

Assessment of the Comparative Efficacy of Two Aerial Baiting Regimes Through Acceptance of Non-toxic Baits by Feral Cats in the North-eastern Goldfields, Western Australia.

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Introduction

This document reports on the third exercise in a series aimed at improving the efficiency of aerial baiting programs for feral cat control in Western Australia. The series is being conducted by the Department of Conservation and Land Management (The Department) and has been made possible by assistance from the Wind Over Water Foundation.

A kangaroo-meat sausage bait, developed and produced by the Department, has been found to be readily accepted by feral cats under certain environmental conditions and has been instrumental to the eradication of feral cats from islands off the coast of Western Australia (Algar *et al.*, 2001 a and b). The current series is aimed at investigating whether or not a similarly high level of efficacy can be achieved at low densities of bait distribution. Investigations involve the aerial deployment of non-toxic baits containing the bait-marker Rhodamine B (RB) and the subsequent sampling of feral cats to determine the proportion of the population that has accepted bait material. To date, this series has demonstrated that a baiting density half that used in island eradications is equally efficacious in the control of feral cats (Angus *et al.*, 2002 a and b). This evidence has been supported by a highly efficacious toxic baiting for feral cats at the Gibson Desert Nature Reserve (Liddelow *et al.*, 2002). The high level of marking and good control of feral cats during these exercises suggests that further reductions in bait distribution will not reduce baiting efficacy.

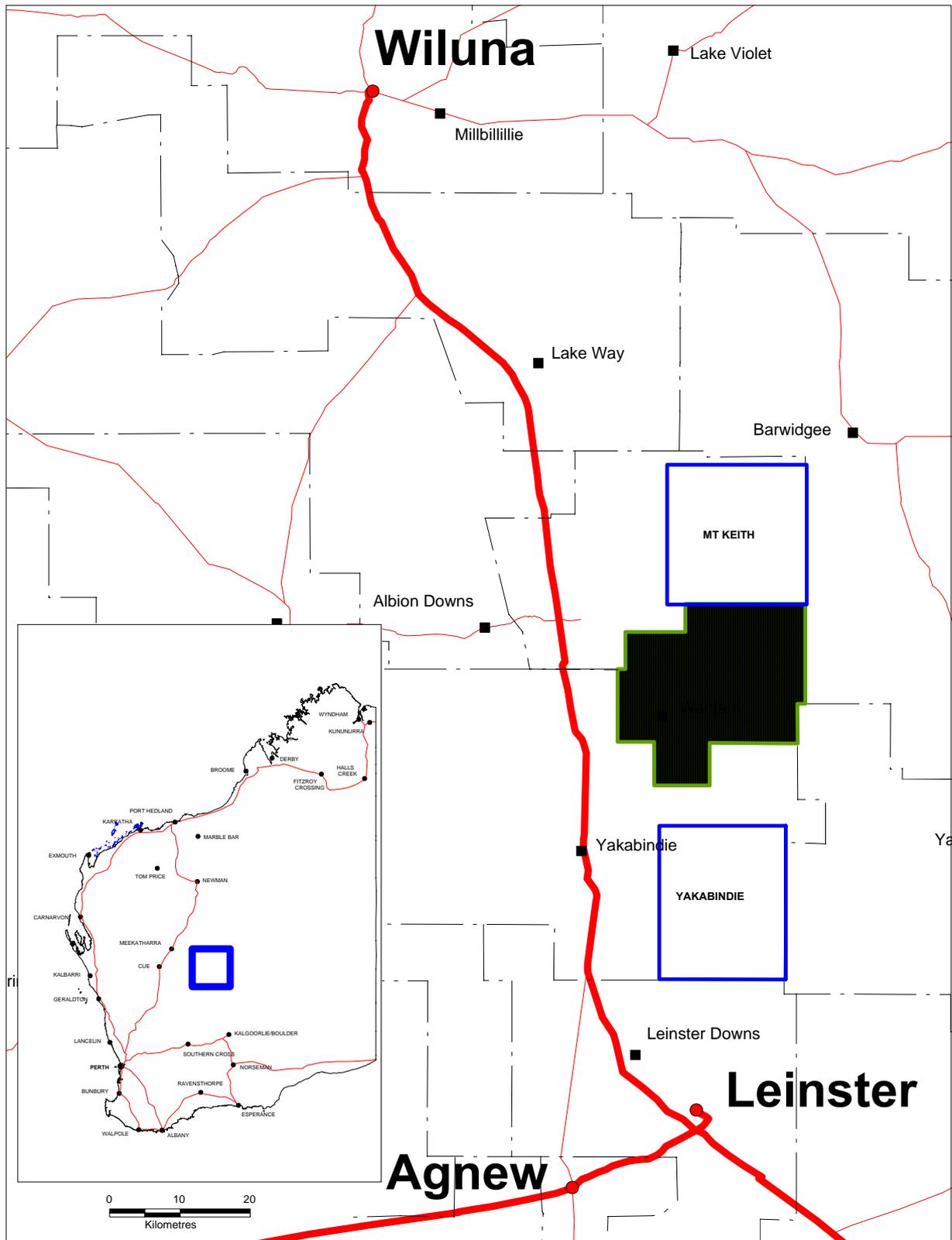
This study compared the relative efficacy of bait distributions of 50 and 25 baits km⁻² in the north-eastern goldfields region of Western Australia. A concurrent assessment of potential risk to non-target species was also conducted. This exercise will be reported separately.

Method

Site Description

This study was conducted at Mt Keith and Albion Downs Stations, to the north and south of Wanjarri Nature Reserve respectively (Figure 1). The two pastoral leases are owned and managed by WMC Resources Ltd for the grazing of sheep and more recently of cattle. The site is approximately 97 km south-east of the Wiluna township and 60 km north of the Leinster township, in the north-eastern goldfields region. Climate of the study area is desert, summer and winter rainfall (Gilligan, 1994). Rainfall is erratic and generally low. Yeelirrie (Figure 1), the closest reporting centre, records a mean annual rainfall of 223 mm over 39 rain days. Significant summer rainfall can occur locally with the formation of thunderstorm cells and the passage of tropical depressions from the north-west. Autumn and early winter rainfall is generally lighter but more regular with the passage of rain-bearing cold fronts across the south-west corner of the State. Annual evaporation at the study site is in excess of 3600 mm. The mean daily maximum temperature recorded at Yeelirrie in January is 37.9°C and the mean daily minimum in July is 3.9°C.

Figure 1. Site location and boundaries of baited treatments.



