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TIMBER USE, PROCESSING CAPACITY AND CAPABILITY BY DIAMETER SIZE CLASS IN THE MEDICINE BOW-ROUTT NATIONAL FORESTS TIMBER-PROCESSING AREA

BY CHEALSEA P. MCIVER, CHARLES B. GALE AND STEVEN W. HAYES

Introduction

Insect and disease outbreaks in the central Rocky Mountains have reached epidemic levels in the past two decades resulting in vast stands of dead trees across parts of Wyoming, Colorado and South Dakota. Both the states and the U.S. Forest Service have increased investments in forest health, hazardous fuels mitigation and safety protection on private and public lands (Wyoming State Forestry Division 2017; State of Colorado 2017; USFS MBRNF 2017). These and other treatments designed to restore ecological condition and function and reduce fire hazards require the removal of a mix of timber valuable enough to offset some of the costs along with smaller trees with limited value and markets (Wagner et al. 2000). The loss of milling infrastructure throughout the West, combined with changing management objectives on federal lands, raise questions about the industry's ability to purchase timber of varying sizes and quality at a rate that is adequate for the forest and sustainable for the industry (Keegan et al. 2005; Keegan et al. 2006).

This report was prepared as a forest planning support document for the Medicine Bow-Routt National Forests and seeks to:

1. Examine the harvest of timber from the counties containing non-reserved timberland for the Medicine Bow-Routt National Forests;
2. Analyze the flow of and identify the location of mills receiving timber harvested from the above counties; and
3. Describe the kinds of mills, their capacity to process timber and their capability to use timber of various sizes.

