A DECADE OF USE OF LIVESTOCK GUARDING DOGS

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ABSTRACT: Results from a ten-year study of livestock guarding dogs show that the dogs are an effective tool for reducing predation. Average reduction attained by five strains of dogs (Anatolian Shepherds, Maremmas, Shar Planinetz, Anatolian/Shars, Maremma/Shars) was 64%, with predation reduced to zero for 53% of reporting producers in 1986. Variations in trustworthy, attentive and protective behavior of the dogs were breed-specific, and offer mechanisms for improving the system.

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INTRODUCTION

This paper presents data from a 10-year study on livestock guarding dogs (Canis familiaris) at Hampshire College. Results from the first 5 years (Coppinger et al. 1983a) and several other papers on portions of the work (see Literature Cited) appear elsewhere.

The impetus for this study occurred in the 1970s, a decade of change in predator control policies that left "neither the livestock industry nor the environmental community...satisfied" (Andrus 1979). The project began in 1976 after consultations with livestock industry leaders at the Winrock International Livestock Research and Training Center in Arkansas. The subject was the staggering losses of sheep to coyotes (Canis latrans) and the associated costs to producers (Balser 1974a, Gee et al. 1977), as well as the renewing effort on the part of the industry, the federal government and environmental groups to find an effective, nonlethal method of predator control (Balser 1974b, Evans and Pearson 1980).

METHODS

Dogs

Initially, guarding dogs were observed during a 1-month tour of a dozen ranches in the United States where producers were reportedly working with guarding dogs, and a 3-month tour of sheep-producing regions in Europe and Turkey where the best dogs available were purchased (Coppinger and Coppinger 1978).

Dogs from working stock were obtained in Italy (Maremma), Turkey (Anatolian Shepherd), and Yugoslavia (Shar Planinetz). Other breeds donated to the project were tested but in very small numbers. The three main breeds were used as breeding stock to produce pups for the various programs. They were also inbred to determine if deleterious genes were present, and crossbred to test genetic or behavioral concordances, and enhancement or depression of structural and behavioral characteristics (see Scott and Fuller 1965 for a review of benefits). Genetically, dog breeds consist of a population of individuals that are continuously variable. Therefore, because the sample of dogs used here is only a small portion of the total populations, data should not be considered as a statement about the breed but rather about strains within the breeds.

Goals

The project focused on three main goals: 1) to place dogs with cooperators who run commercial farms and to track their development, behavior and effectiveness for predator control over time; 2) to clarify the mechanisms of both successful and unsuccessful behavior by means of controlled studies; and 3) to communicate field and research results back to cooperators, as well as to potential cooperators, scientists, animal damage control personnel, dog breeders, and the media.

Cooperator Program

The cooperator program was designed to establish dogs in a wide variety of environments and to monitor several dozen variables for many years. This method mitigated the effect of temporary successes based on the novelty of a dog to predators, and tended to equalize variations in predation pressure and other variables beyond the control of field researchers. The focus was to make this "new" system work, and to rely on end-users to estimate success of their dogs. This approach to introducing and evaluating a new system fit the model presented by Bohlen (1964), where user satisfaction is a valid means to judge the success of a new idea in agriculture.

The original intent was to test 100 dogs in the Northeast. Beginning in 1978, pups were leased to qualifying growers for $1 for the first year and $50 per year once the pup reached a year and the producer judged it was doing its job. In 1983, the lease fee increased to $120 for working dogs. This program minimized financial impact on the grower of buying a dog, paying for a non-working dog, or for a replacement dog if the first one died. It also kept ownership of dogs at Hampshire College so placement and breeding could be regulated or transfers made between farms (Coppinger et al. 1987c).

Producers volunteered for the program but were required

to have at least two dozen sheep or goats and a history or threat of predation. They were sent annually a report form to complete that contained 32 database fields.

News of success of dogs placed in 1978 and 1979 reached producers in other areas. A system of group delivery was established, with producers getting together to apply for a number of dogs. Organization was often done with local agricultural leaders and extension agents. Once a number of producers had been identified and the goals of the project discussed with them, a Dog Project staff member would drive to the specified region, present a workshop on the use and management of guarding dogs, visit individual ranches and place pups. This program permitted us to see the variety of habitats and management schemes used by the growers. Project staff members logged a half-million miles and placed over 1,000 pups.

