Environment Canada
Environnement Canada

Canadian Forestry Service
Service canadien des forêts

FUEL OR FIBER ?
Hardwood Utilization and Marketing Opportunities

J.C. Lees (editor)
Maritime Forest Research Centre

M-X-138

MARITIMES FOREST RESEARCH CENTRE

The Maritimes Forest Research Centre (MFRC) is one of six regional establishments of the Canadian Forestry Service, within Environment Canada. The Centre conducts a program of work directed toward the solution of major forestry problems and the development of more effective forest management techniques for use in the Maritime Provinces.

The program consists of two major elements - research and development, and technical and information services. Most research and development work is undertaken in direct response to the needs of forest management agencies, with the aim of improving the protection, growth, and value of the region's forest resource for a variety of consumptive and non-consumptive uses; studies are often carried out jointly with provincial governments and industry. The Centre's technical and information services are designed to bring research results to the attention of potential users, to demonstrate new and improved forest managment techniques, to assist management agencies in solving day-to-day problems, and to keep the public fully informed on the work of the Maritimes Forest Research Centre.

FUEL OR FIBER?

HARDWOOD UTILIZATION AND MARKETING OPPORTUNITIES

Proceedings of a conference sponsored
by the Atlantic Provinces Council on the Sciences

Edited by J.C. Lees

Maritimes Forest Research Centre
Fredericton, N.B.

Information Report M-X-138

Canadian Forestry Service
Department of the Environment

1982

Catalogue no. Fo46-19/138E
ISBN 0-662-12256-9
ISSN 0704-769X

Copies of this report may be
obtained from:
Maritime Forest Research Centre
Canadian Forestry Service
P.O. Box 4000
Fredericton, N.B. Canada E3B 5P7

Lees, J.C., editor. 1982. Fuel or fiber? Hardwood utilization and marketing opportunities. Proceedings of a conference sponsored by the Atlantic Provinces Council on the Sciences. Can. For. Serv., Marit. For. Res. Cent., Fredericton, N.B. Inf. Rep. M-X-138.

ABSTRACT

These proceedings include the written material provided by 13 of 15 speakers who contributed to the 2-day conference on Fuel or fiber? Hardwood utilization and marketing opportunities, held on March 16 and 17, 1982 at the University of New Brunswick, Fredericton, N.B.

Three papers describe the hardwood forest resource in the Canadian Maritime provinces. Six papers deal with utilization and marketing of a wide variety of finished and partly finished products that range from pulp for export, to fuel for domestic heating. The environmental impacts of hardwood forest management are next examined, and, finally, an account is given of two complementary research programs on hardwood silviculture and management now underway in New Brunswick, Nova Scotia, and Prince Edward Island.

Those who attended the conference are listed in the Appendix.

RESUME

Le présent compte rendu comprend la documentation écrite fournie par 13 des 15 personnes qui ont présenté des exposés lors de la conférence ayant pour thème les possibilités d'utilisation et de commercialisation des bois feuillus qui s'est tenue les 16 et 17 mars 1982 à l'université de Nouveau-Brunswick, à Fredericton.

Trois communications portent sur les forêts feuillues dans les provinces Maritimes. Six traitent de l'utilisation et de la commercialisation d'une grande variété de produits finis et semi-finis, allant de la pâte destinée à l'exportation au bois de chauffage domestique. Les répercussions environnementales de la gestion des forêts feuillues sont ensuite examinées, puis un compte rendu de deux programmes complémentaires de recherche sur la sylviculture et la gestion des feuillus présentement en cours au Nouveau-Brunswick, en Nouvelle-Ecosse et dans l'Île-du-Prince-Edouard est présenté.

La liste des participants à la conférence est donnée en annexe.

PREFACE

The March 16 and 17, 1982 Hardwood Conference was proposed by the Natural Resources subcommittee of the Atlantic Provinces Council on the Sciences, (APICS) and was the result of two years of planning by many concerned individuals and groups. Once the idea of a conference was accepted in principle by the Council, organizational support was provided by the New Brunswick Hardwood Management Technical Committee of New Brunswick Forest Research Advisory Committee, by members of the staff of the 'Continuing Education in Forestry' program, University of New Brunswick, and of the Maritimes Forest Research Centre, Canadian Forestry Service, Fredericton.

Members of these committees and organizations are well known to each other, so the structure of the conference and the roster of speakers quickly took shape. The conference was held at the University of New Brunswick under the chairmanship of Prof. R.B.B. Dickison, Faculty of Forestry. Additional members of the organizing committee were Prof. I.R. Methven, Prof. A. Dickson, Dr. J.C. Lees and Mr. C.A. Dickinson.

The Council was principal sponsor, and the Maritimes Forest Research Centre published these Proceedings. The New Brunswick Department of Natural Resources and the New Brunswick Forest Products Association contributed financially to the support of the Conference. Many others helped.

The background statement which follows was prepared by Prof. I.R. Methven, Chairman, Department of Forest Resources, University of New Brunswick.

Editor

CONTENTS

		Page
BACKGROUND OF THE CONFERENCE	I.R. Methven	1
THE HARDWOOD FOREST RESOURCE IN NOVA SCOTIA	F.R. Wellings	3
THE HARDWOOD FOREST IN NEW BRUNSWICK	D.M. MacFarlane	4
THE HARDWOOD FOREST RESOURCE IN PRINCE EDWARD ISLAND	B. Brown	6
HARDWOOD UTILIZATION AND MARKETING OPPORTUNITIES	D.D. Lockhart	8
HARDWOOD UTILIZATION: A DOWNEAST VIEW	T.G. O'Keefe	11
EFFECTIVE UTILIZATION OF THE AVAILABLE HARDWOOD RESOURCE IN NEW BRUNSWICK	M.R. Clarke	14
HARDWOOD UTILIZATION AT NORTHWOOD PANELBOARD	S. Jones	16
HARDWOOD UTILIZATION AT ST. ANNE-NACKAWIC	C.A. Dickinson	18
HARDWOODS IN THE FURNITURE COMPONENTS TRADE	W.R. Torunski	19
HARDWOOD UTILIZATION OVERVIEW, AND WOOD-CHIP BURNING PROJECT SUMMARY	M.H. Schneider	23
ENVIRONMENTAL IMPACTS OF HARDWOOD FOREST MANAGEMENT IN ATLANTIC CANADA	B. Freedman	25
NOVA SCOTIA HARDWOODS WORKING GROUP, JOINT RESEARCH PROGRAM	J.C. Lees	31
THE NEW BRUNSWICK HARDWOOD MANAGEMENT TECHNICAL COMMITTEE, JOINT RESEARCH PROGRAM	R.C. West	34
APPENDIX I - Scientific and common names of tree species mentioned in this study		36
APPENDIX II - Conversion Factors		36
APPENDIX III - List of Attendants		37

BACKGROUND OF THE CONFERENCE

by
I.R. Methven
Faculty of Forestry, University of New Brunswick

There is basically no hardwood policy in the Atlantic provinces. Hardwoods, except for limited use, are the poor cousins of the Atlantic forest; neglected, abused, and even denigrated as being nothing more than "weed" species in many cases. This results from a long history of softwood being king, from the days of the white pine square timber trade, on which Canada was built, to the current spruce-fir-dominated forest economies of the Atlantic Region.

Having said this, a legitimate response might be: so what? After all, the Atlantic Provinces have enormous reserves of hardwood, and the annual depletion in all four provinces is well below the allowable cut (1). The actual harvest in both New Brunswick and Nova Scotia is estimated to be only about 50% of the allowable cut (2). In the words of Babcock (1974): "Faced with a large allowable cut surplus of hardwoods ... are we justified in spending research effort on trying to grow more and better trees?" (3).

The short answer to this question is yes. The surplus is not an expression of health and vigor; it is an expression of lack of management, poor quality, and missed marketing and manufacturing opportunities. "In the past 20 years ... a number of hardwood veneer and plywood mills have closed due to a lack of suitable wood" (4), and there are only two such mills in the Atlantic provinces (5).

Production of hardwood lumber has been almost static over the last decade (5) and "the days have long gone when large, high-quality sawlogs comprised the major part of the sawmill supply. Every year the typical sawlog is smaller, more defective, and more variable in the characteristics affecting quality"(6). In fact "there is a distinct possibiility that the present considerable undercut in terms of volume is in fact an overcut with respect to quality!" (7).

Dr. G.L. Baskerville*, in his 1976 report to the Maritimes Forest Research Centre, has provided an excellent overview of the hardwood problem in the Maritime Provinces. In short, the problem is multifaceted and can be summarized as involving utilization, supply, high grading, quality, distribution, inventory, growth, age distribution, ownership, management, and marketing.

The last decade, however, has seen a significant, almost dramatic, change in attitude towards the smaller-sized, lower-quality hardwoods, after the construction of the St. Anne-Nackawic hardwood pulp mill and the conversion of the Northwood waferboard plant in New Brunswick, and the Masonite Canada mill in Nova Scotia. In addition, the present perceived energy crisis and the popularity of wood stoves, have resulted in a resurgence of demand for hardwood fuel. These relatively recent changes are providing an impetus for good hardwood management with better utilization and improved quality production.

However, every positive advance contains the seeds of a new problem, and this is no exception. The increased utilization combined with changed public needs and perceptions, could result in serious social conflicts between fuelwood demands and traditional solid wood and wood fiber products (1). In fact, Nova Scotia is already experiencing such a conflict over the proposal to convert the Nova Scotia Forest Industries softwood sulphite mill to a kraft hardwood mill, a move necessitated by the depredations of the spruce budworm (Choristoneura fumiferana (Clem.)) and the no-spray policy. There are already some vociferous voices being raised in the media and elsewhere against this proposal, on the grounds that fuelwood is a much higher value and socially acceptable end-use of hardwood than is pulp. Such conflicts, if not resolved rationally, can do great harm to the Province and the Region.

The hardwood picture then is one of enormous and developing problems requiring greater scientific and managerial knowledge and competence, improved marketing skills, more public awareness and understanding, and finally a sound and rational public policy. The opportunity exists, on the one hand, for great economic and social benefits to the region, or on the other hand, for great loss resulting from ill-informed comment, unnecessary conflict, and short-sighted policy leading to mismanagement of the hardwood resource. We cannot afford the latter.

Objectives of the Conference

1. To focus the attention of university scientists, government researchers and managers, and industrial entrepreneurs and managers on the scientific, economic, and social challenges and opportunities offered by hardwood management.
2. To provide a forum for improved public awareness and understanding of the role of hardwood in the regional economy.
3. To help develop a sound and rational public policy on hardwood management and utilization in the Atlantic Provinces.

* Baskerville, G.L. 1976. Hardwood Research in the Maritimes, Unpublished Report.

REFERENCES

1. Reed, F.L.C. and Associates. 1978. Forest management in Canada, Vol I. Can. For. Manage. Inst. Inf. Rep. FMR-X-102.

2. Lees, J.C. 1978. Hardwood silviculture and management: An interpretive literature review for the Canadian Maritime Provinces. Can. For. Serv., Marit. For. Res. Cent., Inf. Rep. M-X-93.

3. Hardwoods Management Workshop Proceedings. 1974. Ed., W.M. Stiell. Can. For. Serv. Petawawa For. Exp. Sta., Chalk River, Ont.

4. Federal Policy on the Canadian Forestry Sector. 1979. Discussion paper approved by the Cabinet Committee on Economic Development.

5. Review of the Canadian Forest Products Industry. Dep. Industry Trade and Commerce, Resource Industries Branch. 1978.

6. Petro, F.J. and W.W. Calvert. 1976. How to grade hardwood logs for factory lumber. Can. For. Serv., East. For. Prod. Lab., Ottawa. For. Tech. Rep. 6.

THE HARDWOOD FOREST RESOURCE IN NOVA SCOTIA

by
F.R. Wellings
Nova Scotia Department of Lands and Forests

General Forest Condition

Nova Scotia contains 5.5 million ha (13.1 million acres) of land and water with 4.1 million ha (10.1 million acres) of forest land.

The Province can be divided into softwood cover type 40% (2.2 million ha or 5.4 million acres), mixedwood cover type 23% (1.2 million ha or 3.0 million acres), hardwood cover type 12% (0.7 million ha or 1.7 million acres) and all nonforest area 25% (1.4 million ha or 3 million acres).

One of the most significant factors in Nova Scotia forest management is the pattern of land ownership which is categorized as 26% Crown, 21% large private (i.e., owning 400 ha or more), 50% small private (owning less than 400 ha), and 3% Federal, (primarily two National Parks).

Species

The Province contains 88 million m^3 (3.1 billion cu ft or 38 million cords) of hardwood species which is 31% of the total growing stock of the province.

Of this hardwood growing stock, 16% occurs in softwood cover types, 46% in mixedwoods and only 38% in pure hardwood.

Most of the sugar maple and yellow birch occurs in eastern Nova Scotia while 90% of the oak occurs in the western end. The red maple and aspen are primarily in the Western and Central regions of the Province. In total, hardwood is well distributed across the Province and is divided among the following ownerships:

Crown	23%
Large private	24%
Small private	49%
Federal	4%

Hardwood Products

The hardwood resource is basically of poor quality because of past high-grading, sprout growth, and pioneer species growing after cutting or burning.

The quality of the resource can be categorized as follows:

Sawlog	16%
Boltwood	10%
Topwood	9%
Pulpwood	61%
Cull	4%

These products can also be analyzed by geographic distribution:

	Western	Central	Eastern
Sawlog	36	27	37
Boltwood	43	32	24
Pulpwood	27	32	41
Cull	35	24	41

The sawlogs are mainly in the Western and Eastern regions whereas the boltwood is mainly in the Western Region. Most of pulpwood is in the Eastern Region followed by the Central Region. The greatest percentage of cull is in the Eastern followed by the Western Region.

The percentage of products from the individual hardwood species is as follows:

	Saw Log	Bolt wood	Top wood	Pulp wood	Cull
Sugar maple	27	6	11	55	1
Red maple	15	10	9	63	3
Yellow birch	14	4	7	65	10
White birch	7	19	9	64	1
Oak	30	34	17	18	1
Aspen	20	17	12	50	2

Hardwood Growth

The net growth of hardwood species is 2 164 000 $m^3 yr^{-1}$ (0.98 million cords) or 5.25 $m^3 ha^{-1} yr^{-1}$ (75 cu ft/ac per year).

The mortality is 561 700$m^3 yr^{-1}$ (254 000 cords), or 0.133 $m^3 ha^{-1} yr^{-1}$ (1.9 cu ft/ac per year).

Hardwood Harvesting

The present calculation of annual allowable cut for Nova Scotia is 1 055 000 m^3 per year. The present commercial production is about 400 000 m^3 (180 000 cords) of which 14% is sawlog and 86% is pulpwood, and a fuelwood estimate of 440 000 m^3 (200 000 cords) for a total of 840 000 m^3 (380 000 cords). This still leaves a small surplus of hardwood, overall 215 000 m^3 (97 000 cords).

THE HARDWOOD FOREST RESOURCE IN NEW BRUNSWICK

by

D.M. MacFarlane
New Brunswick Department of Natural Resources

Until recently, hardwoods in New Brunswick, except for quality sawlogs and veneer logs, were considered almost weed species. This has changed dramatically in a very short period. Landowners who have good stands of hardwood are now considering them as valuable as softwood. In addition to a steady demand for quality material, we now have demands (sometimes conflicting) for hardwood suitable for pulpwood and for domestic heating. If softwood shortages occur in the future (and in some cases they may be inevitable) hardwood fiber may also be required to supplement wood for traditional softwood mills.

