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Forest Resources of the Wasatch-Cache National Forest

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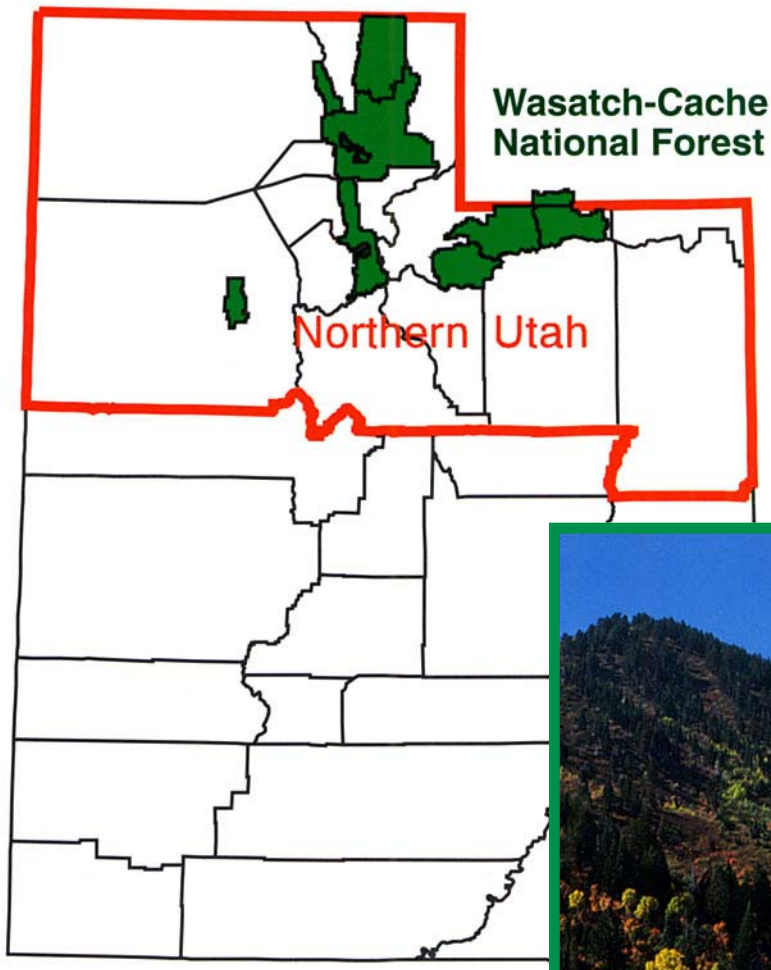
Reese Pope



This summary of the forest resources of the Wasatch-Cache National Forest is based on a comprehensive inventory of all forested lands in Utah. The inventory was conducted in 1995 by the Interior West Resource Inventory, Monitoring, and Evaluation (IWRIME) Program of the U.S. Forest Service, Intermountain Research Station, as part of its National Forest Inventory and Analysis (FIA) duties.

About the authors

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What forest resources are found on the Wasatch-Cache National Forest?

The 1,215,219 acres in the Wasatch-Cache National Forest encompass 863,906 acres of forest land, made up of 90 percent (776,239 acres) "timberland" and 10 percent (87,667 acres) "woodland." The other 351,313 acres of the Wasatch-Cache are nonforest or water (fig. 1). This report discusses forest land only. In the Wasatch-Cache, 26 percent of the total area and 23 percent of the forest land is in reserved status such as Wilderness or Research Natural Areas. Unless otherwise stated, lands of both reserved and nonreserved status are included in the following statistics. Field crews sampled 345 field plots on the Wasatch-Cache.

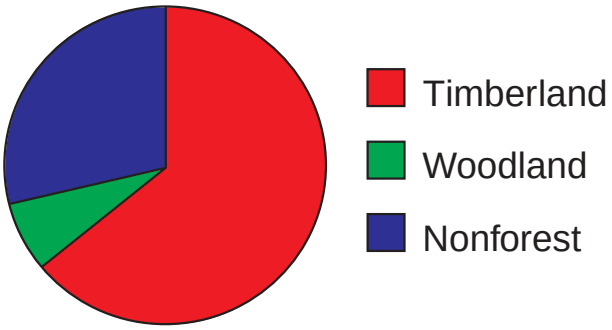


Figure 1—Area by land class, Wasatch-Cache National Forest (see page 8 for definitions of timberland and woodland).

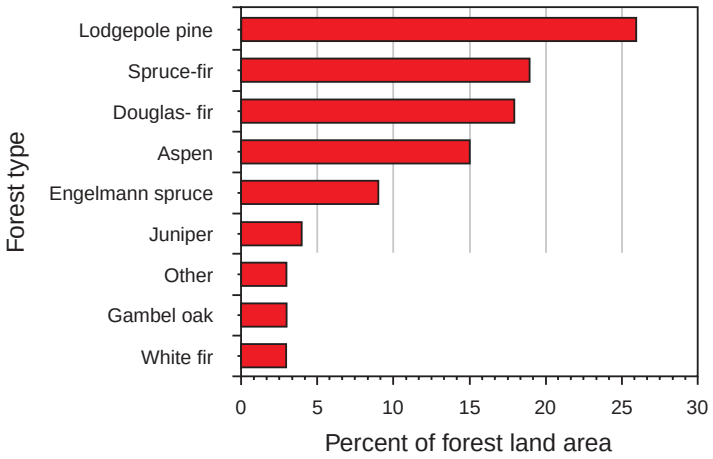


Figure 2—Percent of forest area by forest type, Wasatch-Cache National Forest.

