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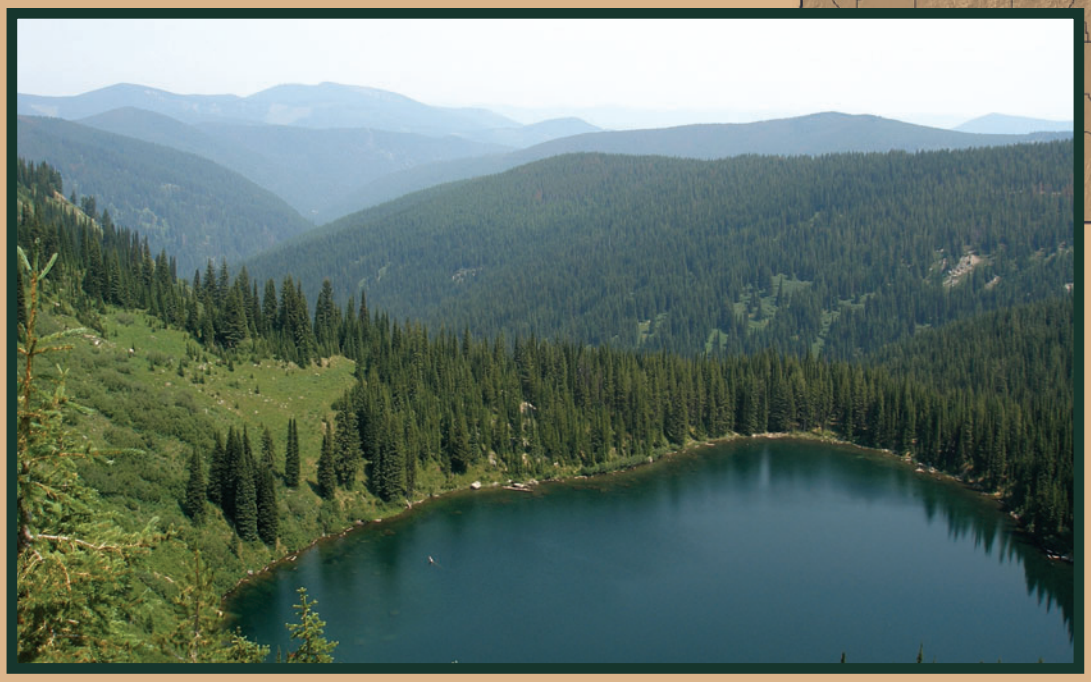
Forest Resources of the Idaho Panhandle National Forest

Joshua C. Holte



About the author

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The Interior West Forest Inventory and Analysis (IWFIA) Program of the USDA Forest Service, Rocky Mountain Research Station, as part of our National Forest System cooperative inventories, conducted a forest resource inventory on the Idaho Panhandle National Forest (IPNF) using a nationally standardized mapped-plot design (for more details see "The inventory methods" section). This report presents the highlights of the 2001 inventory using variables and summaries commonly requested by IWFIA users. The data could be summarized in other ways for different purposes (see "For further information" on the inside back cover). The information presented in this report is based solely on the IWFIA inventory sample (USDA 1999). Supplementary documentation and inventory terminology can be located in USDA (2002). Additional data collected by the IPNF and used separately or in combination with IWFIA data may produce varying results. Changes since the inventory, such as the impact of recent disturbances on the Forest have not been incorporated into this report. Annual inventories will soon replace periodic inventories to help monitor these changes at shorter intervals.

Description of the Idaho Panhandle National Forest

The IPNF is an administrative unit combining most of the Kaniksu, Coeur d'Alene, and St. Joe designated National Forests. This report does not address designated forest areas outside the administrative boundary of the IPNF. The IPNF administers 2,506,649 acres (USDA 2000) of which 97 percent is nonreserved forest land, 2 percent is nonforest or water, and less than 1 percent is reserved (fig. 1). This report describes the characteristics of the forest land sampled on the IPNF. Forest land is at least 1 acre in size and 120 feet wide as well as being at least 10 percent stocked (or formerly stocked) with live tree species. Based on tree species present, forest land is subdivided into either timberland or woodland. Timberland areas are stocked mostly with tree species commonly used for wood products (such as Douglas-fir and ponderosa pine.) In woodland areas most trees have a multi-stem growth form and are not typically used for industrial wood products (such as Rocky Mountain maple.) On the IPNF, 97.3 percent of the total forest land is timberland and 2.5 percent is woodland. It is important to note that in the next inventory Rocky Mountain maple, which is the major woodland component in this area, will be considered a shrub rather than a woodland tree (USDA 2004.) The 'maple woodland' forest type will be dropped causing a change in the classification of these areas. The revised forest type classifications will be based on the remaining non-maple tree species.

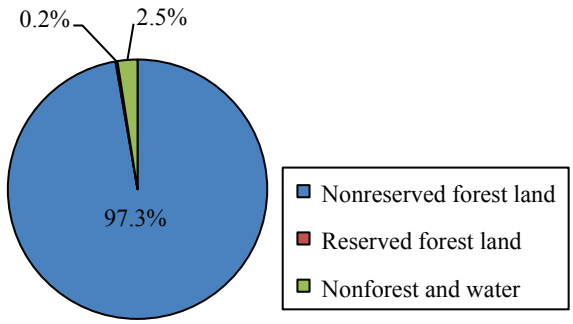

Figure 1—Percent area by land class and reserved status, Idaho Panhandle National Forest, 2001.

Less than one percent of the total area on the IPNF is in a reserved designation. Reserved lands have been withdrawn from management for production of wood products. These reserved lands are located in the Salmo-Priest Wilderness area of Washington. The reserved sample size is too small for a valid characterization in this report.

The first part of this report focuses on forest resources of the forest land administered by the IPNF, including all types of land classification. The subsequent section addresses the roaded areas. The roadless designation used comes from the 2008 Roadless Rule (USDA 2008) and does not include lands defined as wilderness. Characterizations of the five varieties of roadless areas defined in the 2008 rule are beyond the scope of this report. Roadless is an evolving classification, most of the land area covered in the 2008 designation was considered roadless under the earlier 1987 IPNF forest plan and the 2000 Roadless Rule (USDA 2003.)

Forestland highlights of the Idaho Panhandle National Forest

Forest type—Forest resources are often described using a forest type classification. Forest type refers to the predominant tree species in a stand, based on plurality of tree stocking (the most abundant tree species.) Stocking is an expression of the extent to which growing space is effectively utilized by live trees.

Forest types are dynamic and may change slowly through forest succession, or rapidly due to a disturbance such as logging, fire, or insect and disease epidemics. Figure 2 summarizes the distribution of forest land area on the IPNF by forest type. The Douglas-fir forest type is the most common at 25 percent, followed in abundance by Engelmann spruce/subalpine fir (spruce-fir) at 18 percent. The grand fir forest type comprises 13 percent of the forest land area; western hemlock, 9 percent; lodgepole pine, 9 percent; western redcedar, 6 percent; western larch, 6 percent; mountain hemlock, 4 percent; Engelmann spruce, 3 percent; Maple woodland, 3 percent; and ponderosa pine as well as western white pine each comprise 2 percent.

Tree and stand size—The size distribution of trees is an indicator of structural diversity. Figure 3 displays the distribution of the 1.4 billion live trees on the IPNF by diameter class. Overall, this shows a typical diameter distribution with a higher number of small trees than large trees. Trees often reproduce prolifically, but thin out naturally over time due to competition for limited resources.

