



Fire Management Use across the Great Divide: Rangelands Fire Management Survey for Land Managers

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Cape York Peninsula Development Association

*The rainbow bird was above. 'You can go down into the water,'
he called. 'I'm going to give fire to men!' The rainbow bird put fire everywhere,
in every kind of tree except the pandanus.*

- Crocodile Took a Fire Stick



Introduction

Fire use for land management across Queensland affects cattle and agricultural industries, as well as maintaining conservation and socio-cultural values. Stark evidence exists to support use of fire for land management on farms, stations, national parks and other economical, conservation, cultural or tourist localities. Literature and land manager experiences support the use of systematic early burns at the start of the dry season. It has been found that this fire practice negates vast and hotter fires later in the season. Fire-sensitive communities besides humans include rainforest, some native grasses and other native plants, as well as insects, reptiles, marsupials and birds.

Traditional fire-management practices were not explored in this research study. It is advisable that future survey work incorporate a focus group/s method to tap Indigenous knowledge, skills and competencies. It may be that much of the information about how best to care for country using fire is to be located in the stories of the local peoples. However, for this information to contribute to best practices in use of fire for land management; a change in value of country needs to occur among land managers in general. In this research study 99% of respondents were Anglo-Australian. Future research with a focus on traditional practices would do well to include narrative and focus group methods. Other research methods to build on current understandings would include; the comparison of Traditional Owner methods and those of other land managers in Arnhem Land (Yibarbuk, Whitehead, Russell-Smith, Jackson, Godjuwa, Fisher, Cooke, Choquetot, & Bowman, 2001); survey and aerial photography of land management practices in Central Queensland (Fensham & Fisher, 2002); and the 20-year collection of stories and other information in Arnhem Land (Russell-Smith, 2004).

The land area of the Rangelands in Queensland covers over 70% of the State, petering out at the east. Central eastern and south eastern rangelands are a mosaic of land crops suited to the fertile soils of clay (Australian Natural Resource Atlas, 2007). Across the Rangelands are 13 bio-regions. The south-west tends to be dry and hot, becoming sub-tropical and then tropical along the north of the State. There is much more rain in the north in summer as compared to the south. Pastoralism has been the dominant industry across the Rangelands, cattle in the north and sheep in central western and south-western parts of the State. The next largest industry is crops. There are a large number of Indigenous Australian communities in Cape York; cultural differences create opportunities for non-ethnocentric research that is inclusive of the inputs from all stakeholders.

To determine if Northern and southern land managers differed in their perceptions and practices of fire use for land management a mail-out survey was used. The survey was developed for this project and consisted of five Parts;

- 1) Demographic Information
- 2) Fire Management Practices and Goals
- 3) NAFI Information
- 4) Woody Thickening Information
- 5) Attitude toward Fire Management

It was anticipated that more respondents in the North would; use fire for land management; have wildfire response plans; have issues with woody thickening relating to fire use; and would have positive attitudes toward use of fire management, as compare to the South. The survey also expected to explore current practices of fire use, wildfire histories, burning patterns, feedback on NAFI website usefulness and to identify attitudes toward woody thickening that were not negative. The construct "Attitude" was expected to be made up of five dimensions; Cultural, Conservation, Economic, Woody Thickening and Legislation. Ultimately, this research project intends to extend understandings of fire management perceptions and practices across the Rangelands.

Part I: Demographic Information

1. Are you a land manager?

This question was to verify that those answering the survey were the actual land manager of the property. 100% of the responses acknowledged that they were the land manager; however, one response was from a rural residential only land manager and his information was deleted as he did not meet the criteria to be in the sample (n= 116). Three hundred surveys were mailed out And included a cover letter (see Appendix A) and a self-addressed envelope. Six surveys were returned un-opened, giving an overall return rate of 63% which is acceptable. However, this could be improved by providing alternate forms of completing the survey; such as online, phone-in, mail-out and focus group (particularly with regard to Indigenous communities). Also, future surveys need to number (de-identify) questionnaires prior to mail out.

Another three respondents were cut from the sample due to the huge number of questions that remained unanswered on their surveys. In total, the sample numbered (n) 113. Throughout the data there are many questions that went unanswered by many of the participants. On reflection and given the feedback from respondents, the survey is too long for the effort involved.

2. What Shire is your property within?

Discussions amongst the coordinators from Cairns, Townsville and Roma determined the Line of Capricorn to be the divide between Northern and Southern land management groups. The Tropic of Capricorn was used to differentiate "Northern" and "Southern" Regions to provide comparison groups (i.e., Boulia, Winton, Longreach, Ilfracombe, Barcaldine, Jericho, Emerald, Duaringa and Fitzroy). Future research would do well to stratify the sample so that there is an equal representation across Northern and Southern Regions.

Of the 116 respondents, 14 either did not nominate their Shire or nominated more than one Shire. This may be because they felt the question intrusive, irrelevant, did not see the question or did not know which Shire to nominate (as was the case where properties crossed Shire boundaries). Future surveys should develop criteria to aid respondents in determining the most correct Shire. The key provided in Table 1 indicates the number of respondents across Shires and Regional Groups. Shires can be located on the Shire Map (see Appendix B).

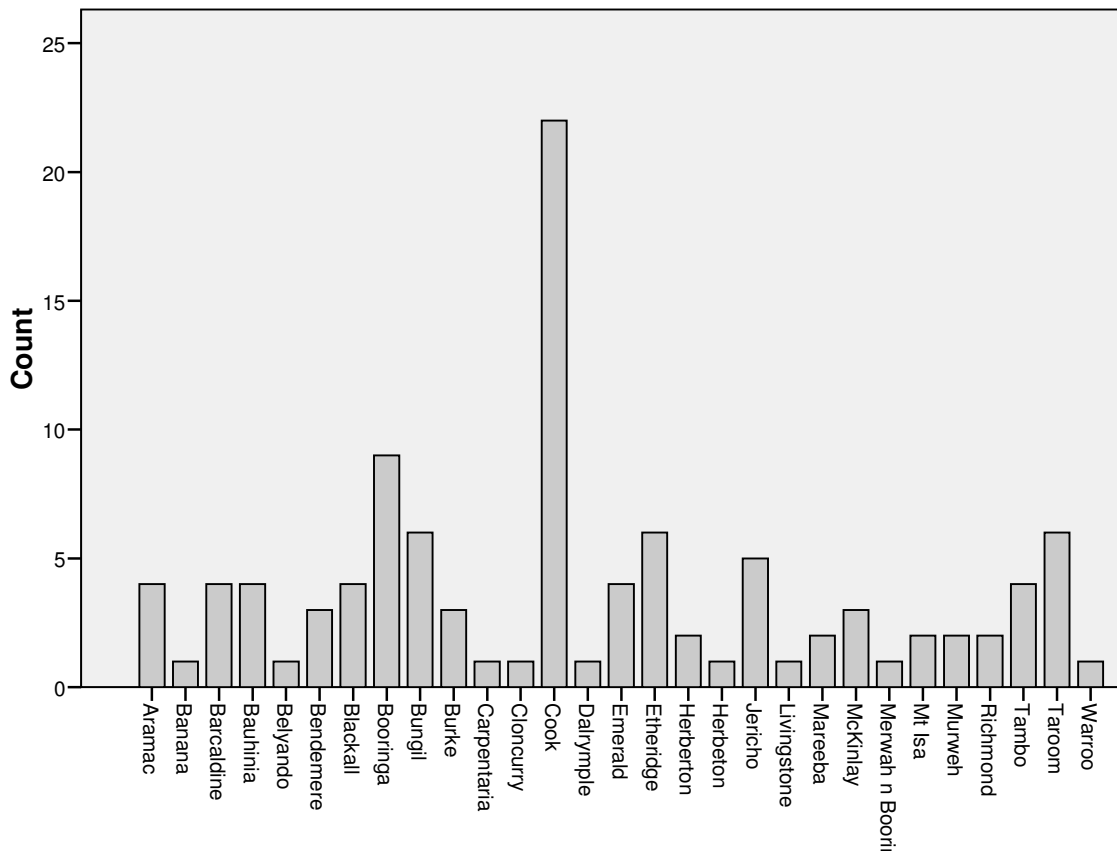
Table 1

Number of Respondents Across Shire and Regional Group (n= 104)

1 Aramac (4)	11 Burke (4)	21 Mareeba (2)
2 Banana (1)	12 Carpentaria (1)	22 McKinlay (3)
3 Barcaldine (4)	13 Cloncurry (1)	23 Murweh (3)
4 Bauhinia (4)	14 Cook (22)	24 Mt Isa (2)
5 Belyando (1)	15 Dalrymple (1)	25 Richmond (2)
6 Bendemere (3)	16 Emerald (4)	26 Tambo (4)
7 Blackall (4)	17 Etheridge (6)	27 Taroom (6)
8 Booringa (9)	18 Herberton (3)	28 Waroo (1)
9 Broadsound (1)	19 Jericho (5)	
10 Bungil (6)	20 Livingstone (1)	

Figure 1

The Number of Respondents across Shires (n=102)



The Cook Shire had the largest number of land managers in this sample (n= 22), followed by Booringa in the South (n= 9). Almost two-thirds of land managers resided in the North (60%).

3. Are you: Female or Male?

Of the respondents (n=116), 15 were Female and 101 were Male.

4. What is your age?

Of the 116 respondents, the majority were aged 51-60 years ($n=42$). Overall, 36.2% of the sample was aged over 51 years.

<i>Age Group</i>	<i>n</i>
<30 years	3
31-40 years	16
41-50 years	26
51-60 years	42
61-70 years	23
>71 years	6

5. How many acres is your land?

Properties ($n=109$) ranged widely from 923.45 acres to 3 015 000 acres. Given the large dispersion of data it was decided to assign properties to one of four categories determined by acres and location: Small Southern; Large Southern; Small Northern; and Large Northern.

Overall, sixty per cent of the properties were located in the North and forty per cent in the South.

