DISTURBANCE EFFECT OF FREE-RUNNING DOGS ON DEER REPRODUCTION

by

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INTRODUCTION

Free-running dogs are supposedly a serious threat to wildlife, but there are few scientific facts to support this viewpoint. The question is filled with emotion, and many writers of popular wildlife articles appear to be caught up in the anti-dog crusade, accusing dogs of running down and killing healthy adult white-tailed deer (Odocoileus virginianus) and their fawns, affecting reproductive success, and causing large home range changes that eventually "run the deer out of the country." Evidence upon which such articles are based can often be traced to a single isolated observation, not scientific research. Yet, some opinions are so widely held as to be regarded as "fact" and several public agencies have initiated dog-control programs on such evidence.

Even the sport of deer hunting with hounds has come under attack in recent years by several state game and fish departments in the South, where dog hunting is still legal. Public resentment has developed because of department efforts to discourage this type of hunting. There is no question that if dog hunting seriously damages the deer herd, it should be terminated. However, dog hunting provides a great deal of recreation, and the sport should not be eliminated or curtailed unless substantial damage to the resource is well documented.

The few scientific studies conducted to date (Corbett et al. 1971, Sweeney et al. 1971) indicate that dogs are likely to catch only extremely old, diseased, or otherwise inferior deer, and that most

deer readily return to their home range after being chased. No study has been made of the effect of dog chasing on deer reproduction, but game wardens and biologists in Virginia surveyed by Perry (1970) believed that chasing deer during their pregnancy was detrimental, and thus seriously affected the productivity of the herd. Because of such widely-held opinion and the fact that no evidence is available to support such a conclusion, this study was initiated to gain insight into the effects of dog chasing on deer reproduction. The study reported here may serve to caution wildlife administrators and other workers that their opinions may be biased. With researchers from Georgia and Arkansas also conducting studies on dog-deer relationships, some clear facts on the subject should be known in the near future.

Objectives of this study were 1) to determine if chasing pregnant deer by dogs reduces fawn numbers surviving to late summer, and 2) to determine home range changes that may occur as a result of dog chases.

LITERATURE REVIEW

The Free-Running Dog and Its Activity

For the purpose of this report, the free-running dog is any uncontrolled purebred or mixed breed having an owner, and returning to him occasionally for food or shelter. This definition is similar to that of Perry (1970), who defined the free-running dog as any uncontrolled dog. Clarke (1956) stated that mongrels, spaniels, and even terriers made good deer dogs for hunting in Ontario. Wilson (1954) reported that the mongrel, hound, beagle, collie, collie mixed, German shepherd, and setter were the most frequently observed types of canines running deer in New Hampshire, in that order. From warden-biologist questionnaires, Perry (1970) stated that hounds, mongrels, and German shepherds did the most damage to deer populations in Virginia. Progulske and Baskett (1958) reported that, in their dog study in Missouri, only hounds seemed to have any influence upon the harassment of deer, and that non-hounds were not effective hunters. Sweeney et al. (1971) felt that caution should be taken when comparing hunting hounds with other free-running dogs, since the hunting behavior of the various types of dogs may be completely different. It should be stated at this point that dogs which have been used to hunt other game species will readily chase deer, if provided the opportunity. Corbett et al. (1971) commented that it was not at all unusual during hunts to have bear hounds chase deer. Unless bear, rabbit, and raccoon hounds are very well trained, deer in the area may receive as much harassment as the species being hunted.

Feral dogs, according to McKnight (1961: 38), are those canines that "live apart from man, reproducing and maintaining themselves in the wild." The feral dog is different from the free-running dog in that it must obtain its own food. Any time spent chasing an animal simply for recreation is a waste of valuable energy (Scott pers. comm.). Scott and Causey (in press) indicated that feral dogs were not observed chasing deer, and suggested that free-running dogs may create a much greater harassment problem than the former. Feeding observations and dog scat analyses indicated that the main foods eaten by feral dogs were garbage, rabbits, mice, persimmons, and carrion. There was no evidence of feral dogs preying on livestock or deer. Barick (1969) reported that in the areas studied in North Carolina, no dogs could be classed as completely wild or feral. Of several hundred dogs "controlled" in the western part of the state, 62 percent showed signs of being owned, and even those that did not show physical signs of ownership, appeared to be domestic. McKnight (1961) believed the majority of so-called "feral dogs" were really dogs that had joined with a roaming pack for a few days, but would return to their owners. During Perry's (1970) study, no dogs seen or captured were feral, but high percentages of wardens (92 percent) and biologists (82 percent) believed feral dogs existed on their areas. Thus, there is a difference of opinion about the type of dog creating the alleged problem.

Dog activity, as reported by Perry (1970), was greatest at dawn and dusk, with 0400 to 0800 being the most active period of the day.

Nocturnal activity of dogs was not observed. Jackson (1972) stated that free-running dogs in New York state were most active in the woods from 0600 to 1000. From warden and biologist questionnaires, Perry (1970) found that spring was the peak season of activity for free-running dogs, followed by fall, winter and summer. Wilson (1954) disclosed that dog activity in New Hampshire started in January and peaked in March. Activity then dropped quickly, but even through April, the amount of activity was greater than in January. Wilson also reported that activity of dogs appeared to be greater in areas of dense human populations, because in such areas there were large numbers of dogs and many opportunities to report and observe the activity.

Perry (1970) found that free-running dogs may roam only once or twice during a 2-week period, and from questionnaire work, that dogs may roam from approximately 6 to 15 kilometers (4 to 9 miles) per day. Scott and Causey (in press) concluded that a feral dog pack traveled from 0.8 to 8.0 kilometers (0.5 to 5.0 miles) within its home range per day, with greatest movement at dusk and dawn. Hunting dogs, when trailing deer, could range from 40 to 81 kilometers (25 to 50 miles), according to hunter interviews conducted by Perry (1970). However, this distance is only achieved after several days of wandering, probably not a single chase. Sweeney et al. (1971) reported that hunting dogs can often run 3 to 6 hours, so long distances are certainly possible.

In counties where hunting deer with dogs is allowed, dog activity usually takes a sudden upsurge during the authorized season. This increased activity is sometimes met with condemnation by other hunters.

However, hound hunting during an authorized season does not necessarily mean an increase of free-running dogs during the rest of the year. Barick (1969) wrote that, in the eastern swamp areas of North Carolina where dog hunting was allowed, dog activity was negligible during the non-hunting season, while it remained constantly high throughout the year where dog hunting was outlawed. Even so, Marchinton et al. (1970) stated that critics of dog hunting felt that large numbers of deer hounds were allowed to run out of season.

Deer hunting with dogs is not new by any standards. Ruhl (1956) pointed out that dogs were used extensively by pioneers who held the dogs in check until the deer were flushed from hiding. Some prairie hunters, running deer with greyhounds, exhausted deer to the extent that they could be approached on horseback. Market hunters often used dogs to drive deer into water or deep snow, where they were easily killed. In the South, knives and sharpened stakes were sometimes set in deer runways, thus mutilating and eventually killing the deer that was trying to escape hounds set upon it.

Because of the extensive use of dogs in hunting deer, it was a highly effective method, and is still considered so by its critics. Marchinton et al. (1970) pointed out that critics of dog hunting felt the use of dogs allowed too large a kill for effective management, and that dogs killed many deer during chases. He also stated that the "diminishing returns" principle did not work with such hunting, as huntered obtained considerable aesthetic benefits from the chase itself. His opinion was that does should generally not be killed during the dog hunting season.

Some authorities feel, however, that dog hunting for deer has too many bad effects to be allowed at all. Jenkins (1952) blamed the decimation of the white-tailed deer in north Georgia primarily on the hunting of deer with hounds. He felt the use of dogs in open, virgin timberland was too effective a method of exploitation. Ruhl (1956) declared that sportsmen in many states felt that an authorized dog hunting season complicated the enforcement of other free-running dog regulations. Murphy (1969: 55) made the statement that, "The sporting ethics of using dogs to hunt deer appears questionable to me."

