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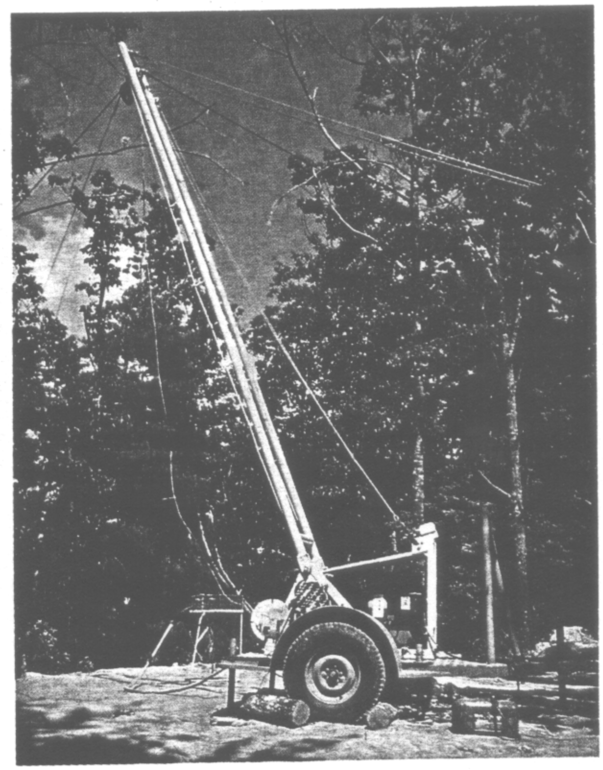

HARDWOOD FUELWOOD IN NORTH GEORGIA:
Resources, Utilization, and Harvesting

By: Frederick W. Cubbage and Joseph R. Saucier

GEORGIA FORESTRY COMMISSION

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INTRODUCTION

The hardwood forests in North Georgia represent a largely untapped opportunity for commercial utilization. Hardwood forests comprise about one-third of the annual net timber growth in Georgia, yet only about one-fifth of the State timber harvest consists of hardwoods. Traditionally, hardwoods have been utilized commercially for either sawtimber or pulpwood. Many residents in North Georgia also have used hardwoods for heating their homes, even before the energy crisis in the 1970's. Since the seventies, many more people have adopted wood as their primary or secondary home heating source. In addition, many firms have considered using fuelwood for industrial heating and a number of projects have been initiated using wood exclusively for heating (Georgia Forestry Commission 1979).

Despite the increased use of hardwoods for fuel, annual growth throughout the State still exceeds harvest by a ratio of almost two to one. Hardwood inventories in the State have increased continuously in the past two decades, while annual harvest has remained relatively constant (Sheffield and Knight 1984). In this paper, the possibilities for increasing utilization of this large resource, particularly in North Georgia, are discussed.

The key factors determining utilization of the hardwood forest resource are markets and harvesting costs. The resource may be plentiful, but economics dictates its use. If the markets for commercial hardwood products are limited, as suggested by Harris (1982), naturally the hardwood inventories will increase--uncut trees continue to grow. Also, even if markets do exist, trees must be harvested and transported economically in order to fetch a price buyers are willing to pay.

The use of hardwoods for fuel has been widely discussed and promoted throughout the country for the last decade. However, the amount of knowledge regarding the utilization and harvesting of hardwoods remains limited compared with the wealth of studies performed on pines. Firewood marketing in particular has remained largely undocumented, with informal or almost unidentifiable market distribution channels. As it apparently has been for centuries, firewood harvesting and marketing remains a backyard business, performed by individuals or families, with virtually no large corporate involvement (Cole 1970). In Georgia, Gold Kist Corporation has marketed some small firewood bundles in a few large metropolitan areas, but this certainly seems to be an exception.

This situation prompted the principal purpose of this paper--an examination of the potential for increased harvest and utilization of the hardwood forest resource in the Georgia mountains. The mountains have the largest hardwood resource in the State, are generally economically underdeveloped, and have some of the largest county unemployment rates in the State. Increased commercial development of their hardwood resources would benefit local economies throughout the region.

FOREST RESOURCE

As of the last published national survey data, Georgia had the greatest area of commercial forest land in the United States (USDA Forest Service 1982). Results from the 1982 Georgia forest survey indicated that the total state land area of 37.2 million acres consisted of a total forested area of 24.2 million acres (65 percent), of which 23.7 million acres consisted of commercial forest land. Of this commercial forest area in the State, 11.4 million acres have softwood as the primary species and 12.3 million acres have primarily hardwoods (Sheffield and Knight 1984). In the North Georgia (Mountains) Forest Survey Unit (Figure 1), forests covered 3.2 million acres out of the total land area of 4.2 million acres--about 75 percent (Tansey 1983).

