Efficacy Of Bait Stations For Broadacre Control Of Rabbits

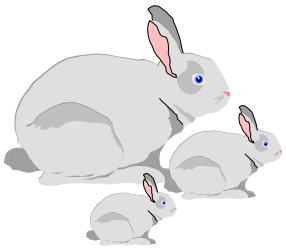
FINAL REPORT TO NFACP/BRS
September, 2001

By

Laurie E. Twigg, Tim J. Lowe & Gary R. Martin

Vertebrate Pest Research Section, Department of Agriculture, Western Australia,
Bougainvillea Avenue, FORRESTFIELD, WA 6058 Australia

DEPARTMENT OF
Agriculture



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EXECUTIVE SUMMARY

The efficacy of bait stations (200 litre drum cut in half longitudinally) for the broadacre control of rabbits was compared to that obtained with standard trail baiting procedures in the southern agricultural region of Western Australia. Bait stations were tested with and without the provision of pre-feed. The bait used was a 1.0% 1080 One-shot oat mix, and corresponding experimental control sites were treated with unpoisoned oats. Spotlight counts over three consecutive nights were used to determine the relative changes in rabbit abundance before, and several times after, baiting which allowed an estimate of efficacy.

The reduction in rabbit numbers obtained with bait stations in the absence of pre-feed was poor, with a mean reduction of only 31% within 14 days. The reduction in rabbit numbers achieved with this treatment did not improve appreciably where sites were monitored for a further 28 days (i.e. 42 days in total). In contrast, the provision of pre-feed for 21 days prior to adding the poison bait resulted in a mean reduction in rabbit numbers of 57% within 14 days after the poison bait was added. However, the greatest reductions in rabbit numbers were achieved with trail baiting where, relative to pre-treatment counts, rabbit numbers were reduced by 72% at Day 7 and 84% at Day 14.

Based on the costs incurred during the trials, trail baiting was by far the cheapest option for broadacre control of rabbits. Associated costs per km of rabbit infested area were: trail (3 parallel trails), $157; bait stations with pre-feed (10 newly constructed stations per km), $738; and bait stations without pre-feed (10 per km), $583. The cost of using bait stations would be offset to some degree as these stations are able to be reused, and the cost of trail baiting reduces to $113 if only two parallel trails are used. Irrespective of whether 1 to 4 parallel trails are used, trail baiting with 1080 One-shot oats was the cheapest control option.

The Western Australian Department of Agriculture currently provides a ready-to-lay 1080 One-shot oat mix which, provided appropriate authorisation is obtained, can be supplied to landholders by licensed Schedule 7 retailers. The oats used to manufacture this product are subjected to Gamma-sterilisation to prevent the germination of the oats, or the seeds of any associated weed species. When offered a choice (matched sets), there was no difference in the amount of non-toxic gamma-sterilised oats and unsterilised oats consumed by free-ranging wild rabbits. Although it adds to the production cost, the routine sterilisation of the grain used to manufacture whole-grain based bait products should continue as this reduces the likelihood of spreading weeds during rabbit baiting campaigns.

RECOMMENDATIONS

- Unless there are mitigating circumstances (e.g. the inability to de-stock paddocks for traditional trail baiting), the use of bait trails should be the preferred method for controlling rabbits, particularly in broadacre situations.

- Because they are acceptable to rabbits, and because they can reduce access to bait by non-target species, 200 litre drums cut in half longitudinally (with access holes each end) offer the best bait station design for controlling rabbits.

- While the use of bait stations may provide some respite from rabbit damage, the use of bait stations alone is unlikely to provide effective broadacre control of rabbits. Where possible, their use should be integrated with other control options such as shooting, trapping and follow-up trail baiting.

- Where bait stations are to be used, non-toxic pre-feed (oats) should be presented in the stations for at least 14 days prior to adding the poison bait mix.

- The spacing between individual bait stations used for broadacre rabbit control should not exceed 90-100 m, and probably should be less than this where rabbits have clearly established territories, as during the breeding season.

- Provided ring-lock fencing (or some other means) is used to prevent the access of domestic livestock to the stations, the use of bait stations may provide a means for partially reducing the impact of rabbits in areas where paddocks can not be de-stocked to enable traditional trail baiting to occur. These situations can arise when water management is difficult over the summer months. However, any bait station control program would need to include follow-up control where possible (e.g. trail baiting, shooting).

- Because many rabbits may not feed at bait stations, a measure of bait take or rabbit activity at these stations will not provide a reliable indicator of the effectiveness of bait stations as a rabbit control option. Other independent means, such as spotlight counts, dusk counts or providing plain oats away from the stations, will give a better measure of rabbit numbers/activity, and therefore provide a more reliable estimate of efficacy.

- Because gamma-sterilised oats were a readily acceptable food item to free-ranging wild rabbits, the routine gamma-sterilisation of the grain used to manufacture whole grain bait products should continue as this will reduce the possibility of spreading weeds during baiting campaigns.

BACKGROUND

Despite the recent introduction of the rabbit calicivirus disease (RCD) for controlling European rabbits, and the continued impact of myxomatosis, there is still an ongoing need for traditional (conventional) control techniques for reducing the impact of rabbits. 1080-baiting is one such technique that has proven to be a highly successful control option (Williams *et al.* 1995). Because the use of such pesticides is being more closely scrutinised by the general public and other interest groups, there is a need to ensure that these control techniques have minimum effects on non-target species and that they pose little, if any, environmental hazard. The use of bait stations is one method by which the exposure of non-target animals and the environment to these pesticides can be minimised. Bait stations may also be an effective control option where small areas are infested with rabbits, and they may provide a method for 'mopping up' those rabbits remaining after other control options have been used. However, little is known about the efficacy of bait stations for broadacre control of rabbits.

The Department of Agriculture, Western Australia has examined the acceptability of four bait station designs to free-ranging rabbits, and has determined the efficacy of three of these designs against urban rabbits using Pindone oat bait (Twigg *et al.* 2001). The raised concrete slab and the 200 litre drum (cut in half longitudinally) gave the best results; however, non-target species, particularly birds, were able to gain greater access to the bait with the slab design. The reduction in rabbit numbers/activity with the drum and slab bait stations ranged from 0%-80% (mean 48%), and generally took around 30-60 days to achieve. The benefit cost gained during these trials was therefore highly variable, mainly due to the lengthy period that the Pindone bait stations needed to be active. However, in a few cases rabbit activity (damage) was reduced by almost 100% within 30 days (Twigg *et al.* 2001). These bait stations may well have been more efficacious had we been able to use an acute poison like 1080, rather than the chronic-acting anticoagulant, Pindone. This was supported by a preliminary field study in an agricultural environment where 1080 One-shot in drum stations reduced rabbit numbers by 34-67% within 25 days (Twigg *et al.* 2001). These results suggest that, at least in some rabbit populations, a high proportion of rabbits are prepared to enter a bait station, but this still needs to be tested in a truly agricultural (broadacre) situation.

The use of bait stations for broadacre control of rabbits is increasing in Western Australia, New South Wales and possibly Victoria. In Western Australia, a number of farmers are using bait stations loaded with 1080 One-shot oats to control their rabbits, particularly where their land abuts bush remnants. They believe the drum type station gives the best results. These stations are secured to the ground and isolated from livestock so they have an advantage over trail-baiting in that domestic livestock do not need to be removed from paddocks during a baiting program. This enables better management of often limited water resources over the summer drought period, and hence improves overall farm management. These bait stations are portable and, therefore, can be readily moved from 'hotspot' to 'hotspot'. However the efficacy of such bait stations for broadacre control of rabbits has not been formally tested, and their effectiveness needs to be assessed before they could be considered for wide-scale use.

This project formally compares the efficacy of 1080 One-shot oats applied in bait stations with that obtained using the standard 1080 trail baiting procedure in an agricultural region in southern WA. Recommendations on the suitability of this technique for the broadacre control of rabbits are made.

PROJECT OBJECTIVES

The objectives of the study were to:

- Determine the efficacy of bait stations for broadacre control of rabbits.
- Compare bait station efficacy with that obtained by trail baiting.
- Examine the effect of pre-feed on the efficacy of bait stations.
- Tabulate the associated costs of the two control techniques, and make inferences about their likely cost effectiveness.
- Advise other agencies and interest groups of project outcomes.
- Prepare and distribute a Farmnote covering the outcomes and recommendations of the trials.
- Submit a manuscript describing this work to Wildlife Research.

