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Forest Resources of the Dixie National Forest

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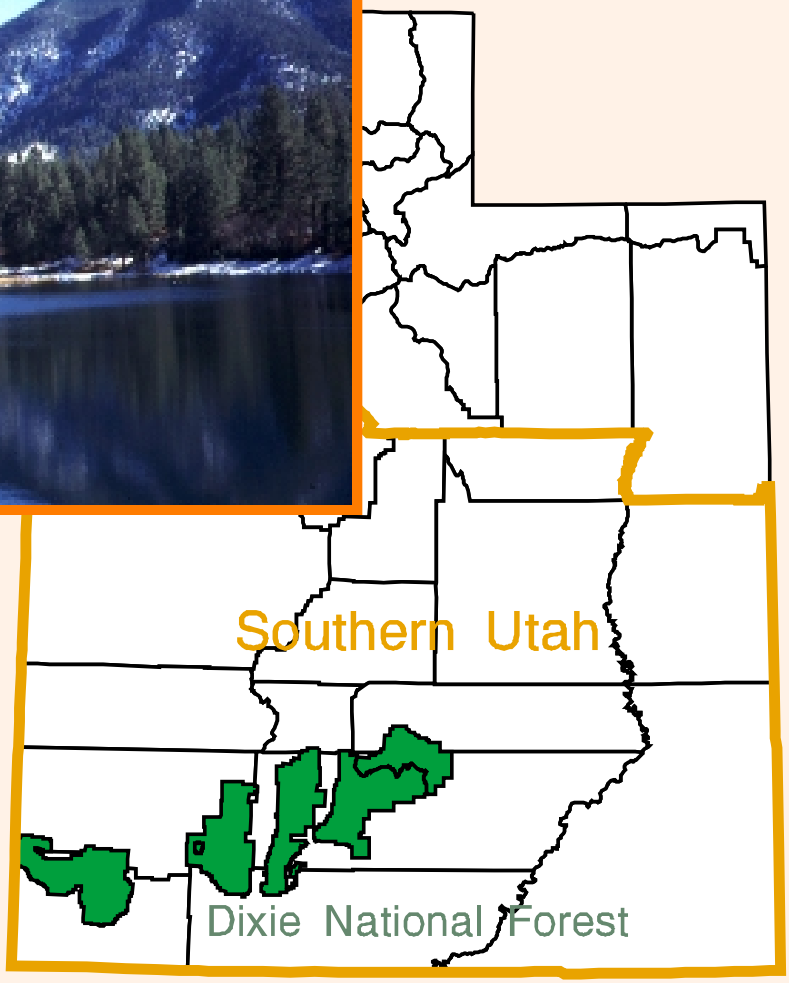

An extensive, comprehensive inventory of all forested lands in Utah was completed in 1995 by the Interior West Resource Inventory, Monitoring, and Evaluation (IWRIME) Program of the U.S. Forest Service, Intermountain Research Station (now called Rocky Mountain Research Station), as part of it's national 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 Dixie National Forest?

The 1,883,895 acre Dixie National Forest encompasses 1,448,852 acres of forest land, made up of 57 percent (827,446 acres) "timberland" and 43 percent (621,406 acres) "woodland" (see definitions on page 8). The other 435,043 acres of the Dixie are nonforest (fig. 1). This report discusses forest land only. Just 4 percent of the Dixie National Forest is in reserved status, which means that the land has been withdrawn from tree utilization through statute or administrative designation, as in wilderness. Unless otherwise stated, lands of both reserved and nonreserved status are included in the following statistics.

