Comparison of Two Aerial Baiting Regimes with Respect to Bait Acceptance by Introduced Predators and Non-target Native Fauna, at the Gibson Desert Nature Reserve, Western Australia.

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Introduction.

The first recorded introduction of domestic cats to Australia was by English settlers in the 18th century (Dickman, 1996). Massive deliberate releases to the wild occurred in Western Australia during the late 19th and early 20th centuries, for the control of rabbits, house mice and native rodents (Long, 1988). However anecdotal evidence, including Aboriginal knowledge of the animal (Burbidge *et al.*, 1998), indicates that introduction could have occurred in the 16th century or earlier (Dickman, 1996). The first reported sightings of apparently free-living cats distant from human habitation in Western Australia were prior to the deliberate releases here (Long, 1988).

The impact of the feral cat upon native fauna is poorly known. There is however broad agreement that the feral cat does impact upon our threatened fauna and as such it has been listed as a 'Key Threatening Process' under Schedule 3 of the Commonwealth *Endangered Species Protection Act 1992*. Potential impact to native fauna has been reviewed by Dickman (1996) and broadly classified as predatory, competitive and amensal. These impacts have generally been inferred from studies of diet, feeding ecology and epidemiology. Clearer evidence of feral cat impact has come from the failure of native fauna reintroductions, due to feral cat predation (Short *et al.*, 1992; Christensen and Burrows, 1994; Gibson *et al.*, 1994), and the demonstration that feral cat predation can regulate populations of prey species (Newsome *et al.*, 1989; Risbey *et al.*, 2000, Rauzon *et al.*, 2001).

Toxic baiting is seen as the method most likely to produce an effective operational method for cat control (Anon., 1999). Development of an effective baiting technique for the control of the feral cat is cited as a high priority action by the national Threat Abatement Plan for Predation by Feral Cats (Anon., 1999). To this end, the Western Australian Department of Conservation and Land Management (The Department) has developed a bait medium that has the potential to deliver humane toxins to feral cats for effective, broad-scale control. This bait medium has been employed as an integral part of successful island eradications off the Western Australian coast (Algar *et al.*, 2001 a and b) and was used as the sole tool of eradication at Faure Island (Algar *et al.*, 2001b).

In order to effectively use this tool in operational control, optimisation of delivery, optimisation of timing and the potential impacts to non-target species require clarification. Although the bait medium has proven palatable to cats in both captive and field studies, how, when and how often to best deliver the bait remain to be elucidated. Information to date suggests that cycles in the abundance of key prey species determines when baiting is most efficacious (Christensen and Burrows, 1994; Short *et al*., 1997; Algar *et al.*, in press). The type of prey available and the factors driving cycles in abundance will vary with broad location. Studies aimed at clarifying this are current.

The study reported here is the first in a series aimed at determining an optimum delivery of baits, from an aircraft, for the control of feral cats. Successful control has previously been achieved by deploying a nominal 100 baits/km^2, in strategic areas (Algar *et al.*, 2001a and b). This nominal distribution was therefore used as a benchmark, against which to assess the efficacy of a lower baiting density.

Two aerial, non-toxic baiting densities were compared for their efficacy in controlling predators. A nominal 100 baits/km^2 was compared with 50 baits/km^2. Small ground-dwelling vertebrates were sampled concurrently and the potential risk of poisoning from the two baiting regimes was assessed and compared.

Method.

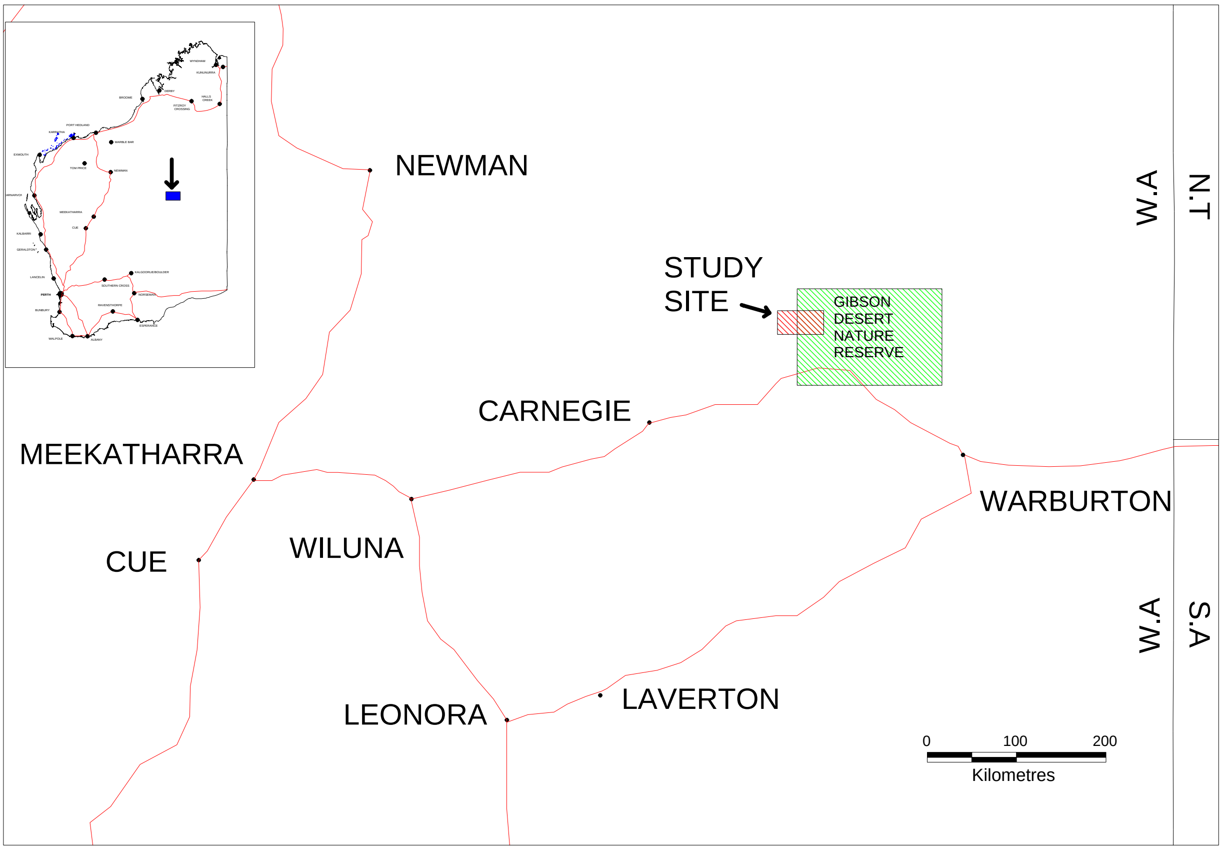
Site.

This study was conducted within and adjacent to the western portion of the Gibson Desert Nature Reserve, Western Australia (Figure 1). Centroid of the site is approximately 24^0 45’ S 124^0 42’ E and topographic map coverage is provided by the Warri (SG51-04) 1:250 000 map sheet (Anon., 1988). The area, known as the Eagle Bore study site, is the subject of a long-term study of introduced predators and the implications of predation for fauna conservation (see for example Christensen and Burrows, 1994). The exact location was initially selected for the existing network of roads, first established in the 1970s by the Eagle Exploration Company for the purposes of mineral exploration. Some of this road network has been maintained and expanded on by the Department for the purposes of wildlife conservation and research.

Climate.

Biological and geological processes in the Gibson Desert are at present influenced by a hot (persistently dry) climate (Anon, 2001). The nearest reporting centre is Warburton (Figure 1) with a mean daily maximum (minimum) temperature of 29.6^0 C (14.7^0 C), mean annual rainfall of 213.8 mm and a mean of 35.2 rain days per year. January is the hottest month with a mean daily maximum temperature of 37.6^0 C and July the coolest with a mean daily maximum of 20.2^0 C and a mean daily minimum of 5.6^0 C. The wettest and dryest months in terms of mean rainfall are February (28.9 mm) and September (4.8 mm) respectively. The wettest and dryest months in terms of mean number of rain days are December (4.4) and September (1.5) respectively.

Figure 1: Location of the Eagle Bore Study Site.



Geology and Geomorphology.

Geology and geomorphology of the area is described by van de Graaff (1974). Much of the study site overlies gently undulating laterite plains. The surface is red-orange quartz sand with ferruginous pisoliths, commonly termed buckshot. Soil is sandier lower in the landscape and along the broadly dissecting drainage lines. A major valley floor runs roughly diagonally across the site from SW to NE. The surface there is a Cainozoic colluvium of orange-brown quartz sand with poorly sorted rock fragments. Claypans of Quaternary clay and silt (often slightly gypsiferous) have formed at lower parts of the valley floor. Several small expressions of nodular and cavernous Cainozoic limestone (commonly termed calcrete) occur on the edges of the broad valley floor. The largest expression is in the far south west of the study site, with another to the north east of camp at Compound Road (Figure 2). The calcrete is scattered with the mounded burrows of the now locally extinct Burrowing Bettong (*Bettongia leseuer*).

Plate 1: Spinifex shrub-steppe occurs on the undulating laterite plains, across much of the study area. Photo – L. Royston.

Vegetation.

Vegetation at the Eagle Bore study site has been mapped and described by Beard (undated) and Beard (1969). The undulating laterite plains are vegetated by a shrub steppe dominated by *Triodia basedowii*. Scattered shrubs include various *Acacia spp*, *Hakea spp*, *Senna spp* and Codonocarpus cotinifolius. The most stony soils, highest in the landscape, support small areas of *Acacia grasbyi* over *T. basedowii*. The sandier soils support *T. schinzii* hummock grassland. The broad, colluvial valley floor is vegetated by mulga (*Acacia aneura*) parkland with scattered *Corymbia opaca*, and *Acacia pruinocarpa*, variously over spinifex or bunch grasses (such as *Eragrostis spp*). Common shrubs include *Eremophila forrestii, Acacia tetragonophylla Ptilotus obovatus* and *Senna spp*. The lower, wetter areas are typified by stands of *Eucalyptus aff. intertexta*. Areas of calcrete are vegetated by tall, dense grasslands of *T. longiceps*. Areas burnt by recent fires are vegetated by pioneers such as *Ptilotus spp*, *Dicrastylis exsuccosa*, and *Codonocarpus cotinifolius*.

Plate 2: Mulga parkland occurs on the broad valley floors. Photo – L. Royston.

Previous Predator Control.

Aerial baiting for introduced predators at the site commenced in 1992. Initial efforts employed 1080 dry meat baits, registered for the control of foxes, over much of the present study area. Baiting was restricted to roads and drainage lines. A distant site was used as a control, against which to compare any changes in predator density resulting from the baiting efforts. During the period 1989 to 1991, prior to any predator control efforts, the predator density indices recorded were similar at the two sites measured. The fox bait and/or the method of deployment was efficacious in the control of foxes and dingoes but not in the control of cats. In fact cat abundance increased at the baited site, relative to the control site. It was hypothesised that the selective removal of foxes and/or dingoes lead to this increase in cat abundance (Christensen and Burrows, 1994). A bait designed to be more palatable to cats was introduced to the site in 1994. The bait was of kangaroo meat, as per the registered fox bait, but smaller and not dried to the same extent. Baiting with the ‘cat bait’ was undertaken in 1994, 1996 and 1998. The area west of Brain Street (Figure 2) was baited with toxic cat baits while the area to the east was not baited and served as the control. Baits were distributed in a grid pattern over the entire treatment zone. All three cat baiting campaigns were successful in markedly reducing cat, dingo and fox density, relative to the control zone. Since cat baiting commenced the cat density index (DI) has been consistently lower in the baited zone than in the non-baited zone. Following the most recent baiting in September 1998, the cat DI for the control zone was 87% greater than that of the baited zone.

Bait Medium.

The bait developed by the Department, for the control of feral cats is a small sausage, measuring 6-8 cm in length and 2 cm in diameter. The sausage is composed of 70% minced kangaroo meat, 20% chicken fat and 10% digest that includes a number of flavour enhancers. Baits are manufactured at the department’s purpose-built bait factory at Harvey.

