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White-Tailed Deer (*Odocoileus virginianus*) on the Department of Energy's Oak Ridge Reservation: Data on Road-killed Animals, 1969–1977

J. D. Story
J. T. Kitchings

ENVIRONMENTAL SCIENCES DIVISION
Publication No. 1320

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

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ABSTRACT

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. 37 pp.

During nine years (1969-1977), 126 white-tailed deer (*Odocoileus virginianus*) were killed by highway vehicles on the Department of Energy's Oak Ridge, Tennessee Reservation. Mortality was highest in the fall, and more males than females were killed among both fawns and adults. While traffic volume increased 8.2% annually, deer road-kills increased 43.8% annually. Increased road-kills were attributed primarily to an increase in the resident population.

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INTRODUCTION

The Department of Energy (DOE) Oak Ridge Reservation encompasses 15,000 ha of land in Anderson and Roane Counties, Tennessee. Mixtures of hardwood, pine and open areas provide excellent habitat for white-tailed deer. Since hunting has not been permitted and there has been little natural predator-pressure, the size of the deer herd, which began inhabiting the area in the early 1950s (Flynn 1976), has been gradually increasing. With the growing deer population, deer-vehicle collisions have shown a steady increase since 1969 when Environmental Sciences Division personnel began recording these incidents.

The deer-vehicle interactions represent an unfortunate loss of one of our wildlife resources, cost motorists thousands of dollars annually, and can result in serious injury or death to the motorist involved. The carcasses of road-killed deer, however, are a valuable tool for monitoring physical condition of the animals. Additionally, records kept on the number of deer killed through several years can provide a reliable, though not precise, index to population trends. These animals are especially valuable in areas where wildlife managers have no hunter harvest data available with which to monitor physical condition, population size, and sex and age ratios. McCaffery (1973) noted that deer inventories are costly processes, but road-kills can provide a less expensive index of population growth. So while Reservation road-kill data do not provide density values for the local deer population, they do provide an index by which population trends can be monitored. Our overall objective in studying the white-tail deer

is the maintenance of this species as one of our natural resources. Second, much of the work we do here can contribute to the total knowledge of this species and thereby aid the professional game manager in his task of maintaining a quality herd. The purpose of this paper, therefore, is to (a) document our present knowledge of the status of the Reservation deer based on data collected from road-kills between 1969 and 1977, and (b) discuss other ongoing and planned research efforts which are a part of the total research on the white-tailed deer.

THE ROAD-KILL MONITORING PROGRAM

Study Area

The dominant oak-hickory association on the Reservation contains elements of the mixed mesophytic association commonly found in the adjacent Cumberland Mountains. The oak-hickory association is typified by extensive stands of mixed yellow pine and hardwoods as well as oak and hickory (Fig 1). Yellow poplar often forms nearly pure stands on well-drained bottomlands and lower slopes while willow, sycamore and boxelder border streams and are dominant on poorly drained floodplains. Species more commonly found in the mixed mesophytic association, such as beech, sugar maple, magnolias, buckeye and basswood, often occur in coves and sheltered slopes. Approximately 2000 ha of the Reservation were planted in loblolly pine between 1947 and 1956, while smaller acreages have since been planted in loblolly pine, black walnut, river birch, sycamore and poplar (Kitchings and Mann 1976).

Roads

Roads where most road-kills occur are paved and two-laned. Four major roads totalling approximately 63 kilometers traverse the Reservation generally parallel to the ridges and valleys of the area; these are Bethel Valley Road, Bear Creek Road, Oak Ridge Turnpike and State Highway 58 (Fig. 1). Two main roads - State Highway 95 and Scarboro Road - run perpendicular to these four and total approximately 12 kilometers. Many one-lane, gravel roads are maintained on the Reservation, but no road-kills have occurred on these roads.

Data Collection

Since 1969, data on deer which have been killed by vehicles on the Reservation have been recorded by Environmental Sciences Division personnel at the Oak Ridge National Laboratory. For record purposes, any animal reported struck by a vehicle was counted as a road-kill.

Routinely, small samples are taken from major organs (heart, lung, liver, spleen, kidney) for pathological examination, and the lining of the brain is examined for presence of meningeal worms. Ages of animals are determined according to Severinghaus (1949). In addition to biological information, samples are taken from the carcasses and used in various research programs in the Environmental Sciences Division. For example, a sample of muscle is taken for radionuclide analysis, thyroids are taken for 99 Technicium analysis, and portions of the lungs and femur are excised for analysis of nickel and fluoride. Results of these analyses are not reported here.

RESULTS AND DISCUSSION

From October 1969 through December 31, 1977, 126 deer were killed or reported hit by vehicles on the roads of the DOE Oak Ridge Reservation. During this period, no personal injuries have resulted from the Reservation deer-vehicle interactions. However, damage to vehicles has ranged from slight to extensive.

The total number of deer killed per year is shown in Fig. 2. A linear regression was calculated using a natural log transformation of the number of deer killed per year and resulted in: $a = 0.1157$, $b = 0.4379$, $r^2 = 0.9680$. If the number of road-killed animals is reflective of the annual increase in the population then the slope, 0.4379, provides an estimate of the average annual population increase. Similar estimates of annual increases in deer herds show considerable variability, ranging from 20% in Ohio (Nixon 1971), to 34.4% in Ontario (Mansell 1974), 41% in New York (Davis 1975), and 44% in Michigan (O'Roke and Hamerstrom 1948). Within a particular deer herd there can also be fluctuations over a wide range when comparing annual increases; the Michigan study (O'Roke and Hamerstrom 1948) found annual increases varying from 11.9% up to 104.1%.

