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LOGGING PRODUCTION RATES in young-growth, mixed-conifer stands in north central California

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To quantify production rates for small trees, this study examined the components of log-making and tractor yarding at the Challenge Experimental Forest, Yuba County, California. Rates were calculated over a range of 12 to 40 inches d.b.h. The rate for incense-cedar was lowest; for ponderosa pine it was intermediate; and for Douglas-fir, white fir, and sugar pine combined, it was highest. Log size strongly influenced production. For log-making, production for 38-inch d.b.h. trees was two and a half times that for 14-inch d.b.h. trees; for yarding, production for a turn of logs averaging 22 inches d.i.b. was two and a half times better than that for one averaging 12 inches d.i.b.

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Retrieval Terms: logging production; logging costs; young-growth stands; California (north central); *Pinus ponderosa; Pseudotsuga menziesii; Abies concolor; Pinus lambertiana; Libocedrus decurrens.*

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Intense competition and narrow profit margins are forcing land managers, foresters, and logging supervisors to become increasingly conscious of logging costs. Tax assessors are similarly concerned with costs as a basis for setting tax rates. At the same time, good silviculture and environmental protection often require that marginal or submarginal trees and logs be removed from the forest. But data on logging cost and production are singularly scant—particularly for young-growth stands. In the Western United States, data on such stands on high-quality sites are especially important. These sites would be the first to be intensively managed because on them the most fiber can be grown in the shortest time. In California, logging production data are needed because many young-growth stands are now of merchantable size. Indeed, as Oswald (1970) points out, "in some areas of the State, harvesting activities on private land are shifting into young-growth stands."

To help fill the need for such information, the Pacific Southwest Forest and Range Experiment Station began a long-term study in 1962 of logging production rates on its Challenge Experimental Forest, Yuba County, California.[1] The most abundant species there is ponderosa pine *(Pinus ponderosa* Laws.*)*. Dominant ponderosa pines average 140 feet tall at 100 years (Arvanitis, *et al.* 1964). Next most abundant is Douglas-fir *(Pseudotsuga menziesii* [Mirb.] Franco*)*. Found in lesser amounts are white fir *(Abies concolor* [Gord. & Glend.] Lendl.*)*, sugar pine *(Pinus lambertiana* Dougl.*)*, and incense-cedar *(Libocedrus decurrens* Torr.*)*.

This paper reports results from a study of young-growth stands on high-quality sites. Objectives of the study were to quantify various components of log-making and yarding production and to examine the relationships among these components and the effect of species. The results are applicable to about 1.5 million acres of highly productive timberland on the lower west slope of California's north central Sierra Nevada.

BACKGROUND

Stand age was about 95 years at the time of study. Commonly, about 30 overstory trees per acre are greater than 20 inches in breast height diameter (d.b.h.). Beneath these trees are the more shade tolerant Douglas-fir, white fir, incense-cedar and hardwoods. Here 12- to 20-inch d.b.h. trees number about 45 per acre; those 3.5 to 12 inches d.b.h. about 200 per acre. The basal area of all trees 3.5 inches in diameter and larger is about 240 square feet per acre. These basal areas and numbers of stems are typical of young-growth stands on high-quality sites and are part of the logging production picture.

Elsewhere in dense young-growth stands, Csizmazia and McIntosh (1964) found that limbing was the factor affecting log-making production most. For yarding production, choker-setting was most critical. In several studies (Csizmazia and McIntosh 1964; Hasel 1946; King 1963; Worthington 1966), either log-making or yarding production rates or both were inversely related to log size—and significantly so.

Previous work in young-growth, mixed-conifer stands at Challenge has shown that log-making and yarding production rates do not differ appreciably among the seed-tree, single-tree-selection, clearcut, and group-selection cutting methods (McDonald, *et al.* 1969). Production rates were independent of cutting method in general.

In this study, six compartments averaging 38 acres each were partially cut from April to August 1962. Leave trees larger than 20 inches d.b.h. numbered from 2 to 20 and averaged about 7 per acre. Cutting removed 28 to 78 percent of the merchantable volume, meaning that trees down to 12 inches d.b.h. were removed. The minimum log size measured 10 feet long and 10 inches in diameter inside bark (d.i.b.) at the small end. Long logs (32 feet) were desired and cut whenever possible.

In addition to being heavily forested, the study compartments were generally similar, having rolling topography, maximum slopes of 25 percent, and little surface rock. Amount of cull and brush (other than small trees) was minimal. Altogether, this was a "good" logging chance as young-growth chances go *(fig. 1)*.

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[1] U.S. Forest Service research at the Challenge Experimental Forest is conducted in cooperation with the Soper-Wheeler Company, Strawberry Valley, Calif.

