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# **Camel Commercialisation in the Goldfields Esperance Region of Western Australia: An Exploratory Scoping Review**

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**PHE3PFP Internship Report**

**Department of Public Health**

**La Trobe University, Melbourne, Victoria, Australia**

Report Completion: 28<sup>th</sup> February, 2020

Research Online: Borchardt Library,

La Trobe University, Melbourne, Australia

Web-Link: <http://hdl.handle.net/1959.9/568768>

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## PREFACE

This report is an exploratory scoping literature review prepared for the *National Indigenous Australians Agency* (NIAA Goldfields Esperance Region) by undergraduate La Trobe University health science students. Support for this report was provided by La Trobe University, Department of Public Health, Participatory Field Placement (PHE3PFP) Undergraduate Internship Program designed to give tertiary interns experience in conducting research on behalf of external agencies.

**Organisation/Department:**

Department of Public Health, La Trobe University

**Referencing System:**

American Psychological Association, 6<sup>th</sup> Edition

**Access:**

Research Online: Borchardt Library, La Trobe University, Melbourne, Australia.

Website Link 1: <http://hdl.handle.net/1959.9/568768>

Website Link 2: <https://doi.org/10.26181/5dc507bd598ed>

**Commencement:** 01 September 2019

**Completion:** 30 January 2020

**Revised:** 28 February 2020

**Topic:** Camel Management and Commercialisation

**Publication Reference:** Hanslow-Sells. E., Perry. D., Carey. L. B., Krikheli. L., Drakopoulos. T., Heath. A., Vargas. C. (2019). *Camel Commercialisation in the Goldfields Esperance Region of Western Australia: An exploratory scoping review*, Melbourne: La Trobe University: <http://hdl.handle.net/1959.9/568768>

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**Acknowledgments:**

Appreciation is acknowledged to Ms. Debbie-Lee Barrington, (Former Adviser and Engagement Officer National Indigenous Australians Agency), Mr. David Pedler (Senior Adviser Midwest, Goldfields Employment Team, Geraldton, WA) and Regional Development Australia Goldfields Esperance (RDAGE), as well as the City of Kalgoorlie Boulder (CKBO). Appreciation is also acknowledged to Mr. Edward Perrett (Agricultural Research Officer), Mr. Mitch Kay and Stephanie Gjorgioski (Academic Field Placement Supervisors, La Trobe University). Finally, appreciation is acknowledged to Ms. Rosanna Ripoli, Senior Learning Advisor, Borchardt Library, La Trobe University Melbourne, for her internship training and assistance.

The authors acknowledge the Wurundjeri people as the custodians of the country on which La Trobe University campus stands and where this report was produced. The authors also acknowledge the Wongai people as the custodians of the country on which this report was formulated, and where the lead authors travelled. The authors pay their respects to the elders; men and women; past, present and emerging.

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## ABSTRACT

**Purpose:** This review aims to explore the benefits and barriers of the commercialisation of camels (*camelus dromedaries*). Included is a discussion section exploring the impacts that commercialisation might have on local communities, including Aboriginal and pastoralist communities. While this report may offer a base framework, further study is necessary to explore related issues and recommendations in more detail. **Method:** The authors utilised online databases, hand-searched grey literature, and anecdotal information via a field trip to Kalgoorlie, Western Australia. These resources were subsequently screened for suitability. Thematic analysis was conducted on the literature. **Results:** Seven key themes were identified in the literature; (i) camel farming, (ii) barriers, (iii) socioeconomic benefits, (iv) rural and remote Australian communities, (v) Indigenous Australians, (vi) camel culling, and (vii) camel by-products. **Discussion:** Current management methods consist primarily of culling. Historically, there have been some government instigated management projects, however, the responsibility for managing camel populations largely falls on pastoralists. Camel populations presently impact rural, remote and Indigenous Australian communities in Western Australia, primarily causing damage to infrastructure and affecting other livestock. The literature suggests that, for commercialisation/farming to be viable, there needs to be a defined market that pastoralists can supply. Currently there are known international markets including meat/by-product markets in China and other areas of Asia, plus Middle Eastern markets, and various halal markets globally. There are also potential domestic markets, namely for pet foods, human consumption, milk, etcetera. **Conclusion:** The authors found that there are economic and social benefits for the formalised commercialisation of camels in Australia, assuming the barriers are adequately addressed. The Western Australian Goldfields Esperance region stands to profit from camel processing and export, both internationally and domestically, as well as increased employment opportunities, specifically for Indigenous Australians. The authors believe that this report is best utilised as a resource for further study into areas including socioeconomic implications, cultural considerations, and long-term farming prospects.

## Keywords:

Camel, Dromedary, Australia, Indigenous, Commercialisation

## INTRODUCTION

Throughout Australia, there is a lack of understanding surrounding the impact that the feral camel population has upon the lives of people living and working rurally. The feral camel has been considered a problem within Western Australia, while simultaneously receiving little attention from the rest of the country. This review aims to highlight refereed literature that explores the concept of culling versus the commercialisation of camels.

Until the 1840's camels were imported to be utilised as a method of transportation through arid regions of Australia (McCarthy, 1980). However, when motorised transportation options were introduced in the early 1900's, many camels were released into the wild, resulting in a large feral camel population across arid areas of Australia. Over ten years ago, the feral camel population was growing at a rapid rate of 8% per year (Edwards et al., 2008, p. 342). It is estimated that there are currently between 600,000 and 1.5 million feral camels in Australia (McGregor et al. 2013, p. 58). A significant number of Australia's feral camel population can be found in the Western Australia, Goldfields and Pilbara regions. The camel was declared a pest in WA by the 'Biosecurity, Agriculture and Management Act 2007' for a range of reasons forming the basis for culling the feral camel population (DBCA, 2014). The main reasons to date have included:

- Wildlife and natural habitat damage (e.g., stripping/trampling vegetation, fouling water supply)
- Damage to Aboriginal Communities and cultural sites (e.g., stampeding, trampling)
- Damage to Pastoral Infrastructure (e.g., grazing land, fence and water supply/storage damage)
- Hazard to motorists (e.g., damage to outback roads, vehicle collision/damage)
- Reduce methane emissions (e.g., greenhouse effect carbon emissions reduction)<sup>1</sup>
- Economic loss to community (e.g., costly repairs to property, competition with livestock)

Given the fact that some management strategies (such as fencing-off key areas to keep out camels) only partly resolve specific areas of concern, the implementation of camel culling (both ground and aerial) has been supported by the Western Australia State Government as the main method of feral camel control, so as to reduce the environmental and economic impact (for the reasons listed above), but particularly to lessen the grazing pressure in remote pastoral areas (McGregor et al., 2013).

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<sup>1</sup> Reduce methane emissions to combat global warming. This rationale and methodology was refused endorsement by the Commonwealth Government (DOIC, 2012; Dittman et al, 2014; Bran, 2014).

However, it has been argued that as an alternative to feral camel culling, funding should be redirected to provide more investment into the commercialisation of the arid-resilient camel — primarily to gain its meat and by-products for export and for local consumption. Research to date indicates the existence of markets that could be utilised for camel commercialisation and that feral camels could create a sustainable industry that supports rural and Indigenous communities throughout Western Australia (Virtue et al. 2016). Although various barriers exist, which this report will discuss, nevertheless potential enablers could assist the camel meat and by-products industry to be effective.

## **PURPOSE**

This report aims to detail the benefits associated with the commercialisation of camels compared to the culling of camels, which is currently occurring throughout the Goldfields Esperance region of Western Australia. This report also provides a review of the existing barriers that are preventing successful camel commercialisation.

Identifying the advantages and disadvantages of camel commercialisation could benefit the key stakeholders (e.g. Indigenous communities, pastoralists) and the Goldfields Esperance region, as it may assist economic growth. While this report was based on, and utilises, research and observations specific to the Goldfields Esperance region in Western Australia, it may also prove a valuable resource for application to other regions of Australia.

## **METHOD**

Preliminary research was completed via the use of database searches to find relevant academic literature. The databases used were Medline, PubMed, Google Scholar and other La Trobe Library data bases. Arksey and O'Malley's (2005) methodology was used for the searching and thematic coding of literature for this report.

'Grey' literature sources, of which there are many, were found by hand-searching, with the addition of anecdotal suggestions from stakeholders that were met during a field trip to Kalgoorlie. Searches were performed using the PICO method to find data relevant to the devised research questions; '*What are socio-economic benefits of commercialisation and commercialisation of camels?*' (Table 1), and '*To what extent would culling or commercialisation impact the rural and Indigenous Australian populations?*' (Table 2). Database searches involved the use of keywords to identify related literature, which were then filtered for relevance (see [Appendix A](#)). During the writing of the report, several articles were found to be of minimal relevance and were discarded. Search terms and synonyms can be viewed in Table 1 & 2.

Academic literature, including some relevant ‘grey’ literature, was organised utilising a thematic table ([Appendix B](#)). This allowed for themes to be systematically identified and presented. Seven themes were identified and are explored in the results section below. During the writing of this report, the lead authors travelled to Western Australia to visit a pastoral station, as well as several local rural communities. The outcomes of this interstate travel included; context of the pastoralist perspective, context of the geographical logistical issues, and gaining first-hand accounts from pastoralists who were being impacted by feral camels ([Appendix E](#)).

**Table 1**

*What are socio-economic benefits of commercialisation of camels?*

<b>Population</b>	<b>Intervention/ Exposure</b>	<b>Intervention/ Exposure</b>	<b>Outcome</b>
“Indigenous Australia**” OR Rural OR Remote OR Aboriginal*	Camel* OR Dromedar*	Commerci* OR Farm*	“Socio-economic benefit**” OR Social OR Economic*

**Table 2**

*To what extent would culling or commercialisation impact the rural and Indigenous Australian populations?*

<b>Population</b>	<b>Intervention/ Exposure</b>	<b>Intervention/ Exposure</b>	<b>Outcome</b>
“Indigenous Australia**” OR Rural OR Remote OR Aboriginal*	Camel* OR Dromedar*	Commerci* OR Farm* OR Cull*	Camel Cull* OR Camel Farm*

## **RESULTS**

Initially, a total of 618 articles were identified from the academic refereed literature search, however, many of these did not directly address the advantages and disadvantages of commercialising camels as an appropriate camel management method. A proportion of these articles were discarded as the legitimacy or relevance of their content was not pertinent. Nine key articles (n = 9) were finally determined to be specifically relevant to the research topic (refer to Table 1 & 2). Analysing these articles allowed for key themes to be compartmentalised (refer to Table 3) which are further considered in the discussion section of this report.

### *Key Themes*

The main themes identified within the literature review were: (1) Camel Farming, (2) Barriers (a) to camel farming and (b) to camel culling, (3) Socioeconomic Benefits, (4) Rural and Remote Australian Communities, (5) Indigenous Australians, (6) Camel Culling, and (7) Camel By-Products (refer Table 3; [Appendix C](#) & [Appendix D](#)).

**Table 3**

*Literature and Thematic codes*

<b>Literature</b>	<b>Thematic codes</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>	<b>7</b>
McCloy and Rowe (2000)		✓		✓				
Virtue et al. (2016)		✓	✓	✓				
Kaethner et al. (2016)		✓			✓	✓		
Edwards et al. (2008)		✓	✓	✓			✓	
Eldridge et al. (2001)			✓		✓	✓		
McGregor et al. (2013)							✓	
Zeng (2015)			✓					
Manefield and Tinson, 1997		✓	✓	✓	✓			✓
Clarke (2014)		✓	✓	✓		✓		
<b>Total</b>		<b>6</b>	<b>6</b>	<b>5</b>	<b>3</b>	<b>3</b>	<b>2</b>	<b>1</b>

*Note: (1) Camel farming, (2) Barriers, (3) Socioeconomic benefits, (4) Rural and remote Australian communities, (5) Indigenous Australians, (6) Camel culling, and (7) Camel by-products (refer Appendix C & D).*

### *(1) Camel Farming*

Camel farming, also known as camel commercialisation, is the management of camels for profit. Small scale camel farming has been occurring in Australia successfully since 1993 (McCloy and Rowe, 2000, p.1). A report by McCloy and Rowe (2000) supported the commercialisation of camels, claiming it had the ability to foster economic growth for Western Australia through the exportation of camel meat to Asia and the Middle East. While distances are considerable in Western Australia (e.g., Kalgoorlie to Fremantle: 617kms; Kalgoorlie to Esperance: 393kms), WA has ports that are currently accessed by pastoralists and can be the avenue for export to Asian and the Middle Eastern countries. Further the unique geographical position of the State of Western Australia could be advantageous to facilitate the exportation of camel meat for a low cost, thus maximising profit for Western Australian camel agriculturalists (McCloy and Rowe, 2000).

Virtue, Gee, Secomb, O’Leary and Gear (2016) argue that the control of feral camels should be facilitated by commercial means, as this allows for a financial gain to be made as an outcome of camel culling. The transportation of camels to abattoirs, accounted for 16.5% of the total camel

removal conducted by the Australian Feral Camel Management Project; thus, arguing that this should be replicated to produce a profit (Virtue, Gee, Secomb, O'Leary and Grear, 2016, p.143). While camel farming is a known form of camel management, limited articles argued for the commercialisation of camels as an alternative method for controlling feral camels. However, Kaethner, See and Pennington (2016) argue that the commercial use of camels could be potentially lucrative, particularly for Indigenous Australian communities that have a large feral camel population on their land. This supports the notion that the commercialisation of camels could be advantageous for rural communities that have an accessible feral camel population they could utilise. Edwards, Zeng, Saalfeld, Vaarzon-Morel and Duffy (2008) recognise the commercialisation of camels as a solution to reduce the impact of the feral camel population. They argued however that overcoming the practical barriers preventing camel commercialisation would be difficult and expensive.

## *(2) Barriers to Camel Farming<sup>2</sup>*

Both Virtue et al. (2016) and Edwards et al. (2008) agree that a range of practical barriers prevent camel commercialisation from currently functioning profitably. However, both articles disagree on the severity of the practical barriers that are necessary to be surmounted. Virtue et al. (2016) and Clarke (2014) claim that the varying distribution of the feral camel population does not guarantee a reliable supply for the purpose of farming. During times of high rainfall, camels are likely to remove themselves from pastoralised land and shift to desert regions, making them inaccessible for commercialisation (Eldridge, Edwards, Wurst, Berman and Gabin, 2001). Clarke (2014) contends that the inconsistent supply of feral camels would result in a loss of reliable business interaction with suppliers. As a result, it would be unrealistic for camel farming to be sustainable, as abattoirs require a continuity of camel supply, which cannot be assured (Virtue et al., 2016).

Both articles by Virtue et al. (2016) and Edwards et al. (2008) also argue that the infrastructure needed for camel commercialisation is currently unavailable. Camel commercialisation would utilise similar infrastructure as used in cattle farming, (e.g. fencing, holding paddocks, yards, loading ramps, etc.) however, it would need to be modified to account for the increased height of a camel (Sharp, 2012). Virtue et al. (2016) and Edwards et al. (2008) also mention the lack of suitable abattoirs needed to prepare camel meat for consumption, as most Australian abattoirs would need to be altered in order to process camel meat. This is a major barrier, which will be briefly noted in the discussion section of this report.

