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Rocky Mountain Research Station

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Forest Resources of the Bitterroot National Forest

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About the author

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The Interior West Resource Inventory, Monitoring, and Evaluation (IWRIME) Program of the USDA Forest Service, Rocky Mountain Research Station (formerly the 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. This report presents the highlights of the Bitterroot National Forest 1995 inventory, using commonly requested variables and summaries. The information presented in this report is based solely on the IWRIME inventory sample. Additional data collected by the Bitterroot National Forest and used separately or in combination with IWRIME data will produce varying results.

What forest resources are found on the Bitterroot National Forest?

The 1,580,550 acre (USDA 1995b) Bitterroot National Forest is 92 percent forest land and 8 percent nonforest or water (fig. 1). Forty-seven percent of the total area of the Bitterroot is in a reserved designation such as Wilderness. The first part of this report will present forest resources on all forest land on the Bitterroot, 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.

Forest type—Forest land tree resources are often described using a forest type classification. Forest type refers to the single predominant tree species in a stand, based on plurality of live 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 in combination they constitute the stocking plurality for a stand, 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 stocking, and subalpine fir must be less than 20 percent of the stocking. In other

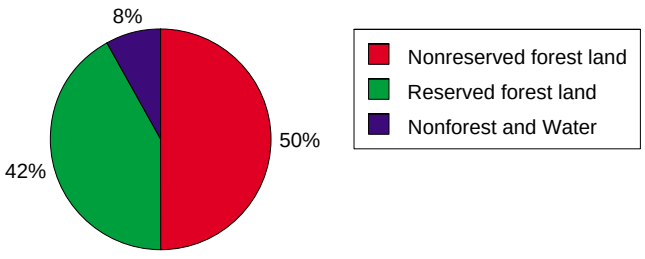

Figure 1—Area by land class, Bitterroot National Forest.

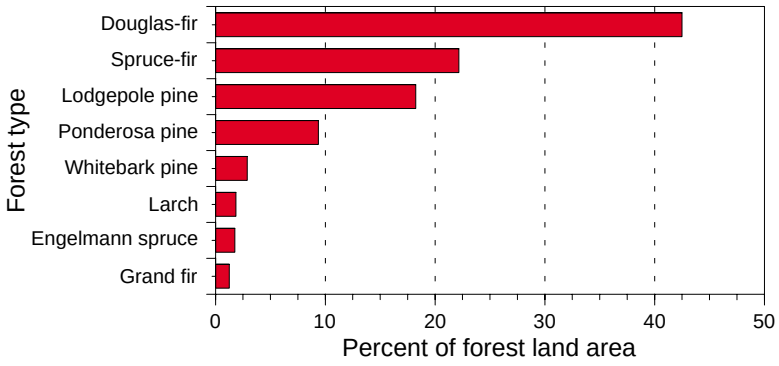

Figure 2—Percent of forest land area by forest type, Bitterroot National Forest.

situations where subalpine fir and Engelmann spruce together have plurality, the classification would be spruce-fir type.

The most common forest type on the Bitterroot, in percentage of total forest land area, is Douglas-fir with 43 percent. Douglas-fir is followed in abundance by spruce-fir at 22 percent, lodgepole pine at 18 percent, ponderosa pine at 9 percent, whitebark pine at 3 percent, larch and Engelmann spruce types at 2 percent, and grand fir at 1 percent (fig. 2).

Habitat type—Forest communities are similarly described using a habitat type classification. Habitat type is generally influenced by site characteristics such as slope, aspect, elevation, soils, and climate. Compared to forest types, which describe the species currently occupying the site, 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 from the Northern Region have subsequently been summarized into Westside and Eastside groups based on similarities in natural disturbance regimes, successional patterns, and structural characteristics of mature stands (Jones 1997; USDA 1995a). These habitat type groups serve as integrators of the moisture availability and temperature gradients of the biophysical environment (Jones 1997).

The Bitterroot has more than 60 unique forest habitat types that have been grouped into Westside habitat classes. Figure 3 shows area of forest land by forest type and habitat type group on the Bitterroot. The most common habitat type group on the Bitterroot is the moderately warm and dry group, representing most of the Douglas-fir and ponderosa pine forest types in the forest. By summarizing forest land area data by habitat type group, the Bitterroot can be categorized in a way that theoretically will not change with disturbance or advancing succession.

Number of live trees—Another way to analyze tree resources is by examining the composition of trees on forest land by individual species. Figure 4 shows total number of live trees by species in two categories 1.0 to 6.9 inches diameter and 7.0 inches diameter and greater. Subalpine fir makes up 31 percent of the total