Forest diversity

Forest type—one indicator of forest diversity—refers to the predominant tree species in a stand, based on tree basal area. On the Wasatch-Cache, the most common forest type in percentage of area is lodgepole pine with 26 percent, followed by spruce-fir 19 percent, Douglas-fir 18 percent, aspen 15 percent, Engelmann spruce 9 percent, juniper 4 percent, and white fir and Gambel oak 3 percent each (fig. 2). Other forest types that make up the remaining 3 percent are maple, mountain mahogany, limber pine, blue spruce, and pinyon-juniper

The composition of the forest by individual tree species is another measure of forest diversity. Lodgepole pine makes up 25 percent of the total number of trees; subalpine fire 18 percent, aspen 17 percent, Gambel oak 12 percent, Engelmann spruce 9 percent, and bigtooth maple 8 percent (fig. 3). Douglas-fir, white fir, Utah juniper, Rocky Mountain maple, curlleaf mountain mahogany, blue spruce, Rocky Mountain juniper, and limber pine contribute a total of about 11 percent. Species that are scarce in the Wasatch-Cache, such as ponderosa pine, may not be encountered with the sampling intensity used for this inventory.

Size distribution of individual trees indicates structural diversity. Figure 4 displays the tree size distribution on the Wasatch-Cache. Another stand structure variable, stand-size class, is based on the size of trees contributing to the

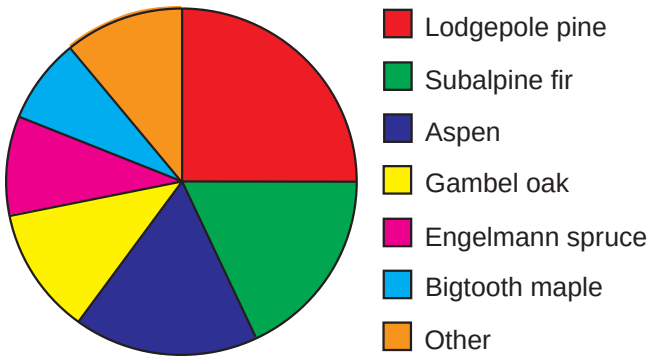


Figure 3—Percent of total number of trees by species, Wasatch-Cache National Forest.

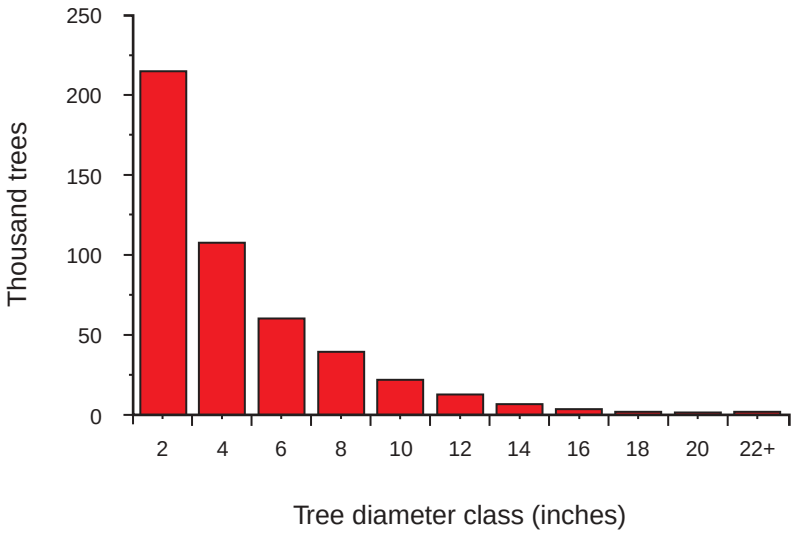


Figure 4—Number of trees on forest land by diameter class, Wasatch-Cache National Forest.

majority of the stocking. Figure 5 gives a breakdown of forest land by stand-size classes. This figure shows that relatively few stands are composed entirely of small trees, such as stands that have been clear cut or burned.

Dead trees—an important component of forest ecosystems—contribute to diversity and serve a variety of functions including wildlife habitat and nutrient sinks. There are roughly 24 million standing dead trees (snags) on the Wasatch-Cache National Forest. This number includes both hard and soft snags of all species and diameters. Many wildlife species are dependent upon these standing dead trees. The species, size, and density of snags required vary according to the species of wildlife. Large diameter snags are generally somewhat scarce, making them more valuable than smaller snags. Considering snags 11 inches in diameter or larger, an estimated 5.5 per acre occur on Wasatch-Cache forest land. Of the large snags (19 inches in diameter or larger) only an average of one per every 2 acres occur on the Wasatch-Cache. The most abundant species of snags in the 19 inch and larger category is Engelmann spruce, followed by lodgepole pine, subalpine fir, and aspen.

