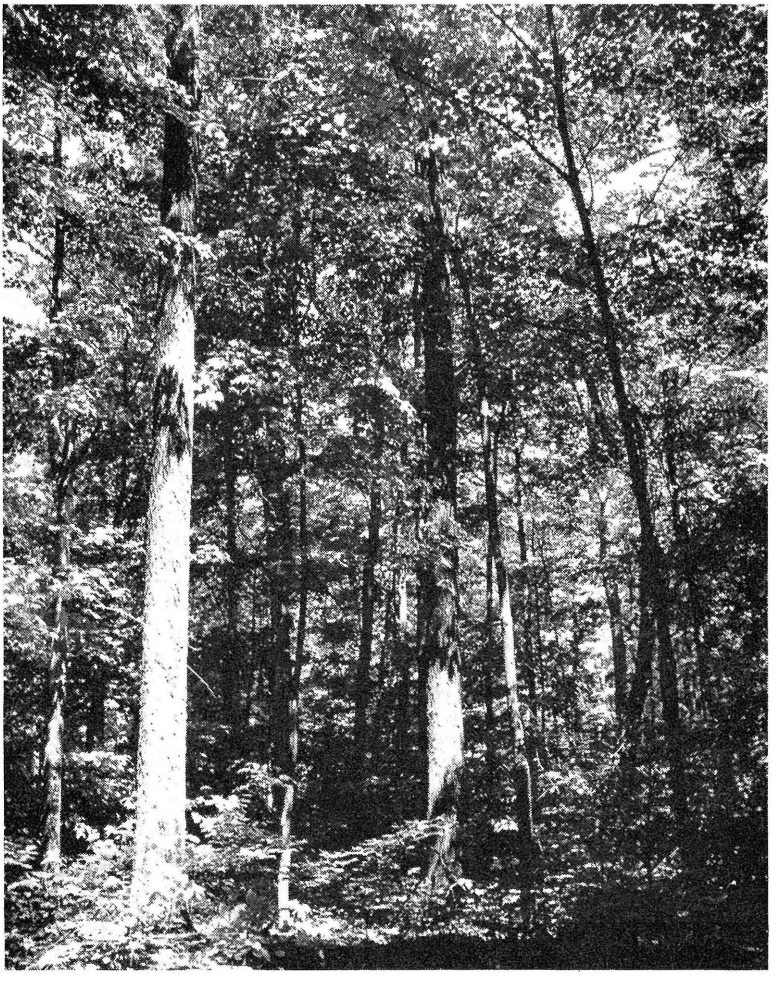
RESEARCH CIRCULAR 3 DECEMBER, 1950

TIMBER SURVEY OF THE HOCKING STATE FOREST



THE OHIO AGRICULTURAL EXPERIMENT STATION
WOOSTER, OHIO

TABLE OF CONTENTS

FOREWORD

Use of Timber Survey Data in Developing a Research Program

The goal of forestry, in general, is to manage timber land in such a way that it will yield maximum net returns on a perpetual basis. When managing any forest area there are four essential points in addition to providing protection from livestock, fire, insects, and diseases. These are: (1) Know the forest inventory; (2) Know the forest growth; (3) Decide what maximum stocking is desired; i. e., the number, size, and species of trees desired per unit area; (4) Plan and cut according to these three factors.

This survey is providing the answers in a general way for points 1 and 2, but forest research has not yet obtained the answers to points 3 and 4. The problem of determining how much growing stock should be developed and carried per acre to obtain maximum growth of high quality timber will require many experiments on pilot plant scale before the answers can be found and the results applied on an entire forest. Furthermore, these experiments must be conducted in many different sites and stand conditions.

The fundamental laws which underlie the perpetuation of the forest and make it pay cannot be determined in a day or a year. They are long range studies that must be conducted out in the forest itself. In southern Ohio it is apparent that the answers to the many problems involved in the sound forest management of large tracts can best be obtained through wholehearted teamwork between administrative and research foresters on publicly-owned lands. The survey data that have been collected to date will serve as a stepping stone in the development of a comprehensive long range research program designed to solve the important forestry problems in this area.

TIMBER SURVEY OF THE HOCKING STATE FOREST

EMMETT A. CONWAY*

An extensive timber survey was made of the Hocking State Forest between March 21 and May 5, 1949, by the writer, assisted by local forest labor. This was a part of a major project begun on January 1, 1948; that of making an extensive cruise or timber survey of all state forests for the purpose of:

1. Providing an up-to-date inventory showing the amount, location, species, condition and current growth of the merchantable sawtimber growing on the state forests.

2. Providing basic information needed for the development of a broad program of fundamental and applied forest research.

FOREST HISTORY

The history of the forests in the Hocking State Forest, of Goodhope, Laurel, and Benton Townships of Hocking County, may be intimated by the statement that the only virgin timber of any consequence to be found is located in the relatively inaccessible gorges. Some of the slopes were never completely cleared for pasture or crop land purposes and now bear fair stands of second growth oak and hickory. The broad ridge tops and gently sloping upper slopes were practically all cleared for farming. The abandonment of fields on the poorer farms was quickly followed by dense reforestation of pitch pine and Virginia pine on the poorer sites and with black locust and sassafras on the better sites. The geometric pattern of many of the pine stands testifies to the abandonment of fields. Most of the pine is less than 60 years old, thus dating the change in land use.

Black Hand Conglomerate Contributes to Ecological Succession:

Not only is the historic treatment of the forests evident in the character of the timber now found, but the prehistoric geological history of the Hocking State Forest area has been responsible for the development and survival of a unique combination of land, water, and forest; the beauty of which is known throughout the United States. Basically it is the existence of the so-called Black Hand member of the Cuyahoga formation of rocks which sets the stage for the vegetative scenery Mother Nature has displayed. This formation is from 100 to 200 feet thick. It is for the most part massive, conglomeratic sandstone. The beds of

* Department of Forestry, Ohio Agricultural Experiment Station. Published in cooperation with the Division of Forestry of the Ohio Department of Natural Resources.

sandstone and conglomerate vary greatly in their resistance to weathering and other erosive agencies, the weaker beds frequently forming hollows or caves, whereas the more resistant layers either stand out as projecting ledges or benches. Erosion of the Black Hand Conglomerate has brought about and retained conditions suitable for the growth of a type of vegetation native to a more northern life zone in the ravines, on cliffs, and in hollows. Botanist Robert F. Griggs describes this as "an outlier of the great Allegheny Mountain flora from which it derives a considerable number of its Applachian plants."[1] In contrast, the ridge tops and dry slopes are sites typical of the remainder of the Southern Ohio hill country.

State Management Begins in 1924:

The Ohio Agricultural Experiment Station began to acquire land in this unusual area in November, 1924. The state forester and other leaders realized that the primeval majesty and beauty of the area should be maintained for the present and coming generations. Public ownership was the only way to assure that condition. The outstanding scenic spots were the nuclei for the acquisition program. By 1930, the scattered state-owned land totaled 3,692 acres. Ten years later, the total acreage was 4,600; and at the beginning of April, 1949, after about three years of intensive acquisition activities, the total area of the Hocking State Forest amounted to 8,322 acres. The Forest is now not just a series of scenic parks with buffer strips around them, but a combination of forest and park where wood, wildlife, and recreation are considered to be equally important objectives of management.

The Ohio Agricultural Experiment Station brought fire protection to the state-owned area and surrounding farmlands. Now, two fire towers provide detection points while experienced fire-fighters, linked to the towerman by two-way radios, assure prompt action on any wild fires.

Reforestation was the first constructive project undertaken on the new state forest. In 1925, plantations were established at Rock House. These were not just show-window plantings, nor were they of the small-sized arboreta type familiar in the earlier work on the Dean and Waterloo State Forests. The failures had for the most part been weeded out of the planting schedules. Red pine, white pine, Scotch pine, and jack pine were planted with confidence. The exotic Corsican pine, which showed early promise was planted, but failed completely in about ten years due to a needle rust. Austrian Pine was planted in limited amounts with fair success. These twenty-four year old plantations today are well-stocked stands. In fact, most of them are too well stocked, not having

[1] Robert F. Griggs, "A Botanical Survey of the Sugar Grove Region," *Ohio Biological Survey Bulletin No.* 3. 1914.

received the thinnings which would have concentrated the growth on fewer stems. Reforestation was given a major place in the CCC program of the 1930's so that every available spot of open ground was given a chance to grow trees. Records show that numerous underplantings were made with some degree of success. There are now between 500 and 600 acres of forest plantations. On the newly acquired lands an office report shows that there are over 200 acres which might be planted. This should prove much less of a job now than in former years, due to the recent introduction of machine planting.

