Title
Performance of sodium cyanide ejectors

Journal
Proceedings of the Vertebrate Pest Conference, 11(11)

ISSN
0507-6773

Authors
Connolly, Guy E.
Simmons, Gary D.

Publication Date
1984

PERFORMANCE OF SODIUM CYANIDE EJECTORS

GUY CONNOLLY, Wildlife Biologist, U.S. Fish and Wildlife Service, Twin Falls Field Station, Denver Wildlife Research Center, P.O. Box 593, Twin Falls, Idaho 83303

GARY D. SIMMONS,* Wildlife Biologist and District Supervisor, Animal Damage Control, U.S. Fish and Wildlife Service, College Station, Texas 77843

ABSTRACT: Performance of three models of sodium cyanide (NaCN) ejectors was evaluated at Port O'Connor, Texas, early in 1982. M-44s, M-50s, and coyote getters were test-pulled and reset at 7-day or 21-day intervals for 42 days. Each pull was recorded as good if, in our judgment, it would have taken a coyote. Based on 402 to 430 test pulls of each ejector model, the percentages of good pulls were 40% for M-50s, 73% for M-44s, and 99% for coyote getters. M-44s with shortened plungers performed better than standard M-44s.

Most pulls of M-50s resulted in ejection failure due to corrosion between the plunger and ejector body. The greatest problems with M-44s were mechanical defects, particularly of triggers, and caking of NaCN in the capsules.

Condition of NaCN was evaluated in 1,354 M-44 capsules that had been weathered for one to six weeks. Eighty-five percent contained normal, dry powder after one week and only 49% were normal after six weeks' exposure. Addition of a beeswax seal decreased capsule deterioration.

Based on these results, we recommended that the Service discontinue the M-50 and concentrate on improving the M-44. The Service's Pocatello Supply Depot has shortened the M-44 plunger and added a beeswax seal to M-44 capsules made for use by the Animal Damage Control program.

INTRODUCTION

Sodium cyanide (NaCN) ejectors have been important in coyote depredation control since about 1940 when the coyote getter was introduced. Several models of ejector have been marketed, but the U.S. Fish and Wildlife Service (FWS) has used only two types extensively--the coyote getter (Marlman 1939), from the late 1930s to 1970, and the M-44 (Poteet 1967), from about 1968 to 1972 and again from 1974 to date.

Coyote getters and M-44s are set into the ground with only their tops protruding. Fetid scent or lure stimulates a coyote to bite and pull, whereupon a lethal dose of NaCN is ejected into its mouth. Coma and death follow within 30-60 seconds.

Although both ejectors dispense toxicant when pulled, they differ in the means by which ejection is achieved. In the coyote getter as used before 1970, toxicant within a .38 special cartridge case was expelled by explosive force of the primer plus a small powder charge. The M-44, in contrast, uses a spring-driven plunger to push out its toxic contents. The M-44 was developed to replace the coyote getter, which was officially withdrawn from use in the Service's Animal Damage Control (ADC) program in 1970.

Chronic complaints about M-44 performance caused the Service in 1977 to redesign the M-44. The result was a larger, more precisely made, and more expensive ejector that was similar in function to the older M-44 but different in many details. Both units are covered by the same Environmental Protection Agency (EPA) registration, but no parts are interchangeable. The new Keenan (1979) model soon became known as the M-50 because its capsule is 0.50 inches in diameter, whereas the standard M-44 capsule is about 0.45 inches in diameter.

The M-50 went into production at the Service's Pocatello Supply Depot (PSD) early in 1979. Field reports soon indicated that, compared to the M-44s, the M-50 was more susceptible to corrosion and more prone to malfunction. By September 1981, the M-50 was being used by only 24 of the 254 district field assistants who used cyanide ejectors (Paul Edstrom, personal communication). Therefore, it appeared unlikely that the M-50 could replace the M-44 without further development.