Non-toxic baits, carrying the dye Rhodamine B (RB), were used in this study as this marker is an efficient tool in determining bait consumption by cats (Fisher *et al.*, 1999) and a wide range of non-target species (Fisher, 1998). When RB is consumed, the compound itself causes short-term staining of body tissues, digestive and faecal material with which it comes in contact. Certain metabolites of RB are absorbed by the body and incorporated into growing tissue. Significantly they are incorporated into growing hair, scales, feathers and nails. Mammal hair, particularly vibrissae, can be readily removed and examined for marking. This method enabled the concurrent assessment of efficacy in feral cat control and risk to non-target species, in the absence of an active toxin.

One hundred millilitres of Red Eye® was added to each ‘batch’ of sausage medium and thoroughly mixed throughout. Each batch of sausage medium produced 1000 sausages, such that each sausage contained approximately 15 mg RB.

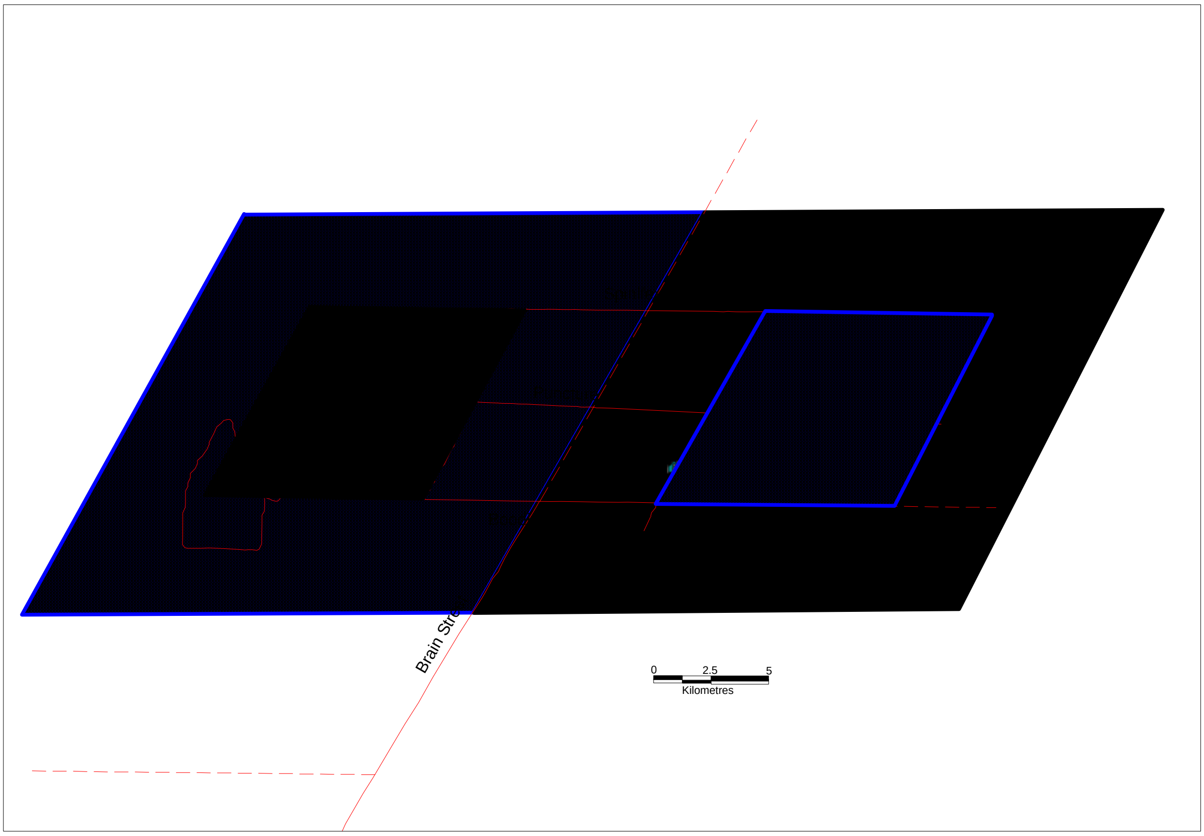
Baits were frozen and vacuum sealed at manufacture and maintained in a frozen state until no more than 24 h before distribution. At this point, baits were laid on elevated sheets of corrugated iron and allowed to thaw. Under direct sunlight, the thawing process causes the chicken fat and dissolved and suspended flavour enhancers to exude from the sausage skin. This process is thought to improve the recognition and palatability of baits as they become more odorous with the flavour enhancers transported to the bait surface. However cool, overcast conditions, with some light rainfall did not allow this process to occur. Therefore baits were distributed in a thawed state, with the lipid-soluble portion of the bait material contained within the sausage skin.

Bait Distribution.

Two densities of non-toxic bait distribution were carried out, the benchmark 100 baits per km^2 and as a comparison, 50 baits per km^2. The western half of the study area was treated with the lower bait density and the eastern half with the higher bait density (Figure 2). The two baited treatment zones were each nominally 350 km^2 in area and support similar vegetation types. A baited buffer of 5 km was employed on all dimensions of each treatment, in which no sampling was undertaken (Figure 2). The buffer was employed to reduce the probability of capturing individual cats generally resident outside the particular treatment area or outside the study area entirely. Taking account of the buffers imposed, the areas sampled were as follows. The western treatment offered 50 km of transect encompassing an area of approximately 90 km^2. The eastern treatment offered 52 km of transect, encompassing an area of approximately 85 km^2. Figure 2 indicates that some of the western transect traversed areas within the 5 km ‘buffer’. The narrowest section of buffer actually maintained during sampling was 2.9 km at point ‘A’.

Baits were distributed from a Cessna 210 aircraft, flying at a nominal 100 kt and 1000 ft AGL. The aircraft was guided a AG-NAV navigation system with pre-set flight lines for the target areas. Point of bait ejection was recorded by a sensor in the bait delivery tube. Course deviation indicator was set to ± 50 m. A timing light indicated to the bombardier a preset interval, at which baits must be distributed, to achieve the desired bait distribution. Flight-lines are presented in Figure 3. Flight cells were 1 km intervals and baits packaged on site to contain the required number of baits per cell, to achieve the nominal 100 and 50 baits/km^2. Baits were delivered to the baiting tube, such that a single bait package was delivered ‘evenly’ over each cell. Lines 1-10 were flown on 13 July 2001. Lines 11-27 were flown on 14 July 2001. Lines 28-40 were flown on 15 July 2001.

Figure 2: Nominal Boundaries of the Two Treatment Areas and Baiting Buffers.

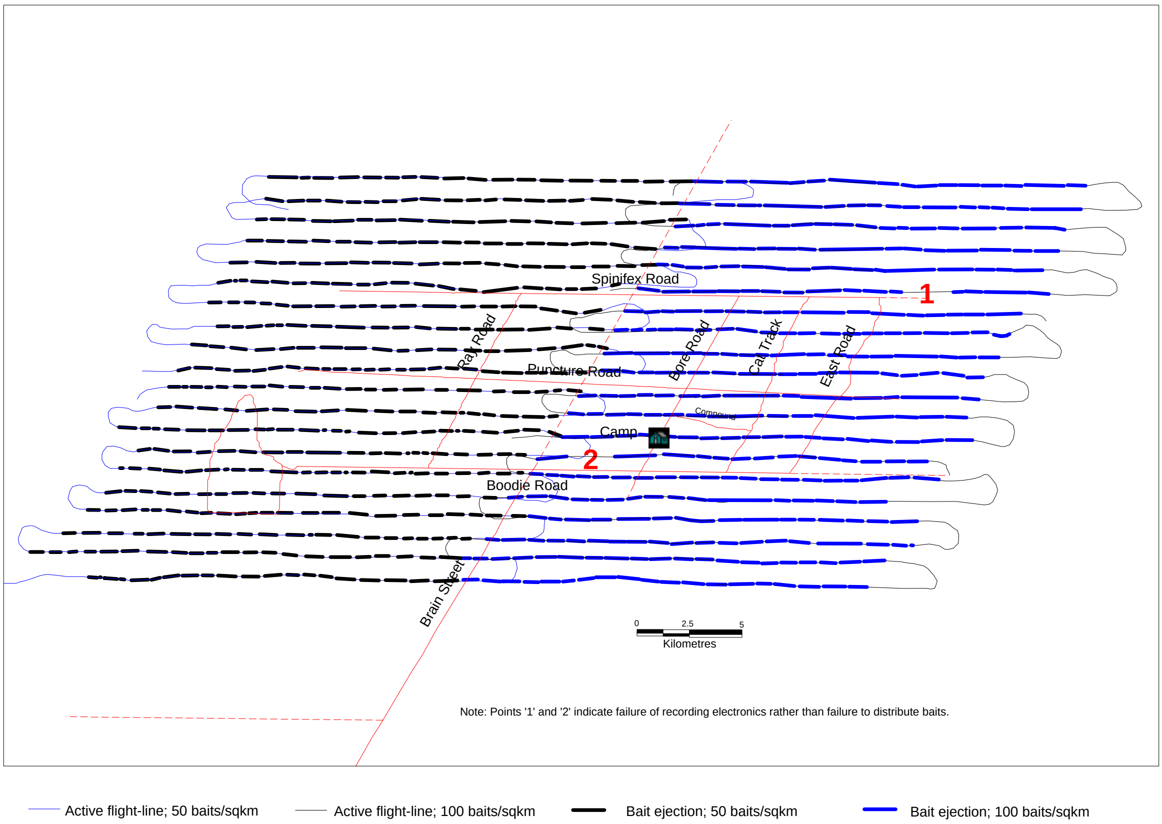


Vehicle access - alignment plotted.

Vehicle access - alignment estimated.

Plate 3: Thawing and packaging Rhodamine B-labelled baits prior to aerial deployment.

Figure 3: Flightlines and Bait Ejection points for the Two Baiting Treatments.



Predator Trapping.

The techniques used for predator sampling were specifically devised by the Department for the live capture of feral cats. However they are also relatively efficient in the capture of wild dogs/dingoes (*Canis familiaris s-spp*) and red foxes (*Vulpes vulpes*). The lure system relies on a combination of cat audio and olfactory signals. The audio lure is a simple, electronic and continuously repeated cat call or 'FAP'. The FAP is employed to attract the attention of cats at distance and may be clearly detected by the human ear at a distance of tens of metres. The olfactory lure is a blend of cat faeces and urine or 'Pongo'. This is the principal lure that imitates the scent marking, and therefore presence, of an unrecognised individual thus enticing the animal into the trap channel. Trap sets were used with or without an audio lure but always employed the olfactory lure. The trap system is a pair of No. 3 Victor Soft Catch ® leghold traps.

Plate 4 illustrates the general configuration of a trap set A blind channel is cleared into a sturdy shrub or spinifex hummock. The channel, 80cm in length and 20cm in width, was cleared of all overhanging vegetation and the ground surface roughly levelled. A depression was excavated, just inside the channel mouth, sufficient to accept the two set traps, in a slightly offset alignment. Traps were anchored in place and covered with a fine layer of clean sand, containing no particles greater than several millimetres in diameter.

Plate 4: Placing a Felid Attracting Phonic at a completed trap set, channelled into a spinifex hummock. Photo – L. Royston.

