





Australian Government

Department of Agriculture, Fisheries and Forestry ABARES

Determining the availability of individual aerially

deployed wild dog baits

Final report to the Australian Bureau of Agricultural Resource Economics and Rural Sciences

Malcolm Kennedy and Kenneth Rose

Supporting your success

The project "Determining the availability of individual, aerially deployed wild dog baits" was carried out in accordance with the Objectives, Key Performance Indicators and Milestones as described in the following report.

Signed

Bu

Date 12 June 2013

83

Dr Ian Wilkinson Senior Research Officer, Invasive Species Science Department of Agriculture and Food, Western Australia

1

Contents

List of figures	3
List of tables	3
Acknowledgements	4
Executive summary	6
Project aims and objectives	8
Project location	8
Methods	10
Results	12
Discussion	14
Objectives and milestones	16
Education and extension strategy	20
Education and extension material	22
Contributions	22
Assets created or acquired	23
Bibliography	24
Appendix 1 Education and extension material	25
Appendix 2 Final acquittal	29

List of figures

Fig 1. Location of	properties used in the main experiment	9
Fig 2: Comparison landforms	of availability of aerially deployed baits acr	oss four 13

List of tables

Table 1: Weights and drift characteristics of baits	12
Table 2: Project milestones and activities to achieve objectives	16

Acknowledgements

Thanks are extended to DAFWA staff who were involved in this project - Gary Martin, Tracey Vinnecombe, Mick Elliot, Andrew Longbottom. Past and present staff of DAFWA Invasive Species Science and Nicky Marlow (DEC) were also involved in the development of the project. Thanks also to Mark Rolle, Randal Crowley and Tom Janke of Heli muster who conducted the aerial baiting. We also thank the Pilbara Recognised Biosecurity Group who allowed us to work in with their annual baiting run and the land managers of Carlton Hill, Coolawanya, Hooley, Juna Downs, Mardie, Mulga Downs, Roy Hill, Uaroo, Warambie & Wyloo stations who allowed us to conduct work on their properties.

Executive summary

This project aimed to contribute to best practice of aerial baiting for wild dogs in Australian rangelands by assessing the availability of individual, aerially deployed baits to wild dogs across several commonly baited landforms in the northern rangelands. Aerial baiting using fixed-wing aircraft is a cost effective method of bait delivery for large and remote locations. However aerial baiting may result in some wastage of baits due to deployment of baits in inaccessible locations. Attempts to address bait loss through compensatory baiting may result in increased costs to the landholder and increased risks to non-target species. This project sought to quantify the loss of baits due to deployment in inaccessible locations.

A pilot trial demonstrated that the use of non-toxic dried meat baits with radiotransmitters embedded in them was a suitable method of assessing bait availability. This pilot trial also allowed us to determine basic metrics about the 'drift' of baits from an aircraft under standard baiting conditions (flying at 300 ft and at 100 kt). Dried meat baits typically fall forward (approx. 99.9 m) and laterally (approx. 8.2 m) from the baiting aircraft.

The main experiment determined the availability of aerially deployed baits (as 'high', 'moderate' or 'low' availability) across four commonly baited landforms in the northern rangelands (gorges, breakaways, riparian vegetation and flat ground with tussock grass). Baits with radio-transmitters embedded were deployed in replicates across each landform, then relocated and their availability visually assessed. The vast majority of baits (91.8%) across all landforms were 'high' availability, with a further 7.5% falling into the 'moderate' category and 0.7% in the 'low' category. There were significant differences in bait availability between landform types with the proportion of 'moderate' and 'low' categories combined was greatest in gorges and lowest on flat ground with tussock grass.

This project contributes to best practice for aerial baiting in two ways. First, it provides metrics on the drift of baits under standard baiting flight conditions which can provide pilots and bombardiers confidence when targeting baits. Second, it clearly demonstrates that in northern rangelands there is only a small amount of bait loss to inaccessible locations. Thus landholders and agencies can maximise cost efficiency of baiting and reduce risks to non-target species through using baiting rates that do not attempt to compensate for 'wasted' baits.

Determining the availability of individual, aerially deployed baits to wild dogs

Project aims and objectives

The aim of this project was to increase the efficacy, and contribute to best practice, of aerial baiting for wild dogs in Australian rangelands by assessing the availability of individual, aerially deployed baits to wild dogs across several commonly baited landforms.

The objectives of the project were to:

compare on-ground availability of baits to wild dogs (and therefore wastage) between four landform types typically targeted in aerial baiting; and

determine the difference from point-of-release to point-of-rest for aerially deployed baits across four landform types.

To address these objectives a pilot trial and a main experiment were conducted

The specific aims of the pilot trial were to:

test the effect on active radio-transmitters of being deployed from aircraft, in wild dog baits;

assess and compare the 'drift' of radio-transmitter and non-radiotransmitter baits from point-of-release to point-of-rest; and validate categories of bait availability.

