

STUDIES OF DEER-RELATED DOG ACTIVITY IN VIRGINIA¹

by

Matthew C. Perry, Virginia Cooperative Wildlife Research Unit,
Blacksburg, Virginia

Robert H. Giles, Jr., Virginia Polytechnic Institute, Blacksburg, Virginia

ABSTRACT

Three study areas and five techniques were used in this study of movements and activities of dogs and influence of dogs on deer. Radio-tracking with telemetry equipment was ineffective due to infrequent and unpredictable movement of dogs. The percentage of licensed dogs estimated from surveys of rural inhabitants was suggested to be inversely related to the number of residents under a dog warden's responsibility. Activity indices determined from sand plot track counts for dogs were not significantly different for three study areas and for the three seasons. Dogs appeared to be most active in the morning between 7:00 AM and 10:00 AM. Activity and movement data from this study were compared with questionnaire responses from game wardens and biologists.

Six dogs were trapped at Big Levels during the fall. Two were instrumented but tracking was ineffective. Approximately 70 percent of the dogs trapped and seen during this study were hounds. Data concerning age and condition of deer killed by dogs in Virginia were scarce. Free-running dogs may present less of a problem in eastern Virginia than in Western Virginia due to physiography of region. Dogs are probably a serious mortality factor in deer stocking programs or in areas of low deer numbers. Enforcing dog laws seems to be the most effective way to control free-running dogs. Trapping, poisoning, and shooting are desirable techniques only when enforcement methods fail. Deer mortality by dogs is probably neither large nor significant in influencing deer population dynamics statewide.

INTRODUCTION

The domestic dog (*Canis familiaris*) was domesticated by man six to eight thousand years ago (Fuller and DuBuis 1962), and since then has maintained a close association with man. The wolf (*Canis lupus*) and the jackal (*Canis aureus*) are the apparent wild ancestors of the dog. Many breeds have been developed to serve the needs of man. Several breeds of dogs have been purposely developed for tracking wild game and are used extensively by hunters.

The hunting ability of dogs resulting from their keen vision and olfactory acuity has created a "good-evil" paradox between dogs and wildlife. Zwickel (1969) discussed the many uses of dogs in wildlife management. Some dogs have been trained by sportsmen to track deer and are legally used in parts of Virginia and other areas of the Southeast to assist man in hunting deer. Many dogs, besides those specifically trained to hunt deer, have the ability to track the scent of deer and often do so. Although dogs under control can be a benefit to man in his use of the wildlife resource, uncontrolled dogs can present a threat to the same resource.

In many parts of the United States, including Virginia, the free-running dog has been accused of causing serious damage to deer. Numerous inflammatory

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articles have been written condemning the free-running dog as a predator of deer (Bowers 1953; Brazda 1957; Cochran 1967; Finlay 1968; Giles 1960; Gilsvik 1970; Hardister 1965; Morrison 1968; Sand 1952; Sullivan 1965; Ward 1954). Although most wildlife managers agree that some dogs kill deer, few can concur or document the extent of the damage to deer caused by dogs. Some people have suggested that dog predation on deer may benefit the condition of the herd in areas where natural predation has been eliminated and hunting pressure negligible. Dog predation may prevent overbrowsing of habitat, and may also be beneficial by eliminating diseased animals from the herd.

In some areas, dog laws and regulations have been enacted with little evidence to justify them. Dog control programs of trapping, shooting, and poisoning have been initiated with questionable justification and objectives and their results have seldom been evaluated. The undesirable relations between agency and dog owners that sometimes result from such program may far outweigh the benefits that accrue. Besides being intriguing and naturally interesting, the dog-deer controversy presents a curiosity to man, a possible problem for which limited resources might be allocated, and a predator-prey relationship that warrants further scientific study.

