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SOME SILVICULTURAL EFFECTS OF CUTTING
ON THE OVAL WOOD DISH TRACT
NEAR MOUNT MORRIS,
FRANKLIN COUNTY, N. Y.*

by

Henry Vettel

1921

* Report on work done in partial fulfillment of the requirements for the degree of Master in Forestry.

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TABLE OF CONTENTS.

	Page
Description and History of the Tract - - - - -	1
Forest Description for Area Studied- - - - -	2
Principal Silvicultural Characteristics of Beech Yellow Birch and Hard Maple - - - - -	3
Growth Following Clearcutting - - - - -	5
Composition of Stand - - - - -	7
Stocking - - - - -	11
Height Growth - - - - -	15
Diameter Growth - - - - -	15
Volume Growth - - - - -	17
Young Growth in Small Openings Following Softwood Logging on the Hardwood Type - - - - -	22
Reproduction Survey of Land Cleared of Merchant- able Timber - - - - -	26
Accelerated Growth of Spruce Following Logging- -	33
Summary - - - - -	38

LOCATION OF THE TRACT.

The portion of the Oval Wood Dish Company's lands, on which the following study was made, is situated on the northwest slope of Mount Morris, about three and a half miles from the town of Tupper Lake and about three-quarters of a mile from the state road, on the Mount Morris trail; in Township 25, Franklin County, New York.

HISTORY OF THE TRACT.

The tract has been logged over by a series of three cuttings. The first cut was made in 1892 for softwood lumber by the A. Sherman Lumber Company. The same operator again cut for hemlock and pulpwood in 1905. The tract has recently become the property of the Oval Wood Dish Company, who in 1920 logged the area for pulpwood and hardwoods.

FOREST DESCRIPTION (Hardwood Slope Type)

The soil is generally a sandy loam, fresh and varying from shallow to deep. The area is fairly well drained throughout. The slope is moderate and generally of northerly exposure.

The litter is characteristic of hardwood growth and varies from two inches to about a foot in depth. The humus is in a good state of decomposition and is an inch to a foot in depth.

The ground cover is moderate, consisting largely of herbaceous weeds (wood sorrel, Solomon's seal, bear berry, violets, etc) with some ferns and moss. The underbrush is moderate and made up of striped maple and witch hobble.

The reproduction, in the main, consists of the seedlings and sprouts of beech, yellow birch and hard maple, with a small amount of spruce scattered over the type. (Note: Miscellaneous species are not taken account of in this description.)

The trees found are beech, yellow birch, hard maple and a small amount of spruce. The stand is of fairly good form and quality. Some of the beech and yellow birch are defective due to fungous attack.

THE PRINCIPAL SILVICULTURAL CHARACTERISTICS OF BEECH,
YELLOW BIRCH AND HARD MAPLE.

The principal silvicultural characteristics of beech, yellow birch and hard maple may best be grasped from the following table of comparisons.*

Species	Seed Production			Seedling Growth Rate.
	Periodicity	Amount	Dispersal	
Beech	Not Annual	Rather Small.	Restricted	Slow.
Yellow Birch	Annual	Large	Wide	Moderate.
Hard Maple	Annual	Large	Moderate	Slow

Species	Tolerance According to Rank. 1 - Most Tolerant.	Aggressiveness in Reproduction, According to Rank. 1 - Most Aggressive.
Beech	1	3
Yellow Birch	3	2
Hard Maple	2	1

Species	Requirements for Rapid Growth.
Beech	Warmth, humus and shade.
Yellow Birch	Cool, moist air and soil, side shade.
Hard Maple	Moist (well drained) soil and air.

The restricted dispersal of beech seed may in part be accounted for by the fact that a large portion of its seed crop is lost through destruction by fungi and animals, and also to the fact that its seed

* Frothingham, E. H. The Northern Hardwood Forest: Its composition, growth and management. United States Department of Agriculture Bul. 285. 1915.

is not wind disseminated whereas birch and maple are both distributed by the wind. Frothingham, 1915, states that: "Sugar maple is the most generally aggressive reproducer throughout the beech-birch-maple type. This is undoubtedly due to the combined tolerance and seeding qualities. Beech, which is probably more tolerant, does not bear large seed crops annually and much of the seed produced is destroyed by animals. Yellow birch, which does bear seed each year, is less tolerant. Its light winged seed are so widely dispersed, however, that many fall where the crown shade is light enough to permit the development of the seedlings. These are adaptable to a great variety of seedbed conditions. Yellow birch thus accomplishes through its reproductive aggressiveness often more than beech can accomplish through its extreme shade endurance."

