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# Mortality of Adult White-tailed Deer on Fort Chaffee, Arkansas

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## Abstract

We conducted a telemetry study on Fort Chaffee, Arkansas, to estimate the extent, timing, and causes of mortality among resident adult white-tailed deer (*Odocoileus virginianus*). Twenty-seven deer were captured, radio-collared and monitored for 1 yr to assess seasonal mortality. Annual mortality rates differed considerably between sexes, with males exhibiting a much higher rate (86.1%) than females (5.3%). The primary causes of death among males were poaching, predation by coyotes, and legal harvest. Legal harvest by a gun-hunter accounted for the only female mortality. No mortalities were attributed to military exercises, which occurred frequently on the study area. Our results suggest that the male segment of the population would benefit from increased enforcement efforts to reduce illegal harvests and that continued liberal harvest of the female segment is advisable to maintain a balanced population sex ratio.

## Introduction

The white-tailed deer (*Odocoileus virginianus*) is North America's most numerous and widespread large mammal (Halls, 1984). The high ecological and economic values of this species have long been recognized (Kellert and Smith, 2000). Because of these values, the public demands that deer populations be managed in a competent and professional manner (Woolf and Roseberry, 1998). Population management usually involves manipulating harvest strategies to adjust density and sex-age composition of the herd to meet specified management objectives. Biologically sound management requires reasonable estimates of age-specific natality and mortality rates (Demarais et al., 2000).

Fort Chaffee is the largest of three military installations in Arkansas where deer hunting is permitted, and it is one of the top deer-producing public areas in the state (unpubl. data, Arkansas Game and Fish Comm.). Data collected from hunter check stations, annual spotlight surveys, and periodic assessments of reproduction and physical condition are used to make management decisions regarding the resident deer population. However, these sources provide no information about the extent of nonhunting-related mortality. Halls (1984) stated "Nonhunting mortality may be the most significant unknown parameter in population modeling and monitoring. When unaccounted for, it can seriously inhibit the setting of hunting regulations to optimize a legal whitetail harvest."

Here, we report on the extent, causes, and timing of mortality in a sample of adult deer that were radio-collared and monitored from January 1995 until January 1996. We hypothesized that nonhunting mortality rates might be higher on Fort Chaffee than in other regional herds because of accidental deaths attributable to military exercises (artillery and small arms fire) and/or high frequencies of poaching.

## Methods

Fort Chaffee is a 29,000-ha military base located in west-central Arkansas. The area consists primarily of second-growth oak-hickory (*Quercus* spp.-*Carya* spp.), oak-short-leaf pine (*Pinus echinata*), and bottomland hardwood forests interspersed with early-successional fields of various sizes. Excellent deer habitat is provided by extensive forest-meadow ecotones, which are maintained by frequent fires ignited accidentally during training activities. This habitat supported a deer population that was approximately three times higher than those on nearby public forests at the time of this study (G. Wilks, AGFC, pers. comm.).

Deer were captured using either net guns fired from a helicopter or rocket nets (Hawkins et al., 1968; Barrett et al., 1982). We attempted to capture equal numbers of each sex to compare mortality rates between sexes. Captured deer were immobilized with a mixture of 2.5mg/kg of ketamine hydrochloride and 0.5 mg/kg of xylazine hydrochloride. Each deer was aged based on tooth replacement and wear (Severinghaus, 1949), weighed on a spring scale accurate to 1 kg, and fitted with a radio-collar (Advanced Telemetry

Systems Inc., Isanti, MN) equipped with a mortality sensor that doubled the pulse rate if the collar remained motionless for 8 hr. All captured deer were monitored until they recovered from the anesthetics, then released at their capture site.

Deer were radio-tracked daily to monitor survival using a 3-element yagi antenna and receiver beginning one day after capture. A minimum of three assessments of survival was made weekly from the time of capture until death or the end of the study (31 January 1996). Mortality was detected by a change in the transmitter pulse rate. Dead deer were located immediately, and the carcass and site were evaluated for clues to the cause of death. Carcasses were returned to the laboratory and systematically necropsied (Woolf, 1978).

