THE GROUP SELECTION METHOD WITH WHITE PINE

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The effect of the new Massachusetts forest tax law, and of the application of silviculture on the financial outcome of timberland ownership are particularly well illustrated by an operation carried out in 1923 by the New England Box Company in co-operation with the Harvard Forest on one of the company's tracts in northern Worcester County. The operation involved principally the group selection cutting of white pine growing on the better grade of light, sandy soil. The logging was done by the company and the Harvard Forest was responsible for the plan of management and the supervision of the operation.

Although insufficient time has elapsed to permit of a report on the reproduction obtained, the outcome in this particular case may be considered successful even though scanty reproduction should result, for the reason that over two-thirds of the area was stocked with young growth to begin with.

Portions of but two of the seven stands on the tract were operated in 1923, but in arriving at the method of handling these portions it was necessary to consider the status of the entire tract. Hence the following tabulations of areas, volumes, costs, etc., are presented.

Areas and Merchantable Volumes by Stands

Stand	Acres	Age class [1]	Volume per acre in bd. ft.	
			Softwood	Better hardwood [2]
White pine	65.0	II-III	5.4 M	.....
Pine, hemlock, and hardwood	20.5	II-III	5.8 M	1.0 M
White pine	9.5	II	10.0 M	.2 M
Pine, hemlock, and hardwood	10.0	II	4.5 M	.9 M
Hemlock and hardwood	2.5	III	10.0 M	5.0 M
Hemlock and hardwood	30.0	I-II	2.0 M	1.2 M
Pine and inferior hardwood	1.0	I	.....	.....
Nonforested land	11.5	.....	.....	.....
Total area	150.0			

[1] Age class I—0 to 20 years; age class II—21 to 40 years; age class III—41 to 60 years.

[2] Include paper, yellow, and black birch, beech, black cherry, and hard maple.

Note.—In the mixed stands listed above there is considerable material below the merchantable limit which may be considered present cordwood, or prospective saw timber.

Financial Status of Lot Just Before Operation

Initial cost of lot compounded to date ($4,000 at 4 per cent for 6 years)		$5,061.20
Taxes compounded to date (Approximately $36.83 annually at 4 per cent for 6 years)		244.29
Total cost		$5,305.49
Estimated sale value	$7,000.00	
Assessed value	$2,000.00	
Assessed value per acre	$13.34	(Maximum allowed for registration under Massachusetts tax law, $25.)
Average volume per acre	15 to 20 cords	(Maximum allowed for registration, 20 cords.)
Prospective yield per acre	Sufficient	(Minimum required for registration, 20 M of softwood or 8 M of hardwood, or relative percentage of both.)

DESCRIPTION OF STANDS OPERATED

White pine, 65.0 acres.—This stand, with which this paper mainly has to deal, approached a two-story, group selection form, and consisted essentially of two age groups of pine, namely, 20 and 50, between which were scattered single pines from 1 to 30 years old. The groups were quite evenly distributed and of medium size (one-sixteenth to one-quarter acre). The average tree of the older group measured 11.0 inches in diameter, and 55.0 feet in total height; that of the younger group, 3.0 inches in diameter, and 25.0 feet in total height. The soil was a loamy sand, a Site II, not heavy enough to permit the presence of any hardwoods other than a few poplars and grey birches which offered no serious hindrance to the growth of the pine. A scattering of pitch pine and hemlock completed the composition of this stand. On a small portion of the area the ground cover was a mat of moss, lichen, and blueberry which precluded the initiation of reproduction unless torn up in logging. The growth of the pine understory was in many places seriously retarded by the overtopping older groups, to the extent that its economic age (about 20 years) was from 5 to 10 years less than its actual age. The younger groups, supplemented by many scattered individual (stem-wise) trees, were so distributed and in such amount as to promise, after the removal of the older groups, a stand sufficiently well stocked to permit of registration under the forest tax law.

Pine, hemlock and hardwoods, 20.5 acres.—This, together with the five remaining stands, was located on a westerly slope having the heavy soil characteristic of upland. It was an unevenaged, mixed stand containing sufficient merchantable pine and hemlock to justify cutting at once. In such event the young pines, hemlocks, and better hardwoods remaining after the cut would constitute nearly a one-half stocked stand. This cutting also could be made without jeopardizing the registration of the lot.

The remaining stands need not be described for purposes of this paper. With the exception of 9.5 acres of "old-field" pine, they were all unevenaged, mixed stands of pine, hemlock, and hardwoods on heavy soil—stands which were not yet ready to cut. All could be readily reproduced naturally by either clear or partial cuttings, though by a clear cutting, hardwoods would be favored to a greater extent than would be the case with the use of certain forms of partial cuttings.