 Treatment Area

 Nature Reserve

Landform of the two treatment areas is described by Pringle and van Vreeswyk (1994) as the Sand Sheet Landform of the Bullimore Landsystem. This Landsystem is of poor pastoral value and is therefore very occasionally grazed. The landform consists of broad, gently undulating plains of red-orange sand with occasional, scattered granitic outcrops. Vegetation is *Triodia basedowii* hummock grassland with sparse emergent shrubs of *Acacia coolgardiensis*, *A colletoides*, *Senna spp*, *Eremophila spp*, *Grevillea spp* and *Hakea spp*. Emergent trees include scattered mallees (*Eucalyptus spp*), *Acacia pruinocarpa* and *A aneura*, the latter forming close groves, up to tens of hectares in extent. Much of the Mt Keith treatment site was burnt in 1998 and then again in January 2001. Therefore much of the site is vegetated by young spinifex (generally <20 cm \varnothing) and fire successors that include *Ptilotus spp*, *Swainsona spp* and *Leptosema chambersii*. Areas of vegetation not burnt in the past 5 years are generally not greater than 1 ha in extent.

Bait Medium and Distribution

The baits used in this study were the kangaroo-meat sausages, described in previous reports in this series (Angus *et al.*, 2002a and b). Each bait contained approximately 15 mg Rhodamine B (RB). Baits were maintained in a frozen state until the day of distribution, then exposed to direct sunlight prior to deployment, such that oily portions exuded from the sausage skin.

Baits were deployed from a Beechcraft Baron aircraft using the AGNAV navigation system described previously (Angus *et al.*, 2002a and b). The two treatment areas are illustrated by Figure 1. A nominal 50 baits km⁻² was deployed over the Mt Keith treatment area and 25 baits km⁻² deployed over the Yakabindie treatment area. Although the dimensions of the two treatment sites vary, each is approximately 400 km² in extent. As with the study at Pimbee Station (Angus *et al.*, 2002b), baits were released at the beginning of each 1 km baiting cell, rather than distributed across the entire cell. Baits were distributed at the Yakabindie treatment site on 8 May 2002 and the Mt Keith treatment site on 8 and 9 May 2002.

Predator Trapping

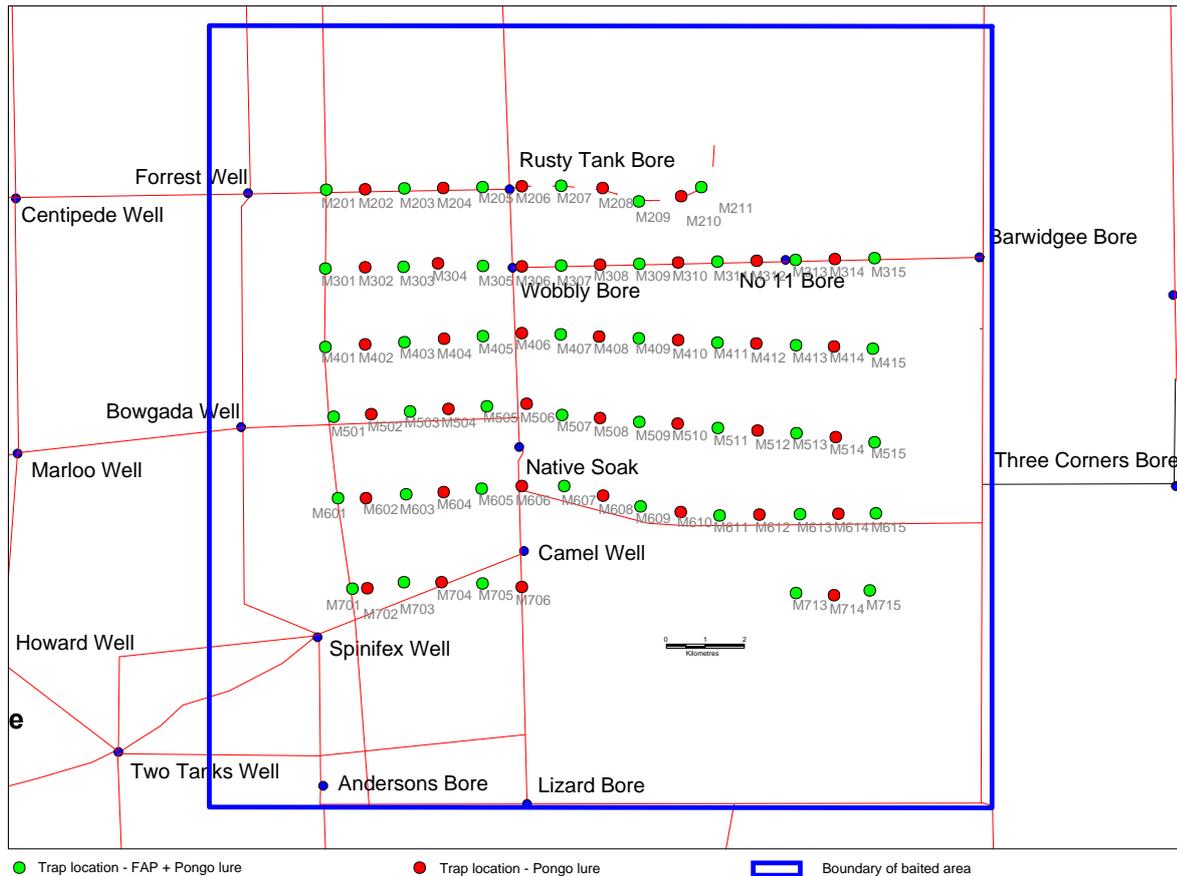
Rubber-jawed leg-hold traps with audio and olfactory lures were employed for this study, as described by Angus *et al.* (2002a). The locations of traps at the two study sites are presented in Figures 2 and 3. A 2 km transect spacing was employed, with off-road access by Suzuki 300cc ATVs. Insufficient traps were available for a 500 m trap spacing along transects, therefore traps were placed at 1 km intervals. The lure type used was alternated between trap sets along each transect, according to Figures 2 and 3. Each trap set was serviced once daily between the hours of 0700 and 1100. A total of 593 trap nights was conducted at the Yakabindie site between the 24 and 31 May 2002. A total of 672 trap nights was conducted at the Mt Keith site between the 24 June and 2 July 2002.

Figures 2 and 3 indicate that a minimum of 2 km baited area was not sampled on all dimensions of each grid. Equipment was available to extend the

sampling grids to within 2 km of the baiting boundaries on all dimensions. This was not carried out as additional trap sets could not be serviced in a timely manner. The southern-most transect at the Mt Keith treatment was discontinuous because of a dense stand of *A. coolgardiensis*.

As discussed in more detail below, trapping continued at the Mt Keith site for two nights longer than at Yakabindie, in an attempt to achieve a sample of cats that approximated the underlying population.

