

Visual characteristics

Bi-annual color photographs were made of each hybrid. Comparisons of notes and photos kept on body coloration indicated that there was no significant difference in body coloration between blacktails, whitetails, and hybrids. It was discovered that the color as well as the length of the metatarsal gland could be used to separate blacktails from whitetails. The hairs covering the metatarsal gland were reddish-brown on blacktails and white on whitetails. The gland coloration of all the hybrids was identical to that found on the blacktails.

Cowan (1956) reported that the dorsal view of the tail and the rump could be used to separate blacktails from whitetails. The tails and rumps of all but one of the hybrids were identical to black-tailed deer. White-tailed deer run with their tails up whereas black-tailed deer run with their tails down. Every hybrid deer did both. The running gait of blacktails differs from whitetails in that blacktails hop along with stiff legs whereas whitetails run with a smooth gait similar to that of a horse. All of the hybrids in this study were masters of both gaits.

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PRELIMINARY STUDY OF THE EFFECTS OF DOGS ON RADIO-EQUIPPED DEER IN A MOUNTAINOUS HABITAT

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ABSTRACT

A study was conducted on Mt. Mitchell Wildlife Management Area in western North Carolina to determine the effects of dogs on movement patterns, behavior and mortality of radio-equipped deer in a rugged, mountainous habitat. Data were obtained from 11 of 15 radio-instrumented deer. Six were radio-monitored during the raccoon, bear and deer seasons and although four were legally harvested no mortality could be related to the effects of dogs. From February to July, eight of the radio-instrumented deer were subjected to 20 experimental chases by hunting hounds. Chases averaged 54 minutes in duration and 2.36 miles in distance with maximums of 165 minutes and 6.77 miles recorded. The chases were generally downhill and streams were crossed repeatedly. Chased deer quickly left their home ranges but returned in all cases where mortality did not occur. Three cases of mortality among radio-instrumented deer occurred during the period of experimental harassment, two deer being killed by the hounds, and one by a bobcat. One of the deer killed by dogs was caught within 3 minutes after release from a live trap. These and two non-instrumented deer in which dogs were

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the suspected cause of mortality were necropsied by Southeastern Cooperative Wildlife Disease Study personnel. All of these animals apparently were predisposed to predation by one or more of the following: old age, injury or severe parasite damage particularly in the lungs. The dog related mortality that we recorded occurred during a 6-week period in late winter and early spring. In general, results of this study in mountainous habitat differed from those of a similar study in coastal plain habitats in the following ways: (1) escape routes during chases were much more predictable in the mountains; (2) the deer apparently suffered some injury during chases as a result of running in the rugged terrain; (3) return to home ranges after a chase required a longer time; and (4) some mortality occurred as a direct result of the dog chases. Possible factors resulting in these differences are discussed.

INTRODUCTION

The potential of the domestic dog (*Canis familiaris*) to be a limiting factor on white-tailed deer (*Odocoileus virginianus*) has been subject to controversy for many years. Although many popular articles have been written on the subject until recently there have been no studies designed to obtain objective information concerning dog-deer relationships. Current interest has prompted investigations and literature on the subject is expanding. Recent publications dealing with the influences of hunting hounds on deer have revealed no detrimental effects in Coastal Plain habitats (Marchinton et al. 1970, Sweeney et al. In press). Others have suggested that dogs (hunting or free-ranging) may have a more significant impact on deer populations in mountainous or extremely hilly terrain (Barick 1969, Perry and Giles 1970). The purpose of our study was to explore that hypothesis.

Study objectives were to (1) record normal movement patterns and behavior of deer in a very rugged mountainous habitat, (2) determine the extent of harassment and mortality caused by free-ranging dogs and by hounds during raccoon and bear hunts, and (3) obtain information on movement patterns, behavior and mortality resulting from an experimental chasing regime designed to intensify dog harassment as much as possible.

This study was made possible by financial aid and assistance provided by the University of Georgia School of Forest Resources, Georgia Forest Research Council, North Carolina Wildlife Resources Commission, United States Forest Service and United States Fish and Wildlife Service. We are indebted to Southeastern Cooperative Wildlife Disease Study personnel for performing the necropsy and histological examinations and are particularly grateful to Dr. T. P. Kistner for personally supervising these examinations. Special thanks are extended to area managers R. Q. Burleson and V. L. Boone for their untiring assistance during field studies and to R. L. Downing for his help in setting up the study. We also appreciate the help of all those who have reviewed the manuscript and especially would like to acknowledge the advice and assistance provided by Dr. A. S. Johnson throughout the study.