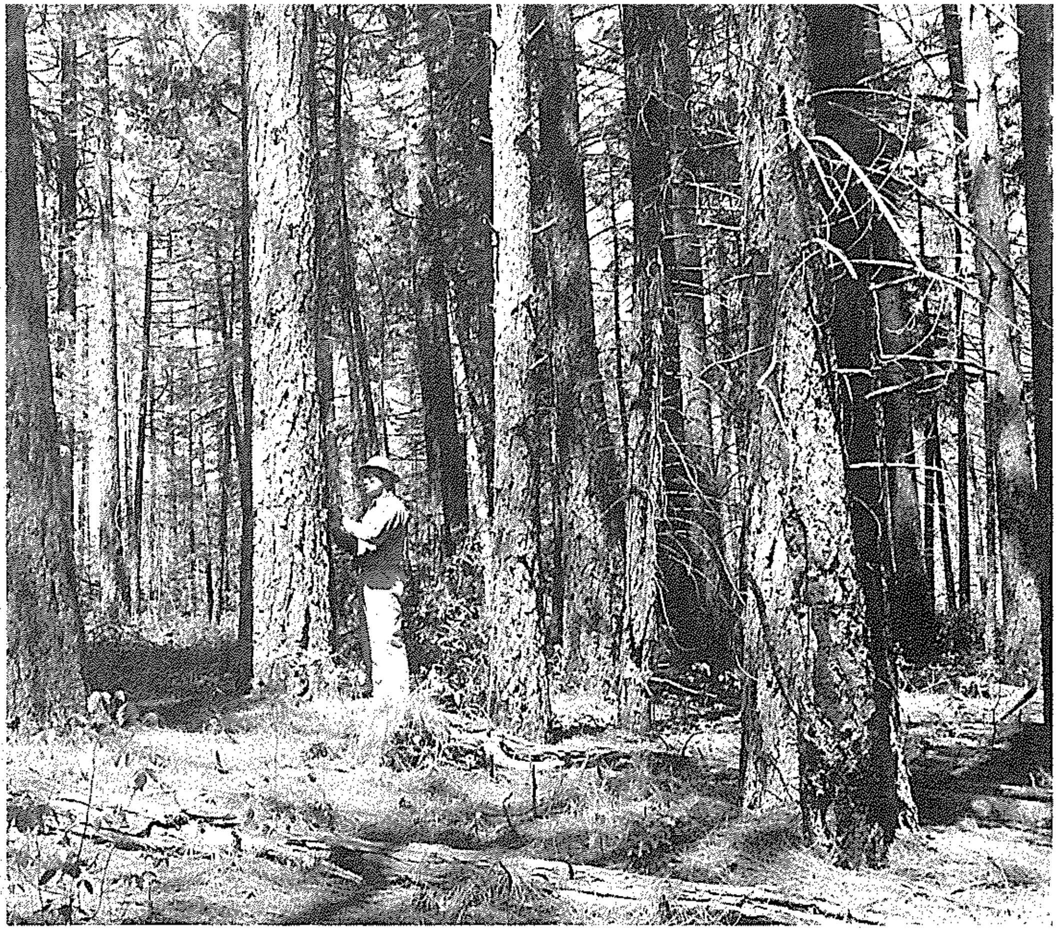


Figure 1—The 95-year-old stand before logging. The large number of trees with their many dead branches is typical of young-growth stands on high-quality sites in north central California.

LOG-MAKING

The fallers were experienced at their trade and paid at a gyppo rate. They worked as two-man "sets" —set members staying well within earshot of each other, but each man limbed and bucked each tree that he had felled.

During the production study, fallers never knew which of them were to be timed or what day timing would take place. These selections were random. A forestry-trained observer timed functions by stop watch to the nearest 0.1 minute. Different components were (1) preparation time, (2) tree-to-tree travel, (3) felling, (4) limbing, (5) bucking, and (6) lopping branches from tree tops. Timing began when the fallers arrived at the landing each morning and ended when they returned to it in the evening. Altogether, timing was performed on 191 trees of 5 different species and took slightly over 8 full days. Production averaged 22,740 board feet Scribner Scale per man-day. Other recorded data included individual log diameters, lengths, and pertinent remarks.

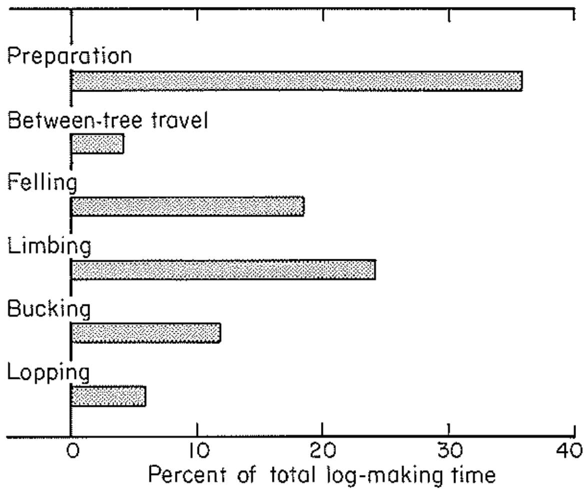


Figure 2—Preparation time is an important component of log-making production.

Preparation

Because of rigorous physical and safety demands, preparation time always is high *(fig. 2)*. Human needs (rest, eat, drink) and mechanical needs (fuel, adjust, and sharpen saw) were the largest categories as the following breakdown shows:

Item:	Portion of preparation time (percent)
File and adjust saw	12.1
Fuel saw	11.6
Scout	5.3
Rest	31.0
Drink and lunch	26.6
Fell snags	6.0
Walk to and from landing	7.4
	100.0

Altogether, preparation time amounted to 8 minutes per thousand board feet.