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<sup>2</sup> Barriers: See also (6) '[Barriers to Camel Culling](#)' (p. 14).

A significant barrier to camel commercialisation are the beliefs of harmful diseases in camel meat. Australia is fortunate to have extinguished the majority of diseases effecting the feral camel population (Commonwealth of Australia, 2010). As a result, this makes the Australian camel popular on the international market. Despite this, a concern for camel commercialisation is the existence of the '1080' poison within the *Gastrolobium* plants which are found throughout Western Australia. The primary concern is the risk of the '1080' poison being consumed by a camel, which is then slaughtered, and sold to be consumed by humans or domestic animals. This could potentially result in a *secondary* 'kill' in whomever ingested the contaminated meat. Manefield and Tinson (1997) claim that camels have the unique ability to avoid poisonous plants. However, while poisoning is rare in camels, it may occur in times of food shortage and drought (Manefield and Tinson, 1997). There are a range of precautionary procedures that can be implemented to prevent a secondary kill occurring, which will be explored further in the discussion.

The barriers to the future commercialisation of camels are diverse and should be thoroughly considered by any future stakeholders. This critically needs to be undertaken to ensure that any decision to establish a commercialised camel industry is done judiciously, with particular respect to the land and people who are most impacted by the feral camel population.

### *(3) Socio-Economic Benefits*

Literature to date indicates that there are socioeconomic benefits that could be gained through camel commercialisation (McCloy and Rowe, 2000; Virtue et al. 2016; Edwards et al. 2008). This is primarily achieved through the establishment of employment opportunities in rural Australia, which would then provide training possibilities and income to potential workers (Clarke, 2014). An increased employment rate in regional, remote and rural Australia would generate economic growth, as more people in these locations would have the income needed to engage with their localised economies. This has been exemplified in other ways throughout the Kalgoorlie-Boulder Growth Plan (2017) which contains details surrounding current implementation of the diverse range of programs that aim to increase employment within the Goldfields Esperance region.

The potential of increased employment opportunities for rural and remote Australia was a key reason McCloy and Rowe (2000) advocated for camel commercialisation. McCloy and Rowe (2000) claim that due to the remote nature of camels, camel commercialisation would naturally occur in rural Australia, an area with limited employment opportunities. Therefore, any industry that would increase

employment in remote Australia has socioeconomic benefits, and worthy for investment. Virtue et al. (2016) and Edwards et al. (2008) also agree with the view that camel commercialisation has a significant potential to provide employment to rural and remote Australia, thus also stimulating economic growth to these regions. Clarke (2014) argues that the employment of Indigenous people in the commercialised camel industry is an important '*spillover*' benefit that should be locally investigated for remote Australia. Edwards et al. (2008) argued that the economic benefits of commercialising camels could be particularly advantageous for local Indigenous communities, if they were involved in the development of a commercialised camel industry.

Aboriginal people are currently underrepresented among the employed population of Western Australia, including the Goldfields region. According to the 2016 ABS Census, the unemployment rate of Aboriginal people in the Goldfields is 28.3%, which is higher than the unemployment rate of Aboriginal people across Western Australia (22.2%). Edwards et al. (2008) argue that there is potential for Aboriginal involvement in camel commercialisation, which could reduce the unemployment rate in the Goldfields region. Indigenous Australians have a respect for their native title land and aspire to look after it by means of working to protect it. From this enterprise other opportunities are expected to develop, such as employment in areas of marketing, transport, growing camel feed, veterinary work, abattoir work, etcetera. Kaether, See and Pennington (2016) recognised the asset camel commercialisation could bring to Aboriginal communities due to the expansion of training possibilities brought to rural communities, especially regional, remote and rural Aboriginal communities. In Western Australia, 63% of Indigenous Australian people stated that inadequate training was a key barrier for them gaining sustainable employment, while 52% agreed that job specific training would be essential for retaining a permanent job (ABS, 2011).

Educating workers would provide rural communities with a skilled workforce, which can be utilised to fulfil the diverse needs of a rural community. Kaether, See and Pennington (2016) article claimed that Indigenous communities want to interact with education services, particularly training involving environmental and agricultural practices. However, consent must be gained from the Indigenous community before any training commences (Kaether, See and Pennington, 2016).

#### ***(4) Rural and Remote Australian Communities***

As the feral camel population occupies remote regions of Australia, it is assumed that any activity to commercialise camels would occur in these regions. Due to the high expenses associated with transporting camels, it is practical to ensure that camel farms are located in areas where camel density

is high, as this would reduce the cost of relocating stock, thus maximising profit (McCloy and Rowe, 2000).

McCloy and Rowe (2000) and Clarke (2014) claim remote Australia, such as the Goldfields region, would receive the socioeconomic benefits as a result of camel farming. As argued by McCloy and Rowe (2000) and Virtu et al. (2016), the employment of local people would ensure that the income of workers is more likely to be consumed by the local economy, thus generating economic growth for the Goldfield region. This would stimulate an overall growth for the rural and remote communities in the Goldfields region, as more industries can be supported by a sustainable workforce (McCloy and Rowe, 2000).

### *(5) Indigenous Australian Communities*

Literature to date displays an agreement that a key beneficiary from camel commercialisation are rural and remote Indigenous Australian communities. As feral camels are resilient animals found in remote and arid regions of Australia, any commercialisation of camels is likely to occur in remote Australia. A quarter of Western Australia Indigenous Australian population live remotely (Australian Bureau of Statistics, 2016). Therefore, it would seem logical that any increase of employment opportunities in remote Australia would more than likely benefit Indigenous Australians.

Kaethner, See and Pennington (2016) state that there are a range of assumptions that are held by some Indigenous Australian communities in regard to feral camels. Firstly, some Indigenous Australian communities hold the belief that it is wasteful to slaughter an animal without a purpose, thus culling camels is considered an unappealing option for some traditional owners. Secondly, some Indigenous Australians consider the camel to be a sacred animal, partially due to the role of camels in the nativity story, and partially because of the history of camels being cohabiters in the arid regions of Australia for more than 200 years. Thirdly, many older Indigenous Australians have memories of camels being used to deliver goods too remote and arid regions of Australia. Therefore, some Indigenous Australians consider it disrespectful to cull an animal that has worked hard to provide for remote communities. Lastly, some Indigenous Australian communities claim that any potential of attaining financial benefits from feral camels found on Aboriginal owned land was a key reason for why it is difficult for them to support indiscriminate culling of feral camels. This was due to the belief held by some Indigenous Australian communities that it is wasteful to cull any camel that could alternatively be used to farm, and from which their community could benefit (Kaethner, See and Pennington, 2016).

Approximately half of the feral camel population in Australia can be found on Aboriginal land (Clark, 2014). Clark (2014) has also noted that, in relation to feral camel ownership, “feral camels can become the property of someone when taken, used or domesticated by the person claiming title to the animal”. He goes on to state that “the taking of possession of the camel can occur by capturing it or confining it and thus acquiring rights to the use of the animal” (Clark, 2014). These factors infer that there is both opportunity and tension regarding camel ownership. Edwards, Zeng, Saalfeld and Vaarzon-Morel (2010) affirm that Indigenous Australian communities could significantly benefit from the income and employment that could result from a commercialised camel industry. McGregor, Hart, Bubb and Davies (2013) and Clarke (2014) also acknowledge that a commercialised camel industry could be profitable to Indigenous Australian communities, as a camel farm could provide employment and training opportunities to remote and isolated areas of Australia.

#### *(6) Camel Culling*

Camel culling generally refers to the slaughtering of the Australian feral camel population to reduce numbers to a manageable quantity. While there are a number of bioethical concerns noted regarding culling and other methods of camel control (Feldmuller et al, 2012), nevertheless culling has been the predominant method employed to control the growth of the feral camel population throughout Australia (McGregor et al. 2013). The management of camels has primarily been endorsed through The National Feral Camel Action Plan (NFCAP, 2010), which aims to lessen the negative impacts camels have on culturally, ecologically and pastorally significant land.

McGregor, Hart, Bubb and Davies (2013) argued for the continued cull of feral camels, claiming camels pose a significant threat to land that has a high ecological and biodiversity value. The report by McGregor et al. (2013) supports the NFCAP arguing that the camel culling methods highlighted within the NFCAP are vital to reducing the negative effects of camels on pastoral land. McGregor et al. (2013) argue that the success of camel culling is reliant on the collaboration of stakeholders (e.g., Indigenous Australian communities, pastoralists, state governments and the Commonwealth Government, etc.). This collaboration would allow for adequate funding to be provided to ensure camel culling is conducted effectively. The annual funding provided by the Australian government was four million dollars (2013), which was considered an appropriate amount to achieve the aims of the NFCAP (McGregor et al., 2013, p 11). McGregor et al. (2013) do acknowledge the potential of the development of the camel commercialisation industry. However, McGregor et al. (2013) argue that camel commercialisation should *not* be solely reliant on feral camels for produce. The authors claim that depending on the feral camel population, commercialisation may prevent a sustainable business plan from occurring, as it could be difficult to guarantee a continuous supply to abattoirs

and customers – although given the current numbers of camels this is unlikely. Also, if a commercialised camel farm uses the feral camel population as their source for livestock, this may intervene in the reduction objectives outlined in the NFCAP – although camel commercialisation does not necessarily exclude ongoing culling to control numbers.

Edwards, Zeng, Saalfeld, Vaarzon-Morel and Duffy (2008) argue that the economic expenditure associated with establishing camel commercialisation would be more expensive than the cost of camel culling. However, the perspective of Edwards et al. (2008) is limited, as they do not acknowledge the assets camel commercialisation could contribute to the social and cultural health of rural and remote communities, including Indigenous Australian communities. The authors claimed that they could not quantify the social and cultural benefits camel commercialisation could have on a community, despite a probable increase of employment due to camel commercialisation having a measurable impact of economic growth on rural and remote regions.

### *Barriers to Camel Culling*

As argued by McGregor, Hart, Bubb, and Davies (2013), productive collaboration between stakeholders must be achieved for effective culling to occur. Cooperation with various pastoralists and Indigenous Australian communities however can be difficult to obtain, as they do not want camel culling to occur on their land (Clarke, 2014). As a result, a large quantity of land is inaccessible to culling due to the nomadic nature of camels. Another consideration is that the employees and organisations conducting the cull may not have legitimate access to land that the animals are residing on, which can greatly reduce the productivity of a camel cull (Clarke, 2014).

The environmental impact of camel culling and camel commercialisation is predominantly measured by the carbon emissions of each activity (Zeng, 2015). Zeng (2015) contends that while culling will minimise the long-term methane emissions of camels, a significant amount of methane is admitted from rotting camel carcasses, thus increasing the methane emissions of a camel in the short term. Nevertheless, Zeng (2015) argues that the culling of camels will reduce the general carbon emissions of Australia. However, the yearly carbon emission of individual cattle is 2.39 tonnes of CO<sub>2</sub>, compared to camels, which admit 0.97 tonnes of CO<sub>2</sub>, per camel, annually (Zeng, 2015, p. 271). Therefore, while camels do contribute to the greenhouse gas output of Australia, compared to the carbon emissions of other domesticated animals, camels do not make a significant contribution to the greenhouse effect of Australia (Dittmann et al. 2014).

## *(7) Camel By-Products*

### *(i) Meat*

Camel meat stands to be the most lucrative market product of camel farming. As McCloy and Rowe (2000, pg.10) suggested, “a clear markets focus is needed for the [Australian] industry to succeed”. Established markets in China, the Middle East and Africa provide demand for camel meat as an economically beneficial product.

A mature animal can weigh anywhere between 400 to 800kg, with carcass dissections showing a composition of 55% muscle, suggesting that a mature camel could produce between 220 and 440kg of meat, with yield being influenced by living conditions (Manefield and Tinson, 1997). Protein content is high, at 20%, with fat content being just 1% (Manefield and Tinson, 1997), compared to kangaroo meat which boasts 22% protein content to 1% fat content (SGM, 2019). Camel meat gains further boon by being rich in calcium, phosphorus, iron and the vitamins A and B (Wu, Chan, & Deng, 2011, pg. v). Camel meat tastes very similar to beef, when the camel is 5 years of age or younger, and it has been suggested that the degradation of taste due to age is less noticeable in camel meat when compared to beef (Manefield and Tinson, 1997).

### *(ii) Milk*

Milk is the second main produce of the camel. Camel milk has many documented health benefits. These benefits include; alleviations of allergies, reduction in insulin dependency, assistance with gut allergies associated with autism, Crohn’s disease, attention deficit disorder and attention deficit and hyperactive disorder (RIRDC, 2016, p.4). When compared to cow’s milk, camel milk is richer in vitamins C and B, iron, calcium, magnesium and potassium (RIRDC, 2016, p.4). In 2016 the Rural Industries Research and Development Corporation (RIRDC) estimated that Australian milk production was 50,000 litres per annum. Wholesale price in 2016 ranged between 16 to 21 dollars per litre. The RIRDC stated that “if an average farm gate price of \$16/litre is assumed, industry gross value can be estimated at \$800,000” (RIRDC, 2016, p.3).

It is important to consider, however, that due to the relatively low reproductive rate of camels, as well as other impact factors including cessation of lactation due to premature calf death, lifetime milk production per camel could be low (Manefield and Tinson, 1997, p.158). Nevertheless, combined with the animal’s suitability to the Australian environment, as well as their various other useful by-products, this barrier could be overcome.

In the RIRDC's 2016 report, current markets in Singapore and New Zealand are being supplied from Australian camel dairies. It was also suggested that there are viable markets in the US, India, Europe, the United Kingdom, and the Middle East (RIRDC, 2016, p.4). According to Wu, Chan and Deng (2011, p. viii), in China camel milk will sell for AU\$2.30 to AU4.60, which is above market value for regular cow's milk. The Chinese market presents a viable option for Australian camel export due to the interest in camel by-products (e.g., meat, milk), given their the significant population, and the trade relationship between Australia and China – which has been quite reliable despite intermittent pandemics.

### *(iii) Various By-products*

As with many other livestock animals, by-products beyond meat and milk are often used. This remains the case with camels. Camels do not have hooves, but feet that are dual-toed. Camel feet remain a sought-after part of the animal, with Wu, Chan and Deng finding that, in China, camel feet fetch a price of 25 Yuan each (AU\$3.83) (2011, p.12). Another feasible by-product of the camel is its hump. The hump does not, contrary to popular belief, contain water for usage but instead fat. As fat absorbs and retains water, it is effectively the equivalent result, in that the camel can utilise the stored moisture for hydration in times of need. Further, it has been noted that the “camel hump is known to be one of the ‘Eight Treasures’ that is served in traditional Chinese banquets, which are only available in high-class expensive restaurants” (Wu, Chan, & Deng, 2011, p.12). The authors could not further corroborate this claim; however, this increases the viability of the camel as an animal for export.

## **DISCUSSION**

This scoping review found that several ideas exist regarding the management of camels in Australia. Literature has clearly stated the positives of the commercialisation of camels, and its ability to be a profitable option for Australia. However, a review of available literature has highlighted a diverse range of areas that should be carefully considered regarding camel commercialisation. These considerations should be contemplated by stakeholders to ensure the future of camel farming is founded on educated and reasonable grounds.