<u>Small Southern</u>	<u>Large Southern</u>	<u>Small Northern</u>	<u>Large Northern</u>
Bauhinia (2)	Banana (1)	Aramac (4)	Amarac (1)
Bendemere (2)	Barcaldine (3)	Barcaldine (2)	Belyando (1)
Bungil (2)	Bauhinia (2)	Broadsound (1)	Burke (2)
Taroom (1)	Belyando (2)	Burke (1)	Cloncurry (1)
	Bendemere (1)	Carpenteria (1)	Cook (13)
	Blackall (4)	Cook (9)	Etheridge (1)
	Booringa (9)	Dalrymple (1)	Jericho (1)
	Bungil (3)	Emerald (4)	Mareeba (2)
	Tambo (4)	Etheridge (5)	Murweh (2)
	Taroom (5)	Herberton (3)	Richmond (1)
		Jericho (5)	
		Livingstone (1)	
		McKinlay (3)	
		Mt Isa (2)	
		Richmond (1)	
		Waroo (1)	

6. What type of property do you manage?

The main type of property ($n = 92$) was managed for Grazing (80.4%). Northern and Southern Regions were almost evenly split with regard to grazing. More Conservation properties exist in the south of the State (12.5%), as do Crop properties (6.3%).

Type	<u>Small Southern</u>	<u>Large Southern</u>	<u>Small Northern</u>	<u>Large Northern</u>
Grazing	4	32	37	1
Conservation	7	1	2	2
Crops	2	3	1	0

7. What is the main type of land use for your property?

The main use of property ($n = 113$) was for Cattle grazing, half of which occurred on Small Northern properties (50.0%). The Northern Region was also more likely to have properties managed for Tourism (7.0%). Of the 8 respondents nominating conservation as their main Land Type in the previous question, only six of those respondents chose to nominate Conservation as their main Land Use. Future surveys should combine the questions so that Type is nominated and then Main Use is noted. Note that several response choices were available; in future rank the choices.

Type	<u>Small Southern</u>	<u>Large Southern</u>	<u>Small Northern</u>	<u>Large Northern</u>
Cattle	7	31	56	9
Conservation	0	1	4	1
Large Crops	1	2	2	0
Tourism	0	0	5	3
National Park	0	0	1	2
Traditional Land	0	0	1	1
Sheep	0	1	5	0
Forestry	0	0	1	0
Small crops	1	1	1	0
Timber	0	0	2	0
Horticulture	0	0	1	0
Aquaculture	0	0	2	0
Other:				
Goats	0	0	1	0

8. How long have you been managing the land you are on now?

On average, respondents (n= 110) have been managing the land they are on for 23 years (SD=15.3). Timeframes ranged from 6 months to 87 years.

9. How long have you lived on the land you are on now?

On average, respondents (n=110) have been living on the land they are on for 29.7 years (SD=20.6). Timeframes ranged from 1 month to 87 years.

10. How many generations has this land been in your family?

On average, respondents (n= 107) have had 1.6 generations on the land (SD=1.1). Timeframes ranged from; first generation to be on the land; to over 40, 000 years (N.B., recognising Indigenous Australian land claims and spiritual affiliations).

11. What is your ethnic background?

Respondents (n= 112) identified themselves as: Anglo-Australian (111), Indigenous-Australian (2), USA (1), Canada (1) and Scandinavian (1). Only one participant chose not to answer this question.

12. Do you identify yourself as an Indigenous Australian?

Of the participants (n=113) many identified themselves as Indigenous Australian; however it was clear that they misinterpreted the definition of Indigenous as: being born in Australia, and not as being of Aboriginal or Islander descent. Future surveys could have options; Anglo-Australian; Aboriginal or Torres Strait Islander Australian; Other-Australian; and Other-Ethnicity.



One of the traditional owners at Pompurraaw in the Cook Shire

Overall, there were only two Indigenous Australian respondents. Future surveys would do well to approach Indigenous communities individually and to provide a liaison to bridge the cultural gap.

13. Are you a member of a Rural Fire Brigade?

Eighty-nine per cent of participants (n=113) answered "Yes" to being a volunteer with the Rural Fire Brigade.

Part II. Fire Management

14. Do you use fire for land management purposes?

Ninety-four per cent of respondents (n= 101) indicated that they did Use Fire for land management purposes. Across Regional Groups, 58.4% of land managers to Use Fire were located in the North.

	<u>Small Southern</u>	<u>Large Southern</u>	<u>Small Northern</u>	<u>Large Northern</u>
<u>Use Fire</u>				
Yes	6	36	34	25

The following table shows the number of land managers who Use Fire by Regional Group and Shire.

	<u>Small Southern</u>	<u>Large Southern</u>	<u>Small Northern</u>	<u>Large Northern</u>
<i>Bauhinia</i> (2)		<i>Banana</i> (1)	<i>Aramac</i> (3)	<i>Amarac</i> (1)
<i>Bendemere</i> (2)		<i>Barcaldine</i> (2)	<i>Barcaldine</i> (1)	<i>Burke</i> (2)
<i>Bungil</i> (2)		<i>Bauhinia</i> (3)	<i>Broadsound</i> (1)	<i>Cloncurry</i> (1)
<i>Taroom</i> (1)		<i>Belyando</i> (1)	<i>Burke</i> (1)	Cook (11)
		<i>Bendemere</i> (1)	<i>Carpenteria</i> (1)	<i>Etheridge</i> (1)
		<i>Blackall</i> (4)	Cook (7)	<i>Jericho</i> (1)
		<i>Booringa</i> (8)	<i>Dalrymple</i> (1)	<i>Mareeba</i> (2)
		<i>Bungil</i> (3)	<i>Emerald</i> (4)	<i>Murweh</i> (2)
		<i>Tambo</i> (4)	<i>Etheridge</i> (5)	<i>Richmond</i> (1)
		<i>Taroom</i> (5)	<i>Herberton</i> (3)	
			<i>Jericho</i> (4)	
			<i>Livingstone</i> (1)	
			<i>McKinlay</i> (3)	
			<i>Mt Isa</i> (2)	
			<i>Richmond</i> (1)	
			<i>Waroo</i> (1)	

By age group, 60.5% of respondents (n= 116) aged 51-60 years use fire for land management. This was not a significant association, perhaps due to the small sample.

Age		Yes	No
<30		3	0
31-40		15	1
41-50		25	1
51-60		40	2
61-70		21	2
>71		5	1

15. Do you use fire to mitigate wildfire (unwanted) damage?

Eighty per cent of respondents (n=113) to this question answered "Yes" to using fire to mitigate unwanted wildfire.

16. Do you use fire as a land management tool?

As this question overlapped with Question 14 it is recommended that it be removed from future surveys.

17. How often do you use fire?

Most respondents (n = 94) use fire Annually (33.0%). Twenty-eight percent of respondents who burn annually live in the Northern Region.

	<u>Small Southern</u>	<u>Large Southern</u>	<u>Small Northern</u>	<u>Large Northern</u>
<u>How Often</u>				
Annually	3	22	13	18
Biannually	1	4	3	1
Every three years	0	1	6	2
Longer	1	8	9	2

A significant although slight relationship was found between Length of Time Managing the land and How Often fire was used for land management purposes (n=116); Spearman's rho=.31.

There was a significant and moderate relationship between Age Group of respondents and How Often they used fire for land management purposes (n=116); Spearman's rho= .39.

18. Do you use fire to encourage healthy country?

Eighty-four per cent of respondents (n= 111) answered "Yes" to using fire to maintain healthy country.

19. Where does your fire knowledge come from?

Ninety per cent of participants (n=113) indicated they obtained their knowledge about fire from practical experience; 55.7% reported knowledge as being passed down; 13.3% stated that knowledge was obtained by training; 3.5% indicated the Internet as a source of fire use knowledge; 26.5% drew on word of mouth guidance; 9.7% sourced newspapers and other print information; and less than 1.0% of respondents nominated formal education or a GLM consultant as a way in which Fire Use knowledge was obtained. Overall, the 51-60 year olds felt that their knowledge predominantly came from practical experience. Note that more than one response option could be chosen; in future rank the responses.

		Age Group					
		<30	31-40	41-50	51-60	61-70	>71
Knowledge	Practical experience	3	14	24	<u>35</u>	21	5
	Passed down	3	10	15	21	12	2
	Training	0	3	3	8	0	1
	Internet	0	1	1	1	1	0
	Word of mouth	0	4	10	11	5	0
	Newspaper/ magazine	0	2	4	4	1	0
	Other: Formal education	0	0	0	1	0	0
	GLM consultant	0	1	0	0	0	0

20. Does using fire aid in maintaining your cultural values?

*The majority of participants (n=72) **do not** use fire to maintain Cultural Values (66.6%).*

		Cultural Value	
		Yes	No
Use Fire	Yes	22	48
	No	0	2

There appears to be a discrepancy as to how the concept of Cultural Value is shared among Anglo-Australian land managers. Whilst 30.5% answered "Yes", this question has not defined what is meant by Cultural Value. Future research could ask for a written definition to identify how the concept is generally interpreted. It is likely that like any value, Cultural Value is multi-faceted and requires more than one question to determine how others perceive it in terms of their fire use practices. However, the concept is clearly differentiated from Conservation and Economic Values for this sample. Future surveys could explore the multi-dimensions of each Value using scales and focus groups.

21. Does using fire aid in maintaining your conservation values?

*Almost all of the respondents (n=108) answered that they **did** consider the Conservation Value of using fire for land management (84.3%).*

		Conservation Value	
		Yes	No
Use fire	Yes	91	1
	No	13	3

22. Does using fire increase your economic viability?

*Most respondents (n= 103) **do** use fire management for its Economic Value (95%).*

		Economic Value	
		Yes	No
Use fire	Yes	95	0
	No	5	3

It is interesting to note the difference in the number of "Yes" responses to Q. 20 and Q. 21 and 22. Across the Regions there was no greater than chance likelihood that an Anglo-Australian land manager would not choose Cultural Value as a reason for their use of fire. The difference between those who answered "Yes" and "No" to the question suggests a difference in perceptions and subsequently practices. It may be that Cultural Value is perceived as being separate to Conservation and Economic considerations.

Given the capitalist culture and market economy that most of the land managers in this sample are a part of, it may be that Conservation and Economic Values overlap and take priority based on the financial outcomes. The western approach to tending the land is not ecological in outlook, ignoring relationships with country as critical in developing sustainable land management practices that impact on the wider community. Future surveys would do well to

explore land manager perceptions, representations and practices of Values among land managers.

23. Have your fire management practices changed over the years?

The majority of respondents (n=107) feel that their fire management practices Have Changed over the years. However it is not known when these changes first came into being, or what practices existed before the change. It is anticipated that this research will provide baseline data for a longitudinal study into perceptions and practices for land managers in the Rangelands.

