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White-Tailed Deer (*Odocoileus virginianus*) on the Department of Energy's Oak Ridge Reservation Supplement 1: 1978 Status Report

J. Thomas Kitchings
Jay D. Story

Environmental Sciences Division
Publication No. 1398

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WHITE-TAILED DEER (*Odocoileus virginianus*) ON THE DEPARTMENT OF ENERGY'S OAK RIDGE RESERVATION

SUPPLEMENT 1: 1978 STATUS REPORT

J. Thomas Kitchings and Jay D. Story

ENVIRONMENTAL SCIENCES DIVISION
Publication No. 1398

Date Published - September 1979

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ABSTRACT

KITCHINGS, J. T., and J. D. STORY. 1979. White-tailed deer (Odocoileus virginianus) on the Department of Energy's Oak Ridge Reservation: 1978 status report. ORNL/TM-6803/S1. Oak Ridge National Laboratory, Oak Ridge, Tennessee. 34 pp.

During 1978 forty-five white-tailed deer (Odocoileus virginianus) were killed by vehicles on the Department of Energy's Oak Ridge Reservation. Patterns of mortality were similar to those previously reported for a nine-year period (1969-1977). During the year the highest number of deer were killed in the fall and more males than females were killed among both fawns and adults. The forty-five deer killed in 1978 are fewer than would have been predicted by the annual rate of increase in the number of road-killed deer during the nine-year base period (1969-1977). This is attributed to both the Tennessee Wildlife Resources Agency's trap-removal program and to a greater degree of driver awareness to the possibility for hitting an animal.

Habitat usage studies were initiated during 1978 by radio-collaring three animals, one buck and two does. Preliminary analysis indicated that the buck showed no preference for a particular habitat. The two does showed a preference for lowland hardwood and pine-dominated areas.

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INTRODUCTION

In a previous document (Story and Kitchings 1979) we published data on the Oak Ridge white-tailed deer (Odocoileus virginianus) herd which had been collected from road-killed animals during the period 1969-1977. This report supplements that information with data collected from 45 deer killed on Reservation roads during 1978. During 1978 we began accumulating information on home range and habitat usage from three radio-collared animals. Preliminary results from this effort are discussed. The study area and general methods of data collection for the portion of this report dealing with road-killed animals were discussed in detail in the base document (Story and Kitchings 1979).

RADIOTELEMETRY MONITORING

Trapping Procedures

White-tailed deer used in this study were captured in box live traps using loose salt as bait. One doe was anesthetized by an intramuscular injection of Cap-chur-sol from Palmer Chemicals which was administered by an injection dart fired from a Palmer dart rifle. The other doe received a combination of Cap-chur-sol and Pneudart (from Pneu-dart Inc.). The buck was anesthetized with a combination of Pneu-dart and xylazine (Rompun, Haver-Lockhart Labs). The first two deer captured were adult females caught on July 31 and September 10, 1978. The weights of these two were estimated at 100 and 120 lb (45.4 and 54.4 kg), respectively. Both animals were fitted with radiocollars and released the same day at the capture site. On October 25, 1978, an

adult male, weighing approximately 150 lb (68 kg), was captured, outfitted with a transmitter and released; this animal was subsequently killed by an automobile on February 25, 1979.

Tracking Equipment and Procedures

The transmitters used were pulsing, high frequency, solar-powered units in the 150-MHz range, purchased from Wildlife Materials Incorporated, Carbondale, Illinois. Recharge life of the batteries of these units is listed by the manufacturer as 8 years; mounted weight is 300 g. A single receiver was used with both a truck-mounted whip antenna and a hand-held four-element Yagi antenna. Range of reception varied and, while signals were received at distances up to 3.79 km on both the whip and Yagi antennas, most bearings were taken at distances of 1.6 km or less from the transmitters. All tracking was done from the ground.

The general location of the deer was determined using the truck-mounted whip antenna and driving until the signal from one of the deer was received. This antenna also enabled us to select sites of optimum signal strength before trying to determine the magnetic bearing to the transmitter. Once a site was selected, the truck-mounted antenna was disconnected from the receiver and the hand-held Yagi was connected. The direction of greatest signal strength was then determined using the Yagi antenna, and the magnetic bearing was read from a Silva Type 1 hand-held compass.

