USDA United States Department of Agriculture

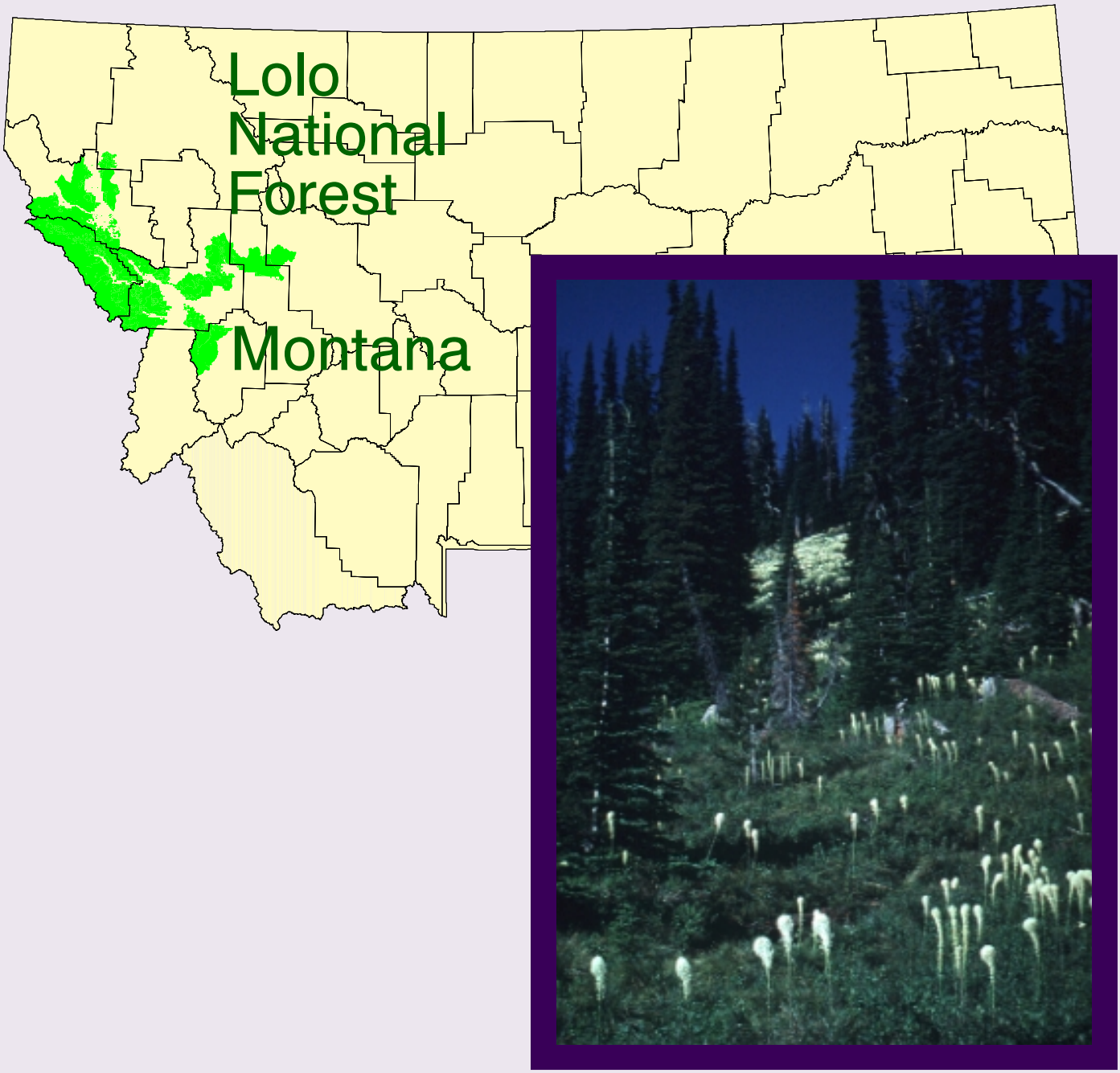
Forest Service

Rocky Mountain Research Station

June 2000

Forest Resources of the Lolo National Forest

Larry T. DeBlander



About the author

Larry T. DeBlander is a Forester with the Interior West Resource Inventory, Monitoring, and Evaluation Program, Rocky Mountain Research Station in Ogden, Utah.

Contents

Several of the photos in this brochure were provided by Vick Applegate, Silviculturist, Lolo National Forest.

Rocky Mountain Research Station
324 25th Street
Ogden, UT 84401

Forest Resources of the Lolo National Forest

Larry T. DeBlander

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 (Region 1) for the inventory of its National Forests. This report presents the highlights of the Lolo National Forest 1996 inventory, using commonly requested variables and summaries. The data could be summarized in other ways for different purposes (see the "For further information" on the inside back cover). The information presented in this report is based solely on the IWRIME inventory sample. Additional data collected by the Lolo National Forest and used separately or in combination with IWRIME data will produce varying results.

What forest resources are found on the Lolo National Forest?

