

which had been concealed in the center of the dung mass. In the other cell the first stage larva, which had emerged July 9, was killed and almost entirely consumed by an *Aphodius* larva on July 15. In each case the reared adults proved to be *Aphodius lividus*.

Additional information was not obtained, since the *Onthophagus medorensis* adults died without having constructed other cells.

A few conclusions can be reached from the information at hand. *Aphodius* occasionally will develop in dung cells buried by other Scarabaeidae. The *Aphodius* larvae destroy and may consume the eggs or larvae of the host. In the five cases observed, the immature stages of the *Onthophagus* were "parasitized" by single *Aphodius* larvae. Chance inclusion of a single *Aphodius* egg in each of the masses formed by the *Onthophagus* seems unlikely. However, it cannot be said definitely that *Aphodius lividus* (Oliv.) is deliberately "parasitic."

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STATUS OF THE WHITE-TAILED DEER IN TENNESSEE

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The southern white-tailed deer (*Odocoileus v. virginianus* Boddaert) was formerly an abundant game animal in Tennessee. Early writers of the history of Tennessee made frequent reference to the abundance of this animal and its utilization by early settlers and explorers in the state. However, such brief reports are of little value to biologists interested in population densities and histories of extirpation in various regions of Tennessee. Apparently complete information on the past status and history of extirpation of this important game animal is lost forever. The purpose of this paper is to present data on the current status of the white-tailed deer in Tennessee and to attempt to piece together a picture of its history. In recent years a number of northern white-tailed deer (*Odocoileus v. borealis* Miller) have been introduced, thus complicating the classification of present individuals as to subspecies. The location and extent of these introductions will be discussed later in this paper.

Rhoads (1896) was probably the earliest scientific writer to present a more or less complete report on the mammals of the state. He presented the following interesting comment in regard to deer, "When we consider the large amount of wild land in the three main divisions of the State, it is surprising how effectually the Virginia Deer has been exterminated over the greater part of Tennessee . . . A few remain in wilder parts of the Cumberland table-land, but even there they are rarely taken." The scarcity of deer on the Cumberland Plateau is emphasized by the fact that in 1894 the Tennessee legislature passed a law forbidding the killing of deer for a five year period in Cumberland, Claiborne, Scott, Morgan and Anderson counties (Rhoads, 1896). Reporting some 30 years later, Ganier (1928) stated, "After a number of trips to the Reelfoot Lake country I am told by the best hunters that the last of the deer in that region were killed more than ten years ago. In middle Tennessee there is no area in which deer can long survive. A pitiful little band which now lives in Cheatham County will doubtless be wiped out within a decade if steps are not taken to give them complete protection. Some deer are also reported from Perry County, from which area a few roam into Wayne and Humphries counties. . . . In the Cumberland Mountains I have been unable to find record of deer during the past few years, and only in the Great Smoky and Unaka Mountains on the east are a few occasionally to be seen." Kellogg's report (1939) contains the most complete available information on the mammals of Tennessee. He merely summarized some early observations of the white-tailed deer in the state and presented very limited information on the present status. His only current reports were from Komarek and Komarek (1938) who reported deer in Blount and Cocke counties. Hamilton (1943) makes little mention of the southern white-tailed deer other than to state that the exact limit of its range is unknown and that it "occurs in the Great Smoky Mountains of North Carolina and Tennessee." In regard to the northern white-tailed deer he stated, "Its exact range cannot now be traced and is a matter for further study." Caldwell *et al.* (1947), in a publication for school children, have listed the deer as currently occurring in 15 counties and increasing under management. In West Tennessee, they remarked that the deer was common in Obion and Lauderdale counties until 1885, in Middle Tennessee common until 1895, and in East Tennessee common until 1850. They reported that during 1940, 125 deer were purchased for breeding purposes on the Cheatham Game Farm. Komarek and Komarek (1938) stated that the white-tailed deer occurred infrequently in the Great Smoky Mountain National Park. Wing (1940), reporting on a game survey encompassing an area roughly between the Holston River and the Tennessee-Kentucky state line, stated, "There are no native Deer in the region. Sixteen have been liberated at Big Ridge