The specific aim of the main experiment was to:

assess the availability (wastage) of aerially deployed baits across four commonly baited landforms

Project location

The project was conducted in the northern rangelands of Western Australia. The pilot trial was conducted on Carlton Hill Station in the North Kimberley, Western Australia (WA), approximately 40km northwest of Kununurra. The main experiment was conducted in conjunction with the Pilbara Recognised Biosecurity Group's 2012 aerial baiting program which was co-ordinated by the Department of Agriculture and Food, Western Australia (DAFWA). This baiting program included 52 properties in the Pilbara. Deployment of baits for the main experiment was conducted on nine properties: Coolawanya, Hooley, Juna Downs, Mardie, Mulga Downs, Roy Hill, Uaroo, Warambie and Wyloo Stations (Fig 1). The area over which the experiment was conducted exceeded 2,000,000 ha.

Within the main experiment, camera traps were used to validate the availability categories that were used. This was initially conducted on Uaroo Station and will be re-run on Mt Florance Station.



Fig 1.Location of Pilbara stations used in the main experiment

Methods

Pilot trial

Single stage radio-transmitters (approx. three grams, Sirtrack[®]) were inserted into non-toxic dried meat baits (as per Thompson and Kok 2002). Baits consisted of 110 g of beef muscle block dried until they were approximately 40% of their initial weight. During the drying process a piece of dowel 10 mm in diameter was inserted into the bait to leave a cavity for the transmitter. Transmitters were fixed in the bait cavity using a small amount of adhesive or toothpicks. Baits containing a transmitter had a whip aerial protruding approximately 150 mm from the bait. All baits were weighed prior to deployment.

Three replicates of 36 baits with radio-transmitters and 75 baits without transmitters were deployed from a Cessna C206 aircraft. Radio-transmitter baits were regularly interspersed with non-transmitter baits. All baits were sequentially numbered and deployed in sequence. Baits were deployed from the aircraft flying at standard aerial baiting conditions: 100 kt at an altitude of 300 ft (approximately 185 km h⁻¹ and 100 m altitude) (Thompson *et al.*, 1990; Thomson and Rose, 2006). A bombardier in the rear of the aircraft deployed baits through a chute at approximately 10 baits km⁻¹ onto flat, cleared ground. An infra-red sensor in the chute, connected to a GPS device recorded the point-of-release (latitude, longitude and altitude) for each bait as it was deployed.

Once deployed, baits were located on the ground by visual searching and telemetry. The GPS location (latitude and longitude) and accuracy of the GPS position were recorded. The impact of repeated drops from approximately 100 ft on radio-transmitters was assessed based on visual inspection and testing the functionality of each transmitter.

Statistical analysis: pilot trial

Comparisons of the differences between the point-of-release and the point-ofrest for transmitter and non-transmitter baits were conducted to determine if the drift of transmitter baits is representative of non-transmitter baits. Comparisons of the forward distance travelled from the point-of-release, the angle of departure from the aircraft and the lateral distance from the aircraft trajectory were conducted using ANOVA. These figures were calculated using ArcMap and the Geographic Modelling Environment (Beyer, 2012) command 'pointdistances'. Weights of transmitter and non-transmitter baits were compared using a t-test. All data was assessed for normality. Where assumptions of normality weren't met appropriate transformations were performed.

Main experiment

Dried meat baits, with embedded radio-transmitters (prepared as above) were used to assess the availability of aerially deployed baits to wild dogs across four landforms which are commonly baited in Western Australian rangelands: riparian strips, flat ground with tussock grass, gorges with Spinifex (*Triodia* spp.) as the primary ground cover and breakaways (heavily eroded hills) with Spinifex as the primary ground cover.

Deployments of 30 transmitter baits were replicated three times in separate locations for each landform. In each case aircraft altitude and velocity were as above (approx 100 kt, at an altitude of 300 ft) and baits were dropped at approximately 10 baits km⁻¹. For two replicates the number of baits used was less than 30 as the landform was shorter than the distance required for 30 baits. In one case 20 baits were deployed on a breakaway and in another, 23 were deployed in a gorge.

Baits were located within three hours of deployment using radio-telemetry. The location of (latitude and longitude) and accuracy of the GPS position of each bait were recorded. A description of each location recorded including surface it came to rest on (vegetation, soil, rocks), distance from, type of, and height of nearest vegetation. The availability of each bait to wild dogs was assessed as either 'High', 'Medium' or 'Low' (Moseby *et al.*, 2011).

High availability referred to baits located in open ground, in a small grass tussock grass or on the very surface of a Spinifex hummock (<10 cm from the edge of the hummock).

Medium availability referred to baits located deep within a grass tussock, on the surface of a Spinifex hummock and >10 cm from the edge of the hummock, or <5 cm deep in a Spinifex hummock.

Low availability referred to baits located >5cm deep in a Spinfex hummock, >20 cm from the edge of a Spinifex tussock, or in one instance in a large (2 m diameter), dense serrated leaf bush.