Rather than discuss the hardwood resource in terms of production and supply, I would like to discuss it in terms of supply and demand. The Province has carried out three supply inventories over the last 20 years in addition to special inventories designed to determine the volume of quality hardwood in specific areas. A large number of permanent sample plots were also established as part of the first inventory in 1958. These plots have had at least three remeasurements over the last 15 to 20 years. Growth estimates for hardwoods over this period ranged from a low of 0.2% for beech to a high of 3.8% for aspen. Sugar maple and yellow birch were 1.7%.

A new forest development survey is presently underway which places more emphasis on individual species and the stage of development of individual stands, and provides volume estimates. The main objective of this present inventory is to provide data that can be used to predict stand development.

Hardwood Supply

Sixteen hardwood species of some commercial importance occur in New Brunswick. Together, these represent 35% of the total timber volume or about 179 million m^3. The tolerant species comprise about 57% of this total, and intolerant species, 43%. The total hardwood volume has in fact, increased by about 14% between 1958 and 1978. This is a direct contradiction of the myth that hardwoods are being eradicated in favor of a softwood monoculture. Table 1 outlines the hardwood volumes by diameter class and species. Based on 1978 forest inventory data, nearly one-half of the total volume is 26 cm dbh or larger. This distribution has remained relatively constant over the last 20 years suggesting that the percentage of log-size hardwood is remaining constant. This is not the case when diameter distribution by individual species is considered. Tables 1 and 2 show that the log-size material for all the tolerant hardwood species (yellow birch, sugar maple and beech) has declined since 1958, while the log-size material for the intolerant species, aspen and white birch, has increased since 1958. Tree size is only an indication that the tree is suitable for sawlog or veneer log use. Information on the quality of hardwoods shows that only a small proportion of the total hardwood volume is suitable for sawlog end-use (Table 2).

Table 1. Volume (millions of m^3) by species and dbh classes for New Brunswick

Species	Dbh classes (cm) 12-14	16-24	26+	Total	Percent of total hardwood volume
Red maple	8.01	26.87	9.17	44.05	25
Sugar maple	2.85	12.61	18.25	33.71	19
Yellow birch	1.52	8.74	12.20	22.46	12
White birch	5.14	5.67	15.04	25.85	14
Aspen	3.92	4.64	22.91	31.47	18
Beech	2.45	8.38	6.45	17.28	10
Other hardwood	1.34	1.87	0.65	3.86	2
Total hardwood	25.23	68.78	84.67	178.68	100

Table 2. Distribution of volume (%) by species and grade

Species	Grades Log	Fiber
Red maple	6	94
Sugar maple	18	82
Yellow birch	15	85
White birch	34	66
Aspen	36	64
Beech	2	98

Table 3. Distribution, by resource region, of various tree species by volume and percentage

Species	1		2		3		4		5		Total
	'000 m^3	%	'000 m^3	%	'000 m^3	%	'000 m^3	%	'000 m^3	%	'000 m^3
Red maple	4.06	9	8.03	18	11.36	26	15.77	36	4.83	11	44.05
Sugar maple	6.48	19	3.69	11	2.89	9	7.86	23	12.79	38	33.71
Yellow birch	3.32	15	2.38	10	3.04	14	5.42	24	8.30	37	22.46
White birch	3.78	15	3.65	14	6.21	24	8.09	31	4.12	16	25.85
Aspen	5.92	19	3.60	11	9.10	29	8.24	26	4.61	15	31.47
Beech	1.57	9	3.75	22	2.07	12	5.45	31	4.44	26	17.28
Other hardwood	0.38	10	0.51	13	0.97	25	1.47	38	0.53	14	3.86
Total											178.68

Hardwood Supply By Ownership

About 23% of the total hardwood inventory in the Province is located on large freehold land, 34% on small freehold, and 43% on Crown land.

In terms of log-size material about 26% is found on large freehold, 26% on small freehold, and 44% on Crown land.

Hardwood Supply By Geographic Location in New Brunswick

All hardwood species are not evenly distributed. About 60% of the hardwood species required for sawlogs and veneer logs (sugar maple, yellow birch, and beech) are located in the northwestern part of the Province. The main hardwood species in the eastern and southern parts of the Province are red maple, white birch, and aspen, (Table 3). This is also reflected in the location of hardwood sawmills, with about 50% of the total production capacity in the northwest section.

Estimates of Sustainable Harvest Levels for Hardwood

The current estimate of sustainable harvest levels for all hardwood species is about 2.6 million m^3. This is an almost meaningless figure if not broken down on the basis of species and quality.

Table 4 shows a breakdown of hardwood supply and demand by species group. Overall, there is an annual allowable cut surplus in New Brunswick. In log size and quality material, however, there is a significant deficit in the traditional hardwoods used as sawlogs. In other words, the present demand for hardwood sawlogs cannot be maintained unless quality and size (length and diameter) standards are significantly reduced. The demand for pulpwood and fuelwood is presently less than the sustainable supply on a provincial basis. Regionally (in areas where hardwood pulpmills are situated), there are shortages in the lower quality material and conflicts are now arising between industrial use and use for domestic heating.

All estimates referred to are based on the bole portion of the tree. If the total tree (tops and branches) were utilized, the sustainable hardwood fiber supply could be increased by 30-40%.

In summary, the growing stock of intolerant hardwood species has increased over the last 20 years. Tolerant species especially in the larger diameters have declined. The traditional sawlog supply cannot be maintained based on current sawlog specifications. Pulpwood and fuelwood supplies can be maintained and expanded in some areas of the Province, however, regional shortages now exist.

Table 4. Hardwood supply and demand by species

Species	Estimated hardwood supply		Present plant capacity including fuelwood*	
	Logs	Pulp or fuelwood	Logs	Pulp or fuelwood
	'000 m^3			
Sugar Maple, Red Maple, Yellow Birch, Beech	170	1 254	242	1 102
Aspen, White Birch	132	1 096	63	748
Total	302	2 350	305	1 850

* Total estimated fuelwood use 400 000 m^3

THE HARDWOOD FOREST RESOURCE IN PRINCE EDWARD ISLAND

by
B. Brown
Prince Edward Island, Department of Agriculture and Forestry

The history of the hardwood forest on Prince Edward Island is one of land clearing and high-grading. It is only recently that this valuable natural resource has received any general appreciation.

Earliest accounts of the forests of Prince Edward Island describe high quality mature tolerant hardwood stands. There are many descriptions of stands of large sugar maple, yellow birch, beech, and oak. These records indicate that all but the poorest sites supported hardwood stands. The poorest sites were occupied by softwoods - mostly balsam fir, black spruce, and pine. The conversion of these forests of tolerant hardwood to those that we know today has been the result of generations of neglect and mismanagement. Far from considering the forest as a valuable resource, the first settlers of Prince Edward Island considered them as a direct threat to their very existence. The forest provided wood for building homes and farm buildings, and fuelwood for heating and cooking, but it also prevented the planting of crops. It was therefore, a settler's first and most essential task to clear a space in the forest large enough to plant a crop.

Normally this clearing was accomplished by logging and burning. The initial burning usually eliminated only the smallest trees and branches. It was necessary therefore to conduct several burnings on the same area to complete the task. Because of the need to clear land quickly, and the difficulty of doing so by hand, it is little wonder that many settlers took the shortcut of starting wild fires.

Not all fires were deliberately set. Many started from burning on the more traditional clearing operations. This however, did not alter the fact that wild fires were such a common occurrence that before a settler built a home he cleared an area of sufficient size to act as a firebreak. These fires were the first and possibly the most dramatic force in the conversion of the forest of Prince Edward Island, because after a fire a stand would regenerate to softwood and intolerant hardwood. To the settlers of that era, this was of little concern because their requirements from the forest were fuelwood and lumber, both of which could be provided by the newly created forests.

During the following generations, the degradation of the forests continued because of agricultural and shipbuilding activities. The low point in the history of Prince Edward Island forests was reached around 1900 when it was estimated that 80% of the available arable land was in agriculture production. From that period until the present, there has been a steady trend of conversion of agricultural land back to forest. The typical successional pattern for this conversion was from agricultural production to white spruce, to one or more generations of mixed stands with varying proportions of white spruce, balsam fir, poplar, white birch and red maple - and finally to more tolerant species such as sugar maple, yellow birch, beech, and eastern hemlock. Because the farms have been abandoned only a short time most areas have progressed into only the first or second phase, and the ratio of hardwood to softwood has not yet reverted to that of the predisturbance period. In those areas that had never been cleared, the harvesting pressure has been so great, and conducted in such a poor way, that the present forest bears little or no resemblance to the original.

There were two typical harvest patterns. The first was to remove only the largest and best quality stems for lumber and boat keels - a progressive degradation of quality. The second method was a clearcutting operation, that totally eliminated the mature stand, - normally resulting in the conversion of the site to less desirable intolerant species.

These are some of the forces that have combined over the past 250 years to create the forest we know today. Unfortunately, at this time I am not able to give you a definite description of the hardwood resource of Prince Edward Island. The new provincial forest inventory, started in 1980, is not yet complete. Preliminary information supports many of the assumptions that have been made in the past. There are at least 243 000 ha (600 000 acres) of forest land on Prince Edward Island, of which one-third is hardwood with a growth rate of one-half cord per acre per year. These assumptions lead to a projected gross annual production of 362 460 m^3 (100 000 cords) of hardwood. With the completion of the provincial forest inventory, it will be possible not only to quantify the volume of hardwood present, but also to describe the quality. The availability of this data is essential in making management decisions for the manipulation of existing stands, and for orderly utilization.

At present the main use of hardwood in Prince Edward Island is for domestic fuelwood. A study during 1979 indicated that about

253 750 m^3 (70 000 cords) of fuelwood were consumed. Unfortunately this amount was not broken down by fuel type but it is safe to assume that the bulk was hardwood. The secondary demand for hardwood is for sawlogs. Although far less volume is consumed, the quality requirements are such that this demand is becoming increasingly difficult to meet. The present demand for hardwood products is estimated at 271 875 m^3 (75 000 cords); 235 625 m^3 (65 000 cords) for use as domestic fuelwood, and 36 250 m^3 (10 000 cords) for lumber and related products. The demands are only estimates because data gathering is extremely difficult where 90% of the resource is privately owned and controlled by about 14 000 individuals.

The forests of Prince Edward Island are again entering a period of high demand. This demand has been brought about by external forces over which the people of Prince Edward Island have little control. Unlike in New Brunswick or Nova Scotia, there is expected to be no significant industrial demand for hardwood fiber. Hardwood will be in demand for energy. Prince Edward Island is in the unenviable position of being almost entirely dependent for energy from sources outside the Island. All oil products and an increasing amount of electricity are imported. For the foreseeable future, the only possible local sources of energy are solar, wind, and biomass. Wood fuel offers the greatest immediate potential for the displacement of imported oil. From a study completed by the Institute of Man and Resources, it is estimated that 982 375 m^3 (271 000 cords) of wood for energy may be used, annually, by 1990. Although this may seem a large increase, the bulk of this new demand for commercial use will not be for hardwood, but for softwood. Present discussions center around a wood-fired electrical generator that would require 435 000 m^3 (120 000 cords) of fiber annually.

Coupled with present traditional demands on the hardwood resource, these new demands will put a stress on the forests surpassed only by those created during the earliest period of settlement. However, the inventory and growth data that are available, indicate that these demands can be met with slightly improved forest management, at least in the short term.

The challenge for those people involved in forest management on Prince Edward Island is straight-forward but very difficult. Simply stated, this challenge is to convince the forest landowner to practice better forest management. Although the forest resources will be placed under stress, the opportunity exists to turn this into a long-term benefit, not only in the long-term production of energy but also in the protection of the forest environment, in the maintenance of the hardwood component of the forest, and the production of smaller quantities of high quality wood.

For this to become a reality, a conscientious decision has to be made by all those people involved with forest management. It is not an easy decision for it will require modification of many aspects of present forest practice, including harvesting, stand tending, protection, and economic expectations. A start has been made on Prince Edward Island and the challenge has been accepted by the Department of Agriculture and Forestry. It will, however, take many years and dollars, but just as importantly it will take the support of groups like APICS.

HARDWOOD UTILIZATION AND MARKETING OPPORTUNITIES

by

D.D. Lockhart
New Brunswick Forest Products Association Inc.

The subject is hardwood and the location is New Brunswick. Table 1, shows that on the basis of a Provincial annual sustainable harvest of about 941 000 cunits of hardwood, there is presently an excess of 300 000 cunits available each year.

Table 2 shows the make-up of this balance, either surplus or deficit in the five forest management regions. All except Region 4 show a hardwood surplus.

Several points must be noted

1. The fuelwood figures are only a rough approximation.
2. The largest surpluses occur in the two regions (SE - Region 3 and NW - Region 5) which do not have a processing facility utilizing hardwood fiber.
3. Species breakdown of these surpluses is not available.
4. Quality breakdown by species is not available.

All that we really know is that the surplus is NOT in the form of veneer logs or sawlogs. The quality is probably "fiber quality" - whatever that may mean. We should treat these figures very carefully. All these estimates are based on traditional simplistic approaches using percent growth rates applied to the total growing stock, and they relate to the year 1980. Table 3 shows the annual demand on our hardwood resources by region.

So, we do not have a good estimate of what is growing - by species, by age, or by quality - on Crown or private lands.

Let's look at the fuelwood situation, particularly with regard to relative costs of heating, using wood, natural gas, electricity, and coal. In Fig. 1, the diagonal line indicates the prices at which wood and the conventional fuel source give an equal energy output. If, when comparing the current or projected cost of conventional fuels with the current or projected cost of wood fuel, the two lines intersect within the upper section, then wood is cheaper.

I suggest that the topic "Fuel or Fiber?" is simplistic. It is not, and cannot be a straightforward "either/or" situation. It is not a matter of assigning our hardwood to a fiber end-use or to a heating end-use. In my opinion, we can and must satisfy many end-uses.