A total deer census of the Reservation has not been made, but in 1974-75 Flynn (1976) determined there was approximately one deer per 50 ha in the area he studied. Flynn, based on his research and observations on the Reservation, estimated the total Reservation deer herd at not more than 250 animals at the end of 1975. Using Flynn's observation as an initial estimate and employing the average annual

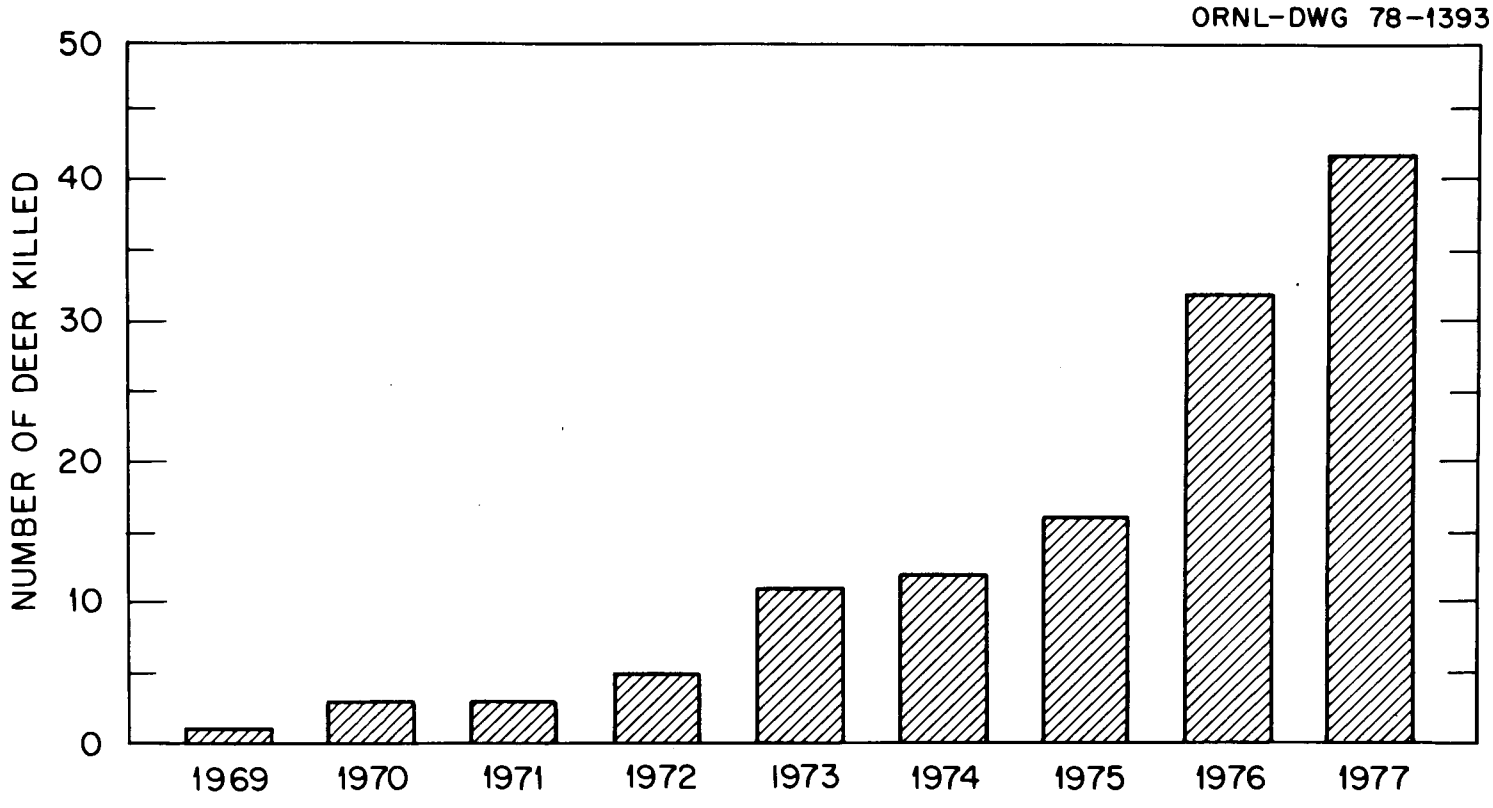

Fig. 2. Number of deer (male and female) killed by vehicles annually from 1969 through 1977.

increase discussed above, we determined the herd size in 1977 to be 518 animals. Generally, the average carrying capacity for deer in upland hardwoods in the south is approximately one animal per 40 acres (Stransky 1969), and if one views the Oak Ridge Reservation as containing 12,146 hectares of suitable deer habitat, then the carrying capacity of the Reservation would be an estimated 750 animals.

Distribution of Road-kills by Season and Sex Ratio

Seasonal variations in total number of deer killed can be seen in Fig. 3 and are similar to variations observed by others (Jahn 1959, Bellis and Graves 1971). A high fall mortality is apparent, and a less apparent mortality peak in the spring is suggested. The fall peak is believed due primarily to increased movement associated with the breeding season; hunting is not allowed on the Reservation and has been ruled out as a factor in this fall movement. However, while poaching is known to occur, the actual number of incidents and their impact are unknown.

A breakdown by month of the total number of males and females killed between 1969 and 1977 (Fig. 3) shows that for eight months out of twelve more males than females were killed. November and December are the months of peak road-kill activity on the Reservation, with approximately three times as many males as females being killed. Hawkins et al. (1971) found November to be the month when the highest number of deer was killed, but in the Illinois study he found that yearling males comprised 80% of November's road-kills. Reservation road-kills, on the other hand, included no yearling males during

