

DESERT KNOWLEDGE CRC

The Working Paper Series

Report on the
Feral Camels Workshops
December 6–7, 2005

Glenn Edwards

Working Paper

26

2008



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Feral Camels Workshops
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Desert Knowledge CRC Working Paper #26

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ISBN: 1 74158 068 4 (Web copy)

ISSN: 1833-7309 (Web copy)

Citation

Edwards G 2008, *Report on the Feral Camels Workshops December 6–7, 2005*, DKCRC Working Paper 26, Desert Knowledge CRC, Alice Springs.

The Desert Knowledge Cooperative Research Centre is an unincorporated joint venture with 28 partners whose mission is to develop and disseminate an understanding of sustainable living in remote desert environments, deliver enduring regional economies and livelihoods based on Desert Knowledge, and create the networks to market this knowledge in other desert lands.

Acknowledgements

The Desert Knowledge CRC receives funding through the Australian Government Cooperative Research Centres Programme; the views expressed herein do not necessarily represent the views of Desert Knowledge CRC or its Participants.

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1. Summary

The growing feral camel population in central Australia is a cause for concern at many levels and is the subject of a cross-jurisdictional Desert Knowledge Cooperative Research Centre (DKCRC) project that has recently been funded by the Natural Heritage Trust (NHT). Opinions and perceptions concerning camels vary; there appears to be no one obvious solution to the ‘problem’, and yet it is important to have stakeholder support for recommendations made as a result of the DKCRC NHT project.

Stakeholder input, as part of the first stage in an alternative futures assessment, was solicited at two workshops held at the Commonwealth Scientific and Industrial Research Organisation (CSIRO) in Alice Springs in December 2005. A team of three scientists from the Desert Research Institute (DRI) in Reno, Nevada, USA conducted these workshops following extensive discussion over several months with the DKCRC and CSIRO team members, and the award of seed money jointly contributed by Desert Knowledge Australia and the DRI.

The two workshops were attended by sixteen outside participants from a variety of backgrounds (e.g. conservation, the meat industry, pastoralists, and government agencies). Following introductions to the NHT project, alternative futures assessments, and scenario-based futures modelling the participants interactively identified stakeholders involved with camels and the driving forces operating on natural, social and economic variables associated with the growing camel population.

Interactions between the stakeholders and driving forces were summarised in two matrices (one for each workshop) which indicated the most crucial issues and stakeholders, and which will be used for developing scenarios (or plans) to show how change might occur.

These workshops were the first stage in the alternative futures assessment process, which will continue with workshops with other stakeholder groups and the development of scenarios during 2006. During 2007 and 2008, the spatial modelling of environmental, social and economic results of the three to four alternative futures (decisions made regarding the management of feral camels) between now and, say, 20 years from now will be carried out. Results will therefore identify not only the range of plausible actions but the effects these actions are likely to have.

2. Introduction

2.1 Camels in Australia

Camels were originally introduced to Australia as pack animals (McKnight 1969) and were released into the wild in the 1920s and 1930s. McKnight estimated the feral camel population to be between 30,000 and 90,000 in 1940, but the lack of predators or disease and the ‘camel friendly’ natural environment of central Australia has led to population growth with numbers estimated at 300,000 in 2001 (Edwards et al 2004) and close to 1,000,000 by 2005 (McGregor pers. comm.).

Perceptions concerning camels vary. They are seen as pests, as an economic opportunity, and as cultural icons. They cause damage to cultural heritage sites, to fences and other property in settlements and their presence on or near roads can result in accidents. Although primarily browsers, camels also consume herbaceous vegetation – up to 80% of species, including those that are rare or endangered (Stafford Smith 2005). Sites of cultural significance, particularly springs, are susceptible to camel damage, but in general Aboriginal people do not regard them as pests (Rose 1995).

Camels are a feature of the tourist industry in Alice Springs, and opportunities for use of camel meat by humans and in pet food are being developed (McCloy and Rowe 2000). There is some market for camel by-products, for example leather goods, but in general only approximately 40% of the feral camel population is suitable for alternative uses (Edwards pers. comm.), partially due to issues of remoteness of viable herds and logistics of transport.

