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Forest Resources of the Kootenai National Forest

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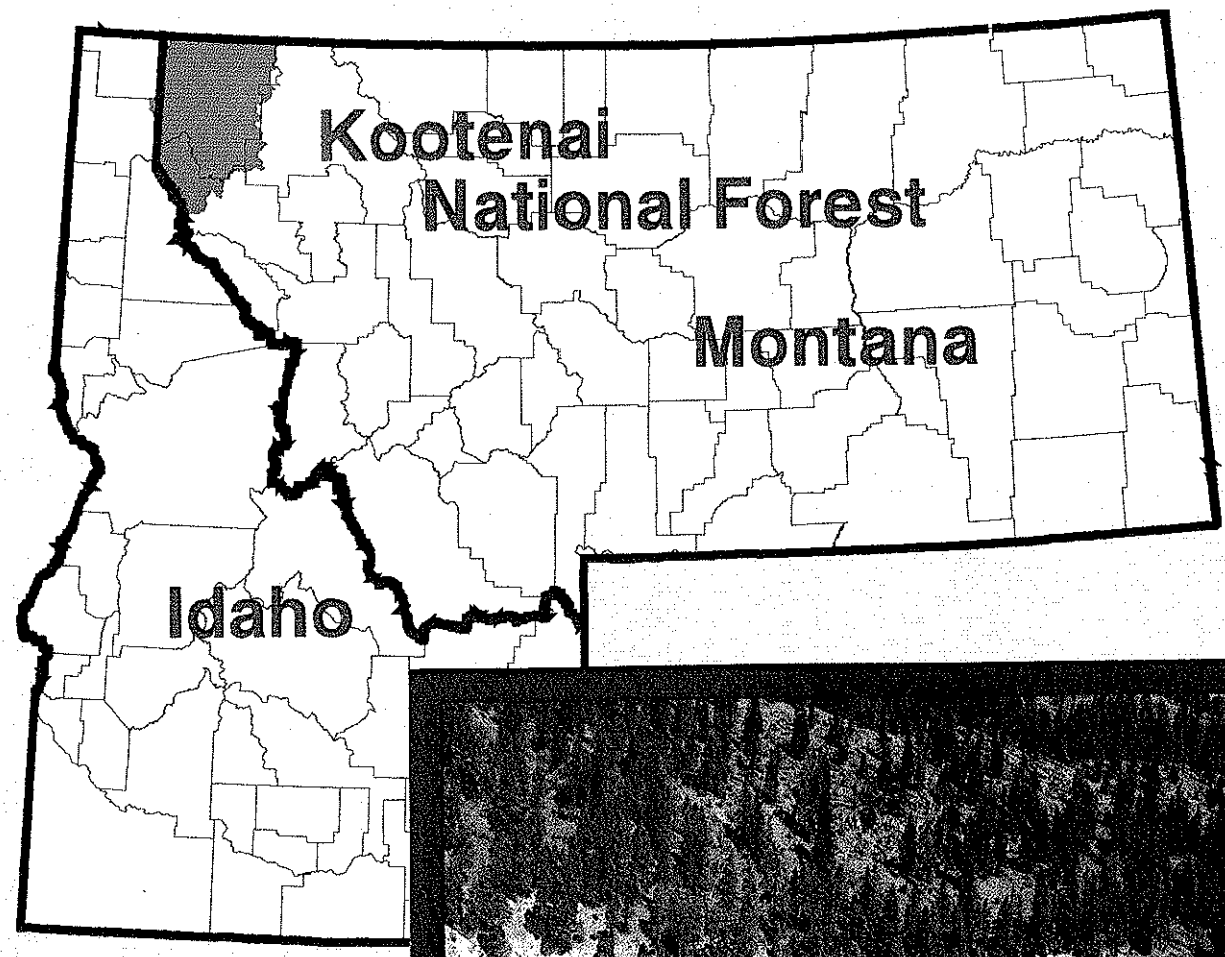

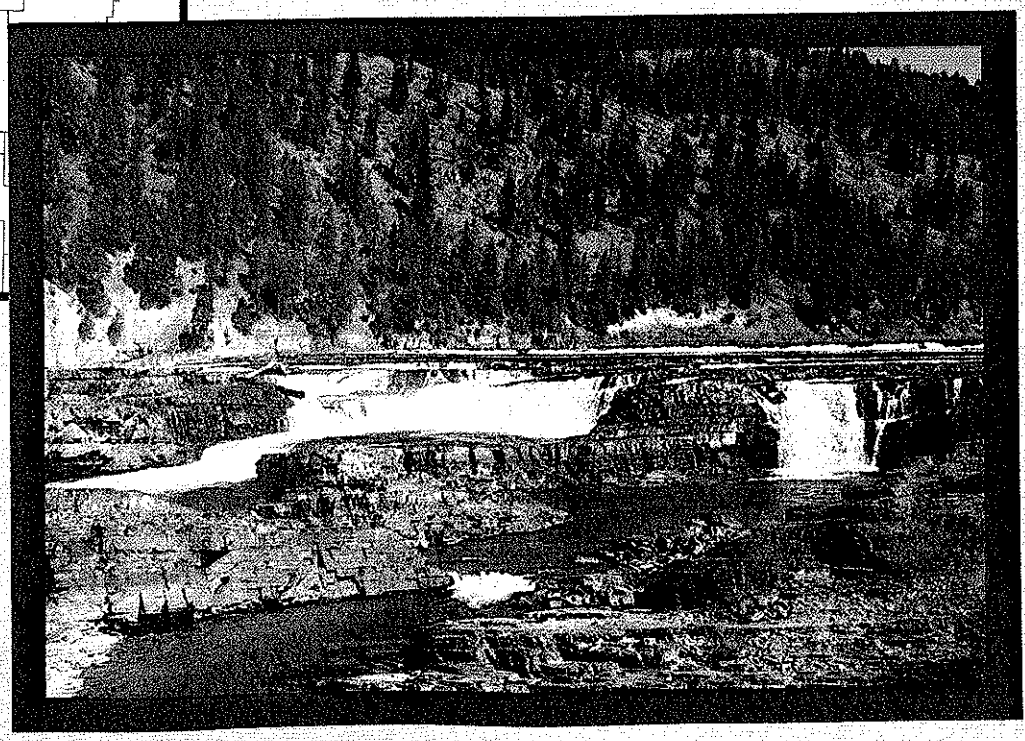

About the authors

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Forest Resources of the Kootenai National Forest

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The Interior West Resource Inventory, Monitoring, and Evaluation (IWRIME) Program of the USDA Forest Service, Rocky Mountain Research Station (formerly known as 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 Kootenai National Forest inventory using commonly requested variables and summaries. The Kootenai National Forest is primarily in the extreme northwestern corner of Montana; approximately 2 percent of the acreage that is administered by the Kootenai is in the state of Idaho. This report is based solely on the IWRIME inventory sample (USDA 1994). The field inventory was conducted between 1993 and 1995. Additional data collected by the Kootenai National Forest and used separately or in combination with IWRIME data may produce varying results. Supplementary documentation and terminology can be found in the IWRIME reference documents for Region 1 Montana National Forests (USDA 2000).

What forest resources are found on the Kootenai National Forest?