Magnetic bearings were plotted on a 1:24,000 scale map using a Jeppesen Navigation Plotter. While two such plots separated by a

sufficiently wide angle (preferably 45-135°) showed the approximate location of the deer, frequently a third bearing was taken to verify the accuracy of the first two. Practice sessions with three transmitters used in this study and with other similar transmitters demonstrated that radio-locations were 148 ± 30 m (N = 23) within actual location.

Habitat Usage - Radiotelemetry Monitoring

One buck and two does were equipped with radiocollars during 1978. Each animal was tracked by the process described in the methods section. The majority of locations were estimated during the mid-morning or mid-afternoon hours and as such may not represent the full spectra of deer activities. Subsequent nighttime tracking of the does (during the spring 1979) indicated that during feeding hours they did not extend beyond the range as shown in Fig. 1, and in fact many of the locations corresponded to those obtained in 1978. For this reason the data probably represented use of certain areas for both bedding and feeding.

The area over which the deer ranged was overlayed with a forest type map provided by the Forest Management group of the Environmental Sciences Division. By determining the forest community type occupied by the animal each time a radio-location was made, we obtained a preliminary estimate of habitat usage. The forest types were grouped into four categories: (1) upland (oaks, hickory, mixed pine-hardwoods); (2) lowland (poplar, beech, maple, floodplain species); (3) pine (either natural stands or plantations); and (4) cutover areas (clearcuts and/or abandoned fields).

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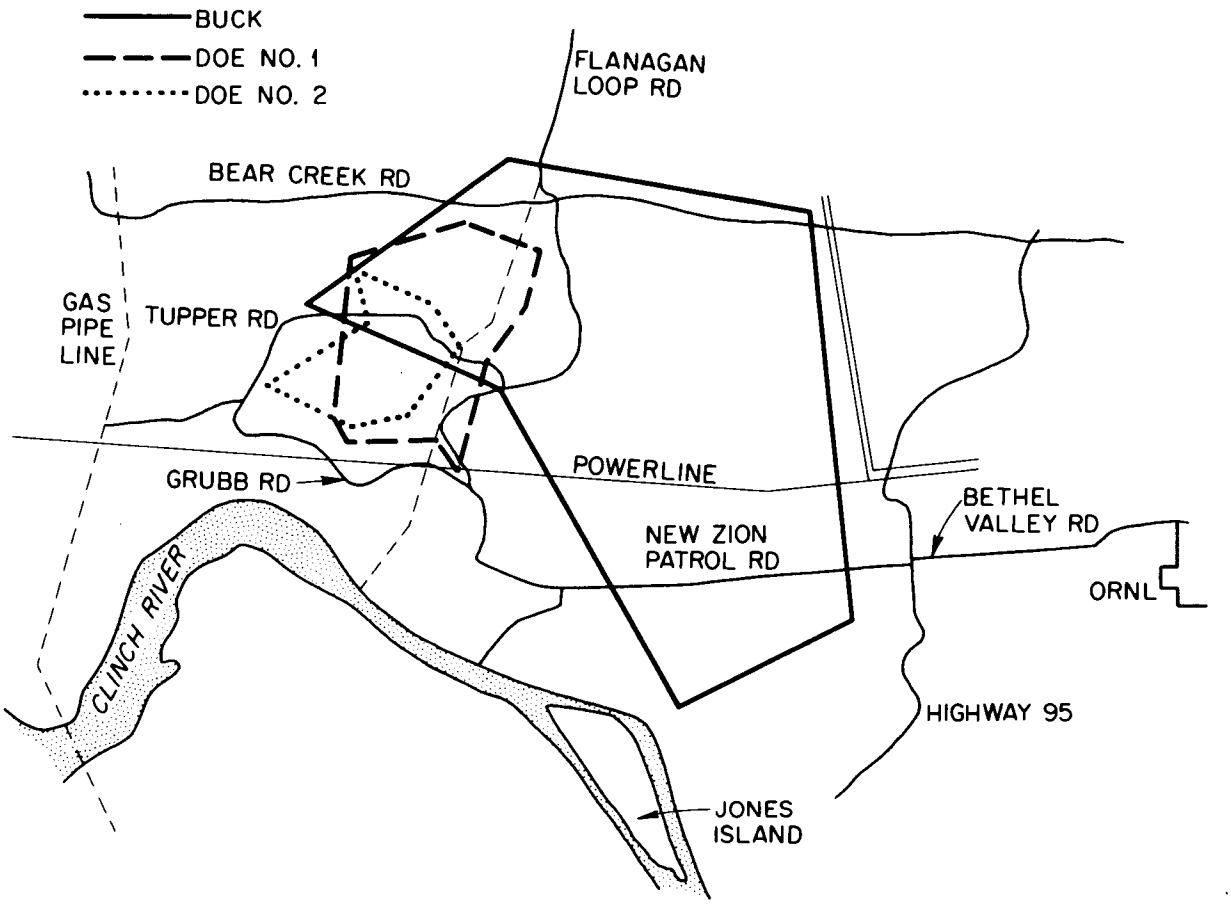