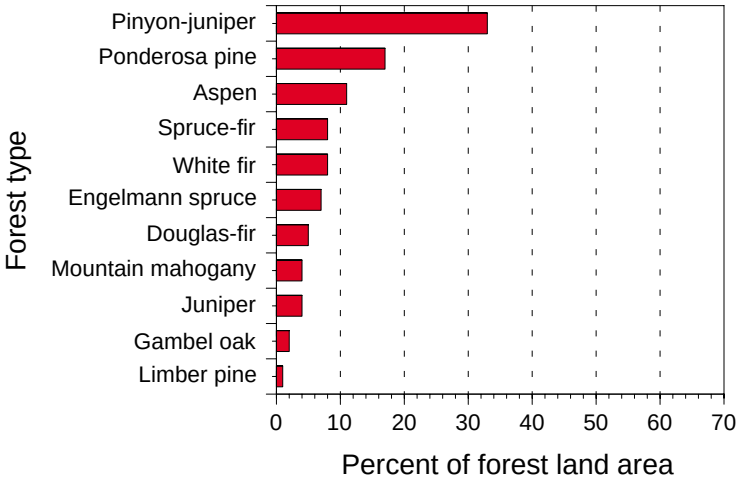

Figure 2—Percent of forest area by forest type, Dixie National Forest.

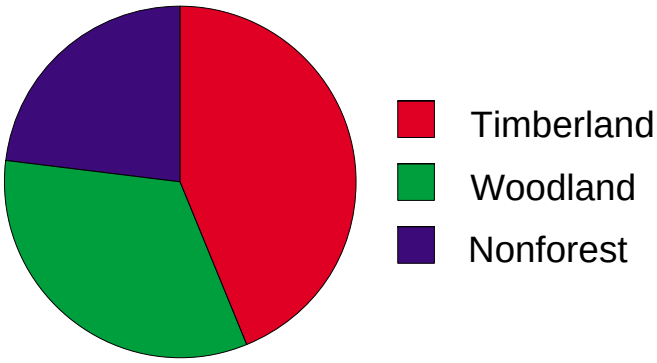

Figure 1—Area by land class, Dixie National Forest (see page 8 for definitions of timberland and woodland).

Forest diversity

Forest type—one indicator of forest diversity—refers to the predominant tree species in a stand, based on tree stocking. On the Dixie, the most common forest type in percent of forested area is pinyon-juniper with 33 percent, followed by ponderosa pine, 17 percent, aspen, 11 percent, spruce-fir and white fir, both 8 percent, Engelmann spruce, 7 percent, and Douglas-fir, 5 percent (fig. 2). Mountain mahogany, juniper, Gambel oak, and limber pine types make up the remaining 11 percent.

The composition of the forest by individual tree species is another measure of forest diversity. Aspen makes up 22 percent of the total number of trees, subalpine fir, 18 percent, Gambel oak, 10 percent, common pinyon and Engelmann spruce, each 8 percent, and Utah juniper and white fir, each 7 percent (fig. 3). Douglas-fir, ponderosa pine, singleleaf pinyon, and curlleaf mountain mahogany each make up 4 percent, and Rocky Mountain juniper, limber pine, blue spruce, Rocky Mountain maple, bigtooth maple, bristlecone pine, and cottonwood

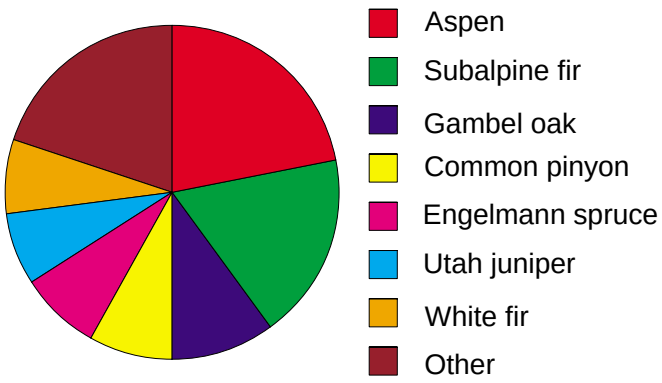

Figure 3—Percent of total number of trees by species, Dixie National Forest.

combined make up the remaining 4 percent. 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 Dixie. 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.