Due to the unusual nature of this research it seems appropriate to define certain terms used to describe dogs throughout this study. *Free-running dogs* refers to dogs that are uncontrolled. Hunting dogs running free during any time of the year, but under their owner's control are not considered free-running dogs. *Domestic dogs* are dogs that are claimed by an owner who feeds them regularly and provides shelter for them. Domestic dogs are usually licensed. *Surplus dogs* are dogs that are unclaimed and unlicensed, although possibly being fed and sheltered. *Stray dogs* are dogs that have no permanent home, but wander aimlessly, usually obtaining food indirectly from man's activities; e.g. garbage dumps and animal roadkills. *Drop-offs* are usually surplus dogs that are abandoned and expected to feed and shelter themselves. Female dogs in heat or when pregnant, or dogs of poor quality, often are abandoned by man. *Feral dogs* are dogs that were once domestic or whose ancestors were domestic, but now are able to maintain themselves and reproduce in the wild (cf. McKnight 1964). This group of dogs is often referred to by field men and the public as "wild dogs".

Although dogs are of great interest to sportsmen and professional wildlife personnel, few studies of free-running dogs and their influence on deer has been conducted. Related research on dogs has been conducted by Barick (1960); Marchinton (1968); McKnight (1964); Sealander and Gipson (1969); Sweeney and Sweeney (1969); Wilson (1954). The research reported herein was conducted to learn more of the movement and activities of free-running dogs and the influence of dogs on white-tailed deer (*Odocoileus virginianus*) in Virginia.

TECHNIQUES AND PROCEDURES

Five major techniques were used in this study: rural inhabitant surveys, radio telemetry, sand plot track counts, warden-biologist questionnaires, and trapping. Field activities were mainly conducted at Broad Run Wildlife Management Area (Craig County), Big Levels Wildlife Management Area (Augusta County), and Poverty Hollow (Montgomery County). These areas were selected due to their dog problem history and their accessibility.

Rural Inhabitant Surveys

To develop a method of predicting dog influence on deer, surveys of rural inhabitants were conducted in the residential areas surrounding the three study areas. Occupants of houses were interviewed and the following information

obtained: number of dogs owned, breed, age, and sex of dogs, whether dogs were tied or not, and general condition of dogs. Dog wardens were contacted to determine the number of dogs that were licensed by the people interviewed. The information obtained was analyzed and compared to determine if there was a correlation between this information and the dog problem on the respective study area.

Radio Telemetry

Radio telemetry tracking procedures were used to determine the average and variability of the daily distance traveled by rural dogs. Owners of free-running dogs were contacted and asked to allow their dog to be tracked with radio telemetry equipment. When the owner's consent was obtained, the dog was instrumented with a collar-attached radio transmitter. The dog was then released on the owner's property and tracking commenced from a road in the vicinity. The location of the instrumented dog was determined by readings made approximately once per hour with a battery-powered portable receiver.

The five radio transmitters used were custom built and emitted a continuous signal on a separate frequency between 26.70 mc and 26.75 mc. Five dogs could be monitored simultaneously. Two power sources were used; one was four 1.5-volt pen light cells in series giving a life expectancy of three to six days; the other, four 1.5-volt mercury energizers in series giving a life expectancy of 30 days. The antenna finally selected was an 18 inch piano wire (B and S gauge 20). The two portable receivers used were small and lightweight and equipped with an 18 inch loop antenna.

Sand Plot Track Counts

In each of the three study areas, 10 sand plots were constructed to measure dog activity in the respective areas. The sand plots were made of fine sand and leveled with a rake to cover an approximate 4 foot square area 1/2 inch deep. Locations of plots were determined by random number tables and plots were placed on the side of the major dirt road in each study area. A dry wooden stick approximately 3 inches in diameter was driven into the ground in the center of the plot so that approximately 1.5 ft were exposed. Each post was scented with a small amount of fox urine. The theory behind the scented sand plots was that a dog in the area would be attracted to the plot by the scent, and while urinating on the post (scenting), would indicate its presence by leaving tracks in the sand. Plots were checked at least daily, and raked after tracks were recorded. Sand plots affected by rain were not included in the data. The plots were re-scented every 5 days or after a rain.

The number of plots containing dog, fox, and wild animals (including fox) tracks were totaled for each of the areas during each season. The number of used plots was then divided by the number of days plots were checked. The figure obtained was the average number of used plots per day and was referred to as the activity index.

A one-way analysis of variance with unequal replication was conducted with the data to determine if there was a difference between the activity indices on the three areas. To determine if activity indices were significantly different between seasons, an analysis of variance was conducted for each of the animal classifications.