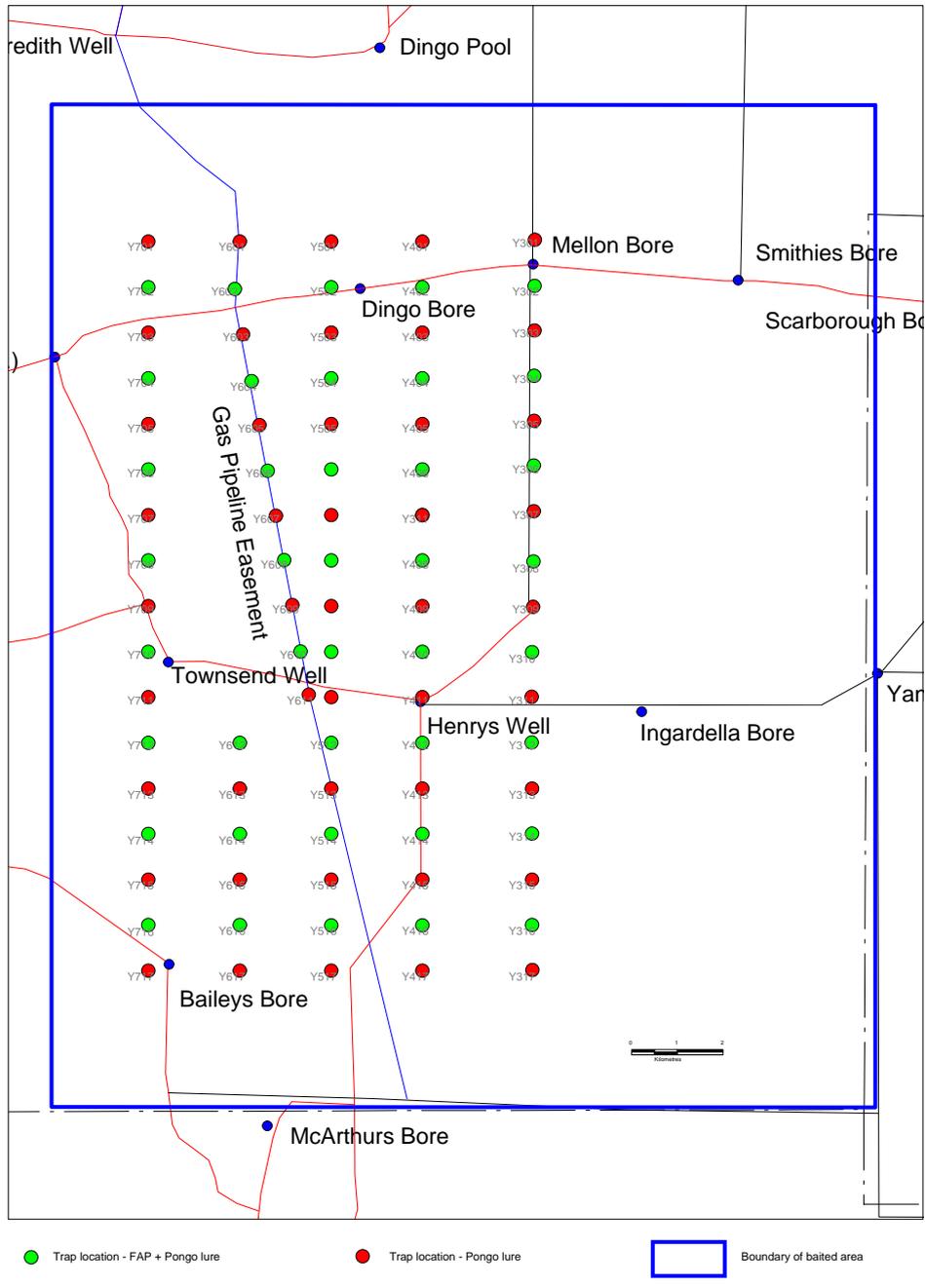
Figure 2. Trap locations at the Mt Keith treatment.



Sample Collection and Analysis

Each captured introduced predator was shot in the trap set at close range with a hollow-point projectile from a .22 calibre firearm. Each animal was weighed, sexed, measured and examined for reproductive activity. Stomachs were removed and stored in a 10% formalin solution before dietary analysis in the laboratory (See Angus *et al.*, 2002a for complete description of methodology). A sample of whiskers was removed and analysed under ultra-violet light for marking by RB, according to the methods described by Fisher (1998). Material from this and previous exercises in this series was also examined for evidence of multiple bait-take.

Figure 3. Trap locations at the Yakabindie treatment.



Results

Predator Trapping

One individual dingo (*Canis lupus dingo*) was recorded at the Yakabindie site and two individuals were recorded walking together at the Mt Keith site. The dingo at Yakabindie did not encounter a trap set. The dingoes at Mt Keith visited several trap sets but were not captured. Feral cats were the only introduced predator trapped during this study. The locations of feral cat captures at the two treatment sites are presented in Figures 4 and 5 respectively. Eighteen cats (0.027 per trap night) were trapped at the Mt Keith site and 23 (0.039 per trap night) at the Yakabindie site. Figure 6 indicates the relationship between the relative frequency of trap interactions and the number of sampling days elapsed. There was a significant correlation between trap interactions and both sampling days elapsed ($r^2=0.76, F=19.00, d.f.=1,6, P<0.01$) and cumulative captures ($r^2=0.77, F=20.50, d.f.=1,6, P<0.01$) at the Yakabindie site. There was no such relationship between trap interactions and sampling days elapsed ($r^2=0.03, F=0.26, d.f.=1,8, P>0.05$) nor cumulative captures ($r^2=0.0002, F=0.002, d.f.=1,8, P>0.05$) at the Mt Keith site. All interactions for the last three nights of trapping at both sites were captures. No captures or interactions occurred on the last night of trapping at the Mt Keith treatment.

Figure 4. Locations of cat captures at the Mt Keith treatment.

