Profitable Woodlot Management in New England

by Stanley M. Filip and William B. Leak

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44 E

The Woodlots of New England

THE woodlot owners of New England have a large stake in the forestry future of the region. In New England there are more than 250,000 woodlots, averaging about 60 acres each. All together they make up about 15 million acres; and they provide a large part of the raw material needed by local wood-using industries.

But most of these woodlots have not been handled on a sustained-yield basis for maximum profit. The average New England woodlot is in poor condition, producing only a fraction of its potential yield. Undesirable species, small timber, and highly defective trees comprise much of the stocking. Yet opportunities for improvement are great. Most woodlots have several built-in advantages, such as easy accessibility, easy logging conditions, and proximity to wood-using plants; and these advantages should help make timber-growing an attractive and profitable business venture.

However, because many woodlots are in a run-down condition and offer rather discouraging prospects for immediate income,

their owners need assistance in initiating sound forestry programs. In addition to on-the-ground advice, both financial and technical information ought to be readily available to woodlot owners—and to service foresters, extension foresters, and others who advise them— if the job is to be done. This report is intended to provide some of the necessary information. It covers costs and returns, technical procedures, and management goals for two typical northern hardwood woodlots on the Bartlett Experimental Forest, Bartlett, New Hampshire.

The Bartlett Study

Recognizing the need for more information on woodlots, the Laconia research center of the Northeastern Forest Experiment Station, U.S. Forest Service, began a woodlot-management study on the Bartlett Forest in 1952. The objectives of the study were:

- To determine costs and returns from repeated cuttings (2-year intervals) under intensive selection management.
- To obtain information on stand growth and development in intensively managed woodlots.
- To develop improved logging and management procedures especially adapted to woodlots.

Two tracts were selected for the study. One, 37 acres in size, supported second-growth timber typical of woodlands that had been clearcut about 50 to 60 years ago in the Bartlett area. The low-value red maple—largely of sprout origin—was the most abundant species. Considerable mature to overmature aspen also was present. However, among the better species were a fair number of paper birch and hemlock, plus a scattering of good ash. About two-thirds of the growing stock was in pole-size trees; stocking of merchantable sawtimber averaged only 4,000 board-feet per acre (International ¼-inch log rule).

The second tract comprised 43 acres of old-growth northern hardwoods—mostly beech, red maple, hemlock, and yellow birch. Although this woodlot was well stocked with sawtimber

Figure 1.—A mature paper birch tree marked for cutting. The sugar maple seedling beside it is ready to move into the stand from beneath.

Figure 2.—Large defective trees such as this beech, which occupy productive growing space, were girdled to make space available to stems of greater potential value.

—averaging about 10,000 board-feet per acre—high-grading some 60 or more years ago for spruce, sugar maple, and yellow birch had left a very high ratio of beech, many of which later developed into low-quality specimens. Then, too, many of the beech trees were dying from the beech scale-Nectria complex—a combination insect-disease attack.

On the second-growth woodlot, the big job was to build up the proportion of sawtimber, improve species composition, and, of course, salvage merchantable poor-risk trees before they died (fig. 1). On the old-growth lot, the immediate need was to salvage the dying beech—many of large size—together with poor-risk trees of all species. Also, on the old-growth lot in particular, many sawtimber-size trees were defective and had to be girdled to make room for more valuable growing stock (fig. 2).

Logging and Markets

In 1952 to 1958, four light improvement cuttings of marked trees were made on each woodlot.[1] In 1952, cutting was done on both lots to get the study started; after that, cutting was alternated annually between the two lots, only one being cut each year.

The first cutting on each woodlot was spread over the entire area so as to salvage merchantable poor-risk trees. Trees that were too defective to be cut into salable products were girdled. The next three cutting operations were concentrated in the portions of each lot having the greatest number of low-quality, poor-risk trees.[2]

Logging on both woodlots was done by private contractors who used skidding equipment well adapted to the size of the marked timber and the topography. Light-weight crawler tractors (20-to-30-hp. class) were suited to the small timber and

[1]For a discussion on woodlot-marking procedure see: Hutnik, R. J. Placing our northern hardwood woodlots under management. U. S. Forest Serv. Northeast. Forest Expt. Sta., Sta. Paper 82, 24 pp., illus. 1956.