Warden-Biologist Questionnaire

Responses of wardens and biologists in Virginia to a mimeographed questionnaire (Perry 1970) were tabulated and analyzed. Comparisons were made by a 2 x 2 contingency table and chi-square between certain questions to

determine if responses were independent of each other. Responses of wardens and biologists were compared to each other and the findings of this study.

Trapping

Trappings was conducted in the fall of 1969 at Big Levels to obtain dogs for use in telemetry tracking and to determine general information of the dogs on the area. Steel traps were set throughout the areas and checked at least once daily. Dogs were removed from the traps with the aid of a dog-catching noose. Telemetry tracking was attempted with several of the dogs.

RESULTS

Rural-Inhabitant Surveys

During the survey of rural inhabitants 151 visits were made to occupied houses. The occupants of 99 houses owned a total of 168 dogs. Findings of the individual areas are presented in Table 1. Because of the small difference between the findings of the three areas in this survey, no correlation to dog-deer relationships on the areas was attempted.

The greatest percentage of licensed dogs near the Broad Run area was probably due to the few residents in the county (3,390) and the subsequent ability of the Craig County Dog Warden to make house-to-house checks of unlicensed dogs. Such checks were difficult in the Poverty Hollow area as the Montgomery County Dog Warden was responsible to 33,305 people and spent most of his time on complaint calls in the Blacksburg and Christiansburg urban areas. This inverse relationship between the number of residents for which a dog warden is responsible and the percentage of licensed dogs may be important concerning dog-deer relationships.

Radio Telemetry

Telemetry equipment for this study worked satisfactorily with the exception of some initial technical problems. During the study 11 dogs were tracked at Broad Run and two at Big Levels for 264.5 and 45.5 tracking hours respectively. A total of 324 location fixes were made for the 310 total tracking hours, with an average of 1.05 fixes per tracking hour. No significant movements were recorded for any of the dogs.

That the dogs did not roam when instrumented does not indicate that they were not free-running dogs. Two of the dogs instrumented were once observed, before being instrumented, 2 miles from their owner's home. The dogs' behavior indicated they were chasing an animal, possible a deer. Several other dogs instrumented were seen away from their owner's home. The problem was not that these dogs did not roam, but that their movements were infrequent and unpredictable. A domestic dog may roam only once or twice during a 2 week-or month-long period. To obtain data on these infrequent movements, continuous and prolonged tracking periods are required. This is physically impossible for one observer and difficult for several observers. The costs per unit of information gained by this method are very high.

Sand Plot Track Counts

The activity indices determined from the sand plot track counts for the three animal classifications during the three seasons were calculated and analyzed. Analysis of variance indicated no significant difference between the three study areas for the activity indices of dogs and fox, but a significant difference for wild animals. Activity indices for each season of the combined sand plot track count for each area are presented in Table 2.

The analysis of variance data revealed that for dogs there was not a significant difference between seasons, whereas for fox and wild animals there was a significant difference. Although there was not a significant difference between

seasons for dog activity, there was a slight increase from summer to winter, which is just the opposite of the wild animal change. During the fall, sand plots at Big Levels were most often used during the morning hours from 7:00 AM and 10:00 AM. Activity of dogs was not apparent during the night.

Table 1. Results of rural inhabitant surveys on the periphery of the study areas, 1969-1970

	Big Levels	Broad Run	Poverty Hollow
Occupied houses visited*	68	54	29
Houses with dogs	44	33	22
Number of dogs	70	61	37
Dogs per occupied house	1.03	1.13	1.28
Dogs per dog owner	1.59	1.85	1.68
Percent adult dogs**	83	82	72
Percent adult dogs tied***	56	60	69
Percent adult hounds	48	48	50
Percent adult dogs licensed****	83	86	73
No. residents in warden's area	9935	3390	33305

* Hunting and summer cabins not included

** Adult dog refers to dog over 6 months (age of licensing)

*** Small house dogs (e.g. Chihuahuas and poodles) considered tied

****Obtained from license records of dog wardens

Table 2. Seasonal activity of dogs, fox, and wild animals (including fox) as indicated by the combined sand plot track counts for Broad Run, Poverty Hollow, and Big Levels, 1969-1970