PROJECT LOCATION

This project was under taken on farming properties at Boxwood Hill (34^{o}17' S; 118^{o}46' E) and Wellstead (34^{o}31' S; 118^{o}35' E) in the southern agricultural region of Western Australia. The major enterprises in this region are merino wool, cereal grain, canola, and to a lesser extent, beef cattle production. This land system is mainly comprised of aeolian sands over laterite cap-rock. These areas are also often interspersed with remnants of native vegetation. Climate is typically Mediterranean with an annual rainfall of around 450 mm. However, rainfall in this region can be highly unpredictable. The basic ecology and biology of rabbits in the region are described in Twigg *et al.* (1998).

METHODOLOGY

The trials were undertaken during the summer/autumn of 2000/2001 in the Boxwood Hill/Wellstead region of Western Australia. Most broadacre control of rabbits in WA is undertaken during this summer drought period. However, because the trials could not be all run simultaneously, the trials were conducted in two discrete 'blocks'. Three properties were used at Boxwood Hill in February/March, and three at Wellstead in March/April. These two areas were approximately 30 km apart. A range of rabbit densities were present on the sites in these two areas at the pre-treatment counts (Table 1). Myxomatosis and Rabbit Calicivirus Disease (RCD) were not active during the trials, although a small number of rabbits (< 10 in total) with mild myxomatosis were seen near four sites in mid to late March 2001.

The bait used for all trials was a 1.0% 1080 One-shot bait mix, where the 'pre-feed' and poison oats were provided simultaneously in the same feed/trail. Each poison grain contains 4.5 mg of 1080 and the final ratio of poison to unpoisoned oats in the mix was 1.0% (i.e. 1 poison oat to 99 unpoisoned filler oats). The drum bait station design (200 litre drum cut in half longitudinally with rabbit access holes each end; Twigg *et al.* 2001) was used as the bait station for all relevant sites (see Fig. 1). This design was chosen because it is known to be acceptable to both free-ranging and urban rabbits (Twigg *et al.* 2001), because it is the design most often used by landholders, and because they may reduce the potential risk to non-target animals. These stations were placed away from the bush remnant vegetation where the rabbits resided, and were approximately 30-40 m into the main rabbit feeding area (pasture/stubble). The distance between individual stations was 80-100 m. Where livestock (sheep) could not be removed from paddocks, a small square (approximately 1.5 x 1.5 m) of ring-lock fencing was erected around each individual station to exclude stock (see Fig. 1). One kg of the bait mix or the unpoisoned oats was placed onto 40 cm dia. plastic saucers inside each station. A half of a house-brick was placed in the centre of each saucer to prevent rabbits from sitting in the saucers and spilling grain, and to stop the saucers being moved to the outside of a station (see Fig. 1). As per current practice, a small amount of unpoisoned oats was also distributed by hand in a trail between each station to help attract

rabbits to the stations. This hand-trail was only used on the day that the stations were initially loaded. To determine if there were significant changes in the hydration of the oats during the trials, hydration controls (oats in stations with rabbits excluded) were also run on three properties during the trial period. All bait was weighed (± 1.0 g) on several occasions during each trial, and bait stations were topped up as required. Spilt bait was retrieved, and any sand was removed with a sieve, before weighing. The results presented were not corrected for changes in the hydration controls because these changes were small, and because it was not always possible to match all sites with these controls.

1080 One-shot bait trails were laid at approximately 6 kg km^{-1} using a disk-style bait layer. Three parallel trails approximately 20 m apart were used when laying the One-shot bait, and these trails were placed in the rabbit feeding areas approximately 20 m, 40 m, and 60 m out from the rabbit refuge. All paddocks were de-stocked when trail baiting with One-shot oats. All trails were checked over the first 7 days to ensure that they were not eaten out; as this did not occur, it was not necessary to re-lay any 1080 One-shot trail. 'Null' trails containing only unpoisoned (filler) oats were laid identically to that described above except for the exclusion of the poisoned oats, and the use of a single trail only which was laid approximately 40 m from the rabbit refuge. Bait take was not formally monitored for any of the trails.

In most instances, at least two independent but similar sites ('matched sets/pairs') were used on each property; the first received poisoned oats (treatment - either bait stations or trail), and the second matching site received unpoisoned oats (experimental control - either bait stations or trail). There was at least 700 m between each member of each set. The trials for each of the 'matched sets' were conducted simultaneously. However, once the efficacy of the 1080 One-shot bait station treatments had been determined (over the first 21 days), the unpoisoned oats were removed from the bait stations on the site with unpoisoned oats and replaced with the 1080 One-shot oat mix. Rabbit numbers at the two 'matched' bait station sites were then monitored for a further 15-20 days. This enabled an assessment of the merits of providing 'pre-feed' with bait stations. Where insufficient rabbit areas were present on individual properties, appropriate sites were selected on the immediate closest nearby property with suitable rabbit habitat and numbers (see Table 1). Thus, there were 4 treatments: drum stations with unpoisoned oats, drum stations with 1080 One-shot oats, bait trail with unpoisoned oats, bait trail with 1080 One-shot oats. The inclusion of the 1080 trails enabled comparison of the two control techniques, and the identification of any reluctance of free-ranging rabbits to enter the bait stations.

Rabbit numbers on all sites (poisoned or unpoisoned oats) were monitored for both the oat trails and bait stations using before and after treatment spotlight counts along permanently marked transects (Table 1; Fig. 1). Counts were undertaken for three consecutive nights, before and several times, after treatment began, with the first census commencing 7 days after 'bait' was added (i.e. over nights 7, 8, and 9 'post-baiting'). These counts commenced 1 h after dusk, and the same counter and 4WD vehicle (travelling at 15 km h^{-1}) were used. The maximum number of rabbits over the counts for the three consecutive nights was used as the index of abundance for that census for each site (Twigg *et al.* 1998). Efficacy was then determined as the percentage reduction in rabbit numbers between the before and after treatment surveys. These proportions were arcsin transformed prior to conducting an ANOVA to examine the effect of treatment. A single factor ANOVA was also used to examine the changes in rabbit numbers on the 'null treatment' (unpoisoned oats) sites over time. These factors could not be all included as a single analysis because the design was unbalanced (i.e. there were less sites with pre-feed, and some trail sites could not be monitored for all time periods as the landholders needed to regain access to their paddocks). Post-hoc tests were undertaken using the Tukey HSD procedure (Zar 1984).

Table 1: *Site description and codes used for the sites at Boxwood Hill and Wellstead in the southern agricultural area of Western Australia.*

Code	Location	Property/ Paddock name	Treatment	Filler oat type[A]	Transect length (m)[B]	Initial rabbits km^{-1}	Vegetation type	Myxo on site[C]	Stations #/fenced [D]	'Matched' with
Bait Stations:										
UPS 1	Boxwood Hill	Hick- South BS/UP 1	[E]Unpoisoned oats → Poison	Sterilised	1100	140	Dry pasture		10/N	PS 1
PS 1	Boxwood Hill	Hick- North BSP 1	[E]Poison only	Sterilised	1100	96	Dry pasture	27/3	11/N	UPS 1
UPS 2	Boxwood Hill	Parsons- Hay BS/UP 2	[E]Unpoisoned oats → Poison	Sterilised	350	83	Canola stubble	5/4	5/Y	PS 2
PS 2	Boxwood Hill	Parsons- Greg BSP 2	[E]Poison only	Sterilised	900	64	Lupin stubble	5/4	9/Y	UPS 2
UPS 3	Boxwood Hill	Hick- Back Left Swp BS/UP 3	[F]Unpoisoned oats → Poison	Unsterilised	1000	109	Dry pasture	20/3	11/N	PS 3
PS 3	Boxwood Hill	Hick- Back Right Swp BSP 3	[F]Poison only	Unsterilised	1000	87	Dry pasture		11/N	UPS 3
UPS 4	Wellstead	Westlands- 13B BS/UP 4	[F]Unpoisoned oats only*	Unsterilised	700	46	Dry pasture		8/N	PS 4
PS 4	Wellstead	Westlands- 6B BSP 4	[F]Poison only	Unsterilised	800	34	Dry pasture		11/N	UPS 4
PS 5	Wellstead	Gnowellen- #5 BSP 5	[F]Poison only	Unsterilised	700	93	Barley stubble		8/Y	UPS 4/UPT 4[G]
PS 6	Boxwood Hill	Hick- BSY BSP 6	[E]Poison only	Sterilised	800	74	Canola stubble		9/Y	UPS 1/UPT 2[G]
Trails:										
UPT 1	Boxwood Hill	Hick- CBH UT 1	[E]Unpoisoned oat trail	Sterilised	1200	115	Barley stubble	21/3		
PT 1	Boxwood Hill	Hick- Back Left PT 1	[E]Poison trail	Sterilised	1250	51	Dry pasture			UPT 1/UPT 2[G]
PT 2	Boxwood Hill	Hick- Back Right PT 2	[E]Poison trail	Sterilised	700	240	Dry pasture			UPT 1/UPT 2[G]
UPT 2	Boxwood Hill	Ford- E4 UT 2	[E]Unpoisoned oat trail	Sterilised	1600	40	Dry pasture			
UPT 3	Boxwood Hill	Parsons- Marra UPT 3	[E]Unpoisoned oat trail	Sterilised	950	50	Canola stubble			
PT 3	Boxwood Hill	Parsons- Swamp PT 3	[E]Poison trail	Sterilised	1000	60	Lupin stubble			UPT 3
UPT 4	Wellstead	Gnowellen- #8 SW UPT 4	[F]Unpoisoned oat trail	Unsterilised	1000	42	Dry pasture			
PT 4	Wellstead	Gnowellen- #8 NE PT 4	[F]Poison trail	Unsterilised	600	88	Dry pasture			UPT 4/UPT5
PT 5	Wellstead	Gnowellen- #8 NW PT 5	[F]Poison trail	Unsterilised	800	44	Dry pasture			UPT 4/UPT5
UPT 5	Wellstead	Kirton # 28 UPT 5	[F]Unpoisoned oat trail	Unsterilised	750	33	Dry pasture			