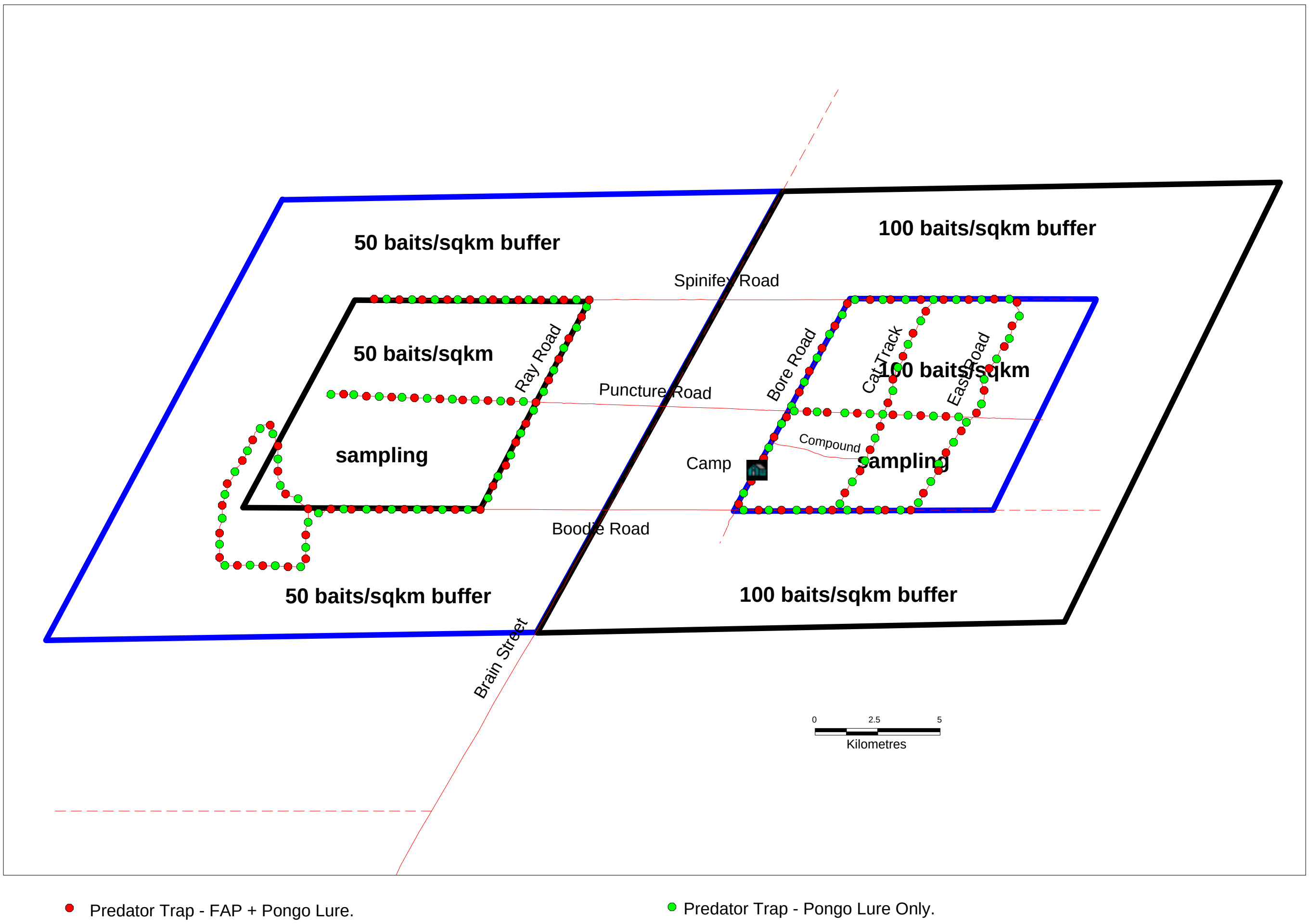
Traps for predator sampling were set, in any given area, so as to allow at least 10 days, following bait distribution, for bait consumption and biomarker metabolism. Table 1 indicates the dates on which particular traps were commissioned and decommissioned. Traps were placed at nominal 500 m intervals along available transects, within each treatment area. The lure types were alternated to include a FAP + Pongo combination at one interval and Pongo only at the alternate interval (see Figure 4). Sampling of the 100 baits/km^2 treatment was for 2-4 nights. Because of a lower trap success, sampling of the 50 baits/km^2 treatment was maintained for 7 or 8 nights, in an attempt to maximise the sample from this treatment. A total of 502 trap nights was undertaken in the 100 baits/km^2 treatment and a total of 773 in the 50 baits/km^2 treatment.

Table 1: Dates of commissioning and decommissioning of predator traps.

Trap Numbers	Commissioned	Decommissioned	Trap Nights
West001-056	23/07/2001	31/07/2001	448
West064-073	23/07/2001	31/07/2001	80
West057-063	24/07/2001	31/07/2001	49
West074-101	24/07/2001	31/07/2001	196
East001-021	24/07/2001	30/07/2001	126
East022-093	25/07/2001	30/07/2001	360
East094-097	26/07/2001	30/07/2001	16

Captured predators were destroyed upon capture with a hollow-point .22 projectile, fired at point blank into the top of the skull. Dingoes and foxes were sexed on site and mystacial vibrissae removed for later examination. Cats were retained for more critical examination. Individuals were weighed and head-body length measured. Females were examined for indications of lactation, foetuses *in utero* and placental scarring. Vibrissae and stomachs were removed for later examination.

Figure 4: Predator Trap locations – July Sampling Exercise.



Dietary Analysis.

Stomachs of captured cats were extracted on site and stored in a 10% formalin solution until formal examination in the laboratory. Each stomach was examined for the composition of food items present. Dietary composition was examined for the identity and number of items present. Composition was determined to the highest level of classification possible, given the type and state of diagnostic features remaining intact. Invertebrates and larvae were classified to the level of Order or Family based upon the descriptions, diagrams and photographs of Haddington and

Johnston (1998). Plant material was classified to various levels, according to the best knowledge of the examiner, then broadly categorised as either ‘grass’ or ‘woody vegetation’. Reptiles were classified to various levels, according to the dichotomous keys and descriptions of Cogger (1996) and Storr *et al.* (1983, 1986, 1990 and 1999). Birds were classified to the level of species, where possible, according to the descriptions and drawings of Storr and Johnstone (1985) and Simpson and Day (1996). No microscopic examination of feathers was undertaken. All mammals were classified to species, according to the descriptions of Archer (1981), McKenzie and Archer (1982), Cooper (1993) and Strahan (1995) or through microscopic examination of hair structure, as described by Brunner and Coman (1974). This methodology was used to compare hair structures with those held in a reference collection, from known sources.

Frequency of occurrence was determined by counting the number of various intact body parts (generally an appendage) and dividing by the number parts the particular organism normally possesses. From a partially digested sample, individual organisms cannot always be discerned as they may consist solely of items such as muscle tissue, hair or feathers. In these instances, a single individual was scored.

Non-target Vertebrate Trapping.

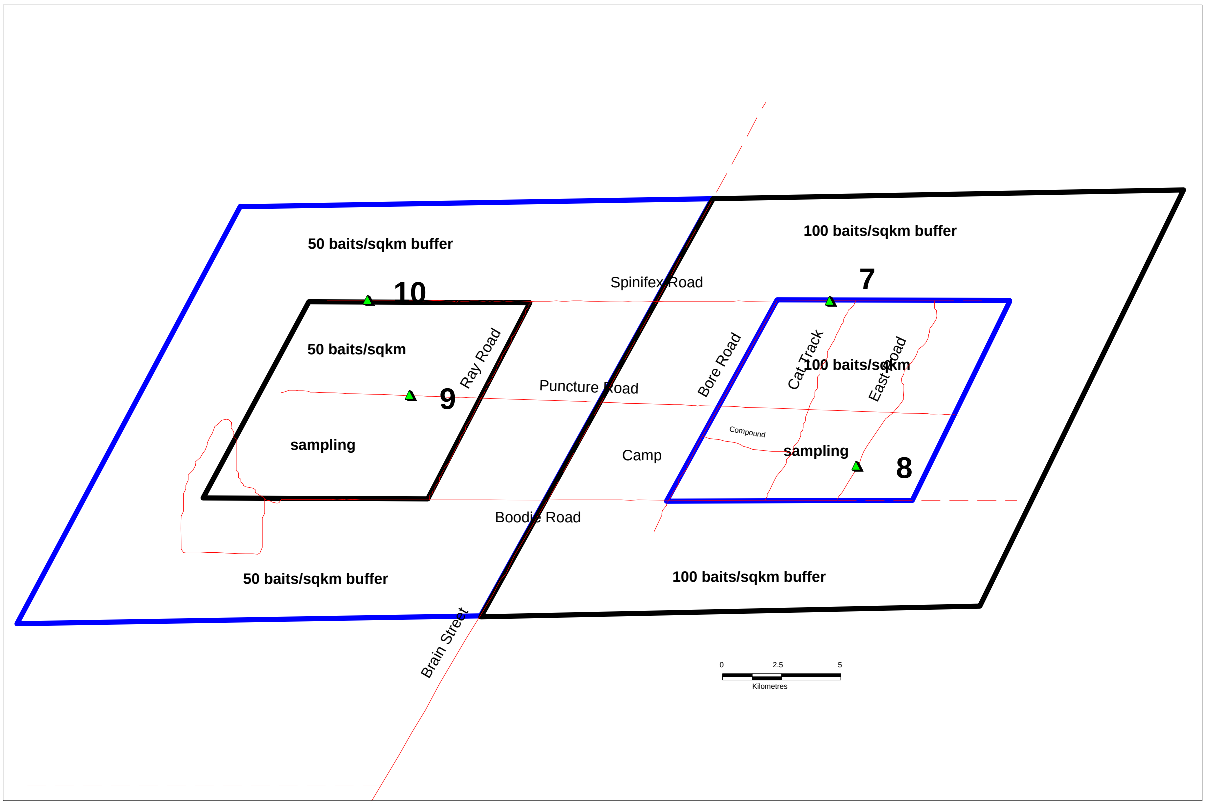
Vertebrate fauna was sampled at four sites within the study area, two in each treatment (Figure 5). Each trapping site consisted of both pitfall and medium Elliott box traps. Five pitfall traps were operated at each site, each consisting of five pitfalls, serviced by a common aluminium insect screen drift-fence. Pitfalls were 500 mm lengths of 150 Ø stormwater pipe, spaced at 3 m intervals. Pitfall sets were spaced at 20 m intervals. Drift-fences were 300 mm in height and extended 1 m beyond the two terminal pitfalls, giving a total length of 15 m for each pitfall trap. Two Elliott traps were placed at each pitfall trap, one at each end of the drift fence, under a shrub and within 2 m of the fence. Elliott traps were baited with a peanut paste and ground (‘quick’) rolled oats mixture, with sufficient peanut paste to bind the oats.

Sites 7 and 8 were operated for the nights of 27-29 July and sites 9 and 10 were operated for the nights of 25-30 July. The latter operated for a longer period because the transects on which they were situated were traversed for a longer period, in order to maximise the sample of predators (see above). The closest distance between a pitfall trap and a bait ejection point was 76 m, 82 m and 116 m for sites 8-10 respectively. A flightline intersected site 7, with baits ejected above and on either side of the trapping location.

Non-target Vertebrate Sampling.

All vertebrate captures were collected daily and returned to a central point for processing. Individuals were identified according to the dichotomous keys and descriptions of Tyler *et al.* (2000), Cogger (1996), Storr *et al.* (1983, 1986, 1990 and 1999), Strahan (1995), McKenzie and Archer (1982) Reptiles were measured (snout-vent and tail length), marked, sexed where possible macroscopically and released. Individuals and their scat were examined externally for staining by RB. Mammals were weighed, measured (head-body and tail length), sexed and examined for reproductive condition. Individuals and their scat were examined externally for staining by RB. Under anaesthesia with Isoflurane (see Anstee and Needham, 1996), mystacial vibrissae were removed for examination in the laboratory, for marking by RB. Individuals were then observed for recovery from anaesthesia, marked and released.

Figure 5: Location of Non-target Fauna Sampling Sites – July Sampling Period.



Non-target Fauna Sampling Site.

Examination of Mystacial Vibrissae.