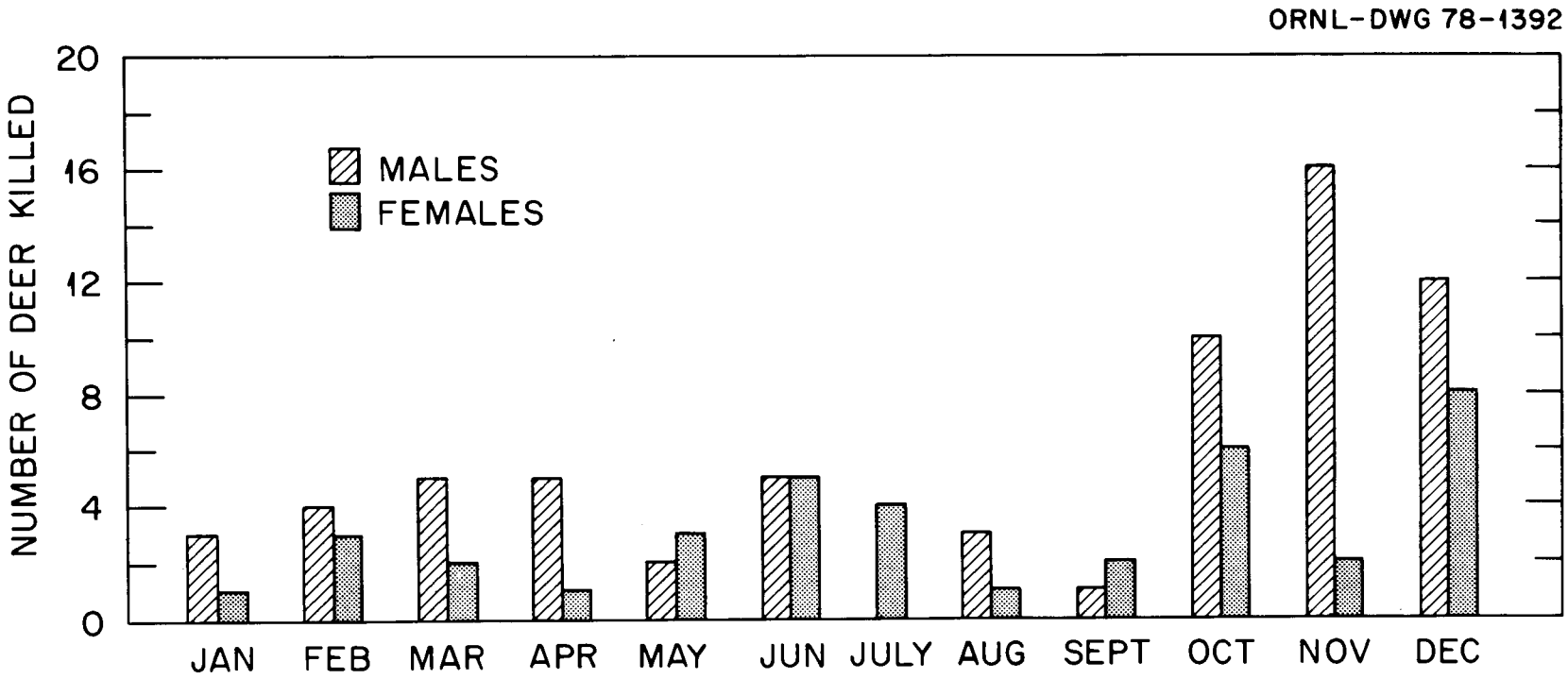

Fig. 3. Monthly distribution of deer killed by vehicles on the Oak Ridge Reservation.

November 1972 through 1977; however, out of the 16 males killed during November, only 10 had ages recorded, and it is possible that the 6 unaged males could have included yearlings. Our age distribution by sex data do not indicate any clearcut difference between sexes in susceptibility to death by vehicles for fawns and one-year-old deer, but in the two-year class twice as many males as females have been killed, and no females three years and older have been killed while twelve males in this group have been killed.

As noted by Davis (1975) male deer travel widely at times, in particular, during the mating season, thus exposing them to hunting and traffic hazards. This undoubtedly helps explain the high male to female road-kill ratio during November (highest of any month), which is well within the expected mating season, but we have no data that would allow us to evaluate this factor or any dispersal factors which may be influencing the movement of Reservation deer.

The sex ratio of killed animals has varied during the 1969-1977 period, but overall the male to female ratio has been 66:38, approximately 2:1. This proportion differs from a number of other road-kill reports. Bellis and Graves (1971) found in their 13-month road-kill study a ratio of 25 males to 66 females in the adult deer they examined and a 49:49 ratio in fawns. Jahn (1959) found 45% males in 4,407 adults reported in Wisconsin. It also has been pointed out by these investigators that the higher female to male ratio is the result of reduced numbers of males in the population due to differential harvesting - hunters going for bucks.

Geographical Distribution of Road-kills

A summary of information gathered in plotting individual road-kill locations is given in Fig. 4; these data are converted to percentages illustrating the relative "hot spots" for deer-vehicle interaction on the Reservation. About 16% of the total road-kills were somewhat scattered and did not lend themselves to grouping; for example, some deer were hit by vehicles and then made their way off into the woods some distance. In these cases it was impossible to determine, with certainty, just where the animal had been hit unless we had a report of a deer-vehicle accident to accompany the discovery of a carcass. In three instances deer made their way to water where they died; two bucks were found in creeks and another was discovered in the pool behind the east weir at Walker Branch watershed.

The highest number of road-kills occur on Highway 58 (26% of all road-kills) and Bethel Valley Road (26% of all road-kills) (Fig. 4). Common to both these stretches of road are (1) transmission line corridors and gas line rights-of-way, crossing the highway at various angles; and (2) relatively heavy traffic (8800 vehicles average daily on Highway 58, 5200 for Bethel Valley Road). In both cases stretches of road are generally bordered by forest openings as close as 10 meters of the pavement. Stretches where forest and highway are separated by as much as 100 meters or more of open grassland are also places where deer are commonly killed. Vegetation types bordering highway in the vicinity of these "hot areas" range from grassland (25 road-kills), to pine and pine-hardwood (21 road-kills), and cedar, cedar-pine, and cedar-hardwood (20 road-kills). The grassy areas along highway

