

THE STATUS OF THE WHITE-TAILED DEER IN
BATH COUNTY, VIRGINIA

by

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INTRODUCTION

Purpose of Study

Studies of deer herd conditions throughout the Commonwealth of Virginia have been initiated by the Virginia Commission of Game and Inland Fisheries as the basis of future deer management. Bath County was selected as one of the counties for detail study since the deer herd in this particular county represents one of the few deer populations in western Virginia presumably not established by restocking. The deer herd in this county is believed, for indications in past years, to be out of balance with its habitat. Measurements to determine if such a belief is justified were desired by the Commission.

Detailed range and deer population data are necessary to determine the present status of the deer and to ascertain if corrective measures are necessary. This information should also provide a basis for an evaluation of corrective measures already taken as well as supply an indication of the future trend of the deer herd and range conditions in Bath County.

Scope of Study

This investigation was concerned both with the vegetation of major deer ranges and deer population characteristics on the ranges. Measurements were taken in an effort to determine differences between available browse and its utilization by the deer populations in various sections of the county. Effects of deer upon the range vegetation and consequently the influence of any vegetative deficiencies upon

deer were further substantiated by measurements of deer characteristics. Differences between deer weights, body sizes, and productivity considered in view of the range from which the deer were obtained should be considered in evaluating practices necessary for practical management.

In determining the scope of this investigation, the principle was accepted that intellegent deer management must maintain a balance between the size of the herd and the ability of the range to support it. No effort was made in this paper to determine if specific areas should be managed primarily for deer or for timber. Instead, findings of this study are presented for consideration in determining conditions that now prevail in Bath County, Virginia, as related to the deer herd.

BATH COUNTY CHARACTERISTICS

Terrain and Drainage

Bath County is situated on the Virginia - West Virginia state line where extremes in elevation occur. Elevations in the county range from a low of 1,140 feet, where the Cowpasture River leaves the county, to a maximum of 4,228 feet at Bald Knob on Warm Springs Mountain. Mad Sheep Mountain has an elevation of 4,226 feet. Most of the farming land is between the elevations of 2,000 and 2,500 feet. Most mountain tops have an elevation from 3,000 to 4,000 feet (Patteson and Fulton, 1951).

The two major watersheds of Bath County are those of the Jackson River and the Cowpasture River. These two rivers join to form the James River which flows into the Atlantic Ocean. Surface water shortage as related to animal consumption is apparently no problem throughout the county.

Soils

There is no published information on the soils of Bath County as they have not been classified or mapped as such, but Figure 1 indicates the relation of the three major soil series occurring within the county. The classification in Figure 1 was derived by use of a geological base map and from personal discussion with Dr. S. S. Obenshain of the Virginia Agriculture Experiment Station.

A comparison of Figure 1 and Figure 2 indicates the relationship between the poorer soil series and forest cover. Elliber soil series consist of mainly cherty dolomitics whereas Muskingum and Montevallo soil series consist of shales and sandstone. The poor soils plus the

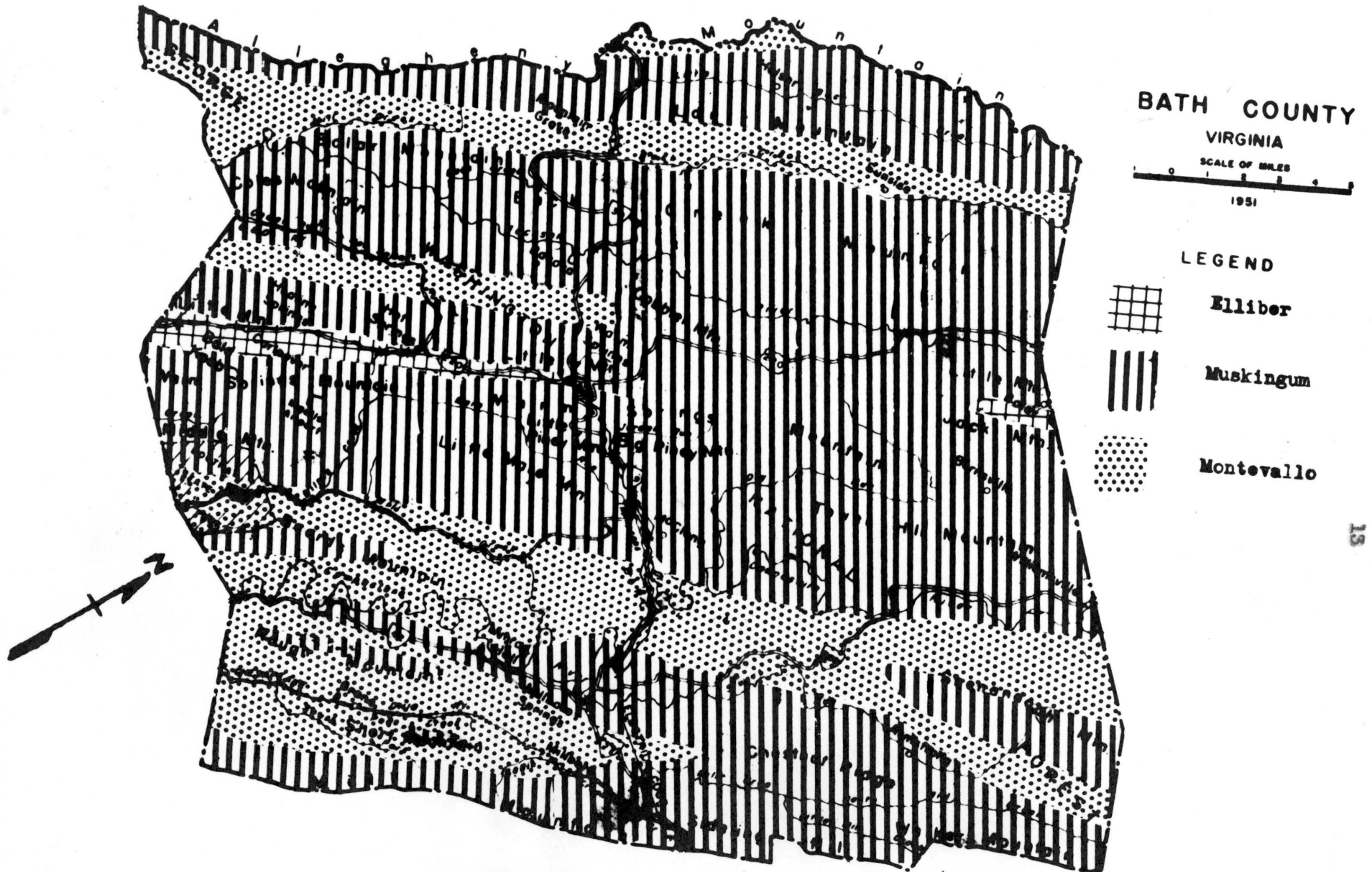


Figure 1. Soil series of Bath County, Virginia

steep slopes and extremes in elevation of the forested areas indicates that these areas have greatly reduced vegetation productivity capacity.

Land Use

The land use pattern of Bath County is conducive to deer habitat and deer management practices. Figure 2 illustrates the relationship of cleared land to forested land in the county. Of the total land area of 545,600 acres, 105,509 acres, or 30.5 percent of the county is in farm land, consisting of 472 different farms. Only 10,294 acres of the 105,509 acres of farm land are used as harvested cropland and 8,188 acres are used as pasture. Farm land reported as grazed woodland amounted to 9,382 acres while 54,980 acres of woodland were reported not grazed. Other pasture, not classified as cropland or woodland, comprised 17,599 acres and the remainder of the farm land consisted of 2,927 acres in house lots, roads, and wasteland (U. S. Dept. of Comm., 1951).

The George Washington National Forest comprises 160,105 acres, or 46 percent, of the county (Figure 3). This extensive area plus the reported private forested areas comprise approximately 72 percent of the entire county. This extensive area of forested land, broken by scattered areas of clearings and fields, indicates that there are no distinct divisions between deer ranges which otherwise would occur if extensive cleared land existed between the mountain ridges.

The land use practices on extensive holdings of national forest land and large tracts of privately owned land probably will not result in any drastic changes in forest distribution; therefore, extensive

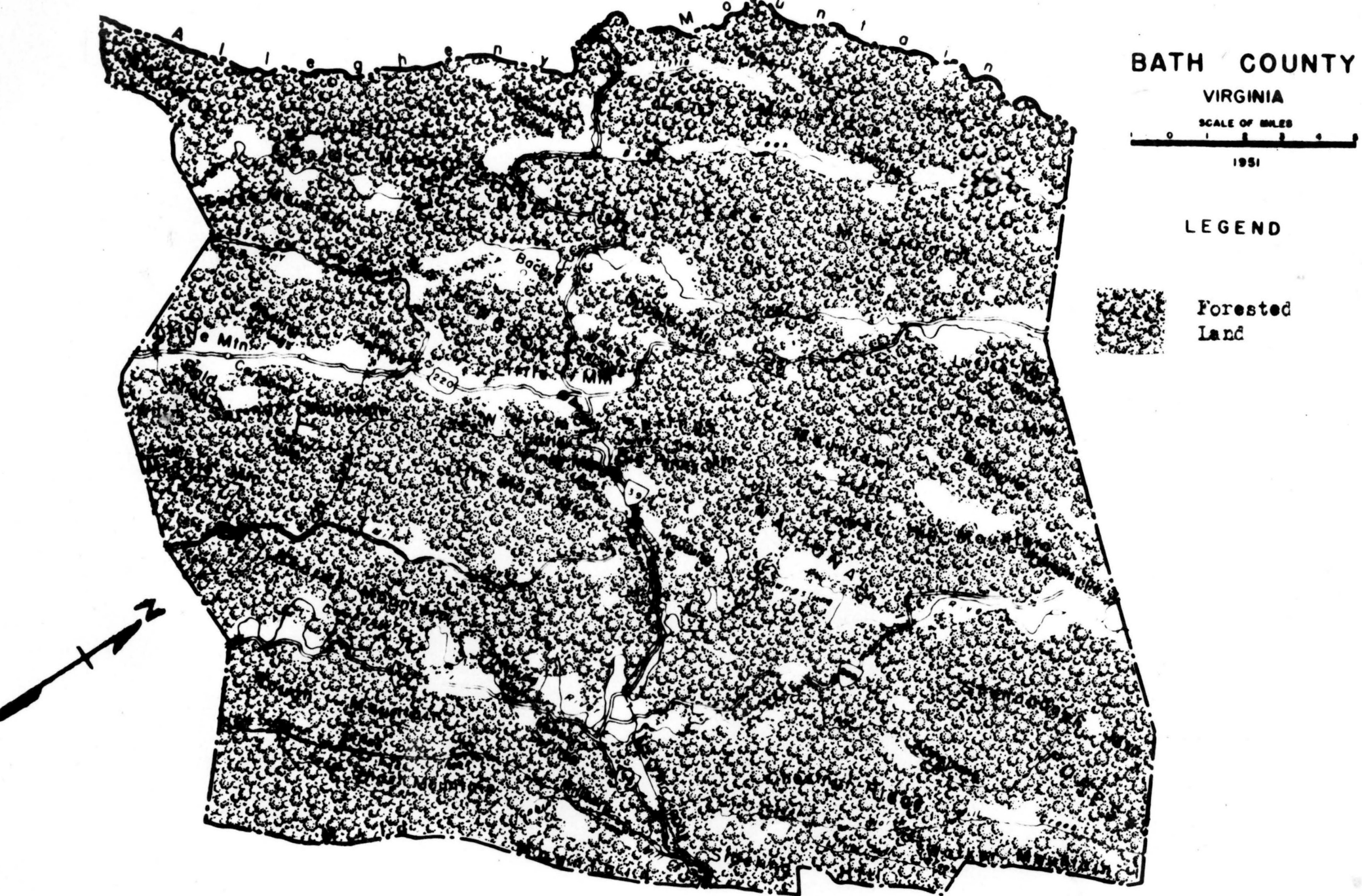


Figure 2. Distribution of forest cover in Bath County, Virginia

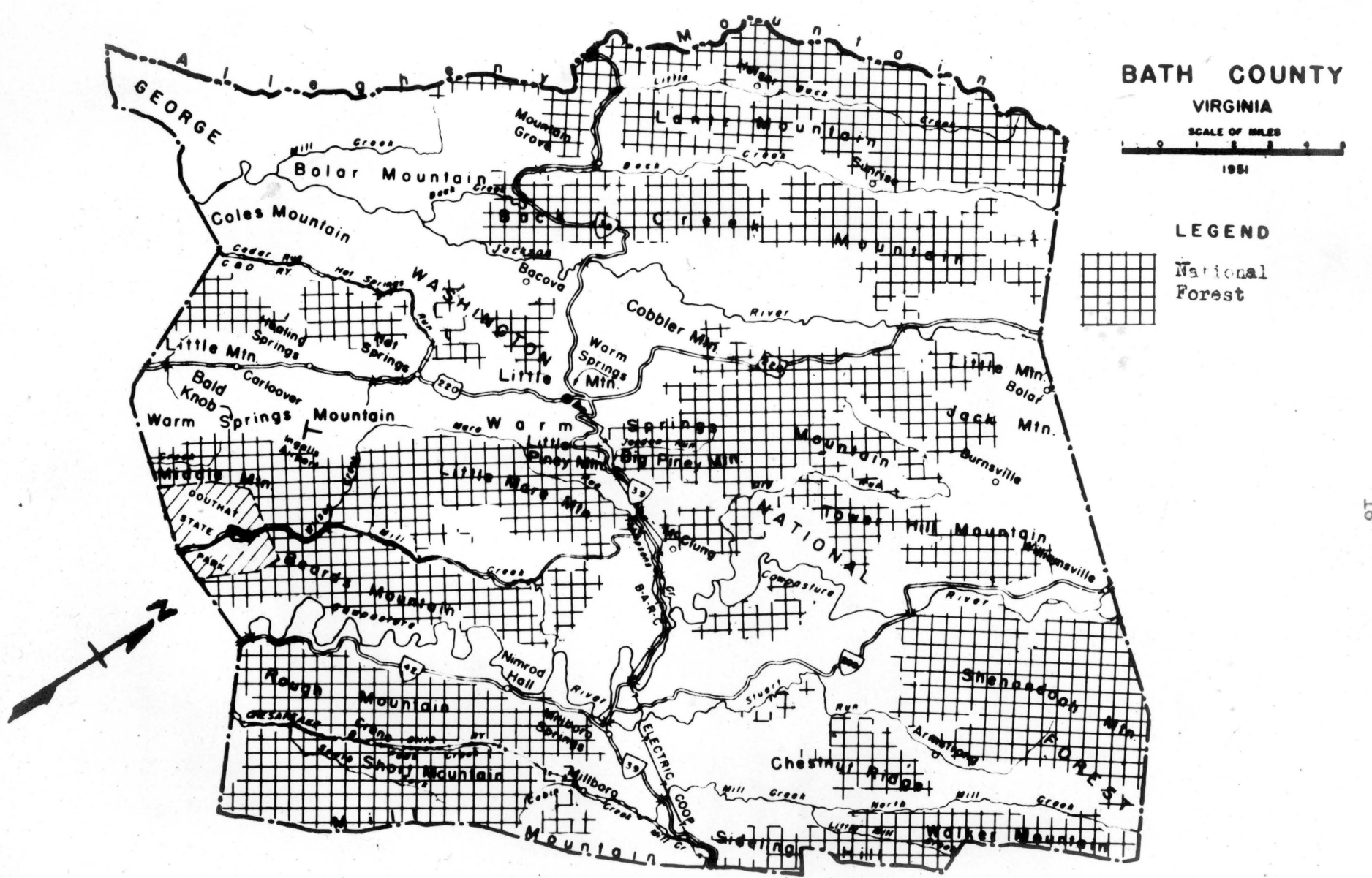


Figure 3. Location of George Washington National Forest in Bath County, Virginia

forested areas probably will remain throughout Bath County. The composition of these forested areas is progressively changing toward more mature forest growth as the result of managed logging and increased fire protection during the last twenty years. This change in forest composition may have greater effects upon deer than any foreseeable changes in forested acreage. This is discussed in greater detail later in the section RESULTS AND DISCUSSION under Browse Availability.

Commercial forest in Bath County consists of approximately 218,500 acres having 19.8 percent softwoods and 80.2 percent hardwoods. The Virginia Forest Service estimates that the annual growth amounts to 10,703,000 board feet while annual drain is only about 5,807,000 board feet (Va. Div. of Planning and Econ. Dev., 1952).

Human Factors

The 1950 population of Bath County was reported as 6,296 persons while the 1930 population was 8,157. This represents a 23 percent decrease in population in twenty years; however, there has been an increase in land use for farming over the same period. Even with this decrease in human population, the sale of Bath County damage stamps has increased from 561 in 1942 to approximately 4,000 to 5,000 stamps in recent years and has remained fairly constant at that level. The large sale of \$1.00 damage stamps, required of all persons who hunt deer and bear in Bath County, indicates that the resident population is not the only source of big game hunters. It is inconceivable to believe that this large number of the resident population hunt big game.