### *(i) Key Considerations for Mustering*

As previously mentioned, the low reproductive rate of camels can prevent the profitable management of camels. Manefield and Tinson (1997, p. 128) suggest that a realistic expectation of reproduction for a healthy female is just eight calves (n = 8) in its lifetime. This is influenced by a gestation period of 12-14 months, which is in-turn influenced by nutritional availabilities, as well as factors which

include seasonal restrictions, embryonic death, abortions and various reproductive tract infections (Manefield & Tinson, 1997, p. 128)

Another difficulty faced by the production enthusiasts is stocking rates. According to Meat and Livestock Australia, “stocking rate refers to the number of livestock on a paddock or a whole farm and is expressed as an indication of number of a particular type of animal per unit area” (MLA, 2019). Stocking rate between cattle and camel are similar, with cattle rates in Western Australia ranging between 1-3 Adult Equivalent cattle per square kilometre (100 hectares) (suggested by AGRIC, 2019). This is a generous rate, as farming ranges in Western Australia are typically far greater in size than those in other Australian states, allowing for more space per animal (Western Australian Department of Biodiversity, Conservation and Attractions, 2014). Manefield and Tinson (1997, p. 129) found that, via plant ecology studies conducted in Central Australia, a camel stocking rate of 1 camel to 300 hectares (3 square km) showed no ecological changes. They also found that a stocking rate of 1 camel to 100 hectares (1 square km) resulted in noticeable ecological diminishment.

#### *(ii) Key Considerations for Water*

A consideration for a potential enabler of camel farming comes from water consumption. Camel physiology is one suited to the arid, harsh central Australian environment. After being introduced to Australia in the 19<sup>th</sup> century as a means of labour, the wild camel population of Australia has thrived. Manefield and Tinson (1997, p. 295) wrote that “the ability of the camel to store water within its body, against future need, is a myth. However, the ability of the camel to conserve water and use it very efficiently is outstanding”. For comparison, the NSW Department of Primary Industries (2014) details that Cattle grazing on salt-bush require 70 to 140 litres of water per head per day, versus the camel which requires just 30 to 40 litres (with variables considered) per head per day (Manefield and Tinson, 1997, p. 297). Camels have the ability to retain water very efficiently, whereas “cattle lose 20 to 40 litres of fluid daily through faeces, whereas camels lose only 1.3 litres” (Breulmann et al. 2007).

#### *(iii) Key Considerations for Feed*

Like any large herbivorous animal, camels need significant quantities of feed. Currently, feral camels have survived from the native plants located throughout the arid regions of Australia (McCloy & Rowe, 2000). Therefore, it can be assumed that commercialised camels could utilise the same food source. This reduces the expenses of camel commercialisation, and is a key benefit to camel farming, especially when compared to farming cattle. Camels can survive on a broad herbivorous diet, when

compared to sheep and cattle which require significant quantities of grass and grain. This seems to be a suitable advantage of the camel in the arid Australian landscape. Camels may also utilise their 3-metre vertical reach to obtain food which other species struggle to achieve (Manefield and Tinson, 1997, p. 129).

Despite this, the existence of the '1080' poison within the *Gastrolobium* plants found throughout Western Australia are a particular concern for any potential harvester of camels. It has been suggested that the presence of '1080' poison in camels ceases after twenty-four hours, which therefore, suggests this point would be eliminated given a sufficient quarantine period to counteract this problem.

*(iv) Key Considerations for Environmental Impact*

It has been suggested that camels contribute less to the erosion of land, when compared to domesticated animals such as cattle (McGregor et al. 2013). The environmental impact of camels is lessened due to their nature to eat plants of low ecological value. As well, camels will not eat the roots of a plant, thus the plant can regrow, and the maintenance of the roots can prevent erosion. Camels have feet which cause very little degradation to the land on which they tread, this contrasts to cattle, which damage the ground with their hooves as they walk. Whereas cattle tend to walk in single-file trains, causing deep grooves in the ground, which following rainfall, water flows throughout and results in erosion.

*(v) Key Considerations for Processing*

The transporting process for camels is expensive, as the number of camels that can be transported at one time is less in comparison to cattle. This is because a truck can only hold one layer (single deck trailer) of camels, compared to the transportation of cattle, in which trucks can hold two layers (double deck trailer). This increases the costs associated with transportation, as distribution of financial off-take decreases with the number of camels transported to an abattoir. Clarke (2014) has detailed the prohibitive factors of transporting camels over land. Larger camels must be transported in a seated position on a single deck (trailer unit), while smaller camels may be transported in two tier crates (Clarke, 2014). He continues by writing that "camels may need to be transported in excess of 1,000km. An allowance of between \$350/head and \$500/head is made for land transport" (Clarke, 2014). This supports the assertion that the cost of land transport is a significant barrier to the live camel export industry.

Camel-ready abattoirs are a necessity for the processing, however, as camels are a larger animal and with different proportions than cattle, larger abattoirs are required. Multiple barriers exist

to deter organisations from investing in abattoir construction and conversion. The significant distances involved in transporting equipment to, and livestock from, isolated processing facilities infer significant costs, both financial and timely. In addition, “aside from needing a continuous chain of supply, the issues facing new and existing abattoirs include maintaining a stable, trained and reliable workforce, [and] utility costs including water and power” (Andrews et al. 2015). Consideration needs to be made for the suitability of an abattoir to process by-products fit for human consumption. current abattoir standards allow for camels to be processed for the purpose of pet food. It has been suggested that “pet food supply is attractive due to low capital costs for establishment infrastructure” (Clarke, 2014).

Supply chain is a significant consideration, as it dictates the potential success or failure of commercialisation. The process of mustering camels has one primary method which is ‘active’ mustering. This involved the use of vehicles and manpower to effectively ‘herd’ camels over a large area into self-contained yards (Andrews et al. 2015). This method has been historically effective in mustering cattle; however, considerations should be made regarding the variables of mustering camel in rural, regional and remote (outback) Western Australia. The alternative method is self-mustering yards. These yards employ a water trough, fed into by an underground water-bore, and/or feed to entice animals to enter the yard through a one-way gate, capturing the animals. Both methods then utilise a ‘run’ to process the animals.

*(vi) Key Considerations for a Potential Employment Opportunity*

The establishment of abattoirs could provide employment opportunities for the Goldfields Esperance region. As well, the development of abattoirs that can cater to the requirements of camel slaughter which would provide the Goldfields Esperance region with a larger control over the camel market. Several key stakeholders expressed the view that pre-existing underutilised processing facilities might be converted for the purpose of camel processing. Roads and infrastructure would need to be constructed and developed to support the emerging industry, offering more employment opportunities as well as long-term area development benefits.

In our visit to the Goldfields Esperance region, it was apparent that the wider community considers the high unemployment rate of Indigenous Australians to be a significant issue. While this problem remains complex, and a solution cannot be sourced instantaneously, the commercialised camel industry is an option that could provide the Goldfields Esperance region with a long-term strategy to combat Indigenous unemployment. Multiple members of the Indigenous Australian community stated an interest to be involved in the commercialisation of camels, therefore it can be

assumed that Indigenous Australians could gain employment through the commercialised camel industry in the Goldfields Esperance region. The engagement of the Indigenous Australian community in the workforce would likely reduce the Indigenous unemployment rate, which would result in a range of socio-economic benefits flowing out to the Goldfields Esperance region.

### Summary

Currently, there is a limited range of literature available regarding camel management in Australia, and even less discussing the possibility of camel commercialisation. While the literature sourced within this report has been of good quality, some of the literature found in the database searches was excluded because it has now been superseded, such as older resources relating to the topic of disease which have been deliberately discarded due to irrelevance, given the fact that disease in camels is no longer a primary concern associated with camel commercialisation. It also should be noted that the report by McGregor, Hart, Bubb, and Davies (2013), cited in this current review, was published by Ninti One Limited (McGregor et al. 2013), whom conducted the majority of key camel culls in Australia and therefore may present a level of bias/conflict of interest. However, McGregor et al's report is a key resource that provides a succinct overview of the reasoning for camel culling, and thus needs to be considered of value within this report.

**Table 4**

*Benefits and barriers to the implementation of camel farming*

Benefits	Barriers
<ul style="list-style-type: none"> <li>• Commercialised industry would be utilising a yet-unused resource, one that could help reduce the feral camel population</li> <li>• Improvements to infrastructure including roads and services</li> <li>• Camels present several viable uses including meat and milk production</li> <li>• Potential employment opportunities for local communities, particularly the Indigenous Australian community</li> </ul>	<ul style="list-style-type: none"> <li>• Prohibitive initial investment cost to develop and repurpose abattoirs and other relevant infrastructure</li> <li>• Supply Chain: Large distances, transport costs need to be justified by reliable supply</li> <li>• Camel farming as an industry would not be enough to wholly manage the camel population</li> <li>• Indigenous Australian Native Title claims and Indigenous Land Use Agreements (ILUAs) need to be considered; not addressed in this report.</li> </ul>

Overall, there needs to be substantial investment in the camel farming industry, as this has the potential to be a viable alternative to the current issues surrounding climate changes and its association with beef production. Refer to the above Table 4 for comparisons of the benefits and barriers associated with a commercialised camel industry. Australia could be at the forefront of

altering the landscape of pressure on the environment if this was managed and effectively marketed as a way of the future.

## **KEY RECOMMENDATIONS**

- Further research is needed to gain a better understanding of the exact costs of camel commercialisation. Ongoing research is also needed to accumulate a detailed comprehension of the international and domestic markets for which the commercialised camel industry could cater.
- An abattoir that can accommodate camels needs to be developed in the Goldfields Esperance region. This would involve establishing a multi-purpose abattoir for human consumption or modifying existing abattoirs to enable the slaughter of camels.
- A commercialised camel industry in the Goldfields Esperance region could provide an avenue to assist in meeting the needs of Indigenous Australian workers. For this to effectively occur, consultation with Indigenous Australian communities needs to be prioritised, and requires liaison with appropriate representative bodies in the region.

## **CONCLUSIONS**

This report should be considered an exploratory scoping appraisal of the key benefits, opportunities and barriers for developing, within the Goldfields Esperance Region (WA), the commercialisation of camels—which have proven to be resilient animals far more suitable and adaptable to remote and harsh areas than most other domestic animals which often require considerable supplementary support in order to survive. Even though a previous report regarding camel live export concluded that, there would be “modest returns”, “considerable risks involved with establishing a trade” and that “live camel exporting is at best a low priority niche opportunity” (Clarke, 2014, p. 27), this current report argues a different perspective.

The literature has shown that a range of domestic and international trade markets, for camel meat and its by-products, are feasible avenues. The commercialisation of camels has the potential to provide sustainable employment opportunities across the Goldfields Esperance region. Local Indigenous Australian communities (particularly within the Goldfields Esperance region of Western Australia) should benefit from the opportunity of employment in camel commercialisation, as occupation in this enterprise is likely to provide a positive employment experience and environment for Indigenous Australians, more so than some other potential employment options within the region.

The literature indicates that camel commercialisation is possible in Australia *if* the practical barriers can be effectively addressed that would subsequently potentiate a viable industry if given appropriate support. Along with other strategies, the development of such an industry would also assist in monitoring and controlling the prolific numbers of feral camels. It was beyond the scope of this paper to perform an economic analysis, however if camel commercialisation is given appropriate support, over time it should be expected that this would help develop the industry beyond modest returns. Further financial support will be required to investigate in detail how the barriers identified in this report could be addressed to ensure the potential of camel commercialisation being successfully realised for the Goldfields Esperance region of Western Australia.

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## REFERENCES

- AgEcon Plus Consulting. (2014). *Camel Live Export Supply Chain and Benefit Cost Analysis*. North Sydney: Meat and Livestock Australia. Retrieved from <http://www.livecorp.com.au/LC/files/66/66995792-0951-4055-8560-00ea3e3dabe2.pdf>
- Arksey, H., & O'Malley, L. (2005). Scoping studies: towards a methodological framework. *International Journal of Social Research Methodology*, 8(1), 19-32. doi: 10.1080/1364557032000119616
- ABS (2020) Labour Force, Australia. Canberra: Australian Bureau of Statistics. Feb 2020 Folio 6202.0: <https://www.abs.gov.au/ausstats/abs@.nsf/mf/6202.0>
- ABS. (2019). Labour Force Characteristics of Aboriginal and Torres Strait Islander Australians, Estimates from the Labour Force Survey, 2011, Canberra: Australian Bureau of Statistics Folio 6287.0. Retrieved 21 November 2019 <https://www.abs.gov.au/ausstats/abs@.nsf/Products/6287.0~2011~Chapter~Participation>
- ABS. (2019). Census of Population and Housing - Counts of Aboriginal and Torres Strait Islander Australians, 2016, Canberra: Australian Bureau of Statistics Folio 2075.0. Retrieved 18 October 2019 <https://www.abs.gov.au/AUSSTATS/abs@.nsf/Lookup/2075.0Main+Features202016?Open>
- Bobbitt, J., Hodgeman, R., Roache, T., (2006). *Potential Markets for New and Emerging Meats*. Rural Industries Research and Development Corporation. Retrieved September 16<sup>th</sup> 2019 <https://www.agrifutures.com.au/wp-content/uploads/publications/06-008.pdf>
- Brann, M. (2014, 20 May). Carbon credits from culling feral animals hits the dust. Darwin: Country Hour. ABC Rural Radio: <https://www.abc.net.au/news/rural/2014-05-20/feral-animal-carbon-credits-hit-the-dust/5462872>
- Breulmann, M., Böer, B., Wernery, U., Wernery, R., El Shaer, H., Alhadrami, G. A., Norton, J. (2007). The Camel: From Tradition to Modern Times – A Proposal Towards Combating Desertification. Doha: United Nations Educational, Scientific and Cultural Organisation. Retrieved on September 28<sup>th</sup> 2019 [https://www.academia.edu/20562947/The\\_Camel\\_From\\_Tradition\\_To\\_Modern\\_Times\\_A\\_Proposal\\_Towards\\_Combating\\_Desertification\\_via\\_the\\_Establishment\\_of\\_Camel\\_Farms\\_Based\\_on\\_Fodder\\_Production\\_From\\_Indigenous\\_Plants\\_and\\_Halophytes](https://www.academia.edu/20562947/The_Camel_From_Tradition_To_Modern_Times_A_Proposal_Towards_Combating_Desertification_via_the_Establishment_of_Camel_Farms_Based_on_Fodder_Production_From_Indigenous_Plants_and_Halophytes)
- Clarke, M. (2014). *Camel Live Export Supply Chain and Benefit Cost Analysis*. North Sydney: Meat and Livestock Australia. Retrieved from <http://www.livecorp.com.au/LC/files/66/66995792-0951-4055-8560-00ea3e3dabe2.pdf>
- DBCA (2014). *Camels in Western Australia*. Perth: Western Australian Government, Department of Biodiversity, Conservation and Attractions. <https://www.dpaw.wa.gov.au/management/pests-diseases/202-camels-in-western-australia?showall=1>
- Department of Primary Industries. (2014). *Water requirements for sheep and cattle*. Sydney: New South Wales Government Retrieved September 28<sup>th</sup> 2019 [https://www.dpi.nsw.gov.au/\\_data/assets/pdf\\_file/0009/96273/Water-requirements-for-sheep-and-cattle.pdf](https://www.dpi.nsw.gov.au/_data/assets/pdf_file/0009/96273/Water-requirements-for-sheep-and-cattle.pdf)
- Dittmann, M., Richard, A., Lang, Moser, D., Kreuzer, M., Clauss. M., (2014). Methane Emission by Camelids. *PLoS ONE*, 9(4). Wollongong: The University of Wollongong. Dio: 10.1371/0094363.
- DOIC (2012). Reasons for Refusal to Endorse Methodology Proposal—Management of large feral herbivores (camels) in the Australian rangelands, DOIC, Canberra, viewed 28 November

2014, <http://www.environment.gov.au/system/files/pages/28f29237-22e3-4a92-bcb8-8c28989abeea/files/001fa2011-doi-c-statement-reasons.pdf> (no longer available).

