UC Agriculture & Natural Resources
Proceedings of the Vertebrate Pest Conference

Title
Guard dogs and gas exploders as coyote depredation control tools in North Dakota

Permalink
https://escholarship.org/uc/item/1xz3c7m0

Journal
Proceedings of the Vertebrate Pest Conference, 10(10)

ISSN
0507-6773

Authors
Pfeifer, William K.
Goos, Michael W.

Publication Date
1982

GUARD DOGS AND GAS EXPLODERS AS COYOTE DEPREDATION CONTROL TOOLS IN NORTH DAKOTA

WILLIAM K. PFEIFER and MICHAEL W. GOOS, Animal Damage Control, U.S. Fish and Wildlife Service, Bismarck, North Dakota 58501

ABSTRACT: Guard dogs and gas exploders have been successfully used in North Dakota to protect sheep from coyote (Canis latrans) depredation since the mid-1970s. They have been used in addition to other lethal and nonlethal control tools. The U.S. Fish and Wildlife Service gathered information from field testing and landowner interviews to measure their effectiveness. Guard dogs reduced the rate of depredation by 93 percent on the 36 ranches surveyed. Gas exploders deterred coyotes from depredating on 30 ranches an average of 31 days during the 1980 and 1981 grazing seasons. An increasing number of sheep producers are using these control methods to reduce losses and become less dependent on a publicly funded damage control program.

INTRODUCTION

People in the sheep industry and animal damage control personnel generally agree that a variety of control methods are needed to obtain best results in reducing sheep losses caused by predators. The most desirable methods should be effective, economical, and environmentally safe. The recent need to test additional methods stemmed from public concern over the nature and extent of predator control activities, the ban on the use of toxicants, and economic restraints.

Since the mid-1970s the U.S. Fish and Wildlife Service, Animal Damage Control (ADC) field personnel in North Dakota have used, or encouraged the use of, nonlethal methods to help reduce coyote depredation of sheep. Guard dogs and propane exploders have been demonstrated to be successful methods of reducing depredation in North Dakota. The following describes the results obtained from the use of guard dogs and exploders. This report does not endorse one breed of dog or brand of exploder over another.

GUARD DOGS

Coyote depredation on some ranches in North Dakota is a problem. Where it occurs, depredation can greatly reduce or eliminate the income from a sheep operation. At least 36 North Dakota sheep producers are now using guard dogs to reduce coyote depredation.

The concept of using dogs to guard sheep and other livestock from predators is an ancient one and can be traced back to many centuries B.C. in Eurasia (Bordeaux 1974). Guard dogs were first brought to the Americas with the Spanish conquistadors to help protect their flocks (Lyman 1844). These guard dogs were commonly seen with large flocks of sheep in South America (Darwin 1839). Apparently, the Spanish dogs did not persist into the 20th century as a result of inbreeding with indigenous Indian dogs (Black 1981).

Guard dogs are still being used in Europe and, although there are a dozen or so traditional guard dog breeds, they share the same basic behaviors. These dogs travel with the flock, stay with them day and night, and are an effective defense against would-be predators (Coppinger and Coppinger 1978). The dogs are bred to be large, placid, powerful, courageous, and loyal to their masters and flocks.

Prior to the mid-1970s, most individual dogs of guard dog breeds in the United States existed only as show dogs or as family pets. Of these breeds, the Great Pyrenees was the most available. The Komondor and Kuvasz were less available and the Italian Maremma, Yugoslavian Shar Planinetz, and the Turkish Karabash existed in low numbers.

Research on the use of guard dogs began in 1976 when Dr. Samuel Linhart, Denver Wildlife Research Center, began a short study of Komondor dogs and their behavior. Four Komondor dogs, used in pairs, were studied during the 1976 grazing season. The Komondor dogs had been trained to attack captive coyotes and to stay within fenced sheep pastures. The dogs were evaluated on three ranches (two in North Dakota and one in Montana) in pastures of 26-134 hectares (65-330 acres) in size, to determine their potential in protecting sheep from coyote depredation. Service personnel made daily checks of sheep losses on each ranch for three consecutive 20-day periods: preceding placement of the dogs, during their time in pastures, and after their removal. Sheep kills by coyotes decreased significantly during and following the use of dogs, suggesting some potential for the deterrence of coyote depredation under fenced-grazing conditions (Linhart et al. 1979).