The per capita income probably has a great effect upon public sentiment toward the deer. The 1947 per capita income was \$844 compared to the Virginia average of \$994. Bath County families and unrelated individuals having incomes less than \$2,000 were 65.1 percent compared to a State average of 46.5 percent (Va. Div. of Planning and Econ. Dev., 1952). This low income can have both a favorable and an unfavorable influence on public opinion toward the deer. The increased revenue obtained during the hunting season is a favorable factor. Likewise, the damage by deer of crops affects the people having these losses to a greater extent. The value of deer meat to the low income group probably increases the rate of illegal kill of deer.

The deer season, with its influx of large numbers of hunters, represents substantial income for county residents for a short period of time. For example, one store operator in the county estimated that he would make a profit of \$1,000 during the six day season in 1953. Another store, which served as deer aging station in 1953, reported an increased income of \$500 over normal rate of business for the six day period. Another value of deer to the county is the large amount of meat furnished cheaply to the low income group. One butcher reported that his meat sales drop sharply during and following the deer season.

Hunting Clubs

Private hunt clubs in Bath County are a very important factor influencing deer hunting pressure. They own approximately 40,000

acres within the county and, in addition, control over 5,000 acres under lease. Included in the 40,000 acres is the 30,000 acres of Hickory Lodge land. A total of 52 hunt clubs have been established in the county with the oldest club having been established in 1905. Only five of the 52 clubs own tracts of land over 500 acres in area; the majority of the other clubs either lease land for hunting or own less than 100 acres.

The greatest influence of hunt clubs upon deer hunting is their indirect control of national forest land. Most of the clubs are located in positions that restrict public use of large tracts of public lands. For example, the Bear Loop Hunt Club located on Wilson Creek owns a narrow strip of land for miles on both sides of the road through that area. Their land is "plastered" with posted signs and access to public land is denied even though national forest boundary markers are within sight (100 yards) of the public road. Large areas of Shenandoah Mountain, Rough Mountain, Back Creek Mountain, and Warm Springs Mountain are similarly restricted by strategically located hunt club lands. This condition removes the necessity of hunt clubs owning and paying taxes on large acreages of land for their hunting purposes.

Public roads to relatively inaccessible areas are being constructed, as timber sales justify their construction, but without additional measures most of the inaccessible areas will remain under control of a few private hunt clubs. This control directly affects hunters' use of such areas and harvest of legal deer populations.

This reduced hunting pressure as a result of strategically located club property is indicated by known deer kill locations which is discussed in the section of this report on RESULTS AND DISCUSSION under Deer kill locations.

DEER HERD HISTORY

Source of Deer Herd

The deer herd in Bath County represents progeny of one of the few original deer populations not eliminated by hunting in western Virginia. There are several reports of deer restocking by private individuals within the county but there are no records of restocking by the Virginia Commission of Game and Inland Fisheries. Mr. T. M. Gaithright, who lives at Hickory Lodge, reported in personal interview that he stocked 49 deer on Hickory Lodge land approximately 24 years ago. Some of these deer were reported to have come from Illinois. This restocking could not be verified from other sources.

Deer were restocked in adjoining counties and probably have spread to portions of Bath County near these adjoining restocked areas. A total of 101 deer were released in Augusta County with some of these releases near the northeastern boundary of Bath County (Woolley, 1940). The influence of restocking of individuals known to be of the Odocoileus v. borealis subspecies in adjoining Virginia and West Virginia counties (DeGarmo, 1950) upon the original deer stock in Bath County is unknown. It may be one factor in the body size differences noted between the southeastern and northwestern sections of the county.

Past Kill Records

The big game checking system was initiated in 1947 in Virginia and until then no exact method of determining the annual deer kill was available. Prior to 1947 the annual deer kills each year were

obtained by estimates by the county game wardens. Table 1 presents data on the reported deer kill in Bath County from 1930 through 1953. Information for the period 1930 through 1952 is from Richards (1953); 1953 kill records are from reports made to the Virginia Commission of Game and Inland Fisheries.

Deer Hunting Pressure

Sale of Bath County deer and bear damage stamps indicates the hunting pressure on deer and bear in the county for the period 1942 through 1953. The records indicate mainly deer hunting pressure, presumedly, as only a few hunters hunt bear only. Every hunter is required by law to purchase a \$1.00 damage stamp before hunting deer and bear in Bath County. Table 2 indicates the number of stamps sold per year from 1942 through 1953. Use of money obtained from sale of stamps is indicated in Table 3 as related to deer damage payments. These data were obtained from official records in the Bath County clerk's office.

Past Deer Decimating Factors

The only recorded drastic reduction in the Bath County deer herd took place in the summer of 1951 in the form of a deer "die-off." Richards (1953) estimated that 50 to 100 deer died of unknown cause during this period. U. S. Forest Service personnel in the county estimate that the "die-off" may have reduced the herd from 500 to 1000 animals, based on deer skeletons found in the forest. Similar deer losses of unknown cause occurred at the same period in other counties in Virginia and also occurred in West Virginia.

Table 1 Reported deer kill in Bath County, Virginia, for the period 1930 through 1953.

Year	Deer killed		Length of season	Type of season
	Buck	Doe		
1930	150	---		Bucks only
1931	110	---		Bucks only
1932	150	---		Bucks only
1933	140	---		Bucks only
1934	202	---		Bucks only
1935	200	---		Bucks only
1936	218	---		Bucks only
1937	226	---		Bucks only
1938	200	---		Bucks only
1939	200	---		Bucks only
1940	190	---	5 days	Bucks only
1941	240	---	5 days	Bucks only
1942	193	---	5 days	Bucks only
1943	224	---	5 days	Bucks only
1944	182	---	5 days	Bucks only
1945	281	---	5 days	Bucks only
1946	391	---	5 days	Bucks only
1947	357	---	5 days	Bucks only
1948	444	---	5 days	Bucks only
1949	460	---	5 days	Bucks only
1950	375	---	5 days	Bucks only
1951	465	---	5 days	Bucks only
1952	709	203	6 days	Bucks 6 days; Does 6th day
1953	689	---	6 days	Bucks only

Table 2 Sale of Bath County deer and bear damage stamps per year from 1942 through 1953

Year	Number stamps sold	Year	Number stamps sold
1942	561	1948	5193
1943	2370	1949	5267
1944	2971	1950	4919
1945	3793	1951	4770
1946	4500	1952	5891
1947	5180	1953	5310
		Total	50725

Table 3 Disbursements of funds from Bath County deer and bear damage stamp for the period 1950 to February 1954

Item	Amount Expended				
	1950	1951	1952	1953	1954
Damage payments	----	\$1557.20	\$1564.21	\$518.50	----
Stamp printing	\$166.55	92.90	93.02	93.12	----
Payment to clerk	----	----	477.00	----	----
Salt	----	----	26.40	22.00	----
Special police salaries	----	183.30	459.42	422.84	\$813.64
Seeding plots	----	249.15	462.50	371.83	----
Game warden radio	----	----	----	882.05	----
Totals	\$166.55	\$2082.53	\$3082.55	\$2310.34	\$813.64
			Total expended		\$8455.61

The cause of the "die-off" remains unknown even though several deer were brought to Virginia Polytechnic Institute and examined by the college veterinarian. Areas of high deer concentrations such as Douthat State Park, Wilson Creek area, and Hickory Lodge land had the greatest reported number of deaths, but remains of deer, which are still being found, indicate that the "die-off" was widespread throughout the county. The supervisor of Douthat State Park reported removing 26 deer carcasses during 1951 from along trails within the 4,000 acre park. In the spring of 1953 the park crew removed numerous deer bones, that had washed down one small stream, from a beach on Douthat Lake.

A measure of the effect of the "die-off" upon the deer herd can be obtained by a comparison of deer observed prior to the "die-off" and those seen in 1953. U. S. Forest Service personnel counted over 100 deer along the Wilson Creek road in one afternoon in 1951. This same road was used as road number 2 in the roadside deer census in 1953 and the maximum number of deer observed in any one afternoon over a six month period was five deer. The Wilson Creek area, which is Area III in the population estimate studies, ranked the lowest in deer populations as compared to all other areas. This area, prior to the "die-off," was considered to have the greatest number of deer of all areas in the county.

METHODS AND PROCEDURES

Population Estimates

Observation lines. A technique for obtaining deer population indices based on work by Hahn (1949) was adapted for this study. Three walking observation lines were established within each of four areas supposedly selected to represent four different deer populations and vegetation types. All lines were located along unused logging roads and existing trails, preferably roads and trails that crossed the different drainages of the area.

The disadvantage of using roads or trails is that they may not cross terrain typical of an area or through deer populations not characteristic of an area, as the result of edge effect caused by clearing. Whether or not the selected lines passed through typical terrain or deer populations would be very difficult to prove. Some of the trails were very old and completely covered by the forest canopy, whereas some ran through clearings and extensive logged areas. Similar conditions, as near as possible, on all lines in the four areas should reduce effects of the differences of trails upon number of deer observed. The advantage of using roads and trails rather than a compass course is that the observer can travel much more quietly, devoting all his attention to observing deer instead of expending effort to remain on the census line.

All 12 lines were a uniform length of 2200 yards as determined by pacing. Numbered markers were placed every 100 yards on the line. These markers were used in plotting locations of deer observed and in

determining the areas of visibility for each line. At every 100 yard marker visibility at right angles to the line was determined by pacing alternately right and left of the trail into the woods until a white handkerchief at hip pocket height, or approximately the height of a deer, disappeared from view. These paced distances were averaged for the entire line and the average visibility distance doubled to compensate for both sides of the line. This average figure was multiplied by the length of line to determine area of visibility. The area of large clearings along the line was determined and added to the previously computed area of visibility for that line. These measurements were made in July and August, a period when the vegetation was in full foliage. The change in visibility as a result of the loss of leaves in late fall was gradual; therefore, no new measurements of visibility were attempted. The perpendicular, flush, and total distances of each deer observed was recorded for comparison with determined areas of visibility.

Conditions of weather, time of day, and direction traveled were standardized for all census lines. The initiation of censusing was as follows: one-half hour before sunset on days with no rain falling for two and one-half hours before the census time. The direction of travel was always from zero to the 2200 yard marker; the time required to complete censusing varied from 40 to 60 minutes. The order of running the lines each month was established by use of a table of random numbers. Use of a random system of selection removed personal bias in the order of running census lines. All 12 lines were traveled once a month and completed as near the first of the month as possible.

A standard form (Appendix Figure 2) was prepared upon which to record information in order to prevent omission of items and to simplify recording information on each line.

Pellet lines. The abundance of deer pellet groups as an indication of deer populations and deer utilization of areas has both advantages and disadvantages. The advantages are: (1) that pellets are evident even though deer may be difficult to observe, and (2) as reported by Bennett, et al. (1940) the number of pellet groups is usually in proportion to the amount of utilization of an area. As far as known, the number of pellets dropped per unit of time is the same irregardless of the season or weather, which is not true of sight observation of deer (Hahn, 1949).

Disadvantages of the pellet group count encountered in this study were primarily due to lack of basic information concerning deer in this region. Therefore, no definite correlation of pellet group abundance to deer abundance can be made from the data collected. Another disadvantage of the pellet group count is that during the fall leaves cover up the pellets and prevent their observation. Deep snows prevent monthly pellet counts on a predetermined schedule.

Selection of areas in which to establish pellet lines was difficult as the distribution of pellets is not homogenous over a region, e.g., some vegetative types are more used by deer for bedding areas while different degrees of slope and exposure contain different amounts of deer pellets.

All pellet lines established in this investigation were in close proximity to one of the deer walking observation lines. Pellet lines

starting from these observation lines were laid out on compass courses crossing the drainage systems of the area. Once the compass course for a pellet line was selected, that line continued for 1000 yards on that compass course irrespective of topography or vegetative cover. Standard size lines, 1000 yards in length and 10.2 feet in width, were marked with painted stakes located every 100 yards along the line. This standard line gave a coverage of 0.7 acre.

Vegetative cover on the line was not disturbed except for blazing markers on trees along the compass course which marked the pellet line. Pellets were removed when the lines were established and thereafter they were removed on a monthly basis. Pellet groups were recorded as the number per hundred yard interval. During the period when the leaves were falling, likely spots, such as visible trails and deer beds, were examined closely for pellets. Differences in size, extent of weathering, and texture were aids in determining if there were one or more pellet groups in one place.

Roadside census. Roadside counts of deer have been used widely to obtain an indication of deer population trends in various areas (Ruff, 1958; Hahn, 1949; Severinghaus, 1953). Variations as to results obtained by these workers causes the writer to question the technique as a method of indicating deer densities. Best results seem to have been obtained when these roadside counts of deer are made by the same observer who makes all observations under uniform conditions of time of day, weather conditions, and similar considerations as is possible.

Secondary unpaved roads which transected major deer ranges were selected for roadside counts. When possible the least traveled roads

were selected in this study. Roadside counts were made during the last hour of daylight as the maximum number of deer are seen (Hahn, 1949) and the least amount of human interference occurs at this time.

Counts were made from an automobile traveling at a speed of 15 to 20 miles per hour, with the observer doing the driving. The vehicle was stopped at large fields, where binoculars were used for locating and observing deer. If both an observer and driver had been available, the number of deer seen may have increased as a driver-observer can not give his full attention to either function. Difficulty was experienced in observing both sides of the roads, especially steep areas; therefore, the observer had a tendency to concentrate on clearings and fields.

Deer kill locations. Deer kill locations for the 1953 hunting season were plotted within square mile grids on a Bath County map. Locations were based upon information obtained from successful hunt clubs and individual hunters. Kill locations from individual hunters were obtained at special aging stations during the first three days of the six day season and the hunt clubs were contacted immediately after the hunting season concerning members' kill. Locations were obtained for approximately 20 percent of the total deer kill in Bath County by these procedures.

Bucks constituted the entire season kill; therefore, only the known kill density for legal bucks per square mile can be presented. No attempt will be made to convert this buck kill to a deer population figure per square mile. Instead, the information is presented to substantiate data obtained by other techniques, attempted in this study,

regarding the relative deer density in various sections of Bath County.

Population Characteristics

Check stations for legally tagging and recording big game kills in Virginia have been used since 1947. Starting in 1951 some check stations were designated as aging stations where the detailed examination of a portion of the legal kill was made. The location of these aging stations may bias the results obtained; this effect will be discussed later in the section, RESULTS AND DISCUSSION.

Critical body measurements collected at aging stations during the 1953 deer hunting season (bucks only) were as follows: age, weight, length of right hind foot, diameter of right antler, and number of points per antler. Deer were aged by the examination of dental replacement and wear criteria developed by Severinghaus (1949). Animals were weighed to the nearest one-half pound using platform scales and the organs removed, if any, recorded. Length of the right hind foot measured to the nearest 1/4 inch and diameter of right antler one inch above the burr to the nearest millimeter were taken. The diameter of the right antler was obtained by averaging two caliper measurements taken at right angles to each other. Antler points were not counted unless they projected at least one inch from the main beam outline.

Some additional measurements of Bath County deer taken by game technicians during the 1952 deer hunting season are presented. Data on the diameter of antlers for 1952 are not included in this report as differences occurred in the units and type of measurements.

Weights of all deer for both 1952 and 1953 were converted to hog-dressed weight, i.e., weight with all of the internal organs removed.

Live-weights were converted to hog-dressed weights by using Severinghaus's (1949) regression equation $(-1.5 + .788)$. Corrections for heart, liver, and lungs left in field-dressed animals were obtained from conversion factors (Table 4), after DeGarmo (1952).

Sex and Productivity Ratios

Records of deer observed in the field were kept for each month and each area throughout Bath County in order to determine sex ratios and to obtain data on the average number of fawns per doe. Only personal observations of animals identified to sex and age were used in this classification. Identification as to sex and age was made by using binoculars. Definite identification as to sex may not have been as much a reality as was thought at the time of identification. Large numbers of the 1 1/2 year age class bucks which were killed in November had very short antlers; therefore, it is possible that they may have been identified in the field as does. These antlers were difficult to see even at close ranges.

Deer Mortality

Losses from the deer herd, other than by legal hunting, were determined by personal observation, warden reports, and reports from other individuals. Complete analysis of such a difficult subject can only be obtained through the cooperation of all individuals in the county. Probably only a fraction of the actual number of deer lost to causes other than legal hunting is observed and reported; however, reported losses may indicate the severity of such losses.