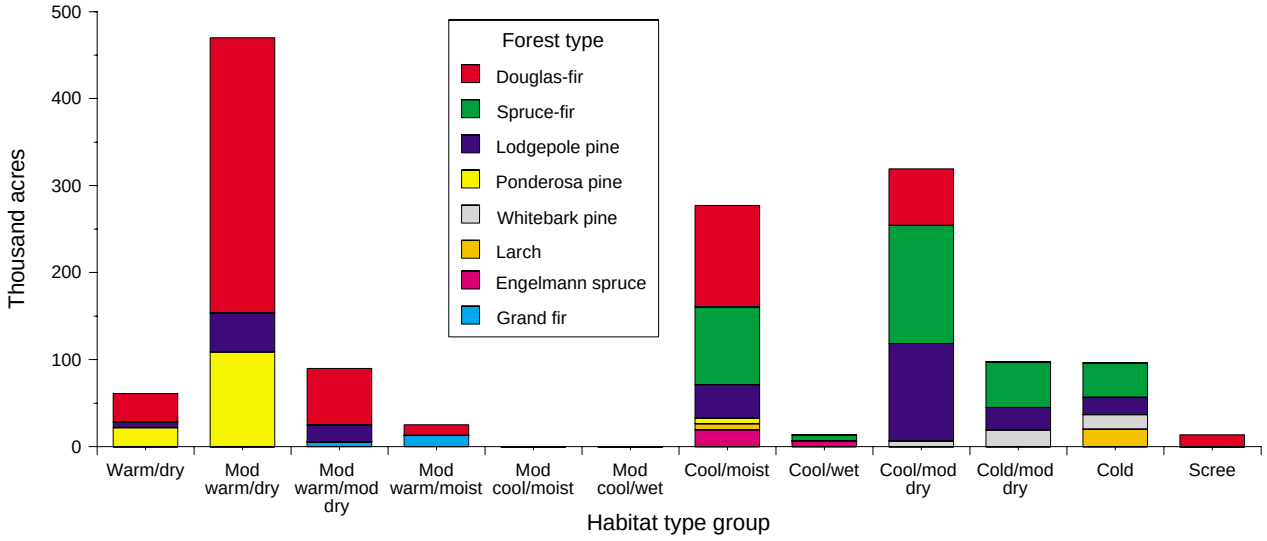

Figure 3—Area of forest land by forest type and habitat type group, Bitterroot National Forest.

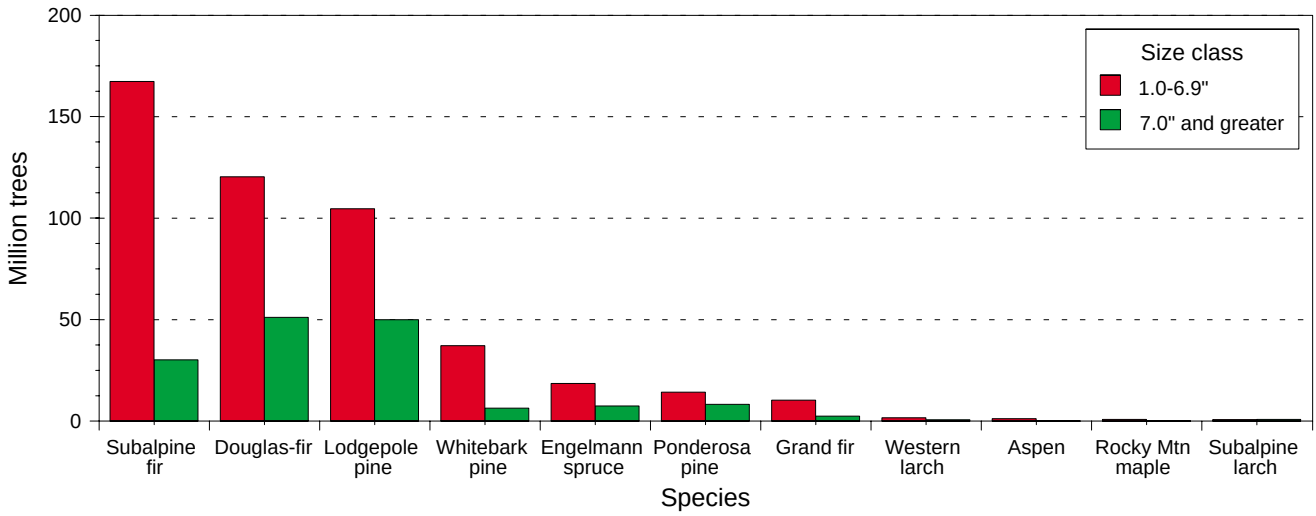

Figure 4—Number of live trees 1 inch diameter and greater, by species and size class, Bitterroot National Forest.

number of trees, Douglas-fir, 27 percent; lodgepole pine, 24 percent; whitebark pine, 7 percent; Engelmann spruce and ponderosa pine, both 4 percent; and grand fir, 2 percent. Western larch, subalpine larch, aspen, and Rocky Mountain maple combined contribute a total of another 1 percent. Species that are scarce may not be encountered with the extensive sampling strategy used for this inventory. Over 75 percent of all live trees on the Bitterroot are between 1.0 and 6.9 inches diameter, and about a third of those are subalpine fir.