Fig. 1. Home range locations for three radio-collared deer tracked during 1978.

The buck was collared on October 25. He was located 17 times between November 1 and December 15. The area he traveled is shown in Fig. 1. Calculation of the area in which this animal was found showed his territory encompassed 705 ha. Table 1 summarizes the frequency distribution for each animal in each habitat category. As seen from this table, the buck showed no clear preference for a particular category.

The does occupied much less territory than did the buck. Doe no. 1 was located 79 times between her initial capture on July 31 and the final date in 1978 of December 15. Her territory encompassed 103 ha. She showed a clear preference for lowland areas and the shelter provided by pine stands (Table 1). Presumably the shrub vegetation of the low-lying areas provided a great deal of browse material. Doe no. 2 was captured September 11 and was subsequently located 57 times between that time and December 15. The 67-ha area she covered was considerably smaller than that covered by the other female. She demonstrated a preference for lowland, pine, and cutover areas (Table 1). Clearly, we need much more information from a larger sample of radio-collared deer before any conclusions regarding specific uses of particular habitats can be made.

RESULTS AND DISCUSSION OF ROAD-KILLED DEER MONITORING

From January 1, 1978, through December 31, 1978, 45 deer were recorded killed by vehicles on the Reservation. Twenty-one (47%) of these were males, 15 (33%) females, and 9 (20%) were recorded as unknown. The unknowns resulted from collisions in which the deer was

Table 1. Percent of time spent in four habitat categories by each radio-collared deer

	Category[a]			
	Upland	Lowland	Pine	Cutover
Buck	29	24	29	18
Doe no. 1	10	60	25	5
Doe no. 2	12	39	28	21

[a]Categories defined by forest type as follows:
Upland - oaks, hickory, mixed pine-hardwoods,
Lowland - poplar, beech, maple, floodplain species,
Pine - both natural occurring stands and plantations, and
Cutover - clearcuts and abandoned fields.

not killed outright and escaped. Of the 45 deer killed, only 27 carcasses were usable or recoverable by Environmental Sciences Division (ESD) personnel. Ten carcasses were removed by individuals unknown to us before ESD personnel could get to the accident scene. Eight animals were too badly damaged to obtain usable data.

Figure 2 shows a comparison of the number of road-kills in 1978 with the number killed annually from 1969 to 1977. (Subsequent reference to information from the Story and Kitchings (1979) paper will be termed the "base document" or "base period data.") The 45 deer in 1978 represent fewer deaths than would have been predicted by the annual rate of road-killed animals during the nine-year base period.

Applying the exponential function ($y = -0.1157\ X^{0.4379}$, where y = number of deer killed and X = years of study with 1969 = 1) derived for the nine-year base data, we would have expected approximately 70 animals to have been killed on Reservation roads in 1978. The fewer road-kills could reflect some success from the Tennessee Wildlife Resources Agency's trap-removal program on slowing herd growth and/or a greater degree of driver awareness and caution in areas where deer have been frequently killed in the past. The TWRA program removed sixteen animals (7 males and 9 females) from the Reservation during 1978.