[2]See table 5 for proportion of area and volume cut in each woodlot, by cutting cycle.

rolling terrain on the second-growth lot. A heavier crawler tractor (40-hp. class) was better for the larger timber and somewhat rougher terrain of the old-growth lot.

Felled timber was skidded in tree-lengths to loading sites located along truck roads within the woodlots. The skidding distances mostly were short, but some exceeded 700 feet. As the

Table 1. Logging crews, skidding equipment, and assigned rates[1], by woodlots and years

Woodlot	Year	Logging crew		Skidding equipment	
		Men	Assigned rate[2]	Type	Assigned rate
		No.	*Dollars per man-hour*		*Dollars per elapsed hour*
Second-growth	1952	3-4	1.94	D-4	2.75
	1954	2	1.94	Horse	([3])
	1956	1	1.94	John Deere 40	2.00
	1958	4	1.94	AC HD/5	2.00
Old-growth	1952	2	1.94	T-6	2.25
	1953	4	1.94	D-4	2.75
	1955	4	1.94	D-4	2.75
	1957	4	1.94	D-4	2.75

[1] All cutting done with chain saw at $1.25/cord.
[2] Includes $1.75 take-home pay plus 11 percent for miscellaneous costs (Social Security, etc.) to employer.
[3] Assigned rate for horse: $2.50/cord.

Table 2.—Net scale of products removed during four cuttings, by woodlots

Item	Second-growth woodlot	Old-growth woodlot
Hardwood logs ..... 1,000 board feet ..	3.7	44.2
Softwood logs ..... 1,000 board feet ..	5.1	2.1
Paper birch bolts ..... standard cords ..	33.9	.7
White ash handle stock ..... 1,000 board feet ..	.7	3.2
Pulpwood ..... standard cords ..	97.8	200.8
Total removed[1] ..... standard cords ..	148.4	285.5
Proportion in pulpwood .....percent ..	65.9	70.3

[1] Board-feet converted to standard cords by using factor: 1,000 board-feet equals 1.7 cords for hardwoods and 1.8 cords for softwoods.

loggers were well advised on product specifications and priorities, they bucked trees to yield the highest returns. Also, enough of a single product was cut to make at least a truckload.

Good markets for five kinds of products were always available. High-value products included paper birch boltwood, hardwood logs, softwood logs, and white ash hande stock. Merchantable material that did not meet specifications for these products was bucked into pulpwood. All cutting was done with one-man chainsaws.

Records

An initial tally was made of all trees larger than 5.0 inches, d.b.h., by 2-inch classes and species. A second tally was made after the fourth cutting. Summaries of these two tallies, plus records of all trees removed by logging, mortality, and girdling, were used to determine volume growth, mortality, species composition, and changes in stand structure during the 5- to 6-year period 1952 to 1957-8.

Most woodlot owners are interested in how much woodlot management costs, and how much it pays; so labor and equipment time records were carefully kept during each cutting operation. Then current local wage and equipment rates were applied to determine logging costs. Information on assigned rates, logging crews, and equipment are given in table 1.

Roadside values of all products were those actually received. Roadside values were used rather than delivered-at-mill values because most woodlot owners generally do not haul their own timber.

Results

Products

The four cuttings on both woodlots yielded varying amounts of the five products for which markets were available. The second-growth woodlot yielded a substantial volume of birch

boltwood, and the old-growth lot yielded a fair quantity of hardwood logs (table 2). The highest yield on both woodlots, however, was in pulpwood. This was to be expected, because the trees marked for removal generally were those of the poorest quality.

Even so, the percentage of high-value products increased during the treatment period. On the second-growth woodlot, the percentage of high-value products in the total cut increased from 30 to 45 percent between the first and fourth cuttings. This indicates that headway is being made in improving the stands. On the old-growth lot a similar upward trend in yield of high-value products occurred, but only for three cuttings. In the fourth cutting, the percentage of pulpwood increased considerably, because most of this cutting (82 percent) took beech trees heavily degraded or recently killed by a prolonged attack of beech scale-Nectria.

