MARTIN MARIETTA ENERGY SYSTEMS LIBRARIES
3 4456 0049547 1

CD

ornl

OAK
RIDGE
NATIONAL
LABORATORY

UNION
CARBIDE

ORNL/TM-6803/S3

White-Tailed Deer (*Odocoileus virginianus*) on the Department of Energy's Oak Ridge Reservation: 1980 Status Report

Jay D. Story
J. Thomas Kitchings

OAK RIDGE NATIONAL LABORATORY
CENTRAL RESEARCH LIBRARY
CIRCULATION SECTION
4500N ROOM 175
LIBRARY LOAN COPY
DO NOT TRANSFER TO ANOTHER PERSON
If you wish someone else to see this report, send in name with report and the library will arrange a loan.

ENVIRONMENTAL SCIENCES DIVISION
Publication No. 1898

OPERATED BY
UNION CARBIDE CORPORATION
FOR THE UNITED STATES
DEPARTMENT OF ENERGY

Printed in the United States of America. Available from
National Technical Information Service
U.S. Department of Commerce
5285 Port Royal Road, Springfield, Virginia 22161
NTIS price codes—Printed Copy: A03 Microfiche A01

This report was prepared as an account of work sponsored by an agency of the United States Government. Neither the United States Government nor any agency thereof, nor any of their employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights. Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise, does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof. The views and opinions of authors expressed herein do not necessarily state or reflect those of the United States Government or any agency thereof.

ORNL/TM-6803/S3

Contract No. W-7405-eng-26

WHITE-TAILED DEER (*Odocoileus virginianus*) ON THE DEPARTMENT OF ENERGY'S OAK RIDGE RESERVATION: 1980 STATUS REPORT

Jay D. Story and J. Thomas Kitchings

ENVIRONMENTAL SCIENCES DIVISION
Publication No. 1898

Date Published - August 1982

NOTICE This document contains information of a preliminary nature. It is subject to revision or correction and therefore does not represent a final report.

OAK RIDGE NATIONAL LABORATORY
Oak Ridge, Tennessee 37830
operated by
UNION CARBIDE CORPORATION
for the
DEPARTMENT OF ENERGY

MARTIN MARIETTA ENERGY SYSTEMS LIBRARIES
3 4456 0049547 1

ACKNOWLEDGEMENTS

We thank the following for help through reporting and/or retrieving road-kills: shift superintendents' offices of X-10, K-25, and Y-12 plants; guard and fire department personnel of X-10, K-25, and Y-12; Oak Ridge Police Department; University of Tennessee Comparative Animal Research Laboratory personnel; Richard Evans, superintendent of the University of Tennessee Forestry Experiment Stations; Tennessee Wildlife Resources Agency Officers from Anderson, Roane, and Loudon counties; F. G. Taylor, Jr. and D. C. West of the Environmental Sciences Division; and many interested private citizens.

We appreciate the expert help provided by Pete Lesslie of the UCCND Computer Sciences Division in handling our data. Curtis W. Sabrosky of the U.S. Department of Agriculture graciously provided the identification of the cuterebrid and calliphorid larvae. William J. Galbraith, a University of Wisconsin Wildlife Management student working with us for the summer, was responsible for finding and necropsying the dead fawn with the botfly larva and alertly collected and preserved the larva.

We appreciate receiving traffic data from the following individuals: Carl Fox, Plant and Equipment Division of ORNL and Wayne Lockett, Tennessee Department of Transportation. We are indebted to James Hawkins, D.V.M., of the Appalachian Animal Clinic, because we have called on him and his staff many times for professional advice and assistance.

G. E. Cosgrove has performed many pathological examinations for us and we are grateful for his assistance.

ABSTRACT

STORY, JAY D., and J. THOMAS KITCHINGS. 1982. White-tailed deer (Odocoileus virginianus) on the Department of Energy's Oak Ridge Reservation: 1980 Status Report. ORNL/TM-6803/S3. Oak Ridge National Laboratory, Oak Ridge, Tennessee. 42 pp.

Ninety-eight white-tailed deer (Odocoileus virginianus) were killed by vehicles on the Department of Energy's Oak Ridge Reservation during 1980, an increase of twenty-five over 1979. Both spatial and temporal patterns of mortality were similar to those reported previously. November and December were the months when the highest numbers of deer were killed. The sex ratio of road-kills was about 1:1 from January through October but shifted to a high male kill (4.8:1) during November and December, presumably the result of the rutting season. Reproductive data collected from does indicated that breeding occurred as early as October 20 and as late as December 21.

Records kept on rutting condition in bucks indicated a breeding season from October through January; antlers were shed from January through April with the peak of shedding activity occuring in March.

Postmortem examination of deer revealed a good general condition of the animals with only a few abnormalities or indications of sickness or disease.

Abomasal parasite counts indicate the Reservation deer population has reached optimum density. Other parasites found include brainworms, body worms, and botfly larvae; papillomas were observed in two deer during 1980. Data from heart girth and weight measurements were presented and compared to similar data from elsewhere in the Southeastern United States.

TABLE OF CONTENTS

	Page
ABSTRACT	v
LIST OF TABLES	ix
LIST OF FIGURES	xi
INTRODUCTION	1
RESULTS OF 1980 ROAD-KILLED WHITE-TAILED DEER MONITORING	1
Distribution of Road-killed Deer by Season, Sex, and Age	4
Geographical Distribution of Road-killed Deer	6
Accidents by Time of Day	8
Vehicular Traffic Trends	9
Summary Statistical Data	11
Reproduction	11
Bucks - Antler Shedding	14
Parasites and Abnormalities	14
Heart Girth - Weight Relationship in Reservation Deer	21
Radiotelemetry Developments and Observations	25
SUMMARY	26
REFERENCES	28

LIST OF TABLES

Table		Page
1	Distribution of road-killed deer during 1980 by age	4
2	All deer mortalities	6
3	Age distribution (%) of road-killed deer on the Oak Ridge Reservation	7
4	Summary of traffic counts made in the Oak Ridge Area . . .	10
5	Summary data for deer killed on the Oak Ridge Reservation during 1980	12
6	Summary of bucks' number of antler points, weight, age (1969-1980)	13
7	Age and sex of fetuses found in four pregnant does during 1980	13
8	Breeding dates of six does	15
9	Bucks in rutting condition	15
10	Months when bucks shed antlers	15
11	Summary of abomasal parasite counts	16
12	Heart girth-weight predictive equations	23

LIST OF FIGURES

Figure		Page
1	Number of road-killed white-tailed deer by year from 1969 to 1980	2
2	Distribution of road-killed white-tailed deer during 1980 by month and sex	5
3	Locations of road-killed white-tailed deer on the Oak Ridge Reservation in 1980	8
4	Road-killed white-tailed deer by time of day during 1980	9
5	Locations of traffic count sites	10
6A	Photograph of papilloma on leg of 17 to 20 month old buck	18
6B	Photograph of papilloma on leg of 2-year-old buck	19
7	Plots of heart girth-weight data	24
8	Plot of home range of Doe #2 based on sightings made since May, 1975	26

INTRODUCTION

The number of white-tailed deer killed by vehicles on the Department of Energy's Oak Ridge Reservation during 1980 showed an increase over the previous year's kill (Kitchings and Story 1980). This is the fourth report in a series whose primary objectives are to document information gathered from road-killed animals and to summarize data collected.

The study area and general methods of data collection have been previously discussed in detail by Story and Kitchings (1979).

Results of 1980 Road-killed White-Tailed Deer Monitoring

During calendar 1980, 98 deer were recorded hit by vehicles on the Reservation and although not all were recovered, any deer reported hit was considered a kill. Fifty-one (52%) were males, 28 (29%) were females, and 19 (19%) were recorded as unknowns. Unknowns resulted when (1) a deer was hit by a vehicle but not killed, and it escaped outright without anyone observing its sex, or (2) the carcass was stolen by a passing motorist before Environmental Sciences Division personnel could reach the scene. Ages were determined for 65 animals, and 57 animals were weighed. Often carcasses were so badly mangled that accurate weight could not be obtained.

