GAME SESSION

FOREST HABITAT AND DEER POPULATIONS IN AN ARKANSAS OZARK ENCLOSURE

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ABSTRACT

A 675-acre Arkansas Ozark enclosure had a carrying capacity of about one deer per 50 to 70 acres. When available, mast provided most of the deer's winter diet, but when mast yields were low winter food supplies became critical. The lungs of all deer examined were heavily infested by protostrongylid larvae. The poor quality of winter range plus the high level of parasitism appeared to be regulating deer numbers.

INTRODUCTION

This report describes relations between the forest habitat and white-tailed deer (*Odocoileus virginianus*) in a 675-acre Arkansas Ozark enclosure from 1963 through the spring of 1971. When the study was begun, deer numbers were declining as the crowns of maturing forest closed and the few remaining old fields in the vicinity were planted to pines, reducing the production of understory vegetation. The purpose of the study was to estimate the carrying capacity of a typical upland Ozark forest and to determine what factors were limiting deer numbers. Preliminary results were published by Segelquist, Ward, Leonard (1969).

AREA DESCRIPTION

The enclosure is in the Sylamore Experimental Forest, a part of the Ozark National Forest on the Springfield Plateau of the Ozark Highlands. The area is deeply dissected by many small streams with narrow valleys and narrow rounded ridges. Slopes range up to 60 percent but usually average from 20 to 30 percent.

Soil on ridges and upper slopes are extremely rocky. Chert fragments make up 30 to 75 percent of the total volume. On lower slopes, benches, and floodplains soils are generally sandy to silty clay loams with fewer rock fragments. Water holding capacity decreases from streambottoms to the ridges.

The four main forest types are upland hardwoods, upland pine-hardwoods, cedar glades, and streambottom hardwoods. The principal hardwoods are white oak (*Quercus alba*) and black oak (*Q. velutina*). Shortleaf pine (*Pinus echinata*) is dominant in the pine-hardwood stands. There has been no timber cutting in recent years and many timber stands are largely mixtures of many size and age classes with only a few acres of even-aged hardwood pole stands. Tree basal area

[1]On the staff of the Wildlife Habitat and Silviculture Laboratory which is maintained at Nacogdoches, Texas, by the Southern Forest Experiment Station, U. S. Forest Service, in cooperation with the School of Forestry, Stephen F. Austin State University.

ranges from 90 to 100 sq. ft. on all types except the glades, where it averages about 70 sq. ft. Overstory canopies are heavy and continuous in all types except the glades, where small noncommercial trees predominate. Each forest type is described in detail by Segelquist and Green (1968).

In 1926, it was estimated that there were only 35 deer on the 173,000 acre Sylamore District of the Ozark National Forest (Donaldson *et al.* 1951). In 1927-28 two Federal Game Refuges were set aside on the District. Intensive protection and predator control helped to reestablish the deer herds in the region. One of the most successful refuges included the area which is now the Experimental Forest. By 1945 the area was becoming seriously overpopulated with deer (Alexander 1954). Concurrently, the increased height growth and shading of the young developing forest reduced the production of understory vegetation (Halls and Crawford 1960). Planting pines on old fields further reduced range productivity. By 1950 the declining forage supply and high deer populations caused heavy overbrowsing and die-offs (Donaldson *et al.* 1951). At the beginning of this study deer populations were low. Deer kills on the Sylamore District were only 49 in 1967 as compared to a high of 463 in 1944 (Ward and Segelquist 1969).

PROCEDURE

The enclosure was completed in 1963 and all deer inside were removed by hunting. Three deer were necropsied for parasites and diseases by personnel of the Cooperative Southeastern Wildlife Disease Study. The enclosure was stocked with 11 deer in 1963. Census drives were made each spring and fall from 1963 through 1970, except for the fall of 1964. Five deer were removed in the winter of 1964-65 to keep stocking at desired levels. Five deer each were removed and necropsied in the winters of 1966-67 and 1970-71. As many deer as possible were trapped each spring to determine condition and longevity. All deer in the enclosure were removed by shooting following the spring of 1971.

Each August, the current annual growth of vegetation up to a height of 5 ft. was sampled on about 125 permanent and 30 temporary 6.2 ft. sq. plots. Current annual growth was estimated on permanent plots while annual growth was estimated then clipped and weighed on temporary plots. Green weights from permanent plots were adjusted by multiplying each estimated weight by a correction factor consisting of the ratio of estimated to actual weights obtained from the clipped temporary plots. Clipped samples were ovendried and the ratio of green to dry weight was computed. Data were converted to pounds of ovendry matter per acre. Detailed descriptions of vegetative sampling procedures are included in a report by Segelquist and Green (1968).