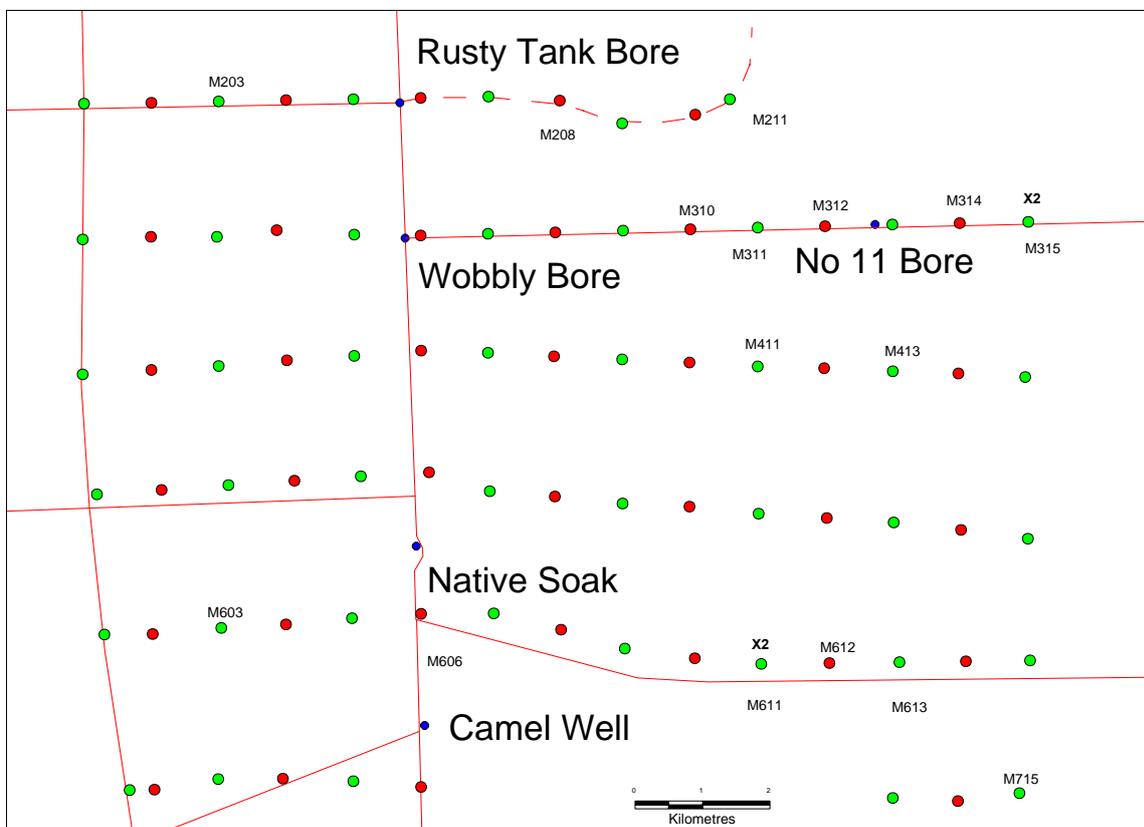


Figure 5. Locations of cat captures at the Yakabindie treatment.

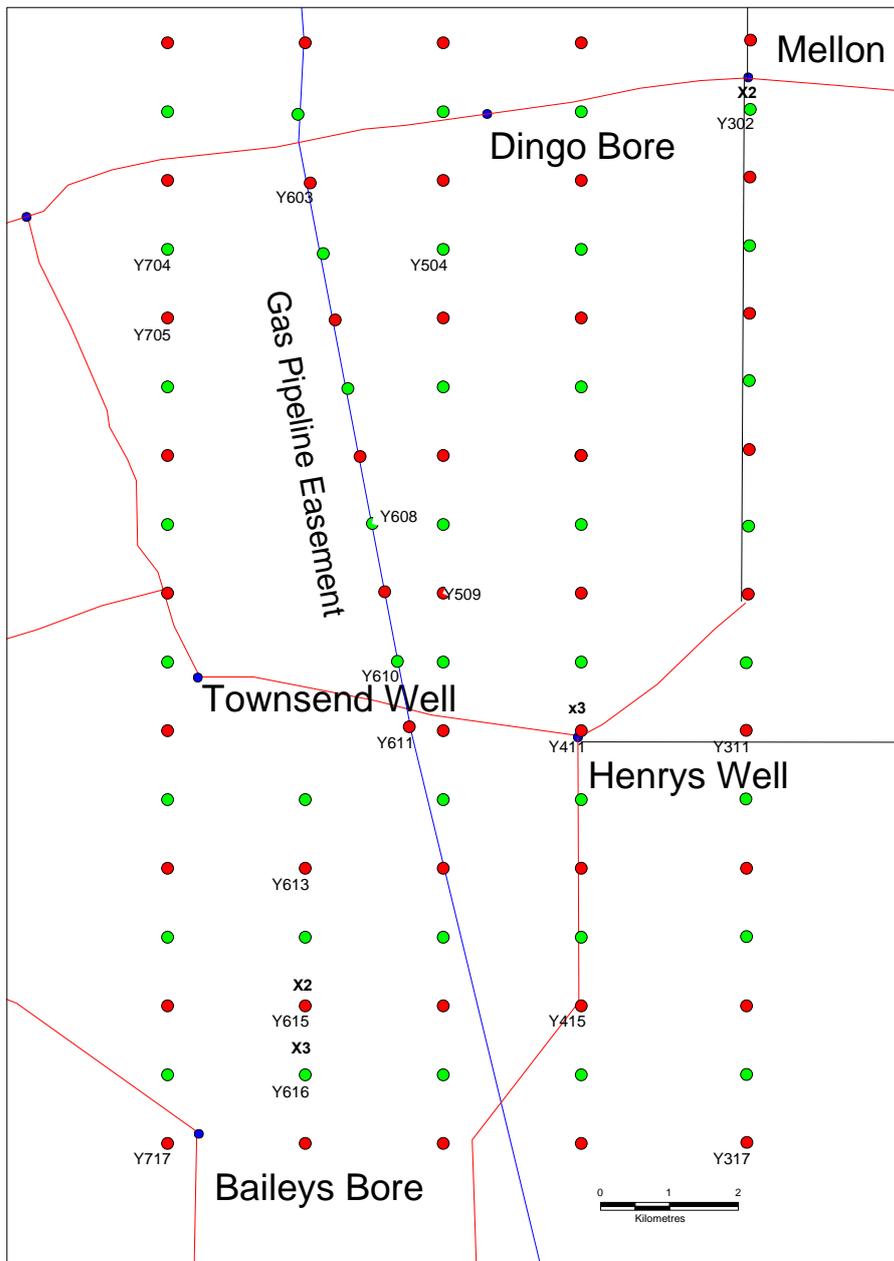
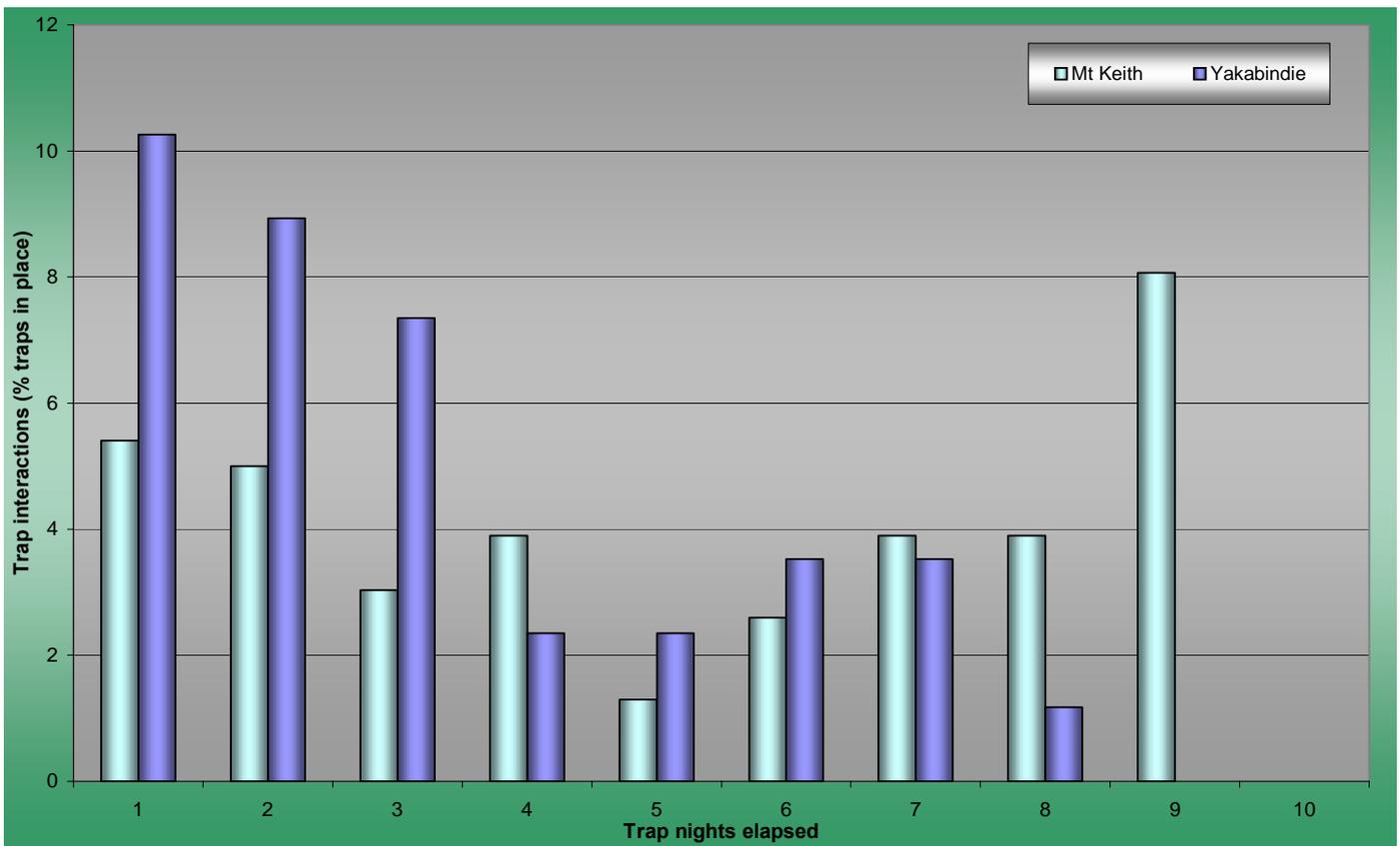