Tree-to-Tree Travel

This component was minimal because the trees to be cut grew relatively close together. Over-all, tree-to-tree travel had a negligible effect on production and amounted to only 0.9 minutes per thousand board feet.

Felling

In felling, size of tree is important. The larger the tree, the greater its height, and the more time and skill necessary to fell it with minimum damage to the residual stand. To avoid damage, some trees were wedged. Occasionally, a small tree or some

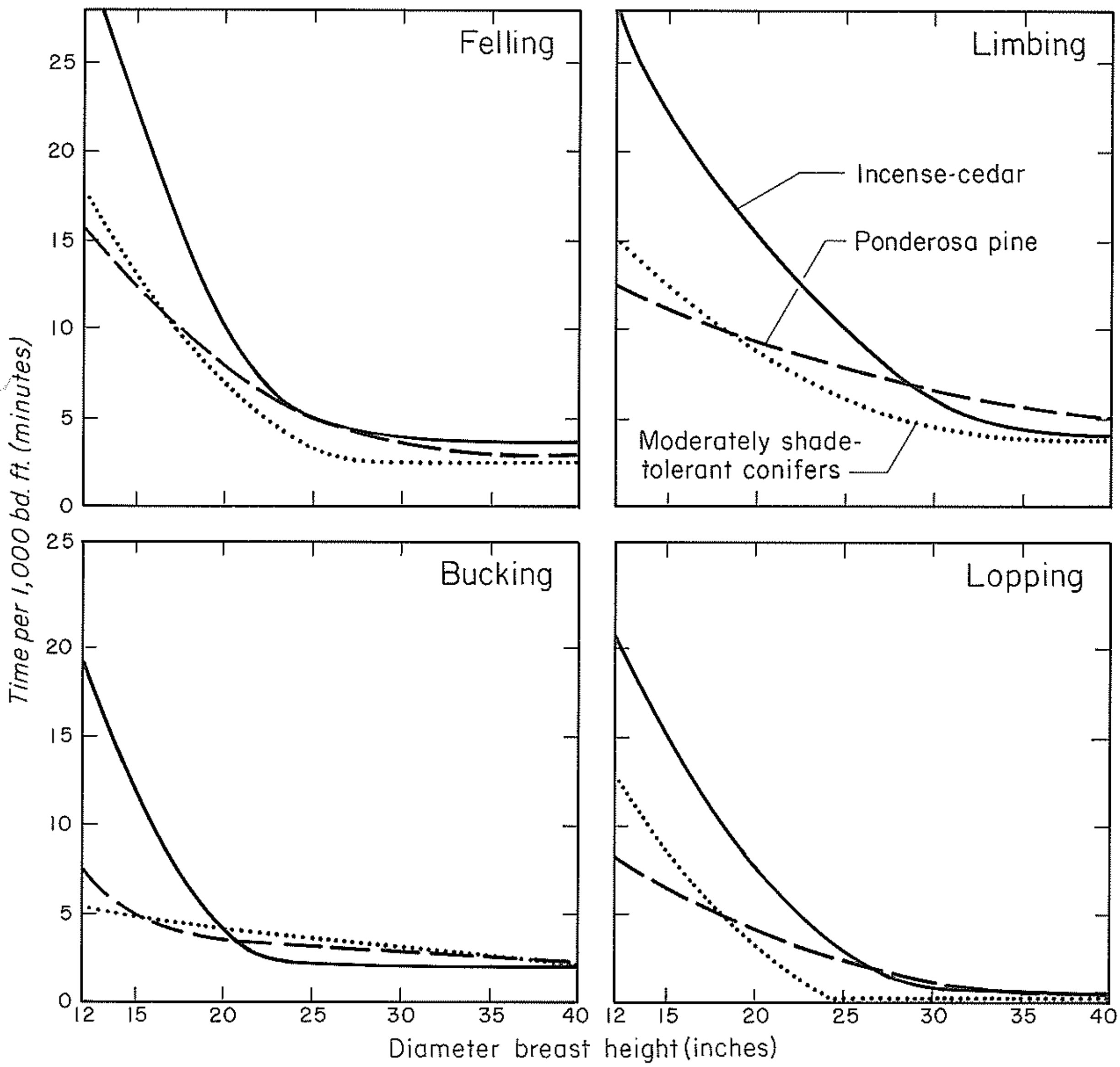


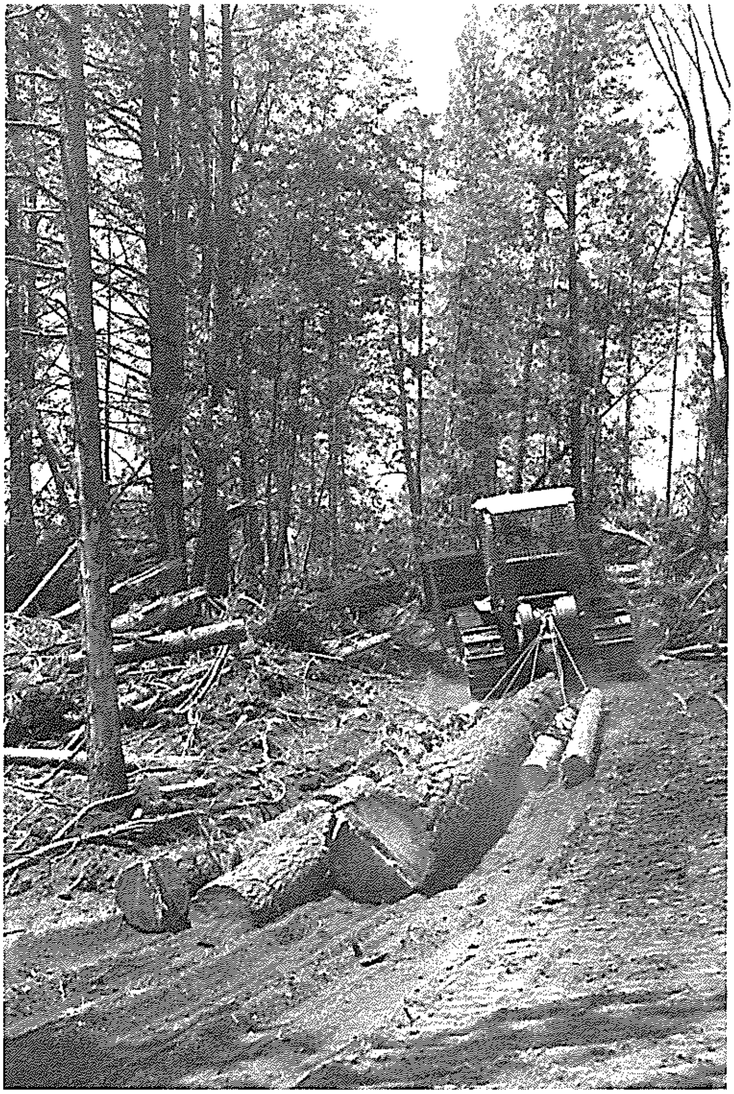
Figure 3—Log-making production rates relative to tree diameters. Species differences are readily seen.


LIMBING


BUCKING

YARDING


SKIDDING



After felling, limbing often is the next step in logging a young-growth stand. "Walking the log" minimizes the effect of the brushy understory.

Bucking is usually done at the same time as limbing, but the two activities were performed separately in the study to facilitate timing.

Yarding begins and ends at the landing. This one is typical in size and shape.

About 39 percent of the skidding in this logging operation was adverse but on gentle grades such as this. The average turn consisted of 4.6 logs.

Unhooking a five-log turn may be slow since the hooking apparatus has a greater chance to lodge against or beneath the logs.

UNHOOKING

brush near the base of a study tree had to be cut before felling could commence. In such cases, brushing time was included in the felling. When brushing or wedging was necessary, felling time often was excessive. Therefore time spent on these activities was considered representative of felling in young-growth stands and was included in felling time in *figure 2*, but ignored in subsequent analyses.

Species differences in felling production rates among trees 12-40 inches d.b.h. were caused primarily by inherent differences in growth form. On high-quality sites Douglas-fir and white fir grow straight and tall with relatively little bole taper. They also have rather thin bark. Young-growth sugar pine has more taper but on such sites grows taller and produces greater volume. This apparently compensated for the taper. Ponderosa pine is generally intermediate in relative