustering operations produced generally high animal welfare standards and adhered closely to the mustering SOP.

A small number of areas for improvement were identified and reported back to the mustering teams so they could implement the appropriate training and changes to mustering operations as part of a continuous improvement process. The management of injured or non-commercial animals during mustering and yarding presents a number of dilemmas, such as availability of a suitable firearm and licensed and skilled user to euthanase animals as required; OH&S issues associated with the use of a firearm in yards or near a mustering operation; carcass disposal; and potential release of non-commercial feral camels, which is illegal and does not result in a good pest management outcome. The transport and processing components of commercial use were not able to be assessed under the AFCMP, so the humaneness of these is unknown and should be assessed in the future.

Case study 8

Case study 8: Ensuring acceptable animal welfare standards

Source: Quentin Hart, Ninti One; Jordan Hampton, Ecotone Wildlife Veterinary Services; Bidda Jones, RSPCA

An allied study developed a model to assess the relative humaneness of pest animal control methods based on work reported by Sharp and Saunders (2008[27]). The model enables a humaneness matrix to be developed for specific control methods that considers the potential for animal suffering in the lead-up process to death (e.g. herding feral camels prior to shooting) and as part of the mode of death (e.g. an animal being shot in the head versus the chest). In 2010, feral camel control/removal methods were assessed by an 'expert panel' using the model, based on the evidence available at the time of each method's perceived animal welfare impacts. The assessment assumes compliance with best practice as defined by agreed SOPs. In practice, the actual humaneness of operations is very much dependent on the skill of removal operators and their ability to comply with SOPs, which includes ensuring that the management practice is carried out in conditions appropriate for that control method. It is acknowledged that there is a level of inherent subjectivity in this assessment process, particularly when there are gaps in the available information on which the assessment is based. The AFCMP MERI process has helped fill some of these information gaps.

There are inherent, but manageable, animal welfare challenges associated with all feral camel removal techniques. Aerial-based culling can be an extremely effective removal technique for feral camels in that it can achieve a high standard of animal welfare and rapid population reduction. Feral camels do not exhibit a strong 'flight' response, moving relatively slowly away from helicopters and very rarely breaking away from the mob. The open country that feral camels typically occur in permits very close helicopter proximity and high visibility, providing ample opportunity for rapid follow-up shots. However, this is a highly technical activity which depends very much on the skill of both the shooter and the helicopter pilot. In the pre-AFCMP assessment, the expert panel considered that aerial-based culling provided minimal suffering prior to death, but potential (dependent on operator skill) suffering due to delayed time to death.

In the case of ground-based culling, operators have the advantages of usually not shooting from a moving platform and, often, not shooting at moving animals. However, they are usually much further away from animals than with aerial-based culling, with associated poorer visibility and reduced opportunities for rapid follow-up shots. Humaneness outcomes are therefore highly dependent on shooter skill. The other problem with ground-based culling as an impact reduction method is that it is not suitable for achieving rapid reduction of high-density populations: it may only remove an individual animal from a group, is geographically limited by vehicle access and is time-consuming. Its main role is to complement other methods to manage relatively small, localised populations. As with aerial

27 Sharp T and Saunders G. 2008. *A model for assessing the relative humaneness of pest animal control methods*. Australian Government Department of Agriculture, Fisheries and Forestry, Canberra, ACT.

Case study 8

culling, the 'expert panel' assessment of the technique found that it provides minimal suffering prior to death, but a potentially protracted mode of death.

Removal of feral camels for commercial use (slaughter or live export) is a multistage process: mustering, holding in yards, loading onto trucks, truck transport and ship transport (live export) or slaughtering (local abattoir processing). There are animal welfare challenges at each stage that require diligent attention by all operators, but this is more difficult to manage than the single-stage process of culling. There are also potential issues with the duration of the commercial use process (days up to weeks, depending on the nature of the operation) which require careful management. The expert panel considered only the first stage of this process (mustering); the technique was considered to involve potentially protracted suffering as operations could take a whole day, as opposed to the seconds or minutes that a mob is herded during aerial culling operations.

AFCMP results against the theoretical humaneness model

The experience of the AFCMP has provided considerable additional information regarding the animal welfare impacts of feral camel removal methods. In light of this new evidence, the relative humaneness matrix for feral camels needed to be reconsidered. For example:

- The SOPs on which the 2010 assessments were based have been improved and refined. In many cases, there is minimal stress inflicted on animals prior to shooting commencing, and the duration of shooting a group of feral camels is relatively short. This is the case relative to mustering, whereby animals will experience a relatively prolonged muster; being held in yards for a period of days; being loaded onto a truck; long-distance transport from remote areas to ports or abattoirs; unloading and a further holding yard phase; loading and shipping transport in the case of live export, or herding/slaughter in the case of a local abattoir; and potentially unknown overseas fate in the case of live export.
- Mustering was assessed in the 2010 assessment as a stand-alone, non-lethal method, but it is usually undertaken in conjunction with transport and slaughter (a lethal outcome). This is noted in the footnotes to the matrix but should be considered in the overall assessment in order to be able to properly compare the relative humaneness of this to shooting methods.
- In the aerial shooting SOP, there is a deliberate 'overkill' policy of placing at least two shots into the head and/or chest region. In reality, the majority of first shots are to the head region, with a well-placed head shot ensuring instant insensibility and/or death, with a follow-up shot to either target region (usually the chest) all but ensuring death. The application of this policy was not fully considered in the 2010 assessment.
- For both parts A (welfare impact prior to death) and B (mode of death), the ratings could have a large span of outcomes, depending on the skill of operators and their ability to comply with the relevant SOP. This is why the AFCMP has had a strong focus on operator skill, training against the SOP and follow-up verification and feedback.

Case study 8

A revised humaneness matrix to account for AFCMP findings

In September 2013, an expert panel was convened to reconsider the 2010 feral camel control technique humaneness assessment in light of AFCMP findings. This panel included several members of the original panel for consistency, as well as the AFCMP National Manager and the vet involved in AFCMP verification work. The findings of AFCMP audits and verifications of commercial use and aerial culling operations were considered in putting together a revised matrix (see www.nintione.com.au).

