FACTORS AFFECTING FAUNA RECOVERY ON NATURE RESERVES IN THE WESTERN AUSTRALIAN WHEATBELT

A Progress Report to the Invasive Animals CRC

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by

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INTRODUCTION

The Western Shield fauna recovery program commenced in 1996, and through broad scale fox control, and native fauna translocations has resulted in the recovery of several species of medium-sized mammals (Start and Mawson 2004). However since 2001, some native fauna populations have declined once again, despite ongoing fox control. A review of Western Shield in 2003 recommended that more research is required on the role of mesopredator release in regulating native fauna populations (Possingham *et al.* 2004). In 2005 the Science Division, Department of Environment and Conservation (DEC) responded with a proposal to examine the reasons for the decline in some medium-sized mammal populations in the south west of WA through assessment of the effectiveness of current fox control programs and the role mesopredator release may play in these declines. Through partnerships with the Invasive Animals CRC and Australian Wildlife Conservancy, this was supported and a four year research program commenced in January 2006. The research was to be undertaken at four sites in the south west of WA to allow comparison of responses to fox and cat control over several biomes.

One of the sites chosen for this research was Lake Magenta nature reserve, 400km south east of Perth. Lake Magenta is one of the largest nature reserves in the WA wheatbelt (104 000 ha) and was identified as a fauna reconstruction site by the Western Shield program. Aerial and ground fox baiting commenced in 2006. Quenda (*Isoodon obesulus*), chuditch (*Dasyurus geoffroii*), and brushtail possum (*Trichosurus vulpecula*) were known to occur in the reserve. Additional chuditch were translocated to the reserve in 2006, and the woylie (*Bettongia penicillata*) was reintroduced in 2007. Populations of these increased over the next 4-5 years but declined after 2000-2001, despite the ongoing fox control program. Quenda and woylies are no longer detectable, and chuditch and brushtail possums have persisted at lower levels (Figure 1). Dunn Rock nature reserve (70 000 ha) 40 km north east of Lake Magenta was chosen as an unbaited control site.

The supporting hypotheses for the research at Lake Magenta are:

- The current fox baiting regime does not kill sufficient foxes to protect vulnerable fauna.
- The current fox baiting regime is adequate to control foxes, but this has led to mesopredator release of feral cats and reduced fauna survival.
- Eradicat cat baits can be used effectively to control both foxes and feral cats and ameliorate mesopredator release.

The objectives for this research are:

- To determine the effectiveness of current fox baiting regimes in a large wheatbelt reserve.
- To assess the impact of fox control on feral cat activity and abundance.
- To determine the effectiveness of feral cat baiting regimes in a semi-arid environment.
- To determine the impact of feral cat and fox predation on vertebrate assemblages in a large wheatbelt reserve.
- To investigate the role of disease in regulating native mammal populations.

The outcomes of this work are expected to be:

- Best practice introduced predator (fox and feral cat) control for WA wheatbelt reserves.
- Continuation of the fauna reconstruction program for Lake Magenta.
- Development of techniques useful to operational staff for the detection and quantification of native and introduced fauna.
- A better understanding of the vertebrate fauna of Lake Magenta and Dunn Rock nature reserves.
- An understanding of the role of disease in regulating native mammal populations.

METHODOLOGY

1. Fox baiting effectiveness

The effectiveness of fox baiting at Lake Magenta was assessed by examining DEC aerial and ground baiting records and determining time intervals between baiting events. Aerial baiting is prescribed to occur every 90 days with a permitted variation of 20 days. Probait sausage baits containing 3 mg 1080 are dropped at a density of 5 baits per sq. km . Perimeter ground baiting is also prescribed to occur every 90 days with a bait being dropped every 200m. The internal tracks (= firebreaks) are baited once a year (April – May) at a rate of a bait every 200m). Approximately 300km of perimeter and internal tracks are ground baited. Fox baiting using Probaits is not effective at controlling feral cats. Another sausage type bait (Eradicat) has been developed for this (Algar and Burrows 2004, Hetherington *et al.* 2007).

The uptake of non-toxic fox baits (Probait) was assessed through two trials. The first examined the uptake of baits on the sand pads by foxes and other species. The second trial examined the uptake by foxes of probaits laid on tracks, compared with those located 100m off tracks i.e among natural vegetation.

2. Fox and feral cat activity and abundance

Activity of foxes and feral cats at Lake Magenta (baited) and Dunn Rock (unbaited) was determined through a system of sand pads set along existing tracks (firebreaks) on both reserves. Each sand pad was 1m wide and laid across the tracks, usually 6-7m. Pads were filled with yellow sand with some clay content making reading and interpretation of tracks easier. Two independent transects, separated by 6-10 km were set at each of Lake Magenta and Dunn Rock. At Lake Magenta 2 x 50 sand pad transects were set, at Dunn Rock 2 x 53 sand pad transects were set. Locations of sand pad transects are shown in Figure 2. Sand pads were set at 400m intervals, and operated in an alternate active / passive pattern. Active pads included a lure of a Felid Attracting Phonic (FAP) and pongo to attract feral cats. Passive pads had no lure.

Sand pads were operated at Lake Magenta and Dunn Rock simultaneously (i.e. two teams) for three - four consecutive days at known intervals after an aerial baiting operation. Accurate identification of tracks relied on the skills of the observers. If there was any doubt the tracks were marked with a ‘?’ and not included in estimation of the activity index.

Fox and cat activity was estimated by calculating a mean activity (= # tracks recorded) for each sand pad over the three - four days, then deriving a mean value for all the pads in the transect from these individual pad means. This is a variation on the methodology of Allen *et al.* (1996) and Engeman (2005); however the final activity index derived is the same for both methods. A variance formula can also be applied to the index derived (Engeman 2005).

The limitations of relating activity indices to density and abundance estimates are recognized. However by examining the patterns of activity and behaviour of foxes on the sand pads it is possible to estimate the numbers of foxes present on the transects when the activity indices are derived. This estimate was then correlated with fox activity. To further improve this an estimate of the numbers of individuals along transects will be obtained using hair capture and DNA assessments. This technology will also allow estimation of the numbers of individuals that may survive, or immigrate into the baited area following a baiting episode. For the Lake Magenta project this aspect is still to be developed.

3. Diversity and abundance of vertebrate fauna

Diversity and abundance of small vertebrate fauna has been assessed using 5 x 5 trapping grids comprising 20 L buckets with 7 m of drift fence set at 20m spacing. Five of these grids are set in the dominant vegetation types at both Lake Magenta and Dunn Rock. Another grid comprising 5 x 5 Elliott traps set at 20m intervals has also been established at Lake Magenta and Dunn Rock to target native rodents that are not normally trapped in pit traps. Larger fauna / medium-sized mammals are monitored using linear transects of Sheffield cage traps set at 200m intervals. These transects cover 20 km at both Lake Magenta and Dunn Rock. The locations of trapping grids and transects are shown in Figure 2. In addition, at Lake Magenta, two trapping webs (7 cage traps per arm, 8 arms, 40m spacings) were established to examine brushtail possum abundance and survivorship. Eight adult possums (5 male, 3 female) were fitted with mortality sensing radio-collars and released at capture sites in salmon gum woodlands at Lake Magenta. Suvivorship, movement patterns and refuge sites were monitored for 14 months.

4. Heath and disease

The disease status of any animals captured is being assessed in a collaboration with Murdoch University through the collection of scats (for endoparasites), ectoparasites, and blood for haemoparasites. A general inspection of each animals captured is also undertaken to assess health and condition, and body measurements used to determine a condition index. Only one sampling session, in May 2007, has so far been undertaken.