Figure 6. Daily trap interactions at the Mt Keith and Yakabindie treatments#.



Note that trapping ceased at the Yakabindie treatment after 8 nights of sampling.

Details of Captured Cats

A summary of measurements made of captured cats is presented in Table 1. A greater proportion of males was captured at the Mt Keith treatment than were females, however this was not significant ($z=0.89$, $P>0.05$). Conversely there was a greater proportion of females than males captured at the Yakabindie site, however this was not significant either ($z=1.46$, $P>0.05$). The sex ratio of the overall population from both treatment sites did not vary significantly from parity ($z=0.47$, $P>0.05$).

No female from either site was carrying a foetus and only 8 of the 22 females captured had recently produced a litter. The mean litter size for the overall female population was less than one.

Table 1. Summary of measurements made of feral cats.

	Mt Keith Treatment Site		Yakabindie Treatment Site		Pooled Sample	
	♂	♀	♂	♀	♂	♀
Sample size	11 (61.1%)	7 (38.9%)	8 (34.8%)	15 (65.2%)	19 (46.3%)	22 (53.7%)
Mean Weight (±s.e.)	3.60 (±0.28)	2.44 (±0.29)	3.70 (±0.27)	2.86 (±0.08)	3.63 (±0.19)	2.72 (±0.11)
Mean Head-Body Length (±s.e.)	47.8 (±2.03)	47.0 (±2.27)	44.6 (±1.08)	42.3 (±0.60)	46.5 (±1.29)	43.8 (±0.93)
Mean Litter Size (±s.e.)	N/A	0.71 (±0.36)	N/A	0.60 (±0.25)	N/A	0.64 (±0.20)

Diet Analysis

A summary of the stomach contents of individuals sampled at the two treatments is presented in Figure 7. Murids and birds were most frequently present in the diet of animals from both treatment sites. Invertebrates were more frequently present in the stomach of animals from the Yakabindie site than in those from Mt Keith. Rabbits were equally as frequent as murids and birds, in animals from the Mt Keith site, however each item was found in the stomach of only two individuals. For the purposes of this study, woody vegetation is not considered a dietary item and is thought to be consumed as a response to the animal being trapped. Grass is considered as a dietary item as it is known to be deliberately consumed by cats under normal circumstances and may have dietary function (see Fitzgerald, 1988).

Marking by Rhodamine B

Within the sample of cats from the Mt Keith treatment (50 baits km⁻²), 83% of cats were marked by RB. Within the sample of cats from the Yakabindie treatment (25 baits km⁻²), 78% of cats were marked by RB. Although a greater proportion of marking occurred in the higher baiting density treatment, this was not significantly different ($z=0.41$, $P>0.05$). From the overall sample population, 80% of cats were marked by RB. The eight individuals not marked consisted of five males and three females.

One individual had RB staining of the gastro-intestinal tract but no whisker marking. One individual from each site had both whisker marking and RB sausage material in the stomach. This represents the first evidence from this series that individual feral cats had consumed bait material immediately prior to capture.

Table 2 presents a summary of the capture locations, in relation to the boundaries of the baited area, and the days elapsed at time of capture for marked and unmarked cats respectively. At the Yakabindie site unmarked

cats were, on average, captured closer to the baiting boundaries but earlier in the sampling period than were marked cats. At the Mt Keith site unmarked cats were, on average, captured further from the baiting boundaries but later in the sampling period than were marked cats.

Figure 7. Frequency of occurrence of items in stomachs of cats sampled.

