

Impact of fox baiting on tiger quoll populations
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Final Report to
Environment Australia
and
The New South Wales National Parks and Wildlife Service

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Executive Summary:

The *NSW Threat Abatement Plan for Predation by the Red Fox* (TAP) identifies foxes as a major threat to the survival of many native mammals. The plan recommends baiting with compound 1080 (sodium monofluoroacetate) because it appears to be the most effective fox control measure. However, the plan also recognises the risk for tiger quolls as a non-target species. Although the actual impact of 1080 fox baiting on tiger quoll populations has not been assessed, this assumed risk has resulted in restrictions on the use of 1080 which render fox baiting programs labour intensive and expensive and which may compromise the effectiveness of the fox control.

The aim of this project is to determine whether these precautions are necessary by measuring tiger quoll mortality during fox baiting programs using 1080. The project has been identified as a priority action (Obj. 2, action 5) of the TAP.

Three experiments were conducted in north-east NSW between June 2000 and December 2001. Overall 78 quolls were trapped and 56 of those were fitted with mortality radio-transmitters. Baiting procedure followed *Best Practice Guidelines* (TAP) except that there was no free-feeding and baits were only surface buried. These modifications aimed to increase the exposure of quolls to bait. 1080 baits (3 mg / bait; Foxoff[®]) incorporating the bait marker Rhodamine B were deployed for 10 days along existing trails. Baits were buried just below the surface of a pad of sand (bait station), which was used to identify prints of visiting animals. Bait stations and radio-collared quolls were monitored daily.

Only the study area for the first two experiments (Werrikimbe NP) harboured a significant number of foxes. Bait takes by foxes were recorded regularly in Werrikimbe NP during both experiments. However, a decrease of fox numbers, measured by counting fox tracks on tracking pads across trails, could be demonstrated only during the first experiment. Foxes were rare in the area used for the third experiment precluding an assessment of the effect of baiting on fox populations.

During the three experiments a total of 37 quoll visits to bait stations were recorded. On 13 occasions quolls excavated and removed the bait. However, in all but one of these cases we were able to retrieve the bait from the vicinity of the bait station (distance from bait station up to 30m). In these cases at most only small pieces had been bitten off the bait before it was discarded. The only bait take where we did not retrieve the bait occurred during the first experiment, before we had begun to make a concerted effort to find baits removed from bait stations. The absence of the bait marker (Rhodamine B) in the vibrissae of all quolls trapped after the baiting (analysis for the last experiment is pending) was consistent with the observed bait rejection. Furthermore, none of the radio-collared quolls succumbed to the baiting.

In these three experiments, fox baiting clearly did not threaten the tiger quoll population. However, the primary reason for this was that quolls did not consume any bait, and thus the question of whether quolls can survive bait consumption was not resolved. It appears that quolls find Foxoff[®] baits unpalatable, either because of the 1080 or because of the bait matrix itself. Regardless of the reasons for bait rejection, deep burial of bait, the daily monitoring of bait stations and free-feeding prior to baiting appear to be unnecessary as long as this specific bait type is used.

Introduction:

Baiting with sodium monofluoroacetate (1080) is the most effective lethal control technique for foxes (Saunders *et al.* 1995). However, baiting is not species specific to foxes and therefore presents a potential threat to some non-target species. In the case of fox baiting (3mg 1080 / bait) this includes a small range of carnivorous marsupials, and in particular quolls. In the eastern part of mainland Australia the tiger quoll (*Dasyurus maculatus*) is of special concern. Since European settlement the distribution of this species has been reduced by approximately 50% mainly due to the loss and fragmentation of habitat (Mansergh 1984). Tiger quolls are now regarded as “endangered” in Victoria and listed as “vulnerable” in New South Wales. Two factors may compound the locally precarious status of the tiger quoll, its estimated low tolerance to 1080 and that it is known to scavenge (McIlroy 1981). Both traits appear to put tiger quolls at risk from fox baiting, but risk assessments based on only indirect measures such as diet, behavioural observations of captive individuals and sensitivity to 1080 are inherently ambiguous.