RESULTS

1. Fox baiting effectiveness

The DEC aerial and perimeter ground baiting prescription for Lake Magenta is once every 90 days. A variation of ± 20 days is allowed for the aerial baiting. Figure 3 shows the distribution of aerial and ground baiting operations since 1996 and while the mean interval is 91 days the variation is between 58 and 158 days. Between 27 – 30% of the baitings have been greater than100 day intervals. In the period of decline at Lake

Magenta (March 2000 – September 2001), three of the six aerial baiting operations were undertaken at intervals of 120 days or later. In addition, there is no consistent coordination between aerial and ground baiting. On some occasions ground baiting is within 5 days of the aerial baiting, but more often the variation is greater than 20 days.

Probait uptake from tracks is higher at Dunn Rock, compared to Lake Magenta (Figure 4). This is probably a reflection of higher fox activity (= higher abundance) at Dunn Rock where no fox control is implemented (Figures 6, 8). However the percentage of baits passed by a fox was more than double at Lake Magenta compared with Dunn Rock. During the four day on track/off-track bait uptake trial, there was a similar rate of uptake of baits on-tracks at both Lake Magenta and Dunn Rock (Figure 5), with approximately 80% of all baits removed by foxes after Day 4. However there was no uptake by foxes of baits placed 100 m off tracks among natural vegetation at Lake Magenta, and only 20% of baits were picked up by foxes off-track at Dunn Rock.

2. Fox and feral cat activity and abundance

Fox activity at Lake Magenta is approximately 60% lower than at Dunn Rock (Figure 6). However there is more or less constant fox activity at Lake Magenta throughout the baiting cycle, with no significant reduction after baiting events. At a finer scale, fox activity extends uniformly from the boundary to the centre of the reserve (20km) – there is no greater activity on the boundaries (Figure 7). This pattern remains the same throughout the baiting cycle. A significant relationship ($p < 0.05$) was found between fox activity and linear abundance at Lake Magenta and Dunn Rock nature reserves (Figure 8).

Feral cat activity is consistently higher at Lake Magenta compared to Dunn Rock (Figure 9), except when there was landscape flooding from heavy rainfall after a baiting event in February 2006 (45 days post baiting). At both reserves feral cat activity is lower than for foxes. No attempt was made to correlate feral cat activity with linear abundance as their behaviour coming onto sand pads is different to foxes and more difficult to interpret. They appear to only come on to single sand pads in response to an attractant (FAP), rather than tracking across several sand pads as foxes do. This makes the estimation of individuals from activity more difficult and less accurate.

A significant negative correlation ($p< 0.02$) was detected between fox and feral cat activity (Figure 10), suggesting that foxes may suppress cat activity. As these changes can be quite rapid it is likely that this is via suppression of behaviour and movements rather than by direct predation.

3. Diversity and abundance of vertebrate fauna.

The diversity of small vertebrates is similar at both Lake Magenta and Dunn Rock (Figure 11). The heath mouse *Pseudomys shortridgei* is one of the few small mammal species that occurs on Lake Magenta but not Dunn Rock. Most small vertebrates are caught in low numbers so it is difficult to compare abundances. In addition, while vegetation assemblages are similar they are not identical and there may be habitat differences which explain differences in abundance. The honey possum *Tarsipes rostratus* appears more abundant at Lake Magenta, while small reptiles (predominantly skinks) appear to be more abundant at Dunn Rock.

Medium-sized vertebrates appear to be more abundant at Lake Magenta compared with Dunn Rock (Figure 12). The chuditch *Dasyurus geoffroii* and brushtail possum *Trichosurus vulpecula* were not known from Dunn Rock until November 2006 and May 2007 respectively. The red-tailed phascogale *Phascogale calura* was trapped at Lake Magenta for the first time in May 2007. Malleefowl are regularly seen at Lake Magenta, but there are very few records from Dunn Rock. The goanna *Varanus rosenbergi* is trapped equally at Lake Magenta and Dunn Rock, however activity indices for this species are considerably higher at Lake Magenta (Figure 13).

There was no mortality of the 8 brushtail possums monitored from November 2006 to December 2007. All possums used hollows in mainly salmon gum trees as diurnal refuge sites and moved up to 650 m overnight between refuges. At least 7 different hollows are used by each possum, and some hollow sharing was observed. The refuge sites were in both extensive woodlands and in isolated and emergent salmon gum trees among a mallee shrubland. Possums would have to travel across the ground for substantial distances to reach these sites.

4. Health and disease monitoring

Six chuditch, eight brushtail possums, five red-tailed phascogales, and six heath mice were sampled for endo, ecto and haemoparasites. All samples have not yet been analysed, however trypanosomes were found in the blood of chuditch.

DISCUSSION AND FUTURE WORK

Earlier work has indicated that aerial fox baiting at 5 baits / sq.km results in a bait uptake by foxes of 66 – 88% (Thomson and Algar 2000), and that this is effective at promoting fauna recovery in WA (Armstrong 2004). However, over the last two years, fox control has reduced fox activity at Lake Magenta by only approximately 40% compared to the unbaited Dunn Rock nature reserve. This may be inadequate to sustain fauna recovery at Lake Magenta. Foxes still persist throughout Lake Magenta, and it is suggested that both ineffective baiting regimes and bait shyness may be an issue.

The aerial and perimeter fox baiting programs at Lake Magenta have been extremely variable with up to 158 days between baitings in the period 1996 – 2006. More recently the baiting interval was extended to over 180 days because of operational problems which grounded the Western Shield baiting aircraft. The prescription baiting interval is 90 $\pm$ 20 days. This has affected all of the Western Shield fox control program, not only Lake Magenta. A simultaneous aerial and ground baiting program is planned at Lake Magenta for July and October during which fox and feral cat activity will be monitored to see if activity can be reduced below what has been recorded to date.

That there is an almost constant level of fox activity in Lake Magenta, irrespective of when baiting occurred indicates that foxes may be resident and avoiding baits at Lake Magenta. This is supported by bait uptake trials which indicate that a greater proportion of foxes walk by baits at Lake Magenta compared to the bait naive fox population at Dunn Rock. Bait shyness by foxes is possible in areas where there is prolonged useage of a particular bait type (Saunders *et al*. 1995). The on track / off track bait trial also suggest that bait uptake among natural vegetation by foxes at Lake Magenta is minimal and baits landing in these areas, particularly densely vegetated areas, are ineffective at controlling foxes.

A good relationship between fox activity and linear abundance along transects has been established, indicating that fox activity is a good indicator of fox abundance at these sites. However, it is still necessary to confirm this through the use of DNA hair traps to identify individuals using the sand pads through DNA genotyping. A negative relationship has also been found between fox activity and cat activity, with cat activity higher at Lake Magenta where fox activity is lower than at Dunn Rock. This may suggest that the mesopredator release phenomenon is being demonstrated.

Despite a continued presence of foxes at Lake Magenta, the medium-sized vertebrates appear to have benefited from some level of fox control. However these may be the more resilient species that were able to persist with higher levels of fox activity when there were large gaps in the fox baiting program. It is hypothesized that the quenda (*Isoodon obesulus*) and woylie (*Bettongia penicillata*) were unable to persist with pulses of higher fox activity resulting from gaps in the fox baiting program and declined to extinction. It is proposed that, providing fox activity can be reduced below current levels through simultaneous aerial and ground baiting, quenda will be reintroduced to Lake Magenta in 2009. If this is successful other native species can be reintroduced and the vision to reconstruct the fauna of this reserve can be realized. This program will be enhanced if effective feral cat control can also be implemented at Lake Magenta.