5.1.4 INVESTMENT GUIDELINES

Project investment guidelines were required to ensure project funds were utilised in a strategic manner and achieved feral camel population reduction at the priority biodiversity assets. Investment guidelines also provided a framework for distributing limited project funds between competing partner feral camel management priorities. Although not a formal milestone requirement, discussions with Steering Committee members and other stakeholders in 2010 made it clear that they supported the need for formal and transparent investment guidelines for feral camel removal activities within the project. Ninti One, in consultation with the Steering Committee, developed a policy position on the forms of feral camel removal the project would support and the criteria for allocating funds for 'proactive' (i.e. negotiated each year as part of annual operating plans) and 'opportunistic' (i.e. outside of annual operating plans to respond to emergency congregation events) removal. Once adopted, these guidelines were used to manage all of the claims for funding support from project partners and have proven to be effective in achieving a shared understanding among project partners about the rationale behind agreed and rejected proposals.

A key issue to resolve was the use of ground culling: while it was acknowledged that ad hoc ground culling conducted by individual landholders was an important component of long-term feral camel management, it was felt that it would be too difficult and costly to ensure the humaneness of such removal as a formal component of the AFCMP for relatively small removal numbers and limited strategic population reduction. The final project position was that ground culling could be supported under the project provided there was some level of government agency coordination and oversight in terms of training and verification processes.

The investment guidelines for proactive and opportunistic management activities under the AFCMP (a summary can be found at www.nintione.com.au) are quite clear that the project would only support the following management methods subject to clear verification processes: aerial shooting (using trained government shooters); commercial use (mustering for human consumption and ground shooting for pet meat); and government-coordinated ground shooting.

5.2 REDUCED DENSITY OF FERAL CAMELS AT TARGETED ENVIRONMENTAL ASSETS

The key objective of the project was to reduce feral camel densities at 50 km and 100 km buffer zones around 18 environmental assets to between <0.1 feral camels per square kilometre to 1.0 feral camel per square kilometre, depending on the asset. It is important to note here that the project was focused on reducing densities to protect designated high-value assets rather than the removal of a specific number of feral camels. Although the two are clearly linked, density accounts for the population dynamics of a species under different seasonal conditions, and is the more relevant figure in terms of impacts. Table 6 details the confirmed achievement of most density targets.

Case study 9

Case study 9: Feral camel removal numbers versus density change

Source: Keith Saalfield and Glenn Edwards, NT Dept of Land Resource Management

The AFCMP in partnership with the Northern Territory Government, the Central Land Council and pastoralists undertook six aerial culling operations in the Simpson Desert (after the 2010 aerial survey) and 12 in Western Deserts (after the 2011 aerial survey). Final aerial surveys were conducted in 2013 to monitor the impact of those operations on feral camel density. Aerial culling operations were supplemented by small-scale, ground-based culling and mustering of feral camels by local landholders.

Simpson Desert:

The 2013 aerial survey block encompassed most of the NT Simpson Desert and some pastoral land in the west:

- estimated density of remaining feral camels at September 2013: 0.03/km^2
- estimated number of feral camels remaining September 2013: 1,800
- percentage reduction in density since 2010: 96%.

Comments:
The aerial culling program and landowner ground culling account for only about 29% of the overall population reduction in the Simpson. A unique combination of environmental factors (wet in 2010, fires in 2011, dry in 2012) has caused considerable natural mortality over that period. This pattern is also apparent in South Australia and Queensland. The density reduction target (0.2 feral camels/km^2) has been exceeded and there is a real opportunity to maintain very low feral camel densities in the Simpson Desert with ongoing 'maintenance' control.

Western Desert (Petermann Ranges and southern Tanami Desert):

The Western Desert aerial survey block encompassed most of Petermann Ranges and southern Tanami Desert, some pastoral land in the east and Newhaven conservation reserve:

- estimated density of remaining feral camels September 2013: 0.28/km^2
- estimated number of feral camels remaining September 2013: 26,678
- percentage reduction in density since 2011: 65%.

Comments:
The situation in the Western Desert is very different from that noted in the Simpson Desert. While there was some natural mortality observed during the summer of 2012/13, it was much less dramatic than that which occurred in the Simpson Desert.

There is a reasonable match between the number of feral camels removed under the aerial culling program and landowner ground culling between the aerial surveys in 2011 and 2013 (55,068) and the estimated population reduction from the aerial survey data (42,750).

It is worth noting that the population was not 'closed' and, as in the Simpson Desert, there may have been other factors at play. Approximately

Case study 9

18 months passed between the aerial surveys, and during this time there could have been a net movement of feral camels into or out of the survey area. There would also have been some reproduction (calves were seen during the 2013 survey) in some areas and natural mortality, which would have either added or subtracted feral camels from the population.

Nonetheless, there is reasonable concordance between the number of feral camels removed and the decline in feral camel numbers indicated by the aerial surveys. This suggests that the aerial surveys do provide a relatively accurate estimate of the number of feral camels actually there.

5.3 COMMERCIAL USE OF FERAL CAMELS

Early on in the project there was perceived conflict between commercial use versus culling. The AFCMP has supported both forms of feral camel removal, with the ultimate decision being made by the landholder rather than by the AFCMP. The project has assisted with the development of a niche camel meat industry and also provided assistance to Ngaanyatjarra Council to support their pet meat enterprise, before demand for feral camel pet meat waned. Over the period that the project has operated, approximately 25,000 feral camels have been used for commercial use. About 10,000 of these have been used for pet meat, with the remainder being processed through an abattoir, producing around 2 million kilograms of export meat for human consumption. The project has supported the following industry-related activities:

- removal of feral camels on Aboriginal lands for pet meat and human consumption, including training and minor infrastructure
- targeted removal assistance to landholders to offset mustering costs
- collection of information on feral camel densities and movement to help guide commercial use operations
- provision of information to potential industry players to inform their business decisions
- a workshop to bring key industry players and landholders together to discuss commercial use opportunities (August 2010)
- the development of an Australian Camel Industry Association Strategic Plan
- an Australian Camel Industry Association field day (July 2012).

