NFACP FINAL REPORT

REFINING TARGET SPECIFICITY OF MECHANICAL EJECTORS – ATTRACTANTS AND PRESENTATION METHODS

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Description

Ejectors are a spring–loaded, mechanical device, which contain a small plastic capsule of sodium cyanide. Coated with a foul smelling, canine-specific attractant, ejectors are concealed in the ground. When discovered and pulled, they eject a puff of cyanide into the mouth of the predator. Unconsciousness occurs within 15-30 seconds and the animal dies within two minutes. However, the ejector must be pulled in a vertical direction, with several pounds pressure and by the mouth to be lethal. Ejectors were invented in United States in 1967 to control coyote and wild dogs. Since then they have been used in a number of countries on a range of predators without any serious human health incident.

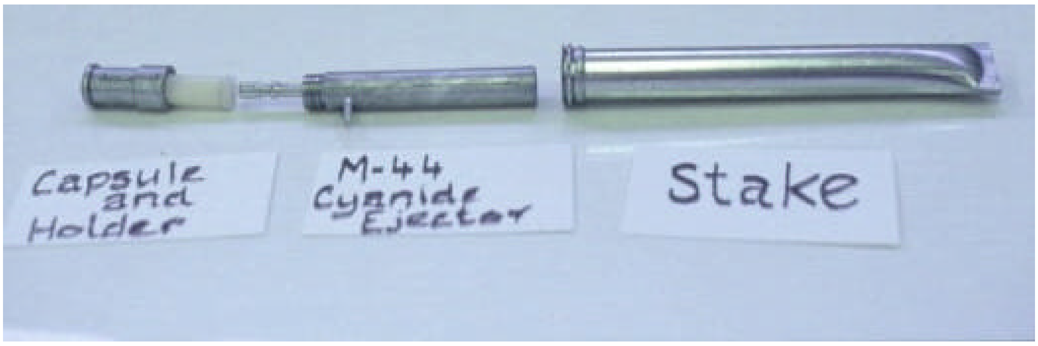

Figure 1 Exploded view of the M-44 cyanide ejector illustrating the stake that is hammered into the ground, the ejector unit (spring-loaded plunger), plastic cyanide capsule and capsule holder.

In a 1999 workshop, participants were invited to consider a range of potential wild dog control methods for the purpose of setting research priorities. Ejectors were recommended for evaluation. The aim of this project was to identify suitable attractants and test deployment methods of ejectors.

Project Objectives

1. Develop and test a range of attractants for "baiting" ejectors for canids and identify what native species are at risk with their use.

2. Compare effectiveness and target specificity of above ground, hidden, collared and buried ejectors.

3. Train and familiarise Land Protection Officers in the use and deployment of ejectors and develop draft operational guidelines for their use.

4. Commence a program of public education on the use and safety of ejectors.

Project location

Field trials were conducted in southeast, southwest and central Queensland including sites as far north as Jericho, Bulloo Downs in the west and Boondall wetlands on the shores of Moreton Bay in Brisbane.

Methodology

During 2000-01, we field-tested eight candidate ejector attractants in six sites across Queensland where either wild dogs and/or foxes were present. Attractants were placed on placebo ejectors (grubstakes) and evaluated for attractiveness (number of target species attracted to the lure), palatability (percentage of animals attracted that bit, chewed or pulled the attractant, Figure 2) and selectivity (number of non-target species biting or pulling the attractant). At three of the trial sites Thargomindah, Mitchell and Maryborough, where the situation was judged to be low risk, attractants were subsequently placed on loaded ejectors and the number of target animals taken on the lures was compared (Figure 3).