PROGRESS AGAINST MILESTONES

Subproject 4 – Lake Magenta	**Start**	**Finish**	**Outcome**	**Progress**
Establish trapping grid, transects and sand pads at Lake Magenta and Dunn Rock	Feb 2006	April 2006	Study areas ready for operation.	Completed
Commence trapping and sand pad assessments. Commence review of previous and current fox baiting regimes at LM	May 2006	Continue to at least Dec 2007, then reassess need.	Collection of data on species abundances and relative activity/abundance of foxes and cats. Obtain information on effectiveness of current fox baiting regimes.	Completed, ongoing
Commence vegetation assessments of grids	May 2006	Ongoing to Dec 2007	Identification of vegetation similarity between grids on LM and DR	Completed
Analyse first years data and report to external review panel	May 2006	Nov 2006	Progress report	Completed
Continue trapping and sand pad assessments	Feb 2007	Continue to Dec 2007, reassess need.	Collection of data on species abundances and relative activity/abundance of foxes and cats	Completed, ongoing
Commence disease screening study.	Feb 2007	Dec 2009	Identification of disease agents that may influence fauna populations	Completed, ongoing
Undertake assessment of bait uptake	Feb 2007	Dec 2007	Assess effectiveness of on and off track baiting	Completed
Analyse second years data and report to external review panel.	Sep 2007	Nov 2007	Progress report Feb 2008.	Completed
Modify fox baiting regime if necessary – simultaneous aerial and ground baiting,	July 2008	Dec 2008	A more effective introduced predator control program at LM	Underway July – Oct 2008
Modify fox baiting regime if necessary – increase density of baits	March 2009	July 2009	A more effective introduced predator control program at LM	APVMA approval obtained.
Introduce cat baiting	July 2009	Dec 2009	Effective cat control	Awaiting non-target trials
Translocate Quenda	Aug 2009	Oct 2009	Establishment of a predator vulnerable threatened species.	Incorporated into DEC translocation plans
Monitor translocated Quenda, mortality, refuges, diet etc	Oct 2009	Dec 2009	Establishment of a predator vulnerable threatened species.	
Continue with trapping and sand pad assessments	Feb 2008	Dec 2009	Collection of data on species abundances and relative activity/abundance of foxes and cats	
Analyse third years data and report to external review panel.	Sep 2008	Nov 2008	Progress report.	
Continue with trapping and sand pad assessments	Feb 2009	Dec 2009	Collection of data on species abundances and relative activity/abundance of foxes and cats	
Assess success of translocated species	June 2009	June 2009	Information required for success of revised baiting program	
Analyse fourth years data and report to external review panel.	Sep 2009	Nov 2009	Progress report.	
Complete field work and disease study		Dec 2009		
Prepare manuscripts for publication	May 2009	April 2010	Peer reviewed papers and management guidelines.	

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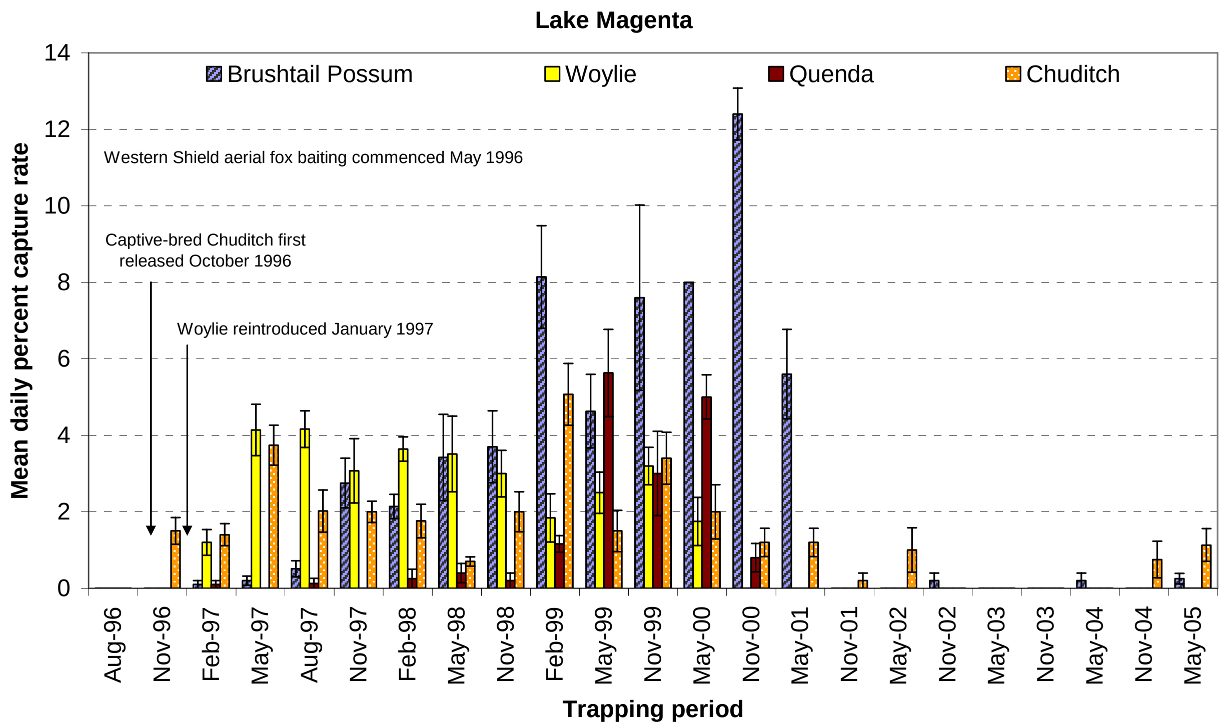


Figure 1. Trap success rates for medium-sized mammals at Lake Magenta NR 1996 - 2005