Validation of the availability categories was attempted using camera traps. Thirty non-toxic baits were separated by 200 – 400 m in an area of high wild dog activity (as indicated by the presence of scats and foot prints). Each bait was randomly assigned to a category of accessibility (high, medium or low) based on the categories used in the aerial bait trial, with ten in each category. A Scoutguard (SC560PV-31B) camera trap positioned 2 m away, 50 cm above the ground and was focused on the bait. Cameras were left in place for 13 days. The intention was not to assess uptake of aerially deployed baits but ensure that the availability categories are valid. At the end of the monitoring period the cameras were retrieved and images assessed to determine if the baits in each category had been taken by wild dogs.

Statistical analysis: main experiment

The proportion of baits in each category for each replicate was calculated. As there was so few low availability baits, in order to provide an conservative assessment of bait availability, the proportion of low and moderate availability baits was combined (square root transformed) and compared between landforms using ANOVA. The proportion of high availability baits was the inverse of this analysis. Tukey's *post hoc* HSD test was used to determine the differences in availability of moderate-low availability baits between landforms.

Results

Pilot Study

We located 96% of the non-toxic baits deployed in the pilot study, including all of those with transmitters. All transmitters survived multiple (three) drops without compromise of functionality, although some showed minor cracks in the external coating.

From the pilot trial we determined that under standard baiting conditions: flying in a straight line at 100 kt, at an altitude of 300 ft in nil-low wind, there is a broad similarity in the drift of transmitter and non-transmitter baits despite the addition of a transmitter to baits resulting in a trailing aerial and a significant increase in the weight of baits (Table 1). Baits (transmitter and nontransmitter combined) typically fell forward from the point of release 99.9 ± 1.7 m (mean ± se), coming to rest at an angle of approx 5.4 ± 0.4 degrees from the point -of-release. Transmitter baits fell closer to the trajectory of the aircraft than non-transmitter baits but this difference was non-significant. Combined the average lateral distance for all baits was 8.2 ± 0.4 m.

	Transmitter baits	Non-transmitter baits	Difference
Weight	43.0 ± 0.9 g.	40.3 ± 0.6 g	T _{1,255} =-2.65, P = 0.009
Distance from point-of- release to point-of-rest	98.6 ± 2.2m	102.7 ± 2.7m	(F _{1,292} = 1.68, P = 0.195)
Angle of departure from aircraft	4.6 ± 0.4°	5.6 ± 0.4°	(F _{1,273} = 2.52, P = 0.114)
Lateral distance from aircraft trajectory	7.1 ± 0.6m	8.7 ± 0.5m	(F _{1,272} = 2.52, P = 0.060)

Table 1: Weights and drift characteristics of baits with and without radio-transmitters.

Main experiment

Of the 342 radio-transmitter baits deployed, 341 were recovered. The one that was unrecoverable could be located (in a large serrated-leaf shrub in a creekline) but not retrieved. It was included in the low availability category. Overall, a high degree of bait availability was recorded irrespective of landform. The majority of all deployed baits (91.8%) were categorised as high availability. A further 7.5% were categorised as moderate availability and the remainder (0.7%) were classified as low availability. Of the very few baits that fell into the low availability category, most were embedded in Spinifex.

The landform on which baits were deployed had a significant effect on the availability of baits in the combined lower categories (moderate and low), $(F_{3,11} = 44.95, P < 0.01, Fig. 2)$. The availability on flat ground with tussock grass was uniformly high, with 100% of baits landing in high availability locations. The mean percentage of baits in high availability locations decreased across landforms from riparian (94.4 ± 1.1%), breakaways (92.8 ± 1.5%) and gorges (79.5 ± 1.7%).



Fig 2: Comparison of availability of aerially deployed baits across four landforms. Letters indicate significant differences in combined 'low' and 'moderate' categories between landforms using Tukey's *post hoc* test (p < 0.05).

The proportion of baits in the high availability category was significantly higher on flat ground with tussock grass than all other landforms (Fig 2). Gorges had a significantly lower proportion of baits occurring in the highest availability of categories than all other landforms. Riparian and breakaway landforms did not differ significantly from one another, but had a higher proportion of high availability baits than gorges and less than flat ground.

Validation of bait categories

Despite the site initially selected for validation of the bait categories (Uaroo Station) showing considerable sign of dog activity in the form of scats, footprints and landholder reports of high activity, camera traps did not record any wild dogs taking baits in any availability category. While the results from the availlbity experiment are clear that most baits land in highly accessible areas, it was seen as valuable to re-run this component of the experiment. It was intended to redeploy camera traps on baits in each category on Mt Florance Station in April-May 2013. This has been postponed until June 2013 due to unseasonal rainfall. Once deployed, camera traps will be retrieved within a month and, if possible, availability categories validated.

Discussion

Aerial baiting is recognised as a cost-effective and efficient way of controlling wild dogs across large and inaccessible areas (Thomson, 1986; Thomson and Rose, 2006). However, aerial baiting may use more baits than are required for wild dog control resulting in inflated control costs, and increased risk to non-target animals (Thomson, 1986). Bait placement and bait distribution have been identified as potential factors affecting the efficacy of aerial baiting programs by multiple authors for almost 60 years (Tomlinson, 1954; Thomson, 1986; Thompson *et al.*, 1990). Bait placement and distribution can affect availability of aerially deployed baits at three spatial scales:

Habitat scale: wild dogs use some habitats preferentially. Even within individual home ranges some areas are used preferentially to others. Baits which are deployed, or land in, habitats not frequented by wild dogs are effectively inaccessible to wild dogs at the habitat-scale.