Distribution of Road-Kills by Season, Sex, and Age

The 1978 data (Fig. 3) suggest a bimodal distribution for kills similar to the data presented in the base document (Fig. 1). A high fall mortality is apparent and is generally associated with the advent

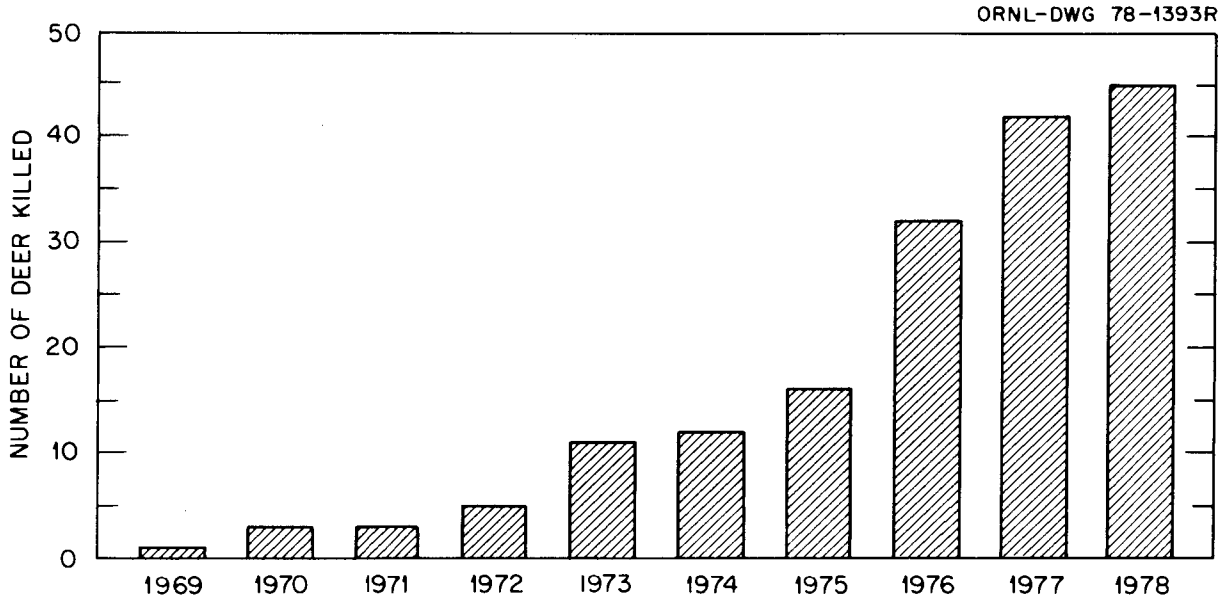

Fig. 2. Number of white-tailed deer road-killed annually from 1969-1978.