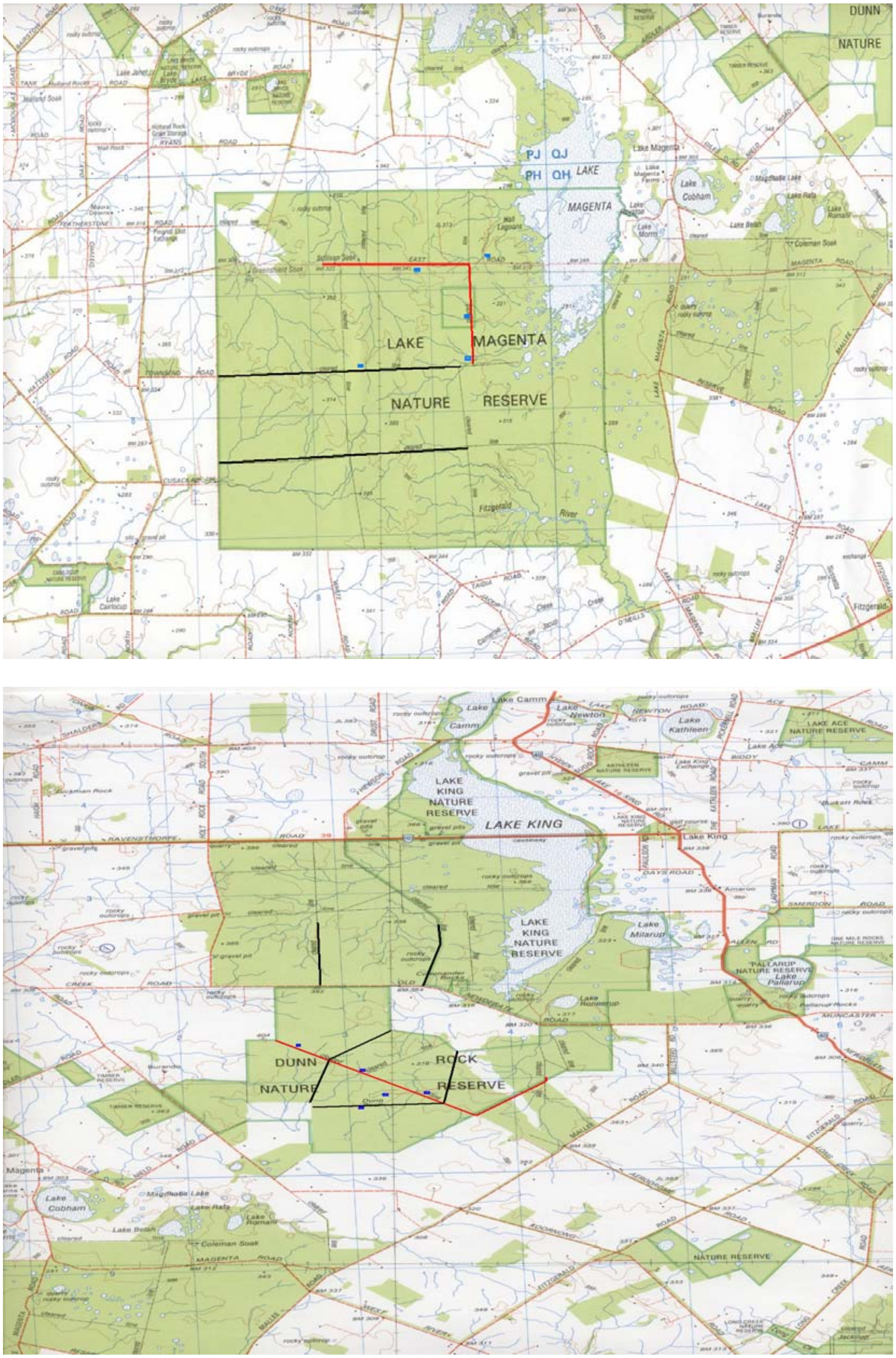


Figure 2. **Maps of Lake Magenta (top) and Dunn Rock (below) nature reserves showing sand pads transects and trapping grids and transects**

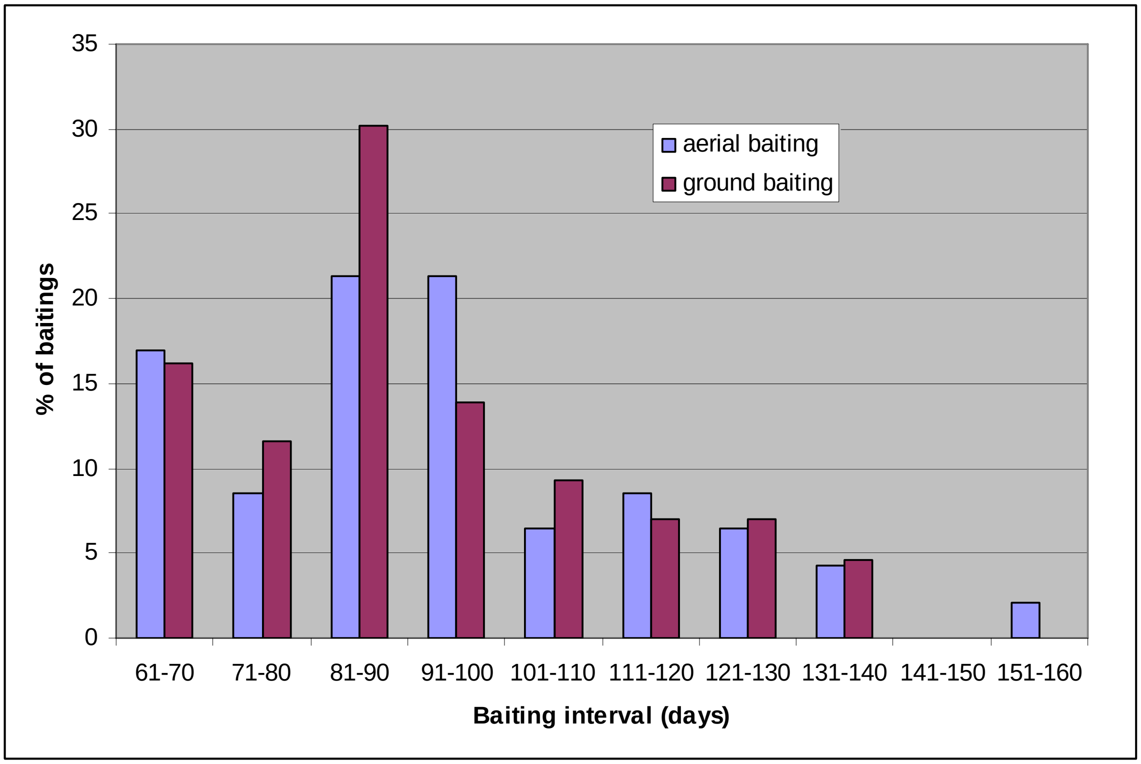


Figure 3. **Aerial and ground fox baiting intervals at Lake Magenta NR (prescription is for once every 90 ± 20 days)**

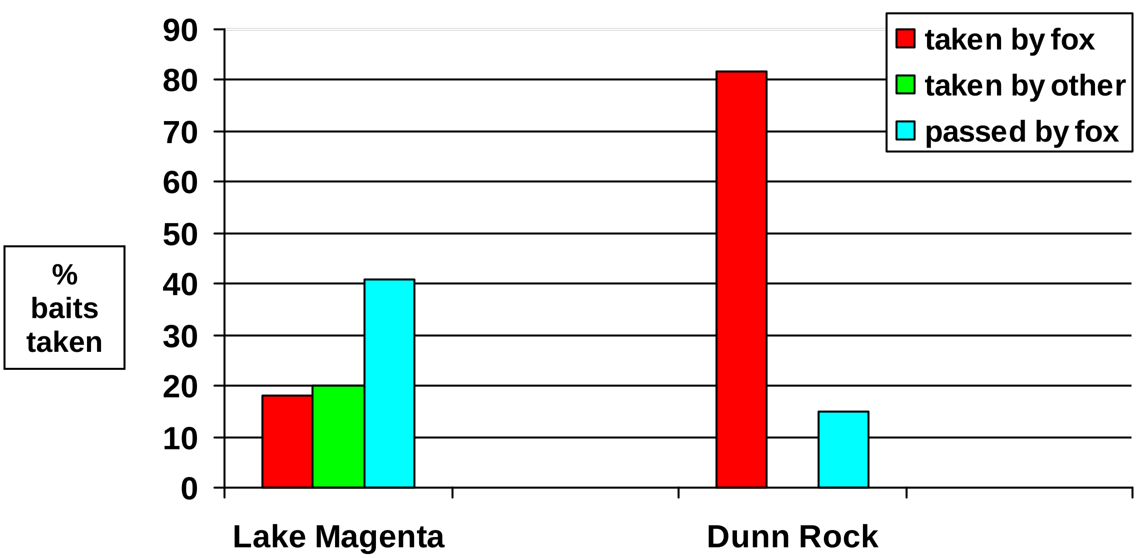
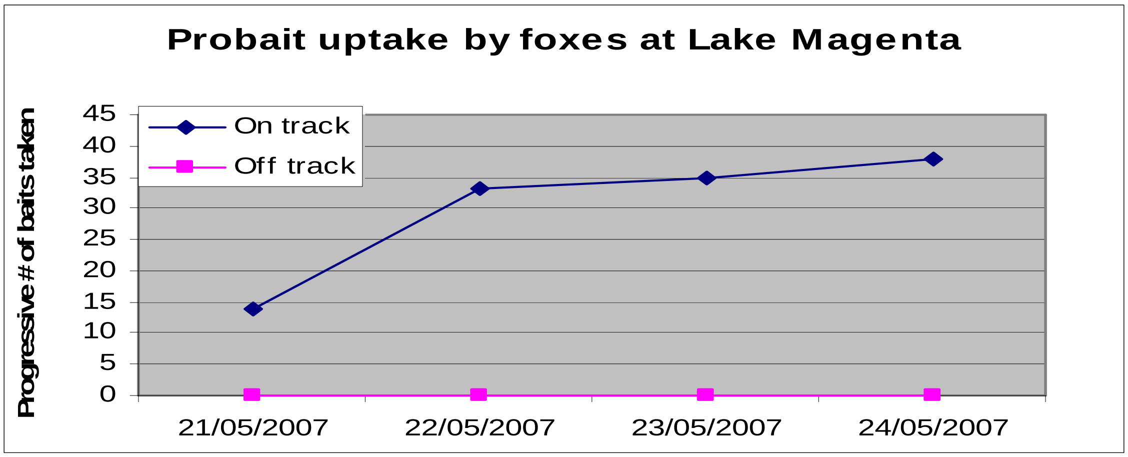


