# *Effect of Deer Browsing on Quality of Hardwood Timber in Northern Michigan*

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THE EFFECT of browsing by whitetail deer on hardwood reproduction has received considerable attention in the Lake States during recent years. The concern has been largely with the influence browsing has had on the quantity of reproduction, with little reference to its effect on the quality of the surviving stems.

Several studies have shown that reproduction in the northern hardwood type may be adversely affected by excessive browsing. DeBoer (1947) in Wisconsin pointed out that heavy browsing by deer resulted in considerable loss of reproduction. He added that although 67 percent of hard maple stems were hard hit one year the stocking averaged *about 1600 stems per acre, and would, even if all heavily browsed specimens were to leave the stand, still have some 528 stems per acre (acceptable stocking under maturing stands). Although this gives some assurance of restocking for this species, it must be remembered that, with the depletion of other non-commercial species of high palatability, the heavy browse rate will probably go even higher and a year or two may result in a far less desirable picture.* Graham (1954) has shown after many years of investigation in the Upper Peninsula of Michigan that deer have a profound effect on their own environment by excessive browsing. At the same time he stated that *From the viewpoint of forest reproduction the situation though not ideal is in most places not actually disastrous.* In a study of deer damage to reproduction in both upland and swamp types in the Argonne Experimental Forest in Wisconsin, Arbogast and Heinselman (1950) placed 96.4 percent of their 648 study plots in the *Heavy* and *Very Heavy* browse damage classes, a condition which they emphasized is silviculturally undesirable.

From the above studies it is evident that severe browsing by deer may limit the number of trees that grow successfully to produce a merchantable stand. Graham's work also has demonstrated that species composition is rendered somewhat less desirable both for deer food and cover and for timber production, as the growth of hemlock, cedar, and yellow birch is curtailed in favor of hard maple and balsam fir. The latter species tend to become dominant after many years of browsing. But, assuming that a well-stocked stand of maple finally escapes, does the excessive browsing that may have eliminated some of the other valuable timber trees actually cut down the dollars and cents profit to the logging op-

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erator through any secondary effects of browsing on the quality of the logs themselves? That is the question we are primarily concerned with in this paper. Specifically, the overall objective of this study was to determine the influence which deformities caused by deer browsing may ultimately have on the quality and quantity of merchantable timber. The study was focused on three major questions:

1. Can northern hardwoods reproduce adequately under severe browsing by deer to produce a satisfactorily-stocked merchantable stand?
2. What will be the quality of the resulting timber, particularly with respect to such defects as rot, crook, and catface?
3. Does browsing have an adverse effect on growth rate of the tree species involved, and if so, how much?

### Description and History of Areas Studied

The area selected for study is an upland island of hardwoods located in a large coniferous swamp some thirteen miles east of Munising, Michigan. The island is approximately one mile long and three-eighths of a mile wide, or about 200 acres in extent. Its main soil type is mapped as Trenary fine sandy loam with some Ogemaw fine sandy loam and Saugatuck sand along the periphery (Veatch *et al.*, 1929). All stem samples were cut in the Trenary fine sandy loam type. Dominant hardwood species at present consist largely of hard or sugar maple (*Acer saccharum* Marsh.), American elm (*Ulmus americana* L.) and black cherry (*Prunus serotina* Ehrh.). Stem size varied from 1 to 8 inches d.b.h., with the preponderance of the stems in the 2-5 inch class. Number of stems counted per acre and basal area calculations on the total stems present indicated adequate stocking.

The area has been heavily used by deer in the past. Much of the logging of hardwood timber in this part of the country occurred during and after World War I (1915-1930). Deer increased in numbers as food conditions improved following cutting. They undoubtedly yarded in the swamp and on this island of virgin hardwood for many years before logging operations began, browsing and rebrowsing the tolerant hard maple reproduction that persisted under the dense shade. In 1922 the timber was clearcut. Abundant reproduction of the hard maple promptly followed, which was utilized by the large numbers of deer that came to the island each winter. It has been estimated by various Michigan game technicians that several hundred deer fed here annually.

*Fig. 1. Effect of severe browsing by deer on hard maple. 1928 photograph.*

In 1928, Michigan Land Economic Survey workers found dense hardwood reproduction not yet of sufficient height to be included in the 0-1 inch d.b.h. class. Obviously, deer had kept most of it in this size class during the six years since cutting. I. H. Bartlett of the Michigan Department of Conservation took a picture (Fig. 1) to show the effect of severe deer browsing. Bartlett revisited the area nine years later (1937), and found that most of the reproduction had escaped the deer (Fig. 2). Cut samples (Fig. 3) indicated that the escape occurred in 1931 or 1932. For a period of approximately ten years, therefore, between 1922 when it was clearcut and 1932 when it escaped, this reproduction was annually subjected to the severest kind of deer browsing.

