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Timber Use, Processing Capacity and Capability of Mills to Utilize Timber by Diameter Size Class Within the Shoshone 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 Shoshone National Forest (NF) is located, annual mortality across all ownerships from insect and disease on timberland¹ is estimated to be 2,483,888 hundred cubic feet (CCF), accounting for 68 percent of total annual mortality in the study area (USDA, 2020). In comparison, fire, logging and other human-caused mortality accounts for nearly 24 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¹ Timberland: Forest land that is producing or is capable of producing crops of industrial wood and not withdrawn from timber utilization by statute or administrative regulation.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 Shoshone NF and seeks to:

1. examine the harvest of timber from the counties containing Shoshone NF timberland – the “study area”;
2. analyze the timber flow and identify the Shoshone 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 with supporting data from Montana 2018 and Idaho 2015 mill surveys (Hayes et al. in press, Marcille et al. 2021, Simmons and Morgan 2017) 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 Hayes et al. (in press), Marcille et al. (2021), Simmons and Morgan (2017), 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 Shoshone NF timberland).

The Shoshone 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. Counties outside the study area were included in the TPA if the volume of timber received from

the study area represented more than 10 percent of the total timber received in that county. 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.

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, sufficient raw material, and usual downtime for maintenance. 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 al. 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 al. 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.

Shoshone National Forest Study Area

The Shoshone NF study area is situated in the north-western region of Wyoming, spreading over five counties (figure 1). The study area contains approximately 1.9 million acres of timberland (USDA, 2019), of which 83 percent (almost 1.6 million acres) is managed by the USDA Forest Service (table 1). Approximately 8 percent of the timberland acres under Forest Service management in the Shoshone NF study area are considered suitable for timber production² (Sidon 2019).

Table 1 – Acres of timberland¹ by county and ownership in the Shoshone NF Study Area.

| County | National Forest | Private | Bureau of Land Management | State | Total |
|-------------|-----------------|---------|---------------------------|--------|-----------|
| Teton | 520,320 | 2,290 | — | — | 522,610 |
| Sublette | 448,172 | 23,144 | 37,205 | — | 508,521 |
| Fremont | 319,038 | 137,548 | 48,903 | 2,138 | 507,627 |
| Park | 272,108 | 13,097 | 10,923 | 13,043 | 309,171 |
| Hot Springs | 15,943 | 29,110 | — | — | 45,053 |
| Grand Total | 1,575,581 | 205,189 | 97,031 | 15,181 | 1,892,982 |

¹Timberland: 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 Jan 29 20:47:43 GMT 2019. 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>].

