REVIEW AND RESULTS OF SODIUM CYANIDE SPRING LOADED EJECTOR MECHANISM (SCSLEM) EXPERIMENTAL PROGRAMS

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ABSTRACT: Sodium cyanide was cancelled for use in predator control in March 1972 along with strychnine and 1080 mainly because of the indiscriminate use of these poisons which posed an imminent hazard and danger to the environment. After due consideration, the EPA Administrator in January 1974 authorized approval of experimental use permits (under Section 5 of FIFRA as amended) for use of sodium cyanide in the M-44 device (SCSLEM) in order to accumulate information necessary to support registration consideration. Subsequently nine permits were issued for this purpose. In August 1975, a public hearing was held in Washington, D.C. to respond to a formal application for registration by the Department of the Interior (U.S. Fish and Wildlife Service), since, in the judgement of the Agency, there was substantial new evidence to refute three main issues set forth in the March 1972 cancellation order. Following this hearing, EPA Administrator Train published his decision on September 16, 1975 which specified that sodium cyanide capsules for use in the M-44 device may be registered under Section 3 of FIFRA to federal and state agencies and to other persons provided that they sell sodium cyanide capsules only to state and federal registrants. Only state and federal registrants are permitted to sell, give or distribute sodium cyanide capsules to trained and supervised applicators. A total of twenty-six restrictions are included in this Order. To date EPA has issued 8 registrations for sodium cyanide capsules for use in the M-44 device.

INTRODUCTION

In a topic as controversial as predator control, often fraught with emotions and hysteria, there is one point of agreement: there is no simple answer to predator problems. Since man first attempted to manage and domesticate certain animal species to his own advantage, he has had to cope with predatory animals. The coyote has increased its range four-fold since North America was colonized. "The prairie wolf or coyote in the western states is becoming so numerous that it looks as though the sheep industry in Idaho and Eastern Oregon would soon be a thing of the past if something is not done to lessen the number of the destructive coyote" (Harding, 1909).

From the 1939 Wildlife Conservation Stamp Album we read, "The coyote, sometimes called a prairie wolf or brush wolf, is one meat eater that has been more than a match for civilization. The coyote, in recent years, has spread its home on the plains into the bush country of the Great Lakes States and Ontario, has crossed the Rocky Mountains to the Pacific slope and is now found from Alaska to Costa Rica. The coyote feeds largely on destructive rodents and on jack-rabbits. The skill of the coyote in avoiding traps and hunters is amazing" (National Wildlife Federation, 1939).

According to the 1972 and 1973 U.S. Fish and Wildlife Service scent post surveys in the 17 western states, the relative abundance of coyotes has increased in 9 states, highest in Nebraska, South Dakota and New Mexico (Linhart, Knowlton, 1975). An estimated one million coyotes live in the west.

The control of depredating animals is one of the most controversial aspects of wildlife management. The apparent increase and concern for the coyote has resulted in numerous research endeavors in coyote ecology, behavior, damage assessment and depredations control (Coyote Research Newsletter, 1975). These include studies in aversive agents, predator-prey inter-relationships, toxicants, fencing to exclude coyotes, ultra-sonic sounds, tranquilizers, etc.

When compared to other biological controls, vertebrate animal control is a relatively primitive science, lacking in the research tools and procedures. Rather than a science, per se, vertebrate animal control is more of an art or skill which depends on the experience of the applicator. Because we are dealing with animals capable of elementary reasoning and learned behavior, efforts to standardize controls have been hampered (ASTM, 1976).

EPA LEGISLATIVE MANDATES

The regulatory authority of EPA requires it to see that an appropriate balance is struck

between the country's environmental objectives on the one hand and those national goals which often seem to compete for the same resources, such as provision of an adequate food supply. The use of poisons to kill predators requires a balancing of the resulting risks and the benefits (Elkins, 1974).

In March 1972 EPA Administrator Ruckelshaus issued an administrative order suspending registrations of strychnine, 1080 and sodium cyanide for use in predator control. This was preceded by the President's Executive Order (No. 11643) cancelling the use of chemical toxicants on federal lands. EPA's suspension was based on evidence of substantial misuse, incidents of human accidents and endangerment to non-target birds and animals.

In October 1972 amendments to FIFRA provided for tighter controls to govern the misuse of pesticides and imposed certain restraints on their use.

Section 3 of FIFRA directs EPA to register a pesticide if it is determined that: (1) it will perform in a manner as claimed; (2) it will perform its intended function without unreasonably adverse effects on the environment; and (3) it will not result in illegal residues on food or feed.

Where there is inadequate data to support registration, experimental use permits can be approved by EPA under Section 5 of FIFRA. The Administrator may put restrictions upon the use of the pesticide and may limit its duration. Under Section 5 experimental use permits allow the use of pesticides for the purpose of gathering data requisite to their registration under controlled field conditions.

Section 18 of FIFRA authorizes the EPA Administrator to exempt any federal or state agency from any provision of the Act if he determines that emergency conditions exist which require such exemption. EPA regulations implementing this section were promulgated in early December 1973.

Sodium cyanide capsules in the M-44 device, though they were widely used (U.S. Fish and Wildlife Service used the M-44 from January 1967 through January 1972 at an annual rate of 46,000 unit years) were never registered with EPA prior to the March 1972 cancellation order. This order was directed specifically at sodium cyanide used in the "Humane Coyote Getter". This explosive device, when activated, propelled the shell wad and contents upward at a high velocity. The sealing wad atop the shell caused a number of human injuries due to the force with which it was propelled. It reportedly often shattered the palate of affected animals.