Behavior Studies

As has been reported (Coppinger and Coppinger 1978, Coppinger et al. 1983a), dog behavior was separated into three basic components: trustworthy, attentive, and protective. The first two were measured by noting a dog's behavior with and orientation to the livestock. The third was based on the cooperator's assessment of the dog's effect on predation plus field studies. Evaluation was made from cooperator reports and from research at Hampshire College and selected sites in the United States and abroad (Coppinger et al. 1983a, 1983b, 1987b, 1987c). The research provided tests of hypotheses about behavior of working dogs. Based on results, adjustments were made in management of individual dogs in order to improve their performance. The behavior studies also led to theoretical discussions about canine behavior and evolution (Coppinger and Smith 1983, in press; Coppinger et al. 1985, 1987b).

Outreach Program

In order to help researchers and producers learn how guarding dogs work, cooperators were required to provide annual reports on the dog's performance. Problems were identified, classified and generalized; solutions were tested and reported back to cooperators. Dialogue was maintained with letters, newsletters, telephone calls, and on-site visits. Local programs were started by sheep growers in order to set up workshops and share expenses of transporting dogs. Media attention was constant. This program and the behavior studies program provided a breadth and depth to networking within the cooperator program that were vital for its success.

Oregon Pilot Project

Observing the success in the early 1980s of two dozen dogs in central Oregon, extension agents, sheep growers and environmentalists worked together to begin a statewide pilot project. Funding was secured in 1984 and Lorenz moved to Oregon to conduct the program under the auspices of the Oregon State University Extension Service and the Hampshire College Dog Project. The Oregon model represented the first substantial commitment by a state government to support a multi-year guarding dog program. Reports from Oregon growers were analyzed for dogs within the state and were also included in Hampshire's national database. This link provided a system of feedback from a larger sample than could be achieved within the state alone. Also, since Oregon contains a variety of sheep-producing systems, it provided an opportunity to examine the effects of guarding dogs on large ranges and smaller fenced pastures within one state. Two publications were written for the Oregon State University Extension Service (Lorenz 1985, Lorenz and Coppinger 1986).

RESULTS AND DISCUSSION

By the end of 1987, the Project was keeping records on 1,091 dogs. The original estimate of 100 dogs needed to analyze behavior and reduction of predation had grown to an average of 109 dogs produced per year for 10 years. This change in design was due mainly to grower demand, the need to study longitudinally the effects of dogs on predation, and the awareness that longevity of dogs was an important factor in cost:benefit analysis. Dog placement expanded way out of New England and attracted satellite groupings in Oregon, Texas, Minnesota, Colorado, Arkansas, Kentucky, and West Virginia. Dogs have been placed in 37 states.

Reduction of Predation

The most important question about guarding dogs is: Do they reduce predation? From a research point of view, it is also the question which is most difficult to answer with accurate and reliable data. Linhart et al. (1979) did a classic study with four Komondors on three ranches and found significant reduction in predation. O'Gara et al. (1983) reported from a 2,000-ha ranch in Montana that "only the dogs stopped coyote predation." Other studies (Green and Woodruff 1980, 1983/84, 1988; McGrew and Blakesley 1982; Pfeifer and Goos 1982; Black and Green 1985) reported reduction in predation from 11% to 93%, mostly in the 70% range, in short-term studies.

From 1980-1986, 1,157 reports were received on Hampshire College dogs for an average of 165 reports per year. (The first 2 years, 1978 and 1979, were not included in the analysis due to the youthfulness of that population; yearlings also were left out of annual analyses.) The effect of guarding dogs on predation over that 7-year period: 20% were at farms or ranches with no predation, 64% with reduced predation, and 16% with no change or increased predation (Table 1). Not much variation occurred between years or between management systems. Prevailing beliefs that guarding dogs would be more successful in fenced pastures than on range operations were not sustained, either in the national data or in Oregon. In 1986, on Oregon farms with an average flock size of 105 (range 30-400), losses dropped from 10 per farm to less than 1 after getting a dog. At the 1985 market price of $67.70/cwt, and assuming 100-lb. market lambs, that was a savings of $626 per ranch or $501 per dog (some ranches had more than one dog). On ranches with an average flock size of 644 (range 50-2600), losses dropped from an average of 31

to 14, a savings of $1151 per ranch or $615 per dog (Coppinger et al. 1987a).