The Lolo National Forest administers 2,079,327 acres (USDA 1996; USDA 2000) of which 95 percent is forest land and 5 percent is nonforest or water (fig. 1). Eight percent of the total administered area of the Lolo 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 Lolo, 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

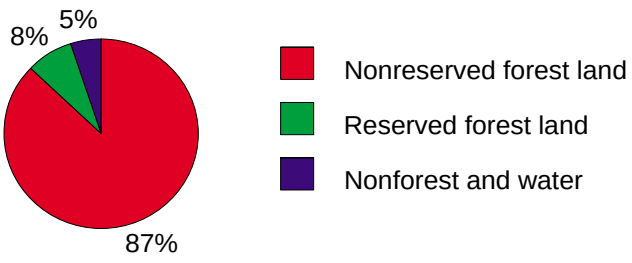


Figure 1—Area by land class, Lolo National Forest.

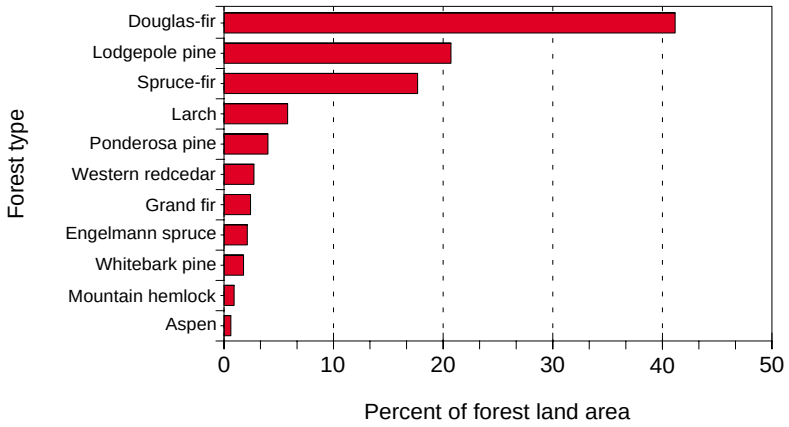


Figure 2—Percent of total forest land area by forest type, Lolo National Forest.

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

On the Lolo, Douglas-fir at 41 percent is the most common forest type by percentage of total forest land area. Douglas-fir is followed in abundance by lodgepole pine at 21 percent, spruce-fir at 18 percent, larch at 6 percent, ponderosa pine at 4 percent, western redcedar at 3 percent, and grand fir, Engelmann spruce, and whitebark pine each at 2 percent (fig. 2). Traces of mountain hemlock and aspen forest types also occur.

Habitat type—Forest communities can be 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 1995). These habitat type groups serve as integrators of the moisture availability and temperature gradients of the biophysical environment (Jones 1997).

The Lolo has more than 80 unique forest habitat types that have been grouped into Westside habitat classes. Figure 3 shows area by forest type and habitat type group on the Lolo. The most common habitat type group is the moderately warm and dry group, occurring on 34 percent of the forest area. By summarizing forest land area by habitat type group, the Lolo 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

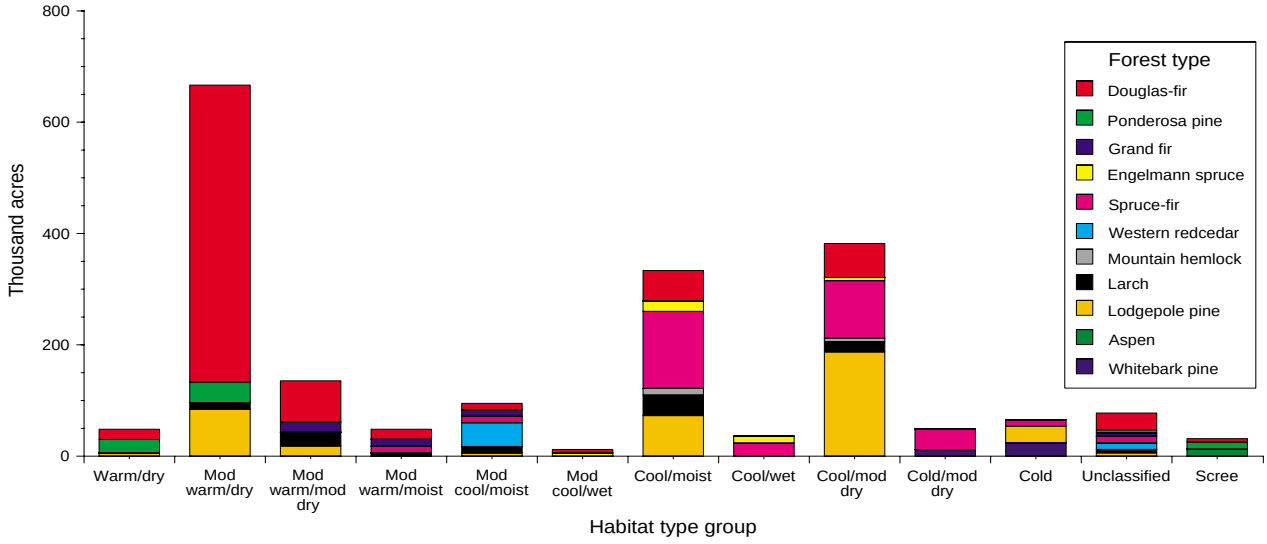


Figure 3—Area of forest land by forest type and habitat type group, Lolo National Forest.