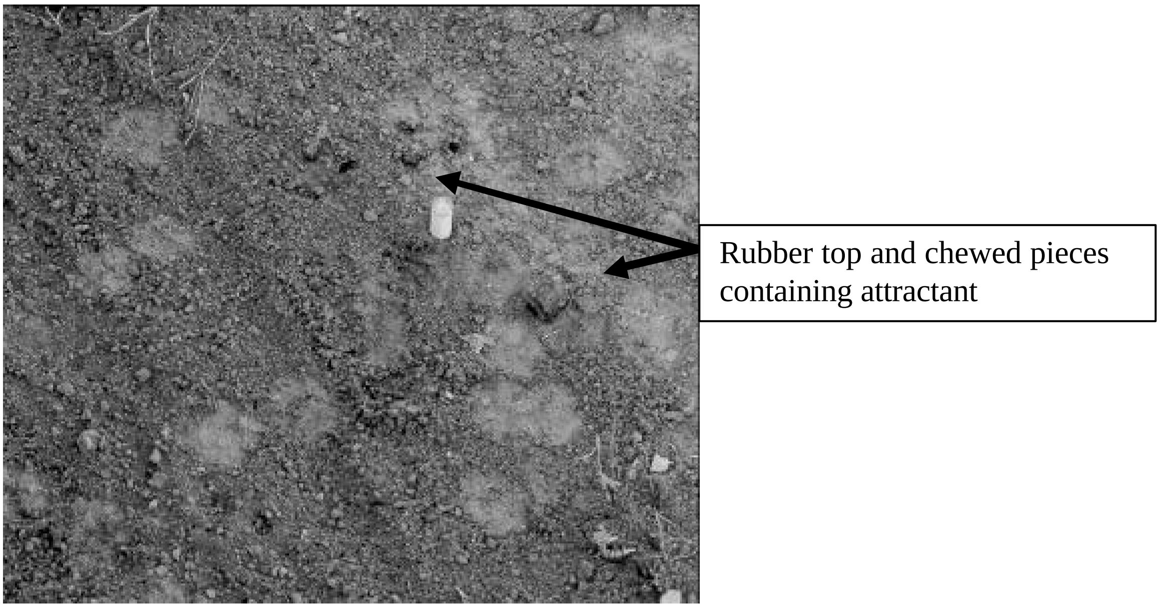

Figure 2 Spoor, detected on a tracking station, shows this grubstake and attractant has been visited and pulled by wild dogs.

In 2001-02, we evaluated different methods of concealing ejectors on non-target discharges to determine whether presentation method reduced or improved ejector performance. Ejectors with identical attractants were placed: on the surface, hidden in grass, in a 100 mm hole or completely buried. A minimum of 500 station nights per method were conducted in field sites near Helidon, Tambo, Springsure, Jericho, Roma, Dunkeld and Mungallala.

Figure 3 Fox victim beside a pulled ejector deployed in a dirt hole set made with 100 mm auger. The top of the pulled ejector is just visible.

Results

Analysis of the field evaluation of eight attractants (ANOVA) shows there are significant site differences (differences in dingo abundance between field sites, $p < 0.001$), attractant differences ($p < 0.001$) and a "day effect" ($p < 0.01$). The day effect shows that day 2 of exposure gets more interactions than days 1, 3 and 4 but there is no interaction between day and attractant indicating all the attractants are showing a similar pattern over time.

Attractiveness

Least Significant Difference calculations rank the attractants as follows:

Table 1 Relative attractiveness of attractants. Least square means of the number of wild dog and fox interactions.

Attractant	LS Means*	LSD rank
Magna Glan	26.5	a
Canine Call	24.7	ab
Salami	23.9	ab
Trails End	22.7	ab
Final Touch	22	ab
Fermented Meat	19.5	bc
Tuna oil	15.7	c
Cooked Beef Liver	13.2	c

* Number of wild dog and fox interactions averaged over six field trials

Ignoring the lack of salami in one of the field trials the LSD is 5.59. All but salami in the top five attractants are commercial products imported from the United States. Their generally superior performance warrants investigation of a broader range of commercial US products for predator management.

Palatability

Table 2 shows the comparison of relative palatability. Again, there is a strong site effect ($p < 0.001$) but a significant attractant effect as well ($p < 0.001$). Standard errors range from 4.28-5.9 giving a pooled value of 4.92 and an approximate LSD value of 14.12. Salami had significantly higher palatability than the others, fermented meat a little more palatable than the rest but less clear differences between the remaining attractants. These data show that there is a critical difference between the attribute of attractiveness and that of palatability. Magna Glan and Canine Call, the two best attractants in respect to attractiveness performed poorly in respect to palatability.

