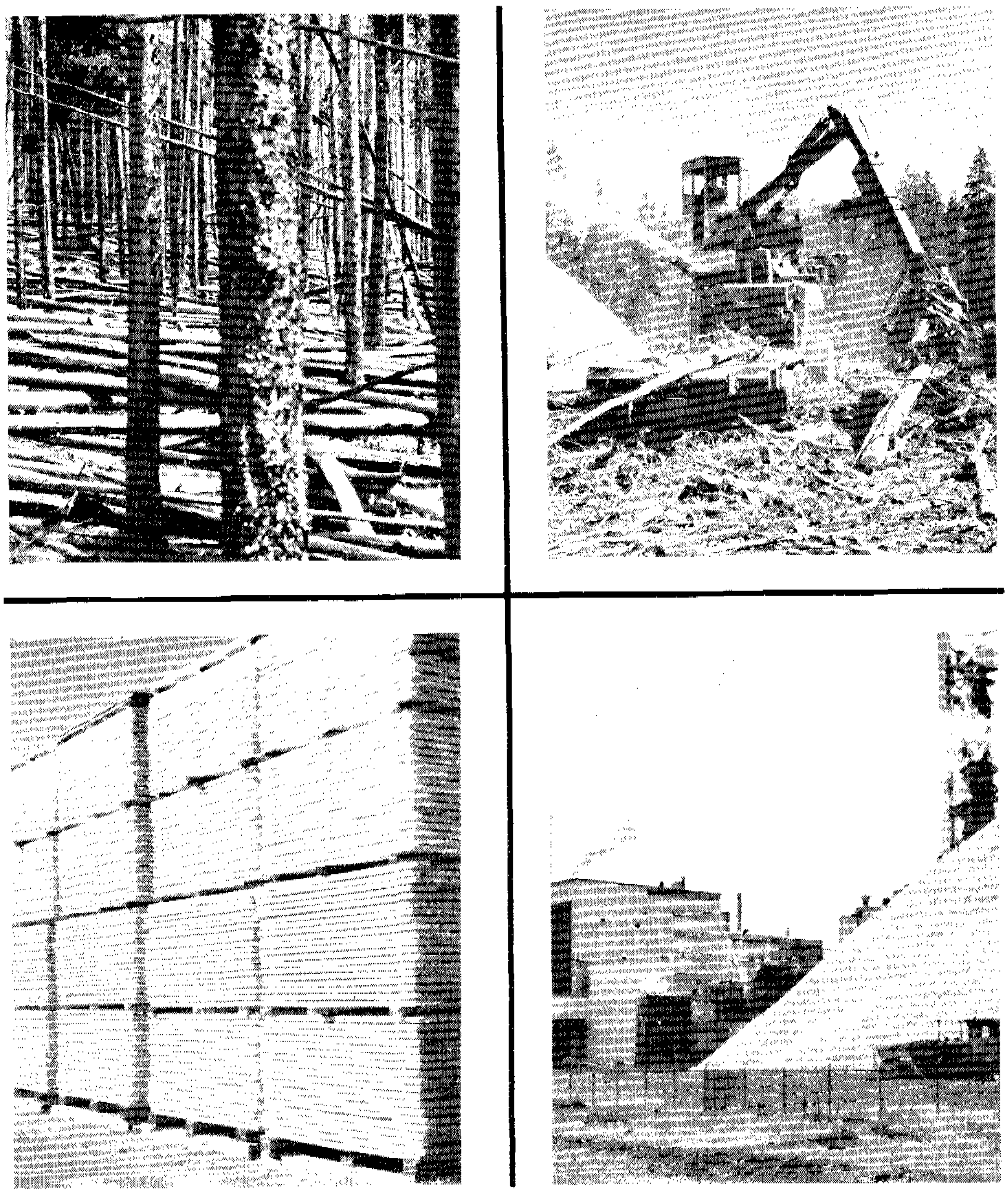
HARVESTING AND UTILIZATION OPPORTUNITIES FOR FOREST RESIDUES in the northern rocky mountains



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EXTENDED USE OF RESIDUE FOR CONVENTIONAL SOLID WOOD PRODUCTS

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ABSTRACT

There is no inherent difference between the wood from dead trees and green trees. Solid wood product studies have indicated that dead trees can be used for lumber, houselogs, and posts and poles although the amount of usable lumber is usually lower for dead trees than for green trees. Dead trees may be preferred for houselogs, posts, and poles; however, extra care is required in selecting and processing these products.