Statewide, hardwoods constitute over one-half of the commercial forest land base of the total cubic foot volume of all live trees and of the total forest biomass on the commercial forest land. However, pine growing stock volume exceeded that of hardwoods and the State's net annual growth of pine was almost double that of hardwoods. In the mountain survey unit, hardwood net annual growth exceeded pine growth considerably because of the larger resource base. Statewide, annual pine timber removals were about 91 percent of net annual growth, but hardwood removals were only 50 percent of growth. In the mountains, pine removals were less than growth (59,724 thousand cubic feet versus 93,162 thousand cubic feet); annual hardwood removals (23,920 thousand cubic feet) were far less than annual growth (84,790 thousand cubic feet). Selected forest resource statistics from the last forest survey are summarized in Table 1 (Tansey 1983, Sheffield and Knight 1984).

The preceding statistics describe the total hardwood resource, but not all hardwood trees are likely to be used for residential or commercial fuelwood. Fuelwood use is most likely to consist of smaller trees, and possibly tops, that are not merchantable for sawtimber or are less desirable for pulpwood. For hardwoods, this would consist of trees that are less than 12 inches at diameter breast height (d.b.h.). For the State, this total hardwood growing stock on commercial forest land for trees less than 11 inches d.b.h. was 5,264,974 thousand cubic feet in the last survey (Sheffield and Knight 1984)--38 percent of the available hardwood growing stock. For the Mountain Unit, hardwood growing stock for trees less than 11 inches was 882,734 thousand cubic feet (Tansey 1983)--36.0 percent of the total in the region.

State timber removals from hardwood growing stock on commercial forest land are also revealing, as summarized above. In general, the statistics indicate that commercial uses dominate State hardwood removals. Fuelwood is recorded as

Table 1. Forest Resource Statistics for Georgia and the Mountain Forest Survey Unit, 1982.

Characteristic	State of Georgia	Mountain Survey Unit[1/]
Land Area:		
all land (ac.)	37,167,713	4,199,251
total forested (ac.)	24,242,438	3,162,984
percent forested	65.2%	75.3%
commercial forest (ac.)	23,733,684	3,096,735
softwood type (ac.)[2/]	11,438,919	1,030,748
hardwood type (ac.)	12,294,765	2,065,987
percent hardwood	51.8%	66.7%
Commercial forest statistics:		
Total Biomass--		
softwood (hun. thous. lbs.)	15,430,022	3/
hardwood (hun. thous. lbs.)	17,897,765	3/
percent hardwood	53.7%	3/
Total Growing Stock--		
softwood (thous. cu. ft.)	15,882,373	1,759,903
hardwood (thous. cu. ft.)	13,689,823	2,454,208
percent hardwood	46.3%	58.2%
Net Annual Growth[4/]--		
softwood (thous. cu. ft.)	1,189,564	93,162
hardwood (thous. cu. ft.)	4,566,689	84,790
Net Annual Removals[4/]--		
softwood (thous. cu. ft.)	1,086,679	59,724
percent of growth	91.4%	64.1%
hardwood (thous. cu. ft.)	281,298	23,920
percent of growth	49.6%	28.2%
Hardwood Growing Stock--		
5.0-10.9" DBH (thous. cu. ft.)	5,264,974	882,734
11.0+DBH (thous. cu. ft.)	8,424,849	1,571,474

SOURCE: Tansey 1983, Sheffield and Knight 1984

1/ Mountain Survey Unit includes Bartow, Catoosa, Chattooga, Cherokee, Dade, Dawson, Fannin, Floyd, Gilmer, Gordon, Habersham, Lumpkin, Murray, Pickens, Rabun, Stephens, Towns, Union, Walker, White, and Whitfield counties.

2/ Commercial forest land.

3/ Not published for Northern forest survey unit.

4/ On commercial forest land growing stock.

Removal Class	Georgia Hardwood Removals (thousand cu. ft.)
Roundwood Products:	
saw logs	76,643
veneer logs & bolts	12,142
pulpwood	50,928
poles & piling	–
posts	–
other	–
fuelwood	22,224
Subtotal	161,937
Logging Residues	54,982
Other Removals	64,379
Total Removals	281,298