Range Conditions

Browse availability. Many techniques have been developed for measuring

Table 4 Conversion of field-dressed weight to hog-dressed weight using correction factor for heart, liver, lungs per field-dressed weight class (Weight ratio - heart : liver : lungs :: 2 : 5 : 3)

Field-dressed weight	Subtract for heart, liver, lungs
to 33 lbs.	2 lbs.
34 - 49	3
50 - 65	4
66 - 81	5
82 - 97	6
98 - 113	7
114 - 129	8
130 - 145	9
146 - 161	10
162 - 177	11
178 - 193	12
194 - 209	13

the relative amounts of forage available for animals. Each method has advantages and disadvantages which must be considered when selecting the appropriate technique or techniques for measuring forage availability in an area to be studied.

Ocular estimates have the following advantages: (1) they are rapid, (2) they are easily made, and (3) they are adaptable to large areas. Ocular estimates have disadvantages as follows: (1) they are not exact measurements, (2) they are biased, and (3) there are no practical means of checking the results and improving individual performance. Some ocular browse measuring techniques were developed by Young (1938), Webb (1942), and Aldous (1944).

Precise measurements such as weighing or counting stems on transects have the following advantages: (1) they are not estimates, (2) comparison between individuals using the technique can be made, and (3) they provide a means of improving individual performance. The disadvantages are: (1) they are time consuming and tedious, and (2) amount of area that can be sampled is limited. Some precise browse measuring techniques were developed by Dalke (1941), Schwan and Swift (1941), and Lindzey (1950).

The procedure followed in this study was essentially a combination of the techniques outlined by Dalke (1941) and Schwan and Swift (1941). All of the current season's growth of all perennial species on a 1/100 acre circular plot (radius of 11.7 feet) was clipped up to a height of five feet for weighing. This height was considered the height to which deer readily browsed in this region as based on personal observations in Bath County and the findings of Dalke (1941) in Missouri.

Clipped browse was placed in paper bags, labeled, air dried, and weighed. Air dry weights reduce the difference between weight of species resulting from differences in succulence. Air dry weights of each species on the plots were made with beam balance scales calibrated to 0.1 gram; any material not weighing 0.1 gram was listed as a trace. A prepared field form standardized the technique of recording field data and reduced the chance of overlooking an item when clipping browse (Appendix Figure 1). Species present on individual plots were checked on the form during collection to facilitate recognition while weighing.

Random sampling of the entire county was not attempted because of the size of the area and limited manpower available. Instead standard mechanical procedures were used in the selection of plots. All plots were established on a 315 degree N. W. or 135 degree S. E. compass course with a clip plot located at every 330 feet paced interval. These compass courses were selected since the mountains in Bath County generally run East - West and the selected compass courses transect both ridges and valleys, in order to obtain representative samples of the vegetation.

Weights of clipping in grams were converted to pounds-per-acre. Frequency of each species was defined as the number of plots in which it occurred on that line. The percentage weight of each species was computed on the basis of the total weight of that species clipped per line divided by the total clipped browse weight for the same line.

Browse utilization. A browse utilization study developed by Casebeer and Rognrub (1950) was modified slightly for use in Bath County. In

brief, this method of determining browse utilization consisted of selecting, marking, and measuring, in inches, samples of browse species within an area. The original measurements were taken again in early spring; the browse utilization by deer was indicated by the differences in these two measurements. Areas with high deer population posed a problem in that preferred browse species with twigs within five feet of the ground were nonexistent. In such areas, small saplings were bent over so that some browse was within reach of deer and marked. Since this was necessary in high deer population areas this bending down of browse species also was accomplished in limited amounts in all areas so that any influence caused by increasing accessibility would occur in all areas.

One walking observation line in each of areas I, III, and IV was selected for a comparison of browse utilization and observed deer numbers. At one-half the distance between every 100 yard marker on the walking observation line, four samples were tagged and measured. These samples were located alternately right and left at right angles to the observation line, one-half the previously determined visibility distance at that portion of the observation line. By this placement, the samples would be located within the area of visibility of the walking observation line.

The remainder of the tagged samples were located either on compass courses throughout the county or on previously established pellet lines. An important consideration was selection of permanent landmarks in order to relocate samples in the spring for final measurements. All

browse utilization samples were marked with small one-inch square wood tags, painted yellow. These tags were placed to mark branches of browse species measured and to locate tagged species. The stakes used to locate sample sites were painted either yellow or white, but those painted yellow were easier to relocate.

RESULTS AND DISCUSSION

Population Estimates

Observation lines. Using the technique as set forth in METHODS AND PROCEDURES, this census was carried out on 12 walking observation lines, three in each of four areas, for the seven month period from August, 1953 through February, 1954. Figure 4 indicates locations of deer observation lines in relation to Areas and pellet lines. Table 5 contains the number of deer observed per area and per line in Bath County during the seven month period. Prior to censusing, Area I was selected as the highest deer population, with Area II as the next highest and representing the highest deer population on national forest land. Areas III and IV were considered to have lower deer population than Area I and II. An analysis of observational data collected on the census lines showed that in general such differences did exist in fact (Table 6).

The analysis involved an analysis of variance with a square root transformation of the original data. No significant difference was observed between months; however, a very significant difference occurred between areas.

Results of analysis indicates that the observation line technique does not necessarily have to be run in any particular month for comparison of areas, but periods of highest deer numbers are desirable. If maximum number of deer observed were the objective of a study, then early fall months should be chosen. If a comparison of areas was the main objective, then this census index would be suitable for use any

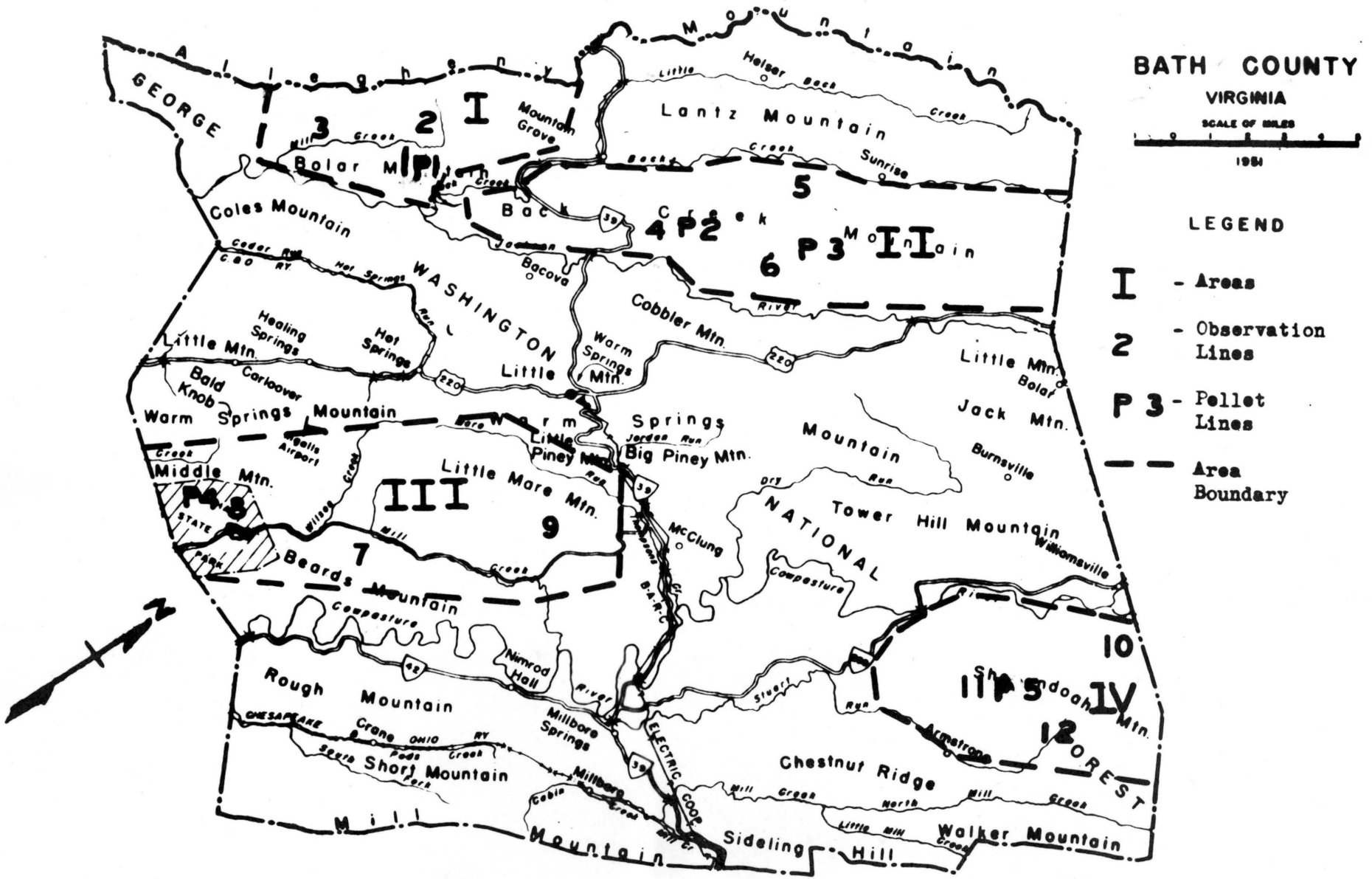


Figure 4. Locations of walking observation lines and pellet lines in Bath County, Virginia

Table 5 Number of deer observed on walking observation lines in Bath County, Virginia, 1953 - 1954

Months	Lines --	Area I			Area II			Area III			Area IV			Totals
		1	2	3	4	5	6	7	8	9	10	11	12	
August		5	6	7	2	0	4	1	0	1	2	0	0	28
September		14	9	3	0	0	11	0	1	0	1	1	0	40
October		7	4	3	3	2	15	0	0	0	0	0	1	35
November		6	2	9	0	6	1	0	0	0	0	0	0	24
December		7	1	3	0	0	0	3	0	0	0	1	0	15
January		5	8	1	0	1	0	0	0	0	0	0	0	15
February		3	2	8	0	0	0	0	0	0	0	1	0	14
Total		47	32	34	5	9	31	4	1	1	3	3	1	171
Average per line		6.9	4.5	4.9	0.7	1.4	4.4	0.6	0.1	0.1	0.4	0.4	0.1	
Area average			5.4			2.1		0.29			0.33			

Table 6 Results of analysis of variance of results obtained from walking observation in Bath County, Virginia, 1953 - 1954

Source of variation	Degrees of freedom	Sums of square	Mean square	F - values		Computed F
				F .05	F .01	
Areas (C)	3	150.3339	50.1113	2.74	3.07	29.793
Months (M)	6	17.5099	2.9180	2.23	3.07	1.735
Interaction (C x M)	18	30.7043	1.7058	----	----	----
Error (E)	56	93.7669	1.6744	----	----	----
Pooled error (E ± C x M)	74	124.4712	1.6820	----	----	----
Total	83	292.3130	-----	----	----	----

month, provided that the actual difference in deer population are not slight.

A multiple range test (Duncan, 1953) was used to compare individual areas. Area I was significantly different from Areas II, III, and IV. Area II was significantly different from Areas I, III, and IV, but the difference between Area III and Area IV was not significantly different. These results further substantiate the fact that differences in deer population in these areas actually exist and are determinable by observations, i.e., an individual can actually select areas of high and low deer populations based on personal observations in the area.

The effects of the hunting season upon observations was tested by use of a "t- test." Results of the number of deer observed on the walking observation lines during the months before and after the November deer hunting season (November 16 - 21, 1953) were compared. November's observations were discarded because it was believed that hunters' activities just prior to the season affected the observation considerably. There was a very significant difference between the average number of deer observed before and after the hunting season ($t_{.01} = 2.65$; computed $t = 3.20$). This would be expected since over 690 deer were killed in the county. Line number 1 was the only line on which no hunting actually occurred, but even there hunting on nearby areas probably exerted some effect on the number of deer observed.

The main purpose of the study was to rate areas according to some standard of deer density. Using the determined areas of visibility and average number of deer observed per month for each walking observation line, deer density ratings were determined as shown in Table 7. These

Table 7 Deer density on walking observation lines in Bath County, Virginia, based on average number of deer observed and the determined areas of visibility

Area	Lines	Area of visibility	Total deer per line	Average deer per line	Deer density per line	Area average density
I	1	56.5 acres	47	6.90	1 to 8 acres	
	2	31.8	32	4.50	1 to 7	1 to 7 acres
	3	27.9	34	4.90	1 to 6	
II	4	22.0	5	0.71	1 to 31	
	5	49.0	9	1.40	1 to 35	1 to 26
	6	51.0	31	4.40	1 to 12	
III	7	32.8	4	0.59	1 to 56	
	8	19.2	1	0.14	1 to 137	1 to 127
	9	26.2	1	0.14	1 to 187	
IV	10	24.6	3	0.42	1 to 59	
	11	25.2	3	0.42	1 to 60	1 to 94
	12	22.7	1	0.14	1 to 162	

values may not be indicative of existing deer populations, however they are probably the best obtainable under the limitations of this study.

Pellet lines. A total of five pellet lines were established in Bath County during the period of August to October 1953. The technique used is described in METHODS AND PROCEDURES. Figure 4 shows the location of the pellet lines in relation to the walking observation lines in each of the established areas. One pellet line was located in each area except for Area II, which had two pellet lines.

Table 8, based on data of pellet groups per pellet line ranked the density, as measured by deer use, of areas in the same order as the density by observations on the walking observation lines (Table 5). The relationship between average number of deer observed per month and average number of pellet groups per month is presented by the regression line in Figure 5. Based on a visual analysis of the regression line there appears to be a definite relationship between the number of pellets per unit area and number of deer observed.

Using the factor determined by McCain (1948) of 12.7 pellet groups per acre per month, a much lower deer density was obtained per pellet line than by observations on the walking observation lines. Pellet line results (Table 8) indicate a density of 1 deer per 15 acres for pellet line 1; pellet line 2, 1 deer per 75 acres; pellet line 3, 1 deer per 41 acres; pellet line 4, 1 deer per 375 acres; and pellet line 5, 1 deer per 177 acres.

Roadside census. Two roads of approximately equal length (12 miles)

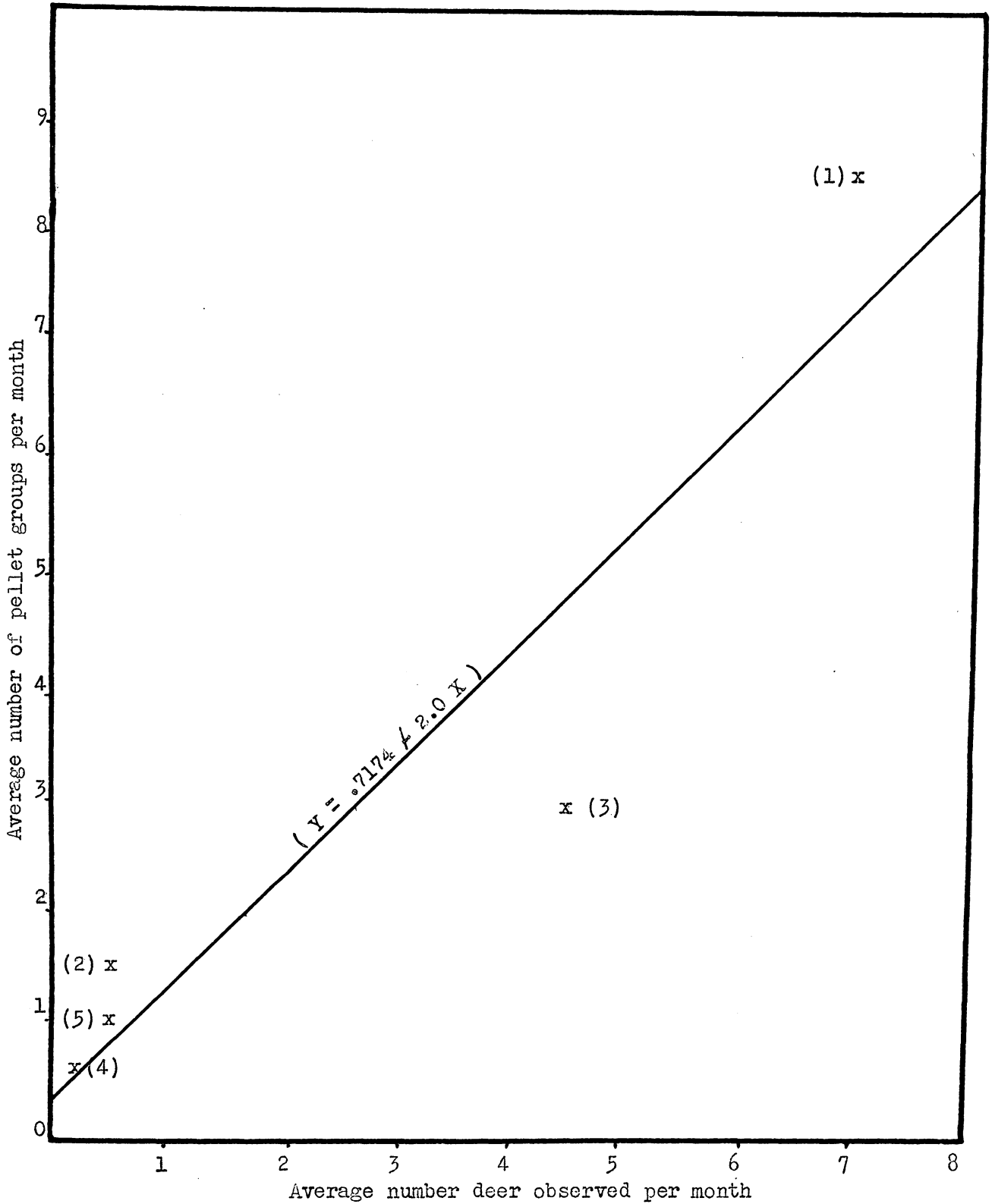


Figure 5. Regression line of average number of deer per month to the average number of pellet groups per month

Table 8 Number of pellet groups per month on 0.7 acre pellet lines in four areas of Bath County, Virginia, 1953 - 1954

Months	Area I	Area II		Area III	Area IV
	Line 1	Line 2	Line 3	Line 4	Line 5
September	12	7	5	2	-- **
October	22	3	8	2	-- **
November	9	0	7	1	1
December	7	1	-- *	0	2
January	13	4	8	1	2
February	40	3	7	0	3
Total pellets	103	18	35	6	8
Total days	168	184	160	177	117
Pellets per acre per month	26.2	4.3	9.4	1.0	2.1

* Ground covered with snow

** Line not established

were selected, one each in a low population area and a high population area in order to obtain indices of the population. The census procedure has been discussed under METHODS AND PROCEDURES. Figure 6 shows location of roadside census routes in Area I and Area III.

