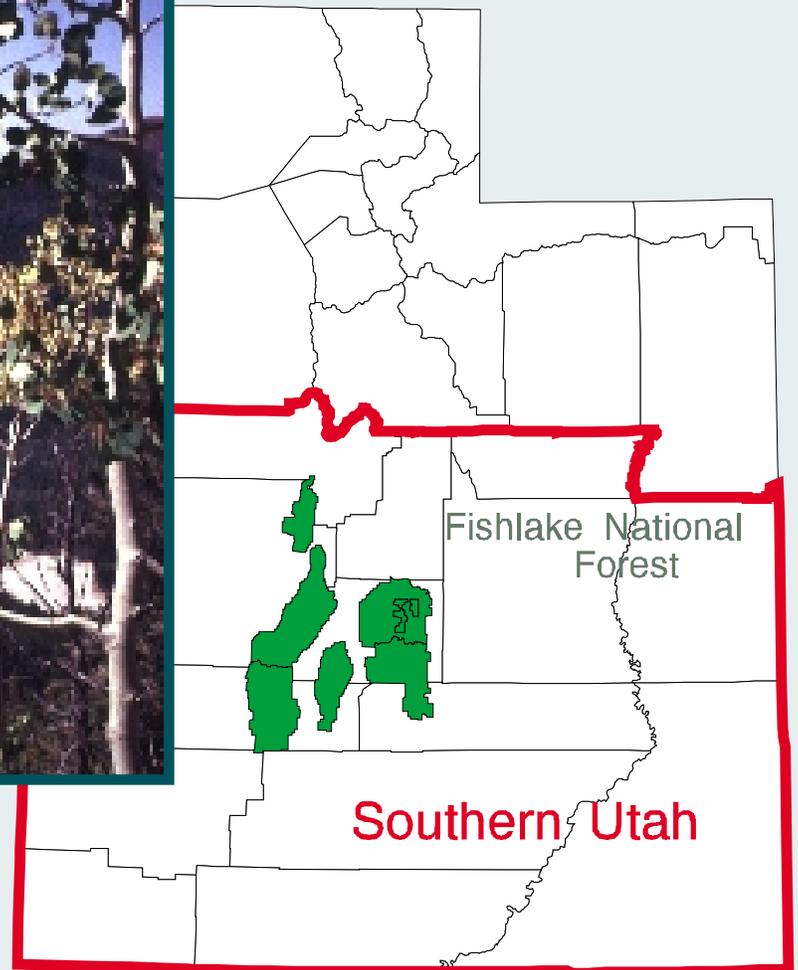
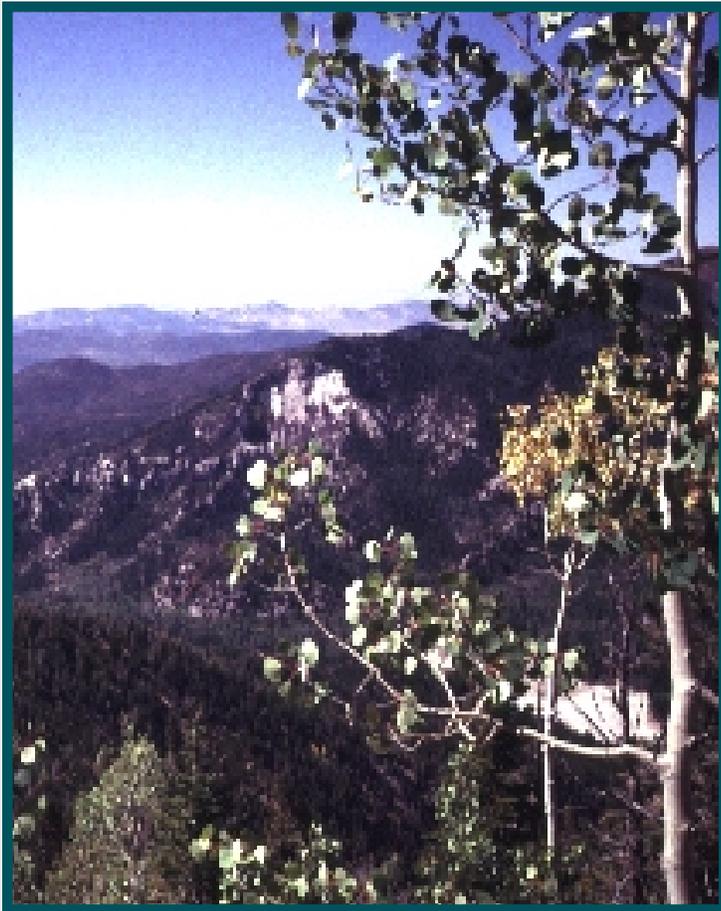




Forest Resources of the Fishlake National Forest

**Renee A. O'Brien
Shirley H. Waters**



An extensive, comprehensive inventory of all forested lands in Utah was completed in 1995 by the Interior West Resource Inventory, Monitoring, and Evaluation (IWRIME) Program of the U.S. Forest Service, Intermountain Research Station (now called Rocky Mountain Research Station), as part of its National Forest Inventory and Analysis (FIA) duties. The information presented in this report is based solely on the IWRIME inventory sample. Additional data collected by National Forests and used separately or in combination with IWRIME data will produce varying results.