Figure 4. **The percentage of non-toxic Probaits on sand pads taken by foxes at Lake Magenta and Dunn Rock.**



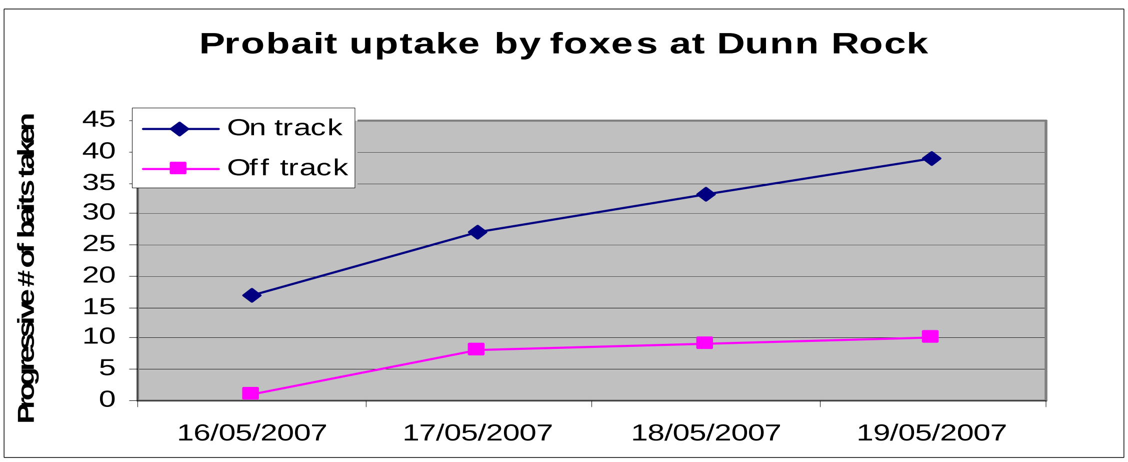


Figure 5. **The numbers of Probaits taken by foxes on and off track at Lake Magenta and Dunn Rock. (out of 50 sites at Lake Magenta, 53 sites at Dunn Rock)**

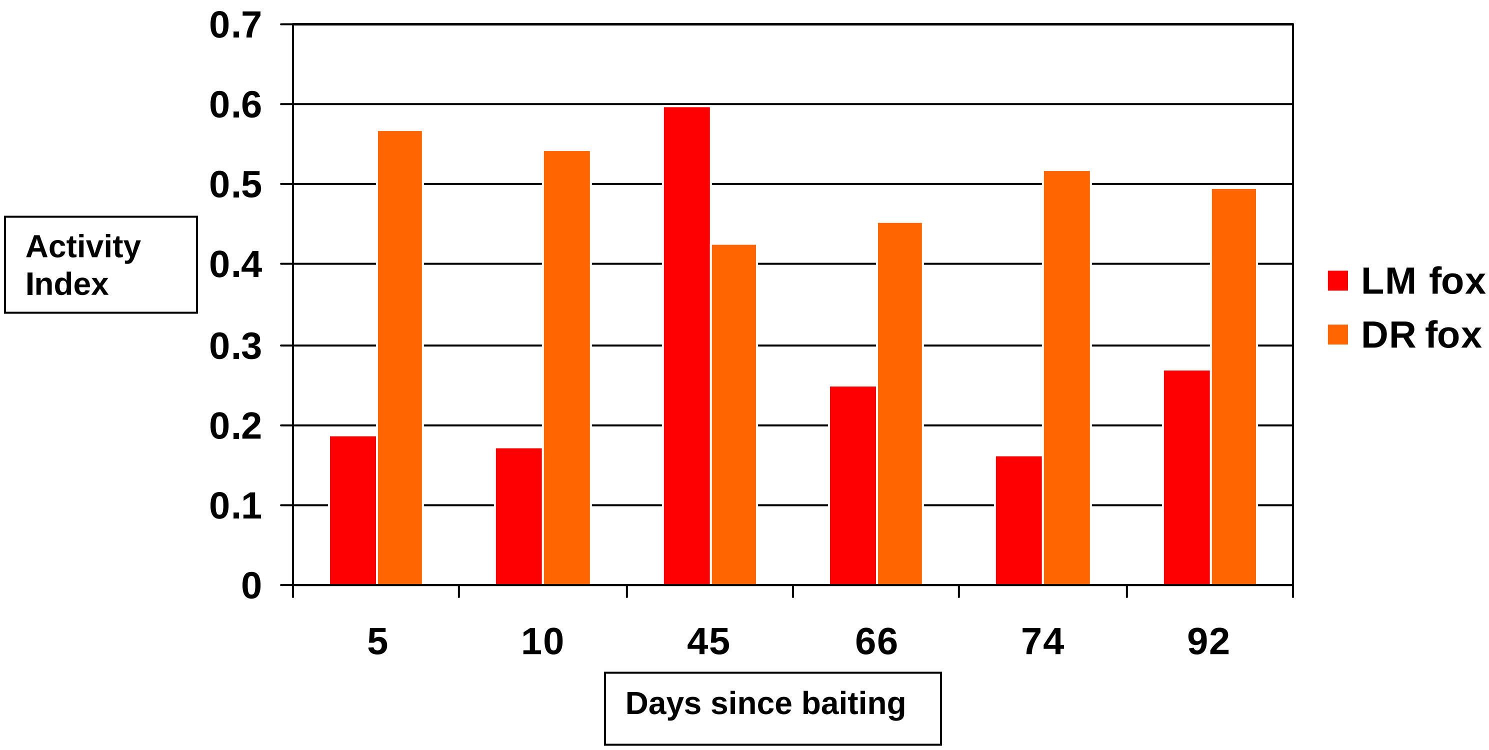


Figure 6. The activity indices of foxes at Lake Magenta (LM) and Dunn Rock (DR) at various times after aerial baiting at LM.
(Note: the 45 day activity index was 6 weeks after a widespread flooding event at LM)