KEYWORDS: dead tree utilization, dead tree lumber, posts and poles, lodgepole pine, western white pine

INTRODUCTION

The management of timber stands, including the harvesting of trees, creates large quantities of forest residue. This residue, of all sizes and shapes, remains on the area after removal of the merchantable logs and includes branches, tops, cull and unmerchantable small trees, broken pieces, long butts, and standing and down dead trees. In the northern Rocky Mountain area, dead timber often constitutes most of the post-harvest residue. The slow rate of wood deterioration in this region allows trees killed by insects and disease to accumulate in the forest, adding to harvest waste. During the past few years, we have investigated the qualities of wood in dead trees and possibilities for utilizing it.

Our initial investigations concerned the inherent wood characteristics, chemical and mechanical, that might inhibit the use of dead trees. One study (Lieu and others 1979) indicated that for lodgepole pine (*Pinus contorta Dougl.*) and western white pine (*Pinus monticola Dougl.*) there was no difference in the quantities of cellulose, lignin, or other chemical constituents between dead and green tree wood. The ash content of the dead trees tended to be slightly greater than for green wood, but this difference was probably due to the wind-blown dust and dirt that had collected in the wood surface of the barkless trees.

Another study (Gernert and others 1979) evaluated physical characteristics, percentages of shrinkage values, and specific gravity of long-term dead, recently killed, and green western white pine. No differences were found in these variables for the three wood types studied.

A third study (Lowery and Pellerin[1]) determined the mechanical, or strength, properties of lodgepole and western white pine. Results indicated that the modulus of rupture and of elasticity for the dead and green dimension lumber were very similar; therefore, the lumber could be used interchangeably without any ill effects.

These studies showed that nothing should limit the use of dead tree wood, however, the appearance and defects of dead trees and logs may inhibit their utilization for solid wood products such as lumber, house logs, posts and poles. Available information on these products is discussed separately.

LUMBER

One of the highest-valued products from green trees is lumber, so dead trees were also evaluated for this end use. Studies have determined the quantity and quality of lumber from dead trees, and compared these values with those of green logs. Summaries of these studies follow.

Lodgepole Pine

Carr (1978)[2] and Dobie and Wright (1978) have reported the results of lumber grade-yield studies for lodgepole pine. Carr summarized investigations made on three National Forests--the Bitterroot, Gallatin, and Beaverhead, in Montana. The Bitterroot study used green and dead trees obtained from a decadent, old-growth stand. The dead trees were from a wide variety of natural mortality quality classes, from the recently dead to downed trees. Both dimension and boards were cut from the study logs.

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[1]Lowery, D. P. and R. Pellerin 1979. Evaluation of dimension lumber made from dead trees. Review draft.

[2]Carr, W. R. 1978. Comparison of lodgepole pine lumber recovery from live and dead timber. USDA For. Serv. Office Report, 19 p. Region 1, Missoula, MT.

In addition to the green control logs, the Gallatin study included green-needled trees that showed signs of medium to heavy bark beetle infestation; red-needled trees, dead less than 3 years; and trees dead longer than 3 years. Only 1-inch (2.5 cm) thick lumber was produced in this study.

The Beaverhead dead trees included a few that were red-needled and a few taken from the ground. The other trees in this category had been beetle-killed for various intervals of time.

All the study logs had a minimum small end diameter of 5.6 inches (14.2 cm) a minimum length of 8 feet (2.4 m) and were at least one-third sound. A summary of the results is shown in table 1.

The table shows that dead trees have considerable value when used in lumber production. The quality of lumber is reflected in the lumber value per thousand board feet (M bd. ft.), which ranged from $178 to $222 for the green trees and from $150 to $200 for the dead trees. Obviously, a lower quality of lumber is produced from dead tree logs. The differences between dead and green tree lumber values ranged from $16.71 in the Beaverhead study to $71.58 in the Bitterroot study.