About the authors

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What forest resources are found on the Fishlake National Forest?

The 1,434,592 acre Fishlake National Forest encompasses 971,500 acres of forest land, made up of 43 percent (421,241 acres) “timberland” and 57 percent (550,259 acres) “woodland” (see definitions on page 8). The other 463,092 acres of the Fishlake are nonforest (fig. 1). This report discusses forest land only. None of the Forest has reserved status for Wilderness, but established, proposed, and candidate Research Natural Areas occupy about 8,000 acres. All of the following statistics represent nonreserved forest land.

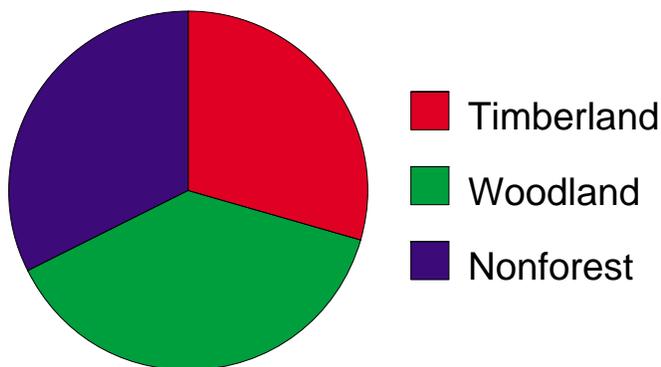


Figure 1—Area by land class, Fishlake National Forest (see page 8 for definitions of timberland and woodland).

Forest diversity

Forest type—one indicator of forest diversity—refers to the predominant tree species in a stand, based on tree stocking. On the Fishlake, the most common forest type in percent of forested area is pinyon-juniper with 44 percent, followed by aspen, 15 percent, spruce-fir, 9 percent, white fir, 7 percent, mountain mahogany and Douglas-fir, each with 6 percent, oak and Engelmann spruce, each with 4 percent, and pure juniper and ponderosa pine, each with approximately 2 percent (fig. 2). Limber pine and maple forest types make up the remaining 1 percent of the area.

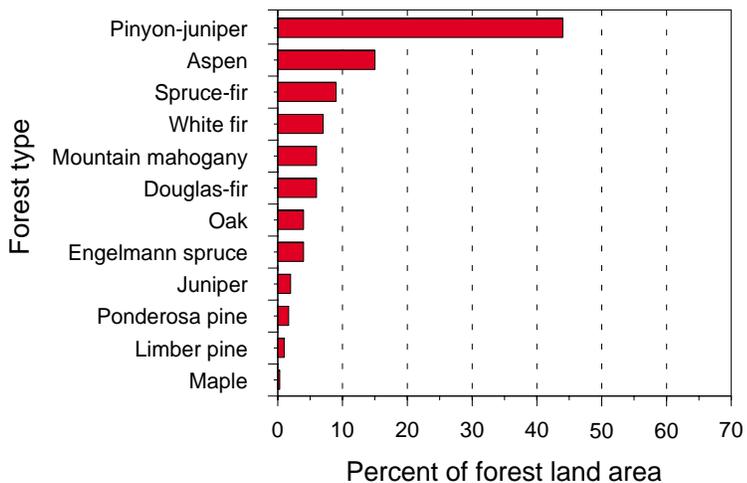


Figure 2—Percent of forest area by forest type, Fishlake National Forest.

The composition of the forest by individual tree species is another measure of forest diversity. Aspen makes up 23 percent of the total number of trees, Gambel oak, 22 percent, twoneedle pinyon, 13 percent, subalpine fir, 13 percent, Utah juniper, 8 percent, white fir, 7 percent, and Engelmann spruce and curleaf mountain mahogany, each with 4 percent (fig. 3). Douglas-fir, limber pine, Rocky Mountain juniper, Rocky Mountain maple, bigtooth maple, blue spruce, bristlecone pine, ponderosa pine, singleleaf pinyon, true mountain mahogany, and



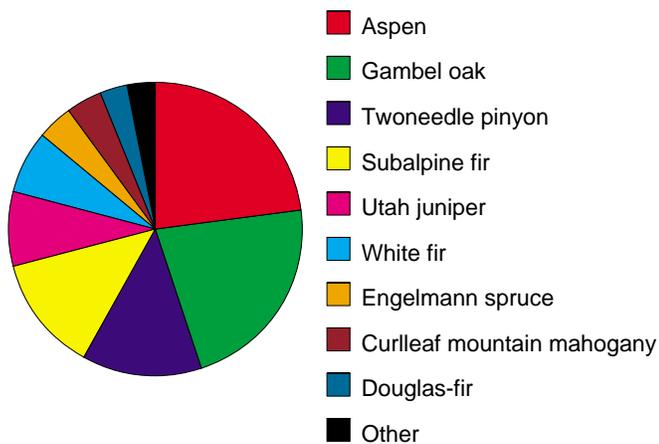


Figure 3—Percent of total number of trees by species, Fishlake National Forest.