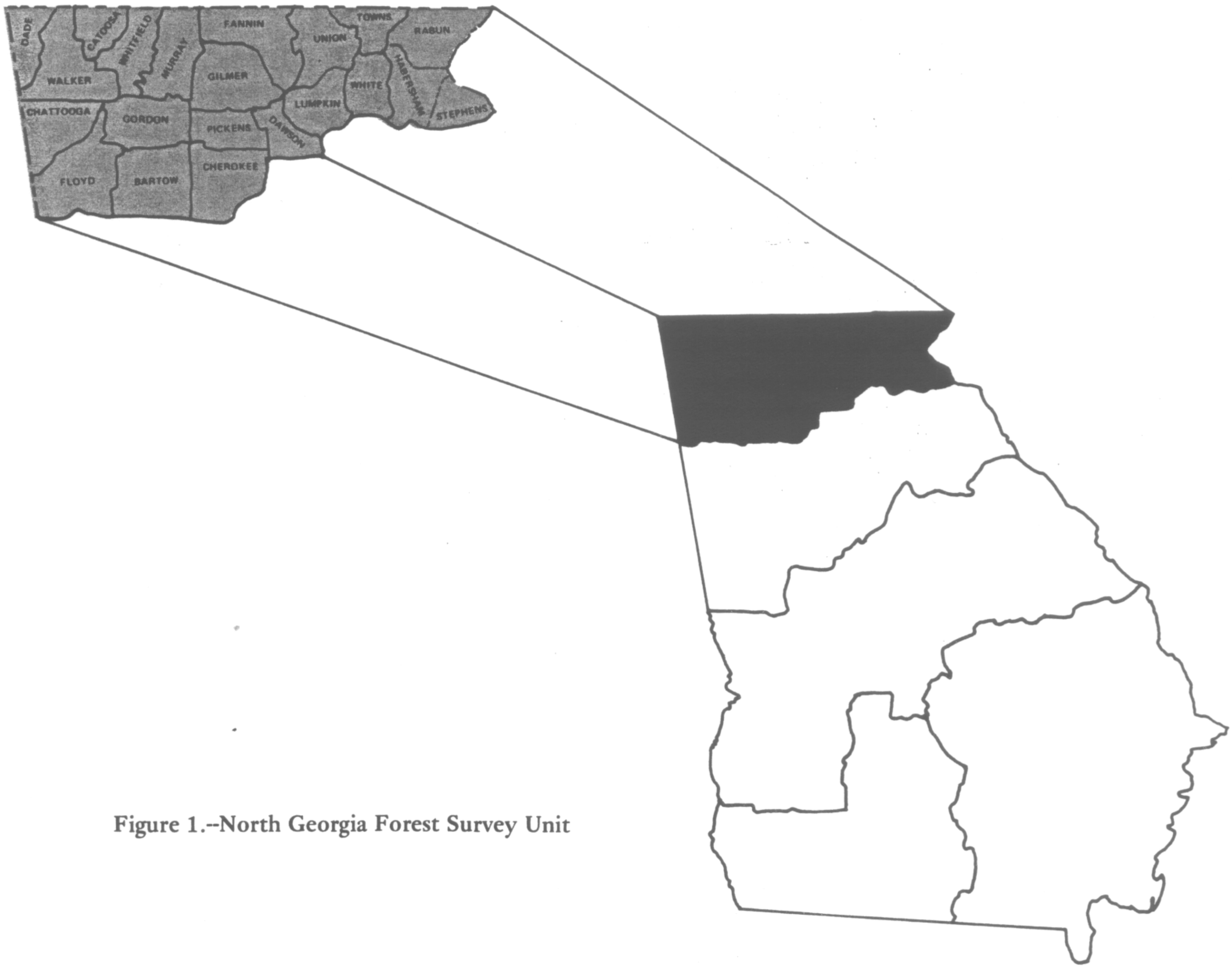


Figure 1.--North Georgia Forest Survey Unit

a minor component, and logging residues alone constitute the second largest portion of removals from growing stock. Thus, not only does growth of timber exceed drain (removals), but much of the removals are actually left in the woods.

CHANGING UTILIZATION

Utilization of small hardwood trees has changed gradually in the last few decades. In 1955 only 2.5 million cords of hardwood pulpwood were produced in the South, or 14 percent of the total pulpwood production. By 1981, southern hardwood pulpwood production stood at 14.2 million cords or 27 percent of the total. The hardwood percentage nearly doubled during the 26-year period. Other uses for small hardwood timber include pallets, structural boards, and fuelwood.

Pallets and Structural Boards

The pallet industry in the United States consumes over 40 percent of the total hardwood lumber production, and has a current annual growth rate of 7 percent. Pallet production more than doubled in the 1970's and the current level of production in the South is expected to increase 60 percent by the year 2000 (Anderson and others 1984).