Winter forage availability was estimated each March from 1965 through 1971. Browse included twigs of deciduous species and twigs and leaves of evergreens as measured the preceding summer.

Forage utilization was estimated each March and August at the same time that forage yeilds were measured. The rumen contents of deer killed for population control and necropsies were also examined to determine food habits. Fecal pellets were collected regularly from January 1966 through January 1968 and examined for mast remains. Pellet group transects, randomly located in each of the main forest types, were examined, and all pellet groups were counted each season from the fall of 1966 through the summer of 1969 to determine concentrations of deer activity.

Mast yeilds were sampled each fall by placing two 55-gallon open-top barrels at each of 99 randomly located points throughout the enclosure. Acorns and other fruits that fell into barrels were counted and numbers of fruit were converted to ovendry pounds per acre.

RESULTS

Summer Forage Yields

Summer forage yields averaged 141 ovendry pounds per acre over the 8 years of the study (Table 1). Yields varied from 128 to 170 pounds per acres. They were lowest in growing seasons with below average rainfall and generally increased with improved moisture availability.

Grasses, sedges, forbs, and ferns accounted for 29 percent of the average yield, and browse 71 percent. Composites, legumes, and mints made up the bulk of the forbs while panicums (*Panicum* spp.) and bluestems (*Andropogon* spp) were the most common grasses. About half of the browse was classified as preferred by deer. Flowering dogwood (*Cornus florida*), lowbush blueberry (*Vaccinium vacillans*), and common deerberry (*V. stamineum*) were the most abundant species of preferred browse. Oaks and hickories (*Carya* spp.) made up most of the nonpreferred species.

Winter Forage Available

Winter forage was scarce, ranging from 14 to 25 pounds per acre (Table 2). Deciduous browse twigs made up about 70 percent of the total winter vegetation. Preferred green forage, consisting primarily of panicums, sedges, pussytoes (*Antennaria plataginifolia*), and eastern redcedar (*Juniperus virginiana*), averaged only about 3 pounds per acre.

Mast Yields

Mast yields average 64 pounds per acre, but ranged from 3 to 206 pounds (Table 3). Acorns made up 92 percent of all mast. White oak acorns were most abundant, followed by black, northern red (*Q. rubra*), blackjack (*Q. marilandica*), and chinkapin (*Q. muehlenbergii*) oaks. Fruit of the flowering dogwood. grape (*Vitis spp.*), blackgum (*Nyssa sylvatica*), and sassafras (*Sassafras altidum*) made up 8 percent of the mast.

Food and Feeding Habits of Deer

Deer diet varied widely between seasons. Based on utilization estimates and stomach contents, deer ate forbs, grasses, sedges, mushrooms, and the succulent portions of browse during spring and summer. During these seasons deer were found in all forest types as indicated by pellet group counts on transect lines.

Deer diet during fall and winter depended largely upon availability of mast. Grapes were highly favored as soon as they began to drop. Acorns were eaten whenever they were available. When plentiful, mast made up almost the entire diet and deer concentrated in the heavily wooded forest types. When acorn crops were low, all mast was soon expended and deer turned to green winter forages such as eastern redcedar, panicums, pussytoes, and sedges. At these times, deer concentrated on the glades, where most of these forages grew. However, the scarcity of green forages forced deer to eat considerable amounts of deciduous browse twigs and dead deciduous browse leaves during periods of extreme mast shortage. Crawford and Leonard (1965) reported similar findings in earlier studies on the Sylamore Experimental Forest. Chemical analyses of the most commonly eaten winter forages indicated that the most sought after forages had the highest nutritional content (Segelquist *et al.* 1972).

Deer Population Dynamics

In 1963, the enclosure was stocked with 10 does and 1 buck. From 1963 through 1971, 32 deer were known to have been born in the enclosure, 19 females and 13 males. The total deer stocked and born was 29 does and 14 bucks. Seventeen does and 10 bucks were shot or trapped and removed, and two does and one buck were found dead. The remaining 10 does and 3 bucks apparently died and their remains were never found.

Table 4 shows a hypothetical reconstruction of the deer herd from 1963 through 1971 based on trap, kill, and carcass records and on biannual census records. Discrepancies between the results obtained by the two methods are accounted for by errors in census drives, incorrect aging, and the fact that some of the animals born in the enclosure were never captured, killed, or found dead.