The curse of our forest management has been and is a "one purpose" orientation. Historically, when white man settled here he found the forests more of a hindrance than a benefit. He cleared them as fast as he could - which,

Table 1. The hardwood situation in New Brunswick in 1980

	Cunits
Provincial sustainable harvest	941 000
Total annual industrial and fuelwood requirements	622 600
Surplus	318 400
Average annual industrial requirements	504 000
Average annual fuelwood requirements	80 000
Average annual net exports (exports-imports)	38 000
Total	622 000

Table 2. Average hardwood supply-demand balance in New Brunswick by region in 1980

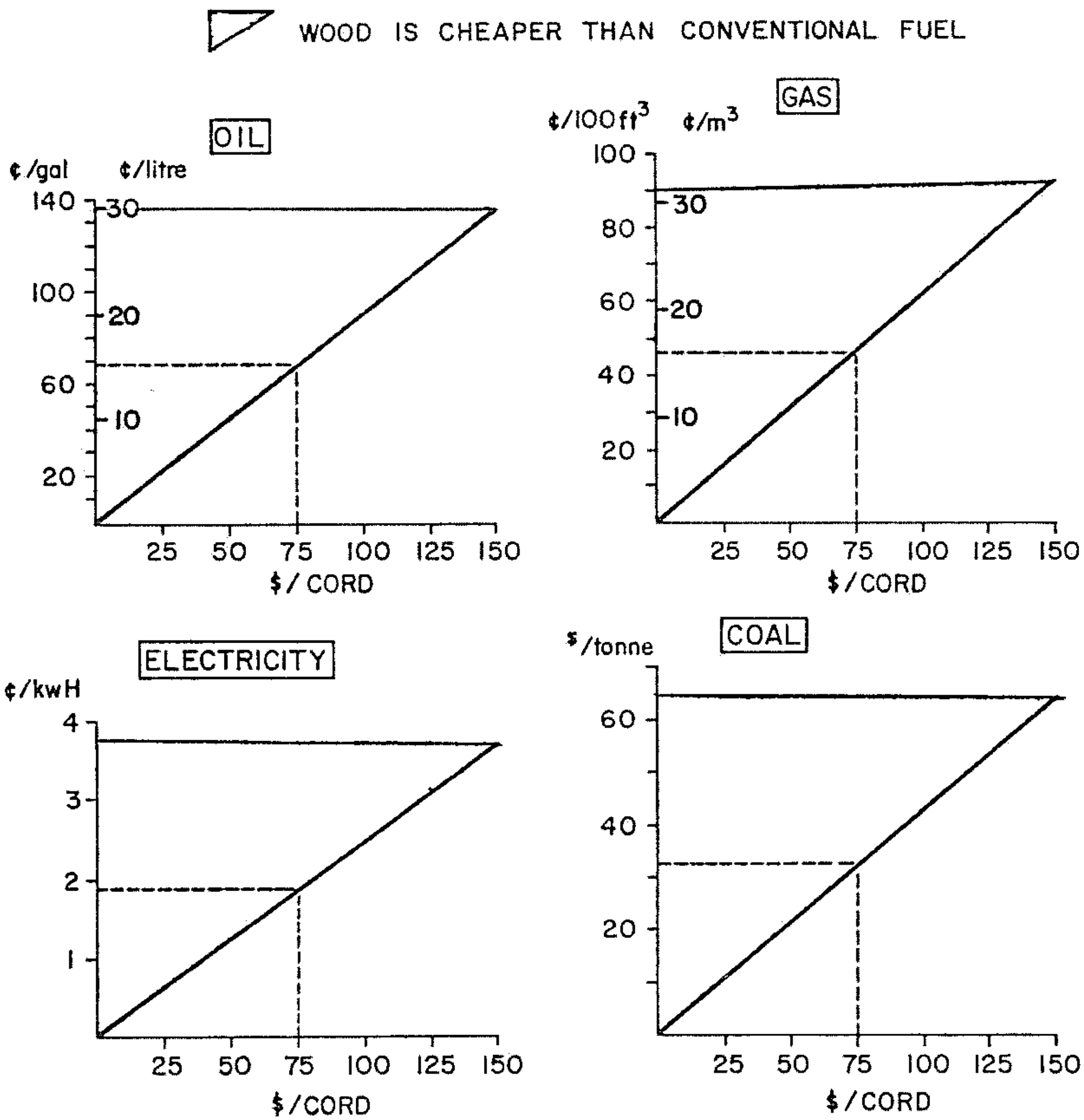
Region	Sustainable harvest	Total demand	Surplus (deficit)
	'000 cunits		
1 - NE	147.0	74.3	72.7
2 - CE	124.0	120.7	3.3
3 - SE	209.0	29.7	179.3
4 - SW	252.0	313.9	(61.9)
5 - NW	209.0	84.0	125.0
Total	941.0	622.6	318.4

Table 3. Demand on New Brunswick hardwood resources in 1980

Region	Net ind. demand	Fuelwood	Net exports (imports)	Total demand
	cunits			
1 - NE	59 692	14 000	545	74 237
2 - CE	108 630	12 000	---	120 630
3 - SE	7 501	22 000	183	29 684
4 - SW	249 650	20 000	44 234	313 884
5 - NW	79 004	12 000	(7 028)	83 966
Total	504 477	80 000	37 924	622 401

Figure 1.

COST COMPARISONS BETWEEN WOOD AND CONVENTIONAL HEATING FUELS



			ASSUMED COMBUSTION EFFICIENCIES
WOOD (Maple at 20% moisture)	22.5×10^6 KJ/CORD	21.3×10^6 BTU/CORD	65 %
OIL (#2 HEATING)	38.6×10^3 KJ/LITRE	166500 BTU/GAL	75 %
ELECTRICITY	3.6×10^3 KJ/kwH		100 %
NATURAL GAS	37.9×10^3 KJ/m^3	1070 BTU/ft^3	80 %
COAL	26.6×10^6 KJ/TONNE		60 %

Comparison table courtesy - "Woodfuel Supply Business in Canada - An Overview"- Communitech and Associates, Ottawa.

thank goodness, wasn't very fast. He took what he needed to build his house, barn, mill, and school, but these uses hardly made a dent in the growing stock. Then the Royal Navy needed masts and spars, so along came the "one purpose" white and red pine square and waney timber operations. Then came the sawmills, again, one purpose. During World War II, large quantities of birch were required, veneer quality only, again one purpose. Now, a veneer plant needs veneer logs, a sawmill needs sawlogs, and a pulpmill needs pulpwood, but a pulpmill can shove a pulpwood bolt or a veneer log or a sawlog, into its chipper and the final product is pulp. In my opinion it is a crime to see high quality bolts or logs going into a digester. Also such material is far too valuable to burn in a wood stove, but it splits nicely.

A plant in Arkansas, Dierks Forest Products, takes delivery of tree-length southern yellow pine and hardwoods - complete with branches and leaves. One man, and one man only, grades each tree length and marks it according to the best end-use - this section is a veneer log and goes to the plywood line, another short 3 ft section goes to a short-log bolter, another 10 ft section goes to the sawmill. Anything remaining which cannot be peeled, sliced or sawn goes into pulp chips - including the branches, a "multi-purpose" operation.

The secret is stem quality assessment and log grading. We don't do it in New Brunswick. I suggest that everyone in the hardwood business should know about, understand, and use the book - "Felling and Bucking Hardwoods - How to Improve Your Profit" (Petro 1975). There are enough examples of bad felling and bucking practices! All have the effect of lost revenues. A companion book is "How to Grade Hardwood Logs for Factory Lumber" (Petro and Calvert 1976). Yesterday's technology is not good for today and most certainly will not do for tomorrow. There is no alternative but the application of the latest technology to solve our utilization problems.

Research is opening more doors. Forintek, has developed high value interior panels and structural panelling using poplar/birch for composites. Structural panelling three to four times as strong as conventional waferboard has been prepared using the improved composite technology. In preserved wood foundations, Douglas fir plywood traditionally has been used for sheathing. Now foundation composite board can be produced competitively, based on a modified waferboard process. Consider, too, a 25 tons per day densified biomass fuel plant with a capital cost of less than $400,000.

Today, we can produce sawn items to a tolerance just about equal to that of steel. The accuracy of present day sawing, edging, trimming, ripping, and defecting equipment is truly startling, and considering the relative low quality of our raw material, this equipment does, in fact, allow us to "make a silk purse out of a sow's ear". A short-log saw, a bolter, does a good job of breaking down short logs, and a "merry-go-round system" for re sawing can now be controlled by one man.

But where is this new technology in New Brunswick and what will be the effect of the three waferboard plants, proposed for a few miles inside the Maine border? Obviously, these plants will draw off a lot of wood from New Brunswick. One must ask the question - if one, two, or three of these plants are viable in Maine, would not at least one of them have been viable in New Brunswick? Another question - if Japanese interests owned or controlled our wood resource, what would there be in place now, and what fantastic developments might be in the planning stage?

Over the past two years or so, we have been wrestling with the new Crown Lands and Forests Act, with the management manual, operating plans, industrial plans, forest management agreements, and with basic silviculture, and compensation for roads and bridges. All are necessary and important. But no one zeros-in on the necessity to obtain better and increased utilization. It is essential to our success and well-being that, via research and the putting-in-place of new technologies, we improve our utilization and that we get more out of each log or bolt. It certainly can be done.

References

Petro, F.J. 1975. Felling and bucking hardwoods. How to improve your profit. Can. For. Serv., East. For. Prod. Lab. Ottawa Publ. No. 1291.

Petro, F.J., and W.W. Calvert. 1976. How to grade hardwood logs for factory lumber. Can. For. Serv., East. For. Prod. Lab. Ottawa For. Tech. Rep. 6.

HARDWOOD UTILIZATION: A DOWNEAST VIEW

by
T.G. O'Keefe
Forest Products Laboratory, University of Maine, Orono

In Maine and throughout much of the United States, softwoods,[1] like pine and spruce have been historically the "backbone" of our forest industry. Hardwoods, on the other hand, have been important only in local areas, and in terms of highest quality stems. In general, hardwood utilization has been a history of misuse, and misunderstanding.

This same hardwood problem is a continuing part of today's utilization and marketing operations. In the past few years, there has been one important change in hardwood use -- fuelwood. Throughout the colder parts of this country the rising cost of fuel oil increased dramatically the consumption of hardwoods as a source of home fuel. Unfortunately, this increased demand for hardwood as fuel often leads to high-grading; the high density species like oak and maple yield more heat per cord, and the good quality, straight stems split more easily.

In continental United States, commercial hardwoods are concentrated in the eastern half of the continent. Hardwoods tends to be site demanding, but some species will grow on poorer sites. For example, black-locust can grow on poor sites, and will also fix nitrogen for soil improvement. On a volume basis, hybrid poplar grows rapidly, while based on value, such species as sugar maple and black walnut are literally "worth their weight in gold".

Traditionally, hardwood utilization has been described in terms of fiber, or non-fiber use. Fiber utilization includes manufacture of lumber and veneer, as well as pulp and board products. Until recently, these fiber uses have been commercially most important. Non-fiber utilization of hardwoods has included in-place use for recreation and wildlife, chemical conversion for maple syrup, birch sugar, and cattle fodder, as well as methanol for fuel. Most recently, solid fuel use in the form of firewood, chips, or pellets has expanded rapidly.

Hardwood research has always been limited. Much of our research has been directed toward better softwood utilization. However, recent Forest Service research efforts have included more attention to hardwood utilization. For example, the Sawmill Improvement Program (SIP), originally designed to assist softwood mills, has been expanded to include hardwood mills. In addition, Roughmill Improvement Program (RIP) Edge Glue and Rip (EGAR), and Serpentine End Matching (SEM) research and assistance programs are directed to hardwoods. There is also growing interest in utilization of light weight — low density, hardwoods for dimension lumber. At the Burlington, Vermont laboratory, Forest Service staff also conduct research on maple and maple syrup production.

Locally, utilization of northern hardwoods in Maine seems to face an uncertain future. On a volume basis, the hardwood resource (about 26% of total State growing stock)[2] is important and is of considerable potential value. Maine hardwoods have been used as the basis for a small, but very important wood-turning industry, concentrated in the western part of the State. Other uses include lumber, furniture, and waferboard. Non-fiber uses of hardwoods continue to provide in-place value for recreation, wildlife, maple syrup production, and for an increasing number of other products. Therefore, obtaining good quality, defect free, hardwood stems remains a major problem for Maine mills.

Resource Use

More efficient use of our hardwood resources will require some new management and utilization strategies. The solution to some of our hardwood problems will depend on more intensive hardwood forest management, and improved hardwood utilization.

Since much of our hardwood land is held in small size parcels, it is very important to address the management question from the view point of the small woodlot owner. There are several important elements:

1. Size and accessibility,
2. Economics,
3. Site quality.

It is important to understand that most woodlot owners have relatively short-term goals, and require an immediate (or relatively rapid) return on their investment. In contrast, a large timber company usually manages the resource on the basis of long-term goals, and with a view for the long-term return on investment.

On large, accessible areas, the woodlot owner can thin and harvest at lower costs, and with quality potential he can segregate the wood for highest use, and greatest return to the landowner. On the other hand, the owner of a small woodlot frequently must use this limited resource in-place, for domestic fuelwood.

One key to better hardwood management is more attention to the details of site quality. Generally, it is most prudent to invest on the better sites, first. On such sites, management should be directed toward the production of heavy weight, good quality, high value species for sawlog and veneer grade products, over a longer rotation. This requires a

---

[1]Softwood in this paper is intended to mean conifers; while hardwood refers to angiosperms.

[2]The Timber Resources of Maine, R. Ferguson, and N. Kingsley, F.S., USDA NE-26, Broomall, PA. 1972

relatively higher investment and more intensive management. Intermediate thinnings can be used for fuel. In addition, it may be possible to realize some other value like maple sap, recreation, and wildlife.

On poorer hardwood sites, management should be directed toward production of light weight, lower quality, low value species, for high volume production on a short rotation. This type of hardwood management could be most useful for products such as pulp and flakeboard. In addition, the smaller size, lowest quality stem, and branchwood could be used for fuel, chips, or pellets.

Improved hardwood utilization involves a wide variety of activity from the wood yard to the retail yard. At the wood yard, careful handling and debarking of logs can substantially reduce waste. Equally important, hardwoods should be sorted on the basis of wood density and species, as well as size and quality. The production of hardwood lumber and veneer requires conversion of relatively large size logs. Quality must include the number and degree of wood defects present in the stem, stem form (or taper), and growth rate. Wood quality is also affected by the presence of juvenile wood and abnormal reaction (tension) wood in the stem.

Each piece of hardwood material should be assigned to an end-use commensurate with the wood quality, and the use-requirements of a particular group of products. This will ensure that the high quality material is used for high value products, like veneer, while low quality wood is used for lower value products, like fuelwood.

Alternatives

The recent fuelwood boom has resulted in a surge of attention to our hardwood resource. Unfortunately, much of this attention has been negative. Higher prices for fuelwood have diverted some of our hardwoods from traditional markets, like the Maine wood-turning industry. In addition, fuelwood cutters have often found it "easier" (and hence, more profitable) to take the best quality stems that should be reserved for higher quality products.

Some of this abuse and misuse of our hardwood resource has been reduced by a program of landowner education and service. The Maine Extension Forestry program, and other agencies have provided information to landowners, designed to improve hardwood management. Service foresters, both state and industrial, together with consulting foresters, have worked a number of hardwood lots to demonstrate good management for the landowners. Much hardwood exploitation, and mismanagement continues, but there is evidence that public awareness about our hardwood resource is increasing.

This loss of our hardwood resources can be reduced in two ways: better technology transfer, and a program of hardwood incentives. At present, there is a large volume of hardwood research — both management and utilization — that has seen little, if any, application. It is now critical that we develop better plans to get this wealth of research data from the lab to the users in the forest and the mill. This technology transfer process requires development of a systematic program, which includes sufficient support, that will result in timely application.

On small woodlots, hardwood management can be an expensive, long-term project. Most small woodlot owners find it difficult to justify hardwood investments, unless they consider the added value of the resource for the next generation. To provide small woodlot owners with some more immediate reason to manage hardwoods, it has been suggested that a special program of "incentive payments", directed only to hardwoods, be developed by government, or wood industry, or jointly. A special hardwood incentives program, which would pay for the cost of management investments, and also provide some short-term returns to the landowner could very effectively increase the level of productive hardwood management.

Management and utilization of the hardwood resource can be improved by appropriate implementation of techniques such as

Management

1. Better site analysis
   — work on better quality sites first, for either long-term or short-term hardwoods.
2. Increased use of selected genetically improved growing stock
   — set-out in plantations.
3. Improved protection
   — from fire, insect or disease, as well as animal or human damage

Utilization

1. Wood density basis for use; species substitution
   — including tropical imports.
2. Stemwood segregation
   — highest quality wood, to highest use.
3. Complete tree use
   — branchwood and residue use.
4. Fuelwood
   — lowest quality stemwood,
   — branchwood and residue,
   — use thinnings.

CONCLUSIONS

In the long term, the demand for hardwood will increase for use as both fiber and non-fiber products, including fuelwood. Fortunately, most projections for fuelwood demand forecast only a very slight increase, and some projections even forecast a decline in demand for fuelwood. A plan to meet this growing hardwood demand requires some action to improve both management and utilization of the domestic hardwood resource. In addition, some attention must be directed to developing a limited system for use of high value, imported tropical hardwoods.

The most important element that will determine the success of an improved hardwood management and utilization system is a strong education program. Much of the hardwood resource is owned and milled by small woodlot owners and small mills. These small enterprises require a great deal of educational assistance, in order to achieve maximum growth and yield. Of course, if education fails to produce the desired results, government, at some level, may consider it appropriate to develop some elaborate system of regulations, to insure an adequate supply of quality hardwoods. On this basis, a program of sound education for increased hardwood production is an essential part of any hardwood strategy.