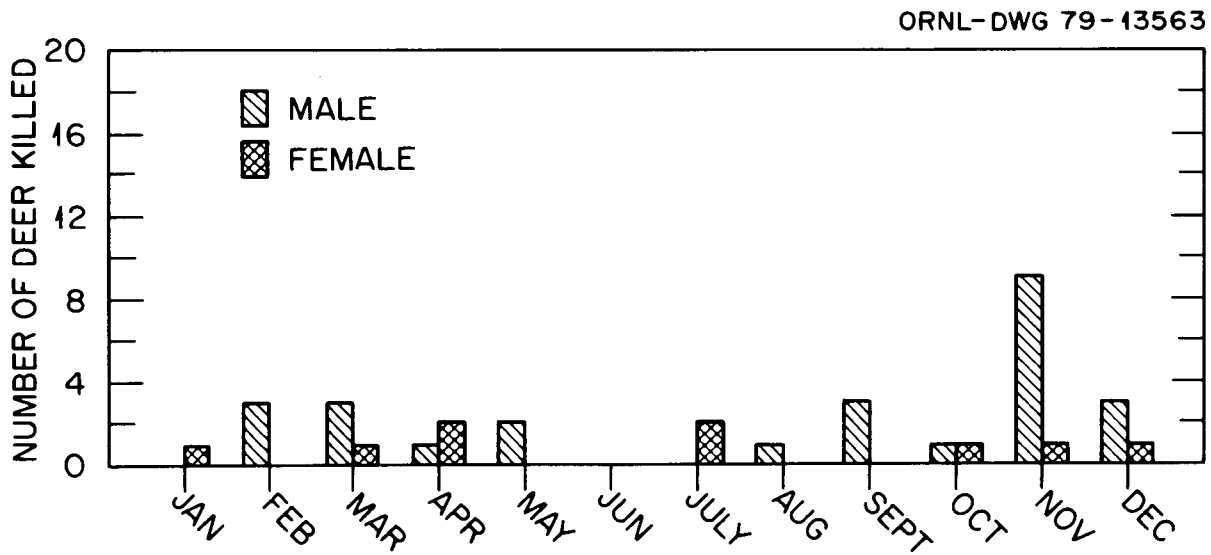

Fig. 3. Distribution of road-killed deer during 1978 by month and sex. The curve appears bimodal with most deaths occurring in the spring (late February through April) and in the fall (November) during the rutting season.

of the breeding season. November and December, during breeding periods, are again the months when the greatest number of deer are killed, with many more bucks dying than females (ratio 6:1). The large area traversed by the bucks during this breeding period is suggested as the cause for the lopsided sex ratio of road-kills (Davis 1975).

The spring peak in the 1978 data could be a result of a combination of dispersal movements and food availability. It is during this time that the yearling bucks are abandoned by the dams (Puglisi et al. 1974) and, thus, must move around to establish their own territory. Secondly, at this time of year the roadside vegetation is beginning to grow. Grass and other foodstuff is available to the animals and their use of these areas puts them closer to a greater potential hazard.

The sex ratio of animals killed during 1978 (approximately 2:1 males to females) does not differ from that reported earlier. As we discussed in the base report, the higher male to female ratio of the road-killed deer on the Reservation is the result of not having a differential harvesting program - that is, hunters going for bucks.

The age distribution of road-killed animals is shown in Table 2. In contrast to the data reported for 1969-1977, 1978 saw many more male fawns road-killed than female fawns (5:1). There was appreciable difference between sexes in the other age groups, however. We also reported in the base document that no yearling bucks had been road-killed during the November peaks from 1972-1977. In 1978, one yearling buck was killed during the first half of November. Two females in the 3- and 4-year groups were killed during 1978.

Table 2. Distribution of road-killed deer by age. These deer include the 27 animals for which both sex and age information could be determined. Values in parentheses are ages for additional animals which died during trapping or for other various reasons.

		Age group				
	Fawns	1 year	2 year	3 year	4 year	
Male	10(5)	4 (4)	0 (0)	2 (0)	1 (2)	
Female	2(1)	4 (3)	2 (0)	1 (2)	1 (1)	
Total:	12 (6)	8 (7)	2 (0)	3 (2)	2 (3)	(Total-27)
Grand total:	18	15	2	5	5	(Total-45)

Geographical Distribution of Road-Kills

Areas where deer were killed by vehicles in 1978 are shown in Fig. 4. Road-kills during this time seem to be less concentrated than those from 1969-1977. Approximately six collisions occurred in areas where no road-kills had previously occurred. Ten animals (24%) were killed on Bear Creek Road. This particular area accounted for only 11% of all road-kills during the nine-year base period. An additional 21% (9 animals) were killed on the Turnpike (Highway 58), with eight of these collisions in the immediate vicinity of the Gaseous Diffusion Plant. This location is the only spot where a large number of kills occurred in 1978. The vegetation bordering the highways along these stretches ranges from grassland to pine and lowland hardwoods - pine, cedar, and cedar-pine areas. The preliminary data from our telemetry efforts show that the white-tailed deer on the Reservation favor these types. A memo report prepared by a student researcher in the Environmental Sciences Division[1] showed a high correlation between deer usage, as indicated by the number of trails traversing a 1.0-km segment, and areas (mixed conifer and cedar) having a vegetational combination of selective clearing by the Forest Management Group.