*Fig. 2. Same area as shown in Figure 1. Escape from deer browsing occurred about 1932. 1937 photograph.*

The relatively unbrowsed stand selected for the control is located about five and a half miles south of the island study area. It is within one-half mile of the extreme southern boundary of the conifer swamp which encloses the hardwood island. Its soil type is the same as that of the island, namely Trenary fine sandy loam. Although somewhat different in quantity of stems, the two areas are very similar in species composition and age classes. Sapling and pole stages (1-8 inches d.b.h.) predominate in both stands, with the majority of stems in the 2-5 inch class.

A detailed history of the control area is not available, but interviews with local inhabitants who had spent a large part of their lives in the immediate vicinity, disclosed that this stand of timber has been subjected to a negligible amount of deer browsing as compared with the study area. Observations as far back as 1923 indicate that not more than ten deer used the area annually, and then only when entering or leaving the winter deeryard to the north. Periodic inspections of the stand by Cusino Station personnel in 1951 and 1952 confirmed this belief, as few signs of deer were found. It is believed the area was cut about the same time as the hardwood island (1922).

## Methods

In discussing the principal field procedures used in this study, the authors would like to express their appreciation to other staff members of the Cusino Wildlife Experiment Station who aided in the work, and especially to Wayne D. Burnett, then assigned to the Station, who supervised cutting operations in the control area and worked up much of the present field data. Credit also is due several members of the staff of the Lake States Forest Experiment Station, U. S. Forest Service, for technical advice on the project.

Three semi-circular 1/10-acre plots were established in each area, and a tally was made of the number of stems within each plot by species. All the stems were then cut at average snow level (2.9 feet) and again at three feet above snow level, removing for study the three-foot length of stem exhibiting the most evidence of deer browsing. Each billet or section of stem thus obtained was split longitudinally through the heartwood and numbered. Each stem was closely examined to determine its quality as a potential saw-log and what deformities may have resulted from the effects of browsing.

Classes were established as follows: (1) *entrance of rot*, which included three sub-classes, *rot absent*, *rot present*, and *serious rot;* (2) *crook formation*, which included the two sub-classes, *crook present* and *crook absent;* and (3) *presence of catface*. Criteria differentiating the classes of rot were established, the primary consideration being the probable future condition of the stem. The *serious rot* classification was defined as including stems in which rot showed no signs of being arrested, in which rot was noted in the entire length of the bole, or in which the width of incipient or

advanced decay was large in comparison with the full diameter of the stem. The *rot present* classification was considered as including the gradation from any indication of advanced decay to the *serious rot* category. The *rot absent* class is self-explanatory. The *crook formation* and *presence of catface* classifications need no further clarification.

Evaluation of the cut stems was made by the authors with the assistance of F. H. Longwood, then research forester with the Upper Peninsula Experimental Forest of the Lake States Forest Experiment Station, and Gene Hesterberg, forester and faculty member of the Michigan College of Mining and Technology.

## Findings

On the basis of stem examination, rot in hard maple in the heavily-browsed hardwood island was only slightly more prevalent (10 percent) than in the relatively unbrowsed control areas. As can be noted in Figure 4, rot was observed in 98.1 percent of the island stems and 88.1 per cent of the control stems. *Serious rot* was more evident on the island with 68.8 percent of the stems affected as compared with 52.5 percent in the control area. The *rot present* class included 29.3 percent of the stems in the island plots and 35.5 percent in the control plots. The *no rot* group included 1.9 percent of the stems in the island and 11.9 percent in the control. Analysis of rot data in both areas indicated there was little reproduction present that showed a total absence of rot.

*Formation of crook* was found in 93.3 percent of the hardwood island maple stems, but in only 67.0 percent of the control stems. Catfaces were present in only 1.3 percent of stems in the island and 3.0 percent in the control areas.

It was felt there was an insufficient sampling of the other species to provide an adequate comparison. Indications, however, were that heart rot was less prevalent in the elm and black cherry stems than in the hard maple.

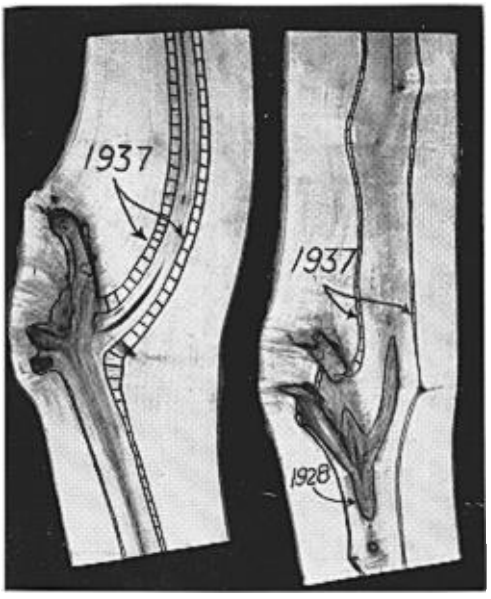


*Fig. 3. Split samples confirm the history of deer browsing on hard maple. Note how corrective growth tends to straighten crook and enclose injuries. 1954 photograph.*

## Discussion

The conclusions to be drawn from this study, while not entirely clear in every instance, seem to show that a satisfactory stocking of hard (sugar) maple can be expected even under the severest of browsing. Since there were more than 2,000 stems per acre in the study area, over 600 of which were free of serious rot, it is evident that escape occurred and that overbrowsing did not result in an appreciable loss in the number of potentially merchantable stems.