The technology for improved management and utilization of hardwoods is available now. Additional hardwood research is <u>not now</u> needed. The fundamental need, at present, is to apply the existing hardwood knowledge, in a timely and efficient way that will solve our hardwood production problems. In short, the question of better hardwood management and utilization is a question of improved technology transfer. In the past, a great deal of money has been invested in hardwood research. Presently, it is time to demand some more practical returns on this tax-supported research effort (more than a highly technical publication that only other scientists understand). It is now essential that adequate funds be allocated for application. The systematic approach to moving our laboratory information from the shelf to the field is the only way we can ensure better long-term management and utilization of our total hardwood resource.

EFFECTIVE UTILIZATION OF THE AVAILABLE HARDWOOD RESOURCE IN NEW BRUNSWICK

by
M.R. Clarke
Forintek, Canada

Many studies have been made of the state of the New Brunswick forests and the future of the forest products industry in New Brunswick. Most of these studies have concentrated on the industrial potential of the forests and, while the job is by no means complete, what is known, to date, gives rise to some concern for the future. To put it simply, the large, high-quality timber has been harvested in many cases leaving a residual forest composed of mainly small-diameter low-grade hardwood trees. The province is already operating deficit forestry with respect to softwoods i.e., harvesting more than the annual allowable cut (AAC).

It is timely that the theme of this conference is the market for the large hardwood resource in New Brunswick which is currently underutilized. We should, therefore, begin by looking at the opportunities that will exist for wood products from New Brunswick from 1987 to the year 2000. Most particularly, I would like to consider the impact that Research and Development (R & D) could have on those opportunities. It is very difficult to predict market conditions in the short term, but economists are unanimous in predicting a strong demand for wood products by the year 2000. The general concensus is that demand will double by that time. While the projected increase in demand is largely for traditional softwood products, current demand has already raised the price of these products to levels where hardwood substitutions are competing strongly.

There is already a large demand for composite wood products made from hardwood. The most obvious example is the manufacture of waferboard from a mix of aspen, white birch, and soft maple substituted for softwood plywood. During the current recession, the composite wood products sector of the industry has suffered less than traditional areas. From the point of view of the forest managers, the volume of underutilized hardwoods is a major factor inhibiting the intensive forest management required to maintain the viability of the softwood industry, which at present, is the mainstay of export earnings for this province.

The volume of wood products manufactured in New Brunswick is eqivalent to about 4 million oven-dry (od) tons (9.8 million m^3) annually. At the same time, it is estimated that over 20 million tons of wood fiber is not being utilized. This consists of currently non-utilized hardwood species, hardwood residuals left behind in softwood logging operations, plant residuals, logging slash, and dead and diseased timber (e.g., spruce budworm (*Choristoneura fumiferana* (Clem.) damaged). This volume of wood is a major factor inhibiting effective regeneration of high-quality forests through intensive management. However, it also represents an opportunity for future expansion of the forest products industry and a means to ensure the viability of the existing industry in New Brunswick. Intensive utilization of this material will result in two benefits, increased raw material supply, and increased cash flow to finance site preparation and other measures required for intensive forest management programs.

We see two major elements in a comprehensive approach to effective utilization of the available biomass. These are

- expansion of existing uses, i.e., improving the products and the processes of the existing industry using known technology (e.g., Forintek's sawmill improvement program);
- developing new technology to utilize the changing resource, i.e., matching technology to the resource and market needs (e.g., new energy products and composite products).

We have sawmill improvement programs for both softwood and hardwood industries. These studies frequently begin with consideration of allocations in the woods, through bucking and finally log breakdown. In softwood sawmills, our studies indicate that small changes in the mix of products can result in major changes in the value of products. A 5% improvement of lumber yield, in an integrated operation, translates into $1 million a year for a sawmill of 105 600 m^3 (44 million bd ft) capacity. The same considerations apply to the hardwood sawmilling industry. A change to operations that can process shorter logs can result in a much higher value of production. A 10% improvement in processing material currently being processed at a loss would translate into a $12-million increase in value in the industry per year. The major thrust here is to influence a change to small-log operation.

Two opportunities exist with respect to the solid hardwood products industry:

- to improve the viability of existing primary and secondary hardwood operations, e.g., lumber, furniture components, pallet stock;
- to increase the degree of integration in current softwood processing operations.

Similarly, we see several opportunities both for energy products and new and improved composite building products. The market for energy products, of course, is going to be determined by the price of wood energy relative to the next best alternative, i.e., oil, coal, or natural gas. As the price of conventional fuel increases, the feasibility of using wood for energy production will increase. Energy products will be of three kinds: solid products, liquid, and gaseous fuels. Solid energy products will be of the greatest improtance. Their major use will be to achieve energy self-sufficiency in forest products operations.

The growth of the composite-product market, as previously mentioned, will depend significantly on the degree of substitution of hardwoods in traditional softwood markets, and the growth of traditional hardwood markets.

There are three major submarkets for composite products, new housing, do-it-yourself[1], and industrial. Each of these markets will have a domestic, overseas, and USA component.

In terms of total panel (construction plywood, waferboard, insulation board, particleboard) consumption, the do-it-yourself market is almost equal to the new building market. The concensus of opinion is that the do-it-yourself market will increase from the current level of $6 billion to $24 billion in Canada by the year 1990. It is also interesting to note that while there has been a drastic reduction in the new housing market over the last couple of years, there has been a 15% increase in the do-it-yourself market during the same period. This trend is expected to continue after new housing starts return to historic levels of 200,000 units per year.

The penetration of composite material in exterior panelling, interior panelling, furnishing, and structural members market is projected to increase rapidly. Each of these product classes must be considered in evaluating utilization options for the available resource (biomass).

[1] Panelling, flooring, and siding, and wood materials for landscaping, patios, sundecks, shelving and add-on rooms.

It is clear that innovation is required to develop products that the market will demand over the next 40 years in order to utilize the available resource in New Brunswick. These include the following products:

- densified biomass fuel that can be transported to industries having a deficit of usable wood wastes;
- structural panels using the mix of species available, interior panelling, and panel for furniture manufacture.

Composite structural members such as floor trusses are already being used in some parts of the continent and are expected to increase their penetration of the market rapidly over the next 20 years.

The scale of processing operations will depend upon the availability of the resource, the market potential of the products, and the various cost factors involved in processing the resource into end-products. A consideration of the existing industry in New Brunswick and the geographical location of the available resource indicates that new processes will have to be developed on a somewhat smaller scale than those which have been used in the past. These should first be integrated into existing operations such as pulp mills and larger sawmills providing better utilization of the forest resource and minimizing the total capital investment required. In some regions, it will be necessary to establish new integrated complexes which may manufacture a different mix of product, e.g., building materials and energy products.

Because of the lack of detailed information on the quality, quantity, and location of hardwoods, detailed resource and economic studies will be required before development can proceed. It is anticipated that the demand for materials will emphasize the need for these studies within the next five years.

HARDWOOD UTILIZATION AT NORTHWOOD PANELBOARD

by
S. Jones
Northwood Pulp and Timber Limited

Let us look at the exciting future for the utilization of low-grade hardwood resource in the manufacture of the building panel product of the future - waferboard.

For many, waferboard is still an unknown product, despite its extensive use in North American construction over the past 19 years. The first waferboard was produced in Hudson Bay, Saskatchewan, in 1962, and from this early beginning the industry has grown to its current 1982 size of 17 mills with a combined productive capacity of 2.43 billion sq ft (3/8 inch basis), representing 2.15 million m^3 of wood. All 16 additional mills came into production after 1972, in Canada and the United States.

Why the success of waferboard? Three factors can be readily noted

1. the market's acceptance of waferboard as a proven and reliable structural panelboard after 19 years of successful performance in all types of construction;
2. a growing concern by producers that the diminishing supply of good peeler logs for plywood manufacture would not adequately satisfy projected long-term demand for structural panelboard; and
3. the plentiful supply of lower-cost, smaller-diameter poplar logs available for waferboard manufacture.

The combination of these factors ensures waferboard a promising future in supplying world needs for structural panelboards in the years ahead.

Product description and end-users

Waferboard is an engineered structural panelboard made from large thin wafers of wood. In the manufacturing process, these wafers, which can be thought of as small pieces of veneer, are mixed with waterproof pheolic resin glue and interlaced together in thick mats, which are then bonded under heat and pressure.

The result is a solid uniform building panel with high strength and water resistance; two key properties which make waferboard suitable for most construction applications associated with exterior grade plywoods, and softwood boards. The high strength of waferboard comes mainly from the uninterrupted wood fibers of the large wafers. When the panel is formed by a random placing of wafers, there is equal strength in all directions. Phenolic resin binder combines with the wafers to provide internal strength, rigidity, and water resistance. Waferboard panels with random wafers show little tendency to warp, and panels are knot- and defect-free. They are easily cut and machined, and provide a good base for painting and other wood finishes.

Waferboard panels were first used in house construction in Canada in 1962. They are specified in the 1980 National Building Code of Canada for subflooring, roof sheathing, wall sheathing, siding, interior wall and ceiling finishes, and panel-type underlay.

In non-residential applications, waferboard is a popular material for form structures, industrial packaging, crafting, pallets, and fencing.

Northwood's Chatham waferboard mill

The mill was constructed by Airscrew-Weyroc in the early 1970's to manufacture particleboard. In the spring of 1975, the operation was acquired by the Northwood group. Due to many reasons, only one of which was market conditions, production stopped in late 1976. The plant was closed for about 1 year, during which time a comprehensive feasibility study was undertaken. The decision was made to convert the plant to manufacture waferboard. Our objectives were to realize savings in the conversion by retaining as much existing equipment as possible. Any new equipment was incorporated into existing buildings and no new buildings were necessary.

The first phase of the conversion was to remove the redundant particleboard equipment including the dryers, graders, chippers, refiners, sanders, and the wax and resin system. The second phase was the installation of the new equipment; barkers, conditioning chests, slashers, waferizers, dryers, and a new resin and wax system. The forming line, press, and finishing line have been essentially left intact, with only minor modifications made. Northwood acted as the general contractors for the total conversion. The Company's equipment operators, millwrights, and electricians were totally responsible for the physical conversion. Their familiarity with the equipment, we believe, was the prime reason for the mill's successful start-up. Two months after start-up in 1979, the plant was running at 90% of rated capacity.

Northwood's waferboard mill utilization of the hardwood resource in the Miramichi Region

The other main reason for Northwood's conversion of the existing mill at Chatham to waferboard manufacture was the hardwood resource available in the Miramichi area. In the past, there has been a surplus of hardwood pulp-quality material in the Region. This underutilized resource was becoming a critical problem for the management of both Crown and freehold lands. Residual hardwoods in the softwood cutovers were a definite hindrance to proper site preparation of these lands so softwood plantations could be established. These plantations are vital to future softwood supply which is projected to be critically short by the year 2000. Our mill has helped alleviate this problem because there is now an outlet for hardwood pulpwood, that previously did not exist.

Since we commenced operations in 1979, Northwood has purchased 1.15 million m^3 (318,000 cords) of hardwood, approximately 50% has come from freehold lands, and the other half from Crown land operations. We are drawing most of our wood supply from within a 130-km (70-mile) radius of Chatham, but have purchased small amounts from other suppliers more than 185 km (100 miles) distant.

Poplar is the most valuable species to us, primarily because of its low density and structural characteristics that make it an ideal species for waferboard manufacture. Poplar makes up to 70% of our total species mix. The majority of waferboard mills in North America that are, or will be operating shortly, are located in regions where the total wood supply will be poplar. In fact, Northwood's new mill at Bemidji, Minnesota, will use only poplar. At Chatham, we have to use other species because the poplar resource in the area is not sufficient to meet our long-term requirements. White birch and red maple are the two next most important species and make up 20% of our total needs. Cedar and other underutilized species in the Region has been found acceptable to us for waferboard manufacture (primarily because of its very low density) and now makes up to 10% of our total wood mix. We have, to date, utilized only a very small percentage of the "hard" hardwoods such as sugar maple and yellow birch. The problem with these species is their high density which adds considerably to the weight of the finished product. All of the wood received at the mill is in 2.54-m (100-inch) lengths and is prepared mostly by power-saw operators, from trail-cut operations. To date, we need to prepare the bolts by powersaw in order that the wood meets the quality necesary for it to be processed in the woodroom.

Northwood will be one of 10 licensees in New Brunswick under the new Crown Lands Act. We have been awarded the Kent License (located south of Chatham), which has a significant inventory of poplar. We plan to operate on the license with our contractors, and the softwood generated from the hardwood cuts will go either to our softwood sublicensee users, or be exchanged for hardwood generated from the other softwood licensees.

Annual wood consumption at the mill's operating level will be 270 000 m^3 or 135 000 cords. We have not reached this level yet. In the spring of 1982, we are commencing operations after being shutdown for three months because of poor market conditions which now exist for the panelboard industry. We are optimistic, however, that the future will allow us to operate the Chatham Mill at full capacity. Northwood will be a major contributor to the economy of the Miramichi and will help ensure the full utilization of the hardwood resource in the Region.

HARDWOOD UTILIZATION AT ST. ANNE-NACKAWIC

by
C.A. Dickinson
Valley Forest Products

St. Anne-Nackawic Pulp and Paper Co. Ltd., Nackawic, N.B. is the largest user of hardwood in the province of New Brunswick, consuming slightly in excess of one-third the provincial hardwood annual allowable cut.

St. Anne produces about 230 000 admt/(air-dry metric tonnes) of bleached hardwood kraft pulp annually for world markets distributed roughly as follows: Canada and U.S.A., 10%; Japan, 30%; and the United Kingdom, 60%. St. Anne pulp is used in the furnish for a variety of printing papers, photographic papers, toilet tissue, paper plates, and computer papers. Our main competition in the market place is similar pulp produced by Georgia-Pacific, Maine, some of the eucalyptus pulps from South America, and pulp produced from European birch in the Scandanavian countries. The bulk of St. Anne pulp is transported by truck from Nackawic to the port of Saint John. From Saint John, the pulp is shipped to three ports of call, namely London, England; Antwerp, Belgium; and Hamburg, Germany. The Canadian market is served by a combination of truck and rail: our U.S.A. markets are served by rail only.

To produce 230 000 admt of hardwood kraft pulp, St. Anne requires approximately 340 000 cunits (956,000 m^3) of furnish in the form of wood fiber. About 85% of this volume consists of hardwood species and 15% softwood species. The current species composition of wood delivered to St. Anne from all sources is maple/beech, 50%; birch/ash, 10%; aspen 25%; and softwood, 15%. St. Anne's technical department has studied the pulping characteristics of each indigenous species to determine the best combination of species to produce hardwood kraft pulp for our particular market. For our situation, a combination of the following species groups is considered most desirable: maple/beech, 30%; birch/ash, 30%; aspen, 30%; softwood, 10%. Valley Forest Products is responsible for woodland operations which will meet these objectives.

The problem is to change the species composition. The lands directly under company management currently supply about 20% of St. Anne's total hardwood requirement. On these lands, through hardwood silviculture, particularly precommercial thinning, the birch/ash content can be significantly increased over the current forest. We are doing this now on freehold lands and will begin this year on our Crown license under the new forest management agreement. The aspen content is naturally increasing in our newly-established forests to approximately the 25% level. The maple/beech content is subsequently decreasing from the current level in the unmanaged forest. Therefore, the trend is desirable, but whether the percentages desired in each species group can be attained is uncertain at this time.

A further complication is that approximately 80% of St. Anne's total hardwood requirement is procured from lands not directly under the Company's management. Our opportunity to modify the species composition to suit our needs is obviously limited, but a degree of influence will result from the management of hardwoods on Company freehold and Crown license.

HARDWOODS IN THE FURNITURE COMPONENT TRADE

by

W.R. Torunski
Craftique Furniture Ltd. N.B.