Guard dog research is now conducted primarily at two locations: the U.S. Sheep Experiment Station (USSES), USDA Agricultural Research Service in Dubois, Idaho; and the Hampshire College's New England Farm Center (NEFC) in Amherst, Massachusetts. Research on livestock guard dogs began at USSES in the fall of 1977; since then over 50 individual dogs have been studied. Most of the dogs have been reared and observed at the USSES; over 25 have been placed with cooperating sheep producers in various western states. Approximately 60 percent of the dogs studies were rated as good-to-excellent with respect to performance in remaining with sheep and significantly reducing predation. Only one of the dogs studied was considered a complete failure. The success rate of the dogs that were acquired, trained, and worked in the last 2 years of the study was greater; over 75 percent were rated good-to-excellent. The

increased success was due to improved dog-rearing techniques and the placement of dogs into operations suited to their temperament and abilities (Green 1981).

Researchers at NEFC have placed over 70 guard dogs with sheep ranchers across the country and most produced good results (Coppinger, L. and Coppinger 1980). They are studying five breeds under direct observation and exchange available information with livestock producers who are using dogs of these breeds (Coppinger, R. and Coppinger 1980).

In 1981 there were 36 known ranchers in North Dakota that had 52 Great Pyrenees (44 working and 8 training) and 2 working Komondor dogs. These ranchers were exposed to the idea by media articles, Linhart's study, and most frequently through a neighbor, relative, or friend. Generally the dogs were worked in the western half of the states, an area characterized by open range, wooded draws, rolling hills, brush, wetlands, and a large coyote population. Most of the statewide sheep depredation occurred in this area. Ranchers placed sheep in pastures during the spring through fall grazing season and kept them near ranch headquarters during the winter months.

OBSERVATIONS

Our 1981 study found that some ranchers have been using guard dogs since 1976. All of the 36 ranchers interviewed used Great Pyrenees, one rancher used both Great Pyrenees and Komondor dogs, and one rancher had used Komondor dogs prior to our study. We have no knowledge of any other breeds being used. The Great Pyrenees were preferred by the two ranchers who used both Komondor and Great Pyrenees dogs because they (1) were less possessive, (2) were easier to work with, (3) were more mobile, (4) are easier to breed, and (5) seemed to mature and start working at an earlier age. The USSES study also observed the apparent earlier working ability of the Great Pyrenees. In the USSES study, the Great Pyrenees matured at an earlier age than the Komondor dogs, which reached behavioral maturity at 18 to 30 months of age (Green and Woodruff 1981). In North Dakota the average age at which the 44 Great Pyrenees studied began working effectively was 6 months. The age of these Great Pyrenees averaged 2.5 years. The age of the two Komondor dogs was 7 years.

The Komondor dogs worked in a 65 hectare (160 acre) pasture and guarded 400 ewes and lambs. The Great Pyrenees worked in pastures of 4-486 hectares (10-1200 acres) with sheep flocks of 10-1300 animals. The typical Great Pyrenees dog guarded an average flock of 590 sheep in a 101 hectare (250 acre) pasture. Larger pastures and flocks were generally guarded by two or more dogs.

