

# HERD DYNAMICS OF A PIONEER-LIKE DEER POPULATION

BY

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## INTRODUCTION

The white-tailed deer (*Odocoileus virginianus*) has been successfully reintroduced into much of its former range in the south. In many of these areas the creation of more and better habitat through practices of logging, burning, and grazing has been the primary factor affecting successful re-establishment (Leopold, 1950). In addition, the tremendous biotic potential of this large herbivore is well documented. Perhaps the best illustration of this phenomenon is the George Preserve deer herd. Six animals were introduced into the enclosure in 1928. The population had increased to 160 individuals by 1933 (O'Roke and Hammerstrom, 1948). A more drastic illustration of the potential of deer to increase can be observed in the history of the Kaibab herd in Arizona. During an eight year period the herd increased from approximately 30,000 individuals to over 90,000. In Maryland three bucks and three does were stocked in Worcester County during 1926. The population was estimated at over 1,000 by 1941. The average annual increase over this 16-year period was 37.7 percent (Wilson and Vaughn, 1942). These are far from being isolated incidents. "Explosions" in deer populations have occurred in many states—particularly in those which have operated under buck laws for any appreciable length of time.

Conversely, in many areas of the south it has been exceedingly difficult to maintain huntable white-tail populations. Low carrying capacity, illegal kill, and free-running dogs are most often cited as major limiting factors. Attempts have been made to increase populations on these areas by habitat management, dog control, and restrictive legislation designed to eliminate illegal kills and reduce the overall kill. Unfortunately on many of these areas deer have been established for such a duration of time that the isolation of limiting factors is difficult and accurate population analysis is impossible.

The study of young and rapidly expanding populations is invaluable in that it provides an insight into the basic biology of the species before the interplay of limiting factors common to older deer herds affects the basic dynamics of the population. The purpose of this paper is to present the preliminary analysis of such a young and rapidly expanding deer population located on the Savannah River Project near Aiken, South Carolina.

The site which comprises the Savannah River Project was acquired by the Atomic Energy Commission during 1950 and 1951. It was officially closed to the public on December 14, 1952. The 315 square mile land area lies in Aiken, Barnwell, and Allendale counties and is bordered on the south and southwest by the Savannah River. Due to the nature of the work being conducted on the area utmost security has been maintained. There has been no public utilization of the wildlife resources until limited public deer hunting was initiated in the fall of 1965 to attempt to constrain the rapidly expanding population.

Much of the area is in young pine plantations or bottomland hardwood. Abandoned housesites are numerous and there are six major abandoned community sites. Deer habitat is considered excellent over much of the project.

Prior to acquisition by the Government deer were practically unknown. Overworked farm land provided little suitable habitat, and continual pressure by the public had all but extirpated the species. Estimates of the deer population in 1950 placed it at approximately 1-2 dozen animals. It is generally agreed that these were in the inaccessible portions of the river swamp.

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Under conditions of virtually absolute protection and rapidly improving habitat the 1963 population was estimated at approximately 1400 animals (Jenkins and Provost, 1964). During the spring of 1965 the population was believed to be in excess of 20 animals per square mile in some areas (Payne, Provost and Urbston, 1966).

It is obvious that the Savannah River Plant deer population is expanding at a remarkable rate. It could be classed as pioneer-like in that a few individuals radiated into a favorable ecological climate with virtually no competition or predation. However, changes in herd thrift are already taking place near the nucleus. Deer management and research on the Savannah River Project has barely entered its third year. Substantially more data must be gathered before final analysis and conclusions can be made. However, due to the unique history of this relatively uninhibited population and the changes that are beginning to take place, it was felt that a report would be in order at this time.

## METHODS

The area discussed in this paper is approximately 49 square miles and lies in the southern portion of the Project. It is bounded on the north by SRP Road B, on the east and west by private land and on the south by private land and the Savannah River. It lies in the Coastal Terrace physiographic subregion; soil fertility is considered as moderately high. Predominate vegetation types are young pine plantations (8-12 years), bottomland hardwoods, and old homesite species. Railroad lines, powerlines, and pipelines permanently maintained in herbaceous vegetation comprise approximately ten percent of the area. The original nucleus of the Savannah River Project deer herd was presumed to be in the Savannah River Swamp lying in the lower extremities of this area. Lateral dispersal of the population, in all probability, was limited due to the presence of three hot water streams (reactor effluents). The population was forced to disperse in a northern direction due to these streams on the east and west and to the Savannah River on the south.