In 1981 the FWS appointed an M-44 Study Team to review the problems associated with NaCN ejectors and to develop a plan to achieve acceptable performance with them. Specifically, the Team was asked to determine which of the two ejectors was best and what further improvements, if any, were needed. This report summarizes a study carried out by the Team to compare and document performance of different ejectors and NaCN capsules under adverse field conditions. The intent was to test equipment made or procured by the Service for its own use. Reference to trade names or commercial products is made only for identification and does not imply endorsement by the U.S. Fish and Wildlife Service.

*Current address: Division of Wildlife Management, U.S. Fish and Wildlife Service, Washington, D.C. 20240.

MATERIALS AND METHODS

Ejectors

Five ejector models or model variations were tested:

1. M-50s produced by PSD in 1981. For description and engineering drawings, see Keenan (1979).

2. M-44s produced by PSD in 1981. For descriptions, see Poteet (1967), Bacus (1969), Matheny (1976), or Shult et al. (n.d.). This model is identified as the "standard M-44".

3. M-44 as described above, but with plungers shortened by grinding 0.125 inches off the top. This model is identified as the "ground-off M-44".

4. M-44 as described above, but with plungers shortened 0.56 inches by breaking them off at the trigger notch. This model is designated as the "broken-off M-44".

5. Coyote getter, as produced before 1970 (Marlman 1939, Robinson 1943).

A total of 600 ejectors was used (120 of each model or variation). Ejectors were not lubricated, boiled, degreased, or subjected to special treatment before evaluations began. All ejectors were typical of those used in the Service's ADC program. The M-44s with shortened plungers were included because field reports indicated that such modifications improved performance. Of the two modifications, the "broken-off M-44" was more popular in 1981 because this modification was more easily accomplished in the field.

Sodium Cyanide Capsules

Throughout this study, M-50s and M-44s were set with standard production capsules loaded at PSD. All M-50 and M-44 capsules were loaded in October 1981 with the EPA-registered formulation, consisting of 88.78% NaCN (95% A.I.); 5.98% Celatom MP-78 (92% diatomaceous silica); 4.99% potassium chloride; and 0.25% FP Tracerite-yellow.

Boxes of capsules were selected randomly from PSD production in November 1981 and stored in Twin Falls, Idaho until January 1982 when the study began.

During the first four weeks of this study, coyote getters were set with production capsules loaded by PSD in July 1969. Each capsule contained 0.94 grams of a mixture of 82.61% NaCN and 17.39% inert ingredients. After the limited stock of old "getter shells" was depleted, pepper shells, also loaded by PSD, were used. These shells resembled NaCN capsules but contained fine black pepper. Pepper shells are commonly used to teach dogs to avoid cyanide ejectors.

Study Area

Because M-44s are used in many different environments, most of which couldn't be included in a single study, we sought an adverse situation where significant numbers of M-44s are used. A coastal prairie site was selected near Port O'Connor, Texas, where heat, humidity, high soil moisture, abundant precipitation, saline soils, and saline air combine to create a corrosive environment. The site was within a few hundred yards of Matagorda Bay, approximately three feet above sea level. Ejectors were set inside a 100-foot square fenced plot on loamy fine sand that supported a sparse cover of grasses, sedges and forbs.

Test Equipment

Ejectors were set with standard tools (Shult et al. n.d.). A Link model PB-3 spring tester (Link Engineering Co., Detroit, MI 48227) was used to measure force required to depress ejector plungers to the set position. A Hunter Spring model L-10 force gauge (Ametek, Hunter Spring Division, Hatfield, PA 19440) was used to measure the weight of pull needed to trigger each ejector. The gauge was used in conjunction with a safety shield that protected observers from ejected toxicant.

Test Procedure

Each ejector was serially numbered and its plunger compression and trigger pull forces were measured. For M-50s and M-44s, these measurements were repeated as the work progressed to determine if they would change with use or wear of mechanical parts.