The annual rate of depredation before use of dogs on the 36 ranches surveyed ranged from 0-21 percent and averaged 6 percent of the flock. This was much higher than the annual statewide average of 0.3 percent. Average depredation rate after use of guard dogs was 0.4 percent, a 93 percent reduction. Normal ADC operations were conducted on or in the vicinity of the ranches before and after implementation of guard dogs. Most of the losses took place in cases where the dog was under 6 months old, the dog was ill, the rancher had the sheep scattered in several different pastures, or the dog wandered too far from the flock. No further losses occurred on 12 of the 36 ranches (33 percent) after use of dogs. On 12 ranches (33 percent), losses were reduced to 2.0 sheep or less per year. Average losses were reduced to 2.0-10 sheep per year on 8 ranches (22 percent). One ranch (3 percent) experienced a loss of 12 sheep one year and the remaining 3 ranches (8 percent) had pups which had not yet been worked (Table 1). There were only two cases in which sheep losses were not significantly reduced. In the first case, the rancher bought sheep and two 3-month old pups at the same time in early spring. Coyotes killed sheep until July when the pups became 6 months old and gained competency. No further losses occurred after July. In the second case, a rancher purchased a 5-month old Great Pyrenees house pet. The dog was encouraged to stay with the sheep but was inconsistent because of prior improper training. This rancher lost 12 sheep one year, the heaviest loss of the 36 ranchers interviewed.

Of the guard dogs in North Dakota 26 (48 percent) were female and 28 (52 percent) were male. Three of the female dogs were spayed, eleven whelped, six were too young to breed, and five, including the female Komondor, were mature but unable to or were prevented from breeding. Four of the 28 males were neutered. Most owners thought that unless the dogs were to be used for breeding they should be neutered or spayed to reduce wandering. Ranchers did not have any preference for either sex. There were 22 ranches which utilized only one dog, 8 with only a female and 14 with only a male. There was a 99 percent reduction on the 8 ranches which used single females compared to a 91 percent reduction on the 14 ranches which used single males. Some of the difference may be due to a reported tendency of males to wander.

Most North Dakota ranchers were inexperienced in raising guard dogs. Ranchers who obtained the best success bought their $300-400 pups at about 6 weeks of age and raised them with lambs. The dogs were not raised as pets or with any other dogs and their natural guarding instincts were allowed to develop without substantial human interference. Most pups were initially placed in an escape-proof pen with bottle-fed lambs. This early association with sheep was thought to emphasize the guard dog-sheep bond rather than the dog-human bond. Dogs raised with sheep at this early age had a greater tendency to remain with the sheep flocks. Actual training of the dog was minimal; "come" and "no" were often the only commands taught. Bad behavior, such as roughing lambs, was corrected. As the pups grew larger, many of them simply jumped out of the lamb pen and moved to the pasture with the main flock. Others had to be more forcibly encouraged to leave the headquarters area. Six pups were whelped in the pastures, remained with their mothers, and learned to mimic the experienced dog. They also became very successful guard dogs.

Table 1. Results of guard dog use in North Dakota 1976-1981. Information was obtained through interviews with ranchers using dogs to guard sheep.

Ranch	Number of sheep guarded	Losses/year before dog(s)	Losses/year with dog(s)	Dogs/ranch male(M)	female(F)	Guarding time year/month
1	300	25	0	1-M		0/5
2	400	35	0		1-F	0/7
3	225	35	0	1-M		1/0
4	400	0	0	1-M	1-F	1/5
5	150	*	0		1-F	1/6
6	10	0	0		1-F	1/6
7	150	10	0		1-F	1/6
8	600	25	0		1-F	1/7
9	400	30	0		1-F	2/0
10	500	12	0	1-M		2/6
11	400	85	0	1-M	2-F	3/6
12	3000	*	0		1-F	4/6
13	1000	65	0.4		2-F	5/6
14	300	20	1	1-M		0/5
15	400	5	1	1-M		1/6
16	300	25	1	1-M		1/7
17	450	70	1	1-M		1/10
18	750	75	1	1-M	1-F	2/0
19	.600	22	1	1-M		2/0
20	700	35	1	1-M		2/6
21	300	27	1	2-M	1-F	3/0
22	650	25	1.5		1-F	3/6
23	1200	20	2	2-M	2-F	2/0
24	1400	12	2	1-M	2-F	5/0
25	600	45	3	1-M		2/8
26	500	35	3	2-M	1-F	4/0
27	600	10	3	1-M	1-F	5/8
28	400	45	5	1-M		0/8
29	275	30	6	1-M		1/11
30	500	35	6	1-M	2-F	1/11
31	275	40	8	1-M		0/11
32	1200	50	10		2-F	0/5
33	550	23	12	1-M		0/5
34**	200	5	-		1-F	0/0
35**	200	5	-	1-M		0/0
36**	450	20	-	1-M		0/0
	Ave 590	Ave 31.3 (6%)	Ave 2.1 (.4%)	28-M	24-F Total 54	Ave 2/2