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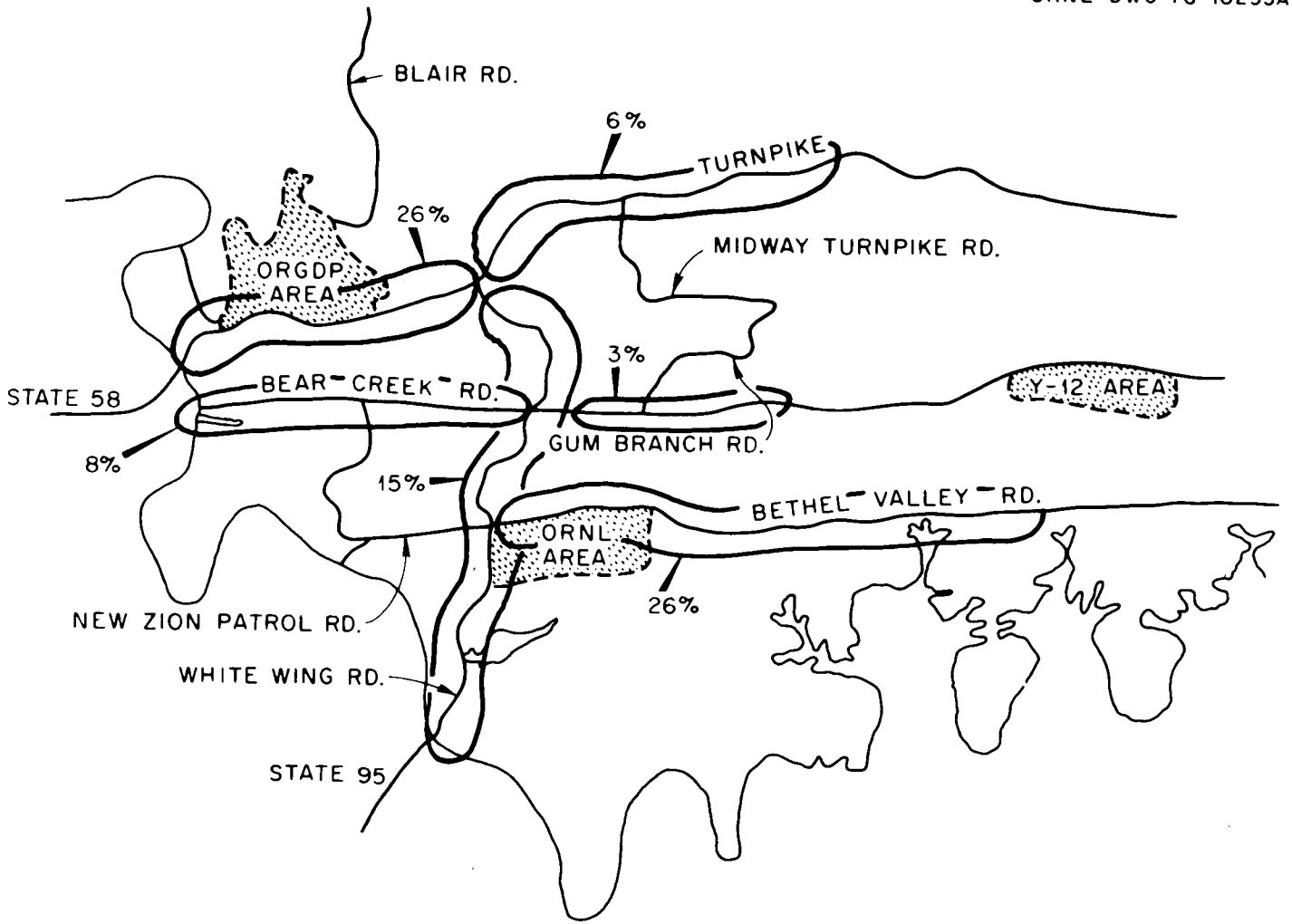

Fig. 4. Geographical distribution of road-killed deer. The areas circled with dark lines indicate portions of the Reservation where high proportion of deer have been killed over the past nine years. The percentage of the total Reservation road-killed animals killed in each area is marked on the figure.

rights-of-way in Pennsylvania have been referred to as "... long pastures bisected by high-speed highways" (Bellis and Graves 1971). While Reservation roads are hardly high-speed highways, the long pasture situation does exist here, and vehicles do travel at speeds high enough to do considerable damage when a deer is struck.

There is some concentration of road-kills about areas where powerlines and gas line rights-of-way cross highways, suggesting that perhaps the deer are grazing these areas and their grazing efforts take them up to and across highways. However, there also are many deer killed at locations which are not close to such rights-of-way. Allen and McCullough (1976) pointed out that lack of concentration of road-kills about a given microhabitat meant that attempts to reduce deer-car accidents by manipulating habitat or fencing short sections was not likely to be very successful. As a result, these authors did not suggest a management tool that would easily reduce deer-car accidents; rather, they brought out that control of the deer herd through harvest was one of the most effective means of reducing accidents.

Accidents by Time of Day

Road-kills were grouped in two-hour intervals (Fig. 5). This figure includes all incidents for which a time of day was recorded during the period 1974 through 1977. Road-kill peaks were 0600-1000 (24%), 1600-2000 (28%), and 2200-2400 hours (25%). The three peak road-kill periods reflect two factors influencing the Reservation deer herd; both deer activity and changes in traffic density contribute to