Under repeated light selection cutting, the yield of high-value products should continue upward on both woodlots. Eventually, when the stands become fully productive, the yield of high-value products probably will stabilize at about 50 to 60 percent of the total cut.

Logging Costs and Returns

Average 4-year roadside values per cord of timber cut were $18.16 for the second-growth woodlot and $16.52 for the old-growth woodlot (table 3).[3] A substantial harvest of paper birch bolts accounted for the higher average value of the second-growth products. However, since most of the volume cut on the second-growth lot was in smaller trees (averaging 10 inches d.b.h., versus 14-inches for the old-growth lot), operating costs were much higher here—in fact, labor costs per cord were almost twice as high as those for the old-growth lot. So, after deducting all operating costs (using current equipment and labor rates),

[3]See tables 6 and 7 for financial returns from each cut.

only $1.96 net return per cord remained for the second-growth lot as compared to $6.09 per cord for the old-growth lot.

Today (1962) marked timber on the old-growth woodlot has an estimated stumpage value of $3.00 to $4.00 per cord as against $0.50 to $1.00 per cord on the second-growth lot.

Table 3.—Costs[1] and returns from four cuttings on second-growth and old-growth woodlots, in dollars per cord

Item	Woodlot		Alternatives available to owner
	Second-growth	Old-growth	
Roadside value	$18.16	$16.52	
Less:			
Equipment	4.78	3.42	
Severance tax[3]	.12	.48	
	13.26	12.62	= returns if owner does all his work.
Less:			
Logging labor	11.26	6.44	
Girdling labor	.04	.09	
	1.96	6.09	= returns if owner hires men and does his own supervision and marking.
Current stumpage price	.50-1.00	3.00-4.00	= returns if owner does his own marking, and sells stumpage.
Operator's returns	1.00-1.50	2.00-3.00	

[1] Labor and equipment costs are based on following total work units:

		Second-growth	*Old-growth*
Tractor	elapsed hours	190	243
Chainsaw	cords	148.4	285.5
Horse	cords	12.4	--
Miscellaneous ($.10/cord)	cords	148.4	285.5
Logging labor	man-hours	861	948
Girdling labor	man-hours	5	20

[2] To convert dollars per cord into annual values per acre, multiply the second-growth figures by 0.67 and the old-growth figures by 1.33. The converting factor for each woodlot equals:

$$\frac{\text{(Total cut in cords)}}{\text{(Woodlot acreage) x (years in management period)}}$$

[3] Severance tax applies to New Hampshire only and is based on 12 percent of stumpage value: $1.00/cord for second-growth and $4.00/cord for old-growth. Bare-land property tax is not included in the costs.

Owner's Alternatives

One can see (table 3) that an owner has at least three choices of income opportunities in managing his woodlot. The amount of money he can make depends on how much time and effort he is willing or able to put into the job.

The choice requiring the least effort, but giving the lowest return per cord, is to sell marked stumpage; the owner would have to do no more than mark the timber himself or get help from a forester.[4] If an owner were to decide that a marked-stumpage sale were best for his purpose, he should insist that the operator cut all marked merchantable trees. Good compliance in cutting would improve the woodlot at no cash outlay to the owner.

The second choice available to the owner would be to hire men to do the cutting, and supervise the operation himself. This is a good procedure for an owner who has time to spend in his woodlot, but who lacks suitable equipment or ability to do heavy work. In order to keep his own supervisory time within reasonable limits, the owner probably should hire two or three men. Experience at the Bartlett Forest indicates that logging crews of not more than three men are most efficient in hardwood woodlots. Although this way of operating would require considerably more of the owner's time, he would obtain more income than if he made a marked-stumpage sale.

Under the third choice, the owner would do all the work. The wages he would have paid under the second choice would remain in his own pocket. If he had woodlots similar to those at Bartlett, he could make about $13.00 per cord on either woodlot (table 3), as he would receive the total roadside value less only the equipment costs and severance tax. So, by doing the work himself, he would reap the greatest returns. This choice is best

[4]Total marking time (all four cuts) for study purposes required 81 man-hours in the second-growth woodlot and 111 hours in the old-growth woodlot. This included time required to determine and record the grade, species, and d.b.h. of all the marked trees. A commercial marking job in the woodlots should take much less time.

suited for an owner who has plenty of time to spare for his woodlot, and who has the equipment and ability to do logging work.