Applications for emergency use (Section 18) of sodium cyanide in the M-44 device by Texas, California and Wyoming were denied by the Administrator in late December 1973. However, he announced that he would favorably consider applications for the experimental use of sodium cyanide in the spring loaded ejector mechanism (known as the SCSLEM or M-44) under Section 5 of FIFRA. The decision was announced on January 18, 1974 (Federal Register, 1974).

EXPERIMENTAL USE PERMIT ISSUANCE

Texas was the first state to submit an experimental use permit application to EPA on February 1, 1974. The permit was approved for 44 counties in Texas on February 4, 1974. Within the permit agreement was a plan which set forth objectives, training format of applicators, M-44 equipment distribution procedures and data collection requirements.

Subsequently six other states (Montana, California, South Dakota, Idaho, Nebraska and Kansas), the Department of the Interior (U.S. Fish and Wildlife Service) and Texas A. & M. University were granted experimental use permits for various time periods. All permits specified the numbers of SCSLEMs, sodium cyanide capsules and, conditions of use (Table 1). All had similar goals and objectives though each was administered according to individual plans.

The U.S. Humane Society challenged the legality of the initial Texas experimental permit program (Humane Society, 1974). In late March 1974 a U.S. District Court denied the injunction sought by the Humane Society. The program in Texas was fully implemented in April 1974.

Table 1. M-44 experimental use permit programs.

Agency	Permit No.	Issue Date	Month Program Started	Expiration Date
Texas Dept. Agric.	33858-EXP-1G	2-08-74	3-74	6-01-75
Mont. Dept. Livestock	34192-EXP-1G	4-04-74	7-74	10-15-75
Calif. Dept. Food & Agric.	10965-EXP-1G	4-11-74	10-74	6-01-75
So. Dak. Dept. Agric.	34275-EXP-1G	7-01-74	10-74	7-01-75
Idaho Dept. Agric.	34272-EXP-1G	4-18-74	12-74	6-30-75
Neb. Dept. Agric.	33253-EXP-2G	10-01-74	1-75	9-30-75
Kansas State Univ.	34898-EXP-1G	2-01-75	2-75	6-30-75
Texas A. & M. Univ.	35899-EXP-1G	2-01-75	2-75	8-31-75
Dept. of Interior (FWS)	6704-EXP-6G	5-28-74	5-74	10-31-75

By agreement with the M-44 patent owner, the Department of the Interior (FWS) manufactures M-44 mechanisms solely for its own use. It also formulates capsules containing sodium cyanide. The states secured their M-44 devices and capsules of sodium cyanide from the M-44 Safety Predator Control Company, Midland, Texas. By special provisions Montana acquired 2500 M-44's from the Department of the Interior early in their program. The cost of the M-44 equipment from Midland, Texas was:

Item	Cost/unit
M-44 devices	$5.00
NaCN capsules	.35
Setting pliers	3.50
Gate warning signs	.15
Stake warning signs	.15
Scent (bottle)	1.50

DESCRIPTION OF THE M-44 EJECTOR MECHANISM

This is simply a mechanical device which projects the contents within a plastic capsule (sodium cyanide) when an upward pull is exerted on it (Figure 1).

The patented M-44 ejector mechanism consists of four parts: the base or tube, ejector unit, capsule or case holder, and the plastic capsule or case containing the sodium cyanide toxicant.

1. The base is a hollow metal 7/8" diameter conduit pipe, crimped at the lower end and fitted with a leylerly split locking ring at the upper end. It is normally six to eight inches in length and is driven into the ground to support and anchor the mechanism.

2. The three inch ejector housing contains a spring, plunger and trigger. It is threaded on top to receive the capsule or case holder. The plunger is depressed with the use of setting pliers and held in place by the trigger. The ejector unit is placed in the base and secured with the locking ring.