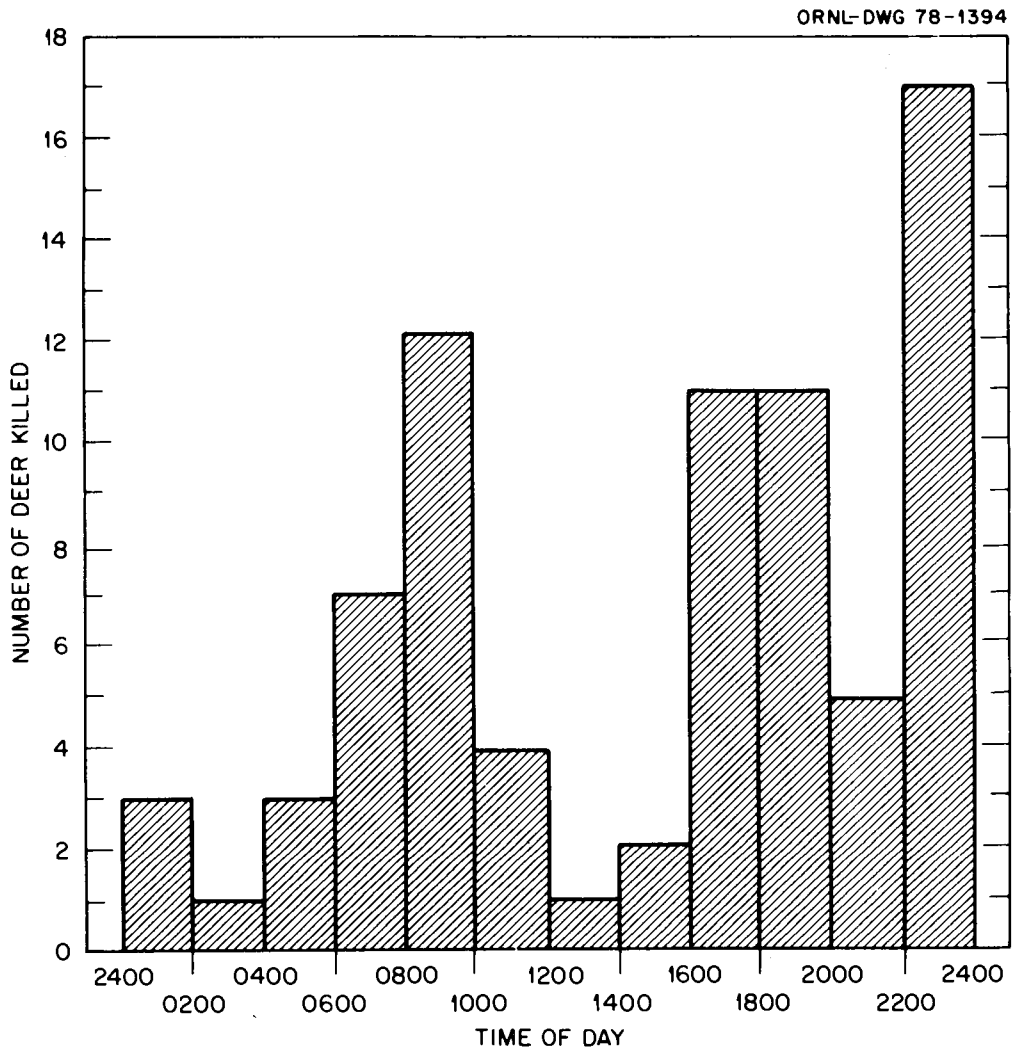

Fig. 5. Grouping of road-kills by time of day in two hour int intervals. The trimodal pattern reflected in this figure is a combination of deer activity and traffic density over the Reservation main roads.

these peak periods. Table 1 shows traffic counts made at three locations east, west and south of the X-10 plant on the Reservation and shows that the traffic flow changed little from 1976 to 1977. Traffic flow peaked at these three locations during the following time periods: 2300-0100, 0600-0900, and 1500-1800. The 0600-0900 and 1500-1800 peaks accounted for 65% of the average daily traffic while the 2300-0100 peak accounted for less than 4%. During this latter period, however, 25% of the road-kills occurred. This suggests that the 2200-2400 road-kill peak probably is influenced more by increased deer activity than by increased traffic.

Traffic counts made by the Tennessee Department of Transportation indicate that between 1972 and 1976 Reservation traffic increased about 41% or 8.2% per year (Table 1). During this same period, deer road-kills increased from 5 to 32 or 640%.

Table 2 shows a summary of data for road-killed animals for which we could determine both weight and age. In addition, 21 bucks and 14 does were killed with only weights being recorded. The average weight of the 21 bucks was 133.2 pounds while the 14 does averaged 79.1 pounds. The heaviest buck was a 10 point, 250 pound animal killed in November 1976, while the largest rack, 14 points, came from a 226 pound animal in June 1974. Of the 29 females killed, 3 were pregnant with twin fetuses, 4 were not pregnant but were lactating, 13 were not pregnant, and reproductive condition of 9 was undetermined. The oldest doe found on the Reservation was over 10-1/2 years old and pregnant with a single fetus; this animal was not killed by a vehicle but was destroyed by a pack of dogs.

Table 1. Traffic counts made at three locations near the Oak Ridge National Laboratory. Values are number of vehicles counted during peak hour traffic flow.

Outbound	1976	1977
East	1060	1041
West	600	586
South	279	276
Inbound	**1976**	**1977**
East	1100	1054
West	380	349
South	349	353

Table 2. Summary data for white-tailed deer killed between October 1969 and October 1977. 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 (53) killed during this period

Age group	Does[a]				Bucks[b]			
	Number killed	Percent of total	Avg. weight[c] (pounds)	Avg. age (months)	Number killed	Percent of total	Avg. weight (pounds)	Avg. age (months)
Less than 1 year	5	0.4	50.2 ± 4.9	5.8 ± 0.4	7	13.2	62.7 ± 5.9	5.3 ± 0.4
More than 1 year, less than 2	7	13.2	91.1 ± 4.7	14.1 ± 1.8	11	20.8	116.7 ± 4.8	15.8 ± 1.9
Two years and older	4	7.5	111.8 ± 11.2	28.5 ± 1.5	20	37.7	179.5 ± 4.5	43.8 ± 3.05
	16				37			

[a]Additional 14 does had weights but no age recorded. Avg. = 79.1 pounds.

[b]Additional 21 bucks had weights but no age recorded. Avg. = 133.2 pounds.

[c]Means ± 1 standard error.

During the past few years eight blind fawns (not road-kills) have been found on the Reservation. One of these was taken by the Southeastern Cooperative Wildlife Disease Study and was later reported to be blind due to previous infection. Subsequent examination of six more blind fawns by a pathologist has resulted in a preliminary report that each case of blindness was due to infection following a previous injury.

To determine the quality of our animals in relation to deer elsewhere in the state, we compared some weights of deer harvested during the 1977-78 hunting season in 16 counties and 5 wildlife management areas of Tennessee (TWRA Technical Report No. 77-14). These results are given in Table 3. Only Reservation deer in the same age classes as hunter-harvested deer were used in this comparison, thus the reason for the relatively small numbers of the Reservation grouping. The small sample size of Reservation deer makes it difficult to draw any conclusions when comparing their weights to those of hunter-harvested deer.