Figure 1 compares the number of deer killed by vehicles annually from 1969 to 1980. Using the 1980 data to update the deer population's rate of increase estimate (Story and Kitchings 1979) resulted in the following equation: $y = 1.0631\ x^{0.3925}$, $r^2 = .9734$, where y = number of

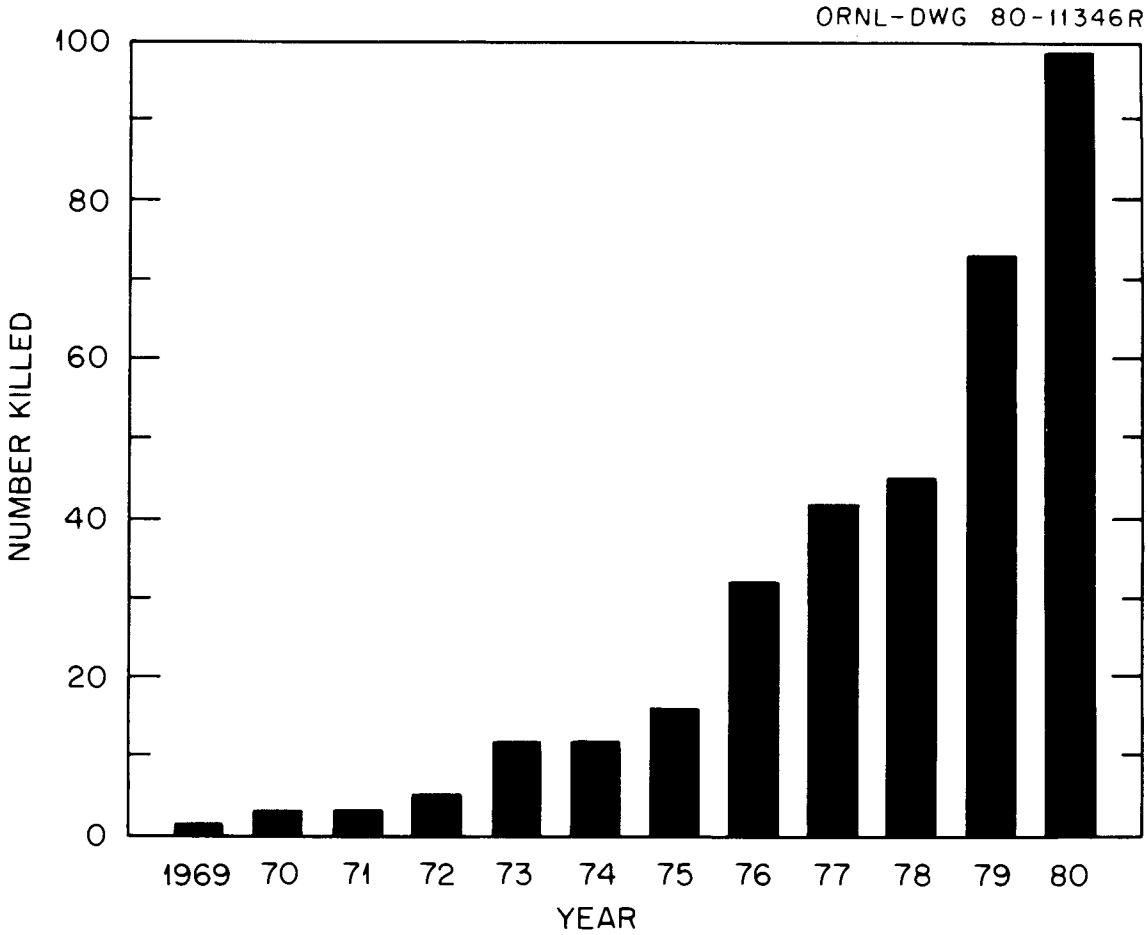

Fig. 1. Number of road-killed white-tailed deer by year from 1969 to 1980.

deer killed and x = number of years since the study began (1969 = 1). The rate of increase, 0.3925, is very near the 0.4018 value calculated in 1979. Applying the 1979 rate of increase to project an expected total kill for 1980 resulted in a projection of 102 animals, while the actual kill totaled 98. Using the 1980 rate of increase (0.3925) we expect to have approximately 136 deer killed by vehicles during 1981.

We do not expect the current rate of increase to continue indefinitely, but with the high rate of increase we are experiencing it seems

logical to expect to find evidence of habitat damage. Information supplied to us by Dick Hurd, TWRA wildlife biologist, indicates that if 1/3 of a plant's current annual growth is eaten by a deer for 3 years or more there is a good possibility that the plant will die. TWRA wildlife biologists consider that any area which exhibits as much as 30 to 35% utilization of preferred browse should be watched closely because of the likelihood of overpopulation. The first deer browse survey on the Reservation was conducted in February 1981 by TWRA and ESD personnel. Eight locations across the Reservation were examined for deer browse utilization during the 1980 to 1981 winter period, and the results indicated extremely high utilization: preferred browse 62%; common browse 9%; and emergency browse 5% (Dick Hurd, personal communication, 1981). These data indicate that damage is already resulting from over utilization of browse by deer. We anticipate continuing this cooperative browse survey on the Reservation in hopes of enhancing our ability to monitor the status of the deer population.

The annual trapping-removal effort was continued by TWRA on the Reservation during the spring of 1980. This effort accounted for the removal of 12 deer, 8 males and 4 females. The number of trapped deer was down from the 1979 total of 25, apparently because the trapping effort for 1980 was about one month shorter than the 1979 trapping period.

While most known deer mortalities on the Reservation result from deer-vehicle collisions, a few die each year from other causes as Table 1 shows. Poaching continues to be a problem on the Reservation as indicated by the discovery of two deer killed by illegal hunters

Table 1. All known deer mortalities, 1980

Cause of death	Anderson County	Roane County
Road-kills	57	41
Poached	0	2
Blind (euthanized)	0	3
Sick (euthanized)	0	1
Unknown	0	3
TOTALS	57	50

during the year. During the fall, winter, and early spring months, gunfire is frequently heard in parts of the Reservation where the deer concentration is known to be dense.

Distribution of Road-killed Deer by Season, Sex, and Age

The 1980 deer-kill pattern differed from the 1979 pattern in two respects. First, the seasonal distribution of kills was not as distinctly bimodal in 1980 as it was in 1979. Secondly, while the 1980 November kill of males was as high as it was in 1979, the December 1980 kill of males was also quite high and differed in this respect from the low December 1979 male kill. We believe extension of the high male mortality into the month of December may have been an indication that rutting season extended through a longer period during 1980. The data we obtained on breeding times for does substantiate this idea. Figure 2 shows November and December were the months when mortality was highest.

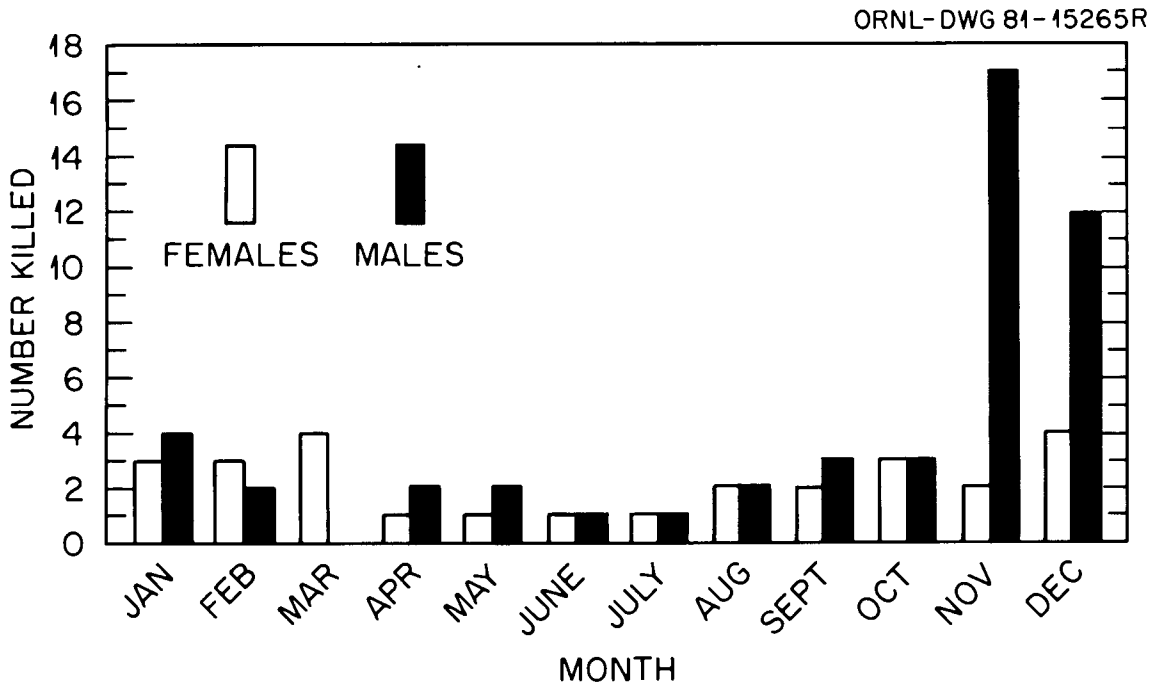

Fig. 2. Distribution of road-killed white-tailed deer during 1980 by month and sex.