Few owners would have a crawler tractor for skidding. But a good horse or perhaps a wheeled farm tractor would be suitable for skidding on areas similar to the second-growth lot. On a similar old-growth lot, a team of horses probably would be able to do the skidding work; but some changes in technique, such as log-length skidding instead of tree-length skidding, might be necessary. However, since we used a horse for only one cutting on the second-growth lot and did not try a wheeled tractor, our study provided no reliable estimates on how much horse-skidding or wheeled-tractor-skidding would cost.

Stand Growth and Development

Annual production[5] in basal area over the 5- to 6-year period was 1.66 square feet per acre on the second-growth lot, and 1.57 square feet on the old-growth lot (table 4)—roughly ⅓ of a cord per acre for both. These growth figures were compared with records of unmanaged second-growth and old-growth stands of similar species composition at Bartlett. Although growth on the managed second-growth lot was about equal to that of unmanaged second-growth, most of the former was concentrated on better quality trees. On the managed old-growth lot, where dead and dying trees could be salvaged, annual production was at least twice as great as in a comparable unmanaged stand.

By reducing mortality and providing more growing space for the best trees, future cuttings concentrated on the remaining poorer trees should raise production of the residual stands to 2 or 3 square feet per acre. Furthermore, as the stands improve in quality, growth in value should increase much more rapidly than growth in volume.

Most hardwood and softwood species grew at a fair rate on both woodlots. However, many beech trees died because of the

[5]Production is the measure of growth on an area as compared to growth on the individual trees. Production = end volume plus volume removed minus initial volume.

Table 4.—Growth and mortality of trees larger than 5.0 inches d.b.h. in square feet of basal area per acre

Item	Second-growth woodlot	Old-growth woodlot
1952 inventory	99.16	131.43
1957-58 inventory [1]	91.85	105.14
Sum of four cuts plus girdling	17.30	34.12
Annual production [2]	1.66	1.57
Annual mortality	.47	.66

[1] Inventory on second-growth lot made in 1958: the growth period is 6 years. Inventory on old-growth made in 1957: the growth period is 5 years.

[2] Annual production = 1957-58 inventory plus sum of volume cut and girdled minus 1952 inventory divided by the number of years in the period. Approximate conversion to standard cords is:

Second-growth: 5 square feet = 1 cord.
Old-growth: 4 square feet = 1 cord.

beech scale-Nectria complex. This, plus heavy cutting of living but diseased beech, reduced the proportion of this species on the old-growth lot from 22 to 10 percent. On the second-growth lot, heavy cutting of aspen reduced the volume of this low-value species considerably. No other important changes in species composition took place on either woodlot.

Future marking in both lots will continue to favor thrifty stems of the more desirable species: sugar maple, yellow birch, paper birch, white ash, red spruce, and eastern hemlock. However, by continuing the light cuttings under our proposed program of single-tree selection management, practically all the paper birch and most of the white ash and yellow birch eventually will be eliminated. These species cannot be expected to regenerate in any appreciable numbers in either woodlot because they need larger openings to get started and develop successfully than are provided by the light cuttings of single-tree selection management.[6] In the long run, this system favors the tolerant

[6]For other systems of management favoring the regeneration of high proportions of paper birch, yellow birch, and white ash, see: Gilbert, Adrian M. and Jensen, Victor S., A management guide for northern hardwoods in New England; U. S. Forest Serv. Northeast. Forest Expt. Sta. Paper 112, 22 pages, illus., 1958.