The 2,246,495 acres (USDA 1996; USDA 2000) administered by the Kootenai National Forest are 96 percent forest land and 4 percent nonforest or water (fig. 1). Four percent of the total area administered by the Kootenai is in a reserved designation. Reserved land is defined as land that has been withdrawn from management for production of wood products through statute or administrative designation. All reserved land on the Kootenai is within the Cabinet Mountains Wilderness. The first part of this report examines all forest land of the Kootenai, including reserved lands. Nonreserved forest land, which can further be classified as being either suitable or not suitable for timber harvest, is addressed in a later section.

Forest type—One common way to describe forest land is by forest type. This classification is based upon and named for the currently existing tree species that forms the majority of live-tree stocking on a site. Stocking is an expression of the extent to which live trees effectively utilize growing space. One exception to the single predominant species concept used for classifying forest type applies to sites where Engelmann spruce and subalpine fir occur together within a stand, and in combination they compose the predominant live-tree stocking; another exception applies to sites where hardwoods and softwoods occur together within a stand (USDA 2000).

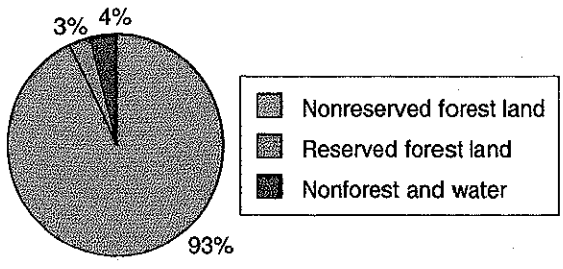
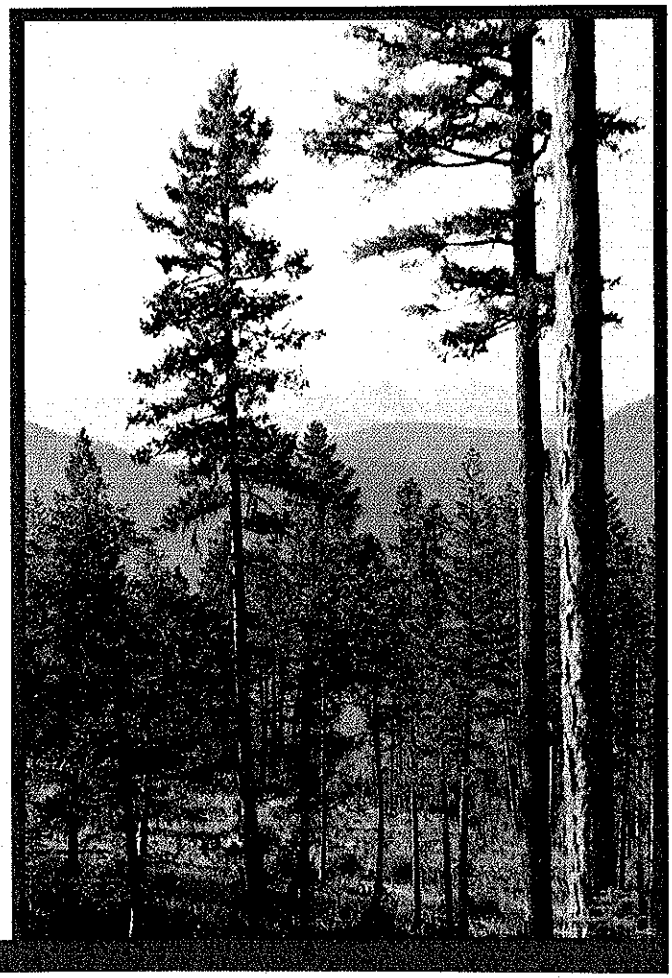


Figure 1—Area by land class, Kootenai National Forest.



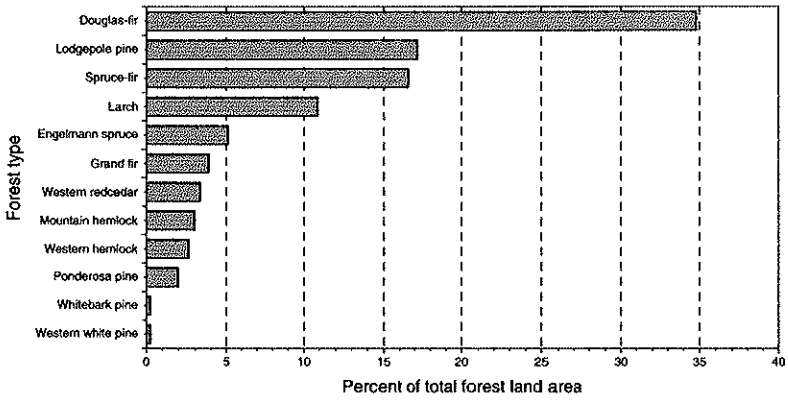


Figure 2—Percent of total forest land area by forest type, Kootenai National Forest.

On the Kootenai National Forest, Douglas-fir is the most common forest type, covering nearly 35 percent of the total forest land area. Next in abundance are lodgepole pine and spruce-fir at approximately 17 percent, larch at 11 percent, Engelmann spruce at 5 percent, and grand fir at about 4 percent of the total forest land area (fig. 2). Traces of western redcedar, mountain hemlock, western hemlock, ponderosa pine, whitebark pine, and western white pine also occur.

Habitat type—Another way to classify forest land is by habitat type, which describes a site in terms of its potential to produce similar plant communities at successional climax. By using habitat type, forest land is classified by the plant community that would eventually develop and perpetuate itself in the absence of site disturbances (Pfister and others 1977). In contrast, a forest type classification describes a site in terms of the currently occurring predominant tree species, and hence may change through time as a result of site disturbances or advancing succession. Habitat type is generally influenced by site characteristics such as slope, aspect, elevation, soils, and climate.

Because more than 100 forest habitat types and phases exist in Montana (Pfister and others 1977), land managers sometimes group habitat types based on a particular item of interest. For example, to assist with subregional and landscape level assessments, habitat types from the Northern Region have been summarized into biophysical habitat type groups—groups based on similarities in successional patterns, in natural disturbance regimes (for example, how the type responds to different levels of fire intensity), and in structural characteristics of mature stands (USDA 1995). Biophysical habitat type groupings provide information about temperature and moisture availability of a particular site, regardless of the geographical setting (Jones 1997); this is implied by group titles such as the "warm and dry" or "cool and moist" group.

The 41 habitat types sampled on the Kootenai National Forest were categorized into 12 Northern Region biophysical habitat type groups. Figure 3 illustrates the area of forest land by habitat type group. The most common biophysical habitat type groups are those classified as moderately cool and moist, moderately warm and dry, and cool and moist, representing 26, 25, and 20 percent, respectively, of the forest land area on the Kootenai. Figure 3 also illustrates the forest types that occur within each habitat type group.