Expanding use of pallets in materials handling systems is an encouraging prospect for underutilized low-grade hardwoods common in the mountains. It is estimated that palletized shipping and handling has a 5 to 1 cost advantage over piece handling. The large cost savings are due, in part, to the availability of low-cost raw material for pallet production. Low-grade recovery and lack of markets for low-grade lumber cause sawmillers to limit acceptance of grade 3 and 4 logs. At present, pallet production is the chief market for low-grade hardwood lumber. As this market continues to expand, greater opportunities will be available to harvest the low-grade hardwoods.

Markets for hardwoods are also likely to increase as new composite products gain acceptance. Several developments and changes have taken place in the forest products industry that have given rise to a family of new forest products.

Manufacturers of plywood and panel products have been acutely aware of the irony that large supplies of low-cost hardwoods are available, while softwood stumpage prices soared with increasing demand. This stimulus caused a concerted effort throughout the industry and by research organizations to increase utilization of hardwoods. These efforts are beginning to pay off in significant breakthroughs in materials engineering and adhesives technology which now pave the way to revolutionizing the panel product industry.

Hardwoods are now being used as a component in the manufacture of softwood plywood, and in new panel products such as flakeboard and oriented strandboard (OSB). The use of hardwoods in these new panel products is increasing and gaining greater acceptance. To date, these products rely on soft hardwoods, rather than the oak-hickory species common in the mountains, which will limit their impact in North Georgia.

Fuelwood

Since the 1973 oil embargo, the forest products industry, having an established handling and delivery system in place, quickly made significant changes from fossil to internally generated fuels for energy. In the solid wood products industry, the shift was primarily to burning of wood residues such as bark, sawdust and trim. That industry achieved 70 percent energy self-sufficiency by 1980. The pulp and paper industry, which is a large energy user, has also made significant progress towards energy self-sufficiency, changing from 38 percent to 55 percent energy self-sufficiency in the relatively short period from 1973 to 1980. These figures are even more impressive considering that their production output was increased 25 percent during the same period. Large investments in wood-fired combustion systems have been made throughout the industry. Many of these systems are only now coming into operation. To achieve the 55 percent level of energy self-sufficiency, the pulp and paper industry uses outside sources of wood for fuel. Of interest here, these outside sources can be, and frequently are, whole-tree chips produced from logging residue, or standing cull and low quality hardwoods.

Other fuelwood markets are growing. These include nonforest-based industries, such as, brick and textile manufacturers; state and federal institutional facilities, such as schools, hospitals and prisons; and power-generating utilities where mixtures of wood and coal provide a very suitable fuel that meets low-sulfur fuel requirements (Georgia Forestry Commission 1979).

Another large and growing fuelwood market is that of residential use. Preliminary results of a recent nationwide survey of residential fuelwood use revealed some startling statistics (Skog and Watterson 1983). The study, conducted by the USDA Forest Service in cooperation with the University of Wisconsin Survey Research Laboratory, found that during the 1980-81 heating season, 22.2 million households, or 28 percent of U. S. households, burned 42 million cords of wood in primray and secondary homes. The market, while defuse, is large. By comparison, the 42 million cords equal approximately one-third the pulpwood volume utilized by the U. S. pulp and paper industry.

Of the 44.8 million cords acquired (42 million consumed), 93 percent was roundwood and 7 percent came from mill residue. The roundwood fuel was made up of 80 percent hardwood and 20 percent softwood. In the East, 95 percent was hardwood. Twenty-eight percent, or 12.4 million cords, of acquired fuelwood in 1980 to 1981 was purchased at an average price of $56 per delivered cord. Prices in 1984 ranged from about $65 per cord in the Georgia mountains to $125 per cord in the Piedmont. Residential fuelwood use will increase if alternate home heating fuel prices increase.

HARVESTING PROSPECTS – A CASE STUDY

As described in the introduction, harvesting is one of the keys to determining hardwood utilization. Even if fuelwood markets are available, trees that are generally small in diameter must be harvested economically to increase utilization. Most residential firewood is either cut by homeowners for their own use or by one or two person part-time operations for retail sale (Marsinko and Wooten 1983, Marsinko and Howe 1983). This probably does not limit rural consumption of wood, but might in urban areas. Also, the lack of large contractors available to deliver roundwood certainly limits industrial applications of wood fuel for energy.