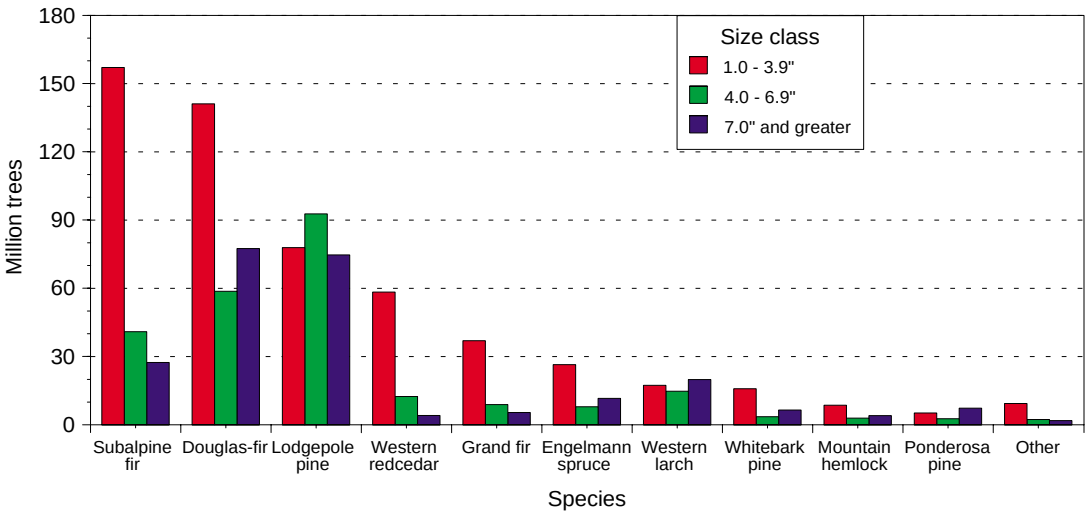


Figure 4—Number of live trees 1.0 inches diameter and greater, by species and size class, Lolo National Forest.

forest land by individual species. Figure 4 shows total number of live trees by species in three categories—1.0 to 3.9 inches diameter, 4.0 to 6.9 inches diameter, and 7.0 inches and greater diameter. Fifty-three percent of all live trees on the Lolo are between 1.0 and 3.9 inches diameter, twenty-four percent are between 4.0 and 6.9 inches diameter, and twenty-three percent are 7.0 inches diameter and greater. Douglas-fir makes up 27 percent of the total number of trees; lodgepole pine, 24 percent; subalpine fir, 22 percent; western redcedar, 7 percent; western larch and grand fir, 5 percent; Engelmann spruce, 4 percent; whitebark pine, 2 percent; and mountain hemlock and ponderosa pine, 1 percent each. Rocky Mountain maple, aspen, Rocky Mountain juniper, western hemlock, western white pine, black cottonwood, and subalpine larch combined contribute a total of about 1 percent. Species that are scarce may not be encountered with the extensive sampling strategy used for this inventory.

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

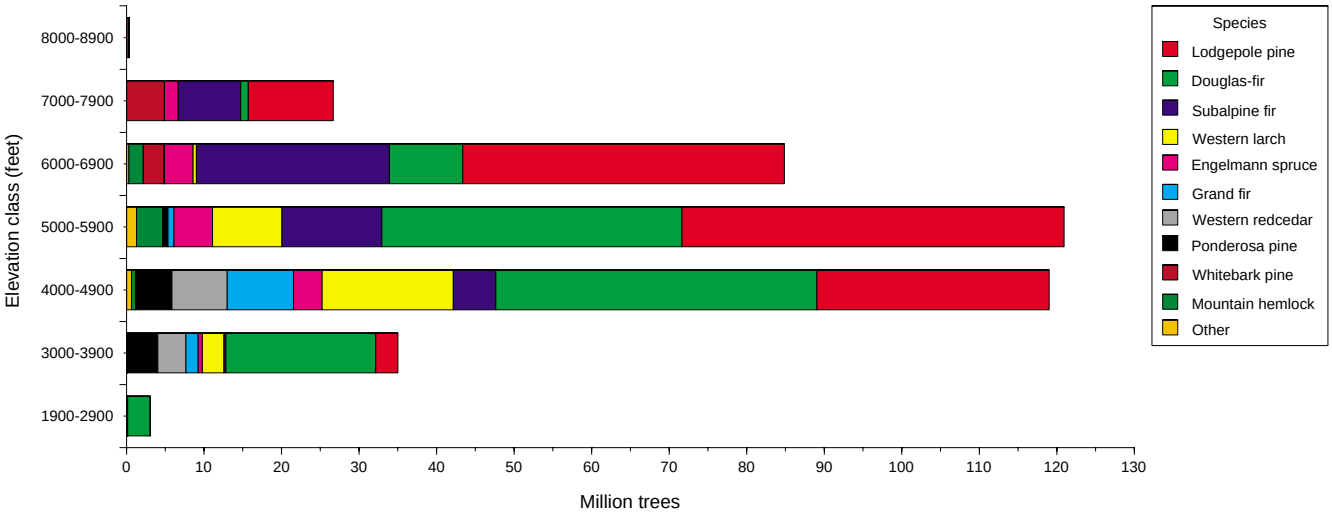


Figure 5—Number of live trees 5.0 inches diameter and greater by species and elevation class, Lolo National Forest.