The test began on January 13, 1982; 300 ejectors (60 of each model) were set. Another 300 ejectors were set on January 14. Ejectors were set to simulate normal field practice, except for two details. First, the tops were not wrapped or scented. Second, ejector triggers were raised to the stop knobs (Shult et al. n.d.) rather than set by feel of trigger-to-sear contact, as is common practice among experienced M-44 users. By setting triggers against stop knobs, we hoped to avoid pull force variations that could have resulted from individual differences in perception of proper sear engagement.

Another detail that was standardized was lock ring position on the ejector stakes. On both M-50s and M-44s, the sliding lock ring has a loop that may be positioned in various ways. If the loop is placed over the ejector trigger, pull weight is reduced about one pound for M-44s and three pounds for

M-50s. All triggers were so positioned during field work. Later we found that lock ring position was not consistent during pretest measurements, so we reported pretest pull force values only for those ejectors with lock ring loops positioned over the triggers. This detail does not apply to coyote getters, as they do not have lock rings.

Ejectors set on January 13 were test-pulled and reset with new capsules on January 20, and at 7-day intervals thereafter until February 24. Ejectors set on January 14 were test-pulled and reset 21 days later, and test-pulled again after another 21 days. Thus, half of the ejectors were evaluated weekly and the others at 3-week intervals during the 6-week test. As the study progressed, ejectors that could not be reset were dropped and sample sizes decreased accordingly. Also, on January 20, ten ejectors of each model were diverted from the 7-day series into another test protocol for which results are not presented here. This accounts for reduced sample sizes shown for the 7-day series after January 20 (Table 1).

Table 1. Results of weekly test pulls of sodium cyanide ejectors at Port O'Connor, Texas in January - February 1982.

	EJECTOR MODEL				
	M-50	Standard M-44	Ground off M-44	Broken off M-44	Coyote getter
First pull (Jan 20)					
Number pulled	60	60	60	60	60
Good pulls (%)	93	92	100	98	99
Second pull (Jan 27)					
Number pulled	50	50	49	50	50
Good pulls (%)	32	82	94	98	100
Third pull (Feb 3)					
Number pulled	47	50	49	47	50
Good pulls (%)	43	66	86	89	98
Fourth pull (Feb 10)					
Number pulled	46	50	46	49	50
Good pulls (%)	24	66	87	80	100
Fifth pull (Feb 17)					
Number pulled	43	50	43	49	50
Good pulls (%)	9	68	77	76	100
Sixth pull (Feb 24)					
Number pulled	44	50	40	47	50
Good pulls (%)	2	58	78	64	100

On each evaluation date, each ejector was pulled using the test gauge. Pull weight was recorded and each pull was rated subjectively as "good" or "bad". "Good" pulls were those that, in our opinion, would have taken coyotes, whereas "bad" pulls probably would not have taken coyotes because of failure to eject, delayed or weak ejection, or deterioration or caking of capsule contents. More specifically, each pull was rated as "good" if the ejection was triggered by a pull force under 8.0 pounds, ejection was vigorous and occurred without noticeable delay, and ejected material was in dry powder form similar to that in newly loaded capsules. Ejectors that malfunctioned were examined carefully to determine the cause(s).

The condition of ejected NaCN was appraised at each pull. Capsules from units that failed to eject were opened manually for inspection. Contents of each capsule were recorded as normal (dry powder, resembling new capsules in color and consistency), partly caked, caked or wet. Discoloration also was noted. Similar evaluations were made of additional M-50 and M-44 capsules that were exposed in the plot for the entire study.

Ejector mechanisms and stakes were inspected for corrosion. Plunger spring compression force was then measured and, if possible, the ejector was reset with a new capsule. On the final evaluation (February 24 or 25, 1982), ejectors were removed from the field and extra capsules that had been exposed throughout the experiment were collected for analysis.