Dead trees—an important component of forest ecosystems—provide wildlife habitat and serve as nutrient sinks, among other uses. There are roughly 29 million standing dead trees (snags) on the Dixie 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, and have important habitat characteristics and longevity that makes them more valuable than smaller snags. Considering snags 11 inches in diameter or larger, an estimated 3.5 per acre occur on Dixie forest land. Of the very large snags (19 inches in diameter or larger) there is only an average of .6 per acre on the Dixie. The most abundant species of snags in the 19 inch and larger category is ponderosa pine, followed by Engelmann spruce.

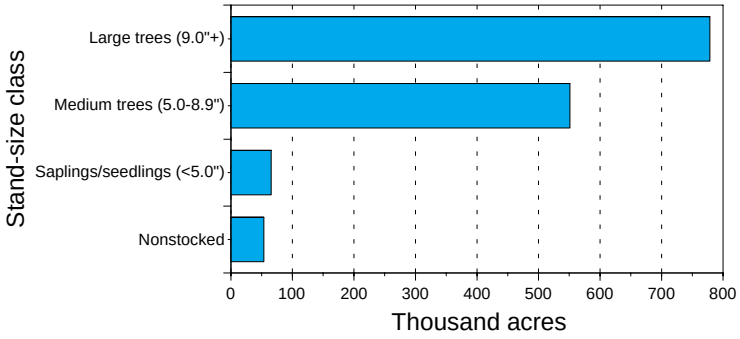

Figure 5—Forest land area by stand-size class, Dixie National Forest.

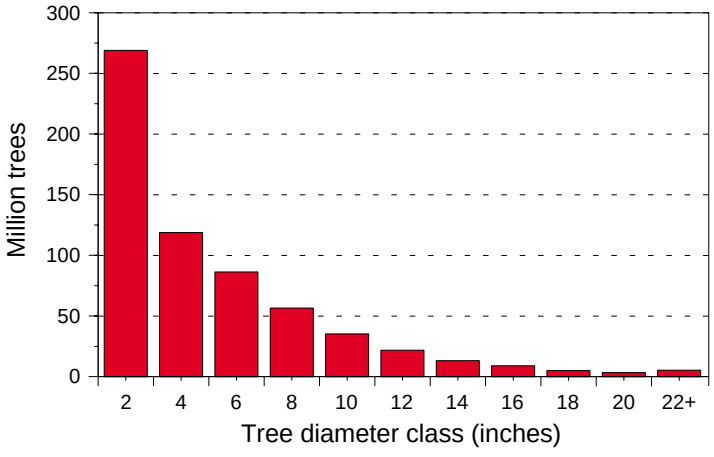

Figure 4—Number of live trees on forest land by diameter class, Dixie National Forest.

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, Dixie 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 Dixie 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-seven percent of all stands, and 72 percent of aspen stands are estimated to be between 51 and 100 years old. Only 7 percent of all stands are estimated to be over 200 years old.