A: Filler oats in the bait mixes were either gamma-sterilised or unsterilised.
B: The length of the baited 'area', and the permanent transect used for the spotlight counts.
C: The date where some rabbits were observed with myxomatosis on site.
D: Bait stations enclosed with ring-lock wire netting to exclude domestic livestock.
E: Commencement date = 6 February 2001.
F: Commencement date = 13 March 2001.
G: Indicates the closest site where these were not directly adjacent to the same paddock.

UPS = Unpoisoned Station
PS = Poisoned Station
UPT = Unpoisoned Trail
PT = Poisoned Trail
* = Paddock unavailable for the poisoning phase.
Y = Yes; N = No

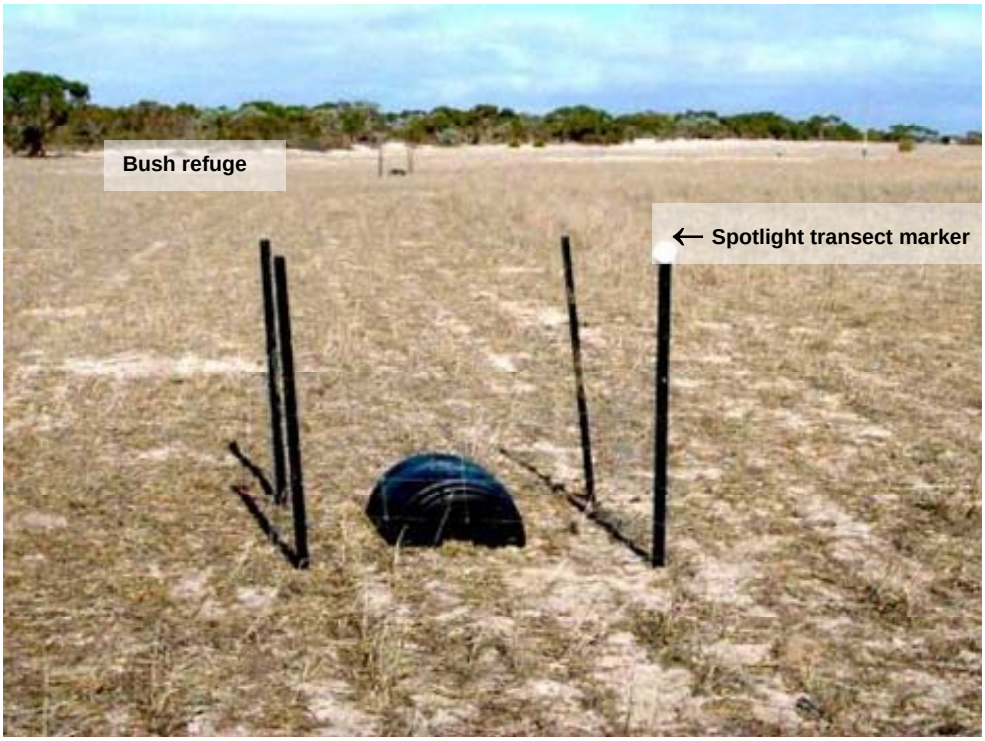


Fig. 1(a): *Bait station layout with and without the ring-lock fencing to exclude livestock and kangaroos, with the bush refuge rabbit harbour shown for some study sites at Boxwood Hill/Wellstead. Note the sandy substrate.*

Fig. 1(b): *A bait station with ring-lock fencing situated in very sandy substrate at Boxwood Hill/Wellstead. Bait station design is also shown where most of the bait had been consumed. The small amount of spilt bait was retrieved before weighing.*

Initially, a 'digs' index was also used to estimate changes in rabbit activity (i.e. potential damage; see Twigg *et al.* 2001) in the treatment and non-treatment areas. A 200 m transect, where rabbit activity could be easily identified, was selected at random adjacent to each of the spotlight transects. After filling in all digs, 'fresh digs' on these transects were recorded for 3 consecutive mornings. However, this index was abandoned after several attempts because we were not able to obtain reliable data due to the very sandy nature of the soils, the very low amount of dry vegetation present, and the influence of the strong winds that often occur in this area during the summer drought (see Fig. 1).

A formal record of the associated material costs and labour involved in the installation and maintenance was kept for both the bait stations and trail baiting.

The bait mixes used at some sites were made with gamma-sterilised filler oats (n = 11), but because of the cost associated with this, the filler oats used for the remaining sites were not sterilised with gamma irradiation (n = 9; Table 1). Therefore, the acceptability of gamma-sterilised and unsterilised oats to rabbits was determined using four matched sets of bait stations; 1 set at Boxwood Hill, 3 sets at Wellstead. The consumption of the sterilised and unsterilised oats from these sets was monitored for 22 days in an identical fashion to that described above.

RESULTS

Consumption of sterile versus unsterilised filler oats

Although there was considerable variation in the consumption of sterilised and unsterilised oats by rabbits at the different sites, there was no difference in the overall consumption of these oats by wild rabbits (n = 4; paired, two-tailed t-test, t = 2.82, $p > 0.05$). Overall mean cumulative consumption of sterilised and unsterilised oats after 22 days was: 1,696 ± s.d. 873 g and 1,103 ± 1,171 g per station respectively. Although we recognise that sample sizes were small (n = 4), it is extremely unlikely that the type of filler oats used during our trials influenced the consumption of the poisoned and unpoisoned oat mixes by rabbits. Furthermore, both types of filler oats were used in the bait station and the trail treatments (Table 1).

Efficacy of trails and bait stations

The changes in rabbit numbers, with and without the presence of poison bait, are shown in Figs. 2 & 3. With the exception of one site where the presence of active myxomatosis corresponded with an associated decline in rabbit numbers between Days 21-34 (UPT 1; Fig. 2), rabbit numbers did not change appreciably on the 'null' treatment sites (i.e. those with unpoisoned oats). This was irrespective of whether unpoisoned grain was offered as a trail, or in bait stations (Figs. 2 & 3). The mean number of rabbits on the null treatment sites was similar between the four census periods from 0 to 21 days (Table 2); that is, the changes in rabbit numbers over time on these sites were not significant (F = 0.44, P = 0.723, df = 3, 33).

In contrast, however, rabbit numbers declined in the presence of poison bait, with the maximum reductions occurring with the poison trails. The mean percentage reductions relative to rabbit numbers at Day 0 (pre-counts) for the three poison treatments are given in Table 2. Those bait station sites where rabbit numbers actually increased (i.e. negative decrease) have been set to a zero decrease in these data. With trails, the mean reduction in rabbit numbers was 72.2% by Day 7 and 84.0% at Day 14. The percentage reductions achieved with trails appeared to asymptote by Day 7-14 (Fig. 2). This time period actually represents a slightly longer period than this because the three-night spotlight counts commenced on Day 7 and Day 14 after the 'bait' was in place (i.e. they cover Days 7-9 and Days 14-16 after 'baiting').