Park and Cove Creek in the Norris Reservoir." Goodpaster and Hoffmeister (1952), reporting on the deer (*Odocoileus v. subsp.*), stated, "The native stock has long been exterminated from Reelfoot Lake, but an introduction of about three bucks and seven does was made in 1932 or 1933. The herd has multiplied, chiefly on the northwest side of the Lake and Lewis Burrus estimated in 1951 that it might number 125." Conaway and Howell (1953), working in Johnson and Carter counties, reported the white-tailed deer as common locally where introduced on the Kettlefoot and Laurel Fork Wildlife Management Areas. In regard to the Cumberland Plateau (Howell and Conaway, 1952) they believed that the deer was "present only on or near places where it has been introduced and protected from hunting."

It is interesting to note that Miller (1923), Barbour and Allen (1922), and Kellogg (1939) made no reference to Tennessee specimens of the white-tailed deer in reference collections.

In order to explain the local abundance of deer in a state it is often necessary to inspect deer release records of the state game department. Available deer release records for Tennessee in the files of the Tennessee Game and Fish Commission are incomplete except from 1943 to date, inclusive. Mr. A. E. Hyder, Chief of the Game Management Section of the Tennessee Game and Fish Commission, reported by correspondence (1954): "... to my knowledge all of the deer used in the state can originally be traced to this subspecies [*Odocoileus v. borealis* Miller]. Most of the ones used have been purchased directly from Wisconsin (vicinity of Jackson). Those stocked on some of the U. S. Fish and Wildlife Service land, such as the Tellico and Ocoee Areas, were secured from Pisgah [National Game Preserve, North Carolina]." He also mentioned that Ruff (1938) stated, "The variety of white-tailed deer now present on the [Pisgah] preserve is a heterogeneous mixture of several subspecies taken from different localities of the East. The exact history of the present stock is obscure and incomplete." Some of the original Pisgah stock came from the Vanderbilt estate near Asheville, North Carolina, the Adirondacks, Florida, Virginia, and native deer on the Preserve. By correspondence, Dr. A. H. Wiebe (1954) reported that the Tennessee Valley Authority stocked 13 Pisgah deer during the winter of 1936-37 on Norris Reservoir [Wing, 1940, reported 16].

As available from Commission records, game department deer releases from 1943 to 1951 follow. The predecessor of the Tennessee Game and Fish Commission probably filed release records but these could not be located. A discussion of the status of stocking prior to 1943 follows this tabulation. Later restocking records are available in Tennessee Federal Aid Progress Reports. Apparently the department commenced restocking deer in the

thirties, but unfortunately release records are not available for the period prior to 1943. The locations in parentheses following the release sites designate the original source of the animals, while the number following is the number of deer released.

1943—Catoosa Wildlife Management Area (Maryland), 19; Cheatham Wildlife Management Area (Maryland), 10; 1944—Prentice Cooper State Forest (Maryland), 30, Catoosa Wildlife Management Area (Maryland), 33, Cheatham Wildlife Management Area (Maryland), 9; 1946—Catoosa Wildlife Management Area (Maryland), 6, (Wisconsin), 82, Prentice Cooper State Forest (Wisconsin), 46; 1947—Catoosa Wildlife Management Area (Wisconsin), 83, Unicoi Wildlife Management Area (Wisconsin), 103, Falls Creek Falls State Park (Wisconsin), 44; 1948—Laurel Fork Wildlife Management Area (Wisconsin), 17; Eagle Creek Refuge (Wisconsin), 7, Andrew Johnson Game Preserve (Wisconsin), 30; 1949—Laurel Fork Wildlife Management Area (Wisconsin), 43, Kettlefoot Wildlife Management Area (Wisconsin), 25, (Cheatham Game Farm), 19, Morgan State Forest (Wisconsin), 41, Pickett State Forest (Wisconsin), 32; 1950—Catoosa Wildlife Management Area (Wisconsin), 80, (Morgan County), 6, (Johnson City Veterans Administration Hospital), 3; 1951—Catoosa Wildlife Management Area (Morgan County), 12, Unicoi Wildlife Management Area (Cove Creek Game Refuge), 3. Where the source is indicated as "Maryland" the records also referred to the Cheatham Game Farm.