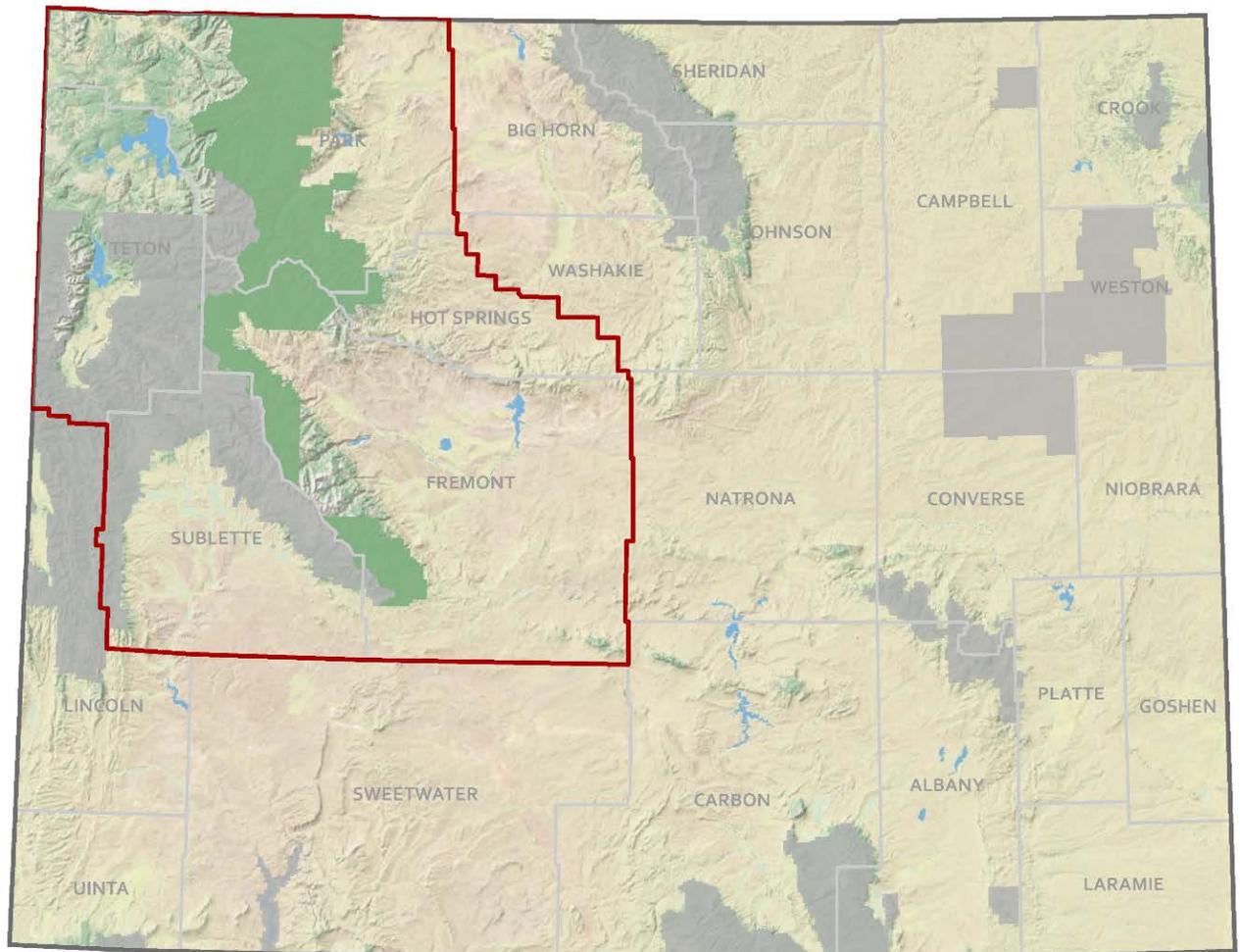
²Lands suited for timber production – Area that defines where timber harvest for the purpose of timber production may occur. Timber harvest for purposes other than timber production may also occur here.

The total volume of timber harvested and utilized from all ownerships in the study area was estimated at 10,539 CCF (5,133 MBF) in 2018 (table 2). Timber harvested from national forest timberlands in the study area accounted for 78 percent (8,222 CCF) of the timber harvested in the study area’s five counties. Of the other ownerships contributing to the study area’s timber harvest, private timberlands accounted for 16 percent (1,691 CCF), state lands 6 percent (616 CCF), and a small volume from Bureau of Land Management (BLM) timberlands. Timber from the Shoshone NF accounted for 81 percent (5,194 CCF) of the National Forest timber harvested from the study area, and the Bridger Teton NF accounted for the balance. The species composition of the timber harvested in the study area was lodgepole pine (49 percent), Douglas-fir (39 percent), spruce (10 percent), and smaller volumes of subalpine fir, ponderosa pine, and aspen (Marcille et al. 2021).

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

| County | National | | | | Grand Total |
|--------------------|--------------------------------------|--------------|------------|-----------|---------------|
| | Forest | Private | State | BLM | |
| | ----- Hundred cubic feet (CCF) ----- | | | | |
| Park | 6,643 | 36 | 0 | 0 | 6,679 |
| Sublette | 1,394 | 1,544 | 0 | 0 | 2,939 |
| Hot Springs | 0 | 51 | 616 | 0 | 667 |
| Teton | 169 | 0 | 0 | 0 | 169 |
| Fremont | 16 | 60 | 0 | 10 | 85 |
| Grand Total | 8,222 | 1,691 | 616 | 10 | 10,539 |

Source: Marcille et al. 2021.