Across the Regions, most respondents indicated "Yes" (66.3%). Overall the Northern Region has the largest number of land managers who felt they had changed their Fire Use practices (42%).

	<u>Small Southern</u>	<u>Large Southern</u>	<u>Small Northern</u>	<u>Large Northern</u>
<u>Fire Use</u>				
Yes	5	21	25	20
No	2	16	13	5

24. If yes, in what ways have they changed?

Most respondents (n= 75), nominated Less Fire Use, those aged over 51 years were more likely to be using Less fire. It is of interest to note that almost one-third of the responses indicated the option: N/A (32%); perhaps unable to answer the question clearly given the variable nature of seasons, prices for management of the land and lack of monitoring actual practices on a day-to-day basis.

	<u><30 years</u>	<u>31-40 years</u>	<u>41-50 years</u>	<u>51-60 years</u>	<u>61-70 years</u>	<u>>71 years</u>
<u>Fire Use</u>						
More	1	5	12	8	2	0
Less	1	6	8	18	10	4

A series of continuous learning workshops could be designed to facilitate interactive learning of Rangeland land managers. Topics would be general and tailored across age group, Regional location and cultural identity. Adding a forum to the NAFI website would encourage land manager visitors that are the target prospects to engage in sustainable land care-business practices. Visitors can exchange ideas, debate topics and highlight issues for future workshops and or policy changes.

Constructing a global set of Corporate Social Responsibility Guidelines on the site would aid land manager understanding of preferred practices. As well as avenues for educating rangelands' land owners about the importance and benefits of fire management.

Linking as joint ventures with other businesses that can provide services/products to the target market creates self-propagating markets and easy access to resources for land managers. One-off sales from affiliates can be leveraged to develop long-term relationships with land managers; and to aggregate resources that meets their identified needs.

25. If you do not use fire what are the constraints?

This question was answered by those who Use Fire for land management (n= 75). Obviously they felt that they still had constraints as to their current practices. Overall, 37% of respondents felt that uncertain rainfall was a constraint, whether they used more fire or not. Lack of grass also appeared to be a common constraint across Regions (28%). Although during the drafts it was decided to swap response choices to as many as were being used, it would increase accuracy to rank options or to have them as scales in the future. Of particular interest is that 14.5% of respondents did not agree to Use Fire for land management.

	<u>Use More Fire</u>	<u>Use Less Fire</u>	<u>Comments</u>
<u>Constraints</u>			
<i>Lack of grass</i>	5	16	
<i>Uncertain rainfall</i>	5	23	
<i>Cost of spelling/de-stocking</i>	2	12	
<i>Concern for neighbours</i>	2	5	
<i>Concern spreading weeds</i>	1	0	
<i>Lack of knowledge</i>	1	1	
<i>Not to use of fire</i>	0	11	<i>"Do not burn paddocks"</i> <i>"Only early storm burns"</i> <i>"Only use for fire breaks"</i> <i>"Lack of time"</i> <i>"Less soil organic matter"</i> <i>"Biodiversity recovery"</i> <i>"Seasonal variations"</i> <i>"Uncertain of benefits"</i>

26. If you use fire what objective is needed for your property?

Overall (n=97), Hazard Reduction was the main objective of land manager fire use (79.3%), particularly on Large Southern properties (31.0%).

	<u>Small Southern</u>	<u>Large Southern</u>	<u>Small Northern</u>	<u>Large Northern</u>	
<u>Month</u>					
January					
Hazard Reduction	2	1	0	3	
Weed control	3	0	2	1	
Green pick	0	0	2	0	
Remove bulk	2	0	1	3	
Tick control	0	0	0	1	
Keep woodland open	0	0	0	3	
Improve sowing	0	1	0	0	
Change species	0	0	1	0	
February					
Hazard Reduction	1	1	0	0	
Weed control	1	1	0	0	
Green pick	0	0	0	0	
Remove bulk	0	0	0	0	
Tick control	0	0	0	0	
Keep woodland open	0	0	0	0	
Improve sowing	0	0	0	0	
Change species	0	1	0	0	
March					
Hazard Reduction	0	0	1	8	
Weed control	0	0	1	3	
Green pick	0	0	1	1	
Remove bulk	0	0	1	3	
Tick control	0	0	0	0	
Keep woodland open	0	0	0	5	
Improve sowing	0	0	0	0	
Change species	0	0	0	2	
April					
Hazard Reduction	0	0	3	7	
Weed control	0	0	1	5	
Green pick	0	0	1	1	
Remove bulk	0	0	0	1	
Tick control	0		0	2	0

<i>Keep woodland open</i>	0	0	2	0
<i>Improve sowing</i>	0	0	1	0
<i>Change species</i>	0	0	0	0
May				
<i>Hazard Reduction</i>	0	1	4	13
<i>Weed control</i>	1	0	0	7
<i>Green pick</i>	0	0	0	1
<i>Remove bulk</i>	0	1	0	1
<i>Tick control</i>	0	0	1	0
<i>Keep woodland open</i>	0	1	0	3
<i>Improve sowing</i>	0	0	1	1
<i>Change species</i>	0	0	0	1
June				
<i>Hazard Reduction</i>	0	1	5	15
<i>Weed control</i>	0	1	0	7
<i>Green pick</i>	0	1	0	6
<i>Remove bulk</i>	1	0	0	3
<i>Tick control</i>	0	0	0	1
<i>Keep woodland open</i>	0	0	2	4
<i>Improve sowing</i>	0	0	0	4
<i>Change species</i>	0	0	0	0
July				
<i>Hazard Reduction</i>	0	4	5	5
<i>Weed control</i>	3	0	1	6
<i>Green pick</i>	0	2	0	0
<i>Remove bulk</i>	1	1	0	0
<i>Tick control</i>	0	0	0	0
<i>Keep woodland open</i>	1	2	1	1
<i>Improve sowing</i>	0	0	0	1
<i>Change species</i>	0	0	3	2
August				
<i>Hazard Reduction</i>	1	16	4	2
<i>Weed control</i>	2	2	2	5
<i>Green pick</i>	2	10	0	0
<i>Remove bulk</i>	1	6	1	1
<i>Tick control</i>	0	0	0	0
<i>Keep woodland open</i>	2	3	4	0
<i>Improve sowing</i>	0	4	1	0
<i>Change species</i>	0	0	0	1

September

<i>Hazard Reduction</i>	1	28	8	2
<i>Weed control</i>	5	8	9	2
<i>Green pick</i>	3	14	5	0
<i>Remove bulk</i>	1	19	5	0
<i>Tick control</i>	0	0	0	1
<i>Keep woodland open</i>	1	18	10	4
<i>Improve sowing</i>	0	6	2	2
<i>Change species</i>	0	0	0	0

October

<i>Hazard Reduction</i>	4	21	12	15
<i>Weed control</i>	2	10	12	10
<i>Green pick</i>	3	12	6	1
<i>Remove bulk</i>	2	13	9	7
<i>Tick control</i>	0	0	0	2
<i>Keep woodland open</i>	2	11	10	13
<i>Improve sowing</i>	0	3	3	8
<i>Change species</i>	0	0	1	0

November

<i>Hazard Reduction</i>	1	5	7	8
<i>Weed control</i>	0	2	4	6
<i>Green pick</i>	0	3	2	2
<i>Remove bulk</i>	0	2	3	2
<i>Tick control</i>	0	0	0	2
<i>Keep woodland open</i>	0	6	7	6
<i>Improve sowing</i>	1	3	1	1
<i>Change species</i>	0	1	1	0

December

<i>Hazard Reduction</i>	7	3	11	8
<i>Weed control</i>	3	1	13	6
<i>Green pick</i>	3	3	2	2
<i>Remove bulk</i>	5	3	10	6
<i>Tick control</i>	4	0	0	0
<i>Keep woodland open</i>	3	1	10	5
<i>Improve sowing</i>	2	3	6	1
<i>Change species</i>	0	0	5	0

If you use fire what fuel load (volume of grass) is needed for your purposes?

Across respondents (n=98), Small Northern land managers tended to use Low-Medium Fuel Loads whilst large Southern managers prefer Medium-High burns. Seventy-nine per cent of respondents indicated 1- 5 000 ton needed to burn, in general.

	<u>Small Southern</u>	<u>Large Southern</u>	<u>Small Northern</u>	<u>Large Northern</u>
<u>Fuel load</u>				
Low (<1, 000)	0	1	5	1
Low-Medium (1-3, 000)	3	11	17	2
Medium-High (3-5, 000)	3	20	7	14
High (>5, 000)	0	2	0	3

As always, contextual factors such as season, available rain water and density of the area to burn will determine fuel load for each burn. The highly variable nature of the use of fire for land management could do well to implement a Logbook to Rangelands land managers for monitoring of their practices. The NAFI site could host an online format of the journal to transfer selected records to a database. This pool of information could then be used to design workshops, develop policy and give direction to research.

28. What application/lighting pattern of fire do you utilise?

Across the Shires (n=83), the most popular methods of Fire Lighting were; Against the wind (84.3%), With the wind (80.7%), Roadside (77%) and Line (38%). The Northern Shires tended to use Roadside, Against the wind, With the Wind and River edge to a greater degree than Southern Shires.

	<u>Small Southern</u>	<u>Large Southern</u>	<u>Small Northern</u>	<u>Large Northern</u>
<u>Lighting pattern</u>				
Aerial	0	3	2	13
Mosaic	3	6	1	7
Line	4	16	7	11
Roadside	1	25	24	14
River edge	0	9	15	10
Against the wind	4	23	24	19
With the wind	4	26	21	16
Random	1	7	0	0

It may be of interest to future surveys to look at the relationship between lighting pattern and costs and benefits to country and land management goals. For example, do National Parks utilize all these methods or just a select few? Are their burning methods that can save costs on fuel and labor, increase safety and benefit the environment?

29. Within a burn area what percentage of the area do you aim for?

On average, land owners that did Use Fire for land management (n=103) aimed for an 80% burn; the range for most burns being 70-90%.

30. What features, if any, are used to contain fires when burning large paddocks?

Overall, most respondents (n=103) used Fire Break Construction to contain fires in large paddocks (84.4%). Northern Shires used all the containing features more so than the Southern Shires.