GROWTH FOLLOWING CLEARCUTTING.

The object of this portion of the study was to determine the composition and growth as to height, diameter and volume of the stand of hardwoods formed after clearcutting.

A portion of the lower slopes of the hardwood slope type was found which had been cut clear of all trees about 25 years ago. The purpose of the clearcutting was to supply fuel wood to a nearby hauling camp.

A series of six one-tenth acre sample plots were laid out on those portions of the area which originally had been densely or fairly densely stocked. All trees, both dead and living, were calipered by inches and tenths, beginning at one inch D.B.H. After all the trees had been tallied, the mean sample tree was determined by means of basal area. (Total basal area divided by the number of trees.) This mean sample tree was found in the stand and cut at the root collar, and measurements taken for the use of pressler's and Schiffel's formulae.

Pressler's Formula.

$$V = \frac{2}{3} B \times H \frac{1}{2} d$$

Schiffel's Formula.

$$V = \left(\frac{1}{6} B + \frac{2}{3} b \frac{1}{2} \right) \times H$$

Where B base at the root collar.
 $b_{\frac{1}{2}}$ base at half the total height.
 H total height.
 $H_{\frac{1}{2}}$ height at which the diameter is half
 that at the root collar.

The volumes were then applied to the plots.
 (Volume of mean sample tree X the number of trees)
 The result was the total volume per plot.

GROWTH FOLLOWING CLEARCUTTING.

The results following clearcutting are as follows:

COMPOSITION OF SECOND GROWTH.

From Table and Diagram it is found that of the three hardwood species, the larger portion, 40.0%, of the stand is made up of hard maple, with yellow birch, 37.8%, second and beech, 15.8%, last.

It has been found that beech, birch and maple seeds, all germinate well on exposed mineral soil mixed with humus. Their best development is attained on well drained, fairly deep loamy soils, but of these three species, birch requires the largest amount of moisture in the superficial layers of the soil.

The soil on this area was found to be a well drained moderately deep, sandy loam. At the time of cutting the seedbed conditions for the three species had been rendered good because at the hauling camp, which had been situated there, work animals had been allowed to run loose over the cutover area nearby. This resulted in a well worked seedbed in which the soil and humus were well mixed. Since the soil requirement for the species was amply met on the area, the varying percentages of species found are influenced by the following reasons. The dominance of maple is probably due to its natural aggressiveness in

seeding of cutover areas. The large percentage of yellow birch is most likely dependent on the moisture content of the soil. The area bordered the upper limits of the spruce flat type, where the amount of moisture was quite large, one of the requirements for the best development of yellow birch. In the case of beech, its restricted seeding, its non-aggressiveness in reseeding cutover areas and the need for shade for best development, accounts for the small percentage of the stand it occupies.

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Table 1.

Plot No.	Beech	Yel. Birch	Hd. Maple	Miscel.
1	8.6	37.1	52.6	1.7
2	16.9	42.9	40.2	0.0
3	32.8	36.6	22.1	8.5
4	13.2	31.1	40.6	15.1
5	5.3	28.9	59.6	3.3
6	18.3	50.0	25.0	6.7
AVERAGE	15.8	37.8	40.0	6.4

PERCENTAGE COMPOSITION OF SECOND GROWTH

HARDWOODS AFTER CLEARCUTTING.

STOCKING.

Tables and Diagrams show the total number of dead and living trees per acre; the average of the six one-tenth acre plots taken was 1115 living trees per acre. This indicates the density of stocking was the result of clearcutting. This dense stocking is one of the necessities of a good second growth stand since it furnishes the individual competition, which tends to give better form and quality to the trees. Diagram shows that since the establishment of the stand, 36.29% of the total number of trees have died, but their competition undoubtedly had a beneficial effect on the rest of the stand. Those trees which were felled and examined showed that during the last few years the growth was beginning to slow down. This was probably because the density of stocking, after the stand reached an age of 25 years, was too great to insure the best growth.

