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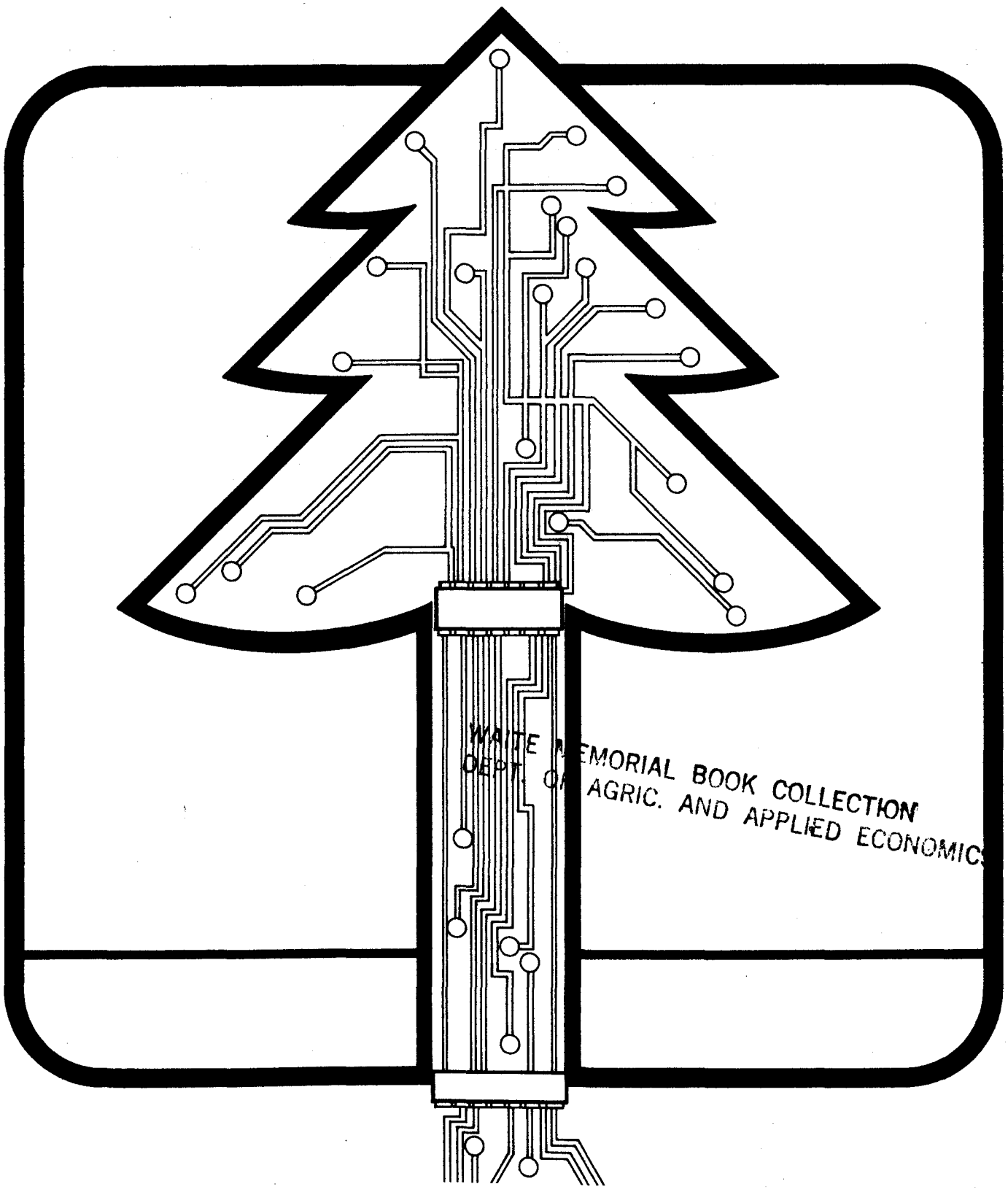
Estimating Production of Forest Cooperative Members



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Estimating Production of Forest Cooperative Members

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Abstract

This study develops methods of estimating annual marketings by members of forestry cooperatives in order to formulate a long range business plan for the cooperative. A reliable prediction of total annual sales by the cooperative is possible, but individual product estimates are subject to significant errors. The report details cautions concerning the development and implementation of projections and makes specific recommendations. The system also permitted estimation of landowner service needs.

Key words: Silviculture, forestry cooperatives, forestry management, marketing

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Preface

Forestry cooperatives in the United States have held a shaky position in the history both of cooperatives and forestry enterprises. The forest is difficult to evaluate from a business perspective because of its wide variety of tree species, growth rates, and markets. When timberland owners agree to cooperative marketing and management, the intricacies of the forest are further complicated by the variety of owner objectives, attitudes, and abilities. Trying to formulate a business plan to coordinate all of these variations into a cohesive, feasible program is a challenge.

The objective of this study was to (1) develop a methodology for estimating the productivity of a forest composed of many small, scattered ownerships, (2) find the objectives that were common to most owners, then (3) combine the two into a system for projecting the amount of wood for sale and the amount of silvicultural work to be done. These products would be the key ingredients of a forest cooperative business plan.

The results of the study are less than precise, as might be expected, but a feasible system was developed and improvements have been identified that will benefit others who may seek to solve the same problem.

This study was conducted through a cooperative agreement between the University of Maine and Agricultural Cooperative Service, USDA. Many individuals contributed ideas and advice to this study, including the board members and manager of the Forest Products Marketing and Management Cooperative, Dover-Foxcroft, Maine; staff members of the Agricultural Cooperative Service; the James W. Sewall Company; and the colleges of Forest Resources and Life Sciences and Agriculture of the University of Maine. Special thanks are due to former students at the University of Maine, Barbara Brusila and Susan Hoyt, for their painstaking collection and analysis of field data, and Thomas Newcomb, for developing the computer graphics software.

Contents

Highlights and Conclusions

This study shows how members and management of a forestry cooperative might obtain an estimate of the productivity and needs of their forest lands to project marketing potential and work needs, which are essential to any business plan. Forest productivity was assessed by the measurement of 284 sample plots distributed throughout the ownership, and member intentions were determined by a comprehensive survey of their attitudes about their land and the practice of forestry.

In this study, 82 landowners, each with an average ownership of 178 forested acres, control 14,620 acres of commercial forest land and produce 9,462 cord equivalents of forest products annually.

Because the cooperative can legally purchase, for resale, up to 49 percent of its annual production from nonmembers, errors in the initial estimates of marketings can be offset. If production does not meet marketing goals, shortfalls can likely be met through purchase and resale from nonmember producers. With experience, this resale capability can and should be used to augment the business of the cooperative and further strengthen its market position.

Using the projection methods described in the study, the cooperative can project its annual production of wood available for sale and estimate the timber harvesting and silvicultural service needs of members.

With the addition of a computerized mapping and data (graphic and statistical) retrieval system, the cooperative can produce a simple, interim forest management plan for any member or group of members. It can also generate maps and timber volume estimates for new members by digitizing property and stand boundaries from aerial photos, and generate marketing maps and timber statistics for any geographical area or forest type within the cooperative's operating area.

Because of the dynamic nature of the forest and the effects of cultural practices on timber volume and tree growth, the projections are limited to short–term use (5 years or less). In order to update inventory and marketing information, a continuous forest management information system is essential. Improvement requires the following:

- Annual updating of timber information through sampling and feedback from operations,
- Eventual cadastral survey of all property boundaries to assure proper boundary location and accurate acreage computations,
- Better quality of aerial photography, and
- Informing and educating owners to improve their level of forestry knowledge and to obtain feedback relative to owner objectives.

An inventory of timber resources combined with a survey of cooperative member needs can be used to predict total cooperative marketings at a reasonable cost. In this instance, 14,620 forested acres belonging to 82 members of Forest Products Marketing and Management Cooperative (FPMMC) were studied at a cost of $20,000, but a doubling in size might increase cost by only 10 percent. It is probable that adequate data for marketing projections could be obtained by less intensive and less expensive inventory methods.

The data used to estimate cooperative marketings can also be used to predict landowner forest management needs, although with less precision than is

desired. Information required for individual owner decisions requires more intensive sampling and normally should not be attempted through a single survey. Such information can best be acquired by a combination of survey methods, including inventories conducted in the normal course of forestry operations.

By digitizing geographic data such as property lines and timber stand boundaries, several additional benefits can be obtained at a modest additional cost. In this case, $5,000 was invested to develop a geographic data system that produces:

- Interim management plans for individual owners consisting of a computer-drawn forest map with a summary of timber data by stand condition class. New owners can be incorporated into the system simply by entering their property and timber stand boundaries into the data file.
- Geographic plots outlining locations of properties that meet needs or offer opportunities for market expansion, cultural work, and harvest potential on a cooperativewide basis. Software is presently incomplete for this application.

The information obtained by this system is suitable for making general, long-range estimates needed for setting business policy on a cooperativewide basis. It is not adequate for specific short term estimates for individual ownerships but can serve as an interim management guide until sufficient information is available.

Cautions concerning the development and implementation of such a projection system are detailed in the text, but three specific recommendations bear emphasis:

- Because of the ability of a cooperative to purchase for resale up to 49 percent of its marketing output, a timber resource inventory with a target accuracy of 15-20 percent is probably adequate.
- Surveys to determine attitudes of cooperative members must be clear and result in positive answers. Most important, members must be specific with regard to (1) how much timber they are willing to cut and market through the cooperative, and (2) what services they wish the cooperative to perform and are willing to utilize through user fees.
- If the survey is designed to answer questions concerning forest management, aerial photographs at a scale of 1:20,000 or larger are best.

Estimating Production of Forest Cooperative Members

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Two common objectives of forestry cooperatives are to sell timber products and to provide management services on members' lands. A major problem in the formative stages is to quantify the condition and productivity of the forest as a means of meeting both objectives.

A first step in any forestry enterprise is to inventory the resource and estimate its productivity. With individual, corporate, or public ownerships, management objectives are generally clear. Once the resource values are identified, operational planning is fairly routine. However, cooperatives may have as many objectives as owners. When a diversity of interests exists, a member attitude survey must accompany the inventory, for the mere presence of merchantable timber is no assurance of its availability to the market.

The Forest Products Marketing and Management Cooperative (FPMMC) of Dover-Foxcroft, Maine, was examined to determine the condition and productivity of its forest land base. Members were surveyed to determine their attitudes about forest management and timber harvesting. FPMMC faces a number of problems inherent to such landowner groups. They are the following:

- Relatively small woodlots (178 acres average size).
- Decentralized ownerships.
- A history of overcutting.
- Initial dependence upon sales of stumpage or logs for income.
- Uncertain availability of dependable logging and silvicultural contractors.

Additionally, this cooperative must maximize income from stumpage and log sales by intensive marketing in an area where low-value pulpwood has traditionally been the chief product.

Recent improvements in whole tree chipping have made it possible to utilize previously unmerchantable trees and unusable portions of merchantable trees. In order to estimate the total fiber product of the land, the inventory system provided for measurement of small trees and estimation of the total wood biomass. The inventory system was one that could also be used for detailed operational examinations of individual forest stands, assuring a comparability of data from all inventories, and providing for continually upgrading and updating the data base.

One problem facing a decentralized ownership is the preparation and maintenance of up-to-date maps. To simplify this task, a computerized mapping system was used. All properties were mapped from aerial photographs to show property and stand boundaries. These details were digitized and stored on magnetic tape so that the geographic data could be retrieved when needed. As changes occur through timber harvest or stand improvement, revisions can be entered into the computer file and new maps printed.

Through the addition of attribute files containing inventory data, it is possible to print not only maps, but to list each stand, its acreage, and its timber volume by major species. Should a new cooperative member desire an interim guide for property management, it is only necessary to delineate his forest stands on aerial photographs and enter the map data into the computer with a digitizer. Using mean data for all stands, the computer can produce a map, to any desired scale, showing the timber types and their estimated volumes. Although crude, this data base would enable the owner to make decisions until a more complete management inventory and plan can be made. An interim plan costs less than the usual initial field reconnaissance by a forester.