	Dogs			Fox			Wild Animals (including Fox)		
	Days	Tracks		Days	Tracks		Days	Tracks	
		Tracks	per day		Tracks	per day		Tracks	per day
Summer	20	10	0.50	20	40	2.00	20	81	4.05
Fall	43	41	0.95	43	67	1.56	43	127	2.95
Winter	30	31	1.03	30	19	0.63	30	53	1.77

Warden-Biologist Questionnaire

Questionnaire were received from 109 Game Wardens representing 95 of the 98 counties in Virginia. Twelve questionnaires were received from the 14 Game Biologists. Wardens (82.5%) stated that a dog can kill a healthy adult deer. A chi-square test indicated that the wardens' responses are independent ($\chi^2 = 0.05 < 3.84_{0.95}$) of whether they are dog owners. A similar analysis was conducted to determine if the responses to the question of whether a dog could kill a healthy adult deer or not were dependent or independent of whether dogs were used legally to hunt deer in the warden's area. Significantly fewer wardens ($\chi^2 = 7.50 > 3.84_{0.95}$) from the eastern half of the state, where deer hunting with dogs is legal, thought that a dog can kill a healthy adult deer.

The relationship between the two latter answers could be the result of one or two factors: respondents' bias and area bias. The respondents' bias could result from the degree of association with the sport of hunting deer with dogs. Those wardens, mainly from the eastern part of the state, who have hunted deer with dogs or have seen deer hunted with dogs, might discount the ability of dogs to kill deer. In contrast, those wardens, mainly from the western part of the state, with little or no experience in the sport of hunting deer with dogs might overestimate the ability of dogs to kill deer. The other bias factor, and probably the most important, is area bias which might be caused by physiography. The lowland eastern part of the state has more water areas than the mountainous western part of the state and, therefore, possibly offers more refuge areas for deer being harassed by dogs. If water areas do offer refuge to deer, as many biologists, wardens, and managers believe, then this could explain the relationship to the two answers. It is also possible that deer activity in the mountainous terrain may result in a greater energy drain on deer being harassed by dogs than the eastern flat lands. These factors may be significant enough to create a potentially greater dog problem in mountainous areas than in the flat land areas of the state.

Trapping

In the fall, 1969, six dogs were captured in steel traps at Big Levels. One of the dogs was tied to a leash and followed through the woods to its owner's home. Two dogs were instrumented with a transmitter after being restrained for one day in a holding box. Tracking was ineffective as the dogs would not leave the area of the senior author. Approximately 70 percent of the dogs trapped or seen during this study were hounds. None of the dogs trapped or seen appeared to be feral. Collared dogs were returned to their owners whereas uncollared dogs were given to the dog warden of the area.

DISCUSSION

There is a paucity of useful data on dog-deer relations, most likely due to the very subjective approach taken in the past to the problem, as well as the controversial nature and complexity of the problem. Many wildlife personnel working with deer are convinced that dogs are a serious predator of deer. Managers in many cases do not have records of known dog-killed deer on their areas. Managers, wardens, and some biologists, under questioning by the senior author, usually exaggerated the problem initially, then greatly modified their statements upon further questioning. The controversial nature of the problem further hinders adequate study because of the covert manner in which many of the dog control projects are conducted. Poisoning, shooting, and trapping programs are conducted, but seldom are records maintained on the program evaluated. The complexity of dog-deer relationships cannot be over-emphasized. For example, during the last several years a slight increase in the hunter deer kill at Big Levels has been credited to the dog control program. However, during this period, habitat changes have been made with forest clear cutting and

subsequent deer food production. Such increased food supplies may be a greater factor than dog control in causing deer population increases.

Relatively little is known about the age or condition of deer most often killed by dogs. Many studies of other predators have shown that weak, old, or young animals are the ones most readily killed as prey (Crisler 1956; Mech 1966; Mech and Frenzel 1969; Murie 1944). Although the number of deer killed by dogs in Virginia is recorded, data are not available concerning the age and condition of these animals. Such data would indicate whether the killing behavior of dogs is similar to that reported for their predatory ancestors or is modified due to their domestic food habits. If free-running dogs do kill healthy deer in all age groups, then they might present a great problem. However, if dogs kill mainly young or old deer, or deer weakened by disease, starvation, or injuries, they might not be as serious a mortality factor or have as profound an effect on population dynamics as presently believed.