Table 2.

Plot No.	Number of Trees Per Acre		Percentage	
	Living	Dead	Living	Dead
1	1160	1350	46.2	53.8
2	1420	950	59.9	40.1
3	1310	480	73.2	26.8
4	1060	440	70.7	29.3
5	1140	370	75.5	24.5
6	600	220	73.2	26.8
AVERAGE	1115	635	63.71	36.29

COMPARISON OF NUMBER AND PERCENTAGE OF DEAD
AND LIVING TREES PER ACRE.

COMPARISON OF DEAD and LIVING TREES IN SECOND GROWTH HARDWOOD STAND.
(Based on 6 sample plots.)

No. of Trees	200	400	600	800	1000	1200	1400
<u>Plot 1.</u>							
<u>Plot 2.</u>							
<u>Plot 3.</u>							
<u>Plot 4.</u>							
<u>Plot 5.</u>							
<u>Plot 6.</u>							
<u>No. of Trees</u>	1000	2000	3000	4000	5000	6000	7000
<u>TOTAL</u>							

* Heavy lines show living trees. Lines of light weight show dead trees.

Diagram 3

COMPARISON OF PERCENTAGE OF DEAD AND LIVING TREES IN SECOND GROWTH HARDWOOD STANDS.
(Based on 6 sample plots.)

* Heavy lines show living trees. Lines of light weight show dead trees.

GROWTH OF STAND - - HEIGHT.

From Table the height growth of the hardwoods will be found to be on the average 45.6 feet or by taking growth per species per year, based on the mean sample tree:-

Beech - - - - 1.8 ft.per year.

Birch - - - - 1.7 ft,per year.

Maple - - - - 1.9 ft.per year.

or an average height growth of almost two feet per year. This excellent growth is due to site and the density of stocking.

GROWTH OF STAND - - DIAMETER.

Table shows the average diameter of the stand at 25 to 30 years to be 3.8" or by species, (mean sample tree) at 25 years:-

Beech - - - 3.94 inches

Birch - - - 3.68 inches

Maple - - - 3.56 inches

Table 3.

MEAN SAMPLE TREE MEASUREMENTS.

Plot No.	Species M. S. T.	Age Yrs	D. B. H Inch	Height Feet.	Volume Mean Sample Tree (Cu Ft)	
					Schiffel's Formula	Pressler's Formula
1	Yel. Birch	25	4.1	47.0	2.7	2.2
2	Hd. Maple	25	3.2	44.0	1.8	1.5 ✓
3	Yel. Birch	27	3.8	41.6	2.0	2.2 ✓
4	Hd. Maple	26	3.7	47.1	2.5	2.5
5	Yel. Birch	25	3.6	43.3	2.0	2.1
6	Beech	26	4.1 ✓	46.3	2.5	2.5 ✓
6	Yel. Birch	30	4.15	48.6	3.1	3.3

Table 4

VOLUME OF SECOND GROWTH HARDWOODS.

Plot No.	Volume per Acre. (Cords)		
	Schiffel	Pressler	Average
1	32.70	26.64	29.67
2	23.40	19.50	21.45
3	23.33	26.78	25.06
4	25.00	25.00	25.00
5	22.22	23.33	22.78
6	14.72	14.72	14.72
6	18.26	19.43	18.85
AVERAGE	22.80	22.20	22.50

In converting cubic feet to cords the factor of 90 cubic feet to a cord was used.

GROWTH OF STAND - - VOLUME.

Tables and Diagrams give the results found for the volume of the stand. The average volume per acre is shown to be 22.5 cords or an average mean annual increment ,in Tables and Diagram ,of .91 cords or 3.86%. This gives the excellent yield of almost a cord per acre per year for second growth hardwoods, at 25 to 30 years.

From a comparison of Diagrams and the general statement may be formulated, that the volume of a stand is in direct proportion to the basal area, which is indicative of density of stocking.

Diagram 4

COMPARISON OF VOLUMES(Cords and Cubic Feet) PER ACRE.