The DKCRC NHT project 'Cross-jurisdictional management of feral camels to protect NRM and cultural values' will develop an effective long-term management strategy for camels that will protect biodiversity, improve natural resources and landholder capacity, and lead to a more effective and efficient use of resources. Alternative futures analysis (AFA) will contribute to the success of the NHT project in several significant ways.

2.2 Role of Alternative Futures Analysis

Alternative futures analysis is a technique that promotes sustainability of desert regions by integrating information from biophysical and social science disciplines, describing alternative pathways by which future conditions may change, and illustrating the impacts of these changes on land and people. A series of workshops are conducted at which stakeholder opinions, management options and regional plans are developed into future 'scenarios' which become alternative futures. For example, a community weighs the construction of holding pens for camels, expanding its road system, and/or remaining traditional.

Concomitantly, biophysical data on the status of environmental parameters such as vegetation and surface water will be collected and used in conjunction with demographic and infrastructure data to develop models of ecosystem structure and function.

The various alternative futures are the spatial manifestation of scenarios related to how change might occur over a given time period. A scenario might therefore be defined as a plan for how a region might change. The scenarios that are developed with stakeholder input are then translated into alternative futures and labelled according to the type of plan they represent; for example: remove camels from central Australia, maintain status quo, increase the camel population as an economic strategy. Models are used to assess the effect of each alternative future on selected environmental parameters; for example, what effect would holding pens have on vegetation, biodiversity and traditional lifestyles? Coupled with analyses of the social and economic effects of decision making, this spatially based analysis provides stakeholders with a strategy for weighing the consequences of each alternative future in terms of environmental impact, economic effect and social change at the landscape scale.

2.3 The term 'landscape'

The term landscape is commonly used in relation to the physical and biophysical environment, for example, 'an expanse of scenery that can be seen in a single view' (wordnet.princeton.edu/perl/webwn, 2006) or in the context of architecture or gardening. Certain connotations of spatial scale are implied and, in some cases, manipulation or a change of state caused by human intervention is accepted.

In this report, for this project and in the workshops described, the term is used in the environmental context as well as in human (social) and economic contexts. Landscape analyses therefore address not only biological, hydrologic and geologic issues, but also demographics such as population characteristics and spatial distribution, infrastructure; and economic parameters including jobs, income, profit/loss and feasibility. This broad use of the term landscape should be envisaged in the context of all components of the AFA part of the NHT project.

3. Background

Several years of discussion between Mouat and Friedel concerning desertification issues and strategies for addressing them, in both environmental and social contexts, have preceded the current collaboration between DKCRC, CSIRO and the Desert Research Institute (DRI). Mouat, Friedel, Lancaster and Stafford Smith met most recently at the International Rangelands Congress in 2003, and alternative future analysis input in DKCRC projects has recently been discussed by Friedel, Mouat and McGregor.

There is a strong convergence in approach within this collaborative team, recognising both the global nature of desertification and its associated problems and the community-level participation necessary to maintain arid land sustainability and develop alternative economic strategies (e.g. Mouat & McGinty 1998, Mouat et al. 2003, Friedel et al. 2002, Greiner & Friedel 2004, Reynolds & Stafford Smith 2002).

Mouat was co-organiser of the first Landscape Futures Symposium held in Armidale in 1999 and assisted in the second. Both he and Bassett presented papers at these symposia. In addition, he has spent considerable time in Canberra with both Environment Australia and CSIRO discussing issues related to landscape 'health'. Bassett and Mouat have been participants in and principal investigators of several alternative futures analysis projects in the United States and Europe.