During 1978, one animal was killed within the city proper of Oak Ridge and five were killed toward the eastern end of the Reservation (Fig. 4). Only six animals were killed in the eastern portions of the Reservation during the 1969-1977 years.

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[1]Deborah M. Lucas and J. Thomas Kitchings. 1977. The Use of Discriminant Function Analysis in Determining Habitat Usage of White-tail Deer. Environmental Sciences Division, December 14, 1978. 11 p.

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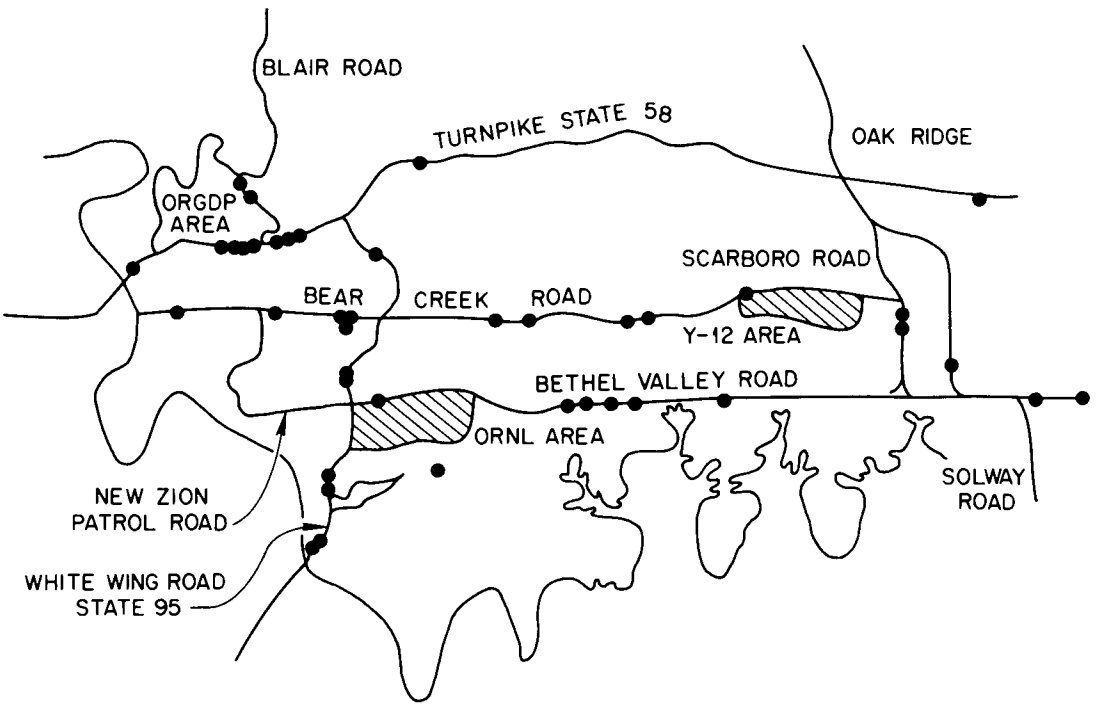

Fig. 4. Locations of road-killed white-tailed deer on the Oak Ridge Reservation in 1978. The dot (•) denotes the actual location where the animal was killed.

Accidents by Time of Day

Analysis of the 1978 data does not indicate a peak period that could be attributed primarily to deer movements rather than to heavy traffic periods such as the 2200-2400 peak noted in the 1969-1977 report (Fig. 5). The early 0600-0800 peak coincides with the heavy morning traffic as persons come to work at all three facilities. During this time period, the high number of kills is a combination of increased traffic and high deer activity. The same is true of the 1800-2000 hour peak.

