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Nevada's Forest Resources, 2004–2013

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Abstract

This report presents a summary of the most recent inventory information for Nevada's forest lands. The report includes descriptive highlights and tables of area, number of trees, biomass, volume, growth, mortality, and removals. Most of the tables are organized by forest-type group, species group, diameter class, or ownership. The report also describes inventory design, inventory terminology, and data reliability. Results show that Nevada's forest land totals 10.6 million acres. Sixty-three percent (6.7 million acres) of this forest land is administered by the Department of Interior's Bureau of Land Management. Forest types in the pinyon/juniper group cover 8.6 million acres or 81 percent of Nevada's forest lands, making them the predominant forest type in the State. The woodland hardwoods forest-type group is the second most abundant, comprising 7 percent of Nevada's forest land. Utah juniper and singleleaf pinyon are the most abundant tree species in Nevada, whether measured by number of trees, volume, or biomass. Net annual growth of all live trees 5.0 inches diameter and greater on Nevada's forest land totaled 16.3 million cubic feet. Average annual mortality totaled 47.7 million cubic feet.

Keywords: Nevada, forest inventory, field data, trees, biomass, volume, growth, mortality, removals

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Resource Highlights

Forest Area

- Nevada's forest land area totals 10.6 million acres.
- Unreserved forest land accounts for most (84 percent) of the forest land in Nevada and totals 8.9 million acres.
- Only 3 percent of Nevada's unreserved forest land is classified as timberland and 97 percent is classified as unproductive forest land.
- Sixty-three percent of Nevada's total forest land area, about 6.7 million acres, is administered by the Bureau of Land Management.
- Forest types in the pinyon/juniper group cover 8.6 million acres and account for 81 percent of forest land in Nevada.
- The woodland hardwoods forest-type group totals 0.7 million acres.
- The most common non-woodland forest types are aspen at 0.2 million acres and white fir at 0.1 million acres.

Numbers of Trees, Volume, and Biomass

- There are 2.6 billion live trees in Nevada.
- Softwood species total 2.1 billion trees or 81 percent of all live trees. Seventy-five percent (2.0 billion) are woodland pinyons and junipers.
- Numbers of singleleaf pinyon trees total nearly 1.3 billion, making this species the single-most abundant tree in Nevada.
- The net volume of live trees in Nevada on forest land totals 6.2 billion cubic feet.
- Growing-stock volume on timberland in Nevada totals less than 0.3 billion cubic feet, only 5 percent of the total live volume on forest land.
- The total above-ground weight of oven-dry biomass of live trees on Nevada forest land is 110 million tons.
- Net volume of sawtimber trees on timberland totals 1.3 billion board feet.

Forest Growth and Mortality

- Net annual growth of all live trees 5.0 inches diameter and greater on Nevada forest land totaled 16.3 million cubic feet.
- Average annual mortality on forest land totaled 47.7 million cubic feet.
- Five species groups, all softwoods, had negative net annual growth on forest land.

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For the first time, forest scientists, managers, and other users have access to a comprehensive forest inventory dataset for the State of Nevada. Although it may not be apparent to the casual observer in many locales, Nevada encompasses a wide variety of environments and forest types. Its forests are valued for their scenic beauty, wood products, traditional forms of food and shelter, wildlife habitat, and ecological functions. This report contains highlights of the status of Nevada's forest resources, with discussions of pertinent issues based on the first full cycle, or 10 years of inventory under the Forest Inventory and Analysis (FIA) annual system (Gillespie 1999).

This chapter briefly describes the implementation of the national FIA sample design in Nevada, as well as some basic differences between this inventory and previous inventories of Nevada's forests. The following chapters describe specific inventory methods; an overview of traditional forest attributes measured by the FIA program, such as forest land area and timber volume; descriptions of selected resources that Nevada's forests provide; and current issues and events affecting Nevada's forests. The appendices include supplemental information, including a glossary of terms used in this report, comparisons of current forest attributes with previous forest inventories, standard forest resource tables, descriptions of forest types and forest-type groups, lists of tree species, and documentation for the equations used to estimate tree volume and site index.

Nevada's Annual Forest Inventory

The annual inventory of Nevada's forests follows sampling procedures specified by Federal legislation and the national FIA program. In 1998, the Agricultural Research Extension and Education Reform Act, also known as the Farm Bill, mandated that inventories would be conducted throughout the forests of the United States on an annual basis. This annual system integrates FIA and Forest Health Monitoring (FHM) sampling designs into a mapped-plot design that includes a nationally consistent plot configuration with four fixed-radius subplots; a systematic national sampling design consisting of one plot per approximately 6,000 acres; annual measurement of a constant proportion of permanent plots; data or data summaries within 6 months after yearly sampling is completed; and a State summary report after 5 years and every 5 years thereafter. The inventory strategy for the Western United States involves measurement of 10 systematic samples, or subpanels, where one subpanel is completed each year and all subpanels are measured over a 10-year period. Each subpanel is pre-assigned to be surveyed during a specific calendar year, which is referred to as inventory year (see Appendix A for standard FIA terminology). The year in which each plot was actually surveyed is recorded as its measurement year. In most States, inventory year and measurement year are the same for the vast majority of field plots.

Interior West Forest Inventory and Analysis (IWFIA) began implementation of the annual inventory strategy in Nevada in 2004 as part of the Nevada

Photo-Based Inventory Pilot (NPIP) (Frescino et al. 2009). Inventory results from the NPIP data are now available (Frescino et al. 2016), which present a slightly different view of Nevada's forest resources and much more information about land cover and land use on Nevada's nonforest areas. Annual inventory continued in 2005 and 2006, but during the 2006 field season, NPIP funding was exhausted and annual inventory ceased. Since the data for inventory year 2006 was incomplete, the 2004 to 2005 inventory data has been the only annual inventory available for Nevada. In 2009, FIA crews resumed work in Nevada on a catch-up basis, trying to complete as many of the plots from previous inventory years as possible. In 2010 and 2011, this effort was accelerated, and in 2012, a full push resulted in the completion of the 2012 plots and all previous inventory years' plots. Under this accelerated sampling, approximately six-and-a-half subpanels were completed within the 4-year period between 2009 and 2012. These subpanels represent inventory years 2006 to 2012, so their inventory years are often not the same as their measurement years. In 2013, the initial full inventory cycle was completed. This report is based on the aggregated data collected in measurement years 2004 to 2006 and 2009 to 2013 from all 10 subpanels whose scheduled inventory years range from 2004 to 2013. Data may be downloaded in table form or queried using a variety of online tools (<http://fia.fs.fed.us/tools-data/default.asp>).

The Nevada inventory continues on the regular inventory schedule. In 2014, the remeasurement phase of the inventory began as field crews returned to plots from the 2004 subpanel. This new plot data can then be compared to the data collected in 2004 to 2013. Note that remeasurement periods for the middle subpanels will range from 4 years, for portions of the 2006 subpanel that were measured as late as 2012, to 9 years for plots that were first measured a year after their scheduled inventory years. Plots from the 2004, 2005, 2012, and 2013 subpanels, as well as about half the plots from the 2006 subpanel, will have a full 10-year remeasurement period. Future estimates of growth, removals, and mortality will account for these different remeasurement periods. Annual inventory summaries are updated each spring to include the most recent subpanels of data available to the public.

In addition to NPIP and the annual inventory, in 2011 and 2012 IWFIA assisted the Spring Mountain National Recreation Area (SMNRA) in measuring plots using FIA protocols on a highly intensified grid. Data from these plots can be used in analysis of forest land within SMNRA, but are not included in the current report. These data, or summaries of them, can be requested by contacting the lead author of this report.

Previous Inventory of Nevada's Forests

Prior to the implementation of the annual forest inventory, Nevada had only a single inventory, initially completed from 1978 to 1982 (Born et al. 1992). Although this was the only previous forest inventory of Nevada, the intent was to repeat it in 10 to 12 years, as in other States. Because these inventories were conducted periodically, they are referred to as periodic inventories. The nominal year assigned to this inventory, 1989, does not specifically represent the years that field

surveys were completed, but rather represents the year the dataset was compiled and analyzed for reporting purposes. A separate inventory of the Humboldt and Toiyabe National Forests was completed between 1994 and 1997. These data are combined with the inventory year 1989 survey in the national FIA database, but other data from the National Forests were used for the Born et al. (1992) summary of the State's forest resources.

Data from new inventories are often compared with data from earlier inventories to quantify forest trends. However, for the comparisons to be valid, the procedures used in the inventories must be compatible. The procedures used in the 1989 inventory, including plot designs and some plot locations, are different enough from current procedures that direct comparisons between them are not recommended. However, it is possible to compare individual plots that were measured during both inventories (Goeking 2015). Although the plot designs were different in the 1989 data, the methods of compiling tree data to the plot level are similar enough that reasonable plot-to-plot comparisons can be made. Therefore, plots on forest land that were sampled during both inventories can be used to evaluate changes in attributes such as per-acre estimates of live volume, mortality, growth, and biomass. A more detailed description of the differences between the periodic and annual forest inventories of Nevada, as well as results from plot-to-plot comparisons of periodic and annual inventory data, can be found in this report in the *Comparisons Between Nevada's Periodic and Annual Forest Inventories* section of the "Special Topics" chapter.

Accessing Nevada's Forest Inventory Data

FIA data are publicly available from the national FIA website at www.fia.fs.fed.us. This site includes data downloads; online tools that allow users to perform custom queries; and documentation of FIA's field inventory protocols, database structure, sampling design, and publications. Plot data may be downloaded in table form or summarized using a variety of online tools (<http://fia.fs.fed.us/tools-data/default.asp>). For assistance with finding information on this site or with performing custom analyses, data users are encouraged to contact one of the members of the Analysis Team of the Interior West FIA Program who are listed as authors at the beginning of this report, or the contact listed on the Customer Service link on the website. The national FIA database contains data from the 1989 periodic inventory as well as annual forest inventory data, which is updated each year as additional measurements are collected. In the annual inventory, groups of inventory years that can be used together to make population estimates are combined. These groups are sometimes designated using the most recent inventory year and may be referred to as "survey years," "inventories," or "evaluations." There are currently three annual evaluations for Nevada: 2005 (consisting of the 2004 and 2005 inventory years), 2012 (inventory years 2004 through 2012), and 2013 (inventory years 2004 through 2013). As new annual data are added, new evaluations are compiled. With plot remeasurement, the previous measurements are dropped and the evaluations become 10-year moving window estimators.

Overview of Standard and Supplemental Tables

Forest Inventory and Analysis produces a set of standard tables that incorporate most of the core FIA program. Appendix B presents tables B1-B41, which summarize annual forest inventory data collected in Nevada between 2004 and 2013 in terms of traditional FIA attributes. These tables encompass statistics for land area, numbers of trees, wood volume, biomass (oven-dry weight), growth, mortality, sampling errors, and forest soil properties. Table B1 is the only table that includes all land cover types, and it summarizes the proportions of sample plots that were recorded as forest, nonforest, and non-sampled (e.g., due to inaccessibility), except those excluded from the analysis (see the “Inventory Methods” chapter for explanation of excluded plots). All other tables exclude nonforest land and therefore include only accessible forest land or timberland (see Appendix A for definitions). Table B37 shows sampling errors of area, volume, net growth, and mortality as a percentage of the estimates.

This report also contains supplemental tables within the body of the report. To avoid confusion between supplemental tables found in individual report chapters and the standard FIA tables found in Appendix B, supplemental tables in the body of the this report are labeled consecutively as they appear. Standard tables will be referred to beginning with the appendix letter followed by the table number (e.g., table B1).

Inventory Methods

This chapter briefly describes five key aspects of the FIA program. The first four sections describe configuration of field plots, the national sample design, the three-phase inventory system, and sources of error, which are consistent among all States. The last section describes FIA’s quality assurance program and presents the results of quality assessments in the current forest inventory of Nevada.

Plot Configuration

The national FIA plot design consists of four 24-foot radius subplots configured as a central subplot and three peripheral subplots (USDA Forest Service 2004, 2006, 2010, 2011, 2013; see fig. 1). Centers of the peripheral subplots are located at distances of 120 feet and at azimuths of 360 degrees, 120 degrees, and 240 degrees from the center of the central subplot. Each standing tree with a diameter at breast height (d.b.h.) for timber trees, or a diameter at root collar (d.r.c.) for woodland trees, of 5 inches or larger is measured on these subplots. Each subplot contains a 6.8-foot radius microplot with its center located 12 feet east of the subplot center on which each tree with a d.b.h./d.r.c. from 1.0 inch to 4.9 inches is also measured.

To enable division of the forest into various domains of interest for analysis, it is important that the tree data recorded on these plots are properly associated with stand-level data. In addition to the tree data recorded on FIA plots, data are also gathered about the condition class in which the trees are located. A condition

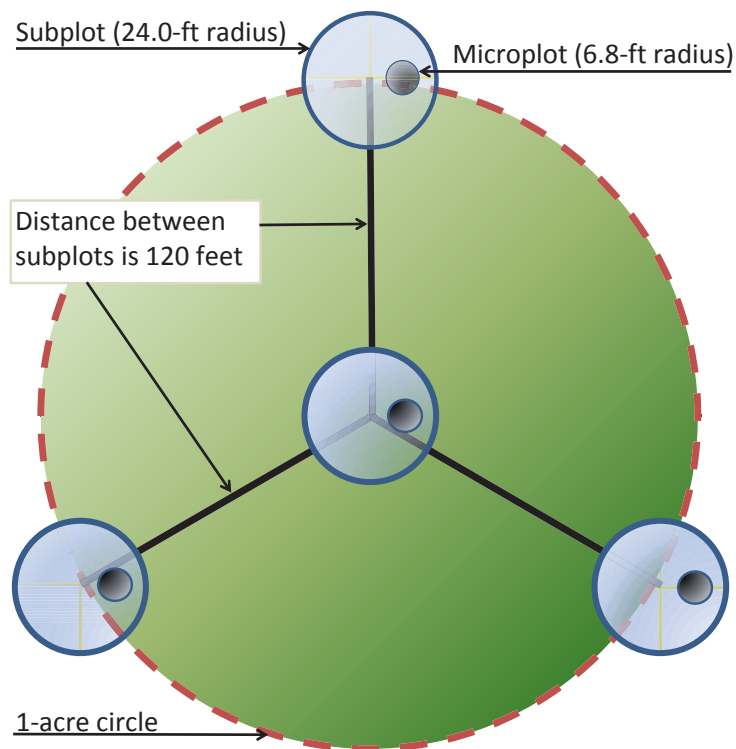


Figure 1—Plot configuration used by the Forest Inventory and Analysis program. Each plot consists of four subplots with a 24-foot radius. The three outer subplots are located 120 feet from the central subplot's center at azimuths of 0, 120, and 240 degrees. Microplots with radii of 6.8 feet are located on each subplot, with centers located 12 feet from the subplot center at an azimuth of 90 degrees.

class (or condition) is the combination of discrete landscape and forest attributes that define and describe the area associated with a plot. The six variables that define distinct condition classes are forest type, stand origin, stand size, ownership group, reserved status, and stand density (Bechtold and Patterson 2005). In some cases, the plot footprint spans two or more conditions if there is a distinct change in any of these six variables. For example, the four subplots on a plot may intersect both forest and nonforest areas, the plot may include distinct stands differentiated by forest type and/or stand size, or the plot may straddle an ownership boundary. All three of these examples would result in more than one condition per plot. Field crews assign numbers to condition classes in the order they are encountered on a plot. Each tree is assigned the number of the condition class in which it occurs to enable partitioning of tree data into meaningful categories for analysis.

Sample Design

Based on historic national standards, a sampling intensity of approximately one plot per 6,000 acres is necessary to satisfy national FIA precision guidelines for area and volume. Therefore, FIA divided the area of the United States into non-overlapping 5,937-acre hexagons and established one plot in each hexagon using procedures designed to preserve existing plot locations from previous inventories.

These sample plots, designated as the Federal base sample, were divided into five spatially interpenetrating panels and 10 subpanels, where each panel consists of two subpanels. In the eastern United States, two subpanels are measured each year such that the inventory cycle is on a 5-year rotation, while in the western United States, including Nevada, one subpanel is measured each year and inventory cycles are completed on a 10-year rotation (Gillespie 1999). For estimation purposes, the measurement of each subpanel of plots can be considered an independent, equal probability sample of all lands in a State, or all plots can be combined to represent the State.

Three-Phase Inventory

FIA conducts inventories in three phases. In Phase 1, remote sensing data are digitally analyzed to stratify each State into forest and nonforest areas. Phase 2 relates to a permanent network of ground plots, where traditional inventory variables such as forest type and tree diameter are measured. In Phase 3, additional variables associated with forest and ecosystem health are measured on a subset of Phase 2 plots. The three phases of the enhanced FIA program are discussed in the following sections.

Phase 1

Phase 1 uses remote sensing data to delineate areas with similar land cover characteristics, or strata, throughout the entire State. The purpose of this delineation is to reduce the variance of FIA estimates through post-sampling stratification of field data. The initial Phase 1 strata map for the Interior West consisted of forest, nonforest land, and census water strata (see Appendix A for definitions), which were delineated at a spatial resolution of 250 meters using a combination of 2004 MODIS satellite imagery, other geospatial datasets, and plot-based calibration data (Blackard et al. 2008). Calibration data in Nevada consisted of periodic inventory plot locations that had been classified as forest, nonforest land, or census water, based on field surveys or human interpretation of aerial photographs. For Nevada, the census water and the nonforest land areas from the map were combined, resulting in the forest and nonforest strata used for estimates.

Post-sampling stratification is based solely on these forest and nonforest strata under the assumption that any nonresponse plots occur randomly across the plot grid. Nonresponse plots are defined as plot locations that cannot be sampled by a field crew. These situations typically occur when landowners or managers do not grant permission for field crews to access plot locations on their lands, although some plots are not sampled due to hazardous conditions that may be permanent in nature, such as sheer cliffs, or temporary hazards, such as active wildfires or logging operations. When access permission is denied over a large contiguous area, the problem of nonresponse spatial bias can be addressed by eliminating the area in question, including its portions of the strata. Such a case occurred in the current Nevada inventory on the Nellis Air Force bombing range, where, due to ongoing military training operations, FIA crews have not yet been able to sample forested plots. The entire area of the bombing range was subtracted from the total State

area, areas of all intersected counties, and the forest and nonforest strata (fig. 2). In this way, the area was removed from the population. All of the plots within this area were dropped from the inventory. Therefore, the estimates in this report are for areas outside the bombing range, including the percent of non-sampled plot area in table B1.

FIA produces estimates at the scale of individual States, which can then be aggregated into regional estimates, as well as at smaller scales within each State. Within-state population estimates are constructed at two scales: survey units that are made up of groups of counties, and smaller estimation units that represent individual counties. Nevada consists of only one inventory unit and 17 estimation units denoted as g , each containing n_g ground plots. The area of each estimation unit is divided into strata of known size using the State's stratification map, which divides the total area of the estimation unit into 250-meter pixels and assigns each pixel to one of H strata. Each stratum, h , within an estimation unit g , then contains n_{hg} ground plots where the Phase 2 attributes of interest are observed. Strata and/or estimation units can be combined if they contain too few ground plots to effectively reduce the variance of estimates.

To illustrate, the area estimator for forest land for an estimation unit in Nevada is defined as:

$$\hat{A}_g = A_{Tg} \sum_{h=1}^H W_{hg} \frac{\sum_{i=1}^{n_{hg}} Y_{ihg}}{n_{hg}}$$

where:

$\hat{A}_g$ = total forest area (acres) for estimation unit g

A_{Tg} = total land area (acres) in estimation unit g

H = number of strata

W_{hg} = proportion of Phase 1 pixels in estimation unit g that occur in stratum h

Y_{ihg} = forest land condition proportion on Phase 2 plot i in stratum h in estimation unit g

n_{hg} = total number of sampled Phase 2 plots in stratum h in estimation unit g

Phase 2

Phase 2 pertains to FIA's network of permanent plot locations, where each plot is assigned spatial coordinates and represents roughly 6,000 acres. To minimize inventory costs, plots that are obviously not forested or wooded are not designated for field sampling, and these plots are recorded as nonforest. A human interpreter examines each plot location using digital imagery from the National Agriculture Imagery Program and distinguishes plots that have the potential to sample forest or wooded land from those that do not intersect any forest or wooded land. This process is known as prefield interpretation, and it was historically considered part of

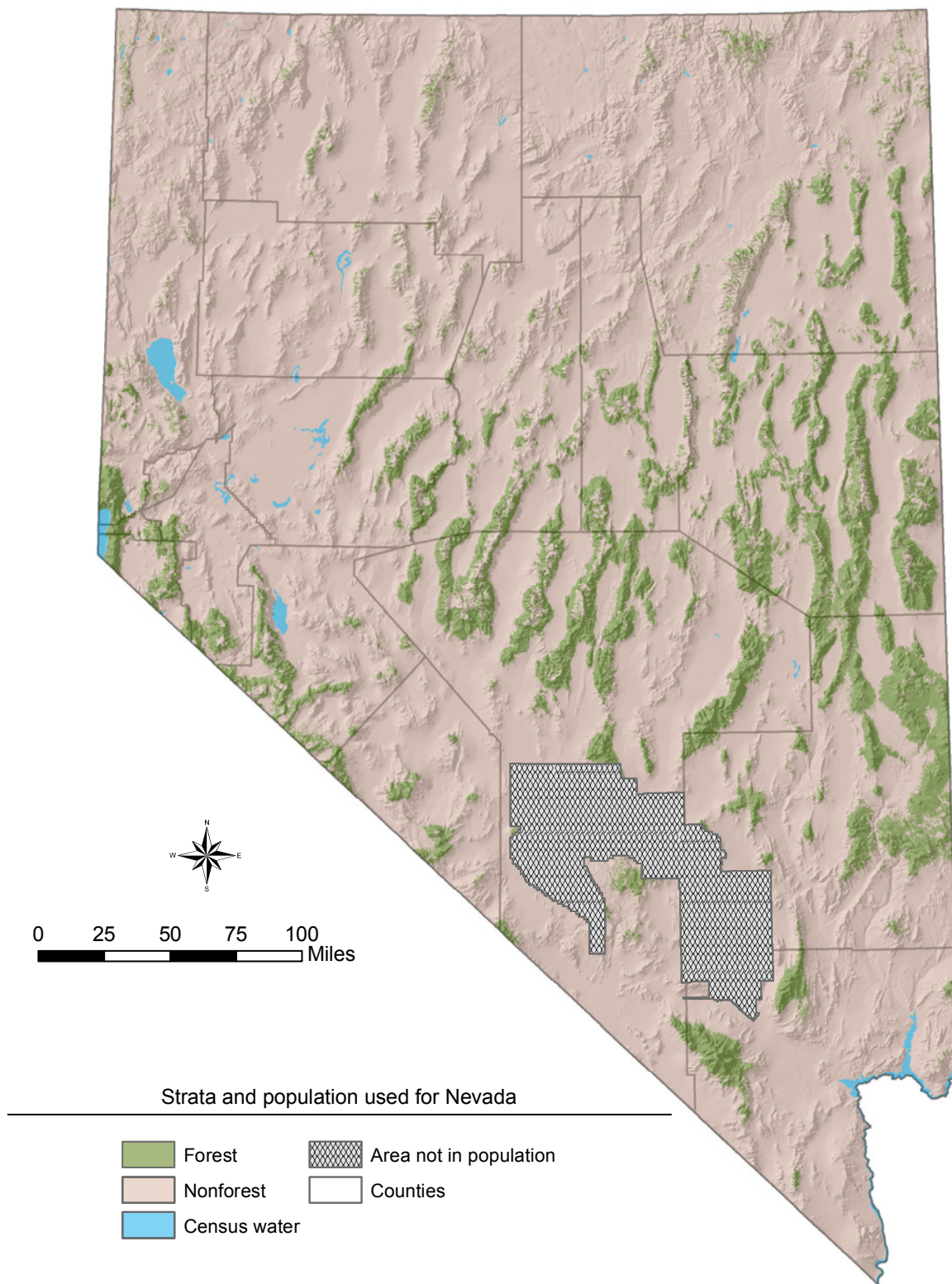


Figure 2—The initial three strata for Nevada’s forest inventory, showing the area removed from the population. The nonforest and census water areas were combined to create the two strata used for post-stratification.

Phase 1 because both prefield interpretation and Phase 1 relied on remote sensing data. However, Phase 1 delineation of forest and nonforest strata occurs independently of current prefield interpretation of the Phase 2 grid. Therefore, prefield data collection is considered part of Phase 2 and not part of Phase 1.

The status of each plot in the Phase 2 grid is eventually assigned as accessible forest land, nonforest land, or not sampled. Plots that were not designated for field sampling by prefield interpreters are automatically recorded as nonforest plots. For plots that are designated for field sampling, field crews record the plot status as accessible forest land if (a) they can physically visit the plot location, and (b) the plot satisfies FIA's definition of forest land (see Appendix A). Some field plots are recorded as nonforest because the field crew determines that they do not meet FIA's definition of forest land. A field plot may be recorded as non-sampled if a field crew cannot safely measure the plot or if they cannot obtain permission to access the plot location. Before visiting privately owned plot locations, FIA crews identify each plot's ownership status by consulting county land records and then seek permission from private landowners to measure plots on their lands. Information about individual landowners and the existence of FIA plots on their property is considered confidential and is never shared with anyone, regardless of whether permission to access the plot location is granted. Table B1 shows the total percentage of Phase 2 plots that represent forest, nonforest, and non-sampled conditions, not including plots in the area removed from the population.