Part of the objection to dog hunting stems from the apparent conflict between dog hunters and still hunters. Ruhl (1956) reported that the states having people most opposed to dog hunting were usually those with the largest hunter populations, capable of making adequate harvests without dog assistance. He felt that sportsmen in these heavily hunted states had numerous objections to use of dogs for deer hunting, and under no circumstances would the sport be permitted. LaHart and Lucas (no date), stated that 78 percent of the stillhunters on the Ocala National Forest in Florida felt that dogs added to their recreational experience. Florida has been a traditional dog hunting state, however, and should not be considered typical. Thus, as Marchinton et al. (1970) pointed out, other factors would be considered when deciding whether or not dog hunting for deer should be allowed; namely, tradition, characteristics of human population, and land ownership characteristics.

Ruhl (1956) felt that dog hunting of deer was not detrimental where allowed and certainly was not inhumane. In fact, he felt it was a necessity in the Southeast where thick, brushy areas and swamps were prevalent. Marchinton et al. (1970) reported that ideal conditions for dog hunting were along the coastal plain, and Perry (1970) stated that dog hunting east of the Blue Ridge in Virginia was allowed because of the difficulty in killing deer in dense, lowland areas.

The Killing of Deer by Dogs

Wilson (1954: 5), using Conservation Officer reports of dog activity as his main source of information, stated that, "If actual loss to dogs were known, it would undoubtedly have ranked the number one mortality factor by a wide margin (other than legal hunting)." Cromer (1967) stated that dogs were the major factor supressing deer populations in the southern region of West Virginia. Barick (1969: 31) reported that, "The primary predator, other than man, in North Carolina is the uncontrolled dog." Similar statements have been made by Bowers (1942), Giles (1960), Morrison (1968), Rue (1961), Severinghaus and Cheatum (1956), and Caras (1973). Howarth (1969), in a survey made by Georgia wildlife rangers on deer mortality, reported that chases of deer by dogs were never seen to the finish, but that many deer were presumed killed by their pursuers. Barick (1969) stated that there were many available and reliable reports of healthy deer being killed by dogs. Barick estimated that annual deer loss due to dogs in North Carolina went from 0 to 30 percent of the herd. He further stated that on protected wildlife management areas in North Carolina,

annual loss by dogs per 15,000 acres could be as large as 37 deer. Such losses could remove up to 50 percent of the annual increment of the herd.

Hulsey (1971: 7) stated that, "Trained personnel who have experience with game and dogs will not deny that a dog is capable of killing a deer. The question is how much effect do dogs have on deer populations and behavior." He further pointed out that people finding dogs feeding on a deer assumed that the dogs killed it, and stated that there were simply not enough data available to determine whether or not the dog was a serious predator. Perry (1970) asked biologists to send in information about deer killed by dogs, so that the deer could be picked up and examined. This request was in effect for 7 months, but no calls or deer were received. Progulske and Baskett (1958) reported that in a 6 1/2 - month period, they received only three reports that dogs had killed deer on or near the study area.

Corbett et al. (1971) completed a recent study on dog-deer relationships in the mountains of North Carolina. They stated that deer may have been more susceptible to dogs in mountainous terrain because dogs may be better adapted to running on slopes than deer. Consequently, they felt that dogs may have a significant impact on populations in the mountains. Of 15 deer radio-tagged and run by hounds, two were killed. One of the deer, a doe, was in poor physical condition (75 lb.), with a macerated fetus, emphysema of the lungs, and parasitic lung damage. The other deer was in fair condition, but contained a heavy parasite infestation. The latter

deer eluded the hounds after a 7.97 kilometer (4.95 mile) chase, but was found (using telemetry) kneeling in a river. The dogs were set on her again, and killed her after a 100-yard chase. A 45-pound doe killed outside the study area by dogs was also examined by these workers and found to have heavy parasite damage in the lungs, making the deer incapable of running for a sustained period.

Kolenosky (1972) reported that wolves in Ontario were successful in killing deer on 46 percent of 35 chases that he reconstructed. The average age of deer killed by wolves was greater than those killed by hunters. Most of the 29 deer kills examined were in excellent condition. He estimated that the wolf pack killed a deer an average of once every 2.2 days. Mech and Frenzel (1971) reported that most wolf kills were of old deer and they indicated that wolves may also be taking a high number of fawns. Deer killed during the winter months by wolves usually had at least one of the following characteristics: They were over 5 1/2 years old, suffered from nutritional deficiencies, were physically impaired, or were fawns. From 6.3 to 37.5 days elapsed between pack kills.

Fawns may be especially susceptible to dogs. Perry (1970) stated that kills of young fawns go unnoticed, but suggested such losses are substantial. Coyote predation was evaluated on three areas of mule deer (Odocoileus hemionus) range by Robinette (in press), and fawn crops were compared before and after the poison "1080" was used. In the first area, fawn numbers were declining for other reasons and

the treatment could not be evaluated. However, in the other two areas, studies indicated that coyotes had a substantial effect on fawn crops. Cook et al. stated that coyotes were the principal cause of fawn mortality in a study in South Texas. Coyotes inflicted 53 percent of all fawn losses, observed by radio-tracking.

Characteristics of Dog Chases

Rue (1962: 109) stated that, "Deer will run from almost any dog, regardless of its size." He felt that all dogs had hunting instinct, and that sooner or later, after a dog killed a deer, it became addicted to the chase.

Chases vary considerably in both length and time. Sweeney et al. (1971) reported that chases ranged from 3 to 155 minutes, averaging 33 minutes. Two of 65 dog chases lasted over 2 hours. He reported that the average distance covered in a dog chase was 2.4 miles, ranging from 3.2 to 21.3 kilometers (0.2 to 13.4 miles). It was felt that chase duration was inversely proportional to deer density. This was because the dogs often switched trails during the chase. Chases involving individual deer varied from 10 to 85 minutes during the study. In all 65 chases, no deer were caught by the hounds. Corbett et al. (1971) reported that in rugged, mountainous habitat, chases averaged 54 minutes and 3.80 kilometers (2.36 miles). The maximum chase was 165 minutes and 10.90 kilometers (6.77 miles). It was felt that chase habits were more predictable in mountain habitats than in lowland swamp areas, and that deer were more apt to suffer injury in the mountains while being chased. It was also reported that deer in the

mountains took longer to return to their home ranges after being chased than those in the lowlands. Much of the time deer continued to travel away from their home range after losing the dogs. This additional traveling averaged 1.14 kilometers (0.71 miles), and conceivably added additional stress on the deer.

Escape patterns of deer being chased by dogs can vary also. Sweeney et al. (1971) reported that deer either remained bedded, ran a zigzag pattern within their home range, ran through water, separated from the main group, or used speed and endurance to outdistance the dogs by running in a straight line and leaving their home range. It appeared from the study that bucks preferred to run in straight lines, leaving their home range, while does preferred to run in a circuitous pattern when chased.

Effects of Dogs on Deer Home Range

The white-tailed deer is an animal of small home range, and unless it is distrubed or disperses will spend its entire life in an area usually no larger than a square mile. This has been well documented by Progulske and Baskett (1958), Rongestad and Tester (1969), Marshall and Whittington (1969), Marchinton (1968), and others. Downing et al. (1969) reported that irregularities in movement of white-tailed deer may occur during hunting seasons, the rut, or in the summer (with certain age classes). He concluded that more than two-thirds of the deer in the Radford Arsenal in Virginia moved outside their normal home ranges during the special archery season. Due to the relatively small number

of observations made, it was difficult to tell how soon the deer moved back into their normal ranges. No permanent home range changes were noticed following the hunting. Marshall and Whittington (1968) stated that heavy hunting pressure did not move five telemetered deer out of their home ranges, but movement within the home range increased as the hunting pressure increased. Rue (1962: 40) declared, "Herds of deer numbering up to seventeen or eighteen are often seen jumping into the Delaware River from the Pennsylvania side," in order to escape the hunting season in that state. Due to these types of movement, Downing et al. (1969) surmised that hunter returns of tagged deer did not necessarily reflect their normal home range due to movement taking place during the hunting season.

Progulske and Baskett (1958) concluded that deer would leave their home ranges when chased by dogs. Sweeney et al. (1971) reported that in 51 of 65 chases by dogs, deer were pushed out of their home range, but returned in 1 day or less. Corbett et al. (1971) reported that, in those chases where deer stayed in their home ranges, duration of the chases was relatively short, averaging 1.17 kilometers (0.73 miles). The short times were due to the deer crossing streams (causing the dogs to lose the trail), very dry or windy weather (causing faint scent), or the dogs switching trails. Deer left their home ranges in 70 percent of the chases, and took from 2 1/2 hours to 7 days to return. Approximately one-half the returning trips were greater than 1 day.