taper and height growth. Variation in thickness and fiber content of bark possibly affect production as well. Within the 12- to 24-inch d.b.h. range, the production rate for incense-cedar, which has a noticeably tapering bole, was poorest of all species. In effect, fallers had to saw through greater diameter, including thick, stringy bark, to produce the scaled volume for this species. (The scale is based on small-end diameter.)

Felling production curves for each tree species were drawn by a least-squares curve-fitting procedure. These curves then were compared graphically. Because curves for Douglas-fir, white fir, and sugar pine (the moderately shade-tolerant species) showed only minor differences, they were combined *(fig. 3)*. Throughout the paper some curves have been extrapolated to a common ending point for comparability.

Limbing

In young-growth stands on high sites, 95 years is not enough time to obtain natural pruning, even when stocking is high. Thus, limbing is second to preparation as the most time-consuming component of log-making. Ranking of species by limbing production rates *(fig. 3)* parallels that of felling—incense-cedar was poorest, ponderosa pine intermediate, and the moderately tolerant conifers were best.

The time required to limb a tree is determined mainly by the size and quantity of its limbs. This in turn relates to the tolerance of the species. Highly tolerant incense-cedar generally does not grow into the dominant crown class. Characteristically it has relatively long, spreading, pliable limbs. Few of its branches break when the tree falls. Consequently most branches must be limbed. This trait, plus its tapering bole, greatly affect incense-cedar's limbing production rate.

Ponderosa pine is intolerant. It grows mostly in dominant and codominant crown classes. Few trees survive in the understory. Those that do survive have small crowns and few branches. For these, limbing production rates are high. Larger ponderosa pines, however, carry numerous dead branches and branch stubs along the lower two-thirds of the bole and their living crowns often consist of heavy, pliable branches. Most branches and many of the stubs need to be limbed, and these reduce the limbing production rate.