Meso-scale: baits which are deployed in suitable habitat but are unavailable to dogs because they are not accurately delivered due to deployment inaccuracies can be considered unavailable at the meso-scale. Baits which are deployed on breakaways or ridges but miss the target would fall into this category.

Fine scale: at the fine-scale baits may be unavailable to wild dogs because they are deployed in the target area but land in inaccessible locations. It may be possible to deploy a bait in an area of high dog activity, with great accuracy but if the bait falls in a Spinifex bush or a crevice it will be unavailable to wild dogs.

As aerial baiting, especially from fixed wing aircraft, does not allow for finescale targeting there is a need to determine the losses of baits at the fine scale. This study addresses that need by providing quantification of the losses of baits at the fine scale in northern rangelands of Australia. It also provides some metrics to assist in the meso-scale targeting of wild dog baits from fixed wing aircraft. Both these aspects of the study contribute to best practice of aerial wild dog baiting.

Bait drift

Comparison of the bait drift of transmitter and non-transmitter baits in the pilot trial showed no significant differences between the two bait types. This means that the findings drawn from transmitter baits can be confidently extrapolated to non-transmitter baits. The pilot trial also allowed us to calculate metrics which can provide pilots and bombardiers a degree of confidence in meso-scale targeting using fixed-wing aircraft to deploy dried meat baits.

The results of the pilot trial mean that fixed wing aircraft pilots and bombardiers can work on the basis of dried meat baits falling on average 100 m forward and approximately 8.2 m to either side of the aircraft trajectory under standard baiting conditions (speed of 100 kt and altitude of 300 ft with little wind). These metrics can assist in targeting baits at the meso-scale and are broadly consistent with previous work performed with different bait sizes and flight conditions. Specifically, Thompson *et al.* (1990) recorded mean lateral movement of baits (nearly twice the weight of a dried meat bait) deployed from a Cessna flying at 300 ft and 80 kt as 9.9 m.

Bait availability

A conservative interpretation of the data shows the overall availability of baits across all landforms was high (greater than 90%). Further, if 'high' and 'moderate' availability baits are considered together then the proportion of baits lost due to landing in 'low' availability locations in rangeland aerial baiting is less than one percent.

The overall high availability of baits deployed in the northern rangelands, does include variation between landforms over which baits are deployed. A clear difference was apparent in 'high' availability baits between flat ground with tussock grasses (100% high availability) and gorges (80%). Riparian vegetation and breakaways fell between these two extremes. It is important to note that despite the variability between landforms, 'low' availability baits accounted for less than four percent on average in any landform.

Variation between landforms may be due, in part, to the ruggedness of the landforms. Declining availability from flat ground to gorge suggests a pattern of decreasing availability with increasing gradient and variability of terrain. Certainly accuracy of baiting can vary with terrain (Thompson *et al.*, 1990) and canopy cover (Robley, 2011). It may be that accuracy and availability are affected similarly by landscape features.

An additional feature of the landscape may have also affected availability. With the exception of one bait, all 'low' and 'moderate' availability baits were located in, or on, Spinifex hummocks. This is not an inconsequential finding. Spinifex dominated landscapes are far the most extensive of the major structural plant communities in Australia covering almost 1.4 million km² across the continent (Specht and Specht, 2002; DEWR 2007). The role of Spinifex in influencing availability is likely to be two-fold. While baits that become well embedded in Spinifex fall into the 'low' availability category, the general structure of Spinifex hummocks, namely multiple, long, strong, overlapping spines may prevent ingress of objects which fall onto hummocks. Thus Spinifex density and age may play a role in determining bait availability in *Triodia* dominated landscapes.

Implications for future management of wild dogs through aerial baiting

Given the relatively low losses of dried meat baits to inaccessible locations resulting from aerial baiting in northern rangelands there is no requirement to include compensatory baits in an aerial bating program to account for lost baits. To do so unnecessarily increases costs and risks to non-target species. Where terrain is particularly steep and variable, as occurs in gorges, there is likely to be a slightly larger proportion of baits that are 'moderately' available at the expense of those that are 'highly' available. However, baits that fell into the low availability category still only account for a small proportion of those deployed. Thus, where there is scope to increase the number of baits in a baiting program, these should be optimally focused on increasing the total area covered rather than attempting to compensate for 'wasted' baits.

Objectives and milestones

Table 2: Project Milestones and Activities to achieve Objectives (Objectives listed above in 'project aims and objectives'). Where an activity has an asterisk (*) in the notes section the deviation from the objective is explained below the table.