Based on the experience of the five years since the DKCRC report was released in 2008, there is now the potential for a more cohesive industry to help reduce impact in some areas as well as providing training opportunities and jobs in remote areas, especially Aboriginal communities. The AFCMP has aimed to support capacity building to improve the cost-effectiveness of commercial use. A key outcome is that Aboriginal communities and ranger groups have developed greater experience in the mustering, handling and ground culling of feral camels. There was also significant training provided to improve the animal welfare aspects associated with mustering and an associated auditing process. On Aboriginal communities, 65 people have been trained as ground cullers, and a further 50 have been trained in feral camel mustering. Mustering companies have been established in Aboriginal communities, and infrastructure such as stockyards and loading ramps have been built to muster and transport feral camels to commercial abattoirs in Caboolture in Queensland and Peterborough in South Australia.

The economics of mustering have been variable. Data from the APY Lands show that they have achieved an average of $100 at the mustering yards for each feral camel sold, and that mustering and other costs – including wages, administration and handling – have amounted to approximately $85 per head, leaving a net return of $15 per feral camel removed. In addition, 'removal assistance' payments of $78 per female feral camel were made by the AFCMP

to APY Executive Council and Ngaanyatjarra Council to encourage the removal of female feral camels and to support capacity building to improve the cost-effectiveness of commercial use, rather than providing direct subsidies. These payments have improved the economic viability of mustering operations and helped build capacity for future commercial use.

The communities in the Central Land Council area undertook six mustering operations, which removed 791 camels. Unlike the APY and Ngaanyatjarra Councils, the CLC did not want 'removal assistance' but the AFCMP provided money (e.g. for training, portable yards) to support commercial use activities. The average return received from the CLC commercial use activities was approximately $100 per feral camel at the mustering yards, and mustering incurred direct costs before wages of approximately $102 per feral camel removed for commercial use; or a loss of $2 per feral camel sold. The returns before wages ranged from a loss of $27 per feral camel removed to net return of $95 per camel. Wages ($48,000) and payments to Traditional Owners ($7,500) added a further $70 per feral camel removed to the costs, but provided a valuable unencumbered income to communities.

It is clear from these figures that mustering for commercial use on Aboriginal lands can be marginal, but the AFCMP has left a legacy in terms of infrastructure, knowledge and experience that will improve the efficiency and profitability of operations in the future. It is important to note that mustering has had social benefits, including skills development and temporary employment, and it has boosted the confidence of those Aboriginal people and involved them directly in the management of their cultural lands.

Apart from the economic challenges of commercial use operations, they are generally less effective in achieving rapid feral camel population reduction than aerial culling. At their peak, mustering operations removed a few hundred feral camels per week. In contrast, some aerial culling operations removed around a thousand feral camels in a day. Mustering operations are often selective in which animals they remove, whereas aerial culling operations are able to cover the landscape rapidly and remove all animals observed, which gives a better population management outcome. Often, by the time large feral camel congregations occur in dry periods, many animals are in poor condition and of little commercial value, meaning that aerial culling becomes the best option for a rapid response – as found in the January 2013 emergency cull on Curtin Springs Station in the Northern Territory (Case study 4).

The culling of feral camels for pet meat has been tried in Aboriginal communities, particularly in the Ngaanyatjarra Lands. The experience is that pet-meating provides localised removal of animals around communities and roads within 50–100 km of communities because the shooting usually occurs from roads and there is a need to stay close to a refrigerated container. The limited landscape coverage provided by pet-meating operations, combined with the fact that usually only a few animals are able to be humanely removed from larger mobs, limits the ability of this method to contribute to population management.

Outcomes

Transport costs are a major challenge for the commercial use industry due to the limited number of camels that can be carried on single-deck trailers. Photo: Phil Gee

"I think in any emerging industry there are always challenges. Certainly some of the challenges are developing a very effective transport network, but also those relationships with the Indigenous communities for removal … certainly there's a lot of training needed for landowners, both Indigenous and non-Indigenous landowners."

Lauren Brisbane, Chair of the Australian Camel Industry Association

Full interview: http://www.youtube.com/watch?v=V-4ZaI3AJcg

The economics of a pet-meating operation are improved where the feral camel meat can be back-loaded with the existing freight operations servicing remote communities. If there were a significant pet meat market for feral camel meat, it could improve the economics of mustering and provide a better means of getting some value from animals unsuitable for transport to an abattoir. While pet-meating operations are unlikely to achieve adequate regional population management, they can provide a valuable service to remote communities in keeping feral camels away from building, roads and airstrips. It could also be seen as a useful adjunct to Aboriginal ranger activities.

The camel meat industry faces a number of future challenges as it develops, including:

- Major beef abattoirs are not interested in processing a niche product such as camel, and the lack of a multi-species export-accredited abattoir in central and Western Australia means that transport costs are high, or prohibitive, for the further development of an industry in these areas.
- The value of camel meat is about the same as beef; yet the costs of mustering, transport and processing are greater per kilo of end product for camel than for beef.
- Mustering costs are high for several reasons. Usually, two to three times more animals need to be mustered to get one animal suitable for sale, and there is the associated challenge of disposal of non-commercial animals. It is often difficult to predict the likely level of harvest of a wild population, and musters that yield a small number of animals can result in inadequate recompense for the time spent mustering. Additionally, the OH&S restrictions in different jurisdictions add cost.
- Commercial use for meat is a relatively complex operation with five main stages: mustering, holding, loading, transport and culling at the abattoir. There are OH&S and animal welfare challenges at all stages, which are more difficult to assess and address than for the relatively regulated and simple aerial culling operations.
- There is a lack of infrastructure to support mustering and holding operations on Aboriginal lands where the highest density feral camel populations are. Although the AFCMP has helped address this issue, there is more work to do in this area.
- Transport costs from holding yards to the abattoir are the biggest expense, ranging from $205 per feral camel ($18.60/km) for a 1,340 km trip from Tempe Downs to Peterborough (which involved double handling) to approximately $140 per feral camel ($7.50/km) for a 1,118 km trip from Fregon to Peterborough. This cost is usually met by the purchaser/processor but is accounted for in the price paid at the mustering yards. The major point of difference is that, unlike cattle, feral camels can only be carried one-high on single-deck trailers in road trains and there are fewer animals per deck, thereby doubling or tripling the relative transport cost per animal.

