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EXPERIMENTAL USE OF SODIUM CYANIDE SPRING-LOADED EJECTOR MECHANISM FOR COYOTE CONTROL IN CALIFORNIA

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The U.S. Environmental Protection Agency under authority of the Federal Insecticide, Fungicide and Rodenticide Act, as amended, granted the California Department of Food and Agriculture an experimental permit to obtain data to support registration of sodium cyanide as a predicide. The program was implemented by the Tehama County Department of Agriculture. The experimental permit provided for use of not more than 300 sodium cyanide spring-loaded ejector mechanisms (SCSLEM) and 1,800 sodium cyanide capsules. The permit was issued April 1, 1974 and expired June 1, 1975.

The program objectives were to: (1) measure the usefulness of the SCSLEM as a method of reducing domestic livestock losses due to predation by coyotes; (2) measure the effectiveness and economics of reducing livestock losses from coyotes only during the principal lambing period from September through May; (3) determine the cost of controlling coyotes with SCSLEM's as compared to trapping, shooting, and denning; (4) evaluate the effect of SCSLEM's on non-target species; (5) evaluate the selectivity of SCSLEM's when used to control coyotes; (6) measure the amount of coyote control that can be achieved through the use of SCSLEM's without causing unreasonable adverse effects on the environment; and (7) evaluate the use of SCSLEM's with regards to human safety.

The following methods of coyote control were used in four areas:

Area "A" - Coyote control was restricted to the use of the SCSLEM.

Area "B" - Coyote control consisted of trapping without the use of the SCSLEM.

Area "C" - Coyote control using traps and supplemented by SCSLEM's during the principal lambing period from September through May when steel traps had not prevented economic loss to sheep, or when adverse weather conditions rendered all normally accepted control measures ineffective.

Area "D" - Preventive coyote control consisting of trapping, shooting and denning.

DESCRIPTION OF STUDY AREAS

The experimental program involved three sheep ranches in Tehama County selected by the County Agricultural Commissioner.

Area "A" and "B" were located approximately two miles apart on a 15,000 acre sheep ranch 15 miles southwest of Red Bluff. Area "A" was 4.5 square miles of fenced rangeland. The southern boundary was an oak woodland association along Elder Creek. Open rolling rangeland surrounded the remaining study area. Area "B" was 5.8 square miles of fenced rangeland. Open grassland interspersed with oaks and brush fields occurred along the northwestern boundary. Rangeland surrounded the remaining study area.

Area "C" was five miles north of Area "A" and nine miles west of Red Bluff. This area was 2.8 square miles of fenced rangeland with scattered trees and brush in the draws and washes. Rangeland, interspersed with oaks and brush, surrounded the area.

Area "D", 14 miles southeast of Red Bluff, was 10.6 square miles of open flat rangeland interspersed with oaks and brush along the northern and southern boundaries. Rangeland continued on the east and west side of the study area.

METHODS

The California Department of Fish and Game cooperated in the experimental program by providing information on coyote and non-target species within the study areas.

Written permission was granted by each landowner to allow representatives of the California Departments of Food and Agriculture, Fish and Game, the Tehama County Agricultural Commissioner's Office and the Environmental Protection Agency to enter upon the property for the purpose of inspecting and monitoring all aspects of the experimental program. The use of SCSLEM's was restricted to county predatory animal control personnel. Landowners were not authorized to use sodium cyanide or to place or retrieve SCSLEM's.

Four predatory animal trappers from the Tehama County Agricultural Commissioner's Office were approved to use SCSLEM's by the Department of Food and Agriculture. Each trapper completed an Environmental Protection Agency approved training program that was conducted by the U.S. Fish and Wildlife Service. The trappers were competent in trapping techniques, but had no previous experience operating SCSLEM's.

The Department of Food and Agriculture purchased SCSLEM's and sodium cyanide capsules from the M-44 Safety Predator Control Company in Midland, Texas. Transfer records of the SCSLEM's and sodium cyanide capsules to the agricultural commissioner's office was maintained by the Department of Food and Agriculture. Cyanide antidote kits were furnished to county trappers.

Weekly records maintained for each study area included individual numbers of traps or SCSLEM's, placement sites, date of animal take and/or release, date of discharge or no take, reason, weather conditions, and trap or SCSLEM removal date. A record of man hours and miles driven in each study area was kept. These weekly records plus the sheep population, confirmed and unconfirmed sheep losses to predators in each study area was tabulated monthly and submitted to the Environmental Protection Agency.