Some Possible Effects of Dog Running on Deer Reproduction Based on Farm Animal Studies

Ulberg and Burfening (1967: 571) stated, "It is usually agreed that early embryonic death is a major factor in mammalian reproductive efficiency...." Referring to farm animals, they declared that the problem seemed to be that the embryo ceased its development after entering the uterus. They also reported that temperature stress during the early developmental stages of the embryo resulted in its later death in both sheep and rabbits. They stated (p. 574), "If a slight increase in temperature surrounding the embryo at time of the first few cell divisions contributes to delayed death, the body temperature of the female near the time of mating should be associated with the chances of success of the mating." Alliston et al. (1965: 337) supported this hypothesis: "It is concluded that the early rabbit embryo is directly affected by the increased maternal body temperature that accompanies thermal stress of the female." Alliston and Ulberg (1965) hypothesized that maternal body temperature effects on the ova of rabbits may be limited to the time before the first cleavage. Howarth et al. (1965) reported that higher ambient temperatures, when shifted from 20 to 32 C (70 to 90 F), increased rectal temperatures in rabbits significantly. Alliston et al. (1965) stated that there was a decrease in implantation sites containing living embryos when high temperatures occurred during the initial cleavage division, and that average rectal temperatures in rabbits increased by 1.0 C (1.8 F),

when the rabbits were exposed to 32.2 C (90 F). Woody and Ulberg (1966) found that significant differences in fertility occurred between ewes exposed to 21 C (70 F) and 32 C (90 F), most of the decrease in fertility of the latter occurring by the end of estrus. The rectal temperatures of the ewes exposed to 32.2 C (90 F) temperature were significantly higher than the former group. Dutt et al. (1957) studied sheared and unsheared ewes in a 32.2 C (90 F) room and reported that an increase in body temperature of 1.0 C (1.8 F) for the sheared and 0.9 C (1.6 F), for the unsheared, probably had a damaging effect on the gametes. It was also possible that an increased temperature resulted in endocrine disturbance; ewes exposed to the heat had long estrual cycles. Rectal temperatures and pulse rates of the ewes in the warmer room were significantly higher than control ewes. Older exposed embryos (8 days post-breeding) were much less distrubed by heat stress in the study than those ewes exposed to heat before breeding, with embryo losses of 15.4 percent and 91.7 percent, respectively. Hulet et al. (1956) stated that sheared lambs had significantly higher fertilization rates than unsheared lambs. He stated that any factor which tended to increase body temperature, including exercise, tended to decrease fertility.

Vincent and Ulberg (1965) supported the concept that temperature stress during conception for short periods is harmful to subsequent embryo survival. Goode (1964) stated that ewes bred in the spring and pastured in hot summer weather during the gestation period produced small, weak lambs at birth, abortions and premature lambs, pre-natal

death or death shortly after birth, or failure of ewes to lamb at all. When ewes were kept in cool barns or sheds during gestation periods, an increase was noted in birth rates, birth weights, survival, percent of ewes lambing, and conception rates. Shelton (1964) also reported that the effects of high temperature during gestation were low birth weights and increased lamb mortality.

Fetal dwarfing is another possible effect of high temperatures on sheep. Yeates (1958) reported that seven ewes kept on a low plane of nutrition and 92 degrees F (wet bulb) from post-servicing until lambing produced only four lambs which were significantly lower in weight than control lambs. Shelton (1964) hypothesized that there were two possible mechanisms for fetal dwarfing. He felt that body temperature had adverse effects on the rate of cell division in the fetus, or that a nutritional deficiency of the developing fetus occurred due to a decrease in blood supply to the fetus. Shelton and Huston (1968) reported that fetal dwarfing and a significant reduction in the number of lambs were a result of temperature stress during the last one-half to two-thirds of the gestation period. They ruled out nutritional deficiencies as the cause of fetal dwarfing.

High temperatures in the female may also affect male spermatozoa upon entering the uterus. Dutt et al. (1959) reported that rams kept at lower environmental temperatures over the summer may sire a higher number of young. The authors also declared that an increase in body temperature of ewes may impair sperm viability or travel,

due to a change in the environment of the female reproductive tract. Ulberg and Burfening (1967: 574) stated that, ..."the possibility exists that temperature could affect spermatozoa in the uterus before fertilization, so that the resulting embryo may not be able to survive." They further found that in one particular experiment, heat-stressed females had embryos which formed implantation sites, but few sites contained normal embryos, due to heat-stressed spermatozoa being introduced to the female. Fertilizing capacity was apparently not affected. Howarth et al. (1965) stated that there was a reduction in pre-implantation embryo survival as a result of the higher temperature of the uterine environment for the sperm.

The primary question that must be asked at this point is exactly how much temperature stress do dogs place on deer. Downing (pers. comm.) measured rectal temperatures of six deer killed while run by dogs, and found temperatures as high as 109 F. Thus, dogs are certainly capable of raising the uterine temperature of deer; and if deer are physiologically similar to sheep and a sizeable portion of the herd is chased at the proper time, it would appear that considerable embryo mortality is a possibility. It has also been suggested that high temperatures over the greater part of the gestation period cause embryonic death or fetal dwarfing in sheep, and these characteristics should be looked for in deer which are similarly stressed. From the existing information, therefore, it appears that the chances of reproductive problems as a result of dog hunting may be great enough

to limit the reproductive potential of the deer herd. These problems may be reflected as lower birth weights, lower conception rates, increased fawn and embryo mortality, and fewer does breeding. However, at this time, the effects of dog running on the reproductive processes of deer are totally speculative.

There are other factors which affect deer productivity. Cheatum and Severinghaus (1950) postulated that fertility levels of deer corresponded generally with range quality. Intensive harvesting of deer left more quality browse, thus raising the fertility rate on such areas. Verme (1965) reported that does on high nutritional planes produced a mean of 1.74 fawns per doe among 17 does, and that the 22 does on low nutritional diets produced a mean of only 0.95 fawns per doe. Giles (1970) suggested that dogs may shorten the food intake time in deer, thus contributing to nutrient deficiencies. However, no information is available at this time to suggest that dogs may limit a deer's nutritional intake enough to cause either fetal dwarfism or embryonic death. McDowell (1959) attributed decreased productivity in older age classes of deer to the quality of range occupied, and not age alone. It was McDowell's opinion that the percentage of pregnancy in age classes above 1 year did not vary greatly.

Bishop (1964) also attributed a large part of the cause of embryonic death to genetic causes which he contended is a means of eliminating unfit individuals at a low biological cost to the species. Thus, dog running could be a cause of embryonic death

in whitetails, but its true significance is difficult to separate from that of other causes.

THE STUDY AREA

This research project was conducted at a portion of the Radford Army Ammunition Plant located in Pulaski County near Dublin, Virginia. (Fig. 1).

Description

The 826 hectare (2,040 acre) area is completely enclosed by a 2.28 m (7 1/2 ft.) chain link fence which restricts deer movement into and from the area. The area is divided into three main watersheds: Sawmill Hollow, M-1 Hollow, and Hazel Hollow (Poux 1972), and contains 20 percent scattered woodlands. Principal grass species are orchard grass (Dactylis glomerata), rye grass (Lolium perenne), and mixed fescues (Festuca spp.). The wooded portion of the plant area contains approximately 60 percent shortleaf pine (Pinus echinata) in plantations, mixed oaks (Quercus spp.), mixed hickories (Carya spp.), eastern red cedar (Juniperus virginianus), black cherry (Prunus serotina), and black locust (Robina pseudoacacia). Water is available from five small spring-fed streams in the area.

The "chase" area used during Phase 1 of this study was similar to the Intensive Study Area described by Poux (1972). Further description of the area is found in theses by Poux, Petcher (1967), and Sandt (1969).