Field crews record a variety of data for plot locations that occur on accessible forest land. Crews locate the geographic center of the plot using geographic positioning system (GPS) receivers and then monument that location to facilitate relocation of the plot for future remeasurement. They record condition-level variables that include land use, forest type, stand origin, stand-size class, stand-age class, site productivity class, forest disturbance history, slope, aspect, and physiographic class. Some of these area attributes are measured or observed (e.g., regeneration status), some are assigned by definition (e.g., ownership group), and some are computed from tree data (e.g., percent stocking). For each tree on the plot, field crews record a variety of attributes including species, live/dead status, diameter, height, crown ratio, crown class, damage, and decay status. The field procedures used in Nevada's forest inventory are described in detail in the FIA field guides (USDA Forest Service 2004, 2006, 2010, 2011, 2013). Data analysts apply statistical models using field measurements to calculate values for additional variables such as individual tree volume and per unit area estimates of number of trees, volume, biomass, growth, and mortality.

Phase 3

The third phase of the enhanced FIA program focuses on forest and ecosystem health. The Phase 3 sample consists of a 1/16 subset of the Phase 2 plots, which equates to one Phase 3 plot for approximately every 96,000 acres. Phase 3 plots include all the measurements collected on Phase 2 plots, plus an extended suite of ecological data pertaining to soil samples, down woody materials, lichen communities, tree crowns, and understory vegetation structure. Phase 3

measurements are obtained by field crews during the growing season. The entire suite of Phase 2 measurements is collected on each Phase 3 plot at the same time as the Phase 3 measurements.

Sources of Error

Sampling Error

The process of sampling (selecting a random subset of a population and calculating estimates from this subset) causes estimates to contain error they would not have if every member of the population had been observed and included in the estimate. The 2004 to 2013 FIA inventory of Nevada is based on a sample of 11,339 plots systematically located across the State. The total area of Nevada, minus the area of the Nellis Air Force bombing range, is 67.8 million acres, so the sampling rate is approximately one plot for every 5,977 acres.

The statistical estimation procedures used to provide the estimates of the population totals presented in this report are described in detail in Bechtold and Patterson (2005). Along with every estimate is an associated sampling error that is typically expressed as a percentage of the estimated value, but can also be expressed in the same units as the estimate or as a confidence interval (the estimated value plus or minus the sampling error). This sampling error is the primary measure of the reliability of an estimate. An approximate 67 percent confidence interval constructed from the sampling error can be interpreted to mean that under hypothetical repeated sampling, approximately 67 percent of the confidence intervals calculated from the individual repeat samples would include the true population parameter if it were computed from a 100-percent inventory. The sampling errors for several of these estimates at the State and county level are presented in table B37.

Because sampling error increases as the area or volume considered decreases, users should aggregate data categories as much as possible. Sampling errors obtained from this method are only approximations of reliability because homogeneity of variances is assumed. Users may compute statistical confidence for subdivisions of the reported data using the formula below:

$$SE_s = SE_t \frac{\sqrt{X_t}}{\sqrt{X_s}}$$

where:

SE_s = sampling error for subdivision of State total.

SE_t = sampling error for State total.

X_s = sum of values for the variable of interest (area, volume, biomass, etc.) for subdivision of State total.

X_t = sum of values (area, volume, biomass, etc.) for State total.

Sampling errors can also be calculated for subdivisions of the data by the online tools referenced in Accessing Nevada's Forest Inventory Data in the Introduction of this report.

Measurement Error

Measurement errors are errors associated with the methods and instruments used to observe and record the sample attributes. On FIA plots, attributes such as the diameter and height of a tree are measured with specialized instruments; other attributes, such as species and crown class, are observed without the aid of an instrument. On a typical FIA plot in Nevada, 10 to 30 trees are observed with 15 to 20 attributes recorded on each tree. In addition, many attributes that describe the plot and conditions on the plot are observed. Errors in any of these observations affect the quality of the estimates. If a measurement is biased—such as tree diameters consistently taken at a height other than 4.5 feet from the ground—then the estimates that use this observation (e.g., calculated volume) will reflect this bias. Even if measurements are unbiased, high levels of random error in the measurements will add to the total random error of the estimation process. To ensure that FIA observations meet the highest standards possible, a quality assurance program, described below, is integrated throughout all FIA data collection efforts.

Prediction Error

Prediction errors are associated with using mathematical models (such as volume models) to provide information about attributes of interest based on sample attributes. Area, number of trees, volume, biomass, growth, removals, and mortality are the primary attributes of interest presented in this report. FIA estimates of area and number of trees are based on direct observations and do not involve the use of prediction models; however, estimates of volume, biomass, growth, and mortality use model-based predictions in the estimation process and are thus subject to prediction errors.

Quality Assurance

FIA employs a quality assurance (QA) program to ensure the quality of all collected data. The QA program provides a framework to assure the production of complete, accurate, and unbiased forest information of known quality. There are two primary facets of FIA's QA program: quality control and quality assessment.

FIA's quality control process operates via data quality inspectors, who assess individual field crews and then provide timely feedback to improve the crews' performance. This is accomplished by means of hot checks and cold checks. During a hot check, an inspector accompanies a field crew to a plot and provides immediate feedback on the quality of their measurements. Cold checks occur when an inspector visits a recently completed plot, typically in possession of the original crew's data but without the crew present, and then verifies each measurement and provides the crew an overall score as well as feedback on measurements that did not meet FIA specifications. On average, hot checks are done on 2 percent of all field-sampled plots and cold checks are done on 5 percent of field-sampled plots.

Quality assessment is the second facet of FIA's QA program, and this process quantifies the overall precision of field measurements by comparing two independent measurements of the same plot. The independent measurements are collected by means of blind checks, where a regular field crew collects measurements and then a second crew collects a second set of measurements, without knowledge of or access to the first crew's measurements (Pollard et al. 2006). Thus, these paired observations provide a means of assessing repeatability of FIA's field measurements.

Quality control and quality assessment both require a data quality standard that defines the target level of precision for field measurements. FIA has specific measurement quality objectives (MQOs) that enumerate data quality standards for individual field-measured variables. These data quality objectives were developed from knowledge of measurement processes in forestry and forest ecology as well as the requirements of the FIA program. MQOs for each variable consist of a measurement tolerance and a compliance standard. Measurement tolerances define the acceptable range of variability between two independent observations, and compliance standards define the target percentage of observations that should be within the measurement tolerance when recorded by two independent observers. The practicality of these MQOs, as well as the measurement uncertainty associated with a given field measurement, can be tested by comparing the results of quality assessments using blind check data.

Quality assessment data for Nevada's current inventory were collected between 2006 and 2014. The results of the QA analysis for this period are presented in tables 1 and 2. Table 1 describes tolerances for condition-level variables, and table 2 describes tree-level variables. Each variable and its associated measurement tolerance are followed by the percentage of total paired records that fall within one, two, three, and four times the tolerance. The last four columns show the number of observations that fell outside the tolerance. For example, table 1 shows that there were 46 paired records, representing 46 conditions that were measured independently by two field crews, for the variable "Forest Type." About 94 percent of those records fell within the tolerance of having no errors. The percentage of observations that fall within the 1X tolerance level is referred to as the observed compliance rate, which can be compared to the compliance standard for each variable's MQO to determine that variable's performance. Compliance standards and measurement tolerances for FIA's field measurements are listed within the field manual (USDA 2011).

The information in tables 1 and 2 shows variables with varying degrees of repeatability. For example, one condition-level regional variable that appears to be fairly repeatable is "percent crown cover." At the 1X tolerance level, its observed compliance rate was about 93 percent. This represents that 93 percent of 44 paired observations were within plus or minus 10 percent of each other. In contrast, the compliance rate for "Habitat Type 1," which has no tolerance variability, was only 65 percent. This low compliance rate warrants further investigation into the potential repeatability issues associated with evaluating habitat type, which can provide insight into successional status when combined with existing vegetation (such as tree numbers, size class, and species by habitat types or series). Habitat types are

Table 1—Results of quality assessment for condition-level variables in Nevada. Variables that did not have any non-null values recorded on any QA plots are not shown; these include secondary and tertiary disturbances and treatments, owner industrial status, and regeneration species.

Variable	Tolerance	Percentage of data within tolerance				Number of times data exceeded tolerance				Number of records
		@1x	@2x	@3x	@4x	@1x	@2x	@3x	@4x	
National core variables										
Condition status	No errors	100.00				0				51
Reserve status	No errors	98.00				1				51
Owner group	No errors	100.00				0				51
Forest type	No errors	93.50				3				46
Stand size	No errors	76.10				11				46
Regeneration status	No errors	100.00				0				46
Tree density	No errors	100.00				0				46
Disturbance 1	No errors	91.30				4				46
Disturbance year 1	±1 yr									
Treatment 1	No errors	97.80				1				46
Treatment year 1	±1 yr									
Physiographic class	No errors	89.10				5				46
Regional variables										
Percent crown cover	±10	93.20	97.70	97.70	97.70	3	1	1	1	44
Percent bare ground	±10	54.30	69.60	91.30	97.80	21	14	4	1	46
Habitat type 1	No errors	65.20				16				46
Habitat type 2	No errors	60.90				18				46

represented as a categorical value, and it is likely that the compliance rate for habitat types would be higher if we could consider habitat type groups (or groups of types that are very similar) in our quality assurance analysis.

The tree measurements that have the biggest influence on estimates of forest volume are tree species, tree diameter, and tree height. As shown in table 2, the compliance rate for the variable “Species” was 99 percent. The variables “d.b.h.” and “d.r.c.” represent the respective diameters of timber and woodland tree species (see Appendix D). Whereas timber species are measured at breast height (4.5 feet above ground level), woodland species are measured near ground level at root collar. The tolerance for d.r.c. is plus or minus 0.2 inches per stem, which allows for larger tolerances on multi-stemmed woodland trees. The 1X compliance rate was almost 89 percent for both d.b.h., which has a 0.1-inch tolerance, and d.r.c., which has a 0.2-inch per stem tolerance. Tree height is represented by the variables “total length” and “actual length.” Both variables have a tolerance level of ±10 percent of the observed length, and compliance rates at the 1X level were about 80 percent and 79 percent, respectively. Tree age was the least repeatable tree-level variable, with a 1X compliance rate of only 25 percent. This is probably due to the difficulty

Table 2—Results of quality assessment for tree-level variables in Nevada. The variable “form defect” is not shown because there were no non-null form defect values recorded on any QA plots.

Variable	Tolerance	Percentage of data within tolerance				Number of times data exceeded tolerance				Number of records
		@1x	@2x	@3x	@4x	@1x	@2x	@3x	@4x	
National core variables										
d.b.h.	±0.1 /20 in.	88.6	88.6	94.3	94.3	4	4	2	2	35
d.r.c. using IW MQO	±0.2 in*#stems	88.9	96.0	97.3	98.2	88	32	21	14	791
Azimuth	±10 °	96.0	97.9	98.3	98.4	33	17	14	13	828
Horizontal distance	±0.2 /1.0 ft	60.0	80.0	82.2	84.4	36	18	16	14	90
Species	No errors	99.3				6				828
Tree status	No errors	99.5				4				828
Rotten/missing cull	±10%	96.7	98.6	99.0	99.4	26	11	8	5	780
Total length	±10%	79.5	96.7	99.3	99.5	170	27	6	4	828
Actual length	±10%	79.0	96.9	99.4	99.6	148	22	4	3	704
Compacted crown ratio	±10%	100.0				0				790
Uncompacted crown ratio (P3)	±10%	92.5	97.4	98.5	99.3	56	19	11	5	744
Crown class	No errors	11.4				700				790
Decay class	±1 class	100.0	100.0	100.0	100.0	0	0	0	0	34
Cause of death	No errors	50.0				3				6
Mortality year	±2 yr	83.3	100.0			1	0			6
Condition class	No errors	99.9				1				828
Regional variables										
Mistletoe	±1 class	96.7	98.5	99.5	99.9	26	12	4	1	790
Number of stems	±1 stem	94.4	97.0	98.5	99.7	44	24	12	2	791
Percent missing top	±10%	99.7	99.7	99.7	99.7	2	2	2	2	780
Sound dead	±10%	44.6	44.6	44.6	44.6	432	432	432	432	780
Current tree class	No errors	95.9				34				828
Tree age	±5%	25.4	33.1	42.4	54.2	88	79	68	54	118

of obtaining accurate tree ages. Several factors that might contribute to inconsistency among tree ages are (1) variation in age estimation when cores do not include tree center, or pith (due to rot or borer/pith misalignment); (2) tree rings are too close together or too faint to read accurately in the field; and (3) some trees are too large for the borer to reach the center. These situations are particularly prevalent in the old and slow-growing trees that are typical in Nevada’s forests, and they could be mitigated through better field procedures and/or processing tree cores in a dedicated tree ring laboratory that uses sandpaper, microscopes, and sometimes modeling techniques to obtain more accurate age estimates.

As more blind check information becomes available, it might become apparent that either more intensive crew training is required, or that a variable’s MQO needs to be adjusted accordingly to better reflect the realistic expectation of quality for that variable. As a result, MQOs are used not only to assess the reliability of

FIA measurements and their ability to meet current standards, but also to identify areas of improvement of data collection protocols and training. This ongoing process improves repeatability or may even lead to elimination of variables that prove to be unrepeatable.

Overview of Nevada's Forests

This chapter summarizes the current status of Nevada's forests in terms of traditional forest attributes such as forest ownership, forest type, stand age, stand density index, number of trees, volume, biomass, growth, mortality, and removals. Most attributes are based directly on FIA plot measurements, except where noted in individual sections.

Ecoregion Provinces of Nevada

Issues and events that influence forest conditions often occur across forest types, ownerships, and political boundaries. As a result, scientists, researchers, and land managers must also find a way to assess and treat these issues in a boundaryless way. Ecoregions are often used as a non-political land division to help researchers study forest conditions. An ecoregion is a large landscape area that has relatively consistent patterns of physical and biological components that interact to form environments of similar productive capabilities, response to disturbances, and potentials for resource management (Cleland et al. 1997). Ecoregions are classed in a descending hierarchy of provinces, sections, and subsections.

Nevada encompasses parts of five ecoregion provinces (Bailey 1995): (1) the Intermountain Semi-Desert and Desert Province, (2) the Nevada-Utah Mountains Semidesert-Coniferous Forest-Alpine Meadow Province, (3) the Intermountain Semidesert Province, (4) the American Semidesert and Desert Province, and (5) the Sierran Steppe-Mixed Forest-Coniferous-Alpine Meadow Province. All of these provinces contain forest land in Nevada, differing in composition and extent. FIA uses the modifications to Bailey (1995) of Cleland and others (2007) to assign plots to ecological province, sections, and subsections (fig. 3).

The following are excerpted descriptions of forest vegetation of Nevada's ecoprovinces from Bailey (1995), followed by a brief overview from the current Nevada forest inventory. For descriptions and composition of FIA forest types and forest-type groups in this inventory, see Appendix C.

Intermountain Semidesert and Desert Province:

Sagebrush dominates at lower elevations. Other important plants in the sagebrush belt are antelope bitterbrush, shadscale, fourwing saltbush, rubber rabbitbrush, spiny hopsage, horsebrush, and short-statured Gambel oak....Above the sagebrush belt lies a woodland zone dominated by pinyon pine and juniper, similar to the pinyon-juniper woodland of the Colorado Plateau. In the montane belt above the woodland zone, ponderosa pine generally occupies the lower and

more exposed slopes and Douglas-fir the higher and more sheltered ones. In the subalpine belt, the characteristic trees are subalpine fir and Engelmann spruce. Only a few mountains rise high enough to support an alpine belt.

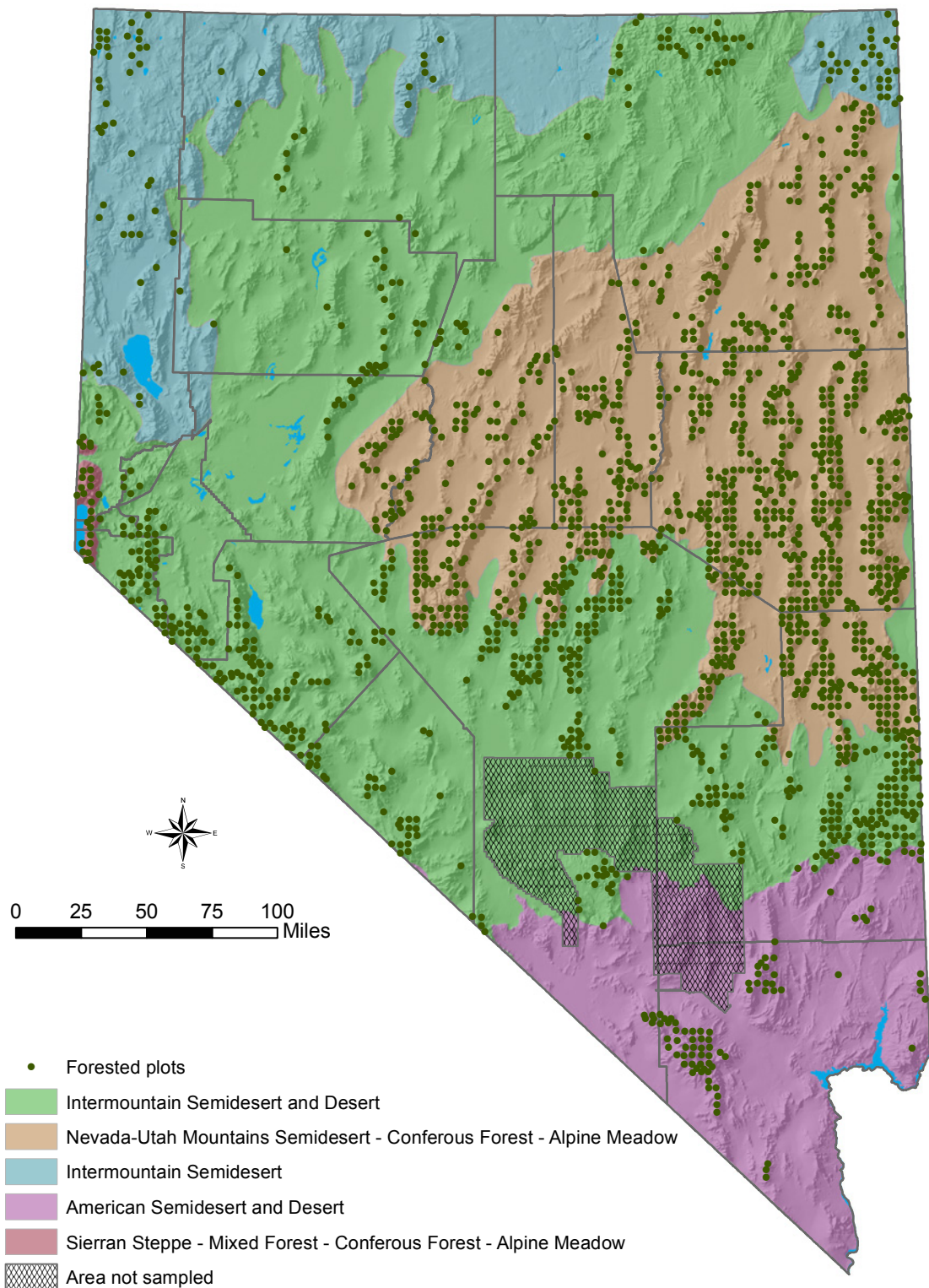


Figure 3—The five ecoregion provinces in Nevada showing forested FIA plots in the 2004–2013 inventory. Background shows shaded relief and county boundaries. (Note: plot locations are approximate; some plot locations on private land were randomly swapped.)

The Intermountain Semidesert and Desert Province is Nevada's largest, covering 47 percent of the State. It is 11 percent forested, and contains nearly 33 percent of Nevada's forest land (fig. 4). Woodlands in the pinyon/juniper forest-type group dominate, occurring at elevations as low as 5,000 feet, but becoming the dominant vegetation between 6,000 and 8,000 feet. Some deciduous oak woodland forest type also occurs at those elevations. Ponderosa pine and Douglas-fir are not important contributors to Nevada's portion of the province, although the ponderosa pine forest type does occur. Aspen, subalpine fir, and limber pine forest types are found at elevations from 7,000 to 10,000 feet. Another important high-elevation type is *Cercocarpus* woodland, which is found above 6,000 feet and is the only type recorded above 10,000 feet in this province.

Nevada-Utah Mountains Semidesert-Coniferous Forest-Alpine Meadow Province:

Sagebrush dominates at lower elevations. Other important plants in the sagebrush belt are shadscale, fourwing saltbush, rubber rabbitbrush, spiny hopsage, and horsebrush...The woodland belt above the sagebrush zone is similar to the corresponding belt on the Colorado Plateau, with juniper and pinyon occupying lower mountain slopes. The belt is frequently interrupted as mountains

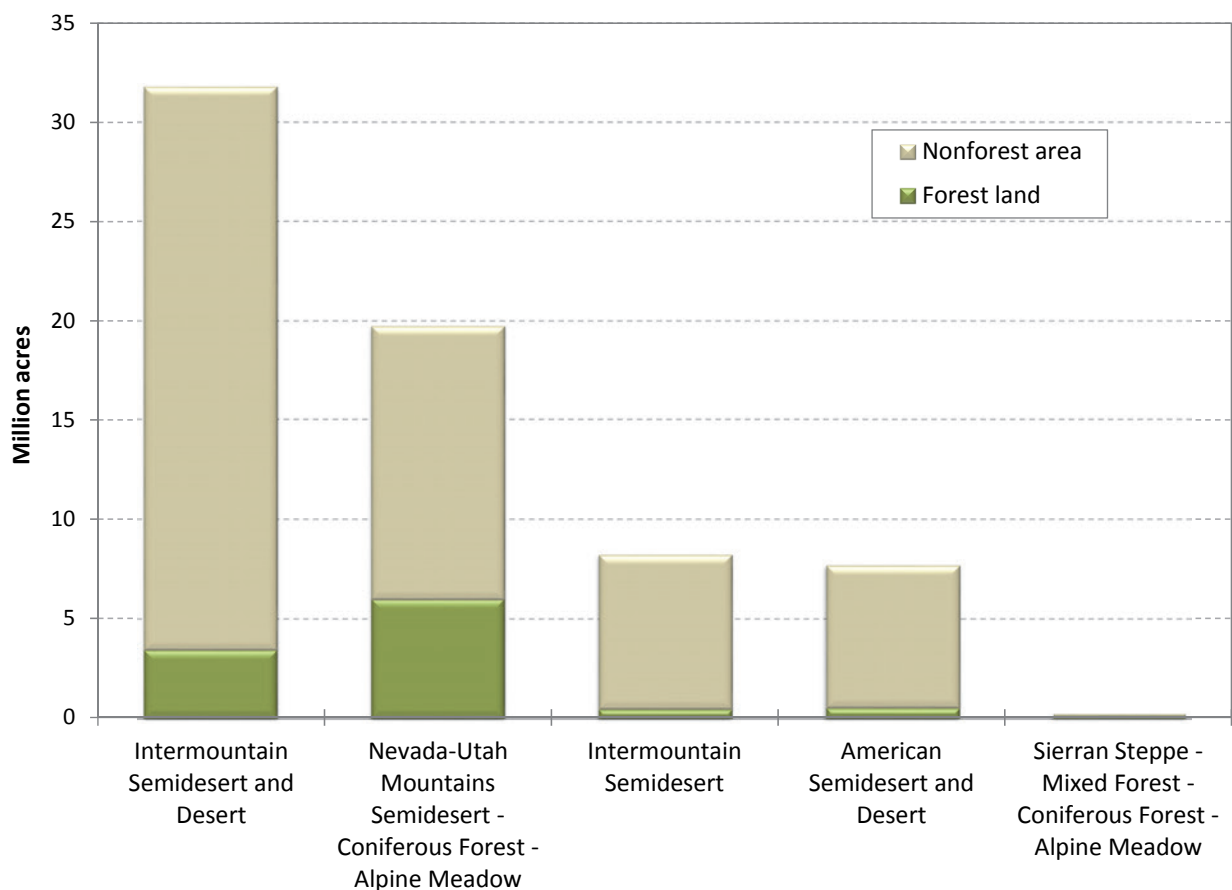


Figure 4—Area of sampled land, by forest/nonforest area, and ecoregion province, Nevada, 2004–2013. Nonforest area includes nonforest land, census water, and noncensus water.

give way to plains. In the montane zone above the woodland belt, ponderosa pine generally occupies the lower and more exposed slopes and Douglas-fir the higher and more sheltered ones. Typical species of the subalpine belt are alpine fir and Engelmann spruce. Great Basin bristlecone pine, with some individuals more than 1,000 years old, occupies widely scattered peaks. Only a few mountains in this province rise high enough to support an alpine meadow belt.

The Nevada-Utah Mountains Province is 30 percent forested, and contains the majority of Nevada's forest land, at 57 percent. The pinyon/juniper forest-type group is again dominant at the lower elevations of forested areas, between 5,000 and 9,000 feet. Although both ponderosa pine and Douglas-fir occur in Nevada's portion of this province, they are not as prevalent here as in the Utah portion of the province, and are relatively minor forest types in the inventory. Starting at above 7,000 feet, white fir is the most common non-woodland forest type. Aspen and *Cercocarpus* woodland forest types also start at about 7,000 feet, and the white-bark pine forest type also occurs above 8,000 feet. Above 9,000 feet, foxtail pine/bristlecone pine, limber pine, and Engelmann spruce forest types appear.

Intermountain Semidesert Province:

The chief vegetation, sometimes called sagebrush steppe, is made up of sagebrush or shadscale mixed with short grasses...A woodland of western juniper covers parts of central Oregon that get little rain.