To a great extent, the expansion of the Canadian economy will depend on the secondary manufacture of primary resources before export to other countries. Hardwood lumber is an example. Lumber is presently exported in large quantities and further processing here into components would produce sizable increases in value and employment. Restructuring of the United States furniture industry to use wood components compels the Canadian lumber industry to make the adjustments necessary for the further processing of lumber.

Based on information available from the Division of Forest Economics and Marketing Research, Forest Service, United States Department of Agriculture, it is evident that the supply of prime furniture hardwoods in the United States is diminishing. It will, therefore, be necessary in the future for United States furniture manufacturers to import hardwood from Central and South America, Africa, Asia, and Canada. It would appear that for the present time, and for the next few years, Canadian wood components manufacturers will have to compete directly with resources in the United States and other emerging hardwood-producing countries.

Technological developments and environmental conditions are rapidly changing the manufacturing methods in the United States' furniture industry. In the past, furniture manufacturers purchased rough lumber from which they produced the respective furniture parts. Today, the most modern and profitable furniture plants are those devoted to the assembly and merchandising of furniture. Parts and subassemblies are purchased in the same manner as those in the automotive industry. Forerunners of these manufacturing developments were the television, stereo, and kitchen cabinet industries, where, because of frequent design changes, manufacturers were unable to stock parts made from all the different species of wood and to make rapid machining modifications. It was, therefore, more practical and more profitable to purchase parts, as required, from specialty woodworking plants. Many furniture manufacturers in the United States have phased-out lumberyards, kilns, and breakout lines in old plants, or have not built these facilities into new plants, and are now solely dependent on the purchase of wood components from outside sources. This situation is becoming more prevalent because of the energy crisis and enviromental controls.

Surveys indicate that 40% of the dollar volume spent on solid wood materials in industry goes toward the purchase of industrial wood components, while the remaining 60% is spent on lumber.

Care should be exercised in interpreting such statistics as they do not mean that 40% of the volume of solid wood materials entering furniture plants is in the form of wood components; for an identical volume of wood, the price of components may be as much as five times greater than the price of rough lumber, depending on the degree of manufacturing. The degree of manufacturing determines into which of the three main categories, rough, semi-machined, or fully-machined, a particular type of component will fall.

Hardwood components are usually identified as doors, rails, and sills in the kitchen cabinet trade, or by squares, turnings, bendings, drawers, doors, panels, or frame parts for the furniture trade. Completely assembled, unfinished furniture also can qualify as components.

The U.S. Hardwood Dimension Manufacturers Association lists four main advantages to the purchase of dimension stock components. They are

1) establishes a controlled inventory and lumber cost,
2) reduces investment in equipment,
3) reduces overhead,
4) eliminates problems relating to yield.

Fully-machined components

There is a marked trend among American furniture manufacturers toward the use of fully-machined wood components. Fully-machined components are those parts which have gone through the complete cycle of machining operations and are ready for assembly, with the possible exception of a light, final sanding which is done in the user plant. These components are often purchased, ready for assembly, in complete sets of parts required for a particular piece of furniture; such sets are referred to as "knocked-down furniture".

All such components must be manufactured according to detailed specifications and strict tolerances with regard to quantity, finished sizes, species, color, and grades. Inspection of incoming components by user plants is carried out to much more rigid standards than would be the case if the components had been manufactured by the user plant.

There is a trend in the United States toward specialization by wood components manufacturers and, as a rule, plants will not supply the full range of components used in the industry. For example, one firm will specialize in supplying quality hardwood cut stock for wood turnings and cut-to-size pieces for case goods, tables, chairs, and home entertainment furniture; another firm will specialize in low-quality hardwoods, cut-to-size softwoods for low-quality upholstery frames and structural members in case goods. A subassembler, in most instances, is even more specialized. He will assemble parts for one specific product; he may be a framemaker for upholstery manufacturers, or an assembler of drawers for unfinished case goods.

In the upholstery industry a noticeable trend is the use of knocked-down, fully doweled furniture components. Upholstery furniture plants will store knocked-down parts to be assembled later, as required by production schedules. These manufacturers who specialize in frame parts purchase lumber on the open market, or buy cut-to-size blanks from which waste material has been removed.

Manufacturing requirements

Furniture manufacturing plants in the United States that purchase wood components will generally do business with well-established components plants with a reputation for supplying a high-quality product manufactured to specific tolerances, and for meeting delivery schedules. In many cases, the potential buyer will insist on visiting a components plant before placing an order so as to have firsthand knowledge of its capabilities. Sawmills integrating slightly forward by installing a few machines to cut lumber into rough dimension, or furniture plants going into the components business to use surplus manufacturing capacity, will definitely not meet the requirements of these potential buyers.

Wood components plants operate most economically when located adjacent to the sources of raw material. To facilitate supply and reduce transportation costs, plants should be situated as close as possible to a sawmill or sawmills, whereby lumber can be delivered directly off the green chains.

Other important factors to be considered in choosing the location for a wood components plant are

- selection of a site which will retain high-quality,
- access to a good source of semi-skilled labor,
- adequate water services suitable for the installation of sprinkler systems,
- transportation facilities (both rail and truck), and
- moderately priced electricity.

Historically, organizations whose main areas of expertise have been in the harvesting and sawmilling of lumber but have branched into the manufacture of components are slow in showing profits because they do not have the knowledge or experience in managing a complex manufacturing operation. By the same token, the particular talents, skills, and experience required for lumber harvesting and sawmilling are not found among furniture manufacturers. Therefore, furniture plants integrating backwards into the manufacture of components have encountered problems of a very intricate nature in their attempts to enter the lumber harvesting and sawmilling industries.

As many successful plants in the business today will bear out, diversification into the components industry does not present insurmountable hurdles, but lack of knowledge of one or more aspects of the business has caused many of these plants to go through long start-up periods during which heavy operating losses were sustained. It is therefore strongly recommended that any company wishing to enter the field of components make the necessary arrangements to obtain the knowledge or expertise, which it lacks, to put a new plant into a profitable position in the shortest possible time.

Critical operating factors

One of the most critical factors in getting a new components plant rapidly out of the start-up period and into a profitable position is the ability of the sales force to obtain, from the start, orders that will use all lengths of stock, which develop from the breakout process, in the proper mixture of solid and glued-up components. A components plant cannot survive by selling only 6-ft solid rail, and markets must be developed for shorts and for glued-up panels in order to keep waste to a minimum.

The optimum product mix and maximum yield in a components plant can be achieved by supplying a broad range of components to several different industries. A components manufacturer's marketing program should therefore not be confined to a particular region's furniture industry.

One species is ideal to use in the manufacturing process and three are the maximum. It becomes difficult to plan sales and schedule production with more than three species.

Specifications

Species of wood   New finishing techniques and the use of plastic overlays have allowed most wood species to be successfully duplicated and are effecting changes in the long-standing patterns and preferences in household furniture in the United States. Today, less importance is being placed on texture since prints, plastics, and painted surfaces are prominent in the industry. In general, prints and plastic overlays are used in combination with lower density hardwoods such as white birch and poplar.

Furniture styles dictate the species to be used. Early American styles are produced from maple, cherry, yellow birch, pine, and red alder. The Mediterranean and Spanish styles are manufactured from high grain, dark species such as hickory, pecan, elm, and oak. Walnut is used extensively in all styles, especially Modern, but is not used in Early American furniture. Maple and birch are the two species used most extensively in Canada.

Kiln drying requirements In practically all cases, wood components used by the furniture industry are bought kiln-dried. Their moisture content should be between 6 and 8%. Uniformity of mositure content is particularly critical in all edge-glued panels and components.

Color matching Color matching refers to the separating of heartwood from sapwood, especially in such species as maple and birch. This practice is required when producing solid panels for the Colonial furniture industry. When color matching is specified, it must be adhered to very strictly.

Quality controls The manufacture of wood components requires the removal of defects from lumber and precision machining in order to meet the specifications demanded by the industry. These functions are regulated by quality control standards set up by producers and end-users. The manufacture of wood components that do not meet quality standards is extremely costly because the components are five times the value of the original lumber. An axiom of the wood components industry is "Zero Defects".

Quality must be controlled throughout the entire manufacturing process, from the kilns to final packaging. Refusal of a shipment can result in considerable loss to the manufacturer and properly applied quality control programs are the only safeguard which will guarantee that products will be continuously manufactured to specifications.

Decision to manufacture components The knowledge and experience of companies presently engaged in primary lumber of furniture manufacturing constitutes the best foundation on which to base a successful wood components operation. The most successful operations have resulted from diversification. The decision to manufacture components usually hinges on a number of considerations, i.e.,

- the need to increase dollar turnover and profitability when faced with limitations of available lumber,
- the need to increase the value of low-quality lumber grades which are difficult to sell profitably,
- the desire to gain access to a more stable market outside the fluctuating lumber trade,
- the high cost of transporting lumber, and the desire to take advantage of a rapidly expanding market in the United States and Canada.

The furniture industry forms less than 40% of the total market for wood components. Other large users of components are the kitchen cabinet, the mobile home, and the office furniture industries, toy manufacturers, and producers of musical instruments.

Choice of products It must be remembered that the wood components industry is made up of a broad range of highly specialized plants. The success of a plant will depend to a great extent on choosing the right products to manufacture from the available resources. A company proposing to enter the industry first needs to assess its available inputs which are the necessary building blocks for a particular component project. Important factors which must be assessed are

- species and volumes of wood available within economic range. In general, efficiencies of scale can be reached only over a 5 million f.b.m. input,
- financial resources: most successful plants require an investment of $1 million or more,
- size of trainable labor force,
- range of products which could be manufactured from the available natural resources, based on species, volumes, quality, etc.

Many softwood-using sawmills and pulp mills are now being compelled to harvest hardwoods. To realize a profit from these hardwoods may require that they be manufactured into wood components. White aspen and white birch are two species that are difficult to merchandise in a standard lumber form and wood components may be the answer to profitable merchandising of these resources.

Market studies and research After determining the lumber resources and other necessary inputs a company desiring to enter the components field, should survey the market. This market study will familiarize the company with a broad range of potential products to manufacture. Market surveys should pinpoint the best value range of products, possible end uses, exact prices per unit to complement the predetermined operational conditions, and market outlets.

Decision on type of plant Seldom can two identical components plants be constructed. Each plant must be specifically tailored to the available raw material resources and major products to be manufactured.

The final decision on the design of a plant should be a direct outcome of the results of the market survey and of the research on the physical and material resources of the company. For example, a company in New Brunswick which has access to hard maple and plans to service the New England Colonial furniture market would construct very different facilities to those required by a company situated in northern Ontario which would process white aspen into components for the low-priced case goods industry in Indiana.

Scope of market for indisturial wood components in the United States

Lumber usage in the manufacture of solid household furniture will keep increasing moderately, as in the last few years, due to increases in output in the industry. The lumber content of furniture, however, (measured in f.b.m. per dollar of sales) has been steadily decreasing. These conditions have been caused mainly by the increasing scarcity of lumber and the resulting influence on prices. This in turn has led to a more efficient use of lumber and a search for alternative materials, e.g., the displacement of solid wood panel core material by particleboard and medium density fiberboard.

Up until two decades ago, the wood household furniture industry relied almost exclusively on solid lumber as a source of raw material, and few, if any, other types of material were used in the fabrication of furniture. As lumber became a scarce commodity, modern technological developments allowed the industry to make more efficient use of lumber. Industrial applications were discovered for waste and residues and new manufacturing methods were developed to economize on the use of high-quality hardwoods and still manufacture aesthetically and structually acceptable products. Typical of these developments are the particleboards and medium density fiberboards now widely used in the industry.

Today, solid wood still constitutes about 30% of the total material costs in the manufacture of wood household furniture. In production of upholstered furniture solid wood represents only about 15% of the total material costs.

Trends in the inventory, current growth, and removals indicate that the hardwood lumber situation is deteriorating in the United States. Annual allowable harvesting is decreasing, especially for the larger diameter trees. Whether the United States will have to look to outside sources will depend to a great extent on raw material displacement trends in the furniture industry.

Effect of plastics

On a cubic unit basis, the cost of plastics is higher than the cost of wood. Plastic components or parts, however, require less labor and can displace wood components on a cost basis when the high cost of the moulds can be apportioned over very large production runs. Thus, the criteria of value for value can be established on only fabrication and application costs. Without a major technological breakthrough and cost reductions, the introduction of plastics should have only minor effects on the present usage of wood and wood components in the industry. However, many manufacturers state, and this point cannot be over-emphasized, that for wood materials to compete, they will have to be made available as fully-machined components (as are most plastic parts) rather than as lumber.

The New England components market

Large quantities of rough hardwood lumber are shipped annually to the New England States from the Atlantic Provinces and the Province of Quebec. The Province of New Brunswick ships the medium and higher grades of lumber such as maple, birch, and beech, while the Province of Quebec ships the higher grades (#1 Common, FAS and Selects) of white and yellow birch. Both regions are shipping small quantities of rough, semifinished and fully-machined wood components to New England furniture companies.

It is considered that medium lumber grades, #2 Common and #3A, and, under certain circumstances, #1 Common, further manufactured into wood components would provide more opportunity for export for New Brunswick than would rough lumber.

Furniture manufacturers in the New England region show a preference for fully-machined subassemblies and finished components. Plant expansions and the development of additional sales are, to a great extent, based on the availability of sustained sources of components.

The major market in New England is for hard maple to be used in the production of Early American furniture. Some companies are contemplating the use of birch for complete furniture lines as well as interior structurals. It is expected that markets for soft maple will develop in the future. Competition to Canadian-produced wood components will come mainly from within the New England States where there are still prime hardwood stands.

New England has the oldest established furniture industry in the United States. The industry in this area has for some time been undergoing structural changes, one of which is the trend towards the increased use of further manufactured lumber. As long as the Early American styles retain their hold on approximately 25% of the household furniture market, the demand for hardwood furniture components will continue to grow and a strong market will exist for birch and beech components.

Many of the furniture manufacturers in the region have old plants and drying facilities located in heavily populated centers. Rather than build new larger plants, most of the furniture companies are resorting to the use of semifinished and fully-machined wood components, which are purchased from outside sources, in order to maintain and expand production levels in existing facilities.

In summary, a New Brunswick wood components plant would be in an excellent position to capture part of the estimated $27 million industrial wood components market in New England which is created by the manufacture of wood household furniture.

Hardwood Utilization Overview, and Woodchips Burning Project Summary
by
M.H. Schneider
Faculty of Forestry, University of New Brunswick

We are here to discuss the use of the hardwood resource - a resource given to mankind, but only loaned to our generation. This is because we of this generation are an extremely small part of mankind, made up of our ancestors and our children and stretching through time and space. I think that anything which is loaned should be used well for its intended purpose, and then returned in at least as good condition. That is good stewardship. Our forebearers have not applied this vision to the forest resource, including hardwoods. We have merely to look at the Maritimes forest to know this.

What can we, as professionals, do to promote good stewardship for our hardwood resource? One way is never to lose our vision, and conferences like this are valuable for that purpose. Another way is for each of us to use his own expertise to attack specific problems and attempt to solve them in good stewardship.

I would like to contribute to our vision by giving an overview of some uses for hardwood (Table 1) followed by a report on some specific research I have done recently which may help to take some pressure from the hardwood resource.

Let us look at the small part my coworkers and I have played in an attempt to relieve the pressure on our resources (including especially hardwood) and at the same time meet people's desire for a local, indigenous space heating fuel and for better silviculture (Table 2).