RESULTS

Ejector Performance

Comparison of different ejector models was based on the frequency of good pulls. All five models gave high percentages of good pulls at their first evaluation (Table 1). Thereafter, the frequency of good pulls declined for all models except the coyote getter. In the 7-day series, large differences in performance of different models appeared by the second pull and the magnitude of these differences increased as the study progressed. At the sixth (final) evaluation, 2% of M-50s, 58% of standard M-44s, and 100% of coyote getters yielded good pulls. Both models of modified M-44s gave higher percentages of good pulls than the standard M-44 (Table 1). Ejectors in the 21-day series showed similar differences among models and, for all models except the coyote getter, their performance also declined as the study progressed.

Based on results of over 400 pulls of each ejector model, coyote getters performed best, M-50s worst, and the standard M-44 was intermediate (Table 2). Modified M-44s performed better than the standard M-44. In the pooled data (7-day and 21-day series combined), the frequency of good pulls was 40% for M-50s, 73% for standard M-44s, and 99% for coyote getters.

Table 2. Summary results of test pulls of sodium cyanide ejectors at Port O'Connor, Texas in January-February 1982.

	EJECTOR MODEL				
	M-50	Standard M-44	Ground off M-44	Broken off M-44	Coyote getter
7-DAY SERIES					
Total pulls	290	310	287	302	310
Good pulls (1%)	37	73	88	85	99
Ejection failures (%)	60	6	3	1	0
Other ejector defects (%)	2	19	8	13	1
Deteriorated capsules (%)	1	2	1	1	0
All bad pulls (%)	63	27	12	15	1
21-DAY SERIES					
Total pulls	120	120	115	120	120
Good pulls (%)	47	73	76	76	99
Ejection failures (%)	45	5	2	2	0
Other ejector defects (%)	6	10	4	7	1
Deteriorated capsules (%)	2	12	18	15	0
All bad pulls (%)	53	27	24	24	1
ALL EJECTORS					
Total pulls	410	430	402	422	430
Good pulls (%)	40	73	84	82	99
Ejection failures (%)	56	6	3	1	0
Other ejector defects (%)	3	16	7	12	1
Deteriorated capsules (%)	1	5	6	5	0
All bad pulls (%)	60	27	16	18	1

We have summarized bad pulls into three categories: (1) ejection failures, (2) substandard ejections due to ejector defects, and (3) normal ejections of caked or wet capsule contents.

Most bad pulls of M-50s were due to ejection failure, which was uncommon with M-44s and did not occur with coyote getters. Virtually all ejection failures were attributed to corrosion that prevented or slowed plunger movement.

Excessive pull force, hang fires (ejections delayed 1 to 15 seconds), weak ejections, and deteriorated capsules all were important problems with M-44s. Only three bad pulls occurred with coyote getters. All were due to excessive pull force, the exact cause of which was undetermined.

Comparing standard and modified M-44s, standard units gave many more ejection failures and hang fires. Differences between ground-off and broken-off M-44s were relatively minor. The numbers of bad pulls due to deteriorated capsules did not differ among different M-44 models, probably because all M-44 capsules were similar. Of 65 bad M-44 pulls attributed to defective capsules, 62 involved caked NaCN. Contents of three capsules were wet.

Capsule Performance

The contents of 1,354 M-44, 474 M-50, and 340 coyote getter capsules were examined, and it is useful to look at the results separately from ejector performance. The frequency of deterioration increased with exposure time. Eighty-five percent of M-44 capsules were normal after one week of field exposure, but only 49% were normal after six weeks (Table 3). M-50 capsules appeared to deteriorate less than M-44s. This difference is attributed to better sealing of M-50 capsules.

Table 3. Condition of sodium cyanide mixtures in ejector capsules after outdoor exposure at Port O'Connor, Texas in January-February 1982.