Hunt returns for 1965 and 1966 supplemented by winter and spring collections during those years provided the data for this paper. The following aspects of the Savannah River Project deer population were used as the criteria for evaluation.

### *Age Class Compositions*

Lower mandibles were salvaged from all deer collected or harvested on the Savannah River Project; age was estimated from dental characteristics (Severinghaus, 1949).

### *Rate of Fawn Breeding as Expressed by Either Uterine Pregnancy or*

### *Active Lactation*

Cheatum and Severinghaus (1950) found the incidence of doe-fawn breeding to be common on exceptionally good range, and responsive to population levels. Fawn breeding has been monitored on the Savannah River Project by either of the following two methods.

Reproductive tracts were examined to determine actual uterine pregnancy.

One and one-half year old does sampled during the period September-December were checked for active lactation. Animals were considered as lactating when the mammary fluid could be extruded through the teats. Lactation was taken as an expression of minimal successful fawn breeding. Admittedly it is possible that some 1½ year old animals not lactating may have successfully bred during the previous year, in that post parturition mortality or early weaning may have occurred. It is believed that such instances were negligible.

### *Fawn-Adult doe ratios*

The ratio of fawns to adult does was determined from hunt returns. Animals entering the previous breeding season as 1½ year olds were considered as adults.

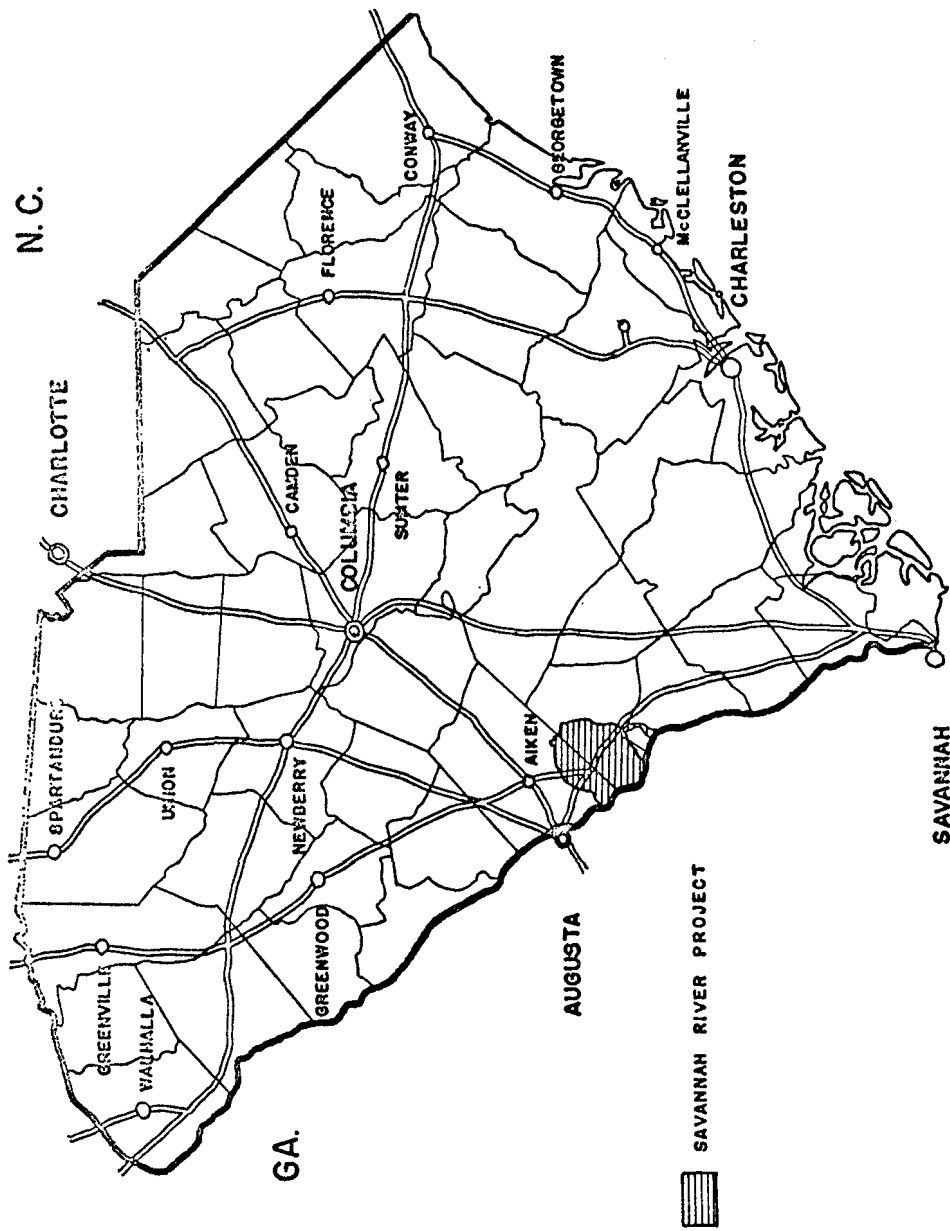


Fig. 1. Location Map, Savannah River Plant

*Antler Development in 1½-Year-Old Males*

Workers in Pennsylvania (French et al., 1955) have demonstrated a relationship between nutrition and antler development. Antler development in 1½ year old males was studied as a possible indicator of herd **thrif**t.

### Population Reconstruction

Populations were reconstructed for a given year by adjusting the age of the animals to that particular year.

### Distinction Between Population and Population Area

For the purpose of this paper the term population area will be interpreted as that area which is occupied by a given deer herd. The boundaries of the population areas discussed in this paper were arbitrarily set by evaluating the dynamics of the herds occupying them.

While this paper discusses the dynamics of the deer populations within these areas, it should be noted that these are actually subpopulations of the overall Savannah River Project deer population.