Table 5.—Area and volume cut in each woodlot, by cutting cycle

Cutting cycle	Area cut		Volume cut [1]	
	Acres	Percent of total area	Cords, net	Percent of total volume
SECOND-GROWTH WOODLOT				
First cut (1952)	37	100	77	10
Second cut (1954)	4	11	12	2
Third cut (1956)	4	11	20	2
Fourth cut (1958)	9	24	39	5
OLD-GROWTH WOODLOT				
First cut (1952)	43	100	167	12
Second cut (1953)	15	35	43	5
Third cut (1955)	11	26	38	4
Fourth cut (1957)	13	30	37	3

[1] Based on mill scale of delivered products (see table 2). Does not include 2 cords of cull trees girdled in 1952 on the second-growth lot, and 32 cords girdled on the old-growth lot.

Table 6.—Costs and returns—second-growth woodlot, in dollars per cord

Item	Cutting operation [1]				Alternatives available to owner
	1st	2nd	3rd	4th	
Roadside value	18.02	18.29	18.16	18.39	
Less:					
Equipment	6.01	3.85	3.23	3.45	
Severance tax	.12	.12	.12	.12	
	11.89	14.32	14.81	14.82	= returns if owner does all his own work.
Less:					
Logging labor	[2] 14.52	10.01	5.28	8.34	
Girdling labor	.08 [3]	--	--	--	
	-2.71	4.31	9.53	6.48	= returns if owner hires men and does his own supervision and marking.

[1] The total cut in standard cords was 76.7, 12.4, 20.2, and 39.1 for the 1st through the 4th cuttings, respectively.

[2] Costs and returns from the first cutting were reported by: Hutnik, R.J., Placing our northern hardwood woodlots under management. Northeast. Forest Expt. Sta., Sta. Paper 82, 24 pp., 1956. His estimated labor costs were lower and returns were higher than those shown in this table because of the lower wage rates that prevailed at that time.

[3] Two cords of cull trees ax-girdled.

sugar maple, beech, eastern hemlock, and red spruce. Yellow birch and white ash may persist in the stands but, at best, only sparingly.

Although desirable timber species are successfully regenerating in both woodlots, some small areas have been invaded by dense weedy growth. On the old-growth woodlot, hobblebush (*Viburnum alnifolium*) has taken over in a few places; in the second-growth lot, ferns and club-mosses are the more common invaders. So far these weed species do not seem likely to interfere seriously with tree reproduction. However, if they do spread enough to interfere seriously, control measures will be undertaken.

Table 7.—Costs and returns—old-growth woodlot, in dollars per cord

Item	Cutting operation[1]				Alternatives available to owner
	1st	2nd	3rd	4th	
Roadside value	17.12	15.58	16.06	15.37	
Less:					
Equipment	3.43	4.28	2.65	3.15	
Severance tax	.48	.48	.48	.48	
	13.21	10.82	12.93	11.74	= returns if owner does all his own work.
Less:					
Logging labor	[2]6.41	8.49	6.30	4.33	
Girdling labor	.15[3]	--	--	--	
	6.65	2.33	6.63	7.41	= returns if owner hires men and does his own supervision and marking.

[1] The total cut in standard cords was 167.4, 43.2, 38.2, and 36.7 for the 1st through the 4th cut, respectively.

[2] Costs and returns from the first cut were reported by: Hutnik, R. J., Placing our northern hardwood woodlots under management. Northeast. Forest Expt. Sta., Sta. Paper 82, 24 pp., 1956. His estimated labor costs were lower and returns were higher than in this table because of the lower wage rate that prevailed at that time.

[3] Thirty-two cords of cull trees ax-girdled.

Stand Structure

Changes that have taken place in basal area distribution are shown graphically in figure 3, by size classes. The estimated size-class distribution of an ideal uneven-aged woodlot is provided for comparison.

A little progress down the long road toward the ideal has been made on the second-growth woodlot by (1) reducing the proportion in the 6- to 10-inch group, and (2) increasing the proportion in the 16- to 20-inch group.