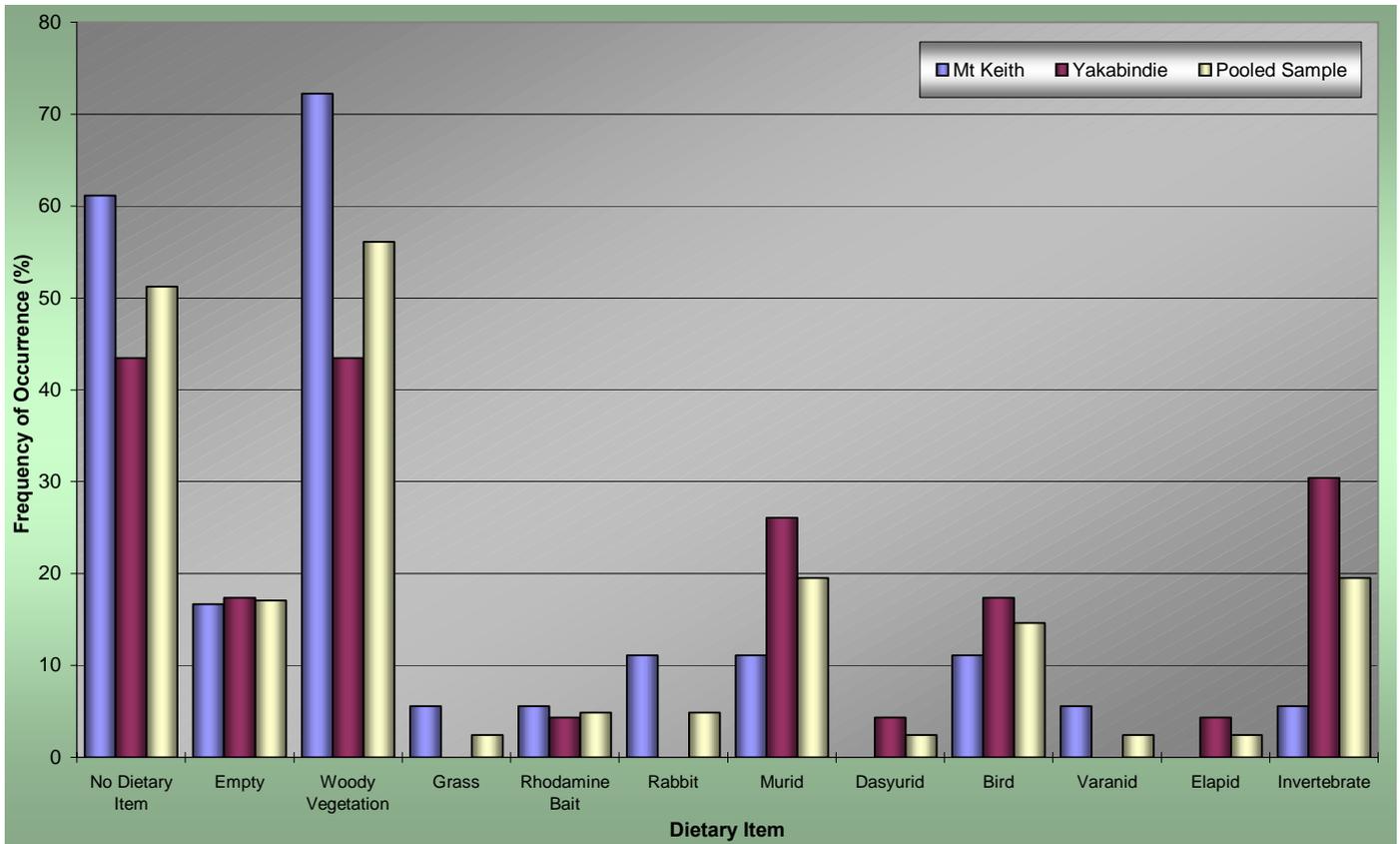


Table 2. Mean distance from capture point to the nearest boundary of baited area and mean days elapsed at time of capture for cats marked and unmarked by RB.

	50 baits km ⁻² (Mt Keith)		25 baits km ⁻² (Yakabindie)	
	RB +ve	RB -ve	RB +ve	RB -ve
Mean distance - (km, ±s.e.)#	4.98 (0.40)	6.33 (0.33)	5.14 (0.45)	3.68 (0.40)
Range in distance – (km) #	3.0-8.0	6.0-7.0	2.1-8.1	2.1-4.1
Mean days elapsed (±s.e)	6.00 (0.76)	6.67 (1.86)	3.94 (0.59)	3.00 (0.45)
Range in days elapsed	1-9	3-9	1-8	2-4

Distance is that between the point of capture and the nearest boundary of the baited zone for the particular treatment.

Table 3 presents the frequency of multiple marking by RB, within the sample populations from this series to date. The greatest proportion of multiple marking within the marked population is from the Mt Keith treatment. The proportion of multiple marking, within the marked population from Yakabindie, is greater than that from the 100 baits km⁻² and 50 baits km⁻² treatments at the Gibson Desert and Pimbee Station respectively. This level of marking is almost equivalent to that from the 50 baits km⁻² treatment at the Gibson Desert. Marked sample population sizes are insufficient for a test of significance.

In instances of multiple banding of individual vibrissae, separate bands exhibited a varying 'intensity' of marking. Some clearly visible bands did not exhibit the distinctive fluorescence described by Fisher (1988). No heavily pigmented cat vibrissa was marked. Where marking of non-pigmented sections of vibrissae was continuous with heavily pigmented sections, marking did not continue into the heavily pigmented region.

Table 3. Frequency of multiple marking by RB from samples collected after various baiting treatments.

Location and baiting treatment	Sample population	Proportion of sample population with multiple marking	Proportion of marked population with multiple marking
Gibson Desert 100 baits km⁻²	22	0	0
Gibson Desert 50 baits km⁻²	13	0.23	0.23
Pimbee Station 50 baits km⁻²	12	0.17	0.17
Mt Keith Station 50 baits km⁻²	18	0.22	0.27
Yakabindie Station 25 baits km⁻²	23	0.17	0.22

Discussion

This study confirms the high bait acceptance achieved previously by distributing 50 feral cat sausage baits km^{-2} (Angus *et al.*, 2002 a and b; Liddelow *et al.*, 2002) and indicates that half this rate of distribution is likely to be equally efficacious under similar environmental conditions. The proportion of marking in the sample population from the 25 baits km^{-2} treatment was significantly lower than marking by the 50 baits km^{-2} distribution at the Gibson Desert ($z=1.81$, $P<0.05$; see Angus *et al.*, 2002a) and that at Pimbee Station ($z=1.74$, $P<0.05$; see Angus *et al.*, 2002b). However the distribution of 25 baits km^{-2} during this study was not significantly different from the proportion of marking from the simultaneously sampled 50 baits km^{-2} treatment at Mt Keith; nor the 100 baits km^{-2} distribution at the Gibson Desert ($z=0.30$, $P=0.62$) (see Angus *et al.* 2002a); nor from the proportion of individuals removed by toxic baiting at 50 baits km^{-2} at the Gibson Desert ($z=1.58$, $P=0.06$; see Liddelow *et al.*, 2002). The lowest bait distribution carried out in this series achieved an equivalent proportion of marking to the highest. The proportion of multiple bait-take was also greater or comparable to that recorded from the more dense baiting treatments. The high level of marking and multiple bait-take reported here suggests that this distribution is not near to the lower limit necessary for feral cat control, under these conditions. Similar results may be achieved at significantly lower baiting densities than those examined in this series to date (see also Burrows *et al.*, in prep; Liddelow *et al.*, 2002). It is recommended that the efficacy of 25 baits km^{-2} be assessed against that of the lower baiting densities of 10 and 5 baits km^{-2} , under conditions of low prey abundance.