The percentage reductions achieved with trails were significantly greater than that achieved with bait stations where pre-feed oats were not provided, for both the Day 7 (F = 3.98, P = 0.009, df = 2,13; Tukey HSD post hoc test, P = 0.009) and the Day 14 (F = 4.26, P = 0.008, df = 2,11; Tukey HSD post hoc test, P = 0.008) post-baiting censuses. However, the reductions achieved using the pre-feed and no pre-feed bait station treatments were not statistically different (Day 7, Tukey HSD, P = 0.317; Day 14, Tukey HSD, P = 0.335). Although the reductions achieved by bait stations with pre-feed were less than

those achieved with trail baiting (Table 2; Figs. 2 and 3), these differences were not significant (Day 7, Tukey HSD, $P = 0.244$; Day 14, Tukey HSD, $P = 0.144$). However, caution should be used when interpreting these analyses because of the small sample sizes available for some treatments. For example, there were 3 sites only with the pre-feed treatment. Despite this, it appears that the exposure of rabbits to unpoisoned oats for around 21 days prior to adding the 1080 One-shot oat mix seemed to improve the efficacy obtained with these bait stations (Table 2; Fig. 3).

Patterns of bait take from bait stations

The cumulative take of poisoned and unpoisoned oats by free-ranging wild rabbits for the bait station treatments is presented in Fig. 4. There was a linear increase in the consumption of unpoisoned oats with time, and this had not reached an asymptote by Day 21. However, bait consumption from these stations decreased considerably once the 1080 One-shot oats were added. Relative to the consumption of unpoisoned oats, considerably less poison bait was consumed at all sites which received the 1080 One-shot mix, irrespective of whether pre-feed was provided or not. The patterns with the poisoned oat-only sites were less clear, but bait take often appeared to start to plateau by between 5 and 25 days (Fig. 4).

Table 2: *Changes in mean rabbit numbers on the 'null' treatment, unpoisoned oat sites, and the mean percentage decrease in rabbit numbers on the poisoned sites relative to rabbit numbers at the pre-treatment (Day 0) counts at Boxwood Hill and Wellstead in the southern agricultural region of Western Australia.*

Rabbit numbers have been standardised to rabbits km^{-1}.

Treatment	Time period	Mean	*s.d.*	*n*
Without 1080 One-shot oats:	**Rabbit numbers per km**			
(Unpoisoned oats used)	Day 0	73.0	39.7	9
	Day 7	63.2	29.0	9
	Day 14	72.3	38.1	8
	Day 21	85.7	52.2	8
With 1080 One-shot oats:	**% decrease relative to Day 0**			
Stations without pre-feed:	Day 7	30.2	21.1	6
	Day 14	31.4	23.3	6
Stations with pre-feed:	Day 7	52.6	9.6	3
	Day 14	56.7	17.3	3
Trails:	Day 7	72.2	17.3	5
	Day 14	84.0	9.9	3

Fig. 2: *Changes in rabbit numbers with (a) 1080 One-shot oat and (b) unpoisoned oat trails on individual sites at Boxwood Hill and Wellstead in the southern agricultural region of Western Australia.*

Rabbit numbers are based on the maximum number seen during spotlight counts over three consecutive nights for each census period, standardised to rabbits km^{-1}. Pre-treatment counts were undertaken 4-5 days before 'bait' was laid. Abbreviations are as per Table 1. M, Myxomatosis seen on site.

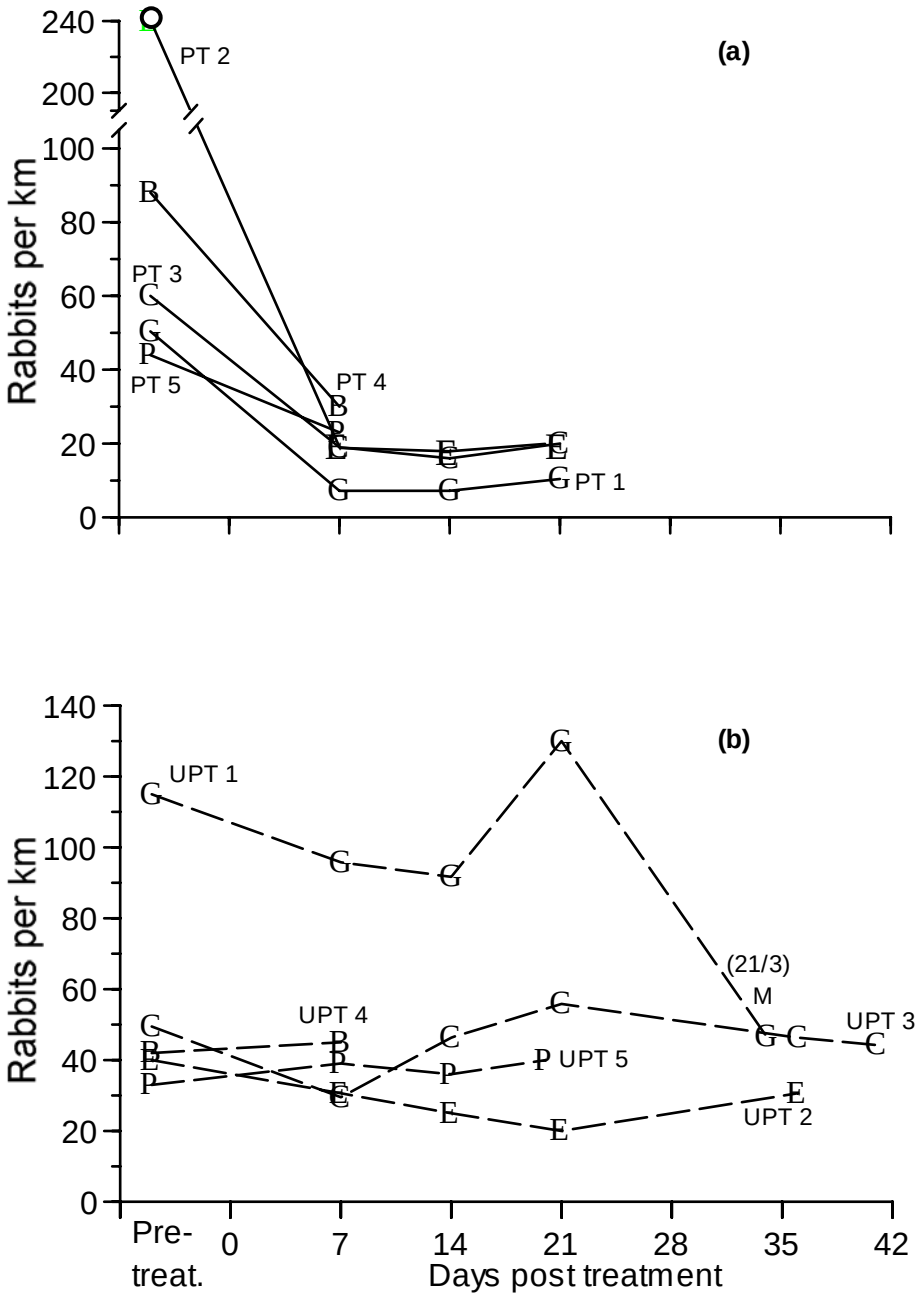


Fig. 3: *Changes in rabbit numbers after 1080 One-shot oats(filled bars) and unpoisoned oats(clear bars) were offered in bait stations on individual sites at Boxwood Hill and Wellstead. Pre-feed (unpoisoned oats) was provided for approximately 3 weeks before the 1080 One-shot oat mix was added to the stations on some sites.*

Rabbit numbers are based on the maximum number seen during spotlight counts over three consecutive nights for each census period, standardised to rabbits km^{-1}. Pre-treatment counts were undertaken 4-5 days before bait stations were loaded. Abbreviations are as per Table 1. *, Addition of pre-feed oats (unpoisoned oats); ⬇, Addition of 1080 One-shot oats; ↓, Unpoisoned oats replaced with 1080 One-shot oats; M, Myxomatosis seen on site; A, Timing of these censuses needed to be varied from 29-34 days after baiting due to the logistics of establishing the second study area (i.e. Wellstead).