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. On the Lolo, the predominantly competing species are Douglas-fir, lodgepole pine, western larch, western redcedar, grand fir, and ponderosa pine at lower elevations, and lodgepole pine, Douglas-fir, subalpine fir, Engelmann spruce, and whitebark pine at higher elevations.

Number of dead trees—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 5.0 inches diameter on the Lolo 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 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 11.0 inches diameter or larger, an estimated 6.7 per acre occur on Lolo forest land. Of the very large snags (19.0 inches diameter or larger) there is an average of 1.1 per acre. The most abundant species of snags in the 19-inch and larger category is Douglas-fir, followed by whitebark pine and western larch.

Below is a list of both total number and percent dead, of all live trees and standing dead trees 5.0 inches diameter and greater, by species on the Lolo. Only species with dead trees sampled are included.

Species	Total number of live and standing dead trees 5.0 inches diameter and greater	Percent standing dead of total
	Thousands	
Western white pine	1,274	68
Whitebark pine	13,719	43
Subalpine larch	25	37
Subalpine fir	63,430	19
Western larch	35,252	17
Lodgepole pine	159,417	16
Ponderosa pine	10,974	13
Douglas-fir	124,278	9
Engelmann spruce	16,222	9
Grand fir	11,967	9
Mountain hemlock	6,182	6
Western redcedar	10,899	1

Size—The size distribution of trees in a stand is an indicator for structural diversity. Figure 6 displays the tree size distribution by diameter class on the Lolo. Overall, there are many more small than large trees. A classification of forest land based on the predominant size of trees present in a stand is called stand-size class. Figure 7 displays a breakdown of forest land on the Lolo by stand-size class. This figure shows that most stands have a majority of stocking from large trees and that relatively few stands are considered to be nonstocked, such as stands that have been recently harvested or burned. In the large tree category, 65 percent of the stands have the majority of stocking in the 9.0 to 14.9 inch diameter range, 11 percent in the 15.0 to 18.9 inch diameter range, and 24 percent 19.0 inches and greater. Figure 8 shows stand-size classes for the five most predominant forest types accounting for the most acreage on the Lolo. About a third of the total forest land area is classified in the Douglas-fir, large tree category.

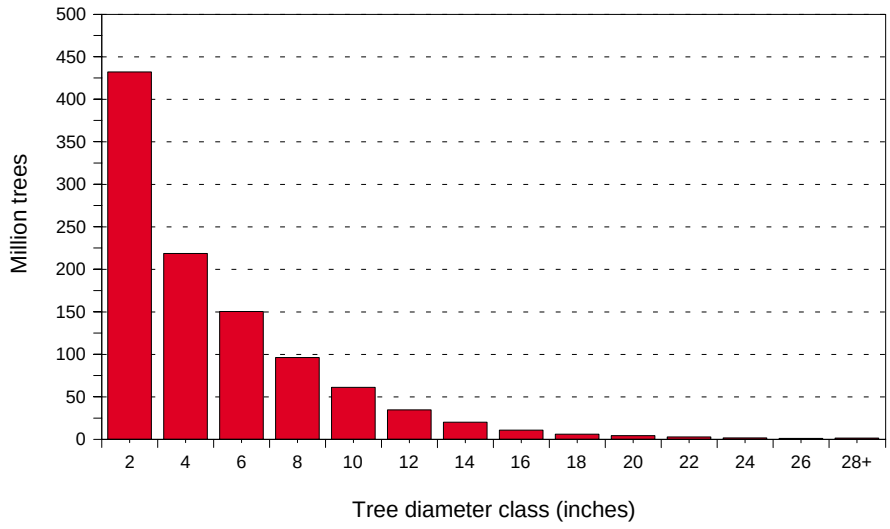


Figure 6—Number of live trees by diameter class, Lolo National Forest.

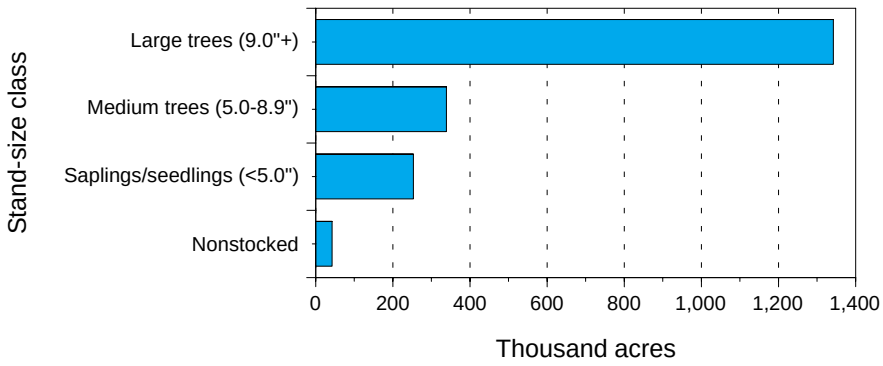


Figure 7—Forest land area by stand-size class, Lolo National Forest.

