FOREST INDUSTRY RESEARCH PROGRAM
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Timber Use, Processing Capacity and Capability of Mills to Utilize Timber by Diameter Size Class Within the Bighorn National Forest Timber-Processing Area

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Introduction

Insect and disease outbreaks in the central Rocky Mountains reached epidemic levels in the last two decades resulting in vast stands of dead trees across parts of Wyoming, Colorado and South Dakota (Wyoming State Forestry Division 2017; State of Colorado 2017; USFS MBRNF 2017). In the counties where the Bighorn National Forest (NF) is located, annual mortality across all ownerships from insect and disease on timberland[1] is estimated to be 143,506 hundred cubic feet (CCF), accounting for 55 percent of total annual mortality in the study area (USDA, 2020). In comparison, fire, logging and other human caused mortality accounts for nearly 16 percent; remaining mortality is from other (i.e. weather, animals, vegetation) or unknown causes (USDA, 2020). 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. These treatments, designed to restore ecological condition and function and reduce fire hazard often 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 during the 1990s and 2000s, combined with changing management objectives on federal lands, has raised questions about the industry's ability to purchase and use timber of varying sizes and quality at a rate adequate for forest management goals and economically sustainable for the industry (Keegan et al. 2005; Keegan et al. 2006). The expressed need to treat millions of acres in the western United States to meet management objectives has made accurate information on timber milling capacity and the capability of mills to handle timber of various sizes an important consideration for managers.

[1] Timberland: Forest land that is producing or is capable of producing crops of industrial wood and not withdrawn from timber utilization by statute or administrative regulation. (Note: Areas qualifying as timberland are capable of producing at least 20 cubic feet per acre per year of industrial wood in natural stands. Currently inaccessible and inoperable areas are included.)

Goals and Objectives

This report was prepared by the Forest Industry Research Program at the University of Montana's Bureau of Business and Economic Research (BBER) as a forest planning support document for the Bighorn NF and seeks to:

1. examine the harvest of timber from the counties containing the Bighorn NF timberland – the "study area";
2. analyze the timber flow and identify the Bighorn NF "timber-processing area" – the counties containing facilities that received timber harvested from the study area; and
3. describe the number and types of facilities and quantify their total capacity to process timber, their capability to use timber of various sizes, and their capacity utilization rates. The study focuses on facilities that exclusively use timber in round form (i.e., logs). Facilities that use only mill residuals (e.g., sawdust or chips) are not included.

Definitions and Methods

This analysis is based primarily on 2018 mill survey data for Wyoming mills with supporting data from Montana 2018 and Idaho 2015 mill surveys (Marcille et al. in preparation, Hayes et al. in preparation, Simmons et al. in preparation) and follows the methods outlined in the Region 2 region-wide report (Simmons et al. 2019).When 2018 data for a mill were not available, prior 2014 or 2010 data were used as a baseline and adjusted to reflect 2018 harvest and market conditions. Mill survey data from Marcille et al. (in preparation), USFS Cut and Sold reports (USFS 2018) and conversations with mill owners, were used to analyze timber harvest and flow from all ownerships within the study area (i.e., the counties containing Bighorn NF timberland).

The Bighorn NF timber-processing area (TPA) includes the counties in the study area as well as counties containing mills that received timber from the study area during 2018. If historic (2010/2014) mill survey data indicated a substantial flow of timber into a county, the

county would be included in the TPA even if recent (2018) flows were relatively small or non-existent. Finally, all other counties receiving timber from the study area were included if the volume from the study area represented more than 10 percent of the total timber received in that county.

In this report, "capacity" refers to the total volume of timber (a.k.a., roundwood or logs) that 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 of measure because finished products (mill outputs and output capacity) are measured in a variety of units: board feet lumber tally for lumber, lineal feet for house logs, and pieces for posts, small poles, and log furniture. Input or timber-processing capacity is a measure of the volume of logs that a facility can process in a given year, given firm market demand and sufficient raw material for all shifts and products produced. Estimates in this report include the capacity of facilities that use timber in round form; this includes sawmills and facilities processing timber into house logs, log homes, posts, poles, log furniture, excelsior, fuel pellets, firewood, and landscaping chips.