Figure 5 shows the number of live trees by species and elevation class. Elevation, mentioned above as a site characteristic affecting habitat type, is associated with variations in local climate. For example, precipitation generally increases with rising elevation, while temperature decreases. These factors have a profound impact on a tree species' ability to compete with other species at various elevations. In the Bitterroot, the ponderosa pine, Douglas-fir, and lodgepole compete at lower elevations and lodgepole pine, subalpine fir,

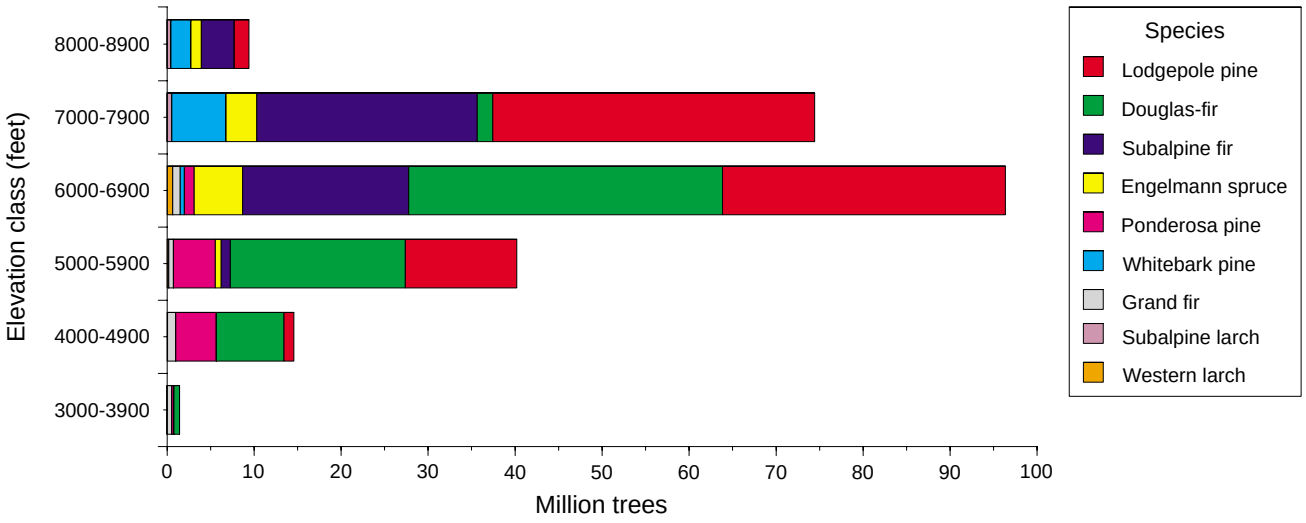

Figure 5—Number of live trees 5.0 inches diameter and greater by species and elevation class, Bitterroot National Forest.

Engelmann spruce, and whitebark pine at higher elevations.

Number of dead trees—Standing and down dead tree resources are important contributors to forest land composition and diversity. Dead trees provide food and cover for wildlife, enrich and stabilize soils, and contribute significantly to forest fuel load. There are roughly 35 million standing dead trees (snags) 5.0 inches diameter and greater on the Bitterroot National Forest. Many wildlife species are dependent upon snags. The species, size, and density of snags required varies according to the species of wildlife. Because large diameter snags are generally somewhat scarce relative to smaller snags, they tend to be the focus of more attention. Considering snags 11 inches diameter or larger, an estimated 8.4 per acre occur on the Forest. Of the very large snags (19 inches diameter or larger) there is an average of 1.2 per acre. The most abundant species of snags in the 19-inch and larger category is Douglas-fir, followed by whitebark pine.

Down dead trees were counted within an 83-foot radius from plot center (0.5 acre) and classified into one of four size classes. There are more than 224 million down dead stems 1 inch diameter and greater on the Bitterroot. Figure 6 shows the average number of down dead stems per acre by forest type for each size class. The majority of forest types on the Bitterroot have an average of more than 50 down dead stems per acre between 1.0 and 4.9 inches diameter and less than 5 down dead stems per acre greater than 19.9 inches diameter.

Size—The size distribution of trees in a stand is an indicator of structural diversity. Figure 7 displays the tree size distribution by diameter class on the Bitterroot. Overall, there are a higher number of small trees than large trees. A classification of forest land based on the predominant size of trees contributing to the majority of the stocking is called stand-size class. Figure 8 displays a breakdown of forest land by stand-size classes. This figure shows that the majority of stands on the Bitterroot are stocked with predominantly large trees and that relatively few stands are considered to be nonstocked, such as stands that have been recently harvested or burned. Figure 9 shows stand-size classes for the 4 predominant forest types accounting for the most acreage on the Bitterroot. About 37 percent of the total forest land area is classified as Douglas-fir, large tree category. Of the large tree size category, 25 percent of the stands have trees 19.0 inches diameter or greater as the majority of tree stocking.