Vibrissae collected from both predators and non-target mammals were stored in sealed plastic bags, out of direct sunlight until examination in the laboratory. All samples taken were labelled with the field number assigned to each captured animal. Methods of detection of Rhodamine B marking and the interpretation of results are described and discussed by Fisher *et al.* (1999) and Fisher (1998). All samples were initially examined in a photographic dark room, under illumination from a portable, low intensity UV light source. Samples indicating marking with RB, under this gross examination, were not examined further. Samples indicating no marking by RB were examined under a fluorescence microscope (see Fisher, 1998). Fluorescence microscopy was used as the definitive indication of marking by RB.

Results.

Predator Trapping.

Locations of feral cat captures are presented in Figure 6**.** A summary of all predator captures is presented in Table 2. The gross number of captures of feral cats at the 100 baits/km^2 treatment was almost double that of the alternate treatment. Given the trap effort invested in sampling the two treatments, trap success for feral cats was significantly greater at the 100 baits/km^2 treatment ($z=3.38$, $\alpha<0.001$). The overall capture rate of feral cats was in excess of twice that of the other predators combined.

Table 2: Summary of predator captures in the two treatment zones.

	50 baits/km2			**100 baits/km2**		
	Cat	**Dingo**	**Fox**	**Cat**	**Dingo**	**Fox**
Gross	13	3	2	22	7	2
Per trap night	0.02	<0.01	<0.01	0.04	0.01	<0.01

Predator Sampling.

All individual cats captured were adult or sub-adult and all were sexually mature. The mean weight of captured males (± S.E.) was 4.0 kg (± 0.11). The mean weight of captured females (± S.E.) was 3.0 (± 0.10). Table 3 summarises the sex ratio of captured cats, from the two treatments. Very few females were captured during the exercise; they represented just 14.3% of all captures. A single female was captured at the 50 baits/km^2 treatment, representing 7.7% of captures. Assuming that a population would normally consist of an approximately equal representation by both males and females, there is a significantly greater representation of males in this sample ($\chi^2=17.86$, $\alpha<0.005$). Of the females captured, none was currently reproductive and two individuals had never conceived. Based on examination of placental scarring, the mean litter size for the entire sample population (± S.E.) was 1.6 (± 0.75).

Figure 6: Location of Cat Captures – July Sampling Period.

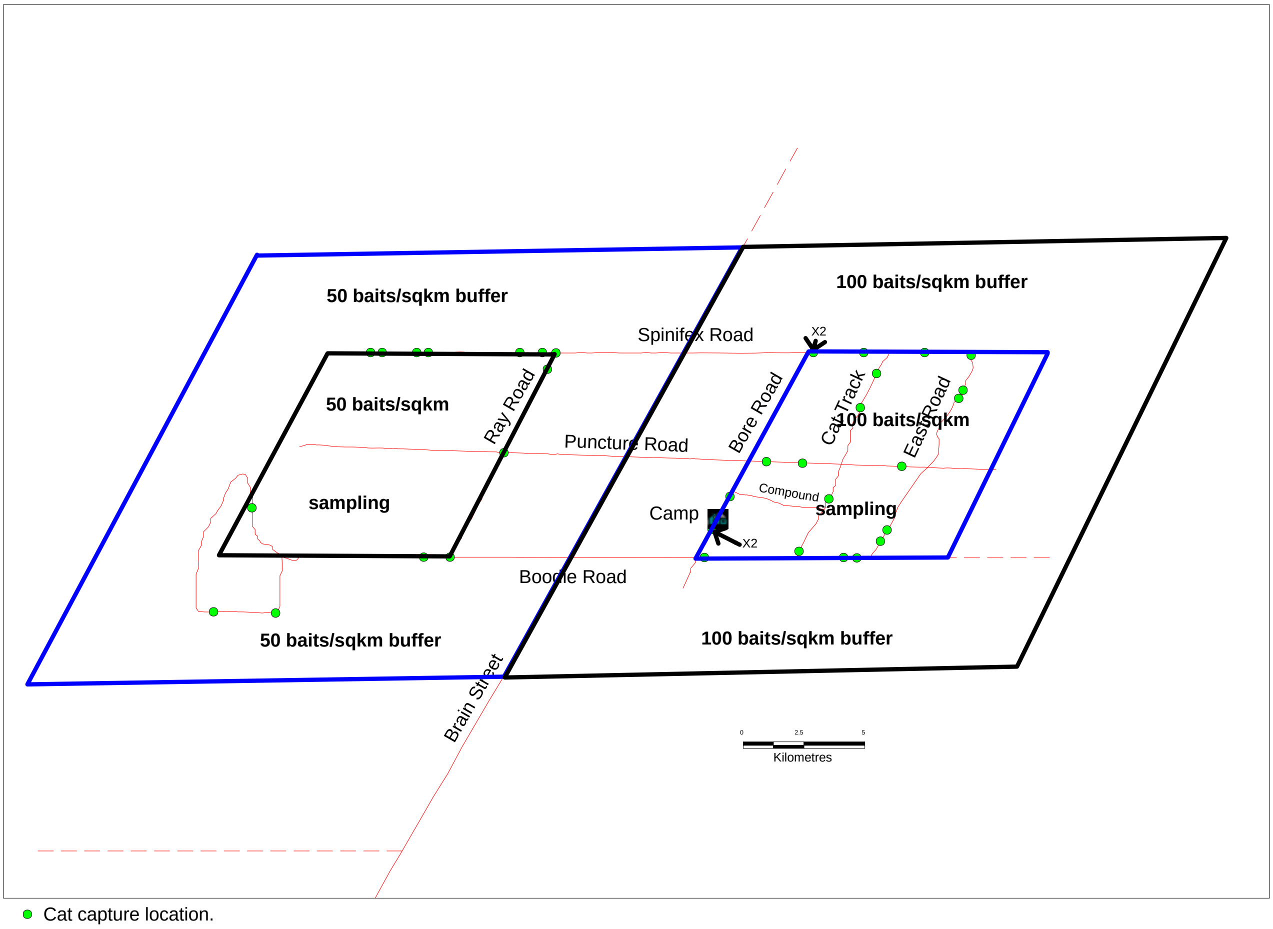


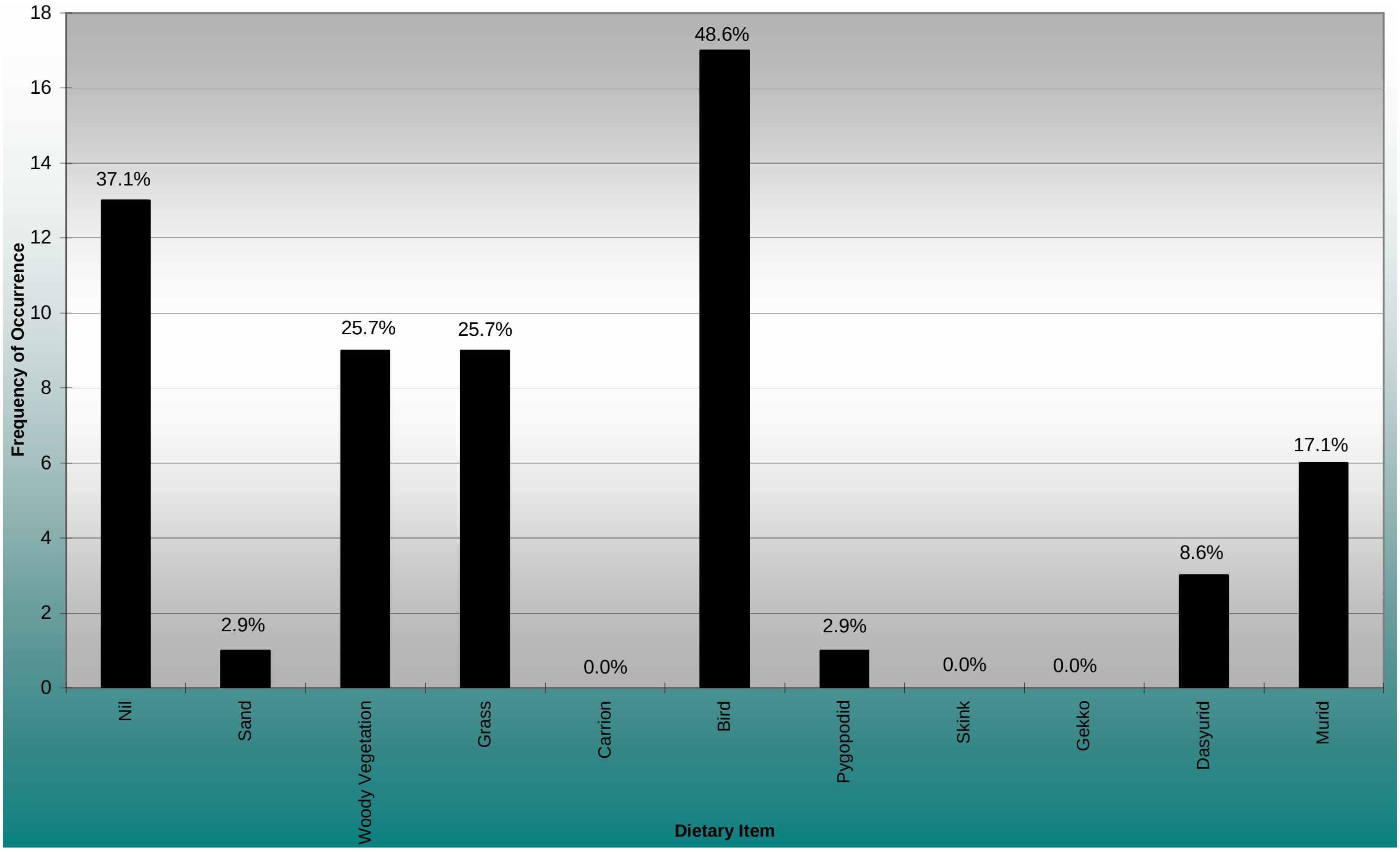
Table 3: Summary of the Sex Ratios of Captured Cats.

50 baits/km2		100 baits/km2	
Male	Female	Male	Female
12 (92.3%)	1 (7.7%)	18 (81.8%)	4 (18.2%)

Dietary Analysis.

Figure 7 illustrates the presence of dietary items of feral cats by frequency. The most frequently occurring food items were birds (mostly Diamond Dove, Richard's Pipit or Budgerigar), present in 48.6% of stomachs collected. Mammals had been consumed by 25.7% of cats captured. Reptiles were an infrequent dietary item with a single cat (2.9% of the sample) having recently consumed a pygopodid. Items not generally considered as food had been consumed by 54.3% of cats sampled. 'Woody vegetation' and 'grass' have been recognised as separate items because the former is likely to be incidental consumption, while the later is more likely to have been deliberately consumed. The category 'nil' is those animals that had not consumed a recognised food item. That is, the categories of 'sand', 'woody vegetation' and 'grass' were ignored as food items, for the purposes of scoring this dietary category. Of the stomachs examined, 37.1% contained no recognised food items.

Figure 7: Frequency of Occurrence of Dietary Items in Captured Feral Cats – July Sampling Exercise.



Non-target Fauna Sampling.

A summary of non-target fauna captures is presented in Table 4**.** Figure 8 presents a summary of captures by family group. All captures were made in pitfalls, no capture was made with Elliott traps. Skinks were the most numerous captures, with a strong representation by *Ctenotus pantherinus ocellifer*. The only taxon represented at all sites was *Ningaui ridei*, with most taxa represented at two or three sites.

No mammal or reptile captured exhibited evidence of marking with RB, from gross examination, at the time of capture.

Figure 8: Pitfall Captures of Vertebrate Families – July Sampling Exercise.