STUDY AREA

Investigations were conducted on the Mt. Mitchell Wildlife Management Area in western North Carolina. The area includes approximately 9,200 acres in McDowell County and 16,000 acres in Yancey County. Elevation varies from 1,600 to 6,200 feet. Most of the study was conducted below 4,400 feet. The forest vegetation included oak and oak-pine communities, mixed mesophytic communities, northern hardwood forest type and spruce-fir forest type (Braun 1950).

Food plots ranging in size from one to four acres are scattered throughout the study area. They total about 30 acres and are seeded in fescue or an orchard grass-white clover mixture. The area was heavily overpopulated with deer prior to 1957 when hunting for either sex was initiated. These hunts continued until 1968, and although the herd was reduced considerably, range damage was evident. Management practices

such as timber cutting have improved the range somewhat, but the deer herd is still apparently near the upper limit of the present carrying capacity and some mortality occurs during late winter and early spring.

MATERIALS AND METHODS

Deer were captured with box traps or a syringe gun using nicotine alkaloids (Cap-Chur-Sol). They were instrumented with 27 mHz collar-type radio tracking transmitters, ear tagged and released at the capture site. Normal movement patterns were determined by systematic radio monitoring procedures as described by Jeter and Marchinton (1964:146). Home ranges were delineated by the "modified minimum area method" (Harvey and Barbour 1965:400).

Deer were monitored during raccoon and bear hunts on and around the Curtis Creek section of the study area to determine whether any of the deer were chased by the hounds used in these hunts, and if so, what the effects were. In order to obtain additional information concerning potential dog harassment, records were kept of the number of free-ranging dogs removed from the area and of hunting hounds picked up and returned to their drivers.

Experimental chases were generally conducted as described by Sweeney et al. (In press) except that on three occasions the hounds were turned loose simultaneously with the release of the deer from live traps. Deer were chased as often as possible, but the number of chases on particular individuals was restricted by the difficulty of moving dogs to a position favorable for them to "jump" the instrumented animal. Many attempts failed when deer were bedded in thick cover on precipitous slopes. Attempts were made to intercept chases and release additional dogs in front of the pack when possible so that maximum pressure was maintained on the pursued deer. Thirteen different hounds were used. Breeds or types were July, Running Walker, Treeing Walker and mixed hounds. Pack size ranged from one to six, but averaged three.

Chase patterns were plotted on maps and when possible deer chased out of their home ranges were radio monitored until they returned. Radio-instrumented and non-instrumented deer that died during the experimental chasing period were taken to Athens, Georgia for necropsy by Southeastern Cooperative Wildlife Disease Study (SCWDS) personnel.

RESULTS

NORMAL MOVEMENT

During the study 15 deer were radio-instrumented with movement or chase data or both being obtained from 11 deer. A summary of information concerning these animals is presented in Table 1.

Movement patterns were variable but the deer tended to bed at high elevations during the day and move down at night. During spring, summer and early fall some individuals frequented lowland fields at night. Most movement occurred early and late in the day or at night. In many cases beds were located near ridge tops. This apparently gave the animals an advantage in detecting danger. When an investigator approached from below, the deer generally crossed the ridge top without being seen. An approach from above, when possible, more often resulted in visual sightings of the deer.

EFFECTS OF FREE-RANGING DOGS AND HOUNDS USED IN RACCOON AND BEAR HUNTS

Six deer were radio-monitored during four of the six managed coon hunts (Table 1). No chases were recorded on the radio-equipped deer and they were radio-located within their home ranges at the termination of each of these hunts. We also had no indication that other deer were chased during the raccoon hunts we monitored. The number of dogs on the area at any one time was 10 or less and they were usually under control of their owners. Most hounds were caught by their owners and removed from the area by the close of the hunts at 7:00 A.M.

TABLE 1. Summary of data concerning study animals monitored.