If the small numbers of deer in each age class are considered representative of the trend of our deer weights, then it appears that the Reservation deer here must be in good physical condition. Pathology reports on thirty-one deer also support the conclusion that the condition of the animals appears good indeed. Animal tissues from the heart, lung, spleen, liver and kidney were sectioned and examined; one animal had only liver, spleen and kidney checked. Out of these samples, three were found to have nematodes, and no other pathological conditions were noted. Gross examination of each road-kill revealed no

Table 3. Weights (pounds) of Oak Ridge deer compared to Tennessee deer harvested in 16 counties and 5 wildlife management areas during the 1977-78 hunting season

	Fawn		1.5 yr		2.5		3.5		4.5		5.5+	
	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female
Oak Ridge Reservation[a]	66.3(6[b])	53.3(3)	109.5(2)	105.5(2)	174.4(7)	120.7(3)	171.0(4)	---	174.0(5)	---	210.5(2)	---
(1977-78) Harvested deer-state	65.5(749)	56.5(553)	111.7(1576)	81.9(324)	139.2(463)	101.3(87)	160.1(517)	107.4(192)	168.6(23)	107.3(85)	181.7(9)	105.4(65)

[a]Only deer of the same age class as those listed in state hunting records were used in compiling data on the Reservation animals.

[b]Sample size.

abnormalities except in the case of one adult female which had a shorter than normal lower jaw with no incisors.

Statewide Deer Road-kills

Data obtained from the Tennessee Wildlife Resources Agency show that road-kills have increased statewide from 154 in 1959-1960 to 979 in 1972-73, or 636%. These records indicate that statewide road-kills were up from 547 during the 1969-70 reporting period to 979 during 1972-73, or a 179% increase, while during this same time period, Reservation road-kills increased from 1 to 11, an 1100% increase. The sex ratio, 41.4% males:57.7% females (0.9% unknown), of the statewide road-kills reflects the shift in favor of females which is a normal response in deer populations undergoing annual hunter harvest (Davis 1975, Jahn 1959). The 66:38 male to female ratio in Reservation road-kills favors males just as expected in an area where males are not exploited by hunters.

Although game managers use fawn sex ratios from antlerless hunts as a relatively unbiased representation of the sex ratio in the whole deer population, our fawn sample size is too small to permit any firm conclusions to be drawn. The trend in the fawn-kill, however, appears to be near the national average ratio (Severinghaus and Cheatum 1956) of 51.5 males:48.5 females. Our 10:7 fawn ratio, while still favoring males rather heavily, probably better represents the actual sex ratio existing in the population than does the 66:38 ratio found when all road-kills are tallied.

CONCLUSIONS

Seasonal variations in number of deer killed on the Reservation are similar to those reported elsewhere. However, the male to female ratio of Reservation road-kills - 66:38 - is considerably higher than that observed in these other studies. This phenomenon is thought to be the result of lack of hunting pressure.

There were three distinct peaks of road-kill activity during a 24-hour period. Two of these coincided with rather high density morning and early evening work traffic and the third occurred during the midnight shift-change time period. While increases in traffic volume (average 6.8% annually) account for some of the increase in road-kill activity from 1969 through 1977, it is believed that most of the increase can be attributed to actual growth of the deer population.

Harvesting deer on the Reservation is not practical because of security restrictions, but since 1976 the public has been informed and alerted to the hazards of deer crossing Reservation roads. Deer crossing signs were installed over two years ago in all areas where deer-car collisions have occurred. Also, we periodically furnish road-kill information to local newspapers and include notes on specific locations where special caution is warranted.

CONTINUING RESEARCH EFFORTS

This document is intended to summarize our knowledge of the Reservation deer based on road-kill data. Much of the information reported here has been the stimulus for initiating additional research

such as (a) use of radiotelemetry to determine habitat usage and behavior patterns, (b) parasitology of white-tailed deer, and (c) reproductive dynamics of area animals. Information from these studies will provide data which can determine the direction of our efforts to actively manage the deer population. We have included this brief discussion of some of these ancillary activities to provide a more comprehensive view of the overall research project.

In 1974 meetings were held with TWRA personnel and University of Tennessee School of Wildlife Management personnel to discuss various phases of deer study, potential problems resulting from a growing herd, and alternative approaches to managing deer on the Reservation. As a result of these meetings and subsequent contact with TWRA, it was decided that a first step in managing Reservation deer would be to allow TWRA to trap and move deer from the Reservation to other parts of the State where TWRA was trying to establish or build deer populations. While we recognize that Reservation deer have not caused habitat damage, trapping and removal efforts have already been initiated to slow the rate at which the deer population is growing toward the carrying capacity of the area. We also recognize that permanent control of the population size by trapping is not possible.

The high incidence of male road-kills to female road-kills may be partially attributable to factors other than those already discussed. A study of Ohio deer (Nixon 1971) revealed that both fawn and yearling does carry significantly more male than female fetuses, while the fetal sex ratio from adult does was not significantly different from the expected 1:1. Concomitantly, does in a good nutritional situation

generally produce more male fawns than females because prepartuition mortality, where more males than females are lost, is low (Robinette et al. 1957). Thus, there are factors, even before the birth of fawns, that would help to account for the high male to female ratio in Reservation road-kills.

According to the Ohio study, does breeding at 5-8 months of age carried 63.7% male fetuses, 16-18 month does carried 64.0% male fetuses, and 28-month and older does carried 53.6% male fetuses. Overall sex (ratio) of Reservation road-kills is 63.5% males, 36.5% females while sex of fawns killed was 58.5% males and 41.2% females. Presently our statistics are low, but as more data are collected we should be able to determine more accurately if this phenomenon is occurring in the Reservation herd.

The routine collection of reproductive tracts from all females killed should provide additional useful information on reproductive dynamics. From the reproductive tracts we have begun to accumulate data pertinent to analyzing reproductive behavior:

(1) number of fetuses per doe,

(2) sex of fetuses,

(3) date breeding took place (to establish peak breeding season for Reservation herd),

(4) relation of age of doe/number fetuses, sex of fetuses in Reservation deer, and

(5) percent of fawns that breed first fall.

Information obtained from monitoring deer movements will provide the basis for assessing various anthropogenic activities on both the

herd's physical condition and distribution patterns. Usage of certain microhabitats for feeding, breeding, and bedding needs can provide direction for forest management activities by providing adequate habitat for all the herd's biological requirements.