As implied in the vegetation description, the Intermountain Semidesert Province is Nevada's least forested at 6 percent. It contains just over 4 percent of Nevada's forest land. The most common forest type is juniper woodland; the only member of the pinyon/juniper forest-type group found in this province. The western juniper forest type also occurs in Nevada's portion of this province. At elevations above 6,000 feet there are aspen and *Cercocarpus* woodland forest types.

American Semidesert and Desert Province:

Vegetation is usually very sparse, with bare ground between individual plants. Cacti and thorny shrubs are conspicuous, but many thornless shrubs and herbs are also present. . . . Mesquite is less widespread and grows only along washes and watercourses... Along the higher northern edge of the province is a belt where the Joshua tree is prominent. At a still higher level is a belt of junipers and pinyons.

In Nevada, the American Semidesert and Desert Province consists of the Mohave Desert. It is 7 percent forested, containing 5 percent of Nevada's forest land. The province is largely nonforest at the predominant low elevations, but forest land is found on isolated mountains, most notably the Spring Mountains and Sheep Mountains. One plot at less than 3,000 feet sampled mesquite woodland. The pinyon/juniper forest-type group is dominant between 5,000 and 7,000 feet.

Deciduous oak woodland occurs between 6,000 and 8,000 feet. Above 8,000 feet, forest types are white fir, *Cercocarpus* woodland, and ponderosa pine.

Sierran Steppe-Mixed Forest-Coniferous Forest-Meadow Province:

Vegetation zones are exceptionally well marked. The lower slopes and foothills, from about 1,500 to 4,000 ft (460 to 1,200 m), are covered by coniferous and shrub associations. On higher slopes, gray or California foothill pine and blue oak dominate, forming typical open or woodland stands. Most of the low hills are covered by close-growing evergreen scrub, or chaparral, in which buckbrush and manzanita predominate. Several oaks are common associates. The montane zone lies between about 2,000 and 6,000 ft (600 and 1,800 m) in the Cascades, 4,000 and 7,000 ft (1,200 and 2,100 m) in the Central Sierras, and 5,000 and 8,000 ft (1,500 and 2,400 m) or more in the south. The most important trees are ponderosa pine, Jeffrey pine, Douglas-fir, sugar pine, white fir, red fir, and incense cedar; but several other conifers are also present. The giant sequoia (big tree) is one of the most spectacular species, but it grows only in a few groves on the western slope. Dense chaparral communities of manzanita, buckbrush, and buckthorn may appear after fire, sometimes persisting for years. Within the Sierran rain shadow, on the dry eastern slopes, Jeffrey pine replaces ponderosa pine. At lower elevations, pine forests are replaced by sagebrush-pinyon forest, part of the Intermountain Desert Province. The subalpine zone begins at from 6,500 ft to 9,500 ft (1,980 m to 2,900 m), depending on latitude and exposure, and extends upslope about 1,000 ft (300 m). Mountain hemlock, California red fir, lodgepole pine, western white pine, and whitebark pine are important. Conditions are severe, and timberline varies from about 7,000 ft (2,100 m) in the north to 10,000 ft (3,000 m) in the south. Lodgepole pine is said to have climax characteristics near the upper limits of this zone. The alpine zone covers the treeless areas above timberline.

Only a small portion of the Sierran Steppe Province occurs in Nevada, making it the State's smallest, but most heavily forested province, at 60 percent forest. But, it contains less than 2 percent of the State's forest land. It is also the most distinct and diverse of the forest land. Plot elevations in the Nevada portion occur between 5,000 and 9,000 feet. Common forest types are Jeffrey pine, red fir, and lodgepole pine, none of which are found in Nevada's other provinces. Other forest types found here are *Cercocarpus* woodland, white fir, aspen, ponderosa pine, whitebark pine, cottonwood, and western juniper. Western white pine, incense-cedar, and mountain hemlock trees are found only in this province as well, but not predominantly enough in the inventory to constitute a forest type. Species mentioned in the description above that occur only on the west side of the Sierra Nevada, and not in this inventory, include gray or California foothill pine, blue oak, and giant sequoia.

Forest Land Classification

FIA uses a nationally consistent standard for defining different categories of forest land based on reserved status and productivity. These categories were originally developed for the purpose of separating forest land deemed suitable for timber production from forest land that was either not suitable or unavailable for timber harvesting activity, which includes woodland forest types. The first division of forest land is unreserved forest land and reserved forest land. Unreserved forest land is considered available for harvesting activity where wood volume can be removed for wood products. Reserved forest land is considered unavailable for any type of wood utilization management practice through administrative proclamation or legislation.

Both unreserved and reserved forest lands are further divided based on productivity. Unreserved forest land is subdivided into timberland and unproductive forests. Timberland is defined as unreserved forest land capable of producing 20 cubic feet of wood per acre per year of trees designated as a timber species. Unproductive forests, because of some species and site conditions, are not capable of producing 20 cubic feet of wood per acre per year of trees designated as a timber species (see Appendix A). Reserved forest land is also divided into productive and unproductive forests. Some characteristics that contribute to productivity can be visibly obvious, such as the presence or absence of non-commercial species, rocky substrates, steep slopes, and high elevation. While these distinctions may be important for understanding reserved area management concerns (e.g., their effect on visitor experience), wood production capability on reserved forest land is useful only as a potential indicator of non-timber values.

The State of Nevada, minus the Nellis Air Force Range, encompasses 67.8 million acres, of which 10.6 million acres (16 percent) are estimated to be forest land by FIA. Unreserved forest land accounts for 84 percent of the forest land in Nevada and totals 8.9 million acres (table B2). Timberland constitutes only 3 percent (less than 0.3 million acres) of Nevada's unreserved forest land, and the remaining 97 percent (8.6 million acres) is classified as unproductive forest land. Reserved forests account for 16 percent (1.7 million acres) of total forest land, with 14 percent (0.2 million acres) productive forests and 86 percent (1.5 million acres) unproductive forests.

Forest Land Ownership

The Bureau of Land Management (BLM) manages more forest land in Nevada than any other land ownership or management class (table B2). BLM forest land totals 6.7 million acres, or 63 percent of the State's total forest land area (fig. 5). The second-largest manager of forest land is the USDA Forest Service's National Forest System (NFS), which manages 3.2 million acres of forest land, or 30 percent of Nevada's forest land. Ninety-six percent (3.0 million acres) of the NFS forest land in Nevada is within the Humboldt-Toiyabe National Forest.

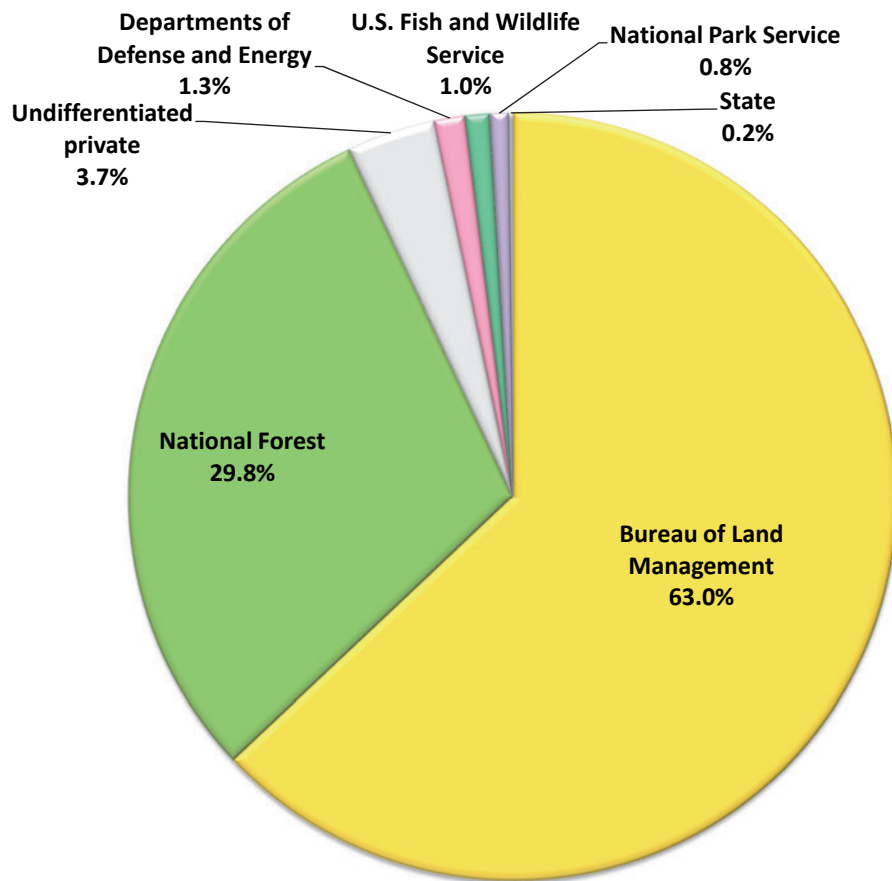


Figure 5—Percentage of forest land by ownership class, Nevada, 2004–2013.

Private landowners manage about 4 percent (0.4 million acres) of Nevada’s forest land. Nevada’s private forest landowners include private individuals/families, corporations, tribes, and unincorporated local associations. Other forest management classes in Nevada include the Departments of Defense or Energy (areas outside of the Nellis Range) with just over 1 percent (0.14 million acres), the U.S. Fish and Wildlife Service with about 1 percent (0.11 million acres), and the National Park Service and the State of Nevada, each with less than 1 percent (0.08 and 0.02 million acres, respectively).

The BLM, the Humboldt-Toiyabe National Forest, and the Nevada Division of Forestry (NDF) all requested forest land estimates for their ownerships and management areas (with the NDF requesting data for State and private owners). These estimates and analyses are presented in this report’s section *Forest Resources by Selected Ownerships and Management Areas* in the “Special Topics” chapter.

Forest Types and Forest-Type Groups

Forest type is a classification of forest land based on the species forming a plurality of live trees growing in a particular forest. Forest-type names may be based on a single species or groups of species. Forest types are an important measure of diversity, structure, and successional stage. The distribution of forest types across

the landscape is determined by factors such as climate, soil, elevation, aspect, and disturbance history. The loss or gain of a particular forest type over time can be due to succession or major disturbances related to fire, weather, climate, insects, disease, and human activity such as timber harvesting or ecosystem restoration.

Forest types are aggregated into forest-type groups to simplify interpretation of large-scale forest trends. Nevada's forests are dominated by the pinyon/juniper group, which makes up 81 percent of the forest land with 8.6 million acres (fig. 6). There are nine other forest-type groups in the State, and all 10 groups are further classified into 21 forest types, which are described in Appendix C. Figure 7 shows the area of each of the other nine forest-type groups. The area covered by the pinyon/juniper forest-type group is made up of three forest types in Nevada: pinyon/juniper woodland (85.6 percent of the group), juniper woodland (14.2 percent), and Rocky Mountain juniper (0.2 percent). The second most abundant forest-type group is the woodland hardwoods group at 0.7 million acres (nearly 7 percent of the forest land). The woodland hardwoods group includes *Cercocarpus* woodland (92 percent of the group), deciduous oak woodland (7 percent), and mesquite woodland (1 percent). The next most common are nonstocked forests (0.6 million acres), then the aspen/birch group (over 0.2 million acres). The aspen/birch group consists of only the aspen forest type in Nevada. Next is the fir/spruce/mountain hemlock group (0.2 million acres), which includes forest types white fir (73 percent of the group), red fir (10 percent), subalpine fir (9 percent), and Engelmann spruce (8 percent). The other western softwoods group covers over 0.1 million

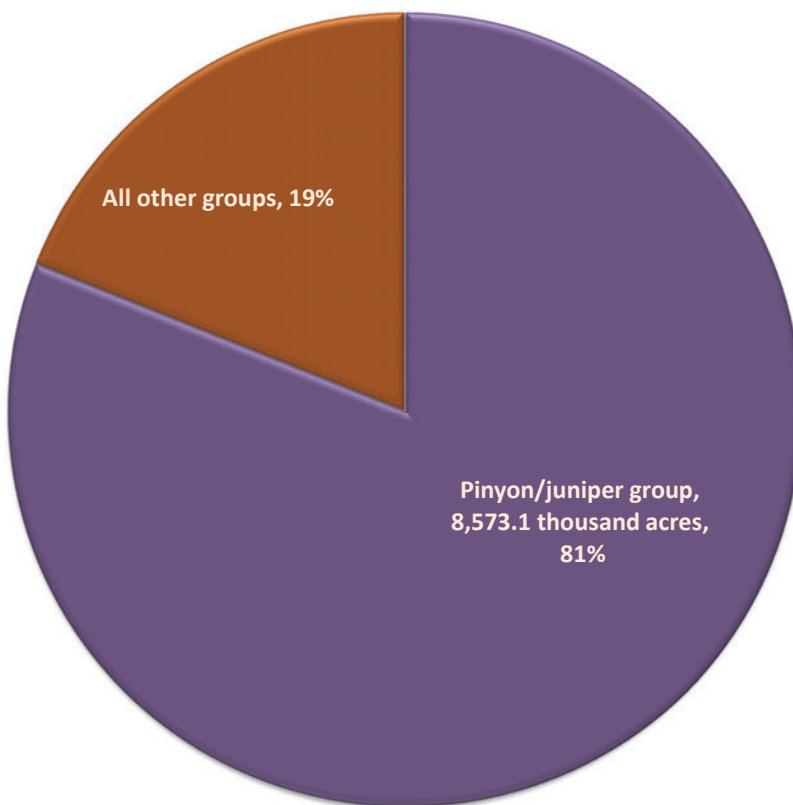


Figure 6—The distribution of forest land percentages between the pinyon/juniper forest-type group and all other forest-type groups, Nevada, 2004–2013.

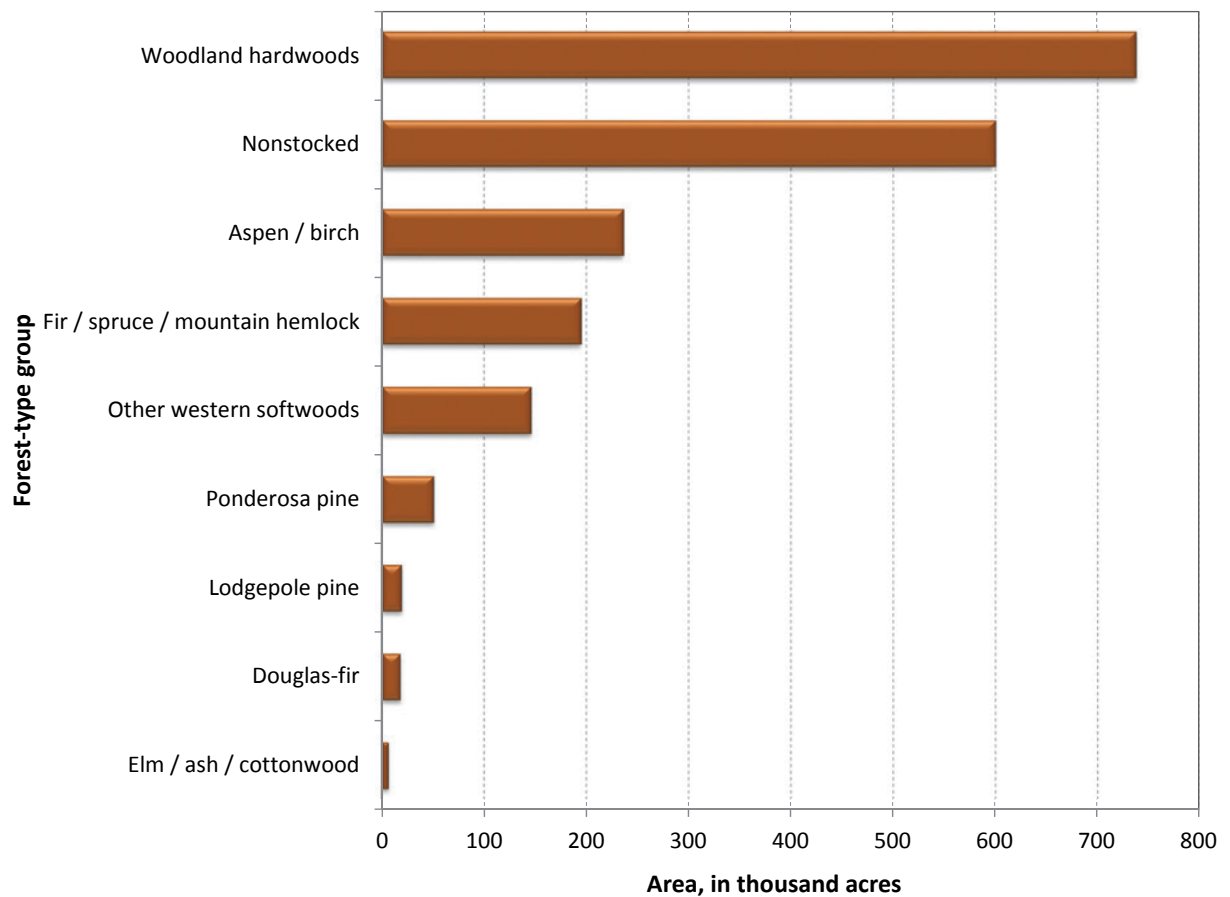


Figure 7—Area of forest land by forest-type groups other than the pinyon/juniper group, Nevada, 2004–2013. See Appendix C for forest types and species compositions of forest-type groups.

acres and includes limber pine (50 percent of the group), foxtail pine/bristlecone pine (25 percent), western juniper (17 percent), and whitebark pine (8 percent) forest types. The ponderosa pine group (50,000 acres) consists of Jeffrey pine (68 percent) and ponderosa pine (32 percent) forest types. The lodgepole pine (19,000 acres), Douglas-fir (18,000 acres), and elm/ash/cottonwood (6,000 acres) forest-type groups all contain a single forest type in Nevada, with the elm/ash/cottonwood group represented by the cottonwood forest type.

Figures 8 through 11 illustrate the spatial distribution of inventory plots in the most common forest-type groups and the forest types within those groups.

Stand Age

The age structure of forest land provides insight into prospective shifts in stand structure and composition over time. On every FIA plot that samples forest land and includes suitable trees for increment core extraction, stand age is estimated based on the average age of only those trees that fall within the calculated stand-size category. For example, an FIA plot sampling a softwood forest type with about 30 percent of the live tree stocking in the large diameter stand-size class (softwoods at least 9.0 inches d.b.h./d.r.c.), and 70 percent in the medium diameter

size class (softwoods between 5.0 and 9.0 inches d.b.h./d.r.c.), would be classified as a medium diameter stand-size class and only the medium size trees would be used in determining stand age. It should be noted that curlleaf mountain-mahogany trees on FIA plots do not have increment cores extracted, and tree age is based on a diameter-age relationship (Brotherson et al. 1980).

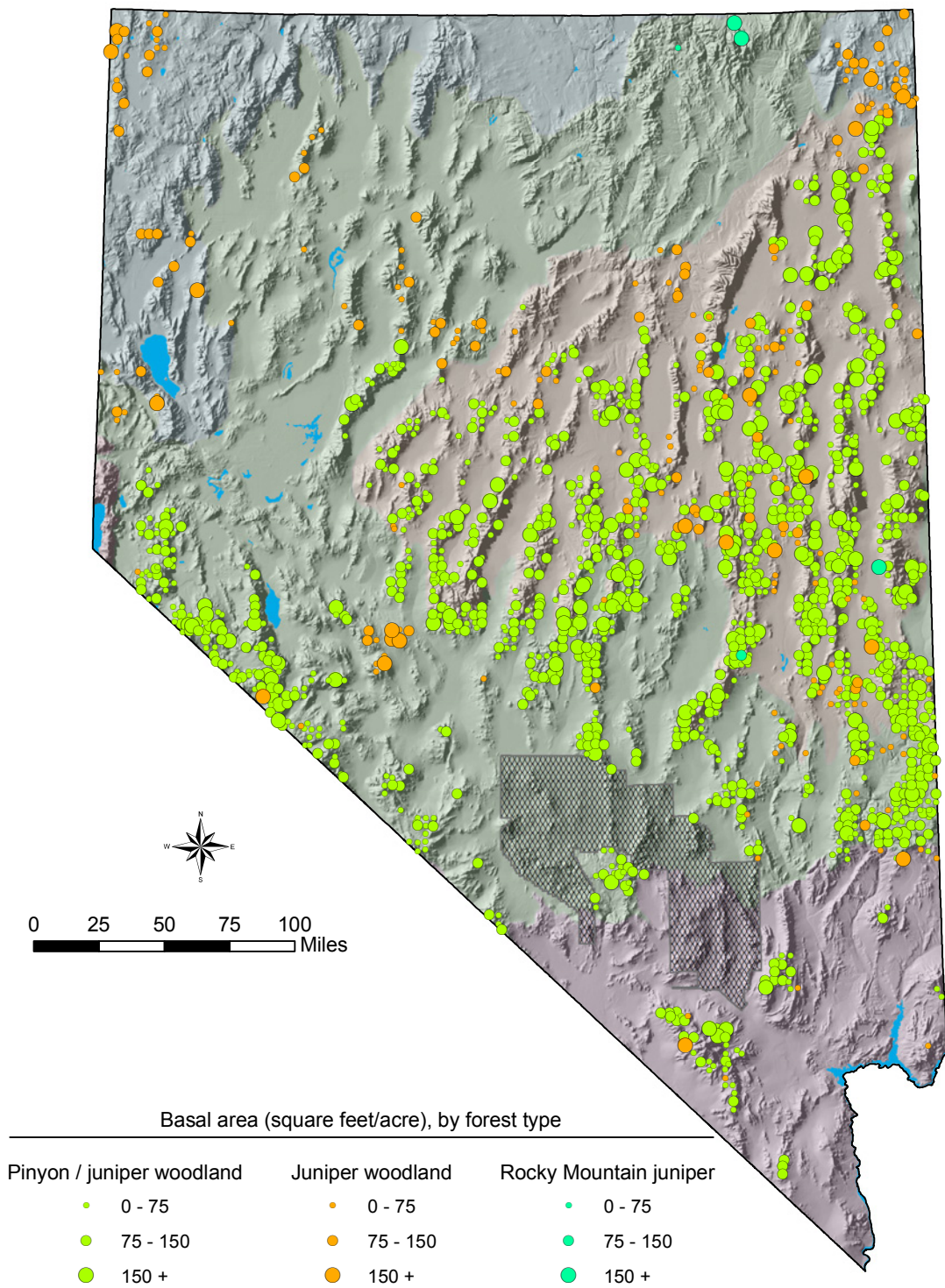


Figure 8—Distribution of inventory plots in the pinyon/juniper forest-type group, by forest type and basal area class, Nevada, 2004–2013. Cross-hatched area not sampled. (Note: plot locations are approximate; some plot locations on private land were randomly swapped.)

There are limitations to collecting data for stand-age computation. Repeatable measurements of increment cores are difficult to collect from certain tree species, particularly woodland species or those that may be very long-lived. Stand age may not accurately depict the age structure of uneven-aged stands, which encompass

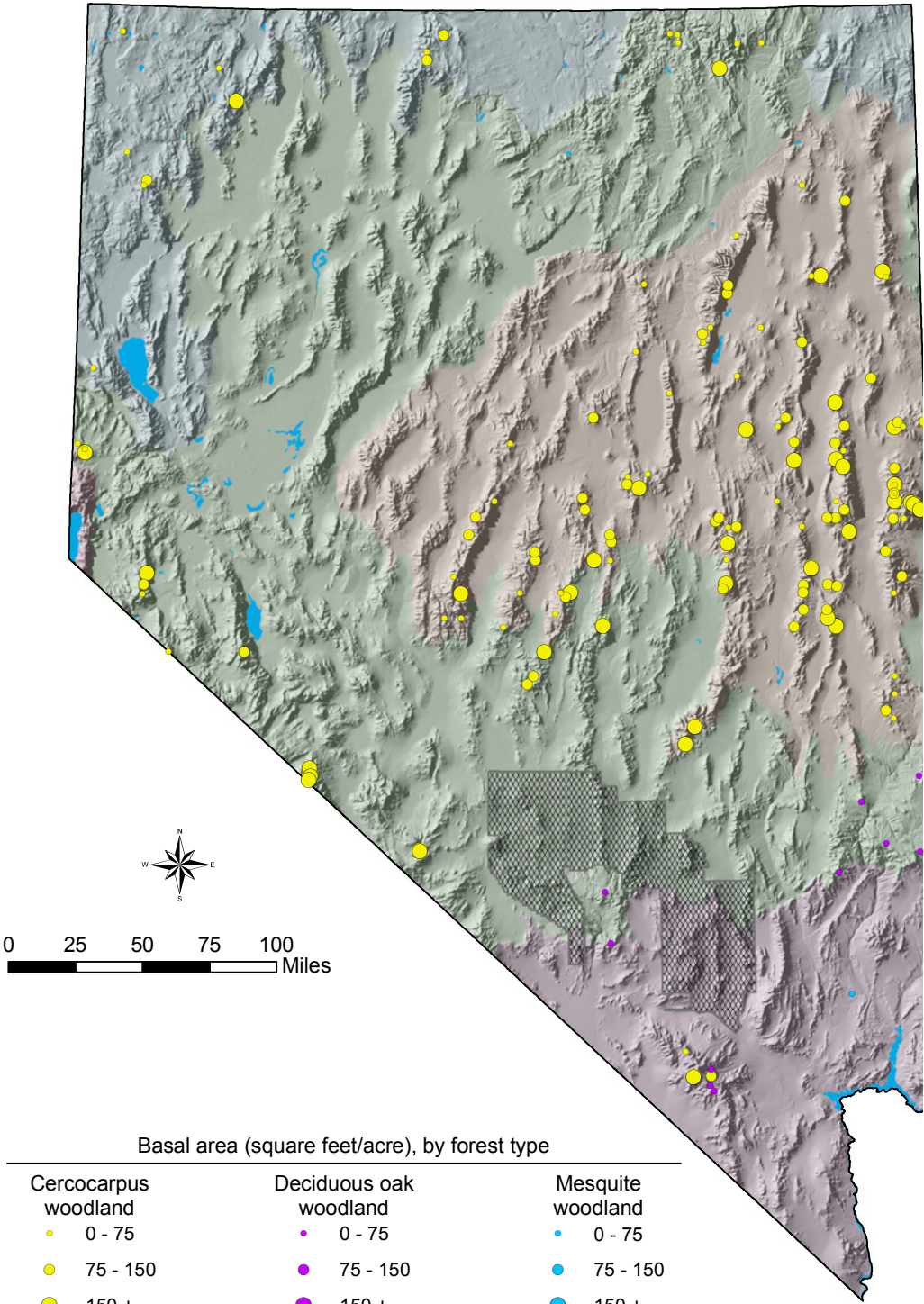


Figure 9—Distribution of inventory plots in the woodland hardwoods forest-type group, by forest type and basal area class, Nevada, 2004–2013. Cross-hatched area not sampled. (Note: plot locations are approximate; some plot locations on private land were randomly swapped.)

multiple age classes. Stand ages are difficult to accurately determine for stands of typically small-diameter species, like Gambel oak. A stand age of zero is assigned to nonstocked conditions, which contain less than 10 percent stocking, usually due to disturbance.