Although the inventory and survey permit estimation of quantities of products available for market, computer mapping offers opportunities to produce maps showing the geographic locations of stands that contain certain products. This is a valuable guide to planning for operations, trucking or concentration of products, and permits instant retrieval of data to meet new market opportunities. The same methods may be used to plan timber harvesting and stand improvement work.

As with any first approximation of a highly variable resource, there are limitations. Although the statistical accuracy of the overall inventory is quite high, facts for individual stands, species, and products are less reliable. Landowners familiar with the many minor forest variations on their property will be dismayed by the lack of detail on computer maps. As future work and operational inventories are performed, more detail and precision will be obtained for improving maps and timber data. With each succeeding inventory of the cooperative, the quantity and quality of individual woodlot data will be greatly refined.

Basic information about cooperative members and their forest resource was collected in two ways. First, the timber resource was mapped and inventoried to a high degree of accuracy. Second, each cooperative member was asked about his/her attitudes toward the management of his timber and his commitment to the cooperative. With these data bases, projections could be made regarding the annual availability of wood for marketing as well as landowner needs for services. Using computer graphic techniques combined with resource data, a system was constructed that permits rapid recovery of information for individual owners or groups of owners.

The first step in timber inventory is to identify the forest stands and compute their area. Using existing owner maps, survey and deed information, aerial photographs, tax maps and town plotting plans, the boundaries of each ownership were plotted on U.S. Geological Survey topographic maps. The topographic maps were used as a base for entering property boundaries into computer files with a digitizer.

Property boundaries were also delineated on aerial photographs used to stratify the timber for inventory. The photos had been taken 18 months earlier at a scale of 1:40,000. A skilled interpreter classified the timber stands and marked the boundaries. In the course of ground inventory, changes in stand boundaries caused by cutting subsequent to the photography were delineated on the photographs. Stand boundaries were then entered into the computer with a digitizer for acreage calculation and retrieval of computer-generated maps.

Timber Inventory

Cooperative member ownerships in two townships had been studied in 1980 and 1981 by senior forestry students at the University of Maine. These studies had identified many of the problems encountered in an inventory of this nature and also provided statistical data on variations in timber conditions needed to distribute sample plots efficiently.

Timber stands had been stratified by the aerial photo interpreter into 27 condition classes, based on three primary characteristics:

- Species groups — hardwood, mixedwood, and softwood.

- Height classes — 0-34 feet, 35-65 feet, and over 65 feet; roughly equivalent to seedling/sapling (or 1), poletimber (or 2), and sawtimber (or 3).

- Density classes — 71-100 percent (or A), 41-70 percent (or B), and 0-40 (or C) percent crown closures.

Twenty-six of these stand condition classes actually existed within the ownerships, but only 10, representing 87 percent of the forest area, were sampled. Acreage in the remaining 16 types was distributed among many small stands scattered throughout the ownership, which made effective sampling impossible. Eleven of these types had insufficient acreage to warrant sampling.

Stratified random sampling was employed using allocation proportional to both area and standard deviation of each stratum. A total of 284 variable radius plots was measured. General plot and individual tree data were measured using accepted timber inventory practice, but each plot was also subsampled to determine the total biomass of woody vegetation.

At each plot, information was recorded concerning age, slope, aspect, drainage, rooting depth, stand damage, condition class and whether the stand was managed or not. A wedge prism with a basal area factor of 10 was then used to select sample trees. Sample trees were recorded by species, product, diameter at breast height (d.b.h. is 4.5 feet above ground) to the nearest inch and defect. In addition, for three trees closest to plot center, greater than 4.5 inches, d.b.h. to the nearest 0.1 inch and height to the nearest foot were also measured and recorded. These sample trees, 850 in number, were used to determine local volume equations.

At the center of each prism plot, a 145 square foot (1/300 acre) biomass plot was established. All trees between 0.6 and 4.5 inches d.b.h. were tallied, by species or genus, to the nearest 0.1 inch. These data were used to compute the biomass of submerchantable trees on the plot. A projection of total biomass per acre was also possible by computing and adding biomass of merchantable timber.

Inventory design and data collection and processing were relatively standard procedures. The forms, procedures, and data processing hardware and software were provided by an experienced consulting firm and are compatible with other inventory work on the cooperative members' lands. Field personnel were provided by the cooperative, although it is preferable to have a consultant's representative on the inventory team.

The inventory leader was a forester employed by the FPMMC who was familiar with the landowners, the location of the lands, and in many cases with the stands. The two-person field crew was trained in the appropriate field measurement techniques by the consultant. Using cooperative employees in such work improves efficiency in the field, improves their knowledge of member's lands and assures a knowledge of the system for future interpretation of data. Further, training them in the standards used in a cooperativewide survey should assure that the same standards are followed in collecting other data that might be merged with it.

Member Attitude Survey

Based on 12 hypotheses proposed about members of the cooperative, Brusila (1983) prepared a questionnaire (appendix A) and used a comprehensive survey approach to obtain an 84 percent response from cooperative members. First, because of the small membership (82), each member was invited to a neighborhood meeting to discuss the cooperative and complete the questionnaire.

Only 19 members (23 percent) attended. The remaining 63 members were mailed a questionnaire and asked to respond within 10 days, and those who did not reply were contacted by telephone. Fifty members responded by mail (61 percent), raising total response to 84 percent.

The three key questions in estimating member needs and marketing potential were:

- What services should the cooperative offer, willingness to pay for these services, services actually used through the cooperative and other sources.

- Willingness to sign first refusal to timber cutting rights and marketing agreements.

- Willingness or ability to cut timber in the next 5 years.

With an inventory of physical resources and a knowledge of owner intentions, an estimate of timber availability could be projected.

Timber Inventory

Cooperative members owned 14,620 acres, of which 14,495 acres were sampled using 284 variable radius sample plots. A total of 125 acres were not sampled and 1,773 were inadequately sampled. Table 1 shows the distribution of acreage and samples by stand condition class.

Total merchantable timber volume was 263,397 cord equivalents, subject to a sampling error of 6.7 percent (95 percent probability). A total of 47 percent of the merchantable volume was in softwoods--namely, pine, hemlock, spruce, fir and cedar--with only 23 percent of this volume (11 percent of total volume) in the budworm-susceptible balsam fir. Hardwoods comprised the remaining 53 percent of timber volume, of which 81 percent (36 percent of total volume) was composed of desirable species.

Generally, stocking was good, with a mean stand volume of 18.2 cord equivalents per acre. Understocked stands (0-40 percent density) occupied only 1,606 acres, including 103 which appear to be grossly understocked and in need of regeneration.

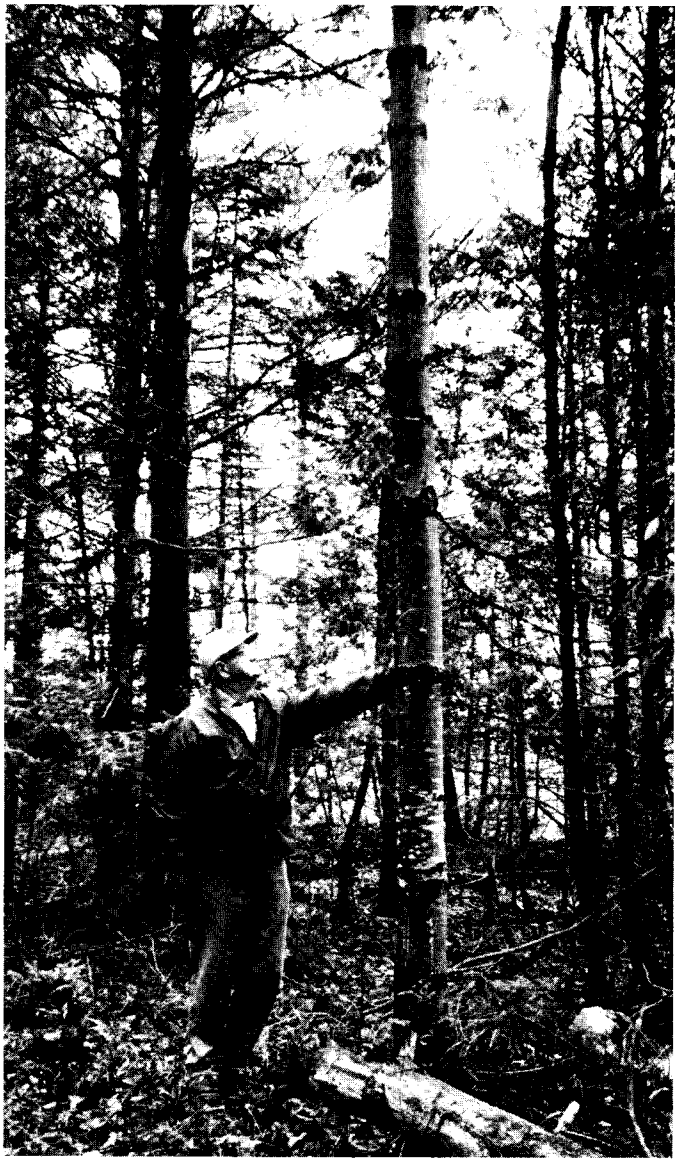
A total of 1,605 acres (11 percent) of the timberland was in the sawtimber class. These stands were understocked with sawlogs but were often heavily stocked with poletimber, indicating the potential for pulpwood thinning on good sites. However, because of the shallow, poorly drained nature of soils on many softwood sites, sawtimber production might be limited by windthrow hazards.

Table 1—Acreage and sampling intensity by stand condition class

Size class	Density [1]	Forest type: Hardwood		Mixedwood		Softwood		Total		Percent	
		Acres	Plots	Acres	Plots	Acres	Plots	Acres	Plots	Acres	Plots
						Number					
1	A	233	1	339	3	287	1	859	5	5.9	1.8
Seedling-	B	60	1	47	0	45	1	152	2	1.0	0.7
Sapling	C	11	0	34	0	31	0	76	0	0.5	0.0
	Total	304	2	420	3	363	2	1,087	7	7.4	2.5
2	A	3,109	25	2,808	35	1,609	18	7,526	78	51.5	27.5
Poletimber	B	1,184	28	1,491	51	258	10	2,933	89	20.1	31.3
	C	948	14	416	49	105	3	1,469	66	10.0	23.4
	Total	5,241	67	4,715	135	1,972	31	11,928	233	81.6	82.0
3	A	371	13	199	7	17	3	587	23	4.0	8.1
Sawtimber	B	574	10	330	6	53	1	957	17	6.6	6.0
	C	27	3	34	1	—	—	61	4	0.4	1.4
	Total	972	26	563	14	70	4	1,605	44	11.0	15.5
Total		6,517	95	5,698	152	2,405	37	14,620	284	100.0	100.0

— = Not applicable

[1]Density classes - A=71-100 percent, B=41-70 percent, and C=0-40 percent crown closures.



Of the 11,928 acres in the poletimber class, 10,459 acres were fairly well stocked. With careful management, the poletimber should grow into the sawtimber class and produce significant volumes of sawtimber in the near future. However, the current unbalanced age class distribution may result in lower production in three to four decades.

Table 2—Inventory and growth by product class

Product class	Volume in 1982	Annual growth
Sawlogs (board feet)	16,075,000	578,700
Boltwood (cords)	31,451	1,132
Pulpwood (cords)	198,623	7,150
Total (cord equivalents)	263,397	9,482

Using Safford's (1968) growth tables, total annual growth was estimated to be 9,462 cord equivalents, a rate of 3.6 percent per annum. Rate of value increase as a result of increased stem size was not computed, but rate of return on investment would surpass the growth percentage. Total inventory and growth, by product class, is given in table 2.

The biomass inventory estimated a total of 1,621,990 green tons (subject to 5.3 percent error, 95 percent probability), of which roughly 80 percent is above ground and could be harvested with present technology. Though no markets exist at the present time, stumpage rates of $1.00 per green ton are paid nearby, and new markets are anticipated by 1987.

Data collected indicate that several properties had been cut in the 2 years since the photos were taken. Plot observations also indicate that 20 percent of the ownerships had some degree of forest management. Table 3 summarizes average stand characteristics per acre, by condition class. These data reflect the level of past management and can be used to estimate needs for the future.