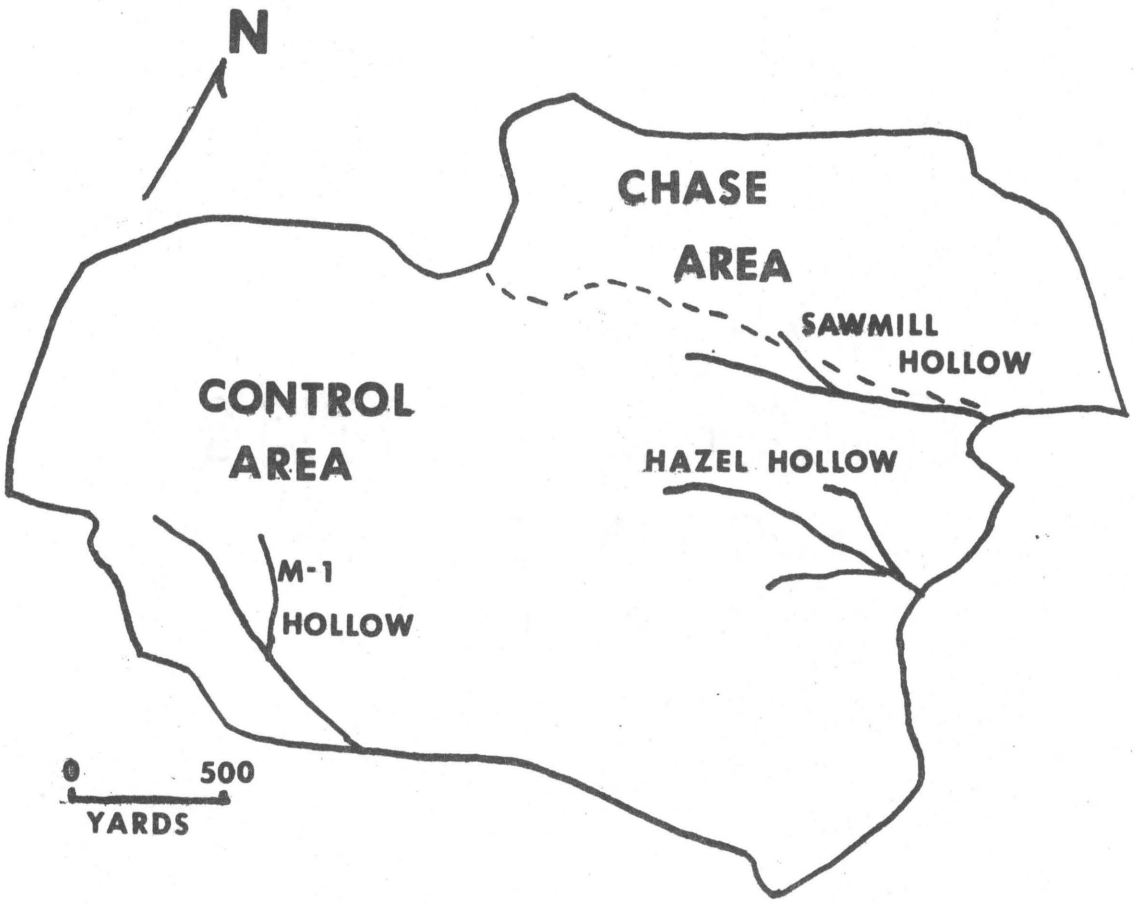

Fig. 1. Map of study area, Radford Army Ammunition Plant, Dublin, Virginia, 1972-1973.

TECHNIQUES AND PROCEDURES

There were two periods in which chases were observed: the first took place in April, May, and June 1972, and the second from October 1972 to May 1973. These two periods are described separately as Phase I and Phase II, respectively. A calendar of major field activities is presented in Table 1.

Phase I

Dog Chases

The area was divided into "chase" and "control" areas during this phase of the study. All doe chasing was confined to a single watershed, Sawmill Hollow, which included approximately one-third of the total area. Approximately one-half of the tagged does occupied this watershed, and most of these frequented several small agricultural plantings in the northeast corner of the enclosure. From 22 April to 3 June, deer hounds were used to run deer in the "chase" area on weekends only. Two hounds were used on most chases. These were chosen from two redbones, one bluetick, and three black-and-tan hounds borrowed by the Virginia Cooperative Wildlife Research Unit from deer hunters for this purpose.

The hounds were transported in the rear of a covered pickup truck until a group of deer was seen near the road. If the group contained two or more does, the dogs were released as close as possible to the deer. Usually in the ensuing chase, other deer were jumped and run by the hounds so that the group of deer often numbered 10

Table 1. Calendar of major field activities during deer-dog study, 22 April 1972 to 20 August 1973.

Dates	Activities
22 April 1972 - 3 June 1972	Run dogs in chase area. Determine number of pregnant tagged does by observation. Mark locations of all tagged does seen. Tag fawns.
4 June 1972 - 15 June 1972	Tag fawns. Mark locations of tagged does.
15 September 1972 - 22 September 1972	Observe number of fawns with each tagged doe, and census marked and unmarked fawns and does.
21 October 1972 - 26 May 1973	Run dogs in entire study area on weekends. Mark locations of tagged deer.
20 May 1973 - 15 June 1973	Tag fawns. Mark locations of tagged does.
11 August 1973 - 20 August 1973	Observe number of fawns with each tagged doe, and census marked and unmarked does and fawns in study area.

to 30. Dogs were followed as closely as possible by the observer in the truck. As the hounds approached the boundary of the "chase" area, they were picked up, rested, and set on another group of deer within the "chase" area. Chases continued on Saturdays until the dogs tired, or every doe was run out of the "chase" area. On Sundays, chasing was allowed only until 0800. Chases were mapped as accurately as possible, and times and characteristics of each chase were recorded.

Techniques of Evaluation and Analysis

Mr. Robert L. Downing, a wildlife biologist with the U. S. Bureau of Sport Fisheries and Wildlife, accumulated data on this deer herd from 1965 until the present. Fawn tagging took place yearly during this period, along with tranquilizing and tagging adult does. In this manner, over one-half of the population of does were tagged, and the majority were of known age.

Several techniques were employed to compare fawn production by "chase" and "control" area does. Pregnancy was visually determined for tagged does during April and May by noting the distinct swelling in the abdominal area.

From late May until the middle of June, fawns were captured and ear tagged using techniques described by Downing and McGinnes (1969). Due to the infrequency with which fawns were observed during the summer (Downing et al., in press), counts of fawns and does were not undertaken until 15 September. Counts were made along a 34 kilometer (21-mile) route that covered the entire study area.

From 11 counts of tagged and untagged does and fawns made daily during early morning and late afternoon, daily ratios of fawns per doe were obtained for both "chase" and "control" areas.

Lincoln Index estimates of numbers of does and fawns were also made in each area, using data obtained during the above 11 counts. Bailey's modified Lincoln Index formula was used for these estimates.

A two-tailed "t" test was used to detect any significant difference between the two areas in terms of fawn production/doe. This test was performed for both types of fawn production estimates previously mentioned. Finally, a X^2 test was used to determine whether the frequency of tagged does which had two, one, or no fawns was different between the "chase" and "control" areas.

Home Range Changes

Locations of all tagged does and fawns were recorded whenever possible to detect home range changes that occurred as a result of dog chasing. Home ranges of nearly all tagged does (106) were previously recorded by Downing, and current locations were compared to these ranges.

Other Activities

The observer was constantly alert for activity that would prove helpful in understanding dog-deer relationships. Deer that were reported killed by dogs were examined to determine cause of death. The general condition of these deer was also noted. Activities

of all domestic dogs observed in the area were noted for any information that might later prove pertinent to this study.

Phase II

Dog Chases

During this period, the entire study area was used for chasing to sustain longer chases. Chasing began 21 October 1972, and continued twice each week until late May, except in late November when the hounds were returned to their owners for the duration of the 6-week deer season. Chasing began again on 7 January 1973, this time using hounds and nonhound types that looked promising. In this manner, all deer in the study area were stressed throughout almost all the gestation period, rather than only during late pregnancy. Dogs were released in the manner described in Phase I, but were allowed to run until an active chase was no longer being sustained. When deer escaped or were so far ahead of the dogs that the deer were no longer being forced to run, the hounds were picked up, rested, and set upon another group of deer. This procedure was followed on Saturday and Sunday mornings from 21 October 1972 through 26 May 1973, with the previously noted exception of late November and December, when trained dogs were not available.