Cartographer: Chelsea Pennick McIver, Bureau of Business and Economic Research, University of Montana
 Last update: April 15, 2021

Figure 1 – Shoshone National Forest and Study Area

Shoshone 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 Shoshone NF TPA is made up of 13 counties, with a total of 18 active primary wood products facilities (table 3, figure 2) operating in 2018. In addition to the five Wyoming counties in the study area, two other counties in Wyoming, five counties in Montana and one county in Idaho received timber from the study area in 2018. Eight of the 18 active facilities in the TPA were located within the study area, three more are located within Wyoming, but outside the study area, and the remaining facilities were located out-of-state.

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

| Type | 2018 |
|--------------|-------------|
| Sawmill | 8 |
| Post pole | 5 |
| Houselog | 4 |
| Firewood | 1 |
| Total | 18 |

Marcille et al. 2021.

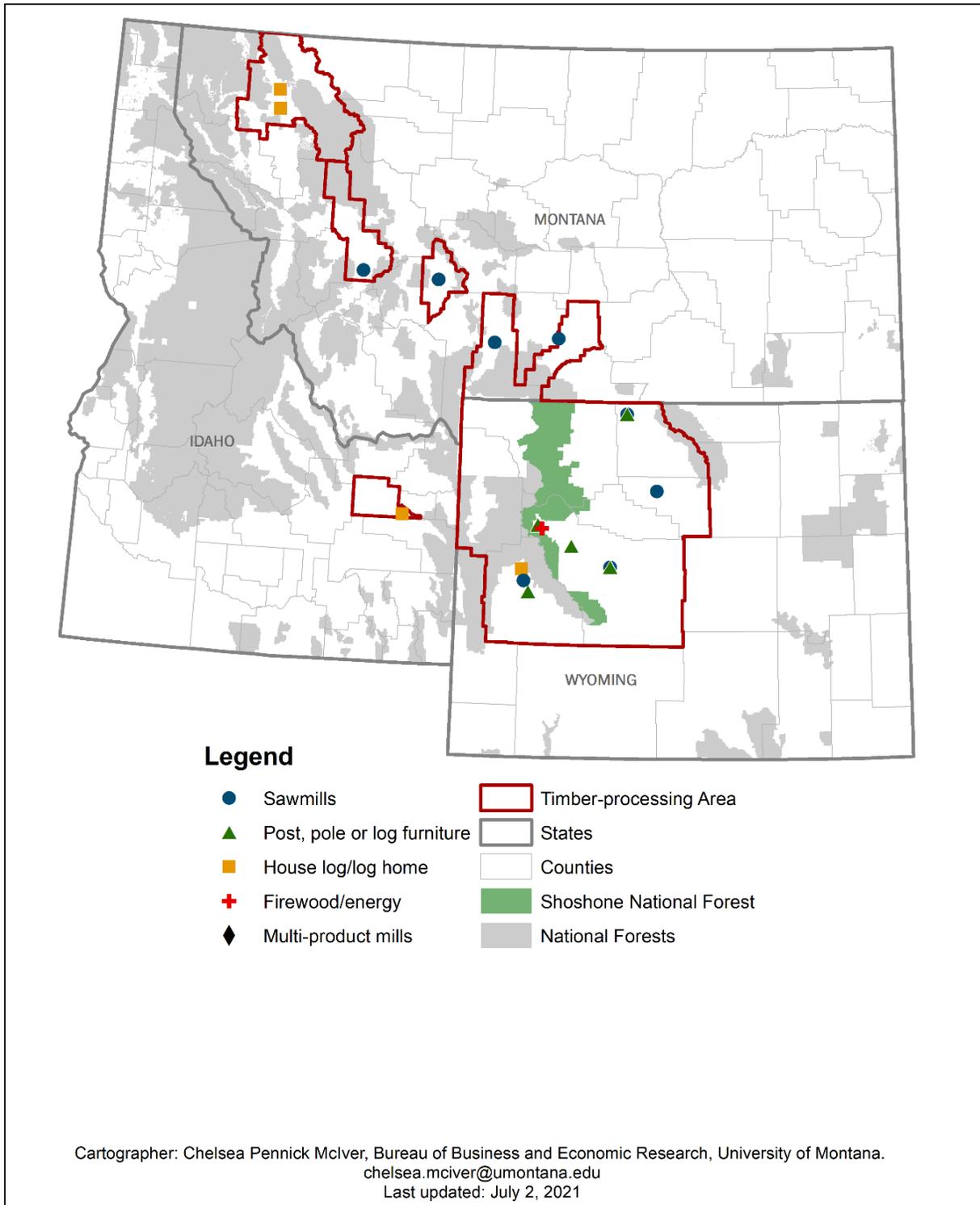


Figure 2 – Active timber-processing facilities in the Shoshone NF TPA by type.