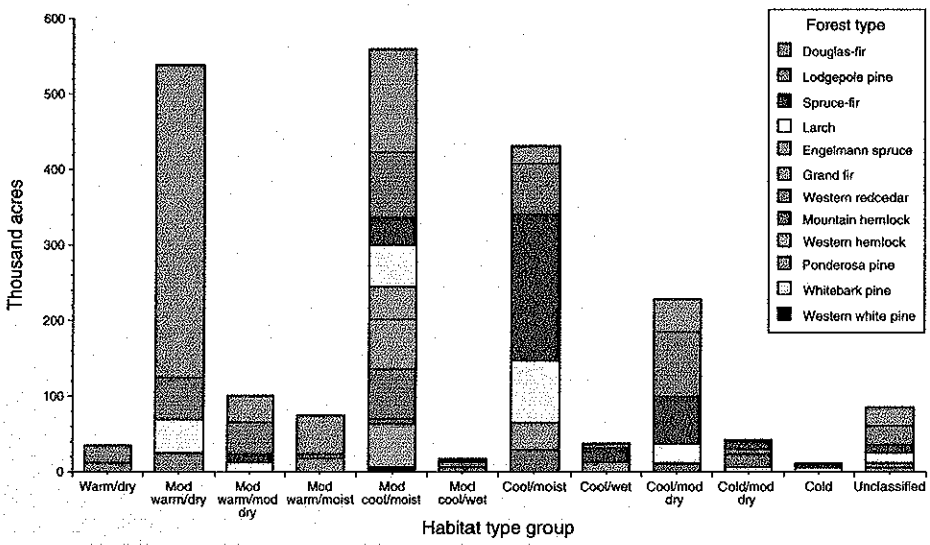


Figure 3—Area of forest land by forest type and habitat type group, Kootenai National Forest.

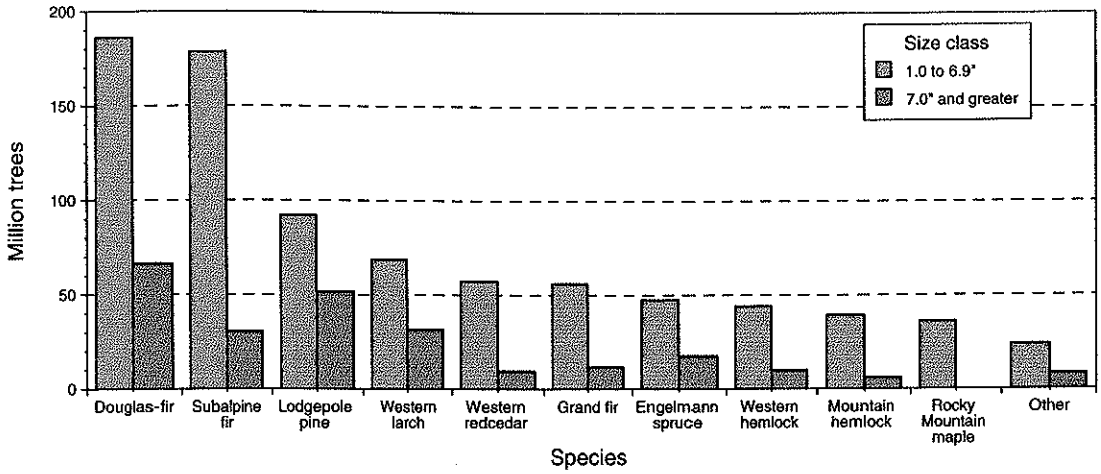


Figure 4—Number of live trees (1.0 inch diameter and greater) on forest land by species and size class, Kootenai National Forest.

Number of live trees—Forest land can also be examined in terms of the composition of existing tree species. Figure 4 shows the number of live trees by species in two categories: live trees 1.0 to 6.9 inches in diameter, and live trees 7.0 inches and greater in diameter. Approximately 77 percent of all live trees on the Kootenai are between 1.0 and 6.9 inches in diameter. By species, Douglas-fir comprises 24 percent of the total number of live trees; subalpine fir, 19 percent; lodgepole pine, 13 percent; western larch, 9 percent; western redcedar, grand fir, and Engelmann spruce, each at 6 percent; western hemlock, 5 percent; mountain hemlock, 4 percent; and Rocky Mountain maple, 3 percent. The following species in combination make up another 3 percent of the total: ponderosa pine, subalpine larch, aspen, western white pine, paper birch, Rocky Mountain juniper, whitebark pine, and cottonwood. Species that are scarce may not be encountered with the extensive FIA sampling strategy used for this report.

IWRIME classifies a tree as being either a timber or a woodland species (USDA 2000). In general, timber species are those that have traditionally been used for industrial wood products. Woodland species commonly have multiple stems and are often extremely variable in form. Overall, 97 percent of all live trees sampled on the Kootenai were timber species. The only woodland species sampled on the Kootenai were Rocky Mountain maple and Rocky Mountain juniper.

Figure 5 illustrates the number of live trees by species and elevation range. Elevation, mentioned above as a site

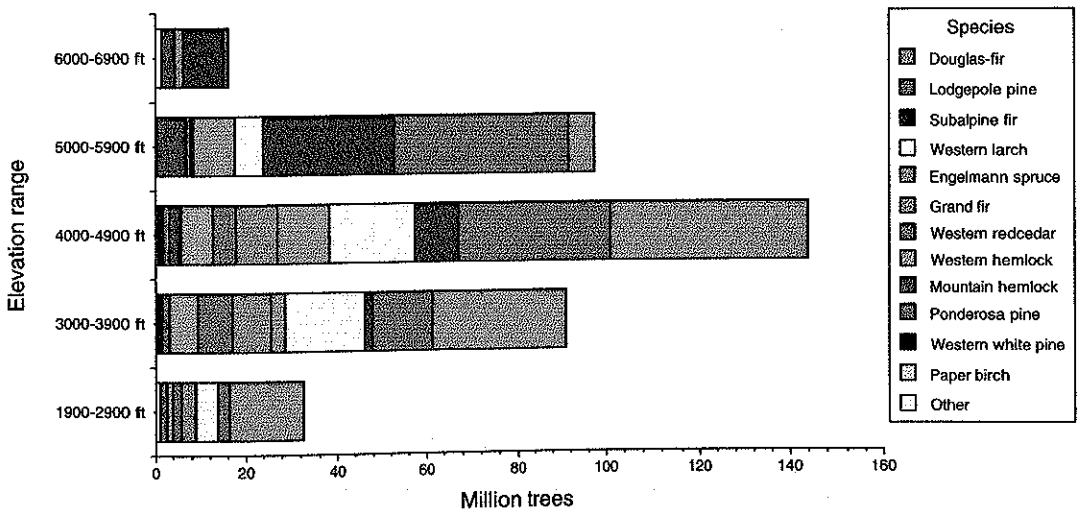


Figure 5—Number of live trees (5.0 inches diameter and greater) on forest land by species and elevation range, Kootenai National Forest. Sample site elevation determined to nearest 100 feet.

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. On the Kootenai, Douglas-fir is the most successful competitor at the lowest elevation range, while subalpine fir is the most successful competitor at the highest elevation range.

Number of dead trees—Another way to analyze forest land is based on the abundance and condition of dead trees, standing or down. Dead trees are an important component of forest ecosystems. Standing and down dead trees provide habitat for many species of wildlife, and down dead trees provide ground cover that may help prevent soil erosion. Down dead trees also contribute to the forest fuel load; the amount, size, moisture content, and site distribution of down material on the forest floor impact forest fire behavior and intensity. Additionally, as dead trees decompose, nutrients are recycled back into the soils.

Approximately 82 million standing dead trees (snags), 5.0 inches diameter and greater, are on forest land of the Kootenai National Forest. Snags are classified as being either hard or soft depending on the level of decay. Figure 6 shows the number of standing dead trees by species within the hard and soft snag categories. Lodgepole pine trees were significantly impacted by a major mountain pine beetle epidemic that peaked during the time of the IWRIME field inventory. This insect outbreak started about 1983 and came to an abrupt halt in 1996 when habitat conditions could no longer sustain the infestation (Maffei, personal communication).