Prior to the placement of SCSLEM's in the study area, bilingual warning signs alerting the public to the toxic nature of sodium cyanide and the danger to dogs were posted at main entrances and access points around study area "A" and "C". In addition, elevated warning signs indicating the direction to SCSLEM placement sites and antidote information for sodium cyanide was placed on survey stakes and positioned 3 to 10 feet from each SCSLEM location. Study areas "B", "C" and "D" were posted with trap warning signs prior to the experimental program.

"Montgomery step-in" and "Victor double spring" off-set traps were used during the study. Trap placement was along dirt roads, ridges, draws and fence crawl holes. Coyote urine and Hawbaker's 500 and 800 scents were used separately or in combination with trap sets.

SCSLEM placement sites were located in similar areas as traps. Maps were prepared showing the location of each SCSLEM. A fetid scent (Mast No. 6, Cunningham's Coyote Food Lure, Hawbaker's Food Lure No. 10, and Simpson's Special) was used with SCSLEM's. SCSLEM and trap sites were visited twice a week.

Non-target animals were released from traps whenever practicable, but some animals died while confined in the traps and others, being crippled, were destroyed. No effort was made to release skunks alive.

After each SCSLEM discharge the immediate area around the site was searched thoroughly, and the distance from the SCSLEM site to the point of animal recovery was measured. When a SCSLEM was discharged without a known take, the animal species was identified by tracks in the immediate area and/or by teeth marks on the SCSLEM case holder.

Livestock Losses

Sheep losses from coyotes during the study were reported as confirmed when verified by the county trapper, and unconfirmed when reported to the trapper by ranch personnel. The percentage of sheep kills confirmed and unconfirmed from predators was calculated from the average lamb and ewe population in each study area from docking, shearing and shipping counts. The percentage of unconfirmed sheep deaths to unknown causes was figured from the average lamb and ewe population in each study area. The value of lambs during the study was obtained from the California Crop and Livestock Reporting Service as of June 15, 1975.

The number of confirmed sheep losses from coyotes in each study area during 1973 was obtained from county trapping records. The average market value of sheep was obtained from the Tehama County Crop Report, 1973.

Scent Post Survey

Wildlife trends were determined by scent post surveys conducted in the study area between September 1974 and June 1975. The first was made in September 1974 prior to the introduction of sheep into the study areas. The weather during the survey was hot and clear. The second survey occurred during the last week of February and the first week of March 1975 after lambing had occurred and sheep populations were high. Weather conditions during the survey were overcast with rain occurring the last day. The last survey was in June 1975 after the sheep were shipped from each study area. A few sheep were present in areas "B" and "C" during the survey. Weather was cool-clear; however, rain prevented the last day's reading of stations in area "D".

The scent post survey method was patterned after that used by the U.S. Fish and Wildlife Service. A two inch square wool pad containing an attractant (O.L. Butcher's Coyote Gland No. 1 Scent) was placed in the middle of a three foot circle of sifted dirt. Scent post stations were established at favorable sites. Fifteen stations were placed in each of the four study areas. Each station was checked daily for five consecutive days and animal visits recorded. Only tracks within the circle of sifted earth were tallied. The tracks of each species were recorded as one visit; however, where tracks were definitely known to be that of two animals (adult and juvenile) two visits were recorded for that night.

With the following exceptions, the location of scent post stations in the four study areas were the same during each survey period. During the second scent post survey five stations in area "A" were relocated because of land use changes (pasture to cultivated lands) and two stations in area "C" were moved approximately 100 yards. The third survey utilized only 11 stations in area "D", as four stations were not accessible.

RESULTS

Study Area "A"

The experimental program in area "A" began October 17, 1974 after 1,062 bred ewes were introduced into the study area. In 5,202 SCSLEM set-days (single sets) three coyotes were killed and recovered during the study. One coyote was taken after five days, a second after 49 days and a third after 95 days. The distances to the carcass from the SCSLEM were 140 feet, 133 feet and 63 feet respectively.

Coyotes discharged an additional six SCSLEM's, but either escaped or the carcass was not found. A raccoon and one domestic dog were killed during 562 days of SCSLEM use.