The potential for fox baiting to impact on tiger quoll populations has resulted in the adoption of strategies to minimise the risk of bait take by tiger quolls and potentially other non-target animals. Where quolls are present, it has been recommended that baits are buried at 10cm. Furthermore, toxic baiting must be preceded by a period of free-feeding and daily monitoring of bait stations. Stations visited by quolls are then not baited (NPWS 2001). Although these methods may mediate the risk for tiger quolls, they may also reduce the effectiveness of baiting for the target species, i.e. foxes. Further, free feeding and daily monitoring of bait stations greatly increase the cost of fox control and thus programs may become too expensive to be conducted frequently enough to counteract fox immigration (NPWS 2001). In areas where foxes have been identified as a threat to native wildlife, it is essential to pursue fox control in the most effective manner. Thus it is important to determine whether restrictions on the use of 1080 for fox control are necessary.

Therefore, this project will determine the actual risk of fox baiting to tiger quoll populations by monitoring the survival of radio-collared quolls during 1080 fox baiting programs and by establishing the cause of death should mortalities occur. This information is crucial to policy makers and managers planning fox control in areas where there are tiger quolls.

Material and methods:

Location:

Three experiments were conducted: winter / spring 2000, autumn / winter 2001 and winter / spring 2001. The first two were carried out in Werrikimbe National Park / Doyles River State Forest, approximately 90km south-east of Armidale. The third experiment was located at a similar distance east of Armidale, on the Petroi plateau, which is part of Cunnawarra and New England National Parks. Both study areas are on the eastern escarpment of the New England Tablelands (Fig. 1). A diversity of habitats occur at both locations, including areas with dense understorey apparently favoured by the tiger quolls. Both areas have a history of predator control. In parts of Doyles River State Forest, at the periphery of the study area, 1080 baiting for wild dogs using meat baits is still conducted on an annual basis. In contrast, at Petroi, which only recently has been acquired by the NPWS, wild dog control was restricted to trapping and shooting. However, on a neighbouring property north of Petroi regular 1080 dog baiting has started recently.

Trapping and radio tracking:

Up to 103 cage traps (30x30x60 cm; Mascot Wireworks) covered with plastic sheeting were set at intervals between 100-200 m along approximately 20-30 km of roads and trails. Trapping occurred for usually 3-4 consecutive days (maximum 7). Traps were baited with chicken heads or wings. All captured quolls were permanently marked with identification transponders (PIT-tags, Destron Fearing Corp). Quolls trapped prior to baiting were fitted with mortality radio-collars (Sirtrack, ~30g).

Re-trapping quolls commenced 3-4 weeks after the baiting trial to allow sufficient time for the bait marker (Rhodamine B) to be incorporated into growing hair. Radio-collared quolls not recaptured along the established trap lines were radio-tracked and traps set at their den sites. This procedure proved only partly successful, because when approached, quolls frequently left their hiding place. For three quolls, all males, we were unable to receive any radio signal. Either these transmitters have failed or the animals moved too far out of the study area.

Prior to baiting radio-collared quolls were tracked opportunistically to detect any mortality or the loss of a collar. Preliminary tracking was also useful in determining movements and estimating home ranges, which was instrumental for monitoring quolls during baiting. Consequently, during baiting we were able to record the mortality status of most transmitters daily, despite the fact that vegetation and rugged landscape often obscured radio signals.

Baiting:

The baiting procedure was discussed in detail with vertebrate pest specialists from NSW State Forests (Paul Meek), NSW Agriculture (Peter Fleming) and NPWS (Paul Mahon) at a meeting in Armidale on 30/5/2000. Baiting procedure followed the interim best-practice guidelines for fox control (NPWS 2001; excluded pre-feeding and deep burial) and the conditions of the *Off-Label Permit* for the use of 1080 for the control of foxes.

At least a week prior to baiting a total of 53, 55 and 38 bait-stations (400m intervals) for the three experiments respectively were established along the same roads and trails as the quoll traps. Bait-stations and trap locations were separated by

approximately a hundred meters. Baiting continued for 10 days. Baits (Foxoff[®] including the bait marker Rhodamine B) were placed in the middle of a sand or soil plot (diameter approx. 1 m) and only lightly covered to avoid removal by birds. Bait-stations were checked daily for animal tracks and bait takes. Missing baits were replaced. All remaining baits were collected at the end of the trial. Fresh Foxoff[®] baits were ordered for each experiment and a 1080 assay was conducted for each batch (1st experiment: 3.25 ± 0.83 mg 1080 / bait, n=5; 2nd experiment: 2.48 ± 0.49 mg 1080 / bait, n=10; 3rd experiment assay results pending).