## RESULTS

Based on an analysis of data obtained it appears that changes in population characteristics are beginning to take place near the nucleus. The nucleus of the original Savannah River Project deer population is shown as a cross-hatched band in the lower Savannah River Swamp. This area corresponds to a series of high ridges which traverse the swamp from northwest to southeast. Relatively free from inundation by periodic river fluctuations and inaccessible to most of the inhabitants of the area it is most probably that this was the area of initial population build-up and diffusion.

### POPULATION AREA A

Population Area A is shown on the map (Fig. 2) as a dotted area to the immediate north of the river swamp. It is probable that deer from the river swamp filtered into this area first, several years after the Project was closed to the public (mid 1950's). Once the herd became established in this area further radiation was directed in a northern direction almost exclusively. Hot water affluents bounding the area on the east and west limited movement in those directions.

All data obtained from this area to date indicate the herd may be reaching maturity, characterized by declining herd thrift, and diminishing productivity. Factors leading to this conclusion are discussed in the following paragraphs.

### Age Class Compositions

The age distributions of animals harvested on the 1966 hunts were as follows:

TABLE 1 — AGE CLASS COMPOSITIONS OF POPULATION A OBTAINED FROM 1966 HUNTS

<u>Age</u>	<u>Males</u>	<u>Females</u>	<u>Total</u>
½ .....	37	31	68
1½ .....	12	26	38
2½ .....	12	32	44
3½ and older .....	14	37	51

The general age distribution as shown above appears to reflect a deficiency in the herd. The fawn crop appears low compared to the older age classes. In addition, there are more 2½ year old animals than sub-adults. The high proportion of animals 3½ years and older is expected since this population had experienced little predation until 1965.

Most disturbing is the preponderance of females to males in the older age classes. Since all deer hunts conducted on the Savannah River Project were for either sex with no bag limit and no significant dispersal rate between sexes has been observed, this author is unable to account for the high differential between sexes.

### Rate of Fawn Breeding as Expressed by Either Uterine Pregnancy or Active Lactation

Eighteen yearling females were collected from the area between March 1 and August 1, 1966. None exhibited pregnancy or active lac-

tation. Twenty-six additional animals were obtained during the month of October. None were found to be lactating. Based on this data it appears that fawn breeding was not occurring in this area during the 1965-66 breeding season. It should be noted that data obtained during the preceding year indicated approximately 35% fawn breeding success. From a limited sample of eleven animals four were found to have bred. It would appear that fawn breeding had been occurring in the herd prior to the 1965-66 breeding season.