Wood volume and biomass—In the past, volume statistics were calculated for assessments of commercial timber resources that meet certain quality standards (i.e. growing stock trees). In this report, we present volume as well as biomass summaries that include measurements of all tree resources. The net volume of wood of live trees on the Bitterroot is estimated to be more than 3.3 billion cubic feet. This includes trees 5.0 inches diameter breast height (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

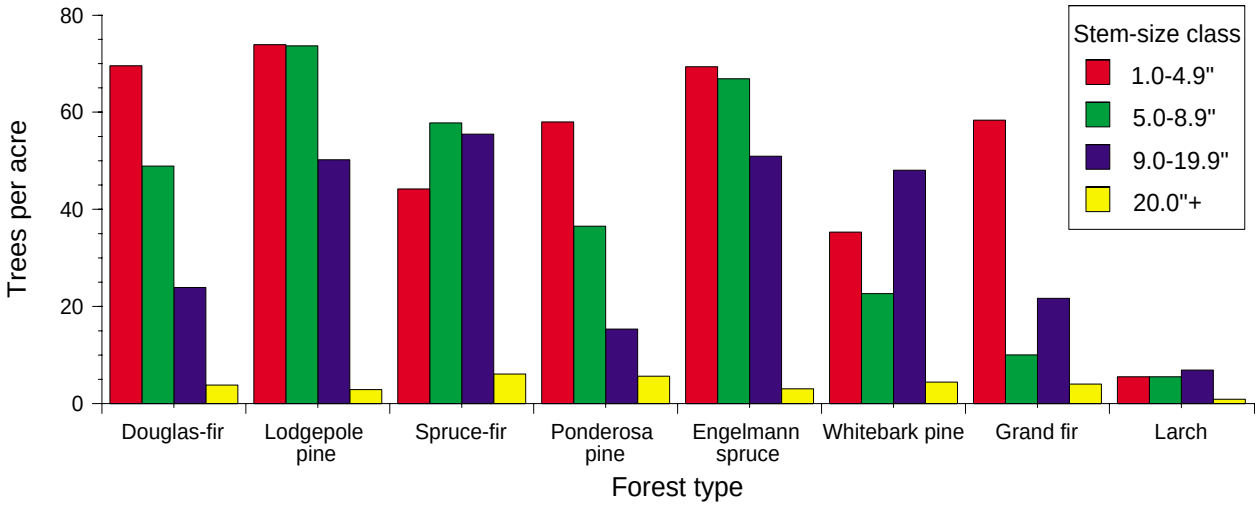

Figure 6—Average number of down dead stems 1 inch diameter and greater on forest land by stem-size class and forest type, Bitterroot National Forest.

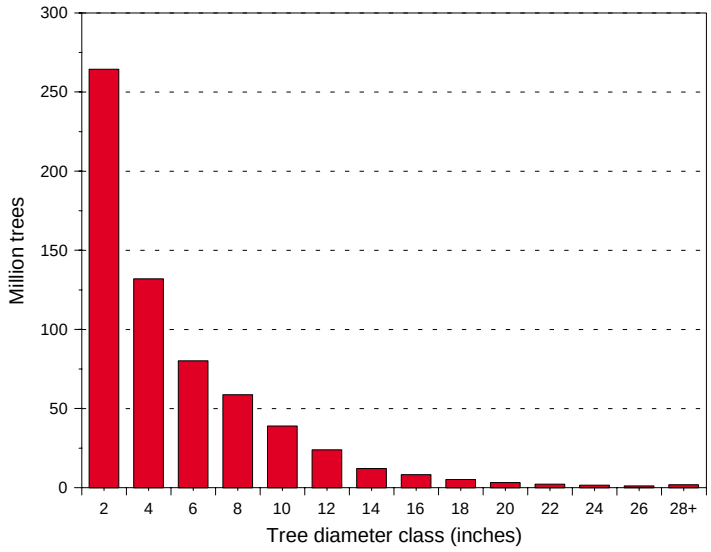

Figure 7—Number of live trees by diameter class, Bitterroot National Forest.

Mountain maple, often referred to as woodland tree species. Total biomass of wood in live trees on the Bitterroot National Forest is estimated at over 65 million tons. Biomass estimates include boles, bark, and branches of all live trees including saplings. The following is a breakdown of net cubic-foot volume and tons of biomass by species:

Species	Million cubic feet	Million tons
Douglas-fir	1,267.7	27.4
Lodgepole pine	794.5	13.9
Subalpine fir	474.7	9.1
Engelmann spruce	362.1	5.7
Ponderosa pine	280.9	6.0
Whitebark pine	88.3	1.9
Grand fir	32.0	0.7
Western larch	27.5	0.6
Subalpine larch	9.3	0.3
Aspen	—	T*
Rocky Mtn maple	—	T
Total	3,337.0	65.6

*T = Less than one million

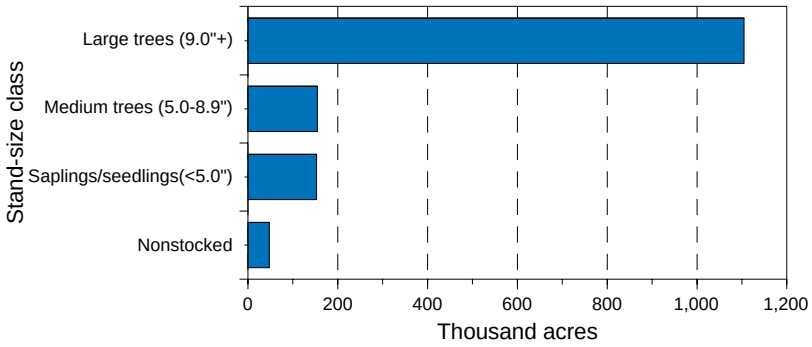

Figure 8—Forest land area by stand-size class, Bitterroot National Forest.