After extensive email and telephone conversations between DRI, DKA and CSIRO scientists beginning in February 2005, the DKCRC's project 'Cross-jurisdictional management of feral camels to protect NRM and cultural values' was identified as the most viable, useful and dynamic collaborative option (with respect to the alternative futures collaboration). Following the award of funding from the DKA/DRI Australia Seed Grant in mid-2005, an AFA was initiated as part of the three-year camel project and DRI scientists visited CSIRO in December 2005 to conduct the initial two workshops. These workshops were attended by a cross section of stakeholders with two exceptions: the Aboriginal community and the urban-based 'general public'. It is hoped that these groups will be included in workshops during 2006 and 2007.

4. Addressing overall NHT camel project deliverables

The AFA component of the NHT camel project will be conducted within the framework of the overall project outputs. The overall project outputs include:

1. Detailed analysis of management system options that lead to a significant lowering of camel numbers and resulting NRM effects.
2. Integrated cross-jurisdictional feral camel management plan.
3. Improved understanding and documentation of the cultural and other barriers to different feral camel management options.
4. An analysis and documentation of the role of at least two alternative market-driven approaches to camel control.

Discussions between DKCRC, CSIRO, and DRI collaborators resulted in agreement that an AFA would contribute to all five of the above, and would directly address items 2, 3, and 4. With this in mind, results of the two preliminary workshops held in December 2005 are described below.

5. Alternative Futures Analysis Workshops

The first of a series of AFA workshops as part of the DKCRC/CSIRO NHT project ‘Cross-jurisdictional management of feral camels to protect NRM and cultural values’ was held on December 6 and 7, 2005 in Alice Springs. Workshops were focused on stakeholders representing broad interest groups, including pastoralists, those with NRM priorities, business interests, and an economic orientation. Many of these stakeholder groups included a governmental component.

5.1 Workshop Objectives

- Initiate process of alternative futures analysis
- Introduce participants to NHT project, and AFA
- Generate interest in collaborative camels/AFA project and stakeholders’ roles
- Identify stakeholder groups
- Determine regional framing issues

5.2 December 6 Workshop

5.2.1 Participants

There were 16 participants in this workshop, which was facilitated by Margaret Friedel (CSIRO). This group of stakeholders had an NRM focus and included government representatives as well as spokespersons for Aboriginal communities. Names and affiliations are shown in Table 1.

Table 1: Participants in December 6 workshop

Name	Affiliation
Geoff Axford	SA Govt. DEH
Tina Baines	Central Land Council
Scott Bassett	DRI
Doug Boyle	DRI
David Chester	SA Govt. Aboriginal Lands INRM group
Andrew Drennan	Ngaanyatiarra Land Management Unit (Warburton Community, WA)
Peter Donohoe	Central Land Council NT
Glenn Edwards	NT Govt. DNRETA
Marg Friedel	CSIRO
Frank Keenan	QLD Govt. DNR
Lexie Knight	APY land management
Judith Lancaster	DRI
Murray McGregor	Curtin University
Sean Moran	National Parks, Uluru
Dave Mouat	DRI
Andrew Woolnough	WA Govt. Agriculture

5.2.2 Presentations

Murray McGregor introduced the NHT project, which aims to identify the best strategy (or combination of strategies) to reduce camel numbers to a level that reverses the current population growth trajectory, and therefore improves NRM. Challenges for the project are the development of a cross-jurisdictional regulation and legislation process, identification of feasible alternative uses for camels and camel products which provide a source of income for rural communities, and the creation of innovative ways to remove supply chain bottlenecks. Several illustrations highlighted the distribution of feral camels and population growth rate.

The varying perspectives associated with camel ‘issues’ will be one of the management considerations taken into account by the project, for example, culling is humane but emotive for Aboriginal peoples and the international community. The remoteness of the camel population, the need for a coordinated response to address a mobile target and for special processing infrastructure are all facets of management that will be addressed by the project. Measuring success is not necessarily straightforward, since reducing the camel population may not result in reduced impacts.