By the end of October 1980 the sex ratio of the road-kills was 1.1:1 (males to females), but the ratio shifted drastically during November and December. For these two months the sex ratio was 4.8:1 (males to females) resulting in an annual kill sex ratio of 1.8:1. This compares closely to a 1.6:1 ratio for the 1979 annual kill. Increased movement by bucks during rutting season probably accounts for the sudden and drastic shift in the male to female kill ratio during November and December.

The age distribution of road-killed animals is shown in Table 2. As in 1979, equal numbers of male and female fawns were killed. However, in the 1.5-year age group many more males than females were killed. In all age groups the number of males killed during 1980

Table 2. Distribution of road-killed deer during 1980 by age

	Age Group (years)					
	Fawns	1.5	2.5	3.5	4.5	5.5+
Male	7	15	7	6	3	0
Female	7	1	4	6	1	0
Total:	14	16	11	12	4	0

equaled or exceeded the number of females killed. Although our numbers are still rather low, there was again an increase in the number of males killed in the 1.5-year age group, and the number of females killed in this age group decreased. However, it should be noted that the number of "unknowns" (19) recorded during 1980 was the highest we have experienced in any year since the study began in 1969.

Table 3 shows the age distribution (% of total sample) from 1975 through 1980. The trend observed in 1979 which reflected a decreasing number of 2.5-year-old males each year showed a reversal.
Considering the variability exhibited in the different age groups of both sexes, it is not readily apparent what, if any, significance this increase represents. It is interesting to note the continuing absence of older animals (5.5+ years) in both sex groups.

Geographical Distribution of Road-killed Deer

The geographical distribution of road-kills was similar to that reported for 1979 except that there was a noticeable decrease in the number of kills at or near the intersection of State Highways 58 and 95

Table 3. Age distribution of white-tailed deer road-killed on the Oak Ridge Reservation

Year	n	Age groups (years)					
		Fawn (%)	1.5 (%)	2.5 (%)	3.5 (%)	4.5 (%)	5.5+ (%)
		Males					
1975	9	33.3	44.4	0.0	11.1	11.1	0.0
1976	15	13.3	26.7	20.0	26.7	13.3	0.0
1977	26	23.1	7.7	26.9	15.4	19.2	7.7
1978	21	47.6	23.8	4.8	9.5	14.3	0.0
1979	35	31.4	37.1	5.7	14.3	11.4	0.0
1980	38	18.4	39.5	18.4	15.8	7.9	0.0
Total males killed	144						
		Females					
1975	2	50.0	50.0	0.0	0.0	0.0	0.0
1976	5	40.0	20.0	40.0	0.0	0.0	0.0
1977	8	37.5	25.0	37.5	0.0	0.0	0.0
1978	16	25.0	37.5	18.8	12.5	6.3	0.0
1979	20	50.0	20.0	20.0	5.0	5.0	0.0
1980	19	36.8	5.3	21.1	31.6	5.3	0.0
Total females killed	70						

(Fig. 3). On the other hand, the increase in road-kills in the eastern part of the Reservation (Scarboro Road eastward to Clinch River), first noticed in 1979, continued in 1980. While six deer were killed in this part of the Reservation during 1979, twenty-one were killed during 1980. Road-kills on secondary roads numbered about the same in 1980 as in 1979. Forty-one deer were killed in the Anderson County portion of the Reservation, and 57 road-kills were recorded for the Roane County portion.

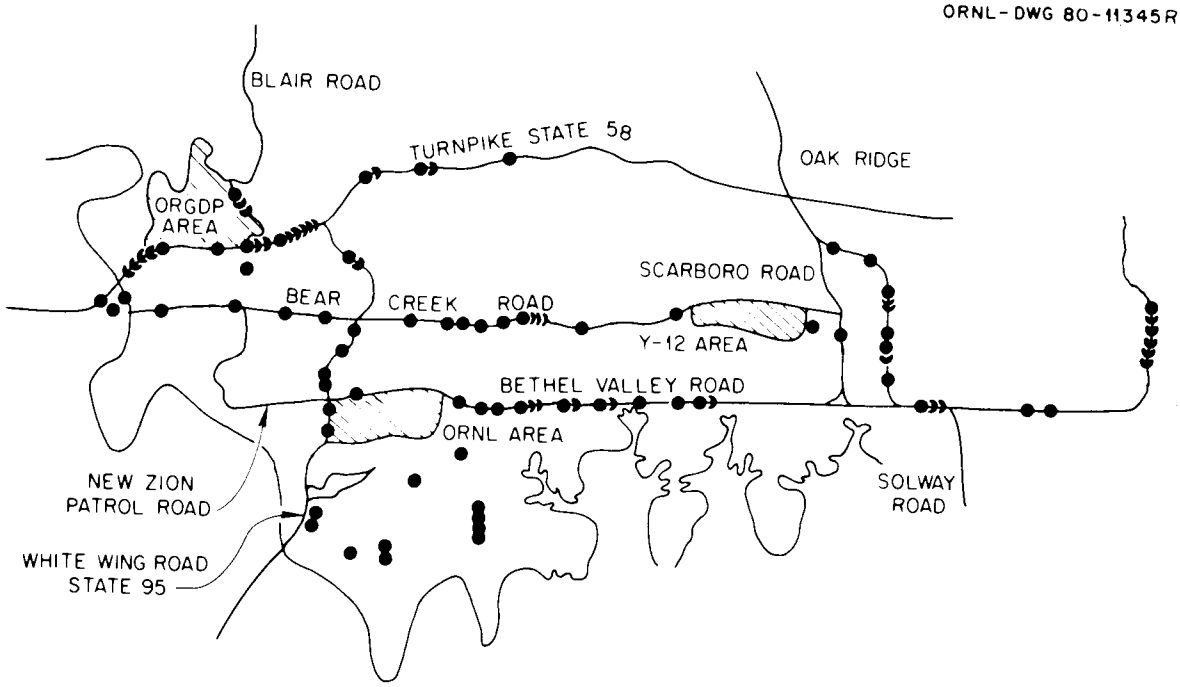

Fig. 3. Locations of road-killed white-tailed deer on the Oak Ridge Reservation in 1980.

Accidents by Time of Day

The 1980 road-kill pattern by time of day (Fig. 4) was similar to the 1979 pattern except that, instead of two sharp peak time periods (0600-0800 and 2200-2400), the 1980 pattern showed a peak during the 0600 to 0800 period, another between 1800 and 2000, and a third between 2200 and 2400. The 0600 to 0800 period accounted for 20% of the known-time road-kills; the 1800 to 2000 period 14.3% and the 2200 to 2400 period 17.1%.