Table 1. Effects of dogs on predation by management system

	No Predation			Reduced Predation			Increased or No Change in Predation			Total Reporting		
	R	F/R	F*	R	F/R	F	R	F/R	F	R	F/R	F
1980	-	1	12	7	9	46	1	-	5	8	10	63
1981	4	3	21	11	18	58	3	1	17	18	22	96
1982	-	-	28	7	14	90	3	3	38	10	17	156
1983	1	-	15	5	14	85	-	6	16	6	20	116
1984	1	-	18	1	22	91	-	9	22	2	31	131
1985	1	12	43	4	22	86	9	4	9	14	38	138
1986	5	2	53	11	14	103	1	3	25	17	19	181

SUMMARY:	No Predation		Reduced Predation		Increased or No Change in Predation	
Ranches	12	16%	46	61%	17	23%
Farm/Ranches	18	11%	113	72%	26	17%
Farms	190	22%	559	63%	132	15%
Total	220	20%	718	64%	175	16%

*R = Ranch (open range), F/R = Farm/Ranch (combination open range and fenced pasture), F = Farm (fenced pastures)

Nationwide, in 1986, of those producers with adult dogs who had sustained predation before getting a dog, 77% reported a reduction during the year after getting a dog (Table 2). Of the total sample (N = 217), 6% reported an increase in predation (but at low levels), and 43% reported no predation or no change. Most striking was the 53% (N = 76) of producers with prior predation who reported zero predation after getting a dog. Minor differences in 1986 results between Tables 1 and 2 are due to lumping of data in Table 2.

In the United States, the only places where dogs were judged not effective were those where sheep scattered widely over a great area and never flocked, or where producers did not spend more than a minimal amount of time with the flock. The essential difference between management of dogs in this country (mainly farm operations) and in Europe (mainly range operations) tends to be the amount of time owner-operators spend with their stock.

Table 2. Producers reporting losses before and after adopting a guarding dog, 1986.

No. of Attacks Before Dog	Number of Attacks After Dog				
	0	1-15	16-50	51-202	Total
0	61	12			73
1-15	55	26			81
16-50	18	21	7		46
51-202	3	10	4		17
Total	137	69	11	-	217

Behavior

Dogs that protect livestock have to display a set of behaviors appropriate to their work. Some of these behaviors are standard in any dog, some are genetically unique to guarding dogs. All have to be induced at some level by proper rearing conditions and management. Dogs not reared properly probably cannot be retrained to be successful guardians, and dogs which do not have the right genes will not train regardless of management. The natural variation in guarding dogs can be capitalized on by matching its behavior with the type of livestock operation and/or the style of the grower.

Trustworthy Behavior

Seven years of reports (N = 925) on five main breeds or crossbreeds on trustworthy behavior of dogs showed three out of five breeds to be well over 80% trustworthy (Fig. 1). The data used to construct this graph were initially analyzed by year and by breed, showing 2 years with significant differences between breeds (1981 $p<.02$; 1985 $p<.04$) and near-significance in 1980 and 1984. The high scores of the Maremma/Shar crossbreeds and the low scores of the Anatolian/Shar crossbreeds were consistent throughout the years.

Trustworthiness results from two types of social interactions, both of which are partially genetic and partially environmental. The first is familiarity. Almost all breeds of dogs as well as their carnivore relatives do not show predatory behavior due to familiarity with individual "prey" (Lorenz and Leyhausen 1973). Many farm families have a dog that is trustworthy with their sheep or other farm animals. The event is not unusual.

Secondly, the traditional breeds of livestock guarding dogs have been selected not to show functional predatory sequences. Coppinger et al. (1987b) suggested that guarding dogs display an arrested development (neoteny) which means that innate predatory motor sequencing does not become fully operational in these breeds. Serendipitously, this form of selection tends to blur species-specific recognition, so that livestock guarding dogs tend to behave toward sheep as

though they were other dogs. Thus guarding dogs tend to display intraspecific social patterns interspecifically with animals they have lived with during critical periods of social development. It is important, therefore, to pay particular attention to critical period theory (Scott and Fuller 1965) in raising a guarding dog in order to develop both familiarity and social bonding and, ultimately, trustworthiness.