Branches on the moderately tolerant white fir, Douglas-fir, and sugar pine tend to be relatively small and of limited pliability; they are readily broken when the tree strikes the ground. This characteristic probably contributed most to the similarity of these species' production rate curves, enabling them to be combined. Together, they had the best limbing production rate.

Bucking

In standard practice, bucking and limbing are an integrated operation. The logger fastens his tape to the end of the butt log, limbs up the log to the desired length, and bucks the tree. He proceeds along the tree in this manner, measuring, limbing, and bucking until the minimum top diameter is reached. For this study, however, limbing and bucking were performed and timed separately. No trees with forks, crooks, or cat faces qualified as sample trees.

Bucking production rates were poorest for incense-cedar below 20 inches d.b.h.; ponderosa pine smaller than 16 inches was the next poorest *(fig. 3)*. With these exceptions, species exerted little influence here. Obviously, measuring and walking from log to log is independent of species.

Lopping

The cutting of limbs from tops of felled trees is seldom practiced when harvesting timber. But in dense young-growth stands, the large number of tops, usually with numerous upright branches, commands attention. They are unsightly, a fire hazard, and susceptible to insects, particularly the engraver beetles *(Ips* spp.*)*. Lopping allows sunlight to reach the boles and render them uninhabitable to undesirable insects. Lopping also places the branches on the ground, speeding their decomposition and returning nutrients to the soil.

Lopping was the last operation performed on each tree. It was done with the chain saw as quickly as conditions would permit.

The lopping production rate was keyed to tree form, taper, and branch habit. It was best for the moderately tolerant conifers *(fig. 3)*. In these species, many limbs broke from the bole and those that remained were easier to reach with the saw. In

Table 1–*Log-making component production rates, by 4-inch diameter classes, all species combined, Challenge Experimental Forest, California*

D.b.h. class (inches)	Volume per tree[1]	Elapsed time for component: Felling	Limbing	Bucking	Lopping	Total time[2]
	Bd. ft.	*Min./M bd. ft.*				
12–16	144	15.4	11.4	4.6	7.8	48.1
17–20	277	7.0	10.0	4.5	3.7	34.1
21–24	506	5.4	8.7	3.7	2.6	29.3
25–28	822	4.4	6.0	3.1	1.7	24.1
29–32	1,334	3.3	6.1	2.5	1.0	21.8
33–36	1,704	3.3	5.3	2.6	.8	20.9
37–40	2,318	3.2	4.0	2.1	.4	18.6

[1]Gross volume, Scribner scale, not adjusted for overrun.
[2]0.9 minutes/M bd. ft. and 8 minutes/M bd. ft. for tree-to-tree travel and preparation respectively, added to each d.b.h. class.

fact, the tops were so shattered on 15 percent of these trees that they required no lopping. Ponderosa pine ranked intermediate in production and incense-cedar poorest.

The production curves relating d.b.h. to time and volume *(fig. 3)* show a common relationship–the smaller the tree, the poorer the production rate. And no matter what the component–felling, limbing, bucking, or lopping–the same relationship holds. This relationship of small trees and poor production rates has been known for years but was not quantified in previous studies. Although statistical comparisons between curves are not possible, differences among species for any diameter between 12 and 40 inches are seen easily for each component.

All Components

A summary of production rates for all components vividly illustrates the effect of tree size *(table 1)*. The comparison of a 14-inch d.b.h. tree to a 38-inch tree shows the larger tree to have nearly five times the felling production rate, three times the limbing rate, twice the bucking rate, and 20 times the lopping rate of the smaller. For all log-making components combined, the production rate of a 38-inch d.b.h. tree bettered the 14-inch tree by two and a half times.

YARDING

"As goes the yarding, so go the profits (or losses)" is an axiom, well known to all who harvest timber. Although log-making is important, relatively little capital goes into that job. But in yarding, expensive equipment and manpower shadow every move in the operation.

Many elements and conditions influence yarding production. Natural elements include weather, soil, ground roughness, slope, and stand density. Spring weather seldom is severe although rainstorms occasionally shut down logging for 2 to 4 days. Deep and internally well drained soil quickly allows logging to resume, however. Ground and stand conditions were described earlier.

Yarding production is also affected by crew organization, the need for minimizing damage to trees and reproduction, and the location of roads and landings.

Two experienced crews contributed to this study. Each consisted of the "cat skinner," a choker-setter, and a landing man who unhooked the logs. The tractors were dozer equipped, and of about 113 drawbar horsepower–a rating probably in excess of that needed in young-growth, mixed-conifer stands. Nevertheless, many forest managers in California harvest both old and young-growth timber, and must gear their size of equipment to the larger-sized timber.

Even though tractor horsepower is more than adequate relative to log size, a limited number of logs are taken out each turn. Four to five logs per turn strikes the best balance–more than that are awkward to hook and unhook; fewer are a waste of tractor capacity. Thus four or five logs per turn was a production goal, although two or three or even six logs per turn were sometimes skidded:

	No. of turns
No. of logs per turn:	
2	2
3	3
4	41
5	59
6	7

Damage to residual trees and advance reproduction was minimized by careful ground skidding, an established policy for the whole logging operation. No logging arches were used.