Dogs are probably a serious detriment when an area is newly restocked with deer or at other times when deer populations are low (Fig. 1). Woolley (1940) stated that dogs were responsible for the major loss of restocked deer in Virginia. Stocking should not be attempted in areas where there is considerable dog activity. In areas where deer populations are high, dogs chasing deer seem to switch tracks which gives time for the originally pursued deer to rest. This phenomena was observed several times at the Radford (Virginia) Army Ammunition Plant where dogs were experimentally released on deer trails. This fenced area has a dense deer population, but the deer were observed never to be in danger of being caught by the six hounds trained to hunt deer. Sometimes the deer would remain stationary while the dogs approached within about 50 yards (once to within 25 yards).

Continual running of deer by dogs has been suggested by some wildlife personnel to affect the physical condition of deer by reducing feeding time of the deer and by excessive energy utilization. Checking stations were conducted during the 1969 deer season at Big Levels and at Broad Run to obtain data on the deer herds. Approximately 10 deer were examined on each of the areas and all appeared to be in good physical condition as indicated by their weight, amount of body fat, and condition of bone marrow. There was no indication that their physical condition had been adversely affected through harassment by dogs. Such harassment would have to be fairly regular to cause a chronic debilitating effect in deer. This steady harassment did not appear to exist on any of the three areas and probably is rare in most areas of the state. Even in high dog population areas, it is doubtful that dog harassment could be enough to seriously affect the health of deer populations by reducing the amount of feeding time or by increasing energy utilization. It is the opinion of the authors that deer populations are influenced by dogs mostly through direct killing following a short chase. The length of chases is probably variable, but most chases that terminate in death are probably less than 4 hours. Deer, however, could probably not evade dogs in a continuous chase for greater than 30 minutes. Deer chases that end in death of the deer probably are shortest when dogs of several types are in the same pack. A mutualistic relationship probably exists in packs between dogs that track by sight and those that track by scent.

Other intrinsic effects of dog harassment may occur with deer. A high percentage of biologists and wardens (100.0% and 80.4% respectively) stated in the questionnaire that dogs affect the natality of deer. Sufficient data, unfortunately, is unavailable to indicate the effect of dogs on deer natality through reduced reproductive function.

A high percentage of wardens and biologists (91.5% and 81.8% respectively) indicated on the questionnaire the feral dogs existed on their areas. No dogs seen or captured during this study appeared to be feral. Although feral dogs probably have occurred in Virginia in the past and may now be present, it is believed that their numbers are small. McKnight (1964) reported that feral dogs

occurred in Virginia as indicated by the response to a questionnaire sent to personnel in Virginia familiar with feral animals. He further stated, however, that dogs are more likely to be strays than completely feral. Atwood (pers. comm.) stated that during 3.5 years of study of dogs in Hanover County, Virginia, he observed only one group of dogs believed to be feral. In later discussion he stated that feral dogs are probably very rare in Virginia. The influence feral dogs have on deer in Virginia is most likely insignificant.

The most effective means of controlling free-running dog numbers appears to be the enforcement of dog laws by an active and interested dog warden. It has been shown in the past that trapping, poisoning, and shooting can be detrimental, due to the bad public relations created and the loss of desirable wildlife. By removing fox in predator trapping programs, and other wildlife that are accidentally or purposely killed in the traps, the dog influence on deer may be increased. These animals present potential chases for dogs and thereby act as a buffer. The removal of these animals possibly causes dogs to increase deer chases (Fig. 2). Trapping, poisoning, and shooting programs should only be employed as control measures of dogs when other methods are ineffective.

The affect of cover on dog-deer relationships may be greater than presently realized. Heavy cover in eastern Virginia and other coastal areas of the Southeast, may supplement marshy areas and streams as potential refuges for deer harassed by dogs. If this were true, free-running dogs might present less of a problem in areas of heavy cover and deer management practices could be modified accordingly. However, it seems just as feasible to believe, that heavy cover may hinder deer movement while not increased dog predation by reducing the speed of deer movements or creating a high energy drain on the deer. Present knowledge of cover as it related to dog-deer relationships does not appear adequate to draw conclusions concerning the advantages or disadvantages of heavy cover to deer harassed by dogs. When sufficient data are available, habitat can be managed to better enable effective deer population responses to dogs.