cottonwood each contribute 1 percent or less. Species that are scarce 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 Fishlake. Another stand structure variable, stand-size class, is based on the size of trees contributing to the 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 mostly of small trees, such as stands that have been clearcut 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 20 million

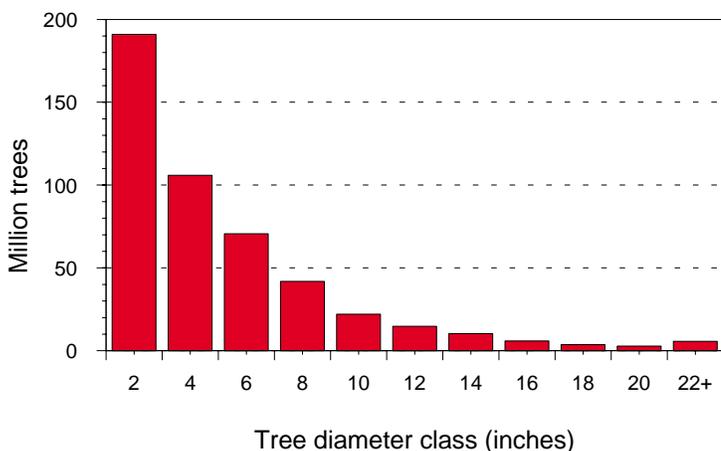


Figure 4—Number of live trees on forest land by diameter class, Fishlake National Forest.

standing dead trees (snags) on the Fishlake National Forest. This number includes both hard and soft snags of all species and diameters. Many wildlife species are dependent upon snags. The species, size, and density of snags required varies 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 3.5 per acre occur on Fishlake forest land. Of the very large snags (19 inches in diameter or larger) there is only an average of 1 per every 2 acres on the Fishlake. The most abundant species of snags in the 19 inch and larger category is Utah juniper, followed by Engelmann spruce, and then Douglas-fir.

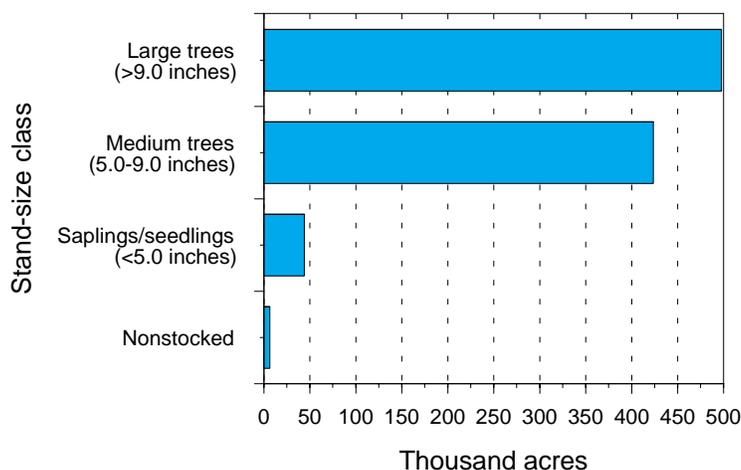


Figure 5—Forest land area by stand-size class, Fishlake National Forest.

Habitat types

Habitat types describe lands in terms of their potential to produce 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 Utah 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

describe existing vegetation and are called community types instead of habitat types (Mueggler 1988). Most “woodland” types remain unclassified in Utah.

By summarizing inventory data by habitat type, Fishlake forest land can be categorized in a way that theoretically will not change with disturbance or advancing succession. The use of potential vegetation to classify forests is not intended to indicate an abundance of climax vegetation in the current Utah landscape, nor is it meant to suggest that climax conditions should be a management goal. 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 Fishlake National Forest, figure 6 compares existing forest types with habitat type series to give an idea of current conditions compared to potential.

Stand Age

Figure 7 shows area of forest type by stand age class. Stand age for timberland is computed using ages of growing-stock trees, weighted by trees per acre. Stand age for woodland is usually based on the age of one selected site tree. Forty-five percent of all stands, and 43 percent of pinyon-juniper stands are estimated to be between 51 and 100 years old. Only 10 percent of all stands are estimated to be over 200 years old.