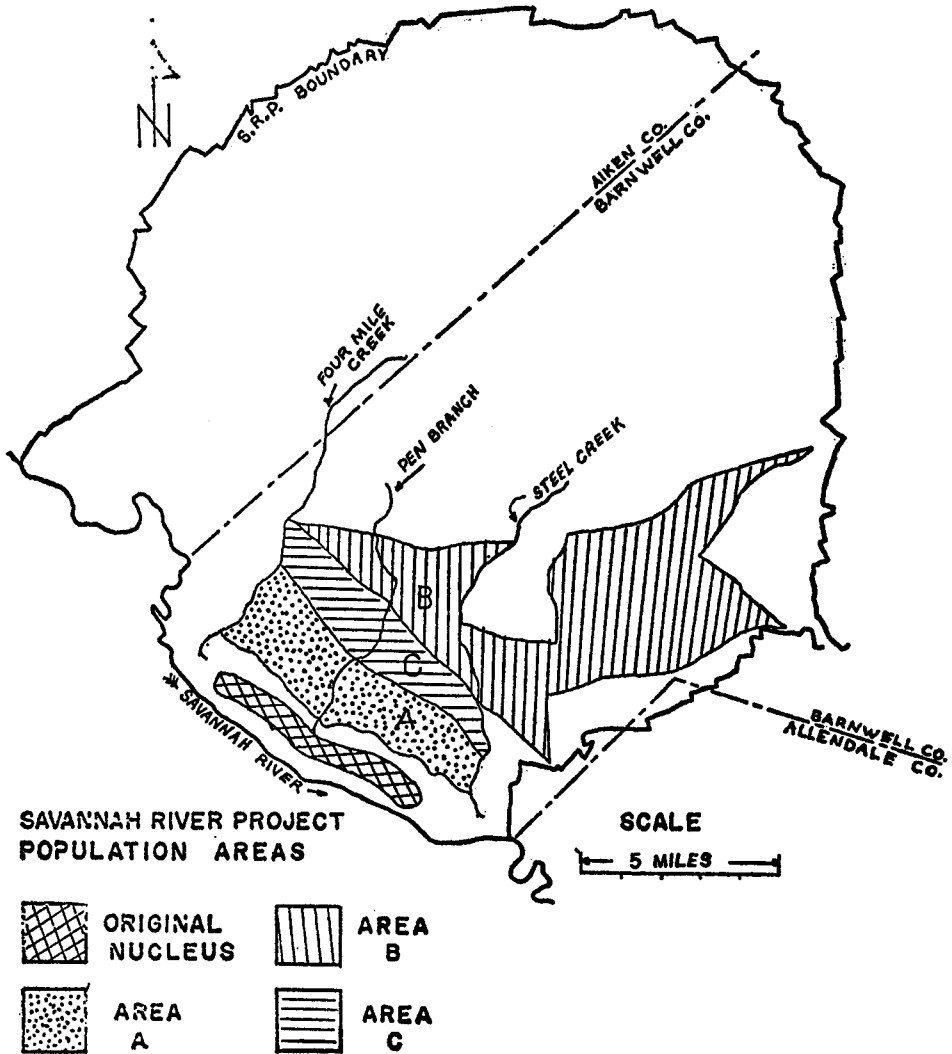


Fig. 2. Delineation of Study Area

#### Fawn-Adult Doe Ratios

The ratio of fawns to adult does ( $2\frac{1}{2}$  and older) obtained from 1966 hunt returns was .33 (32 does  $2\frac{1}{2}$  years and older—68 fawns). Due to the nature of the hunts it is improbable that the sample was biased against fawn shooting in that most of the fawns had lost their spots and were fairly large (mean weight both sexes approximately 55 pounds).

In addition, no bag limit was imposed on the hunter. If the sample is representative it appears that this ratio is quite low and indicative of unthrifty herd conditions.

#### *Antler Development in 1½-Year-Old Males*

Twelve 1½ year old males were harvested during the 1966 hunts. Only one animal had branched antlers. All others exhibited poor antler development.

Unfortunately it is impossible to compare this data with antler developments from previous years due to insufficient data.

#### *Population Reconstruction*

The minimum standing crop during the fall of 1965 was reconstructed by adjusting the ages of all deer obtained in the area to that period. A 10% mortality figure was added to each age class to compensate for losses. The hypothetical rate of increase for this herd was then calculated by back-aging for a period of five successive years to 1960. Adjustments were made to reflect a 10% loss within each age class during each successive year. (Table 2.)

TABLE 2—HYPOTHETICAL POPULATION INCREASE 1960-1965

Age Class	No. Animals in Population						
	1960	1961	1962	1963	1964	1965 <sup>1</sup>	1966 <sup>2</sup>
½	21	68	89	69	107	155	68
1½	3	19	62	81	63	97	
2½		2	17	56	74	57	
3½			2	15	51	67	
4½				2	13	46	
5½	1				2	12	
6½		1				2	
Older		1	1	1	1	1	

<sup>1</sup> Derived Minimum Standing Crop for 1965

<sup>2</sup> Based on 1966 Hunt Returns Only

Several factors become apparent from the population reconstruction data.