In the wood chip heating project, we are evaluating likely possibilities, and demonstrating those most promising. We are working from stump to burner inclusive and are obtaining information about technology, energy balances, and costs. The chip heating project is an example of the sort of wood utilization research and development which can have large effects on both the forest and those whose livelihood depends upon it. It can provide an additional market for currently unmarketable species, and sizes and qualities of wood plants. The act of removing such material can, if done properly, improve the forest. Revenues from selling can make the improvement financially attractive. The results of such marketing on a large scale could be (1) increased employment, and (2) decreased energy money drain from the local economy. Some other utilization and marketing research, development, and strategy along with infrastructural development which could have positive impacts on hardwood are listed in Table 3.

Table 1. Hardwood utilization overview

Conversion energy required	Estimated yield %	Hardwood products	Wood quality required	Relative value	Trends
Fairly low	50	Veneer (to 1/128 inch thick)	High	Very high (the log goes a long way)	Thinner, smaller logs (birch in Scandinavia)
Low	50	Hardwood lumber graded for clear cuttings	High	High	Shorter logs, short clear cuttings & end jointing
Low	50	Hardwood lumber for utility uses (pallets, etc.)	Lower (but large enough to saw)	Fairly low	Composites are replacing
Fairly high	90+	Boards from engineered particles	Low, but flakable Low density hardwoods	Fairly low, mill needs high capital. Economies of scale (E.O.S.)	Replacement for many solid and veneer-built construction components
Fairly high	80+	Boards from small particles	Low and can use residues from milling	Low, mill needs high capital E.O.S.	Replacement for solid and veneer-built finished products
High	35/95	Fiber products (pulp & paper, boards)	Low, can use milling residues	Low, mill needs high capital E.O.S.	Board use decreasing (properties limited). Good pulp & paper prospects
Low	100	Chunk firewood	Competes with 1-4	Tied to other energy costs	Serious threat to categories 1-4
High	95	Pellet fuel	Very low	Tied to other energy costs	Energy-intensive
Fairly low	95	Chip fuel	Very low including logging & milling residues (hardwoods not required)	Tied to other energy costs	Forest fuel of the future

Table 2. Chip burning project summary

Operation	Objectives	Specific targets	Completed
Harvesting	Use non-competitive fiber: Improve stand	Thinnings, residues, low quality woods, unsalable species. Cleaning and thinnings	1 hardwood stand, 1 softwood stand.
Chipping	Use small-scale equipment		1 manufacturer starting, several operations
Drying	Use solar energy	Air movement, heat time	2 methods, 1 operation, several trials
Transport, storage delivery	Automate	Bins, trucks & vans, blower, augers, bucket conveyors	3 operations, 2 trials
Burning	Automate, low emission, no creosote	Homes, commercial, industrial, heating	2 stokers, 4 years experience 3 manufacturers starting

Table 3. Some research, development, and demonstration needs

Program	Reason
1. Develop small-sized, particle-based panel and structural product mills.	Current mills are too large for diffuse resource. Particle-based plants upgrade low quality material, providing new markets.
2. Develop finished-product particle-based capability (using output of small panel and structural-product mills).	Greater finishing means greater benefits for local economy.
3. Demonstrate and further develop small-log veneer cutting technology.	Veneer is high-quality and high-value product which has expensive finished product potential.
4. Develop veneer-finished-product capability (i.e., cross country skis).	Benefits of more highly finished product manufacture.
5. Develop and demonstrate hardwood small-log sawing technology.	Hardwood lumber is valuable and in short supply.
6. Develop and demonstrate end-and-side-matched finished product technology based upon small-log lumber.	There is demand for this finished high-value product.
7. Demonstrate forest residual heating chip supply and burning.	Show practical aspects and overcome some problems. Convince of usefulness.
8. Develop infrastructure for harvesting and supplying thinnings and logging residues as fuel.	Provide market for currently unmarketable material.
9. Further develop overall forest product marketing strategy and infrastructure.	To allow every producer of forest raw materials access to all markets giving him incentive to decrease waste and to segregate his products so each goes to highest-value use.

Environmental Impacts of Hardwood Forest Management in Atlantic Canada

by
B. Freedman,
Department of Biology and Institute for Resource and Environmental Studies, Dalhousie University

The forest industries are an extremely important economic sector in Canada, and especially in Atlantic Canada. Collectively, they accounted for 18.4% of total Canadian exports in 1980, and they provided direct employment for 300,000 persons. In Atlantic Canada, the forest industries accounted for 27.3% of the total value added in manufacturing, and they directly employed 25,600 persons (Reed et al. 1980a,b; Anonymous 1981). To supply the demand for raw materials, millions of tons of biomass are removed from about 750 000 ha of forest land annually in Canada, including about 72 000 ha/yr in Atlantic Canada (Hallett and Murray 1980; Freedman 1982a). Most of this harvest involves softwood species, 147.5 million m^3 in Canada, and 14.1 million m^3 in Atlantic Canada in 1979-80. These accounted for 93 and 87%, respectively, of the total harvested forest biomass in these regions, the remainder being hardwood species (Anonymous 1981). In total, the areas of harvested forest lands undoubtedly represent the most significant annual anthropogenic disturbance to natural terrestrial ecosystems in Canada. The nature of the environmental impacts associated with these disturbances, with particular reference to hardwood forest management in Atlantic Canada, is the topic of this paper. Before proceeding further, it should be acknowledged that this discussion is a condensed version of several previous reports (Freedman 1981, 1982a,b).

Effects of Harvesting on Nutrient Cycles

The harvesting of forests can disrupt nutrient cycling in many ways, but probably the most important effects are losses of nutrients from the site in harvested biomass, and in soluble or particulate forms in groundwater or streamflows.

In recent years, there has been much concern over the potential nutrient losses in very intensive harvests, such as whole-tree (all above-ground biomass) or complete-tree (above and below-ground biomass) clear-cutting, especially if these are used over short rotations. Such harvests remove relatively nutrient-rich tissues (e.g., foliage, small and large branches, and roots.) that after conventional harvests would remain on the site as slash. If these nutrient removals are large relative to the amounts present in the soil, or to inputs over the rotation period from precipitation, dry fallout, or weathering then there could be a decline in site quality. This is a familiar agricultural problem, but it has only recently been recognized for its potential in forestry.

Some Nova Scotia data (Table 1) illustrate the potential biomass and nutrient removals by whole-tree or conventional clear-cutting of a mature hardwood stand. These show about three times as much biomass in the merchantable stem as in the crown, and the yield of biomass from a whole-tree clear-cut of the stand would be about 30% greater than from a conventional bole-only clear-cut. However, as indicated (Table 1), increased removal of major nutrients is more substantial, because relatively nutrient-rich tissues are harvested with the crowns. Consideration of data for a wider range of hardwood stands indicates that, in general, to get a 20-40% increase in biomass yield from a whole-tree clear-cut, the nutrient removals must be increased by at least a factor of two for N, P, and K, but somewhat less for Ca and Mg (see Kimmins et al. 1979; Freedman 1981; Freedman et al. 1982a for compilations of such data).

One simple way to assess the significance of these nutrient removals is to compare them to the amounts that are present within the rooting depth in the soil. Average values of total nutrients for soils in a variety of hardwood stands that we investigated in central Nova Scotia were about 8700 kg/ha N, 3000 of P, 19 700 of K, 14 900 of Ca, and 5250 of Mg (Freedman 1981). Thus, for the sample stand (Table 1), the potential whole-tree harvest removals represent only ca. 5.5% of the total soil N, 1.6% of total P, 1.0% of K, 3.4% of Ca, and 1.3% of Mg. (Note that the harvested amounts compared with nutrients in the available, or plant-exploitable soil pools are much larger. However, these available pools turn over quickly, so that their longer-term significance is less than that of the total pools.) A more detailed investigation of the potential impacts of nutrient removals in harvests would include the influences of other processes, such as i) inputs of nutrients from the atmosphere or weathering, ii) losses in leachates, erosion, and gases (as in denitrification), and iii) the impacts of perturbations other than cutting, such as fire or epidemics of defoliating insects. These other fluxes have been considered elsewhere (Freedman 1981), and they have also been incorporated into dynamic computer models which have attempted to simulate longer-term impacts of forest harvest on nutrient cycling (e.g., Aber et al. 1978, 1979; Kimmins et al. 1980, 1981). The general conclusion seems to be that that the problem of nutrient removals is especially serious in short-rotation situations, for example in high-yield poplar coppice forestry where 1 to 10 year rotations are grown for pulp or energy. However, such "agroforestry" is generally accompanied by fertilization to maintain high rates of productivity. For longer rotations in natural forests, the problem appears to be less severe, and nutrient improverishments may not show up for several rotations on most sites. This is because, as indicated above, the nutrient removals in harvests are small compared to quantities present in the soil, coming from the atmosphere or by weathering of minerals.

Soluble nutrients from harvested stands can also be lost through groundwater and streamwater flows. This loss can be increased by various land management practices, including forestry and agriculture, and also by fire. The process varies with site, and the relatively mobile nutrients (e.g., nitrate, potassium, or calcium) are especially affected (Freedman 1981). Perhaps the most frequently cited study of this effect was done on a small (15.6 ha) hardwood watershed draining into Hubbard Brook, New Hampshire, which was clearcut but not logged, with the trees left on site, and then herbicided for three growing seasons. This was an experiment on the ecological impacts of deforestation-devegetation, and not on clear-cutting. However, it illustrates the syndrome of nutrient leaching that follows disturbance of the site, even if the rates are not strictly relevant to operational forestry practices. Over a 10-year period, the increased streamwater losses were 450 kg/ha of nitrate-nitrogen, 144 kg/ha of potassium, and 319 kg/ha of calcium (Bormann et al. 1974; Likens et al. 1978). Such losses are equal to or greater than the nutrients in the biomass of many forests (and would be additional to nutrient removals with biomass). At Hubbard Brook, the nutrient losses were undoubtedly exacerbated by the herbicide treatment, and probably some losses would have been prevented if a vigorous and productive plant community had been allowed to develop after cutting. Such early-successional plants can incorporate mobile nutrients into their aggrading biomass, and hence prevent leaching from the site.

Effects of Hardwood Management on Wildlife

Forest management can drastically reduce the suitability of sites for some forest animals, while at the same time creating new habitats and opportunities for early-successional species. Changes important to wildlife include modifications of physical structure of the habitat through effects on the distribution of plant biomass, changes in the plant species, and changes in such processes as primary production, nutrient cycling, and litter decomposition.

It is well established that some big game, such as white-tailed deer or moose, can benefit by certain forestry practices, mainly through an increase in the quantity and quality of hardwood browse that is available. Habitat conditions for these ungulates can generally be optimized within a large management area if a mosaic of habitats of various ages are created. However, very large clearcuts are not usually efficiently used as the animals do not like to be too far from cover; the use of herbicides can greatly reduce browse production, and it is critical that suitable mature habitats for winter yarding continue to be available. Some other game or furbearing species can be affected detrimentally by forestry as they require rather extensive areas of mature forest. Examples of such species include caribou, marten, fisher, and spruce grouse (Telfer 1970, 1972, 1978; Freedman 1982 a,b).

Small mammals can also be affected by forestry practices. Mice and voles can in turn affect forestry, as important consumers of tree seeds, and by causing extensive damage in young plantations by girdling stems. They are also important ecologically as the base of the food chain for some predators, as vectors for the dispersal of seeds of some plant species, and possibly for dispersal of some mycorrhizal fungi. In a recent study, we examined the relative abundance of various species of small mammals in 3- to 5-year-old hardwood clearcuts, strip-cuts, shelterwood cuts, and uncut stands. The responses of these small animals to these habitat changes were remarkably conservative, with few changes in species composition or abundance (Swan 1981; Swan and Freedman 1982[1]).

Another wildlife group that is affected by forestry is breeding birds. We recently studied the breeding bird communities in hardwood forests in central Nova Scotia that had undergone a variety of management treatments (Table 2). The average total breeding-bird densities on three uncut control plots, on three plots that were clear-cut 3 to 5 years earlier, on one 5-year-old shelterwood plot, and on two 4-year-old strip-cut plots differed little from the overall mean of about 600 pairs/km^2 However, marked differences occurred in the bird species among the various plots. The most important breeding species on the control plots were Least flycatcher, ovenbird, red-eye vireo, black-throated green warbler, and

[1]Swan, D.M. and B. Freedman. 1982. Forest management practices and populations of small mammals in a hardwood forest in Nova Scotia. Unpublished manuscript. Department of Biology, Dalhousie University. Halifax.

Table 1. Standing crops in a mature sugar maple-yellow birch-beech stand in central Nova Scotia. Standing crops were determined by species and compartment-specific standing crop regression equations, applied to all trees within five 20 x 20 m plots. The coefficient of variation for whole-tree biomass was 17% (modified from Freedman _et al_. 1982a)

Compartment	Biomass (t/ha)	N (kg/ha)	P (kg/ha)	K (kg/ha)	Ca (kg/ha)	Mg (kg/ha)
Live branches	40.2	161.0	22.7	66.5	160.7	19.0
Foliage	3.9	76.3	5.8	33.5	19.6	6.5
Dead branches	3.0	7.2	0.4	1.2	9.4	1.0
TOTAL CROWN	47.1	244.5	28.9	101.2	189.7	26.5
Wood, merchantable stem	139.7	140.8	14.2	61.6	100.8	29.1
Bark, merchantable stem	17.9	94.2	6.1	30.3	222.9	11.2
TOTAL MERCH. STEM	157.6	235.0	20.3	91.9	323.8	40.2
WHOLE-TREE	204.7	479.6	49.2	193.1	513.5	66.7
Increase in whole-tree compared with conventional clear-cut, %	29.9	104.1	142.4	110.1	58.6	65.9

Table 2. Effects of management practices on populations of breeding birds in a hardwood forest region in central Nova Scotia. Data are in pairs/km^2 (Freedman _et al_. 1981)

Species	Uncut forest			3-5-yr-old clear cuts			5-yr-old shelterwood	4-yr-old strip-cuts	
	a	b	c	a	b	c	a	a	b
Common Snipe	0	0	0	10	15	0	0	0	0
Ruby-throated Hummingbird	0	0	0	25	30	15	0	0	0
Chestnut-sided Warbler	0	0	0	100	40	190	110	50	70
Common Yellowthroat	0	0	0	25	300	130	80	0	50
Dark-eyed Junco	15	20	15	50	70	30	0	25	20
White-throated Sparrow	0	20	0	90	190	100	30	0	0
Song Sparrow	0	0	0	90	70	0	0	0	0
Least Flycatcher	290	120	0	0	0	0	140	60	100
Hermit Thrush	60	40	30	0	0	0	0	15	0
Red-eyed Vireo	80	50	30	0	0	0	80	30	70
Black-and-White Warbler	15	50	40	0	0	0	0	70	15
Black-throated Green Warbler	50	30	30	0	0	0	0	15	0
Ovenbird	150	120	200	0	0	0	0	60	100
Rose-breasted Grosbeak	15	10	0	0	0	0	0	0	0
Other species	140	180	170	45	30	120	110	150	150
Total Density	815	660	515	435	745	585	550	475	575
Richness	12	16	9	10	8	7	7	13	10

various other wood warblers and thrushes. In the clear-cut plots the bird community was dominated by chestnut-sided warbler, common yellow-throat, white-throated sparrow, and dark-eyed junco. The species mixture in the shelterwood cut and strip-cut plots were intermediate between those of the control and clear-cut plots (Freedman et al. 1981). We have also studied breeding birds in hardwood stands of various ages that represent a post-cutting secondary succession in this same region of Nova Scotia. Except in 1-year-old clear-cuts, we found no significant changes in overall breeding density, richness, or diversity along this secondary succession. However there were, of course, marked changes in species composition, with relatively opportunistic species in the younger plots and obligate forest species in the uncut stands (Freedman et al. 1982 b,c).

The occurrence of snags in the forest can also be of significance to birds, since many species are cavity nesters, which may require snags as a habitat feature (Scott et al. 1980). Thus, snags could be left, or even created during forest management or harvesting, to improve the habitat for many birds.