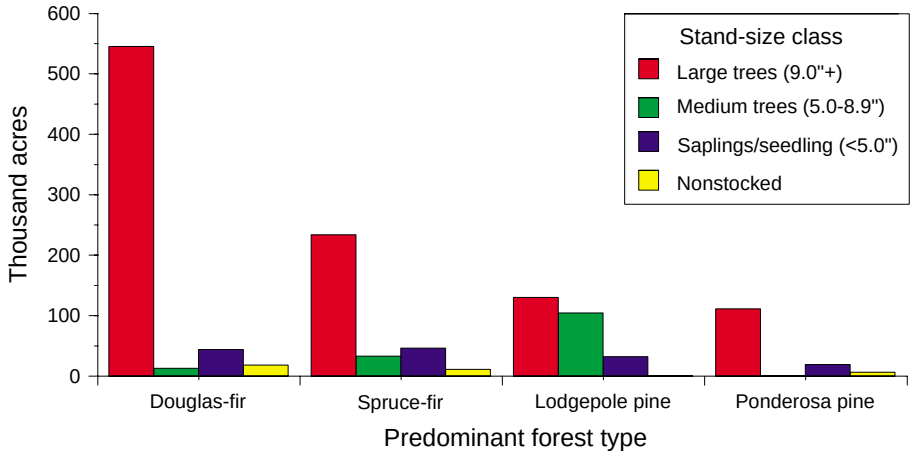

Figure 9—Area by predominant forest type and stand-size class, Bitterroot National Forest.

The percent net cubic foot volume of live trees by diameter class is presented in figure 10. Approximately 96 percent of ponderosa pine, 95 percent of Engelmann spruce, and 91 percent of Douglas-fir volume is in trees larger than 9 inches d.b.h. About 41 percent of lodgepole pine volume and 35 percent of subalpine fir volume is in trees less than 9 inches d.b.h.

Another way to look at wood volume is by forest type, for which net volume per acre can be computed (presented in the next column). These numbers include the many different species that can occur together within each forest type. The highest volume per acre on the Bitterroot is in the Engelmann spruce forest type and the lowest in the larch forest type. Low volume per acre in the larch type and high volume in Engelmann spruce may be a function of small sample size.

Forest type	Net cubic feet volume per acre	Number of plots
Engelmann spruce	3,661	4
Douglas-fir	2,486	96
Lodgepole pine	2,382	41
Spruce-fir	2,362	50
Grand fir	1,730	3
Ponderosa pine	1,450	21
Whitebark pine	1,199	7
Larch	818	4
Total		226

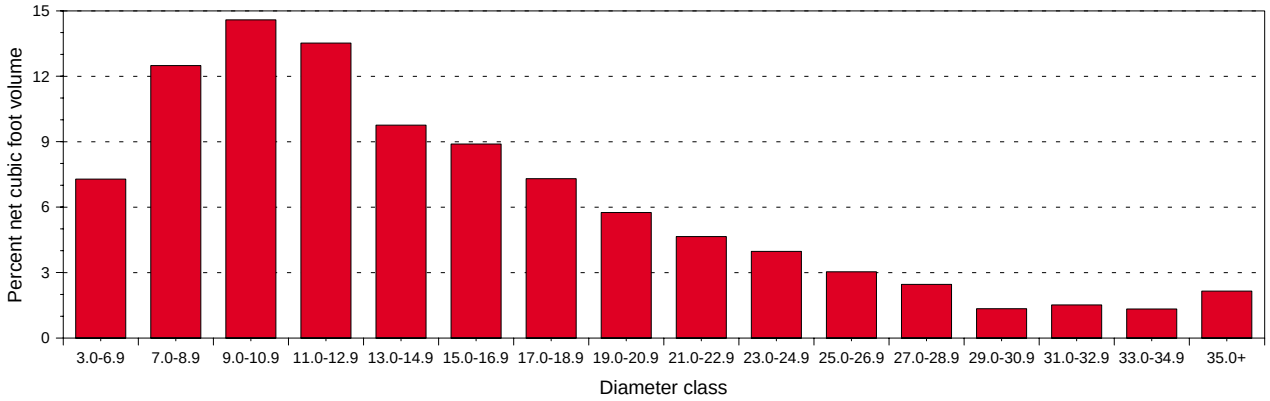

Figure 10—Percent net cubic foot volume of live trees by diameter class, Bitterroot National Forest.

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 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 60 or more 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 11. 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 40 percent of all forest land on the Bitterroot is estimated to be in the high stocking class. This includes about 83 percent of the lodgepole pine forest type on the Forest.