Terrain and the proximity of roads often interact to govern the number and location of landings. These influence the amount of downhill and uphill (adverse) skidding, which in turn, affects the skidding production rate. Like all logging operations, this one aimed at minimizing adverse skidding, but some was inevitable. Thus, 37 percent of the skids were downhill, 24 percent level, and 39 percent adverse. The adverse skidding was on relatively gentle slopes, however.

Felling and skidding rarely take place simultaneously. Usually the trees are converted into logs well in advance of skidding. Thus in typical young-growth stands, the first-arriving skidding crews often are greeted with a profusion of logs. Most of the main skid trails have been located and the fallers have aligned as many trees to them as possible. Landings are also established before skidding. They are temporary, small, level, and strategically sandwiched into natural flats and openings near the main skid roads.

A trained observer timed each skidding component, paced each skid, measured each log, and recorded all data. Timing was by stopwatch to the nearest 0.1 minute for the following components: (1) preparation time, (2) outbound travel (landing to woods), (3) choker-setting, (4) skidding, and (5) unhooking. Data were collected on a full-day basis but the skidding crews never knew when they would be timed. A complete turn began when the tractor left the landing and ended when it returned, had its last log unhooked, and started back for the next turn. Altogether 112 turns were timed over 8 full days. Production averaged about 20,500 bd. ft. per day Scribner Scale.

Preparation

Preparation time amounted to about 19 percent of total skidding time *(fig. 4)* and occurred on nearly 40 percent of the turns. Human needs (lunch, drink), mechanical needs (tractor and winch line maintenance and repair), and building skid trails contributed most to preparation time as the following breakdown shows:

	Portion of preparation time (percent)
Item:	
Service and fuel tractor	24.8
Repair chokers and winch line	5.8
Overcome impediment to tractor (landing blocked, high centered on stump, etc.)	6.1
Build skid trail	24.8
Lunch and drink	38.5
	100.0

Skid trail building time accrues as the tractor operator extends some of the skid trails while outbound from the landing. Altogether, the skidding preparation rate was slightly over 3 minutes per thousand board feet.

Outbound Travel

The tractor operator usually returns to the woods as fast as conditions permit. Therefore this component of skidding production relates directly to distance. Over-all, the outbound travel production time was just over 16 percent of total skidding time and amounted to 2.6 minutes per thousand board feet.

Choker-Setting

Choker-setting is the most time-consuming of all yarding components *(fig. 4)*, partly owing to characteristics of the operation and to conditions inherent in logging young-growth timber. For example, only one set of chokers is used.

The whole choker-setting job consists of moving from log to log, digging furrows (choker-holes) under logs when they are required for setting the chokers, guiding the tractor to the logs, setting a choker around each log, and hooking the chokers to

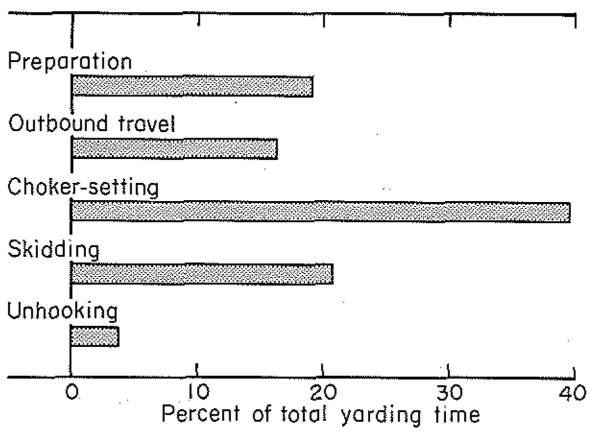


Figure 4—Choker-setting is the most time-consuming component of yarding production.

the winch line. Digging furrows generally takes more time for the larger logs, but this part of the job is usually completed while the tractor is traveling. Consequently, tractor time allocated to choker-setting is about the same for each log regardless of its size, as indicated in the following tabulation (few logs per turn indicate large logs):

No. of logs per turn:	*Average choker-set time per turn (min.)*	*Average time per log (min.)*
3	5.6	1.9
4	8.4	2.1
5	9.7	1.9
6	9.2	1.5

Sometimes logs become jammed against stumps, down trees, or slash, and need nudging with the dozer blade to help set the chokers. In general, the occurrence of these "hangers" is independent of log size.

The experienced choker-setter recognizes that choker-setting time does not depend on log size, and therefore strives to balance each turn to achieve the greatest payload possible with the sizes and lengths of logs on the ground. Thus good choker-setting is not just grabbing the closest bunch of logs. It is getting to and hooking almost the same number of logs each turn and having an equal number of large and small logs and long and short logs in each turn. Since landings are small and have little log storage capacity, the constant and dependable mixture of log lengths and sizes facilitates truck loading and hauling. The choker-setting production rate for a turn of a few logs is better than for a turn of five or six logs *(fig. 5)*. The few-log turn contains more volume and requires less choker-setting time.

