Appendix 33
Forest Resources of the Flathead National Forest

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Rocky Mountain Research Station

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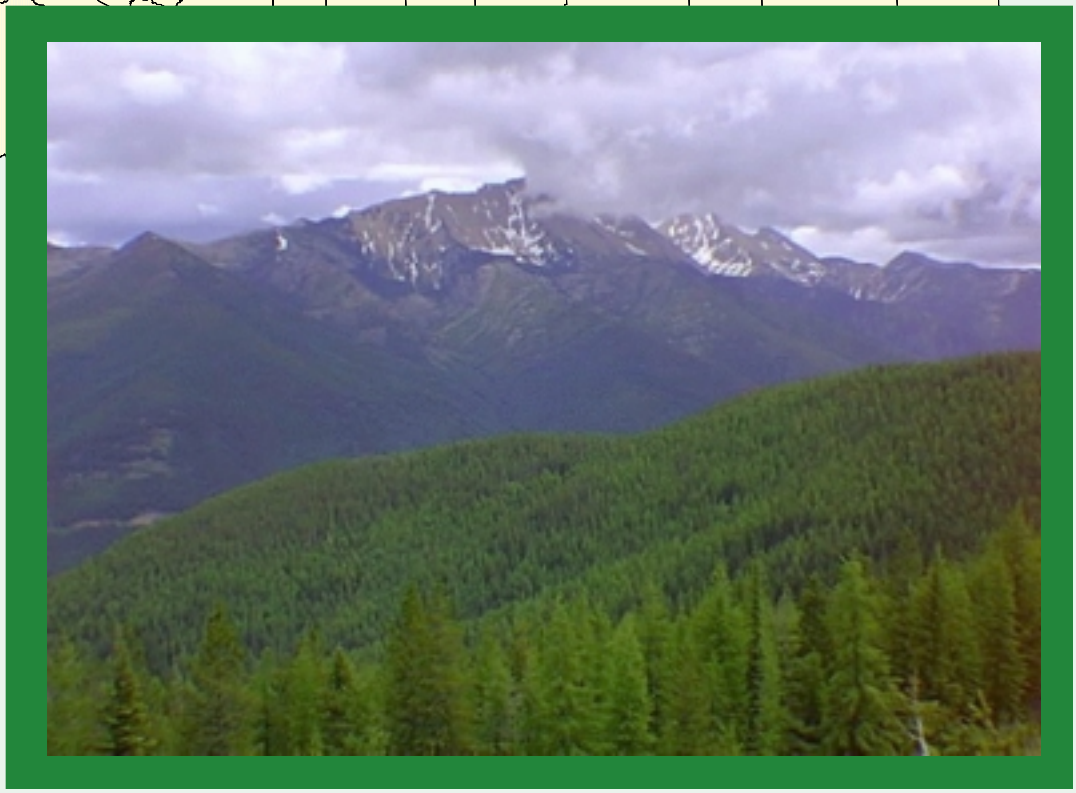
Renee A. O'Brien



About the author

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Forest Resources of the Flathead National Forest

Renee A. O'Brien

The Interior West Resource Inventory, Monitoring, and Evaluation (IWRIME) Program of the U.S. Forest Service, Intermountain Research Station (now called Rocky Mountain Research Station), as part of its national Forest Inventory and Analysis (FIA) duties, entered into a cooperative agreement with the Northern Region for the inventory of the National Forests in Region 1. This report presents the highlights of the Flathead National Forest inventory, using commonly requested variables and summaries. The data could be summarized in other ways for different purposes (see the "For further information" section on the inside back cover). The information presented in this report is based solely on the IWRIME inventory sample. Additional data collected by the Flathead National Forest and used separately or in combination with IWRIME data will produce varying results.

What forest resources are found on the Flathead National Forest?

The 2,351,950 acre (USDA 1995b) Flathead National Forest is 89 percent forest land and 11 percent nonforest or water (fig. 1). Forty-six percent of the total area of the Flathead is in a reserved designation such as Wilderness. The first part of this report will present the forest resources of all the forest land on the Flathead, including reserved lands. Lands not reserved from tree utilization, some of which would be considered suitable for timber production, will be addressed in a later section.

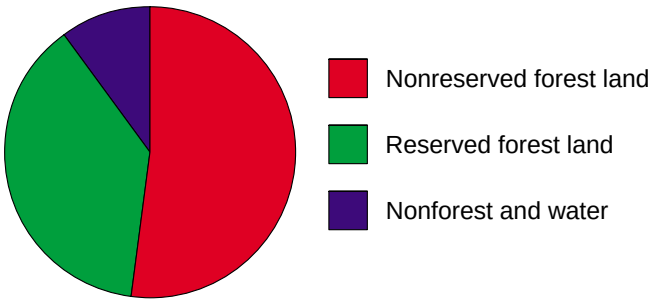

Figure 1—Area by land class, Flathead National Forest.