Survival curves (Fig. 1) were plotted from sex-specific composite life tables based on the vital statistics of the 32 deer born in the enclosure and records of 13 fetuses taken from does killed during hunts. Young females were slightly more vulnerable to hunting than young males, but overall, little difference was indicated in the survival of males and females.

Productivity of the deer herd was extremely low throughout the study. Based on the number of does 2 years of age and older present each spring and a reproduction rate of 1.57 fawns per doe as determined from fetal counts, at least 67 fawns should have been born. As indicated earlier we obtained records on only 32 deer born in the enclosure. Whether the 35 unaccounted animals died as fawns, subadults, or adults is unknown. These figures illustrate the magnitude of the difference between the expected and the observed herd productivity.

Deer Condition

Deer ranged from poor to good condition depending upon their sex, time of year, and the quantity and quality of available food. Deer captured in traps during spring or summer were all in fair to good condition. Some large bucks taken from the enclosure during periods of mast scarcity in late winter were in poor condition.

Deer were hosts to a number of internal and external parasites, but only those of the protostrongylid group were present in significant numbers. Adult meningo worms (*Pneumostrongylus tenuis*) were present in most deer, and the larvae were in the lungs of all deer examined. Unidentified protostrongylid larvae were found in the lungs of deer — larvae whose adult forms were not recorded. Parasitologic and physiologic data indicated that protostrongylid larvae may have held the deer herd at a level below that which the food supply would have supported[1].

Other Factors Affecting Deer

Poaching, predation, and escapes are unaccountable factors that may have affected deer numbers. One deer was shot and killed by a poacher but its ear tag was ultimately recovered. A bobcat killed one yearling buck. Deer jumped out of an adjoining enclosure on two occasions when hard pressed during census drives, but none was ever seen escaping from the study enclosure. The number of deer lost to these causes is unknown, but we believe it to be small.

SUMMARY AND CONCLUSION

While deciduous browse leaves and warm season herbage apparently provided sufficient forage for deer during the spring and summer, there was little winter forage available for deer.

Mast provided some food for deer each fall and when it was abundant it furnished almost all of the deer's winter diet. With moderate yields, deer fed heavily on mast as long as it was available, and only when it became scarce did they turn to forages. When mast yields were very low, deer and other wildlife

[1]Report of the Cooperative Southeastern Wildlife Disease Study for 1971.

quickly consumed all that was available, and deer began feeding on poor quality forages early in the season. Although deer were never found starving, they were in poorer shape following mast shortages and were presumably more susceptible to other environmental stresses such as the infection by protostrongylid larvae.

Based on the information collected during this study, the 675 acre enclosure was capable of supporting only 10 to 13 deer or a deer per 50 to 70 acres. It appears that the carrying capacity was determined by the scarcity of winter foods in combination with heavy parasitism. It is possible that predation, poaching, escapes, or the vulnerability of young females to hunting may have influenced population levels.

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Table 1. Summer Forage Yields

Date	Grasses & grass-likes	Forbs & Ferns	Preferred browse	Non-preferred browse	Total vegetation
		Pounds (oven-dry) per acre			
1963	20	13	50	67	150+23[1]
1964	14	14	44	56	128+17
1965	28	33	50	59	170+20
1966	23	24	53	45	145+19
1967	22	15	40	47	128+18
1968	22	15	45	50	132+19
1969	23	19	51	47	140+21
1970	15	18	49	54	136+20
Average	21	19	48	53	141

[1]95 percent confidence intervals.

Table 2. Forage available in March.

Date	Grasses & grass-likes	Forbs & Ferns	Browse	Total Vegetation
	Pounds (oven-dry) per acre			
1965	1	-	13	14
1966	2	2	17	21
1967	1	1	14	16
1968	2	-	15	17
1969	1	-	18	19
1970	1	1	19	21
1971	2	3	20	25
Average	1	1	17	19

Table 3. Annual mast yields.

Date	Acorns	Other	Total
	Pounds (oven-dry) per acre		
1963	5	6	11
1964	23	5	28
1965	149	9	158
1966	44	1	45
1967	190	16	206
1968	3	tr	3
1969	45	3	48
1970	9	tr	9
Average	59	5	64

Table 4. Estimates of deer population changes from 1963 through 1971.