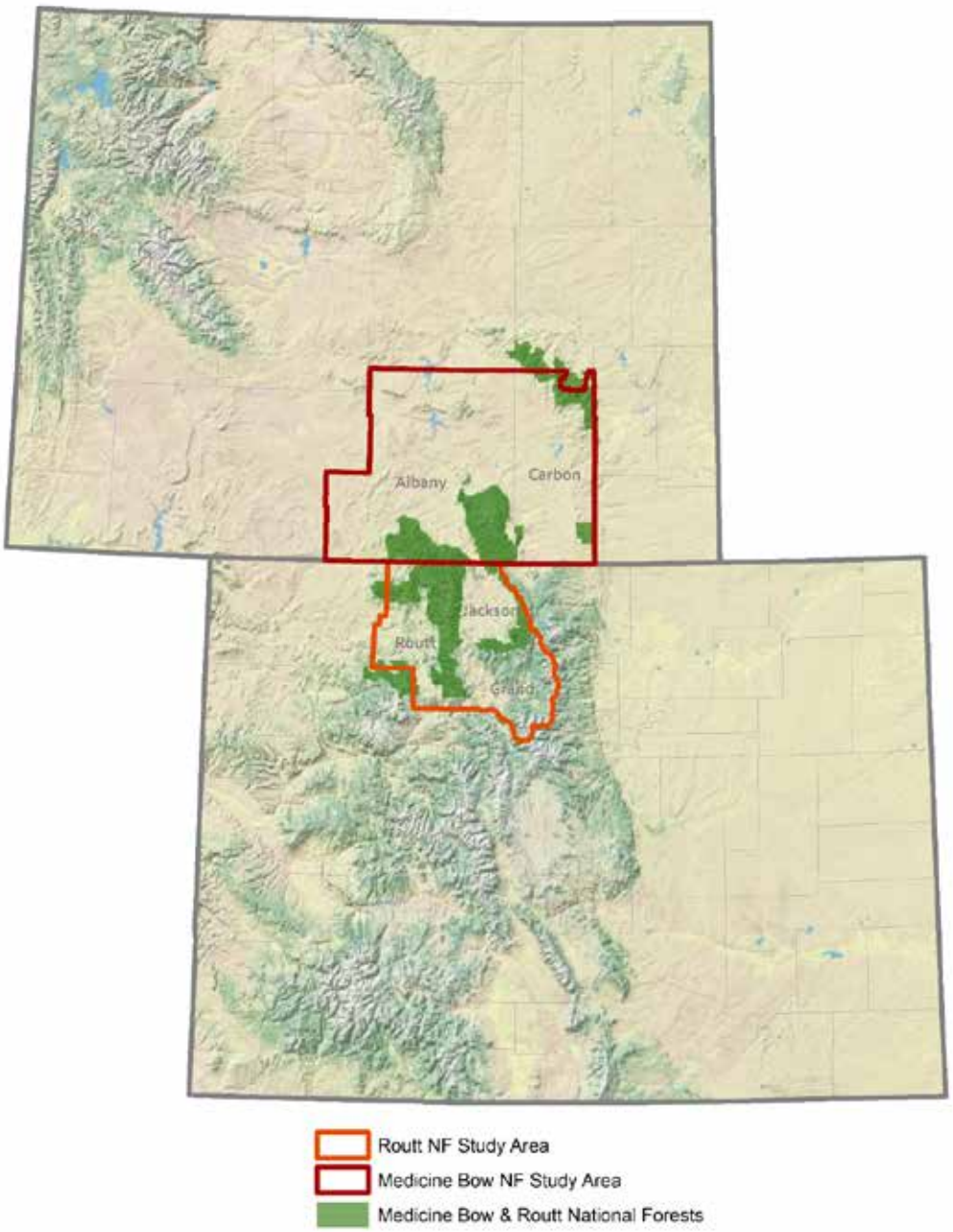
Definitions and Methods

In this report, "capacity" refers to the total volume of timber that existing timber-processors could utilize annually. Also known as "timber-processing capacity," it is a measure of input capacity and generally expressed in board feet, Scribner or cubic feet. Input capacity is a useful measure when attempting to express the capacity of multiple types of mills in a common unit because finished products (output and output capacity) are measured in a variety of units: board feet lumber tally (lumber), thousand square feet (plywood, veneer), lineal feet (house logs) and pieces (posts, small poles and log furniture). Input capacity is a measure of the volume of raw logs that a mill can process in a given year, given firm market demand and sufficient raw material. Estimates in this report include the capacity of active facilities that exclusively use timber in round form; this includes sawmills and facilities processing timber into house logs/log homes, posts and small poles and log furniture.

In contrast, "capability" refers to the volume of trees of a certain size class (measured as diameter at breast height or dbh) that existing timber processors can efficiently and economically process annually. Most facilities are designed to operate using trees of a given size class (e.g., log home manufacturers typically use trees ≥ 10 inches dbh and post manufacturers primarily use trees < 8 inches dbh). Capability at these facilities is readily classified in just one of the size classes. This is true for some sawmills, but sawmills vary greatly in equipment, configuration, product output and ability to process timber of various sizes.

Data for this analysis are based on 2014 data for Wyoming mills (McIver et al. 2017), 2012 and 2016 data for Colorado mills (Sorenson et al. 2016; BBER 2017). In cases where 2016

Figure 1. Medicine Bow-Routt National Forests and study area.