Table 1.--Summary of the results of mill scale studies made on three national forests in Montana.

Study	Timber type	Percent dimension lumber	Value per M bd. ft. lumber tally[1]	Percent lumber recovery	Value per M bd. ft. net log Scale
Bitterroot	Live	40	$221.99	150	$332.98
	Dead	60	150.41	134	201.55
Gallatin	Live	0	261.53	121	316.45
	Dead	0	199.81	141	227.78
Beaverhead	Live	89	177.53	172	305.35
	Dead	91	161.82	150	242.73

[1]The lumber values are based on Western Wood Products Association year-end Report No. 12, 1977.

The highest values for dead wood were obtained when 1-inch thick (2.5 cm) lumber was produced (Gallatin study). The percentage of lumber recovery indicates a smaller amount of lumber was made from the dead tree logs than from the green tree logs, except for the Gallatin study. Just as the increased number of kerfs required to produce 1-inch boards reduced the percent lumber recovery in the Gallatin study, so also the increased number of defects in the dead logs reduced the percent lumber recovery in all the studies. The value per thousand net log scale indicates both the quality and quantity of lumber produced for the two log types.

Four categories of lodgepole pine trees--(1) green, (2) red-needled, with some dead more than 2 years, (3) gray with tight bark, probably dead more than 4 years, and (4) gray with loose bark, dead longer than the preceding groups--were used in a Canadian study (Dobie and Wright 1978). The results of this investigation were essentially the same as for Carr's studies (1978). A smaller quantity and lower quality of material was recovered from the dead trees than from the green trees. The study also indicated that beetle-attacked trees should be harvested prior to foliage loss, if possible. The lowest values and quantities were obtained from those trees dead the longest time.

Western White Pine

Two studies have determined the value of dead western white pine in northern Idaho (Snellgrove and Fahey 1977; Carr 1979).[3] In the first study, the trees were classified as either live, dead 1 or 2 years, dead 3 to 6 years, or dead more than 7 years. The average d.b.h. of the classes ranged from 19 to 21 inches (18.3 to 53.3 cm). All logs were processed into 4/4- and 5/4-inch (2.5 and 3.2 cm) lumber.

The study's results showed that the trees dead the longest time had the greatest loss in usable wood. The loss in volume for the different classes due to felling, handling, and transporting to and around the mill was as follows:

Quality class	Percent loss
Live	4.5
Dead 0 to 2 years	6.7
Dead 3 to 6 years	9.5
Dead 7+ years	10.8

The tops of older trees can absorb less shock, and tend to shatter when the trees are felled. In addition, smaller amounts and lower grades of lumber were obtained from dead trees (table 2).

The second white pine study (Carr 1979) had three classes of trees: (1) live; (2) probably dead less than 5 years, with 90 percent or more of the bark retained on the tree; and (3) probably dead more than 5 years, with less than 90 percent of the bark retained on the tree. All logs were at least one-third sound and were cut into 1- and 2-inch thick (2.5 and 5.1 cm) lumber.

The results, summarized in table 3, showed that older dead trees had a greater percentage of defective material (gross vs. net log scale) but that a greater percentage of lumber, based on net log scale, was recovered from these logs. However, both the value per M bd. ft. and the associated lumber quality were lower for the older wood.

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[3] Carr, W. R. 1979. Comparison of white pine lumber recovery from live and dead timber. USDA For. Serv. Office Report, 14 p. Region 1, Missoula, MT.

Table 2.--Summary of western white pine mill scale data.[1]

Mortality class	Log scale defect	Average value[2] per M bd. ft.	Average value per C ft.[3]	LUMBER GRADE RECOVERY D Select & better	#1,2,3 Shop	#1,2 Common	#3 Common	#4,5 Common
	Percent	Dollars	Dollars	Percent				
Live	14	214	109	5	9	27	47	12
Dead 0-2 yrs	50	167	81	2	3	16	26	53
Dead 3-6 yrs	85	122	49	0	4	4	33	59
Dead 7+ yrs	94	95	34	0	1	1	13	85

[1]Snellgrove and Fahey 1977.
[2]Calendar year 1977 average prices.

