Capacity for utilization of USDA Forest Service, Region 1 small-diameter timber

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Abstract

The need to treat millions of acres in the western United States for fire hazard and ecosystem restoration has been identified as a high priority by the USDA Forest Service. These treatments may require removing increased volumes of timber – including small-diameter trees – from National Forests and other ownerships. The goal of this research was to provide estimates of the forest products industry's capacity to utilize trees of various sizes from the USDA Forest Service Region 1 timber-processing area. The major sources of industry timber-processing capacity data were surveys and telephone interviews with mill managers. Within the USDA Forest Service Region 1 timber-processing area, there were 298 timber-processing facilities in operation as of August 30, 2003: 110 sawmills, 101 house log /log home facilities, 42 post and small pole producers, 23 manufacturers of log furniture, 12 cedar products producers, 7 plywood and veneer plants, and 3 utility pole producers. Annual capacity to process timber within the timber-processing area was 576 million cubic feet (16.3 million cubic meters) excluding pulpwood. Mills utilized 79 percent of their capacity during the 12 months prior to August 30, 2003. Over 91 percent of the timber processed was from trees ≥ 10 inches (25.4 cm) in diameter at breast height (DBH), slightly more than 7 percent from trees 7- to 9.9-inches (17.8 to 25.1-cm) DBH, and only 1 percent from trees < 7-inches (17.8 cm) DBH. More than 71 percent of the industry capacity could not operate efficiently on trees < 10-inches (25.4 cm) DBH, and only 2 percent of the capacity could utilize trees < 7-inches (17.8 cm) DBH.

The USDA Forest Service has identified the need to treat millions of acres of forest lands in the western United States for fire hazard and ecosystem restoration. Implementing treatments designed to restore desired ecological conditions may call for the removal of timber valuable enough to underwrite the costs of treatment (Fiedler et al. 1999). However, these treatments could also require removing smaller trees with limited value and markets. Quantification of current milling capacity and elucidation

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Forest Prod. J. 55(12):143-147.

of the sizes and types of materials that existing mills are capable of utilizing are key components to an overall financial analysis of a fire hazard reduction/ecosystem restoration program.

Goals of this research were to identify the timber-processing area supplied by USDA Forest Service Region 1 timberlands, quantify the volume of timber currently processed from trees of various sizes within the timber-processing area, and estimate the capacity of existing facilities to utilize additional trees of various diameters. The study focused on facilities that exclusively used timber in round form. There is a substantial market in the region for mill by-products (i.e., chips, sawdust, plane shavings, and bark), and it was assumed that by-products could be successfully marketed.

Methods

The major sources of information used to estimate timber-processing capacity and volumes of timber processed were surveys of the forest products industry (Keegan et al. 1995, 1997, 2001, 2003, 2004; Keegan 2001; Cohn and Blatner 2003; Blatner et al. 2004; Morgan et al. 2004). Follow-up telephone interviews with selected mill managers, conducted between May and August 2003, were used to update volumes of timber processed as well as capacity to utilize timber of various sizes.

Idaho and Montana forest products industry data are stored in the Forest Industries Data Collection System (FIDACS 2003). This system focuses on the source (geographic and ownership) and volume of timber used on a state-by-state basis. Mill-level data were combined to create county, state, and multi-state (regional) summaries while protecting individual firm data. Forest products manufacturers provided the following detailed information to FIDACS through written questionnaires for each plant for a given calendar year:

- production employment,
- annual production capacity,
- volume of raw material received, by county and ownership,
- species and sizes of timber received,
- volume, sales value, and market location of finished products,
- utilization and marketing of manufacturing residue,
- plant production equipment, and
- beginning and ending inventory levels of raw materials and finished products.

Because the surveys and censuses used to collect mill-level data included questions addressing total volume of timber processed annually and total volume of products produced (e.g., thousand board feet of lumber, thousand square feet of plywood), recovery per unit of timber input was readily calculated and applied to reported production capacity in units of output for each mill. Thus annual capacity was expressed in common units of timber input (thousand cubic feet), and the capacity figures for various segments of the industry (i.e., sawmills, plywood plants, post and pole plants) were combined to estimate the industry's total capacity to process timber, referred to as timber-processing capacity. Among the questions posed to mill managers were several asking how their facility could and would respond to increased availability of small-diameter trees, and what their shift and annual capacities were at the time of the interview.