Not surprising, food or food-based attractants were generally more palatable. However, cooked beef liver did not perform well. Inadvertently, we used beef liver instead of lamb's fry. Subsequent advice from our Victorian colleagues suggests that their success with cooked liver on ejectors has been with lamb's fry not beef liver. Liver was more difficult to cook or paint onto grubstakes than any of the attractants tested.

Table 2 **Relative palatability of attractants.** Least square means of the number of wild dog and fox pulls of grubstakes evaluating candidate attractants.

Attractant	LS Mean*	LSD rank
Salami	56.6	a
Fermented Meat	37.5	b
Tuna oil	30.3	bc
Trails End	29.5	bc
Final Touch	29.5	bc
Magna Glan	28.6	bc
Canine Call	20.5	c
Cooked Liver	15.8	c

* Mean number of wild dog and fox pulls weighted for the number of interactions averaged over six field trials

Target Selectivity

Birds, principally corvids and brush turkeys, and goannas were the non-target species most likely to pull grubstakes. Data on the number of "pulls" by non-target species needed to be transformed prior to analysis because of the large residuals. Square root transformation worked well giving an LSD value of 0.84 and showed that salami is significantly more attractive to non-target species than all others tested ($p < 0.001$, Table 3).

Ejector Trials

Analysis of the 61 wild dogs and foxes destroyed in the three trials where loaded ejectors were used shows significant differences between sites; clearly a lot more dingoes killed at Bulloo Downs (n=35). However, there were insufficient data to draw conclusions and no statistical difference between attractants was found ($p = 0.3$). Non-target differences were significant at the 5% level with salami attracting 1.7 non-target species on average compared to less than 1.0 for the other attractants. While nontargets often removed attractants and set-off ejectors at times, no non-target species were killed.

Table 3 Relative target selectivity of attractants

Attractant	LS Mean*	LSD rank
Salami	13.12	a
Trails End	1.28	b
Fermented Meat	0.74	b
Tuna oil	0.55	b
Cooked Liver	0.54	b
Final Touch	0.41	b
Canine Call	0.39	b
Magna Glan	0.16	b

* Transformed mean of non-target species pulling grubstakes averaged over six field trials.

Field trials at Springsure, Tambo, Jericho, Roma, Dunkeld, Mungallala and Helidon evaluating presentation method using salami, kangaroo, emu, fetid meat and Final Touch suggest little is gained in target specificity by concealing or "collaring" ejectors. Birds, goannas and ants prove to be a major problem by removing attractants or pulling ejectors when highly palatable meat or salami attractants are used (Table 4).

Table 4 Results of seven field trials comparing the method of ejector presentation.

	Surface	Concealed	100 mm Hole	Buried
Pulled by Wild Dog	2	0	0	0
Visited by Dog	31	36	23	17
Pulled by Fox	4	5	5	5
Visited by Fox	4	2	1	2
Removed by birds	38	35	17	10
Removed by ants	13	22	16	9

Birds (corvids and brush turkeys) are the biggest problem finding and setting off ejectors containing food-based attractants especially when they are not buried. Once habituated to finding ejectors at bait stations, even buried ejectors, birds are very difficult to avoid although fortunately, no birds were killed with ejectors. Ants gradually consume buried as well as surface-laid meat attractants and goannas seem to be a problem mostly in spring. One goanna was accidentally killed in September 2001 on kangaroo meat attractant on an ejector placed in a hole - the first non-target casualty in thousands of ejector nights. Burying ejectors has problems too. Unlike foxes, wild dogs seem more reluctant to visit or pull buried/collared ejectors and there is an increased difficulty in relocating and servicing buried ejectors even with the aid of a metal detector. If meat-based attractants survive non-target animals for more than a few days, desiccation and subsequent loss of aroma/palatability is a problem with meat and salami in warmer seasons.

Extension Strategy

We have been successful in communicating the objectives and progress of this project through Newsletter (*Beefy and the Beast,* Issues 7-9, Issue 10 will be circulated December 2002), radio interviews (several), Pest Management Workshops (Brisbane, Maryborough, Bunya Mountains, Ebor NPWS and Townsville) and a conference paper (attached). Support and interest has been very good. For instance, Issue 8 of our Newsletter (attached) that we would normally circulate 800 copies had a reprint request from QDPI for a further 500 for circulation to beef producers. In addition, the Director of the Wildlife Preservation Society of Queensland, Jan Oliver, wrote to the Natural Resources Minister supporting ejector research (copy attached).