Outcomes

"All the camel meat we export is for human consumption and we are serious about developing this industry further. The export demand is for at least 50,000 camels a year from Australia. The problem is we haven't been able to get a regular supply and we've been turning down business because of it."

Mike Eathorne is the General Manager of Meramist Pty Ltd, which manages Caboolture abattoir. He has been exporting camel meat to the US, Canada and Europe for 12 years.

"There can be, and there should be, and there will be a meat industry based around the camel, but the reality is that it will need to be based around a domesticated product. We can't rely on it into the future on a feral product because the logistics are too hard."

Lyndee Severin,
Curtin Springs Station, NT

Full interview: http://www.youtube.com/watch?v=64GIWNKH-xI

- Pastoralists that border parks and Aboriginal lands may seek to opportunistically muster feral camels when large numbers move onto their lands, but the average density of feral camels in pastoral country is relatively low.
- Many commercial use initiatives seem to be dependent on subsidies, government support or landholder co-investment, particularly where new infrastructure is required.
- The need for strategically located holding areas or staging yards is a critical issue for regular throughput and something that must be addressed in the medium to long term.
- Mobile abattoirs have been discounted on the basis of cost and the difficulty in obtaining meat hygiene standards for human consumption of feral camel meat.
- Continuity of supply is critical to support the industry. In order to have a sustainable industry, a 'buffer' captive population needs to be maintained to smooth out the inevitable supply peaks and troughs associated with any wild harvest operation. This could include 'growing out' smaller animals that are mustered, but it is difficult to do this in rangeland areas. Farmed camels in Queensland, where they are co-grazed with cattle, may help keep the Caboolture abattoir operation running[28], whereas Peterborough abattoir is in a better location to take most of its throughput from wild harvest in the short term.

One of the challenges for commercial use is that in order to obtain the environmental benefits desired by the community at large, there is a need to remove large numbers of animals in a short period of time to drive the population down. If only a few hundred animals are being removed from a region each week for commercial uses, then these can easily be replaced through immigration and reproduction.

What has become clear during the AFCMP is that the camel meat industry is now working together to address the challenges of taking the industry to the next level. The value of a cross-jurisdictional approach has been in facilitating effective business partnerships between landholders and processors. This included the use of contract mustering and demonstrating the value of an integrated approach to strategic feral camel management, inclusive of both commercial and non-commercial approaches.

The number of feral camels exported live between 2008 and 2013 is shown in Table 10. The numbers are very small, with the average shipment size being approximately 50 animals. While some larger numbers have been reported in the past (e.g. 935 in 2002), the export of live feral camels is not seen as a long-term growth prospect.

Table 10: Numbers of live camels exported

2008	2009	2010	2011	2012	2013
0	0	103	52	27	215

28 ABC Rural. 2013. 'Cattle digestion improves when grazed with camels.' ABC website: http://www.abc.net.au/news/2013-07-11/cattle-camel-cograzing/4811026, viewed 16 July 2013.

Outcomes

Rock holes are "a significant site in our culture … they've got to understand we are protecting our land and the rock holes and mother nature … the camels are just being a nuisance … what our ancestors tell us [is] to look after the main waterholes and old mother nature out there. But camels are in hundreds and some travelling and they are destroying it and bush tucker and all … they're eating a lot of Martu's stuff, and look if they're going to eat all the Martu's fruit out in the Western desert or in the Martu land what are we going to survive on now? But camel is going around destroying and that is what I've been hearing and I believe it too. But homeland and rock holes and all them things, we've got keep it significant, and try to put a fence around it … we've got to [do] something to the camels. But I would like to see if we can make some money out of it to market it across to another world, but it will help more Martu people to get a job out there, to make a yard for camel, muster camel, and truck camel and to find a port where we can send it overseas you know and boost this opportunity for our young people. Most of our young people are still in the street today and them sort of project can help us hold the people and plus for the future for them and to control the camel."

Butler Landy,
Senior Martu traditional owner

Full Interview – http://www.feralcamels.com.au/butler-landy-nullagine

5.4 SOCIO-ECONOMIC IMPACTS

The DKCRC research for the first time identified and tried to value the social and economic impacts of feral camels. It also highlighted that the damage caused by feral camels to biodiversity, pastoral production, cultural sites, social infrastructure and individual and community wellbeing was increasing as the numbers of feral camels increased. The research found that the economic costs alone were substantial and that the socio-cultural costs, although not quantifiable, were significant.

The AFCMP has shown that reducing the density of feral camels on key environmental assets has led to improvements in the conditions of those assets (see Chapter 3) and also has led to flow-on cultural and economic benefits to Aboriginal people, the pastoral industry, the commercial camel industry and the Australian people.

Maintenance of the world's oldest living culture is an ethical imperative and of great benefit to all Australians. The 3.3 million km^2 over which feral camels roam contain some of the most significant cultural assets for Aboriginal people, which they have maintained for thousands of years. Feral camels have caused significant direct damage to important cultural assets such as rock holes, wetlands and bush tucker and, as a flow-on impact, the food and water sources for native animals such as kangaroos, emus and lizards. The management of these natural assets is something that has been a core part of Aboriginal culture for many thousands of years; individual people are given the knowledge of particular sites or species and are tasked with their management. The damage caused by feral camels impacts on the cultural and social wellbeing of those individuals who have cultural responsibility for these sites (see Case study 10) as well as their communities and broader Aboriginal culture.