Forest type—On the Flathead, the most common forest type in percentage of total forest land area is spruce-fir with 47 percent. Spruce-fir is followed in abundance by Douglas-fir at 19 percent, lodgepole pine at 17 percent, Engelmann spruce at 6 percent, larch at 5 percent, and whitebark pine at 3 percent (fig. 2). Traces of grand fir, ponderosa pine, and aspen forest types also occur.

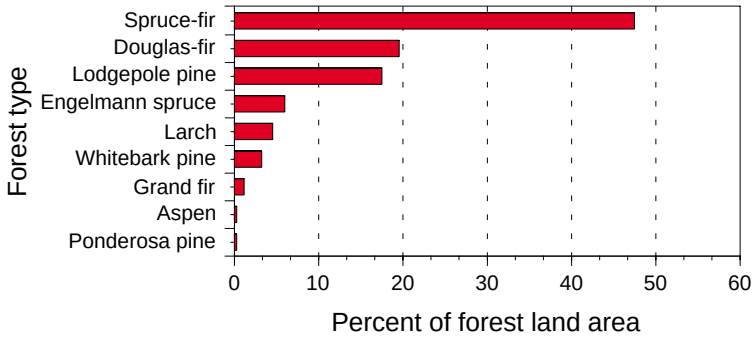

Figure 2—Percent of forest land area by forest type, Flathead National Forest.

Forest type refers to the predominant tree species in a stand, based on plurality of tree stocking. Stocking is an expression of the extent to which growing space is effectively utilized by live trees. One exception to this single predominant species concept is in stands where Engelmann spruce and subalpine fir occur together. If combined they constitute the stocking plurality for a stand, the forest type will be computed using the following criteria: for a stand to be classified as Engelmann spruce type, Engelmann spruce must be greater than or equal to 20 percent of the total stocking, and subalpine fir must be less than 20 percent of the total stocking. Any other situations where subalpine fir and Engelmann spruce together have plurality would be classified as spruce-fir type.

Habitat type—Another way to classify forest land is by habitat type. Habitat type is generally determined by slope, aspect, elevation, soils, and climate. Compared to forest types, which describe the currently occurring species, habitat types describe lands in terms of their potential to produce similar plant communities at successional climax. More than 100 forest habitat types and phases were described for Montana by Pfister and others, 1977. To assist with sub-regional and landscape level assessments, habitat types have subsequently been summarized into groups based on similarities in natural disturbance regimes, successional patterns, and structural characteristics of mature stands. Those groups, described in USDA 1995a, are used in this report.

Figure 3 shows area by forest type by habitat type group on the Flathead. The most common habitat type group is the cool moist group, occurring on 48 percent of the area. By summarizing inventory data by habitat type group, Flathead forest land can be categorized in a way that theoretically will not change with disturbance or advancing succession.

Number of trees—The composition of the total forest by individual tree species is another measure of forest diversity. Figure 4 shows total number of live trees by species in two categories—1 to 6.9 inches diameter breast height (d.b.h.) and equal to or greater than 7 inches d.b.h. Subalpine fir makes up 44 percent of the total number of trees, lodgepole pine, 23 percent, Douglas-fir and Engelmann spruce, both 11 percent, and western larch and whitebark pine, 4 percent each.

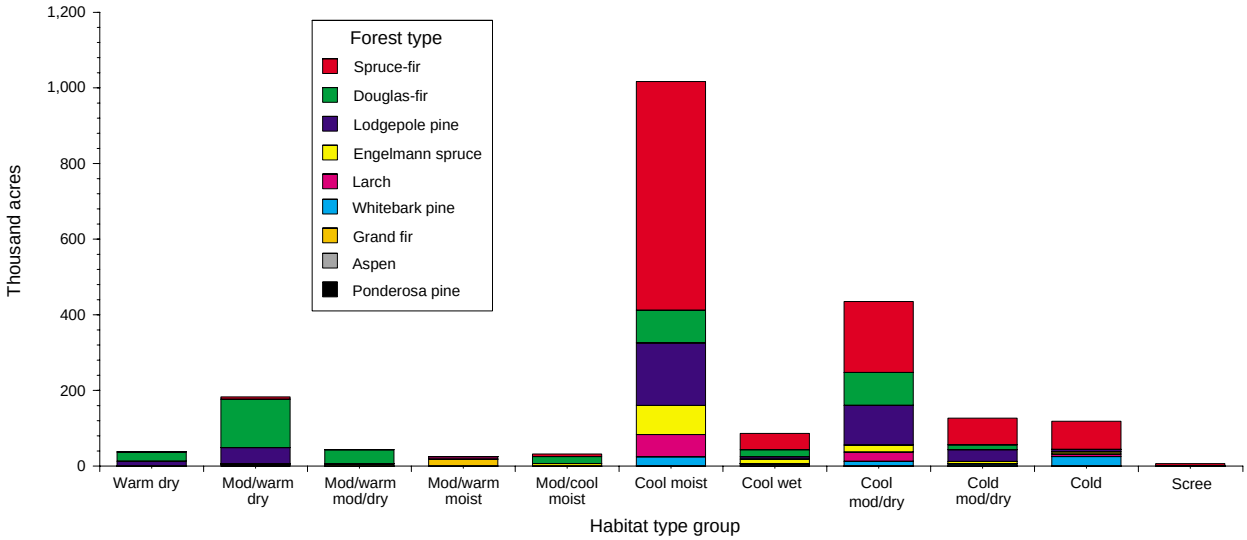

Figure 3—Area by forest type and habitat type group, Flathead National Forest.