Perhaps the best gauge of the extension strategy has been the number of unsolicited graziers writing or phoning to volunteer their properties for ejector research.

Because of the low pull rates experienced in 2001-02 we did not proceed to train LPOs to the extent intended or develop draft use guidelines as proposed in our Objectives.

Additional ejector studies still in progress

Capsule Storage

The cyanide content of 10 capsules manufactured in June 1994 and stored at room temperature were compared to 10 capsules that had been taken to field trials. After seven years the cyanide content was 74.8% (SE 5.3, range 51.7-107%[1]) for stored capsules and 65.7% (SE 6.3, range 39.4 -103%) for capsules taken to the field.

Ten cyanide capsules, manufactured in August 2001 and tested in October, contained a mean of 102% (SD14.2%) cyanide. The label claims 91% a.i. sodium cyanide. Capsules are now stored in an airtight Pelican case with desiccant gel and samples of dried 1994 and 2001 capsules are being compared with shelf-stored capsules from these same dates at yearly intervals.

These tests will indicate whether the gradual decay of cyanide from capsules can be arrested. Unfortunately the results of the October 2002 tests are not yet available.

Operator and Non-target Hazard of Cyanide-killed Corpses

Studies on the persistence of cyanide in the tissues of wild dogs killed by ejectors (Amber Hooke, University of Queensland Honours project) are indicating some surprising results. Tissue samples of heart, lung, liver, muscle and blood taken from wild dogs at time 0, 2, 6, 12, 24, 48 and 72 hours after death by ejectors are currently being analysed. Cyanide levels are extremely variable[2] (probably related to varying quantities ingested when the ejector fired) but appear to increase threefold between death and 24 hours in muscle, heart, lung and liver tissues. Testing of the same tissues taken from Lethabarb-killed domestic dogs at identical times showed that cyanide products are not naturally produced in corpses in any relevant quantities. These preliminary data suggest cyanide compounds are concentrated at death but disperse through various organs subsequent to death from ejectors.

Observations made during the pen trials for this project have shown the interval between pulling the ejector and unconsciousness varies with how effectively the capsule contents is expelled into the dog's mouth (Figure 3). While two animals regained consciousness and showed no effect several hours later, most were unconscious within 15 – 30 seconds and died within two to five minutes. Relatively

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[1] Cyanide content >100% suggest slightly more than the nominal 1.0 g of cyanide is contained in the capsule. The range produced in the tests suggests that while many capsules have lost cyanide others retain the quantity expected at manufacture.
[2] These capsules were manufactured August 2001 and stored with desiccant gel.

little stress is apparent after pulling ejectors. Many salivated and tried to expel the cyanide powder, a couple made barely-audible moans and most walked or trotted freely before losing coordination and consciousness.

Figure 3 A captured wild dog pulling an ejector in pen trials in a project evaluating the non-target risk and persistence of cyanide in the corpse of cyanide-killed canids.

Aging Adult Dingoes

Tooth density was investigated in a University of Southern Queensland Honours project, (Ellerton, 2001), to determine if the method of aging adult dingoes could be improved. While there was a significant relationship found between tooth density and age ($p<0.001$, Figure 4) there was too much variability to be able to assign field captured wild dogs to a particular age class with confidence. The study did show however, that the tooth width: pulp cavity ratio measurement and calculation of Knowton and Whittmore (2001) applied to Australian wild dogs (Figure 5) produced better R^2 values with age than the Thomson, and Rose method (1992) currently accepted for dingoes and wild dogs (Figure 6).