Table 3.--Summary of western white pine mill scale data.[1]

Mortality class	Log scale Gross	Log scale Net	Lumber Quantity	Lumber Percent of	Value per M bd. ft.[2]	LUMBER GRADE RECOVERY #3 Clear & better	Shop	#5 Common & better	Standard & better	Utility & economy
	Bd. ft.	Bd. ft.	Bd. ft.	Pct.	Dollars	Percent				
Live	51,450	41,900	54,350	130	284	13.7	9.8	61.4	12.9	2.2
Dead <5 yrs.	40,330	18,420	37,469	204	214	3.0	5.0	67.8	17.9	6.2
Dead >5 yrs.	42,910	4,980	41,682	237	152	0.4	0.4	14.7	36.3	42.2

[1]Carr 1979 (see footnote 3 in text).
[2]Calendar year 1977 average prices.

Summary

The grade yield studies indicated that dead trees can be used for lumber production. However, the lumber made from such trees is usually lower in quantity, quality and value than lumber made from comparable green trees. Differences in volume result from breakage during felling and handling operations, decay and borer damage in the sapwood, and foreign objects imbedded in the outer wood of barkless trees.

If lumber quality is to be maintained, dead trees must be salvaged before complete foliage loss. Usually the best and highest-valued boards can be cut from the clear wood immediately under the bark. This same wood is most readily attacked by decay and stain fungi and wood-boring insects. Lumber made from the inner part of the log often contains knots or other degrading features. As long as bark remains intact on dead trees, lumber quality decreases slowly; but after about 5 years bark sloughs, deep checks develop, and the rate at which quality declines will accelerate.

Quality and quantity directly affect the value of lumber cut from dead tree logs. As the time since death lengthens, the value of the lumber that could be produced decreases.

SPECIALTY PRODUCTS

One way of increasing the value of relatively low quality lumber obtained from dead tree logs is to promote its use for specialty products, such as interior paneling, picture framing, furniture and decorative moldings. These uses accentuate the differences between dead and green tree wood and emphasize the uniqueness of dead tree lumber. This approach has been used in previous years to develop markets for white pocket veneer and boards, pecky cypress, knotty pine, wormy chestnut and, most recently, gray weathered barn wood.

Recent research at the University of Idaho has concentrated on the recovery of specialty products from dead western white pine (Howe 1978; Christophersen and Howe 1979). Fourteen logs that had been in the mill yard for at least three years were cut into 8/4 and 5/4 inch (5.1 and 3.2 cm) lumber on a circular sawmill. After drying, the pieces were resawn into 7/16 inch (1.1 cm) paneling. The value of the paneling and other recoverable pieces was estimated to be considerably above that of the original dimension lumber.

HOUSE LOGS

In recent years, a large number of dead trees has been used by the log home industry, and this segment of the construction industry has grown dramatically. It has been estimated that 200 manufacturers will produce about 20,000 log homes in 1979 and about 25,000 more in 1980.

Log home producers in the Rocky Mountain States are firmly committed to using dead trees. Dead tree logs are usually relatively inexpensive, and because they have a lower moisture content, they are lighter in weight than green tree logs. This factor makes them easier to handle with smaller, less costly equipment, and reduces their shipping cost. Logs with drying checks can be positioned in the building to minimize the effect of these openings, and preservative solutions or stains can penetrate and coat all exposed wood surfaces. In addition, structures made from dried, dead logs are more dimensionally stable than structures made from green logs, unless the green logs have been air-dried for a long time.

Most dead tree houselogs are either lodgepole or western white pine. Tree-length lodgepole pine logs are preferred because the longer lengths allow cutting to required sizes.

POSTS AND POLES

Because of their size, straightness, minimum taper, and ease of preservative treatment, green lodgepole pine trees have been preferred for fence posts, corral or fence rails and utility poles. The same products made from dead trees possess the advantage of having lower moisture contents, thereby eliminating a long air-seasoning period and reducing the need for a large inventory. The lower moisture content also indicates lighter weight, hence larger loads and easier preservative treatment.