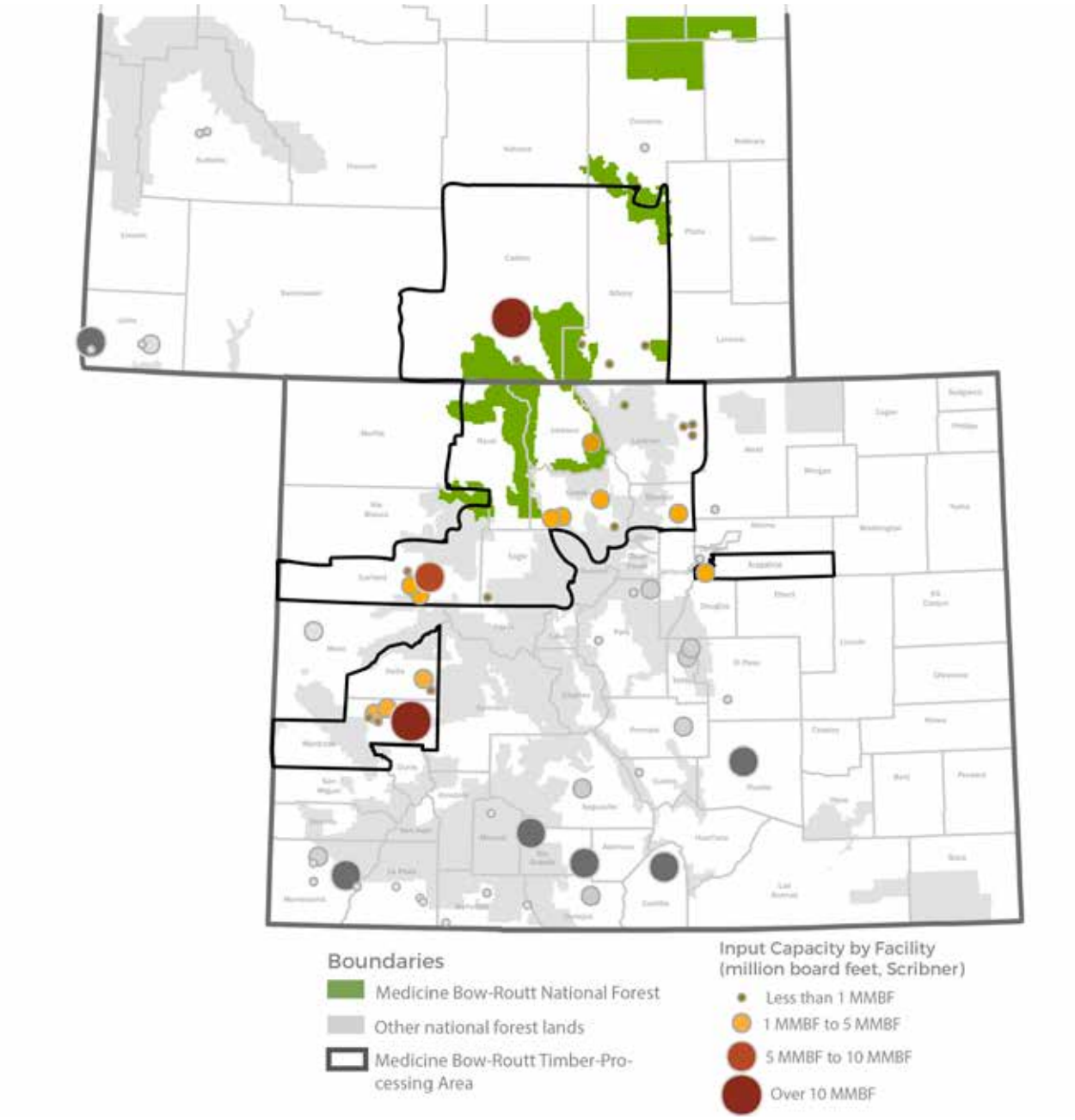


data for a mill was not available, 2012 data was used as a baseline and adjusted to reflect 2016 harvest and market trends. Using BBER databases, U.S. Forest Service cut and sold data and conversations with mill owners, timber harvest and flow from all ownerships within the study area counties were analyzed.

To determine the timber-processing area (TPA) for the Medicine Bow-Routt National Forests, counties containing mills receiving timber from the study area were identified. Contiguous counties that received timber from the study area were automatically included. If historic (2010, 2012) data indicated a substantial flow of timber into a contiguous county, the county would be included in the TPA even if recent (2014, 2016) flows were relatively small or nonexistent. Finally, all other counties receiving timber from the study area were included if the volume represented more than 10% of the total timber received in that county.

For each mill in the TPA, an estimation of the mill's capability to process timber of a given size was made based on conversations with mill owners and the most recent census data, taking into consideration the financial feasibility and physical characteristics of the mill. For this report, three tree size classes were used: <7 inches dbh, 7-9.9 inches dbh and ≥10 inches dbh.

Figure 2. Medicine Bow-Routt National Forests timber-processing area.



BBER researchers first assigned capability to efficiently process timber <10 inches dbh; capability to process trees ≥ 10 inches dbh is then calculated as the proportion of total capacity *not* capable of efficiently using trees <10 inches dbh.

Finally, because data are collected in board feet Scribner, each mill was also assigned a board foot to cubic foot conversion factor based on their mill type and characteristics of their raw log inputs from the most recent census year (Keegan, Morgan, and Blatner 2010).