	----------Period of Exposure----------		
CAPSULES[a]	1 week	3 weeks	6 weeks
M-44			
Number examined	955	352	47
Normal, dry powder (%)	85	76	49
Partly caked (%)	13	7	4
Caked or wet (%)	2	17	47
M-50			
Number examined	308	120	46
Normal, dry powder (%)	83	88	74
Partly caked (%)	15	2	4
Caked or wet (%)	2	10	22
COYOTE GETTER			
Number examined	220	120	0
Normal, dry powder (%)	60	47	--
Partly caked (%)	40	53	--
Caked or wet (%)	0	0	--

[a]M-44 capsules (box code 3023031) and M-50 capsules (box code 2802811X) were loaded at Pocatello Supply Depot in October 1981. Coyote getter capsules (box code DC 30-FI-31CA4I) were loaded at Pocatello Supply Depot in July 1969.

It is noteworthy that no coyote getter capsule contained caked or wet NaCN even though the capsules were about 12-1/2 years old. However, many were partly caked. During this test, observers noted that partial caking of NaCN mixtures was less detrimental to performance of coyote getters than to M-44s, because the primer-activated ejections were more effective in breaking up aggregated capsule contents.

Pull Force Measurements

When the ejectors were new, pull force averaged 1.4 pounds for coyote getters, 2.4 pounds for M-50s, and 3.5 pounds for M-44s (Table 4). As the study progressed, mean pull force tended to increase and become more variable for all ejector models. In general for the results presented in Table 4, differences between means of 0.5 pounds were significant at the 5% level and differences over 0.8 pounds were significant at the 1% level, based on Student's "t" statistics.

Within the same ejector model, pull weights did not differ significantly between 7-day and 21-day series when ejectors were new or at the first pull. Thus, those data were pooled for analysis (Table 4). At the last pull, however, pull weights for the 7-day series were significantly ($p<0.01$) higher than those from the 21-day series for all models except the M-50. Accordingly, these data were presented separately. The differences at last pull were attributed to greater wear on the 7-day series.

Mean pull weights for coyote getters were significantly ($p<0.01$) lower than those for all other models at every measurement. Compared to M-50s, pull weights for standard M-44s were higher when new and at the first pull, but not at the last pull. Mean pull weights tended to be lower for modified than for standard M-44s and some of these differences were significant ($p<0.05$). For all ejector models, average pull weights increased significantly ($p<0.01$) during the test.

Table 4. Pull force statistics for sodium cyanide ejectors at Port O'Connor, Texas, January-February 1982.

	EJECTOR MODEL				
	M-50	Standard M-44	Ground off M-44	Broken off M-44	Coyote getter
NEW					
Mean pull force (lbs)	2.4	3.5	3.5	3.1	1.4
S.D. (lbs)	0.52	1.1	0.99	0.46	0.45
Number tested[a]	20	20	20	120	120
AT FIRST PULL					
Mean pull force (lbs)	3.6	4.3	3.8	3.2	1.7
S.D. (lbs)	1.6	1.6	1.2	1.1	1.4
Number tested	117	120	118	119	119
AT LAST PULL - 21 DAY SERIES[b]					
Mean pull force (lbs)	5.1	4.9	4.3	3.6	1.8
S.D. (lbs)	1.9	1.5	1.4	0.95	1.2
Number tested	50	59	55	60	60
AT LAST PULL - 7 DAY SERIES[c]					
Mean pull force (lbs)	5.2	5.9	5.6	5.8	2.3
S.D. (lbs)	2.4	2.1	1.8	1.9	1.3
Number tested	35	48	38	46	49

[a]Each group began with 120 ejectors, but before the test, only 20 each of M-50s, standard M-44s and ground off M-44s were measured with lock ring loop over the trigger as units were later set. Because the lock ring position affects weight of pull (see text), the other data are omitted here.

[b]Ejectors were pulled twice during the 42-day test.

[c]Ejectors were pulled six times during the 42-day test.