The old-growth lot is, for the most part, nearer to the ideal than the second-growth. But trends during the period were slightly away from the ideal in all size groups. This happened because it was necessary to cut many of the large poor-risk trees,

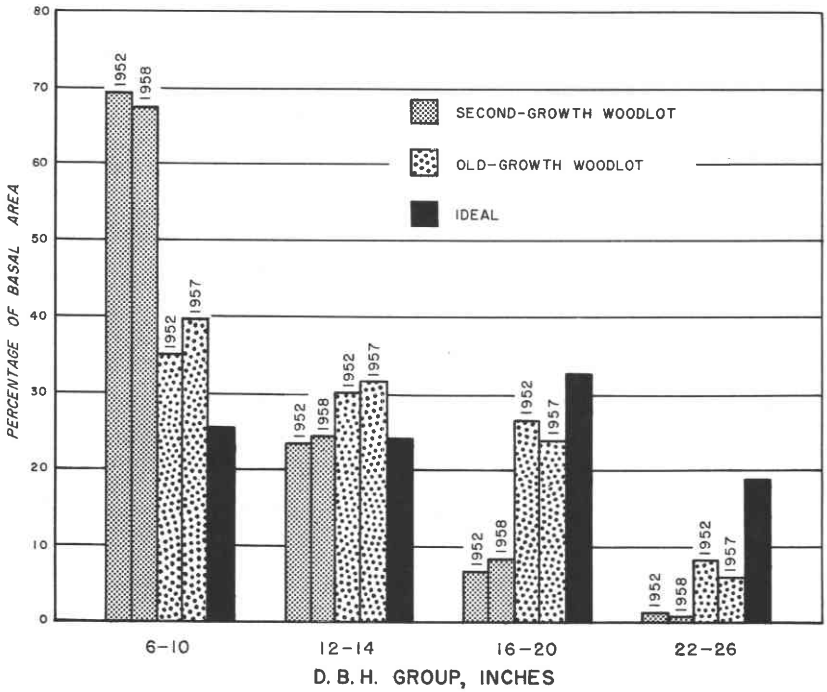

Figure 3.—The percentage of basal area in the two woodlots, compared with an estimated ideal for four d.b.h. size groups.

which (1) reduced stocking in the two larger size classes, and (2) made many openings in the stand that favored tree growth in the two smaller classes.

But the most noteworthy point is that many of the poorer trees have been removed from both woodlots without drastically reducing the proportion of basal area in trees 16 inches d.b.h. and over. These large trees provide most of the good sawlogs that, together with special products such as paper birch boltwood, largely determine how profitable a woodlot will be.

Conclusions

The results from four improvement cuttings on the Bartlett woodlots have provided a reasonably sound basis for the following guides to owners of similar lots:

- Intensive management of old-growth northern hardwood woodlots can be profitable regardless of whether the owner sells marked stumpage, hires labor, or does his own work. Of course, the more work he does, the higher his returns will be. Our results indicate that, by doing all his own work, an owner can make three to four times as much per cord as he can by selling marked stumpage. So, if the owner has the available time, equipment, and ability, it will be well worth his while to do as much of the work as he can.

- Intensive management of second-growth northern hardwood woodlots will not immediately be so profitable as management of old-growth. For the first few cuttings, the stumpage value of the marked timber may be very low. But the owner could still remove or kill the poor material, even if he received nothing for it. This would pay off in the long run by increasing the proportion of saw-timber volume, improving quality growth, and raising the yield. If the owner can afford to spend a little time in his woodlot, he can make perhaps a couple of dollars per cord by hiring and supervising from one to three loggers. If he can do all the work himself, his return per cord

will be up to six times as much—equal to the returns received on the old-growth lot for doing all the work.

In evaluating a woodlot-management program, one must also examine the effects of the treatment on growth and development of the stands. Past growth and development are good indicators of trends in future returns. Results of the first four cuttings at Bartlett indicate that intensive selection management will produce thrifty well-stocked stands in both the second-growth and old-growth woodlots. Growth is fair with good prospects for a substantial increase. Average quality has obviously been raised. The proportions of valuable large timber have increased or remained nearly constant in spite of heavy cutting in the large-size classes. And on both lots some of the less valuable species—beech in the old growth, aspen in the second growth—have been greatly reduced.

Five to six years, the period covered by this study, is a short time in woodlot management. But our results to date show (1) that intensive forest management will raise the productivity of northern hardwood lots; and—more to the point—(2) that intensive woodlot management can be a paying proposition where markets for a variety of products are readily available.

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