Stand-size class is a classification of forest land based on the dominant diameter-size of live trees that contribute to stand stocking. Large trees are timber-type softwoods and all woodland tree species 9.0 inches diameter and greater, and timber-type hardwoods 11.0 inches diameter and greater; medium trees include timber-type softwoods and all woodland tree species 5.0 to 8.9 inches diameter, and timber-type hardwoods 5.0 to 10.9 inches diameter; and saplings/seedlings comprise all trees under 5.0 inches diameter. Nonstocked stands show evidence of having supported stocked stands in the past but have been recently disturbed by tree cutting, forest fire, or other large-scale disturbances. For tree stocking, fewer large-diameter trees compared to small-diameter trees are required to fully stock a site. Figure 4 shows a breakdown of forest land on the IPNF by area and stand-size class. Seventy-four percent of the stands on the IPNF have a majority of stocking from large trees, while 1.5 percent are nonstocked.

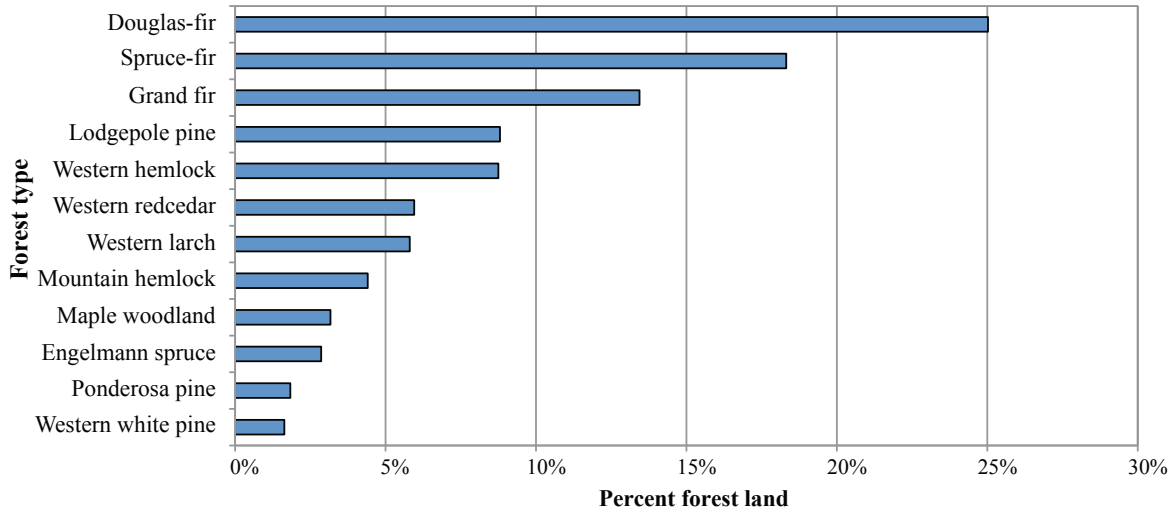

Figure 2—Percent of forest land area by forest type, Idaho Panhandle National Forest, 2001.

Figure 5 shows the area of forest land by forest type and stand-size class on the IPNF. The two most common forest types in the large tree class are the Douglas-fir and spruce-fir forest types, which together make up 47 percent of large tree stands. The lodgepole pine forest type makes up forty-two percent of the stands in the medium tree class. The small size class is much more evenly distributed. Douglas-fir and spruce-fir together make up 36 percent of small stands.

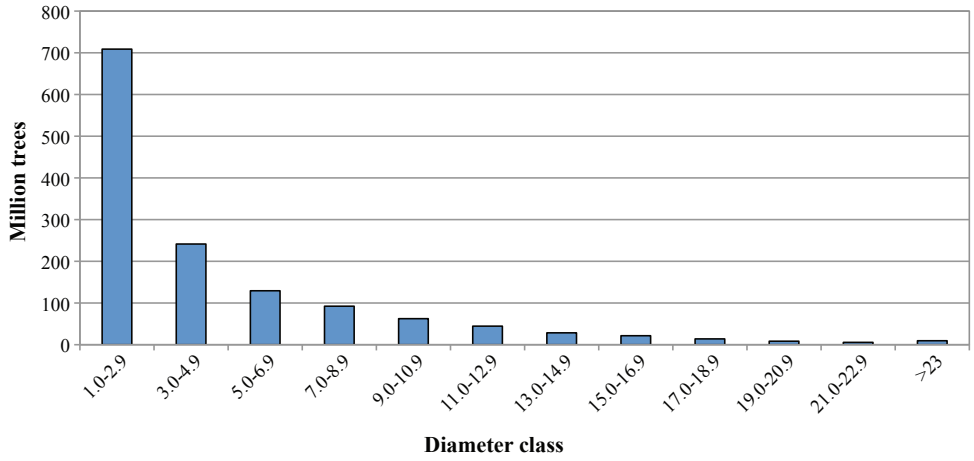

Figure 3—Number of live trees on forest land by 2-inch diameter class, Idaho Panhandle National Forest, 2001.

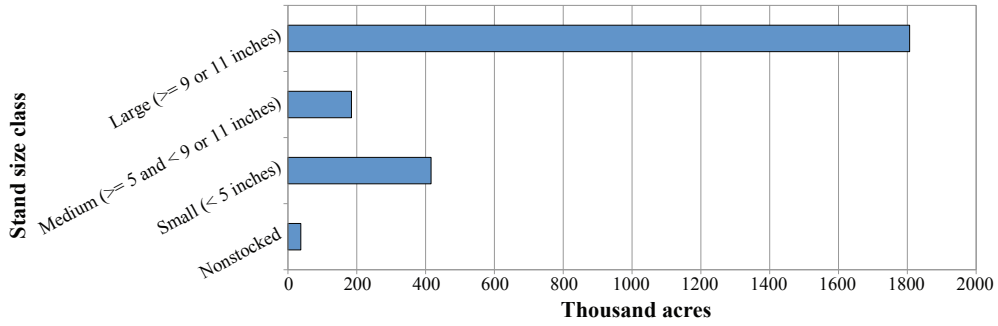

Figure 4—Forest land area by stand-size class, Idaho Panhandle National Forest, 2001.

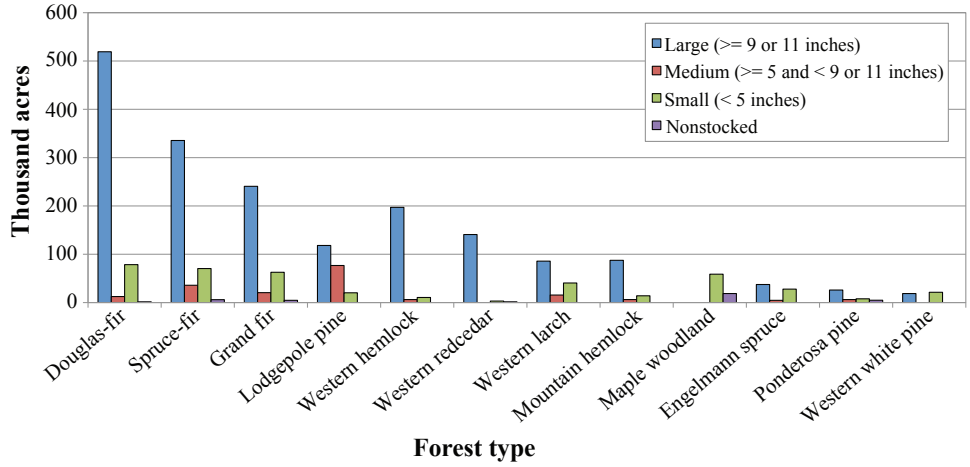

Figure 5—Area of forest land by forest type and stand-size class, Idaho Panhandle National Forest, 2001.