- Edwards, G.P., Zeng, B., Saalfeld, W.K., Vaarzon-Morel, P., Duffy, M., (2008). Managing the impacts of feral camels in Australia: a new way of doing business. Desert Knowledge CRC, In *Managing the impacts of feral camels in Australia: a new way of doing business* (pp. 331-360). Alice Springs: NintiOne. Retrieved September 28<sup>th</sup> 2019 [http://www.desertknowledgecrc.com.au/resource/DKCRC-Report-47-Managing-the-impacts-of-feral-camels-in-Australia\\_A-new-way-of-doing-business.pdf](http://www.desertknowledgecrc.com.au/resource/DKCRC-Report-47-Managing-the-impacts-of-feral-camels-in-Australia_A-new-way-of-doing-business.pdf)
- Edwards, G.P., Zeng, B., Saalfeld, W.K., Vaarzon-Morel., (2010). Evaluation of the impacts of feral camels. *The Rangeland Journal*, 32(3), 43-54. doi:10.1071/RJ09037
- Edwards, G.P., Eldridge, S.R., Wurst, D., Gabin, V., (2001). Movement patterns of female feral camels in central and northern Australia. *CSIRO Wildlife Research*, 28(3), 283-289. doi: 10.1071/WR000531035-3712/01/030283
- Feldmuller, M., Gee, P., Pitt, J., & Feurherdt, 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 camel. (Edn.1). Prepared for the South Australian State Feral Camel Management Project. Adelaide: Rural Solutions South Australia. <https://www.yumpu.com/en/document/read/43309254/final-may-22-bes-practice-camel-book-web-part1-rural-solutions->
- Government of Western Australia. (2007). Biosecurity and Agriculture Management Act 2007, Perth: Department of Justice. Retrieved 12<sup>th</sup> of October [https://www.legislation.wa.gov.au/legislation/prod/filestore.nsf/FileURL/mrdoc\\_41976.pdf/\\$FILE/Biosecurity%20and%20Agriculture%20Management%20Act%202007%20-%20%5B02-c0-00%5D.pdf?OpenElement](https://www.legislation.wa.gov.au/legislation/prod/filestore.nsf/FileURL/mrdoc_41976.pdf/$FILE/Biosecurity%20and%20Agriculture%20Management%20Act%202007%20-%20%5B02-c0-00%5D.pdf?OpenElement)
- Hampton, J. O., & Hyndman, T. H. (2019). Underaddressed animal-welfare issues in conservation. *Conservation Biology*, 33(4), 803-811. doi: 10.1111/cobi.13267
- Harris, J. (2020). Australia slaughtering 10,000 camels to combat global warming. *Western Journal*. 11 January. <https://www.westernjournal.com/australia-slaughtering-10000-camels-combat-global-warming/>
- Kaether., B, See., P, Pennington., A (2016). Talking camels: a consultation strategy for consent to conduct feral camel management on Aboriginal-owned land in Australia. *The Rangeland Journal*, 38(2), 125-133. doi:10.1071/RJ15076
- Lundgren, E. J., Ramp, D., Ripple, W. J., & Wallach, A. D. (2017). Introduced megafauna are rewilding the Anthropocene. *A Journal of Space and Time in Ecology*, 41(6), 857- 866. doi: 10.1111/ecog.03430
- Manefield, G.W., Tinson, A.H., (1997). *Camels: A Compendium*. Sydney: The University of Sydney.
- McCarthy, P. H. (1980). The importation of the one-humped camel (*Camelus dromedarius*) into Australia during 1840-1841. *Australian Veterinary Journal*, 56(11), 547-551. Doi: [10.1111/j.1751-0813.1980.tb02586.x](https://doi.org/10.1111/j.1751-0813.1980.tb02586.x)
- McGregor, H., Bubb, and Davies. (2013). *Managing the impacts of feral camels across remote Australia*. Retrieved September 3<sup>rd</sup> 2019 [https://www.pestsmart.org.au/wp-content/uploads/2015/04/ManagingImpactsFeralCamels\\_FinalReportAFCMP.pdf](https://www.pestsmart.org.au/wp-content/uploads/2015/04/ManagingImpactsFeralCamels_FinalReportAFCMP.pdf)

- Meat and Livestock Australia. (2019). Stocking rate | Meat & Livestock Australia, North Sydney. Retrieved November 4th 2019 <https://www.mla.com.au/research-and-development/Grazing-pasture-management/improved-pasture/grazing-management/stocking-rate/>
- DSIEWPC (2010). National Feral Camel Action Plan: A national strategy for the management of feral camels in Australia. Canberra: The Australian Government, Department of Sustainability, Environment, Water, Population and Communities.
- Rowe, P. McCloy, L. (2000). *Assessing the Potential for a Commercial Camel Industry in Western Australia*. Canberra: Rural Industries Research and Development Corporation. Retrieved September 28<sup>th</sup>, 2019 <https://www.agrifutures.com.au/wp-content/uploads/publications/00-123.pdf>
- Rural Industries Research and Development Corporation. (2016). *Camel Milk Market Assessment 2016*. (17/009). Wagga Wagga: AgriFutures. Retrieved September 28<sup>th</sup> 2019 <https://www.agrifutures.com.au/wp-content/uploads/publications/17-009.pdf>
- Shackleton, R. T., Shackleton, C. M., & Kull, C. A. (2019). The role of invasive alien species in shaping local livelihoods and human well-being: A review. *Journal of Environmental Management*, 229(230), 145-157. doi:10.1016/2018.05.007
- Sharp, T. (2012). PestSmart., Standard Operating Procedure - CAM003: Mustering of Feral Camels [Press release] Canberra: Centre for Invasive Species. Retrieved September 28<sup>th</sup> 2019 [https://www.pestsmart.org.au/wp-content/uploads/2018/01/180110\\_SOP\\_CAM003\\_web.pdf](https://www.pestsmart.org.au/wp-content/uploads/2018/01/180110_SOP_CAM003_web.pdf)
- Vertebrate Pests Committee. (2010). *National Feral Camel Action Plan*. Canberra: The Natural Resource Management Ministerial Council. retrieved September 28<sup>th</sup> 2019 <https://www.environment.gov.au/system/files/resources/2060c7a8-088f-415d-94c8-5d0d657614e8/files/feral-camel-action-plan.pdf>
- Virtue, J.G., Gee, P.D, Secomb, N.M, O'Leary, P.R., and Gear.B.P. (2016). Facilitating feral camel removal in Australia through commercial use. *The Rangeland Journal*, 38(2), 143-151. doi:10.1071/RJ15066
- Wu, M. D., Chan, C.H., and Deng, C., (2011). *Australian Camel Meat: China market*. Canberra: Rural Industries Research and Development Corporation, Retrieved September 6<sup>th</sup> 2019 <https://www.agrifutures.com.au/related-projects/market-study-australian-camel-meat-china/>
- Zeng, B. (2015). Camel culling and carbon emissions in rangelands in central Australia. *Journal of Environmental Planning and Management*, 58(2), 270-282. doi:10.1080/09640568.2013.852077

**APPENDIX A**

Academic Preliminary Search Strategy

**Electronic Databases Searched:**  
MEDLINE, PubMed, La Trobe University Library, and Google Scholar

Databases limited to English

**The Socio-Economic Benefits of Commercialisation and CommercialisationAgriculturalisation of Camels search terms**

("Indigenous Australia\*" OR rural OR aboriginal\* OR remote OR Australia)

AND

(Camel OR Camels OR dromedar\*)

AND

(commerci\* OR farm\*)

AND

("socio-economic benefit\*" OR social OR economic\*)

615 unique results returned  
(duplicates removed)

Abstract Screening for Relevance  
n = 6

Hand Searching of Reference List  
n = 1

Total  
n = 7

**To what extent would culling or commercialisation impact the rural and Indigenous Australian populations?**

("Indigenous Australia\*" OR rural OR aboriginal\* OR remote OR Australia)

AND

(Camel OR Camels OR dromedar\*)

AND

(commerci\* OR farm\* OR cull\*)

AND

("socio-economic benefit\*" OR social OR economic\*)

3 unique results returned  
(duplicates removed)

Abstract Screening for Relevance  
n = 2

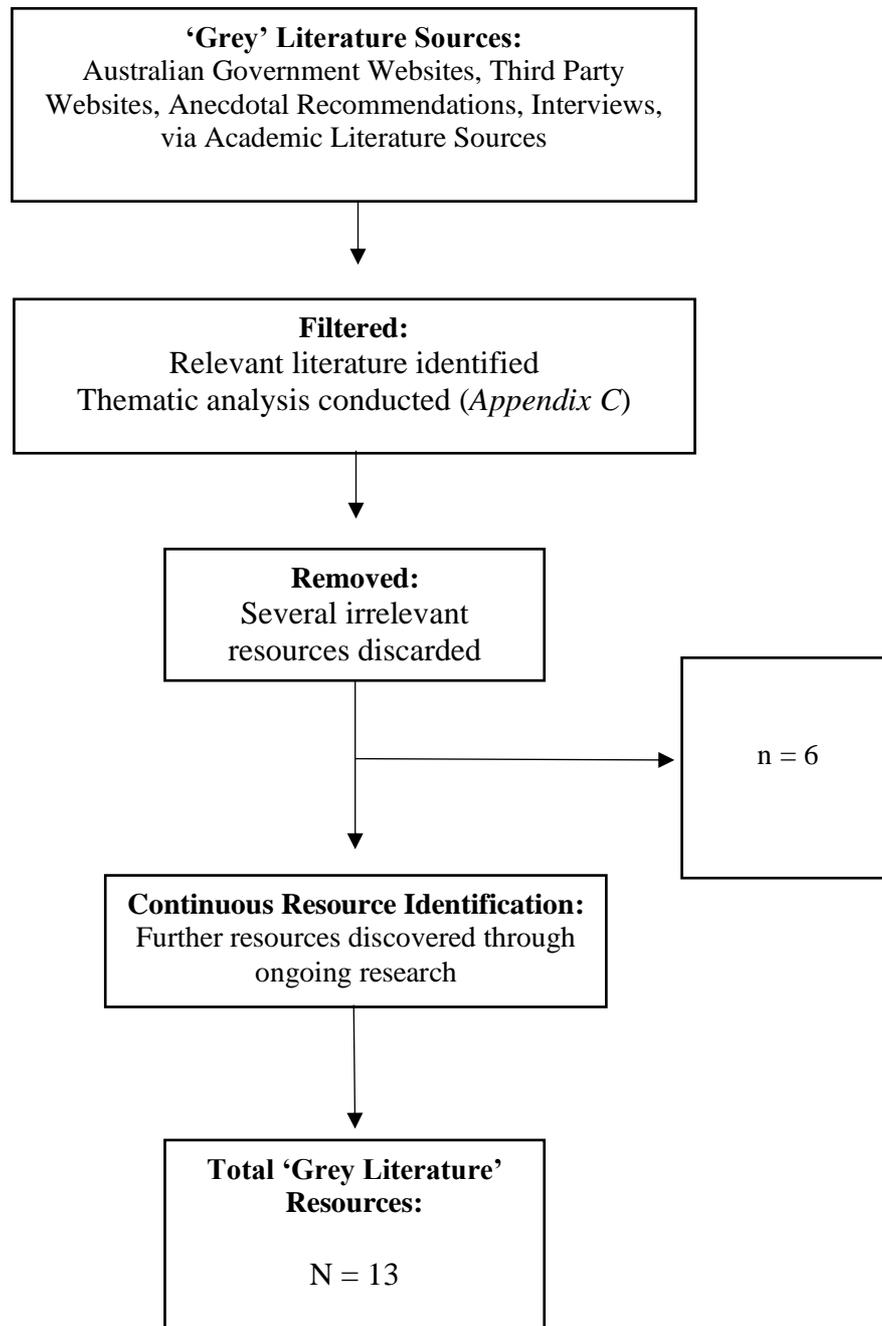
Hand Searching of Reference List  
n = 0

Total  
n = 2

Total  
N = 9

## APPENDIX B

### 'Grey' Literature Search Method



## APPENDIX C

### Thematic Analysis

[Literature: N = 22]

Source Citation	Theme 1: Camel Farming	Theme 2: Barriers	Theme 3: Socio- Economic Benefits	Theme 4: Rural and Remote Australian Communities	Theme 5: Indigenous Australians	Theme 6: Camel Culling	Theme 7: Camel By- products
Bobbitt, J., Haine, H., Hodgeman, R., Roache, T. (2006). <i>Potential Markets for New and Emerging Meats</i> . Rural Industries Research and Development Corporation Retrieved from <a href="https://www.agrifutures.com.au/wp-content/uploads/publications/06-008.pdf">https://www.agrifutures.com.au/wp-content/uploads/publications/06-008.pdf</a>	x	x	x	x	x		
Breulmann, M., Böer, B., Wernery, U., Wernery, R., El Shaer, H., Alhadrami, G. A., Norton, J. (2007). <i>The Camel: From Tradition to Modern Times – A Proposal Towards Combating Desertification</i> . Doha: United Nations Educational, Scientific and Cultural Organisation. Retrieved on September 28th 2019 <a href="https://www.academia.edu/20562947/The_Camel_From_Tradition_To_Modern_Times_A_Proposal_Towards_Combating_Desertification_via_the_Establishment_of_Camel_Farms_Based_on_Fodder_Production_From_Indigenous_Plants_and_Halophytes">https://www.academia.edu/20562947/The_Camel_From_Tradition_To_Modern_Times_A_Proposal_Towards_Combating_Desertification_via_the_Establishment_of_Camel_Farms_Based_on_Fodder_Production_From_Indigenous_Plants_and_Halophytes</a>	x	x	x				
Clarke, M. (2014). <i>Camel Live Export Supply Chain and Benefit Cost Analysis</i> . North Sydney: Meat and Livestock Australia. Retrieved from <a href="http://www.livecorp.com.au/LC/files/66/66995792-0951-4055-8560-00ea3e3dabe2.pdf">http://www.livecorp.com.au/LC/files/66/66995792-0951-4055-8560-00ea3e3dabe2.pdf</a>	x	x	x		x		
Dittmann, M., Lang, R., Moser, D., Kreuzer, C., & Clauss, M. (2014). <i>Methane Emission by Camelids</i> (9th ed.). Public Library of Science (PLoS).	x	x				x	x
Edwards, G., Zeng, B., Saalfeld, K., Vaarzon-Morel, P., & Duffy, M. (2001). <i>Managing the impacts of feral camels in Australia: a new way of doing business</i> (pp. 331-360). Alice Springs: NintiOne.	x	x	x	x	x	x	x
Edwards, G., Eldridge, S., Wurst, D., Berman, D., & Garbin, V. (2001). Movement patterns of female feral camels in central and northern Australia. <i>Wildlife Research</i> , 28(3), 283. doi: 10.1071/wr00053	x			x	x		
Edwards, G., Zeng, B., Saalfeld, W., & Vaarzon-Morel, P. (2010). Evaluation of the impacts of feral camels. <i>The Rangeland Journal</i> , 32(1), 43. doi: 10.1071/rj09037	x	x	x	x	x	x	x
Hampton, J. O., & Hyndman, T. H. (2019). Underaddressed animal-welfare issues in conservation. <i>Conservation Biology</i> , 33(4), 803-811. Retrieved from <a href="https://doi-">https://doi-</a>	x	x	x	x			