Because large diameter snags are generally scarce relative to smaller snags, they tend to be the focus of more attention. Considering snags 11.0 inches diameter and larger, an estimated 7.8 snags per acre occur on Kootenai forest land, and the most abundant species is lodgepole pine, followed by western larch, Douglas-fir, and subalpine fir. Of the very large snags (19.0 inches diameter and larger), there is an average of 1.1 per acre, and the most abundant species is western larch, followed by Douglas-fir, western white pine, and Engelmann spruce.

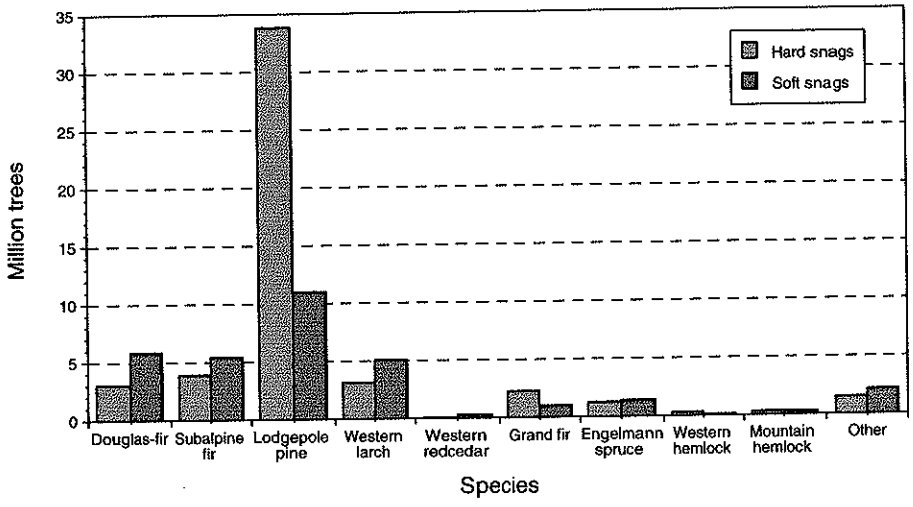


Figure 6—Number of hard and soft standing dead trees (5.0 inches diameter and greater) on forest land by species, Kootenai National Forest.

Size—The structural diversity of a forest can be examined by analyzing the average size (diameter) of tree species. Figure 7 displays the size distribution of live trees on all forest land of the Kootenai National Forest using diameter class. As shown, there are a higher number of small-diameter trees than large-diameter trees overall. "Stand-size class," another stand structure variable, refers to the predominant diameter size of all trees presently contributing to the majority of live-tree stocking on a site. Figure 8 shows a breakdown of forest land by four stand-size classes. Large trees include softwoods 9.0 inches diameter and greater, and hardwoods 11.0 inches diameter and greater; medium trees include softwoods 5.0 to 8.9 inches diameter, and hardwoods 5.0 to 10.9 inches diameter.

Although there are more small-diameter trees overall (as seen in figure 7), figure 8 shows that the majority of stands on the Kootenai are stocked with predominantly large-diameter trees. In terms of stocking, fewer large-diameter trees are required, as compared to small-diameter trees, to fully utilize a site. As also seen in figure 8, few stands are considered to be nonstocked, such as stands that may have been recently harvested or burned. Figure 9 shows area of forest land by stand-size class for the five predominant forest types on the Kootenai National Forest. Engelmann

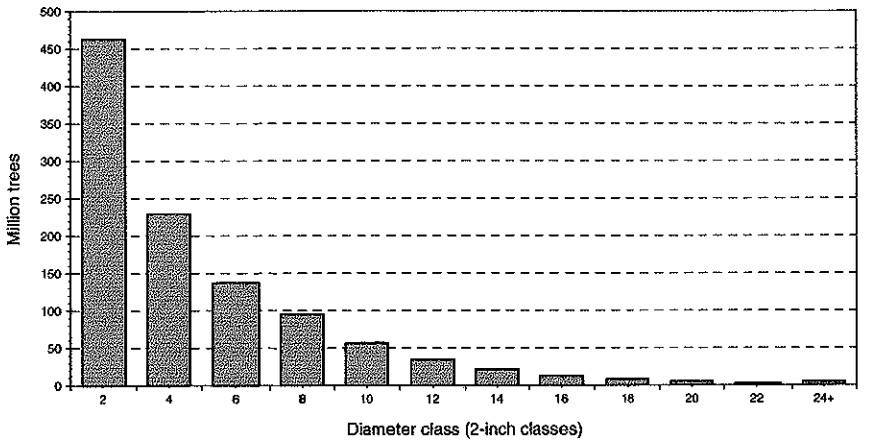


Figure 7—Number of live trees on forest land by diameter class, Kootenai National Forest.

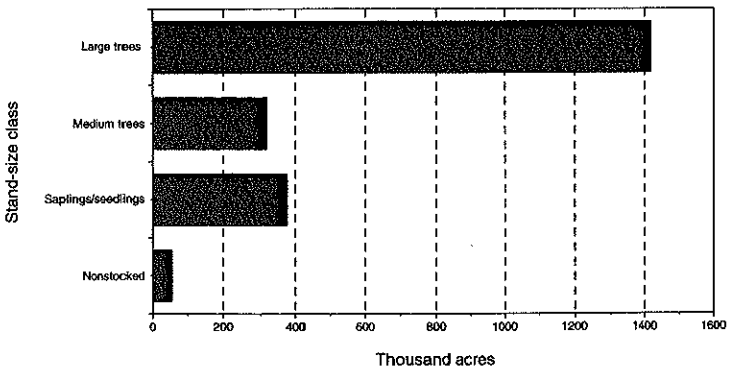


Figure 8—Forest land area by stand-size class, Kootenai National Forest.

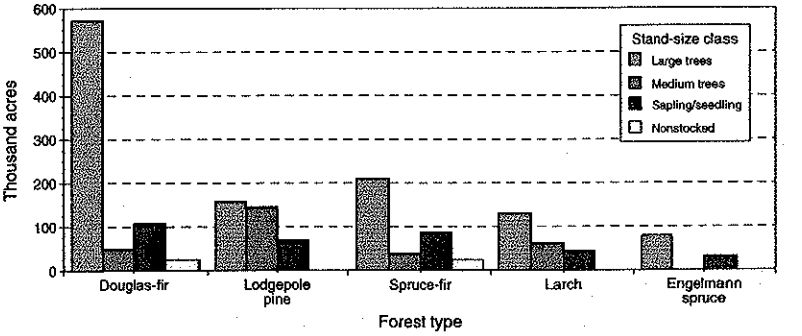
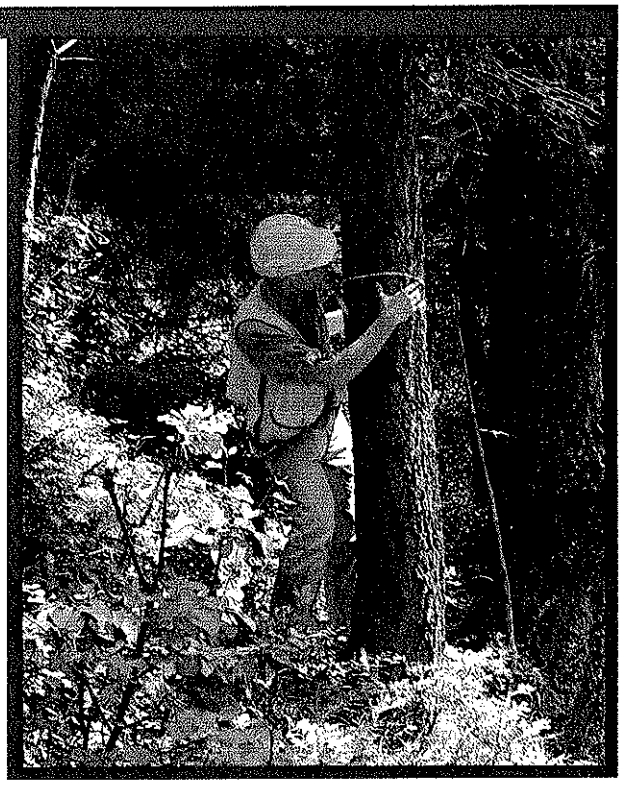


Figure 9—Area of forest land by stand-size class for predominant forest types, Kootenai National Forest.

the lowest volume per acre is in the ponderosa pine forest type.