David Mouat and Scott Bassett introduced the concepts and structure of AFAs and scenario-based planning, and provided examples of two projects that involved this technique. An AFA is a process which uses scenario-based modelling to show the spatial effects of decision making upon a suite of ecosystem parameters, associated with social and economic consequences. Theoretically there are an infinite number of possible scenarios – but only some of them might be thought of as plausible. The AFA process can be thought of as a method of binding decision space to determine which are the most plausible scenarios.

Scenarios are used as a means to develop alternative futures – the spatial manifestation of scenarios projected into the future. It is important to recognise that some futures might be considered as undesirable or impractical by some stakeholders. Even no action – in the context of the NHT project – is an alternative future for feral camel management, but may not be considered as an acceptable strategy. It is of crucial importance to not develop futures that are just positive. Futures that may occur and be unacceptable must be a part of the choices or options.

The remainder of the workshop was devoted to an interactively developing a matrix showing stakeholder perceptions regarding concerns, or framing issues, which drive the landscape (environmental, social, and economic) in the context of camels. It is our intent to expand these matrices and to use them to formulate scenarios for the project.

5.2.3 Structure and organisation of stakeholder participation

The first stage in matrix construction was identifying stakeholder groups, followed by listing regional issues which are affected by camels (or, alternatively, have an effect on camel populations). Stakeholder interaction throughout this process was lively: differences among States and the Northern Territory in terms of organisation and structure were evident, as was the need for interaction between the AFA team and Aboriginal communities.

There was an initial attempt to add each stakeholder group’s perspective on camels to the list, but this was abandoned as it was overly time consuming – partly due to the fact that not all groups were represented among the participants and it became assumptive, which then generated a lot of not necessarily relevant or focused discussion.

The list of stakeholder groups is shown in Table 2, and Table 3 shows the regional issues (pertaining or relevant to camels) selected by the December 6 workshop participants.

Table 2: Stakeholders identified during December 6 workshop

Stakeholders or Stakeholder Group	Additional Comments
Aboriginal landowners as individuals	multiple and communal
Pastoralists	both Aboriginal and non-Aboriginal
Traditional owners	especially cultural sites
Aboriginal administration	CLC, AP, Ng....
Service providers	roads, airstrips, water
Government - Fed/State/Local	policy and NRM Boards
Govt. Land Management	for Govt. owned lands
Pastoralists' Lands Board	
Pastoralists/Grazers	
Tourism	
Camel industry	
Animal rights	
Animal welfare	
Emergency services/Public safety	
Processors/Meat industry	
Scientists	
NGOs - conservation	
Mining industry	
Global/Urban	
Media/film industry	
Heritage interests	
Markets	
Education	
Allied industry	
General industry	
Military	
Hunting (?)	
Bush tucker industry	

Table 3: Regional issues identified during December 6 workshop

Regional Issue	Additional Comments
Rainfall	
Land tenure	
Land use	
Population (people) and demography	
Camel population	
Social needs and views	Aboriginal peoples
Water availability	perception of
Biodiversity	perception of
Species competition	
Economic opportunities	jobs
Range condition	
Policy and regulation	funding
Policy conflict	
Knowledge gaps and education	
Ecological knowledge gap	cultural/social attitudes...
Infrastructure	

5.2.4 Results

There were 28 stakeholder groups and 16 regional issues identified by participants in this workshop – too many to begin the process of developing scenarios. Consequently, we reduced both lists to between eight and ten. This was accomplished relatively quickly, and with positive consensus, resulting in seven stakeholder groups and nine regional issues being selected. The groups and issues regarded as critical are seen along x and y axes (respectively) in Figure 1, the Interactions Matrix.