Source Citation	Theme 1: Camel Farming	Theme 2: Barriers	Theme 3: Socio- Economic Benefits	Theme 4: Rural and Remote Australian Communities	Theme 5: Indigenous Australians	Theme 6: Camel Culling	Theme 7: Camel By- products
<a href="http://org.ez.library.latrobe.edu.au/10.1111/cobi.13267">org.ez.library.latrobe.edu.au/10.1111/cobi.13267</a>							
Kaether, B., See, P., Pennington, A. (2016). Talking camels: a consultation strategy for consent to conduct feral camel management on Aboriginal-owned land in Australia. <i>The Rangeland Journal</i> , 38(2), 125-133. doi:10.1071/RJ15076	x	x	x	x	x	x	
Lundgren, E. J., Ramp, D., Ripple, W. J., & Wallach, A. D. (2017). Introduced megafauna are rewilding the Anthropocene. <i>A Journal of Space and Time in Ecology</i> , 41(6), 857-866.	x	x					x
Manefield, G.W., Tinson, A.H., (1997). <i>Camels: A Compendium</i> . Sydney: The University of Sydney.	x	x	x	x	x	x	x
McCarthy, P. H. (1980). The importation of the one-humped camel ( <i>Camelus dromedaries</i> ) into Australia during 1840-1841. <i>Australian Veterinary Journal</i> , 56(11), 547-551. Retrieved from <a href="https://doi.org/10.1111/j.1751-0813.1980.tb02586.x">https://doi.org/10.1111/j.1751-0813.1980.tb02586.x</a>		x	x	x			
McGregor, M., Hart, Q., Bubb, A., Davies, R. (2013). <i>Managing the impacts of feral camels across remote Australia</i> . Retrieved from <a href="https://www.pestsmart.org.au/managing-the-impacts-of-feral-camels-across-remote-australia/">https://www.pestsmart.org.au/managing-the-impacts-of-feral-camels-across-remote-australia/</a>	x	x	x	x	x	x	
Rowe, L. McCloy, P. (2000). <i>Assessing the Potential for a Commercial Camel Industry in Western Australia</i> . Retrieved from Perth:	x	x	x	x	x	x	x
Rural Industries Research and Development Corporation. (2016). <i>Camel Milk Market Assessment 2016</i> . (17/009). Wagga Wagga: AgriFutures	x	x	x	x			x
Shackleton, R. T., Shackleton, C. M., & Kull, C. A. (2019). The role of invasive alien species in shaping local livelihoods and human well-being: A review. <i>Journal of Environmental Management</i> , 229, 145-157. doi: <a href="https://dx.doi.org/10.1016/j.jenvman.2018.05.007">https://dx.doi.org/10.1016/j.jenvman.2018.05.007</a>	x	x	x	x			
Sharp, T. (2012). <i>Standard Operating Procedure - CAM003: Mustering of Feral Camels</i> . Sydney: Centre for Invasive Species.	x	x				x	
Vertebrate Pests Committee. (2010). <i>National Feral Camel Action Plan</i> . Canberra: The Natural Resource Management Ministerial Council	x	x	x	x	x	x	x
Virtue, J., Gee, P., Secomb, N., O'Leary, P., & Grear, B. (2016). <i>Facilitating feral camel removal in Australia through</i>	x	x	x	x	x	x	

Source Citation	Theme 1: Camel Farming	Theme 2: Barriers	Theme 3: Socio- Economic Benefits	Theme 4: Rural and Remote Australian Communities	Theme 5: Indigenous Australians	Theme 6: Camel Culling	Theme 7: Camel By- products
commercial use. <i>The Rangeland Journal</i> , 38(2), 143. doi: 10.1071/rj15066							
Western Australian Department of Biodiversity, C. a. A. (2014). <i>Camels in Western Australia</i> . Perth: Western Australia State Government	x		x	x	x		
Wu, M. D., Chan, M. C.-H., & Deng, M. C. (2011). <i>Australian Camel Meat: China market</i> . Retrieved from <a href="https://www.agrifutures.com.au/related-projects/market-study-australian-camel-meat-china/">https://www.agrifutures.com.au/related-projects/market-study-australian-camel-meat-china/</a>	x		x				x
Zeng, B. (2015). Camel culling and carbon emissions in rangelands in central Australia. <i>Journal of Environmental Planning and Management</i> , 58(2), 270-282. doi:10.1080/09640568.2013.852077	x	x	x			x	x
<b>Total</b>	20	17	16	15	11	11	11

## APPENDIX D

## Literature and Thematic Coding

No.	Author/ Year	Title	Abstract	Thematic Coding
1	Bobbitt, J., H. Haines., Rachael Hodgeman, Tim Roache. (2006)	Potential Markets for New and Emerging Meats.	“The development of new and emerging meat industries provides many opportunities for Australian agribusiness, not the least of which is supporting the resilience of regional and rural Australia. Meat from animals such as emu, ostrich, kangaroo, buffalo, crocodile and rabbit provide to consumers a novel product of high nutritional quality; and the relatively low-fat content of these products has potential health benefits for the consuming public. Building the markets for these products involves addressing a number of issues, and some of these have been the subject of a number of projects developed by the Rural Industries Research and Development Corporation. The specific aim of this study was to investigate potential international markets for Australian new and emerging meats. Market access for Australian product globally is a function of matching the product to the market and the expectations of consumers in that market; as well as meeting quality, regulatory, and volume demands, and developing supply chains that protect the safety and shelf life of the meat products into market. This report demonstrates, by successful trial export of farmed rabbits to Thailand, that international markets can be identified and developed for new and emerging meat exports from Australia, and as such provides guidance to other sectors of this industry.” (p. vii).	1,3,4,
2	Breulmann, M., Böer, B., Wernery, U., Wernery, R., El Shaer, H., Alhadrami, G. A., Norton, J. (2007)	The Camel: From Tradition to Modern Times – A Proposal Towards Combating Desertificatio n	“Most parts of the Arabian Peninsula and particularly the Arabian Gulf countries are characterized by extreme aridity, which is manifested by adverse environmental con- ditions, leading to fragile ecosystems. This fragility is compounded by overgrazing and other unsustainable activities. The adoption of conservation measures namely, the “hema” system combined with traditional pastoral- ism has allowed people of the desert to live in this harsh environment for thousands of years maintaining themselves solely from their herds and from natural plant resources. Traditional herding patterns have changed significantly over the last forty to fifty years, resulting in a considerable decline of natural rangelands. Also an increase in livestock numbers, which is attributed to various factors, including in- creases in wealth, ready availability of water tanks, and the practice of moving stock to any available natural fodder lead to major changes in herding patterns. Consequently it is esti- mated that 80-90% of rangelands are severely degraded with most of its palatable perennial grasses and shrubs dramatically reduced.” (p. v)	1,2,3
3	Clarke (2014)	Camel Live Export Supply Chain and Benefit Cost Analysis	This document is an analysis of the economics of live camel export. It describes the live export supply chain; provides an assessment of the suitability of the current Cattle and Buffalo ESCAS checklist for the live export of slaughter camels; and includes an economic benefit cost analysis of Australian live camel supply. The world trade in live camels is relatively stable at between 200,000 and 300,000 head per annum. Average prices are around US\$400/head. The trade tends to be between Middle East and North African countries. Australia’s cost of supply is estimated to be between US\$1,000 and US\$1,500/head. Opportunities for Australian export are in small volume higher value niches – breeding stock in the Middle East (approximate sales of 150 head per annum) and slaughter stock in Malaysia where Australia has an advantage in relative proximity and a professional approach to supply (approximate sales of 150 head per annum). Other potential markets, including the US milking sector, may account for a further 50 head per annum if an appropriate supply chain can be established. Live export of Australian camels is a limited opportunity of around 350 head per annum at current supply costs. The current Cattle and Buffalo ESCAS checklist is relevant to the live export of slaughter camels. The Cattle and Buffalo ESCAS checklist requires few changes or additions. Some R&D will be required to confirm metrics relevant to camels and Quality Management manuals will be required. Ensuring there are appropriate importing country disembarkation feedlots, lairage and slaughter facilities for camels may be an additional cost associated with ESCAS compliance. ESCAS training, supply chain monitoring and audit are all additional costs for camel exporters. In addition to ESCAS compliance costs for exporters, resources will be expended by government finalising ESCAS guidelines and negotiating health protocols and potentially MoUs with countries intending to import Australian camels. There is also an opportunity cost associated with negotiating market access for camels at the expense of other red meat and livestock priorities. Benefit cost analysis of Australian live camel supply incorporating ESCAS requirements reveals a total industry present value benefit of \$1.57 million from industry and government investment of present value \$0.41 million resulting in a positive net present value of \$1.16 million over the twenty year period to 2033. While the benefit cost ratio (3.82) is acceptable overall returns are modest. Investment in development of a live camel export industry may also generate spillover benefits including employment for Aboriginal people living in remote communities and potentially, a minor reduction in environmental degradation caused by wild camels. Spillover benefits have not been quantified in the economic benefit cost analysis. Risks associated with live camel trade establishment include animal welfare issues that are both real and perceived by activists; irregular supply of wild camels; the need to establish a market for camels that are not suitable for live export; and a diversion of resources away from other industry priorities. On balance, modest economic returns and substantial risks limit the attractiveness of investment in Australian live camel exports.	1,2,3,5
4	Dittmann, M., Lang, R., Moser, D., Kreuzer, C., & Clauss, M. (2014).	Methane Emission by Camelids.	“Methane emissions from ruminant livestock have been intensively studied in order to reduce contribution to the greenhouse effect. Ruminants were found to produce more enteric methane than other mammalian herbivores. As camelids share some features of their digestive anatomy and physiology with ruminants, it has been proposed that they produce similar amounts of methane per unit of body mass. This is of special relevance for countrywide greenhouse gas budgets of countries that harbour large populations of camelids like Australia. However, hardly any quantitative methane emission measurements have been performed in camelids. In order to fill this gap, we carried out respiration chamber measurements with three camelid species ( <i>Vicugna pacos</i> , <i>Lama glama</i> , <i>Camelus bactrianus</i> ; n = 16 in total), all kept on a diet consisting of food produced from alfalfa only. The camelids produced less methane expressed on the basis of body mass (0.32±0.11 L kg <sup>-1</sup> d <sup>-1</sup> ) when compared to literature data on domestic ruminants fed on roughage diets (0.58±0.16 L kg <sup>-1</sup> d <sup>-1</sup> ). However, there was no significant difference between the two suborders when methane emission was expressed on the basis of digestible neutral detergent fibre intake (92.7±33.9 L kg <sup>-1</sup> in camelids vs. 86.2±12.1 L kg <sup>-1</sup> in ruminants). This implies that the pathways of methanogenesis forming part of the microbial digestion of fibre in the foregut are similar between the groups, and that the lower methane emission of camelids can be explained by their generally lower relative food intake. Our results suggest that the methane emission of Australia’s feral camels corresponds only to 1 to 2% of the methane amount produced by the countries’ domestic ruminants and that calculations of greenhouse gas budgets of countries with large camelid populations based on equations developed for ruminants are generally overestimating the actual levels.” (p. 1)	1,2,6,7
5	Edwards, G., Zeng, B., Saalfeld, K., Vaarzon- Morel, P., & Duffy, M. (2001).	Managing the impacts of feral camels in Australia: a new way of doing business.	“Feral camels are well adapted to the conditions found in desert Australia and have now occupied 3.3 million km <sup>2</sup> . Feral camels are one of the 73 or so species of introduced vertebrates occurring on mainland Australia that do not meet the criteria to justify eradication effort. For such species, the management options are containment, control, or no management (Australian Pest Animal Strategy 2007). Because they occur in sparsely populated areas, feral camels are only noticed when their activities intersect with remote Aboriginal people, pastoralists, and the tourism and mining industries. The significant damage that camels have done, and are currently doing, to the fragile ecosystems, cultural sites, isolated communities, and pastoral enterprises of desert Australia has gone largely unnoticed by the bulk of Australia’s population. The current estimated population of about one million feral camels is doubling approximately every nine years (Saalfeld & Edwards 2008) and there is evidence that impacts will increase along with the population (Edwards et al. 2008). If we do not act now to mitigate the damage being caused by feral camels, irreparable damage may be done, particularly to environmental and cultural values, across much of desert Australia. The longer we take to act, the more it will cost to manage and repair the negative impacts of feral camels. Management of the impacts of pest animals should be informed by a risk management approach and be strategic in determining where management should occur, at what time, and what techniques should be used (Australian Pest Animal Strategy 2007). It requires coordination at the appropriate scale among all levels of government in partnership with industry, land managers, and the community (Australian Pest Animal Strategy 2007). The current management of feral camels, being largely ad hoc (Edwards et al. 2004), fails to adequately meet any of these criteria.” (p. 335)	1,2,4,5,6,7