Wood volume and biomass—In the past, volume statistics were calculated for assessments of commercial timber resources that met certain quality standards (in other words growing stock trees). In this report, we present volume and biomass summaries that include estimates of more tree resources. The net volume of wood in live trees on the Lolo is estimated to be in excess of 4.7 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 Mountain maple or Rocky Mountain juniper, often referred to as woodland species. Total biomass of wood in live trees on the Lolo National Forest is estimated at over 94 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	Volume (Million cubic feet)	Biomass (Million tons)
Douglas-fir	1,605.7	34.6
Lodgepole pine	1,214.4	21.4
Western larch	509.5	10.8
Subalpine fir	466.5	9.2
Engelmann spruce	351.5	5.8
Ponderosa pine	210.7	4.4
Grand fir	131.4	2.6
Western redcedar	106.3	2.4
Whitebark pine	86.6	1.7
Mountain hemlock	52.6	1.2
Western hemlock	9.6	.2
Western white pine	5.7	.1
Cottonwood	3.4	.06
Aspen	1.9	.07
Rocky Mountain juniper	1.5	.03
Subalpine larch	0.2	.02
Rocky Mountain maple	—	.04
Total	4,757.5	94.65

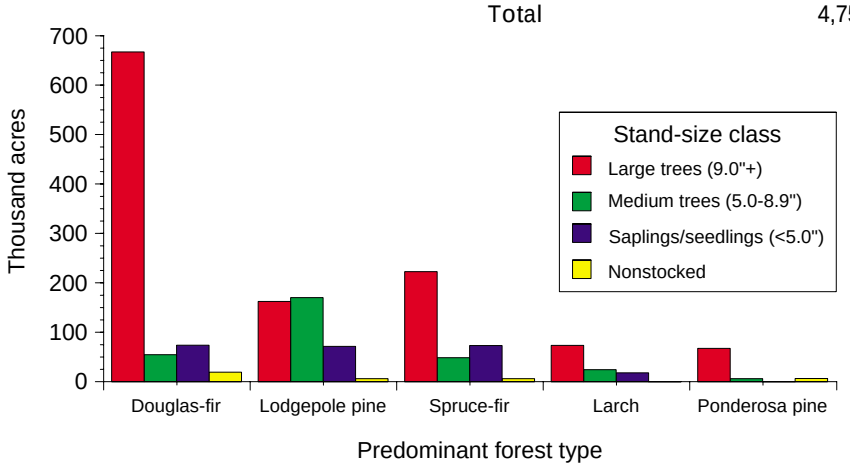


Figure 8—Area of forest land by predominant forest type and stand-size class, Lolo National Forest.

Figure 9 displays the percent net cubic-foot volume of live trees by diameter class. A breakdown by species shows approximately 91 percent of Engelmann spruce, 86 percent of Douglas-fir, and 84 percent of western larch volume is in trees 9.0 inches and greater d.b.h. About 47 percent of lodgepole volume is in trees less than 9.0 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 below). These numbers include the many different species that can occur together within each forest type. The highest volume per acre on the Lolo is in the western redcedar forest type and the lowest is in aspen. Low volume per acre in aspen may be a function of small sample size.

Forest type	Net cubic foot volume per acre	Number of plots
Western redcedar	3,792	9
Grand fir	3,482	8
Lodgepole pine	2,775	68
Larch	2,628	19
Engelmann spruce	2,568	7
Mountain hemlock	2,517	3
Spruce-fir	2,306	58
Douglas-fir	2,249	134
Ponderosa pine	1,371	13
Whitebark pine	1,218	6
Aspen	507	2
Total		327

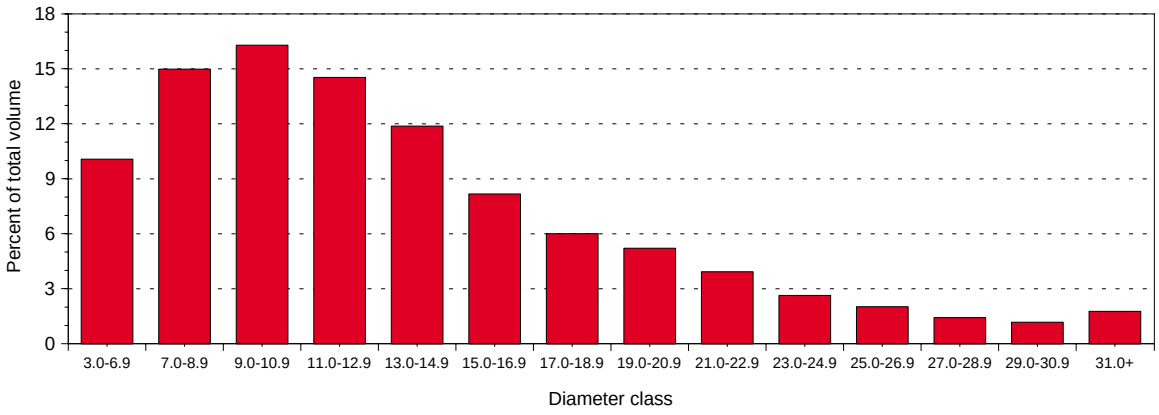


Figure 9—Percent net cubic foot volume of live trees by diameter class, Lolo National Forest.