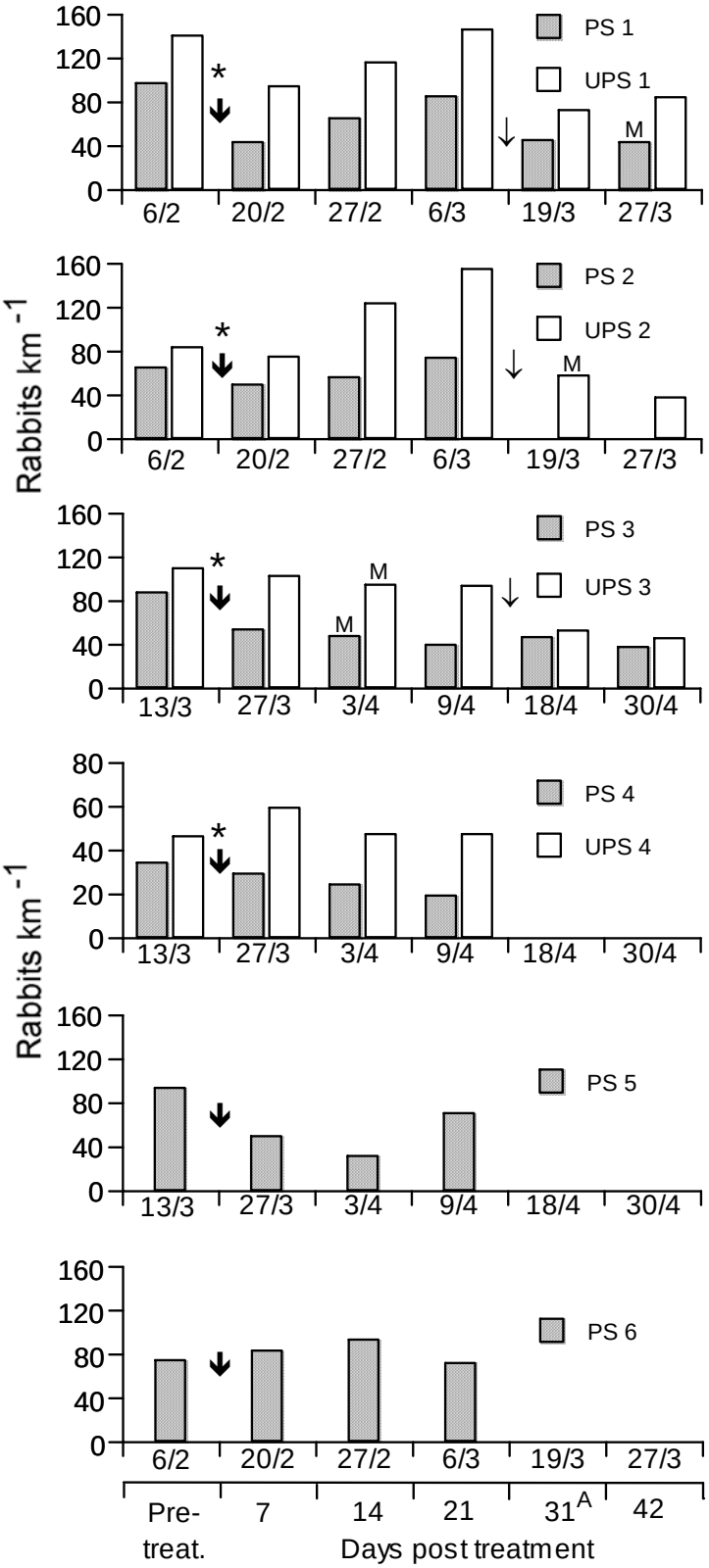
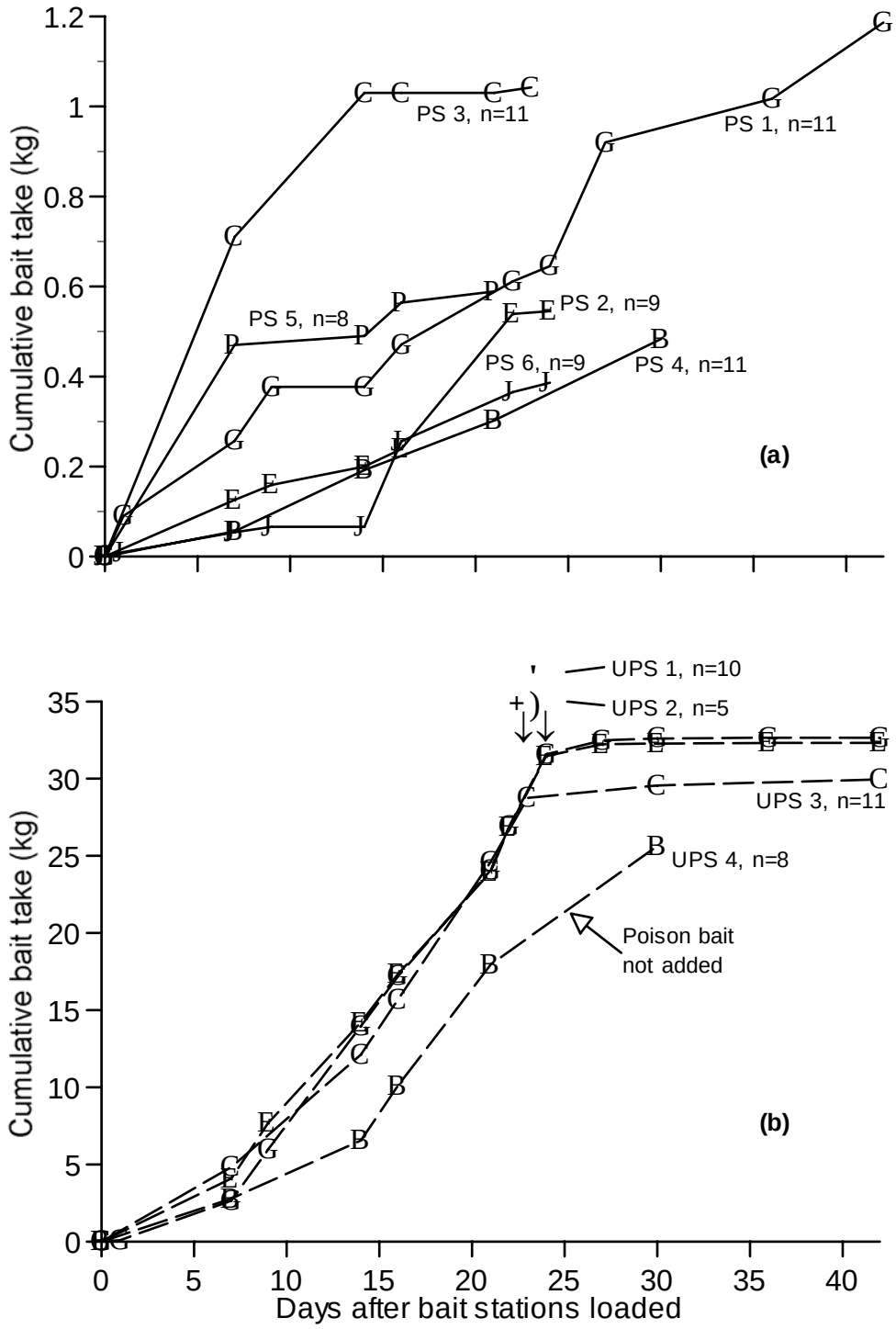


Fig. 4: *Patterns in cumulative bait take (kg) from bait stations without (a) and with (b) the provision of pre-feed (unpoisoned oats) for individual sites at Boxwood Hill and Wellstead. As appropriate, bait stations were loaded with either 1 kg of poisoned or unpoisoned oats on Day 0, and then topped up as required.*

Abbreviations as per Table 1. Like symbols represent a 'matched set'. The number of bait stations (*n*) used on each site is also shown. ↓, Unpoisoned oats replaced with 1080 One-shot oats around Day 21.