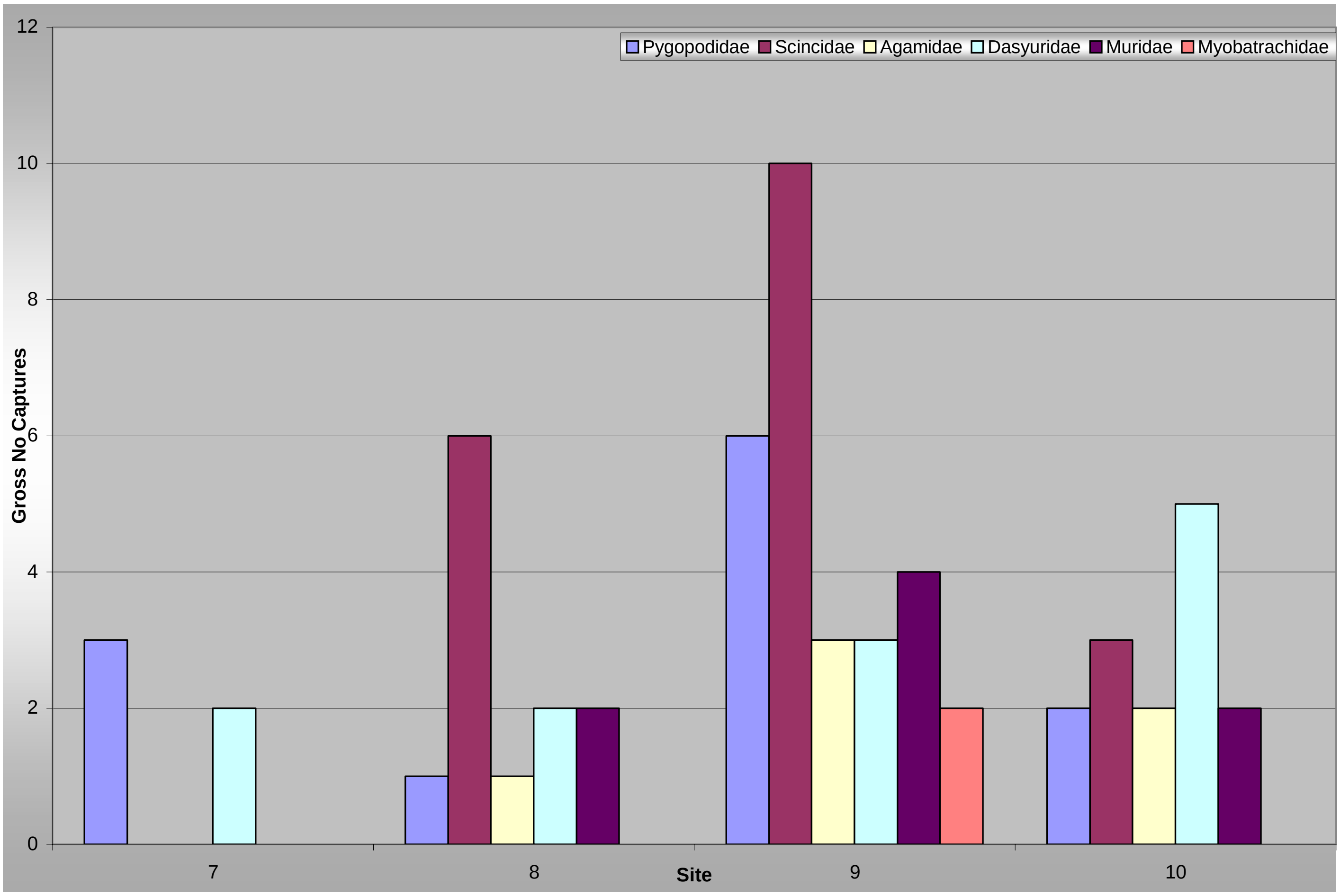


Plate 5: Department staff and Landscope Expeditioners process non-target fauna and collect vibrissae for examination in the laboratory. Photo – L. Royston.

Table 4: Non-target Fauna Captures Per Night of Operation.

	Site				
Taxon	**7**	**8**	**9**	**10**	**Total**
Ctenophorus isolepis gularis		0.3	0.5	0.17	**1**
Pogona minor minor				0.17	**0.17**
Delma haroldi	0.67		0.17	0.33	**1.17**
Delma nasuta			0.83		**0.83**
Delma tincta	0.33	0.3			**0.66**
Ctenotus calurus		0.3	0.17	0.17	**0.67**
Ctenotus helenae		0.3			**0.33**
Ctenotus pantherinus ocellifer		1.3	1.33	0.33	**2.99**
Cyclodomorphus branchialis			0.17		**0.17**
Neobatrachus sutor			0.33		**0.33**
Ningaui ridei	0.67	0.3	0.5	0.83	**2.33**
Sminthopsis youngsoni		0.3			**0.33**
Notomys alexis			0.33	0.17	**0.5**
Pseudomys desertor		0.7			**0.67**
Pseudomys hermannsbergensis			0.33	0.17	**0.5**
Total	**1.67**	**4**	**4.66**	**2.34**	**12.65**

Analysis of Mystacial Vibrissae.

Table 5 summarises the marking of predator vibrissae, by RB. All cats captured in the 50 baits/km^2 treatment were marked by RB. Four individuals from the 100 baits/km^2 treatment were not marked. This sample suggests that the two treatments were not significantly different in efficacy, for the control of feral cats ($z=1.63$, $\alpha=0.05$). The greater percentage of marking from the 50 baits/km^2 treatment suggests that the lower baiting density would have proven at least as efficacious as the greater density, for the control of feral cats. All foxes sampled were marked by RB, suggesting that the two treatments were adequate for the control of foxes at this location. The proportion of dingoes marked in the entire sample was significantly less than the proportion of cats marked ($z=3.11$, $\alpha<0.005$). There was a greater proportion of dingoes marked in the 50 baits/km^2 treatment than the alternate. Sample size was inadequate for a meaningful test of significance. Of the 33 non-target mammals captured, no vibrissa was marked by RB.

Table 5: Summary of predator vibrissae marking with RB, as determined by examination under low intensity UV light source of fluorescence microscope.

	50 baits/km^2			**100 baits/km^2**		
	Cat	**Dingo**	**Fox**	**Cat**	**Dingo**	**Fox**
Marked (Total)	13 (13)	2 (3)	2 (2)	18 (22)	4 (7)	2 (2)
% Marked	100	66.7	100	81.8	57.1	100

Table 6 presents a break-down of the relative proportion of marked male and female feral cats. Sixty percent of females captured were marked and 93.3% of males were marked by RB. The sample of females was insufficient for a meaningful test of significance. As a result of this poor representation by females, neither was a meaningful comparison possible between the efficacy of the two baiting regimes, for the control of female feral cats.

Table 6: Summary of male and female feral cat marking with RB.

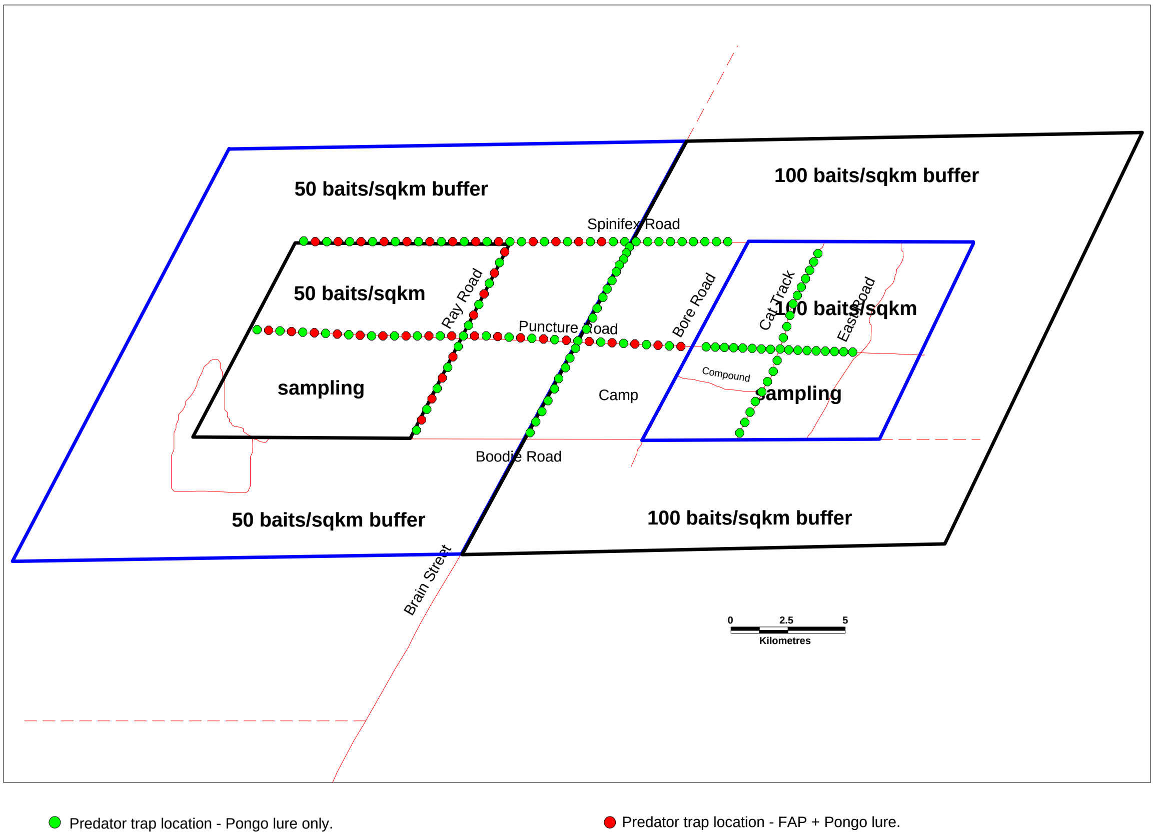
	50 baits/km^2		100 baits/km^2	
	Male	**Female**	**Male**	**Female**
Marked (Total)	12 (12)	1 (1)	16 (18)	2 (4)
% Marked	100	100	88.9	50

A Second Sampling Exercise.

As presented above, there was a difference in the proportion of males and females marked in the overall sample. There was also a difference in the proportion of females marked from the two treatment zones. However the sample of females was insufficient for any meaningful comparison between the sexes or between the marking of females from the two treatments. Because of this under-representation of female cats, in the sample population, it was decided to undertake a further sampling exercise in September 2001. For reasons discussed later, it was seen as important to gain an understanding of the efficacy of the baiting regimes, for the control of both sexes of feral cat. The factors that lead to the under-representation of females may have also lead to an under-representation of females in the marked population.

Plate 6: Trapped male ginger tabby cat.

Figure 9: Predator Trap Locations – September Sampling Exercise.



Predators.

The sampling carried out in September 2001 followed a similar methodology to that outlined above. Figures 9 and 10 illustrate the placement and type of trap and the locations of captures respectively. Due to a shortfall in the number of functional FAPs available, there was no alternation of the lure combination at the eastern-most transects (see Figure 9). Table 7 summarises the commissioning and decommissioning of predator traps, during the second exercise. As illustrated by Figure 9, trapping was undertaken in the area that was previously set aside as the buffer between the two baiting treatments. As no significant difference was measured between the proportions marked populations from the two treatments, it was decided to sample this previously untrapped area, with the aim of maximising the overall sample, particularly that of females. Given that there was no discernible difference in result from the two treatments, proportion of marked females could be pooled for the two treatments, if necessary. As indicated by Figure 10, 10 cat captures were made in the buffer between the two treatments. Therefore further comparison between the two baiting regimes is impossible as these animals may have a core area in the alternate treatment zone to which they were captured, or their core range may have included portions of both treatment zones. Five individual cats were captured within 2 km of the arbitrary line of division, between the two treatments. As indicated by Figure 3, a section spanning several kilometres either side of this dividing line was baited during both baiting exercises. Cats captured in this vicinity may have spent most of their time in one or other or both treatments, and/or the area of overlap between the two treatments, which received an indeterminate bait treatment.

Figure 10: Cat Capture Locations – September Sampling Exercise.