* Got sheep and dogs at the same time.
** Data from ranch numbers 34, 35 and 36 not included because pups were not yet working.

When the young dogs matured their working behavior varied. Most of the dogs remained with the sheep or near the fence boundary. A few roamed farther and spent less time directly with the sheep. Some dogs brought the sheep back to the headquarters at night and led them to the pasture in the morning. Others stayed with the sheep in the pasture during the night but left the pasture during the day to return to headquarters for food. The dogs were quite independent and the rancher allowed the dog to develop its own guarding behavior. Some ranchers using dogs for the first time had difficulty understanding what the dog was doing.

The exact method the dogs used to reduce losses was not known. Ranchers described barking, marking with scent posts, moving sheep away from danger, and actually chasing coyotes, fox, and dogs from the pasture in their observations. Some dogs would not tolerate deer, antelope, eagles or other birds, horses, cattle, or strangers. Although no actual physical encounters were recorded, one dog was seen chasing a coyote for nearly one-half mile. Many of the dogs were seen to enter the pasture or barn ahead of the sheep and not permit the sheep to enter until the dog was satisfied that all was safe.

DISCUSSION

The nature and extent of depredation reduction attributed to the dog's abilities was often difficult to describe. Mere presence of the dog was often sufficient to deter depredation. An example of this occurred on a ranch in which no losses were observed until the dog was temporarily removed from the pasture for 3 nights for eye surgery; coyotes then killed a lamb each of the 3 nights. The dog was returned to the pasture and no further losses occurred. In another case, the dog was brought home to have pups and six lambs were lost before the dog was returned and losses stopped. Dogs were often asleep or away from the sheep during the day but were active during periods of likely depredation. They were quick to react to any disturbance and sheep often gathered around the dog for protection. For example, a rancher, who brought his sheep to the headquarters at night, could not find one of his two guard dogs. He returned to the pasture to find the missing dog protecting a remaining ewe and lamb from a coyote that was only a few yards away.

Ranchers had some risk and problems when using guard dogs: (1) strangers to the pasture had to be warned of the dogs, (2) some dogs wandered onto neighbors' property, (3) some dogs injured lambs during play, (4) dogs were stolen or accidentally killed, and (5) ADC tools such as traps and snares had to be modified to avoid capturing dogs. There was no assurance that the dog would have the instinctive ability to guard sheep even when properly raised.

Most of the ranchers either fed their dogs daily in the pasture or permitted the dogs to eat at home. People who use guard dogs recommend that self-feeders be used in the pasture. The feeders should be sheep-proof or the dog will guard his food from the sheep rather than guarding the sheep from predators. Dogs should not be overfed and should routinely be taken to the veterinarian for care.

Presently 80 percent of the people who raise sheep in the United States maintain their flocks exclusively in fenced pastures or at least during some portion of the year (Gee and Magleby 1976). In North Dakota guard dogs work well under these conditions and it is expected there will be an increase in the use of guard dogs.

CONCLUSION

Guard dogs have been used as a nonlethal, environmentally acceptable, and economical method of reducing depredation. Proper management of sheep and sound husbandry practices, which may include utilization of a guard dog, are important aspects of reducing depredation. It is also widely accepted that many behavioral, environmental, and management factors influence the nature of coyote depredation and any damage control technique may be effective in some situations but not others.