About one-third of the time spent at plots was devoted to measuring the 850 sample trees to be used for constructing volume equations. This sample was inadequate, so volume equations generated from other cruises in the area were used. Very little additional time was required to collect the biomass data.

Member Attitudes About Harvesting and Management

In a survey of landowners in New Hampshire and Vermont, (Kingsley and Birch 1977), only 6 percent listed timber production and income as a primary reason for owning forest land. Among FPMMC members, this proportion was much higher, being 16 percent for those owning their land 10 years or less, but increasing to 24 percent for those who had owned their land for more than 10 years. Those with longer tenure also tended to own more land, comprising 71 percent of the ownerships over 100 acres in size. Tenure and size of ownership affect both knowledge about timber production and ability to produce income.

In terms of income value, 76 percent indicated that less than 10 percent of total family income is from timber production, but they expect this to increase slightly in the next 10 years. This is not surprising, as the average ownership is too small to produce significant income, but the anticipated increase in timber income indicates interest in both management and harvesting.

Some 83 percent of owners would cut wood within the next 5 years, but an additional 10 percent hedged by responding both "yes" and "no" to the question (table 4). Only 7 percent responded "no", and 42 percent of these indicated that their

Table 3—Summary of stand characteristics per acre by stand condition class[1]

	1-Seedling/sapling			2-Poletimber			3-Sawtimber		
	A[2]	B	C	A	B	C	A	B	C
Hardwood									
Number of stems less than 5 inches	(917)	(2,101)	—	868	1,084	629	217	870	144
Number[3]	—	(23)	—	303	236	77	243	264	53
Basal area, sq. ft.[3]	—	(10)	—	92	67	22	98	88	20
Volume bd. ft.	—	—	—	755	451	28	1963	1491	548
Volume cords	—	(2.4)	—	18.0	13.0	4.6	21.7	16.0	3.7
Biomass green tons[4]	(16.1)	(64.0)	—	131.7	103.5	39.1	146.4	120.0	32.1
Mixedwood									
Number of stems less than 5 inches	(5,195)	—	—	1,157	856	1,154	296	148	(433)
Number[3]	(126)	—	—	306	285	175	351	281	(455)
Basal area, sq. ft.[3]	(27)	—	—	97	88	49	141	110	(130)
Volume bd. ft.	—	—	—	1,414	1,422	510	4,569	3,066	—
Volume cords	(4.1)	—	—	17.7	15.4	8.7	24.1	20.6	(26.5)
Biomass[4]	(83.3)	—	—	129.0	112.1	57.9	182.9	132.4	(163.1)
Softwood									
Number of stem less than 5 inches	(522)	—	—	1,032	1,224	2,419	348	(318)	—
Number[3]	(617)	(51)	—	453	278	214	441	(451)	—
Basal area, sq. ft.[3]	(110)	(20)	—	131	82	60	170	(160)	—
Volume bd. ft.	—	—	1,709	1,701	—	6,131	(1,099)	—	—
Volume cords	(14.5)	4.2	22.2	13.0	11.8	26.2	(32.3)	—	—
Biomass green tons[4]	110.9	16.8	145.2	89.1	73.2	205.0	(123.4)	—	—

— = Not applicable. [1]Data in parentheses are based on insufficient samples.

[2]Density classes - A=71-100 percent, B=41-70 percent, and C=0-40 percent crown closures.

[3]Stems 5 inches and up.

[4]Total biomass of all woody vegetation.

Table 4—Willingness of members to cut wood in the next 5 years and reason for cutting

Items		Members	
		Percent	*Number*
Willingness to cut	Yes	83	57
	No	7	5
	Yes and No	10	7
	Total	100	69
Reason for cutting	Timber mature	64	41
	Offered good price	3	2
	Need money	23	15
	Land clearing	12	8
	Timber for own use	48	31
	Thin or T.S.I.	86	55
	Other	9	6

timber was too small to cut. The remaining negative reasons might be overcome by an active cooperative program in forestry assistance and education.

Although 93 percent of the members indicated a willingness to cut timber, their reasons raise questions about the amount actually available for marketing. Forty-eight percent indicated that they would cut for personal use, so presumably some of their wood is not available for sale. Also, 86 percent who were willing to cut wanted to accomplish thinning or timber stand improvement, hence a portion of this wood might not be commercially operable.

With regard to selling timber through the cooperative, 78 percent were willing to sign a first refusal with the cooperative and 74 percent to sign a marketing agreement. A first refusal is a contract giving the cooperative the first opportunity to sell forest products at or above market price, with the owner free

to sell elsewhere if it cannot meet market price. A marketing agreement would give the cooperative the right to sell wood for the member.

Willingness to use the services of the cooperative was also evaluated by the member survey, and the results for the top four services are summarized in table 5. These attitudes are keys to evaluating potential member needs for forestry services.

Information Retrieval

The data processing system used by the consultant provides for retrieval of statistical data in a variety of forms, and samples are contained in appendix B. However, for future research, geographic data were entered and processed on the University of Maine computer. Normally, all data would be entered into the contractor's system to take advantage of interfaces between statistical and geographic software and data.

Table 5—Member rating of cooperative services

Service	Most important	Willing to pay for	Have used services of	
			Co-op	Other
	Percent			
Management plans	64	51	33	13
Timber stand improvement	51	39	19	26
Timber marking	48	45	25	23
Marketing contracts	40	35	13	10

Figure 1-Computer-drawn property map showing forest cover types

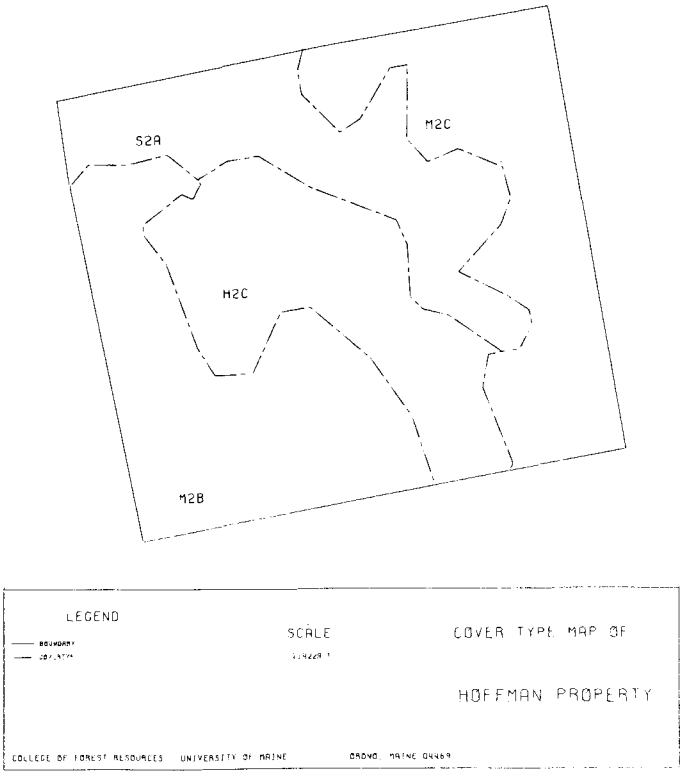


Table 6—Sample of computer output for the total tract summary of the woodlot shown in figure 1

TOTAL TRACT SUMMARY FOR HOFFMAN-(Glenburn)

Table A -TOTAL VOLUMES PER COVERTYPE

Covertype	Area Acres	BASAL AREA		Volume 5 IN DBH+		Total Biomass Tons
		1-4 IN DBH	5 IN DBH+	CORDS	BD FT	
S2A	17.0	613.7	2,225.3	440.3	29,051.3	1,938.0
M2C	21.0	325.5	1,026.9	210.0	10,701.6	882.0
M2B	23.0	611.8	2,037.8	427.8	32,701.4	1,978.0
H2C	18.0	243.0	396.0	82.8	498.6	522.0

Table B -VOLUME PER ACRE BY COVERTYPE

Covertype	Area Acres	BASAL AREA		Volume 5 IN DBH+		Total Biomass Tons
		1-4 IN DBH	5 IN DBH+	CORDS	BD FT	
S2A	17.0	36.1	130.9	25.9	1,708.9	114.0
M2C	21.0	15.5	48.9	10.0	509.6	42.0
M2B	23.0	26.6	88.6	18.6	1,421.8	86.0
H2C	18.0	13.5	22.0	4.6	27.7	29.0

Property lines and timber stand boundaries were digitized and stored. Since property boundaries were related to U.S. Geological Survey coordinates in a statewide mapping system, it is possible to retrieve maps of any ownership or combination of ownerships. Timber stand boundaries were digitized directly from the aerial photographs after completion of the inventory and revision of stand boundaries and were keyed to the property boundaries. The computer can calculate stand and property acreages and print a map at any reasonable scale (fig. 1).

Since statistical and geographic data were not stored in the same system, an attribute file was created for each forest type that listed information such as species composition and merchantable volume. An interactive program was written to permit recall of maps for each individual ownership showing property and stand boundaries and listing, by stand condition class, acreage, and principal timber statistics. Timber data include a total tract summary by volume per cover type and volume per acre by cover type (table 6) and individual stand (stratum) summaries (table 7) for each stand condition class.

Product Availability

This first approximation of market projections is based on facts about forest productivity and owner attitudes. Since both are subject to errors resulting from sampling methods as well as changes in tree growth and owner attitudes, they are crude at best. Further, the method of estimating growth was based on current stand conditions and is adequate only for short-term use.

The first step in the projection was to determine the annual growth. Because of the high cost of conducting a growth study on such a small area, regional growth rates for northern New England were used (Safford 1968), based on the same 27 stand condition classes recognized in the inventory. In the absence of such information, data from statewide forest surveys conducted every 10 years by the U.S. Forest Service might also be used. Most States have been surveyed several times, hence adequate 5-10 year growth estimates are possible.

To determine growth, acreage in each of the 26 stand condition classes was multiplied by the annual growth per acre for each class. These data, in cubic feet, were then converted to cord equivalents using a conversion ratio of 80 cubic feet of solid wood per cord. A growth rate of 3.6 percent was then determined by dividing the total annual growth by the total inventory. Safford's growth values were based on unmanaged stands, which grow less than managed stands. Since 20 percent of cooperative stands had some management, and all are assumed to be managed in the future, this estimate would be conservative.

Individual product inventory values such as lumber (board feet) and boltwood (cords) could be multiplied by this growth rate to obtain estimates of annual production (table 2) but the most reliable value is total growth. Statistically, data for individual forest types and products are less reliable than totals.

Table 7—Sample of stand summary of the S2A covertype shown in table 6 by species

Species [1]	Basal area		Volume		Total
	1-4 IN DBH+	5 IN DBH+	5 IN DBH+		biomass
	- - - -*Sq. Ft.*- - - -		*Cords*	*BD. Ft.*	*Tons*
BE	0.0	0.6	0.2	0.0	0.0
BF	16.1	30.1	4.5	195.3	29.0
CE	8.3	42.8	7.6	0.0	25.0
HE	0.0	7.2	1.7	255.6	6.0
HM	1.1	0.6	0.1	0.0	1.0
OH	3.3	0.6	0.1	0.0	1.0
PO	0.0	3.4	0.8	53.1	3.0
RM	0.6	1.7	0.3	0.0	3.0
RP	0.0	0.6	0.1	0.0	0.0
RS	6.7	26.7	6.1	659.8	28.0
TA	0.0	3.9	1.0	142.9	3.0
WA	0.0	2.8	0.6	0.0	3.0
WB	0.0	1.1	0.3	0.0	2.0
WP	0.0	8.8	2.5	402.2	10.0
Standtotal peracre	36.1	130.9	25.9	1,708.9	114.0
DBH CLASS					
5 - 9	—	91.8	14.5	—	—
10 - 11	—	21.2	5.5	397.4	—
12 & up	—	17.9	5.9	1,311.5	—

— = Not applicable.

[1]See appendix B for species codes.

Theoretically, the cooperative could cut and sell the equivalent of the annual growth on a sustained basis, but this does not consider that many stands are understocked and the owners may wish to improve stocking. An interim alternative is to apply an arbitrary reduction factor to compute "available" growth, but in the long run a more reliable allowable annual cut must be determined.