In some areas of Virginia and other states deer populations are judged to be under-harvested and it appears paradoxical to be overly concerned with dog influence in such areas. The concern regarding deer mortality from dogs should be considered in perspective with other types of miscellaneous mortalities. In 1969 only 76 deer were reported killed by dogs in Virginia. This was a small percentage of the total of 3,395 deer killed by non-hunting causes or of the 34,117 legally taken. It can be argued that many dog-killed deer were unreported which is probably true. However, if the reported number of deer killed by dogs were multiplied by 10, the result would still be less than the known illegal deer kill (910) and approximately one third of the known automobile deer kill (2,154). In view of these figures alone, it would appear to be more appropriate to spend money presently used in dog control programs on alternate activities such as reducing the illegal or automobile-caused deer losses.

Dog influence on deer populations will probably continue to be a popular subject for sportsmen and wildlife personnel in Virginia due to its strong emotional appeal. Little evidence accrued in the study, however, to indicate that dogs, on a statewide basis, are a problem of great magnitude. Certainly problems have existed and do exist in some areas which have caused a reduction in the deer herd or have negated deer stocking attempts. Unfortunately, however, many of the influences of dogs are purely speculative and lack substantial proof. Objective research is warranted in many areas of dog-deer relationships, not only on the basis of deer management but also for further elucidation of an interesting curiosity of man.

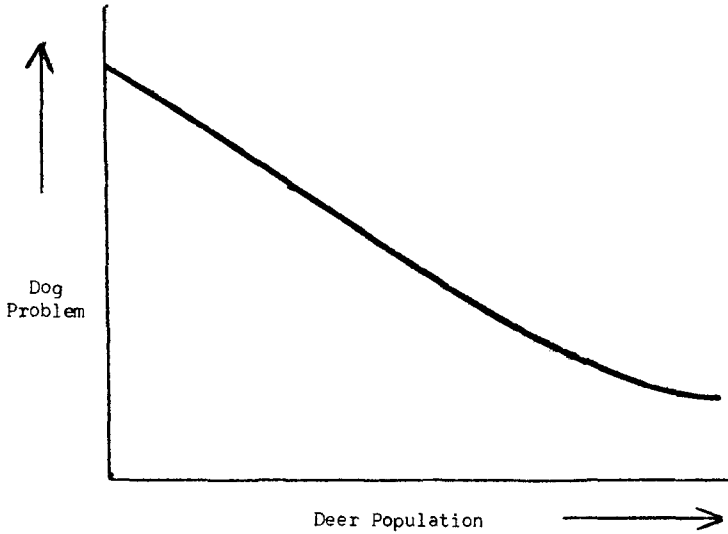


Fig. 1. Probable relationship between the magnitude of a local dog problem and the size of a deer population

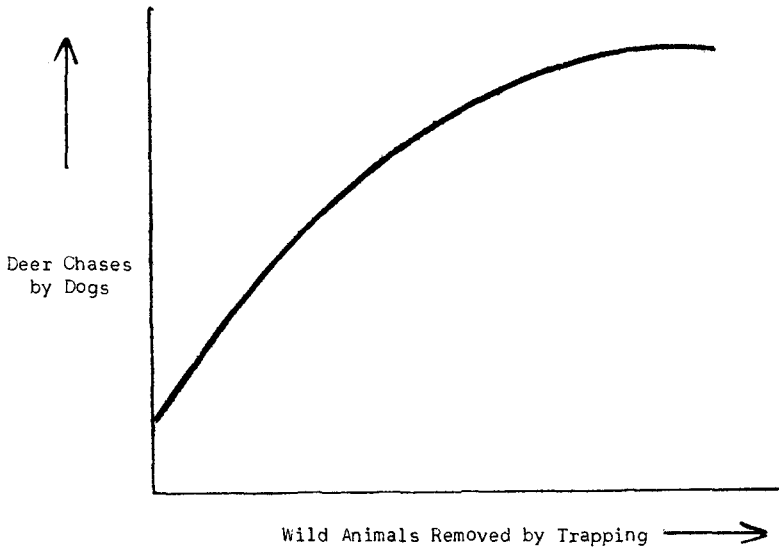


Fig. 2. Probable relationship between the number of wild animals removed by trapping and number of deer chases by dogs