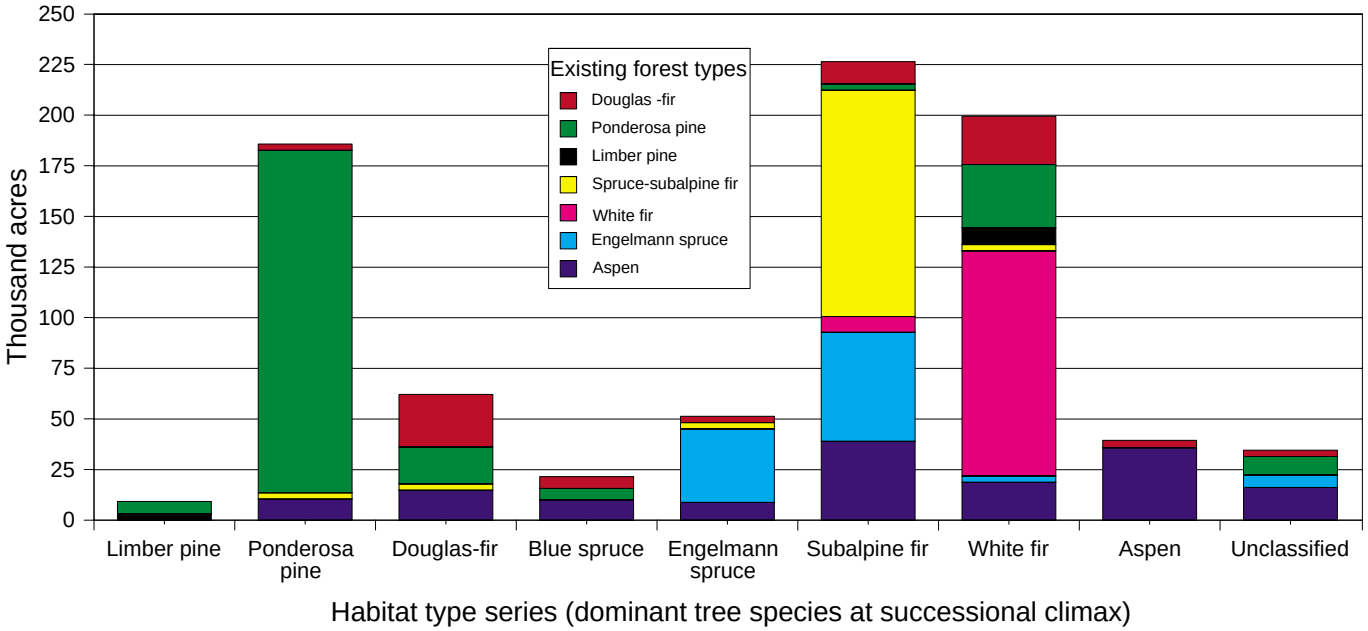

Figure 6—Area of forest type by habitat type series, Dixie National Forest.

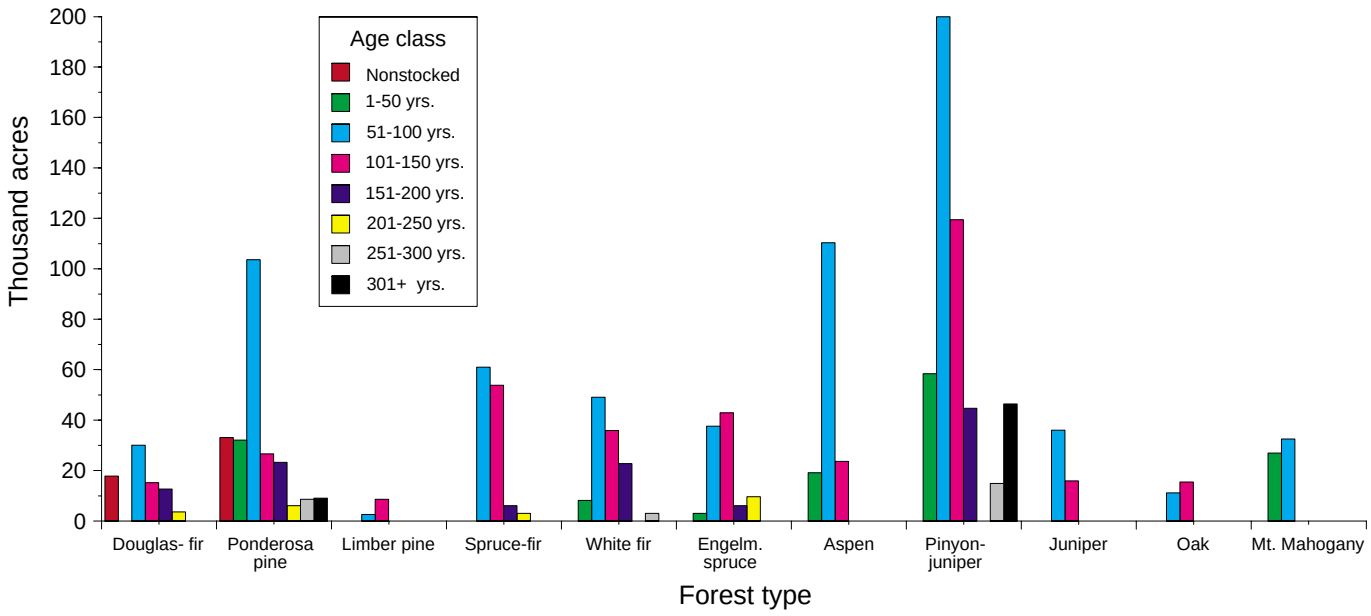

Figure 7—Area of forest type by stand age class, Dixie National Forest.