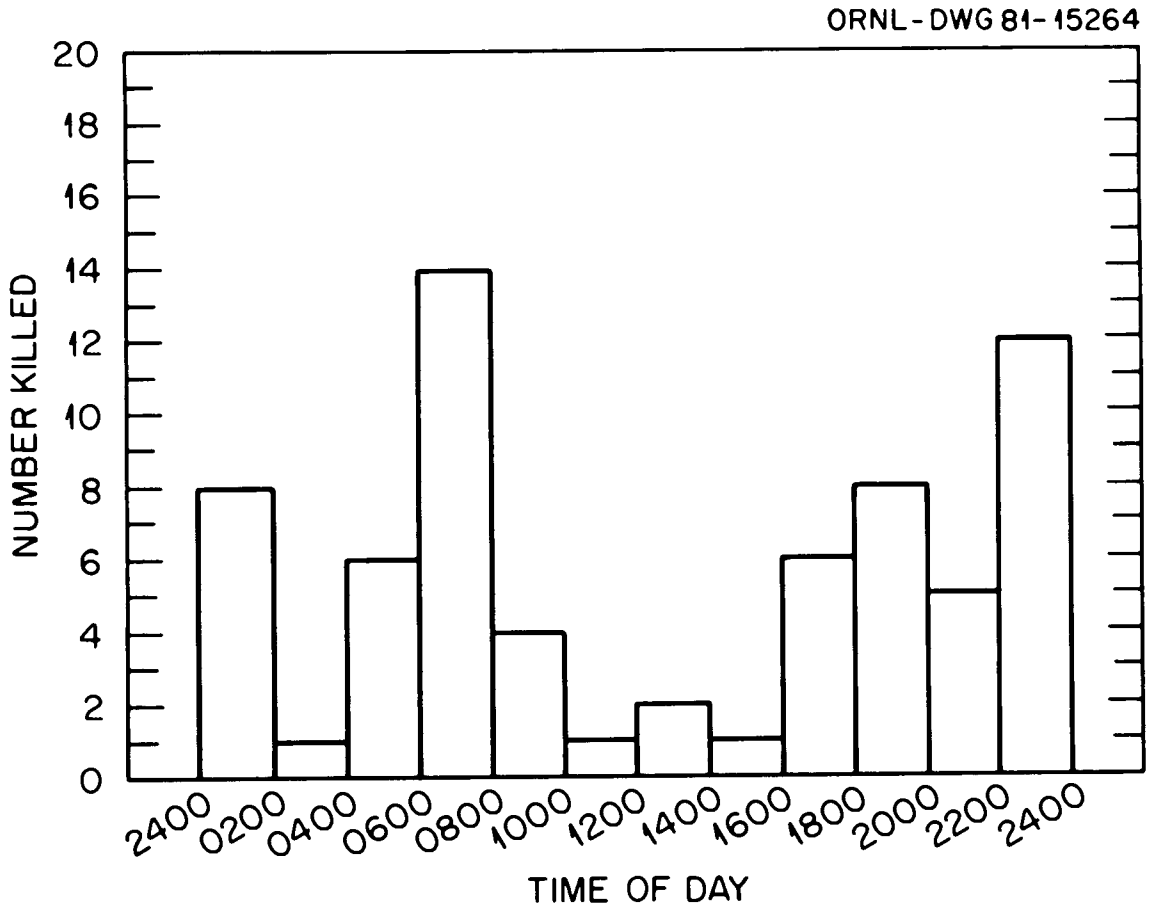

Fig. 4. Road-killed white-tailed deer by time of day during 1980.

Vehicular Traffic Trends

Traffic volume on the Reservation is relatively stable through time. Thus the increase in deer road-kills is attributed to deer activity and increasing deer numbers. Table 4 shows traffic-count data obtained from the Tennessee Department of Transportation and from the ORNL Plant and Equipment Division, and Fig. 5 shows the location of traffic-count sites. These data serve to substantiate our opinion that traffic increases cannot be considered an important contributing factor in the continuing annual increase in the number of road-killed deer.

Table 4. Summary of traffic counts made in Oak Ridge area

Location[a]	Traffic - State Counts 1976	1977	1978	1979	1980	Change from 1979 to 1980 %
K-25	8800	9540	--	9800	9700	-1.0
Turnpike	6680	6860	--	8330	8200	-1.6
Whitewing	5210	3080	--	4570	4500	-1.6
State 62	18,230	21,310	--	18,950	17,600	-7.1

Location[b]	Traffic - ORNL Counts 1976	1977	1978	1979	1980	Change from 1978 to 1980 %
1	1060	1041	1054	--	1089	+3.3
2	600	586	669	--	644	-3.7
3	279	276	218	--	273	+25.2
4	--	1087	1084	--	1078	-0.6

[a]Counts made during a 24-h period.

[b]In each of the four ORNL locations counts were "outbound" counts made during peak traffic periods (4-5 PM) for comparing year-to-year changes.

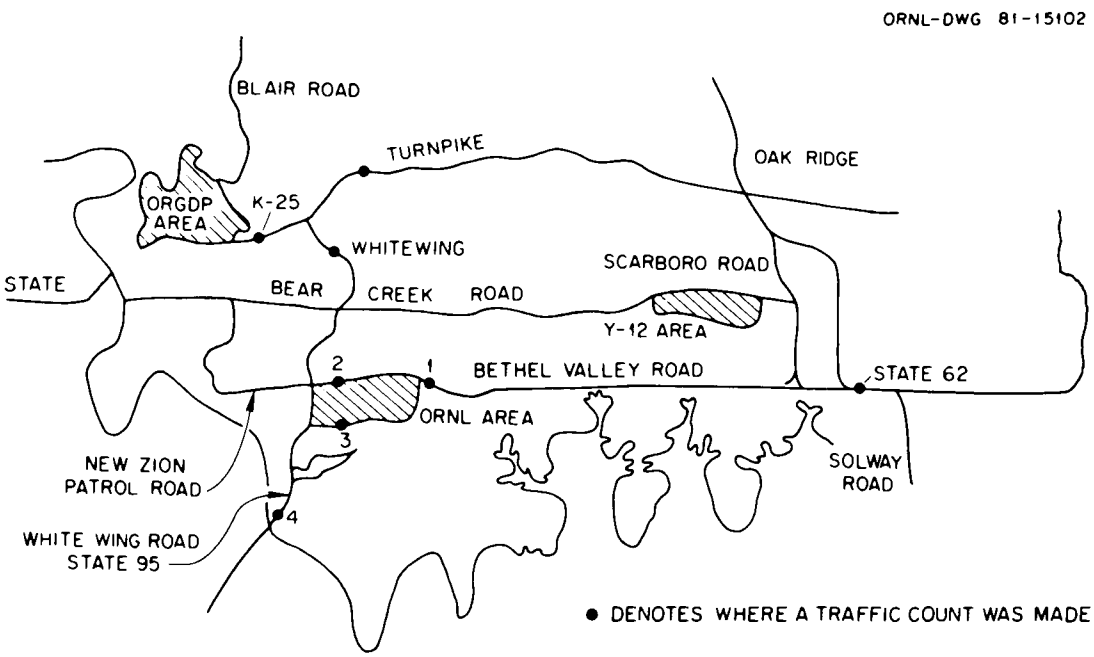

Fig. 5. Locations of traffic count sites.

Summary Statistical Data

Table 5 summarizes age, weight, and sex data for the 50 animals for which all three of these parameters were recorded. As would be expected, males generally weighed more than females except in the under 6-month age class where the average age of the male fawns was slightly lower than that of the females.

A summary of number of antler points, average weight in kilograms (kg), and average age for each antler point group is shown in Table 6 and covers the 1969 to 1980 time period. Very few grossly atypical antlers have been observed; but, as Table 6 shows, nonsymetrical antlers occur rather commonly.

Reproduction

Reproductive tracts from 13 does were examined during 1980. Of the six does examined between January and June, four were pregnant, one (June 11) had recently given birth, and one (a 6-month-old fawn in February) was not pregnant. Information on the four pregnant does is shown in Table 7 and indicates that breeding occurred as early as October 25, 1979, for one doe and as late as December 21, 1979, for another. The third doe bred between November 8 and November 17, 1979, while the fourth bred during the November 28 to December 6, 1979, time period.

A blind male fawn captured on June 26, 1980, was 4 to 7 weeks old, indicating that the mother of this fawn bred during the October 20 to November 10, 1979 period. Another blind male fawn captured on July 2, 1980, was also 4 to 7 weeks old indicating that its mother had

Table 5. Summary data for white-tailed deer killed on the Oak Ridge Reservation during 1980. Percent of total is based on the total number of does (14) and bucks (36) for which both weight and age were known

	Does				Bucks			
Age group	Number killed	% of total	Av. weight[a] (kg)	Av. age[a] (mo)	Number killed	% of total	Av. weight[a] (kg)	Av. age[a] (mo)
Less than 6 months	2	14	31.6	5	4	11	26.1 ± 4.14	4.25 ± 0.75
More than 6 months less than 1 year	2	14	35.7	8	2	6	38.0	10.5
More than 1 year less than 2	--	--	--	--	15	42	58.2 ± 2.47	16.5 ± 0.85
Two years and older	10	71	54.8 ± 1.46	36.6 ± 2.60	15	42	73.0 ± 2.77	38.8 ± 2.41
Total number killed	14				36			

[a]Mean ± 1 standard error

Table 6. Summary of bucks' number of antler points, weight, age (1969-1980)

Number of points	Average weight (kg) ± 1 s.e. (n)	Average age (months) ± 1 s.e. (n)
14	102.5 (1)	30 (1)
12	102.1 (2)	54 (2)
10	86.1 (2)	45 (2)
9	95.0 (2)	30 (2)
8	81.4 ± 3.4 (6)	38.5 ± 2.7 (18)
7	74.8 ± 3.0 (10)	41.8 ± 5.2 (10)
6	68.2 ± 2.4 (15)	32.5 ± 3.6 (17)
5	63.9 (1)	14.5 (2)
4	61.3 ± 2.4 (10)	21.2 ± 1.8 (11)
3	49.4 (2)	18 (2)
2 (Spike or buttons)	40.2 ± 2.2 (30)	9.6 ± 0.9 (31)

Table 7. Age and sex of fetuses found in four pregnant does during 1980

Date of doe's death	Age of fetus(es)[a] (days)	Number and sex of fetuses	Age of doe (months)
January 27	< 37	2 (too young to sex)	42
February 10	66-75	1 female	9-11
February 21	96-105	2 males	30
May 13	181-200	1 female	24

[a]Age determined from Armstrong (1950).

bred during the October 26 to November 16, 1980, period. Breeding dates as determined above are summarized in Table 8.