LITERATURE CITED

- Barick, F. B. 1969. Deer predation in North Carolina and other Southeastern states. Southeastern Deer Symposium. Nacogdoches, Texas. 24 p.
- Bowers, R. R. 1953. The free-running dog menace. Va. Wildl. 14:5-7.
- Brazda, A. R. 1957. Dogs versus deer. N. D. Outdoors 19 (7) : 17.
- Cochran, B. 1967. Delinquent dogs and dead deer. Outdoor Oklahoma. 23 (12): 12-13, 20.
- Crisler, Lois. 1956. Observations of wolves hunting caribou. J. Mammal. 37 (3): 337-346.
- Finlay, E. 1968. Questionnaire reveals much damage to game from free-running dogs over state. S. Car. Wildl. 15 (4) : 2-5.
- Fuller J. L., and E. M. DuBuis. 1962. The behavior of dogs. p. 415-452. In E.S.E. Hafez (ed.). The behavior of domestic animals. The Williams and Wilkins Co., Baltimore, Md. 619 p.
- Giles, R. H., Jr. 1960. The free-running dog. Va. Wildl. 21(6):6-7.
- Gilsvik, R. 1970. Killer pets that waste our white-tails. Sports Afield. 163(1): 44-45. 82-83.
- Hardister, J. P. 1965. Dog: man's best friend. Wildl. in N. C. 29(2):20-21, 31.
- Marchinton, R. L. 1968. Telemetric study of white-tailed deer movement-ecology and ethology in the Southeast. Ph.D. Dissertation, Auburn Univ., Auburn, Ala. 138 p.
- McKnight, T. 1964. Feral livestock in Anglo America. Univ. of Calif. Press, Berkeley and Los Angeles. 87 p.
- Mech, L. D. 1966. The wolves of Isle Royale. U. S. Nat. Park Serv., Fauna Surv. 7. 210p.
- Mech, L. D., and L. D. Frenzel, Jr. 1969. Continuing timber wolf studies. The Naturalist 20(1):30-35.
- Morrison, J. 1968. Hounds of hell. Georgia Game and Fish 3(13):13-19.
- Murie, A. 1944. The wolves of Mount McKinley. U. S. Nat. Park Serv., Fauna Surv. 5. 238 p.
- Perry, M. C. 1970. Studies of deer-related dog activity in Virginia. Unpub. M.S. Thesis. Va. Poly. Inst., Blacksburg, Va. 90p.
- Sand, G. X. 1952. Let's stop the self hunting dog. Pa. Game News 22(11):4-8.
- Sealander, J. A., and P. S. Gipson. 1969. Range, food habits, and reproduction of coyotes and feral dogs in Arkansas. Ann. Prog. Rep., Univ. of Arkansas, Fayetteville, Arkansas. 25p.
- Sullivan, F. W. 1965. The feral or free-running dog. Pa. Game News 35 (3): 24-28.
- Sweeney, J. R., and J. M. Sweeney. 1969. Movement patterns of white-tailed deer (*Odocoileus virginianus*) on the Savannah River Plant. p. 148-154. In 1969 Annual Report, Part I-Savannah River Ecology Laboratory.
- Ward, L. 1954. What's it going to be, deer or dogs in southern West Virginia? W. Va. Cons. 18(6):3-5.
- Wilson, R. M. 1954. Influence of dogs on the New Hampshire deer herd. P-R Report, New Hampshire Fish and Game Dept. 9p.
- Woolley, D. J. 1940. The survival of restocked deer in Virginia. Unpub. M.S. Thesis. Va. Poly. Inst., Blacksburg, Va. 176p.
- Zwickel, F. C. 1969. Uses of dogs in wildlife management. p. 319-324. In R. H. Giles, Jr. (Ed.). Wildlife management techniques. The Wildlife Society, Washington, D. C. 623p.