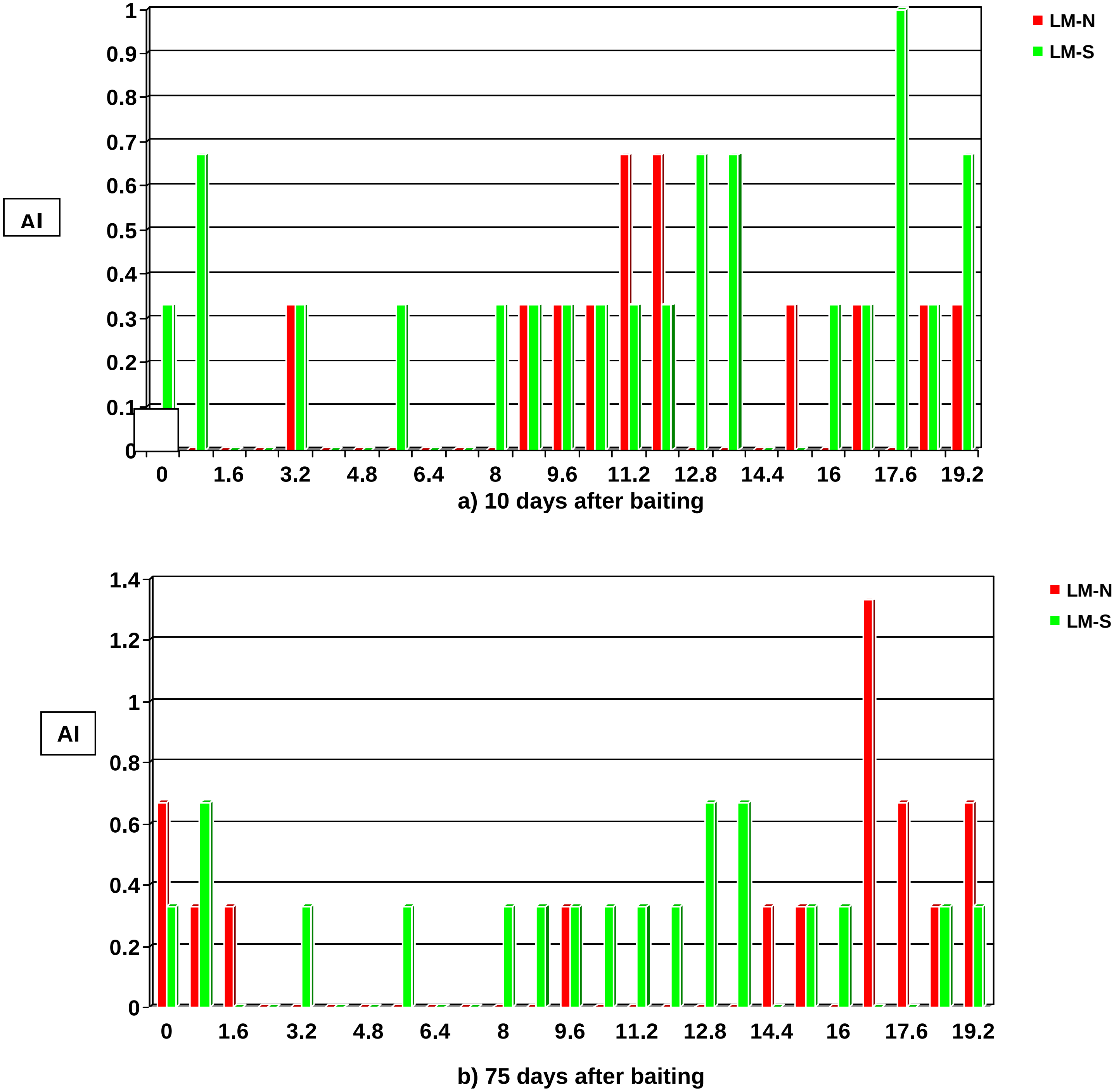


Figure 7. Fox activity on 2 transects (LM-N, LM-S) at Lake Magenta a) 10 days and b) 75 days after aerial baiting.

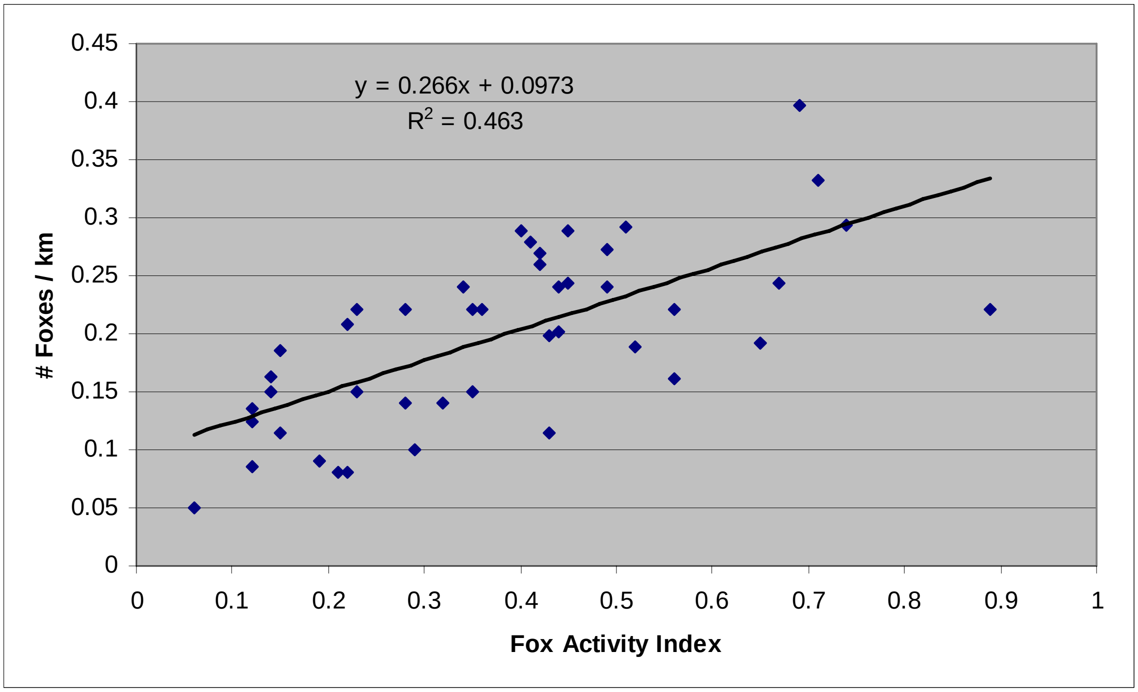


Figure 8. Relationship between fox activity and linear abundance at Lake Magenta and Dunn Rock nature reserves ($p < 0.05$).