Forest type	Volume per acre	Number of sample plots
	Cubic feet	
Western redcedar	4,692	12
Western hemlock	4,608	9
Grand fir	4,036	13
Whitebark pine	3,170	1
Engelmann spruce	2,970	18
Lodgepole pine	2,470	60
Douglas-fir	2,387	123
Larch	2,267	38
Mountain hemlock	2,220	11
Spruce-fir	2,049	59
Western white pine	1,570	1
Ponderosa pine	779	7
Total		352



How does the forest change?

Stocking category—Many factors influence the rate at which trees grow and thrive, or die. As tree size and density, or crowding between individual trees, increases, competition among trees for available site resources also increases. As previously mentioned, stocking is an expression of the extent to which live trees effectively utilize growing space. A stocking classification for forest land provides an indication of whether the trees growing in a stand are distributed in a manner that is optimal for tree growth, and whether tree reproduction is being prevented. Stocking information can apply to many site specific issues, such as assessing risk of attack by insects or disease, identifying wildlife habitat suitability, or determining timber production potential and management alternatives.

Forest types across all forest land on the Kootenai National Forest are categorized by live-tree stocking category (fig. 11) as follows: (1) high stocking - sites that are greater than or equal to 60 percent stocked with live trees;

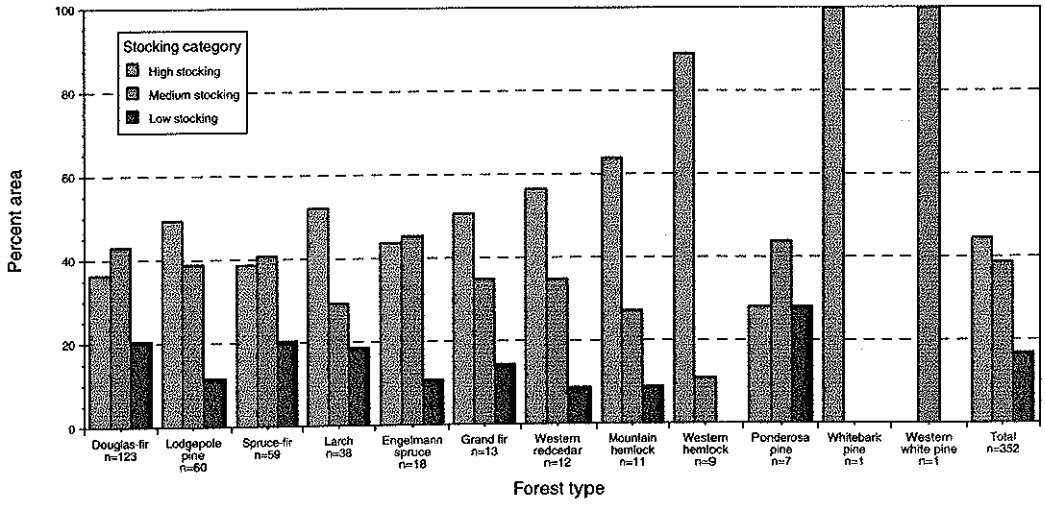


Figure 11—Percent area of live-tree stocking category on forest land by forest type, Kootenai National Forest (n = number of sample sites).

(2) medium stocking - sites that are 35 to 60 percent stocked; and (3) low stocking - sites that are less than 35 percent stocked. At high stocking, tree growth begins to slow and the level of tree vigor starts to decline, which may make trees more susceptible to attack by insects and disease. Approximately 44 percent of all forest land on the Kootenai is in the high stocking category, with 39 percent in the medium stocking category, and 17 percent in the low stocking category.

Growth and mortality—Net tree growth, another indicator of forest vigor, is defined as the difference between gross tree growth and losses due to mortality. For all forest land on the Kootenai, the gross annual growth of growing-stock trees (live timber species meeting specific standards of quality and vigor), 5.0 inches diameter and greater, is estimated at 139.4 million cubic feet. Growing-stock annual mortality is estimated at 97.3 million cubic feet, or 70 percent of the gross annual growth. This results in a net annual growth estimate of about 42.1 million cubic feet for growing-stock trees. However, the mountain pine beetle epidemic on the Kootenai from about 1983 to 1996 had a significant impact on tree mortality. Our inventory at the end of this epidemic may not therefore reflect an average long-term mortality rate. Insect damage accounted for 62 percent of all mortality on Kootenai forest land. Disease and fire were the second most common causes, each resulting in 14 percent of the total mortality.

Figure 12 compares gross annual growth to annual mortality for five high volume species of growing-stock trees (5.0 inches diameter and greater) across all forest land on the Kootenai. Gross annual growth exceeded annual mortality for all high volume species except for lodgepole pine. Overall, about 67 percent of all mortality on forest land can be attributed to losses in lodgepole pine, with the highest levels of loss in the northeastern portion of the Forest. An estimated 80 percent of all mortality for lodgepole pine was the result of insect attacks, with another 11 percent due to fire and 7 percent caused by disease.

Other information about the forest land of the Kootenai

Accessibility—Every forested sample site visited by IWRIME field crews is assigned a "distance to improved road" category; an improved road is defined as one that is graded or otherwise regularly maintained for long-term use. About 56 percent of the forested area on the Kootenai National Forest is less than a half mile from an improved road, with approximately 17 percent between a half and 1 mile, 21 percent between 1 to 3 miles, 4 percent between 3 to 5 miles, and 2 percent greater than 5 miles.

Location history—Field crews also make observations about past evidence of site disturbance, natural or human-caused. Sites are classified by the most predominant type of disturbance. Overall, 33 percent of the forested area on the Kootenai National Forest had evidence of tree cutting as the predominant site disturbance; another 10 percent had evidence of fire disturbance; 9 percent, disease damage; 8 percent, insect damage; and 11 percent had other disturbance such as animal damage, weather-related damage, or road building. Approximately 29 percent of the forested area on the Kootenai had no visible evidence of any site disturbance.