Timber processing area and timber use by size

The timber-processing area for USDA Forest Service Region 1 timberlands was defined as counties with processing facilities receiving timber harvested from counties containing USDA Forest Service Region 1 timberlands. However, counties receiving small volumes (< 50 thousand cubic feet or 1.4 thousand cubic meters) of timber that moved long distances (greater than 200 miles) were not included in the final delineation of the timber-processing area. Mills and associated counties receiving these small volumes – often for specialty products such as house logs – were not included because long-distance flows of timber were often one-time events rather than shipments that would be expected to occur repeatedly. Three tree diameter classes were identified to categorize timber use and milling capacity: trees < 7 inches (17.8 cm) diameter at breast height (DBH), trees 7 to 9.9 inches (17.8 to 25.1 cm) DBH, and trees ≥ 10 inches (25.4 cm) DBH. These size classes were based upon previous analysis that identified minimum tree sizes that could be processed by the region's sawmilling industry which historically has processed over 80 percent of the region's timber (Wagner et al. 1998, 2000; Stewart et al. 2004), descriptions of mill equipment and product lines (including log sizes used by post, pole, log home, and log furniture manufacturers) (FIDACS 2003), analysis of ecological restoration/fire hazard reduction prescriptions which indicate size distribution of trees removed (Fiedler et al. 2001), and discussions with USDA Forest Service Region 1 staff regarding the number and range of tree-size classes that would meet their planning needs.

Estimates of the proportion of timber used in each of the three size classes were made for each mill within the timber processing area. Most facilities were designed to operate using trees of a given size class (e.g., veneer/plywood plants which primarily used trees ≥ 10 in [25.4 cm] DBH, or post manufacturers which can use almost exclusively trees < 7 in [17.8 cm] DBH). Some facilities, in particular a number of sawmills, varied greatly in equipment, product output, and ability to process timber of various sizes. For these mills proportions of timber in each size class were calculated from total volume estimates and size-class proportions provided by mill managers. Managers estimated, to the nearest 10 percent, the proportion of logs processed at their facility with small-end diameters inside bark < 7 inches (17.8 cm), 7 to 9.9 inches (17.8 to 25.1 cm), and ≥ 10 inches (25.4 cm). They also provided preferred and minimum small-end diameters inside bark and preferred and minimum log lengths. Logs in each size class were assumed to have 2 inches (5.1 cm) of taper per 16 feet (4.9 m). Mill managers also provided an estimate of the proportion of logs with small-end diameter < 7 inches (17.8 cm) that came from the tops of large trees vs. from small trees. Smalian's formula (Avery and Burkhart 1994) was then used to calculate the cubic volume of trees processed in each size class based on preferred and minimum small-end diameter and lengths.

Results

The geographic expanse identified as the USDA Forest Service Region 1 timber-processing area included three eastern Washington counties, 25 Idaho counties, and 33 Montana counties (**Fig. 1**). Within the timber-processing area, there were 298 timber-processing facilities in operation as of August 30,

2003: 110 sawmills, 101 house log/log home facilities, 42 post and small-pole producers, 23 manufacturers of log furniture, 12 cedar products producers, 7 plywood and veneer plants, and 3 utility pole producers. In addition to the Idaho, Montana, and Washington mills mentioned, several mills in northern Wyoming and western South Dakota consistently received timber harvested from counties containing USDA Forest Service Region 1 non-reserved forestland. However, due to the limited number of these mills and the related need to protect firm-level data, these mills were not included in the timber-processing area. The volumes of timber involved were small relative to the total timber utilized in the Region 1 timber processing area.