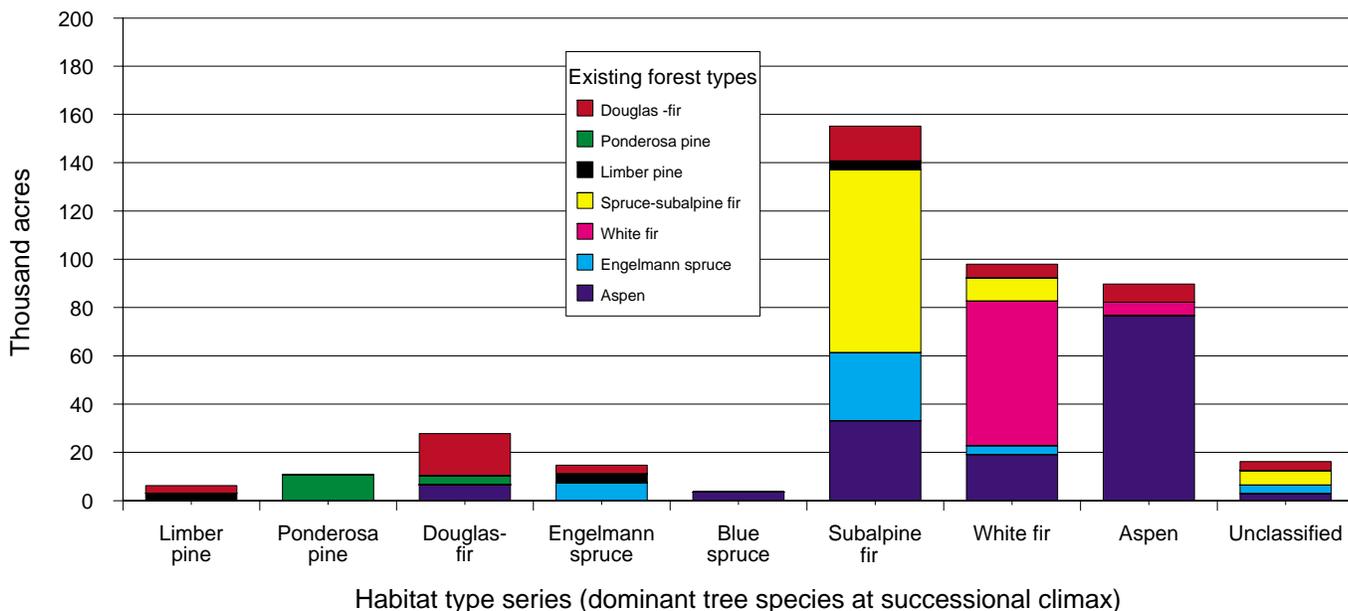


Figure 6—Area of forest type by habitat type series, Fishlake National Forest.

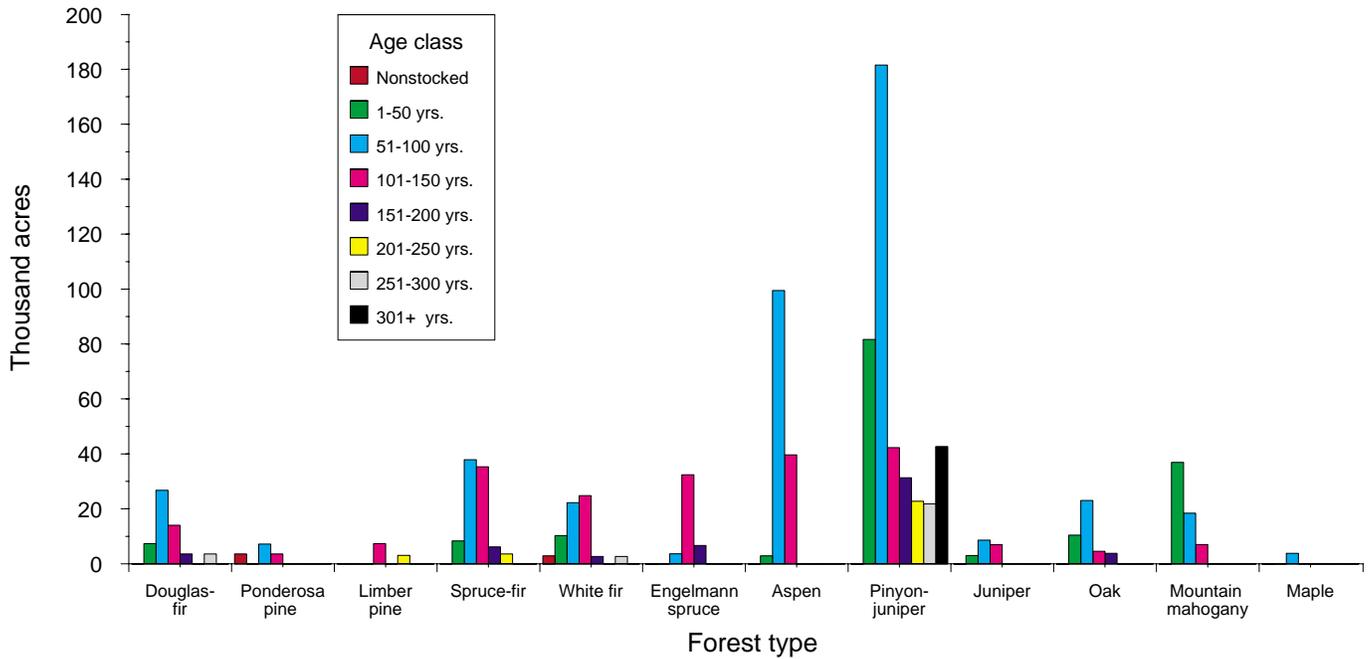


Figure 7—Area of forest type by stand age class, Fishlake National Forest.