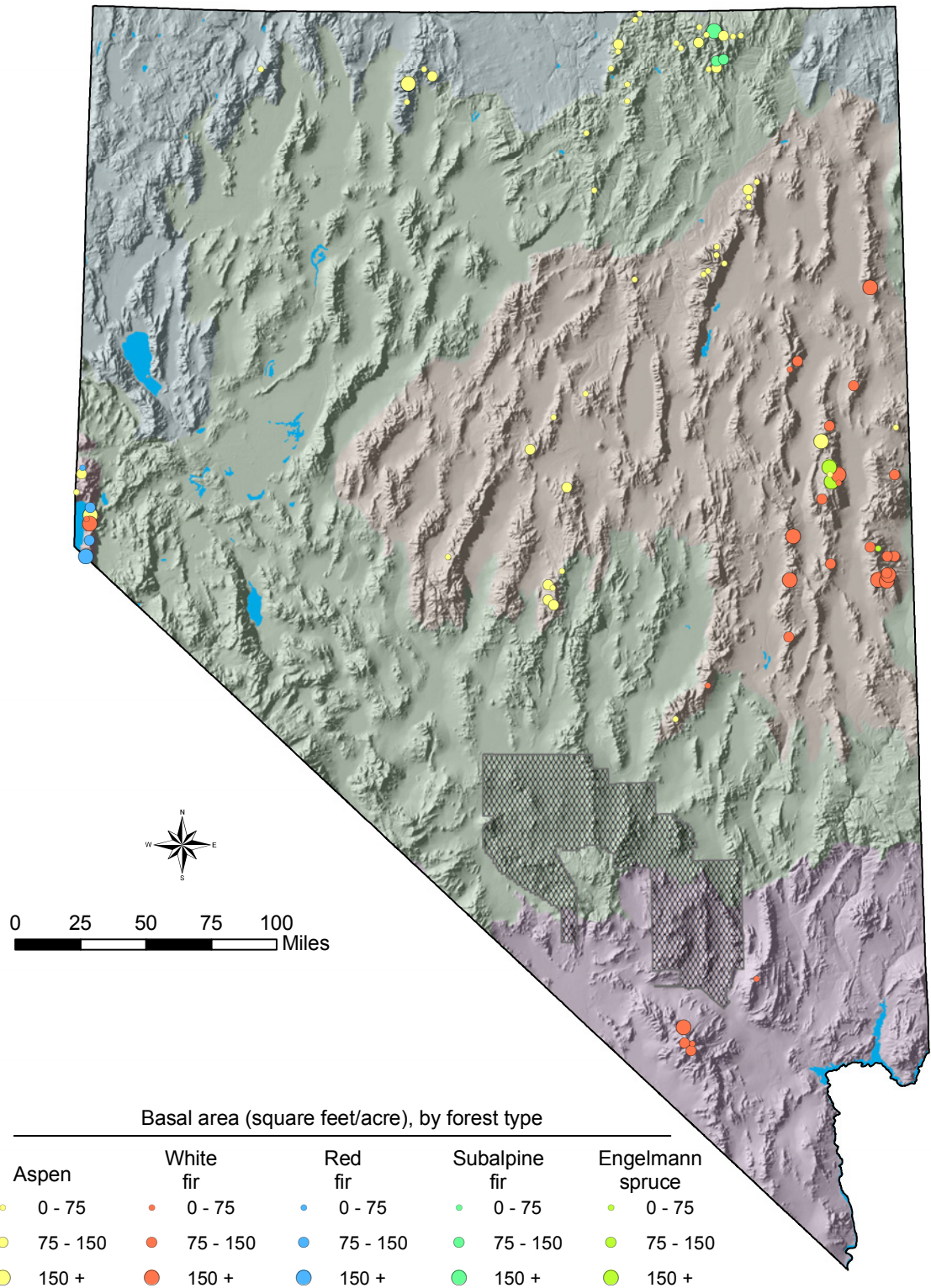


Figure 10—Distribution of inventory plots in the aspen/birch and fir/spruce/mountain hemlock forest-type groups, by forest type and basal area class, Nevada, 2004–2013. Cross-hatched area not sampled. (Note: plot locations are approximate; some plot locations on private land were randomly swapped.)

Table B6 shows the area of forest land, by age class and forest-type group, with 20-year intervals up to 200 years representing stand-age classes. The 201 years and over stand-age class contains over 14 percent of Nevada’s forest land and is the largest single age class. Forty-eight percent of forest land, or 5.1 million

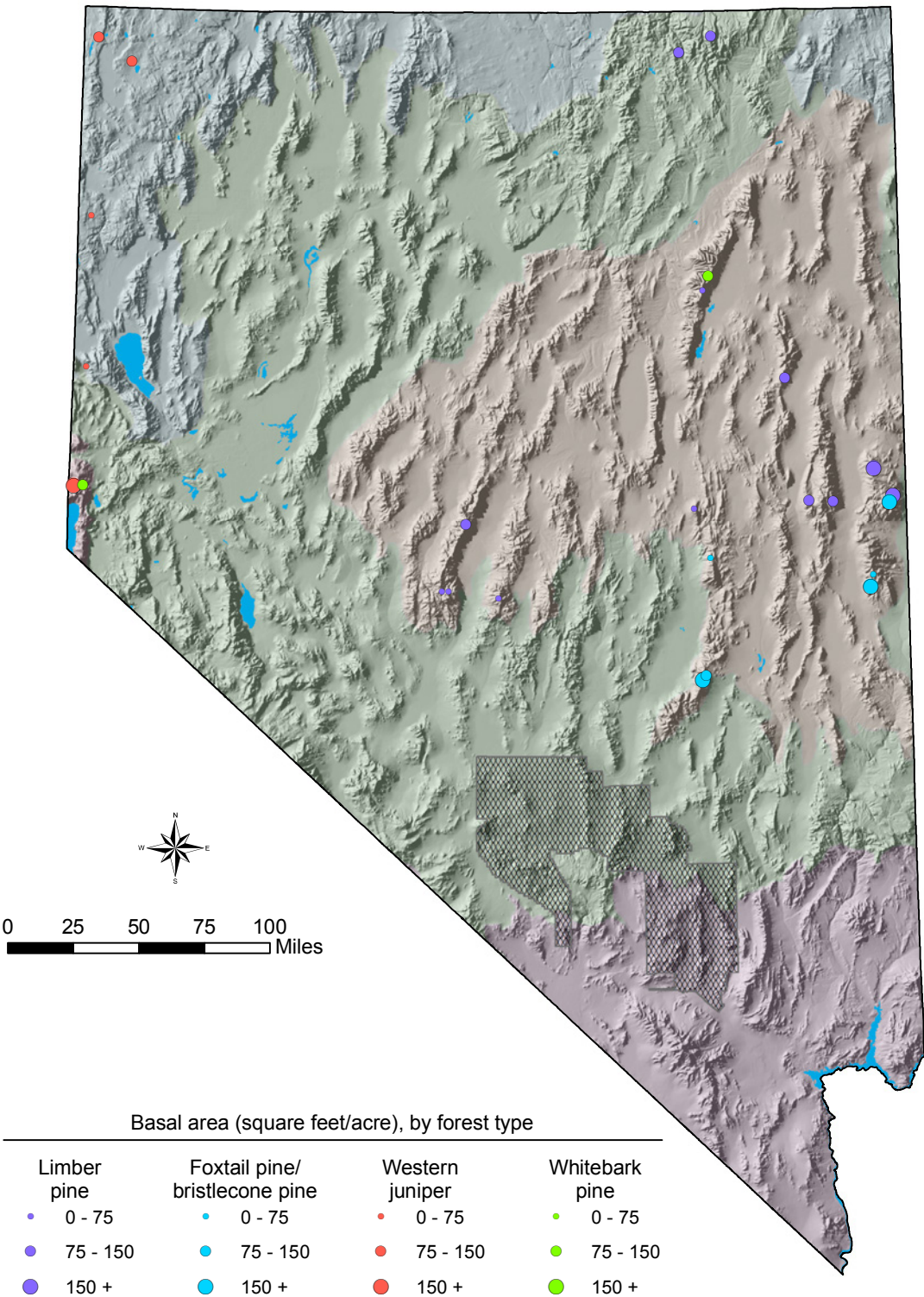


Figure 11—Distribution of inventory plots in the other western softwoods forest-type group, by forest type and basal area class, Nevada, 2004–2013. Cross-hatched area not sampled. (Note: plot locations are approximate; some plot locations on private land were randomly swapped.)

acres, is in stands between 81 and 160 years of age. Stands between 101 and 120 years of age represent the largest single 20-year age class, at 1.3 million acres, or nearly 13 percent of the forest land. Forests between 1 and 80 years make up over 17 percent of the forest land, while forests older than 160 years represent 29 percent. Nonstocked forests, or those with no age, make up almost 6 percent of the forest land.

There is a considerable difference in stand-age distribution among the major forest-type groups in the State. Figure 12 shows stand age-distribution by major forest-type groups in 20-year intervals up to 300 years. Three of the five most abundant forest-type groups have their single highest proportion of area in one of the 20-year stand-age classes between 81 and 160 years. The pinyon/juniper group is most abundant in the 81- to 100-year and 101- to 120-year classes, each with just less than 14 percent of the forest-type group, or 1.2 million acres. Fifty-one percent of the pinyon/juniper group is between 81 and 160 years old, 32 percent is over 160 years, and 17 percent is less than 81 years old. The woodland hardwoods group's most abundant stand-age class is 141 to 160 years, with nearly 23 percent of the group, or 167,000 acres. Also, over 12 percent of the woodland hardwoods group is in the 1- to 20-year class. Over 50 percent of this area consists of the

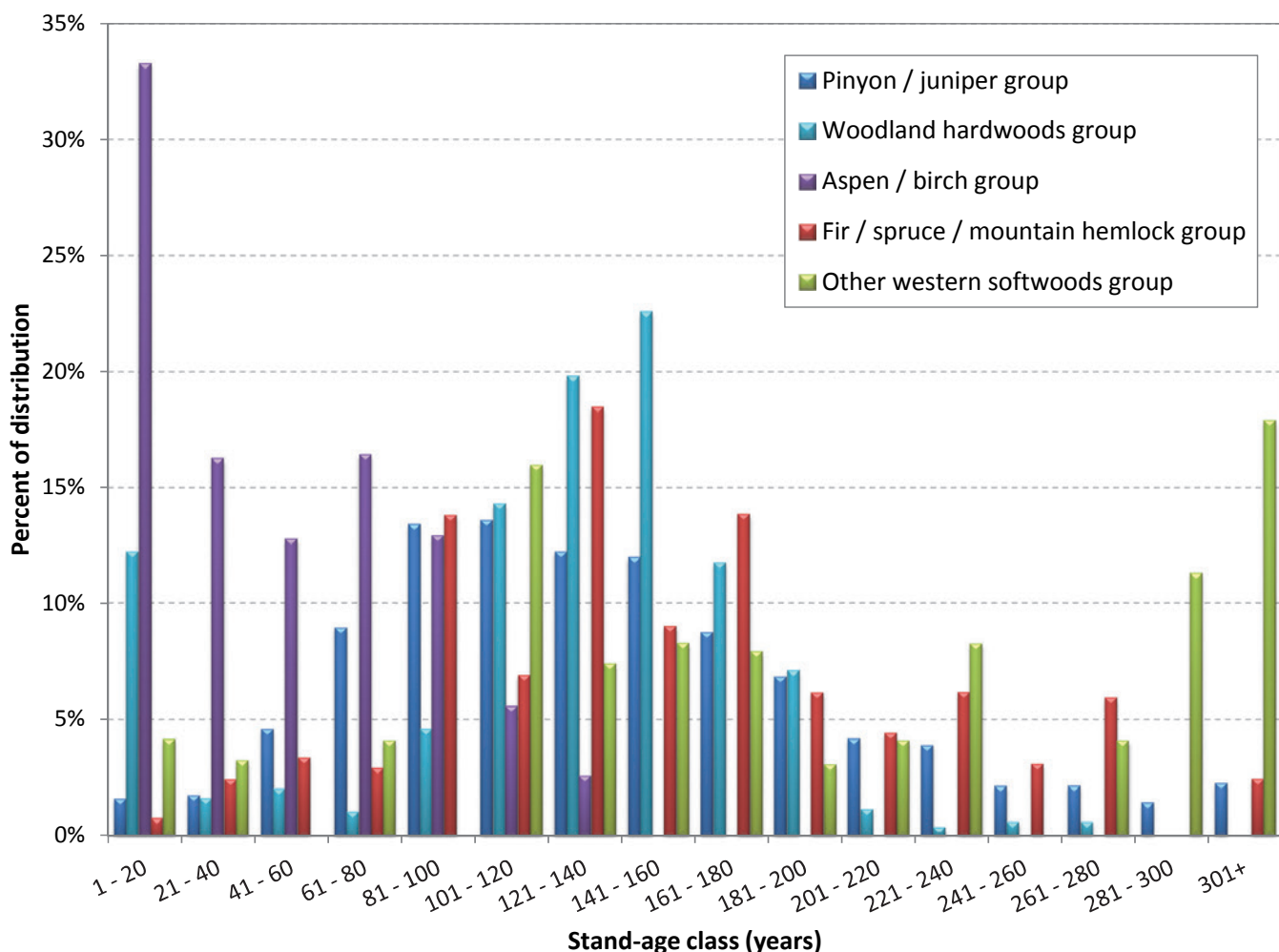


Figure 12—Distribution of forest land by stand-age class for major forest-type groups, Nevada, 2004–2013.

deciduous oak woodland forest type and includes 88 percent of the deciduous oak woodland measured in Nevada. The entire aspen/birch forest-type group is 140 years old or less, with the largest portion, 33 percent, or 78,000 acres, in the 1- to 20-year stand-age class. Forty-eight percent of the fir/spruce/mountain hemlock group is between 81 and 160 years old, 42 percent is over 160 years old, and less than 10 percent is between 1 and 80 years old. The largest 20-year age class in the fir/spruce/mountain hemlock group is the 121- to 140-year class, with almost 36,000 acres, or over 18 percent of the group's area. The other western softwoods group is the only group with the majority of its area with a stand age of over 160 years, at 57 percent, or 83,000 acres. Thirty-two percent is between 81 and 160 years old, and 12 percent is 80 years old or younger. The most abundant stand-age class in the other western woodland group is the 301 years and older class at 18 percent, or 26,000 acres. This oldest age class, together with the next oldest, the 281- to 300-year class, contains 29 percent of the other western softwoods group and 58 percent of the group's area in these stand-age classes consists of the foxtail pine/bristlecone pine forest type.

Stand Density Index (SDI)

Stand density index (Reineke 1933) is a relative measure of stand density, based on quadratic mean diameter of the stand and the number of trees per acre. In the western States, silviculturists often use SDI as one measure of stand structure to meet diverse objectives such as ecological restoration and wildlife habitat (e.g., Lilieholm et al. 1994; Long and Shaw 2005; Shaw and Long 2007; Smith and Long 1987). Originally developed for even-aged stands, SDI can also be applied to uneven-aged stands (Long and Daniel 1990; Shaw 2000). Stand structure can influence the computation of SDI, so the definition of maximum SDI must be compatible with the computation method. SDI was computed using the summation method (Shaw 2000) for each condition that sampled forest land, and the SDI percentage was calculated using the maximum SDI for the forest type found on the condition.

Maximum SDI is rarely, if ever, observed in nature at the stand scale because the onset of competition-induced (self-thinning) mortality occurs at about 60 percent of the maximum SDI. Within-stand variability of density results in the average stand density being well below that of the densest patches. A site is considered to be fully occupied at 35 percent of maximum SDI. Below about 25 percent of maximum SDI, individual trees are considered "free to grow." At these lower densities, individual tree growth is maximized but stand growth is below potential, while at higher densities, individual tree growth is below potential, but stand growth is maximized (Long 1985). There are several reasons why stands may have low SDI. Stands typically have low SDI following major disturbances, such as fire, insect attack, or harvesting. These stands remain in a low-density condition until regeneration fills available growing space. Stands that are over-mature can also have low SDI, because growing space may not be reoccupied as fast as it is released by the mortality of large, old trees. Finally, stands that occur on very thin

soils or rocky sites may remain at low density indefinitely, because limitations on physical growing space do not permit full site occupancy.

Because SDI is a condition-level variable, computation of SDI on individual conditions is sensitive to high scaling factors that are associated with small condition proportions (that is, conditions that occupy only a small fraction of the plot footprint). For this reason, the analysis of SDI presented here only uses conditions with a condition proportion of 0.5 or greater.

The distribution of SDI values in Nevada appears to be slightly skewed toward low-density stands in comparison to other States in the Interior West (fig. 13). Over 41 percent of conditions are considered to be in a “free to grow” state, with an additional 16 percent transitioning to full stocking. This is consistent with the fact that Nevada is the driest State in the United States (USDA 1941) and that its forests are dominated by woodland types. The skew toward lower-density stands may also reflect drought-related mortality that affected mostly singleleaf pinyon prior to the start and during the first 2 years of annual inventory (Shaw et al. 2005; Shaw 2006). However, the remaining 43 percent of forest land acres are at least fully occupied (SDI equal to 35 percent or greater).

Stands with SDI between 35 and 60 percent of maximum SDI (full stocking zone) are desirable from a forest management perspective because that density

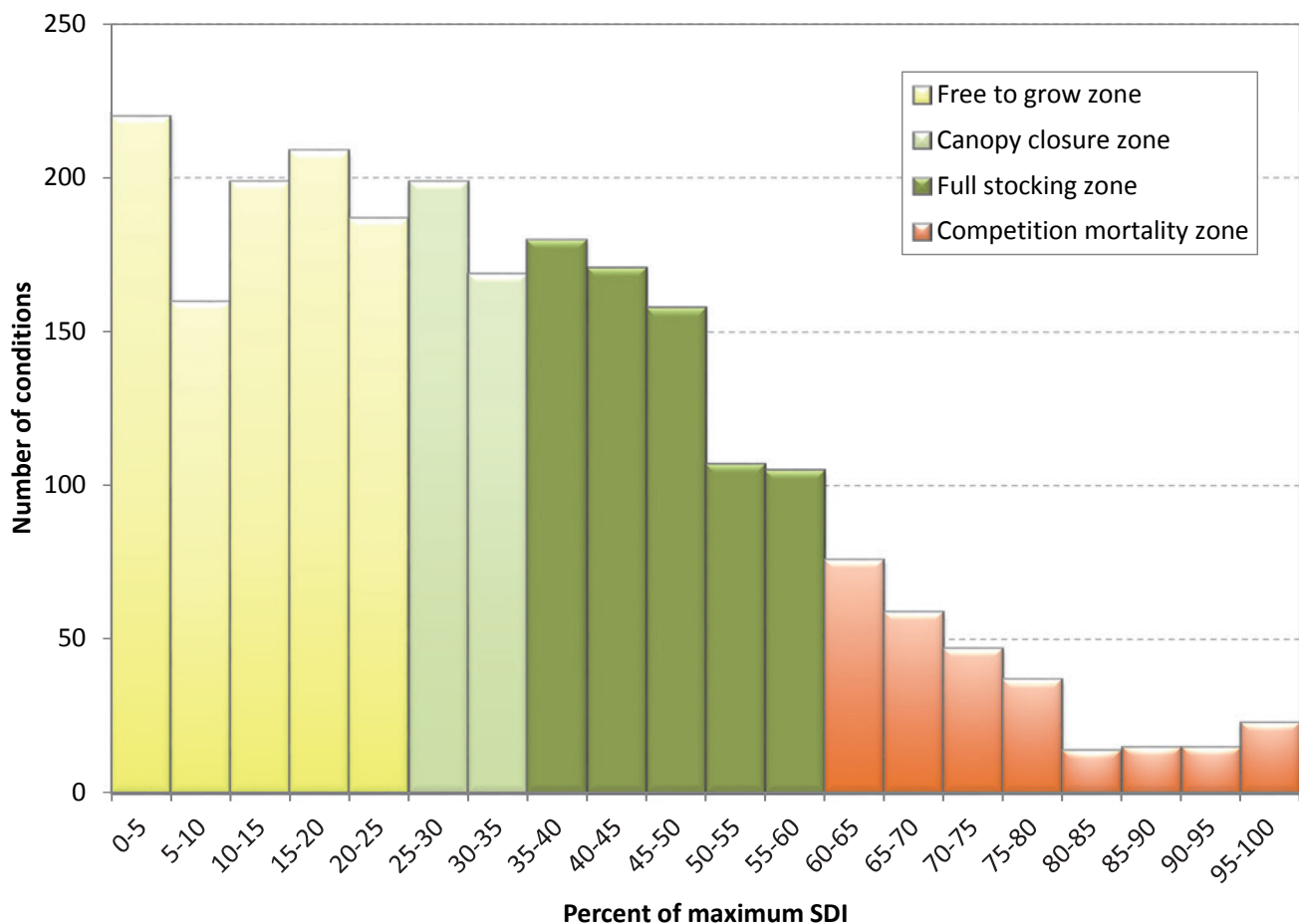


Figure 13—Distribution of forested conditions by stand density index in Nevada, 2004–2013.

range maximizes stand growth and minimizes competition-induced mortality; other objectives, such as fuel reduction or maintenance of wildlife habitat characteristics, may warrant lower relative densities. The proportion of Nevada's forests in the full stocking zone (31 percent) is comparable to the proportions found in other Interior West States (e.g., Arizona, 25 percent; Colorado, 32 percent; Montana, 32 percent; Utah, 32 percent). At 12 percent, the proportion of area in the competition mortality zone is somewhat lower than is found in other Interior West States. The relatively small proportion of acreage in this density range is likely due to a combination of density-reducing natural disturbances, such as fire and insect infestation, and the possibility that there may be a relatively high proportion of harsh sites that cannot support high stocking levels. Given the small amount of commercial forest in Nevada, management activities are unlikely to have a large effect on stand density at the State scale.

Because the first cycle of annual inventory in Nevada was implemented irregularly over time, it is difficult to make any conclusions about density trends based on current data. Given that there are relatively few acres in a very high-density state and a relatively high number of acres in a low-density state, it might be expected that density will trend upward in the coming years. The current inventory provides a baseline against which it should be possible to analyze trend in the future.

Numbers of Trees

Estimates of numbers of trees are beneficial to a variety of silvicultural, forest health, and habitat management applications. These estimates are typically combined with information about the size and species of the trees to provide meaningful summaries of forest dynamics and stand structure. Younger forest stands typically consist of large numbers of small-diameter trees, while older forest stands may contain small numbers of large-diameter trees. FIA classifies individual tree species into species groups, and it also categorizes each species and species group as either hardwood or softwood (Appendix D).