Stakeholder Group	Regional Issue								
	Cultural/Social Attitudes	Knowledge Gaps	Policy and regulations	Jobs and Economics	Biodiversity (range condition)	Water	Cultural Sites	Human Population and Demographics	Camel Population
Landowners (Aboriginal)	○	○ ○	○	○	○	○	○	○	○
Camel Industry	○	○	○	○	○	○ ○	○	○	○
Government	○	○	○	○	○	○	○	○	○
Conservation oriented	○	○	○	○	○	○	○	○	○
Pastoralist	○	○	○	○	○	○	○	○	○
Tourism	○	○	○	○	○	○ ○	○	○	○
Animal rights	○	○	○	○	○	○	○	○	○
Key: Low ○; High ○; Moderate ○;									
Some relationship									
Strong relationship									

Figure 1: Interactions matrix resulting from December 6 workshop

Circles in this figure show strong relationships (connections, associations) between sets of variables within the matrix. In some cases where the relationship is not the same when viewed from either direction, two circles are shown; for example, tourism will be strong/successful when there is abundant water, although when water supplies are limited tourism is still able to function to some extent. Rows and columns with 'high' ratings/scores were highlighted, and are shown in yellow in Figure 1. The four stakeholder groups highlighted were Aboriginal landowners, Government, Conservation-oriented, and Pastoralists. Knowledge gaps, Policy and Regulations, Jobs and Economics, Biodiversity, Water, and Camel population were all considered to be critical regional issues affecting (or affected by) camel populations. Although this was the first of several workshops, it is likely that the scenarios that are developed as a result of the workshops will focus on these variables, with the possibility that Aboriginal landowners, Policy and Regulations, and Camel populations will be considered especially important by everyone.

5.3 December 7 Workshop

5.3.1 Participants

There were 16 participants in the workshop on December 7, including three outside people who attended the session on the previous day. Margaret Friedel (CSIRO) facilitated, and the organisation was very similar to that on December 6 except that presentations (particularly the introduction to the AFA process) were shortened to give more time for interaction and matrix development. Table 4 shows participants and their affiliations.

Table 4: Participants in December 7 workshop

Name	Affiliation
Dave Axon	
David Chester	AW NRM
Ian Conway	Kings Creek station NT
Gary Dann	Amburla station NT
Glenn Edwards	NT Govt. DNRETA
Marg Friedel	CSIRO
Frank Keenan	Qld Govt. DNR
Judith Lancaster	DRI
Murray McGregor	Curtin University
Robin Mills	Warrawagine station WA
Dave Mouat	DRI
Peter Saville	NT Primary Industries Fisheries and Mines
Peter Seidel	Central Australian Camel Industry Association
Neil Waters	Camels Australia
	WA Govt. Agriculture

5.3.2 Presentations

Murray McGregor's presentation on the DKCRC NHT camel project was similar to the one he gave on December 6 (see above) with a focus on management issues and challenges facing the project. Camel distribution, population, and population projection were the subject of several slides, and project deliverables were shown.

David Mouat presented an introduction to the AFA process with a focus on the benefits of this technique for the feral camels project.

The remainder of the workshop was devoted to an interactive development of a matrix showing stakeholder perceptions regarding concerns or framing issues that drive the landscape (environmental, social, and economic) in the context of camels. The matrix will then be used to formulate scenarios for the project.

5.3.3 Structure and organisation of stakeholder participation

The first stage in matrix construction was identifying stakeholder groups, followed by listing driving forces – environmental, social or economic factors which affect camel populations. Stakeholder contribution to this process was considerable and thought provoking. Discussion was focused, and progress through the development of the two lists was relatively rapid in comparison with the workshop session on the previous day. The list of stakeholder groups is shown in Table 5, and Table 6 shows the driving forces selected by the December 7 workshop participants.

Table 5: Stakeholders identified during December 7 workshop

Stakeholders or stakeholder Group	Additional comments
Pastoralists	
Tourism	
Aboriginal communities	
Environmentalists/research/conservation	
Meat industry/research	
Government – Fed/State/Local	political/regulations/service
Animal welfare/rights	
Financial institutions	
Australian community/global	
Service sector	e.g., feed suppliers
Media	
Political process	

Table 6: Driving forces identified during December 7 workshop

Driving force	Additional comments
Regulations and policy	
Weather, seasons, rainfall	
Water availability	
Camel population	
Public perception	
Markets and demand	
Livelihoods, jobs	
Economics	
Infrastructure and access	
Demography	
Impacts of feral camels	on range and on infrastructure
Cultural complexity	
Camel ownership	
Remoteness	
Education and public perception	local, national and international