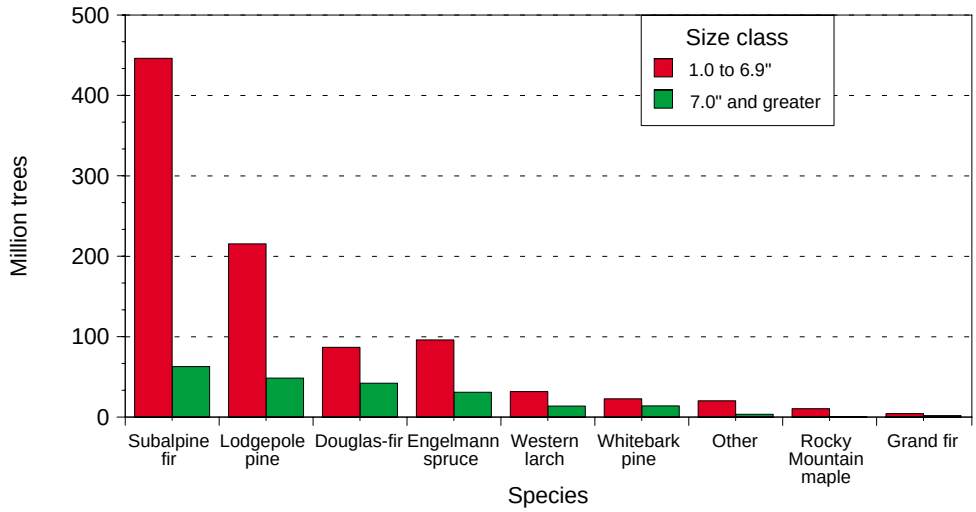

Figure 4—Number of live trees 1 inch d.b.h. and greater, by species and size class, Flathead National Forest.

Rocky Mountain maple, grand fir, aspen, paper birch, cottonwood, western redcedar, western hemlock, ponderosa pine, subalpine larch, western white pine, and Rocky Mountain juniper combined contribute a total of about 3 percent. Species that are scarce may not be encountered with the extensive sampling strategy used for this inventory. Over 81 percent of all trees on the Flathead are less than 7 inches d.b.h., and almost half of those are subalpine fir.

Elevation, mentioned above as an important factor in determining habitat type, is responsible for variations in local climate. For example, precipitation increases with increasing elevation, while temperature decreases. These factors have a profound impact on a tree species' ability to compete with other species at various elevations. To illustrate this relationship, figure 5 presents number of trees by species and elevation for the Flathead.

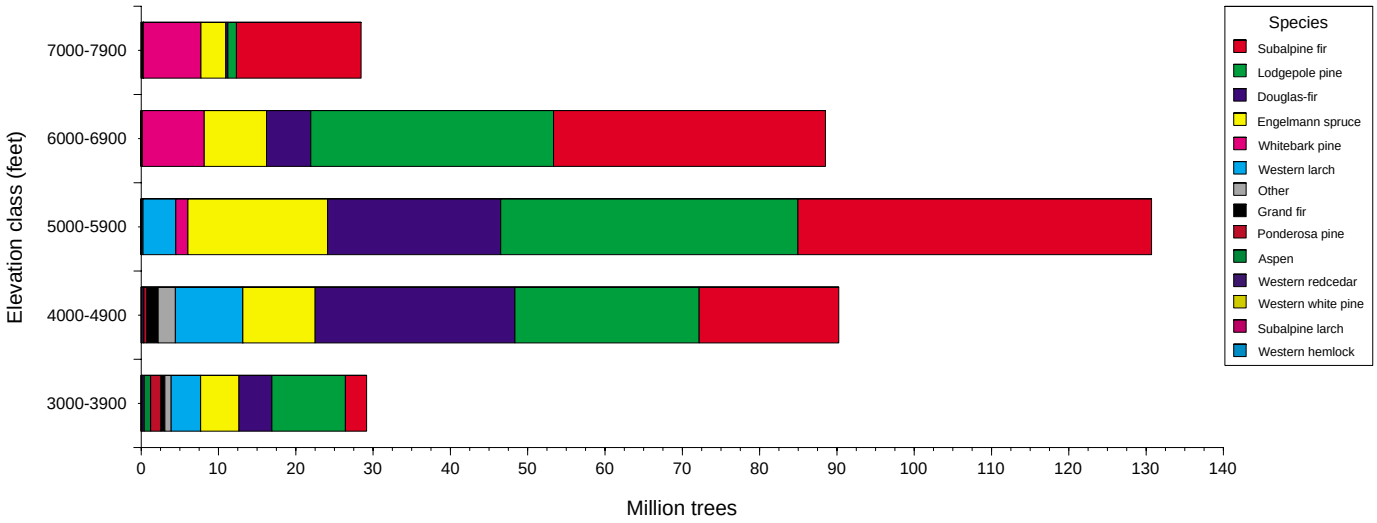

Figure 5—Number of live trees 5.0 inches d.b.h. or greater by species and elevation class, Flathead National Forest.

