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DEER DAMAGE TO FOREST TREES IN PENNSYLVANIA¹

By LEROY FRONTZ, *Assistant in Forest Management*

THE Pennsylvania Department of Forests and Waters has received numerous reports since 1924 concerning deer damage to forest tree plantations and to natural forest growth in many parts of the Commonwealth. To determine the nature and extent of this damage the Department during the winter of 1927 and the spring of 1928 made a thorough study of the regions in which extensive damage was reported. For this purpose, special study plots were established on State Forest lands in Huntingdon, Franklin, Clearfield, Clinton, Elk, and Cameron Counties. These study plots are one quarter of an acre in area, and were located so as to portray average rather than exceptional conditions. The data collected are representative of conditions found not only upon the plots but also in the regions about them.

Special effort was made throughout this study not to charge the deer with doubtful damage. The deer were considered innocent of damage unless there was conclusive evidence that they were actually responsible for the damage. Where definite evidence of deer damage could not be determined, the damage noted was not considered in the computation. The actual basis of recording deer damage consisted of (a) actually seeing the deer destroying trees; (b) hoof prints in the snow leading from tree to tree as the deer fed; and (c) the nature of the damage being such that persons familiar with the habits of deer could be positive that the injury came from no other source.

The deer damage consisted primarily in the eating of buds, accompanied very frequently with the destruction of leaves and young twigs. In many localities the browsing was so complete that large areas that would have otherwise supported a satisfactory stand of young timber were practically denuded of tree growth. In some cases the greatest damage appeared to be concentrated upon planted areas, while in other instances, and without any known reasons, the greatest damage was found in young stands of natural forest growth.

It was also observed that deer show a tendency to congregate in certain localities in which they do great damage, sometimes amounting to the complete destruction of all trees and shrubs below an average height of six feet. Such areas were observed in Franklin and Clear-

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field Counties, and in a number of cases they were separated not more than a mile from areas upon which little or no damage was apparent, and where there was an abundance of similar deer food. This observation seems to indicate that, contrary to popular opinion, the deer are not accustomed to range widely in search of food.

The deer appear to have no set order of preference in feeding on forest trees. In plantations, pitch pine and white pine seemed to be preferred. This, however, may be in a measure attributed to the fact that white pine is the most widely planted tree in the State. In several instances it was observed that Scotch pine was avoided, possibly because of its sharp, stiff needles, especially when other trees of tender age were present.

Practically total destruction was observed in plantations of white pine, shortleaf pine, pitch pine, Banks pine, red pine, Japanese larch, Norway spruce, and American elm. In the natural forest growth, practically all species of trees present on the areas studied were eaten indiscriminately, including black locust, white oak, scarlet oak, black oak, scrub oak, red maple, chestnut, pitch pine, white pine, hemlock, cherry and such shrubs as mountain laurel, sweet fern, and huckleberries.

The major portion of the field work in this special study was confined to plantations, because full records are available of every plantation established in the State Forests of Pennsylvania. With these complete plantation records it was possible to draw accurate conclusions. However, extensive field observations, supplemented by the study plots, show that natural forest growth has been damaged even more seriously than plantations. An examination of natural hardwood areas and natural growth of white pine in Huntingdon and Centre Counties showed that upon specific areas every sprout and seedling tree had been killed.

Study plots in natural growth in the Moshannon State Forest in Clearfield County show that every woody plant less than six feet in height had been entirely destroyed or hopelessly injured by deer. The collected data show that a total of 340 specimens of woody plants were present on a one-quarter acre plot. Of this number 166 were of forestal value, 22 were classed as temporary nurse crop trees, and 152 as shrubs. Of the 166 valuable trees, 41 or 85% were either dead or dying. Only 11 specimens of the valuable trees on the plot showed no evidence of injury from browsing deer. These 11 trees were among the oldest on the plot. Their freedom from deer damage can be attributed to their height, which ranges from 14 to 21 feet. Two hundred and ninety-nine trees and shrubs, or 88% of the total number of woody plants on the plot were either dead, dying or severely injured by deer. In this locality pitch pine trees 16 feet in height were observed, the tops of which had been browsed by deer

while the trees were loaded with snow and bent to the ground. The foregoing data record only the more recent damage on this plot, for the deer had been destroying seedlings and small sapling trees for several years before the study plot was established. The deer damage prior to the establishment of the plot is not included in this computation. It is noteworthy that not a single tree or shrub less than six feet in height could be found on this particular plot and adjoining areas that had not been killed or injured by deer to such an extent that they were practically worthless for timber production. In general, these deer-damaged areas appear much like over-grazed farm woodlots. A network of deer paths ramify over them like cattle paths in heavily grazed woodplots. Conditions on these study plots are typical of extensive areas of forest land in many sections of the State.