1. Few animals were present in the area during 1960-1961. It is believed that while the figures presented may be somewhat low they are representative of conditions during those years.

2. The population has expanded at a rapid rate during the period 1960-1965. Average annual increase during the years 1961-1965 was 33%.

3. Apparently there was a poor fawn crop during the spring of 1963. Severe flooding in the area during that period may partially account for this.

4. Age class compositions obtained during 1966 indicate a low fawn crop during 1965 (38 subadults). Apparently this was not so. Reconstruction figures for 1965 show a proportionately higher percent of fawns for that year than data obtained from the hunts indicate. However, the proportionately higher numbers of animals in the older age classes appear to reflect a herd reaching maturity.

5. The minimum standing crop on the area during 1965 was 447 animals on approximately 10.8 square miles or 41 animals per square mile.<sup>1</sup> Admittedly this does not include approximately 15 square miles of the Savannah River Swamp. However, due to the nature of the swamp the effect of deer ingress is believed to be negligible. At any rate it appears almost certain that the fall population during 1965 exceeded 45 animals per square mile.

### POPULATION AREA B

Population Area B is that area on the map delineated by vertical lines. It lies to the north and east of Population Area A. An inter-

<sup>1</sup> Includes 11 unaged animals.

mediate zone, Area C, varying between one and two miles in width separates the two. Approximate unit size of Area B is 30.9 square miles. Due to the width of intermediate zone C it is believed that there was no overlap in home range of animals in Areas A and B.

General topography and range is similar to that described for Area A. Bottomland hardwood is somewhat less and soils are slightly more sandy. Abandoned homesite vegetation is abundant. Carrying capacity is believed to be somewhat lower than in A.

Data obtained from the 1966 hunts in this area indicated herd conditions which differed significantly from those found in Area A. This herd has probably not yet reached maturity and is increasing rapidly. The biology of this herd is discussed in the following paragraphs.

#### *Age Class Compositions*

The age structure for this herd is shown below.

TABLE 3—AGE CLASS COMPOSITION OF POPULATION B  
(1966 HUNT RETURNS)

<i>Age</i>	<i>Male</i>	<i>Female</i>	<i>Total</i>
½	31	37	68
1½	23	29	52
2½	24	23	47
3½ and older	23	16	39
	101	105	206

Age class composition depicts the herd as relatively young and expanding rapidly. The numbers in the 2½, 3½ and older age class seem consistent with the fact that this herd had been subject to little predation.

#### *Fawn Breeding as Expressed by Either Uterine Pregnancy or Active Lactation*

Twenty-nine 1½-year-old does were harvested during the 1966 hunts from this area. Sixteen of these animals were lactating (approximately 55%). If the sample is representative better than 50% of the fawns had successfully bred during the 1965-66 breeding season. This is considered as excellent fawn reproduction.

#### *Fawn-Adult Doe Ratios*

The ratio of fawns to adult does (2½ years and older) was 1.74, (39 adult does to 68 fawns). If fawns were more vulnerable to hunting mortality this ratio may be slightly high. At any rate it appears indicative of excellent herd conditions.

#### *Antler Development in 1½-Year-Old-Males*

Twenty-three 1½-year-old males were harvested. Antler development was as follows:

TABLE 4—ANTLER DEVELOPMENT IN SUBADULT MALES  
(FALL 1966)

<i>Points</i>	<i>Number</i>	<i>Percent of Total</i>
Spikes	2	8.7%
3-5	11	47.8%
6-8	10	43.5%

#### *Population Reconstruction*

Due to the limited availability of data population reconstruction figures would be academic at this time.

### POPULATION AREA C

Intermediate population Area C overlaps the home ranges of animals in A and B to some extent. It would be expected that herd dynamics

would be intermediate between the two. There are indications that this may have been so during 1965. Hunt returns for that year indicate age class compositions favoring older animals and a somewhat low fawn to adult doe ratio. Fawn breeding and antler development during that year were considered good. In general, herd thrift was considered better than in Area A. Since sufficient information is lacking on the dynamics of the population occupying Area B it is not known whether thrift was better in that area. It is assumed that it was.