Forest successional stage

Habitat types describe lands potentially capable of producing similar plant communities at successional climax. The climax plant community, which is the theoretical end result of plant succession, reflects the integration of environmental factors that affect vegetation such as soils, climate, and landform. Habitat type classifications are named for the predominant overstory and understory plant species at the time of successional climax. In Utah, habitat type classifications have been defined for most forest types traditionally considered to be "timberland" (Mauk and Henderson 1984). However, because well-defined successional states are not known for aspen, classification schemes for aspen are called community types instead of habitat types (Mueggler 1988). Most "woodland" types also remain unclassified in Utah.

The use of potential vegetation to classify forests does not imply an abundance of climax vegetation in the current Utah landscape. In fact, most forest landscapes reflect some form of disturbance and various stages of succession. Fire is a natural disturbance that affects the successional stage of forests. Forest management activities do so as well. For the Wasatch-Cache National Forest,

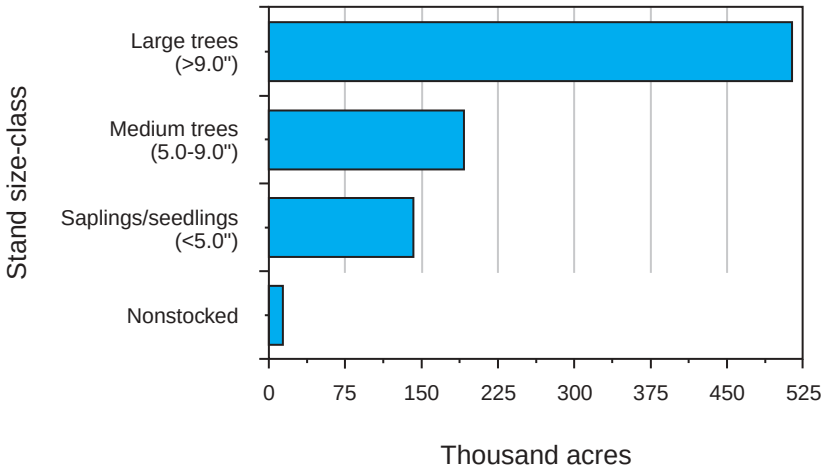
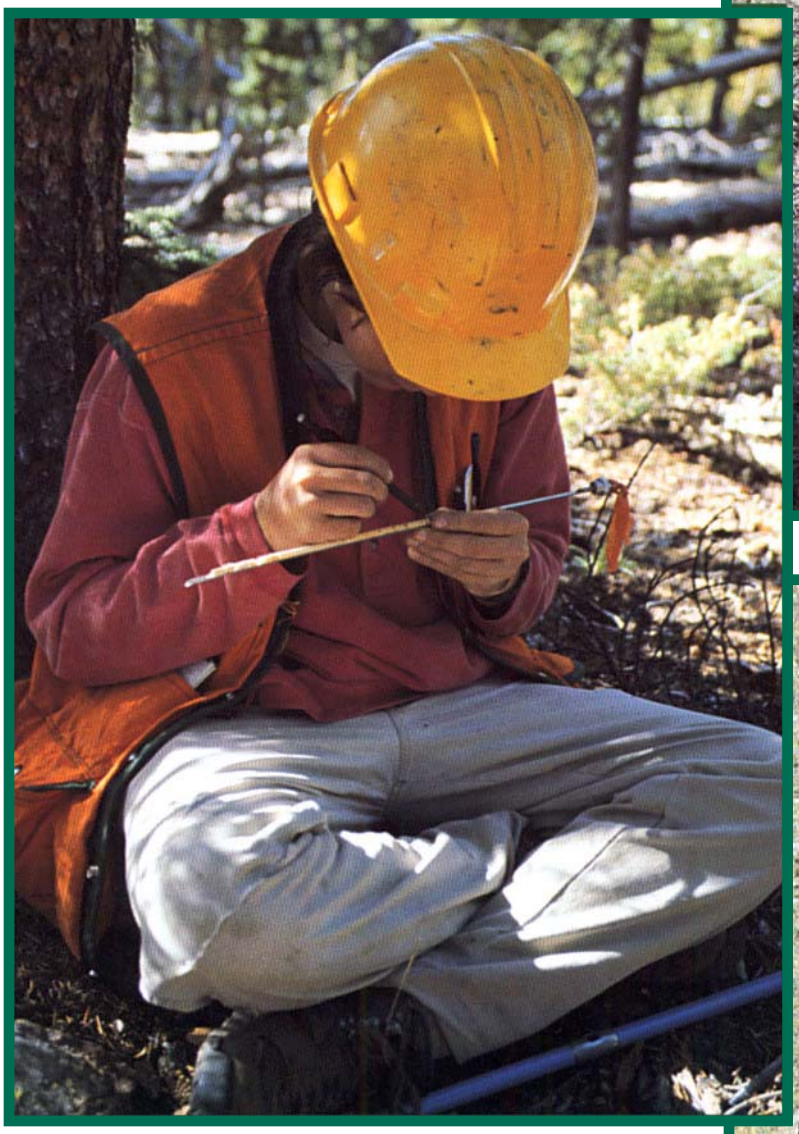


Figure 5—Forest land area by stand-size class, Wasatch-Cache National Forest.