During post-baiting trapping samples of 8 vibrissae were collected from each quoll and analysed for traces of Rhodamine B. The presence of the bait marker would indicate an individual that survived the consumption of a bait (Fisher 1998).

Predator counts:

Predator numbers in the study area were estimated prior to and after baiting using track pads (beach sand or sifted soil) across roads and trails. Track pads were spaced at 600 m (1st exp.) or 800 m (2nd & 3rd exp.) and were established at least 6 days before monitoring commenced to allow animals to get accustomed to the pads. Overall 34, 25 and 21 pads respectively were employed for the three experiments. Pads covered the entire width of the trail and were at least 1 m wide. Both edges of the trail were blocked with branches to prevent animals bypassing the pad. Track pads were monitored for four nights prior to and four nights after baiting. Unless rain precluded, track counts occurred for a consecutive sequence of days. Some of the pads were also checked during the baiting itself (1st experiment). The number of crossings and directions were recorded for quolls, foxes, dogs and cats.

During the first experiment in Werrikimbe NP predator densities were further estimated from scat counts along all baited trails. Both before and after baiting, predator scats were counted 11 days after trails were cleared of scats. When possible scats were assigned to a species. However, the results were inconclusive due to small sample sizes and therefore we omitted this measure from the following trials.

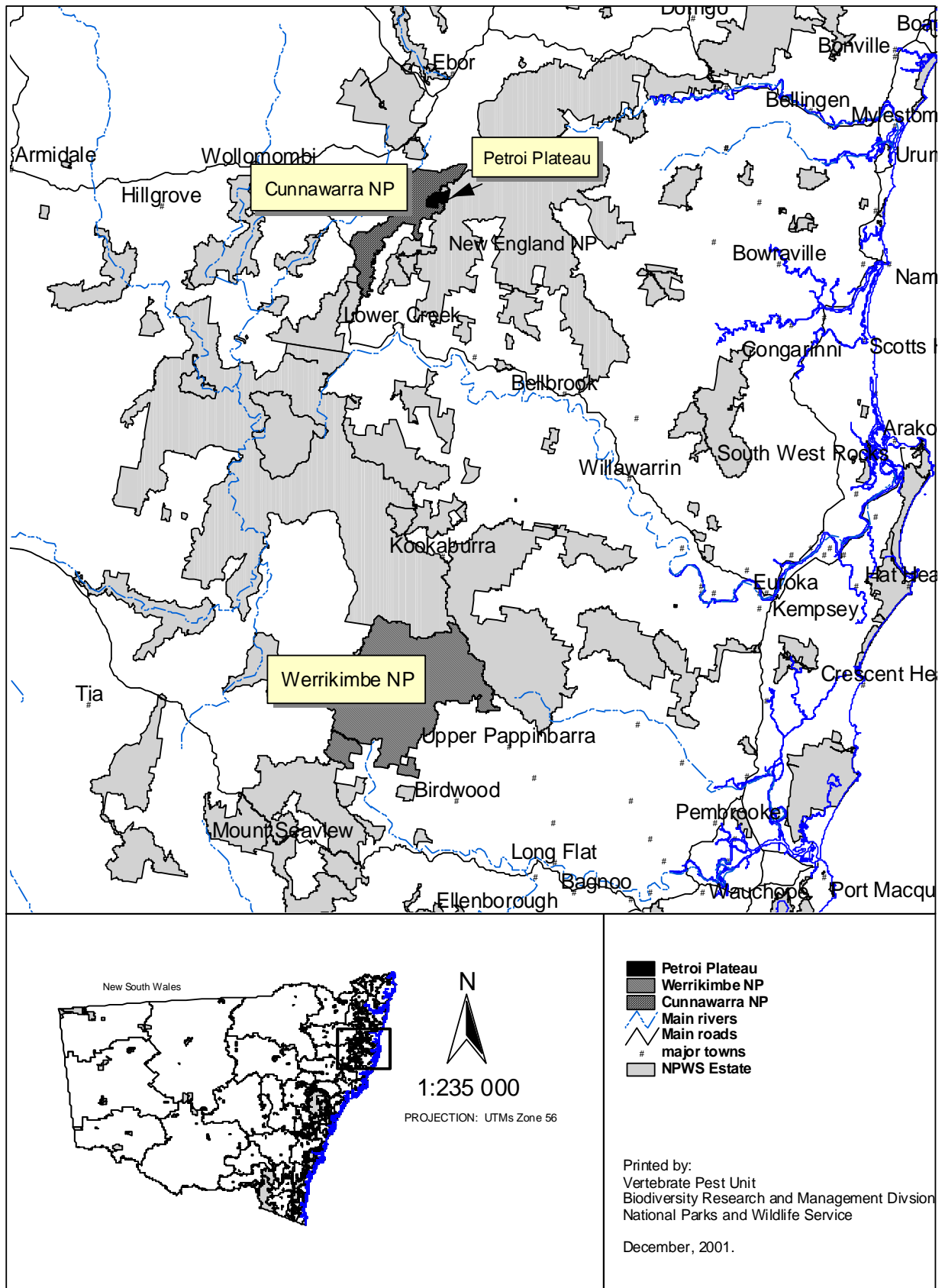


Fig. 1: Location of study areas: Werrikimbe NP (1st & 2nd experiment) and Petroi Plateau, Cunnawarra NP (3rd experiment).

Results:

Quoll trapping:

Pre-baiting trapping was terminated when sufficient quolls had been fitted with radio-transmitters and no or very few new individuals were being captured. For this between 1338 and 1619 trap nights were required. To retrieve the radio-collars a further 1051 to 1435 trap nights were conducted.

For all three experiments the cumulative trap success for new individuals approached a plateau prior to baiting (Fig. 2a) suggesting that we had captured most of the trappable quoll population. For the first and third experiment the post-baiting trapping confirmed this assumption. However, during the second experiment in Werrikimbe NP 11 new animals were trapped after the baiting, indicating either recent immigration or (more likely) that only 69% of the trappable population had been trapped and radio-collared previously.