In contrast, "capability" refers to the volume of trees of a certain size class (measured as diameter at breast height – dbh) that timber processors can *efficiently and economically* process annually. Most facilities are designed to operate using trees of a given size class. For example, 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 a single size class. This is true for some sawmills, but sawmills can vary greatly in equipment, configuration, product output, and ability to process timber of various sizes (Wagner et a. 1998, 2000; Keegan et al. 2005, 2006; Stewart et al. 2004).

For each mill in the TPA, an estimate of the mill's capability to process timber of a given size was made based on literature (Wagner et a. 1998, 2000; Keegan et al. 2005, 2006; Stewart et al. 2004), conversations with mill owners and the most recent BBER mill 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.

BBER researchers first assigned capability to efficiently process timber in the <7 inch and 7-9.9 inch dbh classes. Capability to process trees ≥ 10 inches dbh was then calculated as the remaining proportion of total capacity *not* capable of efficiently using trees <10 inches dbh. Total timber-processing capacity and capability by dbh class are presented in both hundred cubic feet (CCF) and thousand board feet Scribner (MBF) to facilitate discussion among national forest managers, timber purchasers, and wood products facility operators.

Bighorn National Forest Study Area

The Bighorn NF study area is situated in the north-central region of Wyoming, spreading over four counties (figure 1). The resulting study area contains approximately 822,690 acres of timberland (USDA, 2019), of which 78 percent (644,409 acres) is managed by the US Forest Service (table 1). Approximately 29 percent of the timberland acres on the Bighorn NF are considered suitable for timber production[2] (Sidon 2019).

Table 1 – Acres of timberland[1] by county and ownership in the Bighorn NF Study Area.

County	National Forest	Private	Bureau of Land Management	Total
Big Horn	132,920	16,272	8,160	157,352
Johnson	206,373	49,797	70,662	326,832
Sheridan	276,787	23,947	—	300,734
Washakie	28,329	9,443	—	37,772
Grand Total	644,409	99,459	78,822	822,690

[1] Timberland: Forest land that is producing or is capable of producing crops of industrial wood and not withdrawn from timber utilization by statute or administrative regulation. (Note: Areas qualifying as timberland are capable of producing at least 20 cubic feet per acre per year of industrial wood in natural stands. Currently inaccessible and inoperable areas are included.)
Source: USDA Forest Service, Forest Inventory and Analysis Program, Tue Dec 18 20:21:21 GMT 2018. Forest Inventory EVALIDator web-application Version 1.8.0.00. St. Paul, MN: U.S. Department of Agriculture, Forest Service, Northern Research Station. [Available only on internet: http://fsxopsx1056.fdc.fs.usda.gov:9001/Evalidator/evalidator.jsp]

[2]Lands suited for timber production – Area that defines where timber harvest for the purpose of timber production may occur. Timber harvest for purposes other than timber production may also occur here.

The total volume of timber harvested and utilized from all ownerships in the study area was estimated at 12,552 CCF (5,950 MBF) in 2018 (table 2). Timber harvested from national forest timberlands in the study area accounted for 77 percent (9,732 CCF) of the timber harvested in the study area's four counties. Private timberlands accounted for 16 percent (2,046 CCF) of the timber harvested in the study area. Timber from the Bighorn NF accounted for all of the National Forest timber harvested from the study area. The species composition of the timber harvested in the study area was Douglas-fir (30 percent), lodgepole pine (29 percent), ponderosa pine (10 percent), and spruce (8 percent), with smaller volumes of mixed fir species and other softwoods. (Marcille et al. in preparation).

Table 2 – Timber harvest by county and ownership Bighorn NF Study Area, 2018.

County	National Forest	Private	State	Grand Total
	---------- *Hundred cubic feet (CCF)* ----------			
Sheridan	4,947	0	264	5,211
Big Horn	3,394	253	0	3,647
Washakie	1,359	200	0	1,559
Johnson	32	1,593	511	2,135
Grand Total	9,732	2,046	774	12,552

Source: Marcille et al. (in preparation); Simmons et al. 2019.