Summary Statistical Data

Table 3 shows a summary of data for the 37 deer killed on the Reservation during 1978 for which both weight and age could be determined. Twenty-four of these animals were road-kills, one was killed by a dog pack, ten were killed as a result of trapping stress, and two fawns were found blind and were euthanized. In this year's report we divided the less-than-one-year-old groups into two groups: one of deer less than six months and the other of deer greater than six months but less than one year. It was apparent when looking at both the data for does and bucks that the young age of a number of animals would cause a distortion in the average weights of those animals close to a year in age. Bucks had significantly higher weights in both the 1- to 2-year and 2-year and older age categories. The does' weights seem to plateau at 1.5 years of age at approximately 121.0 lb (54.9 kg). Bucks, on the other hand, show a weight gain throughout all age groups. The heaviest doe was a 135-lb (61.2-kg) animal in the two-year-and-over age

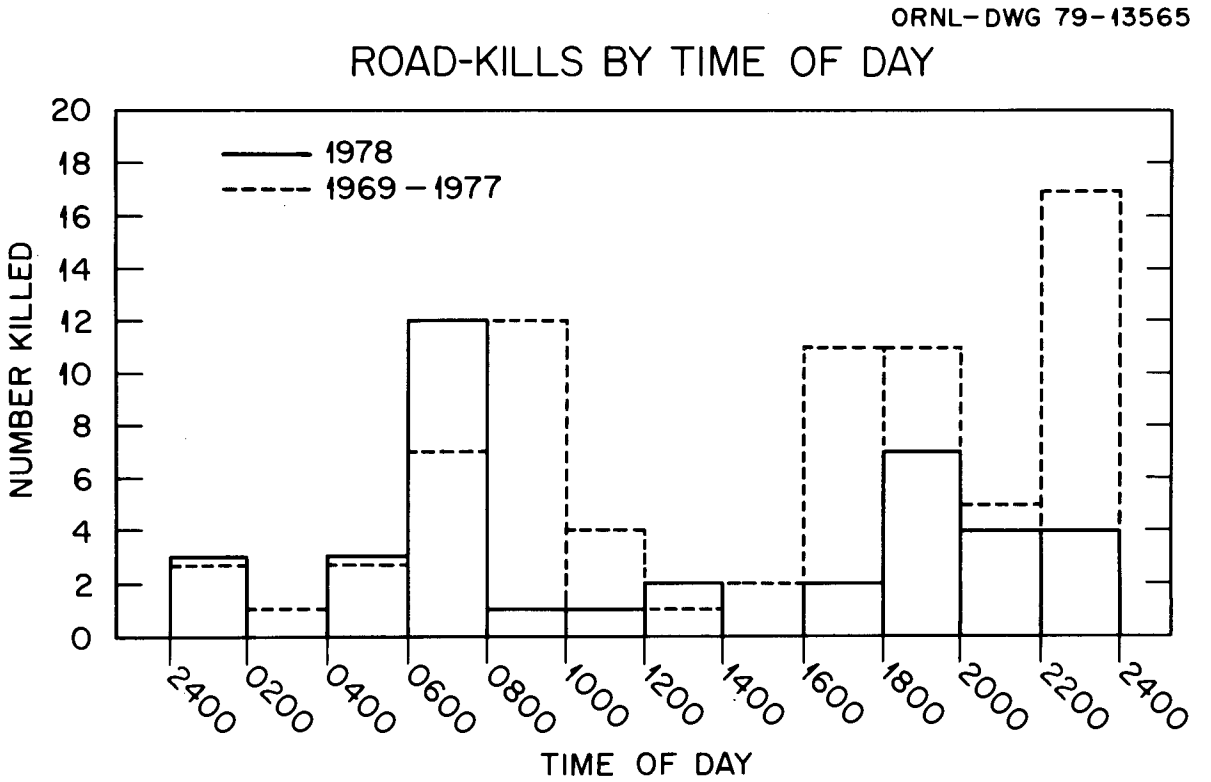

Fig. 5. Road-killed white-tailed deer by time of day during 1978. Data from 1969-1977 is superimposed to illustrate a lack of a peak kill period in 1978 which could be attributed primarily to deer movements rather than heavy traffic periods such as the 2200-2400 peak in 1969-1977. 1978 kills seem to correspond more with peak traffic periods than with any other occurrences.

Table 3. Summary data for white-tailed deer killed on the Oak Ridge Reservation during 1978. Animals included here are ones where both weight and age were known. Percent of total is based on the total number of both does and bucks (37) killed during this period.