An additional seven does were examined from July through December, and six of these were either lactating or showed signs of having nursed young during the past few months. Condition of the udder was not recorded for the seventh animal.

On the basis of gross examination of the necks of bucks (presence or absence of visible swelling) observations were made on the rutting condition of bucks. If visible swelling was present in the neck the animal was considered to be in the rut. Table 9 summarizes these observations and generally agrees with the breeding periods of the does shown in Table 8.

Bucks - Antler Shedding

Table 10 summarizes the number of male deer examined in each of the first five months of the year for the 1969 to 1980 period and also shows for each month the number of bucks that had recently lost their antlers. Notes taken regarding recent loss of antlers were based on a gross visual examination of the pedicel on the deer skull.

Parasites and Abnormalities

We began collecting abomasa (fourth stomach) from road-killed deer in 1978 to determine parasite burdens. These data are useful as an index of whether deer population density is suboptimal, optimal, overpopulated, or critical (deer deaths occurring). In July 1979 Robert Nichols, TWRA Wildlife Biologist, showed ORNL staff the procedure for

Table 8. Breeding dates determined from ages of fetuses and young fawns

Mother of fawn #80-BL1	October 20 - November 10, 1979
Doe #70-028	October 25 - November 13, 1979
Mother of fawn #80-BL2	October 28 - November 16, 1979
Doe #80-012	November 8-17, 1979
Doe #80-010	November 28 - December 6, 1979
Doe #80-008	December 21, 1979 (approximate)

Table 9. Bucks in rutting condition determined from road-kills on Oak Ridge Reservation

Month	Number males examined	Number males in rut	% in rut
September, 1980	3	0	0
October, 1980	3	1	33
November, 1980	17	8	47
December, 1980	12	3	25
January, 1981	9	3	33
February, 1981	1	0	0

Table 10. Months when bucks shed antlers on the Reservations

1969-1980 time period	Number of bucks examined[a]	Number with antlers recently shed	%
January	7	1	14.3
February	8	4	50.0
March	10	7	70.0
April	9	4	44.4
May	3	0	0

[a]Includes animals besides road-kills, e.g., poached and trap mortalities.

processing the abomasum samples as well as how to recognize and count the parasites.

The following ranges of parasite load were developed at the Southeastern Wildlife Disease Study Unit in Athens, Georgia to indicate deer population densities for a given range:

Abomasum Parasite Load	Deer Population Density
0-800	Suboptimal
800-1600	Optimal
1600-2400	Overpopulated
2500+	Critical, deer deaths occurring

Table 11 summarizes the Reservation abomasal parasite counts (APC). Eve and Kellogg (1977) suggested that the APC technique would be more reliable if APC determinations were made during July, August, and September when the parasites reached their peak numbers. Using data

Table 11. Abomasal parasite counts [X ± 1 SE (n)]

	Spring[a]	Summer[b]	Fall[c]	Winter[d]
1977				370 (2)
1978	360 (1)	991 ± 307(5)	640 ± 74(8)	213 ± 56(6)
1979	1220 ± 211(3)	952 ± 374(5)	398 ± 87(13)	380 (1)
1980	592 ± 176(5)	480 (1)	638 ± 127(10)	1130 (2)

[a]March 21 - June 20

[b]June 21 - September 20

[c]September 21 - December 20

[d]December 21 - March 20

from our summer (June 21-September 20) counts, it appears that the Reservation herd has reached the optimum density range. Continued monitoring of the APC in Reservation deer should enable us to determine the population density relative to carrying capacity. Also, the rate at which Reservation deer are approaching the carrying capacity of the area as well as indentification of periods of high disease potential could be determined.

Other parasites found in Reservation deer are body worms (Setaria sp. found in two deer during 1980), brainworms (Parelaphostrongylus tenuis - identified by Dr. Sharon Patten, University of Tennessee School of Veterinary Medicine), and rabbit botfly larvae (Cuterebra sp. - identified by Dr. Curtis Sabrosky, U.S. Department of Agriculture). Of the 46 deer examined during 1980, brainworms were found in five animals, four males and one female. All five infested animals were over one year old.

During 1980, we found papillomas on Reservation deer for the first time. In November a 74.8 kg, 17- to 20-month-old buck was found to have a 2.6 x 3.5 cm papilloma on the upper inside surface of the right front leg (Fig. 6A). Later in the same month a 57.5 kg, 20- to 24-month-old buck was necropsied, and a 3.0 cm diameter papilloma was found 7.0 cm above the "knee" joint of the left front leg (Fig. 6B). The papillomas were preserved in both cases.

Occasionally, blind deer, usually young fawns, are found and captured on the Reservation. These animals usually are euthanized, then necropsied. Eyes from five such fawns have been examined at the Registry of Comparative Pathology, Armed Forces Institute of Pathology,

ORNL-PHOTO 4710-81

Fig. 6A. Photograph of papilloma on leg of 17 to 20 month old buck.

ORNL-PHOTO 4708-81

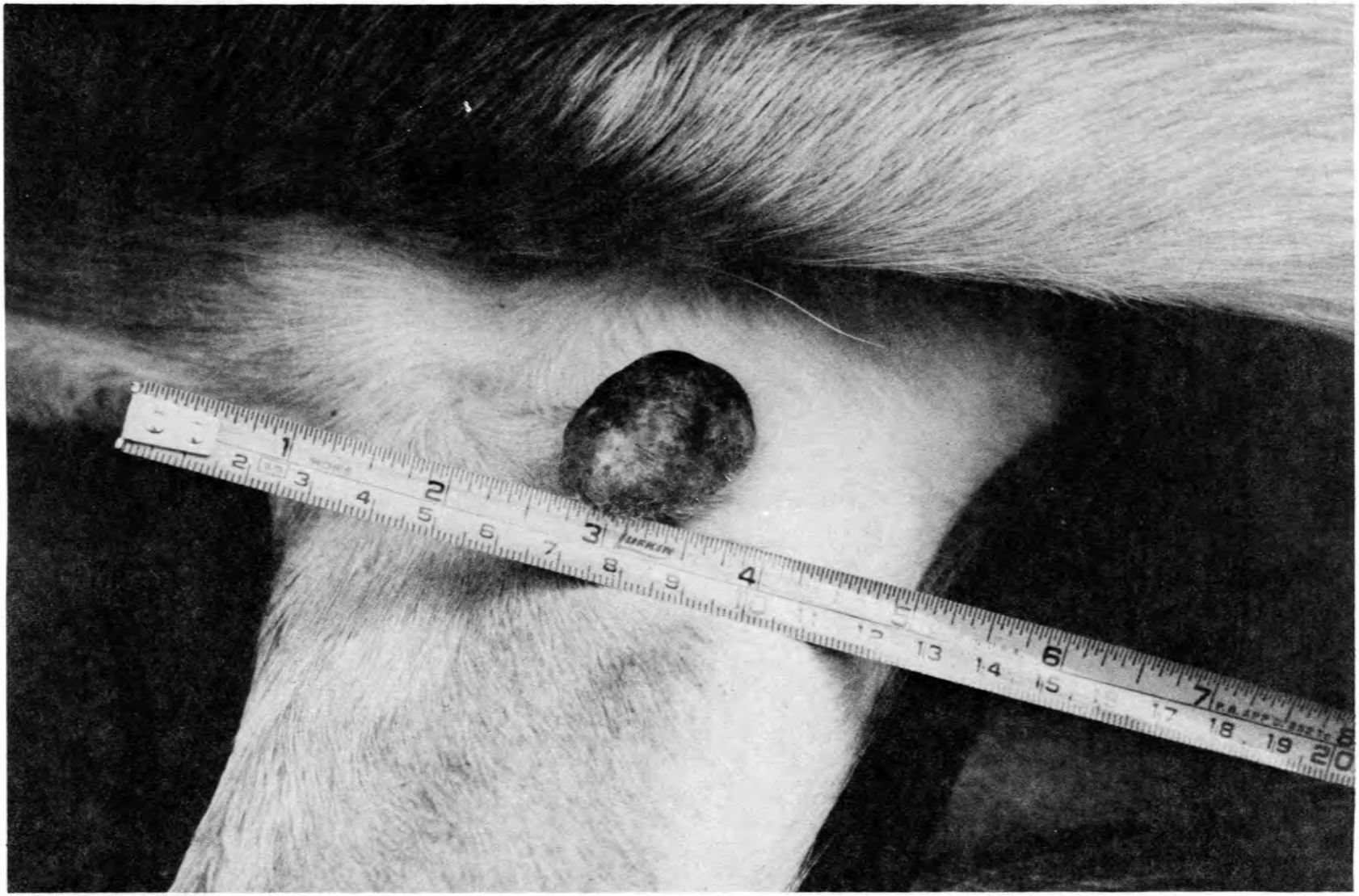

Fig. 6B. Photograph of papilloma on leg of 2-year-old buck.