The color and consistency of femur marrow were used to evaluate the physical condition of deer at the time of death. Deer were considered to be in good condition if they had pink, fatty marrow indicative of normal fat reserves (Cheatum, 1949; Bischoff, 1954). Deer exhibiting red, gelatinous marrow were considered to be in poor physical condition. Signs of human presence near the carcass (e.g., boot tracks, collars that had been cleanly cut) provided evidence that deer were poached. Predation was evidenced by hemorrhage associated with bite or claw marks. Deer that were killed by hunters but not retrieved ("crippling losses") exhibited gunshot or arrow wounds. When scavenged, these carcasses lacked hemorrhage where chewed.

Mortality estimates were calculated using the micro-computer program MICROMORT (Heisley and Fuller 1985). MICROMORT allows the user to specify the time intervals, sources of mortality, and sex-age classes of interest for comparisons of mortality rates. We compared mortality rates during three intervals: spring-summer (1 March to 30 September 1995), gun season (25 November to 7 December and 28 December 1995 to 9 January 1996), and bowhunting season (1 October 1995 to 28 February 1996 excluding gun deer seasons). The sources of mortality were classified as legal hunting, poaching, crippling loss or predation. We calculated mortality rates separately for each sex.

## Results

Twenty-seven deer (7 males:20 females) were monitored during this study. Of these, 7 (6 males:1 female;

25.9%) deer died from various causes during this period (Table 1). Deer ranged in age from 1.5 to 7.5 yr old when captured; deer > 3.5 yr. old comprised 62% of the sample.

Mortality rates varied considerably between the sexes with males exhibiting much higher rates (Table 1). Six of the seven (85.7%) males died during the 13-month monitoring period. All died during the bowhunting season, but only one of these males was legally harvested by a bowhunter. Three bucks (two from areas of Fort Chaffee that were closed to hunting) were poached. The bloody radio-collars from these animals had been cleanly cut from the deer. One of these individuals appeared to have been shot from a road, as the collar was found hanging in a tree near the road. A second male's collar was found on the ground next to the entrails of the field dressed deer which were located in an isolated area approximately 1 km from the nearest road. Fresh boot tracks were observed at both sites. A third buck was killed illegally during the 3-day period when gun permit holders were allowed to scout prior to the hunts. The carcass was scavenged and we categorized this animal as poached because hunters scouting near the carcass reported gunshots at this location on the day this deer died.

One mortality was caused by coyote predation and another was caused by either coyote predation or crippling by a bowhunter. A large portion of this carcass was consumed prior to recovery, so precisely categorizing the causes of death was not possible. The carcass of a yearling male was found approximately 1 km outside the deer's normal home range. The marrow in this carcass suggested that this deer was in poor physical condition prior to death. The individual had been killed on a ledge with a steep bluff on one side and a sheer rock wall on the other. Coyote tracks and feces were present at the site and some evidence of hemorrhage was present. The evidence suggests that this deer had been chased, cornered, and killed by coyotes. The carcass of another yearling male, with marrow typical of a deer in poor condition, was found in a greenbriar thicket along a creek. We could not determine whether this deer was a victim of predation or was a crippling loss, which had subsequently been scavenged by coyotes. However, the deer exhibited normal daily movements immediately prior to death suggesting that disease was not the likely cause of death.

Table 1. Annual mortality rates of 27 radio-collared white-tailed deer on Fort Chaffee AR, during 1995.

Sex	N	Causes of Mortality (%)				Total
		Legal harvest	Poaching	Predation	Unknown	
Male	7	14.3	43.1	14.3	14.3	86.1
Female	20	5.3	0.0	0.0	0.0	5.3

The surviving 2.5 year old male was captured and collared in a section of Fort Chaffee that is open to hunting and located approximately 4 km from the nearest closed area. Throughout the year he made temporary excursions into the closed area and by the time the gun hunts began he was found exclusively in this refuge area.