Timber Flow

Of the 10,539 CCF (5,133 MBF) of timber harvested in the Shoshone NF study area in 2018, approximately 11 percent (1,155 CCF) was processed in the county of harvest, 6 percent (637 CCF) was processed elsewhere within the study area, and 83 percent (8,747 CCF) was processed outside the study area but within the Shoshone NF TPA (table 4). Sixty-four (64) percent of the study area's harvested timber was transported to Montana for processing, where the majority of capacity and the largest sawmills in the TPA are located. Facilities in the study area processed a total of 1,792 CCF (873 MBF) of timber from the study area.,

Overall, national forests supplied nearly 55 percent of the 164,890 CCF (80,264 MBF) volume of timber processed in the TPA. Of that, the Shoshone NF accounted for approximately 7 percent, and the Beaverhead-Deerlodge, Helena, Lolo, and Custer-Gallatin NF's combined supplied 81 percent of the total NF timber processed in the TPA. Private (non-industrial and Industrial), and tribal timberlands combined provided 36 percent of all the timber processed in the TPA. The Bureau of Land Management (BLM) accounted for nine percent of timber processed in the TPA, with nearly all of their timber harvested and processed in Montana.

Within the smaller 5-county study area, facilities processed 1,977 CCF (879 MBF) of timber. National Forest timberlands supplied 46 percent of that timber, with the Shoshone NF accounting for less than 1 percent. State timberlands provided nearly 34 percent and private timberlands supplied the remaining 20 percent of the timber processed within the study area.

This flow of timber indicates that the Shoshone NF relied on facilities in the broader TPA to purchase the majority of its timber, while facilities in the study area had a strong reliance on timber from sources other than the Shoshone NF during 2018.

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

| County of harvest | Processed within the county of harvest | Processed elsewhere within study area | Processed outside study area |
|-------------------|--|---|---------------------------------|
| | ----- <i>percentage of harvest by county</i> ----- | | |
| Fremont | 100 | — | — |
| Hot Springs | 92 | 8 | — |
| Park | — | — | 100 |
| Sublette | 36 | 1 | 63 |
| Teton | — | — | 100 |
| Grand Total | 11 | 6 | 83 |

Source: Marcille et al. 2021.

Note: — less than one percent.

Timber-Processing Capacity, Capability, and Utilization

In addition to the 18 active facilities in the TPA, the timber-processing capacity and capability analysis includes two facilities that were inactive during 2018 (figure 3). In January of 2020, RY Timber in Townsend Montana announced that operations would be indefinitely suspended but will reopen when timber supply increases (Independent Record, 2020). Capacity to process timber in the Shoshone NF TPA during 2018 was 299,096 CCF (144,756 MBF) (table 5). Capacity within the study area was 6,978 CCF (2,866 MBF), just 0.2 percent of the total capacity in the TPA. Timber owners, particularly the Shoshone 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.

Just over 76 percent (228,407 CCF or 110,544 MBF) of timber-processing capacity in the Shoshone NF TPA is not 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. Nearly 94 percent of total capacity to process timber in the TPA resides with mills in Montana, accounting for the vast majority of the capability to process trees ≥ 10inches dbh.

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

| <i>Hundred cubic feet (CCF)</i> | | <i>Thousand board feet, Scribner (MBF)</i> | |
|---------------------------------|-------------------|--|-------------------|
| Tree dbh | Capability | Tree dbh | Capability |
| < 7 in. | 1,359 | < 7 in. | 361 |
| 7 - 9.9 in. | 69,330 | 7 - 9.9 in. | 33,139 |
| ≥ 10 in. | 228,407 | ≥ 10 in. | 111,256 |
| Total capacity | 299,096 | Total capacity | 144,756 |

Source: Hayes et al. (in preparation), Marcille et al. 2021, and Simmons and Morgan 2017.