The study further shows that entrance of heart rot in Lake Superior hardwood stands is not increased appreciably by browsing of deer. It is probable that the reproduction under study was as severely browsed as any hardwood stand could be during its initial development. Therefore, deer browsing should have produced its maximum possible damage short of total kill upon hardwood reproduction in this stand. Despite the severest kind of brows-

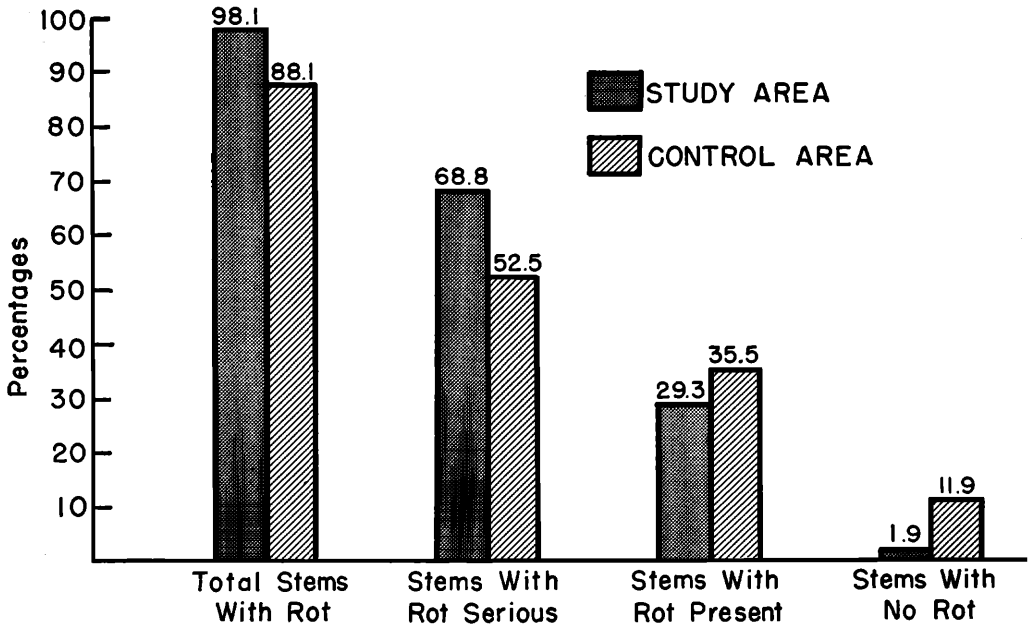


*Fig. 4. Percentages of stems falling in rot classifications.*

ing pressure over an extended period, the amount of rot in hardwoods found in the study area was only slightly greater than in the relatively unbrowsed control area.

Rot is normally serious in Lake Superior hardwood stands as was evidenced by Eyre and Zillgitt (1953) who state that *Old growth northern hardwood stands in the Lake States commonly contain 20 to 30 per cent defect and frequently more if trees wholly unmerchantable because of defect are included.* When the old-growth stands were getting started more than 100 years ago, deer were scarce and probably were not a causative factor.

The fact that both areas were clearcut, which would produce considerable coppice growth, probably was an important factor in encouraging rot. Some breakage undoubtedly occurs even in healthy stems from wind and ice storms, which may result in outright destruction of the tree or indirect damage from later entrance of either sap rot or heart rot. Spaulding and Bratton (1946), in describing the effects of an ice storm in New York, stated that *Much damage occurred in stands of sugar maple and beech averaging about 10-16 inches D. B. H., usually considered too small for sawlogs.* After several years they found that sap rot had gained entry into some of the damaged maples, but did not specifically report evidence of heart rot.

The above implication that deer browsing does not cause a great amount of heart rot in Lake Superior hardwoods should not be construed to mean that rot seldom occurs as a result of browsing. Cases were found in which the entrance of decay definitely could be traced to the point of browsing, although such records were not common.