and all had malformations of the ocular structures with degrees of micropthalmia similar to those reported in the literature (Wyand et al., 1972 and Fulton et al., 1977). No obvious cause for these malformations was detected, and no other malformations were found in the affected animals. During 1980 three such blind fawns were captured on the Reservation; all were males, and two were 4 to 7 weeks old, and the third was 4 to 6 months old.

While botfly larvae (Cuterebra sp.) have been found in numerous rodent species on the Reservation (Dunaway et al., 1967), they had never been observed in white-tailed deer until July 1980 when a 5.75-kg male fawn approximately 7 weeks old was found dead by a roadside. During the subsequent postmortem examination of the fawn, a third instar Cuterebra larva was removed from the right abdominal area of the fawn. Several calliphorid larvae were removed from the same lesion. In addition, a 1.0-cm hole in the skin of the left abdominal skin appeared to be the result of another bot larva which had recently emerged. Except for the emaciated condition of this fawn and a few skin scrapes, no other external or internal abnormalities were found. However, the cause of death was not apparent.

In August 1980 another 7-week-old 12.35-kg fawn was captured and euthanized after consulting a veterinarian about the fawn's loss of mobility. Postmortem of this animal revealed what appeared to be a fresh bot scar on the left side just behind the front leg. A second similar lesion, though not as fresh in appearance, was found midway up the left side just in front of the hind leg. This fawn also had an open wound near the base of the tail. The joints of all four legs were

badly swollen, but no abnormalities were noted during examination of the animal's internal organs.

A third deer was examined in August 1980 and exhibited in the skin of the upper left shoulder a lesion that appeared to be a fresh bot scar. Postmortem examination of this road-killed 4-year-old, 54-kg doe revealed no other external or internal abnormalities.

We do not know the significance of the occurrence of rabbit botfly larvae (Sabrosky, personal communication) in white-tailed deer, but a search of the literature revealed only one case of Cuterebra in white-tailed deer (Severinghaus, 1949). On the other hand, Cuterebra have been observed in mule deer fawns (Hibler, personal communication). The occurrence of a Cuterebra larva in a fawn found dead and what appeared to be evidence of further cuterebrid infestation in a second, debilitated fawn suggest that cuterebrid infestation on white-tailed deer may be more prevalent than currently understood. Perhaps this parasitization produces severe effects in very young animals while being tolerated quite well by adults.

Although many Reservation deer have been examined, both freshly killed as well as live animals, external parasites during these gross examinations have not been found.

Heart Girth - Weight Relationship in Reservation Deer

Beginning in 1975, heart girth (chest) measurements for many of our deer carcasses were recorded. The purpose of taking this measurement has been (1) to look at the relationship between this value and the weight of the animal, (2) to compare this relationship to similar

data collected by deer biologists in other parts of the country, and (3) to gradually build a data set from which a predictive equation could be derived that would allow us to calculate the weight of a deer carcass using just the heart-girth measurement.

In Virginia a tape was developed (Smart et al., 1973) with weight calibrations where its primary use was by personnel of the Virginia Commission of Game and Inland Fisheries and sportsmen. The Virginia study, using data from 528 deer, yielded mean body-weight estimates accurate enough to monitor population condition trends. However, the authors did not recommend the technique for estimating individual deer weights. Smart et al. (1973) found that their data could be handled using two linear regression equations, one for fawns and one for adults; the fawn equation was W = 3.2688, H = 38.5845, r^2 = 0.69, and the adult equation was W = 6.0782, H - 112.1954, r^2 = 0.73 (W = hog-dressed weight in pounds, H = heart girth in inches). To get from the hog-dressed weight to a live weight estimate, the Virginia authors used an equation derived for Michigan white-tailed deer by Hamerstrom and Camburn (1950). We used the resulting tabular data from the Virginia paper to obtain linear regressions for heart girth to live weight conversions: fawn equation y = 0.7307x - 20.7698, adult equation y = 1.3354x - 59.728. This was done so that we could directly compare our predictive equations for Reservation deer to those for the Virginia deer as well as elsewhere (Table 12).

Study reported by Urbston et al. (1976) looked at the relationship between body weight and heart girth in white-tailed deer from South Carolina. Equations for calculating total body weight in this deer

Table 12. Heart girth-weight predictive equations

	Fawn equation	Adult equation
Urbston et al.	$k = 0.9476C - 33.8455$ $r^2 = 0.70$	$k = 1.1834C - 44.1011$ $r^2 = 0.74$
Smart et al.	$y = 0.7307x - 20.7698$ $r^2 = 0.9997$[a]	$y = 1.3354x - 59.728$ $r^2 = 0.9782$[a]
Story and Kitchings	$y = 0.8207x - 25.5274$ $r^2 = 0.9177$	$y = 1.5117x - 73.2881$ $r^2 = 0.8083$

[a]Unusually high r^2 value results from our calculation of regression from table of values from Smart et al.

population were: fawns, $k = 0.9476C - 33.8455$, $r^2 = 0.70$; adults, $k = 1.1834C - 44.1011$, $r^2 = 0.74$ (k = body weight in kg, C = heart girth in cm). As in the Virginia study, data for both sexes were pooled and analyzed by age class only. The South Carolina data were from 545 deer taken primarily during hunting seasons of two consecutive years, 1965 and 1966.

Through December 1980 we had collected heart girth and weight data on 165 Reservation deer, 56 fawns and 109 adults. To determine the linear regression, we pooled the sexes, separating the data into a fawn group and an adult group (Fig. 7). The resulting equations were: fawn, $y = 0.8207x - 25.5274$, $r^2 = 0.9177$; adult $y = 1.5117x - 73.2881$, $r^2 = 0.8083$ [y is weight in kg; x is heart girth in cm]. We also pooled all data into a single data set (Fig. 7) to determine a parabolic estimate; the result was: $y = -6.9276 - 0.0327 + 0.0088x^2$. The value of such an equation lies primarily in its usefulness in field situations