		Population Changes Based On Trap, Kill, & Carcass Records			Census Record
Date	Source	Male	Female	Total	Total
1963	Stocked	1	10	11	11
	Reproduction	2	2	4	5
	Losses	0	1	1	0
	Fall Population	3	11	14	16
	Losses	1	0	1	0
1964	Spring Population	2	11	13	16
	Reproduction	2	6	8	7
	Losses	0	0	0	0

Date	Source	Male	Female	Total	Population Changes Based On Trap, Kill, & Carcass Records Total	Census Record
	Fall Population	4	17	21	23	
	Shot	2	3	5	5	
	Losses	0	3	3	2	
1965	Spring Population	2	11	13	16	
	Reproduction	3	1	4	2	
	Trapped & Removed	1	1	2	2	
	Losses	0	1	1	0	
	Fall Population	4	10	14	16	
	Losses	1	1	2	0	
1966	Spring Population	3	9	12	16	
	Reproduction	2	2	4	5	
	Losses	1	2	3	0	
	Fall Population	4	9	13	21	
	Shot	0	5	5	5	
	Losses	0	0	0	0	
1967	Spring Population	4	4	8	16	
	Reproduction	2	2	4	5	
	Losses	0	1	1	0	
	Fall Population	6	5	11	21	
	Killed in Drive	0	1	1	1	
	Losses	0	1	1	7	
1968	Spring Population	6	3	9	13	
	Reproduction	1	3	4	1	
	Losses	0	0	0	0	
	Fall Population	7	6	13	14	
	Losses	0	1	1	4	
1969	Spring Population	7	5	12	10	
	Reproduction	1	2	3	6	
	Losses	0	0	0	0	
	Fall Population	8	7	15	16	
	Losses	1	1	2	4	
1970	Spring Population	7	6	13	12	
	Reproduction	0	0	0	0	
	Losses	0	0	0	0	
	Fall Population	7	6	13	11	
	Shot	6	1	7	7	
	Losses	0	0	0	0	
1971	Spring Population	1	5	7	-	
	Reproduction	0	1	1	-	
	Shot	1	6	7	-	

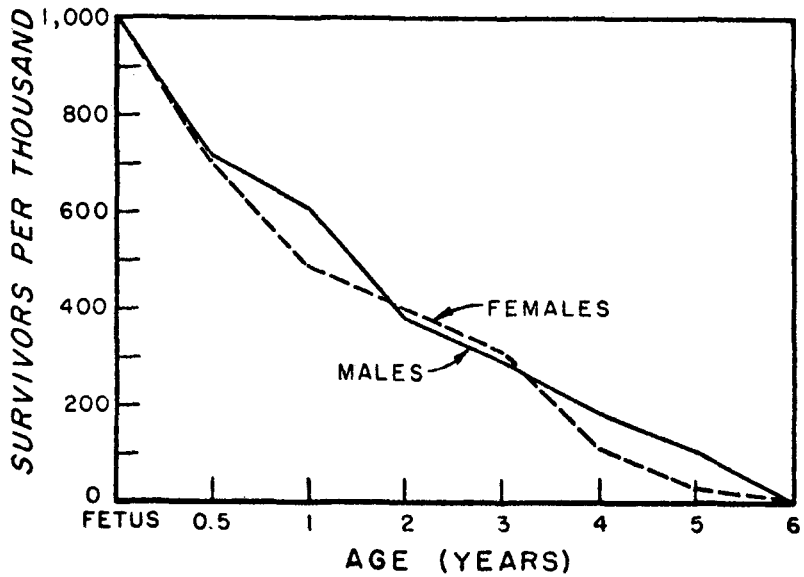

Figure 1. Sec-specific survival curves.

VARIATION IN PEAKS OF FAWNING IN VIRGINIA

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The influence of environmental factors on the timing of the rut and the length of the gestation period in the white-tailed deer *(Odocoileus virginianus)* is poorly understood. Since 1965, we have been recording population data for a confined herd of whitetails in Virginia. Although the peak of the fawn drop appears to be rather consistent from year to year, some variation has occurred during our 8 years of study. This variation led us to examine some factors which might bear on the time of fawning.

Environmental factors as influences on deer reproduction have been studied by several wildlife researchers. McDowell (1970) reported on conception dates of whitetails and concluded that light duration has a powerful influence on breeding periodicity. Cheatum and Morton (1946) found regional differences in the onset of mating between northern and southern New York deer. These differences were believed to be due to latitude, altitude, light intensity, temperature, and other external influences. Cheatum and Morton cited Bis-

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