Project Milestones	Activities to meet objectives	Key Performance Indicators	Date achieved	Notes	
Milestone 1: Conduct a pilot study to	Prepare for pilot study				
a) test the effect of dropping transmitters from aircraft,	Apply for licenses and ethical permits	Research and AEC permits obtained as evidenced by signed documents	April 2012	Proposal was passed through DAFWA Animal Research Committee and Animal Ethics Committee	
b) compare drift of					
baits and	Acquire materials	Materials acquired according to research plan	July 2012	Single stage radio transmitters trialled and purchased. Baits manufactured	
c) validate bait availability categories					
Contract a provider	Contract air services provider	Air services provider scheduled as evidenced by signed contract	June 2012	Heli muster contracted for pilot study	
	Liaise with landholders, staff and RBGs	Relevant stakeholders contacted and co-operation sought. Evidenced by documentation of communications	June 2012	Manager of Carlton Hill Station, local DAFWA staff and managers contacted. Biosecurity staff incorporated into project	

	Conduct pilot study	Conduct pilot study			
	Deploy baits and assess location and availability	Successful conducting of pilot study prior to Sept 2012 evidenced by data collection	July 2012	Baits deployed, comparison of drift between transmitter and non-transmitter baits conducted. Availability was assessed in the main experiment rather than the trial *	
	Assess availability of deployed baits	Successful conducting of pilot study prior to Sept 2012 evidenced by data collection	Not conducted	As above. Bait availability was assessed in the main experiment rather than the trial*	
	Analyse drift of tagged and untagged baits	Preliminary analysis of pilot data (Sept 2012).	August 2012	Performed prior to the August 2012 main experiment to inform experimental procedures	
Milestone 2: Conduct primary experiment to assess availability of aerially deployed baits across four landforms. Acquire materia necess	Prepare for main experiment				
	Acquire/replace materials as necessary	Materials acquired according to research plan (April 2012)	August 2012	All transmitters remained functional after pilot trial	
	Liaise with landholders, staff and RBGs, air services provider	Relevant stakeholders contacted and co-operation sought. Evidenced by documentation of communications	August 2012	Local Pilbara DAFWA Biosecurity staff had considerable input into the development of the schedule of baiting for the aerial baiting program and associated experiment. Potential sites for experiment were identified using GIS. Landholders of potential experimental sites were contacted and consent gained	

	Conduct main experiment			
	Refine experiment based on pilot study results	Successful conducting of experiment prior to December 2012 evidenced by data collection	August 2012	Conducted as an essential component of the main experiment
	Deploy baits across different landscapes	Successful conducting of experiment prior to December 2012 evidenced by data collection	August 2012	Conducted as an essential component of the main experiment
	Assess availability of deployed baits	Successful conducting of experiment prior to December 2012 evidenced by data collection	August 2012	Conducted as an essential component of the main experiment
	Data analysis	Analysis of field data conducted. Documented in Scientific and Milestone report	Nov 2012	Analysis of pilot trial main experiment data conducted prior to presentation at Australian Wildlife Management Conference (Nov 2012). Analysis of availability category validation using camera trap data is pending
	Develop scientific report	Scientific report developed	Not complete	A draft scientific publication is in development developed but has not yet been submitted
	Produce milestone report	Milestone report provided by March 2013	May 2013	Provided as this document
Final Report	Final Report Submitted to ABARES	Final report submitted to ABARES	May 2013	Provided as this document

Variations from the Objectives, Milestones and Activities

The aims and objectives relating to assessment of bait drift characteristics and bait availability were met by the experimental procedure. However there were some variations from the Objectives and Activities listed in the original proposal. Variations from the Objectives are listed below. Variations from the Activities are identified in Table 2 and detailed below.

Variations from the Objectives

There was variation from the second objective listed in the original proposal:

determine the difference from point-of-release to point-of-rest for aerially deployed baits across four landform types.

We determined the difference from the point-of-release to the point-of-rest for aerially deployed baits under standard baiting conditions, rather than for the four landform types. The difference between point of release and point of impact is dependent on several factors additional to the landform on which the baits are deployed including altitude, wind conditions (Thompson 1990) and flight trajectory (curved vs straight). Following initial calculation of the difference from point-of-release to point-of-rest in the pilot trial, it was considered more useful to provide bait drift metrics under standard baiting flight conditions rather than to attempt to account for the multiple variables which vary between each baiting flight.

There was a variation from the original pilot trial aim to

validate categories of bait availability

An initial attempt at validating availability categories using camera traps was unsuccessful. The results from the main experiment are convincing without this component of the study, however we intend to repeat the validation of availability categories. Initial attempts to repeat this component of the study in April-May 2013 were hampered by unseasonal rainfall so we are planning to undertake this work in June 2013.

Variations from the activities

We varied from the activities listed under "Conduct Pilot Study" (Table 2). We did not assess bait availability in the pilot study. We decided against assessing availability in the pilot firstly as, this was the primary aim of the main experiment and would be unnecessary duplication. Second, we were concerned that dropping non-transmitter baits in vegetated areas would result in a high loss rate – jeopardising the ability to assess and compare the drift of transmitter and non-transmitter baits.

We varied from the Activities listed under "Conduct Main Experiment – Develop Scientific Report" (Table 2). This has not yet been achieved however a scientific journal article is in development.