Tree biomass

Total biomass of wood in live trees on the Dixie National Forest is estimated at over 38.7 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	6,352
Engelmann spruce	5,653
Ponderosa pine	4,598
Douglas-fir	4,003
Subalpine fir	3,732
White fir	3,507
Utah juniper	3,314
Common pinyon	2,546
Curlleaf mountain mahogany	1,545
Rocky Mountain juniper	1,200
Singleleaf pinyon	724
Limber pine	644
Gambel oak	541
Blue spruce	200
Bristlecone pine	173
Rocky Mountain maple	14
Bigtooth maple	8
Other poplar	4
Total	38,758

Wood volume

Wood produced on the Dixie National Forest is valuable. The total volume of wood in live trees is estimated to be in excess of 1.8 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
Engelmann spruce	321,554
Aspen	297,731
Ponderosa pine	204,312
Douglas-fir	183,394
Subalpine fir	173,783
White fir	158,286
Utah juniper	155,446
Common pinyon	145,269
Rocky Mountain juniper	56,799
Singleleaf pinyon	36,944
Curlleaf mountain mahogany	32,990
Limber pine	31,161
Blue spruce	10,611
Gambel oak	9,045
Bristlecone pine	7,683
Other poplar	246
Total	1,825,256

About 66 percent of the cubic foot volume on the Dixie is found in trees 11 inches in diameter or greater. Approximately 88 percent of ponderosa pine, 81 percent of Douglas-fir, and 77 percent of Engelmann spruce volume is in trees larger than 11 inches in diameter. Only about 32 percent of aspen volume is in trees greater than 11 inches in diameter.

The volume of sawtimber trees on nonreserved timberland on the Dixie is estimated to be 3.5 billion board feet (Scribner rule). Engelmann spruce and ponderosa combined account for 51 percent of the total sawtimber volume. Figure 8 shows percent distribution of sawtimber on timberland by species.

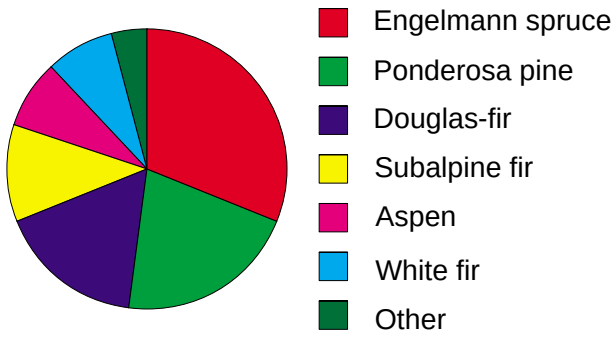

Figure 8—Percent of sawtimber volume on timberland by species, Dixie National Forest.

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 144,016 acres or 17 percent of all timberland on the Dixie is overstocked (fig. 9). This includes 52,015 acres of aspen, which is about 34 percent of the aspen on the Forest. Fully stocked stands may also be susceptible to insects and disease because of decreasing tree vigor. Approximately 159,312 acres, or 19 percent of the timberland on the Dixie is estimated to be fully stocked. For more explanation of stocking, refer to the terminology section in O'Brien [in preparation].

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 Dixie is estimated to be about 15 million cubic feet. Figure 10 compares mortality to gross growth for 6 timber species, and shows that the gross growth to mortality ratio is greater in some species than others. For example, subalpine fir was estimated to have a negative net growth, meaning more volume was lost to mortality than was gained from tree growth.