5.3.4 Results

There were 12 stakeholder groups and 16 driving forces identified by this group of workshop participants, which were then reduced to seven and ten respectively – see Results section above for rationale on this step. The stakeholder groups and driving forces regarded as critical are seen along the x and y axes respectively in Figure 2, which is a second Interactions Matrix. The interactions depicted in the matrix created by this workshop group were coded positive, negative and none (rather than by degree) because it was felt that this would provide a more specific evaluation which would be beneficial in developing scenarios. Degree of interaction (relationship) was a subject of lively discussion, and is depicted by two plus or minus signs if it was considered to be particularly strong.

Stakeholder groups and driving forces which received particularly strong scores were then highlighted (yellow in Figure 2). This process resulted in a further selection, narrowing the stakeholder groups considered as critical by this workshop's participants to five – Pastoralists, Aboriginal communities, Conservation, Government, and Service and Meat Industries. Water, Camel populations, Markets/demand, Livelihood/jobs/demography, Camel impacts, and Public opinion were identified as the most important driving forces. Some similarities with the results of the workshop on December 6 should be noted, and will be discussed below.

Stakeholder Group	Driving Force									
	Regulations (camel)	Water (camel)	Camel population	Markets, demand (camels)	Livelihood, jobs, demography (camel)	Economy, capital (camels)	Infrastructure, access	Camel impacts	Cultural complexity, camel ownership	Public opinion
Pastoralists	+ -	++ --	++ --	++	++	+ -	--	+ --	--	++
Tourism	-	+ --	+ -	+	++			-		++
Aboriginal Communities		++ --	++ --	++	++	+ -	+ --	(+) --	++ -	++ --
Conservation	++	+ --	--	++	+	-	+	--	-	++ -
Government		++ -	++ --	++	++	+	--	--	-	++ --
Australian Community, Animal Rights	+ -	+ -	+ -	++	+	+ -				
Service Industry, Meat Industry	-	+ -	+ -	++	+	+	+ --	+ -	-	+ -
Key: Positive +; Negative -; Neutral/none ; Relationship										

Figure 2: Interactions matrix resulting from December 7 workshop

5.4 Similarities and differences between workshops

Although only two of a series of workshops were conducted in December 2005, the broad similarity between results of the two at the 'Interactions Matrix' level are interesting and encouraging. The stakeholder groups appeared to have very broad common backgrounds, and possibly perspectives, on many issues – but not necessarily on the feral camel population (as was particularly evident by the sometimes heated discussion among workshop participants on December 6). The fact that common stakeholder groups and regional issues/driving forces were identified at these workshops indicates that, when personal views are put aside, many people may share opinions concerning the situation, and therefore of the potential alternative futures that are likely to address this issue.

With slightly different phrasing (see Figures 1 and 2) both workshops selected the same seven stakeholder groups, and, even more significantly, four were scored 'high' in both sessions – Aboriginal communities, Pastoralists, Government, and Conservationists. Importantly, the December 7 workshop also considered the Service and Meat Industries to be critical. This second workshop group had an additional driving force/regional issue scored as 'high'. Again there was consensus between groups on several of the landscape (in its broadest sense) issues that were identified, with Camel population and Water scoring high in both sets of results, and (with allowance for differences in phrasing) Range condition and Jobs as two more. Public opinion (December 7) and Policy and regulations (December 6) have some commonality – which leaves Markets and demand as the additional landscape variable identified by the December 7 workshop.

These results are summarised in Figure 3, a very preliminary combined matrix, which will no doubt be refined somewhat following the completion of the first round of workshops in 2006. The preliminary nature of this figure is reflected in the lack of 'scoring' in the matrix cells. Despite the difference in scoring between the two workshop sessions – December 6 being based solely on intensity while December 7 included positive/negative as well as intensity – we feel that the results of the two groups are broadly comparable and therefore can be combined to the point that we show in Figure 3.