Education and extension strategy

The '*Education and extension*' strategy for this project identified five main stakeholders as likely end-users of this research and different methods of targeting them. Specifically:

Rangeland pastoralists

The results of the project were to be communicated to pastoralists through DAFWA publications and Recognised Biosecurity Groups and communication with industry bodies.

The results have been promoted via each of these three avenues.

Two articles in DAFWA publications (Appendix 1a and 1b).

The Pilbara Recognised Biosecurity Group has been provided an interim report for their April 23rd 2013 meeting. They will also be provided with a copy of the final project report.

The findings of the project have been communicated to industry via the National Wild Dog Management Advisory Group (NWDMAG) which includes both industry and government leaders in wild dog management.

National Wild Dog Management Advisory Group (NWDMAG)

The results of the research were to be directly communicated to NWDMAG via the WA representative at the bi-annual meetings and then subsequently to industry and government bodies by NWDMAG representatives.

The intent of the project was first presented to NWDMAG in the March 2012 meeting and results described in the December 2012 meeting. Feedback and requests for further documentation has been received from industry representatives from other states.

DAFWA and DEC

The results were to guide aerial baiting programs in WA rangelands and communications with staff to be via involvement in the research, discussions with key staff and communication through DAFWA publications.

Communication of the results to DAFWA staff has been conducted by

Involvement of staff in the research: Each of the DAFWA biosecurity staff involved in aerial baiting in the northern rangelands of WA was involved in a direct way with either the pilot trial or the main experiment.

Discussions with key staff. Each of the DAFWA biosecurity staff involved in aerial baiting in the northern rangelands of WA have been involved in discussions with the investigators about the findings. The findings were also presented to most DAFWA staff actively involved in aerial baiting at a DAFWA wild dog strategic planning forum in March 2013.

Communication through DAFWA publications: The publication of two extension articles which go to DAFWA staff and to other stakeholders (Appendix 1a and 1b). In addition the findings from the study will be incorporated in a revised DAFWA Best Practice Manual.

Other state and government agencies involved in or proving advice to aerial baiting programs

Communication with other agencies involved in aerial baiting was to be through publication in a scientific journal, circulation of articles through DAFWA Research Networks and via NWDMAG representatives.

A scientific journal article has not yet been published, although a draft is in development

Communication of the results through research networks have included speaking to and/or providing articles to the Department of Primary Industries Victoria, Department of Primary Industries New South Wales and the Department of Environment and Resource Management Queensland Results were presented at the national conference of the Australasian Wildlife Management Society in December 2012. This conference included representatives from several target agencies.

Scientific Community

Conference presentation and publication of a scientific article were the intended methods of reaching the scientific community with an interest in wild dog control.

Results have been presented at the national conference of the Australasian Wildlife Management Society, December 2012. This conference included scientists from universities and agencies with an interest in wild dogs. A scientific article has not yet been published, although a draft is in development

Efficacy of education and extension strategy

The most effective extension and education approach to be used in the strategy was the involvement of DAFWA biosecurity staff in the pilot and main experiments. This gave the biosecurity staff firsthand knowledge of the project and the results. These staff are directly involved in aerial baiting in Western Australian northern rangelands and have direct interaction with landholders who aerial bait so are able to further disseminate the findings.

Three additional components of the education and extension strategy which have been successful in communicating the study findings have been the production and circulation of DAFWA extension articles, communication the results to the National Wild Dog Management Advisory Group and the presentation of the results to the Australian Wildlife Management Society 2012 annual conference. Each of these three approaches has been met with requests for further information from industry or agency representatives.

Education and extension material

Extension articles

Research update: researching the fate of baits. DAFWA Wild Dog Update December 2012, p5. (Appendix 1a). Where do aerially delivered dog baits really end up? DAFWA Rangelands Memo December 2012, p 6-7. (Appendix 1b).

Internal DAFWA presentations

Kennedy, M. and Rose, K (2013) Science behind the DAFWA Best Practice Manual. DAFWA Wild Dog Management Forum, March 2013, Perth, Australia.

Conference presentations

Kennedy, M., Rose, K. and Martin, G. (2012) Fate of individual aerially deployed wild dog baits. Australasian Wildlife Management Conference, November 2012, Adelaide, Australia. (Appendix 1c)

Contributions

All contributions outlined in the original proposal, both from the grantee and other contributors were received as per below.

Assets created or acquired

The following assets were acquired by the grantee during the period covered by the report.

Asset	Quantity	Tot value (\$)
R1000 telemetry receiver	2	\$1,780
Single stage transmitters	79	\$12,050

Bibliography

- Beyer, H.L., 2012. Geographic Modelling Environment (Software). URL: http://www.spatialecology.com/gme.
- Moseby, K.E., Read, J.L., Galbraith, B., Munro, N., Newport, J., Hill, B.M., 2011. The use of poison baits to control feral cats and red foxes in arid South Australia II. Bait type, placement, lures and non-target uptake. Wildlife Research 38, 350-358.

