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Forest Resources of the Manti-La Sal National Forest

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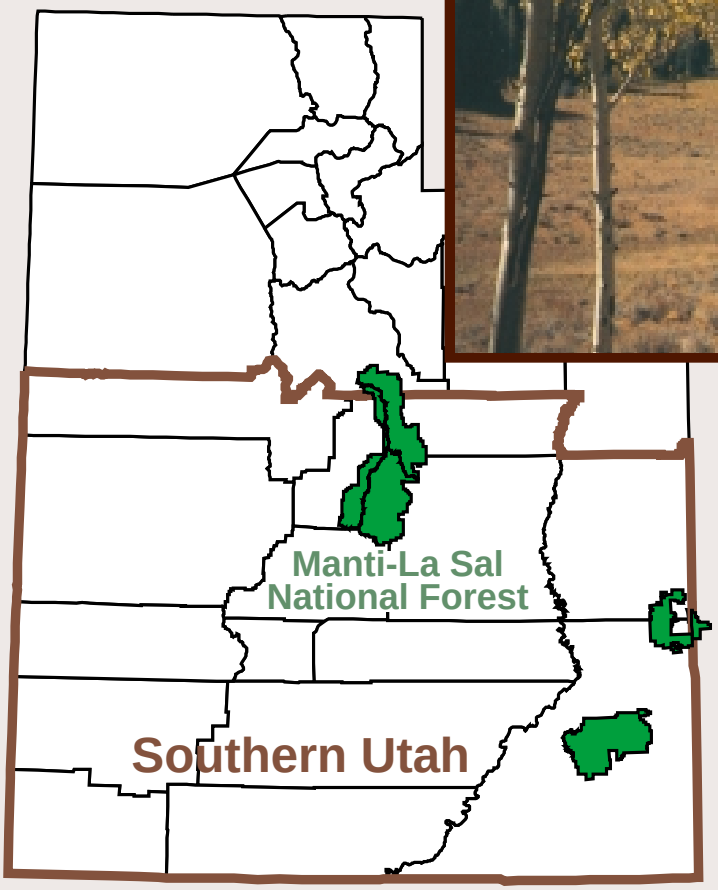

An extensive, comprehensive inventory of all forested lands in Utah was completed in 1995 by the Interior West Resource Inventory, Monitoring, and Evaluation (IWRIME) Program of the U.S. Forest Service, Intermountain Research Station (now called Rocky Mountain Research Station), as part of it's national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

The 1,334,565 acres in the Manti-La Sal National Forest encompass 956,669 acres of forest land, made up of 63 percent (606,287 acres) "timberland" and 37 percent (350,383 acres) "woodland." The other 377,896 acres of the Manti-La Sal are nonforest (fig.1). This report discusses forest land only. Just 3 percent of the Manti-La Sal National Forest is in reserved status, which means that the land has been withdrawn from tree utilization through statute or administrative designation, as in Wilderness.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.

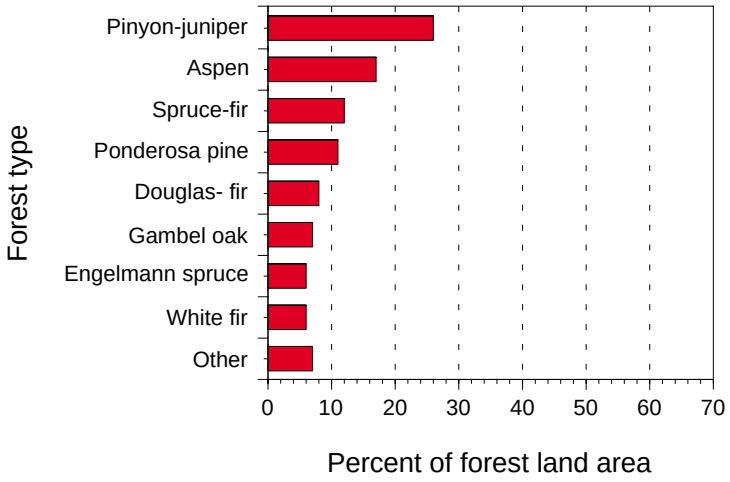

Figure 2—Percent of forest area by forest type, Manti-La Sal National Forest.