The ultimate effect of decay on the final timber product is difficult to predict. At present research foresters are not in complete agreement as to the feasibility of selecting the final crop trees while the trees are in the sapling or pole stage. It is also difficult to foresee the condition of these same trees 70 to 80 years hence. Heart rot in hard maple usually is slow in advancing up or down the bole, and it is pos-

sible that rot pockets formed may become arrested so that decay does not progress further in the vigorous dominant trees which comprise the mature stand. On the other hand, many of the sub-dominant and suppressed trees would die as a result of normal competition in the development of a mature stand regardless of early rot.

The relatively high incidence of crook presents a somewhat different picture. The 26 percent higher occurrence in the hardwood island study area indicates that severe browsing by deer was a possible cause. It is felt that most of the stems that become final crop trees would outgrow the crook and the catfaces. Corrective growth was evident in the split samples (Fig. 3). There is a strong possibility, however, that a downgrading of the log might result where the crook approaches a sweep. Zillgitt and Gevorkiantz (1948) found in Minnesota that even moderate sweep can cause as much as 26 percent cull in a one-log tree. Sweep, however, was not found to be a common defect in the well-stocked stands of either area.

The fact that crook was also extensive in the control area is more difficult to explain. Possibly breakage and bending by the high winds and heavy snows so prevalent in this region may be factors.

The occurrence of catfaces may be serious if they are not outgrown in the early development of the tree. If they indicate the presence of *Nectria* sp., *Hypoxylon* sp., or other cankers which continue to develop and eventually lay the stem open to wind breakage, considerable damage and loss in volume of timber could ensue. Unless such cankers develop, however, it is believed the catfaces would not be serious enough to result in a substantial loss in merchantable wood.

The third point considered in the study was the actual amount and significance of retardation of growth which obviously occurred as a result of heavy browsing. While this was not believed to be as serious as some of the defects described above, the 10-year period during which height growth was virtually held at a standstill must be added to the length of the cutting rotation. From a purely economic standpoint, the loss from such a retardation of growth could be calculated rather simply. But areas of hardwood reproduction following clearcutting that have been held down by deer browsing for 10 years are rare and of relatively small acreage. Observations and reports of Michigan deeryard investigators during the past 25 years indicate that such heavy browsing occurs following clearcutting adjacent to deeryards, but that the reproduction usually escapes the deer by height growth in three to five years.

The effect of deer browsing on the growth of hardwood reproduction in selectively-logged stands was not a specific part of this study, but general observations and recent deer browse surveys in the western part of the Upper Peninsula indicate that browsing may be relatively more detrimental than in clearcut areas. Hemlock-hardwood stands that have had a light selective cut are attractive to deer in winter because desirable food and protection from severe weather are present in the same location. The reproduction is less abundant than in an area that has been clearcut and consequently may be subject to complete browsing and possible elimination of the desirable species.

The present study has opened up some highly interesting possibilites on the entire question of the effect of deer damage on the ultimate quality of hardwood timber in the Lake States. Although the area studied may not be typical of the greater part of the region, it is believed that the particular conditions encountered are at least common in many sections, and are especially prevalent along the Lake Superior shore of the Upper Peninsula of Michigan and in other localities in the Lake States where the hemlock-hardwood association predominates. It is realized that the work done here has only scratched the surface and that many questions still remain unanswered. We especially need to follow up on the pathology of the defects that result where deer brows-

ing is extremely severe. Such studies should be made in other areas of northern hardwoods, as for example on sites favorable to basswood and yellow birch, which were never abundant on the area studied. Certainly, similar investigations might be worth while in parts of Wisconsin and Minnesota which also have a critical deer problem.

The study strongly indicates that overbrowsing of hardwood types by deer may not be as serious as many have claimed, and that although some losses may result directly from too much deer activity, the overall loss in dollars and cents to the final timber crop is small as compared with the effects of the great number of other damaging and physical factors involved. This is not to say that present deer populations should not be controlled. Game men have long agreed with the foresters that for the good of both the deer and the trees, rigid herd control should be exercised in a great many parts of the Great Lakes deer range. For the most part such control is already underway but is generally being limited by public apathy and uninformed opposition rather than by a reluctance of the game man to take necessary action.

## Summary and Conclusions

A study was made of a stand of northern hardwoods in the eastern end of the Upper Peninsula of Michigan that had been severely browsed by deer during its initial development. Results of the study showed that:

1. Satisfactory stocking of hard maple and some other hardwoods was possible even under extremely severe browsing.
2. Heart rot was not appreciably greater in the heavily-browsed study area than in the control area, which indicated that excessive browsing by deer is not an outstanding factor in the formation of heart rot in the locality studied.
3. Crook was about 26 percent greater in the study area, but it is believed the majority of the crook would be outgrown by the time the trees reach merchantable size. Where the crook approached a sweep, some downgrading of the log might result.
4. The catfaces that occurred were small and not very numerous in either area. They are believed to be insignificant from the standpoint of causing any great losses in merchantable timber.
5. Growth was retarded to some extent, but it is believed that the actual monetary losses involved over a long period of time would not be great.

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