Cutting operations on the Hocking State Forest have been few. These have consisted of:

1. Sanitation, pruning, and cleaning work in some plantations performed by CCC enrollees from 1933 to 1942.

2. Salvage of the great amount of chestnut killed by the blight between 1925 and 1935. This was a major operation of the CCC and yielded large quantities of firewood, posts, guard rails, poles, and lumber. In addition to the chestnut, storm-damaged trees and those deemed to be dangerous to the visiting public were removed and utilized when possible.

3. Timber stand improvement work was not a major operation of the CCC program on the Hocking State Forest. The work done in this category was the removal of wolf trees and those that were diseased and dying that contained no merchantable lumber.

4. Harvesting of black locust for fence posts has been a seasonal activity of the winter months since the close of the CCC in 1942.

5. The first general sawtimber cut in mixed hardwoods was done in the spring of 1946 on the Pettit and Rickett Tract #2. The only other general sawtimber cut was begun in December, 1947, on the Pettit and Rickett Tract #1.

6. Thinning has been done in only a very small percentage of the pine plantations and native pine stands. A native stand of pitch and Virginia pine on Pine Ridge near Cantwell Cliffs was pruned by the CCC in 1938 and later in 1947 received a light thinning. This stand is about 35 years old and appears to be in much better condition than unthinned stands of about the same age.

A profitable thinning was made in a plantation of red pine near Bainter Barn in 1946 and 1947. Christmas trees, greens, pulpwood, guard rail posts, and cabin logs were produced and sold. Another red pine thinning was made on an acre in a 24-year old plantation at Rock House in February, 1949. This was an experimental row thinning carried on by the Department of Forestry of the Ohio Agricultural Experiment Station in cooperation with the Division of Forestry of the Department of National Resources.

Christmas trees and greens were first sold as thinnings from plantations in 1942. This practice has continued with the larger sales being of greens. In 1943 the sale of Virginia pine as Christmas trees was begun. This important usage has continued each year. Orders for hemlock greens have been filled by pruning native trees.

INVENTORY PROCEDURE

The method used in estimating the amount of timber growing on the Hocking State Forest in the spring of 1949 was essentially the same as used on the other forests in this project. The 1/5-acre circular plot method of sampling was employed with the plots being spaced on the corners of squares at 30-chain intervals.

The plot locations were first located on 7"x9" AAA aerial photos by the use of an overlay or a scale. They were located on the ground by the use of a hand compass and two-chain measuring tape. Plots were linked to land corners, road and boundary intersections, or other prominent physical features visible on both the photos and on the ground. When at all possible, plots were found by going from one to another on one of the cardinal directions, but paralleling the land boundary lines. Numerous cliffs, the scattered conditions of the trees, and the small size of many of the tracts making up the forest did not allow much walking from plot to plot. Seventeen days were required to locate and measure the trees on all the plots. Work was begun on March 21, and completed on May 5.

The following data were collected on each 1/5-acre plot:

1. The diameter-breast-high (D in 2-inch classes, species, and condition as to whether "Good," "Poor," or "Cull" growing stock of each tree nine inches or over in diameter (Merchantable trees had to be at least 40 percent sound.)

2. The usable length of the first merchantable tree of each species (11 inches and over in diameter occurring in measurement.)

3. The estimated cull percent of the first merchantable tree of each species occurring in measurement.

4. The number of annual rings per radial inch of diameter growth for the first merchantable tree of each species.

5. The topographic position, aspect, slope percent, timber size-class, crown density, and notes on the possibility of immediate cutting. (in walking from plot to plot, observations were made and notes taken as to the possibility of making any kind of cutting in plantations, native pine stands, or hardwood stands.)

Field work was begun on the northwest corner of the Cantwell Cliffs section. Working south and eastward through the various tracts the

field work was finished up on the area east of Ash Cave. The location of each of the plots was marked by a pinprick on a set of aerial photos. The number of the plot was written on the back of the photo beside the pinhole. In this way the notes taken between plots may be correlated with the features shown on the photo.

TIMBER INVENTORY DATA

The data that portray the quantity and condition of the merchantable timber on the Hocking State Forest are presented below in various ways. In general, the figures are reduced to a per acre basis to show a median for the entire acreage of 8,322 acres. Board foot volumes were computed by the International ¼-Inch Scale.

Stand Per Acre by Diameter Classes:

Table 1 shows the distribution of the merchantable and near-merchantable timber by 2-inch diameter classes for the average acre. The number of trees, as well as the net volume, is shown as they were divided between "Good" and "Poor" growing stock.[1] This information is graphically portrayed in Figures 1 and 2.

It may be seen in Table 1 that the average number of merchantable trees per acre was 23.72 and that 17.42 of these were of good stock and the balance of poor stock. The good stock made up 73.5 percent of the total number of merchantable trees, while the poor stock made up 26.5 percent. The near-merchantable trees which totaled. on the average, 14.31 percent per acre were divided between good and poor on approximately the same proportion. There was a normal distribution of trees by diameter classes up to 22 inches. The trees above that diameter were confined mostly, but not always, to the scenic gorges. Owing to the low intensity of sampling, these areas of large timber which occupied only a small proportion of the total acreage, were not well represented.

---

[1] *Good growing stock* is made up of those progressive trees which have firm roots, have no more than moderate rot or frost cracks in the first 8 feet of bole, may have a few limb swells or blind knots, may have a few large dead stubs on the upper bole, have crowns of medium to large size and with average or better crown density and foliage in intermediate or better crown classes.

Poor growing stock is made up of those regressive trees of low vigor which do not meet the specifications above. One or more of the characteristics listed below will definitely place a tree into the low vigor class: Roots sprung or with serious rot or mechanical damage, heavy rot within first 8 feet or moderate rot above 8 feet within the commercial length, large, weak crotches with many large broken limbs and limb swells or blind knots, small suppressed or thin crowns with many large dead limbs and many branches dying back in the tops, generally suppressed or low intermediate crown class. Trees are not graded down because of species. Trees of poor growing stock are generally those which will be lost or become worthless within a 10-year period.

Cull trees of commercial size are less than 40 percent sound.
(Instructions for "Tree Vigor Class Estimate of Timber on Seven Indiana State Forests," November, 1947. Prepared by U.S.F.S.)