Table 9 contains the results of six monthly observations along the roads. Variations in the number of deer observed were greater than for any of the walking observation lines. On Road 1, which was also the starting point for all three walking observation lines in Area I, the average number of deer seen per mile of roadside was 0.6 deer while for all three walking observation lines an average of 4.5 deer per mile was seen. Road 1 passes through large areas of abandoned fields and orchards which it would seem would increase the number of deer observed. Another factor affecting observations was the influence of human activities along roads as was indicated by the results for October, November, and December. During these months, there was an increase in illegal spotlighting of deer. Even with these differences between the results of the roadside census and observation lines, both indicated that Area I had a greater deer population than Area III.

The deer hunting season exerted an appreciable influence on deer activities as was shown in data from the walking observation lines. There was a very significant difference between average number deer observed prior to and following the hunting season. This influence may be greater on the roadside census since large number of hunters travel roads before the hunting season trying to locate areas of high deer populations. Long range roadside censuses by personnel familiar

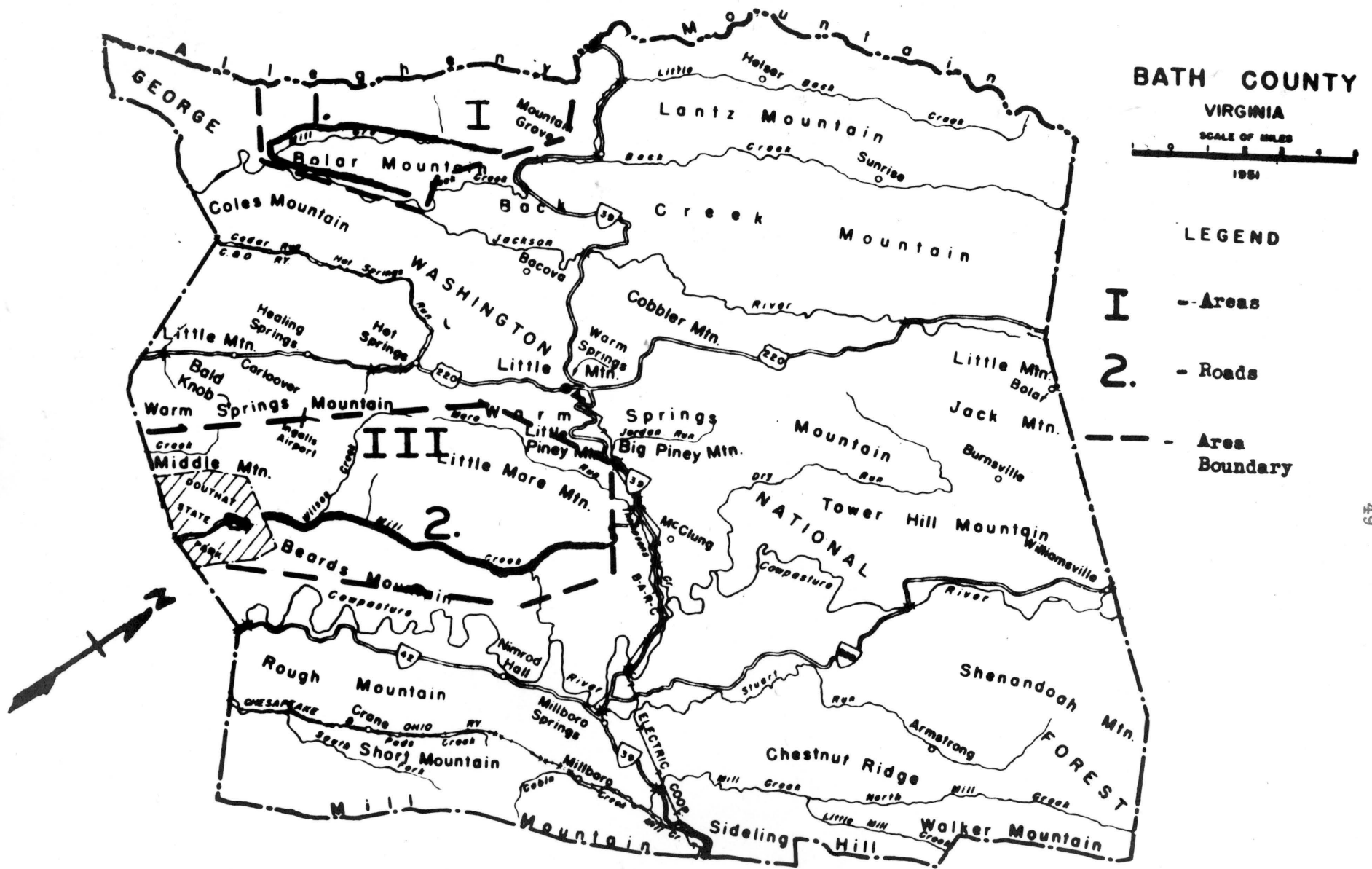


Figure 6. Location of two roads used for roadside census technique in Bath County, Virginia

Table 9 Deer observed on two roadside census lines during the period July through December, 1953, in Bath County, Virginia

Area	Road no.	Length of road	Number of deer observed per month						Average
			July	August	September	October	November	December	
I	1	12 miles	10	20	8	3	0	0	6.8
III	2	13 miles	0	5	3	4	0	0	2.0

with an area, and who can recognize and evaluate factors influencing the number of deer observed, might improve the technique. However, the walking observation line appears to hold greater promise as a census method in this region.

Deer kill locations. Locations of known deer kills for the 1953 hunting season are plotted on Figure 7. The procedure for obtaining these kill locations was explained in METHODS AND PROCEDURES. A total of 190 known deer kill locations were plotted on the map and areas were grouped as to kill density per square mile. The 190 kill locations represented 28 percent of the total kill for 1953. On the 190 locations, 114 of these were plotted from individual hunter's kills checked at aging stations; the remainder constituted kills from four private hunt club lands. The kill figures from hunt clubs are presented in order to illustrate some areas of highest deer kill on private land as compared to the kill on public hunting lands. Of 114 kill locations obtained from individual hunters at the aging stations, 95 deer were killed in sections which contained large portions of national forest land or were entirely national forest land.

The Hidden Valley Hunt Club, hunting on approximately four square miles of land, had a kill of 31 bucks for the six day season in 1953. This number represents a kill of seven bucks per square mile. This kill density could be compared to the kill density on national forest land on Back Creek Mountain near Route 39 which was seven bucks per square mile known kill in the first two days of the season. This comparison probably raises a question in the minds of many studying this

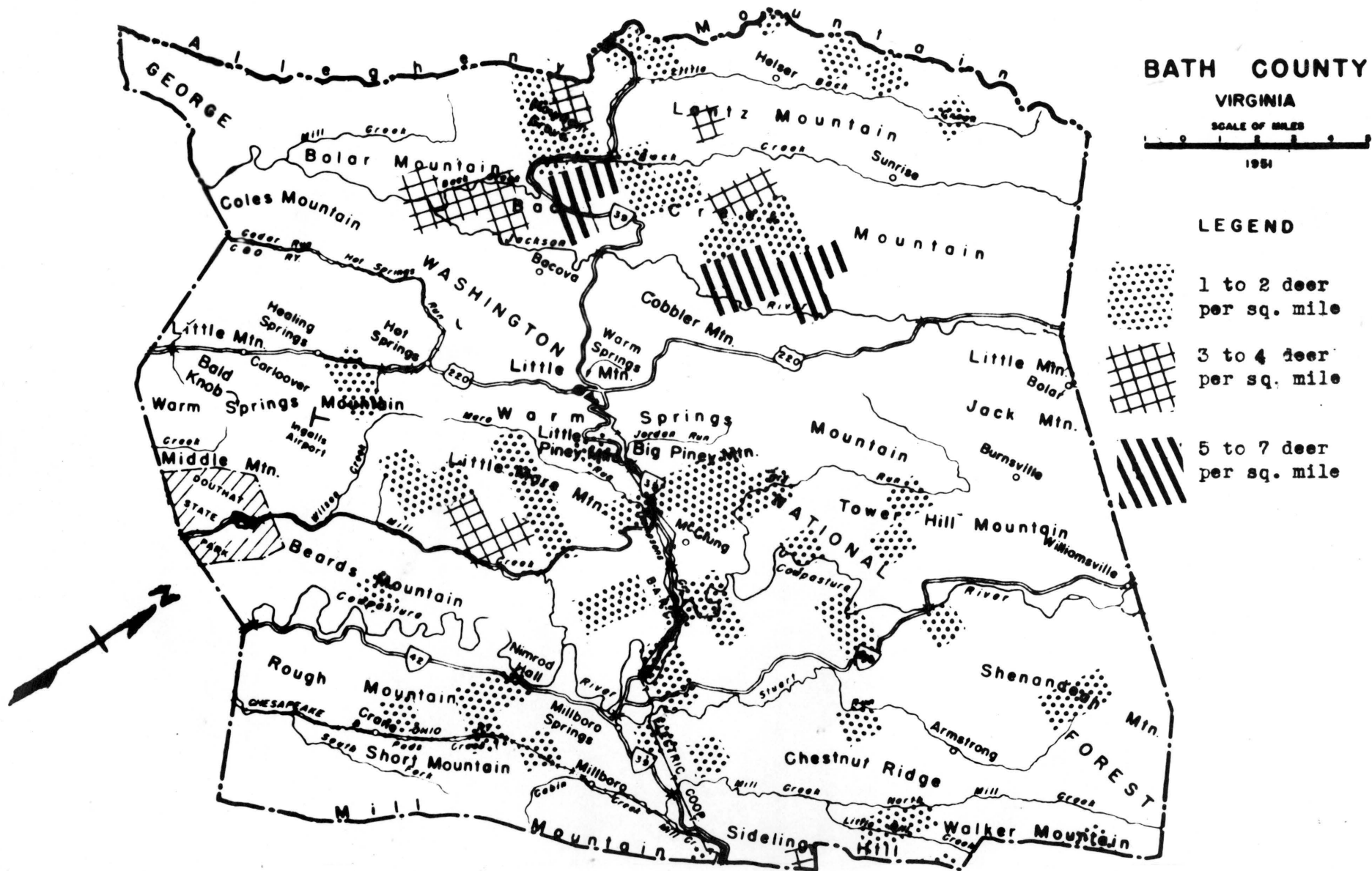


Figure 7. The 1953 deer kill per square mile in Bath County as indicated by the kill locations of 190 deer

situation, i.e., whether there is any actual difference in the deer population as indicated by kill density or is the observed difference the result of kill information? Examining other areas of high kill density, two factors appear to be apparent. Either the areas are on private hunt club lands or they are on public land readily accessible to the hunter. Therefore, the plotted kill locations suggest that the 1953 kill locations may be indicative of hunter accessibility and consequently hunting pressure as well as deer populations. On the basis of these indications, it is believed that a population estimate based purely on deer kill per square mile is not justified, particularly in Bath County. Accessibility of areas may be reduced, by posting of land to hunting, to such an extent that posted land is a greater influence on legal kill than the actual number of deer present on an area.

Based upon the total kill of 689 bucks in Bath County, with a total area of 540 square miles, a kill density of 1.3 bucks per square mile is computed. If only the forested area of the county (72 percent) is considered, then a kill density of 1.8 bucks per square mile is obtained.

Population Characteristics

Four aging stations of the 19 check stations in Bath County were established and manned by personnel of the Virginia Cooperative Wildlife Research Unit during the first three days of the six day 1953 deer hunting season. Measurements taken at these aging stations are discussed in METHODS AND PROCEDURES. A total of 147 male deer were aged and measured at the stations and the data presented in this report

were from 143 of this total. There were 689 legal bucks killed in Bath County during the 1953 hunting season of which the sample of 143 is 21 percent.

The kill per day and percentage of kill sampled per day is presented in Figure 8. The figure indicates that two-thirds of the season's kill was taken during the first three days of the season. During the first day of the season one-third of the total kill was taken and 41 percent of that day's kill was measured and aged.

Based upon observations of range conditions, the deer examined during the 1953 deer season were classified into two groups based on location of kill in relation of U. S. Highway 220 in Bath County. All deer killed southeast of U. S. 220 were placed in one group (Southern herd) and all deer killed northwest of U. S. 220 were placed in a second group (Northern herd). Averages and standard deviations by age classes were computed for weight, length of hind foot, and antler diameter. The significance of the differences between the averages of the two groups was tested by a "t - test." Measurements by age classes of the two groups are given in Table 10. The results of the "t - test" (Table 11) show that differences between the averages of measurements of deer from the two regions were significantly different in 8 of 15 cases and very significantly different in 6 of the 8 cases. In the older age classes the differences might have been significant if larger samples had been available. As indicated by grouping measurements according to square mile grid kill locations, samples from localized areas of the county would probably yield more "homogenous data." Table 12 presents a composite of all body measurements collected for the entire county in

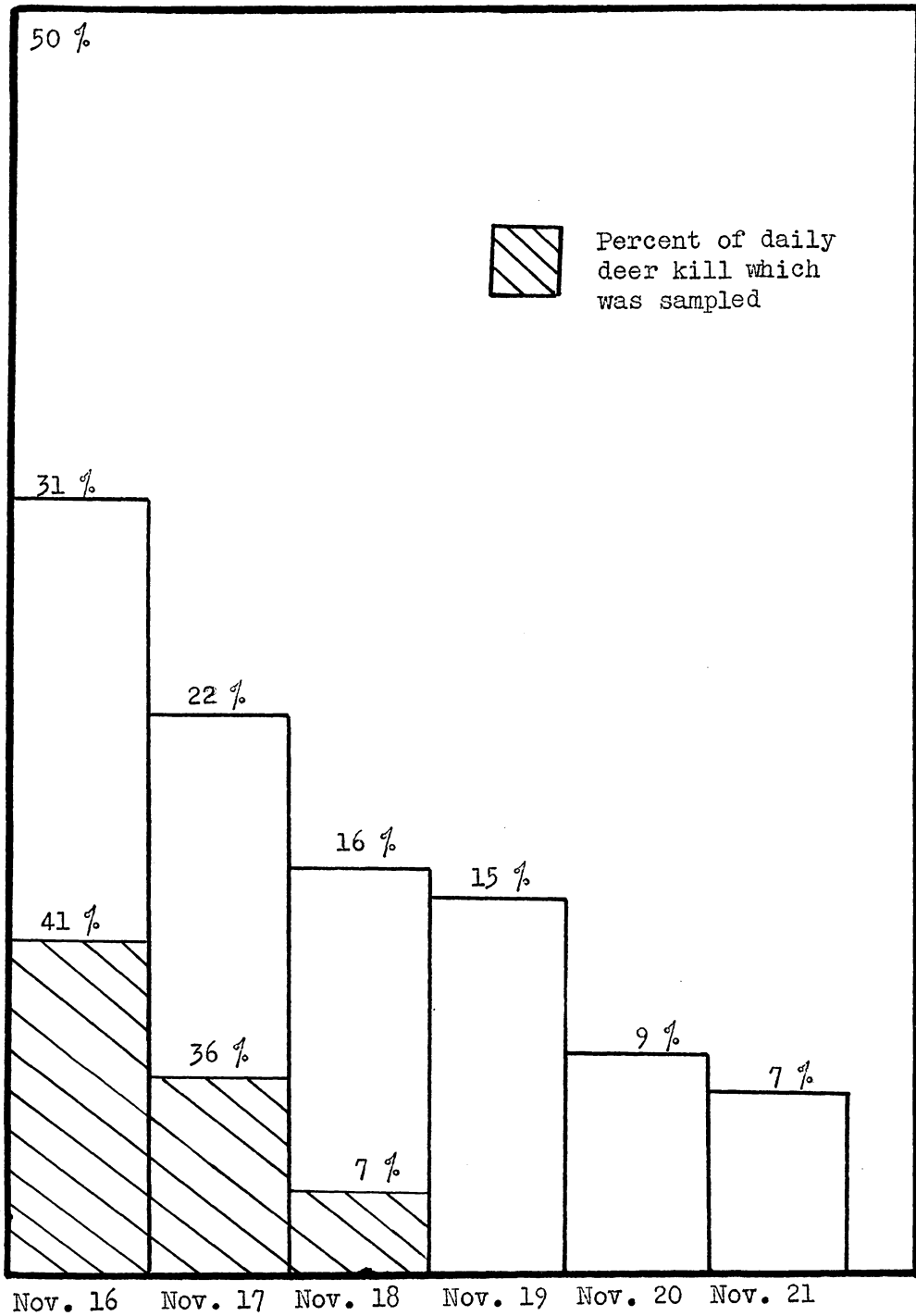


Figure 8. Percent of total deer kill taken each day during the six day 1953 deer season, Bath County, Virginia