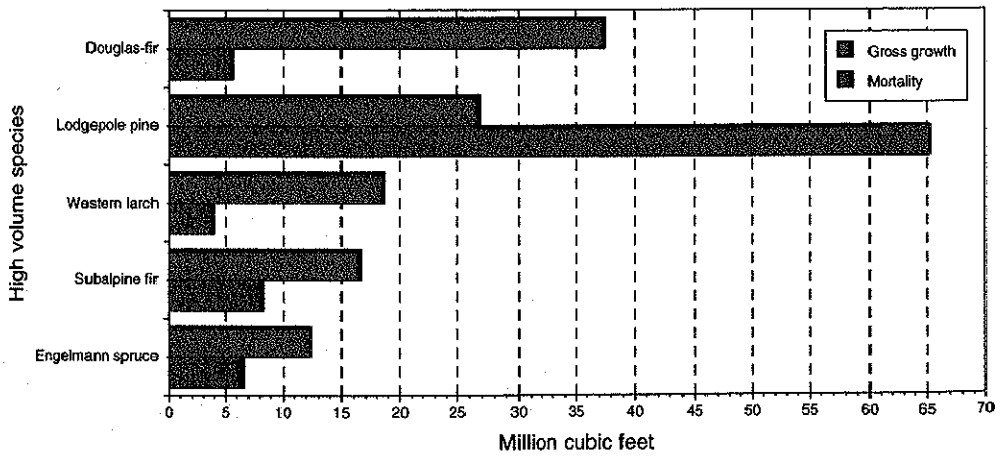


Figure 12—Comparison of gross annual growth to annual mortality for five high volume species (growing-stock trees, 5.0 inches diameter and greater) on all forest land, Kootenai National Forest.

Understory vegetation—The understory vegetation — tree seedlings, shrubs (woody, multiple-stemmed plants), forbs (herbaceous, broad-leaved plants), and graminoids (grasses and grass-like plants) — is an important component of all forest environments. Understory vegetation provides forage and hiding cover for wildlife, and provides ground cover that may aid in the prevention of soil erosion. It also contributes to the forest fuel load and depending on the structure, can have a significant impact on fire behavior. Understory vegetation adds to the aesthetics of a forest, and various understory vegetation species are used for food and medicinal purposes. Particular understory species serve to identify forest habitat types.

The structure and species composition of understory vegetation can be highly diverse from one site to the next. At each IWRIME sample site, percent crown canopy coverage's for tree seedlings, shrubs, forbs, and graminoids were estimated (USDA 1994). Figure 13, as an example, shows the average percent cover of shrubs across all forest land of the Kootenai by height class and forest type.

How much forest land is suitable for timber production?

Wood production is one of the many important uses of nonreserved forest land on National Forests. About 97 percent of the total forest land on the Kootenai National Forest, or 2,095,833 acres, is nonreserved. The net volume of growing-stock trees (5.0 inches diameter and greater) on this nonreserved forest land is over 5.2 billion cubic feet. Nonreserved forest land can be further divided into suitable lands (areas where timber production is considered an appropriate use without irreversible resource damage to soils, productivity, or watershed conditions) or unsuitable lands (areas that are not appropriate for timber production) (USDA 1987). Unsuitable lands may include critical wildlife range, old growth habitat areas, areas designated to provide specific recreational opportunities, habitat types that are difficult to regenerate, or land with physiographic characteristics, such as steep slopes, that are not conducive to timber harvesting.

Approximately 60 percent of the nonreserved forest land on the Kootenai National Forest is considered suitable for regulated timber harvest (USDA 1987). The following summarizes attributes associated with the IWRIME sample plots that fell within the suitable area boundaries.

Forest type and stand size—In terms of forest type, the composition of suitable lands is basically the same as that found across all forest land of the Kootenai. One exception was the spruce-fir forest type, which covers approximately 17 percent of all forest land, as compared to about 10 percent of the suitable forest land area. Another exception is that none of the sample plots within the suitable area were in whitebark pine or western white pine forest types.

Stand-size class distribution on the suitable area is also similar to that on all forest land. About 66 percent of all forest land, as compared to 63 percent of the suitable forest land, is predominantly stocked with large trees. About 15 percent of both total forest land and suitable lands are stocked with medium trees. Additionally, about 17 percent of all forest land and 20 percent of the suitable lands are stocked with saplings/seedlings, and about 2 percent of all forest land and the suitable lands are considered to be nonstocked.

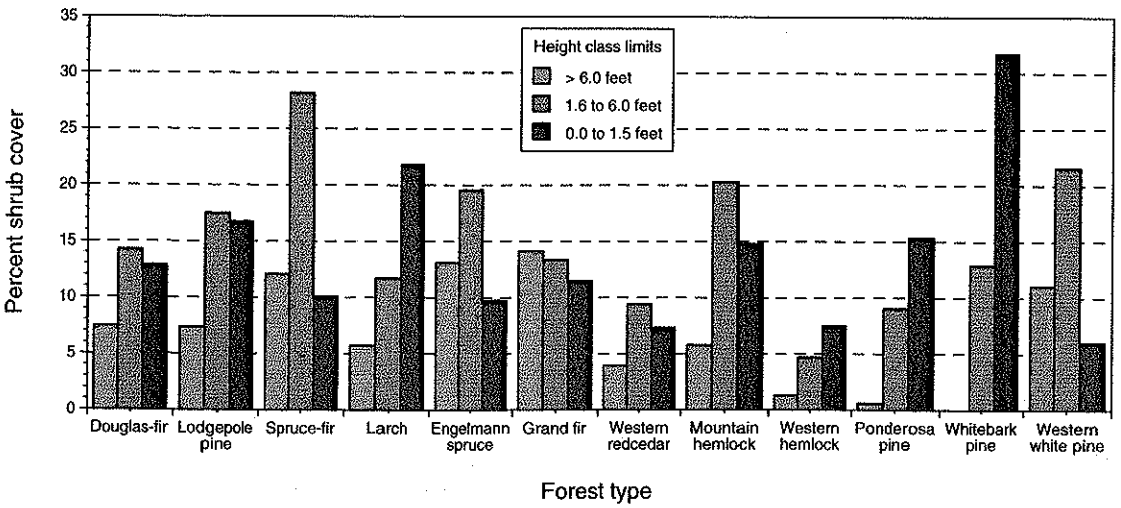


Figure 13—Average percent cover of shrubs on forest land by height class and forest type, Kootenai National Forest.

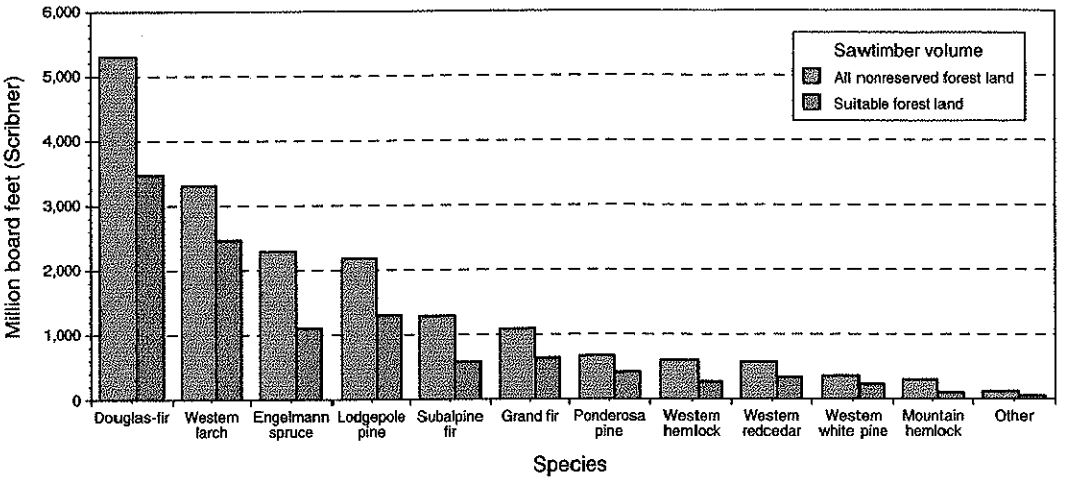


Figure 14—Total net volume of sawtimber on nonreserved forest land compared to the net volume of sawtimber on suitable forest land by species, Kootenai National Forest.