Skidding

Skidding distances ranged from 200 feet to 1,250 feet and averaged 745 feet per turn. The volume per turn averaged 1,464 bd. ft. and generally was independent of length of skid *(table 2)*. Furthermore, the number of logs per turn also was independent of the distance skidded:

No. of logs per turn:	*Average distance skidded (feet)*
2	820
3	647
4	785
5	735
6	619

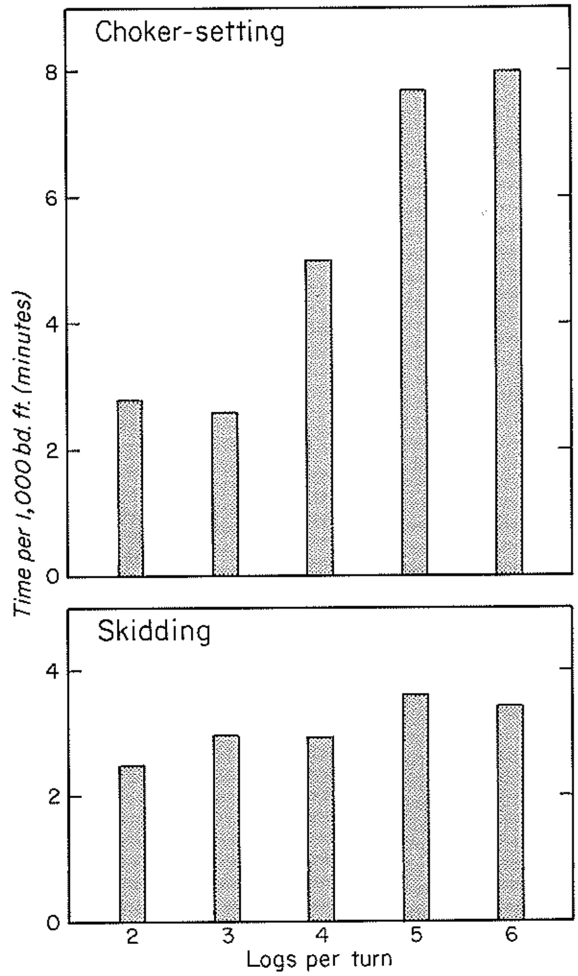


Figure 5—Production rates for choker-setting and skidding in young-growth timber are directly influenced by the number of logs per turn; fewer logs mean a higher volume and a better production rate.

The volume per turn increased greatly, however, as the number of logs per turn decreased. Thus the skidding production rate depended directly on the number of logs per turn and the distance skidded *(figs. 5,6)*.

The skidding production rate curve *(fig. 6)* was based upon all 112 turns. Some turns shuttled along a constant slope and some sprinted and slowed over terrain having several distinctly different grades. Others surmounted adverse grades and some even traversed downhill and adverse pitches. Since many tractor logging operations cover similar terrain, these data have quantitative value.

Unhooking

In skidding, the logs continuously squeeze together and drift apart. Sometimes smaller logs are forced beneath the larger. The choker on each log

Table 2—*Effect of distance on skidded volume, Challenge Experimental Forest, California*

Skidding distance (feet)	Turns	Average volume per turn
	No.	*Board feet*
< 500	10	1,043
501- 600	12	1,619
601- 700	25	1,685
701- 800	22	1,358
801- 900	29	1,584
901-1000	7	1,096
1001-1100	4	1,275
> 1100	3	1,130

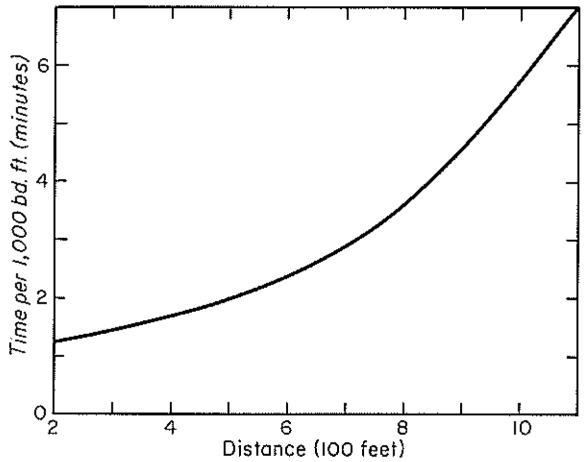


Figure 6—The skidding production rate is related to the distance of logs from the landing.

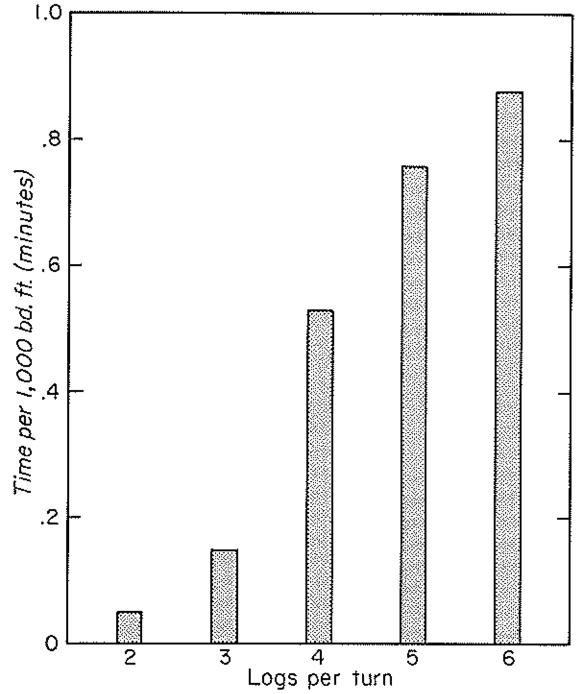


Figure 7—The unhooking production rate is related to the number of logs per turn.