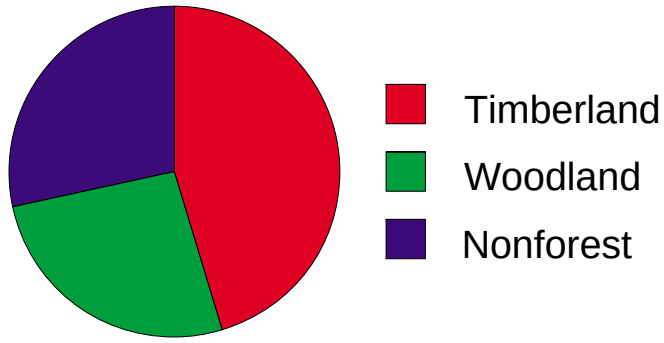

Figure 1—Area by land class, Manti-La Sal National Forest (see page 8 for definitions of timberland and woodland).

Forest diversity

Forest type—one indicator of forest diversity—refers to the predominant tree species in a stand, based on tree stocking. On the Manti-La Sal, the most common forest type in percentage of area is pinyon-juniper with 26 percent, followed by aspen, 17 percent, spruce-fir, 12 percent, ponderosa pine, 11 percent, Douglas-fir, 8 percent, Gambel oak, 7 percent, and white fir and Engelmann spruce, 6 percent each (fig. 2). Other forest types that make up the remaining 7 percent are mountain mahogany, limber pine, blue spruce, and cottonwood and juniper.

The composition of the forest by individual tree species is another measure of forest diversity. Gambel oak makes up 37 percent of the total number of trees, aspen, 19 percent, subalpine fir, 10 percent, twoneedle pinyon, 8 percent, Engelmann spruce, 5 percent, white fir and Utah juniper, each 4 percent, and Douglas-fir, 3 percent (fig. 3). Rocky Mountain juniper, ponderosa pine, bigtooth maple, Rocky Mountain maple, curlleaf mountain mahogany, blue spruce, limber pine and cottonwood combined contribute about 10 percent. Species that are scarce may not be

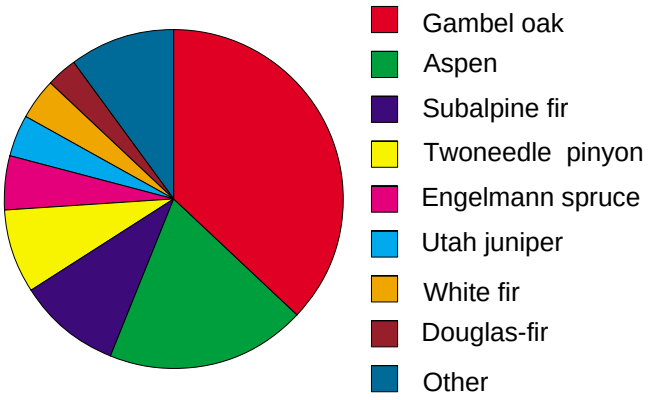

Figure 3—Percent of total number of trees by species, Manti-La Sal National Forest.

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 Manti-La Sal. 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 22 million standing dead trees (snags) on the Manti-La Sal 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 diameter or larger, an estimated 5.5 per acre occur on Manti-La Sal forest land. Of the very large snags (19 inches diameter or larger) there is only an average of 1.1 per acre on the Manti-La Sal. The most abundant species of snags in the 19-inch and larger category is subalpine fir, followed by Engelmann spruce, and then Douglas fir.

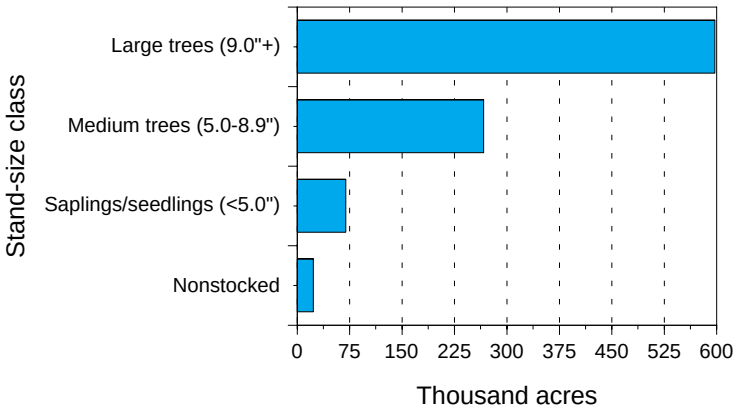

Figure 5—Forest land area by stand-size class, Manti-La Sal National Forest.