Nevada's forest land contains an estimated 2.6 billion live trees 1 inch in diameter and greater (table B10) and 141 million standing dead trees 5 inches in diameter and greater (see *Snags as Wildlife Habitat* section in the "Other Resources" in Nevada's Forests chapter of this report for more details). Much like the area of forest land is dominated by the pinyon/juniper forest-type group, numbers of trees are dominated by the tree species that constitute that group, the woodland softwoods species group. Woodland softwoods account for 75 percent of all the State's live trees at 2.0 billion trees (fig. 14), and 94 percent of the 2.1 billion softwood trees. By numbers of trees, the woodland softwood species group is 65 percent singleleaf pinyon and 34 percent Utah juniper, with very small amounts (less than 0.2 percent) of Rocky Mountain juniper and common or two-needle pinyon. Overall, softwoods are 81 percent of the State's live trees; 49 percent of softwood species are less than 5 inches in diameter and 7 percent are 15.0 inches diameter and larger. After the woodland softwoods species group, the next most common softwood

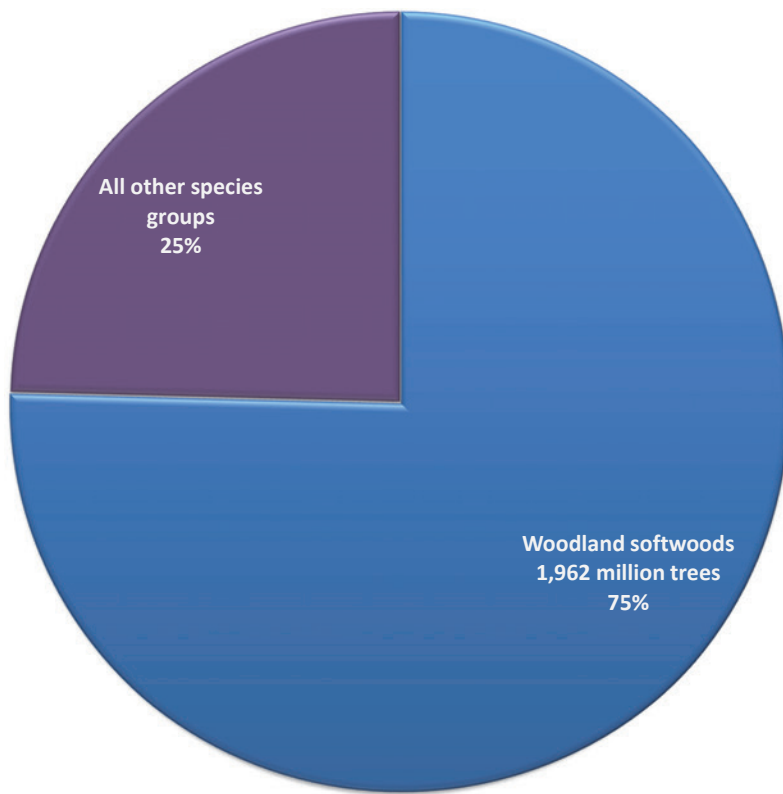


Figure 14—Percentage distribution of live trees 1.0 inch diameter and larger on forest land between the woodland softwoods species group and all other species groups, Nevada, 2004–2013.

group is the true fir species group with nearly 74 million live trees (fig. 15). True firs are 83 percent white fir, 11 percent subalpine fir, and 7 percent California red fir. The third most abundant softwood group is the other western softwood species group with just less than 40 million live trees, which consist of limber pine (54 percent of the species group), whitebark pine (20 percent), western juniper (16 percent), Great Basin bristlecone pine (9 percent), and mountain hemlock (less than 1 percent). The remainder of the softwood species consists of the ponderosa and Jeffrey pine species group with 6.1 million trees (55 percent Jeffrey pine and 45 percent ponderosa pine), the Douglas-fir species group with 5.4 million trees, the lodgepole pine species group with 5.0 million trees, the Engelmann and other spruces species group with 3.5 million trees, the western white pine species group with 2.1 million trees, and the incense-cedar group with 0.1 million trees. These last five species groups consist of only the nominal species in Nevada's forests.

Hardwood species account for 504 million live trees, or over 19 percent of the live trees. Seventy percent of live hardwood trees are less than 5.0 inches in diameter and 2.4 percent are 15.0 inches in diameter or larger. The most abundant hardwood species group is the woodland hardwoods group with 319 million trees, which is 63 percent of the live hardwoods and 12 percent of all live trees, making it the second most abundant species group in the State. The woodland hardwoods species group includes curleaf mountain-mahogany (83 percent of the species group), and the third most abundant species after singleleaf pinyon and Utah juniper), Gambel oak (17 percent), and small amounts of screwbean mesquite and

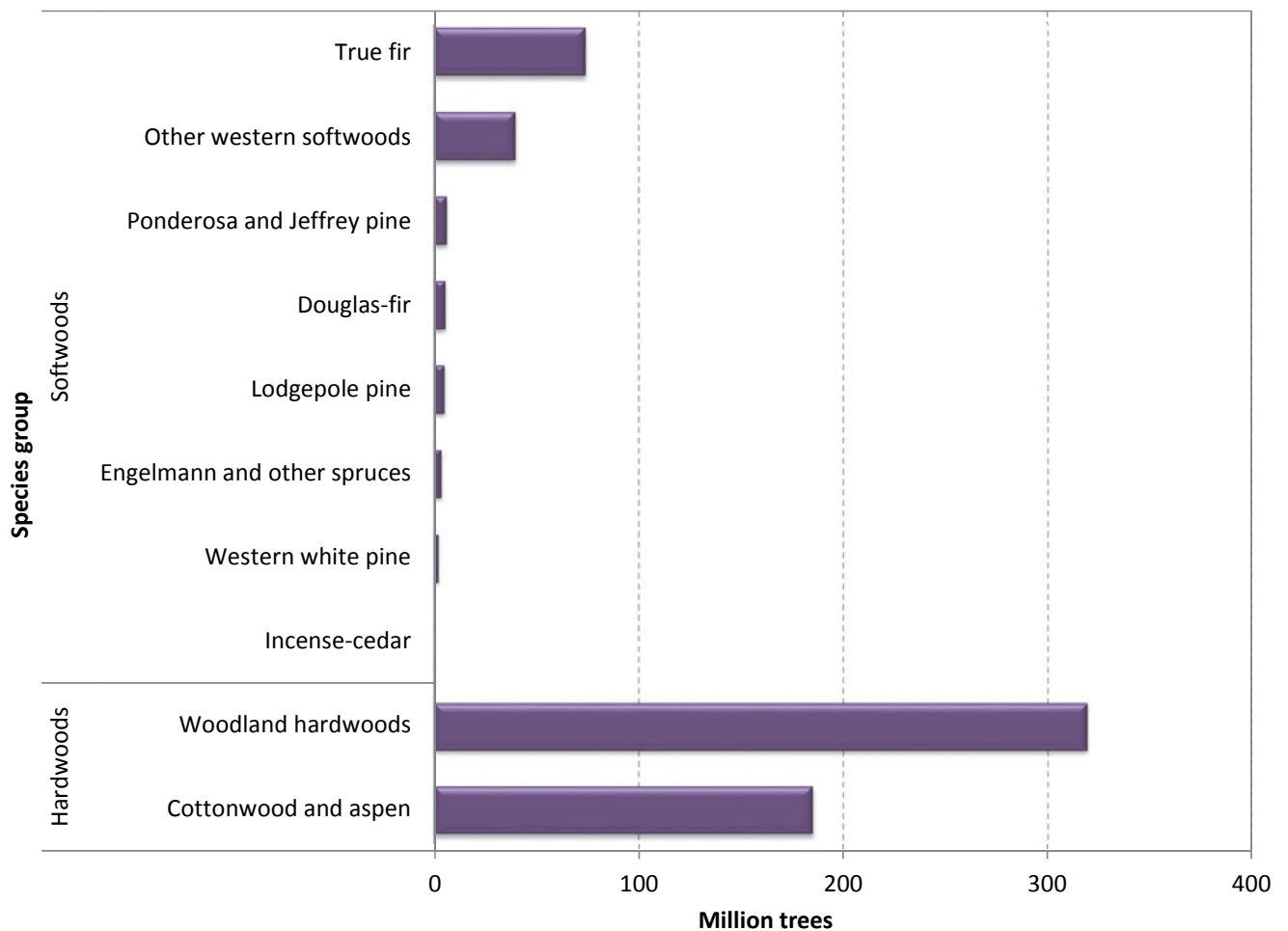


Figure 15—Number of live trees 1.0 inch diameter and larger on forest land, other than the woodland softwood species group, by species group, Nevada, 2004–2013.

honey mesquite (each less than 0.2 percent of the species group). The other hardwood species group in Nevada is the cottonwood and aspen species group with 185 million live trees, 99 percent of which are quaking aspen, the remainder being black cottonwood.

Figure 16 shows the distribution of numbers of live trees by diameter class for the five most common species groups in Nevada. The pattern of many smaller trees compared to fewer larger ones is expected for most species, but it also illustrates the different life histories of various species groups. For example, 85 percent of the cottonwood and aspen species group (primarily quaking aspen) are less than 5.0 inches in diameter. In contrast, 61 percent of the live trees in the woodland hardwoods, 58 percent in the true fir, and fewer than 50 percent in the woodland softwoods and other western softwoods species groups are in these small diameter classes. Nineteen percent of live trees in the other western softwoods group are 11.0 inches diameter or greater; between 11 and 17 percent of the woodland hardwoods, true fir, and woodland softwood species group are that large; and only 1 percent of the cottonwood and aspen species group are that large.

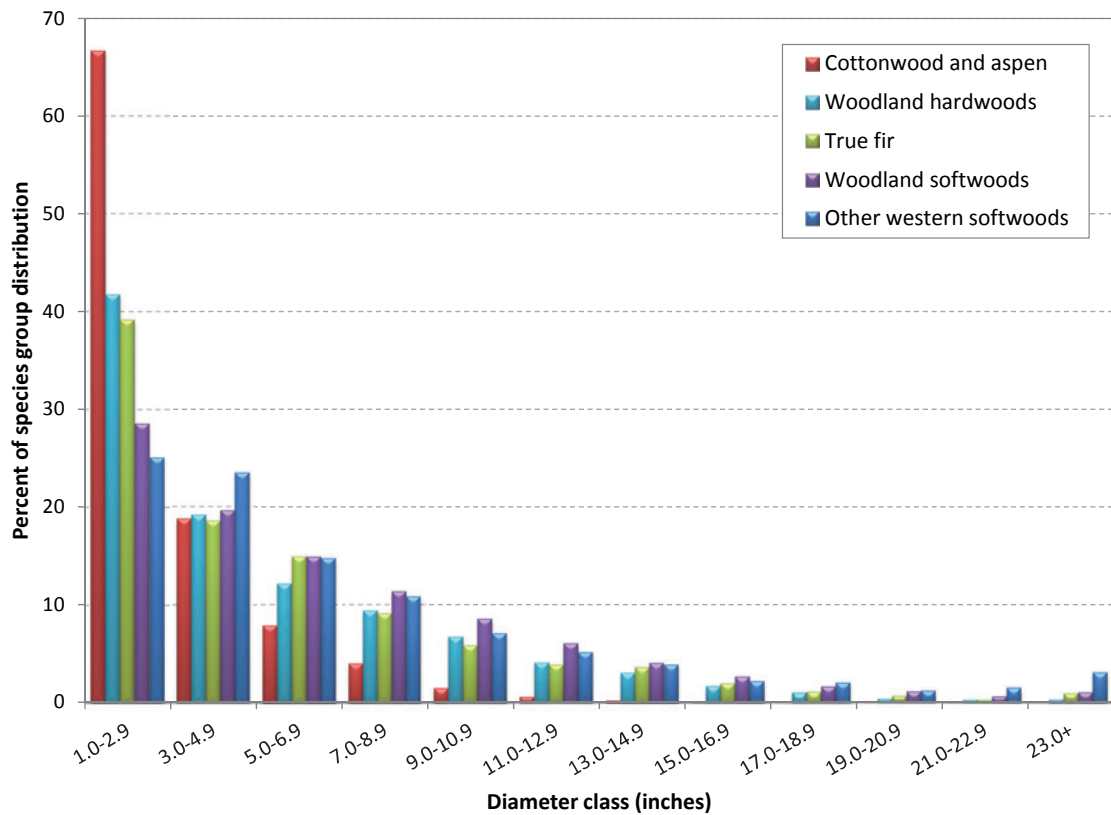


Figure 16—Percentages of numbers of live trees by five common species groups and diameter class, Nevada, 2004–2013.

Tree Volume and Biomass

The amount of cubic-foot volume of wood in a forest is important for determining the sustainability of current and future wood utilization. The forest products industry and forest managers are interested in knowing the tree species composition and size distribution, as well as the geographic location and ownership status, of available wood volume. Estimates of gross and net volume include only the merchantable portion or sawlog portion (e.g., cubic-foot or board-foot) of live trees 5.0 inches in diameter and larger. Net volume is computed by deducting rotten, missing, or form defects from gross volume; and it is reported here as net volume of all live trees, net volume of growing-stock trees, and net volume of sawtimber (all defined in Appendix A). Volume equation sources are listed in Appendix E.

Tree volume

Tables B12 through B16 show the net volume of all live trees 5.0 inches diameter and larger on Nevada’s forest land, by various categories. The net volume of all live trees on Nevada’s forest land totals 6.2 billion cubic feet (table B12). Fifty-five percent of the live volume, or 3.4 billion cubic feet is on lands managed by the Bureau of Land Management (BLM). Only 2 percent of the BLM-managed volume is on land classified as timberland and is considered commercially available. This small percentage isn’t because most of the BLM-managed volume is

reserved (only 12 percent is) but because 97 percent of the volume on unreserved forest land is in woodland forest types (softwood and hardwood) that are considered non-commercial. Forest lands managed by the U.S. Forest Service's National Forest System (NFS) contain 37 percent of the State's total live volume, or 2.3 billion cubic feet. Sixty-seven percent of the volume, 1.5 billion cubic feet, managed by NFS is on unreserved forest land, but only 212 million cubic feet are in forests productive enough to be considered timberlands. About 3 percent of the volume, 204 million cubic feet, is managed by the National Park Service, the Departments of Defense or Energy, or the U.S. Fish and Wildlife Service, none of which is on timberland. Privately owned forests have almost 4 percent, or 218 million cubic feet, none of which is on reserved forestland, but only 18 percent of the volume is on timberland. The State manages 41 million cubic feet, or less than 1 percent of the live tree volume, and 77 percent is on reserved forest land. However, all of the unreserved forests managed by the State are classified as timberland. The total live volume of trees on timberland is 314 million cubic feet.

Live tree volume can also be reported by forest-type group and tree species group. The pinyon/juniper forest-type group contains more live tree volume, by far, than any other forest-type group (table B13). Similarly the woodland softwoods species group, composed primarily of singleleaf pinyon and Utah juniper, contains much more live tree volume than any other species group (tables B14 and B15). The woodland softwoods group contains 80 percent of the State's live tree volume and 65 percent of the standing-dead volume (fig. 17). Total net volume of standing-dead trees on forestland in Nevada is 551 million cubic feet. Pinyon and juniper trees are not considered timber species, so they are not included in estimates of growing-stock volume and sawtimber volume that are presented in tables B17 through B20. Comparing the live tree volume of individual species, singleleaf pinyon has the most volume of any species with 2.8 billion cubic feet. Utah juniper

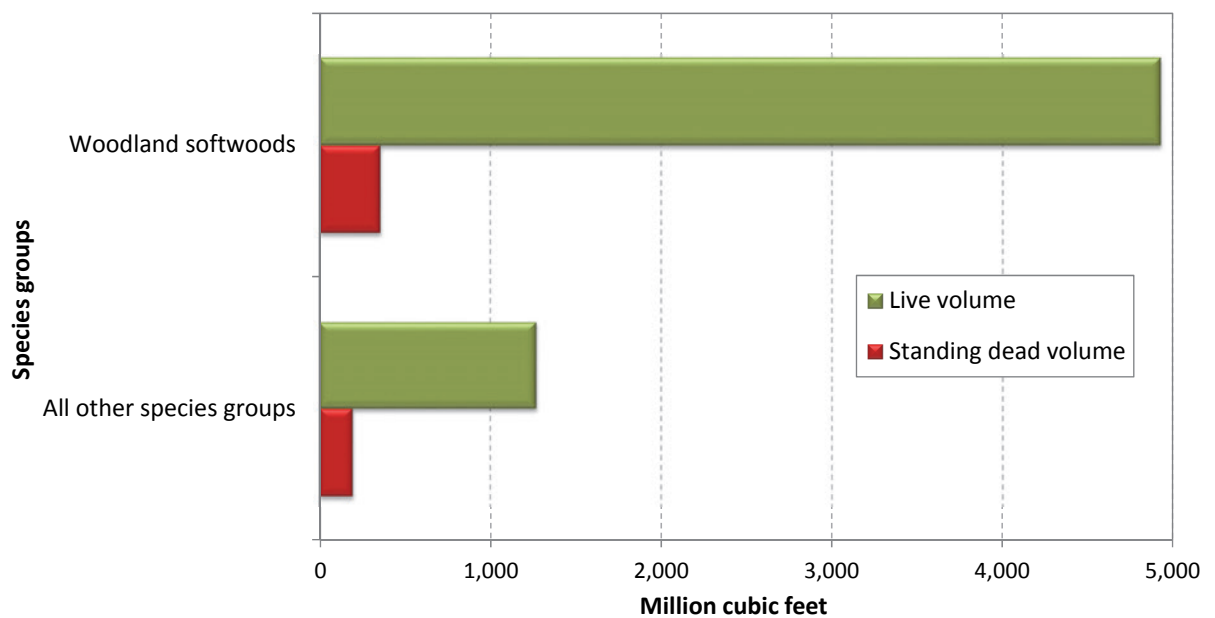


Figure 17—Net cubic foot volume of all live and standing dead trees 5.0 inches diameter and greater on forest land, comparing the woodland softwood species group with all other species groups, Nevada, 2004–2013.

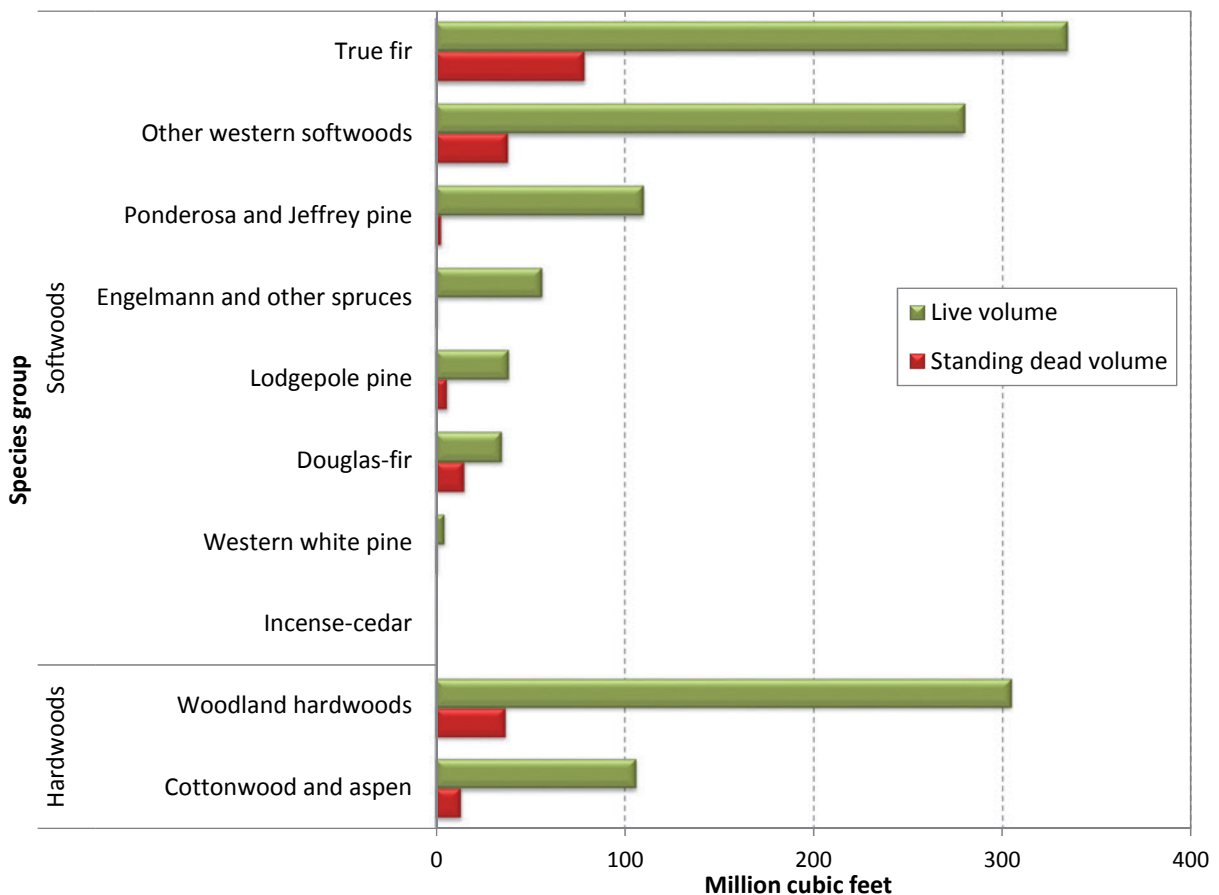


Figure 18—Net cubic foot volume of all live and standing dead trees 5.0 inches diameter and greater on forest land, by species groups other than the woodland softwood species group, Nevada, 2004–2013.

is next with 2.1 billion cubic feet. Live and standing-dead volume by species group other than woodland hardwoods are shown in figure 18, where the largest portion of live tree volume is nearly 335 million cubic feet in the true fir species group (of which 69 percent is white fir). The woodland hardwoods species group contains 304 million cubic feet of live tree volume (well over 99 percent curleaf mountain-mahogany, but also some Gambel oak, honey mesquite, and screwbean mesquite). The other western softwoods species group includes 279 million cubic feet (46 percent limber pine and 43 percent Great Basin bristlecone pine), and the cottonwood and aspen species group has 106 million cubic feet (93 percent quaking aspen) of live tree volume.

The availability of timber volume for harvest is affected by three primary factors: reserved status, productivity, and merchantability. Timberland is defined as unreserved forest land capable of producing in excess of 20 cubic feet per acre per year of wood at culmination of mean annual increment. Merchantability refers to growing-stock trees, which are at least 5 inches in diameter and contain, or have the potential to produce, at least one 8-foot sawlog reasonably free of defects. Therefore, growing-stock on timberland represents the amount of timber that is potentially available for harvest. The net volume of growing-stock trees on timberland in Nevada is 299 million cubic feet (tables B17 and B18), or less than 5

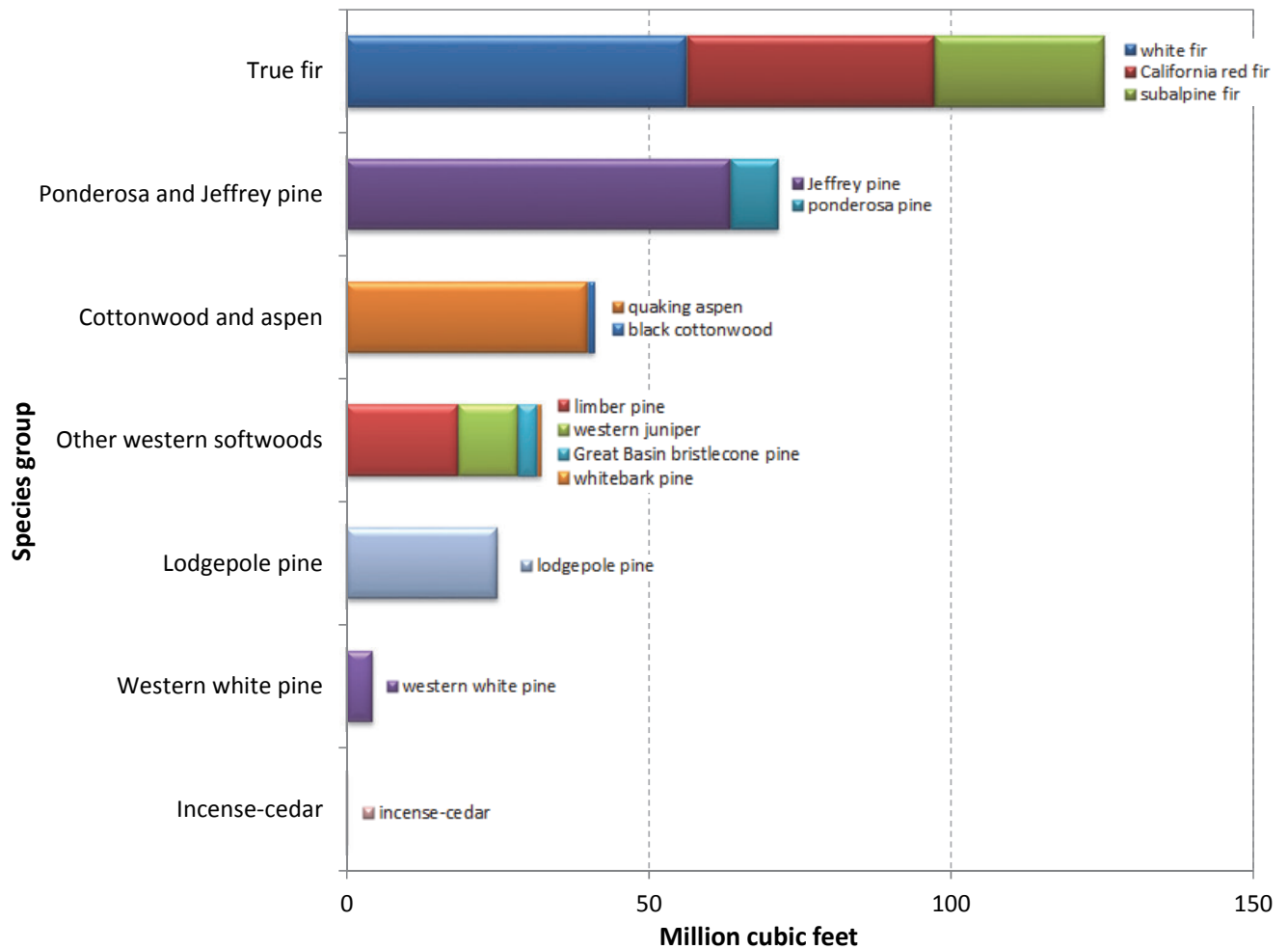


Figure 19—Net cubic foot volume of growing-stock trees on timberland by species group and species, Nevada, 2004–2013.

percent of the total live volume on forest land. Sixty-nine percent of the growing-stock volume on timberland is on NFS lands, 16 percent is on BLM lands, and the remaining 15 percent are found on private and State lands. The largest portion by species group is in the true fir species group at 42 percent. The largest proportion of the true fir growing-stock volume on timberland is in white fir with 45 percent of the group, then California red fir at 33 percent, and the remainder in subalpine fir (fig. 19). The ponderosa and Jeffrey pine species group contains 24 percent of the growing-stock volume on timberland with 89 percent in Jeffrey pine and 11 percent in ponderosa pine. The cottonwood and aspen species group contains 14 percent of the growing-stock volume, 97 percent of which is quaking aspen and 3 percent black cottonwood. Eleven percent of the volume is in the other western softwoods species group, 58 percent of which is limber pine and 31 percent western juniper. Smaller portions of the other western softwoods growing-stock volume is in Great Basin bristlecone pine and whitebark pine. Others with growing-stock volume on timberland include the lodgepole pine, western white pine, and incense-cedar species groups.