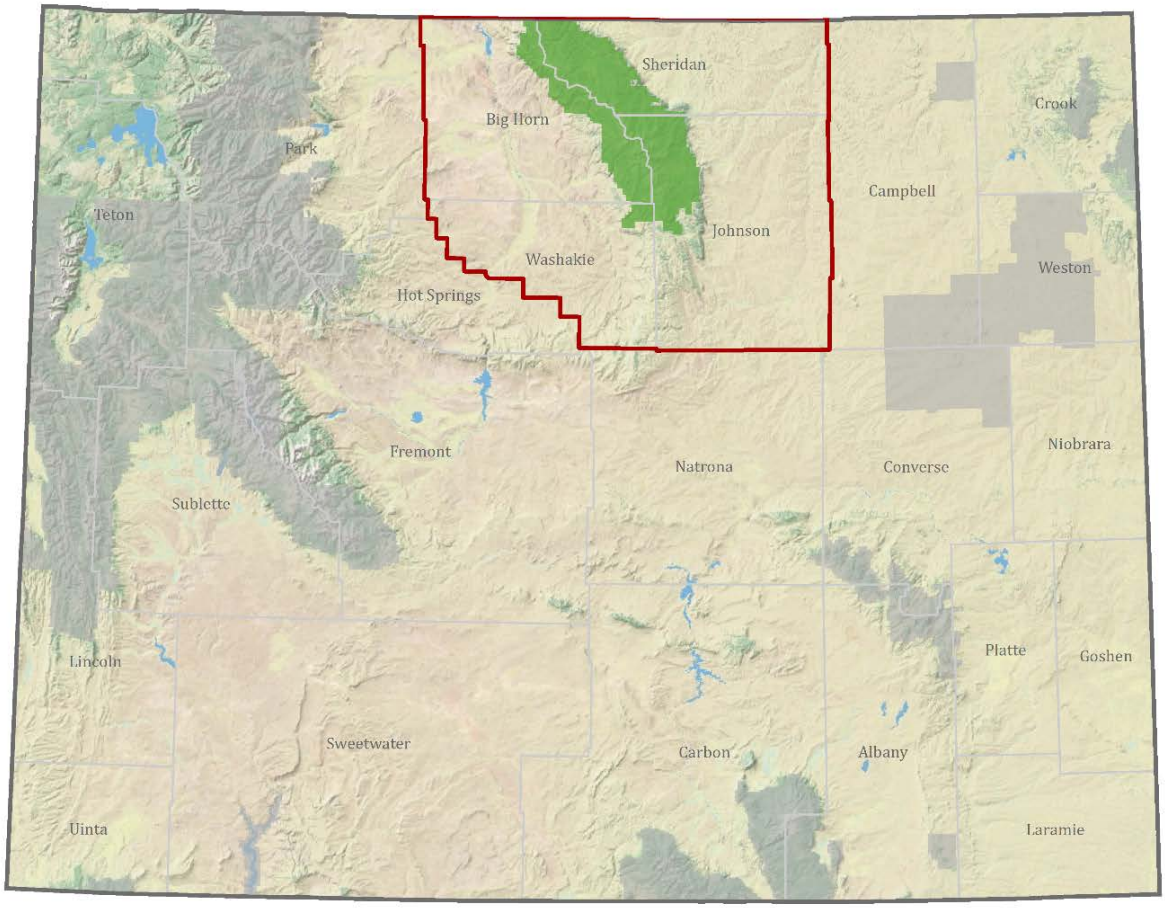

Figure 1 – Bighorn National Forests and Study Area

Bighorn NF Timber-Processing Area

A national forest's timber-processing area (TPA) establishes the geographic region *potentially* influenced by timber harvested from that forest by analyzing the *flow of timber harvested* from all ownerships within the study area. 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 Bighorn NF TPA is made up of 10 counties. In addition to the four Wyoming counties in the study area, four counties in Montana and two counties in South Dakota with timber-processing facilities received timber from the study area in 2018 (figure 2). The majority of the study area's timber was transported to Montana and South Dakota for processing since seven of the 10 active sawmills in the TPA are in these two states. The authors suggest that Bighorn NF managers (e.g., timber sale administrators and forest planners) contact the facilities in the TPA to verify their current operating status and willingness to draw timber from the study area as specific projects are being developed.

Table 3 – Active timber-processing facilities in the Bighorn NF timber-processing area, 2018.

Type	**2018**
Sawmills	10
Post/poles	4
Total	**14**

Source: Marcille et al. (in preparation); Simmons et al. 2019.