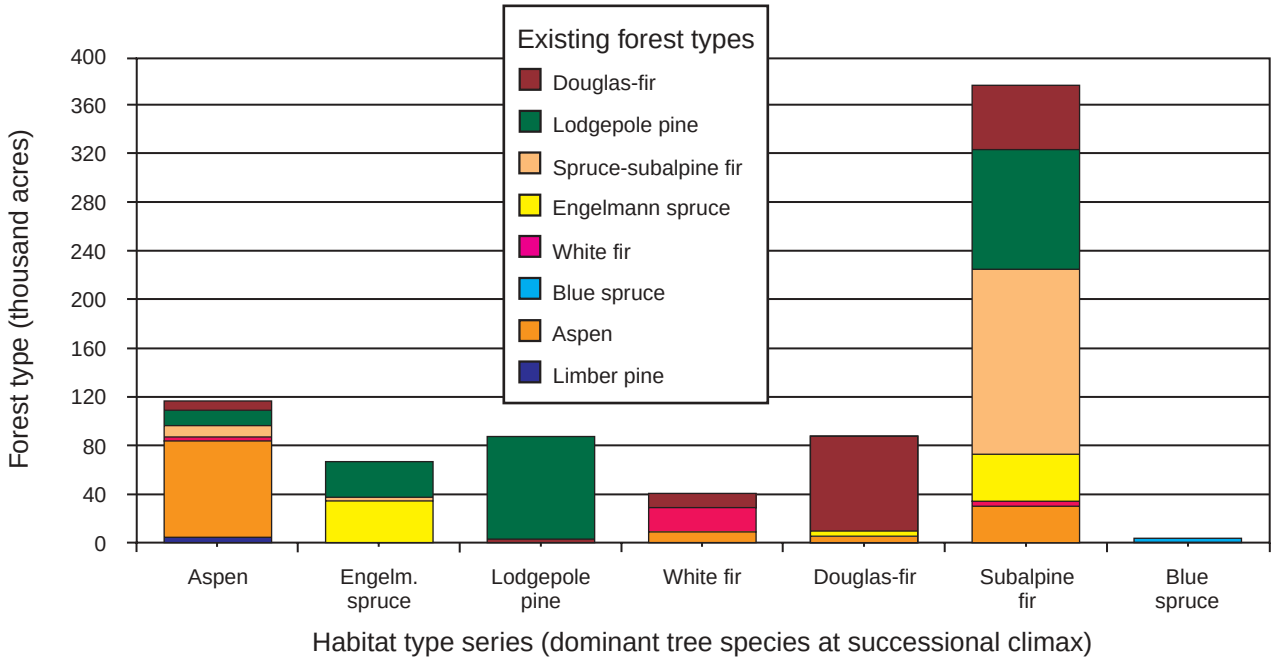


Figure 6—Area of forest type by habitat type series, Wasatch-Cache National Forest.

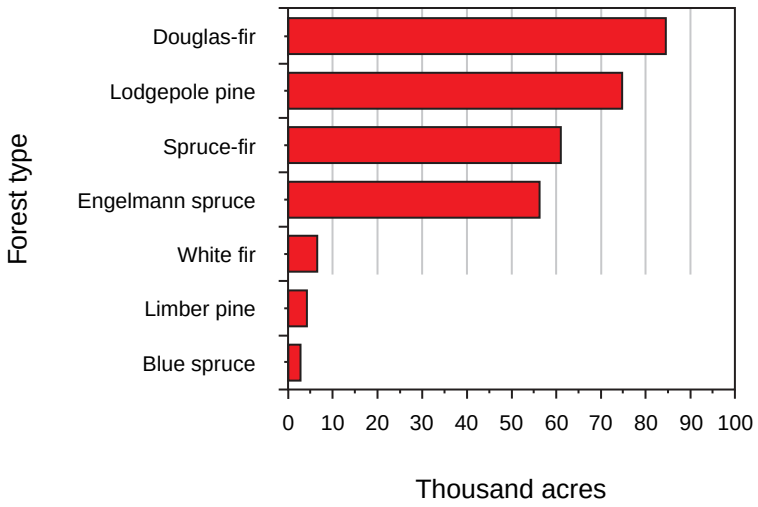


Figure 7—Area of mature stocking condition by forest type, Wasatch-Cache National Forest.

figure 6 compares existing forest types with habitat type series and gives a general indication of forest successional status. The use of classifications based on climax vegetation does not suggest that climax conditions should be a management goal. By summarizing inventory data by habitat type, a picture can be drawn of Wasatch-Cache forests that theoretically will not change with disturbance or advancing succession.

How we define and assess "old growth" forest is important for many reasons. To improve communication about old growth, the Forest Service produced a report on the characteristics of old growth forests in the Intermountain Region (USDA Forest Service 1993). The physical characteristics of old growth are fairly easy to quantify, inventory, and map, but determining functionality with any acceptable agreement or consistency is difficult. Consequently, we prefer to present inventory data using the term "mature" forest, defined as sites with stand age in excess of 100 years. For the Wasatch-Cache, figure 7 shows an estimate of the area of mature forest by forest type, components of which may be candidates for the designation of old growth.