Forestry practices can also affect the freshwater habitats of sportfish. These effects occur mainly as a result of erosion caused by i) harvesting or roadbuilding activities, with subsequent siltation of breeding and feeding habitats, ii) temperature increases in water that result from the removal of shading streamside vegetation, and iii) blockage of streams to fish movement by slash and debris accumulations. To a large degree, these impacts can be avoided or minimized by building roads carefully, by avoiding the traversing of streams during skidding, and by retaining uncut buffer strips beside water bodies (Sabean 1977; van Groenewoud 1977; Freedman 1982 a,b).

Other Impacts of Forest Management

Other environmental impacts of hardwood forest management concern the use of pesticides, ecological reserves and the habitats of rare and endangered species, and effects on aesthetics and recreational opportunities.

Insecticides have not been used in hardwood management in Atlantic Canada, except for small-scale amenity plantings in cities, for example in the control of elm leaf miners. However, recent discoveries of egg masses of gypsy moth in southwestern Nova Scotia and southern New Brunswick indicate the potential for intense, local spray programs to control this voracious defoliator.

Herbicides are generally not used for silviculture on hardwood sites, except in cases where stands are being converted to softwood. The use of herbicides (particularly the phenoxy herbicides 2,4-D and 2,4,5-T) for forestry purposes has become a high-profile and emotional issue in North America, because of controversy over links between their use and human health. Interestingly, the much more extensive use of these same herbicides in agriculture has drawn far less attention. Herbicides used in forestry have other ecological impacts, in that they alter the habitats available for wildlife, and they inhibit the ability of the productive early-successional plants on clear-cuts to conserve nutrients and re-establish biological control over other disturbed ecosystem functions.

Forest management can also affect potential ecological reserves in mature forested sites. Work done under the International Biological Programme identified numerous candidate sites for ecological reserves in Atlantic Canada, some of which were mature hardwood forests (Anonymous 1974). These sites are important for scientific, educational, and aesthetic reasons, and they should be preserved or (in some cases) managed to preserve their unique character.

Similarly, the habitats of rare or endangered species that occur in hardwood forests should be identified, and then protected or managed to preserve their quality as habitat for these species. For example, the pileated woodpecker is a rare but widespread species that needs extensive tracts of mature forest. The wood thrush is both rare and very local in its breeding range in mature hardwood forests of central Nova Scotia, and it is therefore quite susceptible to extinction in the Province if its breeding habitats were harvested or otherwise affected by forest management (Freedman 1982a).

Recreation is socially and economically important in Atlantic Canada, and much of it takes place in forests. Some recreational activities can be accomodated in multiple-use management plans with forestry. To this end, many of the negative impacts of forestry practices on aesthetics and recreation can be reduced by using off-season harvesting, by leaving uncut buffer strips along travel routes, and by using less intensive types of harvests, such as shelterwood cuts, or small, irregular-bordered clear-cuts.

CONCLUSIONS

1. The forest industries are a very important economic sector in in Atlantic Canada. They are also by far the most significant arthropogenic source of disturbance of natural terrestrial ecosystems, with 750 000 ha of mature forest being harvested each year in Canada, mainly by clear-cutting. Most Canadian forestry involves softwoods, and in

Atlantic Canada these account for 87% of the harvested biomass, the remaining 13% being 2. hardwoods.

2. The environmental impacts of forestry on such factors as nutrient cycling, wildlife habitats, and erosion, are generally most severe when large intensive clear-cuts are used, and especially if these are used over short rotations.

3. Some forestry practices have moderate environmental impacts, for example, use of shelterwood cuts, individual tree selection, or small patch clear-cuts arranged to produce a mosaic of habitats. In addition, the use of shelterbelts can reduce aesthetic and many ecological impacts, and the leaving of standing snags will reduce some wildlife impacts.

4. More research is required on most aspects of the environmental impacts of forestry. Considering the scale of the disturbance to natural ecosystems each year, remarkably few studies have documented the impacts of the industry.

REFERENCES

Aber, J.D., D.B. Botkin, and J.N. Melillo. 1978. Predicting the effects of different harvesting regimes on forest floor dynamics in northern hardwoods. Can. J. For. Res. 8: 306-315.

Aber, J.D., D.B. Botkin, and J.M. Melillo. 1979. Predicting the effects of different harvesting regimes on productivity and yield in northern hardwoods. Can. J. For. Res. 9: 10-14.

Anonymous. 1974. Ecological Reserves in the Maritimes. Canadian Committee for the International Biological Programme. Conservation of Terrestrial Communities Subcommittee. Halifax, N.S.

Anonymous. 1981. A Forest Sector Strategy for Canada. Sponsoring Minister: J. Roberts, Environment Canada. Ottawa.

Bormann, F.J., G.E. Likens, T.G. Siccama, R.S. Pierce, and J.S. Eaton. 1974. The export of nutrients and recovery of stable conditions following deforestation at Hubbard Brook. Ecol. Monogr. 44: 255-277.

Freedman, B. 1981. Intensive forest harvest - a review of nutrient budget considerations. Marit. For. Res. Cent. Fredericton, N.B. Inf. Rep. M-X-121.

Freedman, B. 1982a. An overview of the environmental impacts of forestry, with particular reference to the Atlantic Provinces. Prepared for the Environmental Protection Service, Environment Canada. in press.

Freedman, B. 1982b. Environmental impacts associated with increased harvesting and burning of wood for energy purposes in Nova Scotia. Prepared for the Institute for Resource and Environmental Studies, Dalhousie University. Halifax. in press.

Freedman, B., C. Beauchamp, I.A. McLaren, and S.I. Tingley. 1981. Forestry management practices and populations of breeding birds in a hardwood forest in Nova Scotia. Can. Field Nat. 95: 307-311.

Freedman, B., P.N. Duinker, R. Morash, and U. Prager. 1982a. Forest biomass and nutrient studies in Nova Scotia. Part 2. Standing crops in a variety of stands. Marit. For. Res. Cent. Fredericton, N.B. Inf. Rep. M-X-134.

Freedman, B., K. Morgan, M. Crowell, C. Beauchamp, and A. Greene, 1982b. Preliminary observations of breeding birds and vegetation in a post-clearcutting secondary succession in a hardwood forest in Nova Scotia. Rep. Can. Wildl. Serv. Dep. Biol., Dalhousie University, Halifax.

Freedman, B., K. Morgan, M. Crowell, R. Morash, C. Beauchamp, and D. Swan. 1982c. Post clear-cutting secondary succession in a hardwood forest in central Nova Scotia. <u>in</u> Fourth Bioenergy Research and Development Seminar. National Research Council. Ottawa. in press.

Hallett, R.D. and T.S. Murray. 1980. Recent developments and current practices in forestation in Canada. Marit. For. Res. Cent., Fredericton, N.B. Inf. Rep. M-X-116.

Kimmins, J.P., J. de Catanzaro, and D. Binkley, 1979. Tabular summary of data from the literature on the biogeochemistry of temperate forest ecosystems. Report for ENFOR Project P-8. Petawawa Nat. For. Inst. Chalk River, Ontario.

Kimmins, J.P., K. Scoullar, and M.C. Feller. 1980. FORCYTE: a computer simulation approach to evaluating some long-term effects of whole-tree harvesting on the nutrient budget in northwest forests. pp. 25-28 <u>in</u> Proceedings, Second Bioenergy Research and Development Seminar. National Research Council of Canada. Ottawa.

Kimmins, J.P., K.A. Scoullar, and M.C. Feller, 1981. FORCYTE-10. pp. 54-59 in Proceedings, Third Bioenergy Research and Development Seminar. National Research Council of Canada. Ottawa.

Likens, G.E., F.H. Bormann, R.S. Pierce, and W.A. Reiners. 1978. Recovery of a deforested ecosystem. Science 199:492-496.

Reed, F.L.C. and Associates Ltd. 1980a. Regional employment generated by the forest sector in 1979. pp. 153-165 in: The Forest Imperative. Proceedings of the Canadian Forest Congress. Toronto.

Reed, F.L.C. and Associates Ltd. 1980b. Forest management expenditures in Canada compared to taxes generated by the forest sectors. pp. 129-151 in The Forest Imperative. Proceedings of the Canadian Forest Congress. Toronto.

Sabean, B. 1977. The effects of shade removal on stream temperatures in Nova Scotia. Nova Scotia Department of Lands and Forests. Truro, N.S. Pub. No. 77/135/150.

Scott, V.E., J.A. Whelan, and P.L. Svoboda. 1980. Cavity-nesting birds and forest management. pp. 311-324 in Management of Western Forests and Grasslands for Nongame Birds. USDA For. Serv., Gen. Tech. Rep. INT-86. Intermountain For. Range Exp. Sta., Ogden, Utah.

Swan, D.M. 1981. Small mammal responses to harvesting of a hardwood forest in central Nova Scotia. Honours Bachelor of Science in Forestry Thesis. University of New Brunswick. Fredericton, N.B.

Telfer, E.S. 1970. Relationships between logging and big game in eastern Canada. Pulp Pap. Mag. of Can., October 3-7.

Telfer, E.S. 1972. Forage yield and browse utilization on logged areas in New Brunswick. Can. J. For. Res. 2: 346-350.

Telfer, E.S. 1978. Cervid distribution, browse, and snow cover in Alberta. J. Wildl. Manage. 42: 352-361.

van Groenewoud, H. 1977. Interim recommendation for the use of buffer strips for the protection of small streams in the Maritimes. Marit. For. Res. Cent. Fredericton, N.B. Inf. Rep. M-X-74.

NOVA SCOTIA HARDWOODS WORKING GROUP, JOINT RESEARCH PROGRAM

by
J.C. Lees
Maritimes Forest Research Centre

About one-third of the standing forest inventory and the annual allowable cut in Nova Scotia is hardwoods. However, only a small proportion (less than one-half) of the hardwood productivity is presently being utilized. Locally where demands for hardwoods are traditionally high, or where new mills have been installed, hardwoods are being over-cut and it is felt that quality is decreasing. The main constraints to fuller use of the resource are its scattered occurrence (almost always mixed with softwoods), poor quality (poor form and high incidence of decay) and inefficient patterns of transportation and utilization. A rational and integrated management and utilization program is essential to full and orderly use of this potentially valuable resource.

Interest in a program of development of the hardwood resource was first expressed in early 1974 by industry through an approach to the then federal Minister of the Environment, Madame Sauvé. Canadian Forestry Service (CFS) research and development work in Southern Ontario and Western Quebec was acknowledged at that time, and plans were made for Maritimes Forest Research Centre (MFRC) input. A contract was arranged with Dr. G.L. Baskerville, of the Faculty of Forestry at the University of New Brunswick to report on hardwood research and development in the Maritimes. By February 1976 this work was completed and the report was circulated to resource departments of the Nova Scotia and New Brunswick Governments.

In May 1976 a joint government and industry committee on Forest Research in Nova Scotia acknowledged the importance of a cooperative effort in hardwoods research and development in the region.

Dr. Baskerville's report was examined as a background to the evaluation of work on hardwoods already underway in Nova Scotia and to proposals for new work. He set out a three-step approach to hardwood research. At first he called for a statement of provincial forest policy on hardwood resource management. Management objectives then set the scene for silvicultural treatments and demonstrated a need for new information. Baskerville recommended a joint program for provincial management agencies and MFRC.

There were three projects and 12 concomitant studies suggested

PROJECT I - HARDWOOD MANAGEMENT
Objective: To establish a provincial hardwood policy and management guidelines for implementing it.

PROJECT II - HARDWOOD YIELD
Objective: To develop yield information essential to the implementation and evaluation of management.

PROJECT III - HARDWOOD SILVICULTURE
Objective: To quantify the response of specific hardwood site cover types to silvicultural treatments in terms of quantity and quality.

In 1976 at the fall meeting of the Nova Scotia Forest Research Committee in Truro, it was decided to form a hardwoods working group. The group would represent forest agencies concerned with development and utilization of the hardwood resource in the light of declining quality and increasing quantity. The original group members were

- J. Lees, Maritimes Forest Research Centre, C.F.S.
- W. Webber, Masonite Canada
- W. Humphrey, N.S. Agric. and Marketing
- R. Bailey, N.S. Lands and Forests
- R. Robertson, N.S. Lands and Forests
- D. Haines, N.S. Lands and Forests
- G. van Raalte, Maritimes Forest Research Centre, C.F.S.

This mix of government, industry, and a maple sap specialist has been maintained. The task of the group was to establish research priorities, identify lead agencies, and monitor progress, reporting twice a year to the parent committee.

The working group, in two technical sessions on November 9 and December 7, 1976, discussed the 3-step approach as outlined, and identified priorities and research capabilities. There was much research and development work already underway and that was acknowledged to have top or equal priority to new work.

OBJECTIVES

New work should begin within the terms of a forest policy statement. A statement regarding hardwoods would be most useful to the working group in developing a program of research. Objectives were seen to be

1. Better and more complete utilization of the hardwood forest resource through integrated woods operations and multiple product use.

2. Provision of more options for management by use of appropriate cutting techniques, reforestation of selected species, and

stand improvement treatments, i.e. better silviculture.

3. Improved quality of hardwood stands through better management and appropriate cultural treatments.

The program then proposed to the Nova Scotia Forest Research Committee in 1977 is shown in Table 1. The status of the program in 1982 is shown in Table 2.

Progress to date has been steady. Research and development work is coordinated with projects in New Brunswick and Prince Edward Island. In particular, a CFS contracted assessment by UNB of the potential of hybrid poplars and native aspens is of great interest to hardwood users throughout the Maritimes.

Emphasis will be placed in the future on hardwood plantation management and the management of spaced natural stands as if they were plantations.

This report would not be complete without acknowledging the growth and yield study carried out by Nova Scotia Lands and Forests. Stem analysis of mature commercially important hardwoods has provided yield curves for the "natural" forest. A series of 50 or more stands, spaced to 80, 60, and 40% of full stocking over a range of development stages, will provide growth response curves, simulating the managed forests of the future.

The program has generated several published reports and these are listed in the following bibliography.

BIBLIOGRAPHY

Davar, Z., and K.L. Runyon 1980. Economic analysis of three silvicultural systems used in the management of tolerant hardwoods in Nova Scotia. Marit. For. Res. Cent., Inf. Rep. M-X-107, 22p.

Freedman, B. 1981. Intensive Forest Harvest: A review of nutrient budget considerations. Marit. For. Res. Cent., Inf. Rep. M-X-121 78p.

Goldsmith, F.B. and J.C. Lees 1982. Regeneration and management of white ash in Nova Scotia and New Brunswick. For. Chron. 58:35-39.

Lees, J.C. 1978. Hardwood silviculture and management: An interpretive literature review for the Canadian Maritime Provinces. Marit. For. Res. Cent., Inf. Rep. M-X-119 9p.

Nova Scotia Department of Lands and Forests. Thinning mixed hardwoods. Forest practices pamphlet No. 9. Nova Scotia Department of Lands and Forests.

Table 1. Research and Development Priorities - 1977

Topic	Status	Starting date	Time frame*	Responsible Agencies
Hardwoods literature review	on-going		short	MFRC
Site classification/capability	on-going		moderate	NSDLF
Hardwoods inventory update	on-going		short	NSDLF
Quality cruising	on-going		short	NSDLF
Current demand survey	new	1977	short	MFRC/NSDLF
Utilization opportunities	new	1977	short	MFRC/NSDLF
Improved yield prediction for major sites	new	1977	moderate	NSDLF
Silvicultural guide for hardwoods	new	1977	long	MFRC/NSDLF
Role of stump sprouts in hardwood regeneration	new	1977	moderate	MFRC
Regeneration ecology of white ash	new	1977	short	Contract/MFRC
Role of hardwoods in soil nutrient status on marginal sites	new	1978	short	Responsibility yet assigned.