Overall, 67 individual quolls were trapped (overall 329 captures) at an average rate of 3.8 captures / 100 trap nights. However, the trapping success varied considerably between the three experiments (Fig. 2b). These differences are probably partly explained by seasonal effects. Trapping success was highest during the second experiment (autumn / winter 2001). During this time of the year young have become independent and the quoll population is at its yearly maximum. In comparison trapping success during the two winter / spring experiments appeared to be lower. Some seasonal effects could also explain the slight differences in the trappability of quolls before and after baiting, but habituation to traps and natural mortality may also have had some influence. For example, the decrease in trapping success after approximately 600 trap nights during the pre-baiting trapping in the second experiment (Fig. 2b; Werrikimbe 2001) coincides with a period of prolonged heavy rainfall. At least three quolls died of natural causes during this period, probably four.

Trapping during all three experiments was male biased, including the juveniles in autumn 2001. Table 1 summarises the trapping records.

Table 1: Trapping records for tiger quolls

Experiment	ad. male	juv. male	ad. female	juv. female	all	collared
Werrikimbe 2000	18	0	9	0	27	18
Werrikimbe 2001	15	13	5	3	36	25
<i>Werrikimbe total*</i>	<i>26</i>	<i>13</i>	<i>10</i>	<i>3</i>	<i>52</i>	
Cunnawarra 2001	11	0	4	0	15	13

* Some quolls were trapped during both experiments in Werrikimbe NP. Thus the total number does not equal the sum for the two experiments.

Not all of the captured individuals were fitted with radio transmitters because some were trapped either during preliminary surveys (to assess the suitability of the study area) or during the post-baiting trapping. The following table summarises how many transmitters were employed and retrieved for the three experiments conducted.

Table 2: Transmitter use

Experiment	transmitters fitted	transmitters retrieved	alive but not recaptured	lost signal
Werrikimbe 2000	18	17	0	1
Werrikimbe 2001	25	23	1	1
Cunnawarra 2001	13	11	1	1

Non-target species trapped included cats, northern brown bandicoots, a long-nosed potoroo, dusky antechinus, bush rats, water rats, currawongs, a catbird, a lace monitor, a cunningham skink and bluetongues.