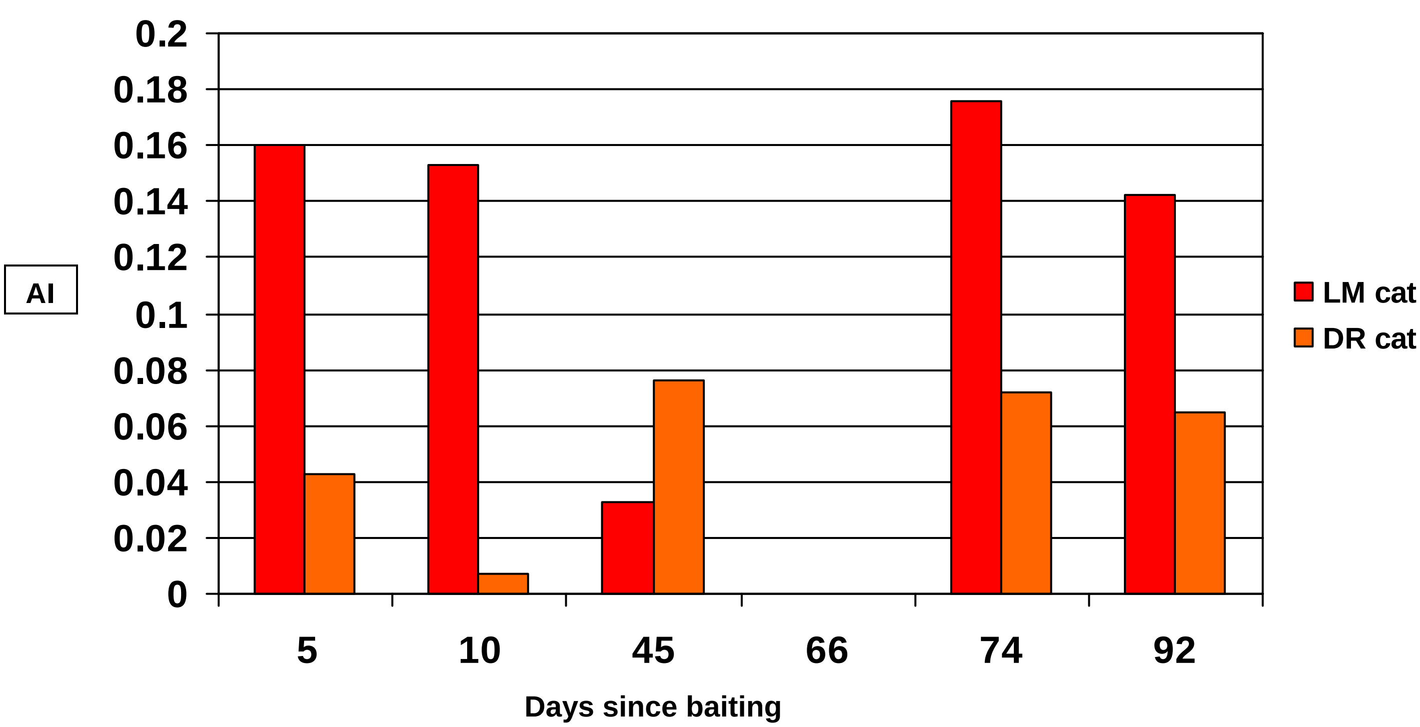


Figure 9. The activity indices of feral cats at Lake Magenta (LM) and Dunn Rock (DR) at various times after aerial baiting at LM.

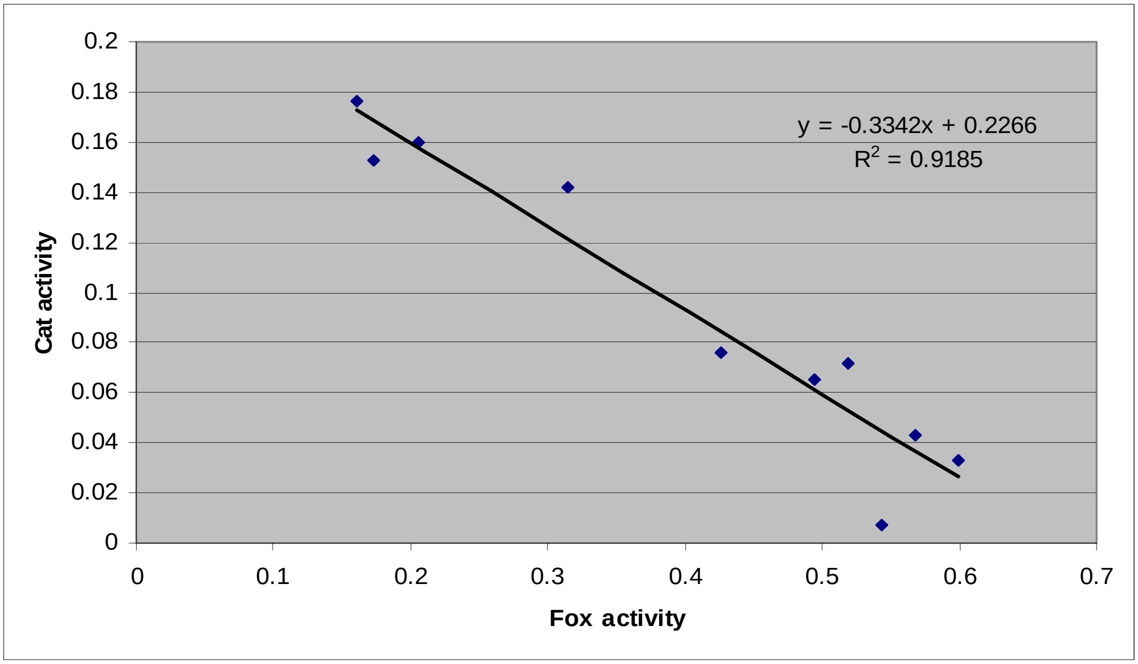
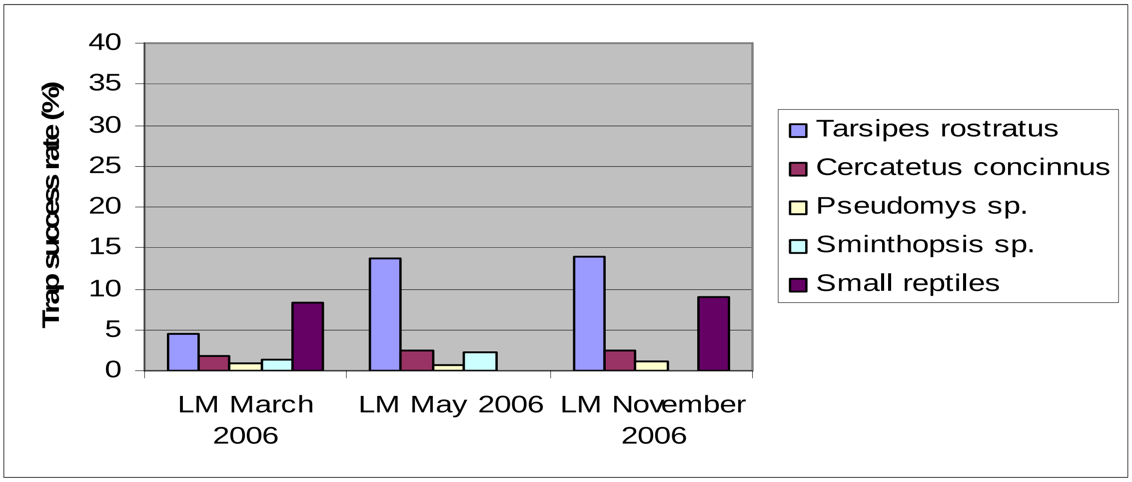


Figure 10. The relationship between fox and feral cat activity at Lake Magenta and Dunn Rock ($p < 0.02$).