Department of Environment and Water Resources, 2007. Australia's native vegetation: a summary of Australia's major vegetation groups. Australian Government, Canberra.

- Robley, A., 2011. Assessing the safe and effective use of aerial baiting for the control of wild dogs in Victoria. Department of Sustainability and Environment, Heidelberg, Victoria.
- Specht, R.L., Specht, A., 2002. Australian plant communities: dynamics of structure, growth and biodiversity. Oxford University Press, Melbourne.
- Thompson, J., Fleming, P., Heap, E., 1990. The Accuracy of Aerial Baiting for Wild Dog Control in New-South-Wales. Wildlife Research 17, 209-217.
- Thomson, P., 1986. The Effectiveness of Aerial Baiting for the Control of Dingoes in North-Western Australia. Wildlife Research 13, 165-176.
- Thomson, P.C., Rose, K., 2006. Wild Dog Management: Best Practice Maunal. In: Australia, Department of Agriculture and Food, Western Australia, Perth.
- Tomlinson, A.R., 1954. Aerial baiting against wild dogs and foxes in Western Australia. Journal of Agriculture Western Australia 31, 37-49.

Appendix 1 Education and extension material

1a. Research update: researching the fate of baits. DAFWA Wild Dog Update December 2012, p5.

Research update

Researching the fate of baits

DAFWA Research has given pastoralists confidence about the effectiveness of aerial baiting programs.

DAFWA research officer Malcolm Kennedy said aerial baiting, across large and inaccessible areas where dogs are known to be active, was already recognised as a cost-effective and efficient control method.

"However, there has been a lack of knowledge about where baits are ending up – that is, the proportion of baits landing in locations that are inaccessible to wild dogs is unknown. Bait rates are sometimes increased to overcome this uncertainty, potentially increasing costs and risks to non-target animals."



DAFWA's research, funded by the National Australian Pest Animal Research Program, was undertaken in tandem with the Pilbara Recognised Biosecurity Group aerial baiting, with assistance from local landholders and DAWA regional staff

Figure 1 Individual wild dogs (represented by circles) occur in one of four population clusters (represented by a unique colour) based on their genetic make-up (Stephens 2011).

Non-toxic baits with radio-transmitters embedded in them were dropped across four landforms in the Pilbara (riparian vegetation, open ground with tussock grass, breakaways and gorges), and then located using radio-telemetry. The availability of each bait to wild dogs was then visually assessed.

"The availability of each bait was identified as high, moderate or low – with open ground being high and embedded in Spinifex or other inaccessible areas being low," Dr Kennedy said. "Ninety two per cent of baits across all areas fell into the high availability category with a further 7.5% considered to be moderately available.

"Landholders in the rangelands can be confident then that when baiting in areas of wild dog activity, the vast majority of baits deployed from aircraft will be available to wild dogs. This outcome corroborates the effectiveness of aerial baiting when used as a component of integrated wild dog control."

Population genetics of wild dogs in Western Australia

Research into the population genetics of wild dogs by Danielle Stephens of the University of Western Australia, in collaboration with DAFWA, has shown distinct genetic clusters in the State's wild dog populations.

Based on their genetic makeup, wild dogs in WA were found to belong to one of four distinct groups, with limited overlap between each group (see Figure 1). The separate populations show patterns of relatedness over many generations, rather than animals moving freely about in each area.

Within three of these populations (south west, midwest, north west), dogs were found to be more related to animals within 150-250 km. This means that over multiple generations, dogs in these regions generally stayed within 250 km of their family territory.

In the fourth and much larger population group, occurring in the State's eastern region, dogs were found to stay within 450 km of their territory.

These findings mean that despite the fact wild dogs have the physical ability to disperse, long-distance dispersal is not a common feature of wild dog behaviour in WA.

Coordinated regional control, targeted at the population scale, is likely to bring about most effective wild dog control. By targeting control at the population scale, the potential for rapid reinvasion is reduced because reinvading animals need to move across, rather than within, population boundaries.

A complete copy of Danielle Stephens' thesis is available from feral.org.au.

For more information contact Malcolm Kennedy, DAFWA Research Officer

malcolm.kennedy@agric.wa.gov.au



1b. Where do aerially delivered dog baits really end up? DAFWA Rangelands Memo December 2012, p 6-7.

RANGELANDS MEMO

DECEMBER 2012

WHERE DO AERIALLY-DELIVERED DOG BAITS END UP?

Effective wild dog control involves using a combination of control techniques including baiting, trapping, shooting and fencing. Aerial baiting is recognised as a cost-effective and efficient way of controlling wild dogs across large and inaccessible areas. However, aerial baiting may use more baits than required for efficient wild dog control, resulting in inflated costs and increased risk to non-target animals. One of the factors likely to influence the efficacy of aerial baiting in the rangelands has been a lack of knowledge about the proportion of baits that land in locations which are inaccessible locations, additional baits are often included when baiting specific target locations. To address this gap in knowledge DAFWA has undertaken research, funded by the national Australian Pest Animal Research Program, to determine the availability of aerially deployed wild dog baits in the rangelands.