Deer Number	Sex	Approx. Age at Capture	Radio Tracking Period	Number of Radio Locations	Monitored During Raccoon and Bear Seasons	Number of Experimental Chases	Mortality
C-1	F	5*	7/29/70-3/ 8/71	119	X	2	killed by bobcat
C-2	M	2	7/31/70-8/ 2/70	2	..	..	capture trauma
C-3	F	unknown (adult)	8/ 3/70-3/28/71	66	X	3	....
C-4	F	8	8/17/70-8/19/70	2	..	..	capture trauma
C-5	F	unknown (adult)	9/ 1/70-3/ 4/71	110	X	2	....
C-6	M	2*	9/11/70-11/26/70	84	X	..	legal harvest
C-7	F	4*	..	6	..	..	....
C-8	F	unknown (adult)	9/29/70-11/13/70	44	X	..	legal harvest
C-9	M	2½*	10/ 9/70-11/25/70	68	X	..	legal harvest
C-10	M	1½	10/27/70-11/ 5/70	2	..	..	legal harvest
S-1	M	1½	3/30/71-4/13/71	7	..	1	....
S-2	F	unknown (adult)	3/30/71-6/29/71	100	..	5	....
S-3	F	10+	4/ 2/71-4/ 2/71	2	..	1	killed by hounds
S-4	F	8+*	4/18/71-4/22/71	18	..	3	killed by hounds
S-5	F	unknown (adult)	4/26/71-6/30/71	24	..	3	....

* Age determined by tagging record.

Bear hunting is legal on lands adjacent to the management area and dogs frequently chase deer into the area. During bear hunts it was not unusual for the area manager to pick up twelve to fifteen hounds a day with several of them being observed chasing deer. The six animals radio-tracked during coon hunts were also tracked during part of the bear season but no chases were monitored. Although no chases were recorded on the study animals during coon and bear season, the number of chases on other deer within the management area boundary could not be documented.

Two instances of deer mortality (these were not radio-equipped study animals) in which dogs were suspected of being involved were observed outside the management area boundaries. The carcasses were taken to the SCWDS for necropsy examination on March 26. One was a four-year-old female found partially eaten in the edge of a creek a few yards south of the management area boundary. Fresh dog tracks and scats were found near the carcass. The deer was only a few yards from a road, and necropsy indicated that the animal had been injured when struck by a car. However, she may have been attacked by dogs prior to death. Carcass condition was poor and no histological examination was possible. She weighed 75 pounds and was carrying two fetuses.

The other deer, a 1½-year-old female weighing only 45 pounds was found lying in a ditch at the junction of a railroad track and a hard surface road. Two German shepherd dogs had been seen feeding on the carcass. Necropsy revealed no evidence of injury other than tooth marks inflicted before the animal's death. The proximate cause of death was diagnosed as attack by dogs. There was considerable disruption of normal pulmonary architecture due to extensive emphysema. Nematode eggs in the lung were surrounded by marked inflammation consisting of reticuloendothelial cells. Based on extensive parasite damage to the lungs it appeared that this deer was incapable of sustained running whereby it could have eluded dogs. She was not pregnant.

EXPERIMENTAL CHASING

Twenty experimental chases were induced on eight radio-equipped deer between mid-February and July 1971. Deer successfully escaped in 18 chases, but two chases resulted in the deer being caught by the hounds. Chase durations and distances are summarized in Table 2.

TABLE 2. Time elapsed and distance covered in experimental chases resulting in the escape of radio-equipped deer from hunting hounds.

Deer Number	Number of chases	Duration (minutes)			Distance (miles)		
		Max.	Min.	Avg.	Max.	Min.	Avg.
C-1	2	45	18	32	1.64	.56	1.10
C-3	3	165	16	76	5.34	.35	2.27
C-5	2	25	10	18	1.62	.52	1.07
S-1	1	..	..	60	..	..	3.14
S-2	5	90	4	52	6.77	.29	3.49
S-4	2	105	30	68	4.95	1.43	3.19
S-5	3	92	31	64	2.11	.70	1.46
All Deer	18	165	4	54	6.77	.29	2.36

Home Range-Chase Relationships

The deer left their home ranges in seventy per cent of the chases. These chases averaged 3.14 miles while those in which the animal did not leave their home ranges averaged 0.73 mile. The chases in which the deer remained in the range were short in duration as a result of the dogs losing the trail when the deer crossed a stream, when the trail was confused with that of other deer or because of very dry or windy weather conditions. In most chases in which deer left their home ranges they moved more than one mile beyond the range boundary. The time required for deer to return to their home ranges varied from 2½ hours to 7 days with about half of the trips requiring longer than one day.