This study and that conducted at Pimbee Station (Angus *et al.*, 2002b) indicate no sex bias in bait acceptance by feral cats. As discussed by Angus *et al.* (2002a), disparity in marking between the sexes could indicate important deficiencies in baiting methodology. As female cats tend to occupy smaller and more discreet ranges than do males (e.g. Jones and Coman, 1982) record of such a disparity may serve as a useful indicator that the lower critical limit of bait density has been approached.

Angus *et al.* (2002b) discussed various factors that may lead to an underestimation of bait acceptance by the methods employed here. An important factor discussed was insufficient time elapsed between bait distribution and assessment. This was based upon studies of bait acceptance by the red fox (*Vulpes vulpes*) in Western Australia (Thomson and Algar, 2000; Thomson *et al.*, 2000). During the current study, one individual exhibited RB staining of the gastro-intestinal tract but no marking of whiskers, suggesting that the animal had recently consumed its first RB bait (see Fisher *et al.*, 1999). This animal was captured 20 days after baits were deployed over an area that had not received RB baits previously. Palatable baits were present at the two sites at the time of sampling as this animal and two others had ingested them recently (Figure 7). It is possible that animals not marked in this sample may have located and consumed baits if captured at a later date. Therefore it is recommended that the time elapsed between bait distribution and sampling be extended for future assessments of this type.

Increasing the time elapsed between baiting and sampling will include animals that are marked later but may reduce the reliability of detecting RB marking in animals that consume bait material soon after bait deployment (Fisher, 1999). Unfortunately studies on the persistence of RB marking in cat whiskers do not appear to have been undertaken (see Fisher, 1999). Information for other species suggests a high level of inter- and intra-specific variability in persistence of marking that is strongly dependent on the dose of RB received (Fisher, 1999; Jacob *et al.*, 2002). Angus *et al.* (2002a) detected cat vibrissa marking by RB, 50-60 days after baiting. There was a lower proportion of the sample population marked than there was just 10-18 days after baiting. However there was no suggestion made of lower precision because markings observed were not near to the distal tip of vibrissae, where they may be more vulnerable to damage and removal (see Fisher, 1998). On the basis of this information and that for other species (Fisher, 1999) delaying sampling (itself) until at least 30 days after baiting will not reduce the reliability of mark detection.

As discussed previously with regard to non-target species (Angus *et al.*, 2002a), work is required to improve our knowledge of the nature and persistence of RB marking in cats, particularly at low doses of RB. There is no literature available on the reliability of RB marking of cat whiskers at low doses (*cf.* Fisher *et al.*, 1999). Although current methods of detecting RB marking offer greater precision (Fisher, 1999), Lindsey (1983) for example, reported unreliability in marking of mountain beavers (*Aplodontia rufa*) from gavage doses of 5 mg kg⁻¹ RB. This is the approximate dose received by the average male cat in the current sample population, from the ingestion of a single RB bait. Fisher (1995) found marking of rats (*Rattus norvegicus*) to be unreliable below 50 mg kg⁻¹ and not detectable in 'most' animals dosed at 5 and 10 mg kg⁻¹. Jacob *et al.* (2002) found marking of house mice (*Mus domesticus*) to be unreliable at doses less than 80-90 mg kg⁻¹. There is some indication of unreliability of vibrissa marking from this current series and that some marking observed may have been the result of the consumption of multiple baits over a short period of time. Although it could not be quantified, Fisher (1995) noted that the intensity of fluorescence of RB markings varied with the dose of RB received. In instances of multiple banding of individual vibrissae, from this study, separate bands also exhibited a varying 'intensity' of marking. Some clearly visible, coloured bands did not exhibit the distinctive fluorescence described by Fisher (1988). If these bands are marking by RB, bait ingestion may be overlooked in certain individuals where the stronger, distinctive fluorescent marking is absent, particularly if marking is continuous with the proximal tip, where 'colouration' under UV light is common in the absence of RB marking. No heavily pigmented cat vibrissa has been marked from any sample in this series to date. Where marking of non-pigmented sections of vibrissae is continuous with heavily pigmented sections, the marking does not continue into the heavily pigmented region. This is in contradiction with the assertion of Fisher *et al.* (1999) that RB marking is reliable in heavily pigmented cat vibrissae. Fisher *et al.* (1999) reported reliable marking of cats at a mean dose of approximately 23 mg kg⁻¹. Reliable marking of heavily pigmented vibrissae may have been a result of the

relatively high doses of RB administered. Therefore it is recommended that not less than 50 mg bait⁻¹ RB be employed for studies of bait acceptance by feral cats. It is also recommended that a study be conducted to determine how long after dosing the detection of RB marking of vibrissae remains consistently reliable. Particular attention should be given to confirming the reliability of marking in heavily pigmented vibrissae.

This exercise represents the first in this series where bait material has been located in the stomachs of captured cats. Both animals appear to have consumed multiple baits as they also bore RB marking in the whiskers. One individual did not have bait material in the stomach itself, however recent ingestion is indicated by staining of the digestive tract and the lack of whisker marking. This may indicate that the period of effective bait availability was greater than in previous exercises. The apparent absence of foxes and relatively sparse distribution of dingoes may have contributed significantly to effective bait availability. Examination of lower baiting densities must consider the presence and activity of other species that are likely to reduce the effective availability of baits to feral cats. Consideration must also be given to the reduction in effective bait availability due to the consumption of multiple non-toxic baits by individual animals (see also Thomson and Algar, 2000). The use of non-toxic baits may not be a useful application for assessing lower baiting densities and no such regime should be rejected on the basis of the acceptance of non-toxic baits alone.