An examination of the natural forest growth in Decker Valley, Centre County, in the Penn State Forest, showed that every kind of natural growth was being eaten by deer. Practically all young growth up to five feet in height was killed as a result of the severe browsing by these animals. The white oak suffered extreme damage in this section. All kinds of natural growth, including shrubs such as huckleberry and sweet fern, have been eaten by the deer. Mountain laurel in places has been practically exterminated.

The ultimate result of deer damage to young natural forest growth will be more fully understood when the present forest stands have reached maturity and are ready to be lumbered. This is especially significant, for forestry in Pennsylvania will for many years to come deal primarily with natural rather than with planted forest stands. It is to these natural stands we must look for a large portion of our future wood supply. These natural forest stands are already, for the most part, composed of poor specimens of inferior trees which will surely continue to deteriorate if deer damage continues at the present rate.

An examination of European larch, red pine, Scotch pine and Banks pine plantations, set out in 1924, 1925, and 1926 on State forest land in Clearfield County, showed 80 to 95% of the planted trees growing at the end of the first season. In 1925 an inspection of these plantations disclosed that the planted trees were being severely damaged by deer, and presented a very unpromising appearance. By the Spring of 1927, it was apparent that to attempt further reforestation was a waste of trees, time, and money, unless some means were found whereby the planted trees could be protected from deer. For this reason no plantations have been made during the last three years in this locality. To have a better understanding of the nature and extent of deer damage, a one-quarter acre study plot was established on the area planted with Banks pine

in 1924. This area represents average conditions for all the plantations. The planted trees were originally spaced approximately five by six feet. In 1928, only 156 trees were left of approximately 400 originally planted on the study plot. This number consisted of dead, dying, and a few living trees which had developed sufficiently vigorous shoots to indicate their ability to recover from the effects of being eaten off repeatedly. Only two trees that had escaped entirely from deer damage were found on the plot. These were growing in a brush covered area. A total of seven trees on the plot appeared to possess sufficient vitality to recover and develop into merchantable size, provided they are not injured later on. Sixty trees were found that still showed some little signs of life. The remaining trees were entirely dead. According to normal growth records the trees on this plot should have had an average height of three feet, had they not been damaged by deer.

Studies of a pitch pine plantation set out in the Kelly fields in Huntingdon County in the Logan State Forest, show that the trees were damaged heavily by deer. The trees were planted in the spring of 1924. They were spaced five by five feet. Only four trees of the total of 352 found on the area on March 8, 1928, had sufficient lateral buds to enable them to live over the following summer. The terminal shoots of every planted tree had been nipped by the deer. The four trees mentioned were the only ones found on the plot that possessed even lateral buds. The average height of the planted trees was seven inches. Records of pitch pine plantations show that under normal conditions pitch pine at four years after planting should attain an average height of approximately three feet.

In the spring of 1924, two plots of American elm, 1-1 transplants, were set out within 500 feet of Forest Ranger Wm. F. McKinney's headquarters in Centre County. The soil, slope, elevation and other growth factors were similar on the two plots. The only difference between the two plantings was that one was fenced and the deer excluded therefrom, and the other was not fenced. An examination of the trees on both areas, made on March 8, 1929, showed that the trees planted in the unfenced areas averaged but 18 inches in height and were either dead or in a dying condition. The trees on the fenced area from which the deer were excluded, averaged six feet in height, and some of the larger trees had attained a height of 10 feet. The contrast between these fenced and unfenced areas shows conclusively the nature and extent of deer damage to forest trees in sections where an over-population of these animals occurs.

It has been observed that deer seem to prefer feeding on a certain kind of tree in one plantation while in another the damage may be negligible. It has been suggested that "seed source" may account for this difference. Associate Silviculturist Perkins Coville of the

U. S. Forest Service, evidently believes that some hereditary difference in trees accounts for the differing degrees of damage. He shows in Figure 9, Volume 20, of the October, 1929 issue of "The Journal of Heredity," deer grazing on western yellow pine, distinguished between stock derived from seeds that came from the Black Hills and stock that came from Leadville and San Isabel sources. Trees grown from seed collected in the Black Hills were almost entirely destroyed by deer, while trees grown from the other sources were only slightly damaged. In Pennsylvania, the difference in severity of damage may be due to the topography of the country with its resulting influence on the more or less definite paths followed by deer in their wanderings from one locality to another in their search for food.

The degree of over-population of deer may be illustrated by a comparison of the deer population of Jackson Township, Huntingdon County, Pennsylvania, with the total number of deer that European experience shows a specific region is capable of supporting. Jackson Township has a total area of 52,000 acres, of which 33,000 acres are classed as forest land. In 1926, an open season was declared on female deer in this township, and according to records of the Board of Game Commissioners, 532 legal doe were shot during the season. It is reported that a total of 1,200 deer were killed in the township during both the regular and special hunting seasons. Included within this total is the number of deer estimated to have been shot by farmers while feeding on their crops.