Associated costs

The tabulated costs associated with the three treatments used in our trials are presented in Table 3. Some explanation of the derivation of these figures is required. The cost of the poison bait used was the current retail price (2001 Au$) for the Department of Agriculture, WA 6 kg pack, ready-to-use 1080 One-shot oat product ($44 per pack), although this product is only currently available as a 0.5% mix. We used a 1% mix because this is what is recommended for coastal areas in southern Western Australia. Two weeks were allowed for the pre-feed period, and bait stations were assumed to have run for 4 weeks with the 1080 One-shot mix. The plain, export grade oats (limits the potential for weed contamination) used as the pre-feed was priced at $10 per 40 kg bag. There were 10 bait stations per km of rabbit-infested area. The baiting rates were 1 kg station^{-1} week^{-1} for pre-feed, and 1 kg station^{-1} 4 weeks^{-1} for the 1080 One-shot bait. Labour was allowed at $20 h^{-1}, and a $5 h^{-1} vehicle running cost component was included (landholders generally already have a vehicle on farm so we did not include the full cost of acquiring and running a vehicle). Bait trails were laid at 6 kg km^{-1}, with three parallel trails laid (i.e. 3 x 6 kg km^{-1}). Crop yields were based on the average production returns for the Boxwood Hill/Wellstead area.

Based upon these assumptions, trail baiting, with either two or three parallel trails, was the cheapest control option and bait stations with pre-feed the dearest (Table 3).

Table 3: *The costs associated with the three treatments used to control rabbits over a 1 km rabbit infested area[A] at the Boxwood Hill and Wellstead sites in the southern agricultural region of Western Australia.*

		Assumed unit cost (2001 Au$)			
			Bait stations (n = 10)		
Item		**Trail**	**With pre-feed**	**Without pre-feed**	**Explanation**
Materials:	Stations		120	120	$10 per half drum, $2 per saucer.
	Ring-lock fencing		200	200	Steel posts 4 x $3.50, Ring-lock $6.
	Pre-feed oats		5		20 kg x $0.25.
	1% One-shot mix	132	88	88	trail: 3 x 6 kg packs x $44. stations: 10 kg needed, 2 x 6 kg packs x $44 used.
Labour:	Set-up phase	25	75	75	$20 h^{-1} plus $5 h^{-1} vehicle.
	Maintenance:- Pre-feed phase		150		3 h week^{-1} for 2 weeks x $25 h^{-1}.
	Maintenance:- Poison phase		100	100	1 h week^{-1} for 4 weeks x $25 h^{-1}.
Total Cost:	With new stations	157[B]	738	583	
	Stations reused	113[C]	418	263	

Expected gross returns[A]		**Yield**	**$ tonne^{-1}**	**$ ha^{-1}**	**$ 15 ha^{-1}**	**Profit ratio(%)[D]**
(2001 Au$)	Canola	1.2 t ha^{-1}	400	480	7,200	55
	Barley	1.5 t ha^{-1}	170	255	3,825	50
	Wool	230 $ ha^{-1}	-	230	3,450	38

A, The assumed area protected by a baiting program is 1000 x 150 m or 15 ha.
B, With three parallel trails used.
C, With two parallel trails used.
D, The estimated proportion of gross returns that would be net profit after allowing for production costs (excludes any rabbit control).

TASKS NOT COMPLETED

1. We were unable to estimate changes in rabbit damage with and without treatment because, despite several attempts, we were not able get reliable data on the changes in the digging activity of rabbits (i.e. 'digs' index). This was due to the very sandy nature of the soils, together with the absence of a suitable amount of dry vegetation cover (see Fig. 1), and the impact of the strong winds at the sites. However, the associated costs of each technique have been tabulated, and this enables some estimate of the likely economic benefits of using each baiting technique (see Table 3).

2. The extension strategy has not been fully implemented at this stage. While a number of people have been verbally advised of project outcomes (e.g. Agency staff, some landholders), the associated Farmnote is yet to be finalised and distributed. We also plan to include some of the information on bait station design contained in Twigg *et al.* 2001 in this Farmnote. A copy of the Draft Farmnote is included in Appendix 1, and the final copy of this will be forwarded to BRS in due course. A manuscript describing this work will be submitted to Wildlife Research by October 2001.

DISCUSSION

Efficacy of trails and bait stations

The percentage reductions in rabbit numbers obtained with the 1080 One-shot bait trails during our study (mean, 84% within 14 days) were similar to those reported previously for rabbit control programs in the south-west agricultural region of Western Australia. Mean reductions in rabbit numbers during these former control programs over the summer/autumn drought ranged from 72% to 88% within 10 to 21 days (Oliver *et al.* 1982). Similar to our study, Oliver *et al.* (1982) also found little increase in the kill rates with One-shot trail baiting after rabbits had been exposed to the trails for more than 10 days. This supports the notion that maximum kill rates with 1080 bait trails are usually achieved within 8-12 days (Oliver *et al.* 1982; Williams *et al.* 1995; Our study). However, mean rates of kill with 1080 One-shot can be as low as 50% during the wet winter months, and this has been attributed to the leaching of the water soluble 1080 from the oat bait (Oliver *et al.* 1982; Wheeler and Oliver 1978).

In contrast to trail baiting, and irrespective of whether pre-feed was used, the efficacy of 1080 One-shot oats presented in bait stations for broadacre control of rabbits was considerably less than (mean reductions of 31% to 57%) that which was achieved in the same region using One-shot bait trails. This result is similar to that obtained for 1080 One-shot in bait stations (drums and tyres) for this region in 1996, where the reduction in rabbit numbers ranged from 34%-67% after 25 days (Twigg *et al.* 2001). Low and variable rates of kill have also been recorded where pindone impregnated oats (0.025% bait mix) have been used in bait stations to control urban rabbits with reductions in rabbit numbers ranging from 0% to 80% over 30-60 days (mean 47.9% ± *s.d.* 32.2%; $n = 13$; Twigg *et al.* 2001).

There are several possible reasons for the low and variable efficacy achieved with bait stations. The most likely reason is that, despite suggestions to the contrary (see Twigg *et al.* 2001), relatively large proportions of some rabbit populations are reluctant to enter bait stations, and this neophobia does not change even with the possible removal of dominant rabbits during baiting. Neophobia in this context is used in its original meaning: 'the avoidance of an unfamiliar object in a familiar place' (Barnett 1958; Oliver *et al.* 1982). This is different to bait-shyness which is an acquired/conditioned aversion resulting from the ingestion of a food item that causes illness (Barnett and Cowan 1976; Oliver *et al.* 1982; Hickling 1994). Neophobia has been suggested as a possible reason for the variable efficacy sometimes seen with 1080 trail baiting, as some rabbits may not take bait even when it is presented properly with pre-feeding, and the furrow passed through their territory (Rowley 1957; Poole 1963). Bait stations are less 'natural', and relatively bulky items compared to a bait furrow, and may therefore induce a greater neophobic response. Support for this is seen in the patterns of bait take we observed. With the pre-feed bait station treatment, take of the unpoisoned oats increased linearly until the 1080 One-shot bait was added; bait take then quickly reached an asymptote thereafter. When this bait-take pattern is considered together with the observation that a considerable number of rabbits were still present on these sites, then this suggests that those rabbits which were prepared to enter a station had done so during the pre-feed phase, and that they were not replaced by other rabbits once the original rabbits that fed at the bait stations had been killed. Rabbits are generally able to modify their home range and social status relatively quickly (within days) after a major catastrophic event (Poole 1963).

Poole (1963) suggested that bait stations would be of limited value in rabbit control programs where groups of rabbits have well defined and strongly defended territories (e.g. during the breeding season). This was because such behaviour is likely to restrict the access of some rabbits to bait. It is therefore possible that the 80-100 m spacing used between the bait stations in our study was too great to allow all rabbits ready access to bait. However, for the following reasons, we do not believe this was the case during our study. 1) The trials were undertaken during the summer/autumn drought when territorial

behaviour is at its lowest, as this period is outside the breeding season of these rabbits (Twigg *et al.* 1998). Further, the levels of pasture biomass were particularly low during our trials, which necessitated long distance movements by our rabbits to their feeding areas. Rabbits in this region are known to move up to 200 m within an existing home range (Twigg *et al.* 1998). 2) If bait station spacing affected the observed efficacy during our trails, then the spatial distribution of the rabbits seen along the spotlight transects would be expected to be patchy. This was not the case, as our rabbits were generally uniformly spaced along these transects. 3) The spacing between bait stations during earlier trials with pindone and urban rabbits was around 30 m, and yet these stations were generally ineffective in reducing rabbit numbers. That study also tested several bait station designs, particularly the use of the drum and a raised concrete slab (see Twigg *et al.* 2001). For these reasons, we now believe that the relatively poor efficacy experienced with bait stations is due to the reluctance of a relatively large proportion of rabbits to enter the bait stations *per se*, rather than any potential effect of the variable spacing used between individual bait stations. If stations are to be used for broadacre control of rabbits, then we recommend that the maximum spacing should not be more than 100 m, and this distance should probably be less than this (e.g. 50 m) if bait stations are to be used during the breeding season.