6	Edwards, G., Eldridge, S., Wurst, D., Berman, D., & Garbin, V. (2001)	Movement patterns of female feral camels in central and northern Australia.	"Movement patterns of female feral camels were studied over four years (February 1993 to December 1996) in central and northern Australia using satellite telemetry. Areas used over 12-month periods (calculated using the fixed kernel method) were large (449–4933 km <sup>2</sup> ) and increased with increasing aridity as measured by long-term mean annual rainfall. No consistent pattern of variation was detected in movement rates of camels across seasons. Data collected over several years are needed to classify movements in feral camels. The only telemetered camel that has been monitored for longer than two years (this study) appeared to move within a large home range over the concluding 3.5 years that it was tracked. Because the areas used are large, extensive buffer zones will be needed in arid regions to protect environmentally sensitive areas from the impacts of feral camels." (p. 283)	1,4,5
7	Edwards, G., Zeng, B., Saalfeld, W., & Vaarzon-Morel, P. (2010)	Evaluation of the impacts of feral camels.	"Feral camels have significant negative impacts on the environment and the social/cultural values of Aboriginal people. These impacts include damage to vegetation through feeding behaviour and trampling; suppression of recruitment in some plant species; damage to wetlands through fouling, trampling, and sedimentation; competition with native animals for food, water and shelter; damage to sites such as waterholes, that have cultural significance to Aboriginal people; destruction of bushfood resources; reduction in Aboriginal people's enjoyment of natural areas; creation of dangerous driving conditions; damage to people and vehicles due to collisions, and being a general nuisance in remote settlements. Negative economic impacts of feral camels mainly include direct control and management costs, impacts on livestock production through camels competing with stock for food and other resources and damage to production-related infrastructure. The annual net impact cost of feral camels was estimated to be –\$10.67 million for those elements that could be evaluated according to market values. We established a positive density/damage relationship for camels and infrastructure on pastoral properties, which is likely to hold true for environmental variables and cultural/social variables as well. Therefore, irrespective of climate change, the magnitude of the negative impacts of feral camels will undoubtedly increase if the population is allowed to continue to increase. Furthermore, the likelihood that camels would be epidemiologically involved in the spread of exotic diseases like bluetongue and surra (were there to be outbreaks of these diseases in Australia) is also very likely to increase with population density. On the basis of our present understanding, we recommend that feral camels be managed to a long-term target density of 0.1–0.2 camels/km <sup>2</sup> at property to regional scales (areas in the order of 10 000–100 000 km <sup>2</sup> ) in order to mitigate broad-scale negative impacts on the environmental, social/cultural and production assets of the Australian rangelands." (p. 43)	1,2,3,4,5,6,7
8	Hampton, J. O., & Hyndman, T. H. (2019)	Underaddressed animal-welfare issues in conservation.	"Much progress has been made toward assessing and improving animal welfare in conservation. However, several glaring knowledge gaps remain where animal-welfare concerns exist, but animal-welfare studies have not been performed in politically sensitive contexts. Based on contemporary issues in Australia, we identified 4 topics that require more research: animal-welfare oversight for operations designated as management (as opposed to research); animal-welfare impacts of biological agents used to control invasive animals; welfare of animals hunted recreationally; and animal-welfare impacts associated with indigenous wildlife use. Animal-welfare science may be applied to these sensitive topics through simple quantitative studies (e.g., quantifying the frequency of adverse animal-welfare events). Several such studies have effectively addressed animal-welfare concerns in similarly contentious contexts, including feral camel ( <i>Camelus dromedarius</i> ) culling in Australia, recreational hunting in Scandinavia, and indigenous whale hunting in the United States. For discussions of animal welfare in conservation to be evidence-based, courageous research is required in the 4 key areas we identified." (p. 803)	1,2,3,4
9	Kaether, B., See, P., Pennington, A. (2016)	Talking camels: a consultation strategy for consent to conduct feral camel management on Aboriginal-owned land in Australia	"Thorough consultation and informed consent are required for any work on Aboriginal-owned land in Australia. Consultations for feral camel ( <i>Camelus dromedarius</i> ) management under the Australian Feral Camel Management Project across the Northern Territory, Western Australia and South Australia were conducted across a vast area, spanning a diversity of cultures and landscape types. Aboriginal organisations from these jurisdictions developed consultative processes that supported Aboriginal communities in making informed decisions on any removal of camels from their country. This article describes the communication techniques used to depict the feral camel issues and opportunities to Aboriginal communities at the local and landscape scale. The decisions that communities arrived at were varied, but consistently focussed on feral camel removal. Their decisions have led to broad-scale feral camel removal under the Australian Feral Camel Management Project, and beyond." (p. 125)	1,2,3,4,5,6
10	Lundgren, E. J., Ramp, D., Ripple, W. J., & Wallach, A. D. (2017)	Introduced megafauna are rewilding the Anthropocene	"Large herbivorous mammals, already greatly reduced by the late-Pleistocene extinctions, continue to be threatened with decline. However, many herbivorous megafauna (body mass ≥ 100 kg) have populations outside their native ranges. We evaluate the distribution, diversity and threat status of introduced terrestrial megafauna worldwide and their contribution towards lost Pleistocene species richness. Of 76 megafauna species, 22 (~29%) have introduced populations; of these eleven (50%) are threatened or extinct in their native ranges. Introductions have increased megafauna species richness by between 10% (Africa) and 100% (Australia). Furthermore, between 15% (Asia) and 67% (Australia) of extinct species richness, from the late Pleistocene to today, have been numerically replaced by introduced megafauna. Much remains unknown about the ecology of introduced herbivores, but evidence suggests that these populations are rewilding modern ecosystems. We propose that attitudes towards introduced megafauna should allow for broader research and management goals." (p. 857)	1,2,7
11	Manefield, G. W., Tinson, A. H. (1997).	Camels: A Compendium	A comprehensive, exhaustive compendium on all known aspects of the camel, including by-products, physiology, anatomy, entertainment uses, diseases, and behaviour. A valuable resource, utilised to great extent in the writing of this report.	1,2,3,4,5,6,7
12	McCarthy, P. H. (1980).	The importation of the one-humped camel ( <i>Camelus dromedaries</i> ) into Australia during 1840-1841	"It is generally agreed that the economic exploitation of the one-humped camel in Australia began in January 1866 with the arrival at Port Augusta of 121 dromedaries aboard the "Blackwell" (Mc Knight 1967). The venture was financed by Thomas Elder a pastoralist of "wealth and vision" who was to play an important part in the development of the South Australian pastoral industry during the latter part of the 19th century. With regard to Elder's camel project he was assisted by his colleague Samuel J. Stuckey who negotiated the purchase of the camels in what is now Pakistan; he organised their embarkation at Karachi late in 1865.  The secret of Elder's success was twofold. Firstly, he realised that men expert in the handling and management of camels had to accompany the shipment and some 31 camel drivers were recruited from Rajasthan, Baluchistan, and adjacent areas for this purpose. Secondly, the time was ripe for the exploration of vast arid areas of the continent where the camel would prove its superiority over horse, donkey and draught ox. Public interest was stimulated as well; in general this was lacking previously. It is possible that Thomas Elder was swayed in his thinking by the importation of 24 camels from Peshawar to Victoria some 6 years earlier. The shipment together with 3 camel drivers, included both racing and draught animals; they were purchased by the then Governor of the colony, Sir Henry Barkly, for use by the Burke and Wills transcontinental expedition, which left Melbourne on 20 August 1860. Although their true worth generally passed unnoticed due to the disastrous outcome of the expedition, the camels proved their endurance and suitability to the Australian environment. Australian Veterinary Journal, Vol. 56, November 1980 Because of the success of Elder's venture and the notoriety given to the camels of the Burke and Wills expedition, relatively little attention has been given to the 3 separate importations of the one-humped camel into Australia during 1840-1841. As some of the	2,3,4

facts associated with each shipment have become distorted and intermingled over the years (Anon 1958), it may be of interest to give the details of these earlier episodes and to acknowledge the efforts, however unsuccessful, of those people involved.” (p. 547)

13	McGregor, M., Hart, Q., Bubb, A., Davies, R. (2013)	Managing the impacts of feral camels across remote Australia	“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.” (p. ix)	1,2,3,4,5,6
14	Rowe, L. McCloy, P. (2000).	Assessing the Potential for a Commercial Camel Industry in Western Australia.	“The aim of this project was to further investigate the potential for a camel industry in Western Australia, to build on already completed work and identify any significant barriers to progress. The project also aimed to work with and build on relationships in the collaborating agencies in the Northern Territory and Queensland. A Western Australian camel steering committee was established and also a pilot kill was planned for a Western Australian Abattoir. The project found that Western Australia could be enthusiastic about a strong camel industry developing from its extensive existing feral herd stocks. Western Australia also has strong trading relationships with Middle Eastern and Asian countries, which are the potential customers of camel meat. The State also has well developed international ports to export from. The northern part of the State has a strong export cattle industry. The required infrastructure for camels is similar, so yarding facilities and some transport can be utilised. Some pastoral leases are very close to export ports such as Port Hedland and this would greatly reduce restrictive transport costs. It is unlikely that a domestic meat market would be sustainable in Western Australia alone, the population is too small it would be difficult for camel to compete with the many different types of meats available on the market already. The financial input to educate and market camels for the domestic market would not be cost effective. The Central Australian Camel Industry Association already supplies the major supermarket chains in Western Australia and the market is not large enough to compete domestically with another supplier. The future lies with export markets and international alliances.  Recently requests from London, Hong Kong, Israel, and Egypt have been received. Potential customers are requesting prices and availability of camel meat and also live camels. This is encouragement to investigate further and locate a strong trading partner who will help drive the industry. There is a lack of confidence found through out all production chain members in the camel industry currently and this stems from a lack export information. There is superficial evidence that markets exist for camel meat and live exports but insufficient work has been done in Western Australia. There is also a lack of cohesiveness within the States of Australia and unless an approach of cooperation occurs the industry will not thrive. Once a camel industry is established, the pay off for Western Australia could be enormous. Camels co-graze effectively with cattle and are quite comfortable in a mixed herd with cattle. The degree of crossover in fodder shrubs selection is low. Adding camels to an existing pastoral cattle lease would involve limited additional costs. Initial trial work in Northern Territory has even shown a slight increase in weight for cattle which have been co-grazed with camels over the control group which had no camels in the paddock. More work must be done establishing export markets but once this is done and a new trade partnership and alliances has been established the industry will move forward creating export opportunities for Western Australia and Australia.” (p.vi)	1,2,3,4,5,6,7
15	Rural Industries Research and Development Corporation . (2016).	Camel Milk Market Assessment 2016.	“The two species of camel are the dromedary or Arabian camel ( <i>Camelus dromedarius</i> ) with a single hump and the Bactrian camel ( <i>Camelus bactrianus</i> ) with two humps. Australia has access to a wild population of dromedary camels from which a small managed population has been drawn. Camels are a desert animal that will adapt to a wide range of climatic conditions. They are difficult to manage in cool and wet environments. Worldwide commercial camel uses include racing, tourism, recreational/showing purposes and beasts of burden. There is a world trade in live camels of between 200,000 and 300,000 head per annum (Clarke 2014). By volume and value, meat is the most important product sourced from camels. Other camel products include leather, wool and milk (Lethbridge and Clarke 2016). Camel milk has been consumed by humans for more than 6,000 years and certainly longer than cow milk. Taste and appearance are similar to cows’ milk. Camel milk is saltier than cows’ milk and quality is at least partially defined by grazing conditions. Camel grazing will provide assistance with woody weed control on cattle grazing enterprises. However, if quality milk is to be produced they require access to high graze (trees and shrubs), pasture and hay of appropriate quality. Hay should constitute 75% of the milking camel’s ration. A managed diet will produce milk with a creamy consistency acceptable to the Australian palette (Lauren Brisbane, Camel, pers. com May 2016). The camel milk industry’s peak body is the Australian Camel Industry Association ( <a href="http://www.australiancamelindustry.com.au">www.australiancamelindustry.com.au</a> .” (p. 1)	1,2,3,4,7
16	Shackleton, R. T., Shackleton, C. M., & Kull, C. A. (2019).	The role of invasive alien species in shaping local livelihoods and human well-being: A review.	“Invasive alien species are a well-recognised driver of social-ecological change globally. Much research has focused on ecological impacts, but the role of invasive species for livelihoods and human well-being is less well known. Understanding the effects (benefits and costs) of invasive species on livelihoods and human well-being is important for guiding policy formulation and management. Here we review the literature on the role of invasive species in livelihoods to assess what is known, identify knowledge gaps and provide recommendations for future research. Literature was collected using key word searches and included both journal publications and grey literature. Slightly less than half (48%) of species studied had both substantial positive and negative impacts on local livelihoods (e.g. Australian <i>Acacia</i> spp. species; <i>Camelus</i> dromedaries; <i>Lantana camara</i> ; <i>Prosopis</i> spp.), with 37% inducing mainly costs ( <i>Chromolaena odorata</i> ; <i>Lissachatina fulica</i> ; <i>Opuntia stricta</i> ) and 16% producing mainly benefits ( <i>Opuntia ficus-indica</i> ; <i>Acacia</i> spp.). Some species, such as <i>Acacia dealbata</i> , fell into different categories depending on the social-ecological context. Key benefits or services included the provision of fuelwood, fodder, timber and food products for local households communities and to a lesser extent supporting and regulating services such as soil improvement and shade. A number of species also provided cultural services such as recreation and spiritual values and provided many with an opportunity to earn a cash income. However, invasive species also harm livelihoods and increase vulnerability through encroaching on land and reducing mobility or access. They can also decrease the supply of natural resources used by households and reduce agricultural production (livestock and/or crops) which can result in losses of income and increased vulnerability. Furthermore, some invasive species were seen to have negative implications for human health and safety and reduce the cultural value of landscapes. Economic impacts on livelihoods as a result of invasive species were highly variable and very dependent on the social-ecological contexts. These negative implications can reduce resilience and adaptive capacity of households and communities thus increasing their vulnerability to change. Drawing on case studies we highlight that efforts for managing invasive species need to safeguard livelihood benefits while mitigating negative impacts. In concluding we highlight future research and policy needs on the topic of invasive species, livelihoods and human well-being.” (p. 145)	1,2,3,4
17	Sharp, T. (2012).	Standard Operating Procedure - CAM003: Mustering of Feral Camels [Press release].	“The population of feral camels ( <i>Camelus dromedarius</i> ) in Australia is currently estimated to be around one million with numbers increasing at around 8% per year. At high densities camels can have serious impacts on vegetation and have the potential to cause significant production losses through competition with cattle. They can also damage fences and watering points, particularly during times of drought. Control methods include capture (by trapping at watering points or mustering), exclusion fencing, ground shooting and shooting from helicopters. Feral camels are mustered by helicopter, motorbike (or other vehicle) or on horseback, often with the assistance of coacher camels. Once mustered into yards, the camels are usually sold to abattoirs for slaughter which can offset the costs of capture and handling. Small numbers are also sold for live export. Where there is no market for them or where removal may be too costly or impractical, e.g. in remote areas without access to transportation, camels are sometimes destroyed by shooting in the yards. This standard operating procedure (SOP) is a guide only; it does not replace or override the legislation that applies in the relevant state or territory jurisdiction. The SOP should only be used subject to the applicable legal requirements (including OH&S) operating in the relevant jurisdiction.” (p. 1)	1,2,6