Preliminary trial

Prior to our main experiment which would use radio-transmitters inserted into non-toxic dried meat baits and deploy them in an aerial baiting program, we conducted a preliminary trial. The purpose of this trial was to determine: (a) if baits with transmitters fell in the same way as non-transmitter baits; and (b) if transmitters would withstand being dropped from an aircraft. The trial also enabled us to determine the distance and angle that baits fall from the aircraft.

With the help of Tracey Vinnicombe of DAFWA Kununurra, DAFWA Invasive Species Science staff deployed non-toxic baits with and without transmitters from an aircraft travelling at 300 ft and 100 knots in repeated runs over Carlton Hill station airstrip in the Kimberley. The delivery point of each bait was recorded by a GPS in the plane and the final location of each bait on the ground was recorded on a hand-held GPS.

We located 96% of the non-toxic baits deployed, including all of those with transmitters. We found that despite being slightly heavier, baits with transmitters fell in a similar manner to non-transmitter baits, although they did not fall as wide of the aircraft as non-transmitter baits. We were also pleased to find that all transmitters survived multiple drops.

The trial allowed us to determine that under standard baiting conditions of flying in a straight line at 100 knots, at an altitude of 300 ft in relatively still conditions, dried meat baits generally fall forward of the point where they were dropped by 99 m and wide of the aircraft by 9 m.

Availability experiment

We tied our availability experiment in with the Pilbara Recognised Biosecurity Group (RBG) aerial baiting this year with the help of local land managers and Mick Elliott and Andrew Longbottom of Karratha DAFWA. During the RBG baiting we dropped non-toxic transmitter baits across four landforms in the Pilbara (open ground with tussock grass, riparian vegetation, breakaways and gorges). We then located the baits using radio-telemetry and visually assessed their availability to wild dogs as high, moderate or low. For example, if a bait was sitting on open ground it was considered high availability. In comparison, if a bait was deeply embedded in the centre of a large clump of spinifex it was considered low availability.

When considered across all landforms, 92% of baits fell into the high availability category with a further 7.5% considered to be moderately available. Availability was highest (100% high

http://www.agric.wa.gov.au

RANGELANDS MEMO

availability) on open ground, but in all other landforms over 95% of baits fell into the high or moderate availability categories (Figure 1). Of the very few baits that fell into the low availability category, most were embedded in spinifex.



Figure 1 Bait availability across four rangeland landforms: breakaways, gorges, open ground and riparian vegetation

Conclusion

Our preliminary trial gave us an understanding of the distances that baits fall, from where they are released in the air to where they are found on the ground. At standard operating speed and altitude in calm conditions, baits on average fall 99 m forward and 9 m wide of the point of release. These figures can be used by pilots and bombardiers to predict where baits are likely to land with greater accuracy.

The availability experiment revealed that bait availability was high across all landforms with very few baits falling into the low availability category. Providing aerial baiting is targeting areas

where dogs are known to be active, landholders in the rangelands can be confident that the vast majority of baits deployed from aircraft are available to dogs. Therefore there is no need to drop extra baits to compensate for any considered potentially inaccessible. Losses are lowest on open ground with tussock grass, but even in steeper terrain with spinifex, there are only minor losses to low availability locations. The high availability of baits in rangeland aerial baiting corroborates the importance of aerial baiting as an effective component of integrated wild dog control.



Tracey Vinnicombe (DAFWA Kununurra) and Ken Rose (DAFWA Invasive Species Science) prepare for a drop of non-toxic transmitter baits at Carlton Hill

http://www.agric.wa.gov.au

1c. Kennedy, M., Rose, K. and Martin, G. (2012) Fate of individual aerially deployed wild dog baits. Australasian Wildlife Management Conference, November 2012, Adelaide, Australia.



AVAILABILITY OF INDIVIDUAL, AERIALLY DEPLOYED BAITS TO WILD DOGS

Dr Malcolm Kennedy, Mr Ken Rose, Mr Gary Martln Department of Agriculture and Food, Forrestfield, 6058, WA malcolm.kennedy@agric.wa.gov.au

Wild dogs are a major pest species of livestock grazing across mainland Australia resulting in lost productivity and significant control costs. Aerial baiting is recognised as a cost-effective and efficient way of controlling wild dogs across large and inaccessible areas. Inefficiencies within aerial baiting methodology can result in inflated costs to producers and increased risk to non-target animals. Sources of inefficiency include poor targeting accuracy and loss of baits as a result of landing in areas inaccessible to wild dogs.

We assessed accuracy of targeting, and on-ground availability of aerially deployed baits to wild dogs (and therefore bait loss), between landform types typically targeted in rangeland aerial baiting. This was done by inserting radio-transmitters into non-toxic baits and deploying them in a standard wild dog baiting program. Baits were then relocated, the difference between their point-of-release and point-of-rest calculated, and their availability to wild dogs visually assessed. Accuracy of bait placement from fixed wing aircraft will be described for commonly baited landforms. Differences in availability of aerially deployed baits between commonly baited landforms and the implications for wild dog baiting in Australian rangelands will be discussed.