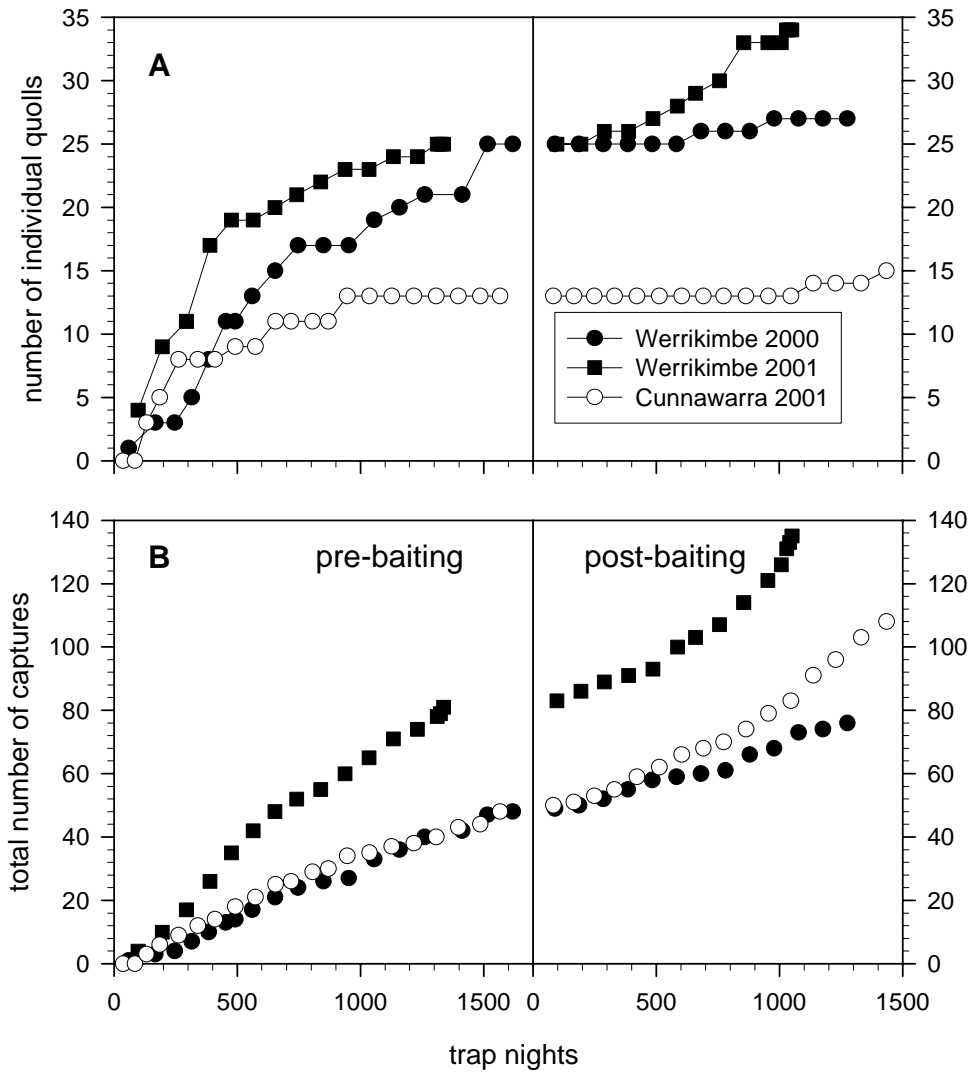


Fig. 2: Cumulative trap success for new individuals (A) and capture rate of tiger quolls (B). The trapping effort to obtain new individuals increased towards the end of the study. The curve approaching a plateau suggests that most of the trappable population had been trapped by the end of the study. The x-axis depicts cumulative trapping effort (trap nights) not real time.

Quoll mortality:

There were 15 mortalities recorded during the three experiments. Carcasses, if not decomposed, were subjected to a post-mortem (two post-mortems are outstanding). None of the mortalities were attributed to the experimental fox baiting trials. Only one quoll died during the baiting phase of an experiment. However, there were no baits taken close to its home range and the carcass, which had been largely consumed by a fox, revealed no traces of 1080. Table 3 summarises the likely cause of mortality for each of the quolls found dead.