Dead trees are an important component of forest ecosystems, with many uses such as providing habitat for many species of wildlife and functioning as nutrient sinks. There are roughly 66 million standing dead trees (snags) greater than 5 inches in diameter on the Flathead National Forest. This number includes both hard and soft snags of all species. Many wildlife species are dependent upon snags. The species, size, and density of snags required vary according to the species of wildlife. Large diameter snags are generally somewhat scarce compared to smaller snags, making them more valuable. Considering snags 11 inches diameter or larger, an estimated 7.5 per acre occur on Flathead forest land. Of the very large snags (19 inches diameter or larger) there is only an average of 1.2 per acre on the Flathead. The most abundant species of snags in the 19-inch and larger category is Engelmann spruce, followed by western larch.

Size—Size distribution of individual trees indicates structural diversity. Figure 6 displays the tree size distribution on the Flathead using tree diameter class, and shows many more small than large trees overall. Another stand structure variable, stand-size class, is based on the predominant size of trees present in a stand. Figure 7 gives a breakdown of forest land by stand-size class. This figure shows that relatively few stands are considered to be

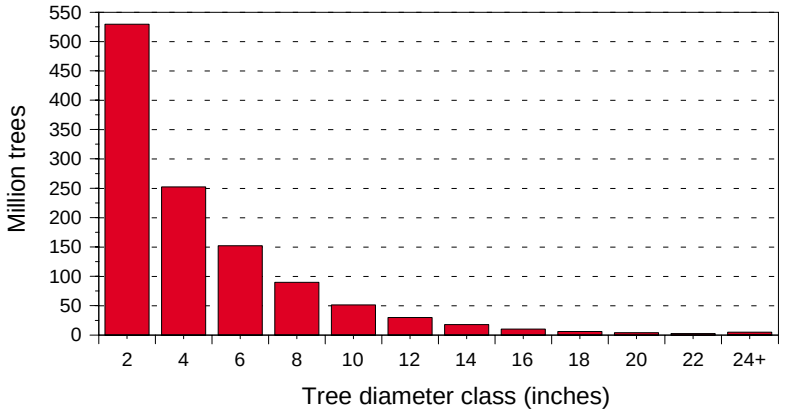

Figure 6—Number of live trees by diameter class, Flathead National Forest.

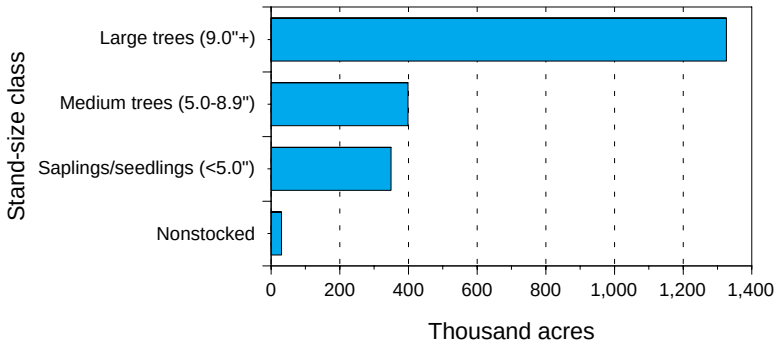

Figure 7—Forest land area by stand-size class, Flathead National Forest.

nonstocked, such as stands that have been recently harvested or burned. Figure 8 shows stand-size classes for the five most predominant forest types.

Wood volume and biomass—The total net volume of wood in live trees on the Flathead is estimated to be in excess of 4.2 billion cubic feet. This includes trees 5.0 inches d.b.h. and larger for timber species, and 3.0 inches diameter at root collar (d.r.c.) and larger for tree species such as Rocky Mountain maple or Rocky Mountain juniper, which are sometimes referred to as woodland species. Total biomass of wood in live trees on the Flathead National Forest is estimated at over 87 million tons. Biomass estimates include boles, bark, and branches of all live trees including saplings. Here is a breakdown of net cubic-foot volume and tons of biomass by species:

Species	Million cubic-feet	Million tons
Subalpine fir	960.6	20.4
Engelmann spruce	921.2	15.9
Lodgepole pine	855.9	16.6
Douglas-fir	852.5	18.9
Western larch	355.9	8.1
Whitebark pine	218.6	4.7
Grand fir	29.2	.6
Cottonwood	28.0	.5
Ponderosa pine	13.4	.3
Western white pine	13.4	.2
Paper birch	11.0	.2
Aspen	6.5	.2
Western redcedar	4.7	.1
Rocky Mountain maple	3.1	.1
Western hemlock	2.0	.1
Subalpine larch	1.1	.1
Rocky Mountain juniper	.4	.01
Total	4,277.5	87.01