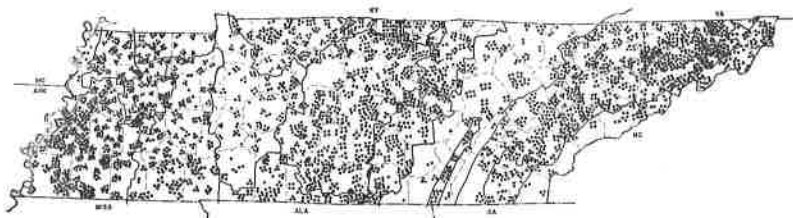


Fig. 1. Distribution of farmer respondents

In regard to departmental stocking prior to 1943 only a limited amount of information is available. Apparently the state was engaged in a restocking program at least by the middle thirties as Headden and Headden (1936) remarked, "The deer is almost extinct in Tennessee. Only a few sections allow hunting at all of this valuable animal at the present time. The State Department of Game and Fish has purchased several hundred and distributed them to wooded areas throughout the state." Due to limited sources of supply, it is the writer's belief that these deer were probably northern white-tailed deer. Apparently these deer were not purchased with Federal Aid funds as according to the Branch of Federal Aid, U.S. Fish and Wildlife Service (correspondence, 1954), their records show "that Tennessee inaugurated a deer-stocking program . . . on March 21, 1940. This project terminated on April 22, 1941. During that period 153 (11 died prior to release) were purchased to stock the Cheatham Area." The purchase sources were Mr. Schowalter of Wisconsin (11 deer), Wisconsin Conservation Department (8 deer), Woodmont Gun Club of Maryland (82 deer) and the Michigan Department of Conservation (52 deer). The Branch of Wildlife

Refuges, U. S. Fish and Wildlife Service (correspondence, 1954), reported that some deer were present on the Reelfoot Lake and Lake Isom national wildlife refuges when placed under their administration and that the Service has not released deer on these areas. They were also "inclined to believe that no stocking has been done by the State in recent years."

Mr. A. J. Marsh, former Chief of the Game Management Section of the Tennessee Game and Fish Commission, furnished the following information on the status of deer restocking prior to 1943 (correspondence, 1954). He reported that individuals have released a few deer throughout the state and that records of these releases would be difficult to obtain. He also reported that the Cheatham Game Farm was established with Federal Aid funds; thereby, it appears that the source of breeding stock was as reported by the U. S. Fish and Wildlife Service as the Service requires records of expenditures. The game farm produced deer for restocking purposes in 1937, '38, '39, '40, '41, '42 and later years. Deer were released on the "Cheatham County Area" in 1941 and 1942. In regard to the stocking of the Reelfoot Lake area, Marsh remarked that approximately 12 deer were released in the thirties, about 1935. About the year 1935, deer were released in Shelby Forest and on the Catoosa Wildlife Management Area commencing in 1937 or 1938 and every year thereafter. In 1939, Mr. Marsh released "northern deer" in this area. The Andrew Johnson Game Refuge was stocked prior to 1939, possibly in 1936 or 1937. As far as he knows no deer were released in Wayne and Perry counties and he believes present populations are the descendents of native animals.

These release records are of utmost importance to taxonomists interested in the taxonomy of Tennessee deer and also for evaluating data presented in this paper.