POSSIBLE METHODS OF TREATMENT

Both for the financial and silvicultural reasons the 65.0 acre stand of pine presented the main problem. In handling this stand there were two alternatives, namely:

1. The present merchantable groups of pine might be cut at once, leaving the young group-wise and stem-wise pines to form the major part of the crop at the end of the next cutting cycle, thus retaining the unevenaged form, or,

2. The stand might be left untouched for a period sufficiently long (about 20 years) to allow the bulk of the trees to reach sawtimber size, and then a clear cutting, thus changing the form from unevenaged to evenaged.

The advantages of alternative 1 were that the capital invested in the lot might be reduced immediately about two-thirds; that since the volume per acre of the tract approached the maximum allowed for registration under the forest tax law, a reduction in volume with, at the same time, little decrease in prospective yield insured the acceptance of the lot by the assessors; the unevenaged form of stand afforded better soil protection which is much needed with light soils, and gave promise of more satisfactory natural reproduction, although the reproduction period would be comparatively long; the increment of the overtopped young growth could be expected to be greatly increased by cutting the older groups; the merchantable groups would be cut at

nearly financial maturity; and no slash burning would be necessary in order to secure a well stocked stand.

On the other hand the only possible advantages of alternative 2 were that logging costs per thousand might be less; the form of stand could be changed to an evenaged one which might conceivably be the more desirable form for a comercial forest; by delaying the operation about 20 years, it could be made to include the bulk of the stands on the lot, thus possibly reducing certain operating costs per thousand, and at the same time the stumpage value of the pine might be sufficiently higher than at present to justify the delay. Among the disadvantages of this alternative the outstanding one was that, since no present reduction in the volume of the tract was anticipated, the registration of the tract was not assured.

After a consideration of the advantages and disadvantages of both alternatives, the first was chosen.

OPERATING UNDER THE GROUP SELECTION METHOD

White pine, 65.0 acres.—On 52 acres of this area the merchantable white pine, pitch pine, and hemlock were marked for removal, the young group-wise and stem-wise trees being left. The material removed (about 6,000 board feet per acre) consisted very largely of groups of age class III white pine. Special care was taken in logging not to damage trees which were unmarked. Marked trees were felled so that their tops would lie along the edges of the openings rather than in the middles, in order to leave the openings free for reproduction. If it had appeared desirable to burn the slash the tops would have been dropped into the middles to facilitate burning and to safeguard the encircling young growth. But in this case nothing would have been gained by slash disposal. As regards fire hazard, sufficient inflamable material would have remained after slash burning to cause a fire fatal to much of the young growth. Furthermore, slash burning in such a stand would have been very costly. No seed trees, as such, were left to start reproduction before the trees now left in the understory could reach seed-bearing size. There was, perhaps, some question as to the wisdom of cutting all the large trees capable of producing an abundance of seed, but the leaving of a scattering of big trees would surely have done harm to the understory, not to mention the

unsightliness of these seeders, and the need of their volume to "fatten up" the cut.

After logging, an inspection of the cutting area showed that the logging had been painstakingly done, and that the area was at least two-thirds stocked with group-wise and stem-wise pines. Of the total area about 30 per cent is now occupied by 20-year-old groups; 35 per cent by stem-wise trees, 1 to 30 years old; and 35 per cent by openings made by the removal of the older groups plus those existing before the operation. Assuming a rotation of 60 years, the following distribution of growing stock may be expected to obtain 20 years hence. A number of 4.0 to 6.0 inch trees, so located and of such size as to have justified their retention, are now present in the remaining stand. In 20 years these may be cut together with some of the groups (the oldest) from those now listed as having an average economic age of 20, thus making a number of openings which may be made to equal about 30 per cent of the total area. At that time the bulk of the groups which now average 20 years of age will be age 40, and not ready to cut for 20 years more. Their area, plus that occupied by stem-wise trees of like age, may also be made to approximate 30 per cent of the total area. Furthermore, at that time the present openings may be partially stocked with age class I reproduction initiated for the most part by the present 4.0 to 6.0 inch trees mentioned above. The area so reproduced may also approximate 30 per cent of the total. The remaining 10 per cent may be considered nonproductive area. Thus, eventually, three age groups may be developed with a rotation of 60 years, and a cutting cycle of 20 years.