Wood volume—The net volume of growing-stock trees (5.0 inches diameter and greater) on Kootenai forest land suitable for timber harvest is estimated to be about 3.3 billion cubic feet; this amount is about 62 percent of the net growing-stock cubic-foot volume found on all nonreserved forest land. The net volume of sawtimber (growing-stock trees 9.0 inches diameter and greater for softwoods, and 11.0 inches diameter and greater for hardwoods) on suitable lands is estimated to be over 11.0 billion board feet (Scribner rule). Figure 14 provides a species comparison of the total net board-foot volume of sawtimber found on all nonreserved forest land to that found exclusively on land suitable for timber harvest. On the Kootenai suitable forest land, about 54 percent of the total net board-foot volume of sawtimber comes from just two tree species—Douglas-fir and western larch.

Growth and mortality—For all nonreserved forest land on the Kootenai, the gross annual growth of growing-stock trees (5.0 inches diameter and greater) is about 135.8 million cubic feet, with growing-stock annual mortality equal to about 97.0 million cubic feet, or 71 percent of the gross annual growth. For suitable forest land, the gross annual growth of growing-stock trees is estimated to be about 88.4 million cubic feet, with growing-stock annual mortality estimated at 69.3 million cubic feet, or 78 percent of the gross annual growth. This results in a net annual growth estimate of about 38.8 million cubic feet on nonreserved forest land, and 19.1 million cubic feet on suitable forest land, for growing-stock trees.

These net annual growth estimates for nonreserved forest land and suitable lands are impacted by the mountain pine beetle epidemic that resulted in high mortality losses in lodgepole pine. Figure 15 provides a comparison of gross annual growth to annual mortality for lodgepole pine and four other high volume species of growing-stock trees on suitable forest land. Figure 15 (as also in fig. 12)

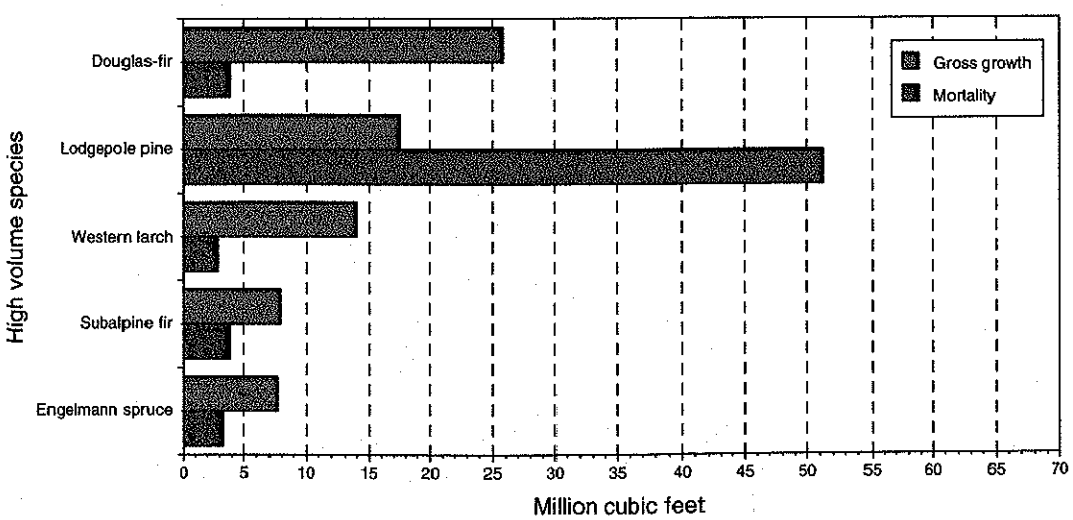


Figure 15—Comparison of gross annual growth to annual mortality for five high volume species (growing-stock trees, 5.0 inches diameter and greater) on forest land suitable for timber harvest, Kootenai National Forest.

shows that annual mortality estimates for lodgepole pine exceeded annual growth estimates.

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. At the time of the Kootenai National Forest inventory, the IWRIME Program had not traditionally conducted inventories on National Forest lands. 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 the IWRIME sampling design.

IWRIME uses a two-phase sampling procedure for all inventories. Phase one is a photo interpretive phase 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 photographs to obtain ownership and vegetation cover information in this phase. In phase two, field crews conduct a comprehensive field inventory on a subsample of the phase one points. The phase two sample uses a 5,000 meter grid, or a plot distribution of approximately 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 366 inventory plots on the Kootenai National Forest. Of these plots, 352 were classified as forest land, 11 were classified as nonforest or water, and three were classified as inaccessible.

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 data. Table 1 contains percent standard errors for net volume, net annual growth, and annual mortality estimates for growing-stock trees on total forest land, nonreserved forest land, and forest land suitable for timber production. Standard errors for other estimates are available upon request (see the "For further information" section on the inside back cover of this report).