Post and rail specifications are usually developed by the individual treating plants and depend, to a large extent, on local conditions and practices. Appearance is often the major consideration. Pole specifications are published by the American National Standards Institute (ANSI 1972), and although standards do not require the use of living trees, the occurrence and placement of defects may eliminate the use of some dead trees for poles. Preservative treatment specifications for posts and poles are published by the American Wood Preservers Association (AWPA 1977).

Posts

A recent publication (Lowery and Host 1979) reports on preservative treatments for posts and poles made from dead lodgepole pine trees. Two treating methods, steeping and pressure, were used to treat fence posts that had been dead for at least 4 years. The 85 peeled, pointed, and capped posts used in the steeping study were placed upright in a series of tanks, filled to a depth of 30 inches with a pentachlorophenol, a light crude oil solution. Six hours was the longest soak period used.

Analysis of the disks and borings taken from the treated posts indicated that none of the treatments gave the minimum retentions required by AWPA standards (0.30 pounds per cubic foot). A slight difficulty was encountered in peeling the dead tree posts. The posts often were stopped in the debarker, and when stoppages were not corrected immediately, an excessive amount of wood was removed. The surfaces of the dead tree posts were also rougher than the surfaces of posts from green trees.

The pressure treating study used 39 posts. These posts were subjected to an initial 30 minute vacuum period followed by a pressure period of either 15, 30, or 45 minutes. (In contrast, the pressure period used for green tree posts is 3 hours.)

An unheated water solution, 1.50 to 1.75 percent fluorchrome arsenate phenol, type B (Osmosalts), was the preservative used.

Preservative retention tests performed on samples cut from the posts showed that all posts had retentions in excess of the 0.4 pounds per cubic foot required.

Poles

A recent survey of lodgepole pine in southeastern Idaho indicated that many of the dead trees in that area were suitable for powerpoles (Tegethoff, Hinds and Eslyn 1977). Of 217 pole-size trees on 46 plots, 165 were dead and about 38 percent (63) of the dead trees yielded poles that satisfied the ANSI pole standard. The most common defect was basal decay, and for many of the dead tree poles this defect had to be eliminated by long butting.

The preservative treatment of poles made from dead lodgepole pine trees has also been reported (Lowery and Host 1979). Thirty poles were randomly assigned to one of six treatment schedules:

1. Six-hour hot bath followed by a 12-hour cold bath
2. Four-hour hot bath followed by a 6-hour cold bath
3. Two-hour hot bath followed by a 6-hour cold bath
4. Nine-hour cold soak
5. Six-hour cold soak
6. Four-hour cold soak

In contrast, the commercial schedule for green poles uses a 6-hour hot bath followed by a 6-hour cold bath. The treating solution was a 5.1 percent pentachlorophenol in a heavy oil carrier.

Measurements showed that only one pole received less than the minimum required preservative penetration of 0.75 inch. All poles, except those given a 4-hour cold soak, met the 85 percent penetration of the sapwood requirement. Preservative retention measurements showed all the study poles treated by the hot and cold bath method exceeded the specification requirement of one pound of dry pentachlorophenol in the outer 0.50 inch. However, none of the poles treated by the cold soak method retained this much preservative.

SUMMARY

Investigations have shown that there is no inherent difference between dead and green tree wood. Dead trees and logs can and are used to produce solid wood products such as lumber, house logs and posts and poles.

Grade-yield studies have shown that the lumber recovered from dead tree logs is lower in value, quality and quantity than lumber produced from comparable green tree logs. Furthermore, the longer the time interval between death and utilization, the lower the value of the material recovered. The manufacture of specialty products is one way of enhancing the value of dead tree lumber.

House logs, posts, rails and poles are other potential uses for dead trees. Dead lodgepole pine trees are preferred by many Rocky Mountain log home manufacturers. Posts and poles made from dead trees can often be treated with a preservative immediately, without a long air-seasoning period, and shorter treating schedules can be used to treat these products.

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