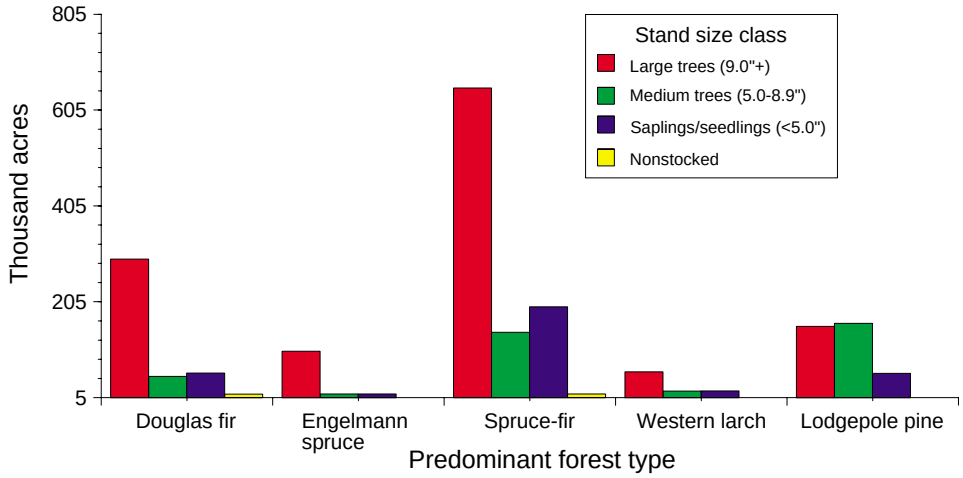

Figure 8—Area by predominant forest type and stand-size class, Flathead National Forest.

Percent of total cubic-foot volume by diameter class is presented in figure 9. Approximately 89 percent of Engelmann spruce and whitebark pine, and 85 percent of Douglas-fir volume is in trees larger than 9 inches d.b.h. About 49 percent of lodgepole volume is in trees less than 9 inches diameter.

Another way to look at volume is by forest type, for which volume per acre can be computed (presented below). These numbers include the many different species that can occur together within each forest type and show the highest volume per acre in the Engelmann spruce forest type and the lowest in aspen. Low volume per acre in ponderosa pine and aspen types may be a function of small sample size.

Forest type	Cubic ft. volume per acre	Number of plots
Engelmann spruce	2,412	20
Lodgepole pine	2,263	60
Larch	2,164	15
Douglas-fir	2,157	67
Grand fir	2,076	4
Whitebark pine	1,993	11
Spruce-fir	1,856	159
Ponderosa pine	601	1
Aspen	566	1
Total		338

How does the forest change?

Stocking class—Many factors influence the rate at which trees grow and thrive, or die. As tree size and density increase, competition for available resources also increases. As was mentioned earlier, stocking is an expression of the extent to which growing space on a site is effectively utilized by live trees. Information about stocking can apply to many issues, such as timber production and management, wildlife habitat suitability, and risk of attack by insects or disease. For this analysis, stocking of all live trees is presented in three classes. High stocking sites are those that are more than 60 percent stocked with live trees. Medium stocking sites are those 35 to 60 percent stocked with live trees. Low stocking sites are those that are less than 35 percent stocked with live trees.

The percent area by forest type and stocking category is shown in figure 10. High stocking indicates conditions where tree growth begins to slow, and tree vigor starts to decrease, which can make trees more susceptible to insect attack. By this definition, about 43 percent of all forest land on the Flathead is estimated to be in the high stocking class. This includes about 71 percent of the lodgepole forest type on the Forest.

Growth—Another measure of forest vigor is net growth. Net growth is the difference between gross growth and losses due to mortality. Gross annual

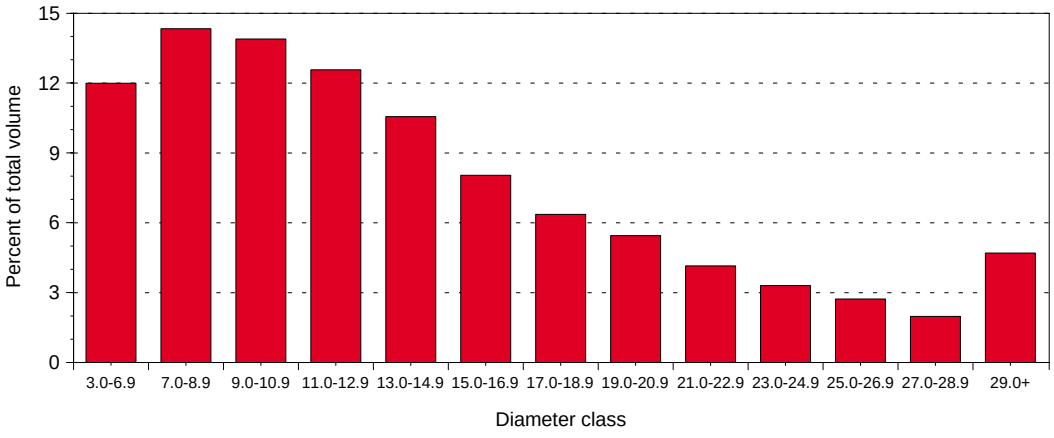

Figure 9—Percent of total cubic foot volume by diameter class, Flathead National Forest.