Senior Aboriginal people living in remote Australia are focused on how to pass on their knowledge to the following generations. From the start of the AFCMP they have looked for opportunities that allow knowledge transmission to occur alongside employment opportunities for young people. Economic participation through employment brings not only money to the individual and community but also, importantly, brings self-esteem, purpose and social cohesion within Aboriginal communities and promotes health and wellbeing. People involved in meaningful employment are less likely to be engaged in crime and domestic violence, and have higher general levels of health. Where this employment is linked to the management of traditional lands, thereby involving elders passing cultural information on, it also leads to increased self-esteem and purpose for the elderly as well as the young people.

The AFCMP has contributed to positive social, cultural and economic impacts in Aboriginal communities through the respect shown to Traditional Owners. Open, two-way exchange of knowledge has led to training and employment, and their associated monetary and social gains, and to better solutions for the maintenance of cultural (natural) assets. The project has also left minor infrastructure, such as portable stockyards, on Aboriginal lands to support ongoing commercial removal.

Case study 10

Case study 10: Traditional management of permanent springs and the impact of camels

Wala is a small spring-fed rock hole in the Petermann Aboriginal Land Trust. According to the local Traditional Owners, it is the spring most visited by people, native wildlife and feral camels. Local people have been visiting the site for thousands of years and, through their active management, kept the spring from filling in with dirt and debris. This ensures that much more water is available for local wildlife and people.

The spring, and the small pools that form below it, are important watering points for wildlife. However, large groups of feral camels often use the site and cause considerable damage. Feral camels can drink the spring dry, trample sensitive riparian vegetation, and fill the spring with dirt and dung. This reduces the amount of water available for native wildlife, and makes any water left unusable for people who often travel this route from South Australia to Uluru.

Traditional Owner Rene Kulitja frequently visits Wala to manage and maintain the site. Here we see Rene arrives at 3.50 pm to dig out the overflow and scoop out leaves, manure and debris. It takes an hour of solid work to clean out the spring and increase the flow into the lower pools.

Case study 10

Before management: The overflow pools are shallow and full of dung, dirt and debris

After management: The overflow pools are deeper and begin to fill with clear spring water.

The spring overflow pools soon fill, and by 6 pm bronzewing pigeons flock to the site to drink the fresh water. Other common wildlife seen at the spring includes emus, dingos, eagles and perenties.

On the same day that Rene cleaned out Wala, feral camels arrive at 8.30 pm and spend the entire night drinking water from the spring pools. No other animals get an opportunity to drink during their stay.

Feral camels stay at the site for 11 hours straight, and by the time they leave at 7.30 am the spring pools are dry and filled in with dung and soil.

This is just one of many examples of traditionally managed water sites that are being impacted by feral camels. Not only is this a problem for the site itself and the wildlife that rely on it, but for the Traditional Owners whose hard work and management will continually be in vain due to feral camel visitation.

Outcomes

5.4.1 COMMUNITY SKILLS AND KNOWLEDGE

The AFCMP has worked with a range of Aboriginal organisations, the pastoral industry and individual landholders to assist them to develop a shared understanding of feral camel impacts and preferred management options in different areas (Case study 11). The project has also helped build a strong foundation to allow these organisations and individuals to measure and manage feral camel impacts into the future. It is important that the momentum built by the AFCMP continues, as monitoring and managing traditional lands is one of the main livelihood opportunities available to these communities.

Some of the key capacity-building activities undertaken by the project are listed below.

Central Land Council (NT)

- The project supported the employment of a Camel Management Coordinator for three years to manage the consultation process with Traditional Owners that resulted in greater awareness of and willingness to manage feral camel impacts on aquatic and terrestrial ecosystems and sites on Central Land Council (CLC) lands with high cultural and conservation significance. Consents for commercial and non-commercial feral camel removal are in place for all priority CLC lands.
- Sixteen rangers have had training in feral camel handling and mustering linked to the project SOPs.
- Fourteen rangers have received firearms training to allow the management of localised feral camel problems, with the incidental benefit of providing a source of fresh meat.
- Over 300 rangers and Traditional Owners have been involved in water monitoring and deployment of motion-activated cameras to monitor feral camel impacts and native animals.

Martu (Pilbara region, WA)

- Fifty Aboriginal rangers and other Traditional Owners have been trained in environmental monitoring and 40 in ground culling. Rangers were involved in mapping areas for feral camel removal, ground culling, satellite tracking of feral camels and monitoring of waterhole and rock hole condition.

Birriliburu (Pilbara region, WA)

- Five Birriliburu rangers and two Central Desert staff were certified against national competency standards for firearms use.
- Ngaanyatjarra Council (Surveyor Generals Corner region, WA)
- Eleven Ngaanyatjarra Lands community members and Council staff were certified against national competency standards for firearms use and butchery.

Outcomes

Pila Nguru (Surveyor Generals Corner region, WA)

- Ten Pila Nguru staff, rangers and community members were certified against national competency standards for firearms use. This training, combined with greater ranger access to lands through track improvement, will support ongoing ground culling on Spinifex land (see Case study 11 below).

Anangu Pitjantjatjara Yankunytjatjara Land Management Unit (Surveyor Generals Corner region, SA)

- Approximately 30 people were trained in feral camel handling and mustering linked to the SOPs at three separate workshops.
- Twenty people were trained in ecosystem monitoring in five communities.

Maralinga Tjarutja (Surveyor Generals Corner region, SA)

- Five people were employed for short periods to assist with aerial surveillance, satellite collaring and aerial cull operations.

Pastoralists

- Twelve NT pastoralists completed a Statement of Attainment in Firearms course.

Aerial culling teams

- The project has provided the opportunity to train additional government aerial cullers, which will benefit the ongoing management of large herbivores.