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 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 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 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 48 percent of all forest land on the Lolo is estimated to be in the high stocking class. This includes about 88 percent of the western redcedar, 83 percent of the lodgepole pine, and 76 percent of the grand fir forest types 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.

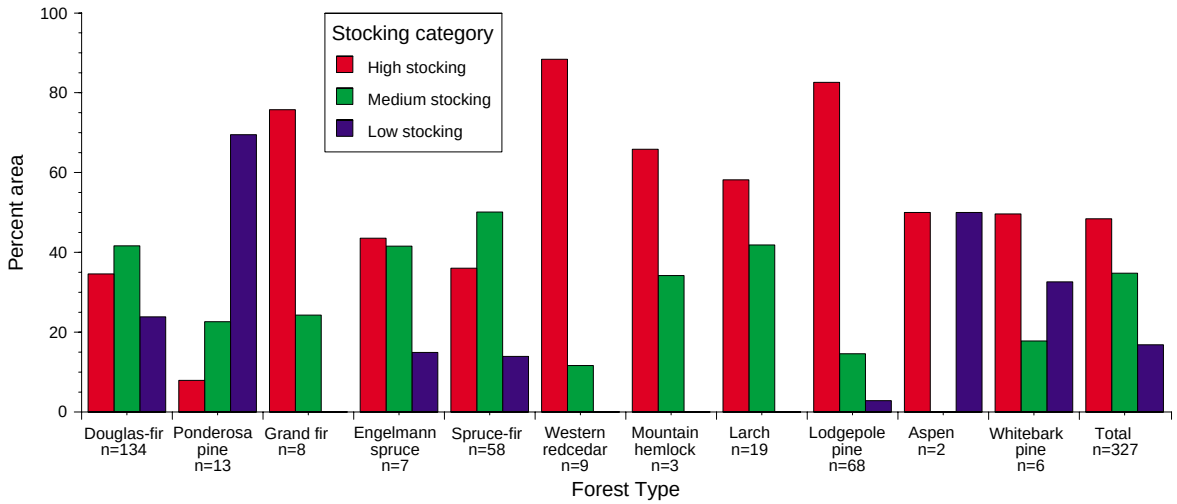


Figure 10—Percent area of live tree stocking category by forest type, Lolo National Forest. Includes number of plots in each type.

Gross annual growth on all forest land of the Lolo is estimated to be more than 113 million cubic feet, and net annual growth is over 90 million cubic feet. Gross annual growth is compared to mortality for five high volume species in figure 11. Mortality on the Lolo is about one-fifth of gross annual growth on all forest land with the largest mortality to growth ratio occurring in lodgepole pine.

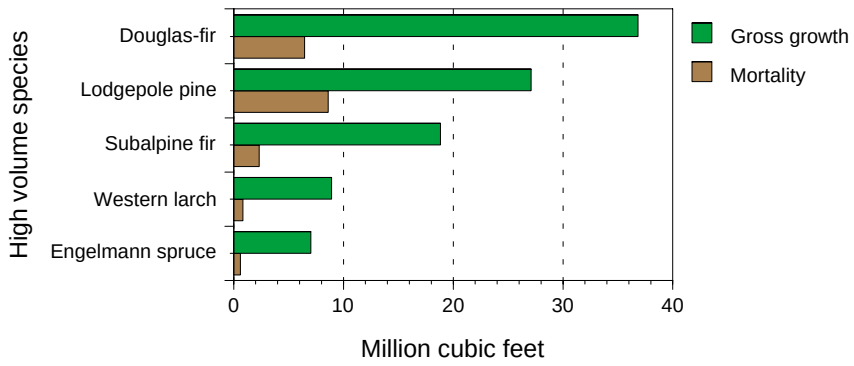


Figure 11—Gross annual growth compared to mortality for five high volume species on all forest land, Lolo National Forest.

Mortality—Field crews assess which trees have died in the past 5 years; these trees are used to estimate annual mortality. In 1995, trees containing an estimated 22.2 million cubic feet of wood died in the Lolo National Forest. About 46 percent of the mortality was estimated to be caused by disease, 25 percent by weather, and 21 percent by insects. About 68 percent of the mortality occurred in just two species, lodgepole pine and Douglas-fir.

Other information about the forest land of the Lolo

Accessibility—All forested plots visited by field crews were assigned a "distance to road" category. Based on this information, it is estimated that 41 percent of the forested area of the Lolo National Forest is less than a half mile from an improved road; 22 percent is between a half and 1 mile; 20 percent is between 1 and 3 miles; 8 percent is between 3 and 5 miles; and 9 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. Twenty-five percent of Lolo forested plots had no visible signs of disturbance. Twenty-six percent had disease damage for its predominant disturbance, 18 percent had evidence of tree cutting, 13 percent had evidence of fire, and 5 percent each had evidence of

insect or weather damage. The remaining 8 percent of forested field plots had evidence of wind damage, 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 Lolo. Nonreserved means the land has not been withdrawn from timber utilization through statute or administrative designation. The area of nonreserved forest land is 1,810,452 acres, or 92 percent of the total forest land area of the Lolo. The net volume of growing-stock trees on nonreserved forest land is over 4.4 billion cubic feet.