Fig. 1 Number of Trees Per Acre by Diameter Classes

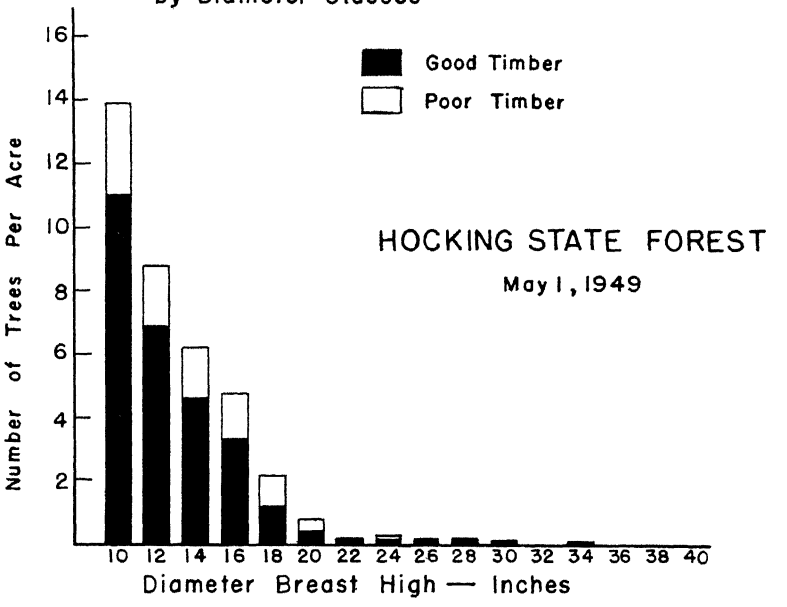


Fig. 2 Volume Per Acre by Diameter Classes

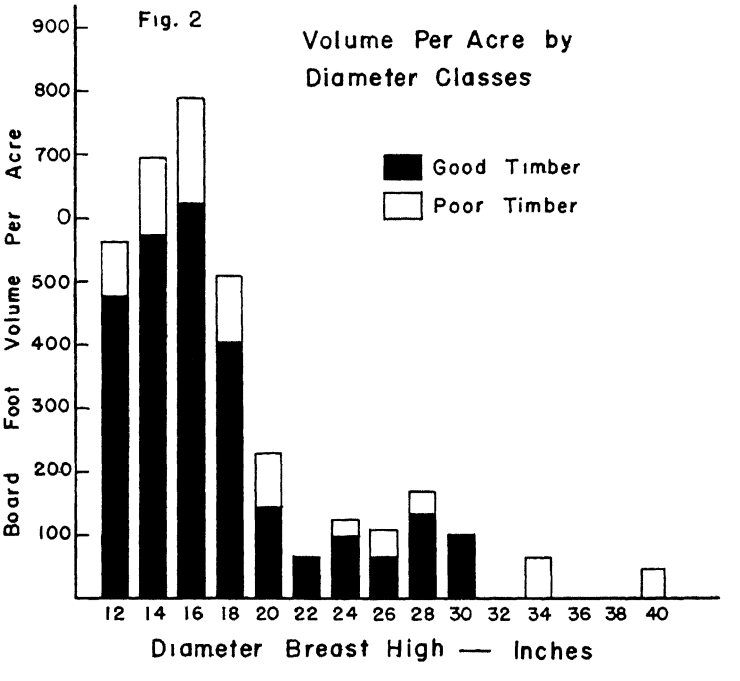


Table 1.—Inventory Per Acre by Diameter Classes and Tree Grade
(International Log Rule)

	D.B.H. (Inches)	Number of Trees			Net Volume		
		Good	Poor	Total	Good	Poor	Total
	10	11.05	3.26	14.31			
Merchantable	12	6.89	1.90	8.79	477	85	562
	14	4.67	1.55	6.22	572	125	697
	16	3.31	1.45	4.76	621	169	790
	18	1.50	.65	2.15	403	107	510
	20	.40	.40	.80	144	84	228
	22	.15	—	.15	62	—	62
	24	.15	.10	.25	95	28	123
	26	.10	.10	.20	65	44	109
	28	.15	.05	.20	134	37	171
	30	.10	—	.10	100	—	100
	32	—	—	—	—	—	—
	34	—	.05	.05	—	63	63
	36	—	—	—	—	—	—
	38	—	—	—	—	—	—
	40	—	.05	.05	—	46	46
	Total Merchantable	17.42	6.30	23.72	2673	788	3461
	Grand Total	28.47	9.56	38.03	2673	788	3461

The net merchantable volume per acre is shown to have been 3,461 board feet of standing timber. Divided between good and poor growing stock, this total is 77.2 percent good, and 22.8 percent poor. Seventy-three percent of the total volume was in trees below 19 inches in diameter. The 16-inch diameter class contained the greatest amount of volume. The influence of the large virgin trees is shown in Figure 2 where volume is distributed by diameter classes. After park zoning, these larger trees would probably be in the part of the forest segregated from the portion of the forest managed for sawtimber production.

In Figure 3, which was prepared to show current and predicted volumes, the current net merchantable volume is shown in another manner. Here the volume is shown graphically by diameter classes in horizontal arrangement. The diameter classes are then grouped according to small, medium, and large timber. From this graph it is seen that the average acre contained 2,049 board feet of small timber, 923 board feet of medium timber, and 489 board feet of large timber.

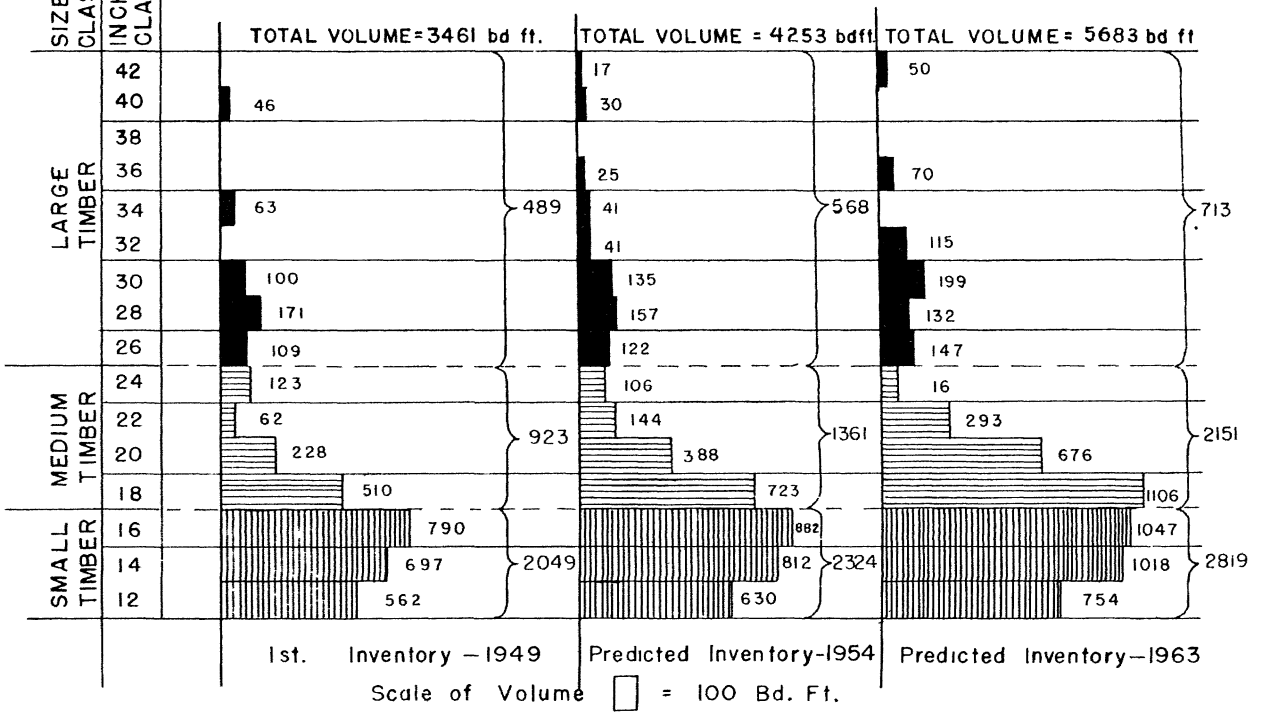
Species Distribution:

The 26 species of trees which contained merchantable volume as shown by the timber survey are listed in Table 2 in descending order according to their total volume. In addition to these 26 species, two are added which contained timber in the 10-inch or near-merchantable class. One would likely find some trees of the last two species in the

Fig. 3

GROWING STOCK IN 1949 AND PREDICTED 1963 VOLUME

Based Upon Current Growth Rate With Neither Cutting nor Mortality



(Right)—The Hocking Forest contains many acres of pine plantations. This shortleaf pine planting is about twenty years old. Markets need to be established for thinnings from these stands.

(Left)—Virginia pine about thirty years old that had restocked an abandoned field through natural reproduction. This stand contains trees of fence post, pulpwood, and small pole size and would benefit from an improvement cut.

merchantable sawtimber class if he were to intensify the sampling. Hemlock lead the list in total volume and in volume of "good" growing stock. Next in line were tulip poplar, red oak, chestnut oak, and white oak. These five species together made up 63 percent of the total merchantable volume. If pitch pine and Virginia pine were combined, they would have been fourth on the list.

The Hocking State Forest is probably the only state forest having a large percentage of trees in coniferous species. Hemlock, pitch pine, and Virginia pine together made up 27.1 percent of the total volume. The reasons for this fact are that hemlock was the most common species in the numerous gorges; and the two species of pine occurred in pure stands on most of the abandoned old fields. Pine has been very aggressive on the many acres of farmland which have been abandoned in the past 50 years.

Black birch and yellow birch are two species of trees characteristic of the Allegheny or Northern type of flora, which are found in only a few places in Ohio. There are numerous other shrubs and plants belonging to this class of flora which occur in the Hocking Region.

One does not, of course, find each of the species listed in Table 2 occurring on one site. The Northern type mentioned above occurs in the gorges and steep north slopes. In it one usually finds hemlock, tulip poplar, black birch, red oak, sugar maple, red maple, beech and bass-

wood. On the drier slopes one finds the mixed oak stands common to Southern Ohio, containing white oak, black oak, red oak, scarlet oak, chestnut oak, hickory, etc. The other common type, which has already been mentioned, is the old field pine type.