Publications

- A best practice feral camel management book was developed and distributed for use by Aboriginal communities and other landholders.
- Ninti One will maintain the broad range of feral camel information developed through DKCRC and AFCMP work on its website.

Case study 11

Photo: Quentin Hart

Ground-culling training is helping Aboriginal people to manage local feral camel problems.
Photo: Adam Pennington

Case study 11: Spinifex land management – using ground-based culling to manage feral camel impacts in lower density areas

Source: Adam Pennington, Ranger Coordinator for Pila Nguru

Spanning an area of 55,000 km^2, the Spinifex Native Title Determined Area (Spinifex Country) is an area of outstanding natural value and integrity, spanning a transition in ecosystems from the Nullarbor Plain to the salt lakes and sand hills of the Great Victoria Desert, to the foothills and breakaways of the Central Ranges. Spinifex Country also has immense cultural heritage value and is dense with cultural sites and 'Tjukurrpa' (which, in general terms, translates to 'creation stories' and Aboriginal cultural law). Spinifex people maintain close connections with cultural sites and Tjukurrpa within Spinifex Country, partly due to their relatively recent contact history with European society – the last known Aboriginal family to be living nomadically in Australia came out of the bush north of Ilkurlka in central Spinifex Country in 1986.

SPINIFEX LAND MANAGEMENT AND CULTURAL KNOWLEDGE PROGRAM

Established and run by Pila Nguru (Aboriginal Corporation), since 2010 the Spinifex Land Management and Cultural Knowledge Program has developed significantly with the successful application by Pila Nguru Aboriginal Corporation to the Australian Government's Biodiversity Fund for the 'Enhancing Western Desert Biodiversity, Connectivity and Ecosystem Resilience Project' (EWD project). The EWD project will include management of fire, invasive species and threatened species; and research into change in habitat condition over time. From July 2013, five men from Tjuntjuntjara will be employed as full-time rangers while others (including Senior Traditional Owners) will be involved as casual rangers.

BUILDING CAPACITY FOR FERAL CAMEL MANAGEMENT

Feral camels have been known to the Spinifex People since before contact with Europeans some 50–60 years ago. Since their arrival, feral camels have been a source of meat, though people still prefer native sources such as red kangaroo (marlu) and bush turkey (kippera).

Despite representing a new source of meat and protein, feral camels have been considered a problem by Spinifex People for quite some time due to the impact they have on valuable water sources and vegetation. However, only since 2010 have Spinifex People actively been removing feral camels from Spinifex Country, since the AFCMP contacted the community at that time to discuss involvement in the project.

One of the core elements of the Spinifex Ranger Program to date has been the removal of feral camels from within and around Spinifex Country. In order to be able to remove feral camels in a professional and humane manner, Pila Nguru realised two important things:

1. Rangers required accredited training to enable ground-based culling beyond the life of the AFCMP
2. Rangers needed increased access to areas known to support higher feral camel densities (there are only three formed roads within Spinifex Country).

Case study 11

Track improvement gives Aboriginal rangers improved access to country for land management activities.
Photo above and below: Adam Pennington

Fouling of rock-holes by feral camels limits access to water by Aboriginal people and native animals. Steel 'spiders' can be placed over rock holes to prevent larger animals from falling into rock holes while still allowing them to drink. Photo: Quentin Hart

Discussions with Ninti One and the Western Australian Government Department of Agriculture and Food (DAFWA) were held about these issues, and AFCMP funds were received for training in firearms safety and ground-based culling techniques for 10 rangers, as well as funding to increase access to Spinifex Country north of Ilkurlka where feral camel densities have been relatively high since surveys first started in 2010.

Commercial use of feral camels was considered and discussed with Traditional Owners, Ninti One and DAFWA as an alternative form of feral camel management in Spinifex Country. However, due to the remote and inaccessible nature of Spinifex Country, commercial operations such as mustering are simply not practical or viable at this stage. It was therefore agreed that the best approach was integrated management involving aerial-based culling for initial population knockdown combined with training rangers in ground-based culling methods for ongoing feral camel removal.

Protection of water sources through installation of rock hole 'spiders' (see photo below) has also been discussed with Traditional Owners and received resounding support. Discussions are being held with the Western Australian Government Department of Parks and Wildlife (formerly Department of Environment and Conservation), with a view to installing the first units later in 2013.

ONGOING COMMITMENT TO FERAL CAMEL MANAGEMENT

Since the firearms and ground-based culling training course was conducted in Spinifex Country in October 2012, around 250 feral camels have been removed in nine days of removal activities. Rangers are proud of this work and have an ongoing commitment to remove feral camels and protect the natural and cultural heritage inherent in Spinifex Country.

One of the side benefits of feral camel removal is the provision of camel meat for dog food. This saves money on dog food as well as showing that waste is minimised as much as possible – an important theme for Spinifex Traditional Owners.

There is also the possibility of providing feral camel meat to the Department of Parks and Wildlife for use in baiting wild dogs. These discussions are in preliminary stages and are another potential source of income for the community.

6. Key messages and recommendations

The Australian Feral Camel Management Project (AFCMP) was a partnership of 20 organisations, led by Ninti One. The project was funded in 2010 by the Australian Government, which allocated $19 million, in addition to contributions from partners, over four years. Due to delayed operations (and therefore expenditure) in 2010–11 due to rainfall, the Australian Government funding requirement was reduced to $15 million (subject to final acquittals), despite the project being extended by six months to 31 December 2013.

The focus of the project was to reduce the density of feral camels and thereby increase the ecological and biodiversity value at 18 nominated 'biodiversity refuges' selected because of their high environmental value, particularly during dry periods. A broad range of management activities were described, including aerial and ground-based shooting, exclusion fencing, trap yards and mustering for commercial use. The project also:

- engaged with land managers to increase their awareness of the impacts of feral camels, and, more importantly, to help them develop ongoing management strategies and capacity
- undertook MERI activities that captured the project's outcomes and achievements
- implemented a communications plan focused on improving community awareness of the impacts of feral camels.