Although total annual timber production of the cooperative is 9,462 cord equivalents, there is no assurance that all is available for sale. Only 83 percent of the owners stated a definite willingness to cut, but their reasons for cutting cloud the potential amount for sale. For example, 86 percent want to thin or improve their stands and some of this wood may be unsuitable for market. Also, 48 percent wanted timber for their own use.

Unfortunately, the survey question was not framed in a manner that elicited a precise response. The responses in table 4 overlap - 64 members gave 186 different reasons for cutting. Further, 10 percent of the members are unclear about cutting, adding to the confusion.

Probably the best indicator of willingness to sell through the cooperative lies in the answers about signing a first refusal (78 percent) or marketing agreement (74 percent), but the question was worded "Would you consider", not "Would you." In future surveys, more definitive questions are needed. A "presurvey" might be used to evaluate the questions and potential responses, though this may not be feasible with such a small (82) population.

To project a reasonable estimate of timber for sale, it is necessary to establish the proportion of members who would sell. As the survey results are unclear, an estimate must be made of owner intentions. In this case, the 41 owners who said their timber was mature, representing 64 percent of those responding, are assumed to own 64 percent of the resource. Some may want part of this timber for their own use, but this should be offset by those cutting for other reasons. If 64 percent of the owners cut each year, 6,056 cord equivalents should be available annually for sale through the cooperative.

Broken down by product classes, using table 2, volumes and values would approximate those listed in table 8. If these values are representative of the annual marketings of the cooperative, potential stumpage sales of 6,056 cord equivalents with a value of $74,223 are possible. If the cooperative's management could, through its market strength, obtain an additional $3.00 per cord, split evenly between members and the cooperative, this would generate an additional $9,084 for participating members and an equal amount to defray operating expenses of the cooperative. By improved marketing, even higher values could be obtained. To be a viable business, the cooperative must obviously grow (Seymour 1983).

Table 8—Annual volumes and values of products available for sale

Product	Volume for sale[1]		Value/unit[2]	Total value
	Number	*Units*	*Dollars*	
Sawlogs	370.4Mbf	50	18,520	
Boltwood	735.0	cords	26	19,103
Pulpwood	4,575.0	cords	8	36,600
Total	6,056	cord equiv.	—	74,223

— = Not applicable

[1]Assumes 64 percent of owners will sell.

[2]Stumpage values estimated from prices published by Maine Dept. of Conservation, Spring 1983.

The results of the study consist simply of statistical tables relating timber information and cooperative member attitudes about forest management, plus a geographic information system. These are the building blocks used to project marketing potential and service needs of the cooperative members, which are essential to constructing a sound business plan.

Reliability of Market Estimates

Market projections are based on estimates obtained by sampling methods which are subject to procedural and statistical errors. Such errors might be additive or compensating. The nature of the major errors and their probable extent is detailed in table 9.

As an example of a possible bad scenario, assume the maximum error in total volume and growth and an error of 25 percent in the amount of wood available for sale. Actual volume available for sale would vary from 4,238 to 8,077 cord equivalents, compared with a projection of 6,065 cords. Either extreme would present problems, although oversupply might be more serious in a tight market situation. Since the cooperative can purchase and resell up to 49 percent of its wood from nonmembers, a shortage might be easily offset.[1] Although precision in estimating timber resources and member intentions is desirable, it is not absolutely essential for predicting cooperative marketings because of the ability to meet needs by outside purchases. This suggests that a less intensive and appreciably cheaper inventory might be preferred. Reducing the number of field plots by half might increase the error by one-third, to about 8.9 percent. It is well within normal goals for planning purposes, but would reduce costs by about 30 percent.

[1]In a study of six active forestry cooperatives by Simon and Scoville (1982), member sales volume averaged 83 percent, ranging from 60-100 percent.

Table 9—Potential sampling errors

Error source	Error of mean	Probability
	Percent	
Area	unknown	—
Owner survey	unknown	—
Timber data		
Sawlog volume	18.3	95
Boltwood volume	20.2	95
Pulpwood volume	16.9	95
Total volume	6.7	95
Stand growth	variable[1]	66.7
Total growth	2.1	66.7

— = Not applicable.

[1]Safford, 1968. Errors ranged from 4-72 percent for individual stands, with one minor stand class subject to 10,000 percent error.

Since reasonable estimates of marketings could be made with significantly fewer field measurements, a possible compromise is to conduct a less intensive field survey and determine its accuracy. The results could be used for early projections of market potential and preliminary business organization. In subsequent years, additional field samples could be measured to update the initial inventory and raise its level of accuracy.

Subject to the availability of high-quality, low-altitude aerial photos, and experienced interpreters, photo interpretation with subsampling by ground measurements might be fully satisfactory and considerably cheaper.

Estimating Management Needs

It is possible to estimate silvicultural needs using the same inventory and owner information that was collected for market projections. However, in addition to being subject to the same types of sampling errors as the market projection, cultural needs require more details of stand conditions. These are subject to greater statistical variations and also require a number of assumptions relating work needs to stand conditions.

Cultural needs, including harvesting, were based on the following assumptions and criteria.

Density class is an indicator of the type of cultural work that might be required:

•Crown closure of 71-100 percent (or A) may require thinning in seedling/sapling and poletimber stands and harvest in sawtimber.

•Crown closure of 41-70 percent (or B) is rarely sufficiently stocked for thinning or harvest but may require improvement cutting to upgrade stand quality.

•Crown closure of 0-40 percent (or C) requires time to recover through growth, but such stocking in seedling/sapling and sawtimber stages may warrant site preparation (including clearcutting poorly stocked sawtimber stands) and regeneration.
Stand size class indicates the method of accomplishing work.

•Seedling/sapling stands (or 1) may require release to improve composition, normally accomplished with spacing saws.

•Poletimber stands (or 2) may require improvement (quality) or thinning (spacing), usually performed with a chainsaw and small skidding equipment.

•Sawtimber stands (or 3) may need improvement, thinning or harvest. Partial cuts are performed with chainsaw and skidder, while clearcuts permit mechanized harvest. Due to the size and scattered nature of cooperative stands, mechanized harvesting is unlikely.

Species composition (H=hard, S=soft, and M=mixed) indicates what products might be obtained.

Average stand conditions for specific type, size and density combinations may be used to estimate work needs. Indicators such as number of trees/per acre, basal area, merchantable volume, and species composition are suitable guides for initial estimates and are adequate for short-term (5-year) planning.

Potential cultural needs are summarized in table 10 by stand condition class, based on an analysis of stocking and species composition. Probable workloads for each condition class are summarized in table 11. The estimates of work to be accomplished were based on assumptions that (1) 26-45 percent of survey respondents who have previously performed TSI, or the 39 percent who said they would pay for TSI, would do so (39 percent used for computation); and (2) 83 percent who would harvest, or 86 percent who would thin or perform improvement cuts, would do so (83 percent used for computation).

This analysis suggests that immediate needs for silvicultural work by members do not warrant establishing a service crew. On the other hand, 1,722 acres may require timber cutting annually, indicating a need for timber marking and sale administration services. Private contractors would do the cutting, although the cooperative might eventually develop its own crew. Especially noteworthy is the extent of service work, thinning, and improvement cutting that require skills not normally found among independent wood contractors. The cooperative board should deliberate carefully before entering into this type of work.

Interim Management Capabilities

Overall volume and growth estimates are adequate for setting initial work priorities and management objectives but not for the day-to-day management of individual properties. In the member survey, 64 percent considered management plans to be the most important cooperative service. Some 51 percent of the respondents were willing to pay for planning, but only 33 and 13 percent, respectively, had actually used cooperative or other planning services. Assuming that 46 percent used management planning services, many no doubt took advantage of free assistance from either the Maine Forest Service, industrial landowner programs, or the Forest Products Marketing and Management Association.

Whether for marketing or management, this study offers a relatively superficial view of the forest resource and its owners. In the long run, firm commitments for marketing and management will require individual owner plans. Much of the preliminary mapping of ownerships and stands accomplished by the study can be used to advantage in future studies of members individual properties.

Table 10—Potential cultural needs by condition class

	1-Seedling/sapling			2-Poletimber			3-Sawtimber		
	A	B	C	A	B	C	A	B	C
Hardwood									
Acres	233	60	11	3,109	1,184	948	371	574	27
NT/BA/A[1]	917	2,101	—	123	97	36	98	88	20
Volume/A	—	—	—	19	14	5	24	19	5
Need[2]	Clean	Clean	Reg.	Thin	Impr.	Impr.	Thin	Impr.	Reg.
Priority[3]	Med.	High	Med.	High	Med.	Low	Med.	Med.	Med.
Mixed Wood									
Acres	339	47	34	2,808	1,491	416	199	330	34
NT/BA/A[1]	5,195	—	—	125	115	69	141	110	130
Volume/A	4	—	—	21	18	10	33	27	26
Need[2]	Clean	Clean	Reg.	Thin	Impr.	Impr.	Harv.	Harv.	Impr.
Priority[3]	High	Low	Med.	Med.	High	Low	Med.	Low	Med.
Softwood									
Acres	287	45	31	1,609	258	105	17	53	—
NT/BA/A[1]	522	—	—	169	112	93	170	160	—
Volume/A	14	4	—	25	16	12	38	34	—
Need[2]	Harv.	Clean	Reg.	Thin	Impr.	Impr.	Harv.	Harv.	—
Priority[3]	Low	Med.	High	High	Med.	Low	High	Med.	—

— = Not applicable [1]NT/BA/A refers to number of trees in seedling/sapling stands, basal area of pole- and sawtimber.

[2]Operations Clean - release, regulate composition; Thin - control spacing; Impr.- improvement cut (quality, spacing, composition); Harv.- harvest cut, partial or clear; Reg.- regenerate

[3]Priority: High — 1 - 3 years Med. — 4 - 6 years Low — 7 years or more

Table 11—Workload in acres, by priority

	High priority 1-3 years[1]			Medium priority 4-6 years			Low priority 7 years or more
	Total	Annual	Prob.	Total	Annual	Prob.	Total
				Acres			
Service							
Clean	399	133	52	278	93	36	47
Regen.	31	10	4	72	24	9	—
Total	430	143	56	350	117	45	47
Harvest							
Thin	4,718	1,573	1,305	3,179	1,060	880	—
RImprove	1,491	497	413	2,050	683	567	1,469
Harvest	17	5	4	252	84	69	617
Total	6,226	2,075	1,722	5,481	1,827	1,516	2,086

— = Not applicable [1]Assumes service work by 39 percent of owners and harvest by 83 percent who would cut.


TREE
FARM
the RIPS

An inventory once every 10 years will maintain an overview of cooperative timber volume and growth. This could be done by annually updating 10 percent of the ownership and periodically revising the total projection, rather than as an expensive project each decade. Annual updates could be performed in some order of priority, preferably in conjunction with other needed work. In the course of normal field work, new information becomes available that can be incorporated into both individual and cooperative data files.

There is no substitute for individual property mapping and inventory to determine specific ownership needs. Priorities for this work go to the highest valued timber in the highest density stands. Recently cut stands need only a postcut inventory and periodic reconnaissance.

If each cooperative member would agree to a 10-year revolving management inventory of his property, in order of stand priority, a superior data system could be developed that would meet both individual and cooperative management needs. By distributing payment for this work over 10 years, the cooperative would receive the annual income needed to accomplish the project and owners would pay only modest annual fees of $30 to $50.

Map precision based on 1:40,000 aerial photographs, USGS topographic maps, and town tax maps is adequate for early planning and management but should be improved. Recent photos at a scale of 1:20,000 or less would permit better identification of stand boundaries and recognition of smaller stands.

Present timber boundaries are not precise and many small stands are unrecognizable. This has little effect on total values for market projections but is unsatisfactory for managing individual properties or finding specific products for market. Field observations made in the course of management are useful for updating and correcting maps; and as newer aerial photography becomes available, even if limited in scope, corrections can be made.