Table 2.—Inventory Per Acre by Species and Tree Grade (International Log Rule)

Species	No. of Merchantable Trees			Net Volume in Board Feet		
	Good	Poor	Total	Good	Poor	Total
Hemlock	2.66	.40	3.06	573	71	644
Tulip Poplar	1.85	.35	2.20	455	119	574
Red Oak	2.01	.40	2.41	282	82	364
Chestnut Oak	2.02	.75	2.77	223	76	299
White Oak	1.92	.35	2.27	270	18	288
Pitch Pine	1.76	.70	2.46	182	63	245
Black Oak	1.05	.50	1.55	156	56	212
Scarlet Oak	60	.55	1.15	90	62	152
Red Maple	75	.40	1.15	71	39	110
Black Birch	.40	.30	.70	77	28	105
Pignut Hickory	40	.25	.65	68	18	86
Beech	.35	.25	60	41	17	58
Yellow Birch	.10	.05	.15	21	37	58
Virginia Pine	.35	.30	.65	34	17	51
Basswood	.25	.05	.30	27	10	37
American Elm	.05	.20	.25	2	28	30
Butternut	.10	.15	.25	13	17	30
Sugar Maple	.15	.05	.20	24	4	28
Black Gum	.10	.10	.20	6	12	18
Sycamore	.15	- -	.15	18	-	18
Red Elm	.10	—	.10	14	-	14
Black Cherry	.10	-	.10	11		11
L. T. Aspen	-	.15	.15		8	8
White Ash	.10	—	.10	8	- -	8
Shagbark Hickory	.10	-	.10	7	—	7
River Birch	- -	.05	.05	-	6	6
Sassafras	—	—	—	- -	-	—
Black Locust	—	—	—	-	- -	—
TOTALS	17.42	6.30	23.72	2673	788	3461

In Table 2 one may get an idea of the condition of the growing stock of each species; for instance, only 12.4 percent of the hemlock volume was in poor growing stock, whereas of the tulip poplar 20.8 percent was in poor stock. Forty-one percent of the scarlet oak was classed as poor stock. The volume of the five leading species that made up 63 percent of the total was composed of 83.1 percent good stock and 16.9 percent poor stock.

Volumes per acre are shown graphically by species in Figure 4.

Species and Size Class Distribution in Per Acre Stand Table:

A more detailed arrangement is made of the volume and number of trees per acre in Table 3. Here the inventory for each species is shown separately by diameter classes. The range in size of each species

is thus made evident. One can see here that the only really large trees were the hemlocks, tulip poplars, and red oaks. The division of each species between good and poor growing stock may also be easily seen here. Table 3 is found in the appendix.

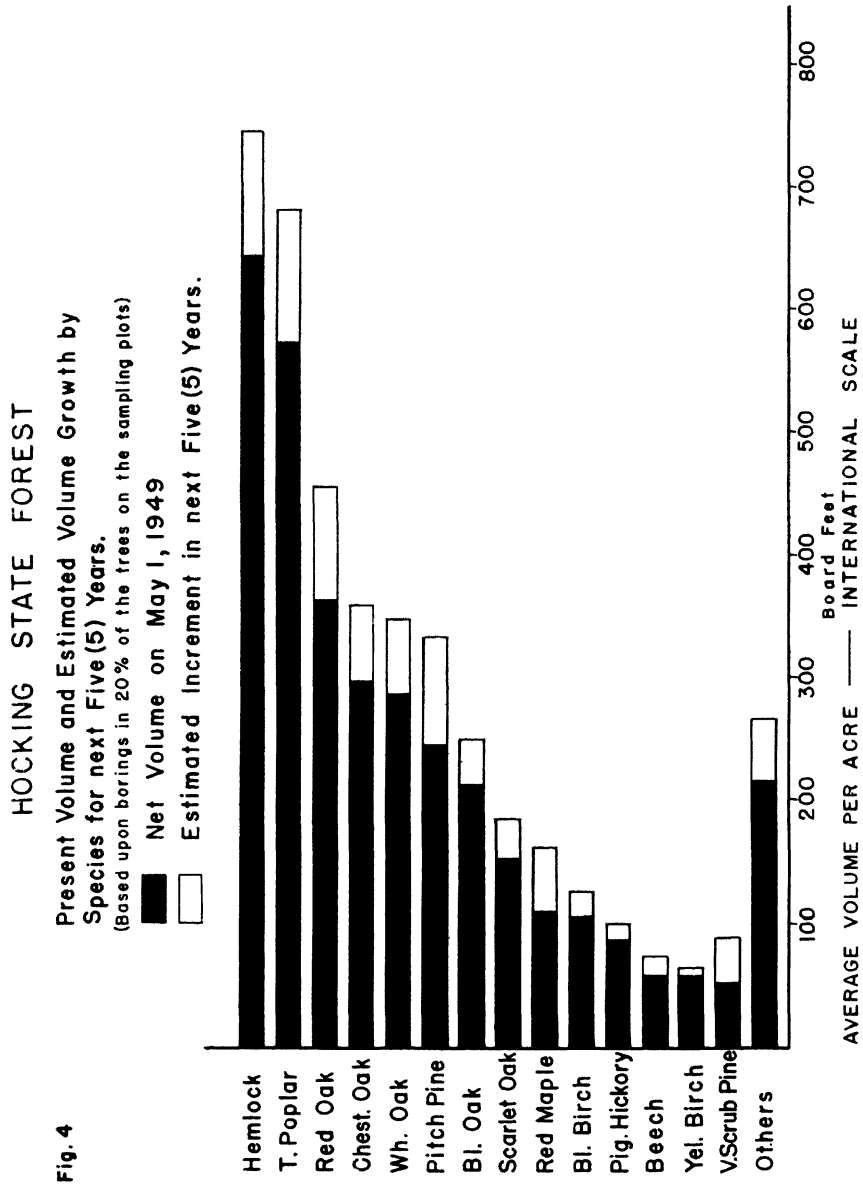


Fig. 4

The six leading species in volume were probably well represented in sampling and should appear in their correct proportions. The remaining species, occurring less frequently, may not show in their true proportions; but they still would remain in the minority. It should be borne in mind that the sampling intensity is based upon getting only a total volume estimate for the entire stand and not for individual species or classifications.

Table 4.—Total Net Volume of Standing Merchantable Timber by Species and Grade (International Log Rule)

Species	Total Net Volume (Board Feet)		
	Good Stock	Poor Stock	Total
Hemlock	4,768,000	591,000	5,359,000
Tulip Poplar	3,787,000	990,000	4,777,000
Red Oak	2,347,000	682,000	3,029,000
Chestnut Oak	1,856,000	632,000	2,488,000
White Oak	2,246,000	150,000	2,396,000
Pitch Pine	1,515,000	524,000	2,039,000
Black Oak	1,298,000	466,000	1,764,000
Scarlet Oak	749,000	516,000	1,265,000
Red Maple	590,000	325,000	915,000
Black Birch	641,000	233,000	874,000
Pignut Hickory	566,000	150,000	716,000
Beech	341,000	142,000	483,000
Yellow Birch	174,000	308,000	482,000
Virginia Pine	283,000	141,000	424,000
Basswood	225,000	83,000	308,000
American Elm	17,000	233,000	250,000
Butternut	108,000	141,000	249,000
Sugar Maple	200,000	33,000	233,000
Black Gum	50,000	100,000	150,000
Sycamore	150,000		150,000
Red Elm	117,000		117,000
Black Cherry	92,000		92,000
L. T. Aspen		67,000	67,000
White Ash	67,000		67,000
Shagbark Hickory	58,000		58,000
River Birch		50,000	50,000
Sassafras			
Black Locust			
TOTALS	22,245,000	6,557,000	28,802,000

Total Net Board Foot Volume on Entire Hocking Forest by Species:

The inventory taken disclosed the fact that there were 28,802,000 board feet of merchantable sawtimber growing on the 8,322 acres of the Hocking State Forest. Good timber made up 77.3 percent of this volume and poor timber made up the other 22.7 percent. The total net volume figures are listed by species in Table 4. Hemlock and tulip poplar alone accounted for over 10,000,000 board feet. The five species of oak made up nearly 11,000,000 board feet. The two species of native pine accounted for 2,500,000 more board feet; which the balance of a little over 5,000,000 is the sum of 19 different species.

Average Heights and Diameters of Each Species:

A listing of the average diameters at breast height and the usable length of each of the species of merchantable size, is shown in Table 5. Species are listed in order of their total volume. Lengths were

Table 5.—Average Diameter Breast-High and Usable Length to a Variable Top With a Minimum of 8 Inches Diameter Inside Bark — By Species for Merchantable Trees Only.