Harvest from Counties Containing Medicine Bow-Routt National Forests Non-Reserved Timberland

The Medicine Bow-Routt is a large forest spread over two states and 5 counties (Figure 1). Within this area there are 2.7 million acres of non-reserved timberland – 72 percent is owned and managed by the U.S. Forest Service (Miles 2017). The total volume of timber harvested and utilized from all ownerships in the study area was an estimated to be 12 million cubic feet (MMCF) (44 million board feet) in 2016 (BBER 2017; McIver et al. 2017; WWPA 2017). Timber harvested from the Medicine

Table 1. Active timber processing facilities in the Medicine Bow-Routt National Forests timber processing area, 2016. Sources: Sorenson et al. 2016; McIver et al. 2016; BBER, 2017.

Type	2016
Sawmills	8
Log home	3
Log furniture	2
Post and pole	8
Fuel pellet	2
Shavings	1
Total	**24**

Bow-Routt National Forests was estimated to account for 50 percent (6 MMCF) of the timber harvested in the five counties (USFS 2016). Approximately 74 percent of the timber harvested in the study area was processed within the study area.

The species composition of the timber harvested in the study area was estimated to consist of primarily lodgepole pine, with smaller volumes of ponderosa pine, Engelmann spruce, aspen, Douglas-fir and subalpine fir.

Medicine Bow-Routt Timber-Processing Areas

A national forests' timber-processing area establishes the geographic region *potentially* influenced by timber harvested from that forest by analyzing the flow of timber harvested from all ownerships in counties containing non-reserved national forest lands. The analysis also describes the area and extent to which timber processors are dependent upon the timber harvested in these counties, and federal timber more specifically.

The timber-processing area for the Medicine Bow-Routt National Forests are made up of 12 counties, including Albany and Carbon counties in Wyoming and Arapahoe, Boulder, Delta, Jackson, Eagle, Garfield, Grand, Larimer, Montrose and Routt counties in Colorado (Figure 2).

However, it should be noted that the Medicine Bow-Routt National Forests are displayed a somewhat bifurcated timber flow pattern, which is likely attributed to the fact that it is an administrative combination of two distinct national forests. Timber harvested from the Medicine Bow National Forest study area in southern Wyoming is primarily processed in the study area counties and a few northern Colorado counties, while timber harvested from the Routt National Forest study area is processed throughout the border region of northern Colorado and southern Wyoming, extending as far south as Montrose county.

Within the Medicine Bow-Routt National Forests TPA there were 24 facilities currently operating as of 2016: eight sawmills, eight post and small pole facilities, three log home manufacturers, two log furniture manufacturers, two fuel pellet mills and one shavings plant (Table 1).

Timber Flow

Of the 12 MMCF of timber harvested in the five-county study area, BBER estimates that 74 percent was processed within the five counties of harvest, while 99 percent was processed within the TPA. Carbon County processed the largest proportion of the harvest originating within its borders (Table 2). Uintah

Table 2. Timber flow from the Medicine Bow-Routt National Forests six-county study area to county of processing facility, 2016.

County of harvest	Processed within the county of harvest	Processed within TPA	Processed outside TPA
	Percentage of harvest by country		
Albany County, WY	7%	93%	0%
Carbon County, WY	99%	1%	0%
Grand County, CO	30%	69%	1%
Jackson County, CO	0%	100%	0%
Routt County, CO	0%	100%	0%

Table 3. Annual volume of timber processed by tree size class (excluding fuelwood) for the Medicine Bow Routt National Forests timber processing area, 2016.

Thousand cubic feet		*Thousand board feet, Scribner*	
Tree dbh	**Volume used**	**Tree dbh**	**Volume used**
<7 in.	4,345	<7 in.	9,319
7 - 9.9 in.	4,813	7 - 9.9 in.	13,326
>10 in.	17,058	>10 in.	71,715
Total	**26,216**	**Total**	**94,360**

County in Utah and Custer, La Plata and Park counties in Colorado received small volumes of timber from the study area, but were excluded from the TPA.

Current Conditions

Timber Use

Capacity to process timber in the Medicine Bow-Routt National Forests TPA during 2016 was 48.1 MMCF. Mills processed 26.2 MMCF that year, indicating that they were operating at approximately 55 percent of capacity (Table 3). The volume processed was greater than the volume harvested in the five-county study area indicating that the region is a net importer of timber. Capacity to process timber in the five-county study area was 21.7 MMCF or 180 percent of the volume of timber harvested in the study area in 2016.