A growing number of dogs are being used in North Dakota in conjunction with the operational ADC program. The 93 percent reduction of coyote depredation appeared to have resulted from the presence of guard dogs. The exact method of depredation prevention used by these dogs is not well known. Only time will indicate if the coyotes will learn to circumvent the guard dogs.

PROPANE EXPLODERS

A variety of visual or auditory scare devices have been used for years to reduce coyote depredation of sheep. Field observations indicate that nearly any uncommon object placed in a pasture will, at least temporarily, affect coyote habits. Examples of devices used include bells, vehicles, scarecrows, dogs, electric lights, and propane exploders. Of these devices, the exploder was chosen for utilization because of its effectiveness, portability, availability, ease of operation, and relatively low initial and operating costs. The exploders were used by sheep producers and Animal Damage Control (ADC) personnel as a supplement to, and in conjunction with, a continuing operational ADC program using both lethal and nonlethal tools.

The ADC program in North Dakota has a climate-controlled variable work load. ADC personnel are often extremely busy during spring, summer, and fall when sheep are on range pastures. The sheep are moved near the ranch headquarters during winter months and the ADC operational workload decreases.

Occasional exploder use began in the mid-1970s and results appeared favorable. Killing was usually delayed or completely stopped on ranches where they were used. Interest developed as results became available, and testing was initiated to analyze the effectiveness of the exploders as a control tool. The exploders tested and used were the "Scare Away" models 3 and 4 produced by Reed-Joseph International Company and utilized propane, a variable firing timer, and electronic or flint ignition. The exploders produced a rifle-like noise when a measured amount of propane was ignited at predetermined intervals. The price of an exploder was about $200.

Information on exploder effectiveness was collected from 24 ranches in North Dakota in 1977 and 1978. When it was determined that coyotes had killed sheep, exploders were placed near sheep bedgrounds, along the coyote's approach route, and upwind of the depredation area. The timer was set to fire every

7-8 minutes. The landowner was advised to start the exploder before dark, shut it off at daybreak, and to change its location every 4-5 days. In all cases exploders were successful in stopping or reducing losses until the offending coyotes could be removed. ADC personnel reported that exploders were an aid to their operation and that most of the success or failure depended upon how the user operated the exploder (Severson, R., USFWS, unpublished data).

The U.S. Fish and Wildlife Service's Denver Wildlife Research Center, encouraged by these results and after discussions with North Dakota ADC field personnel, made plans to document the effectiveness of exploders. A project was initiated to document exploder effectiveness on 10 different ranches with known depredation problems.

A minimum of five verified kills within a 2-week period was required before the study was initiated. After five kills, the exploder was placed at the bedground or elsewhere in the pasture. Payments were to be made to sheep producers for losses incurred by coyotes as long as exploders were used as the sole means of control. The exploder was operated until the grazing season was over or until a minimum of two verified coyote kills occurred. At that time, the test on that ranch would be terminated.

Only three ranches met the criteria of the study and agreed to cooperate. Exploder use was documented during the 1979 and 1980 grazing seasons. On the first of the three ranches, three exploders were placed in a 255-hectare (630 acre) pasture containing approximately 1,000 ewes and lambs after 5 sheep were killed within the previous 16 days. The exploders were set to fire at 8-10 minute intervals and operated only at night. Killing was subsequently stopped for 17 days. On the second ranch, two exploders operated only at night and set to fire every 8-10 minutes were placed in a 182-hectare (450 acre) pasture which contained 190 sheep after 6 sheep kills had been confirmed during the previous 10 days. Killing was stopped for 26 days. On the third ranch, one exploder was placed in a 24-hectare (60 acre) pasture that contained 265 lambs. A second exploder was placed in an adjacent 32-hectare (80 acre) pasture that contained 170 ewes. Both exploders were set to fire every 20 minutes. Exploder use was initiated after seven kills occurred during the previous 4 days. Killing was stopped for 102 days, at which time the lambs were moved to a feedlot (Linhart et al. in preparation).