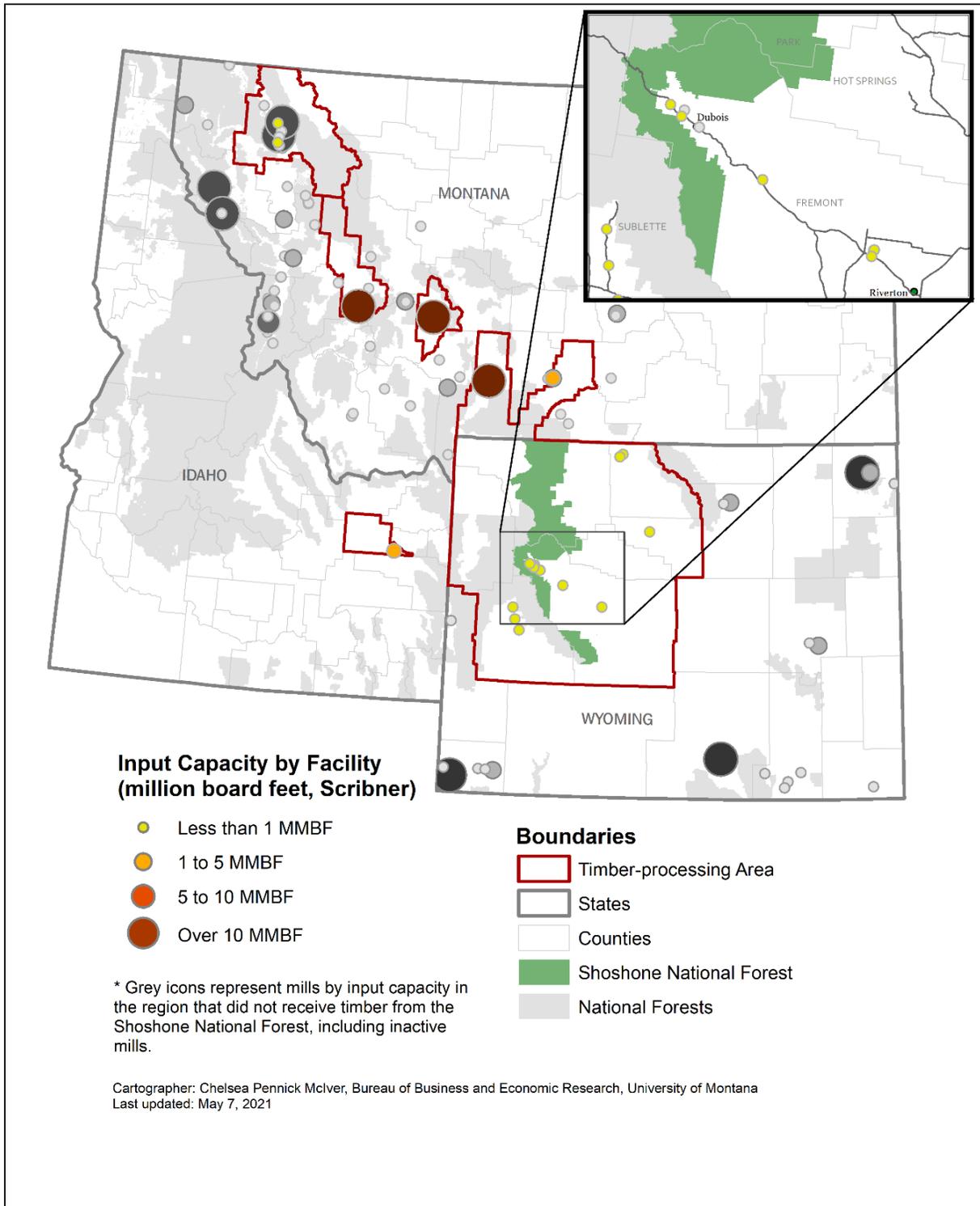


Figure 3 – Shoshone NF TPA timber-processing capacity by facility.