	<u>Small Southern</u>	<u>Large Southern</u>	<u>Small Northern</u>	<u>Large Northern</u>
<u>Features</u>				
<i>Earlier burnt areas</i>	1	15	12	15
<i>Fire break construction</i>	6	33	31	17
<i>River systems</i>	1	12	12	15
<i>Existing roads</i>	3	9	13	5
<i>Other:</i>				
<i>Rainforest edge</i>	0	0	0	0
<i>Backburning</i>	0	0	1	0
<i>Existing fencelines</i>	1	0	0	0
<i>Cattle pans</i>	0	1	0	0
<i>Woody thickening</i>	0	1	0	0
<i>Grazing adjacent paddock</i>	0	0	1	0
<i>Land formations (e.g. crest)</i>	1	0	1	0
<i>Plough line breaks</i>	1	1	0	0

31. Have you attended a Grazing Land Management workshop?

Almost all of the respondents (n=107) answered "Yes" to having attended a GLM workshop (94.3%). Land managers in the North tended to have more of an attendance at workshops.

	<u>Small Southern</u>	<u>Large Southern</u>	<u>Small Northern</u>	<u>Large Northern</u>
<u>GLM Workshop</u>				
Yes	2	8	18	9
No	5	26	22	17
Total				

It would add to the Rangelands Fire research to have individual feedback forms available at workshops and online. The information can be integrated with other records on a main database. It would also provide a better representation of workshop attendance.

If yes, has this influenced your use of fire?

Most of the respondents (n=36) answered "Yes" to the GLM workshops having influenced their fire management practices.

	<u>Small Southern</u>	<u>Large Southern</u>	<u>Small Northern</u>	<u>Large Northern</u>
<u>Use influenced</u>				
Yes	0	3	12	6
No	2	5	6	2
Total				

Not enough participants provided a response to this question, so it is recommended that it be removed in future surveys.

32. What is the frequency of wildfire (unwanted) on your property?

Of respondents (n=99), 55% managers use Longer than every three years, this was across both the North and South Regions. However it was slightly more common in the South.

	<u>Small Southern</u>	<u>Large Southern</u>	<u>Small Northern</u>	<u>Large Northern</u>
<u>Frequency</u>				
Annual	0	3	7	10
Biannual	0	2	4	1
Every three years	1	4	3	8
Longer	5	24	23	4

33. Do you have a wildfire response plan?

Across respondents (n=103), the majority did have a wildfire response plan (79.2%).

Northern managers tended to have a plan as compared to Southern managers.

	<u>Small Southern</u>	<u>Large Southern</u>	<u>Small Northern</u>	<u>Large Northern</u>
<u>Plan</u>				
Yes	4	27	<u>31</u>	19
No	2	7	7	6

34. Do you have enough fire fighting equipment?

Across Regions (n=108) most respondents said "Yes" to having enough equipment (69.4%).

Although, this means that almost a third of participants claim to not have adequate access to fire fighting equipment.

	<u>Small Southern</u>	<u>Large Southern</u>	<u>Small Northern</u>	<u>Large Northern</u>
<u>Equipment</u>				
Yes	6	<u>26</u>	<u>26</u>	17
No	1	9	14	9
Total				

There are opportunities for joint ventures and affiliations to enhance access to equipment and services, especially taking into account availability of online resources.

35. When was the last wildfire you fought on your property/neighbours?

Overall (n=64) November, 2006 was the most cited period for Last Wildfire fought. Sixty-seven per cent of the Last Wildfires reported occurred in Northern Shires, particularly on Small properties. For the past three years, according to respondent recall (n=95) most wildfires occurred in 2006 (29), 2005 (18) and 2007 (8). Wildfire reports for 1999 to 2003 suggest 5-7 wildfires per year. Previous to this (earliest date was 1951) there is recall of only one or two wildfires a year.

36. What is the annual rainfall for your property's location?

Across the Regions (n=109) there was an average of 504 mm (SD=392) of rain per year. The wide dispersion is due to a range of no rain to 2500mm each year. Northern land managers (n=60) reported the highest average annual rainfall, of 379 mm (SD=76).

This question would be more accurately answered by accessing government or research databases that already collects the information.

37. How do you obtain weather forecasts and climate outlooks?

Across the land managers (n=101) most nominated Television as the medium to Obtain Forecasts. The Internet accounted for 89% of participant's responses. There was no association found between respondents accessing NAFI and those who Obtain Forecasts using the Internet.

	<u>Small Southern</u>	<u>Large Southern</u>	<u>Small Northern</u>	<u>Large Northern</u>
<u>Forecast</u>				
Radio	4	34	22	13
Television	6	28	30	26
Internet	4	27	26	18
Nature signals	1	12	13	10
Own interpretation	2	10	12	6
Newspaper	2	10	10	6
SOI	2	10	9	4
Other:				
BOM website	0	0	0	1

3. Satellite Information

38. Do you have access to the Internet on your property?

Across the Regions, land managers (n=110) who use the Internet (86.7%), do so to obtain either; Use Fire for land management information; Obtain Forecasts; and access the NAFI site. All the respondents for this question have a Wildfire Response Plan.

	<u>Small Southern</u>	<u>Large Southern</u>	<u>Small Northern</u>	<u>Large Northern</u>
<u>Internet Access</u>				
Use Fire	2	34	32	23
Have Wildfire Response Plan	2	26	27	18
Forecast	0	1	6	4
NAFI	4	5	28	35

If yes, is the connection speed and reliability adequate?

Speed and reliability of land manager's Internet across the Regions (n=95) suggests that the Northern properties have better service (70.5%).

	<u>Small Southern</u>	<u>Large Southern</u>	<u>Small Northern</u>	<u>Large Northern</u>
<u>Speed/Reliability</u>				
Yes	2	22	25	18

39. Do you access the Internet for fire management information?

Of one hundred and six respondents, 55.6% answered "Yes" to using the Internet for Fire Management Information.

	<u>Small Southern</u>	<u>Large Southern</u>	<u>Small Northern</u>	<u>Large Northern</u>
<u>Fire Management Information</u>				
Yes	1	18	19	21

If yes, are you able to understand the information from the Internet?

The respondents (n=60) indicated that they were mostly were able to Understand Internet Information (91.6%).

	<u>Small Southern</u>	<u>Large Southern</u>	<u>Small Northern</u>	<u>Large Northern</u>
<u>Understand</u>				
Yes	1	16	17	21

40. Are you aware of the Northern Australian Fire Information (NAFI) near time satellite monitoring?

Most respondents (n=102) answered "Yes" to being Aware of the NAFI site. Of these, 44.1% were located in the North.

	<u>Small Southern</u>	<u>Large Southern</u>	<u>Small Northern</u>	<u>Large Northern</u>
<u>Aware</u>				
Yes	1	9	23	22

If yes, are you able to navigate the information?

Across respondents (n=52) most land managers who access NAFI are able to Navigate the site information (69.2%).

	<u>Small Southern</u>	<u>Large Southern</u>	<u>Small Northern</u>	<u>Large Northern</u>
<u>Understand</u>				
Yes	0	5	13	18

41. How long have you been using the NAFI website?

On average, respondents (n=58) have been using the NAFI site for 2.4 years (SD=1.8). The timeframe ranged from never to six years.

42. Are you aware of the fire scar history information on this web site?

Overall (n=94), most respondents were not Aware of the Fire Scar History Information on NAFI (55.3%).

	<u>Small Southern</u>	<u>Large Southern</u>	<u>Small Northern</u>	<u>Large Northern</u>
<u>Aware</u>				
No	6	26	15	5

43. If yes, do you use NAFI near time information to be aware of fires on your property?

Across Regions (n=56) most participants answered "Yes" to using near time information on the NAFI site (55.3%).

	<u>Small Southern</u>	<u>Large Southern</u>	<u>Small Northern</u>	<u>Large Northern</u>
<u>Near Time</u>				
Yes	0	2	11	18

44. Do you use a GPS for mapping infrastructure on your property?

Of the 104 land managers, 64.4% USE GPS infrastructure.

	<u>Small Southern</u>	<u>Large Southern</u>	<u>Small Northern</u>	<u>Large Northern</u>
<u>Use GPS</u>				
Yes	3	20	22	22

45. If yes, what type of GPS do you use?

Respondents (n=61) nominated the Garmin series (58) and the Magellen series (3) as their GPS infrastructure of choice.

4. Environmental Information

46. How do you define "woody thickening"?

Land manager definitions of woody thickening varied; most stated that woody thickening was a negative occurrence; and words such as "excessive" and "invasive" were common:

Negative Definitions

- "Excessive sucker growth/re-growth"*
- "Plant growth that cannot be seen through"*
- "Excessive shrub under story"*
- "Difficult to walk/drive through"*
- "Increasing number of woody plants unpalatable to cows"*
- "Increase trees/timbers growing in woodlands/across open country"*
- "Increase of one species of plant in an area beyond the ecosystem norm"*
- "Lack of grass for hot fires leads to dense thicket"*
- "Infestation of woody weeds"*
- "Invasive native species"*
- "Re-growth from burning over grazing weeds"*
- "Too many seedlings because lack of fire/grass competition"*
- "Unnatural imbalance of re-growth"*
- "Increasing number of young trees"*

Positive Definitions

- "Natural regeneration of mostly native species"*
- "Dense shrub under story"*
- "Early seasonal spring growth due to absence or reduced frequency of fire"*
- "Suckers growing on trees"*
- "Open woodland overgrown with one native species"*
- "Prickly bushes"*

47. Do you have woody thickening on your property?

Across 111 respondents, 87.3% have Woody Thickening. Of these, 107 respondents also Use Fire. Overall, the North has more incidences of Woody Thickening. The Northern properties had the most frequent citing of Woody Thickening and Use Fire. Although there was not a significant

association between Use Fire and have Woody Thickening this may be due to the small sample number.

	<u>Small Southern</u>	<u>Large Southern</u>	<u>Small Northern</u>	<u>Large Northern</u>
<u>Use Fire</u>				
Yes	6	36	34	25
<u>Woody Thickening</u>				
Yes	6	35	35	19

48. How many years have you had woody thickening?

Respondents ($n=101$) reported that Woody Thickening had on average been present for 38 years ($SD=36$). The timeframe ranged from never to 200 years.

49. Is woody thickening a problem on your property?

One hundred and six respondents indicated that they had a Woody Thickening Problem. Thus, five land managers do not consider woody thickening a negative issue.

	<u>Small Southern</u>	<u>Large Southern</u>	<u>Small Northern</u>	<u>Large Northern</u>
<u>A Problem</u>				
Yes	5	34	27	17

There was no significant association between having woody thickening and it being a problem. Future surveys would do well to increase the sample number to allow for Chi Square significance testing.