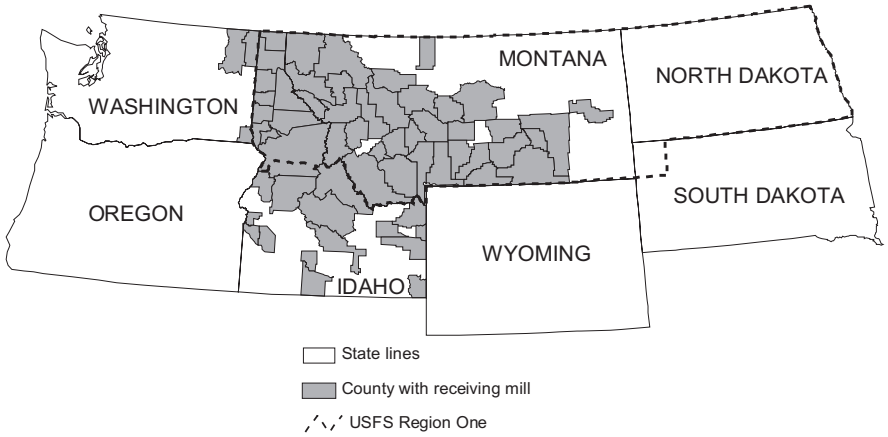

Figure 1. — USDA Forest Service, Region 1 timber-processing area.

Timber processing capacity and utilization by timber size

Annual capacity to process timber within the timber processing area as of August 30, 2003 was 576 million cubic feet (MMCF) (16.3 million cubic meters [MMCM]) excluding pulpwood. Approximately 15 percent of the timber-processing capacity was located in eastern Washington, 39 percent in Montana, and 46 percent in Idaho (**Table 1**). Region wide, these mills utilized 79 percent of capacity, processing 456 MMCF (12.9 MMCM) of timber during the previous 12 months. Utilization ranged from 70 percent of capacity in eastern Washington to 84 percent in Idaho. Montana mills utilized almost 77 percent of capacity.

Table 1. — Timber-processing capacity and timber volume processed by size class (excluding pulpwood).

Sub-region	Capacity	Volume processed	Volume used by size class		
			DBH < 7 in	DBH 7 to 9.9 in	DBH 10+ in
	- - - - - - - - - - - - - - - - - -		(thousand ft^3 of timber)		- - - - - - - - - - - - - - - - - -
Eastern Washington	85,007	59,869	[a]	1,944	57,925
Idaho	264,876	222,085	2,975	11,379	207,732
Montana	226,580	173,705	2,729	20,162	150,814
Total	576,463	455,659	5,704	33,485	416,471

[a] Not disclosed because of the limited number of mills. The volumes are included in the 7 to 9.9-inch DBH class.

Table 2. — Timber volume used by product type and size class (excluding pulpwood).

Tree size class	Lumber, plywood veneer, poles, piling	House logs	Posts, small poles, log furniture	Cedar products	All products
	- - - - - - - - - - - - - - - - - -		(thousand ft^3)		- - - - - - - - - - - - - - - - - -
DBH < 7 inches	[a]	[b]	5,703	[b]	5,703
DBH 7 to 9.9 inches	31,532	555	1,400	[b]	33,487
DBH 10+ inches	403,955	6,054	[b]	6,461	416,470
Total	435,487	6,609	7,103	6,461	455,660

[a] Not disclosed because of the limited number of mills. The volumes are included in the 7 to 9.9-inch DBH class.
[b] No volumes reported.

Within the timber-processing area, the proportions of timber used by size class varied slightly by state (**Table 1**). In Montana, 87 percent (151 MMCF or 4.3 MMCM) of timber used was from trees ≥ 10 inches (25.4 cm) DBH, while 97 percent of timber (58 MMCF or 1.6 MMCM) used by eastern Washington mills was from this larger size class. Almost 2 percent of timber used by Montana mills was from trees < 7 inches (17.8 cm) DBH. Slightly more than 1 percent of timber used in Idaho was from this smallest size class. Across the entire timber-processing area, over 91 percent of the timber processed (416 MMCF or 11.8 MMCM) was from trees ≥ 10 inches (25.4 cm) DBH. Slightly more than 7 percent (33 MMCF or 0.9 MMCM) was from trees 7 to 9.9 inches (17.8 to 25.1 cm) DBH, and only 1 percent (6 MMCF or 0.2 MMCM) was from trees < 7 inches (17.8 cm) DBH.