This document will be updated annually by supplemental reports (three-hole-punched) on the number of animals killed by vehicles, their physical condition, and finally on the effectiveness of various management techniques used to maintain the high quality of the Reservation herd.

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PINE AND PINE-HARDWOOD FORESTS – THE MOST EXTENSIVE TYPE ON THE RESERVATION, OCCUPYING VAST AREAS IN ALL SECTORS, BUT PARTICULARLY ABUNDANT IN THE NORTHWEST. NATURAL FORESTS DOMINATED BY SHORTLEAF (*Pinus echinata*) AND VIRGINIA PINE (*Pinus virginiana*) ARE ASSOCIATED WITH LARGE TRACTS OF PLANTED LOBLOLLY PINE (*Pinus taeda*), A VALUABLE TIMBER SPECIES. THE LOBLOLLY PINE PLANTATIONS ARE MONOCULTURES, WHILE ASSOCIATED SPECIES IN THE SUCCESSIONAL FORESTS INCLUDE OAKS (*Quercus spp.*), HICKORIES (*Carya spp.*), AND TULIP POPLAR (*Liriodendron tulipifera*).

CEDAR, CEDAR-PINE, AND CEDAR-HARDWOOD FORESTS – THIS TYPE IS EXTENSIVE ON THE RESERVATION, PREDOMINATING IN BETHEL VALLEY AND IN SOUTHERN AREAS ADJACENT OR CLOSE TO THE CLINCH RIVER AND MELTON HILL RESERVOIR. WHILE NOT UNCOMMON ANYWHERE, THE AREA OF THIS TYPE DECREASES MARKEDLY NORTH OF BEAR CREEK ROAD. BEST DEVELOPED ON LIMESTONE (OR DOLOMITE), THESE FORESTS APPEAR RAPIDLY FOLLOWING DISTURBANCE, SO THE PRESENT PATTERN REFLECTS BOTH SUBSTRATE GEOLOGY AND THE RECENT HISTORY OF LAND-USE. THE DOMINANT SPECIES IS EASTERN RED CEDAR (*Juniperus virginiana*), ASSOCIATED WITH SHORTLEAF AND VIRGINIA PINE, TULIP POPLAR, OAKS, HICKORIES, REDBUD (*Cercis canadensis*), SASSAFRAS (*Sassafras albidum*), AND OTHER HARDWOODS.

OAK-HICKORY FOREST – THIS TYPE IS IMPORTANT ON THE RESERVATION, OCCUPYING ROUGHLY 20% OF THE TOTAL LAND AREA. LARGEST CONCENTRATIONS OCCUR ON BLACK OAK, EAST FORK, PINE, CHESTNUT, AND COPPER RIDGES. SCATTERED PATCHES OCCUR ALMOST THROUGHOUT THE RESERVATION AREA. THIS FOREST IS AN OAK-HICKORY COMPLEX, REPRESENTATIVE OF THE TERMINAL TYPE IN THIS REGION OF THE EASTERN UNITED STATES. IMPORTANT SPECIES INCLUDE CHESTNUT OAK (*Quercus prinus*), WHITE OAK (*Q. alba*), BLACK OAK (*Q. velutina*), NORTHERN RED OAK (*Q. rubra*), SCARLET OAK (*Q. coccinea*), POST OAK (*Q. stellata*), VARIOUS HICKORIES (*Carya cordiformis, C. glabra, C. ovata, C. tomentosa*) AND ASH (*Fraxinus spp.*), TULIP POPLAR, RED MAPLE (*Acer rubrum*), BLACK GUM (*Nyssa sylvatica*), DOGWOOD (*Cornus florida*), BEECH (*Fagus grandifolia*), AND OTHERS. A SHOWY VERNAL FLORA IS CHARACTERISTIC OF THIS TYPE, AND MANY COMMON WILDFLOWERS IN EAST TENNESSEE ARE VIRTUALLY RESTRICTED TO THESE UPLAND OAK-HICKORY FORESTS.

BOTTOMLAND HARDWOOD FOREST – RESTRICTED TO SMALL FLOODPLAINS ALONG CREEK BOTTOMS, THIS TYPE IS RARE ON THE OAK RIDGE RESERVATION. SMALL AREAS OCCUR ALONG GUM HOLLOW CREEK, BEAR CREEK, AND GRASSY CREEK, WITH LARGER AREAS ALONG WHITE OAK CREEK AND IN THE EAST FORK OF POPLAR CREEK DRAINAGE. ALL OF THE TYPE EXISTS IN THE WESTERN TWO-THIRDS OF THE RESERVATION. DOMINANT ARE COTTONWOOD (*Populus deltoides*), SYCAMORE (*Platanus occidentalis*), AMERICAN ELM (*Ulmus americana*), ASH (*Fraxinus spp.*), WILLOW (*Salix spp.*), SILVER MAPLE (*Acer saccharinum*), AND RIVER BIRCH (*Betula nigra*).

NORTHERN HARDWOOD FOREST – EXTREMELY RARE ON THE OAK RIDGE RESERVATION, THIS FOREST TYPE OCCURS IN SMALL AREAS ONLY ON WESTERN EXTENSIONS OF BLACK OAK RIDGE AND COPPER RIDGE. COMPOSITION IS SIMILAR TO THE OAK-HICKORY FOREST, WITH ADMIXTURES OF SUGAR MAPLE (*Acer saccharum*), HEMLOCK (*Tsuga canadensis*), BASSWOOD (*Tilia heterophylla*), AND BUCKEYE (*Aesculus octandra*).