Live tree volume on forest land can also be expressed in terms of cubic feet per acre. Table 3 shows live tree volume in cubic feet per acre by forest-type group

Table 3—Net cubic volume (cubic feet per acre) of live trees 5.0 inches diameter and greater, on forest land, by forest-type groups and forest types sampled on at least 10 plots, Nevada, 2004-2013.

Forest-type group	Forest type	Number of plots	Volume (ft ³ /acre)
Fir / spruce / mountain hemlock group		39	1,909.2
	White fir	28	1,628.6
Ponderosa pine group		11	1,826.8
Other western softwoods group		26	1,672.2
	Limber pine	13	1,366.9
Pinyon / juniper group		1,543	576.6
	Pinyon / juniper woodland	1,303	610.0
	Juniper woodland	238	369.3
Aspen / birch group		51	481.2
Woodland hardwoods group		151	444.0
	Cercocarpus (mountain brush) woodland	140	480.4
	Deciduous oak woodland	10	8.6
Nonstocked		128	9.3
Total		1,918	586.0

and forest type. The estimates for each forest-type group or forest type include all of the different species that occur within that group or type. Because estimates for forest-type groups or forest types with small samples may not be representative, only groups or types sampled on 10 or more plots were included in this discussion. Three of Nevada's forest-type groups and 13 of its forest types were sampled on fewer than 10 plots. The fir/spruce/mountain hemlock group has the highest per-acre net volume of live trees 5.0 inches diameter and larger, with 1,909 cubic feet per acre. Within that group, the white fir forest type has 1,629 cubic feet per acre, or less than the group average. The other western softwoods group has 1,672 cubic feet per acre, and the limber pine forest type has 1,367 cubic feet per acre, again less than the group average. Not surprisingly, the forest types with the highest cubic-foot net volume per acre are timber types, which typically have larger, taller trees than the woodland types. An exception to this observation is the aspen/birch forest-type group (consisting of the aspen forest type in Nevada), which has a low proportion of its area in large-diameter stands in Nevada compared to other Interior West States, resulting in relatively low volume per acre (see table B5).

Components of Aboveground Woody Biomass

FIA uses several different methods to estimate the weight of woody biomass. Tree aboveground biomass estimates are based on gross volumes and describe tree weight (oven-dry) by various components (merchantable bole and bark, tops and limbs, stump, seedlings, and woodland species). This method of estimating tree

biomass is referred to as the component ratio method and is described by Woodall et al. (2011). The aboveground biomass of standing-dead trees is also estimated in this way, with the exception of saplings, because dead saplings were not measured in this inventory. Tables B29 and B39 show the aboveground weight biomass of live trees 1.0 inches diameter and greater in Nevada, which totals nearly 110 million tons. The aboveground weight of all standing-dead trees 5.0 inches diameter and greater is almost 9 million tons.

Biomass is also calculated for woody biomass components other than live trees in order to estimate the carbon (C) content of these components on forest land. These components include down woody materials, understory shrubs and seedlings, standing dead trees, and organic soil. These estimates are based on models that use computed values at the condition level, so if actual measurements are available, it is advisable to use those. An example is carbon in standing-dead trees. The condition-level model is based on geographic area, forest type, and growing-stock volume. If measurements of actual standing-dead trees are available, as they are in Nevada's inventory, it is better to use estimates derived from the individual trees, as was done above. Understory shrubs and seedlings are a major biomass component where direct, precise measurements are not available. The condition-level model is based on geographic area, forest type, and (except for nonstocked and pinyon/juniper stands) live tree carbon density; and assumes that the weight of carbon in shrubs and seedlings is 50 percent of its oven-dry biomass (USEPA 2008a,b). The estimate from this variable is nearly 13 million tons of carbon, or oven-dry biomass of over 25 million tons.

Beginning in 2006, and continuing through 2012, IWFIA used a trial field protocol for measuring down woody material, including duff and litter, on forest plots (USDA Forest Service 2006, 2010, 2011). In 2013, the IWFIA protocol was replaced with a nationally consistent, core optional down woody material protocol (USDA Forest Service 2013), which was used in Interior West States, including Nevada. However, since these measurements are not available for all plots in the current inventory (plots measured in 2004 and 2005), population estimates are not available for these components. Also, some conditions occasionally encountered by field crews, such as snow covering the ground on all or part of the plot, prevent the measurement of some or all of the down woody material protocol: coarse woody debris, fine woody debris, or duff and litter. However, it is possible to compare average per-acre biomass estimates for different components, keeping in mind that the sample sizes of biomass components are different.

Table 4 shows the number of plots where woody biomass components were measured by forest-type group. Note that biomass components measured on forest-type groups with few plots may not be representative. Figure 20 displays the average tons per acre biomass estimates of six different components of aboveground biomass by forest-type group and for all forest land in Nevada. For combined forest-type groups, the largest biomass component is live trees, at just over 10 tons per acre. This is also true for most individual forest-type groups, with the notable exceptions of nonstocked, where live trees are the smallest component; and the aspen/birch and woodland hardwoods groups, where live-tree biomass is

Table 4—Number of plots used to calculate biomass per acre by woody biomass component, Nevada, 2004–2013.

Forest-type group	Woody biomass component			
	Trees and understory	Coarse woody debris	Fine woody debris	Duff and litter
Pinyon / juniper group	1,543	1,200	1,175	1,182
Douglas-fir group	3	3	3	3
Ponderosa pine group	11	9	8	9
Fir / spruce / mountain hemlock group	39	31	31	30
Lodgepole pine	4	3	3	3
Other western softwoods group	26	20	18	18
Elm / ash / cottonwood group	3	3	2	2
Aspen / birch group	51	39	37	39
Woodland hardwoods group	151	125	123	125
Nonstocked	128	100	96	97
All groups ^a	1,918	1,501	1,467	1,479

^a Values don't add to total because more than one forest-type group may occur on a plot.

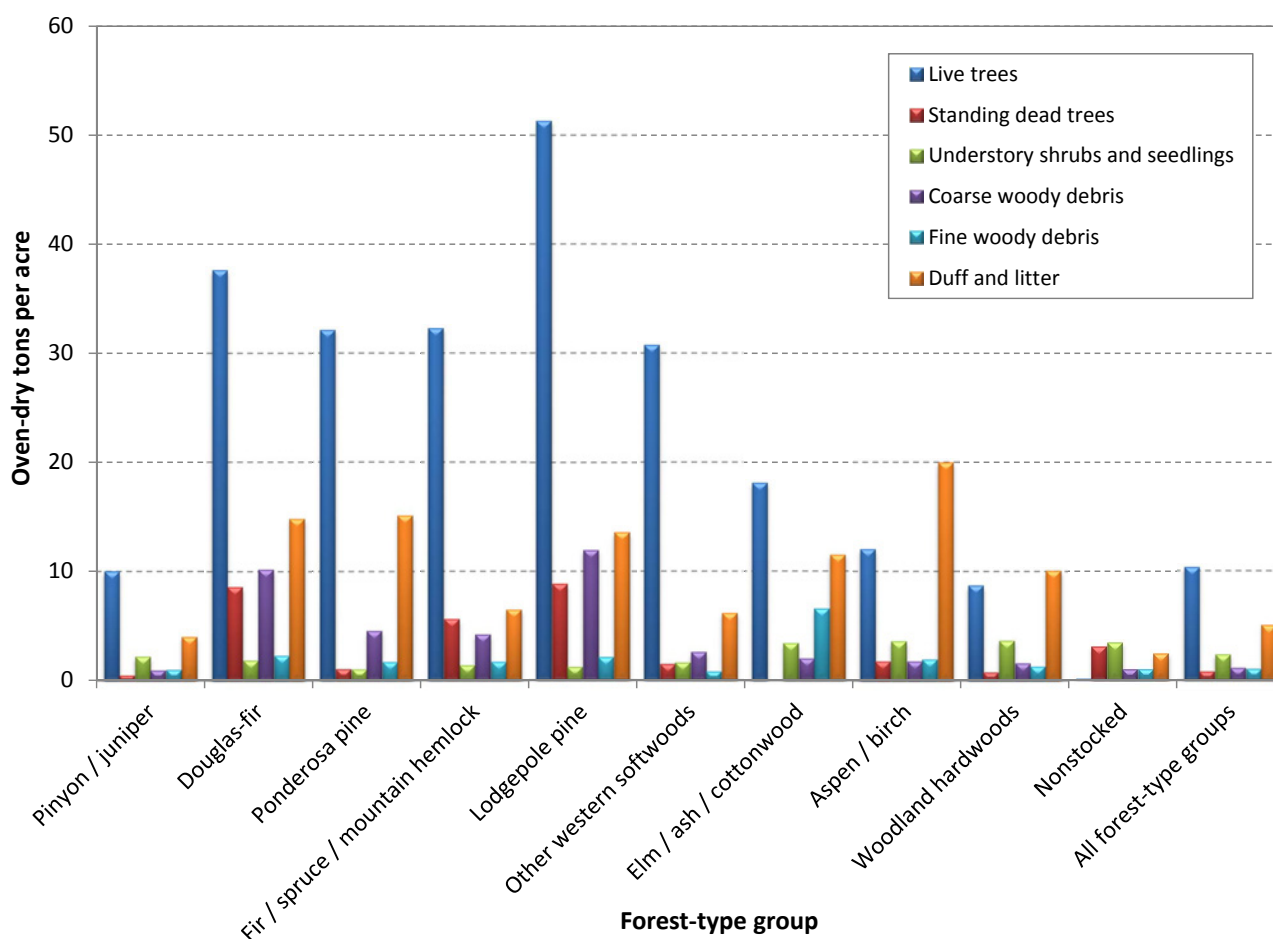


Figure 20—Average oven-dry tons per acre of woody biomass on forest land by forest-type group and aboveground woody biomass component, Nevada, 2004–2013.

secondary to duff and litter biomass. The non-woodland, or timber-type, softwood forest-type groups (the Douglas-fir, ponderosa pine, fir/spruce/mountain hemlock, lodgepole pine, and other western softwoods groups) have especially high biomass in live trees. However, this is slightly misleading, because some of those forest-type groups with the highest live tree biomass have small sample sizes. The overall estimate for live tree biomass in timber-type softwood groups is just less than 33 tons per acre.

The next largest biomass component, overall, is duff and litter at 5 tons per acre. As mentioned above, duff and litter is the major biomass component in the aspen/birch and woodland hardwoods groups, at 20 and 10 tons per acre, respectively. The timber-type softwood groups also have relatively high biomass in the duff and litter component, but with the highest values in the forest-type groups with the smallest samples. The average duff and litter biomass for the timber-type softwood groups is just over 8 tons per acre.

The standing dead trees and coarse woody debris biomass components are also the highest in the timber-type softwood groups, averaging nearly 4 tons per acre and just over 4 tons per acre, respectively.

Forest Change Components: Growth, Mortality, and Removals

Forest vigor, sustainability, and timber supply are assessed by what are referred to as forest change components: growth, mortality, and removals. The relationship among these three change components quantifies the change in tree volume over time. Growth is typically expressed as net annual growth and is defined as the gross, or total, average annual growth in tree volume minus the volume lost through mortality. Mortality is the average annual net volume of trees dying over a given time period due to natural causes and excludes the volume removed through harvesting. Tree mortality often occurs at low and predictable rates due to insects and disease, suppression by overstory trees, or advanced tree age. Occasionally, highly concentrated and localized losses occur due to insect and disease epidemics, wildfire, or severe weather events. Removals represent the net volume of growing-stock trees removed from the inventory by harvesting or other cultural operations (such as timber-stand improvement), by land clearing, or by changes in land use (such as designation as Wilderness or other reserved status).

The three components of forest change—growth, mortality, and removals—are typically analyzed using measurements of the same plots at two points in time. It is possible, however, to estimate growth and mortality rates based on a single inventory, as described below. In contrast, removals cannot be reliably estimated without having two measurements of the same set of plots, and the Nevada inventory began remeasurement in 2014, after the data for this report were collected. Therefore, recent removals can only be estimated using information about the amount of wood cut and processed by the forest products industry. Due to this difference in analysis methods, growth and mortality are analyzed and discussed separately from removals.

Growth and Mortality

In Nevada's current inventory, annual growth was estimated from a sample of increment core measurements and is based on the previous 10 years of radial growth. Mortality was estimated from trees that died within the 5 years prior to the year of measurement, based on the condition of foliage, twigs, branches, and bark by species.

The estimate of annual gross growth of all live trees 5.0 inches diameter and greater on forest land in Nevada is 64 million cubic feet. This is the sum of annual growth on all survivor and ingrowth trees. Survivor trees are defined as those that were 5.0 inches in diameter or larger 10 years prior to the current measurement. Ingrowth trees are defined as trees that were less than 5.0 inches diameter prior to the current measurement and then grew over the 5.0-inch threshold during the previous 10 years. On average, annual mortality of trees 5.0 inches and larger in diameter was 47.7 million cubic feet (tables B25–B27). Annual net growth, or gross growth minus mortality, is estimated at 16.3 million cubic feet on forest land in Nevada (tables B21–B23). Negative values of net annual growth in some cells in tables B21–B23 indicate that annual tree mortality exceeds growth of live trees on these forest land categories.

The 16.3 million cubic feet of net annual growth in Nevada indicates an inventory of live trees that is increasing annually in the absence of trees removed by human activities. The annual increase is relatively small; net annual growth as a percentage of net volume of all live trees 5.0 inches diameter and larger averaged only 0.26 percent per year. High levels of tree mortality are mostly offsetting gains from live tree growth. In figure 21, the map of net annual growth at individual plots shows that plots with large values of net growth, both positive and negative, are dispersed throughout the State. Some plots with negative net annual growth are clustered, representing areas affected by major disturbances such as fires.

The relationship between net growth and mortality varies substantially by ownership group in Nevada (fig. 22). Mortality of trees 5.0 inches diameter and larger on Federal forest lands other than National Forests totaled 29.0 million cubic feet (table B25) compared to 5.5 million cubic feet of net annual growth (table B21). On National Forest lands, mortality was 15.9 million cubic feet and net growth was 10.6 million cubic feet. No mortality was recorded on State and local government forests, and slightly negative net growth (–0.4 million cubic feet) was reported on privately owned forest land.

Figure 23 shows net growth and mortality for the seven major inventory species—those with the greatest total volume—in Nevada. Annual net growth exceeded mortality only in curlleaf mountain-mahogany and quaking aspen. White fir, limber pine, and Great Basin bristlecone pine all experienced negative net growth. Annual mortality of singleleaf pinyon totaled 21.6 million cubic feet and net growth was 10.2 million cubic feet. Annual mortality of Utah juniper totaled 8.4 million cubic feet and net growth 6.4 million cubic feet. White fir, hit hard by insects, had the lowest net growth of any of these species at negative 1.7 million cubic feet annually, and 4.8 million cubic feet of annual mortality.

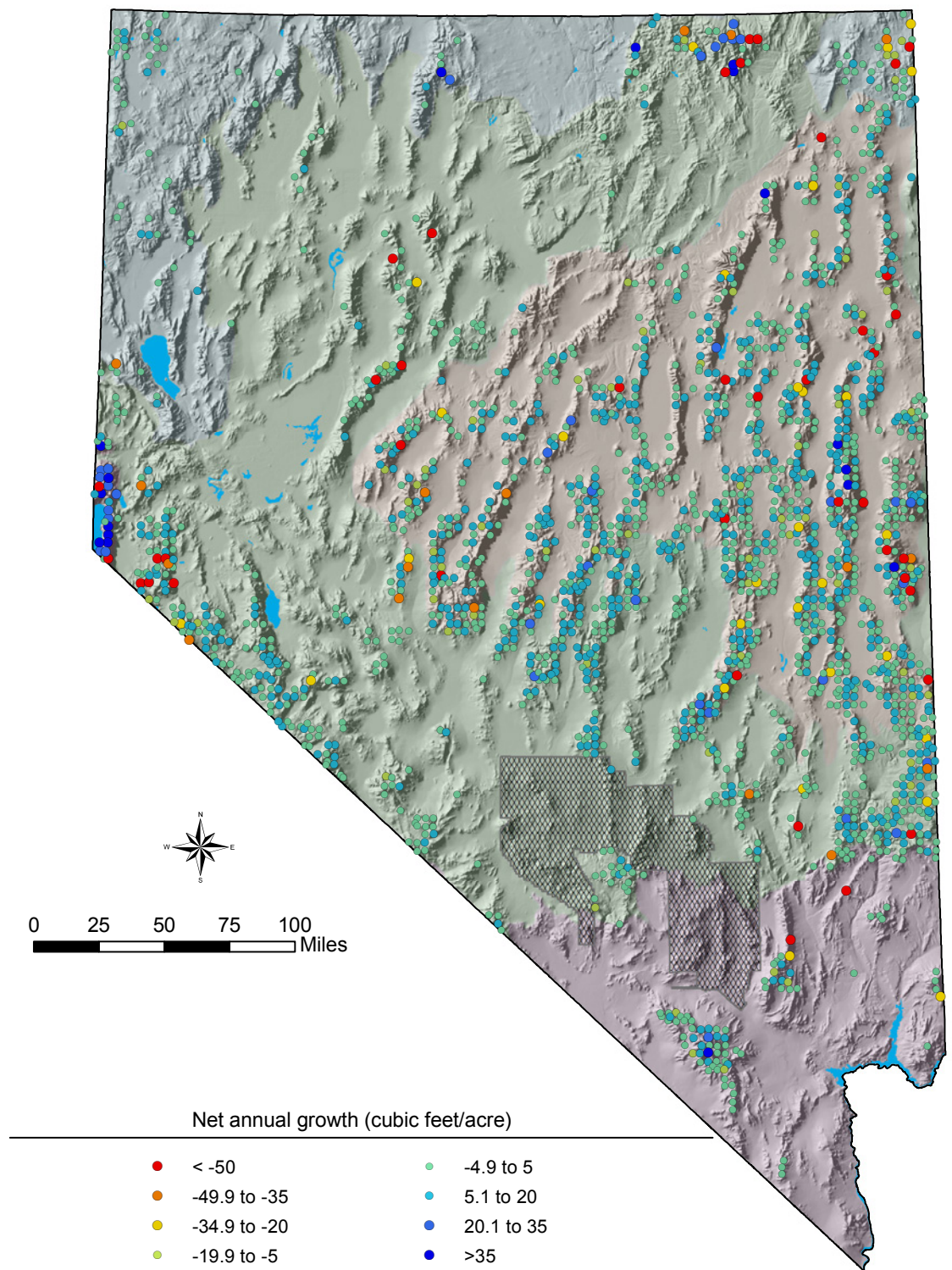


Figure 21—Net annual growth at inventory plots on forest land, Nevada, 2004–2013. Negative values indicate plots where mortality exceeded gross growth. Cross-hatched area not sampled. (Note: plot locations are approximate; some plot locations on private land were randomly swapped.)

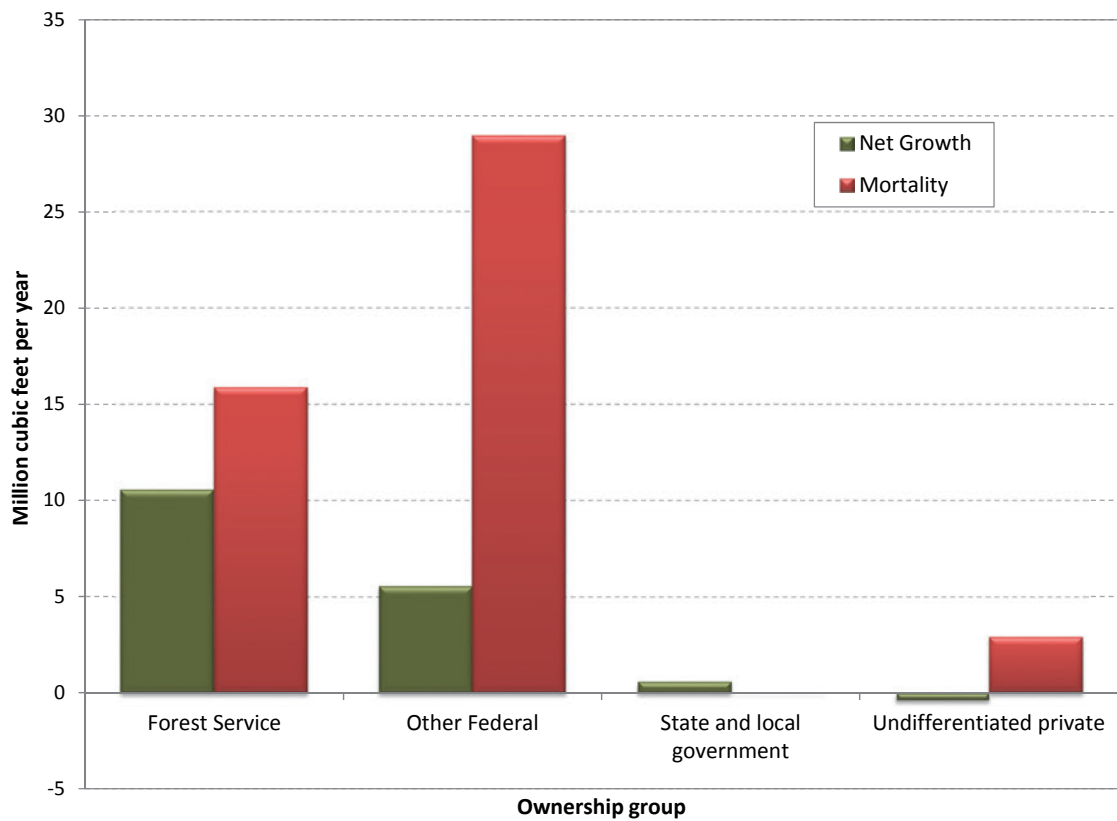


Figure 22—Net annual growth and mortality on forest land by ownership group, Nevada, 2004–2013.

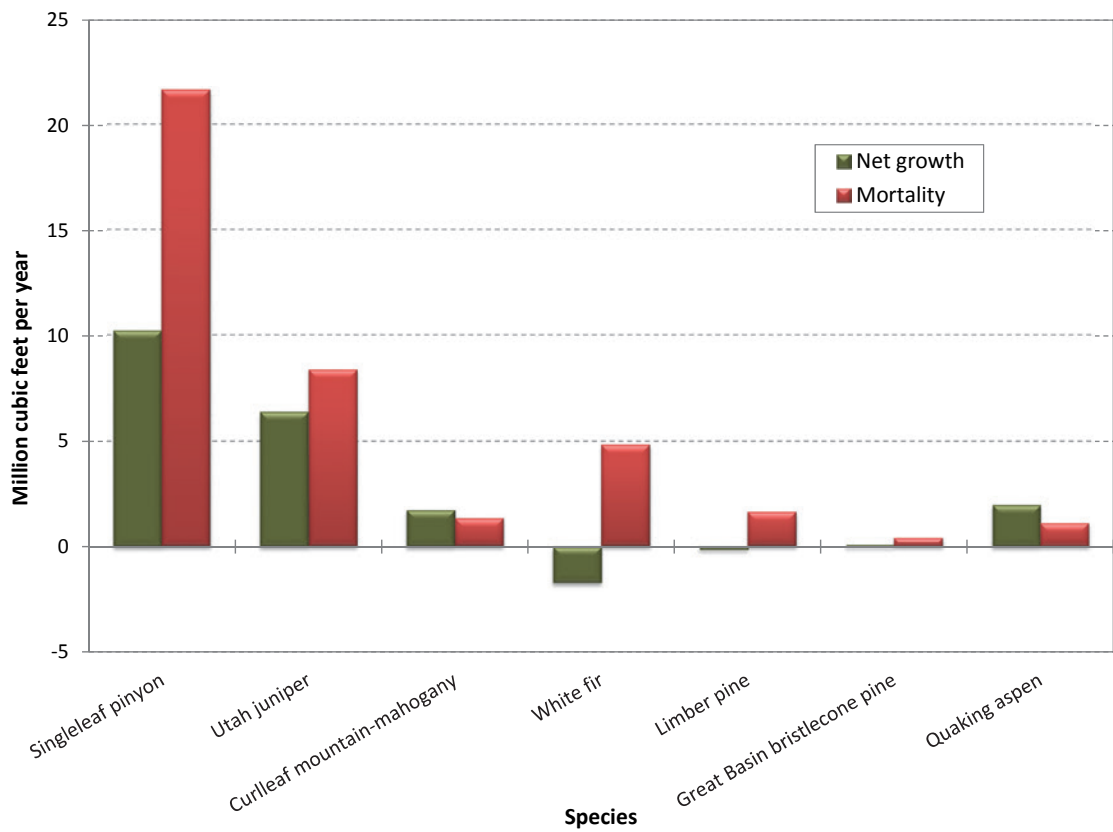


Figure 23—Net annual growth and mortality on forest land by seven major species, Nevada, 2004–2013.