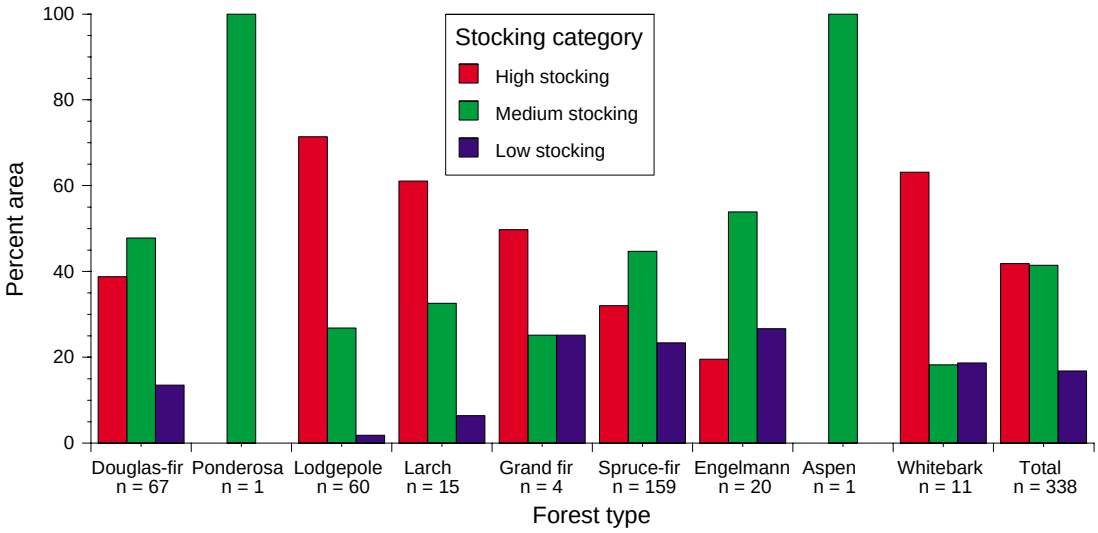

Figure 10—Percent area of live tree stocking category by forest type, Flathead National Forest. Includes number of plots in each type.

growth on all forest land of the Flathead is estimated to be more than 108 million cubic feet, and net annual growth is over 72 million cubic feet. Gross growth is compared to mortality for selected species in figure 11. Mortality is about one-third of gross growth on forest land as a whole.

Mortality—Field crews estimate which trees have died in the past 5 years; this assessment is used to calculate annual mortality. In 1994, trees containing about 35.8 million cubic feet of wood died in Flathead forests. About 42 percent of the mortality was estimated to be caused by disease, and another 27 percent was estimated to be caused by insects. About 71 percent of the mortality occurred in just two species, subalpine fir and lodgepole pine.

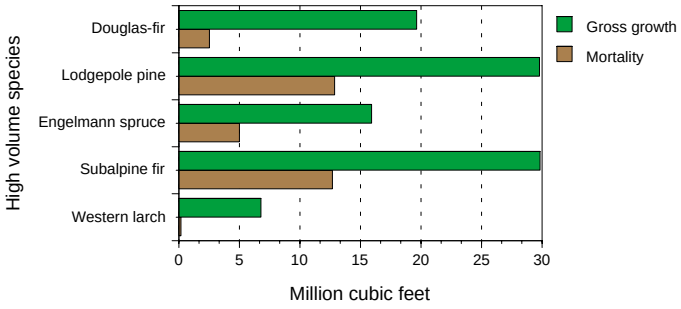

Figure 11—Gross annual growth compared to mortality on all forest land, Flathead National Forest.

Other information about the forest land of the Flathead

Accessibility—Every forested plot visited by IWRIME field crews was assigned a "distance to road" category. Based on this information, it is estimated that 27 percent of the forested area of the Flathead National Forest is less than a half mile from an improved road, 15 percent is between a half and 1 mile, 17 percent is between 1 and 3 miles, 7 percent is between 3 and 5 miles, and 34 percent is greater than 5 miles from an improved road.

Location history—Field crews also make a field observation on each plot of the predominant human or natural disturbance that affects the whole stand. Twenty-four percent of Flathead plots had no visible signs of disturbance. Twenty-two percent had disease damage, 14 percent had evidence of fire, another 14 percent had evidence of tree cutting, and 11 percent had evidence of weather damage. The remaining 15 percent of field plots had evidence of road building, land clearing, or other disturbance.