Figure 1. M-44 COMPONENTS

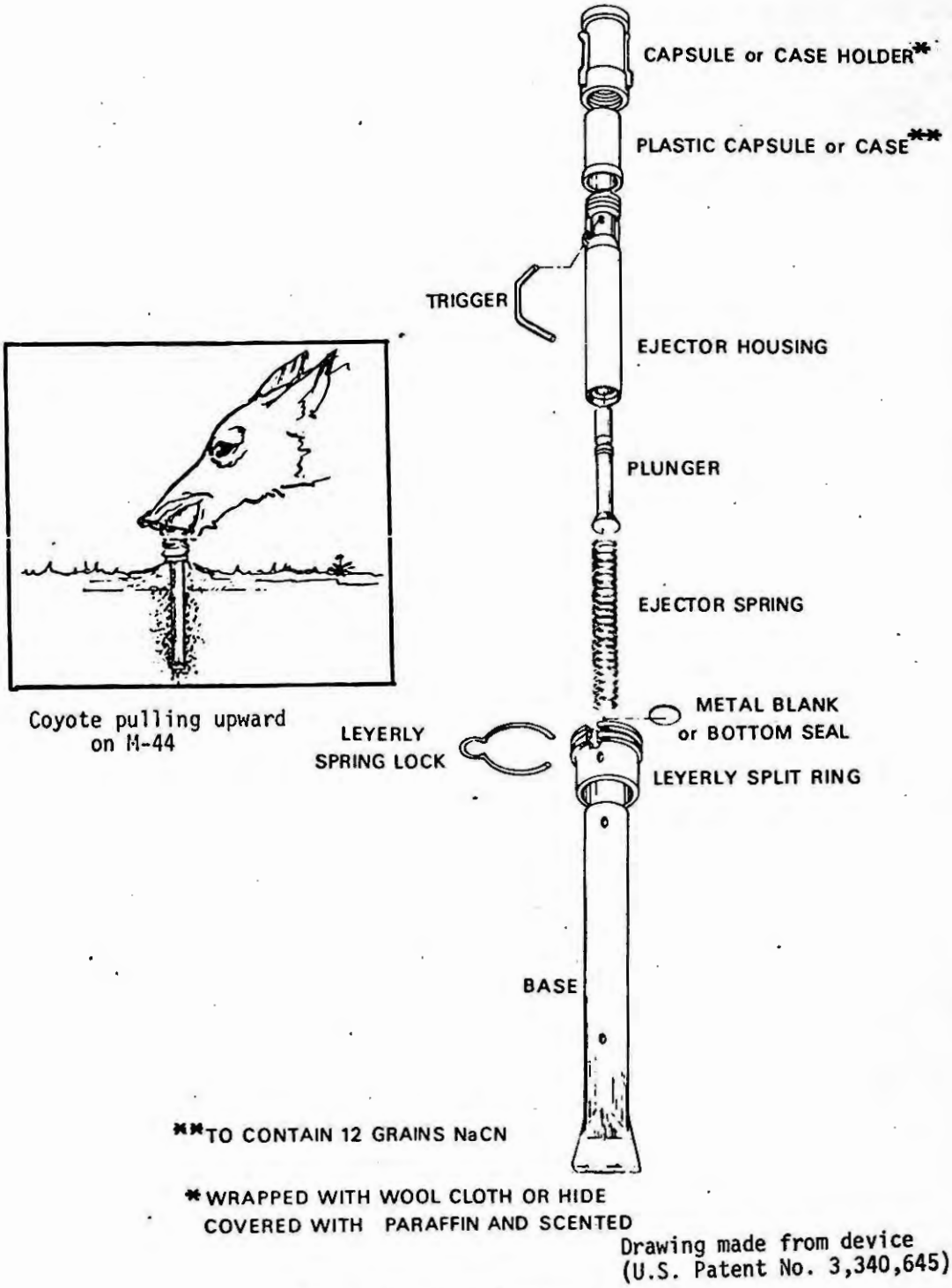

Figure 1. M-44 Components

3. The capsule holder (1 3/8" x 5/8") is a hollow tube of pewter material which is threaded on the lower portion inside. It is wrapped with absorbent material, treated lightly with paraffin, screwed onto the ejector unit and treated lightly with a fetid scent.

4. The capsule is a sealed plastic container, 1 1/8" x 1/2" in dimensions, which holds one gram of formulated toxicant (0.88 grams of sodium cyanide). (The above measurements of M-44 components are approximate and from the Midland, Texas equipment).

PROPERTIES OF SODIUM CYANIDE

Sodium cyanide is a water soluble white solid which reacts with acids to form hydrogen cyanide gas. When perfectly dry, it is odorless. Due to its alkalinity, it is corrosive to the skin. It is a strong reducing agent which with acids liberate highly toxic hydrocyanic acid gas (Merk, 1968). Lethal doses of sodium cyanide are rapidly fatal. Symptoms of human cyanide poisoning can occur within seconds of ingestion of lethal amounts [headache, mental confusion, convulsions and unconsciousness (Sollman, 1957)]. Cyanide causes death by asphyxia resulting from inactivation of enzymes necessary for oxygen utilization. Hirsch (1964) suggests that the lethal dose for humans is 200 mg. Merk (1968) listed the average fatal dose of hydrogen cyanide as being 50 to 60 mg. The LD_{50} of cyanide for dogs is 1.0-2.0 mg/kg and 2.0-3.0 mg/kg. for cattle and sheep.

DESCRIPTION OF FIELD USE OF SODIUM CYANIDE CAPSULES IN THE M-44

During the experimental use permit programs, the Department of the Interior (FWS) deployed the greatest number of sodium cyanide capsules and M-44 devices. Stringent approval procedures were required prior to actual field placement of specified number of M-44 devices. Under the FWS's emergency guidelines, ranchers in cooperating areas could apply for the Fish and Wildlife's use of the M-44 only after:

1) 2% livestock loss was experienced over a period of 7 days;
2) mechanical predator control methods had been unsuccessful for a 14 day period and livestock losses suffered by the grower due to predation have reached an average of 0.6%/week or more for that period; or
3) when mechanical control methods had been unsuccessful for 28 consecutive days and the losses suffered by the grower due to predation had reached an average of 0.5%/week for that period.

The FWS data from this program has been published monthly in the Federal Register. A total of eleven states were involved in protecting sheep and goats and five states in protecting cattle from predation using the M-44 in this program.

The state programs varied in the criteria followed in placement of M-44's. While most devices were placed in response to current livestock depredations problems, some were set out as preventive measures based on previous livestock losses. Some M-44's were set out because coyote signs were visible in lambing and/or calving areas.

CRITERIA FOR REGISTERING PESTICIDES PREVIOUSLY CANCELLED

Before a previously cancelled or suspended pesticide can be registered, EPA, by regulations within Sub-part D of the Rules of Practice (40 CFR 165), is required to determine whether or not there is substantial new evidence that was not available at the time of the Administrator's Order which may materially affect the prior order. EPA must have new evidence that indicates that the previous decision is no longer valid. It must be remembered that there was no hearing before the cancellation order occurred, neither was the decision challenged when it was made. However, in order to reconsider cancelled pesticides the law requires that a public hearing be held before an Administrative Law Judge. His findings are submitted to the Administrator who renders the final decision.