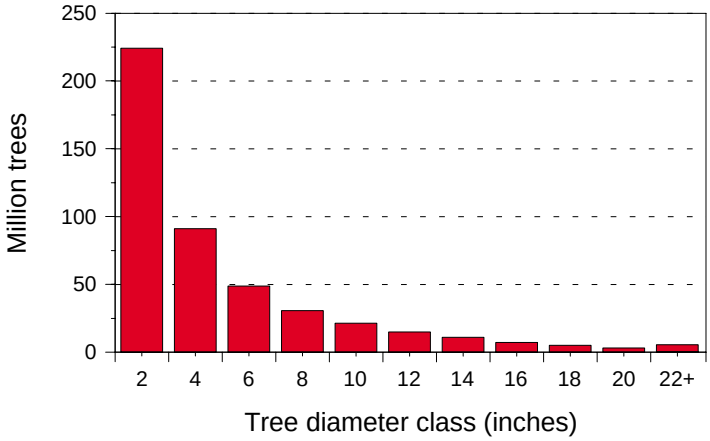

Figure 4—Number of live trees on forest land by diameter class, Manti-La Sal National Forest.

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, Manti-LaSal 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 Manti-LaSal 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-four percent of all stands, 56 percent of aspen stands, and 62 percent of ponderosa pine stands are estimated to be between 51 and 100 years old. Only 6 percent of all stands are estimated to be over 200 years old.

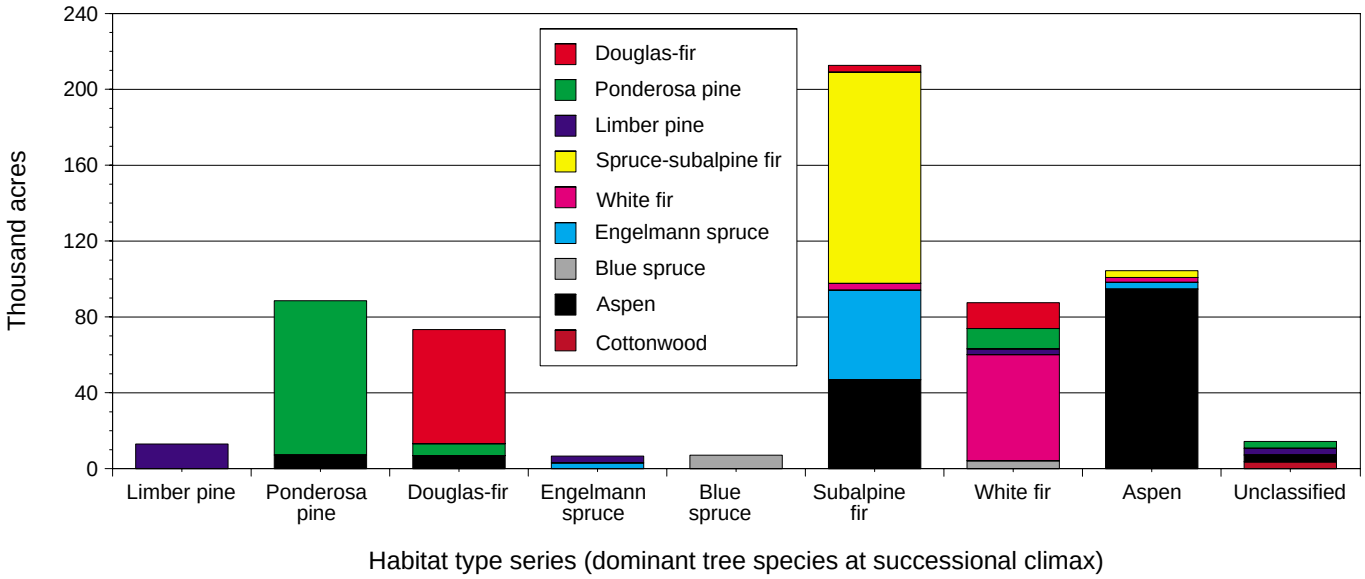

Figure 6—Area of forest type by habitat type series, Manti-La Sal National Forest.