ORNL-DWG 82-13448

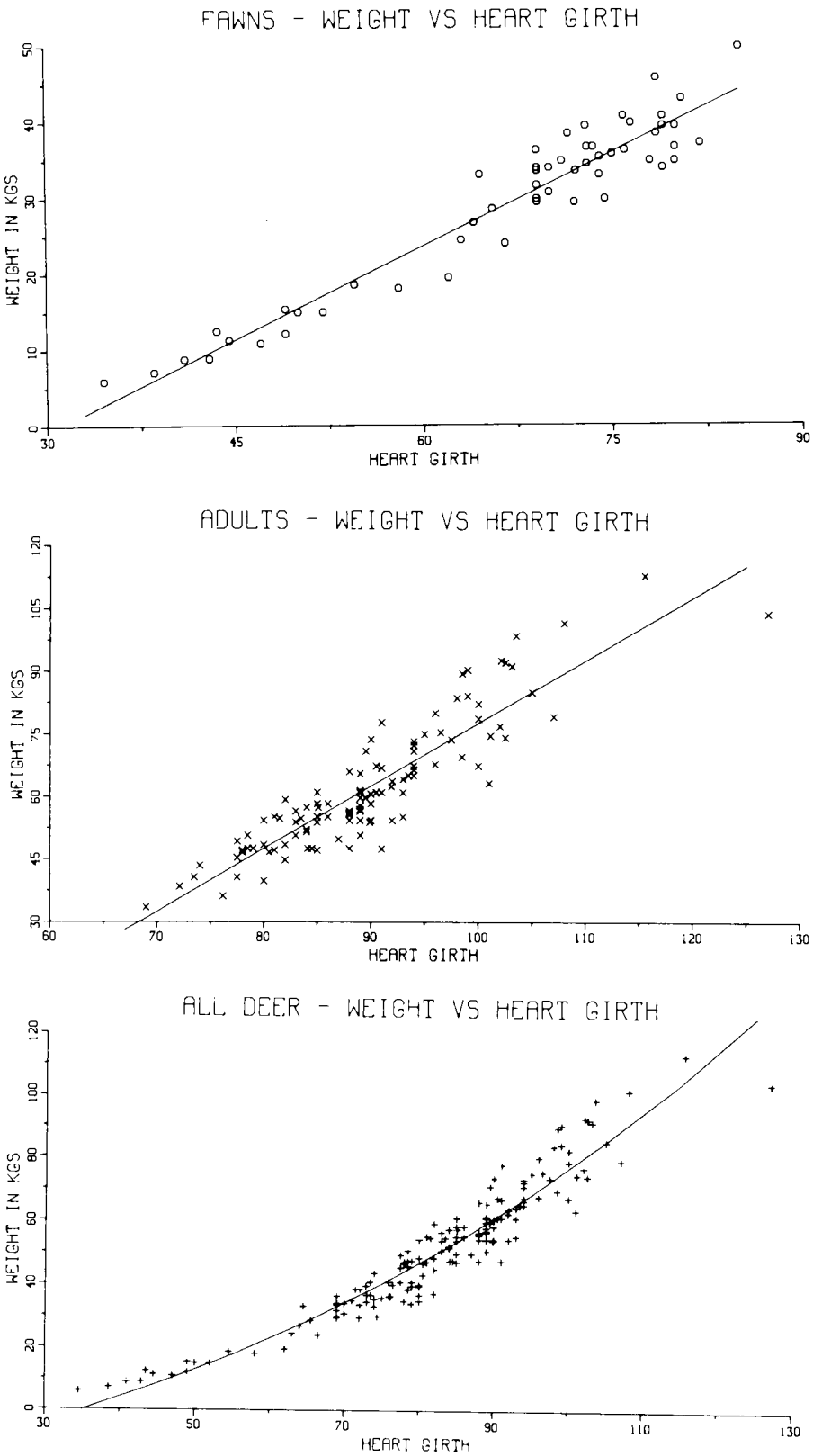

Fig. 7. Plots of heart girth-weight data.

where it is not practical to weigh deer. It is also desirable to minimize the handling stress on an immobilized live deer where one can obtain quickly a chest measurement and thus subsequently a reliable estimate of the animal's weight. However, while this technique for determining weights is obviously not as accurate as scales, it certainly should be superior to visual estimates which are frequently used in field situations. We have already found this heart-girth to weight conversion useful in several cases where a road-killed deer carcass was so badly mangled that an accurate weight could not be obtained using scales. As long as the chest measurement has not been altered by hematoma or loss of tissue, one can obtain a reasonable estimate of the animal's original weight using the heart-girth to weight conversion.

Radiotelemetry and Observations

Home ranges of three does and one buck were reported in the 1978 and 1979 status reports. During 1980 one of the radiocollared does was killed by a vehicle, while the transmitters on the other two does apparently failed. The radiocollared buck was killed by a vehicle in February 1979. Although no additional deer were radiocollared during 1980, we anticipate trapping and radiocollaring six deer during 1981. The purpose of this effort will be to acquire additional home-range data and to look at dispersal movements of young male deer.

Seventeen deer have been captured and marked with ear tags and numbered collars. One of these, a doe, was tagged by Dwight Flynn, a graduate student, in May 1975. Since then, this animal (Doe #2) has been observed eight times. Figure 8 shows where these observations

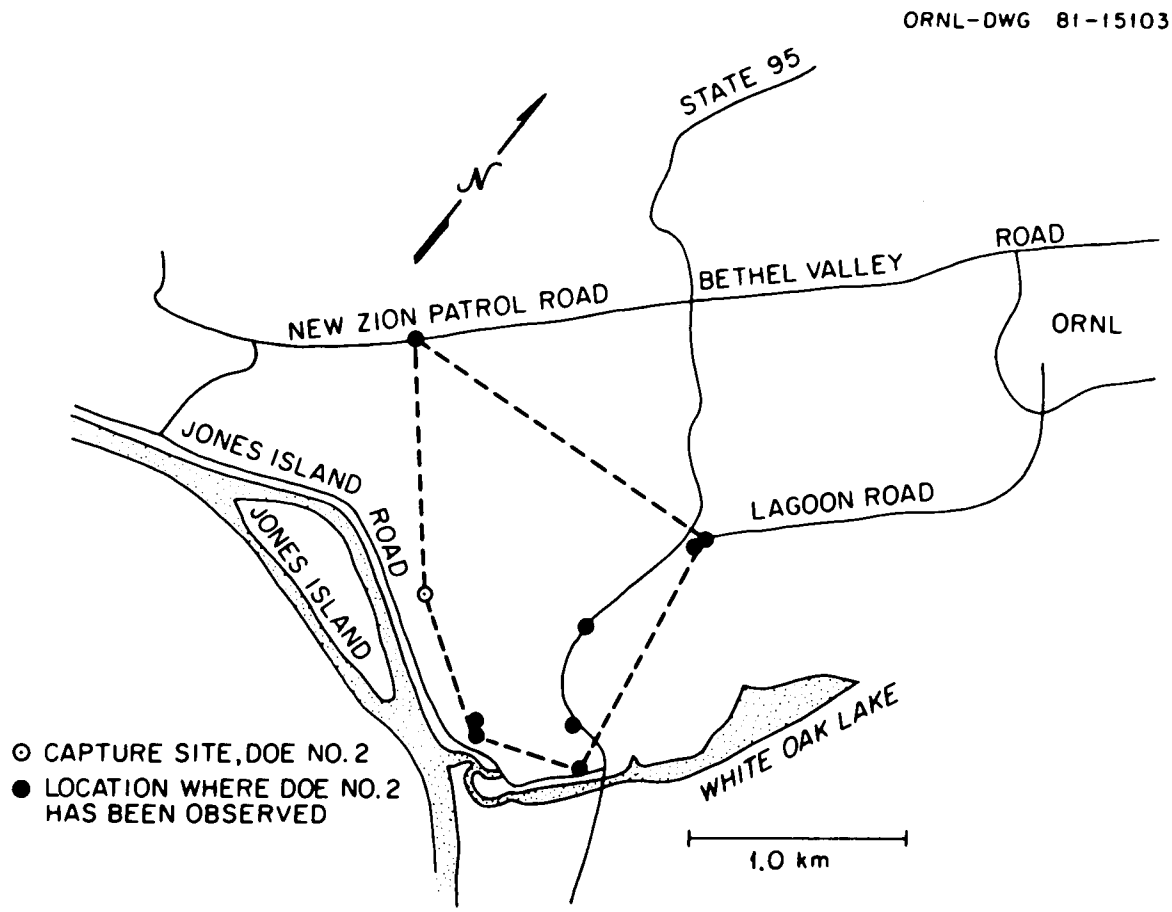

Fig. 8. Plot of home range of Doe #2 based on sightings made since May, 1975

have been made. Connecting the outermost of these locations and determining a home range using the convex polygon method resulted in an area of 155 ha. This compares favorably to the 148-ha, 238-ha, and 34-ha home ranges, we reported previously for three does whose home ranges were determined using radiotelemetry (Kitchings and Story 1980).

SUMMARY

The number of white-tailed deer road-kills on the Oak Ridge Reservation increased again in 1980 indicating that the deer population continued to grow in numbers. Deer browse survey data gathered on the

Reservation for the winter 1980 to 1981 period indicated that in some parts of the Reservation habitat damage is severe because of deer utilization and that in those areas carrying capacity has been exceeded. Continued monitoring of the physical condition of individual animals during 1980 provided evidence that there are not yet any serious health problems appearing. However, abomasal parasite burdens are increasing, and during 1980, brainworms, body worms, and bot fly infestation were observed on Reservation deer.

Reproductive data from bucks and does indicated a breeding season extending from October through January with November being the month of peak breeding activity. This peak was also reflected in the monthly road-kill summary.