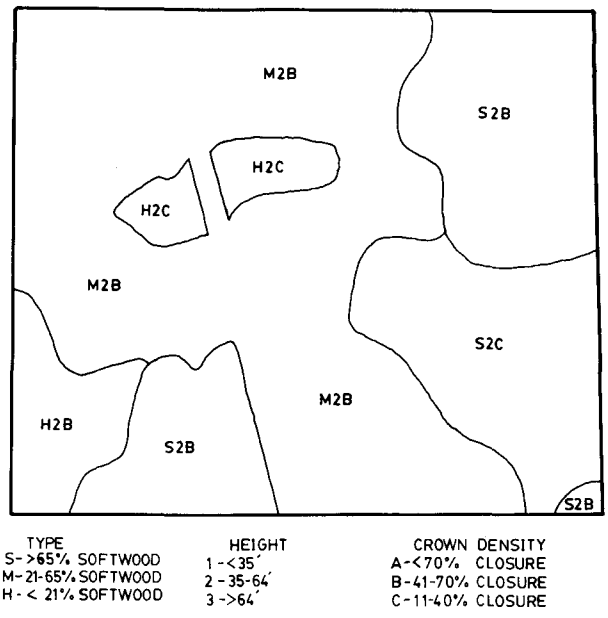
Figures 2 and 3 compare the differences between property and timber stand boundaries on one cooperative woodlot. Figure 2 illustrates a timber type map based on a boundary survey with eight timber types delineated from 1978 aerial photographs at a scale of 1:12,000, supplemented by 40 sample plots. Figure 3, a map of the same property made from town tax maps and 1:40,000 aerial photographs from 1981, shows only four stands. But the degree of conformity of these stand boundaries with those of the more detailed map is quite good. The differences in forest classification result in part from cutting and the effects of spruce budworm since the earlier map was made.

Timber data are averages for a wide range of conditions, even in any one type. Additional sample plots for individual owner management planning, or in the course of sale or cultural activities, can be used to improve estimates for both individual properties and the cooperative. A greater number of plots slightly improves the accuracy of overall estimates, but significantly improves stand and species data. Better sampling will therefore have little effect on marketing information but will improve management decisions.

Location data and boundaries based on USGS and town tax maps are suitable for marketing but not for management, although errors in area estimation can significantly affect both kinds of decisions. Cooperative owners should begin systematic boundary surveying and re-establishment programs. This may represent a substantial cost to some, but as timber and property values increase, the risk of loss through timber trespass and boundary disputes increases. Such work will benefit from the reconnaissance and mapping accomplished by this study and will in turn improve the overall accuracy of the geographic data system.

Recovery and display of data for specific geographic combinations are currently limited by the software available. Capabilities exist to display individual properties with summaries of stand conditions, but it is desirable to display certain types of information on a cooperativewide basis. As an example, a cooperativewide geographic plot might show all stands that (1) need a particular cultural treatment for crew scheduling, (2) contain specific products needed for new markets, or (3) are susceptible to some pests such as spruce budworm.

Figure 2- Forest cover type map of sample woodlot from 1:12,000 aerial photography

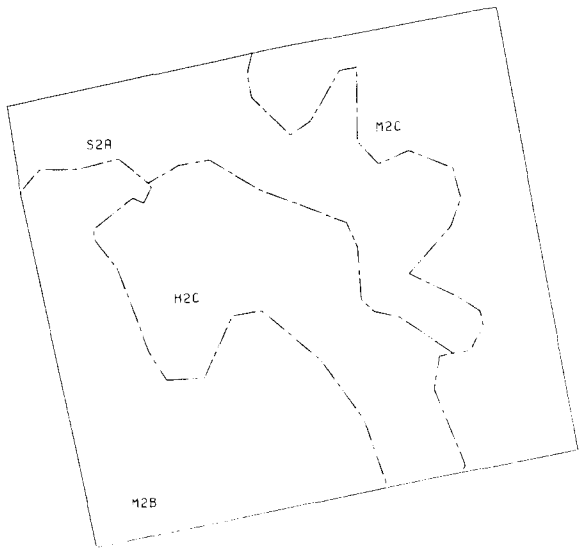


The geographic data are currently being used with market locations to determine the best sites for wood concentration points. With the rapid improvement in small computers, the cooperative could quickly create and maintain its own file of statistical and geographic data.

A problem that surfaced repeatedly throughout this study was the quality of aerial photography. Much of the accuracy of stand and boundary mapping, classifying forest condition classes, computing acreages and implementing management is directly related to photo scale and quality.

The cost of obtaining current aerial photography for analyzing the large geographic area encompassed by a forestry cooperative is prohibitive. Most projects of this nature must rely upon finding suitable, recent photographs from other sources. In this instance, good photographs of portions of the area were available from several sources, but they had differing scales, were flown at different seasons, and used several types of film. Although adequate for the management of individual parcels, these photos lacked the consistency of scale and quality needed for studying the entire ownership. The best available photographs were not at a desirable scale and were nearly 2 years old, but were adequate. When faced with this dilemma, the cooperative usually has three options—use the available photos, wait until the desired quality becomes available, or cooperate with some other agency that needs photos of the same area. In most cases, the first option is the only realistic one, but the third bears investigation, especially if time is not a limiting factor.

Figure 3- Computer-drawn forest cover type map of sample woodlot from 1:40,000 aerial photography



A weakness of the projection system, and one that will prove to be more serious when determining and allocating the annual cut, is the method used to project growth. Current annual growth reflects the volume of wood produced by the stands as they exist at the time of inventory. However, the forest is dynamic. Growth will change as a result of both cutting, which changes the age class distribution (and growth rates), and management, which improves recovery or yield.

To forecast marketings and cutting levels beyond the immediate 5-year period, the age structure of the forest must be studied to determine what will happen under a variety of possible management regimes. The nature of the forest must be continually monitored through sample plots and operational records to maintain an up-to-date record of age class distribution, growth rates, and volumes. Constant revision of estimates will be necessary to ensure that the resource is neither overutilized nor underutilized, and to improve the accuracy of supply projections.

Concurrent with improving collection and analysis of physical data about the resource, the cooperative must also evaluate changing owner objectives. To a great extent, formalized written marketing agreements and work requests can replace estimates based on an attitude survey. However, long-range owner intentions must be understood if the cooperative is to plan ahead for growth.

Based on the low priority that cooperative owners assigned to timber production and its relatively small contribution to income, owners must be made aware of the growing opportunities for profitable forest management. Technological improvements and shortages will contribute to improved income potential. But the market strength of members and their ability to collectively attract higher prices will have an immediate impact.

In the long run, the cooperative will need a commitment from members to plan for both service and sales. The best commitment is a management plan for each member's forest-land, which is understood by the member, and backed by a written agreement to harvest and sell. This will require a higher degree of sophistication in forestry knowledge by the owner, including knowledge specific to the cooperative.

At present, forestry education of FPMMC members is accomplished by an affiliated information and education group, the Forest Management and Marketing Association. Regular informational meetings and field days are held in order to provide landowners with opportunities to learn more about their forest resources. Cooperative members need additional information to help them understand the mutually beneficial relationship between the individuals and the organization and the importance of their individual participation to the success of the enterprise.

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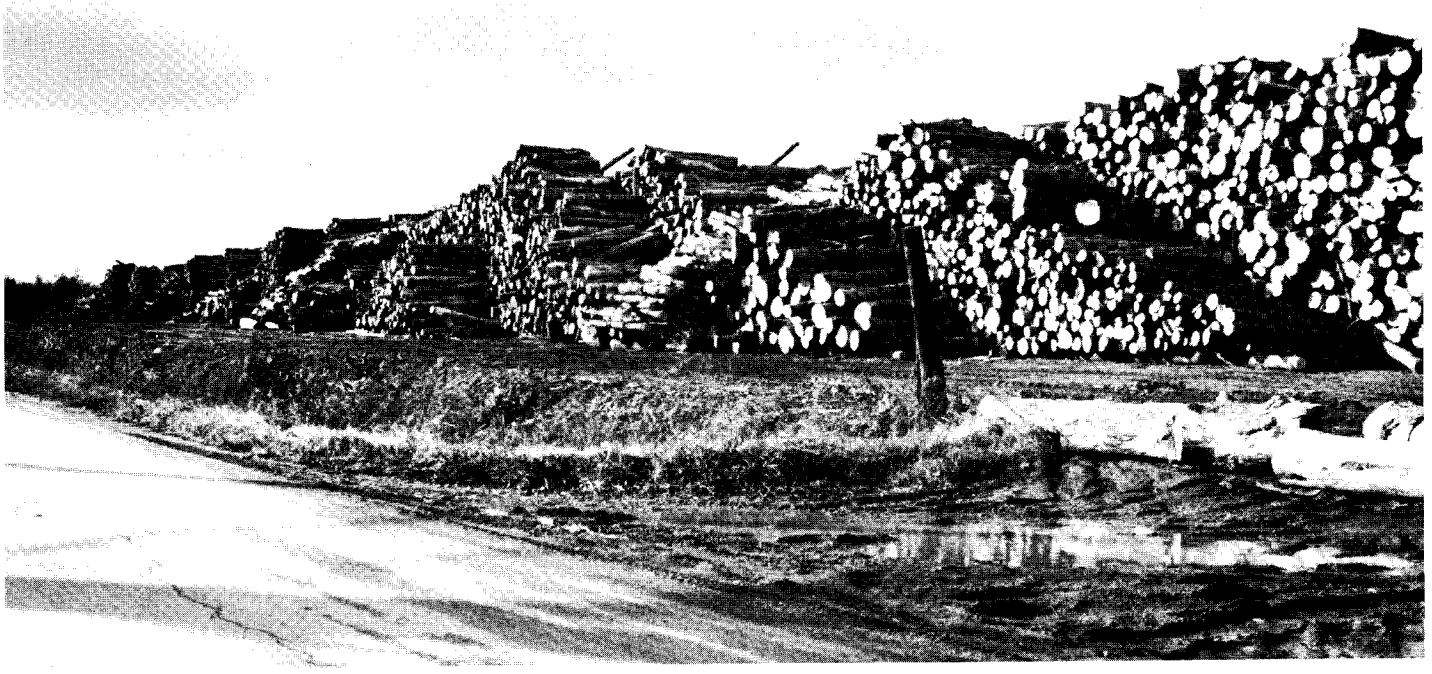

Appendix A FOREST PRODUCTS MARKETING AND MANAGEMENT COOPERATIVES MEMBER SURVEY FALL 1982

Questions asked in the survey—

1. How many years have you owned your woodland?
(If you own more than one lot, state the length of ownership of largest lot.)

2. Approximately how many acres of *woodland* do you own? on how many different lots?

3. What is your job or occupation?
(Please be specific: for example, dairy farmers, logger, retired.)

4. In what year were you born?

5. In what year did you move to you present community?

6. In what state were you born?

7. What are your reason(s) for ownership of woodland? (Please check all which are important to you.)

(1) Investment

(2) Forest products for personal use

(3) Firewood for personal use

(4) Income

(5) Recreation

(6) Wildlife

(7) Timber production

(8) It came as part of the property

(9) Other

Which of the above is your *primary* reason for ownership? (Please state its number.)

8. Why did you join the Forest Products Marketing and Management Cooperative?

9. Place an X by the most *important* services that the Cooperative could provide to you.

(1) Equipment rental (splitter, chipper, forwarder, etc.)

(2) Group equipment purchase

(3) Trucking

(4) Timber marking

(5) Management plans

(6) Timber sale administration

(7) Finding a reliable logger

(8) T.S.I. (timber stand improvement)

(9) Marketing — contracts

(10) Marketing — information (prices, specs)

(11) Sale of specialty woods from your land

(12) Other

Which of the above services would you be willing to pay for? (Please state number(s).)

Which of the above services have you used from the cooperative? (Please state number(s).)

Which of the above services have you used from other sources in the last 3 years? (Please state number(s).)

10. Place an X by what you think should be the requirements of a forest cooperative member. Choose as many as apply.

(1) The purchase of stock minimum purchases?

(2) The signing of a marketing agreement

(3) The *management* of woodland on a long-term, selective basis

(4) The ownership of a minimum number of acres of woodland how many acres?