Why/Why not?

Not many responses were obtained from this question. Although it has the potential to provide critical information as to how Woody Thickening is perceived, it may be that the current survey is too long or that land managers do not see the question as relevant.

A Problem

"Alters the habitat, reduces viability"

"Leads to annual wildfires"

"Changing fuel levels"

"Chokes pasture"

"Mustering is difficult"
 "Thickening competes with grass and causes soil erosion"
 "Suppresses productivity"
 "Cuts access and grazing"
 "Thins grass species"
 "Drought means cannot burn"
 "Reducing stock numbers"
 "Increases erosion"
 "Maintenance"
 "Decreasing critical fauna habitat"

Not a Problem

"Blade plough keeps under control"
 "Controlled with fire"
 "Small problem in small areas"

50. Approximately how many acres of your property have woody thickening?

This data was too variable to obtain a mean from. Future surveys need to re-word this question to make it a scale, or to have respondents shade in an area.

51. What do you consider to be the main cause of woody thickening on your property?

Across land managers (n=91), 63.7% thought that Lack of Fire was the dominant cause of Woody Thickening on their property.

	<u>Small Southern</u>	<u>Large Southern</u>	<u>Small Northern</u>	<u>Large Northern</u>
<u>Cause</u>				
<i>Fire</i>	0	3	6	8
<i>Lack of fire</i>	4	26	20	8
<i>Over grazing</i>	0	1	3	1
<i>Drought</i>	2	3	2	2
<i>Rainfall</i>	0	0	3	0

52. What impact has thickening had on the diversity of flora and fauna species on your property?

Almost a third of the responses were from Large Southern properties, indicating that woody thickening was a problem with regard to fauna and flora diversity (30.7%). Although it tended to be the Small Northern properties on which woody thickening was reported to be not at all impacting on species diversity (6.7%). Land managers answered that thickening had mostly a "medium-high" impact on flora and fauna in the area (20.2%); just over a third (33.6%) nominated that impact was more than medium. Interestingly, over a tenth of responses from the Northern regions indicated that woody thickening was not a problem, and if it was had only a "low" to "low-medium" impact on fauna and flora.

Problem	Impact	Regional Group			
		Small Southern	Southern Large	Northern Small	Northern Large
Yes	low	1	7	7	9
	low-medium	1	8	4	6
	medium-high	2	9	9	1
	high	1	8	5	0
No	low	1	0	4	4
	low-medium	0	0	2	2
	high	0	0	1	0

53. Have you noticed a change in vegetation type?

Overall one hundred and seven land managers answered this question. Of the responses for thickening impacting negatively on species diversity, the Large Southern properties stated most that "Yes" they had seen vegetation changes, mostly in the medium-high" range (4.6%). Overall, 23.4% of those who considered woody thickening to have a negative impact, also responded that they had noticed a "medium-high" to "high" level of species changes.

Impact	Vegetation Change	Regional Groups			
		Small Southern	Southern Large	Northern Small	Northern Large
low	Yes	0	4	2	5
	No	2	3	9	7
low-medium	Yes	1	4	5	5
	No	0	3	1	3
medium-high	Yes	2	7	5	1
	No	0	2	4	0
high	Yes	1	7	6	0
	No	0	1	0	0

If yes, please comment on noticeable species changes:

Of the 111 responses to this question flora nominated were seen as invasive woody thickening, whilst all fauna were considered to be threatened natives.

Acacias

Black Speargrass

Black Wattle

Bauhinia

Boree

Breadfruit

Brigalow

Brush Box

Buffalo Grass

Casaurina

Chinese Apple

Common Sandalwood

Conker Berry

Corkwood

Cyprus Ironbark

Cypress Pine

Ergrostis

Eucalyptus

Ferns

Giant Speargrass

Gidyea
Grasses
Indian Couch
Lantana
Leopardwood
Melaleuca
Mitchell Bluegrass
Needlewood
Northern Mulga Grass
Prickly Peach
Sicklepod
Spinnaphex
Swamp Mahogany
Tea Tree
Wattle
Shipstick
Zamia
Fauna
Bustard Birds
Finches
Kangeroos
Squatter Pigeons
Top Knot Pigeons
Wallaroos
Yakka Skink

54. Estimate the annual negative impact of woody thickening on your property's carrying capacity and production.

Land managers (n= 65) more often than not identified their Annual Negative Impact from woody thickening to be over \$50, 000 (38.4%). It appears that Southern Regions have slightly more respondents experiencing negative impact to this extent.

	<u>Small Southern</u>	<u>Large Southern</u>	<u>Small Northern</u>	<u>Large Northern</u>
<u>Impact</u>				
<\$5 000	0	0	3	2
\$5-10000	4	2	2	2
\$10-20000	2	3	4	1
\$20-30000	0	3	6	0
\$30-40000	0	2	2	1
\$40-50000	0	2	1	0
>\$50000	0	14	8	3

55. Estimate the annual positive impact of woody thickening on your property's carrying capacity and production.

Across respondents (n=23) the dominant response was an Annual Positive Impact of less than \$5, 000 (73.9%). It appears that land managers in Northern Regions reap more positive benefits from woody thickening as compared to Southern Regions.

	<u>Small Southern</u>	<u>Large Southern</u>	<u>Small Northern</u>	<u>Large Northern</u>
<u>Impact</u>				
<\$5 000	1	6	7	3
\$5-10000	0	0	1	0
\$10-20000	0	2	2	1
\$20-30000				
\$30-40000	0	0	1	0
\$40-50000				
>\$50000	0	0	1	0

56. What woody thickening management practices do you use?

According to land managers (n=93) Fire is the main woody thickening Management Practice that they use (86.0%). Next popular management practices were Poisoning (51.6%) and Plough (34.4%). Overall, the North used Fire and Poisoning more, whereas the South used the Plough more.

	<u>Small Southern</u>	<u>Large Southern</u>	<u>Small Northern</u>	<u>Large Northern</u>
<u>Impact</u>				
Poisoning	5	18	15	10
Fire	<u>4</u>	<u>31</u>	<u>27</u>	<u>18</u>
Leave it be	1	2	3	1
Fertilize	1	3	0	0
Mulching	1	0	0	0
Plough	5	18	8	1
Blade	2	10	5	1
Push	2	7	3	1
Pull	2	8	9	1
Ring-bark	0	3	2	0
Ball-and-chain	0	2	3	0
Other:				
Axe/Chainsaw	0	0	0	0
Goats	0	1	0	0
Brushcutters	0	1	0	0
Crocodile seeder	0	1	1	1
No grazing	0	0	0	1
Whipper snipper	1	0	0	0
Slashing	0	0	1	0
Stick raking	0	1	0	0
Legislation	0	0	1	0

57. Of the method/s chosen, which one has aided your management the most?

Across respondents (n=108) 28.7% nominated Fire as the practice which Aided management of woody thickening. Respondents also nominated frequently; Plough (13.8%), Poison (10.2%), Blade (8.3%) and Pull (5.5%).

58. Of the method/s chosen, which one has aided your management the least?

This appears to be not a well written question (n= 92). Instead re-word to "methods that have hindered management". Fire again was the most common nomination (12%). This may be because it is a cold burn, with the lack of available fuel and/or seasonal timing. Poison was nominated by 11 participants due to the expense. Considering global awareness and social responsibility it is ideal that land managers decrease the use of poisons; however, alternatives that meet identified needs of the managers need to be presented in a systematic manner.

Mechanical means dominated the methods which hindered management of woody thickening; blade, plough, push and pull are among the most frequently nominated methods.

Part III: Attitude toward Fire Management Scale (AFmS)

The Attitude Scale was specifically developed for this study. It drew on previous research, literature and discussions between personnel at Cape York Peninsula Development Association, land managers and other land management agencies. Scales can measure subjective perceptions and affect reflected by country, concepts and practices. Scales allow for more information to be gathered as opposed to "Yes/No" responses; providing a guesstimate of degree of sensitivity reflected from each question. The construct "Attitude" was determined to be made up of five dimensions; Cultural, Conservation, Economic, Woody Thickening and Legislation. The twenty-six items on 5-point Likert scales were chosen to measure if these dimensions are reflected in Attitude, and to what degree. It was anticipated that summation of sub-scores (5) for a Total Score would provide a score range from 26-130. The Total Score provides an overall picture of land managers' Attitudes toward Fire Management. As well as identifying areas of concern, interest and innovation, as well as constancy.

As 3 respondents had too many missing data points they were not included in the sample. Respondents may have missed items for several reasons; not understanding the value of survey research to themselves as land managers; or lack of experience completing surveys/reflecting on and communicating practices that tend to be "taken for granted".

Depending on the internal reliability of the scale (the degree that questions correlate/ have something in common) the questions will each measure some aspect (dimension) of the overall construct. A correlation value informs of the relationship between two questions on a scale. The value lies between -1 to +1 and shows direction (positive or negative relationship) and strength of the relationship (> .30 is a moderate relationship; 0.0 is no relationship; >.70 is a strong relationship).

Cronbach's alpha .92 indicates a very strong relationship between items and so Attitude looks to have high internal constituency. It is expected that respondents in future surveys would interpret the items similarly to the sample used here. However, this can only be validated through future testing across Regions, types of land managers, climatic and practice changes. At present, the Attitude questions can be utilized for future research, although it is strongly recommended

that the Factors be revised within a focus group. Re-wording of questions will modify phrasing and to expand the dimension of Factors to provide a concise multi-faceted concept of Attitudes.

With a median of 80 (adding up all the total scores for each respondent), 50% of the land managers (n=113) with positive Attitudes scored 80 or above as a Total Score. Across the Regions, Total Scores reflect a trend/not in positive Attitudes toward Fire Management. There was no significant association between Region and Positive Total Scores (n=108).

Regional Group	Positive	Negative
Small Southern	2	5
Southern Large	20	16
Northern Small	19	20
Northern Large	12	14

There was no significant association found between Age-Group and Total Score on Attitudes. However, this may be amended with a larger sample. The Age Group 51-60 year olds had the most positive responses as well as the highest number of negative responses (n=113).

age	Positive	Negative
<30	3	0
31-40	9	6
41-50	12	14
51-60	23	17
61-70	7	16
>71	2	4

Also, there was no significant association between Type of Land Manager and Total Score (n=113).

type	Positive	Negative
grazing	53	51
conservation	3	6

There was no significant association between Main Property Type and Total Score (n=113). Those who had Positive Total Scores tended to use fire Annually (n= 99).