The inclusion of a pre-feed period into the standard trail baiting technique where all pieces/grains of bait contain a small amount of 1080 during rabbit control programs often leads to an improved overall efficacy (known as 'conventional' rabbit baiting; Gooding and Harrison 1964; Oliver *et al.* 1982; Williams *et al.* 1995). Conventional trail baiting techniques for rabbits usually give slightly higher kill rates than those often achieved with the 1080 One-shot technique where the pre-feed and poison bait is offered simultaneously in a single trail (Oliver *et. al.* 1982). However, when relatively large areas need to be baited, the improved benefit cost ratio of the One-shot baiting technique makes it a more cost-effective option overall (Gooding and Harrison 1964; Oliver *et. al.* 1982). Our data indicate that a pre-feed period should also be used with bait stations, as this will result in improved overall effectiveness (31% vs 57% mean reductions, without and with pre-feed, respectively), and we recommend a pre-feed period with unpoisoned bait material of at least 2 weeks. This period is consistent with that recommended for conventional rabbit control programs (Williams *et al.* 1995), and is similar to the 2-3 week pre-feed period recommended for possum (*Trichosurus vulpecula*) control programs in New Zealand which utilise 1080 (Spurr 1994). Bait stations must be kept adequately loaded during the pre-feed period, however.

Two different bait mix ratios are recommended for the use of the 1080 One-shot product in WA; a 0.5% and a 1.0% mix. This represents the ratio of poisoned to unpoisoned (filler) oats. Each poison oat contains the same amount of 1080 (4.5 mg per oat) irrespective of the mix ratio. The efficacy obtained with the two mix ratios is similar (Gooding and Harrison 1964; Oliver *et al.* 1982). However, the use of the 1.0% mix is generally restricted to areas on the south coast WA where the sandy soils (wind can bury some bait) and the occurrence of unpredictable summer rainfall can make baiting campaigns difficult. The use of the 1.0% mix enables some compensation for these adverse conditions as more poison-oats are present in the bait trail. We tested only the 1.0% mix during our current bait station trails, however, we do not believe the results we obtained would have been any different had we used a 0.5% bait mix. The percentage reductions achieved in our study area during preliminary trials in 1996 with bait stations and a 0.5% 1080 One-shot mix ranged from 34% to 67% (Twigg *et al.* 2001) which is similar to those obtained during the current study (Table 2).

Gamma-sterilisation of the oats used to prepare the ready-to-lay bait mix did not decrease the acceptability of these oats as food items to free-ranging wild rabbits. Thus, although it does add to the cost of production, routine gamma-sterilisation of the grain used to manufacture whole grain bait products should continue as this will reduce the possibility of spreading weeds with these bait products. It will also prevent the undesirable germination of the grain used in these products, which is particularly relevant to areas of conservation concern.

Associated costs

Based on the cost of applying and maintaining each treatment, and on their associated efficacy, trail baiting was by far the most cost-effective method for the broadacre control of rabbits (see Table 3). Trail baiting with 3 parallel trails cost around $157 per km of rabbit infested area controlled while the cost of

using bait stations over a similar area was $738 with and $583 without the use of pre-feed. This reduces to $113 if only two parallel trails are used, and to $418 and $263 once the initial cost of purchasing the materials for the bait stations is discounted (Table 3). However, we recommend against using the no pre-feed option as higher kill rates should be obtained with the pre-feed option. Because we were not able to directly measure the reduction in the damage caused by rabbits, these comparisons assume that the relationship between the rabbit damage and rabbit numbers was similar between the three treatments. While this relationship may not be linear, it is very unlikely that it will vary between the sites used in our study.

Most of the additional cost associated with the use of bait stations was the labour component associated with the lengthy period over which the stations needed to be serviced and maintained. The potential for a localised impact on rabbit numbers only with bait stations is of equal importance when assessing the overall merits of using bait stations for broadacre control of rabbits. In reality, even if the number of stations used was increased considerably, it is difficult to envisage how the use of bait stations could compete with the efficacy and cost effectiveness obtained with a well-planned and executed trail or bait-broadcast baiting program (also see Poole 1963). However, three possible advantages of using bait stations would be: 1) the ability to help control rabbits over the summer/autumn drought and still be able to manage the often scarce water resources for domestic livestock over this period (see below); 2) the protection of bait from adverse weather; and 3) the ability to possibly reduce any potential risks to non-target wildlife. In contrast, the relatively poor efficacy obtained with bait stations suggests that any overall benefits arising from their use for broadacre control of rabbits are, at best, likely to be marginal.

Management implications

It is difficult to say whether the poor efficacy we achieved with bait stations would ultimately lead to the selection of rabbits which are neophobic towards these stations. If the neophobia is against the bait station *per se* and not the poison bait used, then trail baiting should still kill most remaining rabbits. In addition, other forms of mortality, such as myxomatosis and Rabbit Calicivirus Disease (RCD), should be acting as mortality factors which are independent of any bait station neophobia, and should therefore remove rabbits which are neophobic towards bait stations from a population at the same frequency that these diseases remove other rabbits. We recommend, therefore, that bait stations should only be used in broadacre rabbit control programs where they can form part of an integrated approach. That is, they are best used to augment other control options rather than constituting the main option during a control program. 1080 bait stations have been utilised successfully in this way during control programs against introduced possums in New Zealand (Morgan 1994; Spurr 1994).

The use of bait stations alone is unlikely to provide long-term, cost-effective mitigation from rabbit damage. However, their use over the summer drought period in areas where some control of rabbits is required (e.g. crop damage, soil erosion, tree farms, conservation purposes) but where water resources are scarce, may allow improved management of available water resources and the needs of domestic livestock to be met at this time. This should result in improved overall farm management. If bait stations are to be used in broadacre control exercises, then we recommend that, where possible, their use should be followed up with a trail baiting program. If this is not possible, then the use of bait stations should be integrated with another means of control such as a shooting or trapping program. Bait stations could also be used to 'mop-up' after the impact of an outbreak of myxomatosis or RCD, without the need to remove livestock from affected paddocks. However, the use of bait stations is probably most applicable where rabbit numbers are relatively low; that is, rabbit density is likely to have some impact on the effectiveness or otherwise of bait stations.

The length of time required for bait stations to reduce rabbit numbers (and hence damage) is of concern, particularly where high valued crops are involved (also see Twigg *et al.* 2001). Considerable damage is likely to occur during this period, and where efficacy is poor, a considerable number of rabbits are likely to remain and continue to inflict crop/pasture damage after the control exercise was thought to be complete. Forward planning will help significantly with the success of any rabbit control program. For example, the ideal time to control rabbits is during periods when alternative food sources are limited. In Mediterranean climates such as in many areas of Australia where rabbits are a problem, this period of food shortage usually occurs over the summer/autumn drought, and rabbit control programs should

coincide with this period (Gooding and Harrison 1964; Oliver *et al.* 1982; Williams *et al.* 1995; Twigg *et al.* 1998). Rabbits often become disinterested in taking poison bait once crops or pastures have emerged after the opening rains, and this aspect of rabbit behaviour will be particularly important when planning the use of bait stations.

Given the poor bait station efficacy we observed, the effectiveness of these stations should not be determined based on the visitation rates by rabbits, or the bait consumed from the stations, as this will clearly lead to an over-estimate of efficacy. Some independent measure of rabbit abundance should be used instead. For example, spotlight counts, active warrens counts, counts at dusk, damage estimates, and track counts could all be used as independent measures of rabbit abundance (see Williams *et al.* 1995; Twigg *et al.* 2001).

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Appendix 1: **Draft Farmnote describing the use of bait stations in rabbit control**

Farmnote

Agdex 671

Bait stations and rabbit control

Laurie Twigg and Tim Lowe, Vertebrate Pest Research Section, Forrestfield

Why are 'conventional' control techniques still required?

Biological control agents such as the myxoma virus (myxomatosis), and Rabbit Calicivirus Disease (RCD), will not provide 'magic bullets' for reducing the impact of rabbits on agricultural production and the environment. Such agents will be much more effective if they form part of an integrated approach to your rabbit control programs. An integrated approach needs to be able to utilise all available control options, including biological control, the use of vertebrate pesticides (e.g. 1080, Pindone), shooting and trapping programs. Control programs are most effective when they include the greatest number of properties possible (i.e. your neighbours).