Techniques of Evaluation and Analysis

Techniques and analysis were similar to those in Phase I, except that reproductive success in 1973 was evaluated by comparing it with fawn production estimates from previous years, as calculated

by Downing. This meant that the census routes and counts were made for the entire area, as one unit, and not divided as in Phase I. It was, therefore, possible to obtain increased samples for censusing and not have the difficulty of determining whether a borderline doe or fawn belonged to the "chase" or "control" area. Home range changes were detected by techniques described in Phase I.

RESULTS

Phase I

Dog Chases

Thirty chases were recorded during the spring of 1972. During many chases the dogs split off onto different groups of deer; then only part of the pack could be followed. Some chases undoubtedly took place which could not be recorded because of the difficulty of observing the hounds in all situation. Chase time varied from 1 to 30 minutes, and averaged 11 minutes per chase. The short duration for some chases resulted from the observer picking up the hounds before they entered the "control" area. Chase distances ranged from 0.3 to 3.4 kilometers (0.2 to 2.1 miles), averaging 1.3 kilometers (0.8 miles) per chase.

Chase patterns varied greatly but usually resulted in the deer being driven out of their home ranges. Patterns were not necessarily "straight line" (Sweeney et al. 1971), yet outdistancing the dogs appeared to be the objective of most deer. Most deer left the "chase" area, crossed Sawmill Hollow, and entered the "control" area.

The stress placed on deer as a result of chases also varied. However, it should be noted that many deer in the "chase" area, hearing the barking of dogs, would start to flee immediately. Chased deer would also join other deer while running, thus increasing the size of the group. Due to the above chase characteristics, almost every deer would be run out of the "chase" area after three or four releases of the dogs.

Hounds were always quickly outdistanced by the deer. In many instances, deer stopped and looked back for the dogs, seemingly waiting for them to catch up. The hounds usually ran at least 20 to 40 seconds behind the deer, and when the dogs closed to any extent, it appeared to be the choice of the deer, not the hounds.

Other Dogs In the Study Area

Neighborhood dogs were seen in all parts of the study area, but were never seen chasing deer. These observations conflicted with those made by the guards patrolling the study area. Numerous instances of deer chases were reported by plant and Game Commission personnel. On 4 June, at 0615, two dogs were observed by Robert L. Downing feeding on a fawn that had been tagged just 12 hours before. Dr. Libke of the Veterinary Science Department at V.P.I. and S.U. performed a necropsy on the animal, and diagnosed that the fawn had died of a sharp blow to the head. It was surmised that the fawn had been captured and shaken by the two dogs, receiving the fatal blow from a rock or other sharp object. Dr. Libke did not believe the head wound was inflicted by a dog tooth. Seven other dogs were seen the morning of this kill, the most ever seen by the observer during this phase of the study. Domestic dogs were seen in the study area eight other times during the spring of 1972, but at no time were they seen chasing deer. Guards reported that chases sometimes occurred at night, however. Breeds observed were beagle, collie, mixed beagle, mixed labrador retriever, shepherd, and unknown mix. Downing reported a few chases by domestic dogs on

the study area in the past, so perhaps neighborhood dogs have had some effect in disturbing the deer population.

During May 1972, a pregnant doe was observed chasing a mixed black dog to the top of a dirt pile, keeping the dog there for several minutes. Apparently, protective instincts for the unborn fawn caused such behavior. Robinette et al. (in press) reported similar behavior of mule deer when confronted with coyotes and other predators.

Home Range Changes

No permanent home range changes were noted as a result of dog chasing during the spring of 1972. Temporary changes for 6 tagged does took place (see Figs. 2 and 3), but all deer returned to their original home ranges. However, it should be noted that fewer fawns were tagged in the "chase" area during 1972 than in previous years (Table 2). Reasons for this conflict with other findings are unknown, since tagging effort in the "chase" area was equal to that of previous years. Does possibly made more effort to conceal fawns following the disturbance. This same phenomenon also occurred during Phase II of the study (Table 2) when chasing encompassed the entire area, but many of those chases were originated in Sawmill Hollow, making the disturbance there greater than in the remainder of the area.

Fawn Production/Doe

A two-tailed "t" test, using Bailey's modified Lincoln Index, compared the mean fawn/doe ratios for the two areas (Table 3).

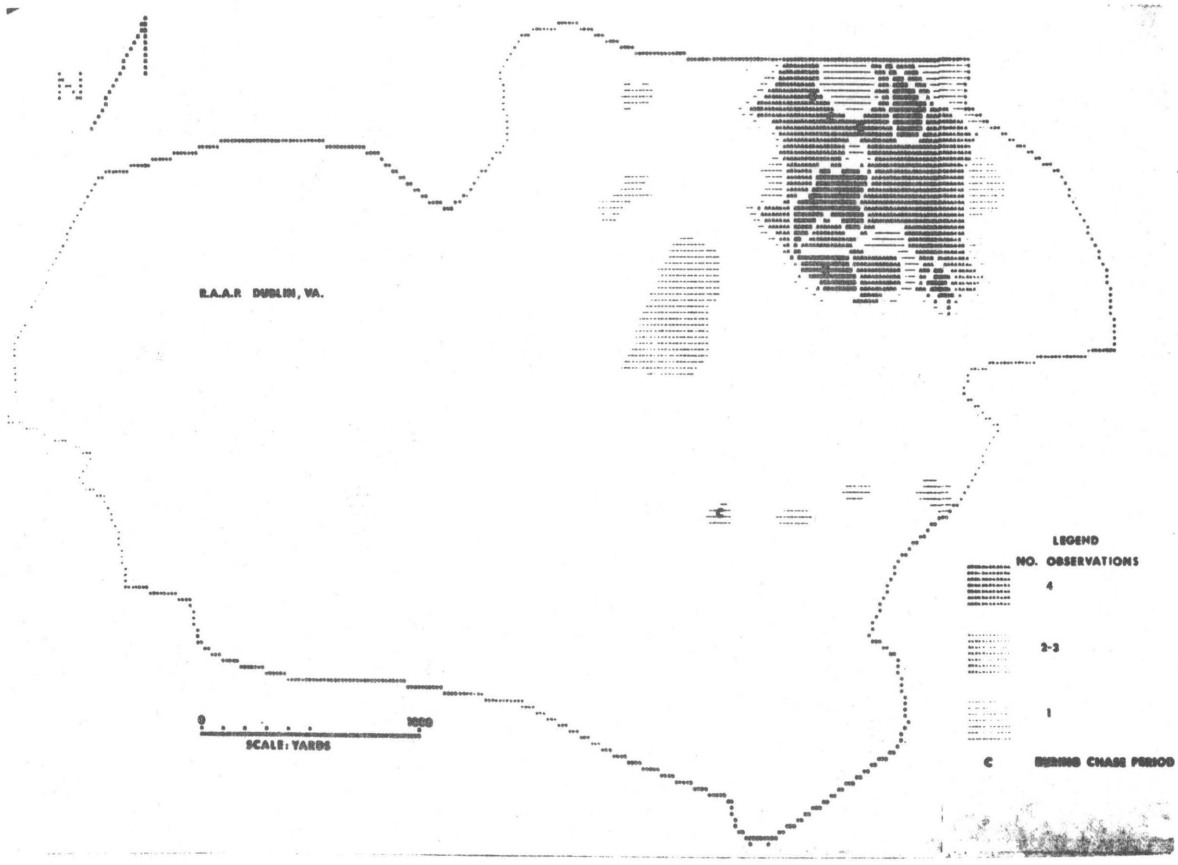

Fig. 2 Temporary home range change in adult doe during chase months at R.A.A.P., Dublin, Virginia, 1972.

Fig. 3. Temporary home range change in adult doe during chase months at R.A.A.P., Dublin, Virginia, 1972.

Table 2. Fawn tagging results on "chase" and "control" areas from 1965-1972, R.A.A.P.