(5) The harvesting of wood by the owner himself

(6) The development of an overall woodlot management plan

(7) Other

Which of the above requirements do you meet? (Please state number(s).)

11. Would you consider signing a first refusal agreement with the Forest Product Cooperative?

(For our purposes, a first refusal is a contract in which you give to a person or organization the first opportunity to sell you wood at or above current market price. If the person or organization cannot meet current market price, you are free to sell your wood elsewhere.)

12. Would you consider signing a marketing agreement with the Forest Products Cooperatives?

(For our purposes, a marketing agreement is a contract in which a person or organization sells for you wood produced on your land.)

13. Should the Forest Products Cooperative make a greater effort to help you get to know the other cooperative members?

14. The following are different aspects of cooperative management. Please check your degree of satisfaction with them in the Forest Products Cooperative.

1 = very satisfied

2 = satisfied

3 = slightly dissatisfied

4 = very dissatisfied

telephone — availability to you

mail — promptness of response to you

forester availability or accessibility

prompt payment of commissions

Board of directors — member communication

Other

15. Do you plan to cut wood or have wood cut on your woodland in the next 5 years?

If yes, why?

Timber is mature

Offered a good price

Need the money

Land clearing

Need timber for own use

Thinning or T.S.I.

Other

If no, why?

Don't know if wood should be cut

Timber not mature or too small

Wait for right markets

Don't want equipment on land

Can't find responsible operator

Price too low

Selling or planning to sell land

Other

16. About what percentage (part) of your income do you derive from your woodlot now?

17. About what percentage (part) of your income do you expect to be deriving from your woodlot 5 years from now?

Do you have any additional comments, questions, suggestions?

Appendix B TIMBER INVENTORY STATISTICAL TABLES

Summaries of acreage, sampling intensity, inventory, and growth by product class and stand characteristics are listed in the text. These data were derived from statistical tables such as the samples in this appendix.

Appendix table 1 is a sample stand and stock table by species and by stand condition class. These tables show numbers of trees, basal area, and volume per acre by diameter class, which are indicators of management needs. In this instance, the table shows the amount of sugar maple per acre in the well-stocked hardwood poletimber class (H2A). Appendix table 2 is a sample table showing volume per acre for all hardwood species in the H2A type, and appendix table 3 shows volume for all species in that type. In addition to tables for individual strata (types), summary stand and stock tables are generated for all strata combined.

Appendix table 4 is a sample table of species composition, in percentages, for the H2A stratum. Similar tables are generated for each stratum and for all strata combined.

Appendix table 5 shows total volume per acre for the H2A class, expanded by total acreage in that stratum. Similar tables are generated for each of the other strata and for all strata combined.

Appendix table 6 is a statistical analysis of the hardwood species group of the H2A type. This analysis was performed for each major species group, and all groups combined, for each stratum and for all strata combined. Comparing the statistical accuracy of each—group versus all groups, stratum versus all strata—indicates the credence which can be given to the inventory data. As total values are subdivided by forest type or product class, the statistical accuracy decreases significantly. This is shown dramatically by comparing data for one species group in the H2A class (appendix table 6) with the summary for all species and strata shown in appendix table 7.

Appendix tables 8 through 12 detail statistical information about biomass for the H2A type, but similar tables are available for each stratum as well as combined tables for all strata. In addition to the unmerchantable trees on the small biomass plots, biomass for trees measured on the variable radius plot are also included, hence these tables reflect the total live biomass.

Appendix table 13 is a projection of total annual growth in cord equivalents, derived by applying Safford's growth rates to the acreages of the different stand condition classes that were observed. Since such a growth estimate is affected greatly by the acreage in each class, changes due to cutting would significantly alter the computed rates. However, as Safford's rates were based on the slower growing, unmanaged stands, it is likely that growth for the cooperative's managed lands would be conservative. This is not a desirable method for estimating growth, but is adequate for short term estimates. A detailed growth survey of such a small ownership would be unreasonably expensive, but growth samples should be obtained from cooperative lands in the course of management. By measuring one growth sample on each plot established for management planning, a base of several thousand measurements can be accumulated which would be suitable for predicting growth. However, regardless of the system used, current growth is no indication of mean annual growth over the long term. Some sort of long range forest regulation must be attempted in order to project long term allowable cut.

Appendix table 12 lists important stand indicators of silvicultural problems which are likely to occur on cooperative member's lands. Basal area and number of stems per acre of "problem" species such as balsam fir, aspen, American beech, red maple, and others were listed only if they exceeded 15 percent of the total. "Other" includes noncommercial species such as alder and hornbeam that might interfere with the development of more desirable species. Number of trees and basal area indicate the importance of the species in the stand, and volume indicates whether there is sufficient timber to warrant improvement cutting. These data were used to set priorities for cultural activities summarized in table 10 in the text.

Appendix table 1—Sample table of volume per acre by species, by stand condition class

Timber Estimate for the Forest Products Marketing and Management Study — Page : 21

- - - Per Acre Table - - -

SUGAR MAPLE (HM)

Stratum Description :

Stratum Name : H 2A — Basal area factor : 10.000

Forest Acres : 3109. — Number of Points : 25

Diameter Class (DBH)	NUMBER OF STEMS	BASAL AREA	PULPWOOD VOLUME IN CORDS	CULL VOLUME IN CORDS	UNDERSZD VOLUME IN CORDS	SAWLOG VOLUME IN B.F.	BOLTWOOD VOLUME IN CORDS	TOPWOOD VOLUME IN CORDS	TOTAL VOLUME IN CORDS
3	36.7	0.8							
4	32.1	1.4							
5	32.1	2.5							
6	11.7	1.6			0.2				0.2
7	12.2	2.4	0.1		0.3				0.4
8	7.5	2.0			0.4				0.4
9	6.0	2.4					0.2	0.3	0.5
10	5.4	2.4					0.4	0.2	0.6
11	5.9	3.2					0.4	0.4	0.8
13	2.4	2.4				28.0		0.1	0.1
15	0.7	0.8				61.2		0.1	0.2
21	0.2	0.4				37.7		0.1	0.1
22	0.2	0.4				37.7		0.1	0.1
Totals	152.4	21.2	0.1		0.9	164.5	1.0	1.2	3.6
1 - 4	101.3	5.2							
5 - 9	43.7	10.8	0.1		0.9		0.6	0.5	2.1
10 - 11	6.9	3.2					0.4	0.4	0.8
12 & UP	1.4	2.0				164.5		0.3	0.6

Volumes of CULL trees are NOT included in the TOTAL VOLUME column.

Appendix table 2—Sample table of volume per acre by species group, by stand condition class

Timber Estimate for the Forest Products Marketing and Management Study — Page : 31

--- Per Acre Table ---

All Hardwoods

Stratum Description :

Stratum Name : H 2A — Basal area factor : 10.000

Forest Acres : 3109. — Number of Points : 25

Diameter Class (DBH)	NUMBER OF STEMS	BASAL AREA	PULPWOOD VOLUME IN CORDS	CULL VOLUME IN CORDS	UNDERSIZD VOLUME IN CORDS	SAWLOG VOLUME IN B.F.	BOLTWOOD VOLUME IN CORDS	TOPWOOD VOLUME IN CORDS	TOTAL VOLUME IN CORDS
1	220.0	1.7							
2	201.7	4.4							
3	146.7	7.2							
4	110.0	9.6							
5	73.3	10.0	0.0		1.0				1.0
6	55.0	10.8	0.2		1.5				1.7
7	26.9	7.2	0.2		1.2				1.4
8	36.7	12.8	0.7				1.3	0.9	2.9
9	22.6	10.0					1.5	0.9	2.4
10	18.3	10.0	0.7				1.0	0.8	2.6
11	5.5	3.6	0.2				0.5	0.2	1.0
12	5.6	4.4	0.2			189.6		0.6	1.3
13	3.0	2.8	0.4			137.6		0.2	0.8
14	1.1	1.2	0.3			17.1		0.1	0.4
15	0.7	0.8				61.2		0.1	0.2
16	0.3	0.4				42.0		0.1	0.1
17	0.3	0.4	0.1						0.1
18	0.2	0.4	0.1						0.1
21	0.2	0.4				37.7		0.1	0.1
22	0.2	0.4				37.7		0.1	0.1
25 +	0.1	0.4	0.2						0.2
Totals	928.4	98.4	3.5		3.7	522.8	4.3	4.0	16.6
1 - 4	678.4	22.4							
5 - 9	214.6	50.8	1.7		3.7		2.8	1.8	9.5
10 - 11	23.8	13.6	1.0				1.5	1.0	3.6
12 & UP	11.6	11.6	1.3			522.8		1.2	3.6

Volumes of CULL trees are NOT included in the TOTAL VOLUME column.

Appendix table 3—Sample table of volume per acre for all species, by stand condition class

Timber Estimate for the Forest Products Marketing and Management Study — Page : 32

— — — Per Acre Table — — —

All Species

Stratum Description :

Stratum Name : H 2A — Basal area factor : 10.000

Forest Acres : 3109. — Number of Points : 25

Diameter Class (DBH)	NUMBER OF STEMS	BASAL AREA	PULPWOOD VOLUME IN CORDS	CULL VOLUME IN CORDS	UNDERSZD VOLUME IN CORDS	SAWLOG VOLUME IN B.F.	BOLTWOOD VOLUME IN CORDS	TOPWOOD VOLUME IN CORDS	TOTAL VOLUME IN CORDS
1	220.0	1.2							
2	293.4	6.4							
3	203.7	10.0							
4	151.3	13.2							
5	85.1	11.6	0.0		1.1				1.2
6	71.3	14.0	0.3		1.8				2.2
7	32.9	8.8	0.2		1.5				1.7
8	47.0	16.4	0.9		0.6		1.3	0.8	3.6
9	27.2	12.0	0.1		0.4		1.5	0.9	2.9
10	19.8	10.8	0.3			30.7	1.0	0.9	2.8
11	6.7	4.4	0.2		0.1	41.3	0.5	0.3	1.2
12	6.1	4.8	0.2			234.9		0.7	1.4
13	3.9	3.6	0.4			195.9		0.3	1.1
14	1.1	1.2	0.3			17.1		0.1	0.4
15	0.7	0.8				61.2		0.1	0.2
16	0.6	0.8	0.1			42.0		0.1	0.3
17	0.3	0.4	0.1						0.1
18	0.2	0.4	0.1						0.1
20	0.2	0.4				56.7		0.0	0.1
21	0.2	0.4				37.7		0.1	0.1
22	0.2	0.4				37.7		0.1	0.1
25 +	0.1	0.4	0.2						0.2
Totals	1171.7	122.4	4.1		5.4	755.0	4.3	4.2	19.6
1 - 4	868.3	30.8							
5 - 9	263.4	62.9	1.6		5.3		2.8	1.8	11.5
10 - 11	26.5	15.2	1.1		0.1	72.0	1.5	1.1	4.0
12 & UP	13.5	13.6	1.4			683.0		1.3	4.2

Volumes of CULL trees are NOT included in the TOTAL VOLUME column.