Table 10 Average weights and measurements of male deer killed in 1953 from northern and southern regions of Bath County, Virginia

Age classes	Sample size	Weight hog-dressed	Standard deviation	Sample size	Antler beam diameter	Standard deviation	Sample size	Length hind foot	Standard deviation
NORTHERN									
1½ yr.	29	77.62 lbs.	13.64	26	14.54 mm.	2.49	27	16.50 in.	0.70
2½ yr.	21	98.00	19.16	23	18.83	3.61	22	17.09	0.47
3½ yr.	16	111.56	21.33	19	23.58	3.32	19	17.28	0.62
4½ yr.	6	126.33	5.40	7	26.14	3.24	7	17.14	0.02
5½ yr.	2	140.50	33.24	2	29.50	6.40	2	17.13	1.24
6½ yr.	1	132.00	-----	1	33.00	-----	1	17.00	-----
7½ yr.	1	124.00	-----	1	27.00	-----	1	17.25	-----
SOUTHERN									
1½ yr.	19	90.10	24.86	24	15.58	2.27	22	17.45	0.95
2½ yr.	15	113.80	13.10	15	21.80	3.03	15	17.78	0.92
3½ yr.	10	135.70	16.80	11	27.00	3.55	11	18.02	0.75
4½ yr.	4	148.25	37.61	4	31.25	5.32	4	19.25	1.62
5½ yr.	3	146.33	26.50	3	33.00	4.58	3	18.42	1.26
7½ yr.	1	208.00	-----	1	48.00	-----	1	20.00	-----

Table 11 Results of "t - test" for the significance of differences between the average weights and measurements of deer killed in southern and in northern Bath County, Virginia, 1953

Measurements and age classes	Number of samples		t .05	t .01	Computed t value
	Southern	Northern			
Hog-dressed weight					
1½ yr.	19	29	2.015	2.697	0.446
2½ yr.	15	21	2.034	2.732	2.762 **
3½ yr.	10	16	2.064	2.797	3.210 **
4½ yr.	4	6	2.306	3.355	1.449
5½ yr.	3	2	3.182	5.841	0.218
Hind foot length					
1½ yr.	22	27	2.028	2.688	4.025 **
2½ yr.	15	22	2.031	2.726	3.913 **
3½ yr.	11	19	2.048	2.763	2.891 **
4½ yr.	4	7	2.262	3.250	3.523 **
5½ yr.	3	2	3.182	5.841	1.136
Antler beam diameter					
1½ yr.	24	26	2.010	2.680	1.545
2½ yr.	15	23	2.030	2.723	2.700 *
3½ yr.	11	19	2.048	2.763	2.651 *
4½ yr.	4	7	2.228	3.169	2.120
5½ yr.	3	2	3.182	5.841	0.729

* Significant

** Very significant

Table 12 Composite of male deer weights and measurements from Bath County, Virginia, 1953

Age classes	Sample size	Weight hog-dressed	Standard deviation	Sample size	Antler beam diameter	Standard deviation	Sample size	Length hind foot	Standard deviation
$\frac{1}{2}$ yr.	1	46.00 lbs.	-----	--	----- mm.	-----	1	14.50 in.	-----
$1\frac{1}{2}$ yr.	48	84.46	16.05	50	15.04	2.40	49	16.93	0.92
$2\frac{1}{2}$ yr.	36	104.58	18.46	38	20.00	3.65	37	17.34	0.74
$3\frac{1}{2}$ yr.	26	120.85	22.84	30	24.17	4.04	30	17.55	0.75
$4\frac{1}{2}$ yr.	10	135.10	24.81	11	28.00	4.73	11	17.91	1.10
$5\frac{1}{2}$ yr.	5	144.00	25.14	5	31.60	8.05	5	17.90	1.39
$6\frac{1}{2}$ yr.	1	132.00	-----	1	33.00	-----	1	17.00	-----
$7\frac{1}{2}$ yr.	2	166.00	59.40	2	37.50	14.90	2	18.67	1.68

1953; this illustrates further concealment of localized conditions by grouping.

Table 13 presents the differences between total antler points by age classes for the deer from the two regions of Bath County. Approximately 50 percent of the $1\frac{1}{2}$ year age class bucks southeast of U. S. Route 220 were "spike" bucks, whereas approximately 70 percent of the $1\frac{1}{2}$ year age class bucks northwest of U. S. Route 220 were "spike" bucks.

The location of aging stations is very important if representative samples are to be secured. The number of deer aged during the hunting season should not be the only gauge as to the effectiveness of sampling. Localized areas of either good or bad herd conditions can have much influence on results. Another influence is selective hunting which is probably more important at the beginning of the season but there is no sure method to test this effect. The plotting of kill is an excellent means of being certain that animals examined came from certain ranges and is useful in evaluating localized deer conditions which may show up on the analysis of collected data.

The average measurements, by sex and age, of all deer sampled during the Bath County 1952 deer hunting season are presented in Table 14. The data could not be segregated into regions since the kill locations were not plotted. The possible number of deer taken from the two regions used with the 1953 data can be obtained by comparing the number of deer checked at aging stations south of U. S. Route 220 to those checked at aging stations north of U. S. Route 220. In 1952, 25 does and 40 bucks were checked at aging stations south of U. S. Route 220 as compared to 58 does and 62 bucks checked at aging stations north of U. S.

Table 13 Number of deer in antler point classes killed in 1953 from northern and southern regions of Bath County, Virginia

Age Classes	Sample size	Total number of antler points										
		2	3	4	5	6	7	8	9	10	15	18
NORTHERN												
1½ yr.	28	20	5	2	-	-	1	-	-	-	-	-
2½ yr.	23	3	1	12	2	1	3	1	-	-	-	-
3½ yr.	18	-	1	3	4	2	3	3	2	-	-	-
4½ yr.	7	-	-	-	-	1	5	1	-	-	-	-
5½ yr.	2	-	-	-	-	-	-	1	-	1	-	-
6½ yr.	1	-	-	-	-	-	-	1	-	-	-	-
7½ yr.	1	-	-	-	-	-	-	-	-	1	-	-
SOUTHERN												
1½ yr.	23	12	2	3	4	1	1	-	-	-	-	-
2½ yr.	15	-	-	1	1	3	2	7	1	-	-	-
3½ yr.	11	-	-	-	-	-	3	5	3	-	-	-
4½ yr.	4	-	-	-	-	-	-	2	-	1	1	-
5½ yr.	1	-	-	-	-	-	-	-	1	-	-	-
7½ yr.	1	-	-	-	-	-	-	-	-	-	-	1

Table 14 Average weight and measurement of male and female deer killed in Bath County, Virginia in 1952

Age classes	Sample size	Weight hog-dressed	Standard deviation	Sample size	Length hind foot	Standard deviation
Males						
$\frac{1}{2}$ yr.	11	45.18 lbs.	6.26	11	14.59 in.	0.73
$1\frac{1}{2}$ yr.	36	75.00	11.81	36	17.00	0.88
$2\frac{1}{2}$ yr.	21	104.66	10.96	21	17.71	0.81
$3\frac{1}{2}$ yr.	10	128.50	20.99	9	18.17	0.75
$4\frac{1}{2}$ yr.	4	137.25	14.20	4	17.81	0.02
$5\frac{1}{2}$ yr.	2	164.00	22.00	2	18.75	1.25
Females						
$\frac{1}{2}$ yr.	14	43.37 lbs.	7.19	14	14.36 in.	0.65
$1\frac{1}{2}$ yr.	28	68.89	10.43	27	16.03	0.62
$2\frac{1}{2}$ yr.	13	78.38	8.29	13	16.40	0.81
$3\frac{1}{2}$ yr.	10	78.70	13.76	10	16.15	0.70
$4\frac{1}{2}$ yr.	9	78.33	7.30	9	16.08	0.50
$5\frac{1}{2}$ yr.	2	86.50	3.50	2	16.25	0.00
$6\frac{1}{2}$ yr.	4	84.25	5.49	4	16.31	0.45
$7\frac{1}{2}$ yr.	1	83.00	----	1	16.25	----
$8\frac{1}{2}$ yr.	1	92.00	----	1	15.50	----

Route 220. Whether the kill locations were also in the region that the deer were checked is not known.

Age composition of the deer killed during the 1952 and 1953 seasons in Bath County is presented in Figure 9. Data for 1953 represents mature bucks taken the first three days of the six day season. One illegal fawn was included in the 1953 check station data (Table 12) and age composition graph (Figure 9). Based on hunters' comments at aging stations, hunter selection probably affected the age classes considerably during the first part of the 1953 season.

The large number of bucks in the older age classes is surprising considering the long period of past buck seasons. Approximately one-third of the bucks aged were in age classes past $2\frac{1}{2}$ year age class, which indicates lower hunting pressure than reported in other counties in western Virginia. In general, the age composition indicates that a good portion of the legal bucks lived past two hunting seasons. Actually Bath County bucks may not be as vulnerable at the $1\frac{1}{2}$ year age class as would be supposed since a large number of the $1\frac{1}{2}$ year bucks killed in 1953 had very short spike antlers. Most of these antlers would be very difficult to detect except when the animals were observed at very close ranges.

Age composition of the 1952 male deer kill, which is a composite of all bucks aged during each of the six days of the 1952 season, probably does not represent the true age composition of the bucks as the daily sample of bucks was not in proportion to the daily buck kill. Of the 709 bucks killed in 1952, a total of 98 bucks were aged which represents 11 percent of the male kill. Another basis for this

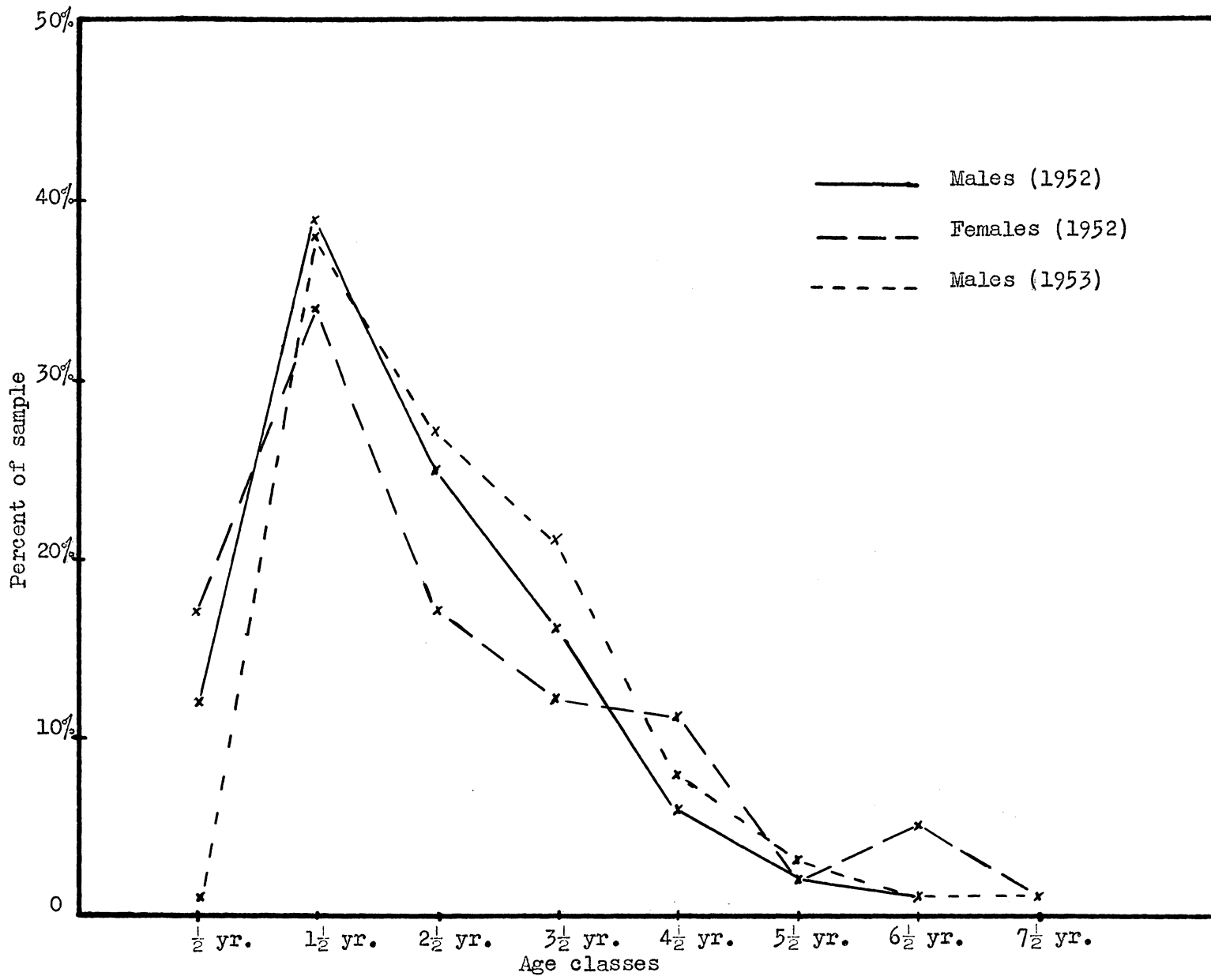


Figure 9. Age distribution of deer killed in Bath County, Virginia, 1952 and 1953

assumption of non-representativeness is the fact of hunter selection during the early portion of the season. This selection is assumed in view of the fact that the last day was a hunter's choice; therefore, the hunter would have an increased chance of obtaining a deer the last day. Here again, the short antlered spike buck would not be as easily recognized as mature bucks; therefore, would not appear in the kill figures in proportion to their actual numbers except in the last days kill.

All female deer were killed the last day of the 1952 season and age figures that were collected probably represent the actual age composition of the female deer population. Of the 203 does killed in 1952, a total of 83 were aged, which represents a sample of 41 percent of the kill. Since female deer had not been hunted in any previous seasons in Bath County, their age composition was unique. The effect of no previous doe season is indicated by the number of animals in older age classes.

The fawn male : female ratio was 78 : 100 (11 males to 14 females). Hunters cannot distinguish between sexes of fawns in the field; therefore, there should be no selection as to the sex killed in this age class.

Sex and Productivity Ratios

All deer observed in the field during the period from July through October, 1953 were recorded by sex and as adults or as fawns. These data as to observed percentages are presented in Table 15. The accuracy of the sex determination by observation may be questionable since several factors probably influenced observations. For example, the

Table 15 Deer observed per month by sex and by age for the period July to November, 1953 in Bath County, Virginia

Classification	Month								Totals	Percentage
	July		August		September		October			
	No.	Percent	No.	Percent	No.	Percent	No.	Percent		
Bucks	4	13	12	16	11	12	1	2	28	11
Does	22	73	47	63	50	56	34	68	153	63
Fawns	4	13	16	21	28	31	15	30	63	26
Totals	30		75		89		50		244	

short, spiked antlers in the $1\frac{1}{2}$ year buck age class may have been overlooked in deer observed at any distance. The $1\frac{1}{2}$ year age class constituted 38 percent of the total male kill aged for 1953, and even this large percentage probably did not represent their true proportion in the buck population.

Differences in the number of deer and in the sex ratio were observed during these four months. Differences between months are presented in Table 15.