About 56 percent of the nonreserved forest land is actually considered to be suitable for timber production (USDA 1982). 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 Douglas-fir, lodgepole pine and spruce-fir types. The Douglas-fir type makes up 51 percent of the suitable forest area, but only 41 percent of the total forest area. Conversely, lodgepole pine and spruce-fir make up only 15 and 12 percent, respectively, of the suitable forest area, but 21 and 18 percent of the total forest area. Another difference is that no whitebark pine, mountain hemlock, or aspen 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 over 2.5 billion cubic feet, which is about 58 percent of the net growing stock volume on nonreserved forest land. The volume of sawtimber on suitable lands is estimated to be over 8.8 billion board feet (Scribner rule). Figure 12 shows distribution of sawtimber volume on nonreserved forest land by species, compared to that on suitable lands. Douglas-fir, western larch, and lodgepole pine together account for about 75 percent of the total sawtimber volume on suitable lands. Lodgepole pine has substantially greater sawtimber volume than western larch on nonreserved forest land, but has less volume on suitable lands. Similarly, subalpine fir has greater sawtimber volume than ponderosa pine on nonreserved forest land, but has substantially less volume on suitable lands.

Growth and Mortality—Gross annual growth of growing stock trees on nonreserved forest land is estimated to be about 105.1 million cubic feet , and net annual growth is estimated to be over 83.6 million cubic feet. Mortality is about 21.5 million cubic feet, or about

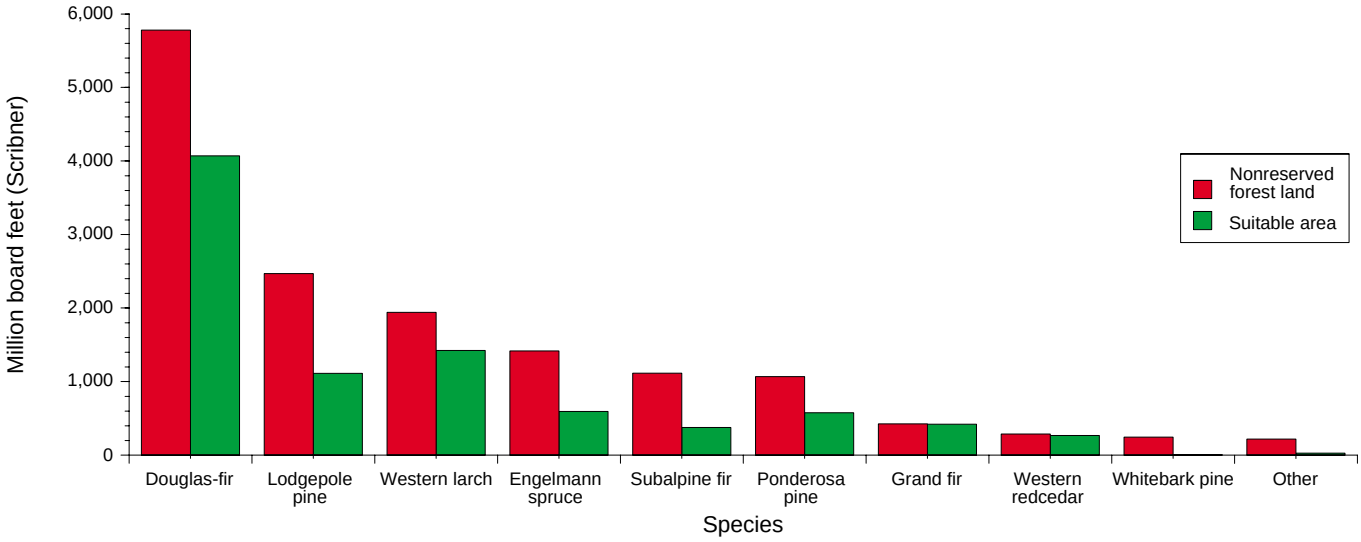


Figure 12—Sawtimber volume on nonreserved forest land compared to sawtimber volume on suitable lands, Lolo National Forest.

20 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 over 63.9 million cubic feet and net annual growth is estimated to be over 48.4 million cubic feet. Mortality is about 15.5 million cubic feet or about 24 percent of gross annual growth in growing-stock trees on suitable lands. Gross annual growth for five high volume species is compared to mortality on nonreserved and suitable lands in figures 13 and 14 respectively. For these species the ratio of mortality to gross annual growth varies little for nonreserved forest land versus suitable forest land, except for lodgepole pine which has a much higher mortality to gross annual growth ratio on suitable lands (46 percent) than on nonreserved lands (34 percent).