Tree biomass

Total biomass of wood in live trees on the Wasatch-Cache National Forest is estimated at 31 million tons. Biomass estimates include boles (trunk and stem), bark, branches, and foliage of all live trees including saplings and seedlings. Here is a breakdown of tree biomass by species: s:

Species	Thousand cubic feet
Lodgepole pine	9,631
Douglas-fir	6,498
Engelmann spruce	5,533
Subalpine fir	3,667
Aspen	2,619
White fir	754
Gambel oak	513
Bigtooth maple	412
Blue spruce	397
Rocky Mountain maple	289
Utah juniper	277
Curlleaf mountain mahogany	181
Limber pine	135
Rocky Mountain juniper	131
Total	31,037

Wood volume

Wood produced on the Uinta National Forest is valuable. The total volume of wood in live trees is estimated to be in excess of 736 million cubic feet. This includes trees 3.0 inches in diameter and larger for woodland species and 5.0 inches and larger for timber species. Here is a breakdown of cubic-foot volume by species:

Species	Thousand cubic feet
Lodgepole pine	519,143
Engelmann spruce	322,079
Douglas-fir	319,546
Subalpine fir	183,747
Aspen	125,038
White fir	35,542
Blue spruce	24,801
Utah juniper	12,818
Rocky Mountain maple	11,041
Gambel oak	8,687
Big tooth maple	6,122
Rocky Mountain juniper	6,085
Limber pine	4,815
Curlleaf mountain mahogany	4,707
Total	1,584,171

Over 62 percent of this cubic foot volume is in trees 11 inches in diameter or greater. Approximately 88 percent of Douglas-fir and 82 percent of Engelmann spruce volume are in trees larger than 11 inches in diameter. About 58 percent of lodgepole pine volume and about 68 percent of aspen volume are in trees less than 11 inches in diameter.

The volume of sawtimber trees on timberland not reserved from timber harvest is estimated to be 3.5 billion board feet (Scribner rule). Engelmann spruce and Douglas-fir account for 53 percent of the total sawtimber volume. Figure 8 shows percent distribution of sawtimber on nonreserved timberland by species.

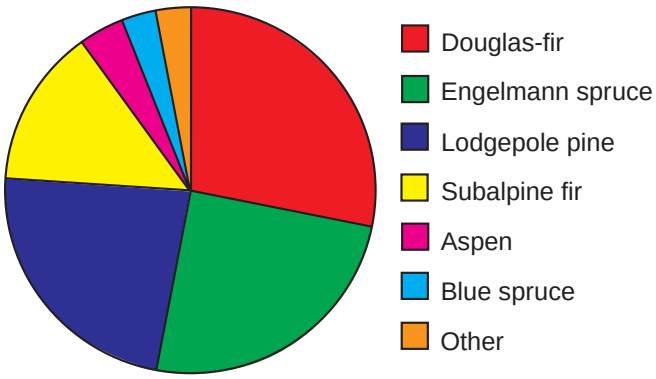


Figure 8—Percent of sawtimber volume on nonreserved timberland by species, Wasatch-Cache National Forest.

How does the forest change?

Many factors influence the rate at which trees grow and thrive, or die. One of those factors is the stocking (relative density) of trees. Overstocking causes tree growth to slow, which makes trees more susceptible to insect attack. About 108,265 acres or 14 percent of all timberland on the Wasatch-Cache is overstocked (fig. 9). This includes 57,274 acres of lodgepole pine, which is about 26 percent of the lodgepole on the Forest. Fully stocked stands may also be susceptible to insects and disease because of decreasing tree vigor. Approximately 192,819 acres, or 25 percent of the timberland, is estimated to be fully stocked.

Another measure of forest vigor is net growth. Net growth is the difference between gross growth and losses due to mortality (fig. 10). Net annual growth on all forest land of the Wasatch-Cache is estimated to be 13.5 million cubic feet. Figure 10 shows that the ratio of mortality to gross growth is greater in some species than others. For example, subalpine fir has a negative net growth, meaning that more volume was lost to mortality than was gained from tree growth.

In 1992, trees containing an estimated 17.8 million cubic feet of wood died in this forest. Almost half of the mortality was estimated to be caused by insects. Disease was estimated to be the cause of another 25 percent. About 57 percent of the mortality occurred in just two species, subalpine fir and lodgepole pine.

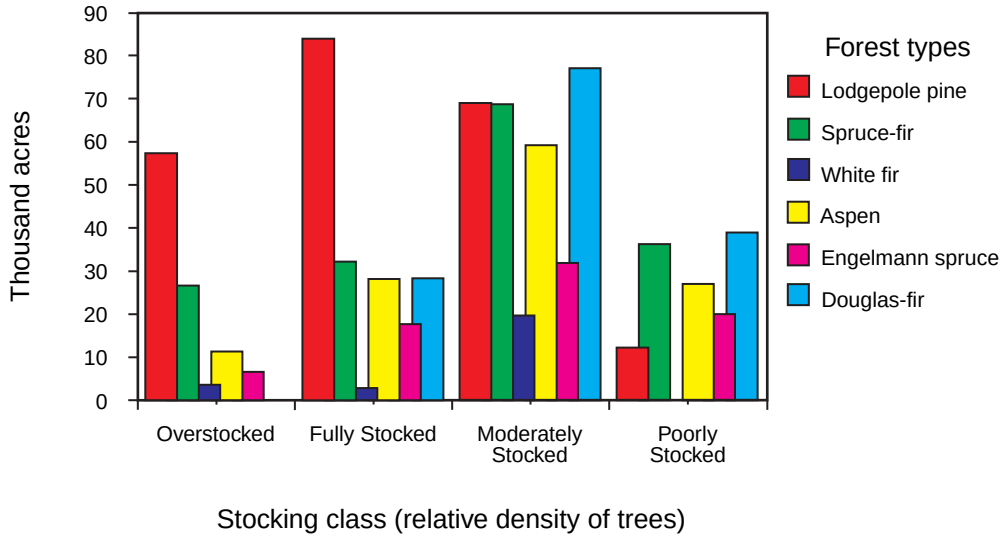


FIgure 9—Area of stocking class by predominant forest type, Wasatch-Cache National Forest.