Appendix table 4—Sample table of species composition, in percent, by stand condition class

Timber Estimate for the Forest Products Marketing and Management Study — Page : 5

Species Composition in Percent

Stratum Description :

Stratum Name : H 2A — Basal area factor : 10.000

Forest Acres : 3109. — Number of Points : 25

Species		NUMBER OF STEMS	BASAL AREA	PULPWOOD VOLUME IN CORDS	CULL VOLUME IN CORDS	UNDERSIZD VOLUME IN CORDS	SAWLOG VOLUME IN MBF	BOLTWOOD VOLUME IN CORDS	TOPWOOD VOLUME IN CORDS	TOTAL VOLUME IN CORDS
RS	:	9/ 2	17/ 3	26/ 4		7/ 2	49/ 15		47/ 2	20/ 3
SF	:	53/ 11	38/ 8	36/ 5		30/ 9	19/ 6		6/ 0	28/ 4
HE	:	17/ 4	30/ 6	38/ 5		54/ 17				38/ 6
CE	:	19/ 4	10/ 2			7/ 2				4/ 1
WP	:	1/ 0	5/ 1			3/ 1	31/ 10		47/ 3	10/ 2
Sftwds	:	21	20	14		32	31		5	15
AL	:	2/ 2								
YB	:	4/ 3	9/ 8	5/ 4		8/ 6	20/ 14	11/ 11	17/ 16	11/ 10
WB	:	7/ 6	12/ 10			15/ 10	5/ 4	26/ 26	12/ 11	13/ 11
HM	:	16/ 13	22/ 17	2/ 2		25/ 17	31/ 22	23/ 23	31/ 29	22/ 18
RM	:	32/ 25	22/ 18	23/ 19		23/ 16	20/ 14	19/ 19	19/ 18	21/ 18
BE	:	21/ 17	16/ 13	49/ 42		7/ 5	10/ 7	4/ 4	13/ 12	17/ 14
PO	:	7/ 5	10/ 8	20/ 17		9/ 6	13/ 9	7/ 7	4/ 4	10/ 8
WA	:	1/ 1	3/ 2			2/ 1		9/ 9	4/ 4	4/ 3
OS	:	1/ 1	1/ 1							
BC	:	2/ 2	1/ 1			2/ 1				
GB	:	1/ 1	2/ 2			6/ 4				1/ 1
OH	:	4/ 4	2/ 1	2/ 2		1/ 1				1/ 1
Hrdwds	:	79	80	96		68	69	100	95	85

Volumes of CULL trees are NOT included in the TOTAL VOLUME column.

In this table the first number shows the percentage of that species in its group.
The second number shows the percentage of that species out of ALL species.

Appendix table 5—Sample table of total volume expanded by acreage, by stand condition class

Timber Estimate for the Forest Products Marketing and Management Study — Page : 6

Total Volume Expanded by Acreage

Stratum Description :
Stratum Name : H 2A
Forest Acres : 3109.
Basal area factor : 10.000
Number of Points : 25

Species	PULPWOOD VOLUME IN CORDS	CULL VOLUME IN CORDS	UNDERSIZD VOLUME IN CORDS	SAWLOG VOLUME IN MBF	BOLTWOOD VOLUME IN CORDS	TOPWOOD VOLUME IN CORDS	TOTAL VOLUME IN CORDS
SPRUCES	476.		372.	355.		327.	1900.
BALSAM FIR	650.		1603.	141.		40.	2586.
HEMLOCK	679.		2876.				3555.
WHITE CEDAR			352.				352.
WHITE PINE			163.	227.		331.	956.
All Softwoods	1806.		5366.	722.		699.	9348.
YELLOW BIRCH	536.		942.	330.	1472.	2158.	5803.
PAPER BIRCH			1753.	87.	3562.	1432.	6934.
SUGAR MAPLE	211.		2883.	511.	3115.	3854.	11164.
RED MAPLE	2443.		2653.	327.	2557.	2382.	10732.
AMERICAN BEECH	5300.		851.	161.	575.	1554.	8603.
POPLAR	2110.		1090.	209.	931.	522.	5106.
WHITE ASH			229.		1236.	512.	1976.
BLACK CHERRY			251.				251.
GRAY BIRCH			746.				746.
OTHER HARDWOODS	207.		135.				342.
All Hardwoods	10807.		11532.	1625.	13448.	12412.	51657.
All Species	12613.		16899.	2347.	13448.	13111.	61005.

Volumes of CULL trees are NOT included in the TOTAL VOLUME column.

Appendix table 6—Sample statistical analysis of species group, by stand condition class

Timber Estimate for the Forest Products Marketing and Management Study Page : 2

--- Statistical Analysis ---

All Hardwoods

Stratum Description :

Stratum Name : H 2A Basal area factor : 10.000

Forest Acres : 3109. Number of Points : 25

Product Class	Mean	19/1	9/1	2/1	SD	CV%	SE%
PULPWOOD VOLUME IN CORDS :	3.5	53.7	44.5	25.7	4.5	130.0	26.0
UNDERSZD VOLUME IN CORDS :	3.7	32.9	27.2	15.7	3.0	79.6	15.9
SAWLOG VOLUME IN B.F. :	522.8	58.1	48.2	27.8	736.0	140.8	28.2
BOLTWOOD VOLUME IN CORDS :	4.3	40.5	33.5	19.3	4.2	98.0	19.6
TOPWOOD VOLUME IN CORDS :	4.0	37.2	30.8	17.8	3.6	90.0	18.0
TOTAL VOLUME IN CORDS :	16.6	19.9	16.5	9.5	8.0	48.3	9.7

Volumes of CULL trees are NOT included in the TOTAL VOLUME column.

--- Table Key ---

19/1 = Allowable error as a percent of the mean at the 95% level
9/1 = Allowable error as a percent of the mean at the 90% level
2/1 = Allowable error as a percent of the mean at the 67% level
CV% = Coefficient of Variation in percent
SE% = Standard Error of the mean in percent

Appendix table 7—Sample statistical analysis, all strata combined

Timber Estimate for the Forest Products Marketing and Management Study Page : 50

--- Statistical Analysis ---

All Species

Stratum Description : All strata combined
Stratum Name : ALL Basal area factor : 10.000
Forest Acres : 14495. Number of Points : 264

Product Class	Mean	19/1	9/1	2/1	SD	CV%	SE%
PULPWOOD VOLUME IN CORDS :	3.6	16.9	14.1	9.3			
CULL VOLUME IN CORDS :	0.0	166.0	139.2	81.7			
UNDERSZD VOLUME IN CORDS :	6.7	8.8	7.4	4.3			
SAWLOG VOLUME IN B.F. :	1104.9	18.3	15.3	9.0			
BOLTWOOD VOLUME IN CORDS :	2.2	20.2	17.0	10.0			
TOPWOOD VOLUME IN CORDS :	2.9	13.9	11.6	6.8			
TOTAL VOLUME IN CORDS :	17.7	6.7	5.6	3.3			

Volumes of CULL trees are NOT included in the TOTAL VOLUME column.

--- Table Key ---

19/1 = Allowable error as a percent of the mean at the 95% level
9/1 = Allowable error as a percent of the mean at the 90% level
2/1 = Allowable error as a percent of the mean at the 67% level
CV% = Coefficient of Variation in percent
SE% = Standard Error of the mean in percent

Appendix table 8—Sample table of biomass in tons per acre, by stand condition class

Biomass Estimate for the Forest Products Marketing and Management Study — Page : 3

Biomass in Tons Per Acre

Stratum Description :

Stratum name : H 24 — Basal area factor 10.000

Forest acres : 3109. — Number of points : 25

Species code	Tree Part	DBH Class 1-5"	6"	7"	8"	9"	10"	11"	12"	13"	14"	15"	16"	17"	18"	19"	20+"	Total
RS	SER	1.	0.		0.	0.	0.	0.		0.								1.
	BOLE	1.	0.		0.	0.	0.	0.		0.								3.
	REST	1.	0.		0.	0.	0.	0.		0.								1.
	TOTL	3.	0.		0.	0.	0.	0.		1.								5.
RF	SER	1.	0.	0.	0.				0.									2.
	BOLE	2.	1.	0.	1.				0.									4.
	REST	1.	1.	0.	0.				0.									2.
	TOTL	3.	2.	0.	2.				0.									8.
RC	SER	0.		0.														0.
	BOLE	0.		0.														0.
	REST	0.		0.														0.
	TOTL	0.		0.														0.
GR	SER	0.	0.															0.
	BOLE	0.	0.															0.
	REST	0.	0.															0.
	TOTL	1.	0.															1.
OH	SER	0.	0.															0.
	BOLE	1.	0.															1.
	REST	0.	0.															0.
	TOTL	1.	0.															1.
MS	SER	0.																0.
	BOLE	0.																0.
	REST	0.																0.
	TOTL	1.																1.
TO	SER	7.	3.	2.	4.	3.	3.	1.	1.	1.	0.	0.	0.	0.	0.		1.	26.
	BOLE	19.	8.	5.	10.	8.	8.	3.	4.	3.	1.	1.	1.	0.	0.		1.	72.
	REST	9.	4.	2.	5.	4.	3.	1.	2.	1.	0.	0.	0.	0.	0.		1.	33.
	TOTL	34.	14.	10.	19.	15.	14.	6.	7.	5.	2.	1.	1.	1.	1.		3.	132.

"SER" is the stump and root portion of the tree. "BOLE" is the merchantable bole.
"REST" includes the rest of the tree.

Appendix table 9—Sample table of total biomass in tons, by stand condition class

Biomass Estimate for the Forest Products Marketing and Management Study — Page : 3

TOTAL Biomass Estimate in Tons

Stratum Description :

Stratum name : H 2A — Basal area factor 10.000

Forest acres : 3109. — Number of points : 25

Species code	Tree Part	DBH Class 1-5"	6"	7"	8"	9"	10"	11"	12"	13"	14"	15"	16"	17"	18"	19"	20+"	Total
RS	S&R	1577.	249.		273.	283.	293.	301.		317.								3294.
	BOLE	4336.	686.		750.	778.	804.	829.		873.								9057.
	REST	1971.	312.		341.	354.	366.	377.		397.								4117.
	TOTL	7884.	1247.		1364.	1415.	1463.	1507.		1587.								16468.
BF	S&R	1948.	1361.	242.	1022.				302.									4875.
	BOLE	5357.	3744.	665.	2810.				831.									13407.
	REST	2435.	1702.	302.	1277.				378.									6094.
	TOTL	9740.	6807.	1209.	5110.				1510.									24376.
WA	S&R	124.		269.		881.	610.	316.										2200.
	BOLE	341.		739.		2424.	1678.	868.										6049.
	REST	155.		336.		1102.	763.	394.										2749.
	TOTL	619.		1344.		4407.	3050.	1578.										10998.
BC	S&R	114.		190.														305.
	BOLE	314.		523.														837.
	REST	143.		238.														381.
	TOTL	571.		951.														1523.
GB	S&R	446.	106.															552.
	BOLE	1225.	293.															1518.
	REST	557.	133.															690.
	TOTL	2228.	532.															2760.
OH	S&R	625.	254.															880.
	BOLE	1719.	700.															2419.
	REST	781.	318.															1099.
	TOTL	3126.	1272.															4398.
MO	S&R	543.																543.
	BOLE	1494.																1494.
	REST	679.																679.
	TOTL	2717.																2717.
TO	S&R	21175.	8906.	5986.	11870.	9198.	8704.	3693.	4080.	3240.	1159.	728.	695.	368.	431.		1656.	81839.
	BOLE	58231.	24492.	16461.	32642.	25294.	23935.	10156.	11219.	8909.	3189.	2003.	1911.	1013.	1185.		4555.	225193.
	REST	26468.	11133.	7482.	14837.	11497.	10880.	4616.	5100.	4050.	1449.	911.	869.	460.	538.		2070.	102361.
	TOTL	105874.	44530.	29930.	59349.	45989.	43518.	18465.	20399.	16198.	5797.	3642.	3474.	1841.	2154.		8282.	409443.

"S&R" is the stump and root portion of the tree. "BOLE" is the merchantable bole.
"REST" includes the rest of the tree.

Appendix table 10—Sample statistical analysis table of fresh biomass

Biomass Estimate for the Forest Products Marketing and Management Study — Page : 1

= = S t a t i s t i c a l A n a l y s i s T a b l e = =

Fresh Biomass Per Acre in Tons

Stratum Description :

Stratum Name : H 2A — Basal area factor 10.000

Forest Acres : 3109. — Number of Points : 25

Group Statistics	Mean	19 to 1	9 to 1	2 to 1	St. Dev.	CV%	SE%
All Softwoods							
STR	4.4	31.8	26.3	15.2	3.4	76.9	15.4
BOLE	12.2	31.8	26.3	15.2	9.4	76.9	15.4
REST	5.5	31.8	26.3	15.2	4.3	76.9	15.4
TOTL	22.2	31.8	26.3	15.2	17.0	76.9	15.4
All Hardwoods							
STR	21.7	14.8	12.3	7.1	7.8	35.8	7.2
BOLE	59.8	14.8	12.3	7.1	21.4	35.8	7.2
REST	27.2	14.8	12.3	7.1	9.7	35.8	7.2
TOTL	108.7	14.8	12.3	7.1	38.9	35.8	7.2
All Non-commercial							
STR	0.2	206.4	171.1	98.7	0.9	500.0	100.0
BOLE	0.5	206.4	171.1	98.7	2.4	500.0	100.0
REST	0.2	206.4	171.1	98.7	1.1	500.0	100.0
TOTL	0.9	206.4	171.1	98.7	4.4	500.0	100.0
All Species							
STR	26.3	13.9	11.5	6.6	8.9	33.6	6.7
BOLE	72.4	13.9	11.5	6.6	24.3	33.6	6.7
REST	32.9	13.9	11.5	6.6	11.1	33.6	6.7
TOTL	131.7	13.9	11.5	6.6	44.3	33.6	6.7

"STR" is the stump and root portion of the tree. "BOLE" is the merchantable bole.
"REST" includes the rest of the tree.