CHRONOLOGY OF EVENTS IN RESPONSE TO AN M-44 APPLICATION

The Department of the Interior (U.S. Fish and Wildlife Service) formally applied for registration of sodium capsules for use in the M-44 device on July 7, 1975. Based on the data gathered in accordance with the applicant's experimental use permit, sodium cyanide when used in the M-44 has been shown to be significantly less hazardous to man than sodium cyanide when used in the explosive device for which it was registered at the time of the 1972 Order and which was known to cause injuries to humans. Based on studies by the FWS since the 1972 Order, use of sodium cyanide in the M-44 device is more selective than use of the chemical in the explosive device and more selective than some other chemical and non-chemical predator control methods.

In response to this registration application it was determined that substantial new evidence was submitted, an announcement was made of a public hearing for August 12-15, 1975 in Washington, D.C. (Federal Register, July 15, 1975).

To review program accomplishments, problems and to discuss a probable course of action, EPA sponsored a two day workshop of experimental use permit personnel in mid-July in Denver. Written and oral reports were presented by those agency personnel involved in the conduct of the various programs. Generally, these programs represent attempts to gather data on the use of the M-44 in a variety of geographical locations by various categories of applicators. They do not lend themselves to statistical analysis by virtue of their design. The programs were to measure the usefulness of the M-44 as a method of reducing domestic livestock and poultry losses due to predation by coyotes and, in some localities, red foxes.

The objectives of the state programs, generally, were similar to those of Kansas:

1) Determine the effects of the use of the SCSLEM in coyote damage with regard to human safety.
2) Determine the selectivity of the SCSLEMs when used to control coyote damage.
3) Determine the effects of the SCSLEMs on livestock losses by coyotes where SCSLEMs are used as compared to livestock losses where SCSLEMs are not used.
4) Determine the most effective placement location of the SCSLEM for taking coyotes.
5) Determine the amount of coyote control that can be achieved through the use of the SCSLEMs without causing "unreasonable adverse effects" on the environment.
6) Determine the effectiveness and cost of controlling coyotes with the SCSLEM as compared to controlling coyotes with non-chemical methods such as trapping and shooting.
7) Determine the economic benefits derived from the use of the SCSLEM and other methods of controlling coyotes.

In the Federal Register notice of July 15, 1975 opportunity was given to any person who wished to intervene to file briefs. Opportunity was also given to states or individuals to apply for registration of sodium cyanide in the M-44 device and become a part at the hearing.

Other applications joined in this proceeding were: Montana Department of Livestock, Wyoming Department of Agriculture, Colorado Department of Agriculture, Texas Department of Agriculture, Oregon Department of Agriculture, Nevada State Department of Agriculture and the M-44 Safety Predator Control Company.

The hearings were conducted on schedule with appearances entered by the U.S. Fish and Wildlife Service, the states of Wyoming, Montana and Oregon, Environmental Defense Fund, et al., the Humane Society, the National Wool Growers, et al. and EPA counsel for the respondent.

The Administrative Law Judge in his Initial Decision lists 37 findings of fact on which he based his conclusions favoring the registration of sodium cyanide for use in the M-44 device. He appended some 26 restrictions or conditions of use (Federal Register, August 29, 1975).

Mr. Russell E. Train, EPA Administrator rendered his final Decision on this matter on September 16, 1975 (Federal Register, 1975). He reviewed the background of events leading up to the experimental programs, the public hearing and his Decision. He set forth in detail his rationale for his Decision which favored registration of sodium cyanide for use in the M-44 with 26 restrictions (appended). These delineate users, permissible and prohibited uses, placement, supervision, inspection and removal of devices, safety precautions, antidote protection and records.

The following summaries of the experimental use permit programs include field observations, written monthly and final reports and the comments made at the July workshop in Denver. Table 2 lists the number of authorized SCSLEMs and capsules, number and category of applicators, number of approved and active counties as well as number of animals taken with the M-44. The summaries that follow are presented in chronological order in which the experimental use permits were issued: 1) Texas, 2) Montana, 3) California, 4) Department of Interior (FWS), 5) South Dakota, 6) Idaho, 7) Nebraska, 8) Kansas, 9) Texas A. & M. University. The dates indicate the month the program started and the permit expiration date.

Table 3 reflects common problems and observations experienced by the users of the M-44 equipment obtained from Midland, Texas.

Table 2. Experimental use permit program data.

Use Permit Holder	No. Authorized SCSLEMs	No. Authorized NaCN capsules	Applicators No.	Applicators Category[1]	No. Counties Approved	No. Counties Active	No. Animals Taken with M-44 Coyotes	Fox	Dog	Total Canids	Non-target Species	Total
Texas	3900	39000	350	RP	44	32	345	125	-	470	173	643
Montana	5250	52500	194	1 SCT, LPO	23	23[2]	670	156	4[3]	830	36	866
California	300	1800	3	CT	12	1	4	-	1[4]	5	1	6
South Dakota	2500	25000	194	RP	23	23	184	40	-	224	15	239
Idaho	600	3000	4	RP	10	8	3	-	-	3	-	3
Nebraska	3000	30000	214	RP	29	27	292	-	-	292	58	350
Kansas	150	2000	16	RP	40	7	26	-	-	26	-	26
Texas A. & M.	150	1500	3	U	1	1	3	-	-	3	5	8
Dept. of Int.	20000	200000	420	FSFA	NA	NA	3443	604	86[5]	4133	506	4639
Total	315850	354800	1398	--			4970	925	91	5986	794	6780
Percentage	-	-	-	--	--	--	73.4	13.6	1.3	88.3	11.7	100

[1] Code for category of active applicator: RP=Rancher-producer; SCT=State/County Trappers; LPO=Licensed Pesticide Operators (ranchers, biologists, others); FSFA=Federal/State District Field Assistants; CT=County Trappers; U=University personnel.