Throughout the four month period, July through October, 1953, the ratio of observed does to fawn observed for the entire county was 1 : 0.41. A preponderance of observations were from Areas I and II, the higher deer population areas. These observations indicate a low productivity rate for the county. When groups of deer were observed in fields in the evening only a few of the does would be with fawns at the time of day that the maximum number of fawns would be expected. Numerous sets of twin fawns were observed but only one set of triplet fawns was reported for the entire county. Considering the doe : fawn ratio when fawns were observed with other deer (multiple groups) the ratio was 63 to 51 or 1 : 0.8. The doe : fawn ratio when only one doe and her fawns were observed was 26 to 32, or 1 : 1.2. This difference in the ratio of the multiple groups of deer with fawns and the single doe : fawn ratio indicates a large portion of the does may be non-productive animals. The doe : fawn ratio of single does with fawns probably represents the highest attained individual productivity rate that did occur within the county.

The different doe : fawn ratios for high, medium, and low population areas in Bath County were tested for independence by a "Chi Square test" but no significant differences were obtained between these ratios. No significant differences were obtained between the multiple doe : fawn ratio, the single doe : ratio, and the total doe : fawn ratio between high and low deer population areas.

A lower productivity of deer in Bath County is indicated by these data than is reported in productivity studies in more northern states. It is the writer's opinion that this low productivity rate may not be an indication of inferior range conditions in Bath County; instead the lower productivity rate may be inherent in this herd. Lower mean ovulation rates were obtained for deer herds in the eastern section of West Virginia, adjoining Bath County, than were determined for the other herds of West Virginia (DeGarmo, 1953). Ovulation rates were reported as increasing in West Virginia's western and Allegheny deer herds after population reductions by "hunter's choice" seasons. However, this reported increase of ovulation rates did not occur in the eastern herd after this same population reduction. Consideration should be given to the fact that the data involved in West Virginia's study were not subjected to statistical analysis but merely to visual interpretation.

The lack of significant differences between observed doe : fawn ratios in areas of high deer population and low deer population (Table 16) indicates no differences in attained productivity rates between these areas. Browse availability studies reveal that the high deer population areas in Bath County were rated much lower in available browse

Table 16 Results of "Chi-square tests" of independence of observed doe-fawn ratios on different deer population areas of Bath County, Virginia, from July to November 1953

	Observed single does with fawns		
	Area I	Area II	Areas III & IV
Does	14	8	4
Fawns	17	9	6
Computed $X^2 = 0.143$			
$X^2_{.05} = 5.991$			

	Observed does with fawns in multiple groups		
	Area I	Area II	Areas III & IV
Does	39	12	12
Fawns	40	11	10
Computed $X^2 = 0.205$			
$X^2_{.05} = 5.991$			

	Total number of does and fawns observed		
	Area I	Area II	Areas III & IV
Does	83	37	17
Fawns	43	15	11
Computed $X^2 = 0.978$			
$X^2_{.05} = 5.991$			

and in quality of browse species. These same areas had significant differences between animal body sizes compared to low deer population areas within Bath County.

Productivity rates have been reported to be indicators of range quality in New York (Cheatum and Severinghaus, 1950). These studies by Cheatum and Severinghaus were supposedly carried out on one subspecies of deer. By means of embryo and "ova" counts they found that, generally, the fertility level of deer corresponds with the quality of their range.

No correlation of observed doe : fawn ratios with deer populations or with range conditions was found in this study. This lack of correlation between doe : fawn ratios and range conditions in Bath County, plus the West Virginia findings, causes the writer to question the use of data obtained in northern states on the northern white-tailed deer (Odocoileus virginianus borealis) in evaluating productivity rates of white-tailed deer in the Southeastern United States. This lower rate of observed productivity of Odocoileus virginianus virginianus, if it does exist, may be one of the reasons for the nonirruptive history of deer in this region.

Deer Mortality

A summary of known losses, other than by legal hunting, of deer throughout Bath County is presented in Table 17. A total of five deer were reported killed by automobiles from May 1953 until February 1954. Three of these animals were examined personally and the other two animals were examined by the game warden. All highway kills occurred on paved primary highways and not necessarily in the higher deer population areas.

Table 17 Known deer mortality, other than legal hunting, in Bath County, Virginia, June 1953 until February 1954

Cause	Deer loss by cause per month								Totals
	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	
Highway	-	2	1	-	-	2	-	-	5
Mowing	3	-	-	-	-	-	-	-	3
Fences	-	-	-	-	1	1	-	-	2
Spotlighting	-	-	2	-	-	2	-	-	4
Poaching	-	-	-	1	1	1	1	1	5
Illegal kills during deer season	-	-	-	-	-	10	-	-	10
Gripping losses	-	-	-	-	-	3	-	-	3
Chased by dogs	-	-	-	-	1	-	-	-	1
Unknown	2	-	1	1	1	1	-	-	6
Total losses	5	2	4	2	4	20	1	1	39

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Known mortality of deer resulting from mowing and injuries resulting from fences accounted for five deer. Two fawns and one mature doe were injured by mowing machines in three separate incidents; all three individuals had to be destroyed. The actual number of deer injured by mowing in the county may not be too much greater than indicated in this report since occurrence of losses to this cause were unusual previous to this year and it would appear that a large percent of such unusual losses would be reported.

One mature doe was destroyed by the county game warden after being injured in a fence. A paralyzed fawn was found near a fence during the 1953 hunting season and examined at Virginia Polytechnic Institute. The cause of paralysis was attributed to injuries to the spinal cord which apparently resulted from striking the fence.

Nine deer were known to have been killed by spotlighting and poaching at times other than during the legal deer hunting season. The months of November and August had the highest report of deer illegally killed, with three and two deer reported killed for those months, respectively. Four of the nine known deer kills were at night by spotlighting. Three nights were spent with the county game warden watching for illegal spotlighting. On one of these nights, one incident of spotlighting was observed and stopped. Even though there were no deer found killed in the above mentioned observations, deer were fired upon in two different occasions by these individuals.

Total losses caused by spotlighting and poaching could not be determined, but undoubtedly it is very large. The percent of crippling

losses during poaching probably are much greater than occur during the regular hunting season because of fear of being caught and the difficulty of shooting at night. It is the opinion of the writer that out-of-season illegal kills may be a major factor influencing deer populations in certain areas of Bath County. One of these areas is located on the upper portion of Muddy Run and Dry Run.

Illegal kills occurred throughout the county, but in general occurred in greater numbers where the larger deer populations occur near accessible secondary roads.

The extent of illegal kills and crippling losses during the deer hunting season could not be determined but the known losses at this period are included in Table 17. Seven illegal does were reported to the county game warden during the six day 1953 season and three does were found after the season by the writer in connection with other studies. Three dead bucks were found during field activities following the 1953 season.

The known loss of 39 deer represents approximately 6 percent of the total legal kill for the same year.

Range Conditions

Browse availability. Amounts of browse available in major deer ranges of Bath County were estimated by use of clip plots as discussed in METHODS AND PROCEDURES. A total of 23 separate lines, containing a total of 127 plots, were clipped during the months of January and February, 1954, in Bath County (Figure 10). Major emphasis was placed on obtaining clipping data from Area I through Area IV and some data were collected in the remainder of the county (Area V).

In areas of high deer populations, the clipping study indicated a lower total browse availability and a lower amount of high quality browse species. Areas I and II, which contain the highest deer populations, have approximately three-fifths the weight of the browse that is available in the low deer population Areas III and IV, and approximately one-third the weight of browse that is available in the remainder of the county sampled. "Quality browse" species were considered the following: dogwood, red maple, sassafras, azalea, witch-hazel, and black gum. These six species comprise 24 percent of the average 4.6 pounds per acre of browse for Areas I and II; 28 percent of the average 7.6 pounds per acre of browse for Areas III and IV; and 35 percent of the average 15.4 pounds per acre of browse for the remainder of the county sampled. This indicates that in Area V there are more pounds per acre of preferred browse than there was total browse available on Areas I and II. Areas III and IV produced approximately twice as much preferred browse as did Areas I and II.

The difference in quantity and quality, as indicated in Tables 18 and 19, gives some idea of the deer pressure on the vegetation in various regions of Bath County. The frequency of each species per line may be another measure of the effect of deer on vegetation succession. One species, buffalo nut, is found only in one section of Bath County and even there, with a low deer population, practically all the buffalo nut on the area has been browsed back to a diameter of one-half inch. Therefore, it appears that some species may have been completely eliminated by deer from sections of the county.

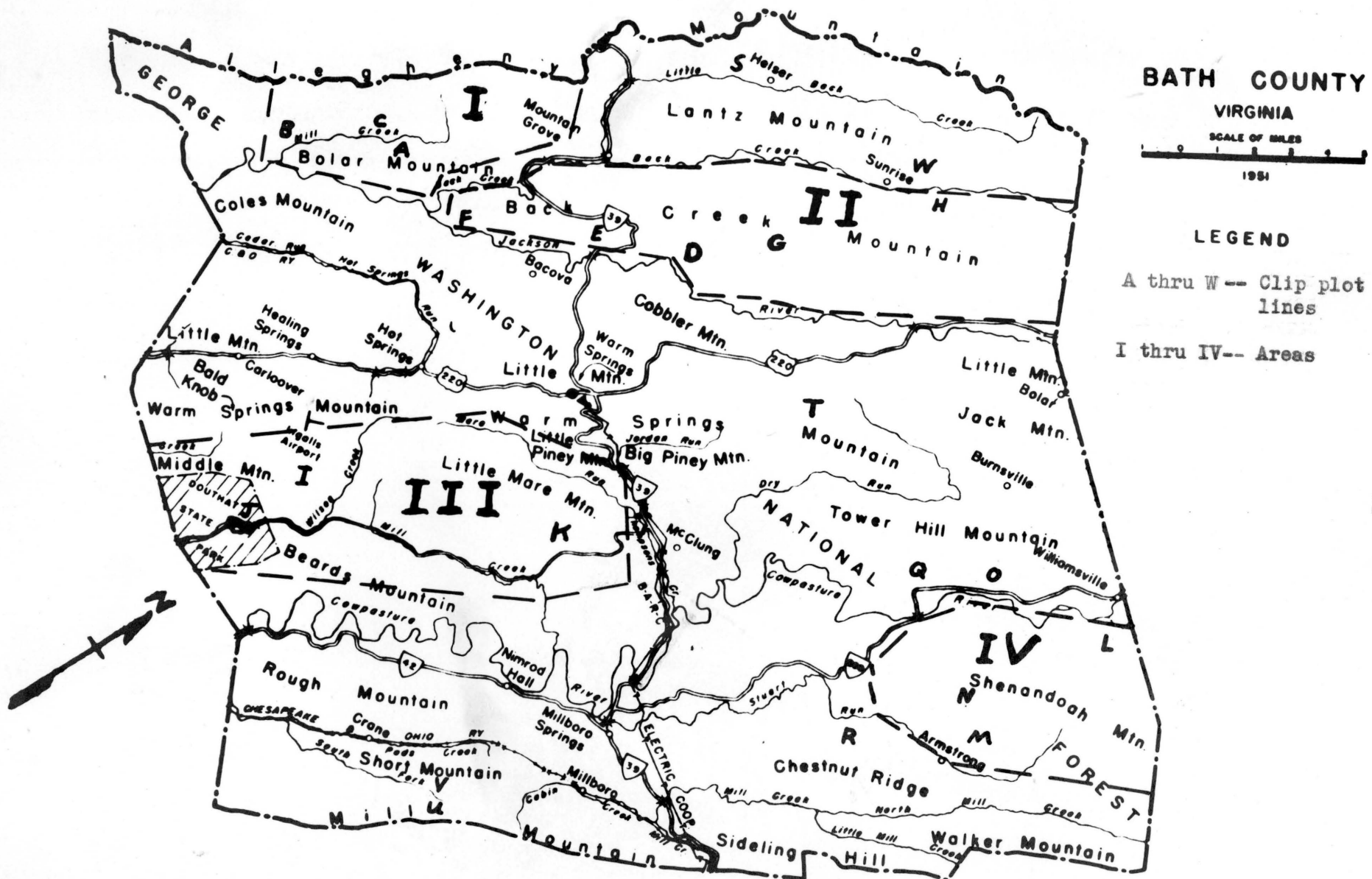


Figure 10. Locations of clipping study lines in Bath County, Virginia

Table 18 Availability of browse in pounds per acre in various areas of Bath County, Virginia

Area	Line	No. Plots											Average lbs. per acre per line
			1	2	3	4	5	6	7	8	9	10	
I	A	10	0.4	1.4	2.5	2.5	0.8	0.3	1.0	5.4	7.1	0.3	2.2
	B	3	2.0	8.4	6.4								5.6
	C	6	1.9	1.9	1.6	5.2	0.9	17.4					<u>4.8</u>
												Av.	4.2
II	D	9	0.8	0.8	9.3	1.7	2.1	10.6	10.1	0.6	3.9		4.4
	E	7	0.5	0.9	1.0	0.7	1.4	1.7	0.9				1.0
	F	8	0.5	0.1	16.4	1.8	7.6	6.3	1.7	0.4			4.4
	G	9	3.0	0.7	2.8	6.9	22.7	5.9	0.1	1.5	7.6		5.7
	H	6	9.0	5.8	11.8	6.9	12.0	10.6					<u>9.4</u>
												Av.	4.9
III	I	2	5.9	10.2									8.1
	J	8	8.1	13.1	13.1	6.3	3.4	5.5	1.8	9.1			7.6
	K	8	9.8	7.7	2.7	2.9	3.6	1.8	12.9	11.7			<u>6.6</u>
												Av.	7.4
IV	L	3	1.8	5.6	13.9								7.1
	M	3	6.6	16.0	9.5								10.7
	N	5	4.6	18.1	2.2	2.2	1.5						<u>5.7</u>
												Av.	7.6
V	O	4	34.1	13.5	9.8	18.4							19.0
	P	6	11.4	5.5	13.1	8.5	15.7	13.4					10.9
	Q	4	7.3	17.8	15.2	4.6							10.7
	R	5	12.4	12.4	5.6	24.4	16.4						14.2
	S	7	6.8	14.1	6.8	15.9	7.0	6.2	6.5				9.0
	T	3	45.9	31.8	18.6								32.1
	U	5	22.5	14.7	4.1	12.4	27.1						16.2
	V	4	8.2	14.4	27.4	12.2							15.6
	W	3	8.9	10.1	10.5								<u>9.8</u>
												Av.	15.4

Table 19 Frequency and percent of total weight of browse by species found on clip plot lines in Bath County, Virginia

Species	Areas		I				II					
	Lines		A	B	C	D	E	F				
	Total plots		10	3	6	9	6	8	Freq. %	Freq. %		
Dogwood	(Cornus florida)		4	77	5	6	5	7	1	2	2	1
Red maple	(Acer rubrum)		2	0	2	1	1	0	2	1	2	0
Sassafras	(Sassafras albidum)		7	8	4	7	2	1	6	13	2	0
Azalea	(Rhododendron nudiflorum)				1	0	1	0	4	13		
Witch-hazel	(Hamamelis virginiana)			1	2	1	3	6	16		1	0
Black gum	(Nyssa sylvatica)		2	0	2	1			3	6	1	0
Greenbrier	(Smilax spp.)		1	0	1	0	4	1				
White oaks	(Quercus spp.)		5	16*	2	5*	3	14*	2	2*	2	3*
Black oaks	(Quercus spp.)		6		3		5		2		6	
Hickories	(Carya spp.)		4	1	3	7	3	1	3	1	2	3
Huckleberry	(Gaylussacia baccata)		9	68*	2	37*	4	43*	1	19*	6	95*
Deerberries	(Vaccinium spp.)		6		3		4		4		4	
Mountain laurel	(Kalmia latifolia)				1	30	2	25	2	2	1	1
Shadbush	(Amelanchier canadensis)		1	0	1	0	2	1			1	0
Alder	(Alnus serrulata)						1	1				
Ash	(Fraxinus americana)			1	3		1	1	2	6		
Black birch	(Betula lenta)		1	0			2	1				
Hawthorns	(Crataegus spp.)				1	0	1	0	1	0		
Chestnut	(Castanea dentata)								3	2		
Black locust	(Robinia pseudo-acacia)								1	1		
Carolina rose	(Rosa carolina)								1	1		
Beaked hazel	(Corylus cornuta)								1	15		
Maple-leaf viburnum	(Viburnum acerifolium)			2	3							
Blue beech	(Carpinus caroliniana)			1	1							
Hop-hornbeam	(Ostrya virginiana)			2	2							
Wild plum	(Prunus americana)				1	0						

* Weight combined

Table 19 Frequency and percent of total weight of browse by species found on clip plot lines in Bath County, Virginia (continued)