Cubic Feet	0	100	1500	2000	2500	3000
Cords	0	2	6	10	14	18
Plot 1	1	1	1	1	1	1
Plot 2	1	1	1	1	1	1
Plot 3	1	1	1	1	1	1
Plot 4	1	1	1	1	1	1
Plot 5	1	1	1	1	1	1
Plot 6	1	1	1	1	1	1
AVERAGE	1	1	1	1	1	1

Diagram 5

COMPARISON OF TOTAL BASAL AREA OF PLOTS.

Table 5

MEAN ANNUAL INCREMENT OF SECOND
GROWTH HARDWOODS.

Plot No.	M. A. I. (Cords)
1	1.18
2	.86
3	.93
4	.96
5	.91
6	.60
AVERAGE	.91

Diagram 6

COMPARISON OF MEAN ANNUAL INCREMENT.

Cords	.0	.2	.4	.6	.8	1.0	1.2	1.4
<u>Plot 1.</u>								
<u>Plot 2.</u>								
<u>Plot 3.</u>								
<u>Plot 4.</u>								
<u>Plot 5.</u>								
<u>Plot 6.</u>								
<u>AVERAGE</u>								

YOUNG GROWTH IN SMALL OPENINGS FOLLOWING SOFTWOOD LOGGING ON THE HARDWOOD TYPE.

On another portion of the hardwood slope type, 33 sample plots varying from one-twentieth to one-tenth acre in area were laid out in such places, where at the time of the cutting in 1896 and 1905, softwoods were taken out singly or in groups. On these areas all trees were calipered and tallied by one inch D.B.H. classes. Stand tables were prepared from which figures on the percentage of composition could be based. Trees up to a D.B.H. of six inches were used in making these tables, since the number of trees dropped off rapidly beyond that diameter. Those above six inches D.B.H. were assumed not to have composed part of the young advance growth or the seedlings that started after the loggings.

Tables and Diagrams show beech to form 60.74% of the stand, with hard maple at 8.05%, birch 7.06% and spruce 3.13%. An examination of table shows beech to dominate in every D.B.H. class, with maple second and birch a close third. This tends to show that the cutting of the softwoods and thereby the breaking up of the crown canopy, admitted a relatively small amount of direct sunlight to the ground. Those hardwoods which dominated in the stand had a natural tendency to close the crown openings rapidly by

increased growth of their crowns. The above conditions gave rise to a situation which only the beech could properly meet through its tolerance.

Table 6

COMPOSITION OF YOUNG GROWTH FOLLOWING SELECTION
CUTTING.

No. of trees Per Average Acre - by species and diam.

D.B.H. inches	Beech	Yellow Birch	Hard Maple	Spruce	Miscel.	Total
1	234	22	32	3	56	347
2	91	12	9	2	46	160
3	41	8	4	3	28	84
4	17	2	3	2	8	32
5	9	2	3	2	5	21
6	8	0.5	2	2	2	14.5
TOTAL	400	46.5	53	14	145	658.5

Table 7

PERCENTAGE OF TREES BY SPECIES IN EACH DIAMETER
CLASS.

D.B.H.	Beech	Yellow Birch	Hard Maple.	Spruce	Miscel.
1	67.44	6.34	9.22	.86	16.14
2	56.88	7.50	5.62	1.25	28.75
3	48.81	9.52	4.76	3.57	33.34
4	53.12	6.25	9.38	6.25	25.00
5	42.86	9.53	14.27	9.53	23.81
6	55.18	3.45	13.79	13.79	13.79

Diagram 7

PERCENTAGE COMPOSITION OF YOUNG GROWTH.

REPRODUCTION SURVEY OF LAND CLEARED OF MERCHANTABLE TIMBER.

All data for this phase of the work were taken on a portion of the hardwood slope type similar to the other area except that this part of the type was better drained. The area was cut over for softwood lumber 29 years ago, then again 15 years ago for hemlock and pulpwoods and for all merchantable pulpwood and hardwoods in 1920. These cuttings gave a final condition very similar to clearcutting. Survey strips were run through the type. All trees were calipered by inch classes beginning at one inch D.B.H. At every two chains sample plots one rod square were laid off and a count made of all young growth below .6 inches D.B.H. The data presented are based on the measurements of 25 sample plots, each one square rod in area.