What about damage from insects?

Hazard ratings for risk of attack by four bark beetle species—Douglas-fir beetle, mountain pine beetle, western pine beetle, and spruce beetle—were adapted for use in Utah forests from Steele and others (1996) and applied to the inventory data. Plots in spruce, spruce-fir, lodgepole pine, Douglas-fir, and ponderosa pine forest types were assigned classes of hazard ratings, and estimates of the area at high, moderate, or low risk of attack by bark beetles were calculated for Utah forests. The area of each forest type in each insect attack risk category on the Wasatch-Cache is presented in table 1. Stands in the spruce and spruce-fir forest types were evaluated for hazard of attack on spruce by bark beetle if there was at least one spruce tree 10 inches in diameter or larger present. Stands in the lodgepole type were evaluated if at least one lodgepole pine tree 5 inches in diameter or larger was present. Stands in the Douglas-fir type needed at least one Douglas-fir tree 9 inches diameter or larger. No ponderosa pine stands were sampled on the Wasatch-Cache. The table also includes the acreage of each forest type where 80 percent of the trees are already dead (and consequently now at low risk of attack) and the area of each type that was not evaluated because the trees in the stands did not meet the minimum size criterion.

Of the spruce/spruce-fir complex, 40 percent is at moderate to high risk of attack by bark beetles. Also, 86 percent of the lodgepole and 90 percent of the Douglas-fir type are at moderate to high risk. High risk conditions indicate the possibility of bark beetle population increases, which can in turn cause significant tree mortality and changes in stand structure over a short time. For forest managers, these changes could greatly affect objectives related to fire, recreation, wildlife habitat, threatened and endangered species, and water quality and quantity.

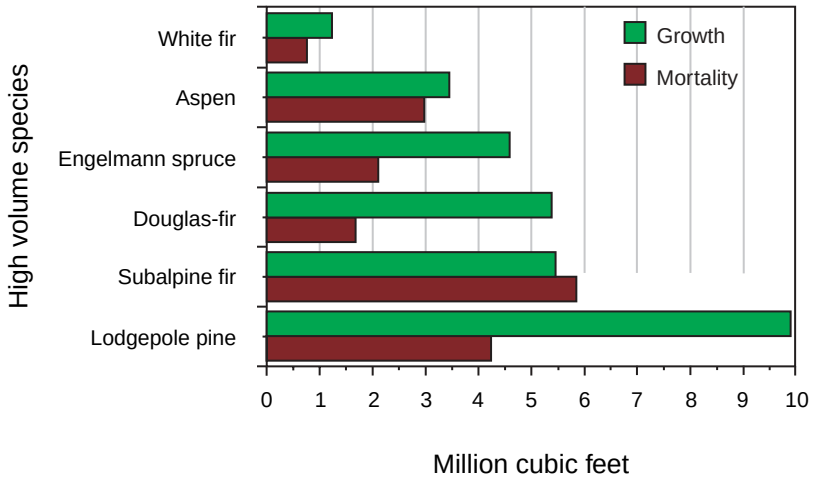


Figure 10—Gross annual growth compared to mortality, Wasatch-Cache National Forest.

Table 1—Area at risk of attack by bark beetles by forest type and risk category, Wasatch-Cache National Forest.

Forest type	Risk rating category					
	Low	Moderate	High	80 percent dead	Not evaluated	Total
	Acres					
Spruce and spruce-fir	66,836	90,043	6,573	—	79,093	242,545
Lodgepole	21,325	174,929	17,028	6,115	3,058	222,455
Douglas-fir	—	47,517	89,135	4,173	11,736	152,560

Are aspen forests declining?

Stands of aspen—an important forest type throughout much of the Western United States—provide critical habitat for many wildlife species, forage for livestock and wildlife, and protection and increased streamflow in critical watersheds. Aspen stands have great aesthetic value and enhance the diversity of the conifer-dominated forests of Utah. Information from various sources indicates that aspen is declining in much of its range (Bartos 1995; USDA Forest Service 1996).

Aspen forests are unique because they reproduce primarily by suckering from the parent root system. Often a disturbance or dieback is necessary to stimulate regeneration of the stands. Because these self-regenerating stands have existed for thousands of years, even minor amounts of aspen in stands probably indicate that a site was previously dominated by aspen. Based on this assumption, an estimated 374,000 acres on the Wasatch-Cache National Forest were formerly aspen forest type. By comparison, only about 129,000 acres (34 percent) currently have the required aspen stocking to be considered aspen forest type. These acreage comparisons support the hypothesis that aspen dominance in Utah forests is decreasing.