Pine, hemlock and hardwood, 20.5 acres.—The lower portion of this stand, which adjoined white pine, 65.0 acres, was also marked for partial cutting. Approximately 8,000 feet of pine and hemlock per acre were removed. The remaining young stand of pine, hemlock, and better hardwoods was of such distribution and amount as to constitute after cutting a one-half stocked stand of age classes I and II. It is expected that the stocking of this area will be gradually increased due to the nearness of seed trees in the uncut portion of the stand further up the slope. About 8 acres of this stand were operated, making a total cuting area of 60 acres.

Logging and Milling Costs Per Thousand Board Feet

(Total amount cut, 381,000 board feet of pine and hemlock.)

Felling, bucking, and skidding		$5.52
Sled haul of 4 miles, and loading logs on cars at railroad	$8.66	
Freight (17 miles by railroad)	4.13	
Unloading at destination	.68	
		13.47
Overhead		1.51
Sawing		4.80
Stumpage		9.65
Total		$34.95

An unusually heavy winter with much snow increased logging costs considerably, though it is true that a portion of the added cost of logging was due to the partial cutting method. This added cost, however, may rightfully be charged against the remaining stand, together with the prospective supplement thereto in the form of new reproduction.

New Financial Status After Operation

Total cost of lot before operation	$5,305.49
Income from cut (381,000 at $9.65)	3,676.65
Present capital investment	$1,628.84
Sale value of lot, about	$3,000.00
Assessed value (land alone; lot registered)	$5.00 per acre

EXPECTABLE RETURNS

Had alternative 2 been chosen the management would probably have called for the operation of the tract in 1940. Assuming that in 1940 the owner decides to sell the tract, both land and timber, and to liquidate the investment, it will be worth while to compare the expectable returns at this time, as influenced by the alternative chosen. It should be borne in mind that the results below are only relatively correct, since the methods of calculating the future yields of mixed, unevenaged stands have not been perfected.

Expectable Return from Alternative 1

Net income from cut in 1940 (clear cutting of all merchantable material on the tract except any material on the 60 acres operated in 1923) (630 M at $15 per M, minus yield tax of 6 per cent	$8,883.00	
Sale value of land and young growth remaining after cut	7,000.00	
		$15,883.00
Investment remaining after 1923 cut, $1,628.84, compounded to 1940 at 4 per cent	$3,172.82	
Taxes to 1940 compounded at 4 per cent (land registered; assessed value per acre, $5, rate 2 per cent	355.46	
		3,528.28
Net profit on lot		$12,354.72

Expectable Returns from Alternative 2

Net income from cut in 1940 (clear cutting of all merchantable material on the tract) (1,400 M at $15 per M).....		$21,000.00	
Sale value of land and young growth remaining after cut...		1,000.00	
			$22,000.00
Initial cost of lot compounded to 1940 at 4 per cent ($4,000 for 23 years).....		$9,858.80	
Taxes to 1923 (as stated above).....	$244.29		
Taxes from 1923 to 1940 compounded at 4 per cent (assumed assessed valuation $3,000; rate 2 per cent; tract not registered.....	1,421.85		
		1,666.14	
			11,524.94
Net profit on lot.....			$10,475.06

A comparison of the above expectable returns from the two alternatives leaves little doubt as to which is the more profitable. In the case of alternative 1 the owner quadruples his money, while in the case of alternative 2 he falls a trifle short of doubling it. In both cases the investment period is 23 years.

The group selection method as applied in this case, instead of a method commonly used by lumbermen (clear cutting), furnishes an example of the increased profitableness of forest production when scientific management is applied.

White pine in the unevenaged form is found growing as a relatively permanent type on light, sand and gravel soils of north central Massachusetts and southern New Hampshire. The permanent character of this type is due to the impossibility of hardwoods of vigorous growth coming in in sufficient numbers to crowd out the pine. On the better grade of light soils where the rate of growth of white pine is sufficient to justify its continuance for successive crops, the selection method, or one of its modifications, appears to offer the best adjustment of financial and silvicultural needs.

On the most sterile of the light soils the rate of growth of white pine is oftentimes so slow that it is probably advisable to recommend its replacement with either red or Scots pine. Plantations of red and Scots pine on sand plains in this vicinity exhibit a much better rate of growth than that of white pine on the same soil.

On the heavy upland soils white pine is commonly found in the evenaged form growing on abandoned farms. While no system of reproducing the "old-field" type has yet been devised which will effectually check the determined ingress of hardwoods both before and during the reproduction period, the clear cutting and shelterwood methods, following by weedings, have given the best results.