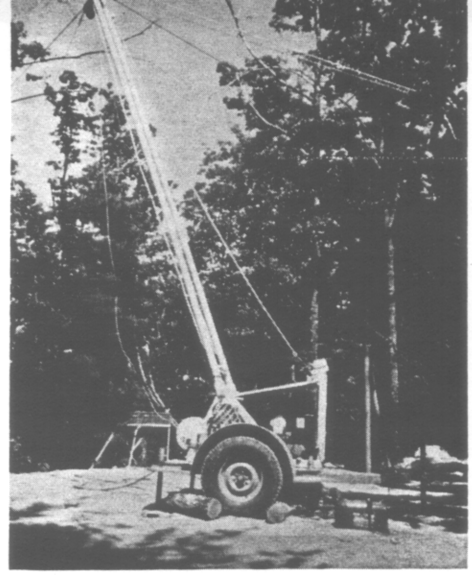
Economical harvesting of hardwood or low-grade pines in the mountains for residential or industrial fuelwood could help in utilizing currently non-commercial trees and provide greater economic returns to local communities. A few whole-tree chip operations have cut wood on a commercial basis in Northwest Georgia, but harvest mainly pine for pulp and paper. Most firewood in the mountains is cut using chainsaws and pickups--sometimes cutting logging residues and often harvesting whole trees. The Forestry Commission recently sponsored a case study to investigate the possibilities for fuelwood harvesting of mountain hardwood stands using a conventional ground-based skidder system and an experimental small cable yarder system (Cubbage and Gorse 1984a, 1984b).

Study Procedures

Possibilities for fuelwood harvesting were examined by timing a skidder and cable yarder in the Georgia mountains in the summer of 1983. Performance of a prototype John Deere 440D skidder in the harvest of small hardwood stands was analyzed on a test site at Berry College near Rome, Georgia. The second piece of equipment examined in the case study was the Bitterroot Miniyarder, developed by USDA Forest Service, Equipment Development Center, Missoula, Montana (1983). The Bitterroot miniyarder was tested in this study on the Chattahoochee National Forest in North Georgia. The machine is a compact, light-weight, two-drum, live-skyline yarder. It was designed to remove light slash, thinnings, and logging residue of either pulpwood

Table 2. Observed Characteristics of JD 440D Skidder, Berry College.

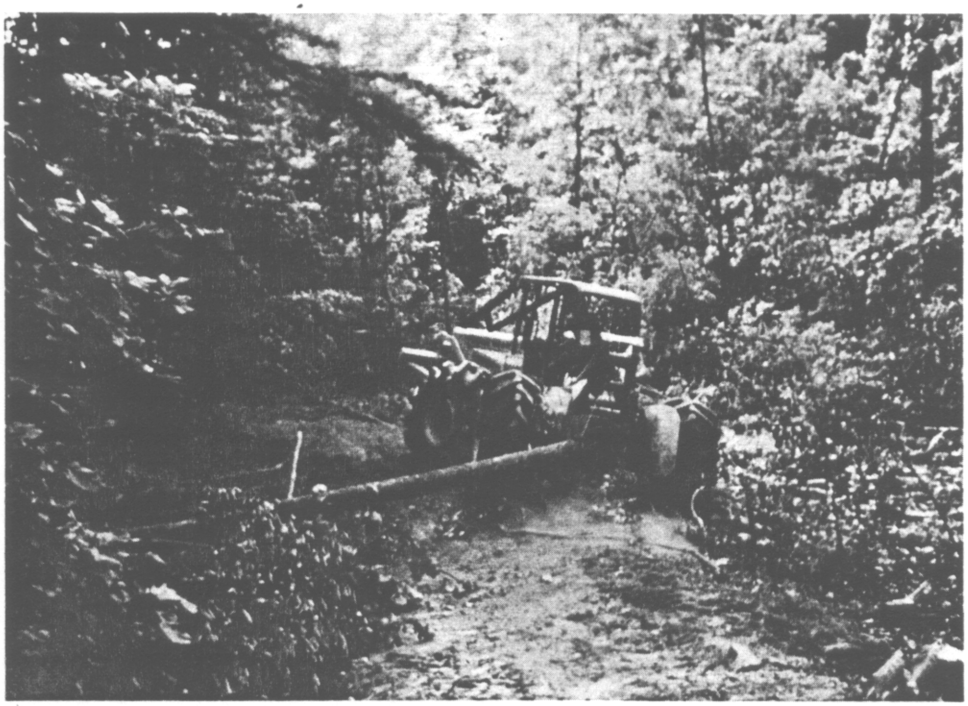
Variable	Mean	Standard Deviation	Minimum	Maximum	Percent	Number of Obser-vations
Cycle Time Including Delay (mins.):						
Travel Empty	2.04	0.80	0.18	4.25	29	101
Hook	2.37	1.11	0.30	5.12	33	101
Travel Loaded	1.90	0.63	0.33	3.75	27	101
Unhook	0.82	0.47	0.22	3.35	11	101
Full Cycle	7.09	1.64	2.85	11.10	100	101
Delay per Cycle	0.68	1.67	0.00	9.00	10	18
Decking	0.46	-	0.59	4.35	-	24
Tree and Terrain measures:						
Stems per turn (no.)	1.6	0.8	1.0	3.0	-	162
Stem length (ft.)	37.6	8.7	16.0	64.0	-	162
Butt diameter (in.)	11.3	3.3	5.2	24.0	-	162
Top diameter (in.)	4.4	1.2	2.0	9.0	-	162
Turn volume (cu.ft.)	14.3	11.4	2.7	73.6	-	101
Turn weight (lbs.)	885.3	710.8	142	4562	-	101
Skid distance (ft.)	385.8	94.8	200	550	-	101



The miniyarder, while small, produced fast turn cycles.