Species	D.B.H. (inches)	Usable Length (Feet)	Species	D.B.H. (inches)	Usable Length (Feet)
Hemlock	15	33	Basswood	15	34
Tulip Poplar	16	42	American Elm	16	11
Red Oak	15	27	Butternut	16	26
Chestnut Oak	14	25	Sugar Maple	14	30
White Oak	15	27	Black Gum	13	30
Pitch Pine	13	24	Sycamore	14	27
Black Oak	15	26	Red Elm	17	22
Scarlet Oak	15	30	Black Cherry	13	25
Red Maple	14	24	L. T. Aspen	12	35
Black Birch	15	26	White Ash	14	15
Pignut Hickory	15	27	Shagbark Hickory	12	25
Beech	15	26	River Birch	16	20
Yellow Birch	19	48	Sassafras	—	—
Virginia Pine	13	19	Black Locust	—	—
				—	—
			ALL TREES	14.7	29

measured with an Abney level to a variable top with a minimum of 8-inch diameter inside the bark.

Almost all the species had average diameters within two inches of the average of 14.7 inches. The usable lengths did not deviate much from the average, except tulip poplar and a few minor species.

Determination of Cull Factor:

The gross volumes were reduced to net figures by the application of cull factors determined individually for each species and for each condition class. The percentage of deduction was determined by a system of sampling comparable to that used in determining growth. In most cases the first merchantable tree of each species and condition class encountered on each plot was closely scrutinized in order to be able to estimate the probable deduction in the gross log scale which would result from rot and crook. These samples were then averaged by their respective groupings and the averages rounded-off to multiples of five. In this way, a stratified sampling was taken.

The cull percentage used for each condition class of each species is shown in Table 6. The species are listed in order of total volume, so as to show their relative importance. The weighted average of all cull estimates for trees rated as good growing stock was 3 percent; while the average for the poor growing stock was 20 percent. Maximum

variations are shown in the last two columns in the table. The good stock of the important species varied between none and 15 percent cull. The poor stock varied between none and 40 percent.

Table 6 also shows the number of trees sampled for cull of each species. In general, the intensity of the sampling is proportional to the number of trees. A differential sampling proportional to the variation of the cull would have been better. For instance, more estimates should be made of scarlet oak and black oak than of chestnut and white oak. Fire history has the most important influence of all in contributing to the amount of loss in merchantable volume in both old and young stands of timber. With all of these variables in mind, it seems that a mechanical sampling of a portion of the trees measured in an extensive survey such as this, will give a reliable estimate of the deductions to be made for cull.

Inventory of Cull Trees:

A tally was made of the species and diameter-breast-high of all cull trees 9 inches or more in diameter which were found on the sampling plots. Cull trees are, by definition, those which have less than 40 percent sound, merchantable material.

Table 6.—Cull Percentage by Species by Condition Class and Supporting Data.

Species	Cull Percent		Number of Samples		Maximum Variation	
	Good	Poor	Good	Poor	Good	Poor
Hemlock	0	5	10	2	0	0–5
Tulip Poplar	5	15	17	3	0–10	10–20
Red Oak	5	20	9	5	0–15	10–25
Chestnut Oak	5	15	11	3	0–10	0–20
White Oak	5	20	12	1	0–15	25
Pitch Pine	0	20	7	2	0	20
Black Oak	5	20	9	5	0–10	20–30
Scarlet Oak	10	35	5	4	5–15	30–40
Red Maple	5	25	5	5	0–10	15–40
Black Birch	3	15	1	1	0	20
Pignut Hickory	5	25	3	2	0–10	25
Beech	10	30	1	1	0	30
Yellow Birch	0	30	1	0	0	—
Virginia Pine	0	10	3	1	0	10
Basswood	30	–	2	0	15–50	—
American Elm	0	10	0	1	—	10
Butternut	5	25	0	1	—	25
Sugar Maple	0	10	0	0	—	—
Black Gum	5	25	1	1	5	25
Sycamore	5	—	1	0	0	—
Red Elm	3	—	1	0	0	—
Black Cherry	0	—	1	0	0	—
L. T. Aspen	0	5	0	1	—	0
White Ash	—	—	0	0	—	—
Shagbark Hickory	0	—	1	0	0	—
River Birch	—	—	0	0	—	—
Sassafras	—	—	0	0	—	—
Black Locust	—	—	0	0	—	—
ALL TREES	3	20	100	39	0–50	0–40

The number of cull trees per acre of merchantable sawtimber is tabulated in Table 7. Merchantable sawtimber covers approximately 59 percent of the total area of the forest according to the classification of the 99 sampling plots. In Table 7, the cull trees are listed by both species and diameter classes. Cull trees were found in almost all diameter classes, in about a direct proportion to the distribution of the sound trees. Most of the cull beech trees were in either the 16-inch or 18-inch class, although culls were found between 12- and 34 inches in diameter. Scarlet oak diameters ranged between the 12- and 24-inch class, with about half of the trees being either the 12- or 14-inch size. Red maple has about the same spread of diameters with the exception that about 1/3 of the cull trees were in the 10-inch class. All the black gum found were in the 12- to 18-inch diameter class, with about 40 percent of the trees being in the 18-inch class.

Fig. 3.—"Cull" trees such as this beech were scattered throughout the sawtimber stands. There was an average of 2.7 cull trees per acre or a total of approximately 25,000 for the entire forest. Such trees should be cut or girdled.

The data showed that there was at the time of the inventory an average of 4.65 cull trees per acre of sawtimber. The average number of cull trees per acre of the entire state forest was 2.70. These figures include the 10-inch diameter class. It is significant that the cull trees were not just the large diameter trees, but that the majority were in the small and medium sawtimber size class.

PREDICTED SAWTIMBER GROWTH

An estimate of current growth in merchantable sawtimber has been made based upon increment borings. About 20 percent of the merchantable trees and about three percent of the near-merchantable trees occurring on the sampling plots were bored to determine the number of rings in the last radial inch at breast height. The data were separated among species and condition classes. Choice of trees to bore was made on an

Table 7.—Number of Cull Trees Per Acre of Merchantable Sawtimber (59% of Total Forest Area)

DBH	Number of Trees Per Acre by Species														
Class	Hem	TP	RO	CO	SO	RM	BB	PH	Beech	Butt	SM	BG	BL	WO	Totals
10				.09		.35		.09					.08	.17	.78
12					.17	.17	.09		.08			.09			.60
14			.09		.17			.08	.09		.09	.08			.60
16	.09				.09	.09	.08		.26			.09			.70
18		08		.17	.09	.08			26	.09		.17			.94
20					.09				.08		.09				.26
22						.09									.09
24					.08	.17			.26						.51
26															—
28											.08				.08
30															—
32															—
34									.09						.09
Totals	.09	08	.09	.26	.69	.95	.17	.17	1.12	.09	.26	.43	.08	.17	4.65

impartial basis choosing either the first merchantable tree on the plot or the tree nearest the center of the plot. The basic data pertaining to this sampling are tabulated in Table 8. Here are shown the average number of rings per radial growth, the number of borings in each species classification, and the total number of trees of each species and classification which occurred on each plot. This information is shown both for near-merchantable and merchantable trees. Figures in parenthesis are assumed for lack of information.

It may be seen in Table 8 that the average length of time for all merchantable trees to grow the last two inches in diameter has been 14.2 years. Good merchantable trees took 13.6 years while poor merchantable trees took 16 years. Individually the species took from 11 years for the good scarlet oak, red oak, tulip poplar and red maple to 30 years for the poor hickory. Data were lacking for the near merchantable trees under 11 inches in diameter, but indications are that the rate of growth in the all-age stands is about the same as that for the merchantable trees. The over-all average rate of growth for all species of near-merchantable trees was 14 years to grow one radial inch, which is equal to a two-inch increase in diameter.