Number of live trees—Another way to assess forest diversity is by examining the composition of forest land by tree diameter and species. Figure 6 characterizes the 1.4 billion live trees by species in three diameter-size classes. Seventy percent of all live trees on the IPNF are from 1.0 to 4.9 inches diameter, 21 percent are from 5.0 to 8.9 inches diameter, and 10 percent are 9.0 inches diameter and greater. Rocky Mountain maple and grand fir each make up 16 percent of the total number of trees; western redcedar and subalpine fir, 12 percent each; Douglas-fir, and western hemlock, 10 percent each; lodgepole pine, 7 percent; mountain hemlock, 5 percent; western larch and western white pine, 3 percent each; pacific yew, 1 percent; ponderosa pine, 1 percent; and the remaining four species in figure 6 comprise the final 1 percent. The hardwoods category includes quaking aspen, black cottonwood and paper birch. Species that are scarce may not be well represented with the extensive sampling strategy used for this inventory.

Figure 7 displays the number of live trees by species and elevation class. Elevation is closely correlated with variations in local climate. Precipitation generally increases with rising elevation, while temperature decreases. Aspect complicates this general rule; allowing relatively warmer and dryer-site species to grow at higher elevations on south and west-facing slopes. These factors have a profound effect on competition between tree species. The IPNF displays distinct elevation patterns in tree distribution: subalpine fir and mountain hemlock do well at higher elevations, while Douglas-fir and grand fir are most common at middle elevations. Low elevations show a less defined gradient with no individual tree species dominating. High levels of precipitation allow a relatively high species diversity, masking the generally well defined species gradation seen on more xeric forests.

Number and weight of dead trees—Standing and down dead trees are important for wildlife habitat and in fire

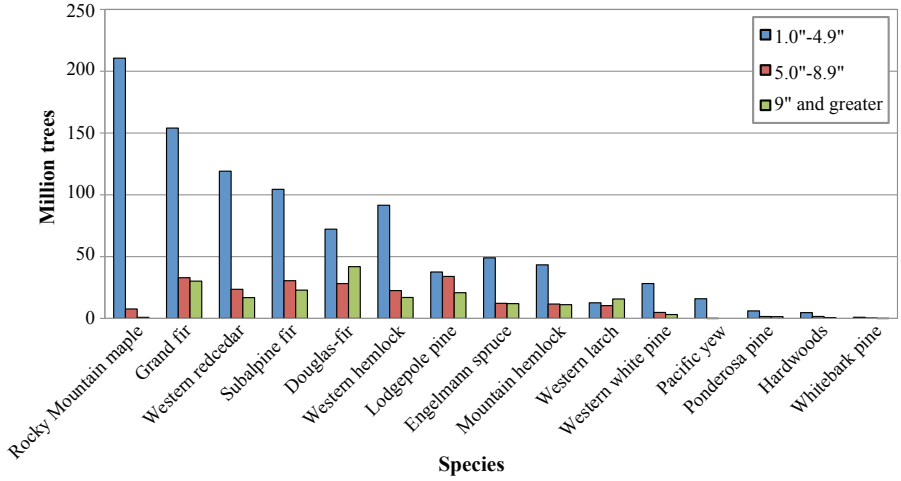

Figure 6—Number of live trees 1.0 inch in diameter and greater on forest land by species and diameter class, Idaho Panhandle National Forest, 2001.

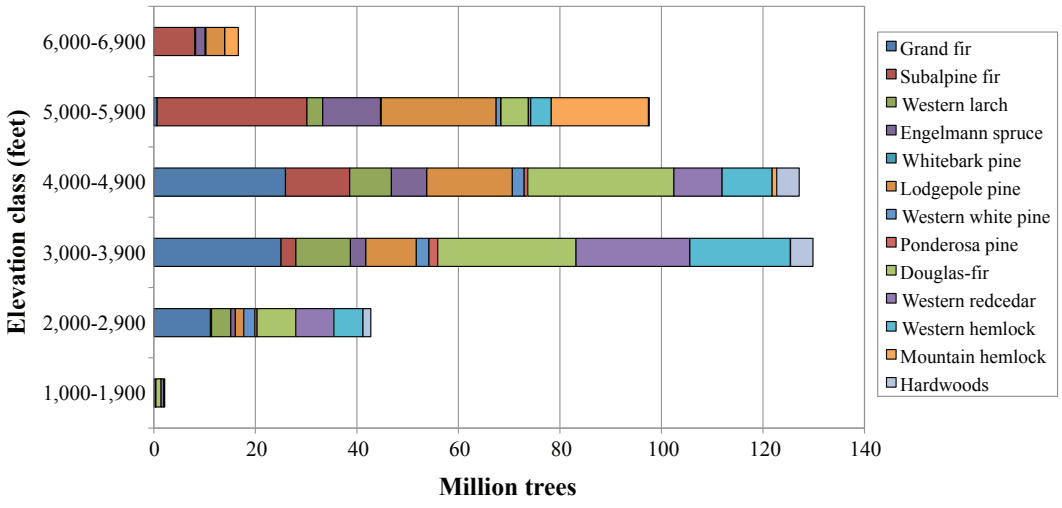

Figure 7—Number of live trees 5.0 inches diameter and greater on forest land by species and elevation class, Idaho Panhandle National Forest, 2001.

ecology, as well as acting as nutrient/carbon sinks and erosion controls. Approximately 88 million standing dead trees (snags) and 83 million down dead trees 5.0 inches diameter and greater occur on forest land on the IPNF. If trees 1.0 inch diameter and greater are included there are approximately 231 million standing dead trees and 263 million down dead trees.

Many animals are dependent upon standing dead trees, but the species, size, and density of these trees required for quality habitat vary depending on wildlife species. Large diameter dead trees are generally scarce relative to smaller trees. Figure 8 shows the number of snags by forest type for three diameter classes. Of the total number of snags, the 1.0-4.9 inch diameter size class accounts for 62 percent with an average of 58.6 trees per acre (TPA); the 5.0-10.9 inch class accounts for 27 percent with an average of 25.2 TPA; and the 11.0 and greater inch class makes up 11 percent with an average of 10.7 TPA.

The amount of dead tree material is a component of forest fuel loads. On the IPNF, about 22.6 million tons of standing dead trees and 18.1 million tons of down dead trees occur on forest land. This estimate includes the merchantable bole and bark of trees 5.0 inches diameter and greater. Figure 9 shows the weight per acre of down dead trees by stand-size class for each of the forest types and all forest types combined. For all forest types combined, the large tree stand-size class has the most dead material at 8.8 tons per acre, followed by the medium class at 4.3 tons per acre and the small at 3.5 tons per acre. For all stand-size classes combined, the western redcedar type has the highest weight at 17.2 tons per acre, followed by western hemlock and western larch at 9.7 and 8.6 tons per acre, respectively. Some class breakdowns in figure 9 such as the Rocky Mountain maple and ponderosa pine classes may not be representative due to small sample size.