Problems arose on farms with mixed stock where experienced dogs that were socially bonded to one species displayed predatory or protective displays against other species. Examples of harassment of wildlife or other domestic species were reported in 40% of the working dogs (Table 3). Some growers encouraged the chasing of vermin or wild competitors for pasture. Disadvantages arose when a few dogs, trustworthy with sheep or goats, drove deer from the range where a producer earned part of his income from hunting leases.

Table 3. Number of dogs affecting other animals

		Bothered		Killed	
		1983	1984	1983	1984
	Mammals	29	38	8	7
Wildlife:					
	Birds	5	9	1	0
	Mammals	18	13	5	6
Domestic:					
	Birds	6	10	5	4
Other	Unidentif.	4	0	5	2
Total		62	70	24	19

1983 total N = 155; 1984 total N = 174

Farmers with dogs showing untrustworthiness tried a number of corrective procedures. For the most part, they reported little success. Some behaviors, such as hyperactivity leading to play routines, were outgrown, or were corrected with diet, punishment, or restraint. Trustworthy dogs sometimes ate dead, injured or otherwise immobile stock; most consumed afterbirths and sometimes killed and consumed "odd" sheep. Sometimes the first newborn lambs a young dog encountered fell into this category. The differences between ontogenetic anomalies (e.g., play) and developing ontogenetic defects (e.g., predatory sequences) can be recognized by an experienced eye. Producers for the most part were willing to accept the "mistakes" of young dogs, or an occasional loss of new lambs or odd sheep, due to the overall reduction of predation on the flock.

Attentive Behavior

Scores for attentive (as well as protective) behavior were influenced by a dog's scores for trustworthiness. An untrustworthy dog often was not allowed to display attentive or protective behavior since it was usually tied up or removed from the flock, and thus skewed results in those categories.

The range of scores (averaged for 7 years) was greatest for attentiveness from 49% (Shar Planinetz) to 80% (Maremma/Shar crossbreeds), indicating a wide difference between breeds. In 2 years, breeds showed significant differences (1980 $p<.02$; 1986 $p<.003$). In each of the 7 years, scores followed the pattern for attentiveness of the most trustworthy dogs shown in Fig. 1 for the years combined: Maremmas and Maremma/Shars scored higher while Anatolians, Shars, and Anatolian/Shars scored lower.

Ethologically this behavior seems the most complicated of the three; certainly it is the least understood. All dogs are basically social animals. Guarding dogs, given proper rearing conditions, display all or most of their intraspecific behaviors toward the livestock they were raised with. These include pack formation, litter behavior, dominance hierarchies, and associated food and sexual competition. Displays of these behaviors are usually at such low levels that they are often measurable only by the dog's presence (attentiveness). Thus, attentive behavior at its best is the display of dysfunctional sequences derived from motor patterns usually associated with dominance, submission, investigation, and predation. Higher levels, or functional displays, such as driving sheep away from feeders, acting aggressively toward rams, sexual mounting, or showing forceful dominance patterns toward ewes are usually termed disruptive or untrustworthy and are not understood by livestock growers or breeders as an underlying ethological basis of attentiveness.

Attentiveness can also be motivated by dysfunctional routines that are predatory and directed at the host species. The line between trustworthy and attentive becomes thin at this point, but good advice and a temporary adjustment in management can contribute to a dog's future success. Inattentive dogs generated the most calls for assistance from the farming community, but a satisfactory cure for all adult dogs has not yet been found.

Protective Behavior

Stockpeople rated their dogs 74% protective, which agrees closely with independent figures on reduction of predation. When dogs that scored highest in trustworthy and attentive were rated for protective, protective scores rose to nearly 100% for that group (Fig. 1). The drop in average of the highest attentive scores (line A, Fig. 1) from line T (average of the highest trustworthy scores) indicates that good dogs are trustworthy a greater percent of the time than they are attentive. The closeness of line P (average of the highest protective scores) to line A indicates that if a dog is attentive, it is also protective.