Tree biomass

Total biomass of wood in live trees on the Fishlake National Forest is estimated at over 27.5 million tons. Biomass estimates include boles, bark, branches, and foliage of all live trees including saplings. Here is a breakdown of tree biomass by species:

Species	Thousand tons
Aspen	5,757
Utah juniper	4,169
Engelmann spruce	3,366
Twoneedle pinyon	2,578
White fir	2,475
Subalpine fir	2,268
Gambel oak	2,191
Douglas-fir	1,988
Curleaf mountain mahogany	1,461
Limber pine	335
Rocky Mountain juniper	334
Ponderosa pine	231
Blue spruce	200
Bigtooth maple	65
Rocky Mountain maple	49
Singleleaf pinyon	24
Other	15
Total	27,506



Wood volume

Wood produced on the Fishlake National Forest is valuable. The total volume of wood in live trees is estimated to be in excess of 1.2 billion cubic feet. This includes trees 3 inches in diameter and larger for woodland species and 5 inches and larger for timber species. Here is a breakdown of cubic-foot volume by species:

Species	Thousand cubic-feet
Aspen	288,006
Utah juniper	204,157
Engelmann spruce	202,154
Twoneedle pinyon	143,933
White fir	111,534
Subalpine fir	103,869
Douglas-fir	92,775
Curleaf mountain mahogany	32,369
Gambel oak	18,973
Limber pine	16,998
Rocky Mountain juniper	14,450
Blue spruce	12,394
Ponderosa pine	9,938
Bigtooth maple	2,502
Rocky Mountain maple	1,664
Singleleaf pinyon	1,295
Other	484
Total	1,257,495

About 64 percent of the cubic-foot volume on the Fishlake is found in trees 11 inches in diameter or greater. Approximately 87 percent of Utah juniper, 83 percent of Engelmann spruce, and 76 percent of Douglas-fir volume is in trees larger than 11 inches in diameter. Only about 39 percent of aspen volume is in trees greater than 11 inches in diameter.

The volume of sawtimber trees on timberland on the Fishlake is estimated to be 2.3 billion board feet (Scribner rule). Engelmann spruce, white fir, and Douglas-fir combined account for 64 percent of the total sawtimber volume. Figure 8 shows percent distribution of sawtimber on timberland by species.

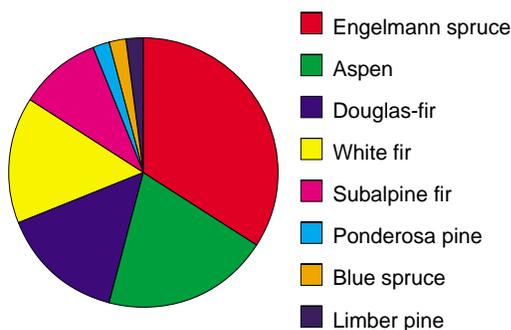
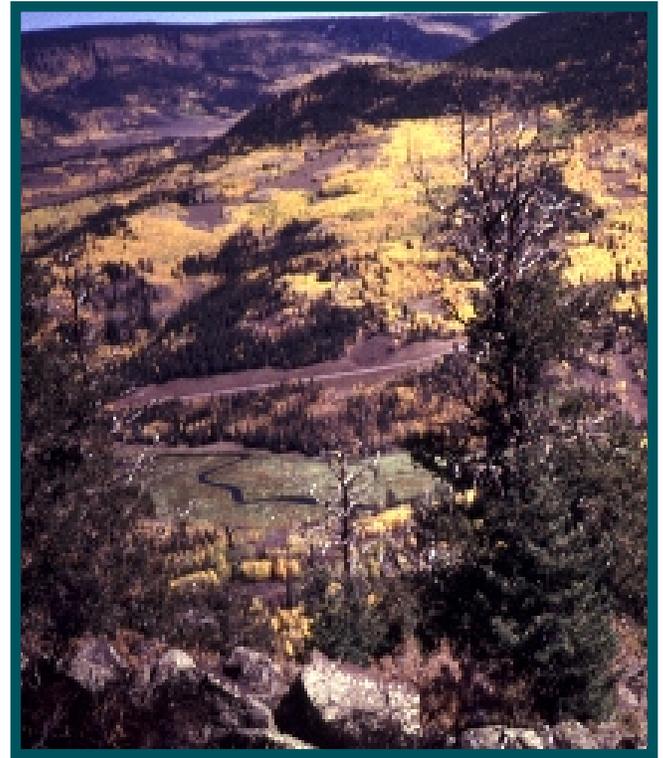


Figure 8—Percent of sawtimber volume on timberland by species, Fishlake National Forest.