Species	Areas Lines Total plots	II				III					
		G		H		I		J		K	
		Freq.	%	Freq.	%	Freq.	%	Freq.	%	Freq.	%
Dogwood	(<u>Cornus florida</u>)	4	1	2	1			2	1	5	8
Red maple	(<u>Acer rubrum</u>)			4	1	1	6	2	0		
Sassafras	(<u>Sassafras albidum</u>)	5	1	6	3	2	11	7	15	8	25
Azalea	(<u>Rhododendron nudiflorum</u>)	1	0	2	5			3	1	5	5
Witch-hazel	(<u>Hamamelis virginiana</u>)	1	2	4	3			2	3		
Black gum	(<u>Nyssa sylvatica</u>)	2	0	4	2			6	3	5	2
Greenbrier	(<u>Smilax</u> spp.)	1	1	1	0			3	1		
White oaks	(<u>Quercus</u> spp.)	3		1				8		4	
Black oaks	(<u>Quercus</u> spp.)	4	1*	4	1*	2	2	8	7*	6	7*
Hickory	(<u>Carya</u> spp.)	1	0	1	0	1	0			2	1
Huckleberry	(<u>Gaylussacia baccata</u>)	9		5		2		8		6	
Deerberries	(<u>Vaccinum</u> spp.)	8	74*	4	28*	2	70*	7	38*	6	51*
Mountain laurel	(<u>Kalmia latifolia</u>)	3	20	6	54	1	4	6	31	2	1
Shadbush	(<u>Amelanchier canadensis</u>)			1	0						
Black birch	(<u>Betula lenta</u>)			2	1						
Chestnut	(<u>Castanea dentata</u>)					1	7	4	0	1	0
Striped maple	(<u>Acer pennsylvanicum</u>)			1	1						

* Weight combined

Table 19 Frequency and percent of total weight of browse by species found on clip plot lines in Bath County, Virginia (continued)

Species	Areas	Lines	Total plots	IV						V					
				L		M		N		O		P		Q	
				3	3	5	4	6	4	6	4	4	4		
				Freq. %	Freq. %	Freq. %	Freq. %	Freq. %	Freq. %	Freq. %	Freq. %	Freq. %			
Dogwood	(<u>Cornus florida</u>)			2	14	1	4	4	7	3	14	4	18	1	5
Red maple	(<u>Acer rubrum</u>)			1	0	3	14	2	2	2	7	3	2	3	1
Sassafras	(<u>Sassafras albidum</u>)			2	1	3	2	4	7	4	19	5	3	4	9
Azalea	(<u>Rhododendron nudiflorum</u>)									3	12	1	6	3	3
Witch-hazel	(<u>Hamamelis virginiana</u>)			2	11			2	1						
Black gum	(<u>Nyssa sylvatica</u>)			1	4	3	10	3	6	4	9	2	5	3	14
Greenbrier	(<u>Smilax</u> spp.)							1	0			1	0		
White oaks	(<u>Quercus</u> spp.)			3	5*	2	25*	4	12*	4	21*	4	18*	4	5*
Black oaks	(<u>Quercus</u> spp.)			1		3		3		4		6		3	
Hickories	(<u>Carya</u> spp.)			2	1	1	3	4	5	1	0	3	1	3	1
Huckleberry	(<u>Gaylussacia baccata</u>)			3	47	3	37*	4	49*	4	9*	6	39*	4	47*
Deerberries	(<u>Vaccinium</u> spp.)					3		3		4		6		4	
Mountain laurel	(<u>Kalmia latifolia</u>)			1	12	3	5	1	10	3	1	2	7	2	15
Shadbush	(<u>Amelanchier canadensis</u>)			3	2			2	1			3	1		
Hawthorns	(<u>Crataegus</u> spp.)							1	0						
Chestnut	(<u>Castanea dentata</u>)									4	7			1	0
Black locust	(<u>Robinia pseudo-acacia</u>)									2	1				
Beaked hazel	(<u>Corylus cornuta</u>)			2	1										
Maple-leaf viburnum	(<u>Viburnum acerifolium</u>)			2	2										

* Weight combined

Table 19 Frequency and percent of total weight of browse by species found on clip plot lines in Bath County, Virginia (continued)

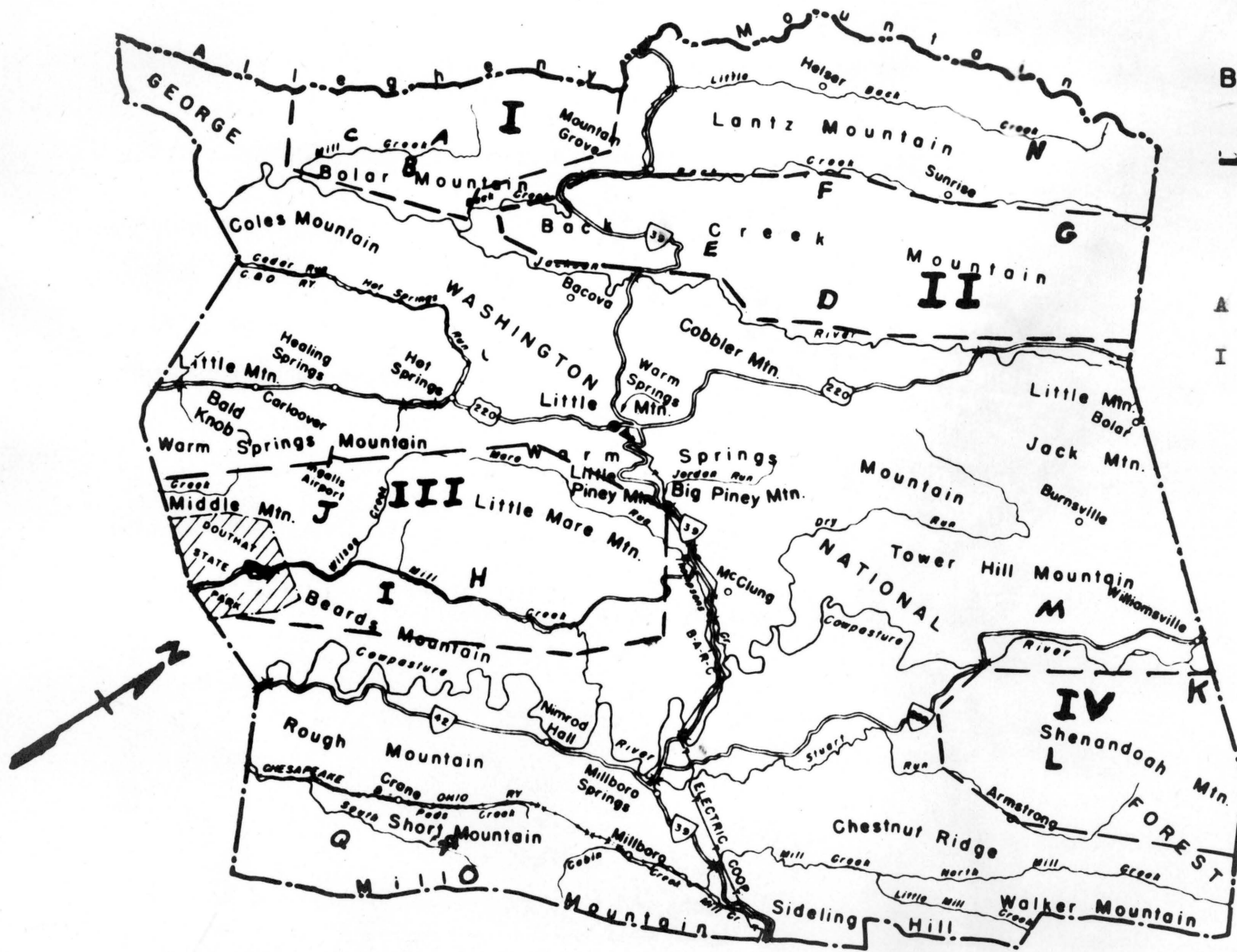
Species	Areas	Lines	Total plots	V											
				R		S		T		U		V		W	
				5	7	5	7	5	7	5	7	4	5	3	5
Freq. %		Freq. %		Freq. %		Freq. %		Freq. %		Freq. %		Freq. %			
Dogwood	(<u>Cornus florida</u>)			3	1	7	20	1	0	3	7	3	13	3	10
Red maple	(<u>Acer rubrum</u>)			4	2	6	3	2	1	3	0	1	0	1	2
Sassafras	(<u>Sassafras albidum</u>)			4	6	1	1	2	2	5	3	4	4		
Azalea	(<u>Rhododendron nudiflorum</u>)			2	0			3	25	5	28	1	4		
Witch-hazel	(<u>Hamamelis virginiana</u>)			3	5	4	12	2	0	3	1			1	7
Black gum	(<u>Nyssa sylvatica</u>)			3	4	1	3	2	4	5	9	4	9		
Greenbrier	(<u>Smilax</u> spp.)			3	1					1	0	1	0		
White oaks	(<u>Quercus</u> spp.)			3	8*	7	13*	2	10*	3	9*	2	11*	2	7*
Black oaks	(<u>Quercus</u> spp.)			5		3		3		5		3		3	
Hickories	(<u>Carya</u> spp.)			3	1	6	9			3	1	2	2	3	4
Huckleberry	(<u>Gaylussacia baccata</u>)			5	55*	4	15*	3	7*	5	23*	4	26*	3	44*
Deerberries	(<u>Vaccinium</u> spp.)			4		4		3		4		3		3	
Mountain laurel	(<u>Kalmia latifolia</u>)			3	16	1	13	3	49	1	7	2	19	3	24
Shadbush	(<u>Amelanchier canadensis</u>)			2	1	4	2					4	1	3	2
Ash	(<u>Fraxinus americana</u>)					1	1								
Black birch	(<u>Betula lenta</u>)					1	1								
Hawthorn	(<u>Crataegus</u> spp.)					1	0								
Chestnut	(<u>Castanea dentata</u>)			1	0			3	2	2	0	1	1		
Beaked hazel	(<u>Corylus cornuta</u>)						2	4							
Maple-leaf viburnum	(<u>Viburnum acerifolium</u>)						1	4							
Blue beech	(<u>Carpinus caroliniana</u>)						1	0							
Buffalo nut	(<u>Pyrularia pubera</u>)									3	7				
Spicebush	(<u>Lindera benzoin</u>)			1	0										
Mountain fetterbush	(<u>Pieris floribunda</u>)											1	10		

* Weight combined

The frequency, percent by weight, total weight and browse species available should be considered when evaluating the lower carrying capacities of high deer population areas. Whether or not conditions found in this investigation are entirely the result of deer alone is questionable but the fact that they do exist cannot be ignored if deer are to be managed wisely in Bath County.

Browse utilization. Seventeen lines, containing a total of 463 sample plants, were established throughout Bath County. Locations of sample lines are shown in Figure 11. The technique adapted to this phase of the browse study was described in METHODS AND PROCEDURES. A total of 14 of the samples tagged were discarded for various reasons. Twelve were discarded as being out of reach of deer as a result of the plant springing back up after being bent over. Two samples were discarded because of loss of tags from the plants.

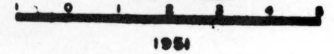
A total of 22,950.1 inches of available used and unused growth were marked and measured during October 1953 and measured again from the 10th to the 14th of April, 1954. Only two samples had been utilized the second time out of the 1,045.4 inches of marked browse that had been partially browsed prior to tagging; therefore only unused available browse was considered in Table 20 for all areas. The percentage utilization of the 21,904.7 inches of unused available browse marked in October is presented in Table 20. Nineteen samples, containing a total of 5,458 inches of unused browse, marked after bending over saplings, are included in the unused available browse (21,904.7 inches) in Table 20. These 19 samples were not susceptible to browsing prior to



BATH COUNTY

VIRGINIA

SCALE OF MILES



1951

LEGEND

A thru Q -- Tag lines

I thru IV-- Areas

Figure 11. Locations of browse utilization lines in Bath County, Virginia

Table 20 Winter browse utilization data collected from October, 1953 to April, 1954
in Bath County, Virginia

Line	Area I			Area II			
	A	B	C	D	E	F	G
Sample size	20	11	80	11	12	19	12
Samples browsed	7	5	23	4	0	5	0
Percent samples browsed	35	45	29	36	0	26	0
No. unused stems available	354	268	1043	174	131	217	183
Stems used	74	47	139	19	0	24	0
Percent stems used	21	18	13	11	0	11	0
Unused browse available (inches)	984.1	611.6	4574.1	338.5	274.0	747.0	416.5
Available browse used (inches)	272.7	77.6	496.1	24.3	0.0	108.8	0.0
Percent available browse used	28	13	11	7	0	15	0

Table 20 Winter browse utilization data collected from October, 1953 to April, 1954
in Bath County, Virginia (continued)

Line	Area III			Area IV	
	H	I	J	K	L
Sample size	12	87	12	87	20
Samples browsed	2	10	2	8	1
Percent samples browsed	17	11	17	9	5
No. unused stems available	242	1206	217	1465	310
Stems used	31	43	8	53	12
Percent stems used	13	4	4	4	4
Unused browse available (inches)	445.8	5351.3	721.4	4167.1	880.5
Available browse used (inches)	57.9	160.2	53.5	107.6	45.3
Percent available browse used	13	3	7	3	5

Table 20 Winter browse utilization data collected from October, 1953 to April, 1954
in Bath County, Virginia (continued)

Line	Area V				
	M	N	O	P	Q
Sample size	15	12	12	12	12
Samples browsed	4	0	0	2	6
Percent samples browsed	27	0	0	17	50
No. unused stems available	247	173	122	209	177
Stems used	16	0	0	57	52
Percent stems used	6	0	0	27	29
Unused browse available (inches)	683.5	466.7	289.1	510.1	443.4
Available browse used (inches)	37.2	0.0	0.0	123.3	130.9
Percent available browse used	5	0	0	36	29

bending over for tagging; therefore, they were not used in Table 22 for comparison of browsing prior to and following tagging.

The data in Table 20 indicates that Areas I and II, with higher deer populations, have higher browse utilization than Areas III and IV, with lower deer populations. Line A in Area I, located on walking observation line 2 which had an average of 4.5 deer observed per month, had a browse utilization of 11 percent. Line I in Area III, located on walking observation line 7 which had an average of 0.6 deer observed per month, had a browse utilization of 3 percent. Line K in Area IV, located on walking observation line 10 which had an average of 0.4 deer observed per month, had a browse utilization of 3 percent. These three browse tagged lines were the only lines located on the walking observation lines.

The data in Table 21 indicates the degree of browsing during the six month winter period on each of the eight species tagged on each line. Comparison by percentage of utilization indicates that striped maple, red maple, oak sprouts, and dogwood received the greatest utilization on all lines.

An important fact brought out by the tagging study was the great amount of browsing which was done during late summer and early fall. Data in Table 22 shows the degree of browsing on stems prior to October marking of samples as compared to browsing during the period October, 1953 to April, 1954. Prior to tagging in October, 228 stems were browsed compared to 418 stems on the same plants browsed in the six month period that the stems were marked. Saplings that were bent over for marking

were not considered in these figures since they were not available before being bent over. In Table 22 a zero indicates the species occurred and was marked but not used prior to marking nor after marking. A dash indicates that the species was not marked on that particular line.

This comparison of browsing prior to and following tagging does not present the entire picture. When individual samples were selected for tagging, an attempt was made to select samples nearest the locating stake, which had been browsed the least amount at the time of marking. The comparison of browsing prior to tagging and following tagging probably represents minimum browsing prior to tagging. Any ocular estimate of browsing such as the "Aldous browse system" (Aldous, 1944) would not permit differentiation as to period of utilization nor would it differentiate browse species which had been browsed two or more times.