The apparent lack of information on the history, distribution and density of Tennessee deer populations, as well as of other game animals, made it necessary that the Tennessee Game and Fish Commission conduct a statewide wildlife survey in order to instigate a sound game management program for the state. Primary field work for this project was begun in September, 1950, and was completed approximately 13 months later. The survey procedure which has been described by Schultz (1952, 1954a) was primarily a personal interview survey based on acceptable sampling methods. Farmers (3,560), dwelling on 1,000 sampling areas, were sampled and personally interviewed concerning their knowledge of the deer and other native fauna in the state (Figure 1). Conservation officers were interviewed by postal questionnaire concerning the presence of deer in their assigned counties. Their replies, hearsay reports of farmer respondents and personal observations of farmer respondents are presented in detail in the final report of the survey (Schultz *et al.*, 1954).

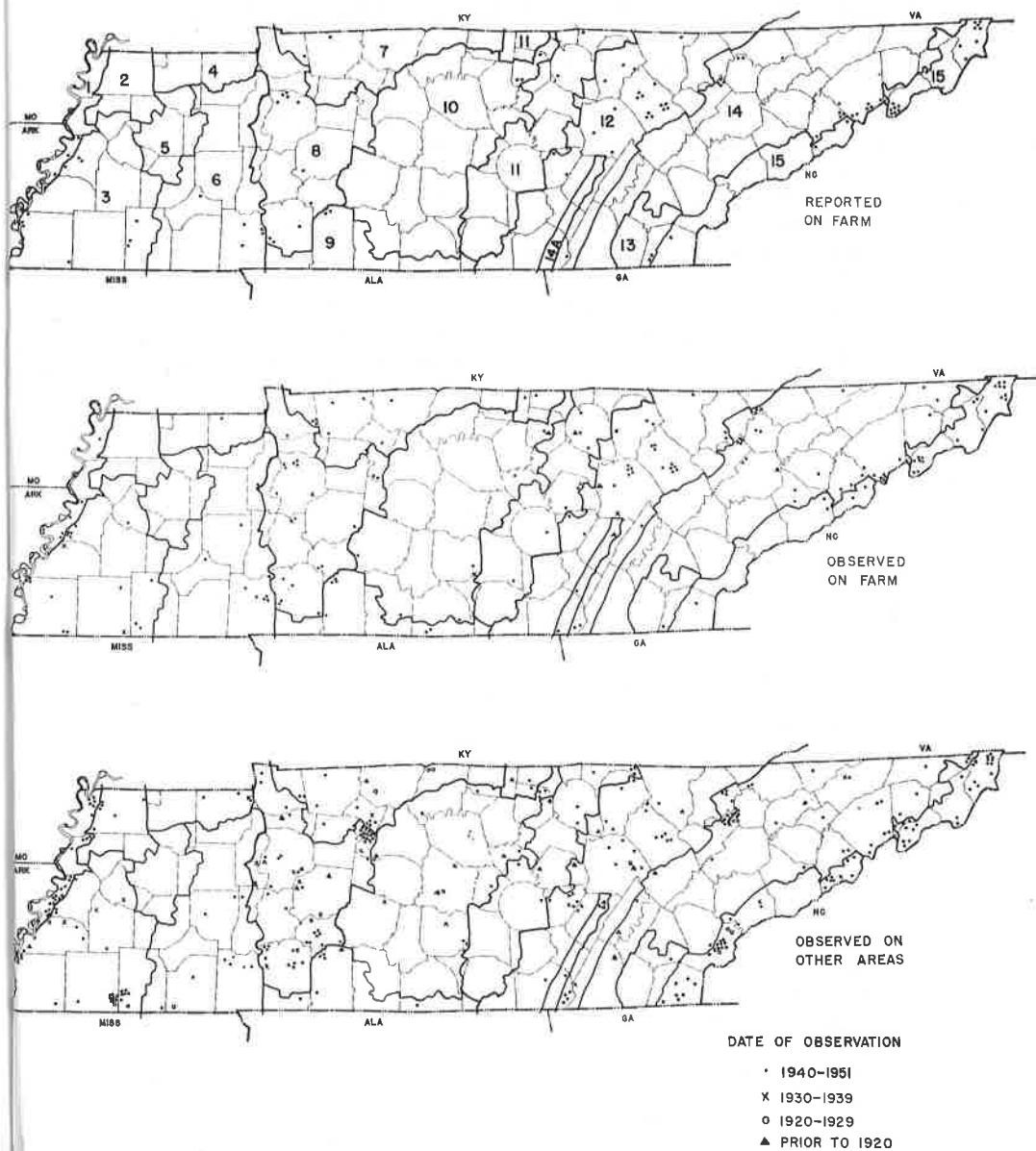


Fig. 2. Distribution of deer reports and observations by farmer respondents.

For purposes of study, data are tabulated on a basis of 15 farming-types (Figure 2, Table 1) which are related to physiographic regions of the state as follows: Mississippi Bottoms, farming-type 1; Plateau Slope of West Tennessee, 2, 3, 4, 5, 6; Highland Rim, 7, 8, 9, 11; Central Basin, 10; Cumberland Plateau, 12; Valley of East Tennessee, 13, 14; Sequatchie Valley, 14A; Unaka Range, 15. Sampling errors (Table 1) indicate the adequacy of sampling for all interviewees and all respondents reporting the white-tailed deer on their farms. The latter are an *indication* of the relative density and dispersion of the animal within the farming-type, i.e., the smaller the sampling error, the greater the possible dispersion and relative density of the animal in the farming-type.