*Short (1-5 years) Moderate (5-10 years) Long (7 + years)

Table 2. Research and Development Priorities - 1982

Topic	Status	Starting date	Time frame*	Responsible Agencies
Hardwoods literature review	complete	1976	short	MFRC
Site classification/ capability	on-going		moderate	NSDLF
Hardwoods inventory update	complete		short	NSDLF
Quality cruising	complete		short	NSDLF
Current demand survey	complete	1977	short	NSDFL/DOD
Utilization opportunities	underway	1977	short	MFRC/NSDLF
Improved yield prediction for major sites	underway	1977	moderate	NSDLF
Silvicultural guide for hardwoods	underway	1977	long	MFRC/NSDLF
Role of stump sprouts in hardwood regeneration	underway	1977	moderate	MFRC
Regeneration ecology of white ash	complete	1977	short	Dalhousie Univ./ MFRC
Role of hardwoods in soil nutrient status on marginal sites	underway	1979	short	Dalhousie Univ./ MFRC
Growth and wood quality in tapped and untapped sugar maple	complete	1978	long	NSDLF
Costs and benefits of silvicultural treatments	complete	1978	moderate	MFRC

* Short (1-5 years)
Moderate (5-10 years)
Long (7 + years)

Group Members

M. Guptill - La Foret Acadienne Ltee
R.E. Bailey - DLF
B. Freedman - Dalhousie Univ.
D. Haines - DLF
J.C. Lees - MFRC (Chairman)
D. MacIsaac - NS Agric. & Marketing
I.C.P. Millar - MFRC
W. Webber - Masonite Canada
R. Young - DLF

THE NEW BRUNSWICK HARDWOOD MANAGEMENT TECHNICAL COMMITTEE JOINT RESEARCH PROGRAM

by
R.C. West[1]
New Brunswick Department of Natural Resources

In the summer of 1979, the New Brunswick Forest Research Advisory Committee (NBFRAC) was established to guide and coordinate forestry related research and development activities in New Brunswick. Members are senior managers and administrators from the provincial forest industries, the Department of Natural Resources (DNR), the Maritimes Forest Research Centre (MFRC), and The University of New Brunswick (UNB).

The committee realized that forestry research and development in New Brunswick could be subdivided into many sectors, and that most effective coordination of effort would result from consultations with managers, researchers, and educators in each sector. To provide a channel of communication, subcommittees were established. One of these is the Hardwood Management Technical Committee.

The Hardwood Management Technical Committee is chaired by Charlie Dickinson, chief forester for Valley Forest Products. The committee, members include foresters from most of the hardwood utilizing industries, representative of the Forest Management Branch, DNR, the Federation of Woodlot Owners, and researchers and educators from MFRC and UNB.

The first task of the committee was to determine the "state of the art" of forest management in New Brunswick, in particular, and in a more general sense throughout northeastern North America. As a second step, seven topic areas where New Brunswick was deficient in hardwood research and development information were identified and assigned a priority. They are as follows:

1. forest inventory
   (a) site classification
   (b) growth and yield
   (c) inventory standards and techniques
2. regeneration response to harvesting
3. guidelines for management of natural stands
4. guidelines for plantation management
5. tree improvement (hybrid poplar, exotic species)
6. utilization
7. marketing.

A similar effort was undertaken by all the subcommittees, and NBFRAC evaluated the proposals to assign priorities to each sector.

The Hardwood Management Technical Committee was assigned three topic areas.

1. The development of hardwood yield tables for managed and nonmanaged stands.
2. An improved procedure for the prediction of regeneration response for hardwoods following contemporary harvesting.
3. The preparation of silvicultural prescriptions for naturally regenerated stands and for plantations to suit management objectives.

At this time the committee's working mandate was redefined to recommend lead agencies and operational requirements for each area of priority and to institute the recommendations.

It was decided that the DNR should be the lead organization in coordinating the collection and compilation of hardwood yield information. The Maritimes Forest Research Centre and industry would, however, assist DNR develop a standarized inventory system. The responsibility for establishing field sample plots would be the appropriate management group.

The task of initiating these recommendations was fairly easy because of the willingness of the DNR inventory group to expand their efforts into this area. The recommendation was timely, also, in that it will generate information which will be of value in new forest-growth simulation models.

The Maritimes Forest Research Centre was designated as the lead agency in developing a reliable procedure for predicting hardwood regeneration response. The committee further recommended that DNR should be responsible for the program implementation, data compilation, and distribution of results. The field work should be conducted jointly by DNR and industry.

The initial implementation of this recommendation was also fairly easy due to the membership on the committee of Dr. Lees who is the research scientist with MFRC responsible for hardwood management. Dr. Lees investigated all existing procedures in the Maritimes which could be used in predicting regeneration response. He finally modified a computerized regeneration survey system which DNR has been using for some time on softwood cutovers. Dr. Lees worked closely with DNR, Valley Forest Products, and Northwood Pulp and Timber and was able to initiate the first field work during the summer of 1981. This responsibility was taken over by the Reforestation Technical Committee of NBFRAC in 1982.

---

[1]Presently at the Maritimes Forest Research Centre.

As a third priority, the committee was assigned the management of naturally regenerated stands and plantations. This is the most important area of research and development in the management of hardwoods. Unfortunately it is a complex area of investigation and the one in which the committee can report the least progress, to date. This lack of progress cannot be blamed on a lack of effort but the research and development that the committee recommended is long-term and will require the appointment of additional staff by the lead agency.

The recommended procedure was for MFRC to act as a lead agency and in conjunction with DNR and industry develop research programs for three major aspects.

I. Plantations - requires research in areas such as
   - A) Sites and site preparation techniques
   - B) Herbicide and mechanical cultivation techniques
   - C) Insect and disease problems specific to hardwood plantations
   - D) Fertilization
   - E) Greenhouse and nursery techniques
   - F) Growth of natural stands compared to plantations.

II. Poplar - requires research in the following areas:
   - A) Natural stands
     - 1) Effect of spacing aspen stands
     - 2) Effects of fertilization
     - 3) Determining optimum age of treatment
     - 4) Investigating harvesting systems with respect to
       - -time of year
       - -effects on regeneration
       - -control of regeneration response.
   - B) Artifical Regeneration
     - 1) Investigate the development of clones of hybrid aspen, (a cross between trembling and largetooth aspens)
     - 2) Investigate hybrid poplar for
       - -site finger-printing of clones using the Ontario site evaluation system
       - -Development of clones suitable for New Brunswick conditions
       - -Comparison of hybrid poplar with natural aspen and hybrid aspen.

III. The final aspect is the investigation of silvicultural prescriptions for natural regeneration of desirable crop trees which would involve
   - A) A study of the effects of clear cutting, shelterwood harvesting, and narrow strip clear cutting on regeneration
   - B) A study of site preparation techniques
   - C) Comparison of 'canopy control with natural regeneration' and 'artificial regeneration with direct seedling', for various species.

APPENDIX I

Scientific and common names of tree species mentioned

Abies balsamea (L.) Mill	Balsam Fir
Pseudotsuga menziesii (Mirb.) Franco	Douglas Fir
Larix laricina (Du Roi) K. Koch.	Larch
Picea glauca (Moench) Voss.	White Spruce
Picea mariana (Mill.) B.S.P.	Black Spruce
Pinus strobus L.	White Pine
Pinus resinosa Ait.	Red Pine
Pinus ponderosa Laws	Yellow Pine
Tsuga canadensis (L.) Carr.	Eastern Hemlock
Robinia pseudoacacia L.	Black-locust
Acer rubrum L.	Red Maple
Acer saccharum Marsh.	Sugar Maple
Acer spicatum Lam.	Mountain Maple
Betula lutea Michx. f.	Yellow Birch
Betula papyrifera Marsh.	White Birch
Betula populifolia Marsh.	Wire Birch
Fagus grandifolia Ehrh.	Beech
Populus grandidentata Michx.	Largetooth Aspen
Populus tremuloides Michx.	Trembling Aspen
Prunus pensylvanica L.f.	Pin Cherry
Quercus rubra L.	Red Oak
Juglans nigra L.	Black Walnut
Thuja occidentalis L.	Eastern White Cedar
Carya sp.	Hickory
Carya sp.	Pecan
Alnus rubra Bong.	Red Alder
Fraxinus americana L.	White Ash

APPENDIX II

Conversion Factors

1 chain	= 20.117 m	1 cunit	= 2.832 m^3
1 acre	= 0.405 ha	1 cord per acre	= 8.956 m^3/ha
1 cord	= 3.625 m^3	1 pound per cubic foot	= 16.019 kg/m^3
1 cubic foot	= 0.028 m^3	1 square foot per acre	= 0.229 m^2/ha

APPENDIX III

Attendants at the Apics Hardwood Utilization Conference
March 16 & 17, 1982

1) Black, David G.
Department of Natural Resources
Forest Utilization Branch
P.O. Box 6000
Fredericton, New Brunswick
E3B 5H1

2) Blouin, Glen
Department of Natural Resources
R.R. #1
St. Paul de Kent, New Brunswick
E0A 3B0

3) Brown, B.
Department of Agriculture & Forestry
P.O. Box 2000
Charlottetown, Prince Edward Island

4) Brown, Gordon
Box 4
Port Howe, Nova Scotia
B0K 1K0

5) Bradley, Merlin
Southampton Lumber Ltd.
Box 160
Nackawic, New Brunswick
E0H 1P0

6) Clarke, Dr. M.R.
Director of Research
Forintek
800 Montreal Road
Ottawa, Ontario
K1G 3Z5

7) Clowater, Wayne G.
Department of Natural Resources
Forest Management Branch
P.O. Box 6000
Fredericton, New Brunswick
E3B 5H1

8) Coles, J.F.
Research Coordinator
N.B. Executive Forest Research Committee Inc.
500 Beaverbrook Court
Fredericton, New Brunswick
E3B 5X4

9) Crawford, W.C.
Department of Commerce & Development
P.O. Box 6000
Fredericton, New Brunswick
E3B 5H1

10) Curtis, David S.
N.B. Federation of Wood Producers
108 Prospect Street, Suite 8
Fredericton, New Brunswick
E3B 2T9

11) Davies, David C.
Department of Natural Resources
Forest Utilization Branch
P.O. Box 6000
Fredericton, New Brunswick
E3B 5H1

12) Dickison, R.B.B.
Department of Forest Resources
University of New Brunswick
Bag Number 44555
Fredericton, New Brunswick
E3B 6C2

13) Dickinson, C.A.
Valley Forest Products Ltd.
P.O. Box 1000
Nackawic, New Brunswick
E0H 1P0

14) Frampton, Gene
Good Wood Fuel Company
6205 Lawrence Street
Halifax, Nova Scotia
B3L 1J8

15) Freedman, Dr. B.
Department of Biology
Dalhousie University
Halifax, Nova Scotia

16) Goggin, T. Austin
MacMillan Rothesay Ltd.
P.O. Box 990
Sussex, New Brunswick
E0E 1P0

17) Hatch, Brian
Department of Natural Resources
Forest Extension Branch
R.R. #5
Fredericton, New Brunswick
E3B 4X6

18) Hebb, D.
Department of Natural Resources
80 Pleasant Street
Newcastle, New Brunswick
E1V 1X7

19) Hogan, Geoffrey G.
Department of Biology
University of Prince Edward Island
550 University Avenue
Charlottetown, Prince Edward Island

20) Hoyt, J.S.
Department of Natural Resources
Forest Utilization Branch
P.O. Box 6000
Fredericton, New Brunswick
E3B 5H1

21) Hughes, Peter J.
N.B. Federation of Wood Producers
108 Prospect Street, Suite 8
Fredericton, New Brunswick
E3B 2T9

22) Hunter, Chipman
Agfor Limited
Florenceville, New Brunswick
E0J 1K0

23) Jones, Stephen
Northwood Panelboard Ltd.
P.O. Box 429
Chatham, New Brunswick
E1N 3A8

24) Johnston, Jack H.
Canadian Forestry Service
Maritime Forest Research Centre
P.O. Box 4000
Fredericton, New Brunswick
E3B 5P7

25) Ker, Dr. J.W.
Faculty of Forestry
University of New Brunswick
Bag Number 44555
Fredericton, New Brunswick
E3B 6C2

26) LeBlanc, P.
Union of Woodlot Owners of
Southeastern New Brunswick
P.O. Box 832
Richibucto, New Brunswick
E0A 2M0

27) Lees, Dr. J.C.
Canadian Forestry Service
Maritime Forest Research Centre
P.O. Box 4000
Fredericton, New Brunswick
E3B 5P7

28) Lockhart, D.D.
N.B. Forest Products Assoc. Inc.
500 Beaverbrook Court
Fredericton, New Brunswick
E3B 5X4

29) MacDonald, Joanne
Department of Forest Resources
University of New Brunswick
Bag Number 44555
Fredericton, New Brunswick
E3B 6C2

30) McDonald, B. Thomas
Minas Basin Pulp & Power Co. Ltd.
Hantsport, Nova Scotia
B0P 1P0

31) Marceau, Pat
P.O. Box 572
Grand Falls, New Brunswick
E0J 1M0

32) Meadows, Barry B.
Department of Natural Resources
Forest Utilization Branch
P.O. Box 6000
Fredericton, New Brunswick
E3B 5H1

33) Methven, Dr. I.R.
Department of Forest Resources
University of New Brunswick
Bag Number 44555
Fredericton, New Brunswick
E3B 6C2

34) Murray, John D.
29 Swan Crescent
Halifax, Nova Scotia
B3M 1T7

35) Malloy, Wayne L.
Canadian Forestry Service
Maritimes Forest Research Centre
P.O. Box 4000
Fredericton, New Brunswick
E3B 5P7

36) Moller, Rolf
Department of Natural Resources
Forest Extension Branch
R.R.#5
Fredericton, New Brunswick
E3B 4X6

37) Nelson, Barry
Department of Natural Resources
Forest Utilization Branch
P.O. Box 6000
Fredericton, New Brunswick
E3B 5H1

38) O'Keefe, Prof. T.
School of Forest Resources
University of Maine
119 Nutting Hall
Orono, Maine 04473

39) Ogden, Dr. J.D.
Department of Biology
Dalhousie University
Halifax, Nova Scotia

40) Pelley, R.M.
31 Lester
St. John's, Newfoundland

41) Poirier, Eugene
P.O. Box 1019
Sussex, New Brunswick
EOE 1PO

42) Savage, Graham D.
Department of Forest Resources
University of New Brunswick
Bag Number 44555
Fredericton, New Brunswick
E3B 6C2

43) Schneider, Dr. M.H.
Department of Forest Resources
University of New Brunswick
Bag Number 44555
Fredericton, New Brunswick
E3B 6C2

44) Simpson, F.J.
President, APICS
1411 Oxford Street
Halifax, Nova Scotia
B3H 3Z1

45) Smythe, Stuart
Department of Agriculture &
Rural Development
P.O. Box 6000
Fredericton, New Brunswick
E3B 5H1

46) Stuart, John
Forest Utilization Branch
Department of Natural Resources
P.O. Box 6000
Fredericton, New Brunswick
E3B 5H1

47) Stephenson, Sue
Department of Biology
University of Prince Edward Island
550 University Avenue
Charlottetown, Prince Edward Island

48) Torunski, W.R.
Craftique Furniture Ltd.
17 Matheson Street
Campbellton, New Brunswick
E3N 1N4

49) van Raalte, G.D.
Canadian Forestry Service
Maritime Forest Research Centre
P.O. Box 4000
Fredericton, New Brunswick
E3B 5P7

50) Wellings, F.
Department of Lands & Forests
P.O. Box 68
Truro, Nova Scotia
B2N 5B8

51) West, R.C.
Canadian Forestry Service
Maritimes Forest Research Centre
P.O. Box 4000
Fredericton, New Brunswick
E3B 5P7