Table 3: Quoll mortality

Experiment	predation & fighting	traffic accident	hypothermia in trap	starvation	unknown
Werrikimbe 2000	2	-	1	-	1
Werrikimbe 2001	2 (1)	1	1	5 (3)	1 (1)
Cunnawarra 2001	1	-	-	-	-

total mortality not in brackets; numbers in brackets juveniles only

Predation, fights between quolls and starvation appeared to be the predominant causes of mortality. Not surprisingly, juveniles were particularly vulnerable to starvation. Prolonged heavy rain during March 2001 caused at least three mortalities. Two quolls were eaten, and probably killed, by foxes. The body of the individual found dead during the third experiment was largely decomposed, but the damage to the radio collar suggest a fight with a large predator, probably a dog. The other cases in this category are, however, more likely attributed to other quolls. This assumption is based on circumstantial evidence such as bite marks found on the carcasses and radio collars. Aggression amongst tiger quolls has been observed in captive individuals (Fleay 1940; Harden pers. com.). That violent conflicts are common is corroborated by the fact that several quolls, both males and females, had to be treated by a veterinarian for what appeared to be fighting injuries. The two animals which died from hypothermia shortly after trapping were in very poor conditions. For one of them this was caused by a severe, debilitating leg injury, probably also inflicted during a fight with another predator.

Bait take:

Table 4 summarises the bait takes by the four carnivorous species present at the study sites.

Table 4: Visits to bait stations and bait take

Experiment	no of bait stations	Quoll		Fox		Dog		Cat	
		visit	take	visit	take	visit	take	visit	take
Werrikimbe 2000	53	6	1	5	4	0	0	9	1
Werrikimbe 2001	55	24	(7)	40	30*	31	10*	10	0
Cunnawarra 2001	38	7	(5)	1	0	2	2	7	(1)

Takes are defined as visits where baits had been excavated.

Numbers in brackets refer to baits discarded

* Four of these bait stations were visited by both dogs and foxes and one of the four showed quoll tracks at the periphery of the bait station, thus, it was unlikely that the quoll had removed the bait.

A total of 37 visits by quolls was recorded during the three experiments. As for foxes and dogs, visits were most frequent during the second trial in autumn 2001. On approximately one third of all visits (13 of 37) quolls excavated and removed the bait.

However, only once was it possible that a quoll consumed a bait. This particular bait take occurred during the first experiment, where initially we did not search for baits removed from bait stations. On all other subsequent occasions we were able to retrieve the bait, although for example one bait was eventually found 30m from the bait station. When found, tooth marks were prevalent and sometimes small pieces had been bitten of the bait before it had been discarded. The absence of the bait marker (Rhodamine B) in the vibrissae of all quolls trapped after the baiting trials (analysis for the last experiment is pending) was consistent with the observed lack of bait consumption.

Bait takes by foxes were only recorded for the Werrikimbe NP / Doyles River SF study area. Most visits by foxes (76%) resulted in bait removal. However, in autumn 2001, when fox takes were considerably higher compared to the previous year, bait caching appeared to be common. At several bait stations baits were removed by foxes for many consecutive days. Foxes were apparently rare in Cunnawarra NP, possibly because the study area was situated at a considerable distance from large areas of cleared farmland (Catling and Burt 1995).

Bait takes by dogs occurred regularly only during the second experiment. No takes were recorded during the first experiment and during the third two baits were taken from adjacent bait stations by probably one juvenile dog.

Cats did visit bait stations, but only two baits were removed (<10% of all visits) and of these one was dropped nearby.

Bait take by small mammals, predominantly bush rats (*Rattus fuscipes*), was common, particularly during the two experiments at Werrikimbe NP. However, the relative density of baits to bush rats would have been too low to affect the rat population.

Predator tracks:

Track pads confirmed the presence of all four carnivorous species (i.e. quoll, fox, dog and cat) during the three experiments. Table 5 summarises track count data for these four species.

We recorded a reasonable number of quoll tracks during all three experiments and these counts did not change significantly between pre- and post baiting measurements. However, during the second experiment, when the largest number of quolls were trapped, track counts were lowest. It appears therefore that track pads are useful as far as detecting the presence of this species, but do not necessarily provide a good index for population size.

Track counts for foxes suggested that this species was reasonably common only in the Werrikimbe NP / Doyles River SF area, corroborating bait take results. At this location, track counts for foxes showed only little day to day variation. During the first experiment fox track counts decreased significantly after the baiting, probably reflecting the death of some animals due to baiting (Table 5). However, the presence of fox tracks after the baiting shows that foxes were by no means eradicated. It is unlikely that fox tracks found shortly after baiting can be attributed solely to immigration because opportunistic track pad inspections revealed that foxes remained present throughout the baiting trial. However, it is surprising that after the second baiting trial track counts for foxes remained unchanged, although bait takes were even higher than during the first trial. Nevertheless, in this case bait take patterns suggested that foxes cached a significant number of baits. The low number of tracks during the third experiments precluded any meaningful analyses.