Stand age—Stand age is estimated from core samples of live trees. The estimate is limited to trees with diameters that fall in a stand's designated stand-size class. Many other factors affect the number of sample trees available for determining stand age. In general, stand age for dense stands that contain more core sample trees is more representative than stand age for sparse stands that contain fewer trees.

Figure 10 displays the percent of forest land area by forest type and stand-age class on the IPNF. Stand age can indicate the duration since the last extensive disturbance of the forest overstory. This figure shows the 61- to 80-year class as the most common on the Forest, followed by the 81- to 100-year and 1- to 20-year age classes.

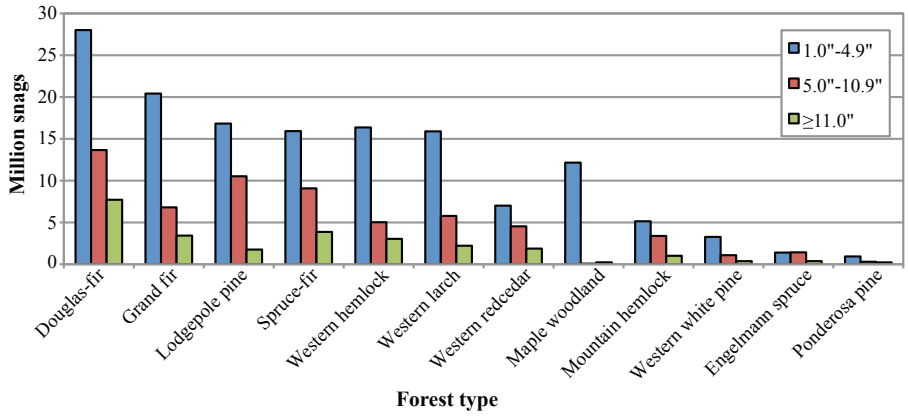

Figure 8—Number of standing dead trees 1.0 inch diameter and greater on forest land by forest type and diameter-class, Idaho Panhandle National Forest, 2001.

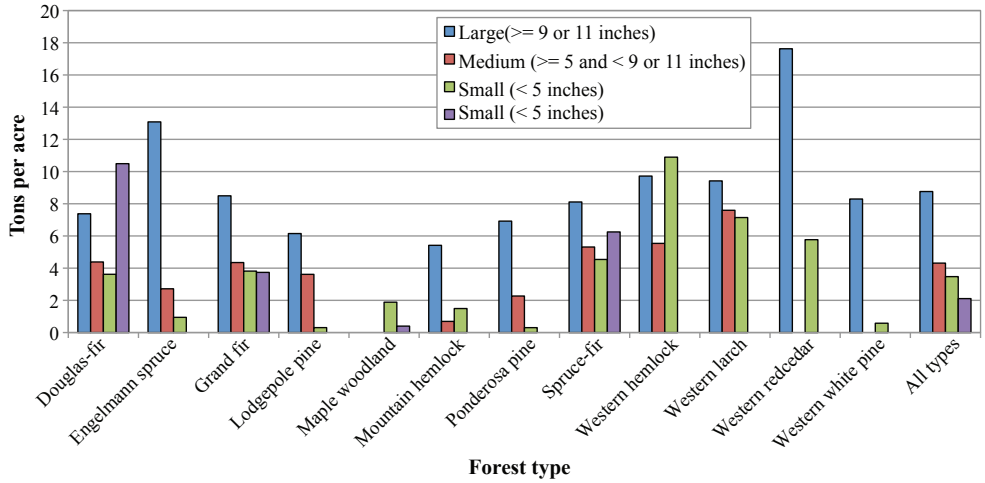

Figure 9—Weight of down dead trees 5.0 inches diameter and greater on forest land by forest type and stand-size class, Idaho Panhandle National Forest, 2001.

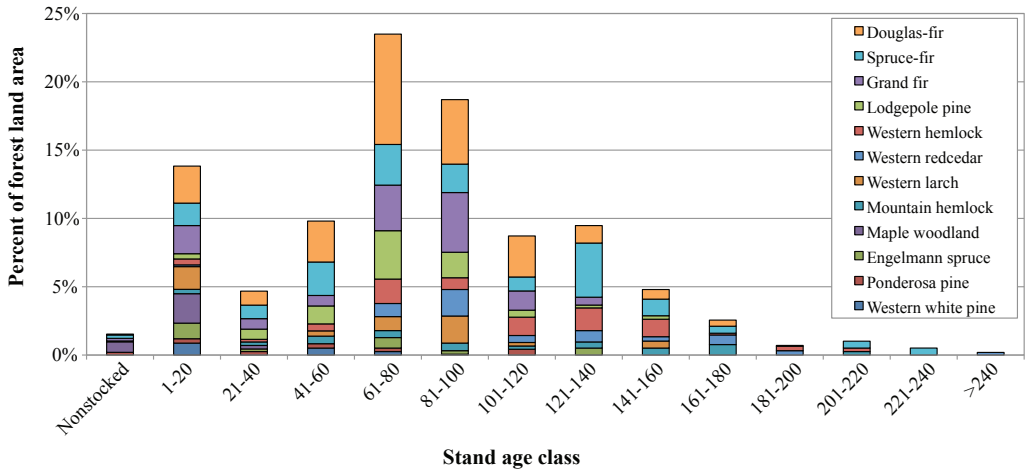

Figure 10—Percent of forest land area by forest type and stand-age class, Idaho Panhandle National Forest, 2001.

Wood volume, biomass, and basal area of live trees—Estimates of cubic-foot volume and basal area include all live trees 5.0 inches diameter and greater. Basal area is the cross-sectional area of a tree stem/bole (includes bark) at the point of diameter measurement. Biomass estimates include boles, bark, and branches of all live trees 1.0 inches diameter and greater. The net volume of wood on the IPNF is estimated to be in excess of 7.9 billion cubic feet. Total biomass is estimated at 142 million tons, and the total basal area is estimated to be about 315 million square feet. Table 1 is a breakdown of volume, biomass, and basal area by species.

Figure 11 displays the percent net cubic-foot volume of live trees by diameter class. Eighty-seven percent of this volume is in trees 9.0 inches and greater diameter class. By species, 100 percent of black cottonwood, 98 percent of ponderosa pine and 93 percent of mountain hemlock volume is in trees 9.0 inches diameter and greater. Common species with low percentages of volume in trees 9.0 inches diameter and larger include paper birch at 54 percent and Rocky Mountain maple at 33 percent.

Another way to look at wood volume is by forest type, for which estimates per acre can be computed along with basal

Table 1—Net volume, biomass, and basal area on forest land by species, Idaho Panhandle National Forest, 2001.

Species	Volume (million cubic feet)	Biomass (million tons)	Basal area (million square feet)
Douglas-fir	1,625.6	32.1	60.8
Grand fir	1,486.3	24.4	44.0
Western redcedar	754.7	11.7	29.9
Lodgepole pine	739.4	12.1	24.9
Western hemlock	733.8	14.7	26.3
Subalpine fir	714.1	11.8	29.9
Western larch	625.3	12.2	20.9
Engelmann spruce	556.9	8.5	17.9
Mountain hemlock	398.9	7.8	16.3
Western white pine	164.9	2.9	5.0
Ponderosa pine	76.3	1.5	2.7
Rocky Mountain maple	32.1	1.5	2.2
Paper birch	12.7	0.3	0.5
Quaking aspen	7.1	0.1	0.2
Black cottonwood	6.0	†	0.2
Whitebark pine	2.2	†	0.1
Pacific yew	0.1	†	†
Total (not exact due to rounding)	**7,936.5**	**141.8**	**281.9**

† Less than 100,000.