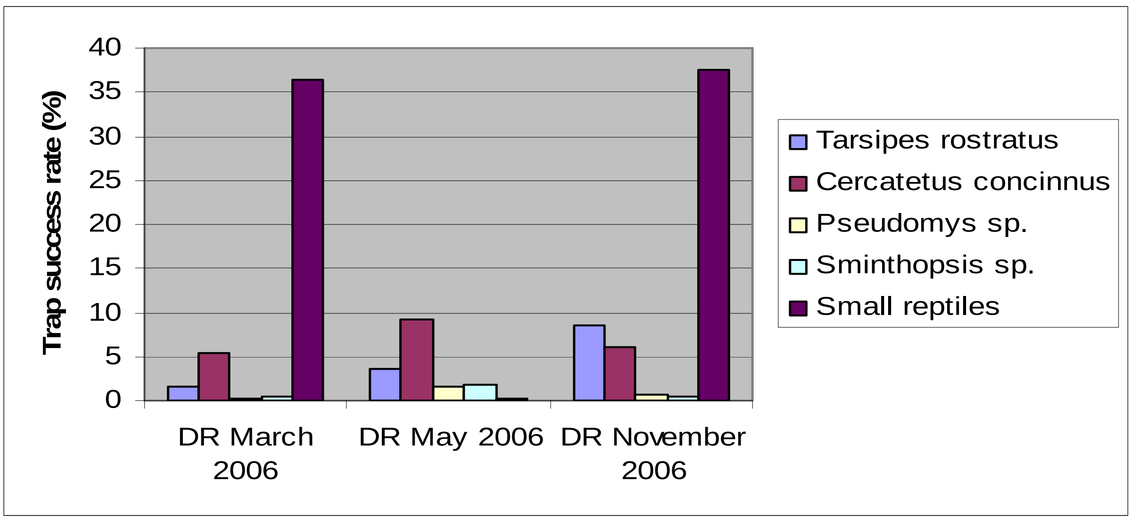
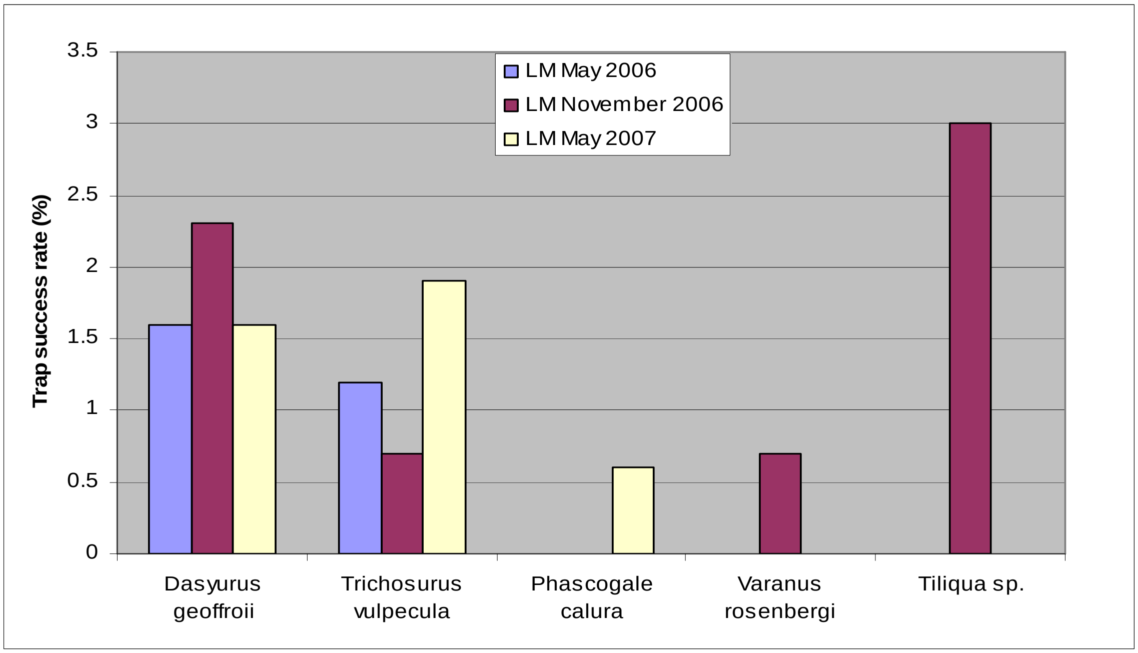


Figure 11. Trap success rates for small vertebrates at Lake Magenta and Dunn Rock nature reserves.



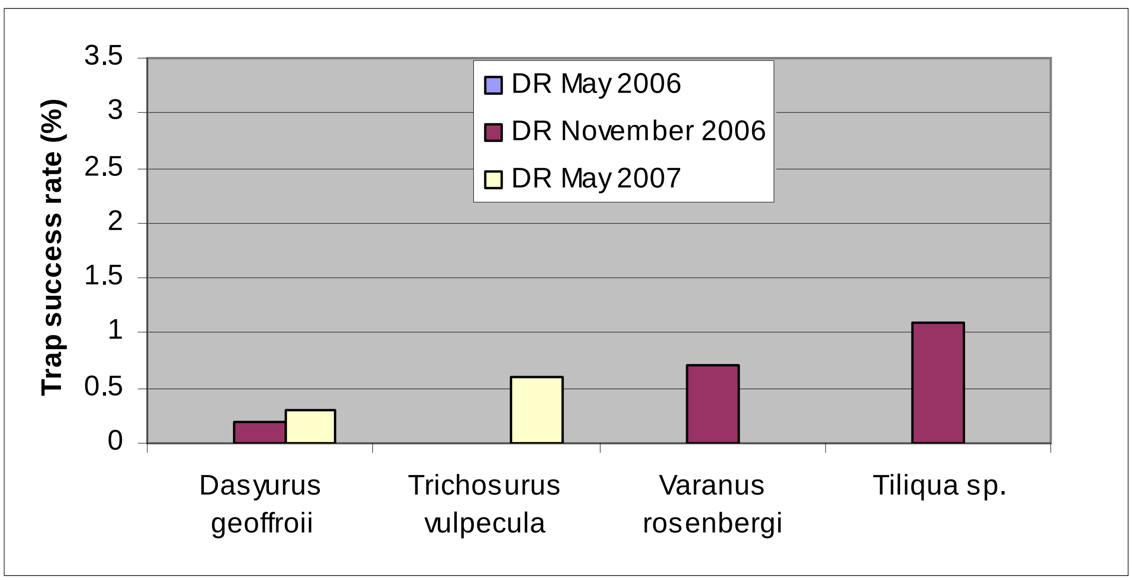


Figure 12. Trap success rates for medium-sized vertebrates at Lake Magenta and Dunn Rock nature reserves.

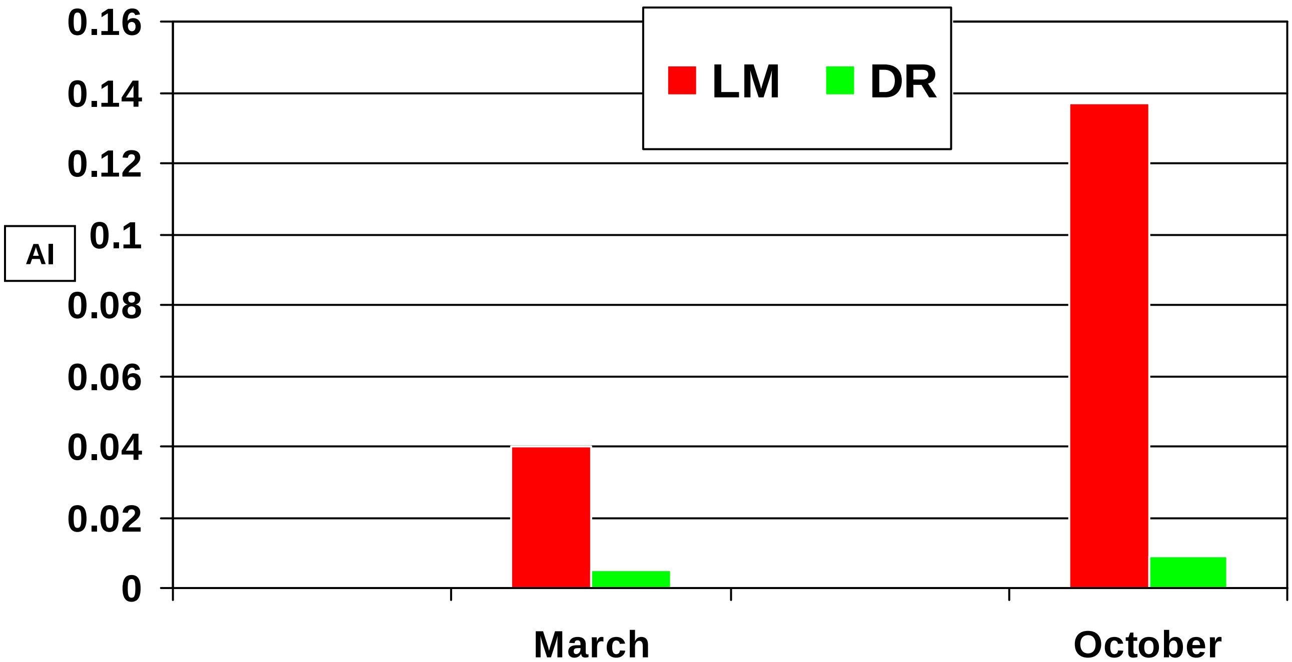


Figure 13. **Activity of *Varanus rosenbergi* at Lake Magenta and Dunn Rock.**