[2] includes Ft. Peck Indian Reservation

[3] 2 predators, 2 stray domestic dogs

[4] domestic dog

[5] includes 1 domestic dog

Table 3. Experimental use permit program observations.

Observation	Texas	Montana	California	So. Dakota	Idaho	Nebraska	Kansas	Tex. A. & M.	DOI (FWS)*
Delay in program implementation because of:									
-court action	X								
-in receiving M-44 equipment		X				X			
Severe caking problems of capsule contents			X					X	
Minor caking problems of capsule contents	X	X		X		X			
Mechanical problems with M-44		X		X			X		
Applicators delinquent in reporting	X			X		X			
Fading of warning signs:									
-area signs		X	X	X	X	X	X	X	
-stake signs	X	X	X	X	X	X	X	X	
Non-canid interference with M-44's			X					X	
Some scents ineffective				X		X			
No accidents with M-44's	X	X	X	X	X	X	X	X	
Need longer M-44 bases for sandy or soft soils	X			X		X	X		
Favor registration for use by:									
-rancher-producers	X						X		
-county/state trappers		X	X	X					
-federal/state district field assistants					X	X			X
-licensed pesticide operators		X							

*Note: D.O.I. (FWS), through previous years' use of the M'44, overcame major problems such as caking of capsules, mechanical problems with the M-44 and fading of warning signs. Only minor problems were experienced during the 18-month study.

(1) Texas Department of Agriculture (3/74-6/75)

While the Department of Agriculture coordinated the Texas program, the Agricultural Experiment Station evaluated the data, Wildlife Extension Specialists held over 50 training sessions for 3200 potential rancher-producer applicators (assisted in part by U.S. Fish and Wildlife Service personnel) and County Agents received and forwarded the 350 monthly applicator reports in 32 active counties. M-44 equipment was sold to approved applicators by authorized county dealers. Because of a lack of manpower, there was no direct supervision of the field use of the M-44.

Evaluation personnel maintain that the design of the program is such that the data is not conducive to objective analysis, sufficient valid livestock loss data is lacking for comparative purposes, the extent of predator control on study sites should be known before experimental uses, and that there must be controls of as many variables as possible.

Animals taken with M-44

Coyote..... 345

Fox..... 125

Non-target species..... 173

(2) Montana Department of Livestock (7/74-10/15/75)

The Department of Livestock administered this program with the Department of Agriculture certifying the 278 applicators who were composed of state and county trappers and licensed pesticide operators (ranchers and other approved individuals). Twenty-three training sessions were presented in 22 counties and the Fort Peck Indian Reservation. This training commenced July 1, 1974 and ended on February 20, 1975. Follow-up supervision of 194 active applicators in the field was given. This 15 month program was conducted throughout the bird and big-game hunting seasons without accidents. Hunters and other recreationists were publicly advised to check at county court hourses regarding the placement of M-44 devices. Data records devised for this program are valuable in providing insights into the preferred M-44 placement locations. Data was collected from a variety of ecosystems. Unusually late and heavy snowfall hampered early spring efforts. A periodic newsletter was sent to applicators and other concerned individuals regarding the status of the program. From 7/1/74 to 7/1/75 equipment to conduct the program costs $14,609.00: average cost/target animal (608 coyotes, 148 fox) = $19.32; versus other control costs/animal: helicopter = $45.00; fixed wing = $25.00 and state trapper = $200.00. Species taken and placement sites of M-44 devices are shown in Table 4.

(3) California Department of Food and Agriculture (10/74-6/75)

This program was initially limited to 11 counties where the County Agricultural Commissioner conducts predatory animal control activities. Division of Wildlife Services trained personnel in the use of the SCSLEM. Of the two counties finally selected for the program, Tehema County actually participated. Three county trappers worked in 4 study areas of 3 large sheep ranches:

Area	Square miles	Type Control
A	4.5	SCSLEMs only
B	5.8	Traps only
C	2.8	SCSLEMs and traps
D	10.5	Traps, snares, denning, shooting (ground & air)

California Fish and Game Department monitored this program regarding the impact on non-target species. Scent post studies were carried out three times during the 13 month study. The use of SCSLEMs in Area A was discontinued in April. As seen from the data charts below, the M-44 device is quite selective when compared to the steel traps.

Animals Taken Per Area

Area	Control Method	Number of Animals Taken		
		Coyotes	Non-target species	Total
A	SCSLEMs	3	2	5
B	Traps	2	53	55
C	SCSLEMs	1	--	1
	Traps	2	14	16
D	Traps	3	18	21
	Shooting - aerial	7	--	7
	Shooting - ground	2	--	2
	Snares, denning	-	--	--
	TOTAL	20	87	107

Table 4. Species taken/placement site: July 1, 1974 - June 30, 1975.