For dogs day to day variations in track counts were pronounced and often one or a few individuals would cross many adjacent track pads. These patterns possibly compromised the usefulness of track pads for assessing dog populations. It is also unlikely that between the first two experiments in Werrikimbe the dog population increased by more than four times as track counts suggest. However, a population increase *per se* is probable, since dog visits to bait stations were also considerably more frequent during the second trial. It appears that perhaps a larger area has to be sampled over a longer period to achieve a reasonable population estimate. Nevertheless, significant changes in dog track counts did not occur during any of the three experiments, even after the second baiting trial, when a considerable number of baits were removed by dogs. That dogs were still common after this trial was confirmed by the large number of dog baits taken by dogs during a dog baiting trial conducted at the edge of Doyles River SF by NSW State Forests shortly after our experiment was completed.

The number of cat tracks increased significantly after baiting during two of the three experiments. However, counts for cats varied substantially between days, a similar result to that for dogs. It is unlikely that the actual number of cats increased due to baiting, but it is not inconceivable that cats increased their use of roads in response to the removal of some foxes and dogs.

Table 5: Track pad counts

Quoll	No. pads	total counts		avg. counts per pad		adj. <i>Gc</i>	Signif.
		before	after	before	after		
Experiment							
Werrikimbe 2000	34*	8	18	0.061	0.132	2.853	ns
Werrikimbe 2001	25	5	8	0.050	0.080	0.309	ns
Cunnawarra 2001	21	8	14	0.095	0.167	1.146	ns
Fox							
Fox	No. pads	total counts		avg. counts per pad		adj. <i>Gc</i>	Signif.
		before	after	before	after		
Experiment							
Werrikimbe 2000	34*	60	11	0.458	0.081	37.354	P<0.001
Werrikimbe 2001	25	25	22	0.250	0.220	0.085	ns
Cunnawarra 2001	21	1	0	0.012	0	0.000	ns
Dog							
Dog	No. pads	total counts		avg. counts per pad		adj. <i>Gc</i>	Signif.
		before	after	before	after		
Experiment							
Werrikimbe 2000	34*	9	2	0.069	0.015	3.687	ns
Werrikimbe 2001	25	41	27	0.410	0.270	2.501	ns
Cunnawarra 2001	21	0	3	0	0.036	1.456	ns
Cat							
Cat	No. pads	total counts		avg. counts per pad		adj. <i>Gc</i>	Signif.
		before	after	before	after		
Experiment							
Werrikimbe 2000	34*	16	41	0.122	0.301	9.584	P<0.005
Werrikimbe 2001	25	13	26	0.130	0.260	3.753	ns
Cunnawarra 2001	21	6	21	0.071	0.25	7.626	P<0.01

Cumulative track counts for 4 nights before and after baiting (*G*-statistics with Yates correction for continuity, one degree of freedom, Zar 1996). Spacing was 800 m except for Werrikimbe 2000 (600 m).

* 5 pads were unreadable for one night before baiting.

Predator scats:

Scat counts were conducted only during the first experiment with fox scats being the most common (21 pre-baiting, 12 post-baiting). For each of the other species fewer than 5 scats were found both before and after baiting. Pre- to post baiting comparisons yielded non-significant results for all species (*G* Test; Zar 1996). The low number of canid scats found suggests that at the time foxes and dogs did not occur at high

densities in the study area. Cats and quolls were observed along roadways as track pads indicated. However cats often bury their faeces and for quolls it is not known whether scats are used for scent marking along regularly used tracks (Kruuk and Jarman 1995). Finding scats of these two predators is therefore less likely than those of canids. Furthermore, given that the chance of missing a scat is higher than miss-counting tracks, scat counts appear to be a less sensitive test for assessing predator numbers. Therefore this technique seems less suitable to detect small changes in predator numbers and was omitted during the following trials.

Conclusion:

This project is the first attempt to measure the actual impact of 1080 fox baiting on wild tiger quoll populations. During our three trials none of the radio-collared quolls died of 1080 poisoning and hence fox-baiting programs when conducted with Foxoff[®] are unlikely to have any significant impact on quoll populations. In this respect it is important to note that no attempts were made to discourage quolls from excavating bait (i.e. no deep burial of bait). Consequently, quolls visited bait stations regularly and also removed baits. However, baits were subsequently discarded. The lack of 1080 related mortality was therefore not due to quolls surviving bait consumption, but is solely attributed to bait rejection.