Deer were reported as occurring on farms of 102 of the 3,560 respondents (Table 1). Their distribution is presented in Figure 2. The larger percentages of farmers reporting deer on their farms were in farming-types 1, 8, 12, and 15, with 15, 7, 16, and 15 per cent of the respondents reporting deer, respectively. A similar relationship existed in regard to reports of deer occurring on sampling areas (Table 1). It is apparent from these data and the distribution map that the primary white-tailed deer populations are in the Mississippi Bottoms, western Highland Rim, Cumberland Plateau and Unaka Range. Undoubtedly the relative lack of farms (Figure 2) in the Unaka Range and Cumberland Plateau has an influence on the number of reports from these two areas. Reports of deer on farms in other farming-types are often adjacent to what has been delineated as the primary deer range in Tennessee. Reports of deer on farms did not necessarily have to be personal observations by the farmer respondent, i.e., such reports could have been based on neighbors' observations, tracks, pellets or others.

In addition to requests for information on the occurrence of deer on the respondent's farm, information on personal observations of deer on the farm and other areas was collected (Figure 2). It should be realized that the farming-type boundaries, which are based on civil district boundaries, only approximate the natural boundaries of physiographic regions. This fact, as well as difficulties that arose in plotting exact locations of observations, resulted in some observations, particularly on edges of farming-types, appearing in one physiographic region when in reality they belonged in another. This is particularly true adjacent to the Cumberland Plateau. As previously stated, specific locations and dates of these personal observations and hearsay reports are available in the final survey report (Schultz *et al.*, 1954). These reports assist in substantiating conclusions that the primary deer populations and range are as delineated above and that deer restocking in various areas of the state resulted in population increases. Observations are concentrated as follows: Reelfoot Lake Migratory Waterfowl Refuge (Lake County), Ames Plan-

TABLE 1. Status of the deer in Tennessee as determined by personal interview of heads of farm households.