Commercial and non-commercial removal was undertaken across around 660,000 km^2 of the highest priority areas, removing around 160,000 feral camels – with most of these being removed in the last two years of the project. Feral camel density targets around environmental assets have largely been met and there is now a real opportunity to maintain very low densities of feral camels in the Pilbara and Simpson regions.

Although densities in the Surveyor Generals Corner region have been reduced, they are still generally above the broad long-term target of 0.1/km^2. Within this region, there are two large areas (APY and Ngaanyatjarra Lands) where the landholders have expressed a strong preference for commercial use. The AFCMP has supported commercial use in these areas in order to maximise the rate of removal through this approach, particularly in terms of encouraging removal of female feral camels. It is hoped that the increased commercial use capacity that has been facilitated by the AFCMP in these areas will allow a level of removal that drives the density down rather than just being a sustainable offtake. The aerial culling that has occurred in the non-commercial use zones of Surveyor Generals Corner has undoubtedly helped reduce the overall density of feral camels in this region over the life of the project, given the mobility of feral camels between commercial and non-commercial zones.

The following discussion highlights the major findings from the AFCMP and associated recommendations for future action.

Key messages and recommendations

6.1 THE NEED FOR CONTINUED FERAL CAMEL MANAGEMENT

Although the current population of feral camels of around 300,000 is a good result, there is clearly more work to be done. The low densities in the Simpson Desert and Pilbara need to be maintained, and densities in the Surveyor Generals Corner region need to be reduced further. The MERI program undertaken by the project has found that localised congregations of feral camels can cause significant damage to vegetation and wetland areas, which in turn generates flow-on impacts for native species and Aboriginal culture and wellbeing, which rely on these areas. This is important nationally as they pose a serious threat not only to a fragile natural environment but also to the maintenance of one of the oldest living cultures in the world. Feral camels also have a significant impact on the built infrastructure (e.g. fences, waterpoints, buildings) and the safety of transport links (e.g. roads, rail and airstrips).

The AFCMP has confirmed that large feral herbivores such as feral camels pose a significant threat to the environmental and cultural integrity of wetlands and biodiversity in arid Australia. This needs greater recognition by policymakers and land managers across all land tenures, and the development of enduring management activities that are appropriately resourced.

Recommendation 1.

That the Australian Government, in partnership with the Queensland, South Australian, Western Australian state and Northern Territory governments, maintain a coordinated approach to the management of large feral herbivores in arid Australia. This approach needs to account for the experience of the AFCMP, including:

- The annual level of AFCMP resources (around $4 million per year of Australian Government funding) was appropriate and allowed the required level of engagement of a diverse range of stakeholders through a necessarily comprehensive governance and consultation structure.
- Large-scale projects such as the AFCMP are likely to require more than a four-year timeframe to account for the establishment phase and seasonal conditions.
- There are benefits in such projects being coordinated by an independent non-government agency that does not have direct land management interests and operates nationally rather than in a particular jurisdiction.

6.2 COLLABORATION FOR EFFECTIVE FERAL CAMEL MANAGEMENT

The scale and complexity of problems such as feral camel management mean that new institutional arrangements are needed if control is to be effective. Feral camels are very mobile, showing no respect for jurisdictional or physical boundaries. The key to the success of the AFCMP was the high level of collaboration on a scale and across an area (3.3 million km^2 of rangeland) that has never been previously attempted.

Key messages and recommendations

The project brought together, for the first time in feral camel management, the Australian Government with state and territory governments; Aboriginal organisations; NRM organisations; pastoral industry; commercial, animal welfare and conservation interests; and research organisations.

Major environmental projects such as this need to recognise that the motivations of landholders are often broader than environmental issues, so achieving environmental objectives on pastoral and Aboriginal lands will require effectively linking to other priorities, such as economic and employment opportunities, improved productivity and cultural priorities. This, in turn, requires support and coordination across a number of government agencies.

The AFCMP adopted a cross-jurisdictional, cross-cultural, cross-disciplinary and cross-institutional approach to meet the needs of the project contract and the expectations of the partners and other stakeholders. The key to the success of the project was that a strong governance structure was established and resourced at the start of the project. The structure adopted allowed a coordinated decision-making approach that accounted for jurisdictional boundaries, landownership and community and industry needs. Important in this process was that the Australian Government (and state and territory governments) was represented on the project Steering Committee and there was continuity in this representation throughout the project.

The AFCMP has significantly increased the capacity for greater commercial and non-commercial off-take of feral camels, but should only be considered as the first step in nationally coordinated feral camel management.

Recommendation 2.
That Governments and land managers maintain AFCMP collaborations at inter- and intra-jurisdictional levels to maintain a coordinated management approach that is appropriately resourced.

Recommendation 3.
That future Federal/State government support for feral camel management ensures that there is significant collaboration between agencies with potentially conflicting objectives (e.g. environmental protection versus commercial industry development).

Recommendation 4.
That large NRM projects have regular formalised contact with funding agencies, and, preferably, continuity of project coordinator positions and funding agency contacts.

Recommendation 5.
That land managers be recognised as key partners in management projects that impact on the land that they own/manage. Recognition involves providing them with the information upon which to make informed decisions as well as including them actively in the decision-making process.

6.3 PROJECT OBJECTIVES AND SCALE

The AFCMP was built from the ground up with the initial impetus coming from NRM and Aboriginal groups in remote Australia. They approached the DKCRC in February 2005 to work with them on a funding proposal to the Australian Government for research which would develop an evidence base on the impacts of feral camels and then recommend an appropriate management approach to the problem. The research report identified the scale of the problem in terms of the number of feral camels, their spread and impacts and proposed a management approach focused on target densities at key environmental sites. The subsequent AFCMP was funded to reduce feral camel densities at 18 'biodiversity refuges' in four separate jurisdictions.