	Positive	Negative
annually	32	27
biannly	5	4
triannly	4	5
longer	8	14

There was a significant association between those who Use Fire and those who use fire to support their Cultural Values, $\chi(2, N=93)= 6.81, p < .05$. Economic Values also showed a

significant association with Total Score, $\chi(2, N=101) = 10.21, p < .05$. However, Conservation Values showed no significant association amongst variables. This may be due to a small sample number. Alternatively, it may be that land managers are not aware of the Conservation Value of Fire Management. Future workshops, website content and other resources would do well to focus on exploring this variable further.

Interestingly, an almost equal number of respondents had Positive and Negative Total Scores when cross-indexed with Have Changed Practices ($n = 110$). It appears that most participants with Positive Total Scores had Changed Practices and were Using Less Fire. This aligns with findings that overall, participants who had changed their Fire Management practices were Using Less Fire ($n=41$).

	Positive	Negative
Yes	37	36
No	18	19

	Changed Practices	
	Yes	No
use more fire	26	2
use less fire	41	3

Across respondents ($n = 104$) the majority of responses were Positive Total Scores ($n = 45$), overall there was no significant difference between those who did and did not have a Wildfire Response Plan and who responded with Positive or Negative Total Scores. This may be due to the small sample number not providing a sample more representative of a normal curve.

	Positive	Negative
Yes	45	37
No	9	14

Most respondents using the Internet also had Positive Total Scores ($n = 113$).

		Positive	Negative
Internet	Yes	50	48
	No	6	9

There was no significant association between Understanding Internet fire management information and Positive Total Scores ($n = 110$).

	Positive	Negative
Yes	33	25
No	5	0

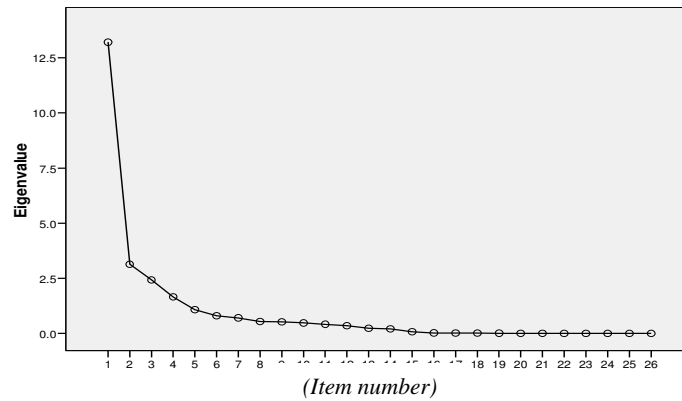
There was no significant association between Have a Wildlife Response Plan and Positive Total Scores (n= 113).

A univariate ANOVA found a significant difference between Age Groups and Total Scores, $F(1,5)= 4.14, p < .05$. There was no significant difference across Gender for Total Scores. Across the Regions there was no significant difference between Regional Groups for Total Scores. There was a significant difference between those who Used Fire for Land Management and those who did not for Total Scores, $t(104)=2.8, p < .05$.

Sub-Scales of the Attitudes toward Fire Management Questionnaire

The construct for Part III of this study was "Attitude toward Fire Management". Although five Factors (dimensions/aspects) were found as expected, the loading of Factors did not align with the hypothesis; Cultural, Conservation, Economic, Woody Thickening and Legislation. Patterns amongst scales multi-responses can highlight issues of importance or neglect. The responses of scales can also be added to provide sub-scales and/or a Total Score. Results showed five Factors (dimensions/aspects of Attitude) that account for 76.3% of the variance in the data. A five Factor model is supported by the elbow and plateau of Eigen values in the scree plot shown in Figure 2. Hence, the Factor Analysis model contains questions that are relevant to the land managers and measures different aspects of the overall construct, Attitude. However, the five Factors identified do not align with those hypothesizes. Future research should pilot the scale to re-word questions to measure five distinct Factors of Attitude.

Figure 2. Scree plot supporting a five Factor Model.



Factors (dimensions/aspects of Attitude)

There was a significant correlation between the items on the Attitude Scale (Bartlett's Test of Sphericity was significant; KMO was .79 for sampling adequacy). This implies questions were asking about the same construct. It is expected that Part III of this survey will have strong reliability and validity across time and land managers in the Rangelands. **The scale could be enhanced by re-evaluating the questions loading onto Factors and differentiate questions that can be re-worded, eliminated or added to clearly differentiate and measure all the dimensions of Attitude.** There is a need to increase the scales cross-cultural measurement that is inclusive of what is of value to Australian's besides economic benefits. The items are skewed in terms of ethnocentrism, focusing on the economic outcomes rather exploring relationships with country.

Factor 1:

<i>Decreased wildfires</i>	.89
<i>Firebreak construction economical</i>	.86
<i>Should obtain permit</i>	.87
<i>Wildfires not caused significant damage</i>	.87
<i>Woody thickening not a big issue</i>	.81

Factor 2: NAFI

<i>Navigation of site is easy</i>	.95
<i>Useful to management practices</i>	.88
<i>Fire scar info not useful</i>	.87
<i>Information relevant to needs</i>	.84

Factor 3:

<i>Thickening decreased capacity</i>	.70
<i>Early burn economically worthwhile</i>	.75
<i>Did remove bulk</i>	.72
<i>Wildfire response plan useful</i>	.70

Factor 4: Biological

<i>Change pasture species</i>	.82
<i>Improve green pick</i>	.62
<i>Aided tick control</i>	.44

Factor 5: Legislation

<i>Regulation increase woody thickening</i>	-.63
<i>Regulations hindered practices</i>	-.57

Future surveys would do well to inform potential participants of the next survey about the value this information has to land managers and changes to policy and best practices. This will likely increase the motivation to answer the scales. The most frequent response choice for each item (question) is highlighted in bold font in Table 3.

Table 3

Percentages of Responses to Attitude to Fire Management Scale (AFmS) Items.

	<i>n</i>	Completely Completely Disagree	Slightly D	Neither D/A	Slightly A	Agree
59. Woody thickening is not a big issue on my property.	111	10.8%	17.1%	5.4%	9.9%	56.8%
60. The Northern Australian Fire Information (NAFI) website is useful to the management of my property.	88	9.4%	2.1%	37.5%	14.7%	36.3%
61. It wouldn't be useful to my land management practices to learn more about satellite technology	101	7.1%	5.9%	14.8%	18.8%	53.3%
62. Woody thickening is widespread on my property.	111	23.4%	9.9%	9.9%	14.4%	42.3%
63. Use of fire management maintains my cultural practices.	92	26.0%	2.2%	41.3%	6.6%	23.9%
64. NAFI is an easy to navigate website.	80	3.7%	2.5%	51.2%	17.5%	25.1%
65. Woody thickening has dramatically impacted the carrying capacity of my property	95	5.2%	1.1%	23.9%	26.3%	37.0%
66. My wildfire response plan has been useful to my management practices.	104	17.3%	6.8%	13.4%	16.3%	46.2%
67. The information I access on NAFI is relevant to my needs.	83	3.6%	1.2%	43.3%	27.7%	24.2%
68. Fire scar information on NAFI has not been of use to my land management practices.	83	7.4%	8.4%	45.7%	10.8%	27.7%
69. Using fire management has enhanced biodiversity.	103	7.8%	1.0%	23.3%	26.2%	41.7%
70. Using fire management has improved the economic viability of my property.	110	4.5%	1.8%	10.9%	24.5%	57.2%
71. Firebreak construction is economically worthwhile.	112	2.6%	1.0%	6.3%	20.5%	69.6%
72. Early season burning is economically worthwhile.	109	10.0%	5.5%	10.0%	20.1%	53.2%
73. Wildfires have not caused significant economic damage to my property.	111	35.5%	15.9%	28.3%	7.3%	28.3%
74. I agree that I should obtain a permit to use fire management.	112	6.3%	1.8%	8.9%	11.6%	71.4%
75. Government regulations have hindered my management practices.	108	11.1%	2.8%	15.7%	13.9%	56.5%
76. Government regulations have led to an increase of woody thickening on my property.	98	18.3%	1.2%	21.4%	12.2%	46.9%
77. Use of fire has aided tick control on my property.	81	14.8%	3.7%	54.3%	9.8%	17.2%
78. Use of fire has not helped to remove the bulk of dry pasture on my property.	99	57.7%	14.1%	21.2%	4.0%	4.0%

79. There is a noticeable increase in weed control on my property due to the use of fire.	103	18.4%	2.9%	26.2%	20.3%	32.0%
80. Use of fire has enabled better green pick on my property.	105	5.9%	1.9%	10.4%	31.4%	50.4%
81. Fire management has decreased incidences of wildfire on my property.	106	12.2%	3.7%	7.5%	12.2%	63.2%
82. Fire management has not aided in keeping woodland open on my property.	92	53.2%	13.0%	22.8%	7.9%	2.1%
83. I have been able to efficiently change pasture species through the use of fire.	98	15.4%	5.1%	41.8%	20.4%	17.3%
84. I have been able to efficiently sow improved pastures through the use of fire.	99	10.2%	6.0%	32.3%	21.2%	31.3%

Part IV: General Feedback

Thirty-two of the land managers provided further information by answering the final open-question that asked for their feedback about the survey and fire management in general. Overall, the respondents support the use of fire management. One land manager has undertaken his own research into fire management (15) and several responses advocated the use of early burns (2), burning after the rains (20, 22 and 30), although two responses pointed to the usefulness of hot fires instead of cold (13 and 31).