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 76,700 acres or 18 percent of all timberland on the Fishlake is overstocked (fig. 9). This includes 44,476 acres of aspen, which is about 31 percent of the aspen on the Forest. Fully stocked stands may also be susceptible to insects and disease because of decreasing tree vigor. Approximately 142,440 acres, or 34 percent of the timberland on the Fishlake 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. Net annual growth on all forest land of the Fishlake is estimated to be about 14 million cubic feet. Figure 10 compares mortality to gross growth for 5 timber species, and shows that the gross growth to mortality ratio is greater in some species than others.

Field crews estimate which trees have died in the last 5 years; this assessment is then used to calculate annual mortality. In 1992, trees containing about 9 million cubic feet of wood died in this Forest. About 67 percent of the mortality was estimated to be caused by disease, and another 11 percent by insects. About 40 percent of the mortality occurred in just one species, subalpine fir.

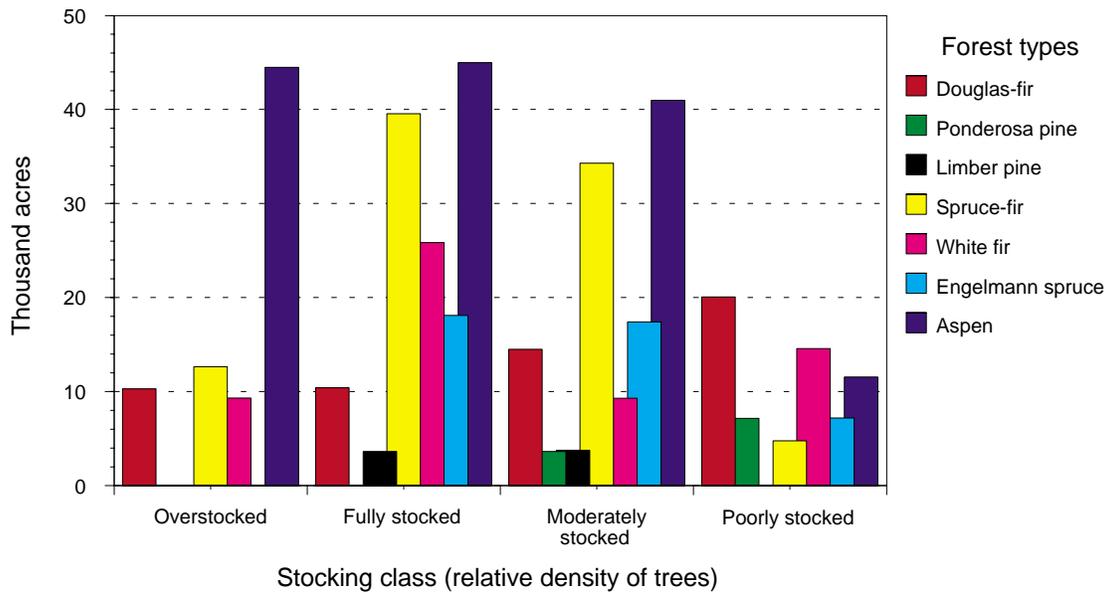


Figure 9—Area of stocking class by predominant forest type, Fishlake National Forest.

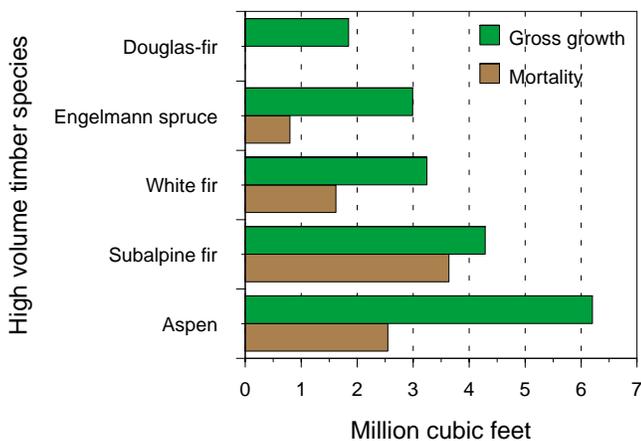


Figure 10—Gross annual growth compared to mortality, Fishlake National Forest.

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, 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 Fishlake is presented in table 1. Stands in the spruce-fir and spruce forest types were

evaluated for hazard of attack by bark beetle if there was at least one spruce tree 10 inches in diameter or larger present. Stands in the ponderosa pine type were evaluated if at least one ponderosa 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 in diameter or larger. 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 stands did not have trees that met the minimum size criteria. On the Fishlake there was no area where 80 percent of the trees were already dead.

Forty-two percent of the spruce and spruce-fir types, 75 percent of the ponderosa type, and 42 percent of the Douglas-fir type are at moderate risk of attack by bark beetles. Thirty-two percent of the Douglas-fir type is at high risk. Moderate to high risk conditions indicate the possibility of bark beetle population increases, which in turn can cause significant tree mortality and changes in stand structure over a short period of 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.