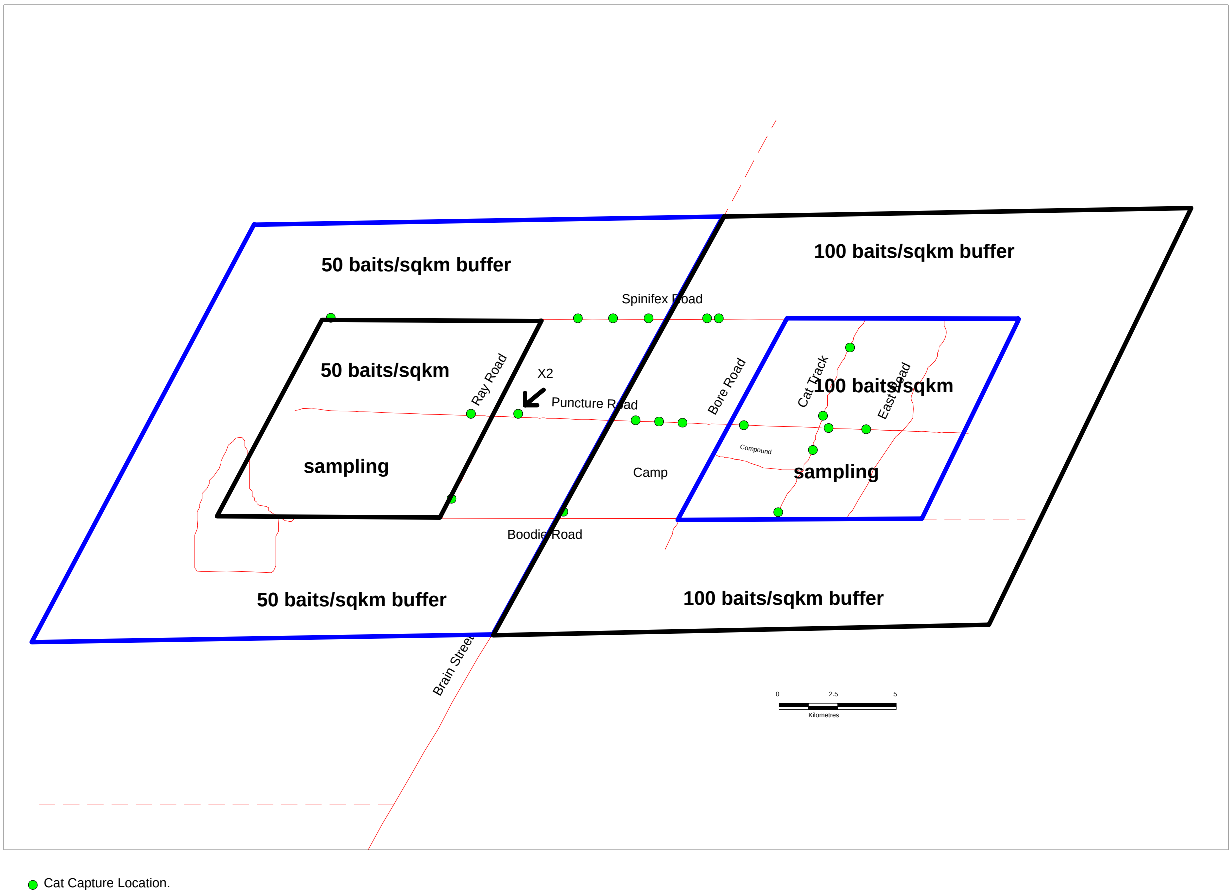


Table 7: Dates of commissioning and decommissioning of predator traps – September sampling exercise.

Trap Numbers	Commissioned	Decommissioned	Trap Nights
001-047	03/09/01	09-10/09/01	302
048-085	04/09/01	09-10/09/01	201
086-117	05/09/01	10/09/01	160
118-148	06/09/01	10/09/01	124

Table 8: Summary of predator captures – September sampling exercise.

	Cat	Dingo	Fox
Gross	21	3	2
Per trap night	0.03	<0.01	<0.01

Despite a stronger representation by females, in the second sample, they comprised just 28.6% of the sample population (Table 9) and this representation was not significantly greater than during the first sampling exercise (χ^2=3.5, d.f.=1 α=0.05). Five of the six females sampled were pregnant and four of the five were carrying foetuses with crown-rump length □5 cm. There was no evidence of post partum oestrus by these animals. Mean litter size for this sample (± S.E.) was 3.3 (±0.49) and 2.5 (±0.49) for all females sampled from both samples.

Table 9: Summary of the Sex Ratios of Captured Cats – September sampling exercise.

Male	Female
15 (71.4%)	6 (28.6%)

Figure 11 presents the frequency of occurrence of dietary items of feral cats, captured during the second sampling exercise. Birds were once again the most frequently consumed items, present in the stomachs of 33.3% of cats captured. However a greater proportion of the sample population (38.1%) had not recently consumed a recognised food item. Despite this, the proportion of cats that had consumed birds was not significantly less than that from the initial sample (χ^2=3.37,d.f.=1, α=0.05). Mammals were consumed by 33.3% of cats; 14.3% consumed dasyurids and 19.0% consumed murids. Reptiles were again poorly represented; they were present in the stomachs of only two cats examined.

Plate 7: Cleaning and servicing predator trapping equipment.

Figure 11: Frequency of Occurrence of Dietary Items in Captured Feral Cats – September Sampling Exercise.

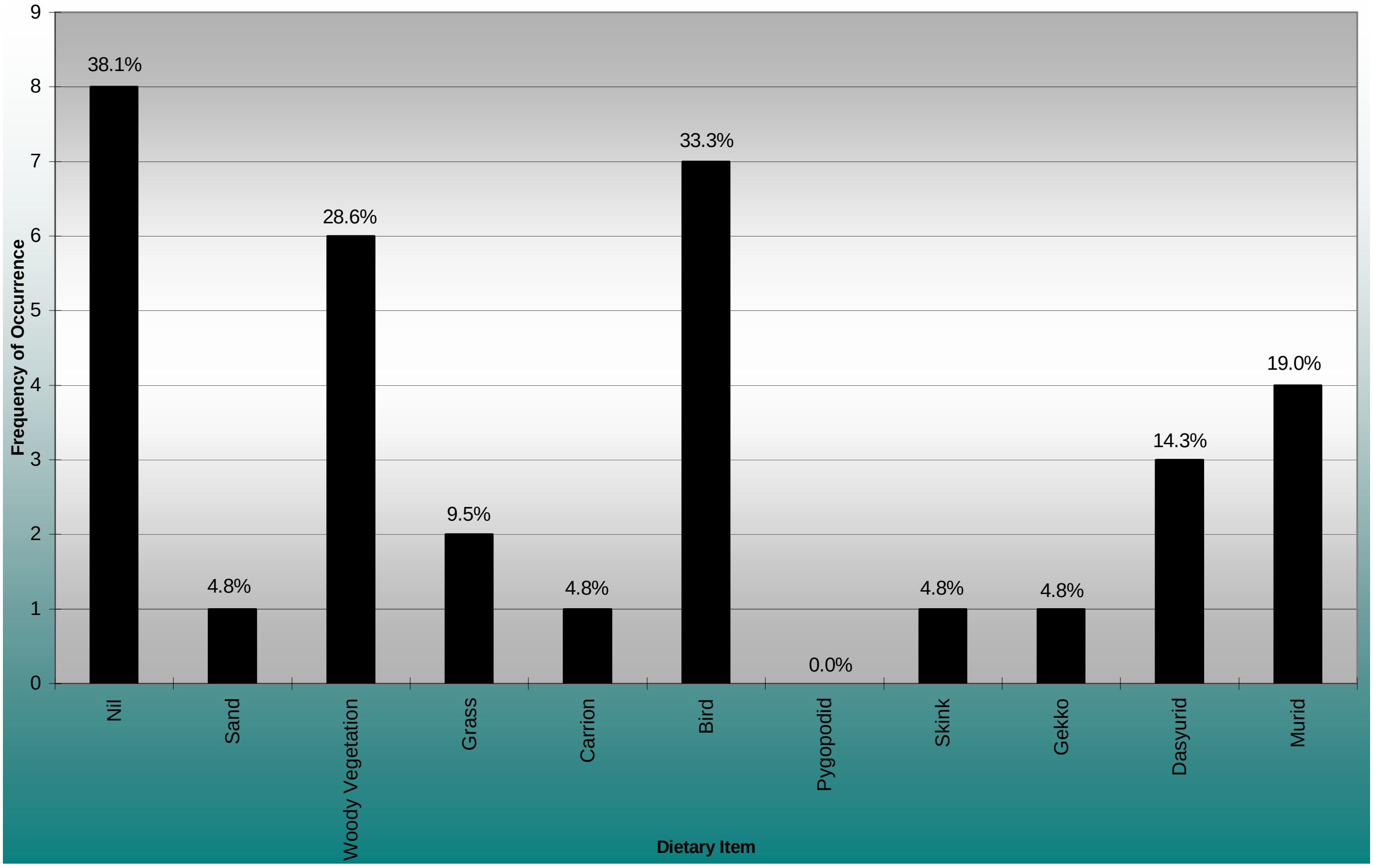


Table 10: Summary of predator vibrissae marking with RB, as determined by examination under low intensity UV light source of fluorescence microscope – second sampling exercise.

	Cat	Dingo	Fox
Marked (Total)	14 (21)	2 (3)	2 (2)
% Marked	66.7	66.7	100

Significantly fewer (χ^2=9.95, d.f.=1, α=0.05) feral cats from the second sample were marked by RB, than those from the initial sample (see Tables 5 and 10). The overall proportion of cats marked by RB from both sampling exercises was 80.4%. All foxes sampled during the two sampling exercises were marked by RB. The overall proportion of dingoes marked by RB was 61.5%. A slightly greater proportion of dingoes from the second sampling had been marked, however the samples were insufficient for a test of significance.

Table 11 indicates that an equal proportion of males and females were marked in the second sample population. For the overall sample 84.4% of males and 63.6% of females were marked by RB. Despite a greater proportion of males being marked, this was not significantly greater than the proportion of females marked (z=1.56, α=0.05).

Table 11: Comparison between marking of male and female cats – September sampling.

	Male	Female
Marked (Total)	10 (15)	4 (6)
% Marked	66.7	66.7

Non-target Fauna.

In the course of the second predator sampling exercise, small ground-dwelling vertebrates were also re-sampled. Two additional sites (Sites 1 and 2), of the same specifications as Sites 7-10, were operated during this second sampling exercise. Figure 12 indicates the locations of fauna sampling sites operated. Sites 1 and 2 were operated for the nights of 6-8 September. Sites 7 through 10 were operated for the nights of 6-9 September. A summary of captures is presented in Table 12. Figure 13 presents a summary of captures by family group. Reptiles were given cursory external examination for evidence of staining by RB. Mystacial vibrissae of mammals were collected and examined in the laboratory as previously described. No individual indicated marking by RB through gross external examination, nor through examination of vibrissae.

Plate 8: A *Sminthopsis youngsonsi* prior to processing. Photo – L. Royston.

Table 12: Non-target Fauna Captures Per Night of Operation – September Sampling Exercise.

	Site						
Taxon	**1**	**2**	**7**	**8**	**9**	**10**	**Total**
Ctenophorus isolepis gularis			0.25	1.25	0.67	0.75	**2.92**
Ctenotus calurus				0.75		0.25	**1.0**
Ctenotus grandis		0.25				0.25	**0. 5**
Ctenotus helenae	0.5	0.5	0.25				**1.25**
Ctenotus pantherinus ocellifer			0.5	1.25	0.5	0.5	**2.75**
Ctenotus saxatilis	0.25	0.75					**1.0**
Cyclodomorphus m. melanops	0.5						**0.5**
Delma haroldi			0.75	0.25	0.75	0.5	**2.25**
Delma nasuta		0.5	0.25	0.25	0.75	1	**2.75**
Delma tincta			0.25	0.25			**0.5**
Delma borea	0.25						**0.25**
Lialis burtonis		0.25					**0.25**
Diplodactylus elderi	0.25	1.25	0.5		0.25	0.25	**2.5**
Nephrurus levis		0.5					**0.5**
Mus domesticus	2					0.25	**2.25**
Ningaui ridei	2.7		0.5	0.5	0.67	0.25	**4.62**
Notomys alexis					0.25		**0.25**
Pseudomys desertor	1	0.7	0.5			0.25	**2.45**
Pseudomys hermannsbergensis		0.33	0.25	0.5	0.25		**1.33**
Sminthopsis macroura		0.33					**0.33**
Sminthopsis youngsoni				0.33			**0.33**
Tiliqua multifasciata			0.25			0.25	**0.5**
Total	**7.45**	**5.36**	**4.25**	**5.33**	**4.09**	**4.5**	**30.98**

Plate 9: Processing and anaesthesia of non-target native fauna. Photo – L. Royston.