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

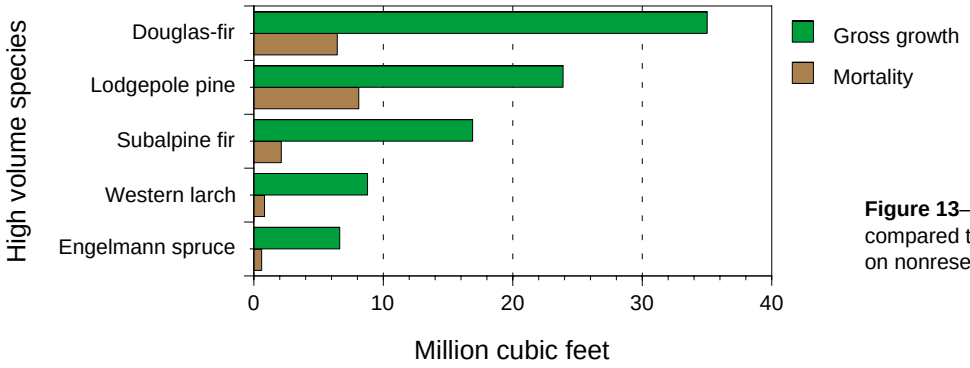


Figure 13—Gross annual growth of growing stock compared to mortality for five high volume species on nonreserved forest land, Lolo National Forest.

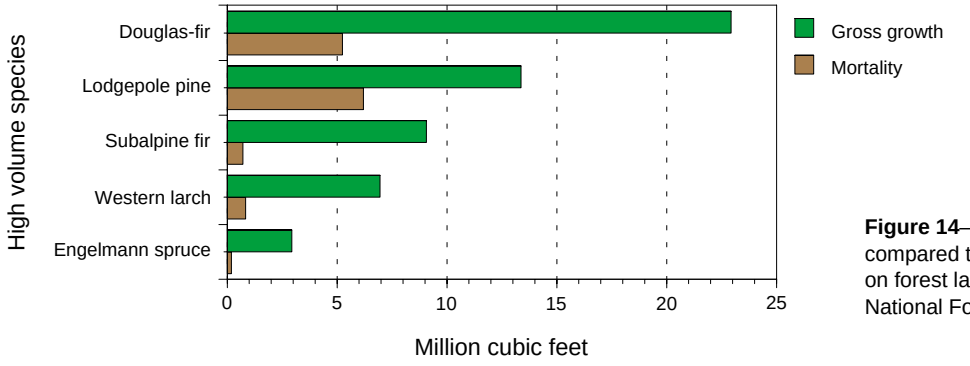


Figure 14—Gross annual growth of growing stock compared to mortality for five high volume species on forest land suitable for timber harvest, Lolo National Forest.

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 347 field plots on the Lolo using the standard IWRIME grid, of which 3 were inaccessible. Of the plots field sampled, 327 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 total area, 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 land suitable for timber production, Lolo National Forest.

Land class	Attribute	Volume	Percent standard error
		Net cubic feet (all live)	
Total forest land	Volume	4,757,501,925	4.1
	Growth	90,894,833	7.5
	Mortality	22,203,769	15.7
		Net cubic feet (growing stock)	
Nonreserved forest land	Volume	4,466,276,326	4.2
	Growth	83,638,202	7.8
	Mortality	21,493,682	16.1
Land suitable for timber production	Volume	2,574,317,379	7.4
	Growth	48,426,110	12.1
	Mortality	15,489,888	20.0

Documentation

Jones, J. L. 1997. Classification of regional habitat type groups—an integration of eastside and westside forest classifications. Unpublished report on file at Flathead National Forest, Kalispell, MT.

Pfister, Robert D., Kovalchik, Bernard L., Arno, Stephen F., and 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.

U.S. Department of Agriculture, Forest Service. 1982. Lolo National Forest Plan. Kalispell, MT: U.S. Department of Agriculture, Forest Service, Northern Region.

U.S. Department of Agriculture, Forest Service. 1995. Biophysical Classification—Habitat Groups and Descriptions. Report on file at Kalispell, MT: U.S. Department of Agriculture, Forest Service, Northern Region.

U.S. Department of Agriculture, Forest Service. 1996. Land Areas of the National Forest System. FS-383. As of September 1995.

U.S. Department of Agriculture, Forest Service. (2000). IWRIME inventory documentation and terminology for Region 1 Montana National Forests (1993-1998). [Online]. Available: http://www.fs.fed.us/rm/ogden/state_reports/montana/nfs/terminology.html (also available on file at: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Ogden, UT).

For further information

Interior West Resources, Inventory, Monitoring, and Evaluation Program
c/o Program Manager
507 25th Street, Ogden, UT 84401
Phone: 801-625-5388
FAX: 801-625-5723
World Wide Web: http://www.fs.fed.us/rm/ogden

Lolo National Forest
c/o Forest Supervisor
Fort Missoula Bldg. 24
Missoula, MT 59804
Phone: 406-329-3750
FAX: 406-329-3795

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

Federal Recycling Program Printed on Recycled Paper

The Rocky Mountain Research Station develops scientific information and technology to improve management, protection, and use of the forests and rangelands. Research is designed to meet the needs of National Forest managers, Federal and State agencies, public and private organizations, academic institutions, industry, and individuals.

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.