- - - T a b l e K e y - - -

19 to 1 = Allowable error as a percent of the mean at the 95% level
9 to 1 = Allowable error as a percent of the mean at the 90% level
2 to 1 = Allowable error as a percent of the mean at the 67% level
St. Dev. = Standard Deviation
CV% = Coefficient of variation in percent
SE% = Standard Error of the mean in percent

Appendix table 11—Sample table of biomass trees per acre, by stand condition class

Biomass Estimate for the Forest Products Marketing and Management Study — Page : 3

---- Trees Per Acre ... for the Point and Plot Sample ------

Stratum Description :

Stratum name : H 2A — Basal area factor 10.000

Forest acres : 3109. — Number of points : 25

Species code	Prod.	DBH Class 1-5"	6"	7"	8"	9"	10"	11"	12"	13"	14"	15"	16"	17"	18"	19"	20+"	Total
RS	ALL	39.	2.		1.	1.	1.	1.		0.								45.
	TOTL	39.	2.		1.	1.	1.	1.		0.								45.
BF	ALL	327.	12.	1.	5.				1.									346.
	TOTL	327.	12.	1.	5.				1.									346.
HE	ALL	15.		4.	3.	4.	1.	1.					0.					28.
	TOTL	15.		4.	3.	4.	1.	1.					0.					28.
CE	ALL	39.			1.													40.
	TOTL	39.			1.													40.
WP	ALL		2.							0.							0.	3.
	TOTL		2.							0.							0.	3.
AL	ALL	24.																24.
	TOTL	24.																24.
YB	ALL	24.	6.		3.	4.	1.		1.	0.	0.		0.				0.	40.
	TOTL	24.	6.		3.	4.	1.		1.	0.	0.		0.				0.	40.
RB	ALL	93.	6.	4.	7.	5.	1.	2.		0.								119.
	TOTL	93.	6.	4.	7.	5.	1.	2.		0.								119.
HM	ALL	180.	12.	7.	7.	5.	6.			0.		1.					0.	219.
	TOTL	180.	12.	7.	7.	5.	6.			0.		1.					0.	219.
PM	ALL	198.	10.	7.	10.	3.	3.	2.	3.	0.				0.				236.
	TOTL	198.	10.	7.	10.	3.	3.	2.	3.	0.				0.				236.
BF	ALL	162.	6.	3.	6.	2.	3.	1.	2.	1.	1.				0.			185.
	TOTL	162.	6.	3.	6.	2.	3.	1.	2.	1.	1.				0.			185.
PP	ALL	15.	10.	1.	3.	2.	2.	1.	1.	0.								36.
	TOTL	15.	10.	1.	3.	2.	2.	1.	1.	0.								36.
WA	ALL	24.		1.		3.	1.	1.										30.
	TOTL	24.		1.		3.	1.	1.										30.
BC	ALL	12.		1.														13.
	TOTL	12.		1.														13.
SP	ALL	12.	2.															14.
	TOTL	12.	2.															14.
OH	ALL	75.	2.															77.
	TOTL	75.	2.															77.
WO	ALL	12.																12.
	TOTL	12.																12.
TO	ALL	1249.	71.	33.	47.	27.	20.	7.	6.	4.	1.	1.	1.	0.	0.		1.	1467.
	TOTL	1249.	71.	33.	47.	27.	20.	7.	6.	4.	1.	1.	1.	0.	0.		1.	1467.

Appendix table 12—Sample table of basal area per acre, by stand condition class

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--- Basal Area Per Acre ... for the Point & Plot Sample ----

Stratum Description :
Stratum name : H 2A — Basal area factor 10.000
Forest acres : 3109. — Number of points : 25

Species code	Prod. name	DBH Class 1-5"	6"	7"	8"	9"	10"	11"	12"	13"	14"	15"	16"	17"	18"	19"	20+"	Total
RS	ALL	3.	0.		0.	0.	0.	0.		0.								5.
	TOTL	3.	0.		0.	0.	0.	0.		0.								5.
BF	ALL	5.	2.	0.	2.				0.									9.
	TOTL	5.	2.	0.	2.				0.									9.
HE	ALL	1.		1.	1.	2.	0.	0.					0.					6.
	TOTL	1.		1.	1.	2.	0.	0.					0.					6.
CE	ALL	2.			0.													2.
	TOTL	2.			0.													2.
WP	ALL		0.							0.							0.	1.
	TOTL		0.							0.							0.	1.
AL	ALL	0.																0.
	TOTL	0.																0.
YB	ALL	2.	1.		1.	2.	1.		0.	0.	0.		0.				0.	9.
	TOTL	2.	1.		1.	2.	1.		0.	0.	0.		0.				0.	9.
WB	ALL	5.	1.	1.	2.	2.	1.	1.		0.								14.
	TOTL	5.	1.	1.	2.	2.	1.	1.		0.								14.
HM	ALL	7.	2.	2.	2.	2.	3.			0.		1.					1.	22.
	TOTL	7.	2.	2.	2.	2.	3.			0.		1.					1.	22.
RM	ALL	7.	2.	2.	4.	1.	2.	1.	2.	0.				0.				21.
	TOTL	7.	2.	2.	4.	1.	2.	1.	2.	0.				0.				21.
BE	ALL	4.	1.	1.	2.	1.	2.	0.	1.	1.	1.				0.			14.
	TOTL	4.	1.	1.	2.	1.	2.	0.	1.	1.	1.				0.			14.
PD	ALL	1.	2.	0.	1.	1.	1.	0.	1.	0.								8.
	TOTL	1.	2.	0.	1.	1.	1.	0.	1.	0.								8.
WA	ALL	0.		0.		1.	1.	0.										3.
	TOTL	0.		0.		1.	1.	0.										3.
BC	ALL	0.		0.														1.
	TOTL	0.		0.														1.
GR	ALL	2.	0.															2.
	TOTL	2.	0.															2.
DH	ALL	1.	0.															2.
	TOTL	1.	0.															2.
MD	ALL	1.																1.
	TOTL	1.																1.
TO	ALL	40.	14.	9.	16.	12.	11.	4.	5.	4.	1.	1.	1.	0.	0.		2.	120.
	TOTL	40.	14.	9.	16.	12.	11.	4.	5.	4.	1.	1.	1.	0.	0.		2.	120.

Appendix table 13—Projected annual growth in cord equivalents

		1-Seedling/sapling			2-Poletimber			3-Sawtimber			Total
		A	B	C	A	B	C	A	B	C	
HARDWOOD	Acres	233	60	11	3,109	1,184	948	371	574	27	6,517
	Growth[1] rate	27.5	32.3	([3])	44.0	46.1	35.3	40.1	39.8	26.6	—
	Total[2] growth	80.1	24.2	4.4	1,710.0	682.3	418.3	186.0	285.6	9.0	3,399.9
MIXED WOOD	Acres	339	47	34	2,808	1,491	416	199	330	34	5,698
	Growth[1] rate	46.7	50.2	36.2	61.6	58.2	55.4	46.1	54.8	([3])	—
	Total[2] growth	197.9	29.5	15.4	2,162.2	1,084.7	288.1	114.7	226.1	23.3	4,141.9
SOFTWOOD	Acres	287	45	31	1,609	258	105	17	53	—	2,405
	Growth[1] rate	48.5	481.0	14.1	68.9	65.6	51.4	54.7	56.9	—	—
	Total[2] growth	174.0	27.0	5.5	1,385.8	211.6	67.5	11.6	37.7	—	1,920.7
TOTAL	Acres	859	152	76	7,526	2,933	1,469	587	957	61	14,620
	Total[2] growth	452.0	80.7	25.3	5,258.0	1,978.6	773.6	312.3	549.4	32.3	9,462.5

— = Not applicable.

[1]Annual growth in cubic feet/acre (Safford 1968).

[2]Total growth is in cord equivalents and assumes 80 cubic feet (solid wood) per cord.

[3]Rates from the nearest condition class were used.

Appendix table 14—Stand characteristics affecting potential silivicultural problems, by stand condition class[1]

		2-Poletimber									3-Sawtimber								
		A			B			C			A			B			C		
		T/A	BA	VOL	T/A	BA	VOL	T/A	BA	VOL	T/A	BA	VOL	T/A	BA	VOL	T/A	BA	VOL
HARD	Fir	–	–	0.8	32	16	0.9	16	16	0.2	–	–	0.2	65	20	0.7	–	–	–
	Aspen	–	–	1.6	–	–	3.0	26	–	0.4	–	–	1.7	–	21	6.4	–	–	–
	Beech	17	13	2.8	–	–	1.1	26	18	0.8	24	19	5.2	–	–	1.1	34	33	1.3
	Other	–	–	0.3	–	–	0.4	19	–	0.3	–	–	0.8	–	–	0.5	–	–	0.8
	R. Maple	25	18	3.5	18	25	2.8	–	–	0.7	–	16	4.6	–	15	2.8	24	22	–
	Max. cut[2]	–	–	9.0	–	–	8.2	–	–	2.4	–	–	12.5	–	–	11.5	–	–	2.1
MIXED	Fir	50	28	3.3	43	27	3.0	17	28	2.0	16	7	1.7	46	16	1.7	–	–	1.3
	Aspen	–	–	1.6	–	–	1.7	–	–	0.7	–	–	1.6	–	–	3.5	70	56	12.8
	Beech	–	–	1.3	–	–	0.4	–	–	0.2	19	–	2.3	–	–	–	–	–	–
	Other	–	–	0.6	–	–	0.4	43	–	0.3	21	–	0.4	–	–	1.2	–	–	–
	R. Maple	–	–	3.0	–	15	2.5	–	15	1.0	–	–	3.9	–	–	1.1	–	–	–
	Max. cut[2]	–	–	9.8	–	–	8.0	–	–	4.2	–	–	9.9	–	–	7.5	–	–	14.1
SOFT	Fir	36	27	4.5	66	29	2.4	86	43	2.4	21	21	7.7	–	–	2.5	–	–	–
	Aspen	–	–	0.7	–	–	–	–	–	–	–	–	1.0	–	–	–	–	–	–
	Beech	–	–	0.2	–	–	–	–	–	–	–	–	0.4	–	–	–	–	–	–
	Other	–	–	0.1	23	–	0.2	–	–	–	–	–	1.2	18	–	–	–	–	–
	R. Maple	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
	Max. cut[2]	–	–	5.5	–	–	2.6	–	–	–	–	–	10.3	–	–	–	–	–	–

– = Not applicable.

[1]Number of stems and basal area/acre are listed only if they exceed 15 percent of the total.

[2]Max. cut is the total volume of all potential problem species, in cords/acre. Minimum operable cut is considered to be 5 cords/acre.

Appendix C SPECIES CODES

AL - Alders

BA - Brown Ash

BC - Black Cherry

BE - Beech

BF - Balsam fir

CE - Cedar

GB - Grey Birch

HE - Hemlock

HM - Sugar Maple

OH - other hardwoods (Hornbeam)

OS - other species (Elm, Basswood)

PO - Poplar

RM - Red Maple

RO - Red Oak

RP - Red Pine

RS - Spruces

TA - Tamarack

WA - White Ash

WB - White Birch

WP - White Pine

YB - Yellow Birch

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