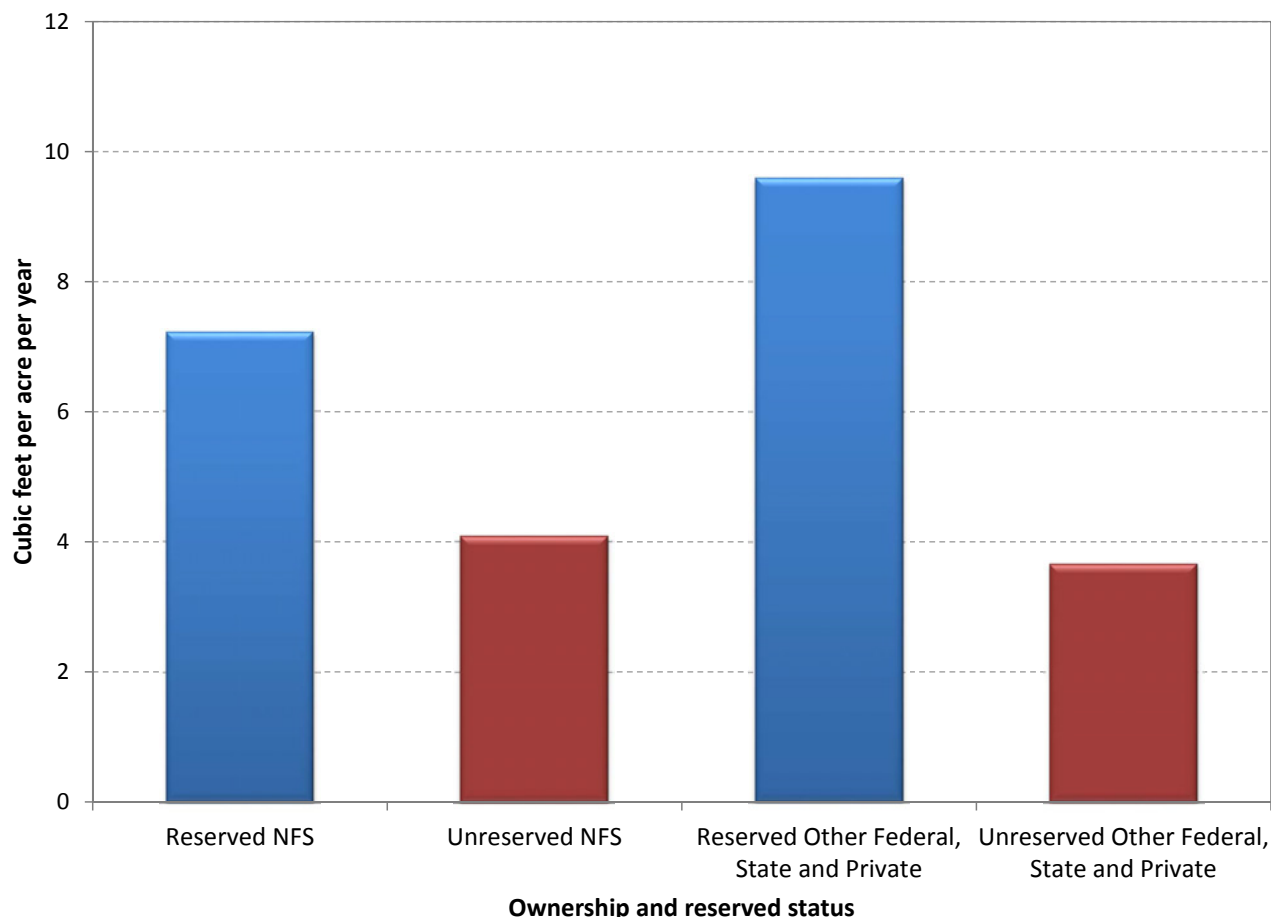


Figure 24—Average annual per-acre mortality on forest land by two major owner categories and reserved status, Nevada, 2004–2013.

Because high mortality is the driving force behind the large differences between gross and net growth, further examination of the change component by other resource attributes can help explain the factors behind the high levels of tree volume estimated to have died in the previous 5 years. Substantial differences were observed in per-acre estimates of mortality between major ownership groups and reserved status. Converting the State-level estimates of mortality into per-acre estimates removes the effect of differences in the amount of forest land managed by different ownership groups. The per-acre estimate of annual mortality averages 4.5 cubic feet per year on forest land across all ownerships. Mortality on reserved forest land was appreciably higher than on unreserved forest land. Average annual mortality on reserved land averaged 8.3 cubic feet per acre, compared to 3.8 cubic feet per acre on unreserved forest land. Figure 24 illustrates per-acre estimates of mortality by two major owner categories and reserved status. Reserved lands in the other Federal, State and private ownership category recorded the highest average level of per-acre mortality at 9.6 cubic feet, somewhat higher than the per-acre estimate of mortality on reserved National Forest lands. It should be noted that it is not possible to have both reserved and non-reserved forest land for some individual ownerships within the other Federal, State and private ownership category; all lands managed by the National Park Service and the U.S. Fish and Wildlife

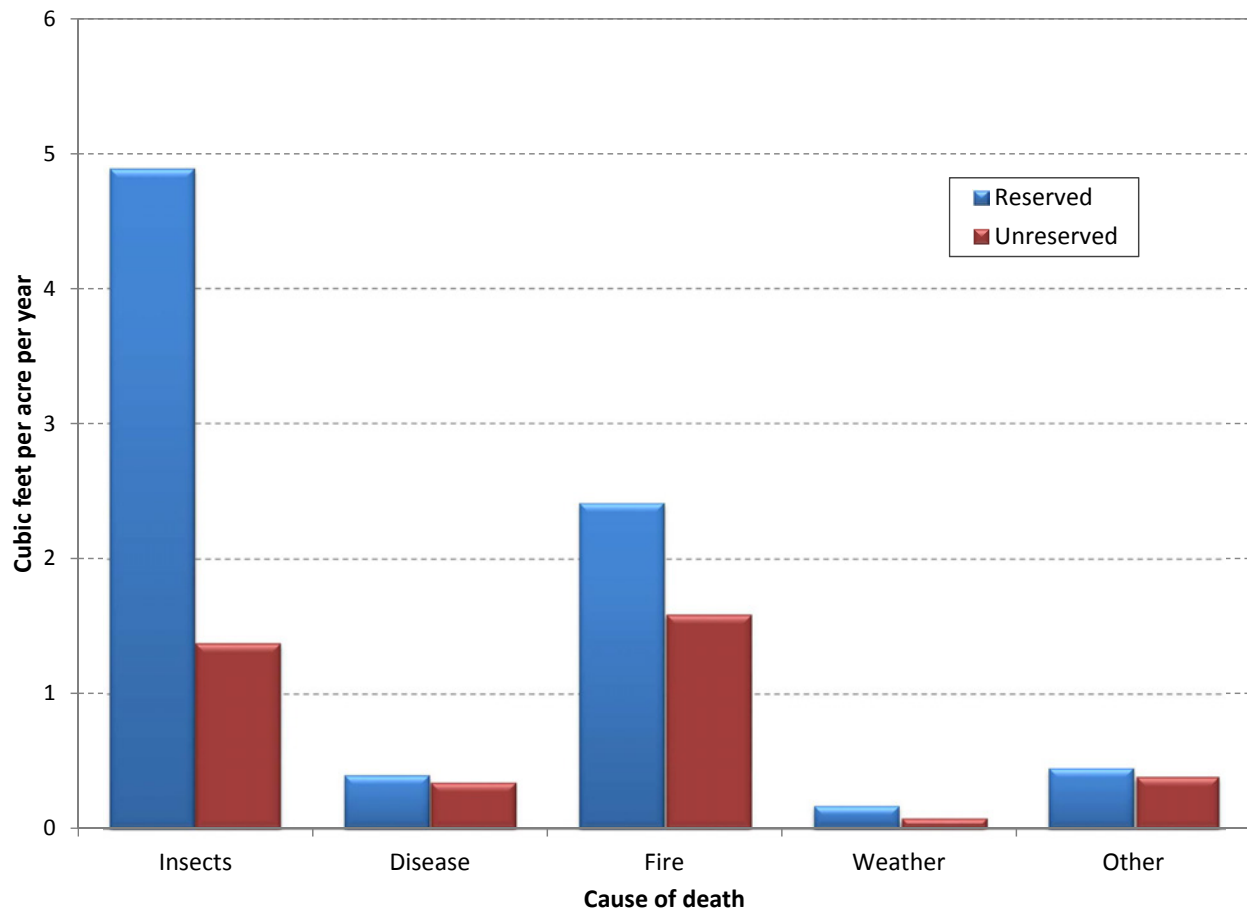


Figure 25—Average annual per-acre mortality on forest land by cause of death and reserved status, Nevada, 2004–2013.

Service are reserved, and no private lands are designated as reserved. In general, though, reserved forest lands had higher per-acre mortality than unreserved lands.

All trees classified as mortality trees are assigned a cause of death in the field. Drawing conclusions from mortality estimates by cause of death should be done with caution because the actual agent that caused a tree’s death may be difficult, if not impossible, to determine. The “other” cause of death category includes trees that have died due to reasons the field crews were unable to determine. Interactions between insects and diseases are complex, and trees that are dead after a fire may have been dead or dying before the fire occurred, making identification of causal agents difficult. Figure 25 illustrates per-acre estimates of mortality by reserved status and cause of death. Mortality due to insects accounted for the largest portion (43.2 percent) of total mortality. Fire was the second leading contributor to mortality, accounting for 38.2 percent of the total mortality. Disease accounted for 7.8 percent. All mortality agents had a higher per-acre rate on reserved forest land than on unreserved forest land, although the differences were minor in the disease and other categories.

High mortality resulted in large reductions in net growth for several species and species groups. In several high-volume species with negative net growth, insects were a particularly important contributor to mortality estimates, causing

over 90 percent of the white fir mortality and nearly 80 percent of the limber pine mortality. For individual species with higher mortality in reserved forests, per-acre mortality was especially high for white fir on National Park Service forests. The reasons behind the difference in levels of tree mortality by reserved status deserve further investigation. The difference has been observed in other State inventories (Goeking et al. 2014; Witt et al. 2012), which may suggest the reserved lands have a larger share of aging forest stands that are more susceptible to insect and disease. This assumption could be verified with additional analysis of stand age, structure, density, species composition, and management regimes.

Removals

Volume removed from forest inventory during timber harvesting is known as removals. Removals are another forest change component and an important indicator of the sustainability of timber harvest levels. Live tree removals that exceed growth for extended periods could indicate over-harvesting and decreasing forest inventory. Conversely, growth that greatly exceeds removals could signal the need for vegetation management to regulate density, inhibit insect and disease outbreaks, or reduce wildfire risk.

Removals can come from two sources: the growing-stock portion of live trees (live trees of commercial species meeting specified standards of quality or vigor), or dead trees and other non-growing stock sources. The two general types of removals are timber products harvested for processing by mills and logging residue (i.e., volume cut or killed but not utilized). Removals, as reported here, are based on a 2012 analysis of Nevada's primary forest products industry, information from the Nevada Division of Forestry's Natural Resources Program, and various logging utilization studies (McLain 1997; Morgan and Spoelma 2008; Morgan et al. 2005).

Total removals from Nevada's forests during 2012 were estimated to be 6.58 million cubic feet (MMCF; table 5). This included 6.51 MMCF of timber used for roundwood products (including fuelwood) and 70,000 cubic feet (MCF) of logging residue left in the forest as slash. Fuelwood accounted for 97 percent (6.4 MMCF) of total removals, comprised almost entirely of residential firewood and nearly all from non-growing stock sources (i.e., dead trees).

Softwoods were the largest component of Nevada's removals, accounting for over 99 percent of total removals and over 99 percent of removals for timber products (table 5). About 3 MCF of hardwoods, predominantly aspen, were used for fuelwood.

Growing-stock removals totaled 247 MCF, with softwoods accounting for 243 MCF (98 percent). About 97 percent (240 MCF) of growing-stock removals went to wood products, including sawlogs and fuelwood. Fuelwood was the largest component (131 MCF, 53 percent) of growing-stock removals, followed by sawlogs (109 MCF, 44 percent). Just under 3 percent (7 MCF) of growing-stock removals were logging residue (i.e., not utilized).

Private and tribal timberlands accounted for almost 61 percent (150 MCF) of growing-stock removals in Nevada, while National Forests accounted for almost

Table 5—Volume of timber removals (in thousand cubic feet) by source of material, species group, and removal type, Nevada, 2012.

Removal Type	Source of material							
	Growing stock			Other sources			All sources	
	Softwoods	Hardwoods	Total	Softwoods	Hardwoods	Total	Softwoods	Hardwoods
Roundwood products								
Saw logs	109	0	109	1	0	1	110	0
Veneer logs	0	0	0	0	0	0	0	0
Pulpwood	0	0	0	0	0	0	0	0
Composite products	0	0	0	0	0	0	0	0
Fuelwood (including residential) ^a	128	3	131	6,269	0	6,269	6,397	3
Posts, poles, and pilings	0	0	0	0	0	0	0	0
Miscellaneous products	0	0	0	0	0	0	0	0
Total roundwood products	237	3	240	6,270	0	6,270	6,507	3
Logging residues	7	0	7	62	1	63	69	1
Total removals	243	3	247	6,332	1	6,333	6,576	4
Total	237	3	240	6,270	0	6,270	6,507	3
Logging residues	7	0	7	62	1	63	69	1
Total removals	243	3	247	6,332	1	6,333	6,576	4

^aIncludes residential fuelwood consumption reported by U.S. Energy Information Administration (<http://www.eia.gov/state/seds/seds-data-complete.cfm?sid=US#Consumption>)
 Totals may not sum due to rounding.

24 percent (58 MMCF). State and Bureau of Land Management (BLM) lands were the source of the remaining 16 percent (38 MCF) of growing-stock removals.

Total roundwood product output from all sources in Nevada during 2012 was 6.5 MMCF, the majority of which (96 percent) came from non-growing stock sources. In addition to 6.3 MMCF of fuelwood, just 1 MCF of sawlogs came from dead trees (i.e., non-growing stock). Of the 240 MCF of roundwood output sourced from growing stock, fuelwood was the leading product type, accounting for 131 MCF of output (table 6).

There is very little industrial timber harvested in Nevada (less than 250 MCF during 2012) and no timber-processing facilities (e.g., sawmills) were identified in the State for the 2012 analysis. Periodically, small volumes of sawlogs or post and pole material are harvested in western portions of the State and processed in California. Several commercial firewood cutters are believed to operate in Nevada, but no information on those operations was readily available. The overwhelming majority (over 90 percent) of removals for products in Nevada is for fuelwood and comes from non-growing stock sources. Nevada's timber harvest in 2012 was about 62 percent of what it was in 2005. This decrease in harvest volume was largely the result of reductions in fuelwood harvest as indicated by annual changes in the U.S. Energy Information Administration's residential fuelwood consumption figures. There is not a clear trend in timber harvest volume in Nevada.

Statewide, average annual gross growth of growing-stock trees on Nevada timberland was about 6.3 MMCF—25 times the 2012 growing-stock removals of 247 MCF. Accounting for average annual growing-stock mortality on timberland (3.6 MMCF; table B28), average annual net growth was 2.1 MMCF (table B24). Thus growing-stock removals during 2012 accounted for less than 12 percent of net growth. The approximately 6.3 MMCF of non-growing stock (i.e., mostly dead) trees removed for products (mostly fuelwood) during 2012 would have come from unreserved forest land, but not necessarily timberland. Mortality of live trees on unreserved forest land was 33.4 MMCF (table B25), meaning about 19 percent of average annual mortality was utilized during 2012. The relatively low levels of growing-stock removals and high levels of tree mortality on Nevada's timberlands suggest there may be opportunities to increase harvesting of live trees to promote long-term forest sustainability. Continued utilization of mortality for fuelwood can help reduce fuels available for wildfire and may allow landowners the opportunity to recover some financial value from dead trees.

Table 6—Total roundwood output (in thousand cubic feet) by product, species group, and source of material, Nevada, 2012.

Product and species group	Source of material			All sources
	Growing-stock trees		Other sources	
	Sawtimber	Poletimber		
Sawlogs				
Softwood	109	0	1	110
Hardwood	0	0	0	0
Total	109	0	1	110
Veneer logs				
Softwood	0	0	0	0
Hardwood	0	0	0	0
Total	0	0	0	0
Pulpwood				
Softwood	0	0	0	0
Hardwood	0	0	0	0
Total	0	0	0	0
Composite panels				
Softwood	0	0	0	0
Hardwood	0	0	0	0
Total	0	0	0	0
Poles and posts				
Softwood	0	0	0	0
Hardwood	0	0	0	0
Total	0	0	0	0
Other miscellaneous				
Softwood	0	0	0	0
Hardwood	0	0	0	0
Total	0	0	0	0
Total industrial products				
Softwood	109	0	1	110
Hardwood	0	0	0	0
Total	109	0	1	110
Fuelwood (including residential)^a				
Softwood	128	0	6,269	6,397
Hardwood	3	0	0	3
Total	131	0	6,269	6,400
All products				
Softwood	237	0	6,270	6,507
Hardwood	3	0	0	3
Total	240	0	6,270	6,510

^aIncludes residential fuelwood consumption reported by U.S. Energy Information Administration <http://www.eia.gov/state/seds/seds-data-complete.cfm?sid=US#Consumption>

Totals may not sum due to rounding.

Nevada's Pinyons and Junipers

As is clear from the previous section of this report, pinyon and juniper and associated cover types are the dominant feature of Nevada's forests and its landscape in general. In this section we will report on forest attributes that are of particular importance to these types of forests.

Pinyon and Juniper in the Nonstocked Forest Type

The nonstocked forest type is used when there are not enough live trees measured to calculate a forest type based on stocking (see Appendix C). However, if the trees in the area are all dead, or so sparse that they are not measured on the subplots and/or microplots, field crews assign a forest type based on trees in the area of the plot, dead trees/stumps, or surrounding stands. If we look at these field forest types, we can gain an understanding of the status of pinyon and juniper types in nonstocked stands, which are the third most abundant forest type in the inventory and cover nearly 6 percent of Nevada's forest land. Figure 26 shows the percentages of the nonstocked forest type by the field-called forest types. The most abundant types, by far, are pinyon/juniper woodland (57 percent of the nonstocked type) and juniper woodland (30.7 percent). Western juniper makes up 3 percent of the nonstocked area. The western juniper forest type is not included in the pinyon/juniper forest-type group, and the trees are not included in the woodland hardwoods

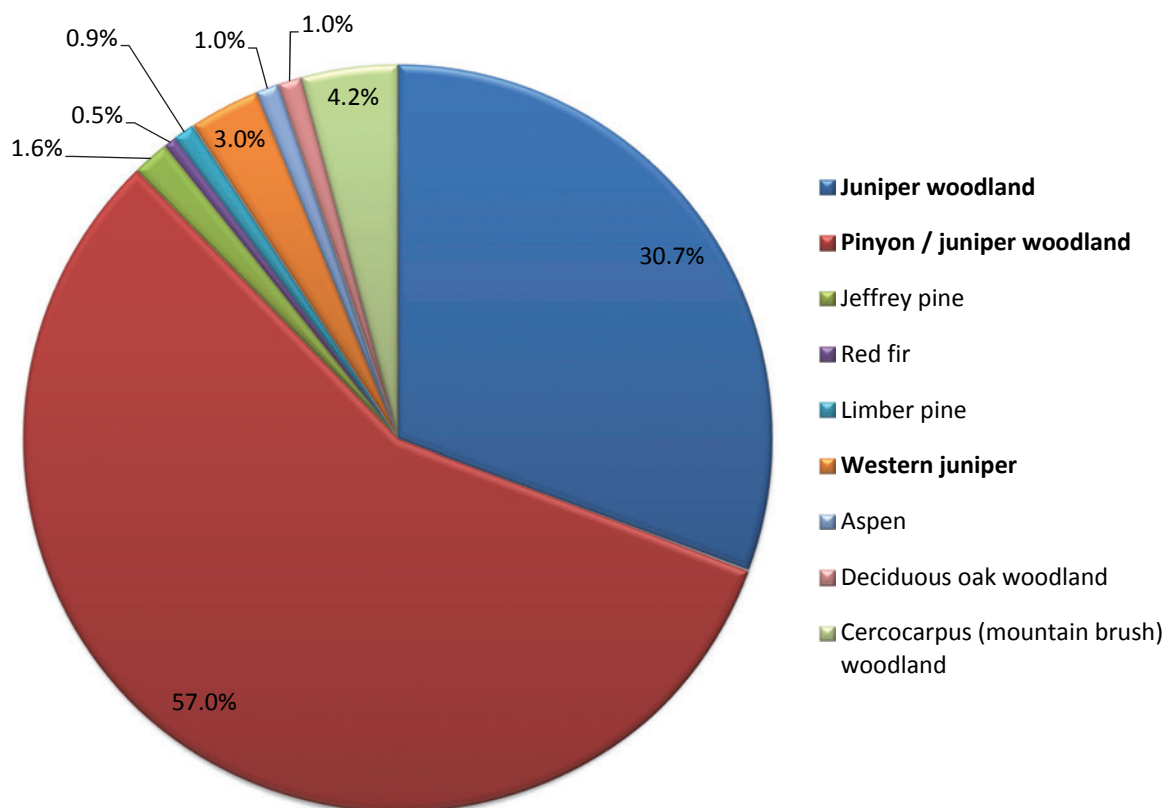


Figure 26—The distribution of forest land percentages of nonstocked forest type by field-called forest types, highlighting pinyon and juniper types, Nevada, 2004–2013.

species group, rather they are in the other western softwoods forest-type group and the other western softwoods species group. This is because they are timber species (Appendix D) and are measured at breast height. However, since they are junipers, they will be included in this and some other summaries in this section. Combined, pinyon/juniper woodland, juniper woodland, and western juniper field forest types for nonstocked stands account for 91 percent of the nonstocked area.

If, for the purpose of comparing the area covered by pinyon and juniper in general, we include western juniper with the other types in the pinyon/juniper forest-type group, and use the field-called forest type for nonstocked, pinyons and junipers can be estimated to dominate 86 percent of Nevada's forest land.

Other Wooded Land

From the beginning of annual inventories until 2012, Interior West FIA (IWFIA) measured trees and other attributes on plot conditions with 5 to 9 percent tree cover. These conditions are called other wooded land (see Appendix A for definition) and were previously considered forest land (DeBlander et al. 2010). In the current inventory, these conditions are included with non-forest, but data similar to forest land data can be retrieved internally. Since no data were collected in 2013, the 2012 evaluation (data collected 2004–2012) was used for the estimates presented here.

Nevada contains about a million acres of other wooded land. The most common forest types are pinyon/juniper woodland at 42 percent, juniper woodland at 32 percent, and nonstocked at 22 percent (fig. 27). Since these stands are very sparse,

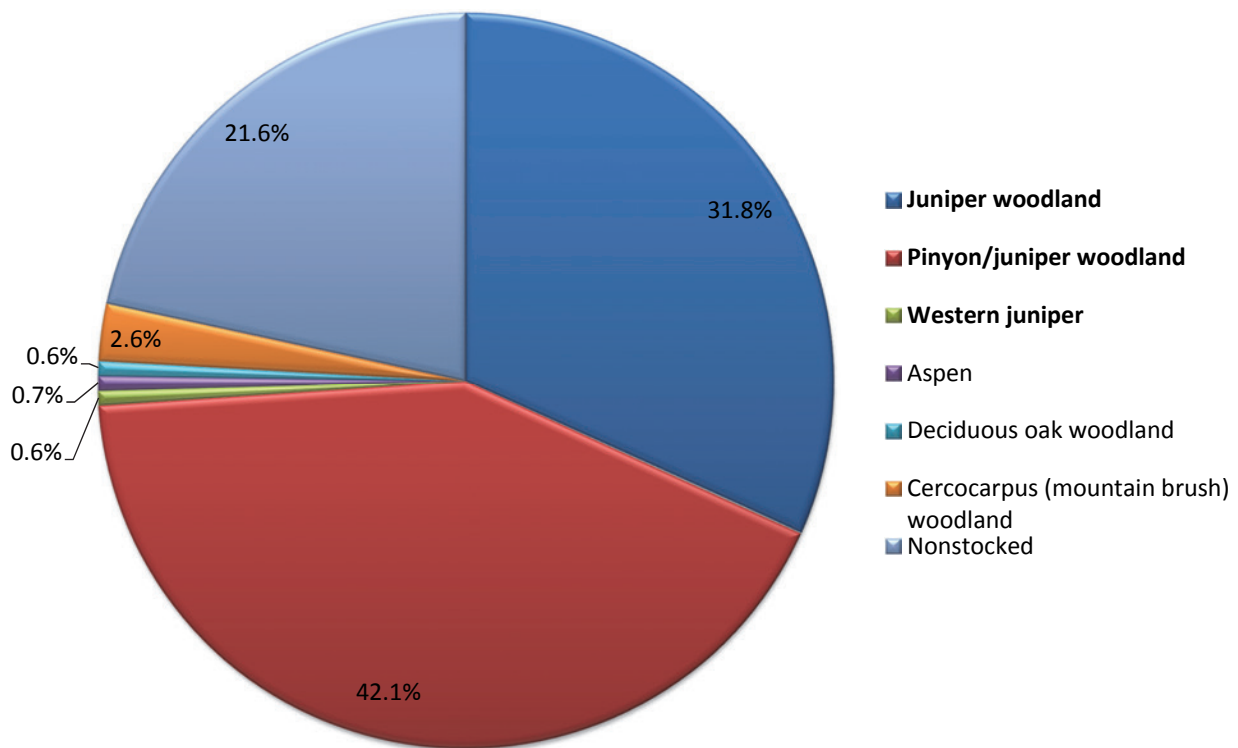


Figure 27—Area of other wooded land by forest type, highlighting pinyon and juniper types, Nevada, 2004–2012.