Over 90 percent (420 MMCF or 11.8 MMCM) of all timber processed in the timber-processing area was from live/green trees. However, sawmills occasionally substituted dead timber from salvage operations, house log producers utilized dead timber for the majority of their raw material, and cedar products producers utilized about 40 percent dead timber. Post, small pole, and roundwood furniture producers almost always used live timber.

Product use and species

Ninety-five percent (435 MMCF or 12.3 MMCM) of all timber was used to produce lumber, plywood, veneer, utility poles, and piling (**Table 2**). This timber came from trees ≥ 7 inches (17.8 cm) DBH with about 92 percent coming from trees ≥ 10 inches (25.4 cm) DBH. Timber for house logs (7 MMCF or 0.2 MMCM) and cedar products (6 MMCF or 0.2 MMCM) was almost exclusively from trees ≥ 10 inches (25.4 cm) DBH. Timber for posts, small poles, and roundwood log furniture (7 MMCF or 0.2 MMCM) showed a much different distribution

with virtually all timber from trees < 10 inches (25.4 cm) DBH and 80 percent from trees < 7 inches (17.8 cm) DBH.

Most timber for post, pole, and log furniture was from lodgepole pine (*Pinus contorta*) in the smallest size class (< 7 in [17.8 cm] DBH), whereas most sawtimber for veneer and plywood was from Douglas-fir (*Pseudotsuga menziesii*) and western larch (*Larix occidentalis*) in the largest size class (≥ 10 in [25.4 cm] DBH). Cedar products manufacturers and utility pole plants processed primarily western redcedar (*Thuja plicata*) from the largest size class. Log home manufacturers processed mostly lodgepole pine (*Pinus contorta*) and Engelmann spruce (*Picea engelmannii*) from the largest size class, while sawmills processed a full variety of species almost exclusively from the two larger size classes (≥ 7 in [17.8 cm] DBH).

Capacity to process timber of various sizes

About 410 MMCF or 11.6 MMCM (71%) of timber-processing capacity could not operate efficiently on trees < 10 inches (25.4 cm) DBH (**Table 3**). This was in mills designed to operate solely on larger timber (≥ 10 in [25.4 cm] DBH) and at "two-sided" mills with parts of the mills designed to process large logs and the other parts designed to process small logs. About 55 percent (226 MMCF or 6.4 MMCM) of this large-log-only capability was in Idaho where it accounted for more than 85 percent of total timber-processing capacity. In Montana, large-log-only capability accounted for about 62 percent of total timber-processing capacity, while in eastern Washington it accounted for just 51 percent of total capacity.

Approximately 152 MMCF (4.2 MMCM) of timber-processing capacity (26% of total capacity) could efficiently process trees 7 to 9.9 inches (17.8 to 25.1 cm) DBH, with about one-half of the capacity in Montana, 27 percent in eastern Washington, and 22 percent in Idaho. Only about 14 MMCF or 0.4 MMCM (2%) of the total timber-processing capacity could efficiently process trees < 7 inches (17.8 cm) DBH. Of this 14 MMCF (0.4 MMCM) of capacity, 66 percent was in Montana and over 30 percent was in Idaho. For the eastern Washington counties, due to the limited number of mills capable of processing timber under 7 inches DBH, volumes are included in the 7 to 9.9 inch DBH class.