Table 3. Observed Characteristics of Bitterroot Miniyarder, Chattahoochee National Forest

Variable	Mean	Standard Deviation	Minimum	Maximum	Percent	Number of Obser-vations
Cycle Time Including Delay (mins.):						
Travel Empty	0.30	0.09	0.13	0.67	8	123
Hook	0.98	0.96	0.08	7.53	25	114
Winch Lateral	1.29	1.97	0.13	13.18	33	141
Travel Loaded	0.95	0.40	0.38	3.23	24	140
Unhook	0.88	0.81	0.25	5.73	22	101
Full Cycle	3.96	2.25	1.77	16.68	100	99
Delay per Cycle	0.63	2.65	0.41	11.75	16	29
Tree and Terrain Measures:						
Stems per Turn (no.)	0.99	0.30	0	2	-	144
Stem length (ft.)	20.7	8.3	6	46	-	142
Butt diameter (in.)	10.6	2.89	4.0	16.9	-	142
Top diameter (in.)	7.4	3.32	2.0	15.0	-	142
Turn volume (cu.ft.)	9.4	4.3	0.4	21.0	-	137
Turn weight (lbs.)	567	268	25	1322	-	137
Slope distance (ft.)	274	109	107	473	-	144
Lateral distance (ft.)	40	32	5	125	-	144



The skidder performed well on slopes up to 20 percent.

or firewood size. The yarder is very portable, and may be mounted on a trailer or a ¾-ton pickup truck (Domenech 1983).

The harvest at the Berry College site consisted of clearcut of about three acres of mixed hardwoods, with a small component of shortleaf pine. That on the Chattahoochee consisted of a "commercial" clearcut of about two acres of mixed hardwoods. The Chattahoochee site had a minor component of white pine, which was harvested and sold to a local sawmill. The operator also cut and removed all the hard hardwoods for firewood, but left all the soft hardwoods standing on the site.

Both machines were timed continuously during the study. Two observers were used at both sites to measure elemental and total cycle times. The person at the deck or landing measured travel empty, unhook, decking, and full cycle times, as well as making log measurements. The observer stationed in the woods timed hook, lateral winch, and travel loaded times and the distance traveled from the woods to the deck.

Data Analysis

The time study and volume data collected in the field were aggregated and computerized for statistical analyses. Characteristics of the harvesting operations are summarized in Table 2 for the skidder data and Table 3 for the cable yarder.

Cable Skidder.--The elemental times excluding delay for the JD 440D seemed reasonable, despite the initial inexperience of the operators who were provided by the Forestry Commission. The drivers learned to operate the machine very quickly and the times were comparable to other cable skidder studies. Travel empty averaged about 2 minutes and accounted for approximately 29 percent of the full cycle time. Hook times accounted for about 33 percent of the full cycle time, averaging about 2½ minutes each turn. Travel loaded times averaged 1.90 minutes and accounted for 27 percent of the full cycle time. Once the logs were winched in, there was usually little trouble in hauling them to the deck. Unhook times averaged less than one minute and only accounted for 11 percent of the full cycle time. Operator aggressiveness was a key factor. Two operators drove the skidder during the study. One was more energetic and faster.

Decking times averaged 0.46 minutes but were not figured into the full cycle times since they only occurred occasionally (about every fifth turn). Little time was required to deck the logs since the deck was located on a slope. The logs were pushed down the slope and braced against two large standing trees. Decking downhill minimized the time and energy requirements of the skidder.

Delays constituted about 10 percent of the total time. Few delays occurred during travel empty. Most happened while hooking trees that were not completely severed from the stump or when the chokers slipped off the log.

Skyline Yarder.--Several characteristics of the Bitterroot skyline yarder were noticeable. The Bitterroot was small. It had an 18-horsepower engine, ¼-inch cable, and an approximate assembled cost of about $16,000. Other yarder systems used in the East had at least 100-horsepower engines, ½-inch or greater cable, and yarder costs ranging from $55,000 to over $100,000. Accordingly, the volumes moved per turn with the Bitterroot were considerably less--only about 1/3 to 1/5 as much as the other systems.