PLACEMENT LOCATION	M-44 PLACEMENT				SPECIES TAKEN							
	Capsules Initially Placed	Capsules Replaced	Total Capsules Placed and Replaced	Total Capsules Retreived (Non-fired)	Coyote	Fox	Bobcat	Badger	Skunk	Raccoon	Dog	Other
kill sight	888	251	1139	151	85	20			6	1	1	
sheep pasture	673	142	815	190	36	43			2	1		
cattle pasture	934	110	1044	195	48	10		1			1	
travel trails	2375	394	2769	479	182	30			8	3	1	
old bone piles	935	194	1129	139	101	19			3	1	1	
stock water dam	376	77	453	48	14	12			1			
den area	102	31	133	17	19	6			1			
other	946	184	1130	158	123	8			2			
Total	7229	1383	8612	1377	608	148		1	23	6	4	

Animals taken with the M-44

Coyote..... 670
Fox..... 156
Dog..... 4 830 canid (96.3%)

Skunk..... 24
Raccoon..... 6
Badger..... 2 Non-canid (3.7%)

Total... 862

Of the total of 20 coyotes, 4 or 20% were taken with the SCSLEM in Areas A and C; traps and aerial shooting accounted for 7 or 35% each. Traps took a total of 85 or 97.7% of the non-target animals [54 of these were released unharmed (Bishoff, 1975)].

Relative Efficiency of Control Methods

Area	SCSLEM set days	Trap set days	Aircraft hours	Number of Coyotes	Number of Non-target species
A	5,202	--	--	3	2
B	--	3,296	--	2	53
C	4,611	--	--	1	--
D*	--	2,399	--	3	18
	--	--	13.4	7	--

*ground shooting in Area D accounted for 2 more coyotes.

Sheep Population and Confirmed Lamb Losses Per Area

Area	Average Population Ewe	Lamb	Confirmed Losses to Predators Number	Percentage
A	1062	1580	50*	3.2%
B	1455	1911	36	1.9%
C	920	1073	6	0.5%
D	2994	3349	55	1.6%

*includes 2 ewes.

The value of the confirmed losses was $6894.30 (at 46.90/head market value). An additional 336 sheep, listed as unconfirmed losses, were valued at $15,758.40 (334 lambs, 2 ewes). The most lambs lost to confirmed predation were in Area A. Coyotes were the primary predator accounting for sheep losses, including 4 ewes. Three lambs were taken by bobcats.

(4) Department of the Interior (FWS) (5/28/74-10/31/75)

This activity was conducted as a part of the U.S. Fish and Wildlife Service's Animal Damage Control Program and was carried out under the emergency provisions of Executive Order No. 11643.

Over 20,000 SCSLEMs were approved for use in 11 western states to control depredations on livestock by wild canids during this 18 month period. The use of sodium cyanide capsules in the M-44 was authorized for specific levels of livestock loss as reported by livestock producers. Losses were verified by FWS District Field Assistants prior to approval.

Table 2 reflects the numbers of animals taken by month from June 1974 through October 1975. The target animals were coyotes, foxes and feral dogs preying on livestock.

The first experimental use permit issued to the DOI covered the period, 5/28/74 through October 31, 1974. The permit was extended for 12 months to October 31, 1975. Three separate reports were submitted covering this activity:

(1) Report on M-44 Efficacy Data - June 1, 1974 to October 31, 1974.
(2) M-44 Use Data - November 1, 1974 to May 31, 1975.
(3) A Report on Emergency Use of the M-44 Cyanide Ejector for Canid Damage Control by the U.S. Department of the Interior - June 1, 1975 to October 31, 1975.

Animals Taken By the M-44 - 5/28/74 to 10/31/75

Species	Period June-Oct.'74	Nov.'74-May'75	June-Oct.'75	Total
Coyote	573	1949	921	3443
Fox	119	424	61	604
Feral dog	6	64	16	86*
Sub-total(canid)	698 (95.0%)	2437 (88.4%)	998 (87.0%)	4133 (89.1%)
Skunk	10	161	36	207
Opossum	16	116	75	207
Raccoon	10	38	31	79
Ringtail cat	--	3	2	5
Raven	--	1	2	3
Bobcat	--	2	--	2
Badger	--	--	1	1
Armadillo	--	--	1	1
Calf	1	--	--	1
Sub-total/%	37 (5.0%)	321 (11.6%)	148 (13.0%)	506 (10.9%)
Total	735	2758	1146	4639

*1 domestic dog.

A total of 1,409,185 M-44 use days removed 3443 coyotes for an average of 409.3 use days per coyote. Other canids taken (604 foxes, 85 feral dogs, 1 domestic dog) bring the total to 4133. Wild canids comprise 89.1% of the total animals taken. A total of 50 non-canid or non-target species made up 10.9% of the total of 4639 animals taken (Table 5). Thirteen species of animals were taken throughout this study. Skunks, opossums and raccoons comprised the largest percentage of non-target species, 40.9%, 40.9% and 15.6%, respectively.

M-44 Use Days

Study Period	No. coyotes	No. M-44 Use Days	Avr. use days/coyote
June-Oct.'74	573	189,010	329.9
Nov.'74-May'75	1949	787,112	403.9
June-Oct.'75	921	433,063	470.2
TOTAL	3443	1,409,185	Avr. 409.3

Over 86% of the requests were approved for use in FWS Region 2 (Texas, New Mexico, Oklahoma and Arizona).