Cmpression Strength of Plunger Springs

Assuming that neither the springs nor stresses on them varied among M-44 models, we pooled spring compression data for the three models. For both M-44s and M-50s, the data were summarized separately for 7-day and 21-day series (Table 5). The values were very uniform and, based on Student's "t" tests, most observed differences were statistically significant ($p<0.01$)

Table 5. Spring compression force statistics for M-50 and M-44 ejectors at Port O'Connor, Texas, January-February 1982.

	M-50		M-44[a]	
	7-day series	21-day series	7-day series	21-day series
NEW				
Mean (lbs)	55	55	52	53
S.D. (lbs)	2.2	3.0	2.8	3.8
Number tested	59	60	180	180
AFTER FIRST PULL[b]				
Mean (lbs)	52	51	50	48
S.D. (lbs)	3.1	2.7	1.4	1.7
Number tested	49	60	150	176
AFTER LAST PULL[c]				
Mean (lbs)	56	52	48	47
S.D. (lbs)	5.6	5.3	2.7	3.1
Number tested	43	58	134	174

[a]Data pooled for standard, ground-off, and broken-off M-44s.

[b]Ejectors had been set for seven (7-day series) or 21 (21-day series) days.

[c]All ejectors had been set for 42 days.

M-50s consistently required about two more pounds of force than M-44s to depress their plungers, and compression strength declined significantly by the first pull (Table 5). Springs in the 21-day series lost more strength than those pulled every seven days. On the average, M-44 springs lost four to six pounds, or roughly 10% of their original compression strength, during the 6-week study.

The apparent increases for M-50s between first and last pulls are spurious. After these units had been exposed for six weeks, their plungers were so corroded that they would not travel freely. Before the first pull, however, it appeared that M-50 and M-44 springs weakened about equally.

DISCUSSION

This study demonstrated large differences in the performance of different ejector models. The coyote getter yielded 99% good pulls, compared to 84% for the best M-44 model, 73% for the standard M-44, and only 40% for the M-50. Assuming that only good pulls would have taken coyotes, these results suggest correspondingly large differences in efficiency for coyote control. However, this study was intentionally carried out in a harsh environment that would quickly reveal any defects. Under more normal field conditions, it seems likely that differences among ejector models would be less apparent. In fact, there is a large body of data that indicates coyote getters and M-44 devices to be equally efficient in coyote control.

In Texas from 1965 to 1971, Service personnel used coyote getters and M-44 devices on standard coyote census lines. Based on some 65 coyote getter years and 121 M-44 years (1 year = 365 unit nights), the coyote take per unit year averaged 11.3 for coyote getters and 11.5 for M-44s (U.S. Department of the Interior 1978). We are unaware of any comparative data that show coyote getters to be more effective than M-44s, although some experts believe the coyote getter to be superior (Wade 1983). In our opinion, the coyote getter deserves serious reconsideration, but M-44 improvement should receive higher priority because it is registered by EPA whereas the coyote getter is not.

We also wish to point out that, in less adverse environments, M-44s function much better than they did in this study. At Twin Falls, Idaho, between June 1982 and April 1983, 25 ground-off M-44s were repeatedly set and pulled until they wore out or could not be reset. These units, which remained set from 1 to 16 days between each pull, yielded an average of 33 good pulls before the first bad pull. Overall, 95% of 948 test pulls were good pulls. And M-44 capsules left outdoors at Twin Falls for a year showed no deterioration until the eleventh month.

At Port O'Connor, Texas, neither M-44 nor M-50 capsules were adequately resistant to deterioration in our opinion. NaCN was caked in half of the M-44 capsules that had been exposed for six weeks (Table 3). This finding stimulated a follow-up study in which addition of a beeswax seal was found to enhance the useful field life of capsules. After 42 days' exposure at College Station, Texas, all beeswaxed capsules contained normal, dry NaCN, whereas only 26% of unwaxed capsules were normal (Connolly and Simmons 1983).