18	Vertebrate Pests Committee. (2010).	National Feral Camel Action Plan.	<p>“There are currently over one million feral camels in the rangeland ecosystems of Australia. Feral camels are causing significant damage to the natural environment as well as to social, cultural and economic values across their extensive range. If left unmanaged, the number of feral camels will double in the next 8–10 years and feral camels will expand into new areas. If this happens, the extent and magnitude of the damaging impacts of feral camels will increase. Management of feral camels and their impacts across the rangelands (primarily consisting of Aboriginal, conservation, pastoral and crown lands) is a complex issue that has two significant challenges: The rapid reduction of the currently over-abundant feral camel population, and building a legacy that will sustain on-going protection of assets and values of the rangelands. There is a substantial number of stakeholders in feral camel management, including governments, landowners and landholders, communities and individuals, and those with commercial interests in feral camels. In order to achieve a significant reduction of the negative impacts of the feral camel population, all these groups will have to work together. However, there are differing views on how feral camels should be managed to achieve this outcome. The National Feral Camel Action Plan (the National Plan) has been developed to guide the management of feral camels now and into the future. It provides a strategic and risk-based approach upon which local, regional and state-based management of feral camels can be undertaken. The National Plan’s vision is: Comprehensive, coordinated and humane management of feral camels and their impacts that maintains and promotes the biodiversity, agricultural assets and social values of our rangelands for all Australians. The four key outcomes identified for the National Plan are the: 1; development of the Australian and international community’s understanding of and support for the humane management of feral camels and their impacts, 2; amelioration of the negative impacts of feral camels by addressing the current over-abundance of feral camels through the immediate, substantial and sustained reduction in their numbers and impacts across the rangelands, 3; adoption of a platform for the on-going humane management of feral camels, and, 4; development of partnerships and social capacities for feral camel management into the future. The National Plan has been developed as a management plan for an Existing Pest Animal of National Significance (EPANS) under the Australian Pest Animal Strategy (APAS). A Feral Camel Working Group of the Vertebrate Pests Committee will oversee the implementation of the National Plan.” (p. 1)</p>	1,2,3,4,5,6,7
19	Virtue, J., Gee, P., Secomb, N., O’Leary, P., & Grear, B. (2016).	Facilitating feral camel removal in Australia through commercial use.	<p>“Approximately 16.5% of feral camel removal under the Australian Feral Camel Management Project (AFCMP) was by commercial means, via mustering for transport to abattoir (9.3%) and pet-meating in the field (7.2%). The challenges of commercial use of feral camels as a removal method include: variable density, mobility and distribution of the feral camel population; achieving landholder collaboration; accessibility to remote areas by road; availability of yard infrastructure and trucking capacity; and distance to slaughter facilities and end-markets. However, the AFCMP recognised commercial use as important to some Aboriginal communities, bringing a range of economic and social benefits as well as environmental outcomes in terms of reduced feral camel density. To facilitate mustering offtake, a removal assistance scheme was developed, whereby a formal landholder agreement was entered into with various legal requirements, including animal welfare. The agreement incentivised removal of both sexes: payments were for cow camels received at abattoir, but with a concurrent requirement for approximately equal sexes to be delivered to abattoir in an annual contract period. Additional project costs included contract development and oversight, landholder engagement, training and animal welfare auditing. Pet-meating, by way of ground culling and in-field butchering for meat storage in mobile refrigeration units, was also supported by the AFCMP via measures to increase harvest efficiency such as satellite tracking, aerial spotting and improved road access. However, pet-meating ceased mid-project due to changed industry demands. Post-AFCMP, mustering operations continue to service market demand for camel meat. The camel industry is also looking to camel farming to ensure greater continuity and quality of supply than can be achieved through wild harvest.” (p. 143)</p>	1,2,3,4,5,6
20	Western Australian Department of Biodiversity, (2014).	Camels in Western Australia.	<p>Website detailing facts and figures related to the background of camels, distribution and density, camel biology and ecology, impacts, control measures, ariel surveys and further resources.</p>	1,3,4,5
21	Wu, M. D., Chan, M. C.-H., & Deng, M. C. (2011).	Australian Camel Meat: China market.	<p>“This travel report assesses China’s consumer market supply and demand of camel meat, in order to determine whether an Australian Camel meat export protocol agreement should be pursued. The report looks at the Chinese population’s views on camel meat, the effects of location and domestic retail price on consumption, population size of domestic camels, and where the current supply of meat comes from. The report is targeted at The Australian Chinese General Chamber of Business and the Australian Camel Industry Association. The relevant Australian industries are located primarily in Western Australia, the Northern Territory, South Australia and Queensland. China has had an established camel meat market for over 3,000 years, but with a declining camel population, small farming population and the offer of alternative meats such as pork, beef and lamb, the popularity and awareness of camel meat has diminished considerably over the last two centuries. The majority of camel consumers are located in China’s western regions (Xin Jiang, Inner Mongolia, Gansu, Qinghai) and northern regions (Beijing, Hebei, Shandong, Ningxia), where the highly prized camel hump meat is considered one of the ‘Eight Treasures’ in Chinese cuisine and the camel foot is made into a thick soup that was named ‘Seven-Treasure Soup’ by a Chinese imperial prince. The meat is also highly valued for traditional Chinese medicinal purposes, where camel stew helps to strengthen a person’s bones and relieves arthritis and stiff limbs. Camel stomach helps a person to aid digestion, cure liver disease and relieve stiffness to joints. Camel hump is believed to contain a Qu tonic that softens human skin. Beyond traditional medicine, camel meat is known in China for its richness in protein, calcium, phosphorus, iron and vitamins A and B; and is low in fat and cholesterol content. From initial research, China’s large Muslim population in Western China consume camel meat as a premium product and during religious occasions such as Ramadan. For this reason, the study primarily focussed on the Chinese provinces of Xinjiang, Gansu, Qinghai and Ningxia where there exists a high concentration of Chinese Muslims. While camel meat is highly valued, it is sold at 20 Yuan per kg (AU\$3.06), and camel feet at 25 Yuan each (AU\$3.83), a price considerably lower than domestically produced pork, lamb (40 Yuan per kg, AU\$6.06) and beef (35 Yuan per kg, AU\$5.30). This price difference is due to higher market demand for the alternative meats and the restricted spending power of consumers in regions where camel meat is consumed.” (p. viii)</p>	1,3,7
22	Zeng, B. (2015).	Camel culling and carbon emissions in rangelands in central Australia.	<p>“There has been much research into impacts of climate change on animal/wildlife management (Griffith et al. 2009; Prato 2011; Wilsey et al. 2013), but few studies investigate how wildlife management could adversely affect climate change. Animal management affects emissions of greenhouse gases (GHGs). Different management approaches have different impacts. Lethal management is an important approach, which always occurs when entire populations of wild animals are targeted for reduction and are systematically ‘controlled’ by legal hunting, culling, poisoning or other means to bring down the population size. Despite the devastating history of many lethal control programmes, removal has a legitimate role in wildlife management in many countries and does contribute to coexistence between people and wildlife (Treves and Naughton-Treves 2005). As lethal wildlife management is an important approach in environmental management, and has been practised on various wildlife species in many countries, such as feral camels in Australia (Edwards et al. 2008), elephants in Africa (van Aarde, Whyte and Pimm 1999; Koenig 2007), swine in the US (Campbell et al. 2012), it is critical to understand the environmental consequences of such a management approach. Carbon emissions are one part of such consequences that requires concern. Feral camels have been managed in Australia as they are one of the major pest animals. There are approximately 750,000 feral camels in arid and semi-arid Australia (Ninti One 2012). Feral camels cause damage to the environment and the economy. In 2010 it was estimated that the economic losses caused by feral camels amounted to at least AU\$10 million annually (Edwards et al. 2010). Currently, a national feral camel management plan is being implemented in Western Australia, South Australia, the Northern Territory and Queensland to control the damage (see <a href="http://www.feralcamels.com.au/">http://www.feralcamels.com.au/</a>). While the culling operation is the main management tool, other approaches, such as commercial harvesting, are also included in the management strategy. However, these do not make a significant contribution to the camel management regime (Zeng and Gerritsen 2013). There have been different views about the impacts of camel management on greenhouse gas emissions and also on climate change. Some claim that the plan to cull camels may have unexpected carbon tax consequences (Carbon Offsets Daily 2009). Others argue that the camel management strategy will fail to contribute to a reduction of greenhouse gas emissions, given the international carbon accounting standards, and that the Australian carbon count can do nothing to address the camel problem (Higgins 2010; O’Sullivan 2010). It has been suggested that culling feral camels will contribute to better land management, which will allow more carbon to be stored in the soil and vegetation (Herald Sun 2010). There have been some studies on live animals’ carbon emissions, particularly of domesticated animals. Based on a range of monitoring and studies, in the National Greenhouse Gas Inventory, estimates have been given for carbon (mainly methane) emissions of major animals such as cattle, sheep, camels, pigs, poultry etc. (Table 1). It suggests that, on average, a domesticated one-hump camel (dromedary) emits 0.97 CO<sub>2</sub>-e tonnes of enteric methane per year, which is lower than cattle and buffalo but</p>	1,2,3,6,7

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much higher than for other animals. Compared to live animals' long-term continuous methane emissions, dead animals (such as culled animals in lethal management) emit GHGs from their carcasses in the short term. Some studies on GHG emissions of other animals' carcasses have been reviewed. For example, a recent experimental study on cattle carcass management methods in the US (Yuan, Saunders and Bartelt-Hunt 2012) estimated that a single cattle carcass of average weight (500 kg) released 50 m<sup>3</sup> (36 kg) of methane and 14 m<sup>3</sup> (25 kg) of carbon dioxide at a standard temperature and pressure, which corresponded to approximately 720 kg CO<sub>2</sub> equivalent. Other researchers have focused on co-composting of animal carcasses with their manures under a controlled environment such as a landfill or a composting system (e.g. Xu et al. 2007; Xu et al. 2009). However, so far no such research on camels has been reported." (p. 271)

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## APPENDIX E

### Interview with Station Manager

Date: 2nd of October 2019

Location: Wiluna, Western Australia

Individuals involved:

**DP** = Dominic Perry

**EHS** = Emmaline Hanslow-Sells

**SM** = Station Manager

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\*Beginning of interview\*

DP: We would like to have a chat colloquially...we just want to get a bit more detail about various aspects...I suppose.

SM: Yep.

DP: Let me know when you want to start recording.

EHS: Yep, we are all good.

SM: Alright, we are on the way.

DP: This one is pretty broad, and we've covered it before, but what do you think are the key points that need to occur before realistic camel farming occurs?

SM: For size?

DP: Yeah

SM: You'll need to at least have an MOU [memorandum of understanding] for off-take and you'll need to have a proven method of catching the camels. Without being able to catch it you're not going to be able to get the numbers, and if you can't get the numbers the economics disappear out the back. You gotta get the numbers and you've got to get an understanding of the off-take...so the market.

DP: You've said before that the logistics of the trapping are pretty much known, in terms of the day to day stuff, right?

SM: Yep, but it's the either side, so the market and then transporting it. To know if it's worth doing is to know that it can be solved. Then, to do that you've got to have an understanding of someone who can take this and can take that at a given rate. That gets parked over there. And then to get confidence to go to an off-take agreement, they've got to know that you can capture and deliver to an abattoir.

DP: Right.

SM: At a given rate. So, if you say you're gonna do ten tonne a month, or one tonne a month, they've got to know that you can deliver that so they're not overdoing their marketing and all the rest that goes behind it.

DP: I think you've got a point that you'd need to you'd need to have about a month's buffer? Or something along those lines?

SM: You've got to get your continuity of supply. If you've got them out in the paddock out here and you can try to bring in ten a week, twenty a week, a hundred a week, whatever the number is, that's okay. And then you can have others being dropped in the paddock behind, that just keep feeding into it. They can be a hundred kilometres away, two hundred kilometres away, wherever, as long as you can pick them up.

DP: Yep.

- SM: To back that up, we deal with [name of bank redacted], and they are more than happy to lend us any amount of money based on the number of cattle we have sitting down in [name of station redacted]. Not an issue. The cattle up here where we might catch them, we might not catch them, they can't work on that.
- DP: Right okay. So, because of the volatility.
- SM: Yes. Say a cyclone blows in a bit of rain and then I might not catch an animal for six months. Now if you have a supply line...chain ... then say this area is out but say 400 kilometres up might still be dry, and then you've got a point. Or next to the Goldfields might still be dry. Or somewhere in South Australia might be dry. And that's where I'm saying that it all depends on what level you're going to. If you're going to get ten a week, then you might have to need 500 a year. And that's small. So, you've got to know where it's going to be...and everything has to back up behind it.
- DP: Okay. The next questions we were kind of thinking of is...we have covered this peripherally but do you think that pastoralists that currently work with cattle, do you think they could farm camels as well, in tandem, or do you think they'd have to farm camels on their own?
- SM: The only stations that are going to get involved in it are those that are on the interface of the UCL [Unallocated Crown Land], it doesn't matter if they're going to come straight off the Nullarbor, all the way around. There are probably only around ten or twelve stations that are located on the interface. They're the ones that are going to get any numbers that worth anything. The others might get ten or twenty and then they've got to work out if its economic for them to have the equipment to truck them all into a yard and pick them up, or however they do it. And you probably need 20 to 25 camels to make the trailer load up. If you can't fill the trailer up, then it isn't worth it.
- EHS: Based on...?
- SM: Based on how the transporters work their rate. The pastoralists, I believe, will be an add onto someone that is running a small business. So, someone that running after the resource that in the centre of Australia (the camels) ...someone that wants to bring up their amount. The beauty of this is if you had a pastoralist that is on the interface that could feed into this. There would be about ten, eleven or twelve...somewhere around that number. Now if they all put in a hundred each year, you've got a buffer there each year that is coming in as well. That's where I see it could work. But the main core has got to be coming into someone that it is working the line somewhere between [location redacted] and [location redacted] and [location redacted], I think it is. Or another line that is set up to work for this.
- DP: Okay, EHS said you guys had a chat about this when you were up in the plane, but what do you think about the environmental effects of camels compared to cattle, in terms of a livestock setting? So, things like erosion or vegetation or landscape effects.
- SM: Okay, you'll have to check my numbers about this, but I'm pretty sure that cattle can eat maybe between of 40% and 60% of the vegetation that's in the region. Camel can eat 80%. So, you've got a bigger food base for them. So, the camels have a longer range between water, and the higher browse line. So, with all of this you should be able to run higher numbers of camels within a station. They are certainly softer on the ground. You do not see dust behind camel. You see the cattle when they walk, and you see the dust come up behind them. With camel you cannot pick up camel by the dust. Like you saw in the plane.
- DP: Yeah, he was incognito.
- SM: Unless you actually saw him, you wouldn't know he was there.
- DP: I don't know how you saw him. But you could see the tracks the cattle made so easily. They were so obvious.
- SM: They cause run off. They cause erosion. There is no other way to say it.
- DP: With the vegetation I suppose, I guess they have a broader spectrum of what they can eat.
- SM: If you look out the window...if 100% of what is out there was nibbled on, then everything would stay in balance. The camel is closer to that then what the cattle are. Or the goats or the kangaroos.
- EHS: As well, because they're tall they only get the first layer of it.
- SM: That's right. Similar to goats, they only eat to about here. Now the trouble with goat is...and I don't fully know about camels, but they will eat patches out of plants. They will just take them out of the environment and that's it, they're just gone. I don't know if you've heard of Trybunalski, cattle will

not eat it out, but sheep will, just because of the length between the plant and their mouth. That's why I think camel will be better.

EHS: From an environmental perspective within this country?

SM: Exactly. That's where I go, its easier to say that if you move out to the UCL, where they are already, and that area with the TO's [traditional owners] there's no reason why that you don't have a full industry there that just needs to be turned on. The livestock are there, they're surviving already, supplement them with a bit of water, and hopefully they get double the numbers ...hopefully you get a big pull off and then you've got your water points. And you've seen how the traps work ...they work the same with camel. When they get thirsty, they come in. The trick then is to accumulate them somewhere, to put them somewhere, so they can get that feed off.