The elemental times, excluding delay, for the Bitterroot were faster than for the other skyline systems timed in the East (Cubbage and Gorse 1984a). Average slope yarding distance for the Bitterroot was shorter, so average travel empty--the time it took the carriage to fall down the skyline--should take less time. The hook times of less than one minute were also much less for the Bitterroot than those found in other studies.

Average time required to winch a tree laterally (0.86 minutes) was greater with the Bitterroot than with other systems studied, and highly variable as well. This reflects a limitation of a small machine. Lateral yarding demands the greatest force to break logs free from the ground and pull them through brush and potential snags. Lateral yarding times should be greater for a low-power machine than for a high-power machine that has greater pulling capacities. Unhook times were similar to those found in other studies. The full cycle times of about four minutes for the Bitterroot were consistently less than those timed on other skyline operations.

Total cycle delays were less than for other systems--but not necessarily because of system advantages. Rather, few delays were recorded because of the timing methods and the inexperience and sporadic work habits of the crew. Problems that might have caused minor delays with other systems and operators tended to cause complete shutdowns during this study--thus being classed as down time, not delay time. Cycle and delay times were relatively small, but overall system down time was excessive.

Production Equations

The data for the cable skidder and skyline yarder were used to develop regression equations for elemental and full-cycle times. For both machines, statistically significant equations were estimated for each elemental and full cycle activity except unhooking. Full cycle equations are presented in Table 4. In many instances, regressions with larger coefficients of determination could be estimated by using variables unique to the study, such as day number, choker setter, or corridor number. The equations reported were selected because they are more useful for general applications.

Results for each machine are fairly straightforward, confirming the logical effects of independent variables on turn times. Increasing turn volumes, skidding or yarding distance, or stems per turn always increased cycle times for both machines. For the data for this study, full cycle regressions with the greatest explanatory power (R^2=.41) for the skidder included the operator, stems per turn, skid distance, and volume per turn as significant independent variables. Using the full cycle equation, average production, excluding delays, would be about 135 cubic feet per operating hour, using average turn volumes, stems per turn, and skid distances, excluding decking times. This production rate is small, and may be explained partially by the small loads carried each turn and perhaps may be due to the inexperience of the sawyers and machine operators. More trees and volume could have been skidded each turn, which would have increased production significantly.

The Bitterroot Yarder equation that uses slope distance, lateral yarding distance, and turn weight as independent variables was chosen as the best for wider applications. Using the mean values in the Bitterroot regression equations, the average production would be 180 cubic feet per operating hour. However, the yarder operated only 30 percent of the time while observed, so had an effective production of 54 cubic feet per scheduled hour. Baumgras and Peters (1984) timed the yarder as well, and found lower potential production rates at mean operating distances and volumes (134 cubic feet per operating hour), even with a three-man crew. However, utilization was greater (about 60 percent), so effective production was 79 cubic feet per scheduled working hour.

Cost Calculations

Average harvesting costs for the two machines were calculated using the regression equations for the full cycle times and machine rate calculations. First, the average costs for each machine were calculated as described by Miyata (1980). Cost information for the Bitterroot was estimated by Forest Service personnel and reported in Baumgras and Peters (1984). Approximate retail price for the JD 440D was used in the calculations, along with inflated operating costs for cable skidders from Cubbage (1981). Since neither machine was utilized to its full capacity, costs were also calculated after making estimates of potential utilization. Cost calculations are presented in Table 5. The eventual conclusions regarding pro-

Table 4. Full-Cycle Regression Equations for Cable Skidder and Skyline Yarder Times[1/]

		R^2	F Ratio
Skidder			
Time	$= 8.4871 + 0.4825$ (Stems Per Turn) $- 1.6421$ (Operator)[2/] $- 635.6125$ (1/Skid Distance_{ft}) $+ 0.0266$ ($\text{Volume}_{cu\ ft}$)	0.41	13.7
Skyline Yarder			
1/Time	$= 0.999786 - 5.867866$ (1/turn weight_{lb}) $- 0.0004514$ (lateral distance_{ft})[3/] $- 0.125545$ ($\log_{10}$ (turn weight_{lb} x slope distance_{ft}))	0.17	5.4

1/ All regressions significant at alpha = .01
2/ Operator: 0 for operator of average skill and aggressiveness; 1 for aggressive, better-than-average skill.
3/ Significant at alpha = .10; all other independent variables significant at alpha = .05.

fitability depend on which calculations are used--the observed or the assumed.