After 51 days into the study the sodium cyanide capsules were found to be absorbing moisture. The cyanide formed into a hard pellet which was then ejected when the SCSLEM was pulled. The moisture problem was confirmed by an Environmental Protection Agency laboratory analysis of 30 sodium cyanide capsules. The supplier of sodium cyanide capsules informed the Department of Food and Agriculture in March that a malfunction occurred during the capsule manufacturing process causing many fine holes in the capsule base. Several attempts to correct the problem by applying a sealant failed.

The experimental program in area "A" ended on April 24, 1975 when the SCSLEM case holders and capsules were removed by county trappers. This was done to prevent the accidental killing of dogs that were being used to track coyotes in connection with an aerial hunting program on property adjacent to the study area.

Twelve coyotes taken by traps and aerial hunting within a five mile buffer strip around area "A" were not included in the study area data. One trapper spent 287 hours servicing the SCSLEM's by horseback or vehicle during the seven month control program. A total of 708 miles was driven. The cost of wages and mileage was \$1,230.09.

Study Area "B"

The experimental program in area "B" began on October 21, 1974 after 1,455 bred ewes were placed in the study area. In 3,296 trap-set days (single or double sets) two coyotes were captured. One coyote was taken after four days and the second after 14 days. Fifty-three non-target animals were captured. Thirty-three were released, 17 were destroyed, and three died in traps. Forty trap-sets were sprung without a take by livestock, unknown animals and/or washouts.

The experimental program in area "B" ended on May 29, 1975. Traps and aerial hunting within a five mile buffer strip around area "B" took 16 coyotes during the study period. These animals are not included in the study area data. The cost of 323 trapline hours and 833 miles of travel in area "B" was \$1,521.16.

Study Area "C"

The experimental program in area "C" began on October 17, 1974 after 920 bred ewes entered the study area. Traps were supplemented by SCSLEM's in mid-December after 11 lambs were killed by coyotes, and adverse weather conditions made it difficult to trap effectively.

In 1,018 trap-set days (double sets) two coyotes were captured. Seventy-five days were required to take the first coyote and 88 days to take the other. Fourteen non-target animals were captured. Ten were released and four destroyed.

In 4,611 SCSLEM set-days (single sets) one coyote was recovered. One hundred fifty-eight days were required to take the animal. The carcass was 168 feet from the SCSLEM. Ten SCSLEM's were discharged without a take by four coyotes, four feral pigs and two unknown causes.

Moisture problems with the sodium cyanide capsules also occurred in study area "C". Defective capsules were involved in three SCSLEM discharges without a coyote take. This occurred after 11, 67 and 72 days into the study. A Varathane spray applied to the capsules solved the moisture problem in May when the only coyote was taken.

The experimental program in area "C" ended on May 30, 1975. No coyotes were taken within a five mile buffer strip of area "C" during the study period. The cost of maintaining trap and SCSLEM lines in area "C" was \$927.57 requiring 215 man hours and 581 miles of travel.

Study Area "D"

The experimental program in area "D" began on October 21, 1974 prior to the introduction in November of 2,994 bred ewes. In 2,399 trap-set days (single or double sets) three coyotes were captured. One coyote was taken after one day, a second coyote after two days and 66 days were required to take the third coyote. Eighteen non-target animals were captured - 9 were released and 9 destroyed. Nineteen trap sets were sprung by livestock, deer or washouts.

Beginning December seven coyotes were taken by aerial hunting. Fixed and non-fixed wing aircraft were used. The aircraft was used nine times and logged 13.4 hours at a cost of \$705.50. Two coyotes were taken on the ground by shooting, one each in November and May. Den hunting in April resulted in no coyotes being taken after a four hour search.

The experimental program in area "D" ended May 30, 1975. No coyotes were taken with a five mile buffer strip of area "D" during the study. Four hundred twenty-nine man hours and 1,094 truck miles traveled in the study area cost \$1,970.69.

Livestock Losses

Sheep losses in the study areas from coyotes in 1973 were obtained from county trapping records. This data is presented in the table below.

<u>Area</u>	<u>Confirmed Sheep Deaths</u>	<u>Value*</u>
"A"	53	\$1,929.20
"B"	22	800.80
"C"	18	655.20
"D"	19	691.60

*Average market value of sheep and lambs was \$36.40 per head (Tehama County Crop Report, 1973).