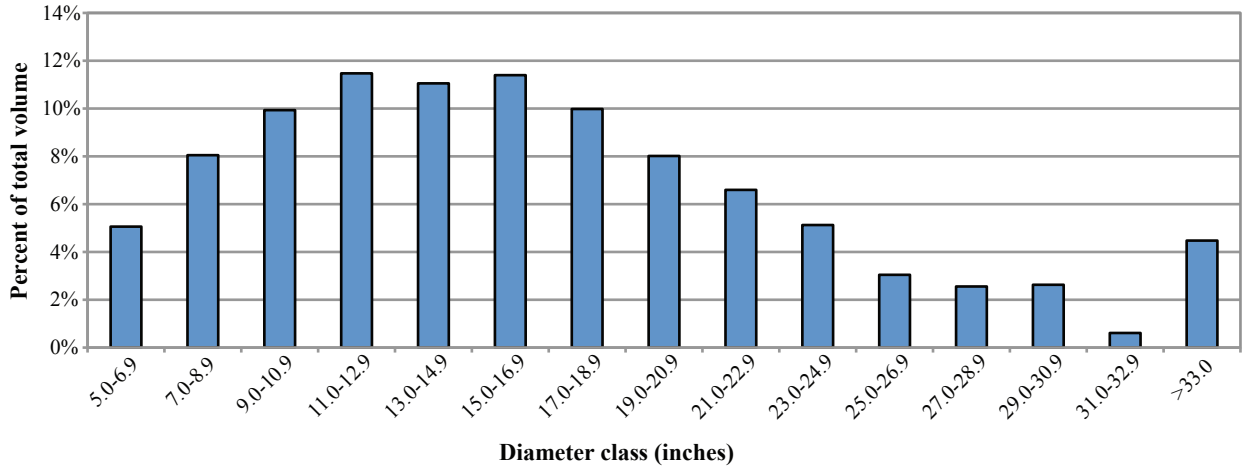

Figure 11—Percent net cubic foot volume of live trees on forest land by diameter class, Idaho Panhandle National Forest, 2001.

area (table 2). These numbers include the many different species that can occur together in each forest type. The highest volume, biomass and basal area per acre on the IPNF is in the western redcedar forest type. Volume and basal area per acre for maple may not be representative due to the small sample size. One characteristic of the mapped-plot design is that a plot may sample more than one condition (last two columns of table 2). A forest condition is generally defined as an area of relatively homogeneous vegetative cover that meets the criteria for forest land. Forest type is one of several attributes that define and separate conditions identified on the plot.

Stand density index—Many factors influence the rate at which trees grow and thrive, or die. As tree size and density increase, competition for available resources also increases. Stand density index (SDI), as developed by Reineke (1933), is a relative measure of quantifying the relationship between trees per acre and average stand diameter. The concept was developed for even-aged stands dominated by one or two related size classes (based on diameter and/or height), but can also be applied to uneven-aged stands composed of three or more size classes (Long and Daniel 1990; Shaw 2000). SDI is usually presented as a percentage of the maximum SDI for each forest type (Van Dyck 2002). Maximum SDI values for the forest types on the IPNF were

Table 2—Net volume per acre, biomass per acre, basal area per acre, number of conditions, and condition proportions on forest land by forest type, Idaho Panhandle National Forest, 2001.

Forest type	Net cubic-foot volume per acre (5″ dia.)	Biomass tons per acre (>1″ dia.)	Basal area sq. ft. per acre (>5″ dia.)	Number of conditions[a]	Condition proportions[b]
Western redcedar	5,297	84	185	30	23.3
Western hemlock	4,283	81	144	39	34.3
Grand fir	4,200	70	131	63	52.6
Mountain hemlock	4,032	78	160	18	16.9
Douglas-fir	3,122	60	114	106	98.0
Western larch	2,977	57	106	25	22.8
Lodgepole pine	2,780	48	102	39	34.2
Spruce-fir	2,701	45	104	77	71.3
Engelmann spruce	2,436	42	85	12	11.2
Western white pine	1,446	26	51	8	6.4
Ponderosa pine	1,092	23	45	10	7.1
Maple woodland	235	8	12	13	12.3
Total:	**3,247**	**58**	**115**	**440**	**390.4**

[a] Number of conditions by forest type that were sampled. These numbers are often greater than the total number of forested plots by forest type because a plot may sample more than one forest condition.
[b] Sum of the condition proportions of plots by forest type that were sampled. These numbers are often less than the total number of plots by forest type because of nonforest condition proportions (from plots containing both forest and nonforest conditions) that are not included here.

estimated using FIA plot data, and formulated specifically to match the procedure used by FIA to calculated SDI (Shaw 2000). Resulting percentages were grouped into four classes (fig. 12), whose thresholds have ecological and management significance. A site is considered to be fully occupied at 35 percent of SDI maximum, which marks the onset of competition-related stresses and slowed growth rates (Long 1985). Based on FIA sample data, 66 percent of all forest stands on the Idaho Panhandle National Forest were considered to be fully occupied.

Components of change: growth—Another measure of forest vigor is net annual growth. Net annual growth is the difference between gross annual growth and losses due to mortality. Gross annual growth of live trees (5.0 inches diameter and greater) on all forest land on the IPNF is estimated to be 217 million cubic feet, and net annual growth is 177 million cubic feet. Gross annual growth is compared to mortality for twelve high volume species in figure 13. Mortality on all forest land on the IPNF is about 18 percent of gross annual growth. Mortality is about 53 percent of gross annual growth for lodgepole pine, 46 percent for black cottonwood and 31 percent for ponderosa pine. In 2001 no species on the IPNF displayed a net loss of growth.

Components of change: mortality—Field crews assess which trees have died in the past 5 years; these trees are used to estimate an average annual mortality. Based on this estimate, in 2001, 39.7 million cubic feet of wood from live trees (5.0 inches diameter and greater) died on the IPNF. About 43 percent of the mortality was caused by disease, 26 percent by weather, 17 percent by insects; fire and animal damage each account for 0.5 percent. The following are the top five tree species accounting for about 82 percent of

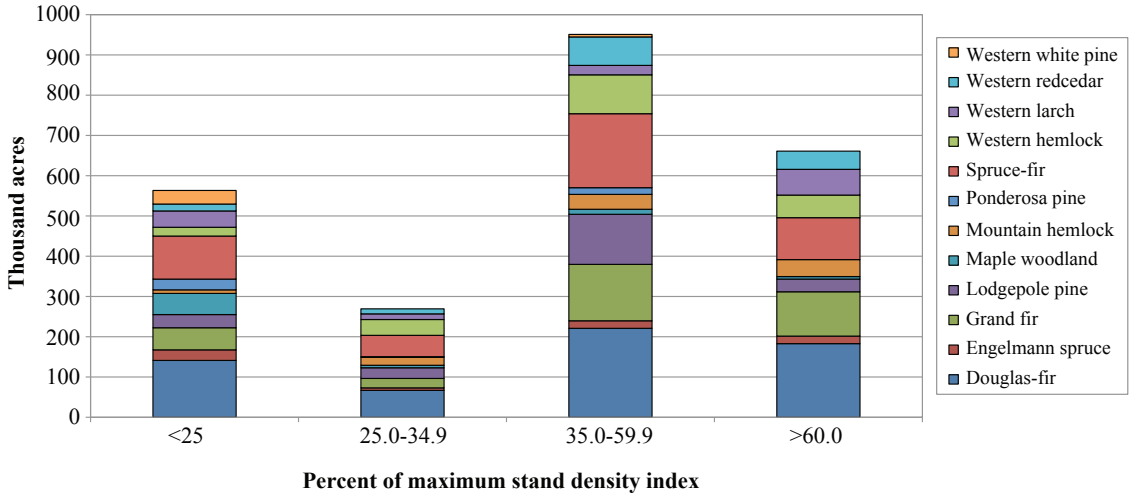

Figure 12—Area of forest land by forest type and percent stand density index, Idaho Panhandle National Forest, 2001.