Table 8.—Sawtimber Growth Data

Species	Average Number of Annual Rings per Last Radial Inch				Intensity of Sampling							
	Merch.		Near Merch.		Number of Trees on all Plots				Number of Borings on all Plots			
					Merch.		Near Merch.		Merch.		Near Merch.	
	Good Stock	Poor Stock	Good Stock	Poor Stock	Good	Poor	Good	Poor	Good	Poor	Good	Poor
Hemlock	14	24	9		53	8	32	1	9	4	2	0
Tulip Poplar	11	13			37	7	11	1	12	3	0	0
Red Oak	11	14	9		40	8	10	3	8	2	1	0
Chestnut Oak	16	(20)	22		40	15	12	6	6	0	1	0
White Oak	17	(22)			38	7	25	5	9	0	0	0
Pitch Pine	14	(16)	13		35	14	33	20	4	0	1	0
Black Oak	12	21		23	21	10	3	3	5	1	0	1
Scarlet Oak	11	(12)			12	11	3	2	4	2	0	0
Red Maple	11	14			15	8	16	4	4	1	0	0
Black Birch	17	(20)			8	6	9	2	2	0	0	0
Pignut Hickory	31	(30)	13		8	5	17	0	2	1	1	0
Beech	(14)	(16)			7	5	5	3	0	0	0	0
Yellow Birch	16	(20)			2	1	0	0	1	0	0	0
Virginia Pine	13	(15)			7	6	34	3	2	1	0	0
Basswood	12	(15)			5	1	0	0	3	0	0	0
American Elm	(14)	(14)			1	4	1	0	0	0	0	0
Butternut	(16)	19	8		2	3	1	3	0	2	1	0
Sugar Maple	12	(16)			3	1	0	0	1	0	0	0
Black Gum	12	24			2	2	1	1	1	1	0	0
Sycamore	13				3	0	2	0	1	0	0	0
Red Elm	17				2	0	1	0	2	0	0	0
Black Cherry	13	(16)			2	0	0	1	1	0	0	0
L. T. Aspen	(15)	19	20	16	0	3	3	4	0	1	1	1
White Ash	(14)				2	0	2	0	0	0	0	0
Shagbark Hickory	(30)	(30)			2	0	3	0	0	0	0	0
River Birch		(20)			0	1	0	0	0	0	0	0
Sassafras	(14)	(14)			0	0	1	1	0	0	0	0
Black Locust		(14)			0	0	0	2	0	0	0	0
All Trees	13.6	16	12.9	19.5								
	14.2		14.2		347	126	225	65	77	19	8	2

NOTE: Those in parenthesis are assumed.

Method of Computing the Amount of Growth:

The method used in predicting the amount of growth which will take place on the Hocking State Forest was that of advancing all trees one diameter class of two inches, computing a new volume, and subtracting the original or present volume. This difference in volume or periodic increment was divided by the average number of years it took to grow two inches in diameter in order to get the periodic annual increment. In computing the increment by species, the average number of rings per radial inch of each condition class of each species was used. As mentioned above, this was from 11 to 30 years. When all of the species were grouped to show volume increase by diameter class for a five-year period, the average number of rings per radial inch growth used as a divisor, was 14. Because of compensating rates of growth among

the many species, the total growth amounted to practically the same no matter which of the two methods was used. No mortality deduction was made in the tabulated volumes.

Estimated Volume After Five Years by Species:

The total annual increase in merchantable sawtimber without deducting for natural mortality is indicated by the study to have been 157 board feet per acre. This added to the present volume of 3,461 board feet should give a volume per acre of 4,246, after five growing seasons, or in the spring of 1954. These figures and the breakdown by species are shown in Table 9. This table presents an inventory of

Table 9.—Board Foot Volume — International Rule — Growth Prediction

Species	Inventory Spring – 1949			Annual Increment			Predicted Inv. Spring – 1954			Periodic Annual Percent Growth		
	Good	Poor	Total	Good	Poor	Total	Good	Poor	Total	Good	Poor	Total
Hemlock	573	71	644	19.6	1.2	20.8	671	77	748	3.4	1.7	3.2
Tulip Poplar	455	119	574	19.1	2.7	21.8	550	133	683	4.2	2.3	3.8
Red Oak	282	82	364	15.2	3.1	18.3	357	99	456	5.4	3.8	5.0
Chestnut Oak	223	76	299	9.9	2.2	11.9	271	88	359	4.4	2.9	4.0
White Oak	270	18	288	11.5	.6	12.1	327	22	349	4.2	3.3	4.2
Pitch Pine	182	63	245	12.4	5.1	17.5	243	90	333	6.8	8.1	7.1
Black Oak	156	56	212	6.6	1.1	7.7	188	63	251	4.2	2.0	3.6
Scarlet Oak	90	62	152	4.4	2.4	6.8	112	74	186	4.9	3.9	4.5
Red Maple	71	39	110	8.5	1.9	10.4	114	48	162	12.0	4.9	9.4
Black Birch	77	28	105	3.4	.8	4.2	94	32	126	4.4	2.8	4.0
Pignut Hickory	68	18	86	2.5	.3	2.8	81	19	100	3.7	1.7	3.2
Beech	41	17	58	2.3	.9	3.2	53	21	74	5.6	5.3	5.5
Yellow Birch	21	37	58	.6	.3	.9	24	39	63	2.8	.8	1.5
Virginia Pine	34	17	51	6.6	1.0	7.6	67	22	89	19.4	5.8	14.9
Basswood	27	10	37	1.1	.3	1.4	33	11	44	4.1	3.0	3.8
American Elm	2	28	30	.3	.6	.9	4	31	35	15.0	2.1	3.0
Butternut	13	17	30	.7	.6	1.3	16	20	36	5.4	3.5	4.0
Sugar Maple	24	4	28	.9	.1	1.0	29	4	33	3.7	2.5	3.6
Black Gum	6	12	18	.7	.3	1.0	9	14	23	11.7	2.5	5.5
Sycamore	18		18	1.1		1.1	23		23	6.1		6.1
Red Elm	14		14	.4		.4	16		16	2.8		2.8
Black Cherry	11		11	.3	.2	.5	12	1	13	2.7		4.5
L. T. Aspen		8	8	.5	.8	1.3	2	12	14		10.0	16.2
White Ash	8		8	.5		.5	10		10	6.2		6.2
Shagbark Hickory	7		7	.8		.8	11		11	11.4		11.4
River Birch		6	6		.1	.1	6		6		1.7	1.7
Sassafras				.2	.2	.4	1	1	2			
Black Locust					.3	.3		1	1			
TOTALS	2673	788	3461	130.1	26.9	157.0	3324	922	4246	4.9	3.4	4.5

NOTE: No account has been taken of mortality.

the average acre in the spring of 1949 and the predicted inventory per acre in the spring of 1954. The good and poor growing stock is listed separately. Also shown in this Table is the annual increment for each species for both good and poor growing stock. The percentage of growth is also shown in the same manner. It may be noted that the volume of

the forest was estimated to increase 4.5 percent each year. Of the six most common species, pitch pine had the highest percentage of annual growth.

The predicted change in volume of each species over the next five-year period is shown graphically in Figure 4. The species there are listed in descending order of total volume.

Estimated Volume Increase by Size Classes:

The predicted change in the stand structure may be seen in Table 10, where volumes are tabulated by diameter size classes. Here is shown the average stand per acre as of the spring of 1949, 1954, and 1963. These growth figures have been based upon the average of 14 years to grow two diameter inches. The same figures are graphically shown in Figure 3.

Table 10.—Predicted Change in Stand Table for the Average Acre Based Upon the Average Growth Rate of 14 Years to Grow Two Inches in Diameter.

		Net Volume in Board Feet								
	D B H	Spring – 1949			Spring –1954			Spring – 1963		
	Class	Good	Poor	Total	Good	Poor	Total	Good	Poor	Total
SAWTIMBER — Small	12	477	85	562	524	106	630	611	143	754
	14	572	125	697	676	136	812	863	155	1018
	16	621	169	890	702	180	882	848	199	1047
SAWTIMBER — Medium	18	403	107	510	569	154	723	869	237	1106
	20	144	84	228	283	105	388	533	143	676
	22	62		62	106	38	144	185	108	293
	24	95	28	123	88	18	106	76		76
SAWTIMBER — Large	26	65	44	109	82	40	122	114	33	147
	28	134	37	171	114	43	157	78	54	132
	30	100		100	120	15	135	155	44	199
	32				41		41	115		115
	34		63	63		41	41			
	36					25	25		70	70
	38									
	40		46	46		30	30			
	42					17	17		50	50
	TOTALS	2673	788	3461	3305	948	4253	4447	1236	5683

NOTE. No deduction made for mortality

The graphs in Figure 3 show quite well the change in stand. It may be noted that the amount of small sawtimber increases in five years' time from 2,049 board feet to 2,324 board feet, and that the medium sawtimber increases from 923 board feet to 1,361. At the end of fourteen years, the medium sawtimber would amount to 2,151 board feet. The large sawtimber indicated on the graphs is nearly all in the scenic areas which would not come under any silvicultural management.