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 21 million cubic feet of wood died in this Forest. About 43 percent of the mortality was estimated to be caused by insects, and 41 percent by disease. About 39 percent of the mortality occurred in just one species, subalpine fir.

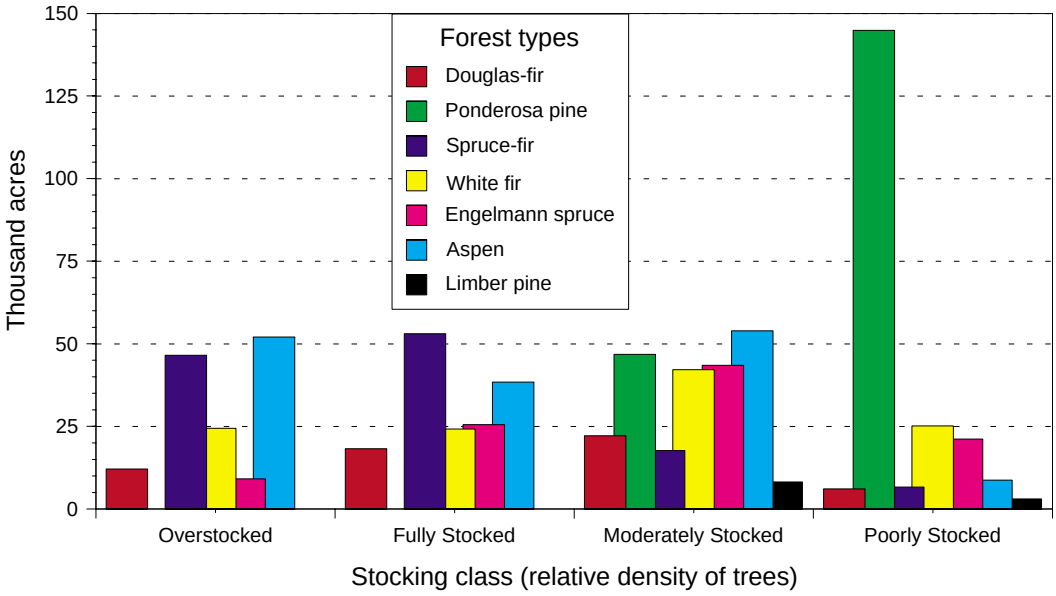

Figure 9—Area of stocking class by predominant forest type, Dixie National Forest.

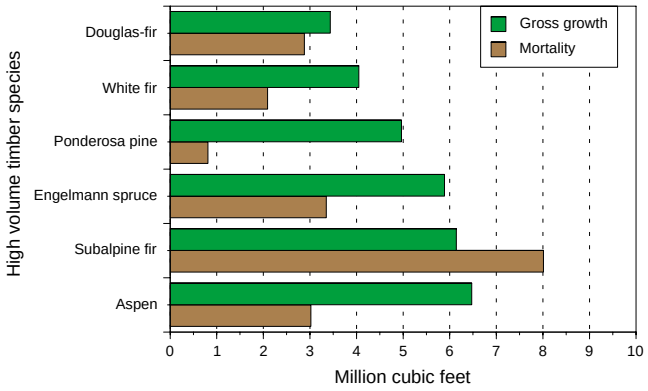

Figure 10—Gross annual growth compared to mortality, Dixie National Forest.

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 Dixie 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.

Of the spruce and spruce-fir types, 45 percent is at moderate to high risk of attack by bark beetles. Also, 67 percent of the ponderosa, and 63 percent of the Douglas-fir type are at moderate to 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 value and enhance the diversity of the conifer-dominated forests

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

Forest Type	Risk rating category					
	Low	Moderate	High	80 percent dead	Not evaluated	Total
				Acres		
Spruce-fir and spruce	79,836	89,748	9,647	—	43,722	222,952
Ponderosa pine	59,792	87,109	74,452	3,020	17,873	242,247
Douglas-fir	20,051	26,457	23,779	—	8,938	79,224

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 437,715 acres on the Dixie National Forest were formerly aspen forest type. By comparison, only 153,053 acres (35 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 Dixie 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 Dixie 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 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.