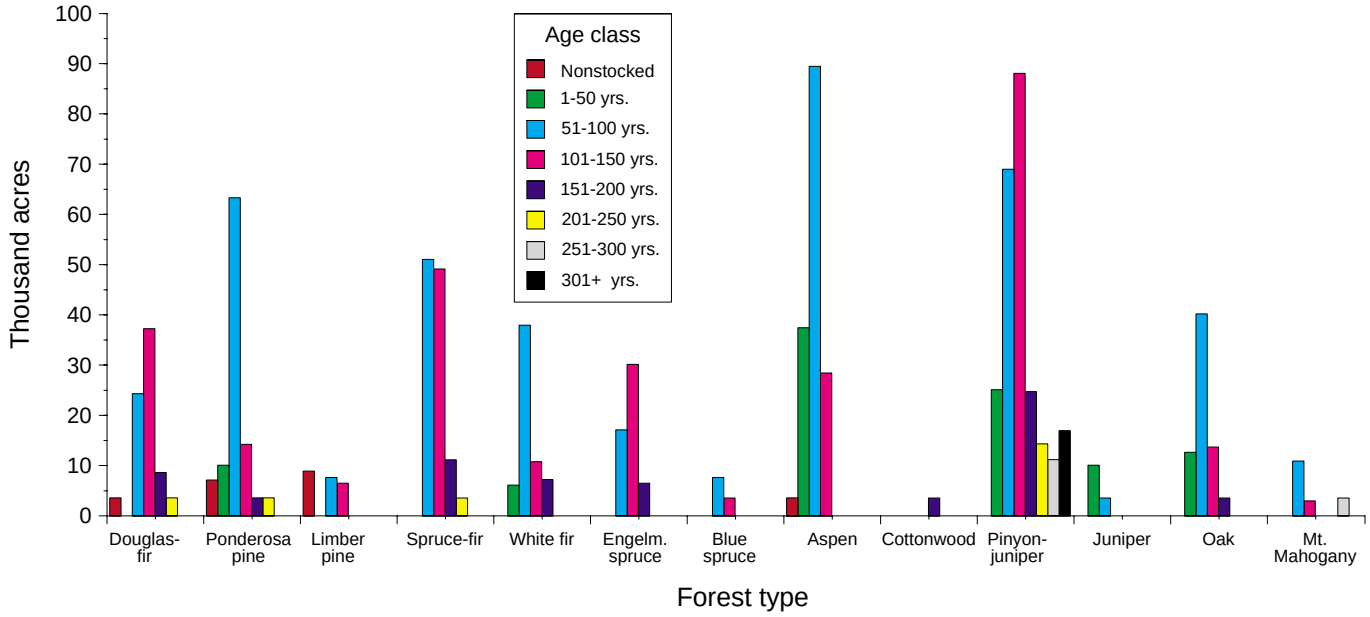

Figure 7—Area of forest type by stand age class, Manti-La Sal National Forest.

Tree biomass

Total biomass of wood in live trees on the Manti-La Sal National Forest is estimated at over 32 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
Engelmann spruce	5,777
Aspen	4,946
Subalpine fir	4,296
Douglas-fir	2,844
Utah juniper	2,801
Ponderosa pine	2,793
Gambel oak	2,397
Twoneedle pinyon	2,257
White fir	1,896
Rocky Mountain juniper	647
Blue spruce	554
Curlleaf mountain mahogany	470
Limber pine	368
Bigtooth maple	151
Other poplar	97
Rocky Mountain maple	42
Total	32,336

Wood volume

Wood produced on the Manti-La Sal National Forest is valuable. The total volume of wood in live trees is estimated to be in excess of 1.6 billion cubic feet. This includes trees 3 inches 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	361,023
Aspen	248,808
Subalpine fir	245,994
Douglas-fir	137,713
Utah juniper	134,443
Ponderosa pine	129,791
Twoneedle pinyon	129,434
White fir	93,337
Gambel oak	38,235
Blue spruce	34,019
Rocky Mountain juniper	28,277
Limber pine	17,248
Curlleaf mountain mahogany	9,519
Bigtooth maple	4,895
Other poplar	2,771
Rocky Mountain maple	313
Total	1,615,819

Almost 74 percent of the cubic foot volume on the Manti-LaSal is in trees 11 inches diameter or greater. Approximately 89 percent of Engelmann spruce, 87 percent of ponderosa pine, and 83 percent of Douglas-fir volume is in trees larger than 11 inches diameter. About 54 percent of aspen volume is in trees less than 11 inches diameter.