	Does				Bucks			
Age group	Number killed	% of total	Avg. weight[a] (lb)[b]	Avg. age[a] (months)	Number killed	% of total	Avg. weight[a] (lb)[b]	Avg. age[a] (months)
Less than 6 months	2	5	26.5 ± 2.1	1.8 ± 0.4	3	8	59.3 ± 28.9	4.7 ± 0.6
More than 6 months, less than 1 year	5	14	93.8 ± 12.8	11.6 ± 0.9	8	22	84.8 ± 12.3	9.5 ± 1.4
More than 1 year, less than 2	3	8	121.0 ± 14.2	18.2 ± 0.3	6	16	149.8 ± 13.9	18.5 ± 3.1
Two years and older	6	16	121.7 ± 13.2	36.0 ± 9.9	4	11	177.3 ± 28.8	47.3 ± 6.2
Total no. killed	16				21			

[a]Means ± 1 standard error.

[b]x 0.4536 = kg.

group while a 200-lb (90.7-kg), 3.5-year-old buck was the heaviest. When compared with the 1969-1977 base data, the animals killed in 1978 were both heavier and older. For example, the average age of bucks in the 1- to 2-year age class in 1969-1977 was 15.8 months with an average weight of 116.7 lb (53 kg). In 1978 the same age group averaged 18.5 months and 149.8 lb (67.9 kg).

Reproduction

The reproductive tracts from five road-killed does were examined in the first six months of 1978 (January-June). Of the five, four were at various stages of pregnancy. Information on these animals is shown in Table 4.

Based on information from these does and one blind fawn, breeding dates ranged from late November (11/25) through late February (2/26). Five does were also killed during July and August, and of those, four were lactating. From this information it would seem that a large portion of the females in the population have young each year. Indications are that even the doe fawns born early in the year are bred the same year.

The first fawn observation was made on June 5, 1978, and subsequently 12 fawns (10 males and 2 females) were killed by vehicles during the year. Some very small fawns, still with spots, were seen as late as October, indicating that breeding on the Reservation took place into the early spring.

The incidence of twinning in the population can provide some insight into the condition of the overall herd. A high proportion of

Table 4. Age and sex of fetuses found in four pregnant does killed by vehicles during the January-June period of 1978

	Age of doe (months)	Number and sex of fetuses	Age of fetuses (days)
January 6	18	1 sex unknown	37-40
March 8	30-36	2 males	not determined
March 24	17-24	1 female	111-120
May 12	11-13	1 female	76-85

twinning indicates that habitat and food conditions are excellent and thus more animals can be supported. The number of observations of fawns during 1978 break down as follows: doe + 1 fawn, 7 observations; doe + 2 fawns, 13 observations; doe + 3 fawns, 1 observation.

CONCLUSIONS

The information we collected in 1978 led to two interesting findings. First, the rate of deer population increase, when measured by the number of road-killed animals, seems to be less than indicated in the previous report for 1969-1977. Second, the physical distribution of road-killed animals in 1978 is more widespread than previously reported.

The preliminary data on habitat use tend to support the concept that the males are more often exposed to potential hazards because they range over larger areas than do the females. The radiotelemetry data also seem to point toward a use of areas similar to those found along the Reservation highways as both feeding and bedding sites, as was suggested in the base document. Radio-location data collected over 24-hr periods during 1979 will enable us to more adequately assess both of these situations.

The next few years will see our research directed to three main topics: (a) continued population monitoring, (b) habitat needs, and (c) parasitological characteristics of the Reservation deer. Data collected from the road-killed animals during 1979 and the preceeding ten years will be used to construct a life-table for the Reservation population. Radiotelemetry monitoring can continue to provide data on the usage of

various vegetation types by the deer and can also give some insight into the comparative degrees of movement across hazardous areas by both bucks and does. Increased parasite loads in abomasum samples collected from road-killed animals generally point to overcrowding within the population (Eve and Kellogg 1977). This information when coupled with data on browse utilization (obtained by establishing a number of browse lines) can provide an early warning of overcrowded conditions requiring additional population management.

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