	FARMING TYPE															Total
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	
Number of Respondents	27	97	489	69	131	261	200	139	116	538	306	137	57	862	131	3560
Relative Sampling Error ¹ Number reporting deer on farm	16.4	7.6	5.0	6.7	6.8	4.6	5.9	6.7	8.8	3.2	5.7	7.7	10.2	3.0	6.5	1.5
Percent reporting deer on farm	4	0	11	0	0	6	2	10	2	3	2	22	2	19	19	102
Relative Sampling Error ¹	23.9	—	35.1	—	—	44.3	70.1	40.3	105.2	43.6	68.4	24.3	96.6	33.4	34.8	12.3
Number of Respondents ² Number reporting deer on sampling area	16	78	341	58	94	184	158	120	95	417	239	116	45	724	122	2807
Percent reporting deer on sampling area	3	0	10	0	0	7	1	12	3	9	9	31	3	34	45	167
	19	0	3	0	0	4	1	10	3	2	4	27	7	5	37	6

¹ Computed by use of analysis of variance, with computations by the Iowa State College Statistical Laboratory.

² Includes only respondents who have lived on area, or not over 2 miles from area, during the last five years.

tation (Fayette County), Cheatham Wildlife Management Area (Cheatham County), Catoosa Wildlife Management Area (Cumberland and Morgan Counties), Pickett State Forest (Pickett County), Falls Creek Falls State Park (Van Buren and Bledsoe Counties), Prentice Cooper State Forest (Marion County), Norris Reservoir Area (Anderson and Campbell Counties), Ocoee Wildlife Management Area (Polk County), Tellico Plains Wildlife Management Area (Monroe County), Unicoi Wildlife Management Areas (Green, Unicoi and Washington Counties), Kettlefoot Wildlife Management Area (Johnson and Sullivan Counties). It is interesting to note that older observations are not in general localized in the vicinity of restocked areas.

Although there is probably an abundance of younger farmers and a memory bias resulting from farmers neglecting to report old observations, it appears that the distribution of observations for the periods of tabulation give a partial picture of the history of deer populations in the state. The relative absence of reports for the periods 1930-39, 1920-29 and earlier indicates that current deer populations in the state are relatively new. While the grouping of current observations (1940-1951) in the vicinity of restocked areas indicates that restocking has been a major factor in this increase, with, of course, increased law enforcement playing an important role. It might be suggested that the relative absence of early observations is due to the vagaries of sampling; however, the same respondents reported numbers of observations of the wild turkey during these periods, an animal, in general, more difficult to observe than the deer (Schultz, 1954b).

Information on population trends was requested from respondents reporting deer as present on sampling areas. Population trends were requested only from persons residing on, or within, two miles of the areas during the last five years. Of the 165 eligible respondents, 67 (or 41 per cent) reported the population up during the last five years; 9 (or 5 per cent) reported down; 21 (or 13 per cent) reported no change; 68 (or 41 per cent) reported trend as unknown.

In summary it might be stated that: (1) deer are distributed in general throughout the state with concentration areas being in the Mississippi bottoms, western Highland Rim, Cumberland Plateau and Unaka Range; (2) populations were at a low level in the state during the period 1900 to 1930; (3) restocking has apparently resulted in population increases in restocked areas; (4) the deer population is currently increasing in the state; and (5) the present deer is probably a mixture of *Odocoileus v. borealis* and *Odocoileus v. virginianus* with apparently pure stock of *Odocoileus v. virginianus* being in the lower Mississippi bottoms and western Highland Rim.

ACKNOWLEDGMENTS

This paper is based on data collected by the Tennessee Game and Fish Commission with Federal Aid to Wildlife Restoration funds under Pittman-Robertson Project Number W-16-R. Acknowledgments are due assistant project leaders: R. H. Anderson, J. A. Fox, W. H. Griffin, W. M. Weaver, Jr., G. A. Webb, and particularly E. Legler, Jr., A. E. Hyder and A. J. Marsh furnished the writer information on deer restocking in Tennessee. This manuscript was initiated while the writer was a staff member of the Dept. of Biology, Virginia Polytechnic Institute and completed while he was a Public Health Service Research Fellow at Johns Hopkins University.

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