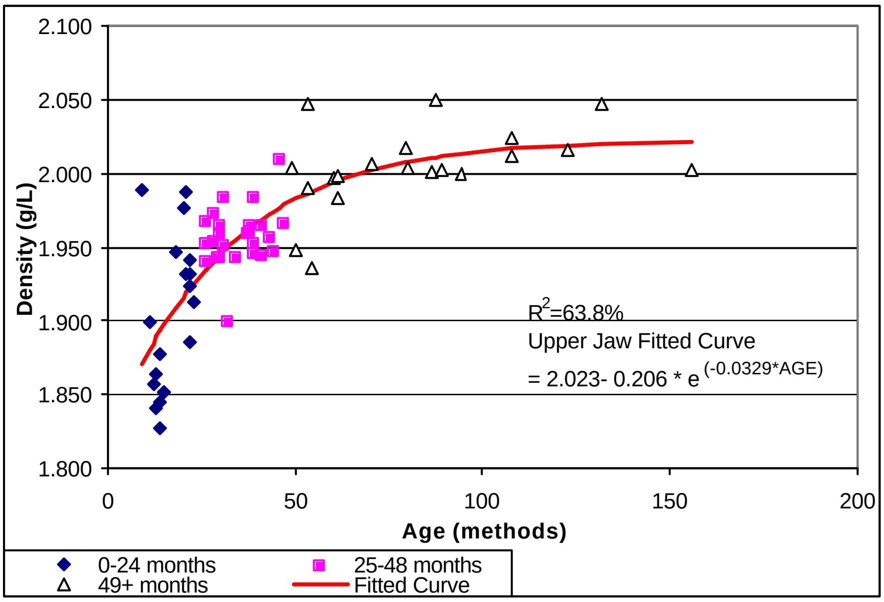

Figure 4: Comparison of age and tooth density for upper jaw canine teeth from known-age adult dingoes. (From Ellerton 2001)

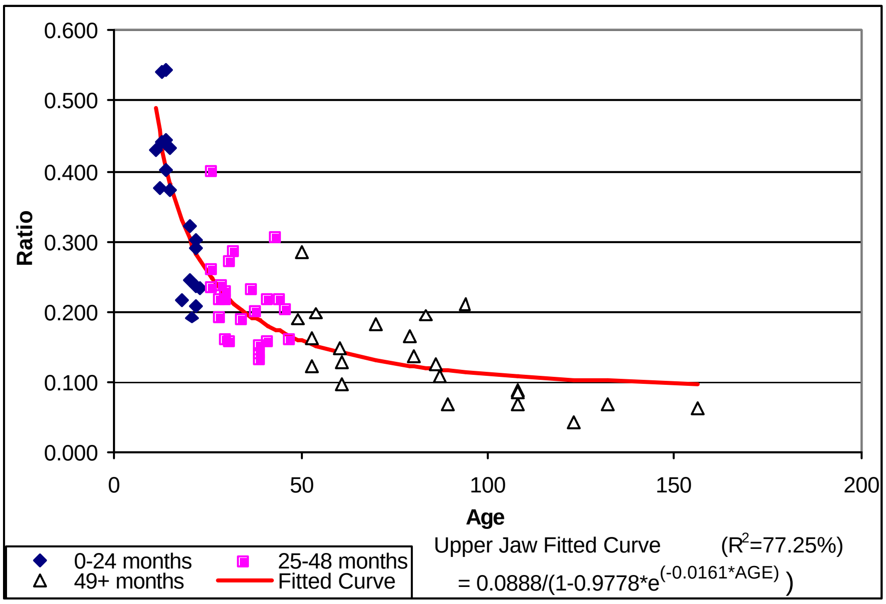

Figure 5. Comparison of age and Knowlton and Whitmore's method of calculating and measuring pulp cavity ratios for upper jaw canine teeth from known-age adult dingoes. (From Ellerton 2001)