MANAGEMENT APPLICATIONS

Based on results of this study, the M-44 Team recommended that the Service phase out the M-50 and concentrate further improvement effort on the M-44. Further investigation of the coyote getter also was recommended.

In mid-1982, the standard M-44 was modified to incorporate a shorter plunger. The ejector currently (March 1984) produced at PSD is similar to the ground-off M-44 tested at Port O'Connor.

On the basis of field reports and this study, the Team identified NaCN capsules as the M-44 component most in need of improvement, and since August 1983 a hot beeswax seal has been used on all capsules loaded at PSD. These capsules have not yet been evaluated in a research study, but field reports indicate satisfactory performance.

This study demonstrated a variety of parameters that could be measured as indicators of ejector performance. The results were adequate for comparison of different ejector models and capsules, but in the absence of established performance standards it was not possible to specify which ejectors or ejector components were acceptable for Service use. Therefore, the Team recommended that the Service establish measurable performance standards for NaCN ejectors.

ACKNOWLEDGEMENTS

We thank members of the FWS M-44 Study Team, Denver Wildlife Research Center, Texas Rodent and Predator Animal Control Service, and Texas Department of Agriculture for advice and assistance.

LITERATURE CITED

ANONYMOUS. 1966. Proceedings of the Coyote Getter Symposium. Southwest Research Institute, San Antonio, Texas, November 29, 1966. 9pp.

BACUS, L. C. 1969. Introducing the M-44. Field Training Aid No. 3, Division of Wildlife Services, Bureau of Sport Fisheries and Wildlife, Denver, Colorado. 2pp.

BUSH, D. L. 1958. Investigations to improve the coyote-getter chemical cartridge. Idaho Chemical Industries, Inc., P.O. Box 2641, Boise, Idaho. 6pp, unnumbered.

CONNOLLY, G., and G. D. SIMMONS. 1983. Beeswax seal increases useful field life of M-44 capsules. U.S. Fish and Wildlife Service, Denver Wildlife Research Center, Denver, Colorado. March 1983. 20pp.

CRABTREE, D. GLEN, and W. H. ROBISON. 1961. Project F-19: Improvement of coyote-getter shell. p. 112 In: Wildlife Research Laboratory, Denver, Colorado, July 1 - December 31, 1960 Highlight Activities.

KEENAN, V. A. 1979. Report on M-44 Improvement project. U.S. Department of the Interior, Fish and Wildlife Service. 7pp + 14 drawings.

MARLMAN, E. P. 1939. Trap gun. Patent No. 2,145,188. U.S. Patent Office, Washington, D.C., January 31, 1939. 3pp.

MATHENY, R. W. 1976. Review and results of sodium cyanide spring loaded ejector mechanism (SCSLEM) experimental programs. Proc. Vertebrate Pest Conf. 7:161-177.

POTEET, J. L. 1967. Trap gun. Patent No. 3,340,645. U.S. Patent Office, Washington, D.C., September 12, 1967. 3pp.

ROBINSON, W. B. 1943. The "humane coyote getter" vs. the steel trap in control of predatory animals. J. Wildl. Manage. 7(2):179-189.

SHULT, M. J., C. W. RAMSEY, and W. G. KLUSSMANN. n.d. [1974?]. Using the M-44 in coyote control. Publication MP-1181, Texas Agricultural Extension Service, the Texas A & M University System, College Station, Texas. 12pp.

U.S. DEPARTMENT OF THE INTERIOR. 1978. Predator damage in the West: A study of coyote management alternatives. Fish and Wildlife Service, Washington, D.C. 168pp.

WADE, D. A. 1983. Coyotes. pp. C-31 to C-42 In: R. M. Timm, Ed., Prevention and Control of Wildlife Damage. Great Plains Agricultural Council and Nebraska Cooperative Extension Service, University of Nebraska, Lincoln.