Growth—Another measure of forest vigor is net annual growth. Net annual growth is the difference between gross annual growth and losses due to mortality. Gross annual growth on all forest land of the Bitterroot is estimated to be more than 59 million cubic feet, and

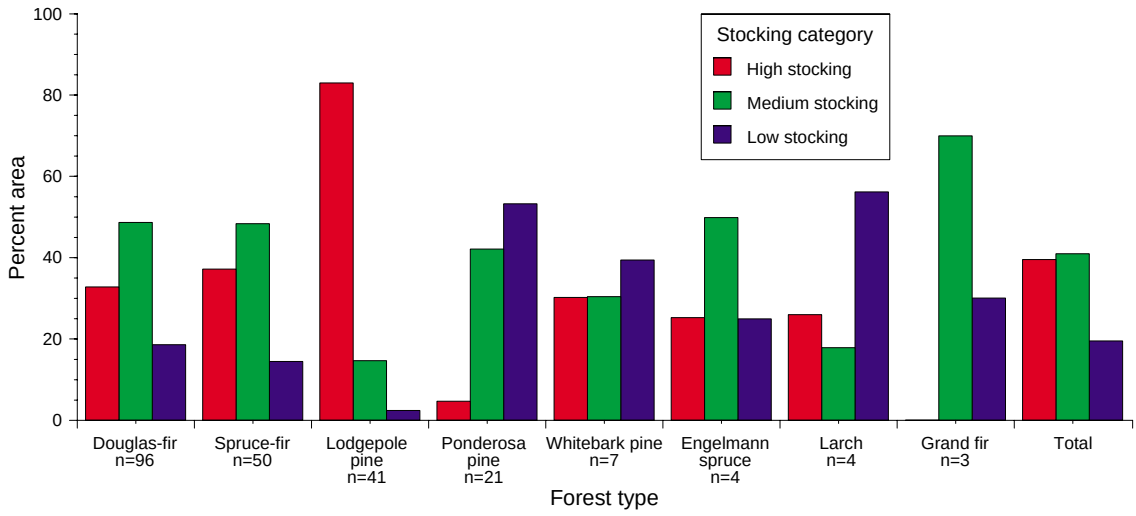

Figure 11—Percent area of live tree stocking category by forest type, Bitterroot National Forest. Includes number of plots in each type.

net annual growth is just over 42 million cubic feet. Gross annual growth is compared to mortality for 4 high volume species in figure 12. Mortality is about one-third of gross annual growth on forest land as a whole with the largest mortality to growth ratio in subalpine fir.

Mortality—Field crews assess which trees have died in the past 5 years. These trees are used to estimate annual mortality. In 1994 trees containing about 16.8 million cubic feet of wood died on the Bitterroot. About 64 percent of the mortality was estimated to be caused by disease, and another 18 percent was estimated to be caused by insects. Over two-thirds of the mortality occurred in just two species, subalpine fir and Douglas-fir.

Other information about the forest land of the Bitterroot

Accessibility—All forested plots visited by field crews were assigned a "distance to road" category. Based on this information, it is estimated that 24 percent of the forested area of the Bitterroot National Forest is less than a half mile from an improved road; 12 percent is between a half and 1 mile; 24 percent is between 1 and 3 miles; 14 percent is between 3 and 5 miles; and 26 percent is greater than 5 miles from an improved road.

Location history—Field crews also make a field observation on each forested plot of the predominant human or natural disturbance that affects the whole stand. Thirty-seven percent of Bitterroot plots had no visible signs of disturbance. Twenty-six percent had disease damage for the primary disturbance, 13 percent had evidence of fire, another 11 percent had evidence of tree cutting, and 5 percent had evidence of weather damage. The remaining 8 percent of forested field plots had evidence of insect damage, wind damage, or other disturbance.

Understory vegetation—Understory vegetation provides forage and cover for wildlife, contributes to forest fuel load, and can be an indication of the successional stage of the forest community. Field crews visually estimated crown canopy coverage and assigned a percent cover class for 3 different height classes (layers) of shrubs, forbs, and graminoids (See USDA 1994 for details). Figure 13 shows the average percent cover of shrubs on forest land by height class and forest type based on the cover class midpoints.

How much forest land is suitable for timber production?

Wood production is one of many important uses of nonreserved forest land on the Bitterroot. Nonreserved means the land is not withdrawn from timber utilization through statute or administrative designation. The area of nonreserved forest land is 798,449 acres, or 55 percent of the total forest land area of the Bitterroot. The net volume of growing-stock trees on nonreserved forest land is over 1.7 billion cubic feet.

About 60 percent of the nonreserved forest land is actually considered to be suitable for timber production (USDA 1987). Field 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, Douglas-fir, and ponderosa pine types. Douglas-fir makes up 42 percent of the total forest but makes up more than 54 percent of the suitable area. The spruce-fir type makes up 22 percent of the total forest land, but only 9 percent of the suitable area. Conversely, ponderosa pine makes up only 9 percent of the total forest, but about 21 percent of the suitable area. Another difference is that no whitebark

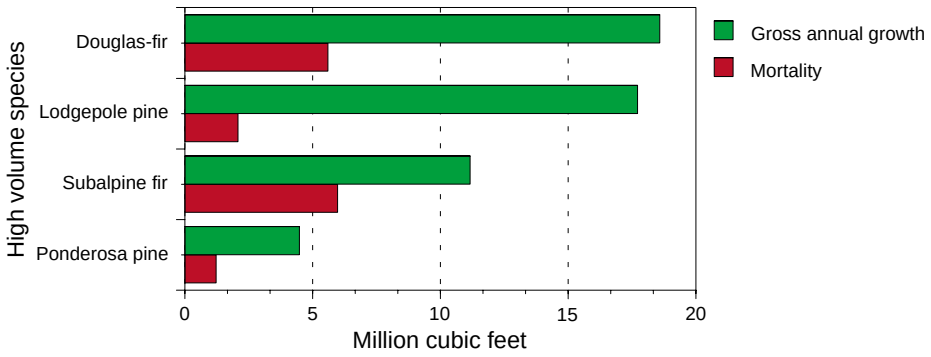

Figure 12—Gross annual growth of all live trees compared to mortality for 4 high volume species on all forest land, Bitterroot National Forest.