No.	COMMENT	THEMES
1	Our property is in the early stages of development but my lifetime on the Cape York has given us a good insight to the fire & property we manage. Answers are based on that	<ul style="list-style-type: none"> ▪ Knowledge due to lifetime of living in area.
2	When to burn is a hard call as to prevent wildfires need to burn early but this seems to encourage thickening, late burning before wet season seems to help control this but is not always possible if country is lost early due to fires either deliberately lit or camp fires left burning	<ul style="list-style-type: none"> ▪ Early burns needed to prevent wildfires ▪ Early burns encourage thickening ▪ Late burn before wet season controls thickening ▪ Early burns deliberately lit or from campfires
3	In our country if the grass is not eaten by the end of winter it has no value. Without fire we could not make a living	<ul style="list-style-type: none"> ▪ Grass of no value if not eaten by end of winter ▪ Fire needed for income/profit
4	You should mention somewhere a section of questions relating the properties that join Q P & WLife land. This is where all "wildfires" that occur in our area start or build energy to travel if a weather change becomes nasty	<ul style="list-style-type: none"> ▪ In this area properties adjoining QP&W land is where all wildfires occur ▪ Or wildfires build energy (in these areas) to travel if weather changes
5	Planned & monitored Fire management can have a positive impact on the sustainability of our native flora & fauna across our landscape	<ul style="list-style-type: none"> ▪ Good fire management = sustainability of flora & fauna
6	Any land management in which government has control always turns out a stuff up. Control of fire by locals in rural fire boards is the only effective method of control. It can't be learnt at university (incidentally I do hold tertiary qualification)	<ul style="list-style-type: none"> ▪ Government controlled land management has negative impact ▪ Local controlled (rural fire boards) is effective
7	On this property fire has been used mainly for burning country prior to seeding with other grasses. During a developmental period of 30 odd years which has coincided with economic pressures to run more livestock which means less fires to control natural regrowth from seedlings resulting in woody thickening which in turn leads to less grass growing completing a negative (for grass growth) circle. This property is 1/3 Brigalow, 1/3 Box. 1/3 Cypress Pine.	<ul style="list-style-type: none"> ▪ Fire used mainly prior to seeding ▪ Economic pressures to run more livestock means less fires to control natural regrowth from seedlings ▪ Less fires resulting in woody thickening ▪ Growth of woody thickening leads to less grass growing
8	Fire is a good resource for short term economic gain.	<ul style="list-style-type: none"> ▪ Fire is good for short term economic gain.

9	Since undertaking appropriate fire management we have noticed more native Australian wildlife on the property, have also noticed more feral animals that are attracted to green pick, open country etc.	<ul style="list-style-type: none"> ▪ Appropriate fire management increased native Australian wildlife on property ▪ Appropriate fire management increased number of feral animals attracted to green pick
10	Some topics have included a knowledge of CYPDA methods through my involvement with other sections of the Fire Service. Hence my knowledge. But no use.	<ul style="list-style-type: none"> ▪ Knowledge of CYPDA methods gained from other sections of fire service are of no use
11	The long term affects of fire increases woody weeds due to drying out of the country and it increases fire tolerant species Eucalyptus – Wire & Spear grasses etc.	<ul style="list-style-type: none"> ▪ Long term effects of fire increases woody weeds ▪ Long term effects increases fire tolerant species Eucalyptus, wire & spear grass etc.
12	I personally do not believe in burning grass in this hilly country as it is required for mulch, so try to graze enough to keep grass say cropped ½ length to prevent wild fires as we have experienced in 2006 & 2007 from the build up of excessive grass fuel following 2003/4/5/6.	<ul style="list-style-type: none"> ▪ Do not burn grass in this area as it is needed for mulch ▪ Only graze to keep grass cropped ½ length to prevent wild fires ▪ Have experienced wildfires from build up of excessive grass fuel
13	Most days we have cloud cover being so close to the coast and the satellites don't pick up fires much.	<ul style="list-style-type: none"> ▪ Coastal area has cloud cover and satellites don't pick up fires
14	Due to unpredictability of seasonal conditions I do not have a set fire regime and have not carried out burning for a few years. A set wildfire response plan is not appropriate as each wildfire must be considered unique and a unique approach utilized – often the only effective means is to cut a lead break and back burn as much of the property is not readily accessible by vehicles due to terrain. I do maintain a system of Road/Fire breaks but wildfires do not always start in convenient locations. Woody thickening tends to be seasonal and more noticeable following prolonged drought. I have not included the large areas of Spinifex and turpentine (native wattle) hills & ridges in the woody thickening areas as these vegetation types tend to remain stable. Hot fires are necessary to control turpentine but are used sparingly due to extreme damage to other species.	<ul style="list-style-type: none"> ▪ Unpredictable weather infringes on having a set fire regime/management ▪ A set wildfire response plan not appropriate as each is unique ▪ Only effective means is to cut lead breaks and back burn as most terrain is not accessible by vehicle. ▪ Maintain a system of road/fire breaks ▪ Woody thickening tends to be seasonal & more noticeable following prolonged drought ▪ Hot fires are needed to control turpentine but used sparingly as this can cause extreme damage to other species.
14	Some questions are a bit too simplistic and need discussion to clarify the true position on some matters regarding fire & fire management.	<ul style="list-style-type: none"> ▪ The survey needs to be complemented with a discussion to understand the complex issue of fire management.
15	Results to date of a long term fire project on property. The associated practice of burning before (1 year) and after (> 3 months) has seen a significant increase in bulk & diversity of native/and pasture	<ul style="list-style-type: none"> ▪ Undertaking own research into best practices for burning. ▪ Have noted that burning has benefited capacity and environment.
16	After attending the [workshop] by DPI in Georgetown 29/08/07 it is very evident that fire will be a very useful tool in the control of the thickening.	<ul style="list-style-type: none"> ▪ Fire is very useful tool in the control of woody thickening.
17	Lack of water. Last wildfire on nearby property over 8 years ago. The Emerald District Fire Brigade Office has closed a few months ago. The Fire officers available are responsible for 90 odd Brigades. And brigade meetings are spaced too far apart- a farcical situation.	<ul style="list-style-type: none"> ▪ Lack of fire due to drought lowers the risk of wildfire ▪ Not enough Fire Brigades.
18	I have a longstanding and passionate interest in land management and of course decisions about fire use are a central issue. Fire is not though a "natural" occurrence...the majority of fire has been due entirely to human activity. ...The huge destructive fires down south...are largely due to mismanagement and failure to control fuel loads....The Aborigines kept the fuel load down with a regime of constant low intensity creeping fires....people seem to think that there is only one time of year to burn, i.e., Spring. ...Depending on conditions to decide when to burn leads to a mosaic burn pattern which is best for ecological purposes. The grazing industry has a different set of objectives and uses fire to maintain a particular state of bio-diversity...probably the key focus for management is the question of frequency.	<ul style="list-style-type: none"> ▪ Fire use is a critical issue. ▪ Need a better definition of "fire". ▪ Wildfires due to mismanagement of fuel loads ▪ Indigenous Australians burnt more frequently, depending on areas needing it. ▪ Low fuel intense fires more often is best ecologically. ▪ Frequency of burn is the key.
19	Fires have got to be controlled or they can cause an awful lot of trouble and burning in the right time so as they won't get away sometimes fires does a hell of a lot of good but they be very dangerous	<ul style="list-style-type: none"> ▪ Fires need to be controlled. ▪ Fires can do a lot of good. ▪ Fires are very dangerous.
20	Burning as soon as possible after rain helps to mitigate the growth of fresh wattle. Also if rain falls soon after a burn rather than later Spinifex will respond much better	<ul style="list-style-type: none"> ▪ Burning after rain mitigates growth of fresh wattle. ▪ If rain falls soon after a burn Spinifex will respond much better.
21	There is country inside the dingo barrier fence near to us. People haven't been able to burn country there for years due to a combination of drought and extremely high red and grey kangaroo numbers. Country in this area can't even be spelled to encourage grass regeneration as the roos move in and clean it out	<ul style="list-style-type: none"> ▪ Some country cannot be burned due to high numbers of red & grey kangaroos. ▪ Cannot spell this country for grass regeneration as kangaroos eat it.

22	If we get late Wet Season rain – followed by rain in May/June – we often burn open swamps to get green pick – otherwise spend the last half of year keeping fires off our property from fires being lit on neighbours at random	<ul style="list-style-type: none"> ▪ If late wet season we with rain in May/June we burn open swamps to get green pick. ▪ Last half of year keeping wildfires off property.
23	Wildfires started on uncontrolled indigenous owned lands and on National Parks (by pig hunters) are a major problem	<ul style="list-style-type: none"> ▪ Wildfires started on uncontrolled indigenous owned lands and on National Parks (by pig hunters) are a major problem.
24	In general I find using fire as a tool for control of seedlings and grass which renders no protein value for animals. It also helps native pastures to survive as they are used and generate new growth after a burn has been over the land concerned.	<ul style="list-style-type: none"> ▪ Using fire as a tool to control seedlings and grass renders no protein value for animals. ▪ Fire helps pastures to survive and generate new growth.
25	The unkindest use of fire on rural property is of great importance to stop wildfires from escaping from unmanaged State forest & national parks that are our neighbour	<ul style="list-style-type: none"> ▪ Use of fire on rural properties stops wildfires from escaping unmanaged neighbouring state forest and national parks.
26	NB: National Park	
27	Q23 & 24: I am using less ignition points more strategically. This results in a better fire mosaic pattern but requires (overtime) more fires being lit)	<ul style="list-style-type: none"> ▪ Using less ignition points more strategically results in better fire mosaic pattern.
28	I would like to see the law changed on the max clearing along fence lines to assist brigadiers in control of wild fires.	<ul style="list-style-type: none"> ▪ Change law on max clearing along fence lines.
29	It is too difficult to understand that the lack of fire since grazing sheep & cattle started has greatly changed the landscape. Now huge numbers of kangaroos prevent spelling country for burning. Our best country (by miles) has had the best burns over the years. I predict though that fierce buffer grass fires are going to kill many box trees in years to come. Box can not stand the extra heat. Regrowth or thickening + drought or kangaroos = less grass=less fire =lower grass = lower \$\$ = more stock to maintain viability = less grass =less fire & so on. Politicians & DNR & DPI & desert uplands etc have not done anyone including the environment any good in the whole veg management process	<ul style="list-style-type: none"> ▪ Huge numbers of kangaroos prevent spelling country for burning. ▪ Best country on our property has had best burns ▪ Fierce buffalo grass fires will kill box trees in years to come. ▪ Regrowth/thickening + drought or roos=less grass=less fire=lower grass=lower \$\$=more stock to maintain viability=less grass=less fire. ▪ No positive impact from whole veg management process.
30	Always try and burn after rain event	<ul style="list-style-type: none"> ▪ Always burn after rain.
31	Bryan Fire Management practices have changed on certain parts of Traditional Country with the invasion of noxious weeds (rubber vine) in particular. We need hot fires to help contain this weed. With the change in our culture we have less time to care for our country for we now work 5-6 days a week. This is why now we are starting to see some woody thickening of our country. But with people like Big Kev Anderson up here now in the Gulf Country we are starting to understand the need to have good fire practices on Country and developing fire ranger teams for the traditional owners we can care for country again to make sure it is positive conditions for our children and our children's children.	<ul style="list-style-type: none"> ▪ Need hot fire to control noxious weeds ▪ Less time for caring for country as we work 5 days a week ▪ There is a need for good fire practices on country ▪ Develop Fire Ranger teams for positive conditions and caring for country
32	My grandfather could remember when there were open wooded grasslands – none replaced with growth- trees & wattle – Trouble is the DPI NT does not understand history and says my grandfather needed glasses. We should be able to turn these lands to the state when white man took over with grazing animals & controlled fires – aboriginals had no way to fight fire – they hid in caves!	<ul style="list-style-type: none"> ▪ Our property long ago (grandfathers era) had previously open wooded grasslands and were not revegetated – we should be able to hand these lands back to government

Part V: Conclusion

The aim of investigating land manager fire use across the Rangelands was to recognise the advantages in taking needs-orientated approaches to direct future research and development. None of the expectations for this research were met. It was anticipated that more respondents in the North would more likely; use fire for land management; have wildfire response plan; have issues with woody thickening relating to fire use. There was no significant association between whether the land manager was located in the North or the South of the State and; fire use; having

a wildfire response plan; and having an issue with woody thickening. The small sample number, an unstratified sampling method and land managers being unfamiliar with survey protocols may be reasons for outcomes not meeting expectations. However, it may be that regardless of regional location similar values, issues and experiences are occurring.