Figure 12 : Location of Non-target Fauna Sampling Sites – September Sampling Exercise.

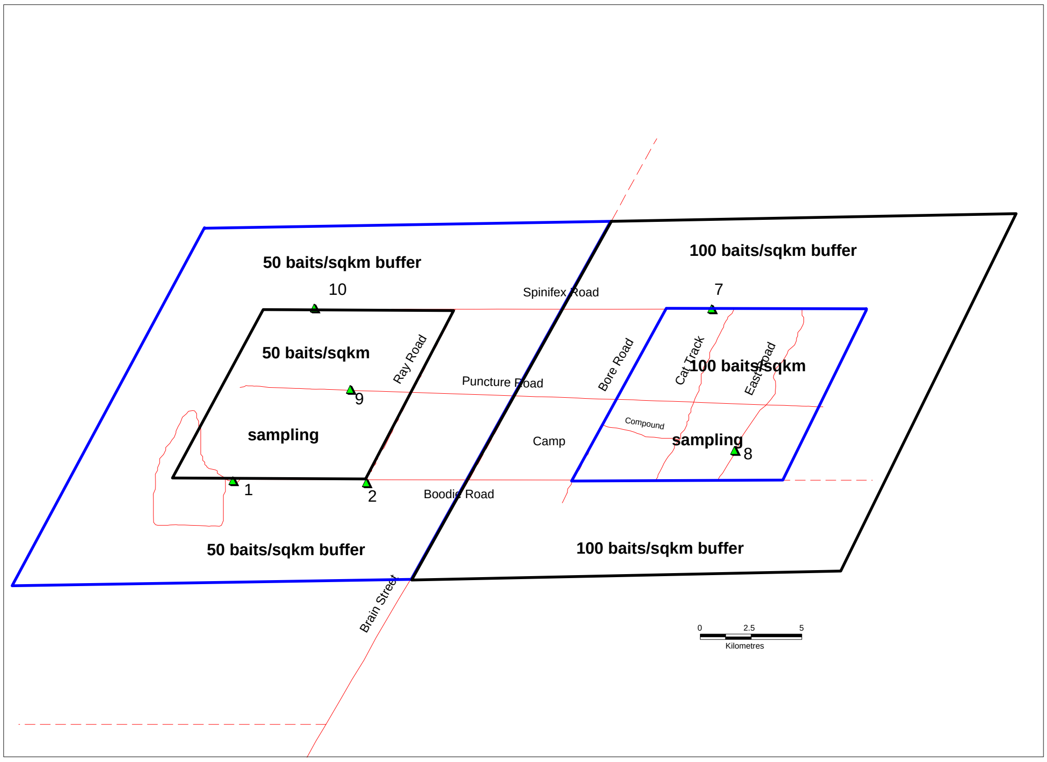
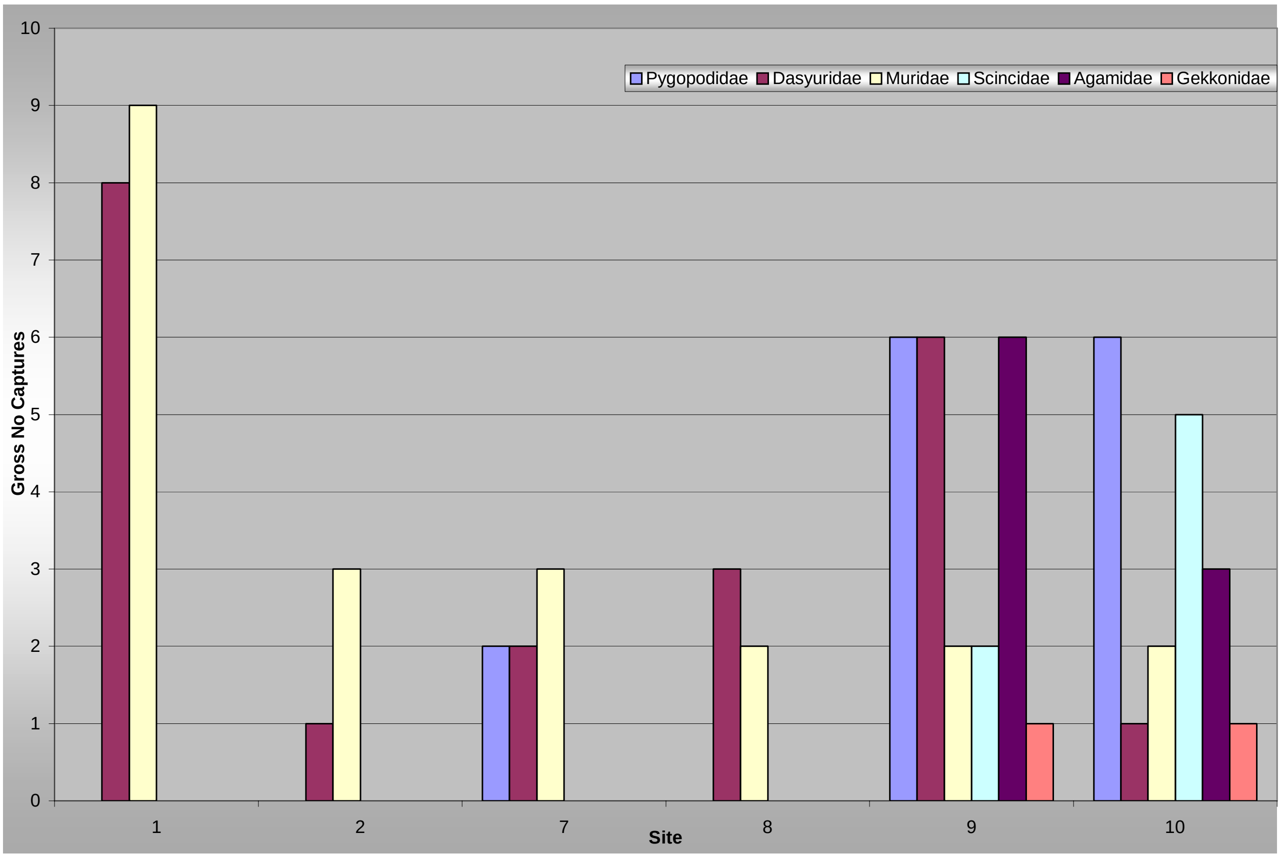


Figure 13: Pitfall Captures of Vertebrate Families – September Sampling Exercise.



Discussion.

The feral cat was the most abundant introduced predator at the study site and has been since monitoring began in 1989, prior to any control efforts. Since control efforts commenced in 1992, dingoes and foxes have generally remained at low levels in the unbaited zone and have often been completely absent from the baited zone. Both baiting regimes undertaken during this exercise were adequate for the short-term control of foxes at this site, as all foxes sampled had taken at least one bait. A smaller percentage of dingoes were marked during this exercise, however the 50 baits km^{-2} treatment would appear as efficacious as the 100 baits km^{-2}. A greater proportion of animals sampled from this treatment had been marked by RB. The relatively low proportion of dingoes marked may be due to behaviour and the fact that non-toxic baits were used. Although feral cat bait acceptance trials have generally been deliberately conducted in areas of low dingo abundance, the current bait medium has proven palatable to these animals. That is, animals that come into contact with baits have generally consumed several to many. Relatively large home ranges reported for dingos (eg Thomson, 1992) suggest that some of the individuals sampled during this exercise may have had a core usage area at least partly outside the baited zones. Any portion of the home range outside the baited area may have reduced the probability of encountering and therefore consuming a bait. As also suggested by Thomson and Algar (2000), the use of non-toxic baits may have compounded this influence as any predator (individual or group) encountering baits would have been capable of consuming multiple baits, thus reducing or completely removing the probability of other individuals/groups encountering baits. Toxic baiting aimed at the control of feral cats has been successful in controlling foxes and dingoes at this site in the past (N. Burrows *et al.* unpub. data). However if predation by foxes and dingoes is considered a serious threat to the conservation and reconstruction of native fauna populations at this site, control efforts will have to take these species into consideration. Effective control buffers will take into consideration both the home range usage of resident animals and the rate of immigration to vacated territories. Thomson *et al.* (2000) suggest maintaining control in a buffer 10-15 km wide to address immigration by foxes. Thomson (1992) suggests a buffer of 15-20 km to address immigration by dingoes. The timing and effort required to maintain a baited buffer will depend upon prevailing seasonal conditions and the timing and nature of dispersal by juveniles (see Thomson *et. al.*, 2000).

No non-target animal sampled was marked by RB. If any individual did consume bait material, the amount consumed was insufficient to produce a detectable marking by RB. The distance between the mid-point of the most adjacent bait drop and the edge of the fauna sampling grids varied. This distance may have been greater than that normally traversed by some individuals sampled. However no bait drop was more than 130 m distant from the nearest sampling grid and baits were delivered directly overhead at two of the sites. Based on published home range usage data (e.g. Strahan, 1995; see Moro and Morris, 2000 for specific example of details) many of the individuals sampled and perhaps all at Sites 2 and 7 will have potentially encountered baits. Not all species represented in the overall sample were present at Sites 2 and 7. Not all species known to occur in the same broad location were represented in the sample. The assessment of risk to non-target fauna was not the primary aim of this study and the information presented here does not indicate that no species present at the study site is at risk from poisoning by a similar toxic campaign.

However it is significant that four small mammal species were sampled from sites that had directly received a high concentration of baits and that none indicated having consumed any bait material. Future work, specifically aimed at assessing non-target risk, will require a maximisation of the quantity and diversity of non-target animals that are likely to come into contact with a field application of baits. Another outstanding issue is the verification that the concentrations of RB used in these exercises is sufficient to mark all the species sampled (see Fisher, 1998). There appears to be a lack of information on the marking of small dasyurids in particular. Work is planned to commence in mid 2002 that will confirm whether or not the concentrations of RB used here are sufficient to produce marking in a range of mammal species that are endemic to Western Australia.

Previous baiting efforts at this site appear to have lead to a long-term reduction in the feral cat population in the western half of the study site. The capture rate of feral cats in the previously baited area, during the first sampling exercise, was significantly lower than that in the unbaited area. Feral cat capture rate in the previously unbaited control was 41% (per trap night) and 71% (per km transect) greater than in the baited treatment. This would indicate a significant difference between the two populations some 33 months after the last toxic baiting exercise and a slow rate of recovery through reinvasion and recruitment. Future efforts to control feral cats at this site can be expected to have lasting impacts on the target population, in the medium to long term.

No significant difference in the proportion of cats marked by RB was recorded between the two baiting treatments measured during the first sampling exercise. All individuals sampled from the lower baiting intensity had been marked by RB. This confirms the efficacy of 50 baits per km^2 for the control of feral cats and effectively halves the known distribution rate required to achieve control. The success of previous toxic baiting programs (Algar *et al.*, 2001 a and b) can be expected to be repeated by distributing 50 baits per km^2. Halving the number of baits distributed during control programs will lead to significant and immediate savings in the cost of effective feral cat control programs and significantly reduce the potential risk of poisoning non-target species. Because all individuals sampled from the 50 baits per km^2 treatment had consumed baits, this density of distribution does not appear to be near to the critical lower limit for effective control. Potential exists to further reduce the rate of bait distribution, thus further reducing the cost and associated risk to non-targets. Future studies in this series will be aimed at identifying a critical lower limit to the density of baits required for effective control, with the aim of minimising both risk and cost.