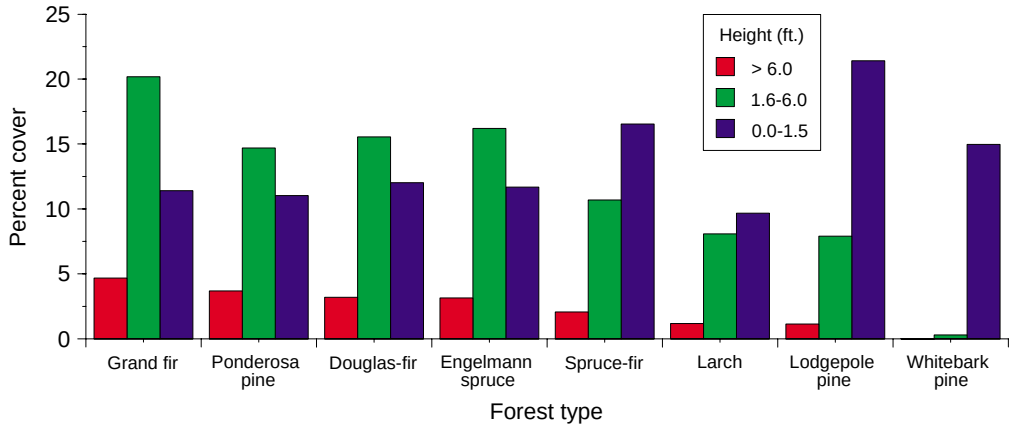

Figure 13—Average percent cover of shrubs on forest land by forest type, Bitterroot National Forest.

pine, larch, or grand fir forest types occurred on plots in the suitable area. Stand-size class distribution on the suitable area is similar to that of the forest as a whole except the sapling/seedling category comprised 10 percent of the total forest land but 18 percent of the total suitable forest land and the medium size stands changed from 11 percent of total forest land to 5 percent of the total suitable land on the Bitterroot.

Volume—The net volume of growing stock trees on suitable lands is estimated to be about 1.0 billion cubic feet, which is about 59 percent of the net growing stock volume on nonreserved forest land. The volume of sawtimber on suitable lands is estimated to be over 3.8 billion board feet (Scribner rule). Figure 14 shows distribution of sawtimber volume on nonreserved forest land by species, compared to that on suitable lands.

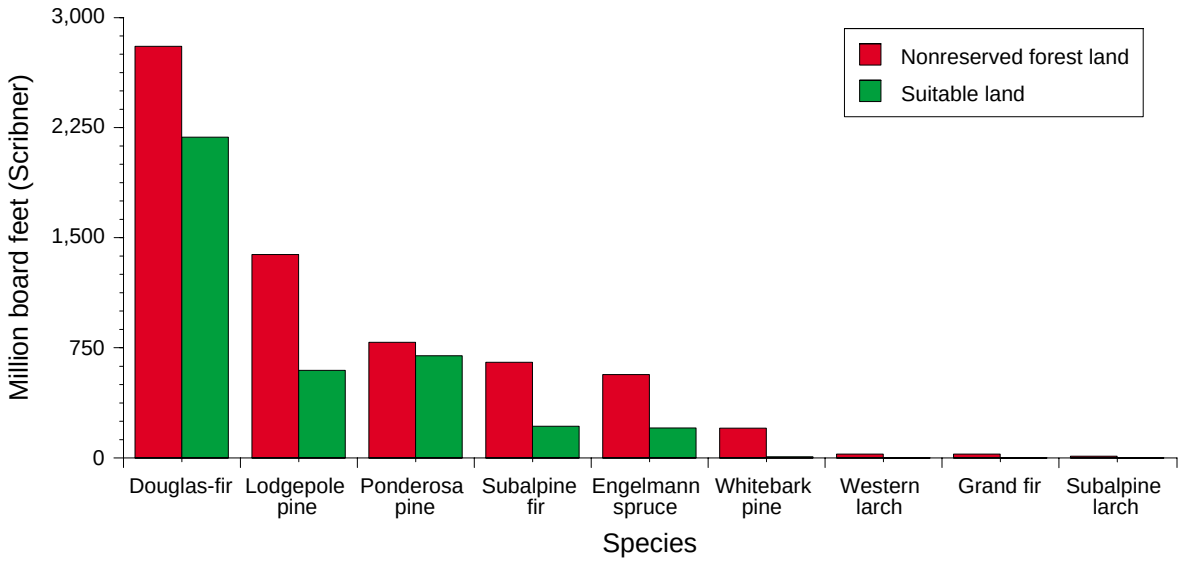

Figure 14—Sawtimber volume on nonreserved forest land compared to sawtimber volume on suitable lands, Bitterroot National Forest.