OBSERVATIONS

During the 1980 and 1981 grazing seasons, exploders were used by North Dakota ADC District Field Assistants (DFAs) on an additional 30 ranches where coyotes were killing sheep. Coyotes were deterred from killing from 1 day to 180 days (average 29 days), at which time the last test was terminated. Losses were stopped for the remainder of the grazing season without coyote removal on six ranches (20 percent). In seven instances (23 percent), the exploder prevented further losses until the depredating coyotes were removed. On four ranches (13 percent), no additional losses occurred until the exploder became inoperable due to landowner neglect. Losses only occurred when the exploder malfunctioned in two cases (7 percent). Killing occurred in the remaining 11 cases (37 percent) with the exploder in use; however, coyotes were deterred from killing for an average of 18 days (Table 2).

Landowners purchased and used gas exploders to prevent losses. For example, two North Dakota sheep ranches, each with a history of losses to coyotes, have used exploders for the past 3 years. On one ranch, no losses have occurred. On the other ranch, losses have occurred only when the exploders malfunctioned or ran out of propane. At each of these ranches the landowner moved the exploder every 3-4 days and varied the firing intervals. Each rancher used a different firing pattern varying from just a few minutes to occasionally not firing the exploder all night.

DISCUSSION

Use of the propane exploder in North Dakota deterred coyotes from killing sheep. The delay provides a longer time period for locating depredating coyotes, thus increasing effectiveness of ground control tools and aerial hunting. The delay also allows the DFA to schedule his time more efficiently, coordinate his operation, and reduce the cost of control.

When Service assistance was requested, the DFA determined if the exploders were to be used. The DFA considered workload, area, pasture size, expected coyote population, expected landowner cooperation, and acceptance by neighboring landowners. Generally, the depredating coyote or coyotes had to be removed and each DFA decided which control tools were used in conjunction with the exploder. Use of the exploder was especially valuable when the DFA had a heavy workload. The exploder deterred or reduced losses until other control tools could be used. This allowed the DFA to conduct operations on many ranches simultaneously or delay depredations in one area and concentrate efforts where a greater need existed.

The exploder was also placed to shift the area frequented by coyotes or their approach path to the pasture. This was especially helpful when there was an access problem on adjacent land or if it was difficult to use a selected control tool in certain terrain. The exploder was also used to change a killing pattern. For example, if the coyote(s) was killing at night and leaving the pasture before dawn, a DFA would fire an exploder through the night until dawn. The exploder was then shut off and the coyote(s) was no longer discouraged from entering the pasture, thereby becoming more vulnerable to aircraft or firearms.

Landowners were encouraged to purchase and utilize exploders to prevent depredations. The exploder was especially effective when lambing occurred in range pastures. The exploder was used to prevent the establishment of a kill pattern. If the lambs can be protected for even a month, the use of the exploder is economically feasible.

Table 2. Results of propane exploder use in North Dakota. Information from 1980 and 1981 on 30 ranches where propane exploders were used to deter coyote depredation.

Ranch	Pasture size hectares/acres	Livestock number sheep(S) cows(C) turkey(T)	Days coyote(s) deterred	Resolution of complaint	
1	24/60	540 (S)	32	A	
2	32/80	300 (S)	117	A	A - Losses deterred without coyote removal.
3	49/120	780 (S)	60	A	
4	65/160	220 (S)	180	A	
5	16/40	180 (C)	60	A	
6	4/10	2000 (T)	14	A	
	Ave 32/78	Ave 670	Ave 77		
7	4/10	185 (S)	1	B	
8	28/70	410 (S)	23	B	B - Losses deterred until coyote removal.
9	40/100	560 (S)	5	B	
10	49/120	200 (S)	1	B	
11	65/160	300 (S)	8	B	
12	130/320	550 (S)	45	B	
13	65/160	350 (C)	14	B	
	Ave 54/135	Ave 365	Ave 14		
14	32/80	200 (S)	1	C	
15	65/160	400 (S)	30	C	C - Losses deterred until landowner caused exploder malfunction.
16	73/180	240 (S)	20	C	
17	81/200	625 (S)	15	C	
	Ave 63/155	Ave 366	Ave 16		
18	32/80	880 (S)	20	D	
19	49/120	205 (S)	14	D	D - Losses deterred until exploder malfunctioned.
	Ave 40/100	Ave 542	Ave 17		
20	24/460	155 (S)	4	E	
21	65/160	240 (S)	4	E	E - Losses occurred with exploder in use.
22	65/160	300 (S)	9	E	
23	65/160	800 (S)	2	E	
24	73/180	240 (S)	10	E	
25	162/400	1300 (S)	22	E	
26	202/500	200 (S)	40	E	
27	202/500	200 (S)	80	E	
28	259/640	700 (S)	16	E	
29	486/1200	230 (S)	1	E	
30	324/800	230 (C)	12	E	
	Ave 175/433	Ave 418	Ave 18		
	Ave 94/233	Ave 457	Ave 29		