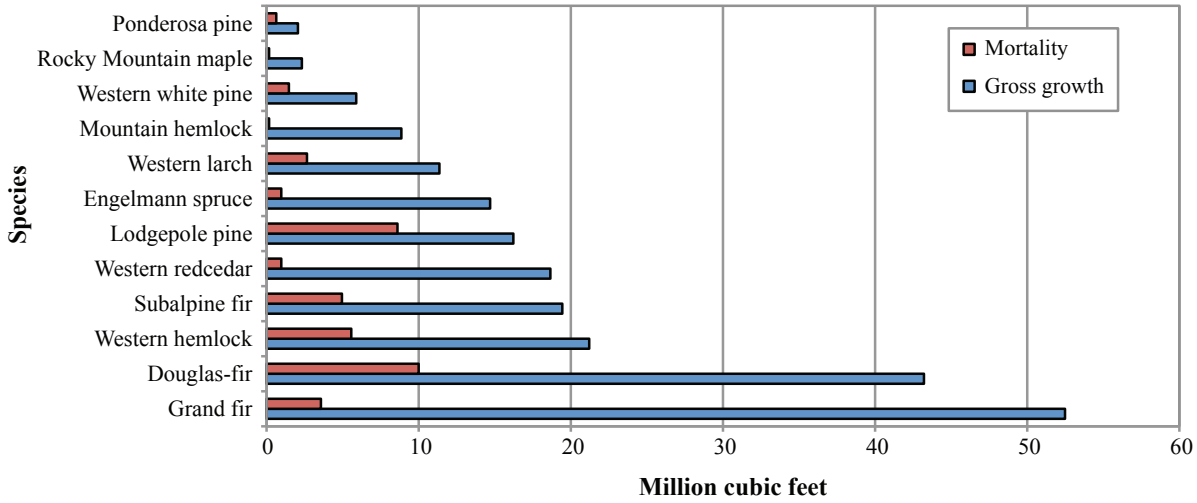

Figure 13—Gross annual growth of live trees 5.0 inches diameter and greater compared to mortality for twelve high-volume species on all forest land, Idaho Panhandle National Forest, 2000.

overall mortality on the IPNF: Douglas-fir (25 percent), lodgepole pine (22 percent), western hemlock (14 percent), subalpine fir (12 percent), and grand-fir (9 percent).

Understory vegetation—Understory vegetation provides forage and cover for wildlife, contributes to forest fuel load, and can be an indication of the successional stage of the forest community. On each plot, field crews visually estimated crown canopy coverage for four plant groups—tree seedlings/saplings, shrubs, forbs, and graminoids (see USDA 1999 for details). Figure 14 shows the average percent cover of plant groups on forest land by forest type. Forest wide, Rocky Mountain maple is the most abundant understory seedling/sapling species, followed by grand fir. The most abundant understory shrubs are big huckleberry, mock azalea and mountain lover. Bear grass, broadleaf arnica, and goldthread are the most abundant forbs; and pinegrass, various sedge and wheatgrass species are the most abundant understory graminoids on the forest.

Roaded timberland highlights of the Idaho Panhandle National Forest

Reserved lands are those that have been withdrawn from management for production of wood products, such as wilderness areas, wild and scenic rivers, and national parks. The nonreserved portion of the IPNF contains over 99 percent of the forest land on the forest, 97 percent of which is defined as timberland. The nonreserved portion of the IPNF is further divided by roadless designation. Currently, approximately 856,958 acres of nonreserved timberland, or 35 percent, is designated as roadless area, which limits management for wood products production. There are 1.03 billion live growing-stock trees on nonreserved timberland, 684 million in roaded portions and 348 million in roadless areas.

Forest type—Douglas-fir was the most common forest type on nonreserved timberland on the IPNF at 22 percent of nonreserved timberland, followed by spruce-fir (16 percent) and grand fir (14 percent). On the roadless portion, Spruce-fir was the most common at 26 percent, followed by Douglas-fir

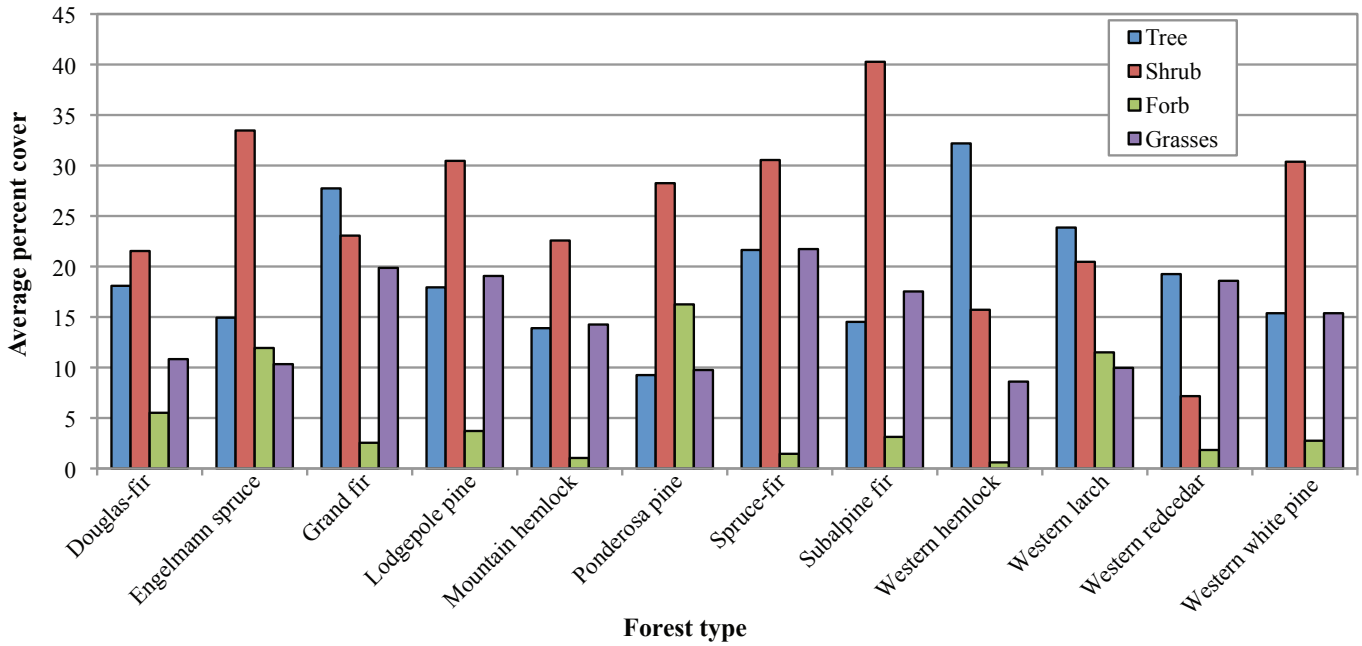

Figure 14—Average percent cover of four major understory plant groups on forest land by forest type, Idaho Panhandle National Forest, 2001.