Analysis of 1966 hunt returns indicated that there may have been a sharp upswing in general herd thrift in this area. Table 5 summarizes the data obtained for both years.

TABLE 5—SUMMARY OF DATA OBTAINED IN POPULATION AREA C (1965-1966)

I. Age Class Compositions							
1965			1966				
Age	Male	Female	Total	Age	Male	Female	Total
½	16	16	32	½	21	18	39
1½	6	13	19	1½	6	11	17
2½	4	4	8	2½	6	8	14
3½+	17	19	36	3½+	11	12	23
II. Approximate Rate of Fawn Breeding							
1965.....			32%	1966.....			54%
III. Fawn-Adult Doe Ratio							
1965.....			1.4	1966.....			1.9
IV. Percent of 1½ Year Old Males Having Branched Antlers							
1965.....			100%	1966.....			83%

### DISCUSSION

It is apparent that the white-tail deer has expanded rapidly over the entire area. This paper has explored some of the dynamics of the species over a relatively small portion of the project. Deer are now present in the northernmost extremities of the area twenty miles from the original nucleus.

Area A is believed to be nearing overpopulation despite two successive years of heavy removal. The data presented in this paper seem consistent with this conclusion.

Fawn breeding was non-existent, fawn-adult doe ratios were low, and antler development in subadult males was poor. Population reconstruction figures for 1965 show a minimum standing crop of 41 animals per square mile and indicate continual herd expansion even though general thrift is declining. It is possible that the principle of inversivity was beginning to operate during 1966—more data will be required to substantiate this.

It is unfortunate that more data was not obtained from this area at an earlier date. The limited information available indicates that fawn breeding had occurred during 1964-65, and the age structure of the population does not reflect a poor reproductive rate of long standing.

The unequal sex ratio distribution obtained from 1966 hunt returns is unexplainable at this time. Uterine sex ratios favored males slightly and no significant evidence of uneven sex dispersal has been found. It seems improbable that for some mysterious reason bucks were able to avoid being shot. This is confirmed to some extent in that even distribution of sexes was obtained on the other areas. Presumably it is possible that a sex mortality rate differential existed in the older classes since the ratio of sexes in the fawn class was approximately equal. This question becomes of further interest since non hunting season collecting was biased in favor of females—presumably the hunt returns should have shown a higher proportion of males.

Herd dynamics in the original population center, the Savannah River Swamp, were unknown due to the inaccessibility of the area. Presumably, they were similar to the conditions described for Area A.



General herd thrift appeared much better in population Area B. Age structure of the herd characterized a young population, fawn-adult doe ratios were high, fawn breeding was in excess of 50%, and antler development in 1½-year-old males was excellent. Although the population was estimated to be in excess of thirty animals per square mile it was apparently below carrying capacity.

Intermediate Zone C was somewhat surprising in that general herd thrift was comparable to that found in Area B during 1966. Although adjacent to Area A it exhibited none of the unthrifty herd conditions found there. There may be two partial explanations for this:

1. A buffer strip lies between Areas A and C. This strip is approximately ⅓-¼ mile wide. No hunters were placed in this strip during the hunts. However, it is rather difficult to believe that this strip acted as a barrier, particularly when dogs were used to drive the deer.
2. A rather heavy removal was affected during 1965 by hunting and collecting (approximately 12 animals per square mile).

Analysis of 1965 data showed 32% fawn reproduction, 1.4 fawns per adult doe, an age class composition favoring older animals, and good antler development. Slightly fewer animals were removed during the 1966 hunts (11 per square mile). Analysis of this data indicated that fawn reproduction increased to 54%, fawn-adult doe ratios rose to 1.9, and age class compositions favored younger animals. There is some reason to believe that general thrift was declining during 1965, and that removal during that year actually stimulated the population.

#### SUMMARY

The Savannah River Plant deer herd has expanded remarkably during the past fifteen years. The original population nucleus isolated in several square miles of river swamp has radiated so that all portions of the 315 square mile land area now contain deer.

Two types of deer herds were described on the basis of age composition and declining herd thrift. A herd near the swamp was composed of a high portion of older animals and had poor reproduction and antler development. Herd dynamics in an area 2-5 miles further north were characterized by a young and thrifty population. The dynamics of deer obtained from an intermediate zone lying between these two extremes were also studied. Twelve animals per square mile were removed during 1965 and herd condition was considered as good. Data obtained from the area during 1966 indicate that herd conditions may have improved considerably.

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