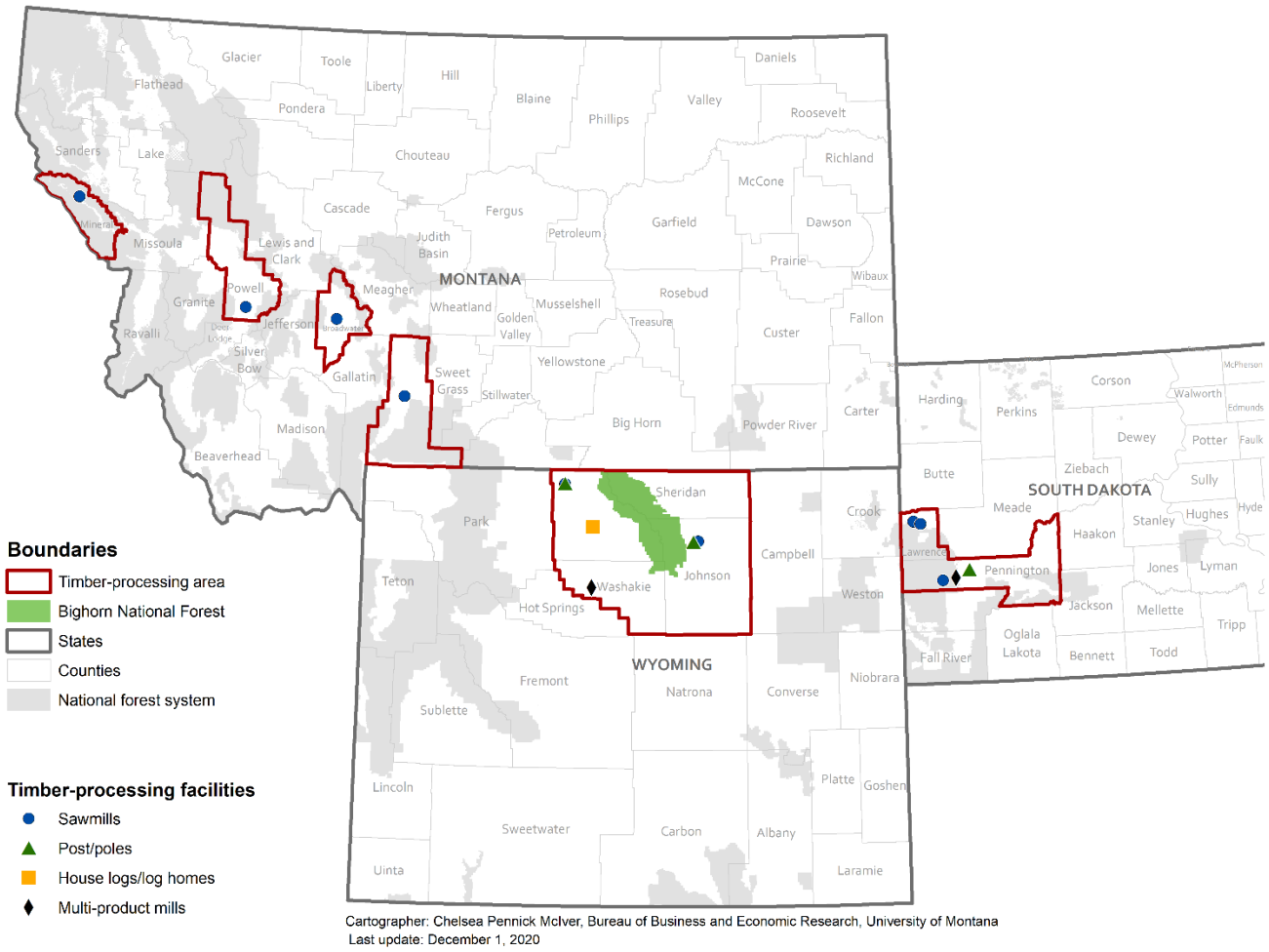

Figure 2 – Timber-processing facilities in the Bighorn NF TPA by type.