Prior to our project, risk assessment for the tiger quoll was based on circumstantial evidence and at first glance the outcome of our project seems to contradict previous findings. It is therefore important to analyse the contradicting evidence in detail. First, our trials confirmed that quolls take fox baits, but more importantly have demonstrated that bait take is not equivalent to bait consumption. Apparently quolls can carry food items for considerable distances, before eating or discarding them. Consequently, it is futile attempting to measure the impact of baiting by only recording bait removal using track pads around bait stations or automatic cameras (see Belcher 1998; Glen 2001).

Second, consumption of fox or dog baits by quolls, as reported in previous experiments, always refer to non-toxic baits (Belcher 1998, Murray *et al.* 2000) and most observations regarding Foxoff[®] bait were done in captivity under highly artificial circumstances (Belcher 1998). Non-toxic baits were obviously used because of ethical considerations. If quolls had rejected non-toxic baits, a projection to toxic baits would have been justified. However, it is known that some species such as the related fat-tailed dunnart (*Sminthopsis crassicaudata*) can detect 1080 and will reduce food intake or reject food entirely. A reduction in food intake has also been demonstrated for several small rodents (Calver *et al.* 1989). Therefore, the use of non-poisoned bait for assessing the risk for target or non-target species can be considered only as a first step. If the presence of 1080 in baits can change the palatability of baits considerably, a simple extrapolation from non-poisoned to poisoned baits is not warranted. Certainly the contrasting results between previous studies and the one presented here could be explained easily by the absence or presence of 1080 in the baits. Alternatively, it is possible that the matrix of Foxoff[®] bait itself is unpalatable for quolls. However, this explanation appears to be less likely because quolls have been recorded eating the non-toxic variety of Foxoff[®] (Belcher 1998). Rhodamine B, which is not added to “normal” Foxoff[®] bait, has also been used in previous experiments, where quolls were shown to consume non-toxic bait. It is therefore extremely unlikely that this bait marker caused the observed bait rejection. Furthermore aversion to Rhodamine B has never been

observed in any species tested so far including quolls (Fisher 1998; Fairbridge pers. com.). Nevertheless, even if the inclusion of 1080 was causing the observed bait rejection, quolls might ignore the presence of the poison if a potentially more attractive bait type such as fresh meat (Soderquist and Serena 1993) is used.

While preliminary trials using non-toxic baits suggested a relatively high exposure of quolls to 1080, it is interesting to note that the only two field trials using toxic baits on two related quoll species failed to show any 1080 related mortality. The first study tried to assess the impact of dog baiting on northern quolls (*Dasyurus hallucatus*) (King 1989). Unfortunately the experimental design did not allow the determination of whether any of the northern quolls encountered or consumed bait. The lack of mortality in that experiment therefore remains unexplained. Similarly, in Western Australia extensive aerial fox baiting (Western Shield) failed to kill any of the radio-collared western quolls (*Dasyurus geoffroii*) (Morris *et al.* 1995). In fact the population appeared to have increased probably due to the removal of foxes. The findings of both studies are therefore in line with the outcome of our experiments and are also not inconsistent with the hypothesis that 1080 may render bait unpalatable to quolls.

Although the presence of 1080 appears to be the most likely candidate causing bait rejection on tiger quolls, a more thorough assessment is deemed necessary. So far our results are valid for only one commercial bait type of unspecified composition. The answer to the question of whether quolls can detect 1080 in baits is therefore not only of academic interest, but has important management implications.

Nevertheless, after three experimental trials during two different seasons and at two different localities with no bait related quoll mortality, it appears reasonable to conclude that fox baiting using Foxoff[®] has minimal impact on tiger quoll populations. Therefore, deep burial of bait, daily monitoring of bait stations and free-feeding prior to baiting appear to be unnecessary as long as this specific bait type is used.

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The NPWS Animal Care and Ethics committee approved the project (ACEC No. 03040001) and scientific licenses were issued to all personnel involved (R.H. A60; G.K. B2128; S.G. B2142; B.M. B2313). NSW State Forests issued a Special Purpose Permit for Research for Doyles River State Forest (No. 05494 and 05563). Each of the three baiting trials was subjected to a Review of Environmental Factors (REF2) which were subsequently approved by NPWS, CPPD, Northern Directorate.

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