Year	"Chase" Area No. Fawns Tagged	"Chase" Area Percent of Total	"Control" Area No. Fawns Tagged	Total No. Fawns Tagged
1965	9	39	14	23
1966	19	33	38	57
1967	20	40	30	50
1968	17	40	26	43
1969	35	45	43	78
1970	17	35	32	49
1971	16	42	22	38
1972	10	25	30	40
1973	14	23	47	61

Table 3. Comparison of fawn/doe ratios and standard deviations in "chase" and "control" areas, based on Bailey's modified Lincoln Index estimates and actual ratios determined by field observations. Both types of data were obtained during 11 observation periods.

	Fawns/Doe Estimated Population (Bailey's Technique)	Fawns/Doe Observed Population (Daily Totals)
"Chase" Area	0.55 $\pm$ 0.17	0.68 $\pm$ 0.18
"Control" Area	0.92 $\pm$ 0.43	0.61 $\pm$ 0.11
Entire Study Area	0.90 $\pm$ 0.34	0.63 $\pm$ 0.14

There was no significant difference at the .05 level. It should be pointed out that production estimates in the "control" area were abnormally high, while those in the "chase" area were similar to previous years data. The author suspects that the total number of tagged does in the "control" area may have been underestimated, leading to a smaller estimate of does and thus a higher fawn/doe ratio than was actually present.

Further evidence that fawn production was not higher in the "control" area is found in the direct counts of does and fawns, which were also not significant (Table 3). In fact, the mean ratio of fawns/doe was higher in the "chase" than in the "control" areas using direct counts. There was also no significant difference, concluded from a X^2 test, between the portion of tagged does which reared two, one, or no fawns in the two areas (Table 4). The ratios of fawns per tagged adult doe for the two areas were almost identical. It should be noted that the doe component of other fawn/doe ratios in this paper includes a large number of yearlings, and thus other estimates of fawn production are much lower due to this method of expression.

The proportion of visually pregnant tagged does giving birth did not differ significantly between the "chase" and "control" areas (Table 5). Fetal loss was apparently not a limiting factor for production in the "chase" area.

Table 4. Fawn production of tagged adult does during the 1972 season at R.A.A.P., Dublin, Va.

	Adult Does Producing							
	2 Fawns		1 Fawn		0 Fawn			Fawn/Doe
Dogs	Number	Percent	Number	Percent	Number	Percent	Total	Ratio
Chase Area	5	23	11	50	6	27	22	0.95
Control Area	7	17	24	59	10	24	41	0.93

Table 5. Results of visually pregnant tagged does giving birth in "chase" and "control" areas during the 1972 season at R.A.A.P., Dublin, Va.

Area	No. Pregnant Does	No. Giving Birth	% Giving Birth
Chase	13	11	85
Control	12	9	75

Phase II

Dog Chases

During this phase of the study, 11 dogs (7 hounds and 4 non-hounds) were used. At least four dogs were used during each chase day, and hounds and non-hounds were mixed to assure a full array of chasing techniques. Hound types included black-and-tan (2), redbone (3), and Walker (2). Non-hound types were collie, German shepherd, mixed Doberman, and mixed setter and Labrador. Some non-hounds obtained from the pound could not be trained to run deer, and approximately nine dogs were returned before an effective pack was formed.

In general, hounds appeared to be slower than the non-hound types, but sustained longer chases, and apparently could stay on trail for longer periods. Relative speed for the dogs observed was as follows, from fastest to slowest: Shepherd and collie, mixed Doberman, mixed setter and Labrador, redbones and Walkers, black-and-tans. An enthusiastic and vociferous lead dog seemed to be very important for the pack to sustain long chases, and hounds most often assumed this role.

Due to the difficulty in keeping up with the dogs over the expanded chase area, it was impossible to determine how far individual deer were chased. Chase characteristics were similar to those in Phase 1, with dogs switching trails and splitting up, often following several groups of deer during an extended chase. When the dogs fell far behind and were no longer actively engaged

in a chase, they were picked up, rested briefly, and set upon another group of deer. Usually, after 3 to 4 hours, the dogs became so tired that chasing was stopped for the day. Because there was no need to pick up the dogs until they became tired or hopelessly outdistanced, chase times were longer than in Phase I, with many chases extending over 30 minutes.

During chases, dogs rarely got closer than 50 yards to any deer being chased, with three exceptions. A guard reported that a small buck being run by three hounds ran against the perimeter fence, tried to jump it, and then ran in the opposite direction. The dogs were about 10 seconds behind the deer. During another chase, a farm boy living near the study area reported that four of the dogs running a group of deer trapped a buck against the fence, but that the deer escaped. The incident was first reported to the local dog warden, who informed the author that a buck had been dragged down by the dogs, but escaped. After checking with the boy who had seen the incident, it was affirmed that the dogs made no contact with the buck.

In only one instance did a dog catch a deer. On 28 January, 1973, a tagged piebald fawn was observed with three does about 50 yards from the truck. Before the dogs could be released, the three adult does ran. The fawn ran about 50 yards and stopped, and when the dogs were released, it ran another 80 yards to the top of a small hill and stopped again. A black-and-tan hound overtook the fawn and knocked it to the ground. The fawn probably would have been killed had the hound not been immediately restrained. When

running, the fawn moved in a sideways manner and was extremely slow and uncoordinated. This deer also had physical deformities, notably short legs and enlarged, crooked joints and feet.

Other Activities

Reported "dog kills" were investigated during this phase of the study. Although none occurred within the study area, two "kills" were investigated at the main plant of the Radford Army Ammunition Plant. On 23 February, a 10-to 12-year-old buck, reported to have been a dog kill, was brought to the Cooperative Wildlife Research Unit. Personnel at the main plant had observed dogs feeding on the deer while it was still warm, and when examined, the deer had tooth punctures in the scrotal and hip area. The buck was extremely emaciated, with hip bones and ribs protruding markedly. The deer, therefore, may have been run down by dogs, but was certainly not in healthy condition. During January of 1973, a fawn was also reported to have been run down by dogs near the main plant. Plant personnel said that dogs had been following the deer for several days, but were chased away when they tried to drag down the deer. The deer was located in a ditch, injured but still alive. The animal was sacrificed and examined by personnel from the Southeastern Cooperative Wildlife Disease Study located in Athens, Georgia. It was surmised that the animal had been hit by a vehicle, as both of its rear legs were broken above the hoof. Dogs probably could not have produced such clean breaks. The deer was otherwise completely healthy.

Other dogs were frequently seen in the study area during this phase, but, as in Phase I, were at no time seen chasing deer. However, in three different instances, deer ran from domestic dogs, but the dogs did not give chase.

Home Range Changes

As in Phase I, no permanent home range changes were observed for any tagged doe as a result of dog chasing. Temporary changes were noticed for six tagged does during this period, but all these deer returned to their original home ranges within a few days.

Fawn Production/Doe

Estimates of fawns/doe in 1973 are presented in Table 6, along with estimates of production in previous years. No significant difference was found between estimates made during 1973 and those of any previous year.

Table 6. Comparison of fawn/doe ratios and standard deviations during 1973 with ratios* from 1967-1972. Data based on Lincoln Index and actual ratios determined by field observations.

Year	Fawns/Doe Estimated Population (Lincoln Index)	Fawns/Doe Observed Population (Daily Totals)
1973	0.56 ± 0.14	0.61 ± 0.09
1972	0.90 ± 0.34	0.73 ± 0.16
1971	0.59 ± 0.13	0.55 + 0.08
1970	0.58 ± 0.13	0.62 ± 0.14
1969	--	0.64 ± 0.12
1968	--	0.59 + 0.11
1967	0.42 ± 0.26	0.61 ± 0.11

*Observability varies from month to month (Downing et al., in press). Direct field observation ratios were adjusted to correct unequal observability of fawns and does.

DISCUSSION

This study dealt with a densely populated (i.e., one deer per 5 acres) deer herd in a relatively confined area. The high density of the herd made it difficult to stress individual deer for lengthy periods, and the fence surrounding the 2,040-acre study area did not permit long-range movements.

Caution must be taken when assessing dog-deer problems, as the density of the herd and the amount of dog activity must be taken into account. In an area that has been recently restocked or has low populations, the deer could possibly be chased for longer periods and receive more stress than those in this study, even though the study area was fenced around the perimeter. Dogs chasing deer were constantly switching trails during this study, and individual deer were usually stressed less than 30 minutes. It was the opinion of Perry (1970) and Marchinton et al. (1970) that, as the population of deer increases, the stress placed on individual deer by dogs decreases.