The mortality rate among males during the bowhunting season was 86.1%, with 43.1% due to poaching, 14.3% due to bowhunting, 14.3% due to predation and 14.3% due to unknown causes, likely crippling and/or predation. Because no mortalities occurred during the other two intervals, the annual mortality estimate for Fort Chaffee males was 86.1%.

Only one mortality occurred among the 20 adult females monitored during this study (Table 1). A collared doe was harvested on the first day of the gun season. Consequently, the seasonal mortality rate for the gun season and the annual mortality rate for females was 5.3%.

It is noteworthy that we observed no mortalities during the spring or summer; all 7 deaths occurred after the opening day of bow season on 1 October. No mortalities occurred due to military activities or deer-vehicle collisions.

In addition to the radio-collared deer carcasses that were recovered and necropsied during this study, we also investigated the cause of death of 8 deer that were discovered on separate occasions while conducting field work. Four of these (all antlered males) had been poached on the Fort Chaffee golf course. The cause of death could not be determined for the other 4 deer; however, all were found between 26 September and 24 November on areas open to hunting. Two of these were fawns and 2 were older deer.

### Discussion

Few adult deer mortality studies have been conducted in the southern United States and none in western Arkansas. Dinkines et al. (1992) conducted an adult mortality study at Fort Sill, Oklahoma, and reported that 50% of these deaths were directly attributable to military training. Other causes of death at Fort Sill included collisions with vehicles (16%), crippling loss (11%), and poaching (6%). These researchers noted that their study "strongly suggests that the consequences of military training activities should be considered in the management of white-tailed deer herds on military installations." In contrast, we found no evidence of military-related deaths or injuries on Fort Chaffee. However, the timing of mortalities was similar on Fort Sill and Fort Chaffee. Dinkines et al. (1992) reported that 75% of adult mortalities occurred between September and February on Fort Sill; all 7 deaths among deer on Fort Chaffee occurred during this period.

Previous studies have concluded that mortality rates tend to be higher among male than female deer. In Minnesota, the annual mortality rate for adult males was

53%, but only 21% for adult females. Predation by gray wolves (*Canis lupus*) and legal hunting were the primary mortality factors for both sexes (Nelson and Mech 1986). DeYoung (1989) reported the annual mortality rate for adult male deer in south Texas was 29%, with predation, legal hunting, and poaching accounting for most of the deaths.

Dusek et al. (1992) reported annual mortality rates from 17 to 57% for females in Montana. Hunting, which included legal harvest, crippling loss, and poaching comprised 74% of all mortalities in that study; whereas, only 8% of deaths were attributed to natural causes such as predation, disease, and malnutrition.

We recognize that adult males in the Fort Chaffee population could not sustain annual mortality rates of 86%. We caution readers that this high estimate likely reflects sample bias associated with the small number of males monitored during this study. In fact, harvest data collected at biological check stations on Fort Chaffee during the 1990's suggest a reasonably normal distribution of the age-classes among males. For example, 2.5 year old males comprised 25%, and older males 21%, of the male harvest in 1995 (unpubl. data, Arkansas Game and Fish Comm.). Nevertheless, it is interesting to note that only two of 27 deer in our sample were legally harvested, whereas three males were poached. Additional enforcement efforts to reduce poaching of antlered males, particularly between September and February, appears to be warranted on Fort Chaffee.

Harvest data collected at check stations on Fort Chaffee since 1991 have consistently shown that adult females comprise the largest proportion of the legal harvest (34-39%). This has caused some hunters to speculate that this segment of the population has been over-harvested. However, the observation that only 1 of 20 females in our sample was harvested suggests that these concerns may not be justified and regulations which encourage a more liberal harvest of females than males is warranted to maintain a balanced population sex ratio.

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