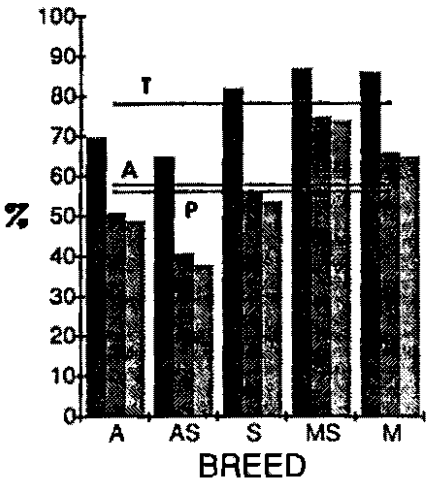

Fig. 1. Breed scores for 10 years (1980-86). (T = average of the highest trustworthy scores; A = average of the highest attentive scores from population T; P = average of the highest protective scores from populations T and A. Breed designations are: A = Anatolian, AS = Anatolian/Shar, S = Shar, MS = Maremma/Shar, M = Maremma.)

Protection does not therefore come from a separate set of behaviors, e.g., aggressiveness. Many of these dogs had mild dispositions and even though the producers had zero or few losses, they sometimes asked for a more aggressive dog. However, guarding dogs enter into social interactions with predators, rendering their predatory behavior contextually inappropriate at best and inefficient at least. This means that the predator may totally avoid a dog-guarded flock, or else enter into greetings, scent-marking, dominance displays, play, exploratory behavior, or ritualized aggression, which might be sexually specific or not, but any one of which diverts the predator from attacking the stock. Thus the mere presence of the dog has the effect of disrupting a predator's behavior and thereby reducing predation. Attentiveness, therefore, is the key to success. This argument also supports the conclusions of Black and Green (1985) that selection for aggressiveness, large size, color, or other "purebred" characters, are not necessary.

These findings have several positive implications. First, in the interest of environmental protection, predators can remain present and active in predator/wild prey balances. Second, predators do not leave their territories, so that protection of one farm does not necessarily mean increased pressure on the neighboring farm.

The question of whether guarding dogs could be used to protect against larger species than coyotes, or against endangered or threatened species, was addressed in two studies, one in New Mexico with cougars (Felis concolor) and one in Minnesota with wolves (Canis lupus). Results of the New Mexico study were inconclusive (Coppinger 1984). Results in Minnesota, with cattle as the prey, were encouraging (Coppinger and Coppinger 1987). Several documented interactions between single dogs and wolves occurred throughout both field seasons (summers of 1986 and 1987), but even when fights occurred they were ritualized and drew no blood. Wolves were ever-present during these trials, yet the dogs appeared to be protective.

Longevity

In assessing cost effectiveness of guarding dogs one must consider not only the percentages of dogs that display trustworthy, attentive and protective behavior, but also the length of time they display them. Lorenz et al. (1986) constructed a mortality curve based on our first 450 dogs and found that the semi-annual mortality rate on farms was 13% before 33 months of age and 5% thereafter. Most of the post-33-month period was projected from a very small sample of older dogs and it now appears that the post-33-month mortality might be twice what was predicted. After 10 years, the annual production of 100+ dogs/year has yielded a stable field population of just under 300 dogs. Theoretically this means that the present cost of a dog to the industry could be $600/year. Reduction of this figure depends on producer attention to hazards to dogs, and to an overall refinement in breeding and managing systems.

CONCLUSIONS

Guarding dogs can reduce predation on farms and ranches by 60 to 70% or more. On an individual basis, reduction of losses to predators can be spectacular. For producers in areas where lethal controls are inappropriate, guarding dogs made staying in business possible. Problems within the system are solvable, given long-term record-keeping and expert attention. We focus on the problems, but there have been far more successes than problems over the past 10 years. This management system has attracted increasing attention and use not only because of its effectiveness but because producers feel they can take charge of what happens on their farms or ranches. Dogs provide a good alternative to environmental liabilities of lethal control methods. Costs should decrease and effectiveness increase as more growers, extension agents, wildlife damage control personnel, and breeders become familiar with the system.

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