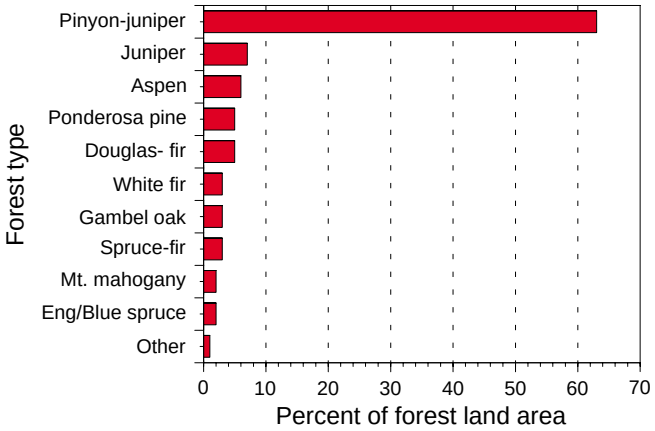

Figure 11—Percent of forest land area by forest type, southern Utah.

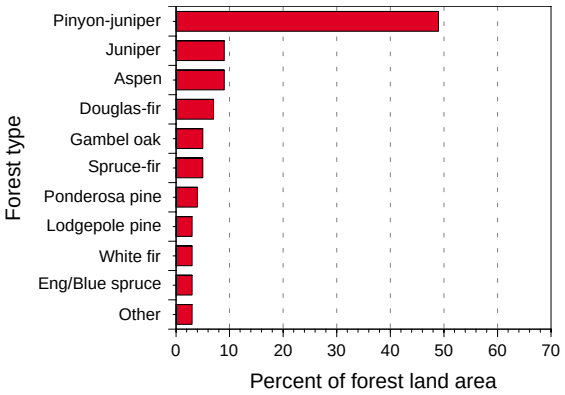

Figure 12—Percent of forest land by forest type, entire Utah State total.

How was the inventory conducted?

In 1995, the Interior West Resource Inventory, Monitoring, and Evaluation (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 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.

IWRIME field crews sampled 474 field plots on the Dixie, of which 348 were forested. Information presented in this report is based solely on the IWRIME inventory sample. Due to the extensive nature of this sample, results cannot necessarily be applied to site specific analysis needs on the Forest. 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).