Examination of the calculations reveals several things. First, the average costs for both systems were quite large during the times observed--$40.56 and $63.90 per cord for the skidder and yarder, respectively. Second, these costs could be reduced greatly if both machines were used at levels closer to their potential. Skidder costs could be reduced to $19.64 per cord if the operator hooked 4 logs per turn and utilization increased from 65 to 67 percent. Miniyarder costs could decrease more, to $18.03 per cord, if utilization increased to 65 percent. With experienced operators and sawyers, both of these assumptions seem possible. Thus, the potential costs would probably be the most reasonable estimates for long-running operations.

The average costs for the operations as observed were expensive. In the South, average delivered prices of mixed hardwood pulpwood were $32.10 per cord delivered to a log yard (Timber Mart-South Yearbook 1983). Stumpage prices were $3.70 per cord, leaving an average price of $28.40 per cord for the cut, harvest, and delivery of wood. This is clearly much less than the observed costs of $40.56 and $63.90 per cord. Neither system would be profitable for pulpwood, especially including felling, loading, and trucking costs.

However, using the potential costs with experienced operators and full utilization, cost per cord would decrease to reasonable levels. Certainly the yarder could be utilized more than 30 percent of the time. Similarly, the skidder should be able to haul 4 logs, increasing the average payload from 14.3 cubic feet to 36 cubic feet, which would still be far less than its designed capacity.

Profitability of the operations looks more feasible when average costs are compared to prevailing firewood prices. In the Piedmont, delivered firewood costs up to $125 per cord of split wood. Prices in the Mountains are less, at about $60 to $75 per cord of delivered, split wood. These prices provide a greater margin for profit using a skidder or yarder, especially if they can operate at their production potentials.

Table 5. Cable Skidding and Skyline Yarding Costs Per Cord, Observed Data and Potential Productivity.

Characteristic	Machine: Skidder	Machine: Yarder
Machine Costs:		
Eqpt. Per Operating Hr.	$25.10	$ 9.34
Labor Per Scheduled Hr.[1/]	$ 6.00	$12.00
Utilization		
Observed	65%	30%
Potential[2/]	67%	65%
Eqpt. Per Scheduled Hr.[3/]		
Observed	$38.62	$31.13
Potential	$37.46	$14.37
Man & Machine Per Scheduled Hr.		
Observed	$44.62	$43.13
Potential	$43.46	$26.37
Machine Productivity:		
Production Per Operating Hr.		
Observed[4/]	135	180
Potential[5/]	264	180
Production Per Scheduled Hr.[6/]		
Observed	88	54
Potential	177	117
Average Costs:		
Per Cubic Foot		
Observed	51¢	80¢
Potential	26¢	23¢
Per Cord		
Observed	$40.56	$63.90
Potential	$19.64	$18.03

[1/] 1 operator for skidder; 2 for yarder

[2/] Estimated from other studies--only slight improvement for skidder; substantial for yarder

[3/] Equipment cost per operating hour ÷ utilization

[4/] From mean values for prediction equations

[5/] Skidder--increased production to 4 logs per turn (36 cubic feet); yarder operating at close to potential

[6/] Cost per scheduled hour ÷ productivity per scheduled hour (80 cubic feet per cord--per Bolin 1980).

DISCUSSION

This study examined the economics of utilizing the hardwood resource in the Georgia Mountains, particularly for fuelwood. The mountains have an abundance of hardwood growing stock that is underutilized. Use of hardwoods for pulp, composite boards, and fuel has increased, but still has not even begun to approach the annual growth rates in the State. Economical harvest of hardwoods has been an obstacle to increasing their utilization, especially in small-diameter stands.

An examination of a small skidder and skyline yarder was made to determine potential harvesting costs. For harvesting small hardwood trees, the small skidder performed well on the slopes of up to 20 percent. It had no difficulty traversing the area or hauling the loads required. In fact, the skidder was grossly under utilized, which caused large average costs for harvesting fuelwood. The production data for the Bitterroot Miniyarder showed that the yarder can have quite fast turn cycles. McMinn (1984) reported on the comparative environmental effects at the same sites, concluding that the yarder did cause less soil disturbance.

The two harvest machines examined indicate the potential and limits of firewood harvests. If the machines are used to their capacity and operated full-time, average logging costs would be reasonable for firewood harvests. But operators with no experience are likely to produce high-cost wood when operating in small hardwood stands and gaining the experience necessary will be difficult in an economical time span. Thus, new machines are unlikely to be adopted for firewood-type harvests of small hardwood stands unless average costs can be reduced quickly or firewood prices increase substantially. The outlook for harvesting of small hardwoods for industrial fuelwood is even less promising, because of low prices for dirty chips. Until greater demand and markets create greater prices for hardwoods, utilization of hardwoods will remain less than their potential.

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Cost $2305.
Quantity 5M