Deer Kills by Dogs

After observing chases for more than 10 months, there was no indication that dogs are capable of catching a normal, healthy deer unless the deer injures itself during the chase. It has been noted that deer tend to panic when confronted with obstacles such as fences and buildings. It is very possible that a deer being pushed hard by dogs might not avoid such an obstacle, and thus

perhaps injure itself. Under the conditions of this study, it appeared that healthy deer easily outdistance dogs; but it was not possible to judge whether or not this superior speed can be maintained during longer chases which can sometimes last up to several hours.

Reports of dog kills received during this study were either false or unsubstantiated by good evidence. Some of the reports submitted to state game commissions that are recorded as deer killed by dogs may also fall into this category.

A source of concern to many sportsmen and biologists is that young fawns are easy prey for free-running dogs. During fawn tagging work at the study area, dogs used for capturing fawns were unable to scent the latter if it was only a few days old. Within a week, however, fawns could be scented, and were easy prey. This susceptibility probably decreases until a fawn is approximately 3 weeks old, when it is able to easily outdistance its pursuers. Until this time, the fawn is more likely to hide, rather than run with the mother. The mother, in turn, is often adept an enticing the dog to chase her, leaving the fawn in hiding. In this manner, the fawn avoids much predator contact unless the dog chances upon it. Undoubtedly, there are fawns killed by dogs every spring, but the chance nature of this contact probably rules out the problem ever being a serious one.

Home Range Changes

Home range changes as a result of dog running were slight or nonexistent during this study. The temporary movements that occurred were probably normal, as Downing (pers. comm.) has noticed similar

changes in previous studies in the area. Deer that were chased were not adverse to leaving their home ranges, but returned in a short time. Though it was impossible to say how long deer stayed out of the home range, the observer feels that most deer returned to their regular movements and activities within a day or two after each chase.

Effects of Dogs on Deer Reproduction

From results analyzed in this study, it is evident that dog running had no significant effect on the fawn production of the herd. As stated previously, sustained chases were impossible to maintain due to the density of the herd. However, during Phase II every doe was run at least once a month, and many were run more than twice a month. An average chase day would move over 100 deer, most of them adult does and yearlings. During Phase I, almost every deer was run out of the "chase" area twice each week. Though chase times for individual deer may have been shorter, the chases at Radford were believed to be equal or greater in frequency than would occur in most herds.

The peak of conception during Phase II occurred during the first week of November, based on birth dates estimated from fawns captured during the spring of 1973. Deer were chased at least 2 weeks beyond this peak through 19 November, 1972, before the dogs were returned to their owners for the 6-week hunting season. In addition, Mr. Dave White reported that neighborhood dogs chased numerous deer on one occasion during mid-December.

Undoubtedly many deer were stressed within a week after conception, but their reproduction apparently was not affected by dog chasing under these conditions.

Most deer accepted these chases in a relaxed manner. Stopping frequently to observe the dogs, the deer never were seen to be out of breath, to panic, or otherwise in serious trouble. The author never observed a deer running at its highest speed due to critical danger.

If such leisurely running increased body temperature, it apparently was not to the point of inducing embryo mortality. From previous literature review, it was noted that except for a brief period after conception, higher temperatures had to be maintained over a fairly long period to cause embryo mortality, and this was certainly not the case with the dog chases that occurred during this study. Whether even a prolonged chase would elevate and maintain body temperature of a deer at high enough levels to cause mortality is unknown. Further research on this point is needed.

Management Implications

Although deer hunting with dogs does not appeal to all segments of the hunting public, it has many enthusiastic advocates. Rather than being unsporting, dog hunting appears to stress aspects of the hunt other than the kill. Because this study demonstrated no detrimental effect on the deer, their reproduction, or their home range, there seems to be no valid reason to further limit the sport. However, this study was performed on a high density herd, and as

pointed out previously, more stress could be imposed if there were fewer deer and thus less opportunity for dogs to switch trails. Additional research may be justified for low density herds.

CONCLUSIONS

This study dealt only with the effects of dogs on a densely populated deer herd, and additional studies are needed for other densities. It is obvious that the efficiency of the free-running dog as a predator has been exaggerated in the past. It is felt that dogs can catch a deer only if the deer is in poor physical condition as a result of disease, deformity, old age, or injury. These conditions were present only once during this study, when the piebald fawn was captured.

Home range of white-tailed deer is not often permanently changed by disturbance. This has been substantiated by past studies, and apparently dog chasing is not an exception. As with hunting, dog chases may cause temporary changes, but once conditions return to normal, deer quickly return to their home range.

Fawn production was not significantly affected by dog chases during this study. Deer were chased throughout their gestation without effect. However, the fact that a deer's temperature can be elevated by running and that elevated body temperature immediately following conception causes embryo mortality in domestic ungulates seems to justify further research.

It is felt that dog hunting for deer in this country should not be curtailed without positive proof that the sport is detrimental to the deer herd. No such evidence was found during the course of this study. Legislation to control the free-running dog in the future must be approached with caution, as resentment by the public may far outweigh any benefits gained.

LITERATURE CITED

Alliston, C. W., B. Howarth, Jr., and L. C. Ulberg. 1965. Embryonic mortality following culture *in vitro* of one-and two-cell rabbit eggs at elevated temperatures. J. Reprod. Fertil. 9:337-347.

_____,and L. C. Ulberg. 1965. *In vitro* culture temperatures and subsequent viability of rabbit ova. J. Anim. Sci. 24:912. (Abstr.).

Barick, F. B. 1969. Deer predation in North Carolina and other Southeastern states. Pages 25-31 *in* Proc. of the Symposium on White-tailed deer in the Southern Forest Habitat. Nacogdoches, Tex. Southern For. Exp. Sta. 130 pp.

Bishop, M. H. 1964. Review. A paternal contribution to embryonic death. J. Reprod. Fertil. 7:383-396.

Bowers, R. R. 1953. The free-running dog menace. Va. Wildl. 14(10): 5-7.

Caras, R. 1973. Meet wildlife enemy no. 2. Natl. Wildl. 11(2):30-31.

Cheatum, E. L. 1949. The use of corpora lutea for determining ovulation incidence and variation in the fertility of white-tailed deer. P. R. Project 35-R, N.Y. State Conserv. Dept. 282-291.

_____, and C. W. Severinghaus. 1950. Variation in fertility in white-tailed deer related to range conditions. Trans. N. Am. Wildl. Nat. Resour. Conf. 15:170-190.

Clarke, C. H. D. 1956. Dogs for deer in Ontario. Pages 294-299 *in* Taylor, W. P. (ed.). The deer of North America. The Stackpole Co., Harrisburg, Pa. 668 pp.

Cook, R. S., M. White, D. O. Trainer, and W. C. Glazener. 1971. Mortality of young white-tailed deer fawns in South Texas. J. Wildl. Manage. 35(1):47-56.

Corbett, R. L., R. L. Marchinton, and C. E. Hill. 1971. Preliminary study of the effects of dogs on radio-equipped deer in a mountainous habitat. Proc. Southeastern Assoc. Game and Fish Commissioners 25:69-77.

Cromer, J. T. 1967. Southern West Virginia deer study. P.R. Proj. Rep., W-25-R-18, West Virginia Dept. Nat. Resour.

Downing, R. L., and B. S. McGinnes. 1969. Capturing and marking white-tailed deer fawns. J. Wildl. Manage. 33(3):711-714.

_____, _____, R. L. Petcher, and J. L. Sandt. 1969. Seasonal changes in movements of white-tailed deer. Pages 19-24 in Proc. of the Symposium on white-tailed deer in the Southern Forest Habitat. Nacogdoches, Tex. Southern For. Exp. Sta. 130pp.

Dutt, R. H., and E. C. Simpson. 1957. Environmental temperature and fertility of Southdown rams early in the breeding season. J. Anim. Sci. 16:136-143.

_____, E. F. Ellington, and W. W. Carlton. 1959. Fertilization rate and early embryo survival in sheared and unsheared ewes following exposure to elevated air temperatures. J. Anim. Sci. 13:308-317.

Flyger, V. F., T. R. Ridgeway, A. K. Prestwood, and F. A. Hayes. 1962. Trauma with secondary shock in four whte-tailed deer. Chesapeake Sci. 3(4):236-243.