The landscape approach adopted by the AFCMP was appropriate as the problem being addressed was a nationally significant one that involved a highly mobile species. There were also benefits in highlighting the threat to individual priority assets in terms of understanding specific impacts and the level of protection required to reduce impacts.

The project had a full range of management options available to it to achieve density targets. Often more than one management option was used at each of the sites of interest and, through ongoing project monitoring and annual work plans, the mix of options could be tailored to meet the specific requirements at a particular site. Informed landholder preferences ultimately determined the form of management at each site.

Recommendation 6.
That large NRM projects have specific, quantifiable project objectives (e.g. pest animal density targets) based on solid research, with enough flexibility to alter the management approach as the project is rolled out. The AFCMP was based on a three-year research program and involved an adaptive management approach whereby annual plans were developed to account for improved knowledge and changing conditions.

Recommendation 7.
That regional density targets continue to be the main quantifiable performance measure for feral camel management, with the assumption being that at an average regional density of <0.1 camels per km^2, the frequency and severity of feral camel congregations will be substantially reduced. Although local density is more relevant than regional density in relation to feral camel impacts, for such a mobile species, local density is a transitory notion.

Recommendation 8.
That the landscape-scale approach be considered for other mobile pest species with the option of adopting distinct operational regions (as per the three used in the AFCMP of Simpson, Surveyor Generals Corner and Pilbara) where there are distinct high-density areas and/or differences in seasonal patterns, preferred form of removal etc.

Key messages and recommendations

Recommendation 9.
That resourcing of feral camel management is flexible enough to account for the variable opportunities provided by seasonal conditions – i.e. to ensure that removal operations can be undertaken at short notice to manage developing feral camel congregations and emergency events.

Recommendation 10.
That future feral camel management employs an integrated management approach which acknowledges the role of commercial use where it is able to contribute to sustained high levels of off-take in conjunction with other removal approaches; and that there will always be a key role for aerial culling to achieve rapid population knockdown and where feral camels are too remote or in too poor a condition for commercial use.

6.4 COMMERCIAL USE

The use of feral camels for meat (and related products) or live sales has been slow to develop. The AFCMP has assisted with the development of a niche camel meat industry, and approximately 25,000 feral camels were used for commercial use over the period of the project. There is now the potential for a more cohesive industry to help reduce impact in some areas as well as providing training opportunities and jobs in remote areas, especially Aboriginal communities. One of the challenges for the commercial use industry is to build a sustainable business model that is not reliant on feral camels to supply the demand for meat.

Recommendation 11.
That the commercial use industry reduces its reliance on feral harvest and builds captive herds. This will improve the reliability and quality of supply to abattoirs and also reduce potential conflicts between commercial use and impact reduction objectives.

6.5 KEY OPERATIONAL ISSUES

The scale and nature of the project meant that at times the partners and management and implementation teams found solutions to unique operational problems, which can be of use to others considering similar projects. The following recommendations are derived from the key operational lessons learned during the implementation of the AFCMP.

Recommendation 12.

That, although legislative differences between jurisdictions have not been a major impediment to the rollout of the AFCMP, feral camel management agencies continue to look for opportunities to address the issues identified in the Desert Knowledge CRC review as well as the legislation/policy review undertaken by the SA Government during the AFCMP.

Key messages and recommendations

Recommendation 13.
That future large pest animal management programs consider the process for setting and assessing the humaneness of removal operations developed under the AFCMP.

Recommendation 14.
That neighbouring jurisdictions keep each other informed about feral camel densities/movements and removal operations, to improve ongoing national coordination of feral camel management.

Recommendation 15.
That remote area operations involve at least two helicopters for OH&S reasons.

Recommendation 16.
That the size of 'no go' areas (e.g. communities, waterholes and cultural sites where culling cannot take place) for aerial culling be reduced as much as possible to reduce the distance that feral camels need to be moved before culling.

Recommendation 17.
That the 'Judas' technique (using satellite-collared individual animals to guide removal of associated groups of animals) be considered where feral camel populations have been reduced to very low densities (e.g. in the Simpson Desert).

Recommendation 18.
That the improved ground culling capability that has been developed on Aboriginal lands under the AFCMP be maintained and enhanced to allow Aboriginal rangers and other community members to effectively manage small numbers of animals that are causing problems at waterholes, roads, airstrips, communities etc.

Recommendation 19.
That exclusion be considered a relatively minor component of effective feral camel management due to the cost-effectiveness of construction and maintenance relative to other management approaches.

Recommendation 20.
That the 'removal assistance' payments made under the AFCMP be maintained for a limited time period to continue to encourage the commercial removal of female camels and to ensure that mustering operation comply with the SOP.

Recommendation 21.
That, although 'removal assistance' payments have some potential to contribute to feral camel management, the use of 'Market-Based Instruments' in general is considered carefully as their administration requirements can outweigh the theoretical benefits of a competitive tendering process, particularly where there is only a small number of potential tender proposals.

Key messages and recommendations

6.6 FUTURE INFORMATION NEEDS

The project illustrated the importance of developing a predictive capability to manage uncertainty. Strategies such as intelligence gathering (aerial surveys, satellite tracking); sharing of information (direct contact with landholders and CamelScan); monitoring of project impacts and monthly NOG teleconferences during peak removal periods were built into the project from the beginning. These processes, often used in combination, led to the implementation of more cost-effective management strategies and have left a legacy that can now be built upon for the future.

Recommendation 22.
That the environmental monitoring framework and sites established through the AFCMP be maintained and involve Aboriginal rangers. Wherever possible, this work should be linked to national data collection processes for the rangelands.

Recommendation 23.
That population surveys be continued at a frequency of 8-10 years to improve population modelling and therefore help to refine the management approaches. Ongoing investigation of more automated aerial survey approaches is required to allow increased survey frequency and/or area.

Recommendation 24.
That intelligence networks for obtaining and collating information on feral camel congregations be maintained to provide early warning to support more proactive operational responses. These networks can be combined with monitoring weather and fire information to locate potential feral camel congregations.