Douglas-fir accounts for about 56 percent of the total sawtimber volume (Scribner rule) on suitable lands but only 43 percent of the total sawtimber volume on all nonreserved forest land. In contrast, lodgepole pine volume makes up only 15 percent of the suitable land and 21 percent of the total nonreserved land.

Growth and Mortality—Gross annual growth of growing stock trees on nonreserved forest land is estimated to be about 30.5 million cubic feet and net annual growth is estimated to be over 23.7 million cubic feet. Mortality is about 6.8 million cubic feet, or 22 percent of gross annual growth in growing-stock trees on nonreserved forest land. By comparison, gross annual growth of growing stock trees on suitable lands is estimated to be about 19 million cubic feet and net annual growth is estimated to be over 16.2 million cubic feet. Mortality is about 2.8 million cubic feet or about 15 percent of gross annual growth in growing-stock trees on suitable lands. Gross annual growth for 4 high volume species is compared to mortality on nonreserved and suitable lands in figures 15 and 16, respectively. Looking at the ratio of mortality to gross annual growth for suitable forest land compared to nonreserved forest land and forest land as a whole (figure 12), the most significant difference is in subalpine fir with substantially less growth on suitable lands as well as a lower rate of mortality to gross growth ratio on suitable lands.

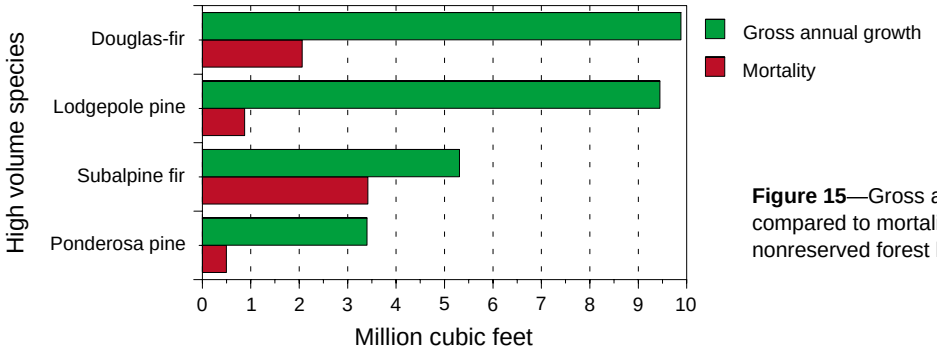

Figure 15—Gross annual growth of growing stock compared to mortality for 4 high volume species on nonreserved forest land, Bitterroot National Forest.

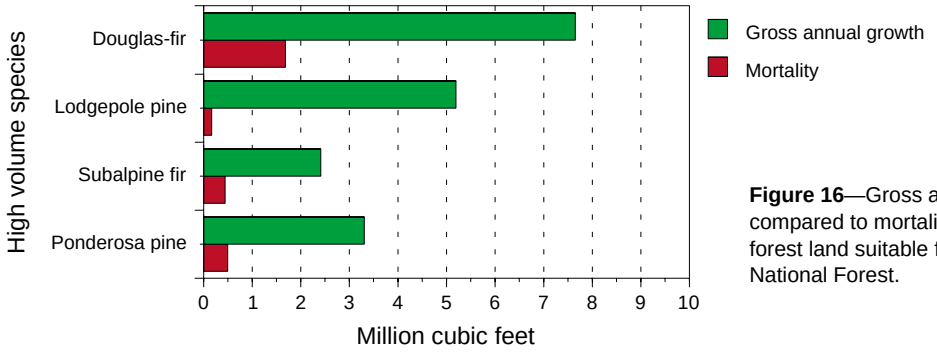

Figure 16—Gross annual growth of growing stock compared to mortality for 4 high volume species on forest land suitable for timber harvest, Bitterroot National Forest.

How was the inventory conducted?

FIA 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. There were 252 inventory plots on the Bitterroot using the standard IWRIME grid, of which 6 were inaccessible. Of the plots field sampled, 226 were forested.

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, page 12. 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 land suitable for timber production, Bitterroot National Forest.

Land class	Attribute	Volume	Percent standard error
		Net cubic feet (all live)	
Total forest land	Volume	3,337,056,000	4.7
	Growth	42,132,000	11.4
	Mortality	16,877,000	19.2
		Net cubic feet (growing stock)	
Nonreserved forest land	Volume	1,741,329,000	6.5
	Growth	23,705,000	11.8
	Mortality	6,850,000	27.6
Land suitable for timber production	Volume	1,034,915,000	11.3
	Growth	16,264,000	16.4
	Mortality	2,789,000	36.2

Documentation

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Selected data for this forest are 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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Studies accelerate solutions to problems involving ecosystems, range, forests, water, recreation, fire, resource inventory, land reclamation, community sustainability, forest engineering technology, multiple use economics, wildlife and fish habitat, and forest insects and diseases. Studies are conducted cooperatively, and applications may be found worldwide.