Just over 65 percent of the volume processed in the TPA was composed of trees with a diameter at breast height (dbh) greater than 10 inches. Another 18 percent came from trees 7 – 9.9 dbh, while the remaining 17 percent was made up of trees less than 7 inches dbh.

Processing Capacity and Capability

Most facilities are designed to operate using trees of a given size class (for example, post and rail manufacturers generally use trees less than 7 inches dbh, while house log manufacturers typically only use trees greater than 10 inches dbh). Capacity at these facilities is readily classified as being capable of processing timber in just one size class. While this is also true for some sawmills, sawmills can vary greatly in equipment, products produced, configuration and ability to process timber of various sizes.

In addition, sawmills often process trees that are larger than the smallest tree size they are capable of processing due to higher recovery rates, and thus greater profitability. However, some mills that process larger trees are not capable of processing smaller diameter trees. For this reason, capability to process trees greater than 10 inches dbh is calculated as the proportion of total capacity *not capable* of processing trees less than 10 inches dbh. Conversely, capability to process trees less than 7 inches dbh is presented as a maximum volume that could be processed efficiently (Wagner et al. 2000 and Stewart et al. 2004). Thus, for those mills with a great deal of flexibility in the size of material utilized (e.g. whole log chipping or grinding), all of their capacity was assigned to the smallest size class since this is where the greatest limitations in the industry exist.

The authors estimate that 68 percent of existing capacity in the Medicine Bow-Routt National Forests TPA is *not* capable of efficiently utilizing trees less than 10 inches dbh (Table 4). However, as much as 17 percent of total capacity is capable of utilizing trees less than 7 inches dbh and another 15 percent is capable of processing trees between 7 and 10 inches dbh.

Approximately 59 percent of the stated capability to process trees < 10 inches dbh was used in 2016. Mills processed 9,158 MCF of the estimated 15,544 MCF capable of processing trees <10 inches dbh. Capability in the 7-9.9 inch dbh class had the highest utilization rate (66 percent) indicating some substitution

Table 4. Annual capacity and capability of mills to process trees by size class (excluding fuelwood) for the Medicine Bow-Routt National Forests timber processing area, 2016.

Thousand cubic feet		*Thousand board feet, Scribner*	
Tree dbh	**Capability**	**Tree dbh**	**Capability**
<7 in.	8,241	<7 in.	17,502
7 - 9.9 in.	7,303	7 - 9.9 in.	27,861
>10 in.	32,533	>10 in.	138,499
Total	**48,077**	**Total**	**183,862**

of larger (7-9.9 inches dbh) logs when smaller logs could be utilized. However, most of this substitution is likely occurring among roundwood chipping operations (e.g. fuel pellet and shavings) where the niche they fill is more oriented to lower quality logs as opposed to exclusively small diameter logs of higher quality that can be utilized for other higher value uses such as studs and fence rails. In contrast, mills used 52 percent of their capacity to process trees > 10 inches dbh.

Discussion

As noted above, the size and quality of logs influence utilization in different ways. Smaller, high quality logs are more likely to be utilized for higher value products such as studs and fence rails, while lower quality logs of any size may be utilized by chipping operations with more flexibility for end uses, such as fuel pellets and shavings. Because log quality is not a measurable attribute in these studies, capability for chipping operations default to size characteristics that *could* be utilized, i.e. smaller material. As the results of this study indicate, just because these users are capable of utilizing very small material does not mean they do.

Sawmill owners also spoke to the impact that the condition of timber, namely live versus dead, has on their ability to recover economic value from the material. Specifically, mills stated that their capability to process timber <10 inches dbh would be greater if they were processing green trees due to the associated higher grade recovery. Similar relationships among log size, live versus dead trees and value have been documented by Fahey et al. (1986).

Finally, while the region shows unutilized capability to process small diameter timber, some mills reported using greater volumes of small diameter timber than they felt they were capable of *efficiently and economically* processing. This is likely a reflection of the fact the national forests comprise the overwhelming majority of timberland, and the national forests are offering substantial quantities of small trees and relatively few larger trees in efforts to mitigate the impacts of widespread tree mortality due to insects and disease.

When considering the economic feasibility of removing trees from the landscape, land managers should balance their need to remove small and/or dead trees with the local industry's ability to profitably use that material. Offering larger quantities of small and/or dead trees than the industry can profitably use will likely lead to unsold sales and fewer acres being treated.

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