Table 21 Winter utilization in inches of marked browse species from October, 1953 to April, 1954 in Bath County, Virginia

Species	Line	Area I			Area II			
		A	B	C	D	E	F	G
Dogwood (<u>Cornus florida</u>)		<u>179.0</u> 657.0	<u>5.0</u> 345.8	<u>163.6</u> 2514.7	---	<u>0.0</u> 44.8	<u>39.2</u> 449.4	<u>0.0*</u> 289.7**
Red maple (<u>Acer rubrum</u>)		<u>0.0</u> 81.8	<u>60.1</u> 65.7	<u>215.9</u> 938.0	<u>16.3</u> 158.7	<u>0.0</u> 10.2	<u>0.0</u> 50.8	<u>0.0</u> 70.2
Witch-hazel (<u>Hamamelis virginiana</u>)		<u>33.7</u> 108.6	---	<u>115.6</u> 853.3	---	<u>0.0</u> 52.2	<u>13.6</u> 74.1	<u>0.0</u> 46.2
Sassafras (<u>Sassafras albidum</u>)		---	---	<u>0.0</u> 168.3	<u>4.0</u> 179.6	<u>0.0</u> 128.2	---	<u>0.0</u> 46.2
Azalea (<u>Rhododendron nudiflorum</u>)		---	---	<u>1.0</u> 32.4	---	---	---	---
Striped maple (<u>Acer pennsylvanicum</u>)		---	---	---	---	---	<u>56.0</u> 122.0	---
Black oak group*** (<u>Quercus spp.</u>)		<u>60.0</u> 136.7	---	<u>0.0</u> 24.0	<u>4.0</u> 17.0	---	---	---
Black gum (<u>Nyssa sylvatica</u>)		---	<u>12.5</u> 200.1	---	---	<u>0.0</u> 38.6	<u>0.0</u> 50.7	---

* Total inches browse utilized
 ** Total inches browse available
 *** Sprouts only

Table 21 Winter utilization in inches of marked browse species from October, 1953 to April, 1954 in Bath County, Virginia (continued)

Species	Line	Area III			Area IV	
		H	I	J	K	L
Dogwood		<u>57.9</u> 448.0	<u>64.9</u> 3078.7	<u>0.0</u> 418.2	<u>80.9</u> 2979.0	<u>45.3*</u> 691.3**
Red maple		<u>0.0</u> 44.5	<u>87.5</u> 1072.2	<u>1.5</u> 37.5	<u>19.7</u> 344.5	<u>0.0</u> 23.3
Witch-hazel		<u>0.0</u> 24.9	<u>0.0</u> 538.3	--- ---	<u>0.0</u> 512.0	<u>0.0</u> 77.8
Sassafras		<u>0.0</u> 28.4	<u>7.8</u> 455.0	<u>0.0</u> 59.0	<u>7.0</u> 103.0	<u>0.0</u> 70.4
Azalea		--- ---	--- ---	<u>0.0</u> 51.9	--- ---	<u>0.0</u> 17.7
Striped maple		--- ---	--- ---	<u>52.0</u> 154.9	--- ---	--- ---
Black oak group***		--- ---	<u>0.0</u> 217.1	--- ---	<u>0.0</u> 155.4	--- ---
Black gum		--- ---	--- ---	--- ---	--- ---	--- ---

* Total inches browse utilized
 ** Total inches browse available
 *** Sprouts only

Table 21 Winter utilization in inches of marked browse species from October, 1953 to April, 1954 in Bath County, Virginia (continued)

Species	Line	Area V					Totals	Percent used
		M	N	O	P	Q		
Dogwood		<u>36.0</u>	<u>0.0</u>	---	<u>183.3</u>	<u>120.1</u>	<u>975.2*</u>	7
		458.8	285.8	---	324.4	272.3	13257.9**	
Red maple		<u>0.0</u>	<u>0.0</u>	---	<u>0.0</u>	<u>10.8</u>	<u>411.8</u>	13
		30.0	73.9	---	74.4	73.7	3149.4	
Witch-hazel		---	<u>0.0</u>	---	<u>0.0</u>	<u>0.0</u>	<u>162.9</u>	7
		---	94.4	---	44.4	37.4	2463.6	
Sassafras		<u>1.2</u>	---	<u>0.0</u>	<u>0.0</u>	<u>0.0</u>	<u>20.0</u>	1
		36.2	---	123.8	9.0	29.0	1400.3	
Azalea		<u>0.0</u>	---	<u>0.0</u>	<u>0.0</u>	---	<u>1.0</u>	1
		4.9	---	70.3	36.0	---	213.2	
Striped maple		---	<u>0.0</u>	---	---	---	<u>108.0</u>	37
		---	13.6	---	---	---	290.4	
Black oak group***		---	---	---	---	---	<u>64.0</u>	12
		---	---	---	---	---	550.2	
Black gum		<u>0.0</u>	---	<u>0.0</u>	<u>0.0</u>	<u>0.0</u>	<u>12.5</u>	3
		39.4	---	94.0	22.3	31.0	476.1	

* Total inches browse utilized
 ** Total inches browse available
 *** Sprouts only

Table 22 Number of stems browsed prior to marking compared to number of stems browsed from October, 1953 to April, 1954, Bath County, Virginia

Species	Line	Area I			Area II			
		A	B	C	D	E	F	G
Dogwood (<u>Cornus florida</u>)	10-50*	---	---	58-35	---	1-0	5-0	4-0
Red maple (<u>Acer rubrum</u>)	---	---	---	47-34	---	0-0	5-0	0-0
Witch-hazel (<u>Hamamelis virginiana</u>)	3-11	---	---	1-29	---	0-0	1-4	0-0
Sassafras (<u>Sassafras albidum</u>)	---	---	---	4-0	---	1-0	---	0-0
Azalea (<u>Rhododendron nudiflorum</u>)	---	---	---	---	---	---	---	---
Striped maple (<u>Acer pennsylvanicum</u>)	---	---	---	---	---	---	7-9	---
Black oak group** (<u>Quercus</u> spp.)	2-13	---	---	6-0	3-1	---	---	---
Black gum (<u>Nyssa sylvatica</u>)	---	---	---	---	---	---	0-0	---
Totals per line		15-74	0-0	116-98	3-1	2-0	18-13	4-0

* Prior-after
 ** Sprouts only

Table 22 Number of stems browsed prior to marking compared to number of stems browsed from October, 1953 to April, 1954, Bath County, Virginia (continued)

Species	Line	Area III			Area IV	
		H	I	J	K	L
Dogwood		7-2*	19-22	0-0	4-44	2-12
Red maple		---	0-18	0-2	0-4	0-0
Witch-hazel		5-0	2-0	---	2-0	---
Sassafres		0-0	0-3	0-0	0-0	0-0
Azalea		---	---	0-0	---	0-0
Striped maple		---	---	0-6	---	---
Black oak group**		---	0-0	---	---	---
Black gum		---	---	---	---	---
Totals per line		12-2	21-43	0-2	6-48	2-12

* Prior-after
 ** Sprouts only

Table 22 Number of stems browsed prior to marking compared to number of stems browsed from October, 1953 to April, 1954, Bath County, Virginia (continued)

Species	Line	Area V				
		M	N	O	P	Q
Dogwood		0-15*	0-0	---	0-57	0-48
Red maple		0-0	0-0	---	0-0	2-4
Witch-hazel		---	0-0	---	0-0	0-0
Sassafras		0-1	---	0-0	0-0	0-0
Azalea		6-0	---	1-0	0-0	---
Striped maple		---	0-0	---	---	---
Black oak group**		---	---	---	---	---
Black gum		15-0	---	5-0	0-0	0-0
Totals per line		21-16	0-0	6-0	0-57	2-52
Total all lines						228-418

* Prior-after
 ** Sprouts only

SUMMARY AND CONCLUSIONS

A study of deer herd conditions in Bath County, Virginia, was undertaken from June, 1953 until April, 1954. The study was conducted under a fellowship of the Virginia Cooperative Wildlife Research Unit. The objectives of this study were to determine: (1) the history of the Bath County deer herd as it relates to the present range and herd conditions, (2) the present condition of the deer herd, and (3) present deer range conditions, and (4) the influence of existing range conditions on the deer herd.

Data on the history of the deer herd revealed an increase in legal deer kill within the past three years although there was no increase in hunting pressure as indicated by Bath County damage stamp sales. The only severe deer mortality known to have occurred in the county was a "die-off" due to undetermined causes in 1951. The deer population within the county is presumed to represent descendants of original stock (thought to be Odocoileus virginianus virginianus) rather than progeny of restocked animals. The influence of restocking in adjoining counties upon this herd is not known.

Deer herd conditions were determined by sampling portions of the legal kill, by census indices, and observed population composition. Body measurements of animals from areas with a demonstrated high deer population were compared with similar measurements from low population areas. Analysis of the differences in averages of body sizes of various age classes from high and low population areas gave significant differences in 8 of 15 tests, with 6 of the 8 differences being very significant.

Age composition of the kill indicated a lower hunting pressure than has been found in other counties of Virginia. The percentage of older animals in the 1953 kill indicated that over one-third of the kill had survived two previous hunting seasons.

Three census techniques were used to obtain population indices in four different areas of Bath County. Variations in the results obtained by these techniques occurred within the areas. Even with these variations between results of techniques within the areas, the rating of the deer densities in the four areas was similar for all three techniques. It is the writer's opinion that the pellet line and walking observation line are best suited for use in this region.

Observed doe-fawn ratios were analyzed as a measure of productivity. The single doe-fawn ratio was 1 : 1.2; the observed doe-fawn ratio for multiple groups of does and fawns seen together was 1 : 0.8. Tests indicate no significant difference between doe-fawn ratios in areas of high and low deer populations.

Range conditions were studied by clipping and browse tagging techniques. Results of the clipping study reveal that the higher deer population areas have much lower quantities of available browse. On areas of higher deer population, the available browse was found to be of a lower quality as compared to the browse available on areas of lower deer population. Browse utilization studied by means of the tagging technique revealed greater utilization of browse in areas of higher deer population areas. Both studies indicate the impact of deer upon vegetation of ranges throughout the county. The inverse correlation of browse utilization and browse availability in areas of high

and low deer population refutes the idea that deer are not exerting pressure on the vegetation succession in portions of Bath County.

RECOMMENDATIONS

Management Practices

1. This investigation conducted in Bath County, Virginia, indicated that the deer herds in sections of that county are out of balance with their habitat. Reduction of deer populations within these over-populated sections is the only solution for correction of this condition. Reduction of deer herd sizes may necessitate drastic measures until range vegetation responds to the decrease in browse utilization. The lower populated areas probably would not be affected greatly since the "law of supply and demand" should affect hunting pressure. Therefore, reduction of over-populations of deer by legal hunting of female deer with such hunting permitted for all of Bath County is recommended as a practical management plan.
2. Hunter's choice deer seasons are recommended for the complete utilization of this natural resource. Losses of large numbers of deer in the 1951 "die-off," to illegal hunting, and natural causes indicated in this study point out this waste. Utilization of the deer by the hunter rather than loss to these causes should be stressed to the public who have been accustomed to buck seasons only.
3. Deer herd and range condition trends should be continually determined and studied. Trends should indicate the status of the deer herd and from these trends management practices can be formulated. The measurement of both habitat and deer herd trends will also provide a basis of evaluating past and current management practices.
4. Accessibility of national forest land to public use in areas of

Bath County exerts an influence on deer hunting pressure. Measures are necessary to permit use of inaccessible, public-owned areas by the general public. Deer kill locations for 1953 indicate that the use of these areas is restricted, either by distance of these areas from roads or by posting of adjoining private lands. The posting of adjoining lands restricts the use of public land to a few select individuals. Points for entrance into these national forest lands could be provided by construction of public roads and trails and by clearly marking existing points of entrance.

Recommended Techniques

5. The use of pellet lines and the walking observation lines as practical population indices appears to bear merit. Deer population estimates, in areas selected for future studies, could be determined by use of these two techniques.
6. Plotting kill locations of all future samples taken of hunting season kill is recommended by the writer. Correlation of animal conditions with range conditions is practically impossible without kill locations. Kill locations also provide an evaluation of kill density and hunting pressure within various sections of the counties.
7. Adequate browse utilization studies should be continued in Bath County and initiated in all major deer ranges in other counties. These studies should provide a basis for determining present range conditions and determining trends over a period of time. Simplicity is the greatest feature of the tag (Montana method) technique for studying browse utilization; therefore, studies can be easily conducted by numerous

personnel. Standardization of procedures should provide similar results by all individuals participating in the study.

LITERATURE CITED

- Aldous, S. E. 1944. A deer browse survey method. *Jour. Mamm.*, 25(2):130-136.
- Bennett, I. J., P. F. English, and R. McCain. 1948. A study of deer populations by use of pellet-group counts. *Jour. Wildl. Mgt.*, 4(4):398-403.
- Casebeer, R. and M. Rogrueb. 1950. A browse utilization study of big game winter ranges within the Flathead Forest of the Continental Management Unit. Progress Report 1-R, Montana Fish and Game Comm., 27 pp.
- Cheatum, E. L. and Severinghaus, C. W. 1950. Variations in fertility of white-tailed deer related to range conditions. *Trans. N. Am. Wildl. Conf.*, 15:170-190.
- Dalke, P. D. 1941. The use and availability of the more common winter deer browse plants in the Missouri Ozarks. *Trans. N. Am. Wildl. Conf.*, 6:155-160.
- DeGarmo, W. R. 1953. White-tailed deer investigation. Quarterly Progress Report 25-R-4. (July 29) Conservation Comm. of West Virginia, Charleston, W. Va., 4 pp.
- DeGarmo, W. R. 1952. White-tailed deer investigation. Quarterly Progress Report 25-R-4. (October 15) Conservation Comm. of West Virginia, Charleston, W. Va., 42 pp.
- DeGarmo, W. R. 1950. Phase B - a white-tailed deer study. Final Report, Project 8-R. Conservation Comm. of West Virginia, Charleston, W. Va., 184 pp.
- Duncan, D. B. 1953. Multiple range and multiple F test. Tech. Rept. No. 6, V. P. I. Dept. of Statistics, Blacksburg, Virginia, 55 pp.
- Hahn, H. C., Jr. 1949. A method of censusing deer and its application in the Edwards Plateau of Texas. Texas Game, Fish and Oyster Comm., Austin, Texas, 24 pp., illus.
- Lindzey, J. S. 1950. The white-tailed deer in Oklahoma. Okla. Game and Fish Dept., Oklahoma City, Okla., 105 pp., illus.
- McCain, R. 1948. A method of measuring deer range use. *Trans. N. Am. Wildl. Conf.*, 13:431-441.

- Patteson, G. W. and Z. M. F. Fulton, Jr. 1951. Economic land classification of Bath County. Bulletin 447, Virginia Agricultural Experiment Station, Blacksburg, Virginia, 19 pp., illus.
- Richards, E. V. 1953. Virginia's white-tailed deer investigation. Unpub. report. Virginia Comm. of Game and Inland Fisheries, Richmond, Va., 35 pp.
- Ruff, F. J. 1938. The white-tailed deer on the Pisgah National Game Preserve, North Carolina. File Copy, U. S. Dept. of Agric., Forest Service, Southern Region, Atlanta, Ga., mimeo., 249 pp., illus.
- Schwan, H. E. and L. Swift. 1941. Forage inventory methods, with special reference to big game ranges. Trans. N. Am. Wildl. Conf., 6:118-125.
- Severinghaus, C. W. 1953. An evaluation of tallies of roadside observations of deer as an index of trends in deer abundance. P. R. Report P 28-R, N. Y. State Conservation Dept., Albany, N. Y., mimeo., 20 pp.
- Severinghaus, C. W. 1949. The live weight-dressed weight and live weight-edible meat relationship. New York Conservationist, October - November, p. 26.
- Severinghaus, C. W. 1949. Tooth development and wear as criteria of age in white-tailed deer. Jour. Wildl. Mgt., 13(2):195-216.
- U. S. Dept. of Commerce. 1950. Preliminary 1950 census of agriculture farms, farm characteristics, farm products. Bath County, Virginia. U. S. Dept. of Commerce, Washington, D. C., 4 pp.
- Virginia Division of Planning and Economic Development. 1952. Bath County, Virginia. Div. of Planning and Econ. Development, Richmond, Va., 4 pp.
- Webb, W. L. 1942. A method for wildlife management mapping in forested areas. Jour. Wildl. Mgt., 6(1):38-43.
- Woolley, D. J. 1940. Survival of restocked deer in Virginia. Unpub. Master's thesis, Virginia Polytechnic Institute, Blacksburg, Virginia, 176 pp.
- Young, V. A. 1938. The carrying capacity of big game ranges. Jour. Wildl. Mgt., 2(3):131-134.

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Appendix Table 3 Browse utilization study form

Dates: Fall _____ Species _____ Stake # _____ Tag # _____
 Spring _____ Area _____ Drainage _____

Location of stake:
 Location of tag:
 Crew: Fall _____ Spring _____

Length classes	<u>Length of stem available</u>				<u>Length of stem left</u>			
	Unused		Used		Unused		Used	
	Tally	Total	Tally	Total	Tally	Total	Tally	Total
0 to .4								
.5 to .9								
1.0 to 1.4								
1.5 to 2.4								
2.5 to 3.4								
3.5 to 4.4								
4.5 to 5.4								
5.5 to 6.4								
6.5 to 7.4								
7.5 to 8.4								
8.5 to 9.4								
9.5 to 10.4								
10.5 to 11.4								
11.5 to 12.4								
12.5 to 13.4								
13.5 to 14.4								
14.5 to 15.4								
15.5 to 16.4								
16.5 to 17.4								
17.5 to 18.4								
18.5 to 19.4								
19.5 to 20.4								
20.5 to 21.4								
21.5 to 22.4								
22.5 to 23.4								
23.5 to 24.4								
24.5 to 25.4								
Others								
	Total growth available				Unused stems available			
	Total growth left				Unused stems left			
	Total growth utilized				Stems used			