The most important factor determining the success of the tool was user operation and maintenance. Results were greatly improved when the exploder was kept operational, moved, and used with different firing intervals. Those who operated the exploder as recommended obtained the most beneficial results. Another factor which may have increased effectiveness was hunting pressure; the greater the pressure the more fear the coyote had of rifle-like noises.

CONCLUSION

Propane exploders were not the complete answer to coyote depredation but they did deter coyotes from depredating for varying lengths of time. The delay time was used to increase the effectiveness of other control tools. Depredation was delayed, reduced, or prevented for the entire grazing season with proper exploder use by the landowner. Proper use included changing exploder firing patterns and location

to prevent habituation by coyotes. The most effective use of the propane exploder was prevention; it was easier to prevent the establishment of a kill pattern than to stop the killing after it had started. Results of exploder use have varied but usually poor results were due to a lack of effort by the rancher. Many times the exploder did a good job in spite of landowner inattention. Service field personnel will continue to utilize the exploder as a valuable management control tool in conjunction with other methods of control and prevention.

LITERATURE CITED

BLACK, H.L. 1981. Navaho sheep and goat guarding dogs: a new world solution to the coyote problem. Rangelands 3(6):235-237.

BORDEAUX, E.S. 1974. Messengers from ancient civilizations. Academy Books, San Diego, California. 43 pp.

COPPINGER, L. and R. COPPINGER. 1980. So firm a friendship. Nat. History 89:12-26.

COPPINGER, R. and L. COPPINGER. 1978. Livestock guarding dogs for U.S. agriculture. Hampshire College, Amherst, Massachusetts. 25 pp.

_____. 1980. Livestock guarding dogs, an old world solution to an age-old problem. Country Journal 7(4):68-77.

DARWIN, C. 1839. The voyage of the Beagle. P.F. Collier and Son Corporation. 524 pp.

GEE, C.K. and R.S. MAGLEBY. 1976. Characteristics of sheep production in the western United States. USDA Econ. Res. Ser. Ag. Econ. Rep. No. 345. 47 pp.

GREEN, J.S. 1981. Controlling coyote damage to sheep with non-lethal techniques. Presented at the Fifth Great Plains Wildlife Damage Control Workshop. Lincoln, NE. 13-14 Oct. 1981.

_____ and R.A. WOODRUFF. 1981. In Press. Livestock guarding dogs: developments and current status. Proc. Symp. Situation management of two intermountain species: aspen and coyotes. Utah State Univ., Logan, 23-24 April 1981.

LINHART, S.B., R.T. STERNER, and G.J. DASCH. In preparation. Predation of pastured sheep reduced with use of nocturnal, intermittent strobe-light and siren device.

_____ T.C. CARRIGAN, and D.R. HENNE. 1979. Komondor guard dogs reduce sheep losses to coyotes: a preliminary evaluation. J. Range Manage. 32(3):238-241.

LYMAN, J.H. 1844. Shepherd dogs. The Amer. Agriculturists 3(11):241-242.