The volume of sawtimber trees on nonreserved timberland on the Manti-LaSal is estimated to be 4.4 billion board feet (Scribner rule). Engelmann spruce and subalpine fir together account for 54 percent of the total sawtimber volume. Figure 8 shows percent distribution of sawtimber on nonreserved timberland by species.

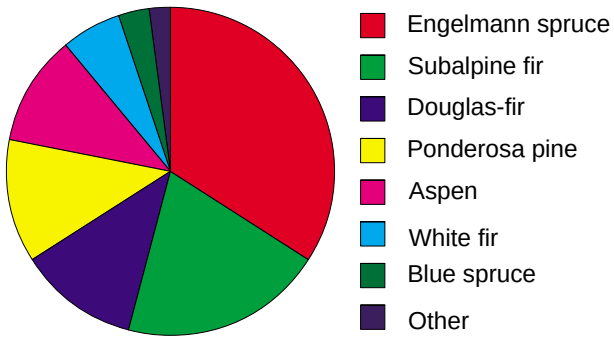

Figure 8—Percent of sawtimber volume on timberland by species, Manti-La Sal National Forest.

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 77,628 acres or 13 percent of all timberland on the Manti-La Sal is overstocked. This includes 32,905 acres of aspen, which is about 21 percent of the aspen on the Forest (fig. 9). Fully stocked stands may also be susceptible to insects and disease because of decreasing tree vigor. Approximately 156,010 acres, or 26 percent of the timberland on the Manti-La Sal 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 Manti-La Sal is estimated to be about 12.3 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. 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 19 million cubic feet of wood died in this Forest. About 48 percent of the mortality was estimated to be caused by insects, and 37 percent by disease. About 53 percent of the mortality occurred in just one species, subalpine fir.

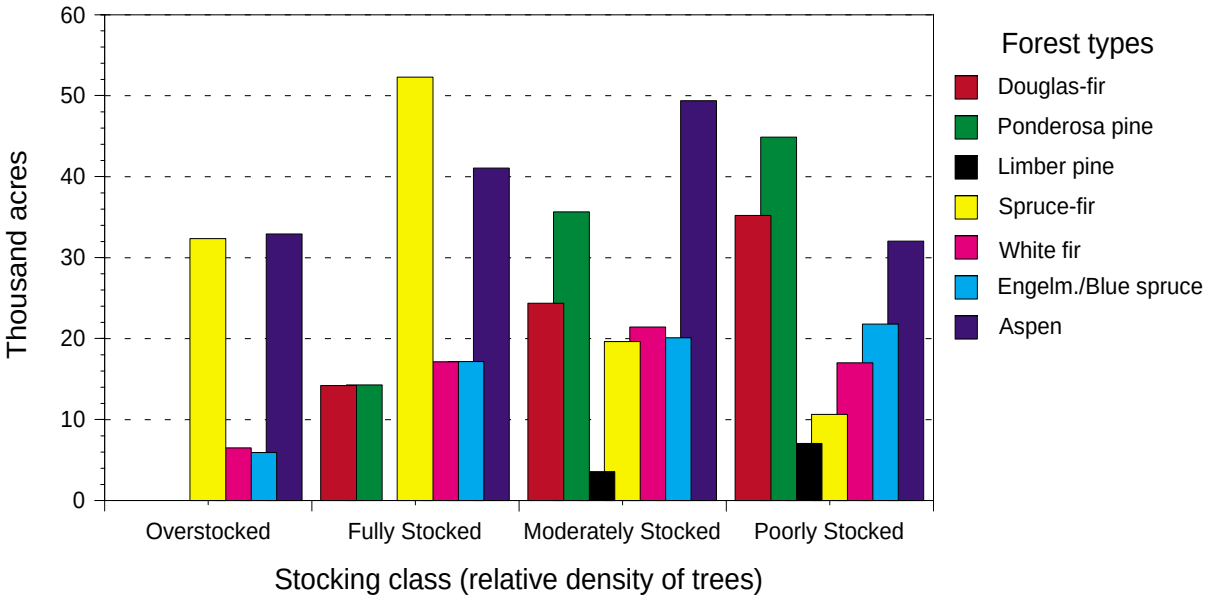

Figure 9—Area of stocking class by predominant forest type, Manti-La Sal National Forest.