Are aspen forests declining?

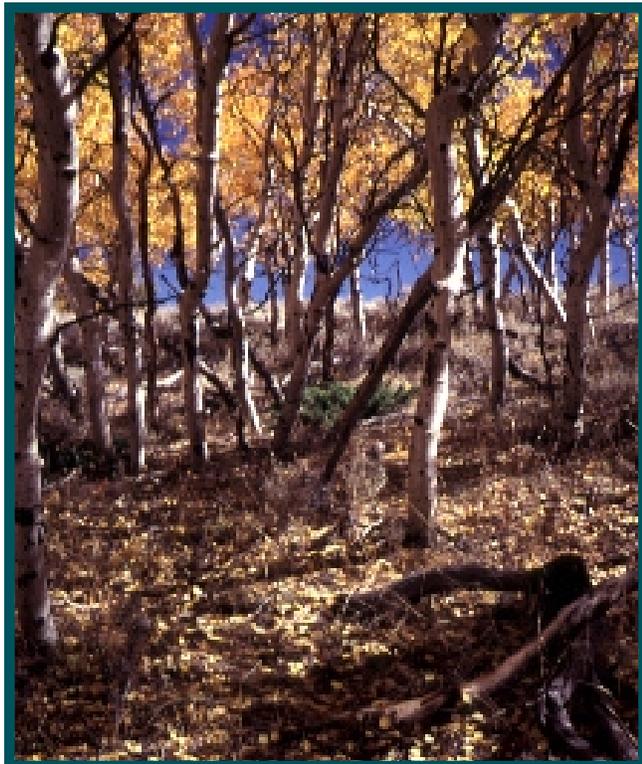
Stands of aspen—a very important forest type throughout much of the Western United States—provide critical habitat for many wildlife species, forage for livestock and wildlife, and protection and increased streamflow in critical watersheds. Aspen stands have great aesthetic

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

Forest Type	Risk rating category					Total
	Low	Moderate	High	80 percent dead	Not evaluated	
-----Acres-----						
Spruce and spruce-fir	43,978	56,498	—	—	33,390	133,867
Ponderosa pine	3,575	10,757	—	—	—	14,332
Douglas-fir	10,286	23,282	17,907	—	3,751	55,225

value and enhance the diversity of the conifer-dominated forests of Utah. Information from various sources indicate that aspen is declining in much of its range (Bartos 1995; Bartos and Campbell 1998; Mrowka and Campbell 1997; USDA FS 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 at one time dominated by aspen. Based on this assumption, an estimated 313,724 acres on the Fishlake National Forest were formerly aspen forest type. By comparison, only 141,948 acres (45 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 Fishlake compare with the rest of Utah's forests?

Reports summarizing the inventory data for northern Utah have been published by O'Brien (1996) and Brown and O'Brien (1997). 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 31 percent of southern Utah, is forest land. The most common forest type in southern Utah (fig. 11) and the entire State (fig. 12) is pinyon-juniper, followed by aspen or juniper. Comparing figures 11 and 12 to figure 2, the reader will see how the overall breakdown of the Fishlake differs from southern Utah and the entire State in terms of forest type.

Another report on the condition of Utah forests is being prepared by the Rocky Mountain Research 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 will include estimates of area and volume that are impacted by mistletoe and root disease, and the number of acres at risk of attack by bark beetles.

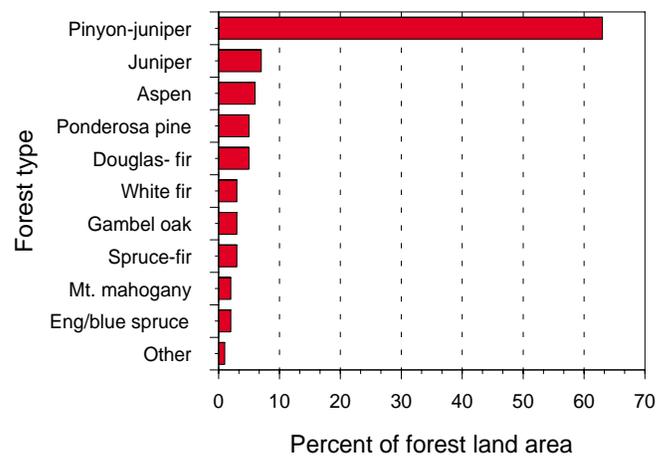


Figure 11—Percent of forest land area by forest type, southern Utah.

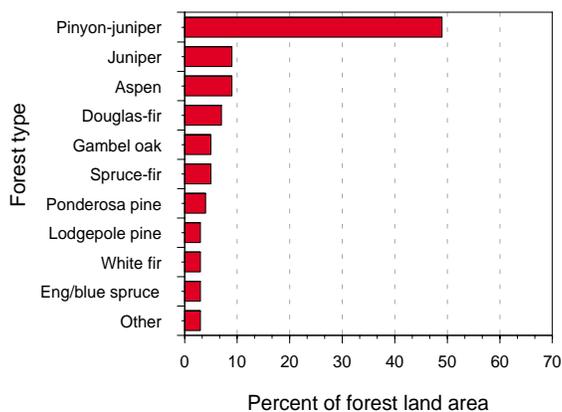


Figure 12—Percent of forest land by forest type, entire Utah State total.