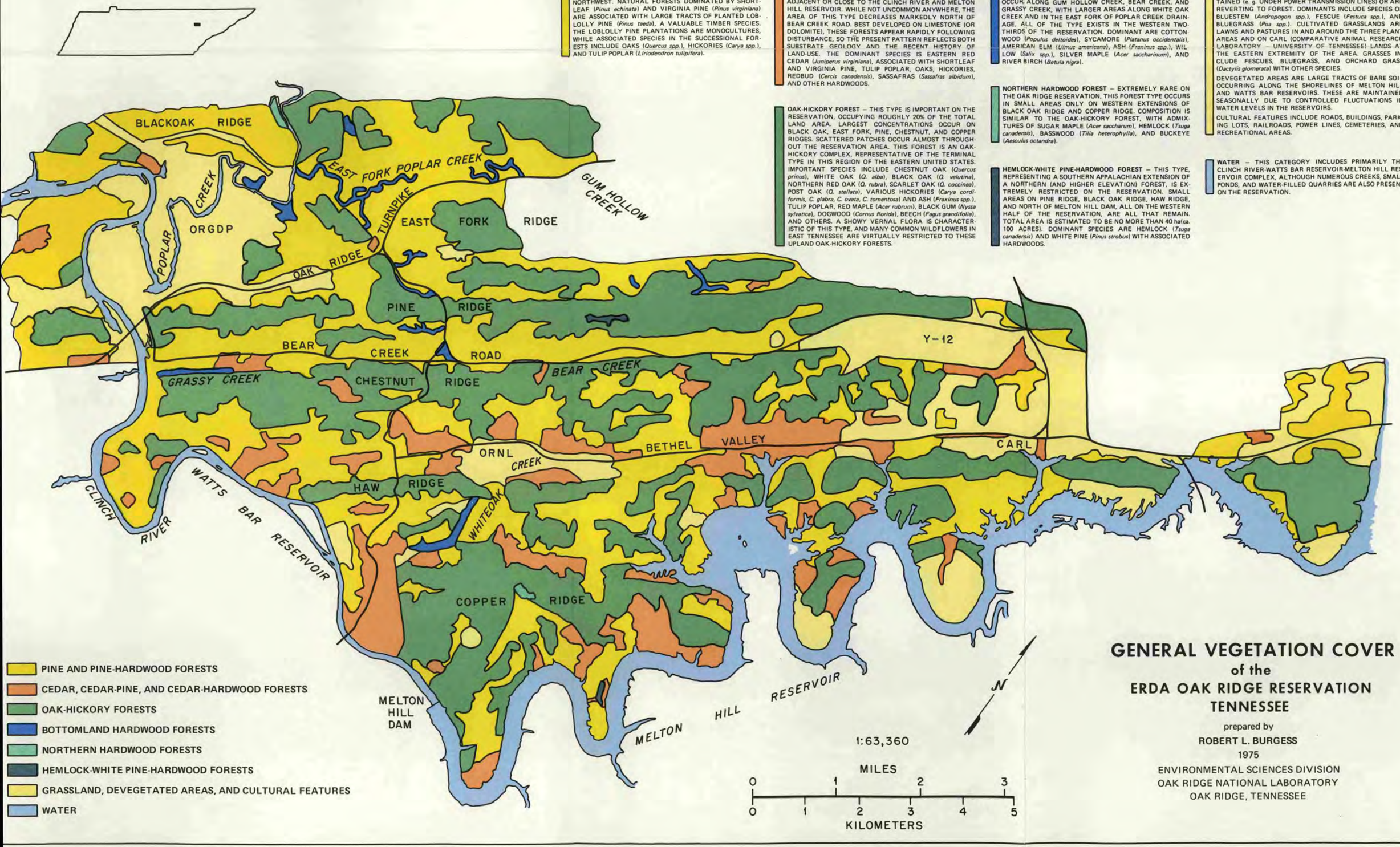
HEMLOCK-WHITE PINE-HARDWOOD FOREST – THIS TYPE, REPRESENTING A SOUTHERN APPALACHIAN EXTENSION OF A NORTHERN (AND HIGHER ELEVATION) FOREST, IS EXTREMELY RESTRICTED ON THE RESERVATION. SMALL AREAS ON PINE RIDGE, BLACK OAK RIDGE, HAW RIDGE, AND NORTH OF MELTON HILL DAM, ALL ON THE WESTERN HALF OF THE RESERVATION, ARE ALL THAT REMAIN. TOTAL AREA IS ESTIMATED TO BE NO MORE THAN 40 ha(ca. 100 ACRES). DOMINANT SPECIES ARE HEMLOCK (*Tsuga canadensis*) AND WHITE PINE (*Pinus strobus*) WITH ASSOCIATED HARDWOODS.

GRASSLAND, DEVEGETATED AREAS, AND CULTURAL FEATURES – THE GRASSLANDS INCLUDE NATIVE OR SEMI-NATIVE SUCCESSIONAL AREAS THAT ARE EITHER MAINTAINED (e. g. UNDER POWER TRANSMISSION LINES) OR ARE REVERTING TO FOREST. DOMINANTS INCLUDE SPECIES OF BLUESTEM (*Andropogon spp.*), FESCUE (*Festuca spp.*), AND BLUEGRASS (*Poa spp.*). CULTIVATED GRASSLANDS ARE LAWNS AND PASTURES IN AND AROUND THE THREE PLANT AREAS AND ON CARL (COMPARATIVE ANIMAL RESEARCH LABORATORY – UNIVERSITY OF TENNESSEE) LANDS AT THE EASTERN EXTREMITY OF THE AREA. GRASSES INCLUDE FESCUES, BLUEGRASS, AND ORCHARD GRASS (*Dactylis glomerata*) WITH OTHER SPECIES.

DEVEGETATED AREAS ARE LARGE TRACTS OF BARE SOIL OCCURRING ALONG THE SHORELINES OF MELTON HILL AND WATTS BAR RESERVOIRS. THESE ARE MAINTAINED SEASONALLY DUE TO CONTROLLED FLUCTUATIONS IN WATER LEVELS IN THE RESERVOIRS.

CULTURAL FEATURES INCLUDE ROADS, BUILDINGS, PARKING LOTS, RAILROADS, POWER LINES, CEMETERIES, AND RECREATIONAL AREAS.

WATER – THIS CATEGORY INCLUDES PRIMARILY THE CLINCH RIVER-WATTS BAR RESERVOIR-MELTON HILL RESERVOIR COMPLEX, ALTHOUGH NUMEROUS CREEKS, SMALL PONDS, AND WATER-FILLED QUARRIES ARE ALSO PRESENT ON THE RESERVATION.



GENERAL VEGETATION COVER
of the
ERDA OAK RIDGE RESERVATION
TENNESSEE

prepared by
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