(21 percent) and lodgepole pine (16 percent). The Douglas-fir forest type was the most abundant on the roaded portion of the nonreserved timberland at 23 percent, followed by grand-fir (18 percent) and western hemlock (15 percent).

Dead trees and fuels—There are approximately 87 million standing dead trees (snags) and 82 million down dead trees 5.0 inches diameter and greater on nonreserved timberland, with 56 million standing dead and 55 million down dead occuring on the roaded portion. The merchantable bole and bark of all dead trees at least 5.0 inches in diameter on nonreserved timberland was equal to about 22.4 million tons in standing dead (15.0 million tons in the roaded portion) and 17.9 million tons in down dead (12.1 million tons in the roaded portion). The weights per acre of down dead trees on nonreserved roaded timberland were similar for those on all forest land, both by stand-size class for all forest types combined (large tree class at 9.2 tons per acre, medium tree class at 4.5 tons per acre, seedling/sapling class at 4.1 tons per acre) and by forest type for all size classes combined (western redcedar at 17.1 tons per acre, Engelmann spruce at 11.8 tons per acre and western larch at 8.8 tons per acre.)

Stand age—Stands were generally very similar on nonreserved roaded timberland when compared to all nonreserved forest land, with the 61- to 80-year age class being the most common, followed by the 81- to 100- year age class (fig. 15). Roaded areas show more area in the 1- to 20- year age class and roadless areas show a relative increase in the 121- to 140-year age class.

Wood volume, biomass, and basal area of growing-stock trees—Table 3 displays a breakdown of net cubic volume, tons of biomass, and square foot basal area for growing-stock trees 5 inches diameter and greater by species on nonreserved roaded timberland for the IPNF. The total net cubic-foot volume on nonreserved timberland was over 7.8 billion cubic feet, with 65 percent (5.1 billion cubic feet) of the volume in the roaded areas. Douglas-fir and grand fir together account for 43 percent of the volume on roaded timberland. Total biomass was estimated at 131.5 million tons, 66 percent of it on the roaded portion of the forest. Forty-six percent of the biomass on roaded timberland consists of Douglas-fir and grand fir. Total basal area was estimated at 275.8 million square feet, with 64 percent of it in roaded areas. Douglas-fir and grand fir comprise 43 percent of basal area on roaded timberland. Roughly 74 percent each of the growing stock volume, biomass, and basal area of Douglas-fir and 73 percent each of grand fir on nonreserved timberland were in roaded portions of the forest.

The net volume of sawtimber trees (sawtimber volume) on nonreserved timberland was estimated to be 21.9 billion board feet (International ¼-inch rule). This includes all growing-stock trees 9.0 inches diameter and greater for softwoods, and 11.0 inches diameter and greater for hardwoods. Figure 16 illustrates the sawtimber volume on nonreserved timberland by diameter class and roadless designation. The 15.0 to 16.9-inch diameter class had the most volume at 13.2 percent, followed closely by the 13.0 to 14.9-inch class at 12.3 percent. Twenty-one percent of the total sawtimber volume on the Idaho Panhandle National Forest was from Douglas-fir (16 percent in roaded areas), with 20 percent from grand fir (15 percent in roaded areas), 10 percent from western hemlock (7 percent in roaded areas), and 9 percent from western redcedar (5 percent in roaded areas). Overall, 65 percent of the sawtimber volume was on the roaded portion of the forest.

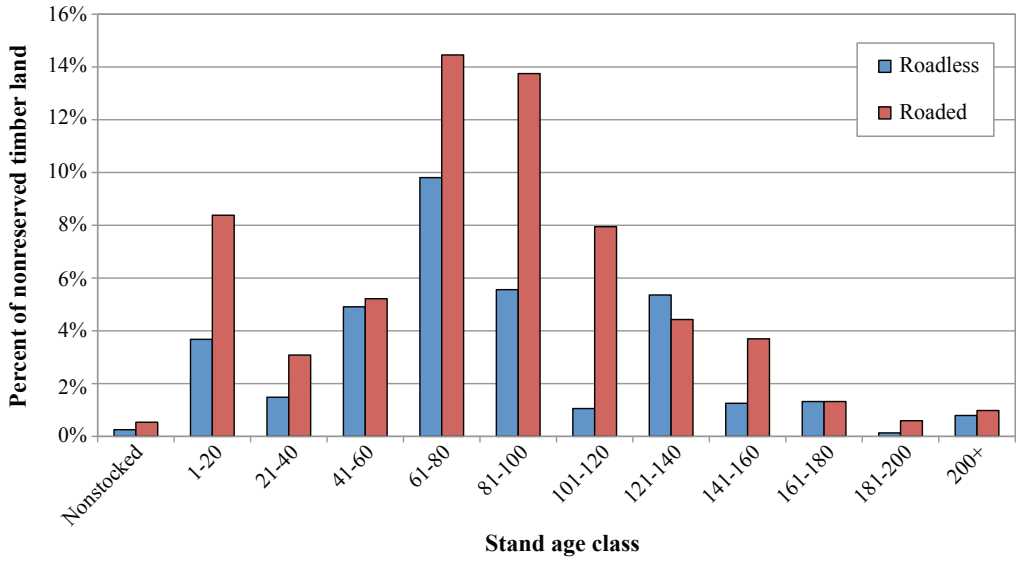

Figure 15—Percent of nonreserved timberland by roadless designation and stand-age class, Idaho Panhandle National Forest, 2001.

Table 3—Net volume, biomass, and basal area of live growing-stock trees 5 inches diameter and greater by species on nonreserved roaded timberland, Idaho Panhandle National Forest, 2001.

Species	Volume (Million cubic feet)	Biomass (Million tons)	Basal area (Million square feet)
Douglas-fir	1,203.4	23.1	44.2
Grand fir	1,073.1	16.7	32.4
Western hemlock	559.4	10.3	19.9
Western larch	488.0	9.3	15.9
Western redcedar	475.5	6.8	19.3
Lodgepole pine	424.6	6.7	13.9
Subalpine fir	288.4	4.3	11.9
Engelmann spruce	259.6	3.7	8.3
Western white pine	123.3	2.0	3.6
Mountain hemlock	107.6	2.0	5.1
Ponderosa pine	65.0	1.2	2.3
Quaking aspen	6.9	0.1	0.2
Paper birch	6.6	0.1	0.3
Black cottonwood	4.3	†	0.1
White bark pine	0.6	†	†
Pacific yew	0.1	†	†
Total (not exact due to rounding)	**5,086.5**	**86.4**	**177.4**

† Less than 100,000

Stand density index—Sixty-nine percent of the roaded timberland stands on the Idaho Panhandle National Forest were at 35 percent or more of SDI maximum, or considered to be fully occupied. One hundred percent of mountain hemlock stands, 89 percent of western redcedar stands, and 74 percent of grand fir stands were fully occupied. Western white pine had the least fully occupied stands with 23 percent reaching that level.