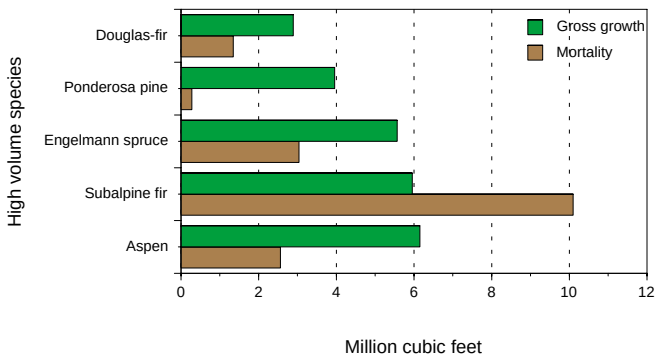

Figure 10—Gross annual growth compared to mortality, Manti-La Sal National Forest.

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 Manti-La Sal 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 pine tree 5 inches diameter or larger was present. Stands in the Douglas-fir type needed at least one Douglas-fir tree 9 inches 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/spruce-fir complex, 62 percent is at moderate to high risk of attack by bark beetles. Also, 93 percent of the ponderosa, and 72 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.

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 of Utah. Information from various sources indicate

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

Forest Type	Risk rating category					
	Low	Moderate	High	80 percent dead	Not evaluated	Total
	Acres					
Spruce fir and spruce	22,353	97,730	12,989	—	46,667	179,739
Ponderosa pine	3,562	31,429	63,291	3,562	—	101,845
Douglas-fir	21,441	27,237	28,585	—	—	77,263

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 338,008 acres on the Manti-La Sal National Forest were formerly aspen forest type. By comparison, only 158,866 acres (47 percent of the 338,008 acres) 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 Manti-La Sal 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 Manti-La Sal 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 in the entire State.

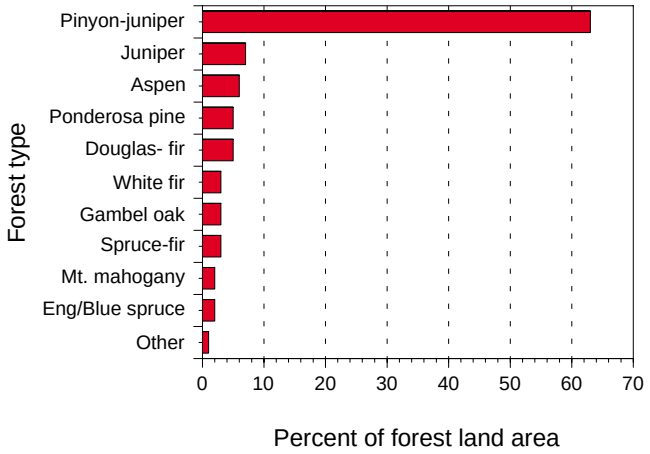

Figure 11—Percent of forest land area by forest type, southern Utah.

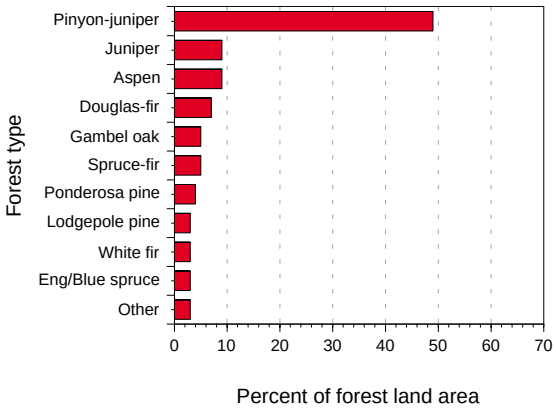

Figure 12—Percent of forest land by forest type, entire Utah State total.

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 or not 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 340 field plots on the Manti-LaSal, of which 242 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.