During the experimental program the average lamb population in area "A" was 1,580 from January to May 29, 1975. There were 48 confirmed lamb kills by coyotes during this period (eight of these lamb kills occurred after the SCSLEM case holders were removed from the study area). Two ewes were killed by coyotes early in the study. Sixty-five unconfirmed lamb kills were attributed to coyotes. Fifty-two unknown sheep losses occurred between docking and shearing.

The average lamb population in study area "B" was 1,911 from January to May 29, 1975. There were 36 confirmed lamb kills, 33 by coyotes and three by bobcats. There were 57 unconfirmed lamb kills attributed to coyotes. An additional 39 lambs were lost to unknown causes between docking and shearing.

The lamb population in area "C" averaged 1,073 from January to May 30, 1975. There were six confirmed and 23 unconfirmed lamb kills by coyotes. Two unconfirmed ewe kills attributed to coyotes occurred late in the study.

The average lamb population in study area "D" was 3,349 from February to May 30, 1975. There were 55 confirmed lamb kills by coyotes. One hundred eighty-nine unconfirmed lambs were reported as killed by coyotes.

This data in addition to the market value of sheep losses is summarized below.

Study Area	Average Ewe Population	Average Lamb Population	Confirmed Predator Lamb Deaths		Value ^{1/}	Unconfirmed Predator Lamb Deaths		Value
"A"	1,062	1,580	50 ^{2/}	3.2%	\$2,345.00	65	4.1%	\$3,048.50
"B"	1,455	1,911	36	1.9%	1,688.40	57	3.0%	2,673.30
"C"	920	1,073	6	0.5%	281.40	25 ^{2/}	2.3%	1,172.50
"D"	2,994	3,349	55	1.6%	2,579.50	189	5.6%	8,864.10

^{1/}Average market value of lambs was \$46.90 per head (California Crop and Livestock Reporting Service, June 15, 1975).

^{2/}Includes two ewes.

Coyotes were responsible for nearly all confirmed and unconfirmed lamb deaths during the experimental program. Three lambs were killed by bobcats and four ewes were killed by coyotes.

Scent Post Survey

Fifteen species of wildlife were attracted to the scent post stations in the four study areas. The most numerous animals recorded were rabbits and rodents, followed by coyotes, deer, skunks, birds, foxes, raccoons, bobcats, feral cats and domesticated burros.

The low number of wildlife species that visited scent post stations in the second survey was attributed to the sheep population in each study area and the adverse weather conditions that occurred during that period. One exception was the red or grey fox population which increased their frequency of occurrence from three to 14 visits during the second survey in areas "A", "B" and "C". No coyotes visited the scent post stations during the second survey. There was a difference of only ten visits by animals to scent post stations from the first to the third survey. The frequency of occurrence of wildlife to scent post stations in area "A" where only SCSLEM's were used increased throughout the study.

The following chart lists the total station nights, visits, nights per animal visit and the numbers of wildlife that frequented the scent post stations during each survey period.

SCENT POST SURVEY
September 1974 - June 1975

Study Area	Area "A"			Area "B"			Area "C"			Area "D"		
	Sept	Feb Mar	June	Sept	Feb Mar	June	Sept	Feb Mar	June	Sept	Feb Mar	June
Total Station Nights	63	75	75	75	31	75	75	56	75	75	26	44
Total Station Visits	21	44	46	47	17	41	33	11	33	57	8	28
Nights Per Animal Visit	3.0	1.7	1.6	1.6	1.8	1.8	2.3	5.1	2.2	1.3	3.2	1.6
Coyote	4	0	4	2	0	3	0	0	1	15	0	9
Bobcat	1	1	0	2	0	0	6	0	1	0	0	1
Fox	1	8	5	2	4	1	0	2	0	0	0	0
Raccoon	0	2	0	2	0	1	7	0	5	1	1	0
Skunk	1	9	5	0	1	3	0	0	6	5	1	2
Ringtail Cat	0	0	0	0	0	0	0	1	0	0	0	0
Porcupine	0	0	0	0	0	0	1	0	0	0	0	0
Feral Cat	2	0	0	0	0	0	2	0	0	2	0	0
Rabbit	2	10	11	13	2	13	3	1	10	9	1	7
Deer	4	3	5	8	2	5	7	0	2	1	0	4
Burro	1	0	0	0	0	4	0	0	0	1	0	0
Rodents ^{1/}	4	10	12	13	8	3	5	7	0	21	5	3
Birds	1	0	4	5	0	4	2	0	7	2	0	2
Unidentified Tracks	0	1	0	0	0	4	0	0	1	0	0	0

^{1/} Ground squirrels, mice and kangaroo rats

Rainfall

Precipitation occurred during each month of the experimental program. Approximately seven inches of rain had fallen before the moisture problem was detected in the sodium cyanide capsules. The rainfall recorded at the Red Bluff Airport by the U.S. National Weather Service from October 1974 to May 1975 totaled 21.55 inches: October: 2.16, November: 0.91, December: 4.88, January: 1.80, February: 5.69, March: 4.72, April: 1.39, and May: trace.