DP: By the way, have you heard of, or do you know anything about in the past decade about what has happened with goats? I was having a chat with a family friend about this, and we were having a chat about how ten/fifteen years ago there was a bounty with goats, and they were stating to cultivate them for their meat and I think it might have been in Queensland?

SM: Over here in Western Australia, goat goes for about \$7 a kilo.

DP: Okay.

SM: While beef goes for around \$3 a kilo. I think it's because they're exporting it to Asia.

EHS: That would make sense, every time I've been over there everyone is eating goat. You're often eating goat and you don't even realise you're getting goat.

SM: Yes.

DP: I was thinking that we could use that for almost a case study. I was just interested if you had any thoughts on it.

SM: It's going to be the case. What will happen is one day there was a guy who rounded up around 2000 goats and he got a call from an agent saying that he would take a thousand and this guys who got them said they were all gone, and the agent said hang on a second and called up and said the price now is this...and he doubled the price. He thought they were gonna get them for nothing because they were a pest. And this is what is going on down in [name of abattoir redacted]. They are getting what they need being dribbled into them because the market hasn't developed.

DP: So, we are almost in this teething initial phase of what could make a large market.

SM: [Name of SM's wife redacted] was pushing us to get a camel backstop that you could try camel and say is this beef or camel. We didn't get it.

DP, EHS: \*laughter\*

SM: It's just dawned on me how [sponsors name redacted] could get it for you and cook it up when you get back to [name of town redacted].

DP: That would be great.

SM: I'll do it after dinner, remind me so I don't forget.

EHS: \*laughter\*

SM: People who eat it say it's just like beef. And they like it.

EHS: So, is it just about finding a market that eats camel meat routinely?

SM: Well it's more about finding a market that will give you an off take.

EHS: Okay, yep.

SM: No one can do anything for free. We said that we wanted kangaroo for dinner tonight. Let's think about that. We hop in a vehicle and drive around to find one. If we work out the wages and count them all up...the reason why agriculture works is because of production. It's because things flow through and it's there. Wheat is not three times the price it was in the seventies. Then it was \$120 a tonne. Agricultural products come down in price because of the price of production. Agricultural products have come down in price because of the scale of production. To compete, you need to get it into the same bracket. I hope I'm not going over your heads too much.

EHS: No, no, it makes sense.

SM: So, it's gotta be a scale. And then you've got to kick it off, and the market has to be there to do this.

- EHS: We sort of talked that the main cost was going to be the transporting to the abattoir and that there isn't an abattoir that would work for camels.
- SM: The problem with the abattoir is that it's got to have the right hang height.
- EHS: Yep.
- SM: It's a longer animal and someone will have to modify their chain. So, you need a --
- DP: Is that an easy task?
- SM: It's engineering so there's money involved. I can't tell you an exact price but I'm guessing around a million to change the one in [name of abattoir redacted]. It's all stainless steel, it's all about how you do it. You've either got to excavate or go up, which means lifting a roof. You've got to stop the whole floor while it's done.
- EHS: So, if there was a possibility that someone was to fund the installation of an abattoir, whether than was in [name of town redacted] or wherever it would be, would it make camel farming more viable than it is now? Is it really just about updating and investing in infrastructure that gets camel farming happening?
- SM: What I need to do is get my phone and call [name redacted] and ask if someone was to fund the lifting of the chain in [name of abattoir redacted] to bring camels to [name of abattoir redacted], what is the chance of getting an off-take. And he will scream at me. \*SM calls stock agent and leaves a voicemail\* G'day [stock agent name redacted] I just some questions about the [name of abattoir redacted] meat works because I have some people up here that are doing a study and we would really like your input. Cheers. [hangs up phone] That will get him arked up.
- DP, EHS: \*laughter\*
- EHS: So, he's very doubtful about camel farming and all this?
- SM: He's quite dynamic, he's a stock agent, does that make sense to you?
- EHS: He trades livestock?
- SM: He trades pigs, goats and cattle...I haven't tried him on horses...but his the one who got me the price camel was going for down in [name of abattoir redacted]. I've got them tucked away somewhere. They are low. They are underground. They are playing games and they know they don't have a big market so their pulling them out and selling them up here. And that is what will happen when you've got small numbers. There will be a big push.
- EHS: So, until the infrastructure can be made, farming camels and getting an off-take for them is just hard thing to do. They won't sell for a lot and they won't make any money. So why would an abattoir invest in changing their abattoir for something that might not make them much money. Do I have that right?
- SM: Yeah you do. If I digress for thirty seconds, and in a previous life when I was mining an industrial mineral, when I moved the very small plant to [location redacted] to the farm up to [location redacted] for a company in [location redacted]. A gentleman named [name redacted] asked me "how much will it cost to prototype plant up there". I said to [name redacted], "half a million bucks". And this is in 1995. And then he said, "okay how much is it going cost to move that plant up there and set it all up?" And I said "Oh [name redacted], probably between 800,000 and a million". And [name redacted] said "we're just gonna have to make that plant the production plant". The difference between 500,000 and 800,000 or million is not a lot of money. So, he said "the expectation that it will work, and we sort of know it will work, so why wouldn't we just go ahead and put the plant in?" And I said, "look [name redacted] it's your money, that's exactly what I would do", and he said, "well we will go ahead and do it". And then he said, "at least as soon as we get a customer on board we can supply, and then we build, and we build". Then we had one guy [name redacted] who was from [company name redacted] and we were sitting like how we are sitting now and I said "[name redacted] this is where I'm at and this is what we have coming through" and he said "why would I cut off my supply and take you on board?". And I said, "because we're here and we can help you". And he said, "well you've got no track record, you're here now but you could be gone tomorrow, and I'm stuck, and I'll have to go back to my old supplier, and they'll do me over". I said "well, we'll try and give you a price advantage and we're Australian and, um, tell me what you need, tell me what you need to be comfortable, do you need a month's supply, three months' supply, six months' supply? I'll put it in \*location redacted\* for you just to show you that we can do it". And he said "ahh you're getting a bit defensive [station manager's name redacted]"

DP, EHS: \*laughter\*

SM: I said, “well we want your business”. And he said “okay, for the first six months, it’s six months, from there after it’s four months and at a later date it will be three months”. Done. He became the cornerstone of our business. And about five years after that, we turned to him and said “[name redacted], you know [company name redacted] we’ve got a little bit of a problem”. I want to do a big dig; I want to dig out four years and put the dirt on top so we can just keep pulling it off. That way the cost of bringing all the equipment in and taking it out it...otherwise it gets mob and de-mob and bringing all the equipment in to do a big mine...I don’t have enough money to do it. I asked, “how much of a discount would you need for you to pre-pay me for your supply for the next six months, cause that’s how much money I need”. He said, “could you do five percent?”, and I said, “I’ll do five percent”. He said, “Give me ten minutes” and he comes back and he says, “you’ve got a deal”. Right, twelve months later he tells me that that five percent jacked their numbers up, so he and his boss got their bonus.

DP, EHS, SM: \*laughter\*

SM: He reckons that got everyone happy. He was happy, his boss was happy, we were happy, and they were right. So, it’s really just a case of getting a start-up happening.

EHS: Yep.

SM: I was dealing with the company that actually owned the deposit, which was [company name redacted] a rather small Australian company and they owned the deposit we were working. They wouldn’t buy the stuff off us, they were getting twenty dollar a tonne royalty, and they just kept saying no, no, no. I said, c’mon, at some point, at some price, you’ve got to buy your own ore, because straight away you get that twenty dollar a tonne discount anyway. It doesn’t show up because it’s coming up through royalty. And they umm-ed and they ahh-ed, but in the end I got them to buy anyway by asking “what do you need and what will get you to be comfortable?”. We ended up with ninety percent of the Australian market. But it took three years, and it’s that grind to get out. That’s why I was saying you need someone whose got money who can carry it to get it to that point. But you need someone whose good enough to get out and do what we’ve been doing here out there to get the supply coming in. Cause without that happening, what else do you do? It’s got to happen.

DP: Alright.

SM: Sorry, I get excited.

DP, EHS: No, that’s good.

DP: Can I just touch up from before, can we talk about culling, because that’s a part of our study. But I’d like to get a better scope of it. I think I understand that there’s not any incentive from the government to pastoralist to shoot camels. Do you think there would be a change in mindset if there was a bounty, or, ahh, reimburse you? They give you five hundred rounds, I hear?

SM: They gives five hundred dollars a year, that’s what they give us.

DP: I mean, I think I heard that it’s a hundred dollars a dog you get or something.

SM: No not here. In Western Australia there are no bounties.

DP: Is that, like, a policy thing?

SM: I don’t...I don’t know. I haven’t heard of any bounties. I haven’t heard for one for wild dogs or wild pigs. I haven’t heard from any.

DP: Do you think, if they were to hypothetically create that, would there be more of an incentive to go that route instead of --

SM: Well, are you gonna end up with having licensed bounty hunter, or will you open up to the wild west? You’ll bring in an element that is unattainable. You can imagine the bucks down from [location redacted] that get a week off and want to come up and shoot as much camel they can get. Say they get fifty bucks per camel, so that’s a carton of beer per camel and if they shoot a hundred camels, they’ll get a hundred cartons. You just get a different element of people coming out, rather than getting qualified hunters who bring their own equipment out, all insured. Look if you do that, you’re gonna get cowboys, and you’re opening up a pandora’s box.

EHS: I reckon that’s nearly all we have... but I was wondering if there is anything else that is really core to our research that you want to add?

- SM: The day the camel has a commercial value is the day it is no longer a feral animal. Let's say we caught fifty to a hundred a year, and they go for about four hundred a head. You're getting about 40,000 dollars. And that all helps. You could set up all the gear to do it and make a plan and then all of a sudden you go, making a bit of cash from this is pretty easy now.
- EHS: Yeah, you learn.
- SM: Yeah, and you step it up more and more. Like, what's his name [name redacted] he was getting significant income from the feral animals. He set it all up, he got himself commercial chillers and he'd herd them up himself. He has agriculturalised them.
- DP: So, he has taken that step.
- SM: He is supplying camel meat, horse meat to Malaysia Zoo. Small market, but it gets flown there and that's that.
- DP: We've done preliminary checks into the international market, and ahh, it's there.
- EHS: Oh yeah, it's definitely there.
- SM: At some point you've got to decide what you're targeting. Are you targeting pet food? Are you targeting fresh? Or are you targeting dried? Or are you targeting whatever. I would have a good look into the guy up in [location redacted] who is doing dried Kangaroo meat, if you can. Find out if his happy to share it. He was mixing it and drying it.
- DP: We will look into it.
- SM: Again, all of these things need a continuity of supply. This is a bit second and third hand, but someone was supplying pet food to a gentleman who was freezing it, this is camel, and then he was moving it to an Asian country and selling it.
- EHS: As human food?
- SM: He was moving it to an Asian country and selling it. I also know that kangaroo gets sold to Bolivia as pet food as well. They reckon it tastes good on the barbie.
- EHS: \*laughter\*
- DP: Okay, okay.
- SM: What I'm saying is there's a bit of a shady boundary to all of it. It's like the horse and lamb substitute in Europe.
- DP: What?
- SM: They pushed the horse meat into the pies over there and that kind of thing.
- DP: Alright. Thank you so much.
- EHS: Yes, thank you, it really does help.
- SM: Pleasure.

\*End of interview\*

## APPENDIX F

### Itinerary

Date	Program	Arrangements
29/09/19	<b>1845</b> - Virgin Australia VA 1898 - Depart Melbourne <b>2020</b> (Local Time) - Arrive Kalgoorlie	- Debbie-Lee Barrington greeted interns at Kalgoorlie Airport
30/09/19	<b>0730</b> - Departed Kalgoorlie <b>1215</b> - Arrive Laverton (Great Beyond Visitor Centre) <b>1400</b> (approx.) - Depart Laverton <b>1800</b> - Arrive Prenti Downs Station	<u>Laverton</u> - Travelled to Laverton via Menzies & Leonora (~350km) - Met with <b>Patrick Hill</b> (Shire of Laverton President, Lake Wells Station Manager) - Met with <b>Mike &amp; Kyle Tucker</b> (Members of Goldfields Indigenous Australian Community)  <u>Prenti Downs</u> - Travelled to Prenti Downs Station via dirt road (~300km) - Met with <b>Tim &amp; Louise Carmody</b> (Prenti Downs Station Managers) - Met with two station hands - Donga accommodation - Debbie-Lee Barrington of the NIAA provided transport and drove to meeting locations
01/10/19	<b>0530</b> - Breakfast/Prep for day <b>0615</b> - Left station homestead <b>0630</b> - Tim & station hands processed cattle <b>0800</b> - Resumed tour of station <b>1600</b> - Returned to station homestead <b>1730</b> (approx.) - Dinner <b>1800</b> - Discussion	- Mr. Carmody provided a tour of station; visited water bore sites, camel cull sites, and self-mustering yards - Mr. Carmody detailed successes and failures of camel management
02/10/19	<b>0530</b> - Breakfast/Prep for day <b>0615</b> - Interns conducted report work <b>1300</b> (approx.) - Tim & Dom performed ariel tour of south-easterly section of station <b>1430</b> (approx.) - Tim & Emma performed ariel tour of eastern section of station <b>1730</b> (approx.) - Dinner <b>1800</b> - Discussion	- Morning report work consisted of debriefing experience thus far, research, report writing, and preparation for Friday meeting - Survey from air allowed further insight into distances involved in the management of a station
03/10/19	<b>0530</b> - Breakfast/Prep for day <b>0630</b> - Depart Prenti Downs <b>0930</b> - Arrive Laverton (Great Beyond Visitor Centre) <b>1030</b> - Depart Laverton <b>1200</b> - Arrive Lake Wells Station <b>1500</b> - Depart Lake Wells Station <b>1830</b> - Arrive Kalgoorlie <b>1930</b> - Dinner in Kalgoorlie	- Met with Patrick Hill in <u>Laverton</u> - Mr. Hill provided tour of Lake Wells station, joined by the Tucker's - Dirt road back to <u>Kalgoorlie</u> (~250km) - Debbie-Lee Barrington of NIAA provided transport and drove to meeting locations
04/10/19	<b>0930</b> - Meeting at NIAA, Kalgoorlie offices <b>1240</b> - Virgin Australia VA 1897 - Depart Kalgoorlie	- Meeting to speak with key stakeholders <ul style="list-style-type: none"> <li>• Mia Hicks - Exec Manager Economic Development (Coolgardie Shire)</li> <li>• Debbie-Lee Barrington – Adviser and Engagement Officer (NIAA)</li> <li>• Lee Jacobson - Chairperson (Regional Development Australia)</li> <li>• Malcom Cullen - Shire President (Coolgardie Shire)</li> <li>• Michelle Donaldson - CEO Goldfield Nullarbor Rangelands Biodiversity Association</li> <li>• Alex Weiss - Exec Manager Economy Growth (Kalgoorlie/Boulder)</li> </ul>

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