Data on the heart girth and weight relationship in Reservation deer were presented and compared to similar data from other southeastern states. A set of predictive equations was derived for calculating the weight of a deer when only the animal's heart girth was known.

Observation data were presented for a doe collared in 1975, and a home range was calculated from these data and compared to home ranges, derived from radiotelemetry techniques, of other does.

Geographical distribution of the 1980 road-kills suggests that as the deer population increases in number it is expanding into parts of the Reservation that heretofore have contained few if any deer.

REFERENCES

Armstrong, R. A. 1950. Fetal development of the northern white-tailed deer (Odocoileus virginianus borealis Miller). Am. Midl. Nat. 43(3):650-666.

Dunaway, P. B., J. A. Payne, L. L. Lewis, and J. D. Story. 1967. Incidence and effects of Cuterebra in Peromyscus. J. Mammal. 48(1):38-51.

Eve, J. H., and F. E. Kellogg. 1977. Management implications of abomasal parasites in southeastern white-tailed deer. J. Wildl. Manage. 41(2):169-177.

Fulton, A. B., D. M. Albert, and N. Buyukmihci. 1977. Spontaneous anophthalmia and microphthalmia in white-tailed deer. J. Comp. Path. 87:557-568.

Hamerstrom, F. N., Jr., and F. L. Camburn. 1950. Weight relationships in the George Reserve deer herd. J. Mammal. 31(1):5-17.

Kitchings, J. T., and J. D. Story. 1980. White-tailed deer (Odocoileus virginianus) on the Department of Energy's Oak Ridge Reservation. Data on road-killed animals, 1979. ORNL/TM-6803/2. Oak Ridge National Laboratory, Oak Ridge, Tennessee. 33 pp.

Severinghaus, C. W. 1949. Occurrence of a botfly larva in white-tailed deer. J. Mammal. 30:75.

Smart, C. W., R. H. Giles, Jr., and D. C. Guynn, Jr. 1973. Weight tape for white-tailed deer in Virginia. J. Wildl. Manage. 37(4):553-555.

Story, J. D., and J. T. Kitchings. 1979. White-tailed deer (Odocoileus virginianus) on the Department of Energy's Oak Ridge Reservation. Data on road-killed animals, 1969-1977. ORNL/TM-6803. Oak Ridge National Laboratory, Oak Ridge, Tennessee. 25 pp.

Urbston, D. F., C. W. Smart, and P. F. Scanlon. 1976. Relationship between body weight and heart girth in white-tailed deer from South Carolina. Proc. 30th Annu. Conf. S.E. Assoc. Fish Wildl. Agencies 30:471-473.

Wyand, D. S., M. Lehav, D. M. Albert, and W. B. Stone. 1972. Intraocular lacrimal gland tissue with other ocular abnormalities occurring in a white-tailed deer. J. Comp. Path. 82:219-221.

INTERNAL DISTRIBUTION

1. S. I. Auerbach
2. D. M. Bradburn
3. G. C. Cain
4. M. I. Dyer
5-9. J. T. Kitchings
10. R. L. Kroodsma
11. L. K. Mann
12. P. D. Parr
13. D. E. Reichle
14-18. J. D. Story
19. F. G. Taylor, Jr.
20. L. D. Voorhees
21. Biology Library
22. Central Research Library
23-40. ESD Library
41-42. Laboratory Records Dept.
43. Laboratory Records, ORNL-RC
44. ORNL Y-12 Technical Library
45. ORNL Patent Office

EXTERNAL DISTRIBUTION

46. Bob Allen, Department of Forestry, Room 261, Clemson University, Clemson, SC 29631
47. I. Lehr Brisbin, Savannah River Ecology Laboratory, Aiken, SC 29801
48. Ernest D. Campbell, Nevada Operations Office, Department of Energy, Las Vegas, NV 89114
49. R. C. Dahlman, Carbon Dioxide Research Division, Office of Health and Environmental Research, Office of Energy Research, MS-G256, ER-12, Room A1-3101, Department of Energy, Washington, DC 20545
50. Robert Downing, U.S. Fish and Wildlife Service, Department of Forestry, Clemson University, Clemson, SC 29631
51. P. B. Dunaway, Department of Energy, Nevada Operations Office, P.O. Box 1400, Office of Effect Evaluation, Las Vegas, NV 89114
52. L. E. Eberhardt, Los Alamos Scientific Laboratory, Los Alamos, NM 87545
53. Kenneth M. Garner, U.S. Fish and Wildlife Service, Rm. 511, 1720 West End Ave., Nashville, TN 37203
54. R. E. Fitzner, Pacific Northwest Laboratories, Richland, WA 99352
55. J. Whitfield Gibbons, Savannah River Ecology Laboratory, Aiken, SC 29801
56. Tom E. Hakonson, Los Alamos Scientific Laboratory, P.O. Box 1663, Los Alamos, NM 36544
57. Richard Handler, Department of Energy, Oak Ridge Operations, P.O. Box E, Oak Ridge, TN 37830
58. Wayne C. Hanson, Pacific Northwest Laboratories, Richland, WA 99352
59. W. F. Harris Program Director, Ecosystem Studies Program, National Science Foundation, Washington, DC 20550
60. Ray S. Harvey, E. I. DuPont de Nemours, Savannah River Laboratory, Aiken, SC 29801

61. Frank F. Hooper, Ecology, Fisheries and Wildlife Program, School of Natural Resources, The University of Michigan, Ann Arbor, MI 48109
62. Dick Hurd, TWRA, 216 East Penfield, Crossville, TN 38555
63. LaMar J. Johnson, Los Alamos Scientific Laboratory, Los Alamos, NM 87545
64. F. A. Koomanoff, Director, Carbon Dioxide Research Division, Office of Health and Environmental Research, Office of Energy Research, MS-G256, ER-12, Department of Energy, Washington, DC 20545
65. O. Doyle Markham, Idaho National Engineering Laboratory, Idaho Operations Office, Idaho Falls, ID 83401
66. Helen McCammon, Director, Division of Ecological Research, Office of Health and Environmental Research, Office of Energy Research, MS-E201, ER-75, Room F-322, Department of Energy, Washington, DC 20545
67. Marvin K. Moss, Director, Program Integration Analysis Division, Office of Health and Environmental Research, Office of Energy Research, MS-G256, Century 21 Bldg. #20010, Room A14020, Department of Energy, Washington, DC 20545
68. Haydn H. Murray, Director, Department of Geology, Indiana University, Bloomington, IN 47405
69. John D. Murray, TWRA, P.O. Box 40747, Nashville, TN 37204
70. Robert G. Nichols, TWRA, 1929 W. Morris Blvd., Morristown, TN 37814
71. William S. Osburn, Jr., Division of Ecological Research, Office of Health and Environmental Research, Office of Energy Research, Department of Energy, Washington, DC 20545
72. W. H. Rickard, Pacific Northwest Laboratories, Richland, WA 99352
73. Paul G. Risser, Office of the Chief, Illinois Natural History Survey, Natural Resources Building, 607 E. Peabody Ave., Champaign, IL 61820
74. L. E. Rogers, Pacific Northwest Laboratories, Richland, WA 99352
75. Charles D. Scott, TWRA, 1929 W. Morris Blvd., Morristown, TN 37814
76. Wayne Smith, School of Forestry and Conservation, University of Florida, Gainesville, FL 32611
77. David Swan, Vice President, Environmental Issues, Kennecott Corporation, Ten Stamford Forum, P.O. Box 10137, Stamford, CT 06904
78. Wayne T. Swank, Coweeta Hydrologic Laboratory, Franklin, NC 28734
79. David Trauger, Assistant Director, Northern Prairie Wildlife Research Center, U.S. Fish and Wildlife Service, Box 1747, Jamestown, ND 58401
80. Robert L. Watters, Division of Ecological Research, Office of Health and Environmental Research, Office of Energy Research, Department of Energy, Washington, DC 20545
81. Jerry Webb, TWRA, 216 East Penfield, Crossville, TN 38555
82. Clifton J. Whitehead, TWRA, P.O. Box 40747, Nashville, TN 37204

83. Jerry Wing, Department of Energy, Oak Ridge Operations, P.O. Box E, Oak Ridge, TN 37830
84. Office of Assistant Manager for Energy Research and Development, Oak Ridge Operations, P. O. Box E, Oak Ridge, TN 37830
85-111. Technical Information Center, Oak Ridge, TN 37830

*U.S. GOVERNMENT PRINTING OFFICE: 1982-546-067/119