The overall proportion of marked animals in the first sample was 88.6%, suggesting that toxic baiting at this time and location would have been extremely successful in the control of feral cats. This high proportion of marking is consistent with the results achieved previously with this bait medium (Algar *et al.*, 2001a and b). Acceptance of this bait medium is outstanding in contrast to the lesser to extremely poor bait acceptance recorded for other bait media employed elsewhere (Veitch, 1985; Risbey *et al.*, 1997; Short *et al.*, 1997; Algar *et al.* in press). The baiting regimes examined here have also proven significantly more efficient than alternate control measures such as trapping, hunting and the deliberate release of infectious disease (Bloomer and Bester, 1992; Veitch, 1985). This study confirms the significant potential of this bait medium as an efficient management tool in the conservation of fauna. Baiting for the control of foxes is an important tool in the conservation and recovery of fauna in Western Australia (Bailey, 1996) and has been instrumental in the recovery of some of our most severely restricted mammal species (Kinnear *et al.*, 1988; Friend, 1990; Morris, 1992). The efficacy recorded during this study exceeds that recorded over the same time frame, for the control of foxes in arid areas of Western Australia (Thomson and Algar, 2000; Thomson *et al.*, 2000). This feral cat baiting regime will contribute further to the conservation and recovery of native mammals and allow programs to proceed that were previously obstructed by predation by feral cats (Short *et al.*, 1992; Christensen and Burrows, 1994; Gibson *et al.*, 1994).

While the taxa represented varies with location, small mammals such as rodents and rabbits are most frequently consumed by feral cats on mainland Australia (Coman and Brunner, 1972; Jones and Coman, 1981; Triggs *et al.*, 1984; Catling, 1988; Martin *et al.*, 1996; Molsher *et al.*, 1999; Risbey *et al.*, 1999; Read and Bowen, 2001). When present in abundance, rabbits are consistently the most frequently consumed and voluminous food item. Other groups such as birds, reptiles and invertebrates are consumed less frequently, but the taking of a variety of food items by individuals and between individuals in a group, is a consistent observation. Cats generally exhibit apostatic food selection (preferential consumption of commonly occurring or familiar food items) however they are adept at selecting rarer food items to maintain nutritional balance (Church *et al.*, 1996, Bradshaw *et al.*, 2000). This is consistent with the observation of feral cat diet in Australia, where diet has been compared to the relative abundance of prey species (e.g. Jones and Coman, 1981; Catling, 1988; Martin *et. al.*, 1996; Molsher *et. al.*, 1999).

The preferential predation of certain taxa has also been discussed in relation to energetic balance. The hypothesis is that in addition to maintenance of nutritional balance, preferential predation of certain species by felids is also governed by the balance between the input required to successfully predate a particular species and the energetic benefit gained by consuming that particular item (Kitchener, 1991). The predominance of birds in the diet of cats sampled during this study is likely to be a function of both their relative abundance and their relative nutritional (including energetic) importance, at the time of sampling.

Seasonal/temporal variation in bait acceptance by feral cats appears to be related to the apostatic/anti-apostatic characteristics of feral cat food selection (Short *et al.*, 1997, Algar *et al.* in press). As suggested by Chuch *et al.* (1996), cats will accept novel or uncommon food items when there is a nutritional (and/or energetic) advantage but will be apostatic in food selection if the pre-existing common prey items are nutritionally adequate. Therefore novel food items, such as baits, will not be readily accepted in the presence of abundant, readily obtained and nutritionally adequate prey. Conversely baits will be readily accepted if the abundant prey items present are nutritionally deficient or energetically expensive to procure. The predominance of birds in the diet of cats during this study suggests that obtaining adequate nutrition was at least energetically expensive, relative to the predation of an abundant, medium-sized, ground-dwelling mammal. If as suggested by Jones (1977) adult cats consume approximately 300 g of live prey per day, this would require considerable input if gained predominantly from small birds. Presentation of an energy-rich and readily procured alternate food source – the bait medium – was successful in inducing anti-apostatic food selection in most individual cats sampled.

This study supports the assertion that the relative abundance of rabbits is the most influential factor driving bait acceptance by feral cats in arid Australia (Short *et al.*, 1997, Algar *et al.*, in press). Rabbits were uncommon at the study site and completely absent from feral cat diet. This bait medium and others has been less readily accepted in the presence of a greater abundance of rabbits (Short *et. al.*, 1997; Algar *et. al.*, in press) but well accepted in their complete absence (Algar *et. al.*, 2001 a and b). The timing of feral cat control programs to coincide with seasonal declines in rabbit abundance is fundamental to their efficacy. It is important to acknowledge that although feral cat reliance upon rabbits as prey is proportional to rabbit abundance, this species may form a significant proportion of diet, even at relatively low abundance (Molsher *et. al.*, 1999). In certain locations, rabbit abundance, particularly that of juvenile animals, may not regularly fall sufficiently to impact upon their importance as prey, if at all (Short *et. al.*, 1997; Molsher *et. al.*, 1999). Therefore the control of rabbits, apart from the direct benefits to those native species that compete for resources, may be an important tool in improving control programs for feral cats.

The under-representation of female cats from the first sampling exercise was significant and led to the planning of a second sampling effort. Priority was placed on achieving a reasonable sample of female cats because of the differences between male and female behaviour and home range usage, particularly during periods of breeding. The differences in behaviour between the sexes is potentially sufficient to influence the relative efficacy of aerial baiting and control will not be successful without the adequate control of both male and female cats. As the application of baits was not uniform over the entire target area (Figure 3), differences in home range usage may have influenced the probability that any given individual intersected a bait transect and encountered and consumed a bait. The smaller the home range, the smaller the probability of bait encounter. Representation by females in the first sample was insufficient to adequately assess any potential difference in the efficacy of the two baiting regimes, for the control of this sex.

Bias toward the capture/observation of male cats, via various means and under various conditions, has been recorded previously (Jones, 1977; van Aarde, 1978; Brothers *et al.*, 1985; Page *et al., 1992*; *Yamane et al.*, 1994; Edwards *et al.*, 1997; Molsher, 2001) but is not always the case (Jones and Coman, 1982; Bloomer and Bester, 1991). Prenatal studies suggest there is generally parity between sexes at birth (van Aarde, 1978; Bloomer and Bester, 1991). However Page *et al.* (1992) and Yamane *et al.* (1994) recorded sex bias through relatively unobtrusive observation of ± closed populations and Jones (1977) suggested that some element of differential mortality may select for males. van Aarde (1978) and Molsher (2001) disagree, suggesting that sex bias in observations is often likely to be a reflection of the difference in home range usage between the sexes (and therefore a result of sampling technique), rather than a reflection of the actual sex ratio in the population.

The bias toward capture of males in this study (86% ♂ : 14% ♀) was greater than that reported elsewhere (50-71% ♂ : 50-29% ♀). At the time of sampling, it was thought that this exceptional bias may be a result of female cats engaged in breeding behaviour (nursing/weaning) which can dramatically restrict their movement and range usage (Pascal, 1977; Martin, 1982). This difference between male and female home range usage is exacerbated during breeding because of a concomitant increase in male home range (Yamane *et al.*, 1994; Langham and Porter, 1991; Langham, 1992). If a significant breeding event did occur in July, something closer to parity was expected if sampling was resumed after 3-4 weeks. However the second sampling again yielded significantly fewer females than males. The disparity in representation of the sexes does not appear to have been a result of a short-term difference in behaviour, such as a breeding event. Thirty-four days elapsed between the two samplings, allowing sufficient time for a proportion of nursing mothers to range further from the litter (see for example Martin, 1982). The reproductive condition of females captured during the second sampling suggested that a breeding event was just beginning as four of the six females were carrying immature foetuses and there was no evidence of post partum oestrus.

Spacing of sampling transects in this study was up to 4.5 km in the west and 4 km in the east. This transect spacing may have sampled a limited proportion of the population and is unlikely to have intercepted the home range of all females present in the area (see for example Jones and Coman, 1982). Based on evidence of heterogenous use of space by male feral cats, Edwards *et al.*, (2001) suggest control (sampling) units placed at 1-2 km intervals, in a grid pattern, to ensure encounter by most feral cats within a specified area. The transect intervals employed in this study were greater than those expected to intersect the home range of all male cats within the study area. Given that female cats consistently occupy smaller home ranges than males, the experimental design was biased toward the capture of males, regardless of any possible temporary differences in behaviour or real skew in the sex ratio of the resident population.

Bloomer and Bester (1991) recorded no changes in sex ratio (from parity) as a result of hunting pressure on a closed population of feral cats. However it is possible that previous control efforts at the Eagle Bore study site have altered the sex ratio there. The population is not closed and therefore subject to reinvasion from areas outside the zone of predator control. If as the data suggest, good control of feral cats has been achieved in the past, the current population will consist of a significant proportion of recent immigrants. Adolescent males may disperse more readily and greater distances from the natal home range than do females (see Langham and Porter, 1991). Therefore a population consisting of a high proportion of recent immigrants may support an over-representation of males. The sex bias recorded here appears to have resulted from a combination of experimental design and previous control efforts.

Significantly fewer feral cats were marked in the second sample population than in the first. This may be due to reinvasion from outside the baited area or inadequate sampling of the resident population or both. The five kilometre baiting buffer may have been readily traversed by individuals which recognised that previously occupied territories had been rendered vacant. Edwards *et al.* (2001) suggest that a buffer of 4 km around a control (sampling) zone will be sufficient to remove (sample) all resident individuals but insufficient to absorb immigrants. The period between sampling exercises at the Eagle Bore site will clearly have allowed individuals from outside the sampling area to disperse into territories vacated during the initial sampling. Edwards *et al.* (2001) suggest that a control buffer for feral cats may need to be as large as 20 km or more in extent to be effective for limiting immigration by feral cats. As discussed above, the sampling regime may have intercepted a limited proportion of the resident population. The spacing between trapping transects may have lead to an over-representation of more mobile individuals. The more mobile individuals in the population may also have been more likely to encounter and consume baits. As more individuals were removed by sampling, the inherently less mobile individuals may have been encountered more frequently, resulting in a lower proportion of marked individuals in the sample.

Despite an under-representation by females there was no difference in the proportion of males and females that were marked by RB, from the second sample. There was a smaller proportion of females marked in the overall sample population, however this was not significant. These data do not suggest that the baiting regimes compared would have an equivalent efficacy in the control of male and female cats. Rather they suggest that the disproportionate representation of the sexes leaves us with little confidence to conclude that the baiting would have been significantly more efficacious in the control of male cats. The data obtained were inconclusive in assessing the efficacy of the two baiting regimes in the control of female cats. However if the sample was an accurate reflection of the population present, the failure to mark 36.4% of the female population may indicate a real limitation to the efficacy of such control programs. Given the mean litter size of the sample population and the potential for mature females to produce at least two litters per year, there is significant potential for recovery through recruitment.

This study has highlighted certain possible limitations in both the sampling and control of feral cats that have been alluded to previously (e.g. Edwards *et al.*, 2001; Algar and Angus, 2000). In order to achieve an unbiased sample or adequate control of a feral cat population, the techniques employed must maximise the probability of intercepting all individuals of both sexes. The sampling regime employed here was based upon the use of pre-existing vehicular access. This simplified the exercise in terms of logistics, however confidence in drawing conclusions from the data obtained was limited.

Despite these limitations, the unequalled efficacy recorded here confirms the significant potential of this baiting regime as an important tool for fauna conservation. Furthermore this study has led to a significant improvement in the efficiency with which baiting may be undertaken and improved the understanding of how prey abundance may influence bait acceptance. The previous known benchmark of bait density, for reliable control, has been halved. This will lead to significantly reduced risk, significant cost savings and/or allow the control of feral cats over significantly broader areas than previously possible with a limited budget. This reduction in known bait density required for adequate control does not appear to be near the lower critical limit and further reductions in the known bait density required can be expected from subsequent studies in this series.

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