		Landscape Variable				
Stakeholder Group	Camel population	Water	Range condition	Jobs	Policy and public opinion	Markets and demand
Aboriginal Communities						
Pastoralists						
Government						
Conservation						
Service and Meat Industries						

Figure 3: Provisional combined interactions matrix

6. Media coverage

During the period December 6–8, the workshop process and alternative futures assessments received some media coverage as a result of two reporters attending sessions and talking with workshop participants about the problems and opportunities associated with feral camels. These discussions, while at times distracting, allowed the NHT Project team and the AFA team to understand the importance of the topic at a different level of interest. Furthermore, it became very apparent, especially to the AFA team, of the importance of the issues at the national and regional levels. There was also a story about the NHT project on SBS World, which aired nationwide. This piece featured Murray McGregor and Glenn Edwards and did a good job of presenting the workshop and issues to a national audience.

7. Process for workshops

In order to assist comparison between results of workshop sessions, the process was similar on both December 6 and 7, 2005, and will be retained for the others with different stakeholder groups. These half-day sessions were introductory in nature with relatively few ‘hard deliverables’ but considerable participatory interaction among all who attended. (See above for workshop objectives). There were three stages in the workshop process:

1. Introductions

- by individuals
- the NHT project (Murray McGregor)
- alternative future analysis (David Mouat [and Scott Bassett on December 6])

2. Interactive discussion in which everyone participated

- perceptions concerning the critical issues in managing feral camels
- the stakeholders and stakeholder groups involved in this ‘issue’
- regional issues affected by (and/or affecting) camel populations – December 6
- driving forces affected by (and/or affecting) camel populations – December 7
- critical stakeholder groups and regional issues/driving forces
- the interactions between these; how do we score them and which are the most important?

3. Summary and the next stages in the AFA process? (David Mouat and all participants)

- next steps in the process of developing alternative futures for camels
- workshop evaluation

Ideas and suggestions for stakeholders and stakeholder groups, and for the regional issues/driving forces, were captured on flip charts and then were further discussed to reduce their number to between six and ten in each category. Whiteboards were used to record the interaction matrices (see discussion above for more information on this). The desired end-point (product) for the workshops was this interaction matrix, although the shorter introductions session on December 7 resulted in some time for the summary which had been very brief on December 6.

Differences in phrasing between ‘regional issues’ and ‘driving forces’ resulted in part from participants in the workshop on December 6 having slight difficulty in capturing the focus and direction of discussion based on the ‘issues’ concept. The two terms have almost total conceptual overlap – but ‘forces’ is more specific, and the workshop organisers felt that it might lead more easily into the next phase of the AFA process – which is development of critical uncertainties and scenarios.

8. The AFA Process

The AFA process may be visualised as a series of steps or activities, each of which influences the following operations (Figure 4). For two out of a possible four stakeholder groups, the process through the first two components of the analysis has been completed. Once the most important driving forces have been identified, the critical uncertainties can be framed. The effects of decisions made by land managers such as pastoralists and Aboriginal landowners are influenced, to varying extents, by the action of others within the same or adjoining ecosystems who may have different land use priorities (Shearer 2005). This generates critical uncertainties, which are questions relating to use, condition or trend of the environmental, social or economic ‘landscape variables’ upon which the driving forces are acting. Therefore, critical uncertainties may relate to water (e.g. ‘will there be enough water to sustain our needs?’) or to culture and social customs (e.g. ‘will people eat more camel meat if there is a wider selection available in the shops?’) or to economics (e.g. ‘will improving infrastructure be a worthwhile investment?’). Typically, there are six to ten critical uncertainties for an alternative futures assessment and each of these are specifically addressed as each of the scenarios is developed.