Mills in the TPA processed 164,890 CCF (80,264 MBF) of timber, indicating that approximately 55 percent of total capacity (on a cubic foot basis) within the TPA was utilized (table 6). Again, the majority of the timber processed in the TPA was harvested and processed in Montana. Trees with dbh \geq 10 inches comprised 54 percent of the volume processed in the TPA, 46 percent came from trees 7-9.9 dbh, while less than one percent was made up of trees < 7 inches dbh. (table 6)

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

| <i>Hundred cubic feet (CCF)</i> | | <i>Thousand board feet, Scribner (MBF)</i> | |
|---------------------------------|--------------------|--|--------------------|
| Tree dbh | Volume used | Tree dbh | Volume used |
| < 7 in. | 477 | < 7 in. | 127 |
| 7 - 9.9 in. | 75,235 | 7 - 9.9 in. | 36,585 |
| \geq 10 in. | 89,178 | \geq 10 in. | 43,552 |
| Total processed | 164,890 | Total processed | 80,264 |

Source: Hayes et al. (in preparation), Marcille et al. 2021, and Simmons and Morgan 2017.

There is considerable unutilized capability, primarily at sawmills, to process trees \geq 10 inches dbh (139,228 CCF or nearly 67,704 MBF). Facilities in the Shoshone NF TPA indicated that they exceeded their capability to process trees 7 – 9.9 inches dbh by nine percent, suggesting that they were processing more timber in the size class than is considered economically efficient. Capability in the TPA to process trees < 7 inch dbh class had a utilization rate of 35 percent, indicating unutilized capability of 882 CCF (234 MBF) in this smallest tree size class.

The 11 active facilities in the five-county study area comprise 1 percent of the TPA's total capability to process trees \geq 10 inches dbh and 29 percent of this capability was utilized in 2018. Capability in the study area for trees 7-9.9 inches dbh was one percent of the TPA total and 30 percent was utilized. Facilities in the study area accounted for nearly 38 percent of the TPA's capability to process trees < 7 inches dbh in 2018, and 28 percent of this capability was utilized in 2018.

Discussion

Three of Montana's larger sawmills are in the Shoshone NF TPA. These facilities account for a considerable amount of the Shoshone NF TPA's capability to process trees >7 inches dbh. Many sawmills in the region have some unused capability to use trees ≥ 10 inches dbh. However, in the larger TPA, trees 7-9.9 inches dbh were over-utilized in 2018, meaning firms received more volume in this size class than they indicated would be sustainable to operate profitably. This finding suggests that facilities in the TPA would not be able to efficiently use increased volumes of trees in the 7-9.9 dbh class without equipment modifications. Since the majority of this capacity is at sawmills out-of-state, the cost of upgrading and transportation of raw materials makes the probability of such investments to process Shoshone NF timber unlikely. That is not to say those facilities may not invest in equipment upgrades if dynamics in their larger market area makes it necessary to remain competitive.

Additionally, nearly 29 percent of the timber harvested in Wyoming during 2018 were dead trees (Marcille et al.2021) thus it is good to remember that 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). The Shoshone NF TPA has just 882 CCF of unutilized capability to process trees < 7 inches dbh.

With 139,229 CCF of unused capability to process trees ≥ 10 inches dbh, the Shoshone NF should be able to offer current or increased volumes of suitable trees in this size class. However, the majority of this capability resides 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. The authors suggest that Shoshone NF managers (e.g., timber sale administrators and forest planners) contact the facilities in the outlying TPA to verify their current operating status and willingness to draw timber from the study area as future projects are being developed.

The findings are different when looking at facilities in the Shoshone NF study area, which are running at relatively low utilization rates for all tree size classes. These facilities rely on timber from national forests other than the Shoshone NF as well as other public and private timberlands. For trees > 7" dbh, facilities in the study area had 4,504 CCF (about 2,000 MBF) of unused capability in 2018. Although 38 percent of the capability to process trees < 7 inches dbh resides with facilities in the study area and only 28 percent of that was used in 2018, remaining capability is only 465 CCF. Since smaller trees tend to be processed near where they are harvested, 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 in the study area to profitably use the material. Additional engagement in the Shoshone NF's timber program by these facilities would likely be a matter of necessity rather than choice in the event their current timber supply became strained.

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. , Local facilities may not be able to accommodate larger volumes of small trees with current equipment. Generally, 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. 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. 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.

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 (Simmons et al. 2019) 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, particularly in the smaller size classes, than can be processed.

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