On the basis of 1,200 deer shot, it is apparent that one deer was killed for every 26 acres of forest land in the township. Estimating that for every deer killed four remained, it is apparent that when the hunting season opened in Jackson Township in 1926, there was probably a total of 6,000 deer in the township, that is, approximately one deer to every five or six acres of forest land. European experience shows that it is possible for one deer to live on about 40 acres, causing little or no damage. The late Dr. Filbert Roth of the University of Michigan states in his "First Book of Forestry," that "In hardwood forests like those of the Alleghenies, 25 deer should feed and live on 1,000 acres of land without interfering with the real object of forestry; but in all cases the number should be regulated, and the old does as well as old bucks should be removed." These data appear to indicate that the deer population of Jackson Township in 1925 was from eight to ten times greater than the normal carrying capacity of the forest.

The record of the legal deer killed in Pennsylvania as reported by the Board of Game Commissioners is a reliable index to the rapid increase of the deer population and the resultant damage to forest growth:

<i>Year</i>	<i>Number of Legal Deer Killed</i>
1914	1,102
1915	1,287
1916	1,722
1917	1,725
1918	1,754
1919	1,939
1920	3,300
1921	4,840
1922	6,115
1923	6,452
1924	7,778
1925	7,287
1926	11,646
1927	14,374
1928	25,097
1929	22,394

The foregoing table shows that during the last five years the number of legal deer killed in Pennsylvania has doubled and tripled, which implies a corresponding increase in the total deer population, and a proportionate increase in deer damage to forest growth.

This preliminary study of deer damage to forest trees revealed the fact that very little reliable information is now available on this important subject. To bring together accurate and reliable information, and to help develop a better understanding of this serious problem, the Pennsylvania Department of Forests and Waters and the Board of Game Commissioners are cooperating in a special study of deer damage, started in the spring of 1929. In accordance with this cooperative plan ten study plots were established on five different State Forests in Clearfield, Cumberland, Huntingdon, Pike, and Potter Counties. Each of these five study areas consist of two one-acre plots. One of each of these two one-acre plots was completely enclosed with a deer-proof fence seven and one-half feet high; the other companion one-acre plots were left unfenced. Special care was used in selecting companion plots with similar natural growth conditions and other factors that would affect tree growth. Eight of the ten one-acre plots (four fenced and four unfenced) were planted with selected planting stock. The fenced areas were planted with the same species and in the same manner as the unfenced areas. The species used in the planting of these plots were white pine, red pine, pitch pine, Scotch pine, Banks pine, Austrian pine, Japanese larch, and white spruce. These ten experimental plots have been established too recently to give any conclusive results at this time, but within a few years they will begin to give accurate and reliable information as to

the nature and extent of deer damage to forest trees in plantations and natural growth in different regions in Pennsylvania.

Among the conclusions that have been developed from this preliminary study of deer damage to forest trees are the following:

1. Deer frequently damage forest tree plantations and natural forest growth by eating the buds, leaves and younger, more succulent twigs. This damage is likely to prove fatal at any time during the life of a stand until the trees reach a height of at least six feet.
2. Deer feed indiscriminately upon plantations and natural growth. The damage ranges from a partial destruction of the stand and crippling of the individual trees, to complete destruction. Crippled trees that are not killed are usually deformed and made practically worthless for future lumber production purposes.
3. Deer feed upon practically all kinds of forest growth. If a preference is shown among the conifers, it appears to be for pitch pine and white pine.
4. Excessive injury may be confined to a comparatively limited area, while tree growth in the surrounding regions may not be extensively damaged.
5. Deer damage unless checked, will result in the ruin of extensive areas of plantations and young natural growth under 10 years of age.
6. The establishment of forest tree plantations upon thousands of acres of State-owned as well as privately-owned forest land, located in these regions where deer are abundant, is impractical at this time.
7. The damage now being done to natural forest growth precludes the possibility of lumbering in many sections of the State and the successful carrying on of improvement cuttings for the purpose of encouraging the development of young trees of valuable species. To clear cut in these particular localities would mean the disappearance of valuable tree growth, such areas becoming barrens.
8. It is apparent that if the forest lands of Pennsylvania are to be restored to productivity, something must be done to control the deer population in such a way as will not seriously interfere with timber production, which is the primary purpose of forestry.

RESEARCH PUBLICATIONS
OF
PENNSYLVANIA DEPARTMENT OF FORESTS AND WATERS

Research Bulletin 1.—A Guide to Forestry Studies and Demonstrations on the Mont Alto and Michaux State Forests.

Research Bulletin 2.—Pitch Pine in Pennsylvania.

Research Bulletin 3.—Woody Plants of the Mont Alto Forest: Native and Introduced.

Research Circular 1.—Recovery of the Chestnut in Pennsylvania.

Research Circular 2.—White Pine Blister Rust in Pennsylvania.

Research Circular 3.—Deer Damage to Forest Trees in Pennsylvania.

The publications listed above are distributed by the Pennsylvania Department of Forests and Waters, Harrisburg, Pa., and by the Pennsylvania Forest Research Institute, Mont Alto, Pa.

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