Timber Flow

Of the 5,950 MBF (12,552 CCF) of timber harvested in the Bighorn NF study area in 2018, approximately 17 percent (2,205 CCF) was processed in the county of harvest, 4 percent (464 CCF) was processed elsewhere within the study area, and 79 percent (9,884 CCF) was processed outside the study area but within the Bighorn NF TPA (table 4). Five of the 14 active facilities in the TPA were located within the study area, the remaining facilities were all located out-of-state. Facilities within the study area processed 2,669 CCF (1,265 MBF), or 21 percent, of

the timber harvested in the study area. Facilities in the study area processed 2,848 CCF (1,350 MBF) of timber from all ownerships and geographic origins. Approximately 5 percent of the timber processed in the study area came from the Bighorn and other National Forest timberlands. Private timberlands supplied the majority of the remaining timber. This flow of timber indicates that landowners within the study area relied on facilities in the broader TPA to purchase the majority of their timber and that facilities in the study area had a strong reliance on private timber from within the study area in 2018.

Table 4 - Timber flow from the Bighorn NF Study Area, 2018.

County of harvest	Processed within the county of harvest	Processed elsewhere within study area	Processed outside study area
	percentage of harvest by county		
Big Horn	7	1	92
Johnson	89	—	11
Sheridan	—	5	95
Washakie	3	10	87
All counties	17	4	79

Source: Marcille et al. (in preparation).

Note: — less than one percent.

Timber-Processing Capacity and Capability

In addition to the 14 facilities in table 3, the timber-processing capacity and capability analyses includes one facility that was inactive in 2018 and the RY Timber sawmill in Townsend Montana that curtailed operations in 2020 (Independent Record 2020) but, to date, both facilities have retained the infrastructure to process timber. Capacity to process timber in the Bighorn NF TPA during 2018 was 617,236 CCF (294,219 MBF) (figure 3). Capacity within the study area was 10,720 CCF (3,620 MBF), just under 2 percent of the total capacity in the TPA. Timber owners, particularly the Bighorn NF, rely on favorable market conditions (like rail transport rates) and the right mix of timber by size and species for out of state facilities to purchase and transport timber long distances.