How does the Wasatch-Cache compare with the rest of Utah's forests?

Reports summarizing the inventory data for northern Utah have been prepared by O'Brien (1996) and Brown (in press). A Utah State report is also currently being prepared (O'Brien, in preparation). These researchers found that an estimated 29 percent of all Utah, and 25 percent of northern Utah, is forest land. The most common forest type in northern Utah (fig. 11) and the entire state (fig. 12) is pinyon-juniper, followed by aspen.

Comparing figures 11 and 12 to figure 2, the reader will see how the overall breakdown of the Wasatch-Cache in terms of forest type differs from northern Utah and the rest of the State. For example, lodgepole pine is the most common forest type on the Wasatch-Cache, and the spruce-fir forest type is second. By comparison, pinyon-juniper is the most common forest type, with aspen second, both in northern Utah and the entire State.

Another report on the condition of Utah forests is being prepared by the Intermountain Station's Interior West Resource Inventory, Monitoring, and Evaluation Program, in conjunction with the Intermountain Region's Forest Health Protection staff (LaMadeleine and O'Brien, in preparation). That report for the entire State will include estimates of area and volume that are impacted by

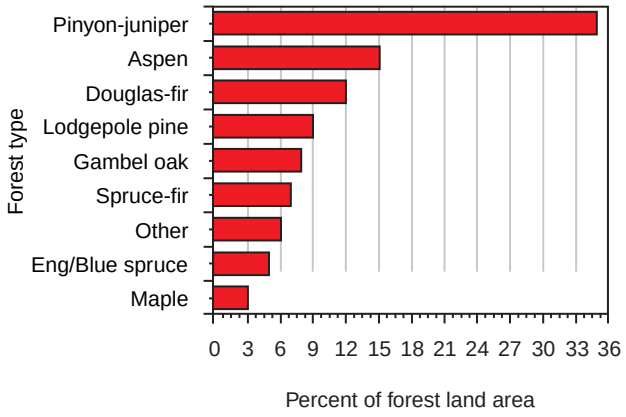


Figure 11—Percent of forest land area by forest type, northern Utah.

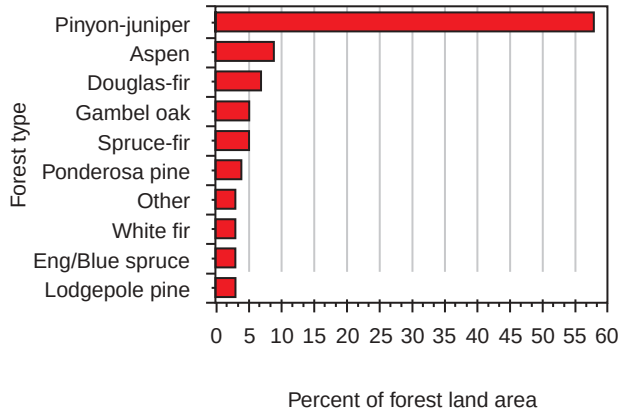
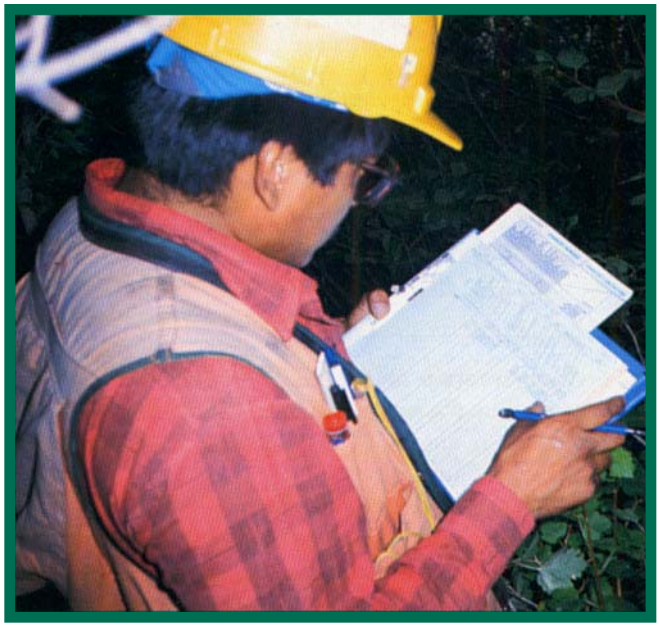


Figure 12—Percent of forest land by forest type, entire Utah State total.



mistletoe and root disease, and the number of acres at risk of attack by bark beetles.

How was the inventory conducted?

In 1995, the Interior West Resource Inventory, Monitoring, and Evaluation Program of the U.S. Forest Service, Intermountain Research Station, as part of its national Forest Inventory and Analysis duties, completed a comprehensive forest resource inventory of all forested lands in Utah. Our 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. We have not traditionally conducted inventories on National Forest lands in the West, but in Utah, a cooperative agreement and funding from the Forest Service Intermountain Region made possible an expanded inventory that included National Forest System lands.