Escape Behavior

All escape patterns described by Sweeney et al. (In press) were observed, but the most frequently used was "distance running" which occurred in all but three chases. In many instances the dogs lost the trail when the deer ran through streams.

A typical chase consisted of a deer being jumped from its bed on a ridge and running a short distance uphill. After a few minutes, however, the animal usually turned and ran a relatively straight course downhill crossing and paralleling streams. The chase often ended with the deer escaping in the relatively level terrain of stream valleys at lower elevations. Chases on the South Toe section of the management area revealed that certain escape routes were used repeatedly (Fig. 1). These routes were most evident at points where they intersected roads and after a few chases it was possible to predict where the chase would cross. There was an apparent tendency for animals jumped anywhere within a watershed to use the same route when moving down into the valleys.

An interesting aspect of escape behavior was that the deer often continued to travel for considerable distance in a direction away from the home range after the hounds lost the trail. The straight line distances moved from the point where dogs lost the trail ranged from 0 to 2.28 miles and averaged 0.71 mile for 15 chases in which data were available.

Mortality

Nine of the study animals died while being radio-monitored (See Table 1): Three of these were killed by predators: one by a bobcat and two by dogs. These deaths occurred under unusual circumstances and will be discussed individually.

On March 5, 1971, a 5½-year-old, 65-pound doe (C-1) successfully escaped the hounds after being chased out of her home range, but on March 10 her partially eaten carcass was found high on a ridge in a

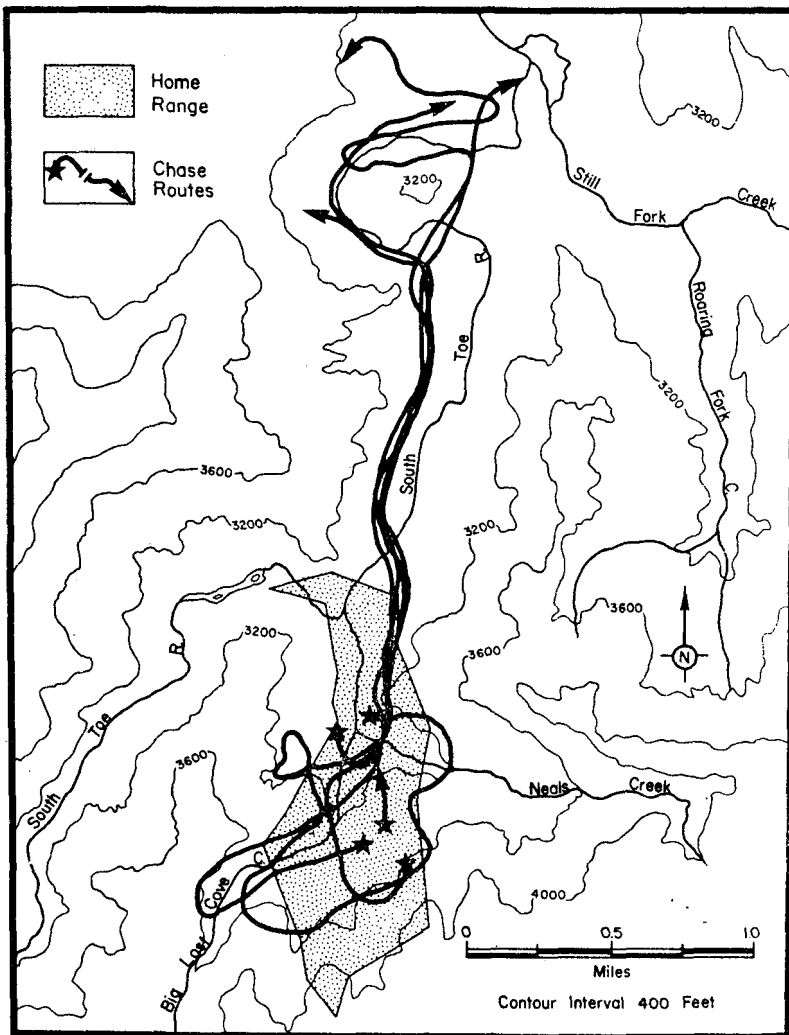


FIGURE 1. Escape routes in relation to home range and physiographic features recorded during five chases of an adult doe (S-2). Hounds chased the deer from locations indicated by stars to areas designated by arrows where they lost the trail.