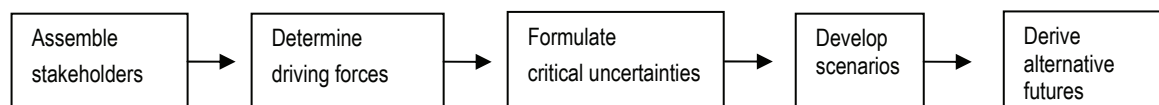


Figure 4: Trajectory of an alternative futures analysis process

Uncertainty can be partially managed by comparing the potential consequences of planned actions against alternative future contexts or scenarios (Shearer et al. 2005). Shearer (2005) suggests that scenarios have the following four characteristics:

- they are fictitious, but plausible, accounts representing a process of change over time
- they describe situations, events, actions and consequences which are contingently related
- they are understood to be predictive judgments describing what *could* happen; they do not describe what *will* happen
- they organise information within explicitly defined frameworks

Scenarios assist in defining conditions and evaluating consequences of actions or decisions. The fictionality of scenarios creates a testing environment that is not based on past or analogous situations, yet scenario formulation demands a specific set of information in ‘who,

what, when and why' categories which results in identification of a broad suite of implications, and permits consideration of individual factors across differing frameworks (Shearer et al. 2005). Alternative futures describe the forces of change operating through the different scenarios relating to each of the critical uncertainties, in a series of landscape scale analyses using GIS and related technology.

8.1 Landscape models

Landscape models will be used to provide a spatial assessment of the potential results of management decisions for the feral camel population using scenarios developed during stakeholder workshops. To describe the geography and the dynamic processes at work within central Australia, a computer-based geographic information system (GIS) will be organised to contain spatially explicit and publicly available environmental, social and economic data on the region. These spatially explicit data will address questions on how the landscape operates in terms of natural and social systems, through process models – one of which is described below – that provide information for multiple analyses. The potential impact of scenarios relating to feral camel management will be assessed through the execution of the process models using the scenarios as inputs, thereby altering existing conditions. The scenarios shaping the modelling effort will be those developed as a result of the first phase of the AFA process, which was initiated with the two workshops in early December 2005.

The process models describing the system's biological function will be broken into several discrete models, all of which may be affected by implementation of management decisions. The biological processes will be selected to address scientific concerns and assist policy makers with information to better address concerns related to feral camels. Thus, output from each individual biological process model will derive qualitative and quantitative values to address the overall function of the landscape, and socioeconomic models will use these values as inputs. Some biological process models rely on output from physical process models to fully evaluate biological function. Furthermore, many of the biological functions evaluated within one process model provide input into a subsequent and different process model. The model for vegetation assessment is described below.

8.2 Vegetation

Change in vegetation composition and cover in large areas of central Australia is a function of several variables including fire, fauna, weather patterns, and, especially, human use (the vegetation, itself, is a function of other variables as well). Increased pressure by feral camels could lead to negative impacts to both vegetation and hydrological resources, which may reduce biodiversity and rangeland productivity and increase the potential for land degradation.

To describe, quantify, and predict vegetation change, the relationship among the potential land use patterns and the potential variations in the climatic regime must be determined. Initial vegetation community identification will involve the use of two Landsat ETM images at a 30-metre pixel resolution. An isodata algorithm for classifying satellite imagery applied by mosaicing images as described in Homer et al. (1997) and utilised in other studies (see, for example, Edwards et al. 1995) will be key to identifying vegetation communities and other land cover, and will be verified by Australian experts. From this base map a number of relationships will emerge, linking the range management and water management practices with a vegetation transition model (Mouat and Lancaster, 1996).

The range component of the vegetation transition model will aid in determining the relative threat of degradation. Livestock grazing and fire management practices are traditional behaviours with the greatest influence on vegetation change, and which might be influenced, positively or negatively, by new policies involving camel management. A portion of the vegetation transition model will interpret the effects of these management practices on the distribution of key species, including bush tucker.

Changes in vegetation will be the major output from the vegetation transition model. Various camel management scenarios may then be compared to assess the relative threat they pose to the sustainability of vegetation communities. These outputs will be used as input into other measures of biodiversity and the socioeconomic process models.

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