Scientific documentation

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For further information

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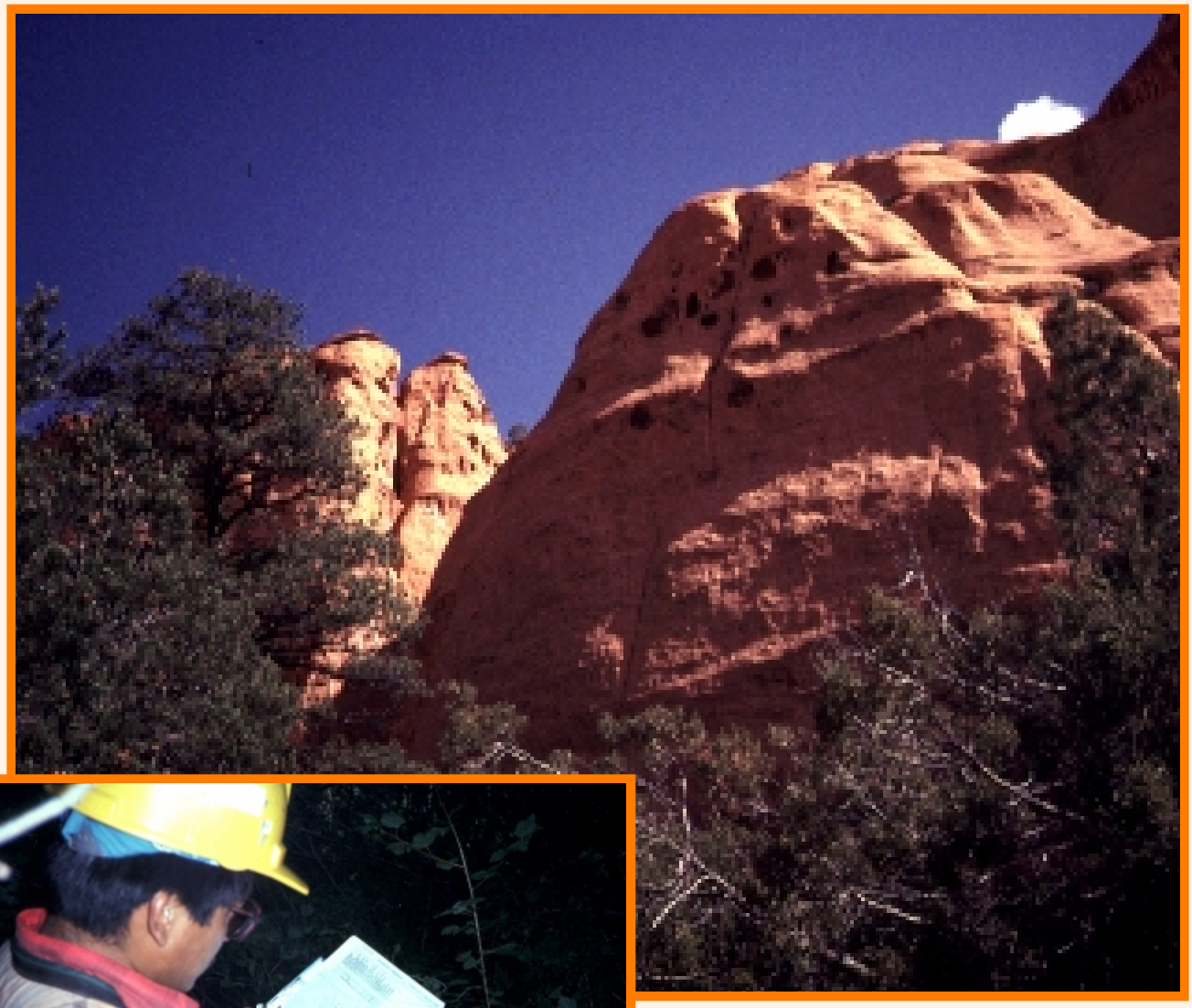
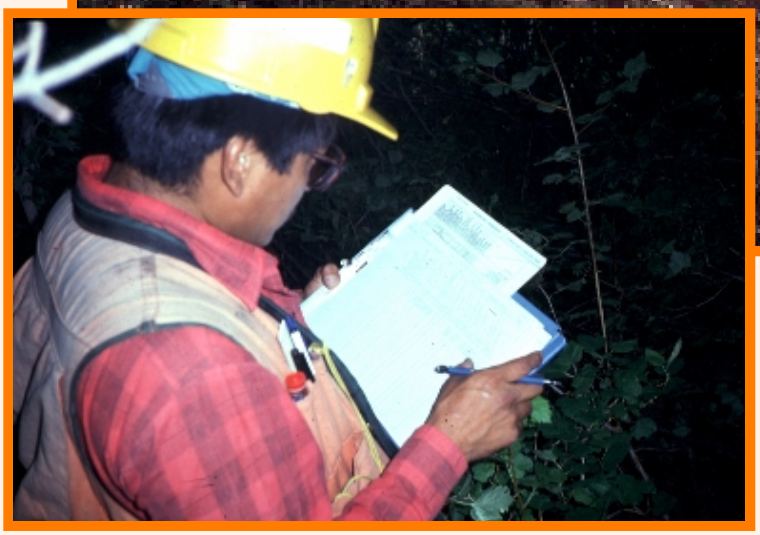
The information presented here is just a small part of a national data base that houses information for much of the forest land in the United States. This data base can be accessed on the Internet at the following web site:

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.

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.