How much forest land is suitable for timber production?

Wood production is one of many important uses of nonreserved forest land on the Flathead. Nonreserved means the land has not been withdrawn from tree utilization through statute or administrative designation. The area of nonreserved forest land is 1,215,048 acres, or 58 percent of the total forest land area of the Flathead. The net volume of growing-stock trees on nonreserved forest land is over 2.4 billion cubic feet.

About 51 percent of the nonreserved forest land is actually considered to be suitable for timber production (USDA 1985). IWRIME plots that fell within the suitable area were identified, and attributes associated with those plots were then summarized to characterize the forest resources of the suitable lands.

Forest type and stand size—In terms of forest type, the composition of suitable lands is slightly different from that of the Forest as a whole. The largest differences are in the spruce-fir and Douglas-fir types. The spruce-fir type makes up 47 percent of the total forest land, but only 38 percent of the suitable area, and Douglas-fir makes up 19 percent of the total forest, but about 29 percent of the suitable area. Another difference is that no whitebark pine was sampled on plots in the suitable area. Stand-size class distribution on the suitable area is similar to that of the forest as a whole.

Volume—The net volume of growing stock trees on suitable lands is estimated to be about 1.3 billion cubic feet, which is about 53 percent of the net growing stock volume on nonreserved forest land. The volume of sawtimber on suitable lands is estimated to be over 4.1 billion board feet (Scribner rule). Figure 12 shows distribution of sawtimber volume on nonreserved

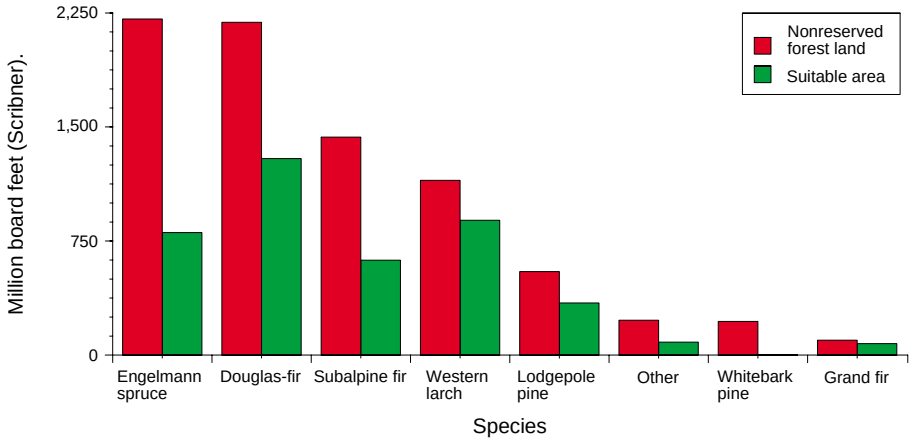

Figure 12—Sawtimber volume on nonreserved forest land compared to sawtimber volume on suitable lands, Flathead National Forest.

forest land by species, compared to that on suitable lands. Douglas-fir and western larch together account for about 53 percent of the total sawtimber volume on suitable lands.

Growth and Mortality—Gross annual growth of growing stock trees on nonreserved forest land is estimated to be about 59.9 million cubic feet, and net annual growth is estimated to be over 34.1 million cubic feet. Mortality is about 25.7 million cubic feet, or 43 percent of gross growth in growing-stock trees on nonreserved forest land. Gross growth for five high volume species is compared to mortality on nonreserved forest land in figure 13. By comparison, gross annual growth of growing stock trees on suitable lands is estimated to be about 35 million cubic feet, and net annual growth is estimated to be over 18.7 million cubic feet. Mortality is about 16.3 million cubic feet or about 47 percent of gross growth in growing-stock trees on suitable lands. Gross growth for five high volume species is compared to mortality on suitable lands in figure 14. Lodgepole pine has a much higher mortality to gross growth ratio on nonreserved forest land than on the suitable lands, and than on forest land as a whole (fig. 11).

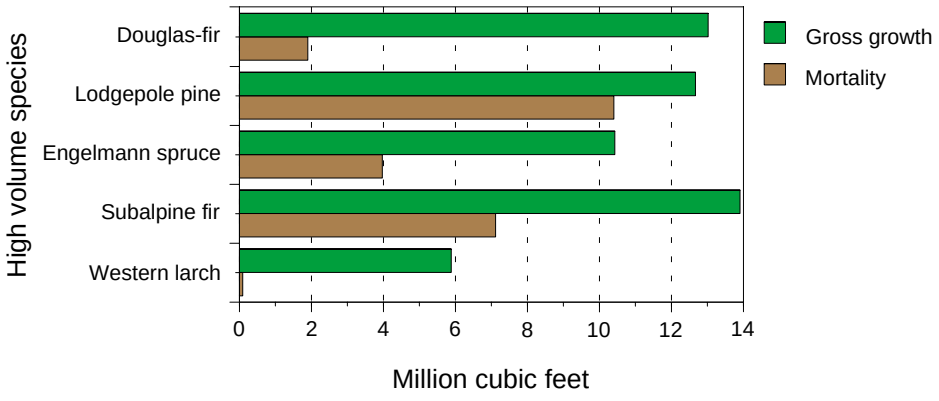

Figure 13—Gross annual growth of growing stock compared to mortality for nonreserved forest land, Flathead National Forest.