(5) South Dakota Department of Agriculture (10/74-7/1/75)

This program was administered by the Department of Game, Fish and Parks in cooperation with the Agriculture Extension Service and the South Dakota State University. Animal Damage Control Trappers in 14 districts served as coordinators of 194 rancher-producer applicators in 23 approved counties west of the Missouri River. Applicators were issued 1100 SCSLEMs, however, insufficient numbers of devices early in the program delayed planned use. All reports from three control areas were not submitted.

Table 5. Department of Interior (FWS), animals taken with the M-44 by month.

Month(s)	Coyote	Fox	Feral dog	Total Canids	Raccoon	Skunks	Opossum	Ring-tail Cat	Bob-cat	Other	Total Non-Canids	Total Animals
May 28-Oct. 31,'74	573	119	6	698	10	10	14	--	--	1 calf	35	733
Nov.'74	251	73	6	330	5	14	5	--	--	--	24	354
Dec.'74	271	77	5	353	9	14	2	--	1	1 raven	27	380
Jan.'75	295	78	13	386	5	9	6	--	1	--	21	407
Feb.'75	307	68	13	388	1	28	12	1	--	--	42	430
Mar.'75	393	58	10	461	11	49	43	2	--	--	105	566
Apr.'75	206	44	10	260	7	25	31	--	--	--	63	323
May '75	226	26	7	259	--	22	19	--	--	--	41	301
June '75	152	4	2	158	2	14	20	--	--	1 badger	37	195
July '75	139	8	5	152	3	12	28	--	--	2 ravens	45	197
Aug.'75	124	7	1	132	4	3	--	--	--	--	7	139
Sept.'75	226	23	3*	252	5	3	17	--	--	--	25	277
Oct.'75	280	19	5	304	17	4	10	2	--	1 armadillo	34	338
Total	3443	604	86	4133	79	208	207	5	2	6	506	4639
%	74.2	13.0	1.8	89.1	1.7	4.5	4.5	0.1	Trace	0.1	10.9	100

*1 domestic dog

M-44 Data: November 1974 - July 1975

Month	No. M-44's Used	No. Capsules Discharged	Number Animals Taken				
			Coyotes	Red Fox	Total Canid	Non-Targets	Total
Nov.'74	266	54	31	9	40	4	44
Dec.	356	48	41	12	53	--	53
Jan.'75	434	58	49	13	62	7	69
Feb.	336	56	47	4	51	3	54
Mar.	217	39	11	--	11	1	12
Apr.	119	15	4	2	6	--	6
May	49	12	1	--	1	--	1
June	2	--	--	--	--	--	--
Total	--	282	184	40	224	15	239
Percentage	--	--	77.0	16.7	93.7	6.3	100

Of the 184 coyotes, 168 or 91.3% were taken during the Nov.-Feb. period. An additional 292 animals were taken by non-chemical means during this study period. Of these, 186 or 63.7% were coyotes and 90 or 30.8% were red foxes. Most of these were also taken during the Nov.-Feb. period.

(6) Idaho Department of Agriculture (12/74-6/30/75)

The Idaho Sheep Commission administered this program which was to involve 8 large sheep ranches in 10 counties. Heavy snowfall in Idaho prevented effective use of the M-44. Two applicators actually used the device in western Idaho only, accounting for 3 coyotes. Helicopter hunting took 307 coyotes and destroyed 2 dens over a 5 month period in an area where the M-44 was placed for one month.

(7) Nebraska Department of Agriculture (1/75-9/30/75)

Department of Agriculture and U.S. Fish and Wildlife personnel trained 214 rancher-producer applicators in 29 counties. Game Commission employees were designated as District Coordinators to maintain applicator's records, distribute SCSLEM equipment and monitor the program. Applicators purchased 1367 SCSLEMs and used 1278 capsules to take 350 animals (292 coyotes, 58 non-targets) during this 9 month operational program.

M-44 Data: Jan.-Sept. 1975

Month	No. Active Applicators	No. M-44's Used	No. Capsules Used	Number Animals Taken		
				Coyotes	Non-Targets	Total
Jan./Feb.	155	734	642	150	16	166
March	117	563	341	84	13	97
April	54	247	154	32	9	41
May	14	63	48	12	1	13
June	4	14	8	1	--	1
July	6	27	22	2	4	6
Aug.	3	15	22	--	4	4
Sept.	3	20	41	11	11	22
Total	--	--	1278	292	58	350
Percentage	--	--	--	83.4	16.6	100

There were 277 discharges of SCSLEMs with no animal recovery. Of the 275 livestock reported lost to coyotes, 133 were calves, 8 cattle, 29 sheep, 9 lambs, 84 poultry, 2 hogs and 10 pigs. Skunks comprised the highest number of non-target animals (31 of the 58 taken). Steel traps took an additional 103 animals (67 or 65% were coyotes, 18 skunks, 9 opossum and 1 dog). Ground shooting accounted for 203 coyotes while denning took 22 coyotes and 4 fox.

(8) Kansas State University (2/75-6/30/75)

The Extension Service directed this program in cooperation with the Forestry, Fish and Game Commission and the Agricultural Experiment Station. Extension Agents served as county coordinators. The SCSLEM cannot be used in Kansas during the open game season (normally Sept. 1-Jan. 31). Kansas law also requires a permit be issued to each qualified applicator and the Wildlife Damage Control Extension Specialist investigate each case where the SCSLEM device is requested. The Extension Specialist personally assessed each livestock damage situation and trained individual applicators. Of 21 permits requested, 16 were granted. Applicators rented SCSLEMs and purchased capsules of sodium cyanide and state printed warning signs. Of 72 SCSLEMs used, 57 discharged, accounting for 26 coyotes. Twelve SCSLEMs malfunctioned.