small ravine, 1.6 miles outside of her home range boundary. She was completely covered with leaves, and bobcat (*Lynx rufus*) tracks were found nearby. Necropsy examination the following day by personnel of the SCWDS revealed tooth or claw marks sustained while she was alive. There was no evidence of physical injury by dogs and trauma resulting from attack by bobcat was diagnosed as the cause of death. Radio-tracking data indicated that she was probably killed by the cat during the night following the experimental chase. Several old wounds including healed fractures of 4 ribs and some old skin wounds were evident. Her internal organs and general physical condition strongly suggested that

she was in a debilitated condition prior to death. Meaningful histopathologic examination of tissues was precluded by post mortem changes. She was not carrying a fetus.

A 75-pound female over 10 years old (S-3) was captured in a live trap on April 2, 1971. She was held in the trap longer than usual and was not radio-instrumented until 26-36 hours after capture. The dogs and deer were released simultaneously and the dogs immediately pursued her but sounds of the chase ended within two minutes. Ten minutes later, with the aid of telemetry equipment, the deer was found in a small creek 175 yards from the release point. All dogs had left the deer at that time. Necropsy diagnosis indicated that trauma resulting from a direct attack by dogs was the immediate cause of death. The animal's physical condition, however, was poor and she was carrying a macerated fetus (1969-70) in the uterus. Extensive emphysema of the lungs with relatively large areas of consolidation was present. Parasite lung damage (verminous pneumonia) and gastrointestinal parasite burden strongly indicate that the animal was incapable of eluding dogs by sustained running. Two other deer released from traps simultaneously with dogs successfully escaped.

On April 22, 1971, an 80-pound doe (S-4) that tagging records indicated was over 8 years old, eluded the dogs after a 4.95 mile chase. The deer was then relocated with telemetry equipment and was found kneeling in South Toe River. She seemed reluctant to move even when the investigator approached to within 20 yards. Two hounds were brought to the site within 10 minutes and released less than 10 yards from her. Only when the hounds began swimming toward her did she move. She ran less than 100 yards then bayed in water about one foot deep. After a short battle the dogs seized and killed her. Necropsy examination revealed a parasite burden indicative of a high deer population density. Connective tissue proliferation of both inner and outer walls of some bronchioles and arterioles resulted in marked thickening of walls and a reduction in size of the lumen. Her physical condition was considered to be fair and she was carrying one fetus (95-105 days old).

DISCUSSION AND CONCLUSIONS

This study involved a small sample and only one study area. Because of this it may raise as many questions as it answers. It does suggest areas in which further inquiry can be focused. The earlier Coastal Plain studies (Marchinton et al. 1970, Sweeney et al. In press) involved several diverse study areas and a larger number of chases. We feel that they were adequate to conclude that the impact of hunting dogs as predators on deer is of no significance in most Coastal Plain habitats. Our data from experimental chases suggest that dogs are capable of killing some deer in rugged mountainous terrain with high deer population densities. Although further study is probably necessary before definite conclusions can be made, dogs may have a significant impact on the populations. We did not record any mortality resulting from bear or coon hounds during managed hunts, but free-ranging dogs other than hounds may be of more importance.

Some interesting comparisons can be made between results obtained in the mountainous area with those of the Coastal Plain studies. (1) Chase patterns were much more predictable in the mountainous habitat. This was apparently the result of the stringent dictates of the rugged terrain. One can presume that legal or illegal hunting with dogs under such conditions is much more efficient because the hunter can predict more consistently where the deer will run. (2) Deer seem to suffer physical injury more frequently while being chased in the mountains. These injuries include bruises, cuts, and occasionally broken bones, apparently sustained by running and falling on the rocky terrain and steep slopes. Undoubtedly fatal accidents sometime occur when deer run off ledges or steep drop offs. (3) The deer in mountainous habitat required considerably longer to return to their home ranges than in the Coastal Plain (Sweeney et al. In press). This may have resulted from the ani-

mals being more exhausted after the chase and the greater physical effort required to move back into the home ranges which were usually at higher elevations. (4) Finally, some mortality occurred in which dogs were the immediate mortality factor, whereas in the Coastal Plain environments no such mortality occurred.