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, Engelmann spruce, 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 timber 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 vegetation cover type. This information is then used

for stratification of field plots. 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 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 in diameter at root collar (drc) or larger, and 8 feet or more in length to a minimum branch diameter of 1.5 inches. The sampling intensity on lands outside 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.

Interior West Resource Inventory, Monitoring, and Evaluation field crews sampled 358 field plots on the Fishlake, of which 226 were forested. Information presented in this report is based solely on the IWRIME inventory sample. Additional data collected by the Forest, used separately or in combination with IWRIME data, will produce varying results.

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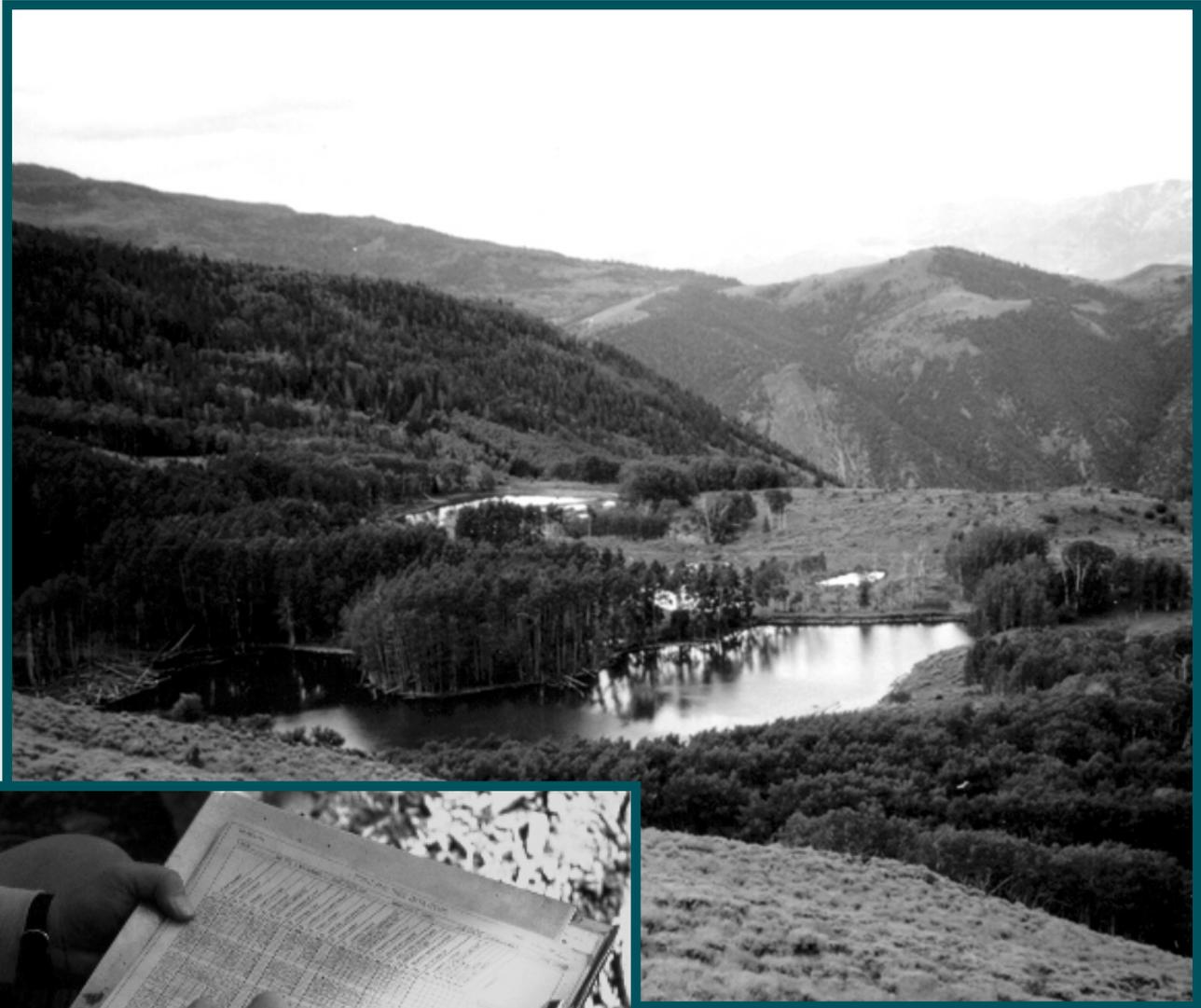
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The information presented here is just a small part of a national data base that houses information for much of the forest land in the United States. This data base can be accessed on the Internet at the following web site:

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



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.

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