Why do we need bait stations?

While the use of suitably approved poisons (e.g. 1080, Pindone) is an acceptable method for reducing the impact of rabbits, the use of such pesticides is undergoing ever closer scrutiny. Bait stations provide one means by which potential risks to non-target species may be further reduced. Once properly secured and isolated, bait stations may also enable baiting programs to be undertaken in the presence of domestic livestock, and during adverse weather conditions.

What type is best?

The acceptability of a number of different bait station designs to urban and free-ranging wild rabbits has been examined. The raised concrete slab (60x60 cm, on house bricks) and the drum (200 litre drum cut in half longitudinally, with rabbit access holes each end) designs were the most acceptable to rabbits. However, the slab design allowed far greater access to the bait by non-target animals, particularly granivorous birds, so we do not recommend its use. The drum station (Figs. 1 & 2) is the best design if you need to use bait stations for controlling rabbits. *However, trail baiting should be your first choice for baiting programs where possible because bait trails are much more effective in reducing rabbit numbers.*

How to use bait stations effectively

Depending upon the size of the area where rabbits are to be controlled, the spacing between individual stations should not be more than 30 m (urban use) to 100 m (broadacre). These distances may need to be reduced if the stations are to be used during periods when rabbits have well defined territories, such as during the breeding season. The stations should be placed within known rabbit feeding areas, around 20-30 m away from the areas where the rabbits reside (e.g. obvious warrens, bush/scrub refuge). If non-target animals such as kangaroos are known or suspected to be present, enclose each bait station with ring-lock wire-netting so that large animals are excluded (1.5 x 1.5 m; Fig. 2). Do not place bait stations in areas where small native animals (e.g. bandicoots) are likely to be present. Bait stations can also be made more secure by running wire straps over the stations which are then pegged to the ground.

To ensure maximum effectiveness, a pre-feed period must be used with bait stations. This involves the provision of unpoisoned plain oats in the stations for at least 2 weeks before adding the poison bait. Check the stations regularly (every 2-3 days) and make sure that adequate pre-feed is always available. This allows the rabbits to become accustomed to the stations, and ensures that the maximum number of rabbits will feed at the stations once the poison bait is added. Remember to remove any remaining pre-feed before adding the poison bait.

The best method for applying bait is to place 1 kg of plain or poison oats on plastic saucers (30-40 cm dia.) within the stations. This enables easy monitoring of bait take, and reduces the potential for the bait to become scattered outside the stations. Also place half a house-brick in the centre of the saucers as this prevents rabbits from sitting in the bait, and from moving the saucers. Scattering some unpoisoned oats outside the stations will also help to attract the rabbits. The 1 kg of bait should last for up to 4 weeks for the One-shot and around 2-3 days for the pre-feed, depending upon rabbit densities. But you must check the stations frequently to ensure sufficient bait is always present. *The poisoning phase should not last for more than 4 weeks.* If you still wish to continue with the bait stations in a particular area, then leave the stations empty for 1 week and then repeat the above procedure. *Do not leave the stations permanently loaded with poison bait,* because this is likely to increase the possible development of resistance to the poison used.

Which poison?

Either Pindone or 1080 poisoned oats can be used, and a ready-to-use bait is available for both products from a variety of licensed retailers in WA. Pindone is a chronic acting anticoagulant poison which requires the poison to be ingested over several feeds to be effective. In contrast, 1080 is an acute poison which interferes with energy production within cells, and only requires a single exposure to the poison. 1080 is highly water soluble so it can leach from baits during rainy periods. There are both water insoluble and water soluble types of Pindone bait available. Permits/authorisation are required for some of these products, and these can be obtained through your local Department of Agriculture office. Because of the lack of an effective antidote, 1080 cannot be used in built-up areas as there is a greater potential risk to humans and pets.

How effective are bait stations?

1) Against urban rabbits

Because 1080 cannot be used in or around built-up areas, Pindone is the only pesticide available for use in these situations. However, reductions in rabbit numbers achieved with Pindone in bait stations can be highly variable and may have little effect, or may achieve kills of up to 80%. The average reduction in numbers is usually around 50%. More importantly, it can take rabbits a considerable period to become accustomed to the stations, and it may take 30-60 days for any noticeable reduction in numbers. Thus good forward planning is required to ensure you gain the maximum benefit from any bait station program. You should be pro-active and undertake your rabbit control program before planting/sowing, particularly with crops of high value (e.g. market gardens, horticultural crops). Also remember that the bait stations alone may not necessarily alleviate your rabbit problem and other control measures may need to be undertaken (e.g. trapping, shooting). Although the initial cost outlay for rabbit-proofing your boundary fences with wire-netting may be high (ca. $1600 per km), this will provide a better long-term and cost-effective solution to many rabbit problems in urban areas.

2) Broadacre use

The use of bait stations alone is unlikely to provide long-term, cost-effective mitigation from rabbit damage in broadacre situations. If bait stations are to be used for broadacre rabbit control, their use

Fig. 2: A bait station using a half 200 litre drum with rabbit access holes at each end, and ring-lock to exclude livestock and kangaroos.

should be followed up with a trail baiting program where possible. If this cannot be done, then the use of bait stations should be integrated with another means of control, such as a shooting program. Bait stations will probably work best where rabbit numbers are low to moderate (< 50 per spotlight km).

The known reductions in rabbit numbers using 1080 One-shot oats in bait stations for broadacre control of rabbits vary from 34%-67% with an average of around 57% after 14 to 25 days. In contrast, the average reduction with One-shot trail baiting within the same region was around 84% after 14 days. Maximum kill rates with One-shot bait trails are usually achieved within 8-12 days. This illustrates why *trail baiting should be the preferred option wherever possible.*

Cost comparison

Assuming the baiting campaigns are carried out by landholders using the Ready-to-use 1080 One-shot bait product, then the relative comparison of the estimated cost of the two control options is as follows. Trail baiting (3 parallel trails at 6 kg per km per trail) will cost around $160 per km of rabbit infested area controlled. In contrast, the cost of using bait stations in a similar area with a two week pre-feed period and a 4 week poisoning phase is $740 with newly purchased bait stations, and $420 if the stations do not need to be purchased. These estimates include all associated labour costs at $20 per hour, and a $5 per hour nominal vehicle running cost, with 10 stations per km.

When should bait stations be considered?

- Bait stations may offer some solution to the problem of reducing the impact of rabbits in urban situations, such as when rabbits are causing damage to home gardens, horticultural industries and market gardens.
- Provided they are fenced appropriately (see Fig. 2), bait stations can provide a means for reducing the potential risks to non-target species such as kangaroos and granivorous birds. This is particularly relevant to urban areas where Pindone bait needs to be used (e.g. golf courses, parks, market gardens).
- Bait stations can protect the bait if rabbit control needs to be carried out during periods when adverse weather is expected. For example, during the winter months when rainfall is likely. However, *any* rabbit control program is best carried out when other food for rabbits is limited, such as during the summer/autumn period. Wherever possible, it is best to avoid undertaking a baiting program when green feed is available because rabbits are less likely to take bait at this time.
- Broadacre use:- Provided they are secured and isolated from livestock, the use of bait stations during the summer drought period will permit some control of rabbits if the need for rabbit control becomes a high priority (e.g. crop damage, soil erosion, tree farms, conservation purposes) and where paddocks cannot be de-stocked because water resources are limited. However, follow-up control should be undertaken as soon as possible after the bait stations have been used, and/or other means of control should be incorporated in the control program.
- Bait stations could also be considered where rabbit numbers are relatively low, where only small areas need to be baited, and/or as a means for mopping-up after rabbit numbers have been reduced by other means (e.g. RCD, myxomatosis, shooting).

Remember, however, that trail baiting should be your first choice wherever possible.

Further reading

- Farmnote 56/2001 'Options for rabbit control' (Agdex 671).
- Farmnote 111/2000 'Rabbit warren and harbourage destruction' (Agdex 671).
- Farmnote 105/96 'Safe use of 1080 poison' (Agdex 686).
- Farmnote 58/2001 'Landholder use of 1080 One shot rabbit bait' (Agdex 671).

Contact

For further information call your nearest office of the Department of Agriculture of Western Australia or the Vertebrate Pest Research Section, Department of Agriculture of Western Australia [Forrestfield, ph (08) 9366 2300].