Components of change: growth and mortality—Gross annual growth of growing-stock trees on nonreserved timberland on the IPNF was estimated at 212 million cubic feet, while mortality was an estimated 39 million cubic feet. Sixty-six percent of the growth and 71 percent of the mortality occurred on the roaded portion of the nonreserved timberland. Gross annual growth is compared to mortality of growing-stock trees for eight high volume species in figure 17. Mortality was 18 percent of growth on nonreserved timberland, 20 percent on the roadless portion, and 16 percent on the roaded areas. Mortality volume was highest in Douglas-fir and lodgepole pine. No species experienced net negative growth on the IPNF. A major difference between growing-stock mortality on roaded timberland and live tree mortality in all forest land was the much lower mortality to growth ratio on roadless timberland for western hemlock and western white pine.

The inventory methods

Forest Inventory and Analysis (FIA) provides a statistically based sample of forest resources across all ownerships that can be used for planning and analyses at local, state, regional, and national levels. IWFIA uses a two-phase sampling procedure for all inventories. Phase one is based on a grid of sample points systematically located every 1,000 meters across all lands in a state. Phase one points are assigned ownership and vegetative cover attributes using maps and remotely sensed imagery. Field crews conduct phase two of the inventory on the sub-sample of phase one points that occur on forest land. The sampling intensity is one field plot every 5,000 meters, or about every 3 miles. Phase two plots are stratified based on phase one ownership and vegetation information, and weights are assigned to each stratum based on the proportion of phase one points in that stratum.

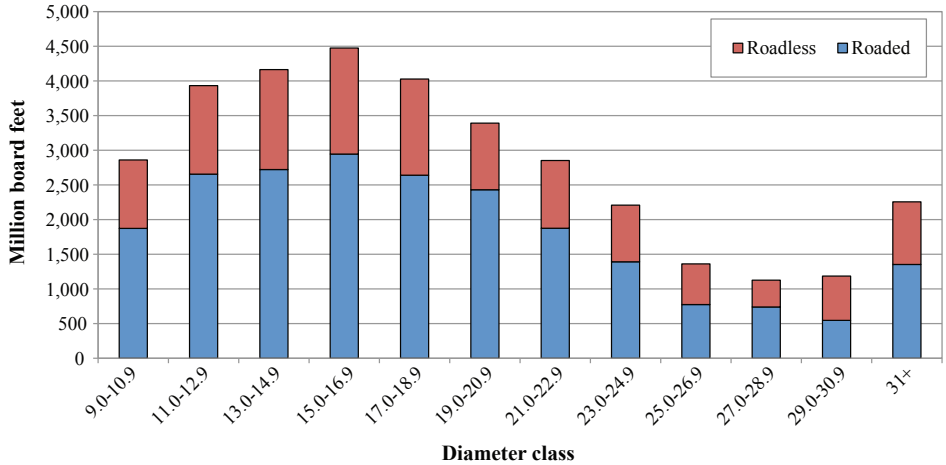

Figure 16—Net volume of sawtimber trees (International 1/4" rule) on nonreserved timberland by 2-inch diameter class and roadless designation, Idaho Panhandle National Forest, 2001.

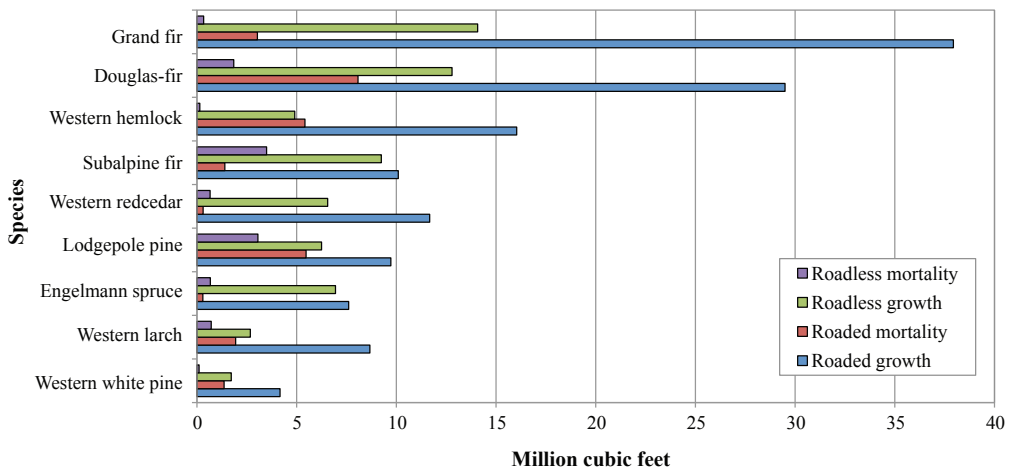

Figure 17—Gross annual growth of growing-stock trees 5.0 inches diameter and greater compared to mortality for nine high volume species on nonreserved timberland, Idaho Panhandle National Forest, 2000.

Phase two plots were sampled using the mapped-plot design (see next section). There were 403 field plots on the IPNF, 3 of which were determined to be inaccessible. A total of 373 field plots sampled only forest conditions, 22 sampled both forest and nonforest conditions, 3 sampled both forest and water conditions (rivers, reservoirs, lakes, etc. at least 30 feet wide or 1 acre in area), and 1 was entirely in a nonforest condition. A total of 440 forest conditions were sampled on 398 plots that contain 390.4 forest, 9.1 nonforest, and 0.5 water condition proportions.

About the mapped-plot design—The mapped-plot design was adopted by FIA nationwide by 1995. Its predetermined subplot layout uses boundary delineation, when necessary, to classify differing conditions. Most plots sample one forest condition, therefore, delineating conditions is often not required.

Conditions were separated, or mapped, based on differences in any of five attributes: forest/nonforest, forest type, stand-size class, stand origin, and stand density. The condition proportion is the fraction of plot area sampled in each condition. The sum of all condition proportions for any given plot equals 1.00. Therefore, the number and relative size of plot conditions determines the weighted area used for sample expansion.

Standard errors—The sample was designed to meet national standards for precision in state and regional estimates of forest attributes. Standard errors, which denote the precision of an estimate, are usually higher for smaller subsets of the data. Forest-level estimates and percent standard errors by land class or type of trees for various attributes are presented in table 4. Standard errors for other estimates are available upon request (see "For further information" section on the inside back cover).

Table 4—Percent standard error for area estimates on total forest land and nonreserved timberland; and percent standard errors for estimates of net volume, net annual growth, and annual mortality for live trees on total forest land and growing-stock trees (5.0 inches d.b.h. and greater) on nonreserved timberland, Idaho Panhandle National Forest, 2001.

Land class or Type of trees	Attribute	Area or volume	Percent standard error
Total forest land (acres)	Area	2,444,544	±0.6
Total forest land	Volume	7,936,478,247	±3.8
(all trees cubic feet)	Growth	177,646,924	±5.2
	Mortality	39,679,794	±13.5
Nonreserved timberland (acres)	Area	2,360,866	±1.1
Nonreserved timberland	Volume	7,839,665,512	±3.8
(growing-stock trees cubic feet)	Growth	173,591,299	±5.3
	Mortality	38,700,934	±13.8

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Selected data for this National Forest are 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://fia.fs.fed.us/tools-data/

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.