No rabbit density assessment was conducted during this exercise, however the area is known to support few rabbits. Algar *et al.* (2002) reported a mean (\pm s.e.) rabbit presence of 0.98% (\pm 0.38) on transects assessed at Wanjarri Nature Reserve (see Figure 1) between January 2001 and January 2002. Rabbit presence during May and June 2001 was 0% and 0.46% respectively. This is in contrast to Peron Peninsula, for example, where Algar *et al.* (in press) recorded a mean (\pm s.e.) rabbit presence between November 1999 and March 2000 of 49.43% (\pm 3.49), employing the same sampling technique. Mean (\pm s.e.) monthly rabbit abundance at Peron Peninsula for the months of May and June, for the period 1996-2000, was 50.87% (\pm 4.57; n=15; range=30-85%) and 51.75% (\pm 8.98; n=4; range=27-65%) respectively (Project Eden, unpublished data – note that these figures were obtained from 1 km sample stations and varying transect distances). This study represents the 6th reported exercise involving the aerial deployment of this bait medium in Western Australia, under conditions of relatively low prey abundance, particularly that of rabbits. All exercises have resulted in relatively strong bait acceptance by feral cats. This is in contrast to the seasonally poor results achieved in the Shark Bay area with this bait (Algar *et al.*, in press) and others (Risbey *et al.*, 1997; Short *et al.*, 1997), where prey species (rabbits) are in relative abundance. Sufficient evidence exists to suggest that prey availability (particularly that of rabbits) and seasonal factors influencing their abundance and breeding success are an important influence in seasonal/temporal/spatial variations in bait acceptance by feral cats (see also Burrows *et al.*, in prep.). If reliable and repeatable control of feral cats is to be achieved through baiting, a sound knowledge of the influence of prey availability on bait acceptance is

required. In particular an indication of the limits of prey abundance under which baiting will be efficacious is essential (see Short *et al.*, 1997).

A transect-based technique has been employed by the Department to examine the influence of various environmental factors on bait acceptance by feral cats and to predict the efficacy of aerial baiting regimes (see Algar *et al.*, 2002; Algar *et al.*, in press.). This transect technique is relatively inexpensive and efficient, however there is no indication of how the index derived from this technique relates to the behaviour of and bait acceptance by the broader population. It cannot be assumed that animals using or occupying roads are accurately representative of the population as a whole (Mahon *et al.*, 1998). Abundance studies elsewhere have indicated that transect-based assessments of carnivore activity/behaviour, particularly those that are non-passive, have limited reliability and are not necessarily sensitive to the condition of the underlying population (e.g. Conner *et al.*, 1983; Mahon *et al.*, 1988; Kendall *et al.*, 1992; Diefenbach *et al.*, 1994; Thompson and Fleming, 1994; Allen *et al.*, 1996; Edwards *et al.*, 1997; Sargeant *et al.* 1998; Stander, 1998, Edwards *et al.*, 2000 Wilson and Delahay, 2001). These authors cite a range of intrinsic and extrinsic factors that confound analysis. Mahon *et al.* (1988) and Edwards *et al.* (2000) indicate particular shortcomings of road-based techniques in the study of feral cat activity. Useful prediction of baiting efficacy may not require the same level of precision demanded by measures of abundance, however as it serves as an index of absolute activity, calibration with the underlying population is essential (see for example Wilson and Delahay, 2001). The current investigations of baiting efficacy offer some opportunity to calibrate the transect technique and to determine whether or not the derived index is sensitive to the condition of the underlying cat population. Therefore it is recommended that comparison between the transect technique and bait acceptance from the aerial deployment of baits be undertaken.

Figure 6 (and the statistical treatment of this information) suggests that the sample of cats from the Yakabindie treatment approximates the underlying population present but that the sample from Mt Keith may not (see Seber, 1973, pp296-327). This arises from the relatively strong station response at Mt Keith on 1 June until which time station response was declining. These animals may have been captured later in the sampling period because they did not encounter a sampling station (trap-set) within their 'normal' set of 24 h home ranges (see Edwards *et al.*, 2001). Their area of usage may have increased in response to the removal of neighbouring individuals (see Allen *et al.*, 1996 and the data of Thomson and Fleming, 1994). That is, feral cat activity may be density-dependent (see Edwards *et al.*, 2000), as suggested for the red fox (Ables, 1969; Phillips and Catling, 1991). Algar *et al.* (in press) reported responses by feral cats to cycles/changes in short-term environmental factors. The apparent increase in activity of these five individuals, over the course of the one evening, may also have been such a response.

The importance of an approximation of the underlying population in such samples has been discussed by others (see Angus *et al.*, 2002b). The

methods employed here offer no indication of whether or not sub-samples of a population are in any way biased. Neither do they offer any indication of whether or not any intrinsic bias in sampling is related to the likelihood of individual animals accepting bait material. It cannot be assumed that the probability of bait acceptance by an individual and the probability of sampling that individual are independent. Therefore conclusions on the nature of the underlying population can only be made with any confidence if the sample population approximates, or is calibrated for, this underlying population. A demonstration that the underlying population has been sampled adequately should be one of the aims of this type of exercise in the future.

This exercise employed a smaller baited buffer than did previous exercises in the series. The narrowest buffers were 2.1 km (Yakabindie) and 3.0 km (Mt Keith). This appears to have been sufficient in ensuring that animals normally resident outside the baited area were not sampled with any frequency. Indications that recent immigrants are being sampled would include a greater proportion of unmarked animals near the edges of the sampling area and a greater proportion of unmarked animals captured late in the sampling period. Unmarked individuals were not sampled more frequently near the edge of the grids nor near to the end of sampling, than were marked animals (Table 2). Therefore future investigations of this type will be achieved more efficiently by reducing the baited buffer to at least as narrow as 3.0 km.

Summary of recommendations

- Investigate the possibility of further improvements in baiting efficiency by comparing the distribution of 25 baits km⁻² with 10 and 5 baits km⁻² respectively.
- Increase the time elapsed between RB baiting and feral cat sampling from 10 days to 30 days. Ensuring that sampling occurs outside expected periods of seasonal dispersal.
- Increase the concentration of Rhodamine B in baits from 19 mg to 50 mg.
- Undertake a manipulative investigation into the relationship between rabbit abundance and bait acceptance by feral cats, with the aim of identifying densities of rabbits under which baiting is and is not efficacious.
- Compare indices derived from transect-based bait acceptance exercises with bait acceptance achieved through the aerial deployment of RB or toxic baits. This could be achieved concurrently with future exercises in this series.
- Include a demonstration that an adequate sample of feral cats has been achieved as an aim of future exercises of this type.
- Reduce the imposed baiting buffer from 5 km to 3 km for future RB bait acceptance exercises.

- Make final determination of relative efficacy of baiting regimes on the basis of toxic baiting.

Acknowledgments

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