Giles, R. H., Jr. 1960. The free-running dog. Va. Wildl. 21(6):6-7.

Goode, L. 1964. Effects of summer confinement upon ewe productivity. J. Anim. Sci. 23:906 (Abstr.).

Howarth, B., Jr., C. W. Alliston, and L. C. Ulberg. 1965. Importance of uterine environment on rabbit sperm prior to fertilization. J. Anim. Sci. 24:1027.

Howarth, R. C. 1969. Effects of free-ranging dogs as deer mortality factors. P.R. Proj. Rep. W-37-R-8, Georgia Fish and Game Comm. 10-14.

Hulet, C. V., A. S. El-Sheikh, A. L. Pope, and L. E. Casida. 1956. The effect of shearing and level of feeding on fertility of rams. J. Anim. Sci. 15:617-624.

Hulsey, A. 1971. Deer and dogs. Arkansas Game and Fish 4(3):6-9, 27-28.

Jackson, L. W. 1971. Law enforcement activities including documentation of activities that may affect deer populations. P.R. Proj. Rep., W-89-R-15, New York Dept.of Environ. Conserv. 12 pp.

Jenkins, J. H. 1952. The extirpation and restoration of North Georgia deer - a sixty year history. Trans. N. Am. Wildl. Nat. Resour. Conf. 17:471-476.

Kolenosky, G. B. 1972. Wolf predation on wintering deer in east-central Ontario. J. Wildl. Manage. 36(2):357-368.

La Hart, D. E. and E. G. Lucas. (No date). A survey of hunters' attitudes towards hunters and hunting dogs on the Ocala National Forest, Florida. (Unpublished).

Libke, K. G., and H. S. Mosby. 1968. Stress induced hemopericardium (cardiac tamponade) in a deer. J. Am. Vet. Med. Assoc. 153(7): 813-817.

Marchinton, R. L., and L. K. Jeter. 1966. Telemetric study of deer movement-ecology in the southeast. Proc. Southeastern Assoc. Game and Fish Commissioners 20:189-206.

_____, A. S. Johnson, J. R. Sweeney, and J. M. Sweeney. 1970. Legal hunting of white-tailed deer with dogs: Biology, sociology, and management. Proc. Southeastern Assoc. Game and Fish Commissioners 24:74-89.

_____. 1968. Telemetric study of white-tailed deer movement-ecology and ethology in the Southeast. Ph.D. Dissertation, Auburn Univ., Auburn, Ala. 138 pp.

Marshall, A. D., and R. W. Whittington. 1968. A telemetric study of deer home ranges and behavior of deer during managed hunts. Proc. Southeastern Assoc. Game and Fish Commissioners 22:30-46.

McDowell, R. D. 1959. Embryo counts as a measure of white-tailed deer productivity. Proc. N.E. Sect. The Wildlife Society, Oglebay Park, W. Va. 4 pp.

McGinnes, B. S. and R. L. Downing. 1969. Fawn mortality in a confined Virginia deer herd. Proc. Southeastern Assoc. Game and Fish Commissioners 23:188-191.

McNight, T. 1961. A survey of feral livestock in California. Assoc. of Pacific Coast Geographers Yearbook. 23:28-42.

Mech, L. D., and L. D. Frenzel. 1971. An analysis of the age, sex, and condition of deer killed by wolves in Northeastern Minnesota. Pages 35-50. in Mech, L. D., and L. D. Frenzel (ed). Ecological studies of the timber wolf in Northeastern Minnesota. North Central For. Exp. Sta., U.S.F.S. 62 pp.

Morrison, J. 1968. Hounds of hell. Georgia Game and Fish. 3(13):13-19.

Murphy, A. D. 1969. Hunting methods, limits, and regulations. 54-61. in Proc. of the Symposium on White-tailed deer in the Southern

Forest habitat. Nacogdoches, Tex. Southern For. Exp. Sta. 130 pp.

Perry, M. C. 1970. Studies of deer-related dog activity in Virginia. Unpublished M.S. Thesis. Va. Poly. Inst., Blacksburg, Va. 90 pp.

Petcher, R. L. 1967. A population study of confined deer herd. Unpublished M.S. Thesis. Va. Poly. Inst., Blacksburg, Va. 90 pp.

Poux, R. J., Jr. 1972. Deer behavior as it affects sex and age ratio counts. Unpublished M.S. Thesis. Va. Poly. Inst., Blacksburg, Va. 41 pp.

Progulske, D. R. and T. S. Bassett. 1958. Mobility of Missouri deer and their harassment by dogs. J. Wildl. Manage 22(2):184-192.

Rongstad, O. J. and J. R. Tester. 1969. Movements and habitat use of white-tailed deer in Minnesota. J. Wildl. Manage. 33(2):366-379.

Rue, L. L. III. 1962. The world of the white-tailed deer. J. B. Lippincott Co., Philadelphia and N. Y. 134 pp.

Ruhl, H. D. 1956. Hunting the whitetail. Pages 261-334 in Taylor, W. P. The deer of North America. The Stackpole Co., Harrisburg, Pa. 668 pp.

Sandt, J. L. 1969. The influence of a clearcut area on a confined deer herd in a predominantly grassland habitat. Unpublished M.S. Thesis. Va. Poly. Inst., Blacksburg, Va. 52 pp.

Severinghaus, C. W., and E. L. Cheatum. 1956. Life and times of the white-tailed deer. Pages 29-332 in Taylor, W. P. (ed.) The deer of North America. The Stackpole Co., Harrisburg, Pa. 668 p.

Shelton, M. 1964. Relation of environmental temperature during gestation to birth weight and mortality of lambs. J. Anim. Sci. 23:360.

_____, and J. E. Huston. 1968. Effects of high temperature stress during gestation on certain aspects of reproduction in the ewe. J. Anim. Sci. 27:153-158.

Sweeney, J. P., R. L. Marchinton, and J. M. Sweeney. 1971. Responses of radio monitored white-tailed deer chased by hunting dogs. J. Wildl. Manage. 35(4):707-716.

Ulberg, L. C., and P. J. Burfening. 1967. Embryo death resulting from adverse environment on spermatozoa or ova. Am. Soc. of Anim. Sci. 26(3):571-577.

Verme, L. J. 1965. Reproductive studies on penned white-tailed deer. J. Wildl. Manage. 29:74-79.

Vincent, C. K., and L. C. Ulberg. 1965. Survival of sheep embryos exposed to high temperatures. J. Anim. Sci. 24:931-932. (Abstr.)

Wilson, R. M. 1954. Influence of dogs on the New Hampshire deer herd. P.R. Report W-12-R-6, New Hampshire Fish and Game Dept. 5 pp.

Yeates, N. L. 1958. Fetal dwarfism in sheep--an effect of high atmospheric temperature during gestation. J. Agric. Sci. 51:85.

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DISTURBANCE EFFECT OF FREE-RUNNING DOGS ON DEER REPRODUCTION

by

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ABSTRACT

Dogs were used to run white-tailed deer at the Dublin Arsenal of the Radford Army Ammunition Plant between 22 April and 3 June 1972, and from 21 October 1972 to 26 May 1973. During the first phase of the study, trained deer hounds were used to chase deer in one-half of the study area, using the other half as a control area. During the second phase, hounds and non-hounds were used, and the entire study area was used for chasing. No significant differences in fawns per doe surviving to late summer censuses were found between deer run by dogs and those not subjected to chasing.

No permanent home range changes as a result of dog chasing were noted, but some temporary changes did occur. These changes were usually of short duration, with most deer returning to their normal home ranges within a few days.

Dog chases were usually of less than 30 minutes duration, and, due to the high density of the herd, dogs often switched trails and did not chase the same deer for extended periods. Hounds appeared to be more effective and persistent trailers, while

non-hounds were generally faster.

No healthy deer were caught by the dogs. In all chases, deer stayed well ahead of the dogs, with the exception of a deformed piebald fawn that was caught easily.

Reported dog kills were investigated whenever possible. These reports were either inaccurate, or involved deer that were previously injured or for other reasons not in good physical condition.

Dogs were not detrimental to this densely populated study herd, either by limiting its reproduction, inducing permanent home range changes, or killing individual deer.