Estimated Natural Mortality:

Without the establishment and re-measurement of permanent plots over a long period of years, it is impossible to have an exact measure of

the volume of timber dropping out of the merchantable class because of excessive decay, storm damage or any other natural causes; however, with the inventory data at hand, it is possible to make a reasonable estimate satisfactory for management purposes.

It is noted that the poor growing stock makes up 22 percent of the total merchantable volume, or 6,557,000 board feet. This poor growing stock by definition is that which will fall out of the merchantable class and into the cull class within ten years time. One can therefore divide 10 years into this amount and assume that the annual mortality will amounted to 655,700 board feet. This is the amount of sawtimber which the data indicates will go to waste each year unless harvested. Separation of park area from timber production area would alter this data.

FOREST MANAGEMENT RECOMMENDATIONS

The first step in formulating a long-range management plan for the Hocking State Forest should be a zoning of the entire area into three classifications, namely: (1) forest park, in which the aim should be to restore and maintain primeval forest conditions; (2) park buffer areas, where forest cover is to be established and maintained with light selective thinning or harvesting permitted; and (3) timber production areas where the aesthetic value is not forgotten, but the production of wood products is the primary objective. Cutting practices in this third area should be of a type which will produce maximum yields of quality timber in the long-run. This may mean light selection or it may mean clear-cutting in certain types and under certain conditions. The zoning of these three different types of land use should be definitely delineated before any detailed forest management plan is adopted.

The second step needed for orderly timber management on this state forest is the assignment of the production area to *working units* and their further subdivision into first *blocks,* then *compartments,* and then *lots.*

Third, the success or failure of the state's timber management will depend upon an orderly sequence in cutting. These three steps, coupled with allowance for frequent revisions of the working plan, were pointed out one hundred years ago by Cotta, one of the greatest of all foresters, as being far more important than a mere calculation of the permissible amount of timber to be cut.

The timber inventory just taken shows the amount of sawtimber and condition of the stands. It also shows the rate of growth of the stands for the last two-inch increase of diameter. Of equal importance is the list of areas in need of cutting operations at the present time. Without further study most of these areas could be more intensively sampled and marked for cutting. However, in order to anticipate and

prepare for more complete utilization of the harvest, an estimate of the total yield which might be made regularly and annually for the next five- to ten-years is of use.

Estimated Annual Cut:

The data obtained in making an inventory of the Hocking State Forest indicates that an annual cut of from 700,000 to 900,000 board feet should be made. The data are based upon measurements in both park and forest areas, hence the total annual cut would be due for reductions as soon as park areas are excluded. Inasmuch as the figures on total cut are approximate, a reduction of acreage could be a function in reducing the annual cut.

The reasons behind the above estimate of annual cut are briefly explained. It was shown that the forest has been increasing in merchantable volume at the rate of 157 board feet per acre per year. By cutting 80 percent of the amount of yearly growth, one arrives at a total figure of 1,000,000 board feet which is in excess of that recommended. Another substantiation might be made by referring to the amount of poor timber. This, for the entire 8,322 acres to which the data apply, was shown to have been 6,557,000 board feet or 788 board feet per acre. In order to salvage these trees in ten years' time, 79 board feet per acre or, at present acreage, 655,700 board feet per year would have to be cut. In addition to this latter amount, there would be some mature trees and new growth which could be counted on.

Social and Economic Aspects of the Timber Survey:

It is no new contention that there might be an intensification of the harvesting of sawtimber in the Hocking State Forest. Until the completion of the timber survey, of which this is a report, there was insufficient data on which to base such a conclusion.

The value of the knowledge of the state's timber resources in the Hocking region is that it can safely lead the way to an expansion of private enterprise. With timber from the state lands as a backlog, private industry can be more safely established.

Regular amounts of timber offered at fair market prices should lead the way to better use of our woodlands in a CONSERVATION PROGRAM THAT PAYS.

PROPOSED EXPERIMENTAL AREA

It is the opinion of the writer that the greatest service which could be rendered to farmers in the Hocking State Forest Region would be to demonstrate how to take advantage of the natural ability of the area to produce pine. The area shown by the following map is proposed as an experimental area for carrying out the forest research work in the Hocking State Forest. Nature has been and is converting abandoned

fields into dense stands of pitch pine and Virginia pine. This is providing an enormous supply of wood for present and future use. Little has been done to utilize and improve the quality of this raw material. The pine forests add much to the scenic value of the region, but they are background rather than a part of the main attraction, which is the hemlock, tulip poplar, birch, red oak, etc., of the gorges.

PROPOSED EXPERIMENTAL FOREST
HOCKING STATE FOREST
HOCKING CO. LAUREL TWP.
Aug 25, 1949

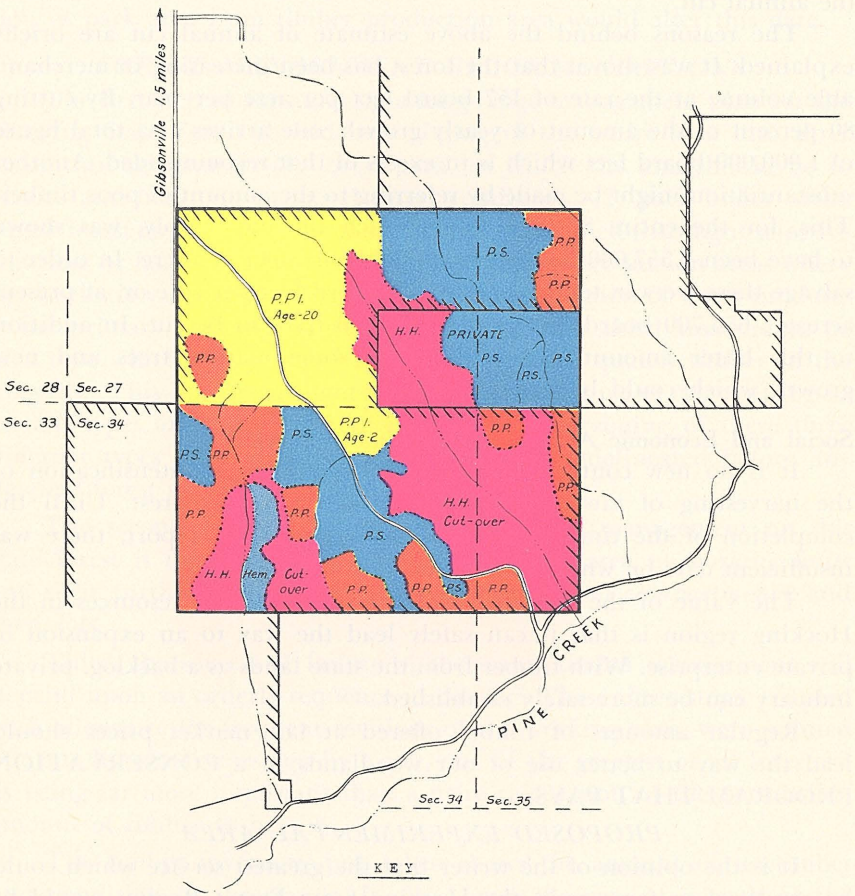


Table 3.—Per Acre Stand Table—Number of Trees and Board Foot Volume of Hocking State Forest.