DISCUSSION AND CONCLUSIONS

The effectiveness of SCSLEM's in reducing sheep losses due to predation by coyotes could not be determined from the experimental program because of the moisture problem created by the defective sodium cyanide capsules. Only four coyotes were taken and recovered with SCSLEM's during the study. The majority of the confirmed lamb kills by coyotes in area "A" occurred after the moisture problem was detected.

The effectiveness and economics of reducing sheep losses from coyotes was not demonstrated during the principal lambing period in area "C" because: (1) defective sodium cyanide capsules; (2) only one coyote taken and recovered; and (3) the limited size of the study area and the apparent low coyote density of that area.

A cost comparison of the SCSLEM method in relation to the other coyote control techniques is not meaningful when based on the limited data derived during the study. Therefore, the economics in reducing sheep losses to predation cannot realistically be compared.

Under the conditions of the experimental program control costs per coyote taken in study are "A" amounts to \$410, "B" - \$760, "C" - \$309 and \$223 in Area "D". Assuming that the moisture problems with the SCSLEM devices in area "A" had not been encountered, the total coyote take would have been nine animals resulting in a cost of \$137 per coyote. Had this been an operational program, frequency of inspection and maintenance of SCSLEM's would

be half of this amount or \$68 per coyote. This is based on the fact that operational programs would be visited once every week. This would be a substantial savings when SCSLEM's are used for coyote control in relation to other control methods.

Results of the scent post survey showed that coyote damage control as conducted in this program did not substantially change the abundance of wildlife during the experimental program. The survey indicates that coyote control operations can be conducted through the use of SCSLEM's without causing unreasonable adverse effects on the environment.

The most selective method of coyote control in the experimental program was achieved by aerial and ground shooting. SCSLEM's were more selective in taking coyotes than by steel traps. In 9,813 SCSLEM set-days four coyotes, one domestic dog and one raccoon were killed and recovered. There were 16 SCSLEM discharges, 10 by coyotes, four by feral pigs, and two by unknown causes. In 6,713 trap-set days (single or double sets) seven coyotes and 85 non-target animals were captured. Fifty-two non-target animals were released. No effort was made to release 11 skunks. Three animals were found dead in traps and 19 others, being crippled, were destroyed. The impact on wildlife populations from the use of steel traps in the study was negligible.

The county trappers who participated in the SCSLEM experimental program received training prior to the study on environmental and human safety precautions to be observed when using the SCSLEM. Accidents were not encountered with the SCSLEM device during the eight month study.

PROGRAM EXPENSES

<u>QUANTITY</u>	<u>ITEM</u>	<u>COST</u>
	<u>Food & Agriculture Expenditures</u>	
300	SCSLEM Mechanisms	\$ 1,500.00
1,800	Sodium Cyanide Capsules	630.00
500	SCSLEM Stake Signs	75.00
6	Ejector Mechanism Pliers	21.00
	Field Supplies	108.18
659 hours	Biologist	5,917.82
6,413 miles	Biologist - mileage	577.17
	Biologist - Per Diem expenses	<u>1,912.31</u>
	Sub Total	\$10,741.48
	<u>Fish & Game Expenditures</u>	
435 hours	Biologist	\$ 3,906.30
182 hours	Seasonal Aide	575.12
4,620 miles	Biologist & seasonal aide mileage	415.80
	Biologist & seasonal aide per diem	<u>1,796.31</u>
	Sub Total	\$ 6,693.53
	<u>Tehama County Expenditures</u>	
320 hours	Supervising Trapper	\$ 2,080.00
1,264 hours	Trappers	5,263.59
3,216 miles	Trapper mileage	385.92
	Field Supplies	<u>192.00</u>
	Sub Total	\$ 7,921.51
	TOTAL	\$25,356.52