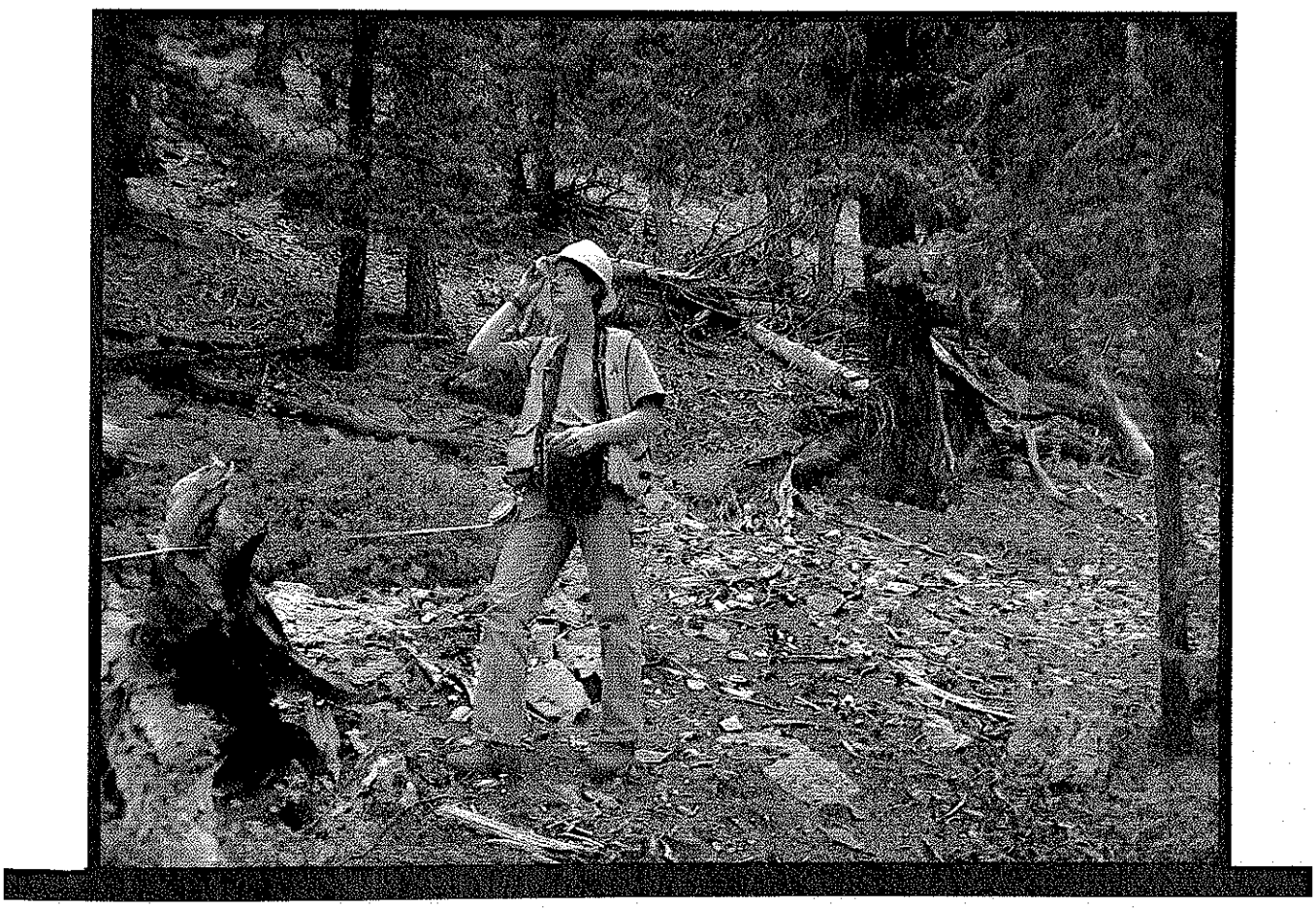


Table 1—Percent standard errors for net volume, net annual growth, and annual mortality for growing-stock trees on total forest land, nonreserved forest land, and land suitable for timber production, Kootenai National Forest.

Land class	Attribute	Growing-stock volume	Percent standard error
		Cubic feet	
Total forest land	Volume	5,391,213,263	4.3
	Growth	42,131,991	34.9
	Mortality	97,304,435	13.6
Nonreserved forest land	Volume	5,251,531,691	4.3
	Growth	38,841,597	37.7
	Mortality	96,959,827	13.6
Land suitable for timber production	Volume	3,281,836,343	6.7
	Growth	19,125,313	64.6
	Mortality	69,255,251	16.6

Documentation

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

Maffei, Tom. 2000. [Personal communication]. March 16. Phone conversation. U.S. Department of Agriculture, Forest Service, Kootenai National Forest, Libby, MT.

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.

U.S. Department of Agriculture, Forest Service. 1987. Kootenai National Forest plan. Libby, MT: U.S. Department of Agriculture, Forest Service, Northern Region.

U.S. Department of Agriculture, Forest Service. 1994. Interior West forest land resource inventory field procedures. Inventory Service Center, USDA Forest Service, Kalispell, MT. 208 p.

U.S. Department of Agriculture, Forest Service. 1995. Biophysical classification—habitat type groups and descriptions. Report on file at: U.S. Department of Agriculture, Forest Service, Northern Region, Kalispell, MT. 17 p.

U.S. Department of Agriculture, Forest Service. 1996. Land areas of the National Forest System. FS-383. As of September 1995. 123 p.

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

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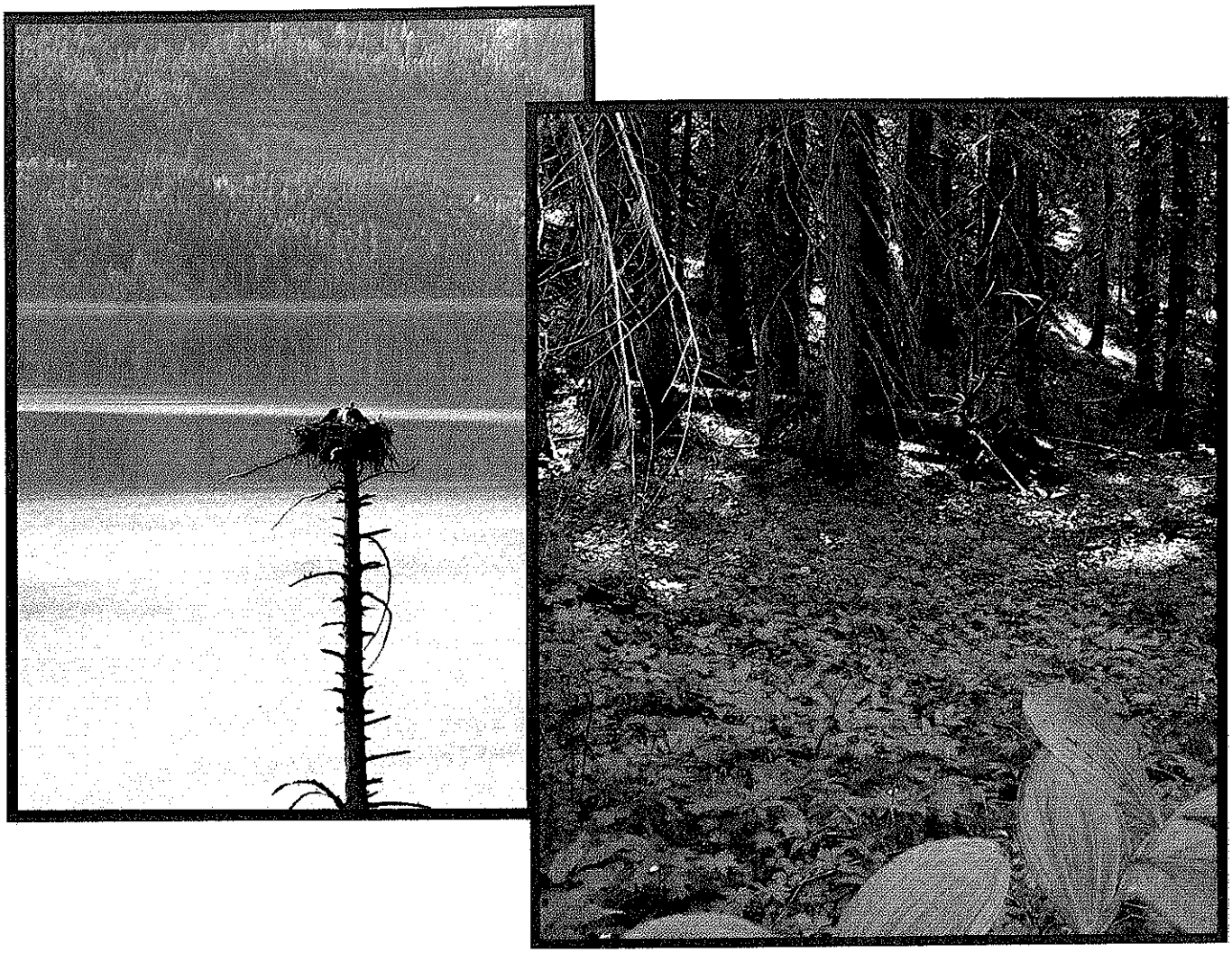
Selected data for this forest are part of a national database that houses information for much of the forest land in the United States. This database can be accessed on the Internet at the following web site:

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



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.