Table and Diagram show hard maple to make up the larger portion, 74.02%, of the stand, beech next, 20.61%, and yellow birch last, 3.58%. Tables and show the original composition of the stand and the remnant left after cutting. These data show that in the original stand maple dominated, with beech next and birch last. In the remnant left after cutting, only a few good yellow birch seed trees were found, which probably were not enough to properly reseed the

area. Another point to be considered is that the seedbed conditions were rather unfavorable for birch since the area was well drained and liable to drying out due to the opening up of the stand and since the cover of hardwood litter did not allow the seeds to get to the mineral soil where they might germinate. The third point to be brought out is the fact that the time which has elapsed since the last cutting has not been long enough to enable the seeding of these openings with birch. It will be seen from Table and Diagram that spruce constitutes a very small portion of the young growth, in percentage only .03% or six seedlings or saplings per acre. The reasons that spruce will not reseed the area are; unfavorable seedbed and insufficient moisture. The fairly large amount of hardwood litter makes a poor seedbed. The seeds may germinate on the leaves but their roots are unable to get through to the mineral soil, because of the impenetrable texture of the hardwood leaves. The litter also sheds water easily and dries out, leaving the seedling without the required amount of moisture. Another disadvantage lies in the fact that spruce seed is often dispersed before the hardwood leaves fall. This tends to cover the seed to such a depth that a fairly large proportion of the seedlings are killed, by lack of light, too much heat, and too humid

growing conditions, since the seedlings are not able to push through the covering of litter. A plentiful supply of moisture is essential at the time of germination and throughout the period of establishment. The area on which the data were taken was found to be well drained and did not have a plentiful supply of moisture. The amount of moisture in the soil was made less, to some extent, by the drying out of the soil due to exposure through cutting.

Table 8

COMPARISON OF THE NUMBER OF SEEDLINGS AND PERCENTAGE
COMPOSITION OF THE REPRODUCTION.

Species	No.Of Seedlings	Percent of Total
Beech	4135	20.61
Yel.Birch	719	3.58
Hd.Maple	14859	74.02
Spruce	6	.03
Miscel.	353	1.76
TOTAL	20072	100.00

Diagram 8

COMPARISON OF NUMBER OF SEEDLINGS PER ACRE and PERCENTAGE COMPOSITION OF THE

REPRODUCTION.

Table 9

ORIGINAL STAND BEFORE CUTTING.*

D.B.H	Beech	Birch	Maple	Spruce	Miscell.
4	15.78	6.31	8.42	5.26	8.42
5	6.84	5.79	7.90	5.79	1.58
6	5.26	2.10	5.26	6.84	.53
7	1.58	.53	6.31	4.21	.53
8	4.72	.53	2.61	2.61	
9	1.58		2.61	2.10	.53
10	4.72		2.61	.53	
11	2.10		2.10		
12	2.10		3.68		.53
13	1.58		7.38		
14	1.58	.53	3.16		.53
15	.53		3.68		
16	.53		2.10		.53
17	1.05		2.10		
18	.53				
19	.53		.53		
20	1.58		1.58		
21	.53		1.05		
22			2.10		
23			1.05		
24			1.58		
25			1.58		
26		.53			
27			1.05		
30			.53		
TOTAL	53.12	16.32	70.97	27.34	13.18

* Number of trees per acre.

Table 10

REMNAINT LEFT AFTER CUTTING.*

D.B.H.	Beech	Birch	Maple	Spruce	Miscell.
4	4.87		.90	1.33	
5	2.90	.23	.23	1.33	.33
6	2.00		.33	1.33	
7	1.67	.33	.67	1.23	
8	.57	.23	.57	1.33	.67
9	1.00		1.33	1.33	
10			.67	.67	
11	.67			.67	
12	1.67	.23	.23	.33	
13	.67				
14		.33			
15			.33		
16					
17					
18				.33	
19					
20					
21		.33	.23		
TOTAL	16.02	1.68	5.49	9.88	1.00
Percent of Original Stand	30.16	10.29	7.73	36.14	15.68

* Number of trees per acre.