The reasons for the greater susceptibility to mortality are not clear, however, our data and observations indicate several factors which may contribute. First, the ability of dogs to run in the steep terrain relative to that of deer may be greater than in typically flat Coastal Plain habitats. The physical condition of deer on the mountain study area may have made them susceptible because of marginal habitat conditions and high population density resulting in severe nutritional deficiencies. All predation observed was in the late winter and early spring (March 8-April 22) when the deer are probably weakest, even though experimental chases were conducted from February to July. Deer in the mountainous habitat may not be as genetically or behaviorally adapted to dog pressure as most Coastal Plain stocks which have been legally hunted with dogs since Colonial days. And finally, the occurrence of certain parasites in large numbers particularly those attacking the lungs (e.g. protostrongilid larvae), may severely debilitate a percentage of the population making them more susceptible to dog predation.

Jenkins (1952) suggested that running hot, tired deer into cold mountain streams or lakes may result in mortality. In the present study deer repeatedly crossed or ran down mountain streams even after having been chased for several miles. Except for those that were actually caught, all of the deer experimentally chased eventually returned to their home ranges with no apparent deleterious effects. The streams on the area were not large and a deer could usually cross them without swimming. The effect of the cold water may be greater when the animal is completely emersed as would occur while swimming.

Errington (1967) pointed out the error of confusing the "fact" of predation on the individual with the "effect" of predation on the population. Although our sample was too small to provide conclusive evidence it certainly suggested that most deer killed are severely weakened animals. All of the deer in which predators were the proximate cause of death were predisposed by one or more of the following factors: lung parasite damage, physical injury or old age. The two deer caught by the hounds during experimental chasing were the oldest of the ten study animals for which ages were obtained. It must be emphasized that because no truly random sample of physiological and parasitological parameters within the deer population as a whole was obtained it is impossible to accurately compare the predator killed sample with the overall population. We did not determine what percentage of the population was debilitated to an extent predisposing them to predation. Also we cannot be certain as to how many, if any, of the deer killed would have survived until hunting season and thereby added to the legal harvest.

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COMPARISON OF CRIPPLING LOSSES OF WHITE-TAILED DEER CAUSED BY ARCHERY, BUCKSHOT, AND SHOTGUN SLUGS

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ABSTRACT

Of the 126 deer killed by hunters within a 746-acre enclosure at Albany, Georgia, during a 10-year period, 24 (19 percent) were not found by the hunter. Archers lost 4 of 8 deer killed (50 percent), gunners using buckshot lost 16 of 61 (26 percent), and gunners using shotgun slugs lost only 4 of 57 (7 percent). Antlered bucks were lost at more than twice the rate of antlerless deer. Only 2 of the 24 lost cripples were fawns, the lowest rate recorded for any group. In both sexes, yearlings were lost at a higher rate than older deer. Archery loss data from Virginia are included for comparison.

INTRODUCTION

Deer herd managers never obtain a complete picture of the kill on their lands because there is always a portion of the herd that is mortally crippled or for other reasons not retrieved. This paper reports on a 10-year effort to find and classify every hunting season mortality of white-tailed deer (*Odocoileus virginianus*) within a 746-acre enclosure at the Marine Corps Supply Center, Albany, Georgia. The area was described in detail by Johnson and Downing (1962) but can be briefly characterized as slightly rolling, upper coastal plain containing a mixture of cutover pineland and abandoned old fields. Most upland sites had sparse overstory with a ground cover of dense forbs, grass, blackberry brier (*Rubus* spp.) and Japanese honeysuckle (*Lonicera japonica*). Clumps of hardwoods and plum (*Prunus angustifolia*) occupied old fence rows and moist sites.

Thanks are due personnel of the Georgia Game and Fish Commission, U. S. Forest Service, and the Marine Corps Supply Center for their support and assistance.

METHODS

During 1959-63, all deer were killed with buckshot. From 1964-69, all gun hunting was with shotgun slugs, but a few deer were killed by archers. Throughout the study, hunters were required to report immediately every deer thought to have been wounded but which could not be found. A trained dog was available at every hunt to trail wounded deer to determine their fate. Numerous searches were also made after the hunting season to find additional carcasses. Periodic removal of low-growing vegetation by controlled burning facilitated these searches. Since 1964, two skeletons were found in which cause of death could not be determined, but inasmuch as most hunting during those years was with shotgun slugs, these two animals were assigned to the slug category.