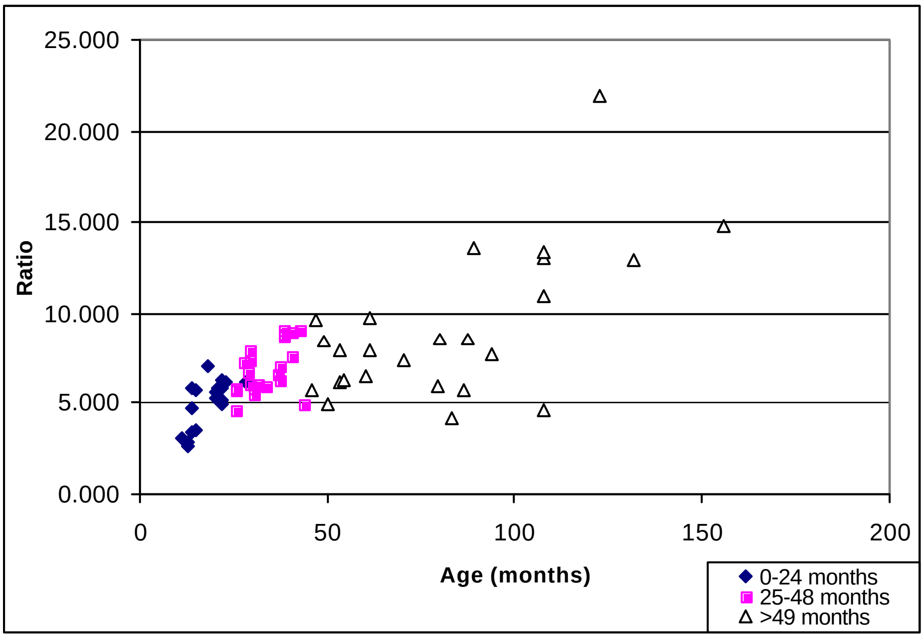

Figure 6. Comparison of age and Thomson and Rose (1992) method of calculating and measuring pulp cavity ratios for upper jaw canine teeth from known-age adult dingoes. (From Ellerton 2001)

Discussion of the results and the implications for future management of pest animal damage

Results of the 2001-02 ejector trials have been disappointing. It appears that wild dogs and to a lesser extent foxes are naturally neophobic to ejectors. This research suggests neophobia can be overcome by using grubstakes and/or multiple attractants prior to deploying ejectors, or alternatively, if ejectors are deployed continuously as "sentinel" bait stations to overcome their neophobia. The very low pull rate of ejectors (<2%) we encountered during 2001-02 is a concern and contrasts with the 2000-01 attractant trials that achieved pull rates between 16% and 57%. Methodology is different between grubstake and ejector trials however. In the former, eight different attractants on grubstakes were 250 m apart and placed in the centre of raked tracking stations and were inspected daily in order to detect visits. Ejectors in the latter trials were 0.5 km apart, used few attractants and were either on the surface, concealed, buried or placed in a hole with a small tracking surface to detect visits and were inspected every two to four days. The former presentation being overtly conspicuous and encountered frequently, the latter being less common, more cryptic and suspicious to wild dogs perhaps.

Alternatively, dingoes may be able to detect cyanide escaping from capsules and without prior "training" with grubstakes they were averse to pulling ejectors. Aversion to cyanide-impregnated baits used in New Zealand possum control programs has been well documented. USDA, Pocatello Supply Depot (pers comm. Sherm Blom), advises that cyanide is most likely escaping through the plastic case rather than the "sealed" ends. Results of the storage trials however, show that even after seven years, some capsules retain their full NaCN content (107%) while others are depleted (39.4%). Logic suggests that if cyanide were escaping through the case, loss would be relatively constant across capsules of similar storage age. If it were leaking through imperfections in the sealed ends there would be large variations. I conclude the result of the storage trials is consistent with this latter scenario.

A solution to low ejector pull rates needs to be found before they can be viewed a serious control method. Nevertheless, ejectors are very target specific, humane and mechanically effective for wild canids and many pest control operators and graziers recognise their potential use and are keen to have them made available.

Preliminary field testing of kangaroo and emu meat wrapped in fresh kangaroo hide did maintain moisture and palatability and reduced the problem with ants but birds still persisted until they removed the meat. I conclude that while meat baits and salamis are superior in respect to palatability to canids they are not practical attractants on ejectors where corvids, brush turkeys or ants are active or in high temperatures. Thus, attractants that can be incorporated into or coated onto stable, inedible ejector tops appears to be the way to go. Attractants painted onto sponge rubber tops performed comparatively well to meat baits. However, I conclude there is much to learn about attractant formulation, seasonal use and how/where they are used on ejectors; research that is expensive, time consuming and difficult to get statistically sound data. Attractant research and deployment methods remain priority areas for ejector research.

Recommendations

This project has identified the following three priority areas for future ejector research:

1. Investigate whether cyanide, escaping from the capsules is the cause of neophobia and if so, substitute a different toxin.

2. Evaluate how pre-feeding or training wild dogs to pull ejectors might be practically undertaken in a control situation.

3. Investigate a broader range of commercial US products for predator management as the four evaluated in this project showed generally superior attractiveness.

References

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