In the past, we collected inventory data only for tree species normally favored for commercial timber harvest—"timber species" such as ponderosa pine, lodgepole pine, and Douglas-fir. Since the early 1980's, we have expanded our inventory to include other tree species such as pinyon, juniper, and oak, collectively known as "woodland species." In Utah, a location was classified as timberland if there existed a minimum of 5 percent crown cover of timber species. For current and future reporting, the more ecological and all-encompassing term "forest land" is preferred instead of timberland and woodland. However, some mensuration and silvicultural definitions and techniques that were developed for timberland species are not yet available for woodland species. Therefore, the separate terms are used occasionally in this report.

We use a two-phase sampling procedure for State 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 used maps and aerial photos to obtain ownership and stratification for field sampling. Field crews, made up of forestry technicians, biologists, botanists, and some college students, conducted the second, or field, phase of the inventory on a subsample of the phase one points that occurred on forest land. For this inventory, we defined forest land as land with at least 10 percent stocking (or 5 percent cover) of trees; or lands currently nonstocked but formerly having such stocking, where human activity does not preclude natural succession to forest. All conifers of any size except pinyon, juniper, and yew automatically qualify as trees, as do aspen, cottonwood, and paper birch. Other species such as pinyon, juniper, maple, mountain mahogany, and oak were classified as either trees or shrubs, depending on whether they have the capacity to produce at least one stem 3 inches or larger in diameter at root collar, and 8 feet or more in length to a minimum branch diameter of 1.5 inches. The sampling intensity on lands outside the National Forest was one field plot every 5,000 meters, or about every 3 miles. The sampling intensity on National Forest System lands was double that of outside lands.

Our 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, such as National Forest summaries. Standard errors were computed for each National Forest and are available upon request (see the "For further information" section on the following page).

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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.mmstate.edu/scripts/ew.htm

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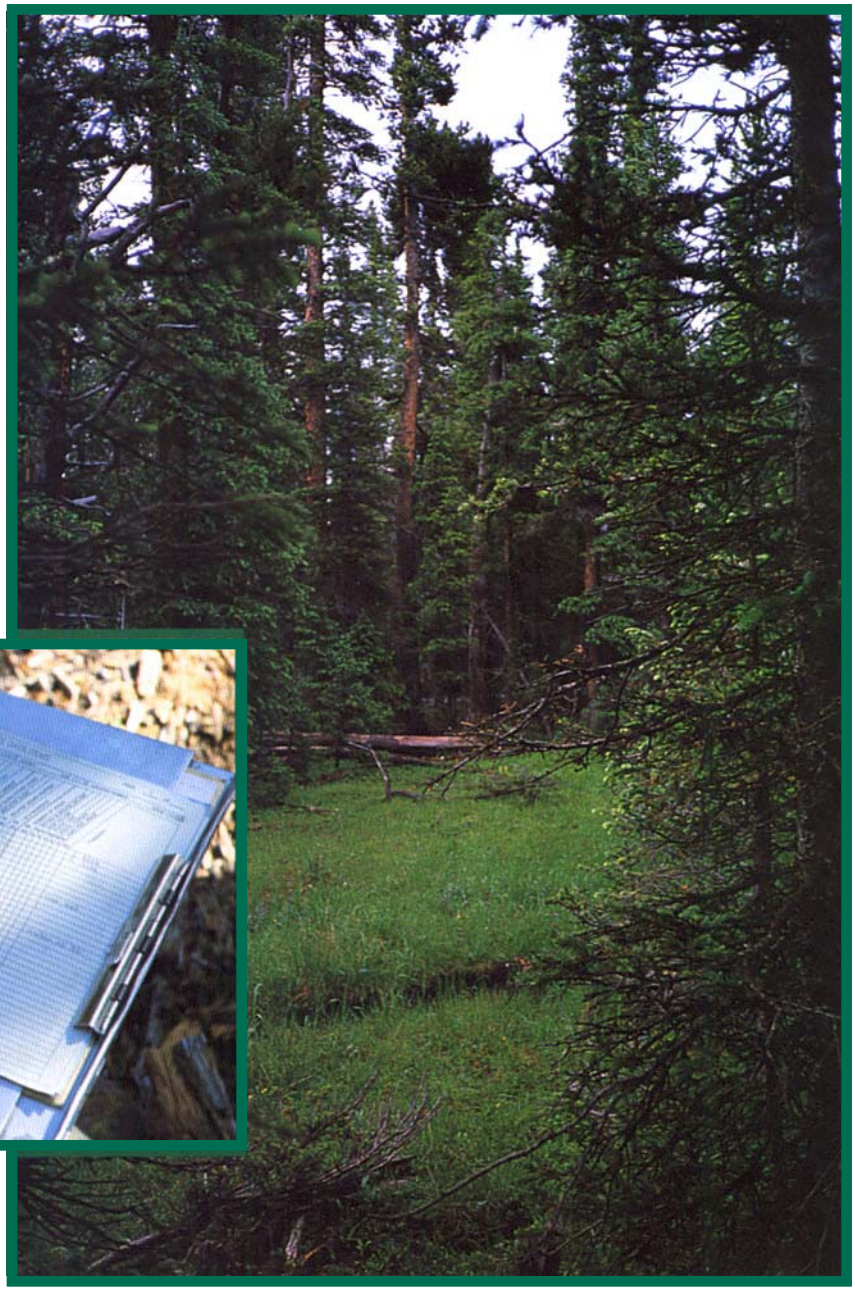

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