ACCELERATED GROWTH OF SPRUCE FOLLOWING LOGGING.

The purpose of this study was to determine the effect of cutting on growth in volume of spruce, released from suppression. The trees from which the data were gathered were situated on the lower slopes of the hardwood type, adjoining the upper limits of the spruce flat type. These have had twice been cut over for softwoods, thereby releasing the trees. These cuttings gave the remaining stand almost full light. The remaining softwoods were cut in 1920 and these trees, which had not yet been removed in logging, offered the material from which the required data were gathered.

Tables and Diagrams show the remarkable growth in volume due to the releasing of the spruce from suppression. A comparison of average diameters at the stump, at the time of release (25 years ago) and the stump diameters at the present time, shows the following results.

Average diameter 25 years ago - - - - 5.5"

Average diameter at present - - - - 13.3"

Percent increase in diameter - - - - 153.64%

The increase in volume due to release in trees, which at the age of cutting averaged 127 years equalled

83.35% of the total volume. This result must not be taken as the criterion for what spruce will do after release from suppression, since the site was a very favorable one for this species. The area was immediately adjacent to the spruce flat type. The soil was of good quality with sufficient moisture for good spruce growth. A fairly large amount of hardwood litter which had ample opportunity to decay when the stand was opened would also tend to increase growth. An interesting feature of the accelerated growth is that not only the younger trees but also the older ones responded equally well to release from suppression. In fact the oldest tree, 168 yrs old, made an increase in growth equal to 87.4% of the total volume, while the youngest tree, 84 years old, made an increase in growth of 86.8% of the total. The data are however quite meagre and so it cannot definitely be said that all ages of trees respond equally well to release from suppression.

Table 11

Tree No.	Age		Yrs of Accel Growth	Volumes(CuFt)		Percent Accel.Growth is of Total
	Total	At Time Of Accelerat.		Total	Acceler. Growth	
1	182	158	24	8.75	6.35	72.6
2	170	145	25	29.38	23.03	78.4
3	117	91	26	6.85	5.05	71.0
4	110	84	26	16.45	14.38	86.8
5	192	166	26	29.40	25.71	87.4
6	150	120	30	8.98	7.91	88.1
7	174	142	32	44.90	40.05	89.2
8	145	113	32	24.30	22.68	93.3

COMPARISON OF TOTAL VOLUME AND VOLUME DUE TO ACCELERATED ..
GROWTH OF SPRUCE RELEASED FROM SUPPRESSION.

Diagram 9

COMPARISON OF TOTAL VOLUME and VOLUME DUE TO ACCELERATED GROWTH OF

SPRUCE RELEASED FROM SUPPRESSION BY CUTTING.

* Heavy line shows total volume Lighter weight line shows volume due to accelerated growth.

Diagram 10

CHART SHOWING PERCENTAGE WHICH ACCELERATED GROWTH IS OF TOTAL GROWTH.

SUMMARY

Growth Following Clearcutting.

(1) On site adapted to the growth of beech, birch and maple, but where there is a fairly abundant supply of moisture in the surface and subsurface layers, maple and birch will make up the large portion of the stand in almost equal percentages, with beech forming the lesser portion.

(2) Clearcutting results in a very densely stocked stand in which the mortality is high in early life.

(3) Height growth amounted to about two feet per year.

(4) Diameter growth was about four inches in 25 years.

(5) The stands showed an average volume growth of .91 cords per year or an M.A.I. of 3.86%.

Young Growth in Small Openings Following Softwood Logging.

(1) In small openings beech made up the larger portion of the stand due to its extreme tolerance.

(2) Spruce is almost wholly crowded out after selection cutting, in percentage of the total stand it occupies only 2.13%.

Reproduction Survey of Land Cleared of Merchantable Timber.

(1) On typical hardwood land, heavily cut and having only a small amount of moisture in the surface layers, maple made up about 75% of the stand, beech 20% and yellow birch about 4%.

(2) Spruce is almost absent in the reproduction on typical hardwood land heavily cut, in percentage only .03%.

Accelerated Growth of Spruce Following Logging.

(1) Spruce released from suppression about 25 years ago, made in that time an increased growth of 126.64% or the accelerated growth equalled 83.35% of the total volume.