	Species	Yellow Birch			Virginia Pine			Basswood			American Elm			Butternut			Sugar Maple		
	DBH	Good	Poor	Total	Good	Poor	Total	Good	Poor	Total	Good	Poor	Total	Good	Poor	Total	Good	Poor	Total
VOLUME IN BOARD FEET	12				15	8	23				2	—	2	4	—	4	5	—	5
	14	9	—	9	19	4	23	20	—	20	—	7	7	—	3	3	8	4	12
	16	12	—	12	—	5	5	7	10	17	—	5	5	9	5	14	11	—	11
	18																		
	20													—	9	9			
	22																		
	24																		
	26										—	16	16						
	28	—	37	37															
	Total Merch.	21	37	58	34	17	51	27	10	37	2	28	30	13	17	30	24	4	28
NUMBER OF TREES — Merchantable	10"				.96	.15	1.11				.05	—	.05	.05	.15	.20			
	12"				.20	.20	.40				.05	—	.05	.05	—	.05	.05	—	.05
	14"	.05	—	.05	.15	.05	.20	.20	—	.20	—	.10	.10	—	.05	.05	.05	.05	.10
	16"	.05	—	.05	—	.05	.05	.05	.05	.10	—	.05	.05	.05	.05	.10	.05	—	.05
	18"																		
	20"													—	.05	.05			
	22"																		
	24"																		
	26"										—	.05	.05						
	28"	—	.05	.05															
	Total Merch.	.10	.05	.15	.35	.30	.65	.25	.05	.30	.05	.20	.25	.10	.15	.25	.15	.05	.20
	Grand Total	.10	.05	.15	1.31	.45	1.76	.25	.05	.30	.10	.20	.30	.15	.30	.45	.15	.05	.20

Table 3.—(Continued)

	Species	Black Oak			Scarlet Oak			Red Maple			Black Birch			Pignut Hickory			Beech		
	DBH	Good	Poor	Total	Good	Poor	Total	Good	Poor	Total	Good	Poor	Total	Good	Poor	Total	Good	Poor	Total
VOLUME IN BOARD FEET	12	28	2	30	10	9	19	32	4	36	6	4	10	6	2	8	8	4	12
	14	32	9	41	30	—	30	12	12	24	6	9	15	22	16	38	5	8	13
	16	29	14	43	28	11	39	27	6	33	8	6	14				15	5	20
	18	67	—	67	—	32	32	—	17	17	24	9	33						
	20	—	17	17	—	10	10				33	—	33				13	—	13
	22				22	—	22							40	—	40			
	24		14	14															
	26																		
			14	14															
	Total Merch.	156	56	212	90	62	152	71	39	110	77	28	105	68	18	86	41	17	58
NUMBER OF TREES — Merchantable	10"	.15	.15	.30	.15	.10	.25	.81	.20	1.01	.45	.10	.55	.86	—	.86	.25	.15	.40
	12"	40	.05	.45	.15	.20	.35	50	.10	.60	.10	.10	.20	.10	.05	.15	.15	.10	.25
	14"	.25	.15	.40	.25	—	.25	.10	.15	.25	.05	.10	.15	20	.20	.40	.05	.10	.15
	16"	.15	.15	.30	.15	.10	.25	.15	.05	.20	.05	.05	.10				.10	.05	.15
	18"	.25	—	.25	—	.20	.20	—	.10	.10	.10	.05	.15						
	20"	—	.10	.10	—	.05	.05				.10	—	.10				.05	—	.05
	22"				.05	—	.05							10	—	.10			
	24"	—	.05	.05															
	26"																		
	Total Merch.	1.05	.50	1.55	.60	.55	1.15	.75	.40	1.15	.40	.30	.70	.40	.25	.65	.35	.25	.60
	Grand Total	1.20	.65	1.85	.75	.65	1.40	1.56	.60	2.16	.85	.40	1.25	1.26	.25	1.51	.60	.40	1.00

Table 3.—(Continued)

	Species	Hemlock			Tulip Poplar			Red Oak			Chestnut Oak			White Oak			Pitch Pine		
	DBH	Good	Poor	Total	Good	Poor	Total	Good	Poor	Total	Good	Poor	Total	Good	Poor	Total	Good	Poor	Total
VOLUME IN BOARD FEET	12	100	9	109	37	7	44	33	4	37	51	3	54	40	5	45	79	12	91
	14	48	11	59	59	7	66	97	—	97	86	13	99	39	—	39	59	22	81
	16	94	8	102	90	10	100	83	17	100	62	30	92	102	3	105	30	20	50
	18	59	—	59	95	14	109	52	15	67	24	7	31	60	4	64	14	9	23
	20	19	15	34	62	18	80	17	—	17	—	9	9	—	6	6			
	22																		
	24	30	—	30	65	—	65				—	14	14						
	26	36	28	64										29	—	29			
	28	87	—	87	47	—	47	—	46	46									
	30	100	—	100															
	34				—	63	63												
	Total Merch.	573	71	644	455	119	574	282	82	364	223	76	299	270	18	288	182	63	245
NUMBER OF TREES — Merchantable	10	1.62	.05	1.67	.56	.05	.61	.50	.15	.65	1.06	.30	1.36	1.26	.25	1.51	1.67	1.01	2.68
	12	1.31	.15	1.46	.45	.10	.55	.50	.10	.60	.81	.10	.91	.66	.20	.86	1.11	.25	1.36
	14	.35	.10	.45	.40	.05	.45	.81	—	.81	.76	.20	.96	.35	—	.35	.45	.25	.70
	16	.45	.05	.50	.40	.05	.45	.45	.15	.60	.35	.30	.65	.61	.05	.66	.15	.15	.30
	18	.20	—	.20	.30	.05	.35	.20	.10	.30	.10	.05	.15	.25	.05	.30	.05	.05	.10
	20	.05	.05	.10	.15	.05	.20	.05	—	.05	—	.05	.05	—	.05	.05			
	22																		
	24	.05	—	.05	.10	—	.10				—	.05	.05						
	26	.05	.05	.10										.05	—	.05			
	28	.10	—	.10	.05	—	.05	—	.05	.05									
	30	.10	—	.10															
	34					.05	.05												
	Total Merch.	2.66	.40	3.06	1.85	.35	2.20	2.01	.40	2.41	2.02	.75	2.77	1.92	.35	2.27	1.76	.70	2.46
	Grand Total	4.28	.45	4.73	2.41	.40	2.81	2.51	.55	3.06	3.08	1.05	4.13	3.18	.60	3.78	3.43	1.71	5.14

Table 3.—(Continued)

	Species	Black Gum			Sycamore			Red Elm			Black Cherry			L. T Aspen			White Ash		
	DBH	Good	Poor	Total	Good	Poor	Total	Good	Poor	Total	Good	Poor	Total	Good	Poor	Total	Good	Poor	Total
VOLUME IN BOARD FEET	12	6	4	10	4	—	4				4	—	4	—	8	8			
	14				6	—	6				7	—	7				8	—	8
	16	—	8	8	8	—	8	6	—	6									
	18							8	—	8									
	20																		
	22																		
	24																		
	26																		
	Total Merch.	6	12	18	18	—	18	14	—	14	11	—	11	—	8	8	8	—	8
NUMBER OF TREES — Merchantable	10	.05	.05	.10	.10	—	.10	.05	—	.05	—	.05	.05	.15	.20	.35	.10	—	.10
	12	.10	.05	.15	.05	—	.05				.05	—	.05	—	.15	.15			
	14				.05	—	.05				.05	—	.05				.10	—	.10
	16	—	05	.05	.05	—	.05	.05	—	.05									
	18							05	—	.05									
	20																		
	22																		
	24																		
	26																		
	Total Merch.	.10	.10	.20	.15	—	.15	.10	—	10	.10	—	.10	—	.15	.15	.10	—	.10
	Grand Total	.15	.15	.30	.25	—	.25	.15	—	.15	.10	.05	.15	.15	.35	.50	.20	—	.20

Table 3.—(Continued)

	Species	Shagbark Hickory			River Birch			Sassafras			Black Locust			TOTALS					
	DBH	Good	Poor	Total	Good	Poor	Total	Good	Poor	Total	Good	Poor	Total	Good	Poor	Total			
VOLUME IN BOARD FEET	12	7	—	7										477	85	562			
	14													572	125	697			
	16				—	6	6							621	169	790			
	18													403	107	510			
	20													144	84	228			
	22													62	—	62			
	24													95	28	123			
	26													65	44	109			
	28													134	37	171			
	30													100	—	100			
	34													—	63	63			
	40													—	46	46			
	Total Merch.	7	—	7	—	6	6							2673	788	3461			
NUMBER OF TREES — Merchantable	10	.15	—	.15				.05	.05	.10	—	.10	.10	11.05	3.26	14.31			
	12	.10	—	.10										6.89	1.90	8.79			
	14													4.67	1.55	6.22			
	16				—	.05	.05							3.31	1.45	4.76			
	18													1.50	.65	2.15			
	20													.40	.40	.80			
	22													.15	—	.15			
	24													.15	.10	.25			
	26													.10	.10	.20			
	28													.15	.05	.20			
	30													.10	—	.10			
	34														.05	.05			
	40														.05	.05			
														17.42	6.30	23.72			
	Total Merch.	.10	—	.10	—	.05	.05							28.47	9.56	38.03			
	Grand Total	.25	—	.25	—	.05	.05	.05	.05	.10		.10	.10					.05	.05