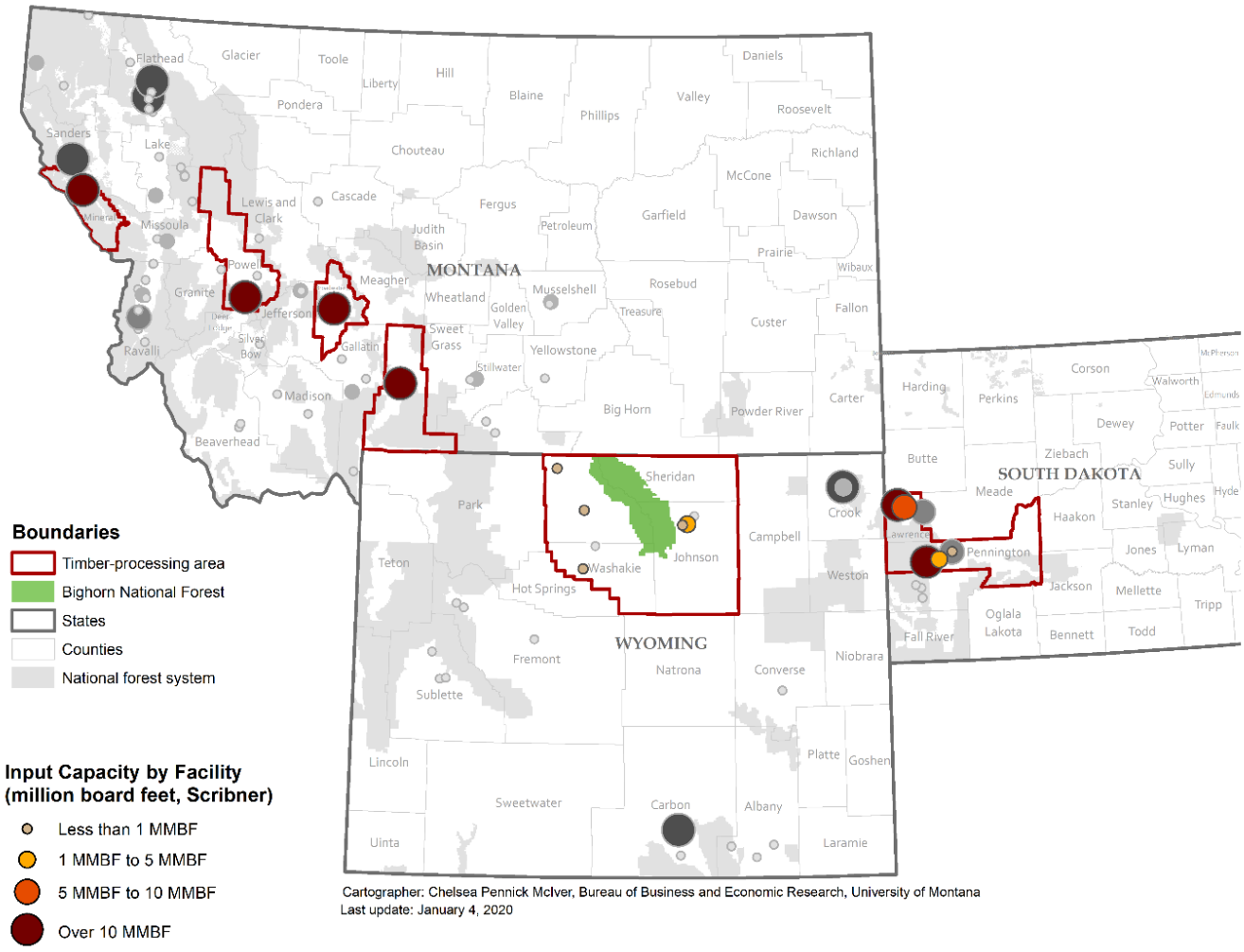

Figure 3 – Bighorn NF TPA timber-processing capacity by facility.

Based on the 2018 industry and harvest data for Wyoming mills with supporting data from Montana 2018 and Idaho 2015 mill surveys (Marcille et al. in preparation, Hayes et al. in preparation, Simmons et al. in preparation), the author's estimate that nearly 77 percent (475,912 CCF or 229,219 MBF) of timber-processing capacity in the Bighorn NF TPA is <u>not</u> capable of efficiently utilizing trees < 10 inches dbh (table 5). Capability to efficiently utilize trees 7-9.9 inches dbh accounts for 23 percent of total timber-processing capacity; while less than one percent of total capacity in the TPA can efficiently utilize trees < 7 inches dbh. Over 98

percent of total capacity to process timber in the TPA resides with mills in Montana and South Dakota, accounting for the vast majority of the capability to process trees ≥ 10 inches dbh.

Table 5 – Annual capacity and capability of mills to process trees by size class for the Bighorn NF TPA, 2018.

Hundred cubic feet (CCF)		*Thousand board feet, Scribner (MBF)*	
Tree dbh	**Capability**	**Tree dbh**	**Capability**
< 7 in.	2,385	< 7 in.	477
7 - 9.9 in.	138,938	7 - 9.9 in.	64,654
≥ 10 in.	475,912	≥ 10 in.	229,088
Total capacity	**617,235**	**Total capacity**	**294,219**

Source: Marcille et al. (in preparation); Simmons et al. 2019.

Table 6 shows that mills in the TPA processed 416,652 CCF (197,433 MBF), indicating that approximately 68 percent of total capacity (on a cubic foot basis) within the TPA was utilized. Overall, national forests supplied nearly 59 percent of the timber processed in the TPA of which 2.5 percent was from the Bighorn NF. State and private (non-industrial and Industrial) timberlands combined provided 37 percent, primarily from Montana and South Dakota timberlands and was processed by mills in the state where harvested. The Bureau of Land Management (BLM) accounted for 3.6 percent, with all of that timber harvested and processed in Montana. The Bighorn NF had a strong reliance on the facilities outside of the study area to purchase their timber while facilities in the study area received the majority of their timber (94 percent) from other ownerships in the study area for their products during 2018.

Trees with dbh ≥ 10 inches comprised nearly 67 percent of the volume processed in the TPA, 33 percent came from trees 7-9.9 dbh, while less than one percent was made up of trees < 7 inches dbh.

Table 6 – Annual volume of timber processed by tree size class for the Bighorn NF TPA, 2018.

Hundred cubic feet (CCF)		*Thousand board feet, Scribner (MBF)*	
Tree dbh	**Volume used**	**Tree dbh**	**Volume used**
< 7 in.	1,483	< 7 in.	297
7 - 9.9 in.	137,270	7 - 9.9 in.	64,895
≥ 10 in.	277,900	≥ 10 in.	132,241
Total processed	**416,653**	**Total processed**	**197,433**

Source: Marcille et al. (in preparation); Simmons et al. 2019.