The construct "Attitude" was thought to be made up of five dimensions; Cultural, Conservation, Economic, Woody Thickening and Legislation. However, the Factor Analysis showed that although five factors (dimensions/aspects) were found, they did not align with the *a priori* labels. Questions need to be re-worded, removed or expanded to identify the make-up of Attitudes toward Fire Management. It was also thought that respondents in the North would have more positive attitudes toward fire use however a *t*-test found that this was not the case; the small sample may be a reason for this non-significant result.

Despite expectations not being immediately met, the research has provided a wealth of data about land manager perceptions and practices of fire use which can inform workshop topics, information, skills and competency needs of land managers, and gives a direction as to where to focus future research. Almost a third of the respondents didn't indicate either way if the NAFI site was a useful source of information. This lukewarm response suggests that they are not accessing/understanding the information to be able to give an opinion. Although, over half of those answering this question indicated that they found the NAFI site to be of use to their management practices (51%). A *t* test found no significant difference between those who answered "Yes" or "No" to Understanding the NAFI site and scores on the scale for Usefulness of the NAFI site. This may be due to the small number of respondents to the scale question (n=88).

A large number of land managers do feel that satellite technology is relevant to their practices (72.1%). A small percentage of land managers do not feel that satellite information will aid their practices (13.0%) and it would be of interest to explore their reasons for this. Most land managers who used the NAFI site neither agreed nor disagreed as to the ease of navigation. Cross-referencing responses showed that these participants had answered "No" to using the NAFI site and/or to having the Internet.

Forty-two per cent of respondents found the website easy to navigate. Just over half the sample (51.9%) found NAFI website information to be relevant to their needs. However, 48 per cent of respondents either do not have access to the Internet and/or the NAFI site, or they do not find the information relevant to their needs as land managers. Fire scar history on the NAFI site is useful to over one-third of the respondents (38.5%). The relationship between usefulness of scar

history, and the use of satellite, usefulness of the site and ease of navigation show a slight positive correlation (.26, .37 and .33 respectively). It would be of benefit to increase the sample number to have a better idea of the links between these variables. It may be that navigation affects the usefulness of the site and the motivation to access and interpret satellite information.

Most of the sample couldn't decide either way if use of fire maintains their cultural practices (41.3%). This suggests that they may not have understood the question, or do not find the issue of cultural value of any importance. A similar amount of land managers answered that fire use did or did not maintain cultural values. The concept of "cultural practices" needs to be better defined to respondents in future surveys.

Over two thirds of land managers find that the biodiversity of their property is enhanced with the use of fire (67.9%). Just over eighty per cent of respondents found that economic viability was increased with fire use. Most of the responses indicated that firebreak construction is economically worthwhile (90.1%). Seventy-three per cent consider an early burn economically worthwhile. Although a sizeable percentage do not (15.5%) and this should be investigated further.

Twenty-seven per cent found that fire use aided in the control of ticks. Over half of the responses though, were not able to say one way or another if ticks were less likely with fire use (54.3%). Many respondents found that fire use did decrease their dry bulk (71.8%). Just over half of the responses noted that there were fewer weeds on their property with fire use (52.3%). Twenty-one per cent did not have a decrease in weed population, mostly occurring on Small Northern properties. A better green pick appears to occur for most land managers (81.8%). Two thirds of land managers found that use of fire did help to keep woodlands open. Over a third of participants stated that they could successfully change over pasture species with fire use (37.7%). That 20.5 per cent have not been able to change successfully highlights an area for investigation. Over half of the responses stated that efficiency of sowing had improved with fire use (52.5%).

Most land managers stated that their wildfire response plan was useful (62.5%), although twenty-four per cent indicated that it was not useful. It would be of benefit to explore what wildfire response plans land managers have to determine needs and gaps in knowledge and resources. Many land managers felt that they should obtain a permit to burn (83.0%), despite that over half consider government regulations to be a hindrance to management. Three quarters of respondents identified use of fire as an aid to decrease wildfire. There was no significant association between Regional Group and having a decrease in wildfire.

Woody thickening **does** appear to be a big issue for most participants (65.6%), although twenty-eight per cent noted that woody thickening was not a problem. However, over half of the respondents answered that woody thickening was widespread on their property (56.7%). There was a moderate correlation between how widespread woody thickening was and how much of a problem the thickening was perceived to be (.61). Sixty-three per cent of land managers identified woody thickening as having an impact on their carrying capacity. Seventy-six per cent of land managers identifying woody thickening as a problem also stated that it had a dramatic impact on capacity.

Over half of the responses saw regulations as encouraging woody thickening growth (59.1%). Nineteen per cent of responses said that regulations did not negatively impact on the constraint of woody thickening. There is a moderate correlation between regulations being a hindrance and increasing the spread of woody thickening (.68). Evaluation of what regulations actually exist, and which ones are out of favour with managers, needs to be carried out.

Overwhelmingly, a dominant factor in limiting efficient and effective consistent fire use is the lack of "sense of country" amongst land managers. However, due to the dearth of research into fire use among land managers and the lack of a pilot test it may be that the questions are ethnocentric (measuring financial impacts and neglecting values and affect). The economic focus within the data suggests that the survey be re-evaluated for bias in question selection (i.e., see Factor Analysis, p. 35). **Future research needs to explore the inter-relationships of environment-land managers, placing an ecological theory or model with Value/Spirit as the hub of outcomes.**

Differential Ownership and Value beliefs may be underlying causes of imbalance between land manager practices and environmental issues in the Rangelands. It needs to be explored as to whether short-term goals of land management are in conflict with long-term societal goals (e.g., sustainability and conservation). Ways to decrease personal costs to land managers by using fire in their land management needs also to be determined. Shades of "Green views" such as conservation (protecting a resource), preservation (moral to protect nature from use), ecocentrism (nature has independent value) and anthropocentrism (what value is it to me?), are not understood according to the results of this sample. Beliefs and value systems cultivate shared understandings and meaning making. A model could then be used to guide antecedent and consequent variables for developing workshops, policies and general decision-making protocols. This requires looking beyond the individual interpretation of the perceptions and practices. Social analysis of shared

representations and collective understandings of "use of fire for land management" recognises belief systems and value orientations. The link between individual land manager and the collective of Rangeland property managers can highlight a **person's** relationship with extrinsic factors. The understanding of where land managers can be placed to represent spatially their perceptions of land management. This will inform fire use, non use or misuse by way of being an underlying belief/value system. Beliefs and values can be modified to a large extent, depending on the circumstances. Workshops and other resources to foster an engagement in appropriate use of fire for land management can be guided by belief/value systems.

Firstly, a clearly defined concept of land management needs to be developed that is inclusive of all stakeholder interpretations. Focus groups aid disclosure of perceptions of attachment, memory and sense of place, as well as narratives and representations of "land management". The inclusion of Value within land management identifies the dynamic and organic (cultural) conceptualisation of this construct. Value (within land management) is an ideal variable to track over the long-term because change occurs gradually. Influential factors can be more readily observed, measured and accommodated.

Limitations and Recommendations

It was found during data entry that the survey was too long for many respondents, evidenced in their feedback as well as the numerous skipped questions. Future surveys are recommended to omit NAFI and Woody Thickening information, instead creating separate surveys to explore these topics. It appears that many of the land managers are not used to completing surveys or do not recognise the value to themselves and/or to country, by investing their time and energy into answering the survey as comprehensively and honestly as possible. The Demographic Information questions would serve well to be included as a section across all survey work to obtain standardized control variables that will allow for comparisons across research projects.

Future research is recommended to increase the sample by at least 25%. This could be achieved by stratifying recruitment across Regional Groups (i.e., Small Southern and Small Northern, and Large Southern and Large Northern). **The survey also needs to be shortened to an instrument that takes a maximum of 10 minutes to complete.** Such changes will enhance land manager engagement with the survey, and the lack of effort to respond would motivate them to complete the survey accurately, honestly and comprehensively.

In general, there needs to be more effort made to contact and facilitate Traditional Owner land manager participation. As well as making up a large proportion of land managers in the North, Traditional Owners have a wealth of communal experience, representation and application skill that can inform other land managers. **Funding can be sought to train and develop an Indigenous Australian liaison to mediate research and community needs, concerns, expectations and outcomes. The development of a "sense of country" among land managers to use fire in a sustainable manner requires the direct input of Indigenous Australian communities.** The lack of respondents identifying themselves as land managers of Conservation areas, and their observed difficulty in answering fixed responses available on this survey, suggests a different population to the other land managers. **It is suggested for future research that a separate survey be developed for land managers of Conservation properties.**

In summary, understanding land manager perceptions and practices with regard to fire use informs CYPDA and other stakeholders of the **awareness** to benefits of using fire appropriately. **There appears to be a culture of intuitive management among land managers not being drawn on** to guide policy formation, decision-making, workshop training and information provision, as well as to understand their relationships with country. For those at the forefront of land management the design of property boundaries, land use, fire break construction and best practice responses to environmental change, can aid custodianship, protection and restoration of country.