(9) Texas A. & M. University (2/75-8/31/75) (Beasom & Gober, 1975).

Three areas of approximately 4 sections each in Pecos and Brewster counties in Southwest Texas comprised the treatment sites. Twelve miles distance separated the study areas. A uniform flock of 450 randomly selected pregnant ewe sheep were divided into three flocks of 150 which were placed in the study areas in Feb. 1975. Lambing began in April; all sheep were removed in mid-August. Each study area had a different level of treatment:

Study Area	Type Treatment
1	100 M-44's
2	50 M-44's, 60 snares, 40 traps, 12 hours helicopter flying
3	control

Daily observations of sheep were made from horseback, foot and/or vehicle throughout the study period. Coyote numbers were indexed by track and scat counts monthly, strip transect censuses identified other animals present and, rodent densities were monitored by live trapping and release. M-44 placements were checked daily, scent baits renewed every two weeks and capsules of sodium cyanide replaced in April and June. Data on sheep and lamb survival, intensity and type of predator control techniques deployed, range conditions, number of predators removed and predator populations solicited from as many as 100 Pecos County producers.

Vegetation in study areas consists primarily of short grass and scrubby species such as creosote bush, tar bush and mesquite.

Program Results: Feb.-Aug. 1975

Control Method	No. Use Days	Number of Animals Taken			
		Coyote	Bobcat	Other	Total
M-44's	10,163	3	-	5*	8
Steel traps	6,710	3	6	75**	84
Snares	12,119	19	1	83***	103
Helicopter shooting (12 hours)		21	-	-	21
Ground shooting	-	4	1	-	5
Total	-	50	8	163	221

*2 raccoons, 1 ewe, 1 calf, 1 rodent **includes 17 jackrabbit, 16 cottontail, 16 porcupine ***includes 43 jackrabbit, 11 cottontail, 11 javelina

Sixteen of the 19 coyotes taken by snares and 15 of the 21 coyotes taken by helicopter hunting were in February.

Sheep and Lamb Losses by Study Area

Area	Number of Losses					
	To all causes			To predation		
	Lambs	Ewes	Total	Lambs	Ewes	Total
1	23	8	31	1	1	2
2	53	6	59	27	1	28
3	62	12	74	14	1	15
Total	138	26	164	42	3	45

The inefficiency of the M-44 in this study is believed to be related to the abundance of available prey (high density of rabbits and other small rodents), also lower levels of predator activity reduced chances of predator-M-44 interactions. Cattle accounted for discharging 94 of 105 M-44 devices.

This study, made possible through an EPA grant, is continuing into a second year under the leadership of Dr. Sam Beasom of Texas A. & M. University.

SUMMARY

Each of the nine experimental use permit programs, regardless of size, contributed to the knowledge of the M-44's use to control predators. The findings essentially support earlier use of the device: it is safe and reasonably selective when used by trained applicators under supervision. Admittedly, some of the programs were too short lived to produce any quantity of valid data and it is recognized that the programs were not designed adequately to eliminate all variables. Ideally, the programs should have been conducted over a much longer period of time (perhaps 3 years). Long term studies, such as being carried out by Texas A. & M. University, are needed to more accurately compare costs of the various control methods, determine the economic benefits of taking problem coyotes and define predator-prey relationships.

There is concern that the rancher-producer does not have or take the time to accurately record predator kills, placement sites and other pertinent data. Some persons contend that "scientific data" should be collected only by the full time professional government affiliated trapper or agent.

Of the nearly 7000 animals taken throughout the period of these nine experimental use permit programs, 88.3% were canids (73.4% coyotes, 13.6% foxes, 1.3% dogs). While nearly 12% of the animals were classed as non-targets, the biggest percentage of these were skunks and opossums. These smaller species are more abundant and their removal is not regarded as having an appreciable impact on their populations. With current technology, it is difficult to determine the significance of those numbers in terms of the percentages of species actually exposed (Knowlton, 1975).

The M-44 is placed generally upwind of well traveled coyote trails. The sites preferred are ridge tops and saddles, feeder ridges leading to lambing ranges and areas adjacent draw stations. The best time of placement may vary per locality but normally more coyotes are taken with the M-44 during the cooler months.

There is a consensus among the users that the M-44 is a rather selective, safe, efficient and humane tool to temporarily control depredating predators. Compared with other predator control methods it is reasonably economical. With registration of the M-44 sodium cyanide capsules, under Section 3 of FIFRA as amended, there are adequate controls to ensure that it will not pose a hazard to the environment.

To date there have been 8 registrations for sodium cyanide capsules for use in the M-44 or SCSLEM device:*

*7 registrants have written authorization to use U.S. Fish and Wildlife's data to support their applications for registration.

	Agency	Date of Registration
1)	U.S. Dept. of the Interior Fish and Wildlife Service	Nov. 3, 1975
2)	Wyoming Dept. of Agriculture	Nov. 3, 1975
3)	Montana Dept. of Livestock	Nov. 18, 1975
4)	Oregon Dept. of Agriculture	Nov. 18, 1975
5)	California Dept. of Food & Agriculture	Nov. 26, 1975
6)	South Dakota Dept. of Game, Fish & Parks	Dec. 3, 1975
7)	Colorado Dept. of Agriculture	Dec. 17, 1975
8)	M-44 Safety Predator Control Company	Mar. 3, 1976

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