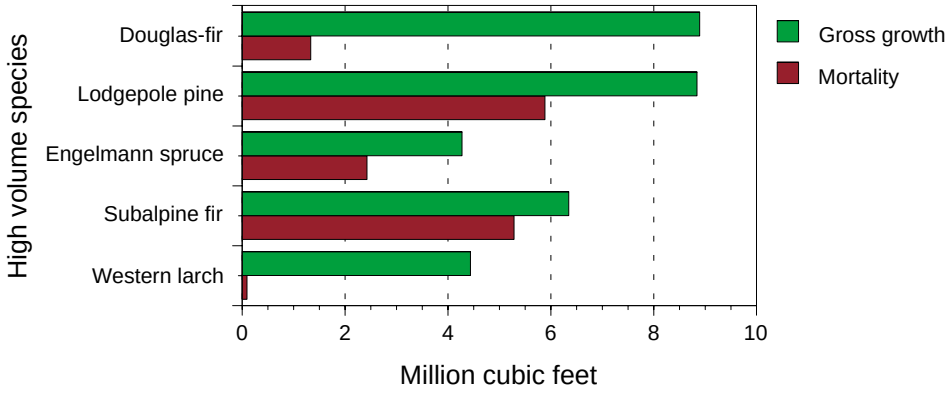

Figure 14—Gross annual growth of growing stock compared to mortality for forest land suitable for timber harvest, Flathead National Forest.

How was the inventory conducted?

The Interior West Resource Inventory, Monitoring, and Evaluation Program (IWRIME) of the U.S. Forest Service, Intermountain Research Station, as part of its national Forest Inventory and Analysis (FIA) duties, entered into a cooperative agreement with the Northern Region for the inventory of the National Forests in Region 1. Forest Inventory and Analysis inventories provide a statistical-based sample of forest resources across all ownerships that can be used for planning and analyses at local, State, regional, and national levels. IWRIME has not traditionally conducted inventories on National Forest lands in the West, but in Montana, a cooperative agreement with funding and personnel from the Inventory Service Center of the Forest Service Northern Region, made possible an inventory of National Forest System lands, using IWRIME procedures.

IWRIME uses a two-phase sampling procedure for all inventories. The first, or photo interpretive, phase is based on a grid of sample points systematically located every 1,000 meters across all lands in the State. Forestry technicians use maps and aerial photos to obtain ownership and vegetation cover information. Field crews conduct the second, or field phase, of the inventory on a subsample of the phase one points that occur on forest land. The sampling intensity is one field plot every 5,000 meters, or about every 3 miles. Phase two plots are stratified based on phase one ownership and vegetation information, and weights are assigned to each stratum based on the proportion of phase one points in that stratum.

Inventory Service Center field crews sampled 375 field plots on the Flathead using the standard IWRIME grid. Of the field plots sampled, 338 were forested. Information presented in this report is based primarily on the IWRIME grid sample. Additional data collected by the Forest, used separately or in combination with IWRIME data, will produce varying results.

The sample was designed to meet national standards for precision in State and regional estimates of forest attributes. Standard errors, which denote the precision of an estimate, are usually higher for smaller subsets of the data. Standard errors for volume, growth, and mortality estimates for total forest land, nonreserved forest land, and forest lands suitable for timber production are presented in table 1. Standard errors for other estimates are available upon request (see the "For further information" section on the inside back cover).

Table 1—Percent standard error for volume, growth, and mortality on total forest land, nonreserved forest land, and lands suitable for timber production, Flathead National Forest.

Land class	Attribute	Volume	Percent standard error
		Net cubic feet (all live)	
Total forest land	Volume	4,277,427,038	4.4
	Growth	72,305,113	10.7
	Mortality	35,833,035	14.8
		Net cubic feet (growing stock)	
Nonreserved forest land	Volume	2,423,066,385	5.5
	Growth	34,159,288	16.8
	Mortality	25,768,141	18.4
Land suitable for timber production	Volume	1,271,328,166	9.9
	Growth	18,713,680	25.3
	Mortality	16,364,564	23.8

Documentation

Pfister, Robert D.; Kovalchik, Bernard L.; Arno, Stephen F.; Presby, Richard C. 1977. Forest habitat types of Montana. Gen. Tech. Rep. INT-34. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Forest and Range Experiment Station. 174 p.

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For further information

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The information presented here is just a small part of a national data base that houses information for much of the forest land in the United States. This data base can be accessed on the Internet at the following web site:

http://www.srsfia.usfs.msstate.edu/scripts/ew.htm

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