usually is hooked on its upper surface. When the logs reach the landing, however, it is a matter of chance whether the hook is up and easy to unhook, or down and difficult to unhook. The more logs per turn, the greater the chance that one of them will be difficult to unhook. This fact, and the relatively fixed amount of time needed to unhook each log, make the number of logs per turn of primary importance to the unhooking production rate *(fig. 7)*.

Table 3—*Yarding component production rates, by 2-inch log classes, Challenge Experimental Forest, California*

Small-end d.i.b. class (inches)	Number of turns	Volume per turn[1]	Elapsed time for component: Choker-setting	Skidding	Unhooking	Total[2]
		Bd. ft.	*Min./M bd. ft.*			
10-11.9	31	630	15.8	5.5	1.5	28.4
12-13.9	21	1,056	7.7	3.8	.8	17.9
14-15.9	19	1,375	6.7	3.5	.7	16.5
16-17.9	22	1,996	4.6	3.0	.5	13.7
18-19.9	10	2,320	3.9	2.5	.3	12.3
20-21.9	6	2,597	4.5	2.0	.2	12.3
22+	3	3,050	2.5	2.6	.1	10.8

[1]Gross volume, Scribner scale, not adjusted for overrun.

[2]3 minutes/M bd. ft. and 2.6 minutes/M bd. ft. for preparation and outbound respectively, added to each small-end d.i.b. class.

All Components

In general, the larger the number of logs per turn, the greater the bark, the larger the amount of taper, and the less the volume, then the greater the reduction in efficiency.

Thus no matter what component—choker-setting, skidding, or unhooking—the volume in each turn had a pronounced effect on production rates *(table 3)*. Comparison of a turn in which logs averaged under 12 inches d.i.b. to one in which logs averaged 22 inches d.i.b. showed that the turn with the larger logs had six times the choker-setting production rate, twice the skidding rate, and 15 times the unhooking rate of the turn of smaller logs. When all yarding rates were combined, the turn with the larger logs bettered the other by two and a half times.

SUMMARY

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In California the amount of land supporting young-growth timber stands is increasing steadily. Some of this timber is being harvested now; more will be soon. Thus, forest managers and loggers are concerned with the effect of small logs on logging cost and production rates and in turn the effect on forest management costs. Each is asking for quantified production-rate values for the major components of logging young-growth timber.

This study provides some answers. Stopwatch times were recorded for every step in the logging process: felling preparation, tree-to-tree travel, felling, limbing, bucking, and lopping; skidding preparation, outbound travel, choker-setting, skidding, and unhooking. These times and corresponding volumes were then transformed into production rates for 12- to 40-inch d.b.h. trees and related to tree species, tolerance, tree diameters, number of logs per turn, and distance.

Log-making production rates depended upon tree size. Production rates were poorer for smaller trees for all steps in the process. When all log-making production components were combined, results for the 38-inch d.b.h. tree were two and a half times better than for the 14-inch d.b.h. tree. As for species, incense-cedar ranked poorest in all components, followed by ponderosa pine, while the moderately tolerant conifers (Douglas-fir, white fir, and sugar pine) had the best production rate. Tolerance influenced the size, number, and tendency of branches to break when fallen—greatly affecting limbing and lopping production rates.

Size of tree and resultant size of logs also affected skidding production rates associated with the 113 drawbar horsepower tractors used in this study. For a turn of skidded logs that averaged 22 inches d.i.b. the production rate was two and a half times better than for a turn that averaged under 12 inches d.i.b. Choker-setting and unhooking production rates were influenced most by the number of logs per turn, and the skidding production rate was governed by the number of logs per turn and the distance skidded.

An inescapable conclusion from this study is that even in young-growth timber, relatively large differences in tree size occur. In turn, these differences play a major role in determining logging production rates as well as costs and returns for forest management. Recognition of this fact should aid loggers, forest owners, timber appraisers, and tax assessors in their work.

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To quantify production rates for small trees, this study examined the components of log-making and tractor yarding at the Challenge Experimental Forest, Yuba County, California. Rates were calculated over a range of 12 to 40 inches d.b.h. The rate for incense-cedar was lowest; for ponderosa pine it was intermediate; and for Douglas-fir, white fir, and sugar pine combined, it was highest. Log size strongly influenced production. For log-making, production for 38-inch d.b.h. trees was two and a half times that for 14-inch d.b.h. trees; for yarding, production for a turn of logs averaging 22 inches d.i.b. was two and a half times better than that for one averaging 12 inches d.i.b.

Oxford: 66:187X466(794).
Retrieval Terms: logging production; logging costs; young-growth stands; California (north central); *Pinus ponderosa; Pseudotsuga menziesii; Abies concolor; Pinus lambertiana; Libocedrus decurrens.*

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