At 58 percent utilization in 2018, there is considerable unutilized capability, primarily at sawmills, to process trees ≥ 10 inches dbh (198,012 CCF or 96,847 MBF). Approximately 98 percent of the capability to process trees < 10 inches dbh was used in 2018 resulting in unutilized processing capability of 2,571 CCF or approximately 542 MBF. Capability in the TPA to process trees < 7 inch dbh class had a utilization rate of 62 percent indicating unutilized capability of 902 CCF or approximately 190 MBF. Facilities in the four-county study area comprise 51 percent of the TPA's capability to process trees < 7 inches dbh. In 2018, 45 percent of this capability was utilized and the majority of the timber processed came from private timberlands. This finding suggests the possibility that facilities in the study area are by choice insufficiently engaged in the Bighorn NF's timber sale program. This could be the result of the timber products up for bid from the Bighorn NF are not desirable for the products these facilities produce, the timber sale contracts are too large, excessively complex and onerous, or sales are not affordable due to competition for the larger diameter timber in the contracts.

Discussion

Two of the largest sawmills in the northern portion of the Rocky Mountain Region, Spearfish Forest Products and Rushmore Forest Products, are located within the Bighorn NF TPA. These facilities, account for a considerable amount of the processing capability for trees ≥ 10 inches dbh. Many sawmills in the region have some capability to use trees 7–9.9 inches dbh. However, the feasibility and profitability of using smaller trees, primarily those in the 7-9.9 inch dbh class, is improved with green trees, since more lumber can be recovered and operating costs are lower with live trees than dead or salvaged trees. Similar relationships among log size and log quality for live versus dead trees relative to value have been documented by Fahey et al. (1986) and Loeffler and Anderson (2018).

At 198,012 ccf of unused capability to process trees ≥ 10 inches dbh in 2018, the Bighorn NF TPA may be able to sustain timber sale programs that offer current or increased volumes with suitable trees in this size class. However, the majority of this capacity resides in facilities

with long supply chains in Montana. Changing market conditions could cause these facilities to concentrate on timber supplies closer to home, long term timber sale planning will need to take into account that the bidders on future sales may not include these facilities.

Capability to process trees in the 7 -9.9 inch diameter class had a 99 percent utilization rate in 2018. Again, the majority of this capability resides in out-of-state facilities, some with long transportation distances. The data for the larger sawmills outside of Wyoming indicates that some facilities used greater volumes of trees 7 – 9.9 inches dbh than their log preferences indicate would be financially sustainable for their operation.

While the Bighorn NF TPA has some unutilized capability to process trees < 10 inches dbh, this capability is primarily for trees < 7 inches dbh but is a relatively small volume (902 ccf). Although 51 percent of the capability to process trees < 7 inches dbh resides with facilities in the study area 45 percent of that was used in 2018, leaving just 66 ccf of unused capacity for trees in this size class. Like most of the National Forests in Region 2, the Bighorn NF may have considerable volumes and acres of overstocked smaller diameter trees requiring treatments to restore ecosystems, or reduce insect, disease, and fire risk. Planning large scale or large numbers of treatments with substantial volumes of trees in the <7 inch dbh class could strain or exceed the ability of the current infrastructure to profitably use the material without investments to increase capability

Capability to process trees < 7 inches dbh tends to be concentrated among facilities that produce only posts, small poles, chips, mulch, shavings and log furniture. Considering that it is less capital intensive (i.e. less expensive) to increase post and pole capacity than to re-fit a larger sawmill to process smaller diameter logs into lumber, with sufficient markets and timber supplies some facilities may explore the possibility of making the investments to increase capabilities to process trees < 7 inches dbh. If future treatments are planned to remove large volumes of small trees then distance to markets for this size of material may need to be expanded or local capabilities encouraged to increase to accommodate more raw material.

When planning to remove 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 may lead to unsold sales and fewer acres being treated.

A final note, many of the facilities throughout Region 2 are included in the timber processing areas of more than one National Forest. So the sum of the capacity and capability of all the individual National Forests is greater than the total for the region. The region wide report provides information on total capacity and capability for the whole region. We encourage coordination at the Regional, Forest, and even the district level among timber planning staff to share information about prospective projects and potential buyers to prevent offering more timber in certain size classes than can be processed.

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