Pulpwood and industrial fuelwood

Roundwood pulpwood used as a raw material by the pulp and paper industry has been variable and relatively unpredictable from year to year. Reported roundwood pulpwood use, including some timber for industrial fuelwood by pulp and paper mills within the timber-processing area, has ranged from less than 20 MMCF (0.6 MMCM) to more than 40 MMCF (1.1 MMCM) annually in recent years. An estimated 30 to 40 percent of this material was from green trees < 10 inches DBH. The remainder came from larger cull trees. Variability and unpredictability of the pulpwood markets exist primarily because timber in round form is an alternative to the major source of raw material of the pulp and paper industry which is mill residue from sawmills (Keegan et al. 1999). The year-to-year wood-fiber requirements of pulp and paper mills vary less than the supply of mill residues. Pulp and paper mills have much higher fixed costs and are much more expensive to operate at varying production levels than sawmills. Thus, during recessions when lumber production and related mill residue supplies decline, demand for roundwood pulpwood increases to fill the raw-material void.

Table 3. — Timber-processing capacity by size class (excluding pulpwood).

Sub-region	Total capacity	Capacity by DBH size class		
		< 7 in.	7 to 9.9 in.	10+ in.
	(thousand ft^3 of timber)			
Eastern Washington	85,007	[a]	41,420	43,587
Idaho	264,876	4,715	33,720	226,441
Montana	226,580	9,130	77,329	140,121
Total	576,463	13,845	152,469	410,149

[a] Not disclosed because of the limited number of mills. The volumes are included in the 7 to 9.9-inch DBH class.

Conclusions

Utilization of timber-processing capacity in the timber-processing area is 79 percent which leaves almost 121 MMCF (3.4 MMCM) of capacity unutilized. Mill managers indicated that they would increase production if raw material availability increased. However, mills have rarely operated at more than 90 percent of capacity (Keegan et al. 1997, 2001; Cohn and Blatner 2003; Schlosser and Blatner 2002). Thus, it is unlikely that all of the unutilized capacity would be used. However, the existing industry could readily process an additional 60 to 80 MMCF (1.7 to 2.3 MMCM) of timber annually. Additional volumes of trees ≥ 10 inches (25.4 cm) DBH would be most preferred by existing mills.

Results of this study indicate a distinct opportunity to expand the utilization of trees 7 to 9.9 inches (17.8 to 25.1 cm) DBH with no change in industry infrastructure. Over the 12-month period ending August 30, 2003, mills processed 33 MMCF (0.9 MMCM) of timber (**Table 1**) in this size class. However, existing mills could have processed over 150 MMCF (4.2 MMCM) (**Table 3**). Processing more volume in the 7 to 9.9 inches (17.8 to 25.1 cm) DBH size class could come about if more volume became available, and mills substituted these smaller trees for larger trees. However, while many mills may be capable of processing a larger volume of trees in the 7 to 9.9 inches (17.8 to 25.1 cm) DBH class, many prefer trees ≥ 10 inches (25.4 cm) DBH. It should be noted also that a number of mills, most commonly sawmills, indicated that ponderosa pine (*Pinus ponderosa*) < 10 inches DBH could not be processed as efficiently as other major species.

Expanded utilization of the smallest-size class (< 7 in [17.8 cm] DBH) would be more limited. Study results indicate that only about 14 MMCF (0.4 MMCM) of existing capacity could efficiently utilize trees < 7 inches (17.8 cm) DBH, and about 45 percent this capacity is currently being used. Additionally, much of this processing capacity is in facilities such as post plants with a strong preference for lodgepole pine (*Pinus contorta*). Thus, utilization of large volumes of trees < 7 inches (17.8 cm) DBH would require an increase in total timber-processing capacity or increased use by the existing pulp and paper industry.

Potential for industry expansion

Managers from about two-thirds of the mills interviewed said that they were willing to make modest improvements (generally under $1 million) to enhance their ability to process

small-diameter timber. These improvements included automating more of their operation and improving the efficiency of sorting and handling, conveyors, down-line processing, and breakdown procedures. Other improvements included upgrading machinery and modifying saws and planers. Slightly more than one-half said that they would make a major capital investment to expand the mill, while less than one-half would not. Mill managers that stated they would make capital investments tempered their replies by stressing the need for an assured, long-term supply of timber in order to recoup investment costs. An overwhelming majority of mill managers commented that a guaranteed, long-term supply of timber would be needed to make any investment in new small-log technology. Good markets, profitability, less expensive logs, and investment capital were also mentioned.

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