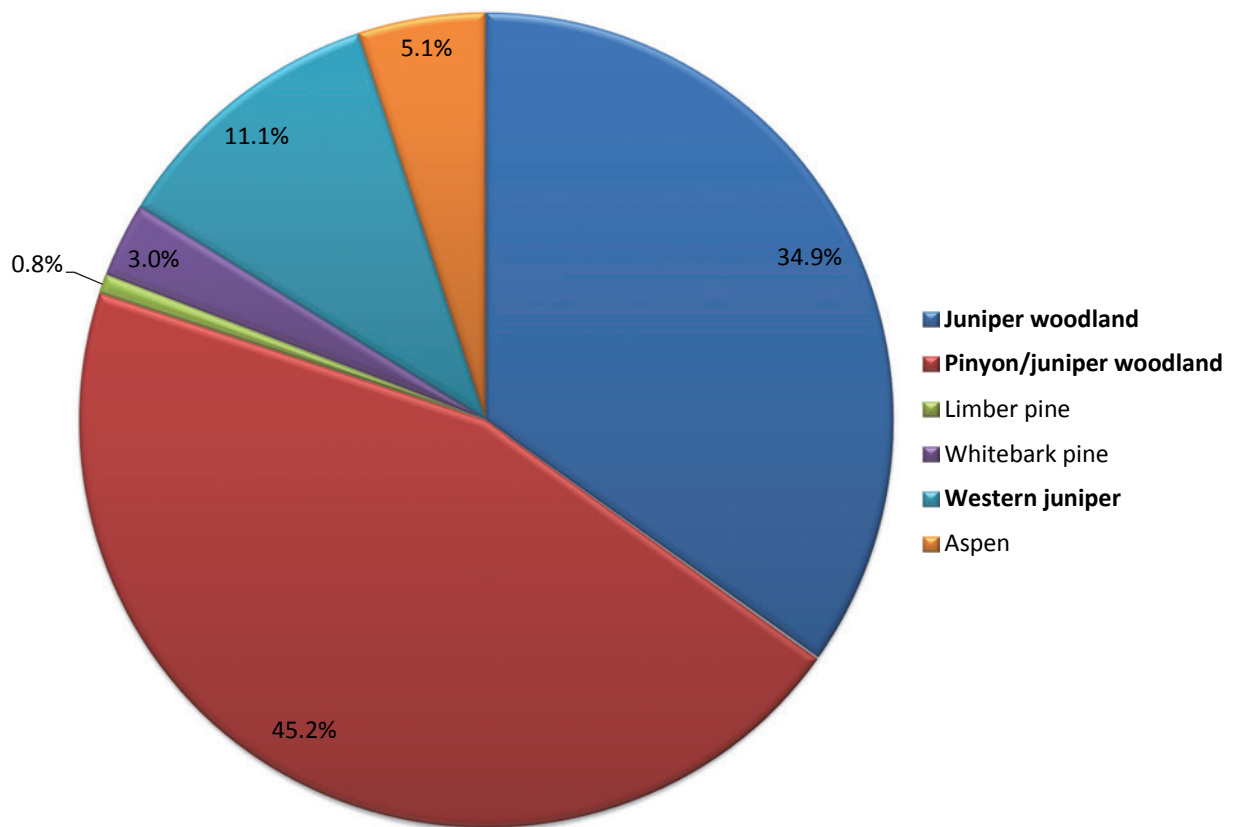


Figure 28—The distribution of other wooded land percentages of nonstocked forest type by field-called forest types, highlighting pinyon and juniper types, Nevada, 2004–2012.

it should not be a surprise that the nonstocked type is so abundant. However, as with forest land, field crews assign a field forest type to these plot conditions. The most common field forest types on other wooded land nonstocked stands are pinyon/juniper woodland at 45 percent, juniper woodland at 35 percent, and western juniper at 11 percent (fig. 28). In total, other wooded land dominated by pinyons and junipers constitute about 94 percent of Nevada’s other wooded land.

Trees are measured on other wooded lands, as well, but because these are sparse stands, fewer are measured than on forest land. There are 56.4 million trees on other wooded land compared to 2.6 billion on forest land. However, nearly 92 percent of these are either Utah juniper (25.9 million trees), singleleaf pinyon (25.6 million trees), or western juniper (0.2 million trees). Other species encountered on other wooded land include curlleaf mountain-mahogany (3.4 million trees), quaking aspen (1.1 million trees), and limber pine (0.1 million trees). Only one tree each of white fir and whitebark pine were encountered on other wooded land, resulting in estimates of less than 50,000 trees.

In-Fill in Nevada’s Pinyon/Juniper Woodlands

Pinyon/juniper woodland is the most common forest type in Nevada covering nearly 70 percent of the forest land (see section *Forest Types and Forest-type Groups* in the “Overview of Nevada’s Forests” chapter). These woodlands

are commonly associated with sage-steppe communities, which often border the woodlands at their upper and lower elevation limits. Sagebrush (*Artemisia* spp.) is also often found in the understory of pinyon/juniper stands and provides habitat for many organisms, including young pinyon trees (Chambers et al. 1999). There is concern among some land managers and ecologists that pinyon/juniper stands are quickly expanding into previously unoccupied shrub-steppe communities and existing stands are becoming denser as a result of in-fill (i.e., the recruitment of younger trees within a stand resulting in a higher stem density and a reduction of the shrub understory). These processes influence species that use pinyon/juniper woodlands by providing additional food, cover, and nest resources while simultaneously affecting habitat for species that rely on sage-steppe communities by changing fire regimes, habitat suitability, and predator-prey interactions (Manier et al. 2013; Miller and Tausch 2001). Knowing the extent, rate, and circumstances under which in-fill and/or expansion commonly occur can aid land management decisions aimed at mitigating the impacts of these processes. FIA data can be a tool to formulate these strategies by providing landscape-level assessments of the extent to which pinyon/juniper woodlands are currently experiencing in-fill and under what conditions they are doing so.

Here we use FIA data to estimate the proportion of pinyon/juniper woodland that is currently producing seedlings. The presence of seedlings was used as a confirmation that a stand is currently in the process of in-filling. We compared the proportion of stands currently undergoing in-fill in differing age classes, elevation groups, and aspect. Stand-age classes used here were defined by when settlement by European immigrants began (before and after 1850), and by the incorporation of the Taylor Grazing Act (1939), which greatly reduced livestock impacts on Nevada's pinyon/juniper and sagebrush communities. For this analysis, age class was based on stand age assigned to the plot or the age of the oldest pinyon or juniper tree measured on the plot, whichever was oldest. Aspect groups were divided into the four cardinal directions, with south (136°–225°) and east (46°–135°) aspects receiving more solar energy than do north (316°–45°) and west (226°–315°) aspects, resulting in more moisture available to trees on the north and west facing slopes. Elevation groups are based on the distribution of pinyon/juniper woodlands along the elevation gradient found in Nevada. Higher elevations generally receive more precipitation, with a greater proportion of it falling as snow during winter months. We also look at species frequency (singleleaf pinyon versus Utah juniper) of seedlings on the plots to gauge whether one species accounts for more in-fill than the other. Sample size for these analyses was robust, ranging from 1,183 conditions (plots or portions of plots categorized as pinyon/juniper woodland) for the species analysis to 1,210 conditions for the age-class analysis.

Roughly 71 percent of the pinyon/juniper woodlands in Nevada are experiencing active regeneration as defined by the presence of seedlings on a forested condition (fig. 29). Pinyon/juniper stands that have persisted through the period of European settlement appear to be experiencing less in-fill than those stands that have originated since that time. Woodlands less than 150 years old have an 8 percent higher incidence of active regeneration within the stand than do stands older

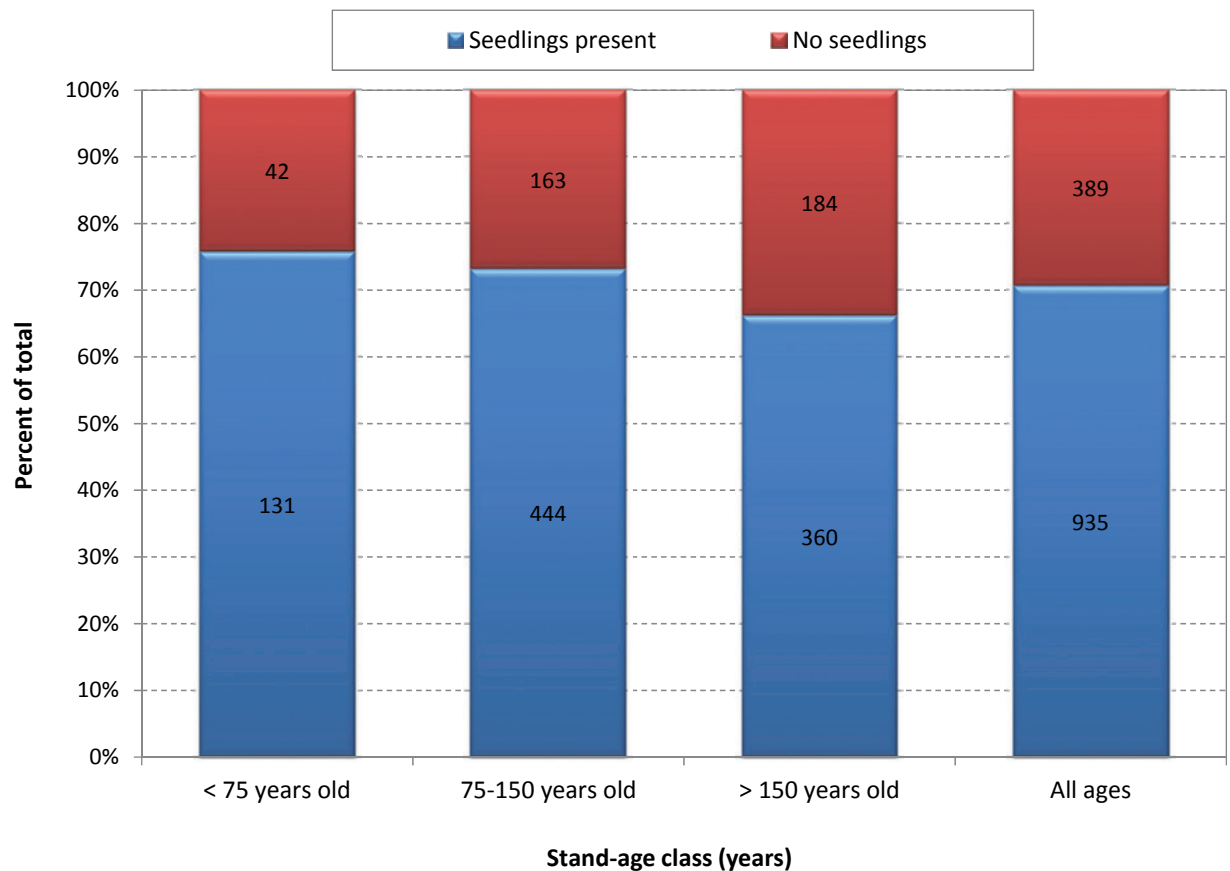


Figure 29—Proportion of Nevada's pinyon/juniper woodland currently experiencing in-fill (by stand-age class) as determined by the presence of pinyon pine or juniper seedlings on the plot, Nevada, 2004–2013.

than 150 years. Pinyon/juniper stands that have originated in the past 75 years do not differ notably from stands of 75–150 years old. This suggests that younger (<150 years old) pinyon/juniper stands are more likely to be experiencing in-fill than older stands. These younger stands represent an estimated 62 percent of the total acres of pinyon/juniper forests in Nevada.

Pinyon/juniper woodlands show a normal distribution across elevation-classes, with stands found from 6,000 to 7,500 feet having the largest proportion showing signs of active in-filling (fig. 30). The woodlands found higher than 7,500 feet have the lowest percentage of their population experiencing in-fill. However, at least half of these high elevation stands do have seedlings present so it is not a rare occurrence at any elevation. Pinyon/juniper forests are most common at 6,500 to 7,000 feet in Nevada, which is also the elevation-class where most in-fill is occurring.

Aspect appears to have a larger effect on the incidence of in-fill than either elevation or stand age. Stands residing on north or west aspects have a higher percentage of their acreage experiencing in-fill than do east or south facing stands (fig. 31). This is most evident in the north facing stands, which have a 16 to 18 percent higher incidence than east and south facing stands, and 6 percent higher than west facing stands. North-facing slopes in Nevada receive less solar energy than other aspects and thus retain moisture (in the form of snow pack and in the soil)

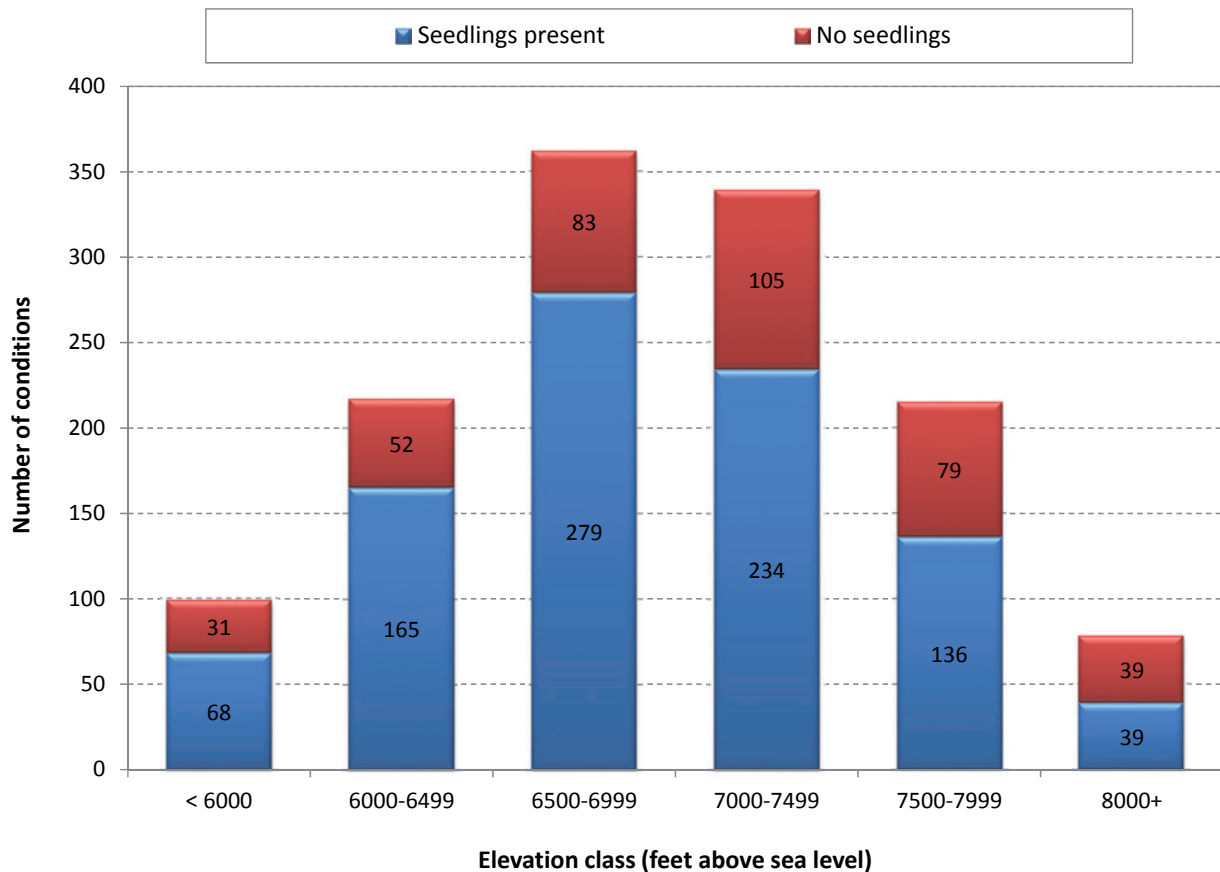


Figure 30—Pinyon/juniper woodlands currently experiencing in-fill (by elevation class) as determined by the presence of pinyon pine or juniper seedlings on the plot, Nevada, 2004–2012.

for longer periods of time. This may create better conditions for seed germination and/or seedling survival in these stands. This might also be the case in west facing stands but to a lesser degree.

Sixty-six percent (880 conditions) of the pinyon/juniper woodlands sampled had pinyon seedlings present while only 21 percent (274 conditions) had juniper seedlings. This suggests that pinyon pine is responsible for the bulk of the in-fill currently taking place in Nevada’s pinyon/juniper woodlands. In-fill can take place from seeds that drop from the parent tree and are then buried by rodents but most often results from seeds cached by pinyon jays (*Gymnorhinus cyanocephalus*) and to a lesser extent Clark’s nutcrackers (*Nucifraga columbiana*) and scrub jays (*Aphelocoma* spp.) (Lanner 1981). These birds are thought to be largely responsible for the current distribution of pinyon in North America. Knowledge of the habitat requirements and cache site preferences of pinyon jays would be helpful in predicting where woodland expansion and in-fill will occur in the future. This information would also be useful in managing pinyon/juniper woodlands for the benefit of pinyon jays and other wildlife that utilize pinyon seeds.

Resource managers who are concerned with the consequences of in-fill can use FIA data to target areas where treatments will have the best chance of achieving management goals. Data can also be used to minimize impacts of treatments

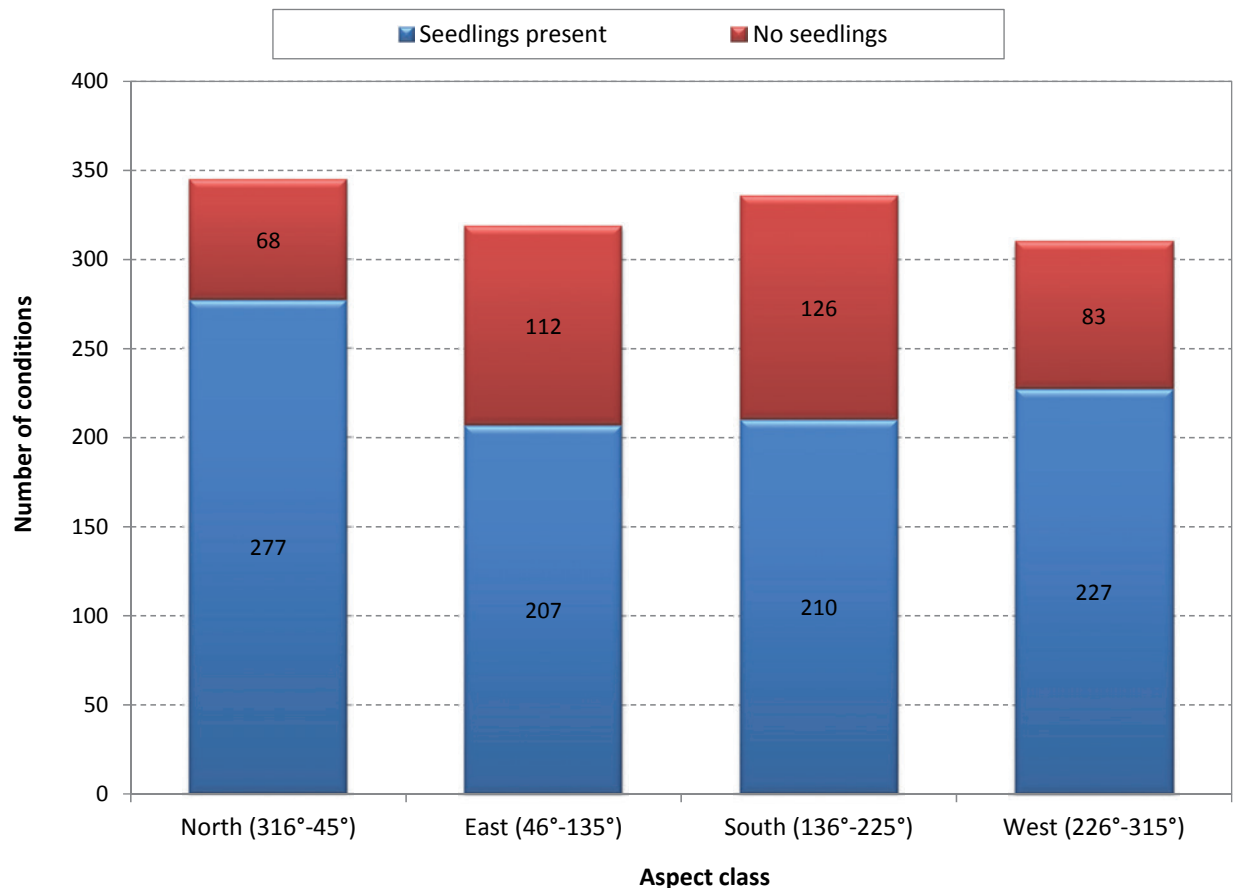


Figure 31—Pinyon/juniper woodlands currently experiencing in-fill (by aspect class) as determined by the presence of pinyon pine or juniper seedlings on the plot, Nevada, 2004–2012.

in areas that provide habitat to sensitive species in their current state or that reflect rare or underrepresented stand structure, such as old-growth or stands producing large seed crops. The overall rate of in-fill can also be tracked over time as FIA revisits plots in the future.

The Pine Nut Resource of Pinyon/Juniper Woodlands

Pinyon/juniper woodlands cover an estimated 7.7 million acres in Nevada, including field-called forest types for nonstocked stands, making it the most abundant forest type in the State by a substantial margin. This woodland type consists of singleleaf pinyon and Utah juniper, with occasional Rocky Mountain juniper. Pinyon/juniper woodlands commonly occur in the mid-elevation belts between the lower grass/shrublands and either subalpine forests or tree line above (Lanner 1981). Trees from these woodlands have been utilized by indigenous peoples for thousands of years, providing them with building materials for basketry and clothing, hunting tools, shelter, firewood, and medicine (Floyd and Kohler 1990; Janetski 1997). Pinyon and juniper continue to be used as fuel wood in many Native American communities in Nevada, making these woodlands a very important local resource for that reason alone. However, the most important utilization



Figure 32—Nevada pine nuts for sale in Utah (photo: John D. Shaw).

of pinyon/juniper woodlands has been (and continues to be) the abundant and nutritious seeds of the pinyon.

Pinyon seeds, or pine nuts, are an extraordinary food resource very high in protein and fats, and contain all 20 amino acids required for human growth (Janetski 1997). Unlike many other food items used in the past by native cultures, pine nuts could be stored for several years, making it a critical food in winter, times of drought, and periods of game scarcity. Pine nuts continue to be an important cultural and economic staple of contemporary tribal communities in Nevada. Each year, pine nuts supplement the diets and incomes of those who know how and where to collect, process, store, and sell them (fig. 32). U.S. pine nut production is estimated to be 400 to 500 tons per year, contributing to a \$100 million domestic market for the seeds (Sharashkin and Gold 2004).

Singleleaf pinyon generally begins producing seeds at around 35 years of age. Although important to wildlife at this stage, the numbers of seeds produced by these young trees are not economical to harvest. Not until tree age reaches 75 years or so do pinyon trees start producing pine nuts in sufficient quantities to harvest. Singleleaf pinyon trees reach maximum seed production around 160 years old and continue until roughly 300 years old, at which time production often falls off considerably (Lanner 1981). Thus, it is useful to know how many acres of pinyon/juniper are currently of sufficient age to provide a useful crop of pine nuts, and how many acres are close to moving into and out of the most productive age classes.

Here we use FIA data to estimate the extent and age distribution of Nevada's pinyon/juniper woodlands and relate the estimates to potential seed production. Estimates were stratified by the age-class groups that reflect the varying seed productivity levels discussed above. In addition, the portion of each age class that will change over the next 20 years (in the absence of natural or anthropogenic disturbance) is identified. This information is useful to resource managers interested in perpetuating pinyon/juniper woodlands that produce large quantities of pine nuts. The results of this analysis is displayed in figures 33 and 34.

Over half (53 percent) of Nevada's pinyon/juniper woodlands are currently in the 75- to 160-year age class. This age class represents fully mature trees that consistently yield harvest-worthy quantities of pine nuts. The second-most abundant age class, at 29 percent, is 160 to 300 years. These stands produce the most pine nuts of any age class. While very few pinyon/juniper woodlands are expected to move from a productive class into an unproductive one, many acres of woodland are within 20 years of moving into a more productive age class. Barring any major disturbance, almost 69 percent (502,038 acres) of the 35- to 74-year age class will move into the 75- to 160-year age class, with over 912,000 acres moving from that category to the older 161 to 300 class (fig. 33). While most age classes show a reduction in total acres over the next 20 years, the most productive age class of 161 to 300 years will see an estimated 27 percent net increase in area (to roughly 3 million acres) during this time (fig. 34). This projection assumes no new disturbance and no new woodland establishment during the 20-year time period.

These data suggest that in the absence of a major disturbance, Nevada's pinyon/juniper woodland will likely increase its pine nut output over the next 20 years due to a large recruitment of stands into the most productive age class. However, if a major disturbance were to convert large areas of seed-producing woodlands into zero-aged (nonstocked) sites, net productivity in the State could remain flat or decrease. Pinyon/juniper woodlands become more susceptible to catastrophic wildfire, disease, and insect outbreaks as they age and become more heavily stocked. So as time passes, the likelihood and amplitude of a major disturbance in these more heavily stocked woodlands increases. In addition, as these woodlands become more productive in terms of pine nut production, they often become less valuable to many wildlife species due to changes in stand structure and understory plant composition (Miller et al 2008). Therefore, there are trade-offs that need to be considered when managing pinyon/juniper woodlands for the pine nut resource.

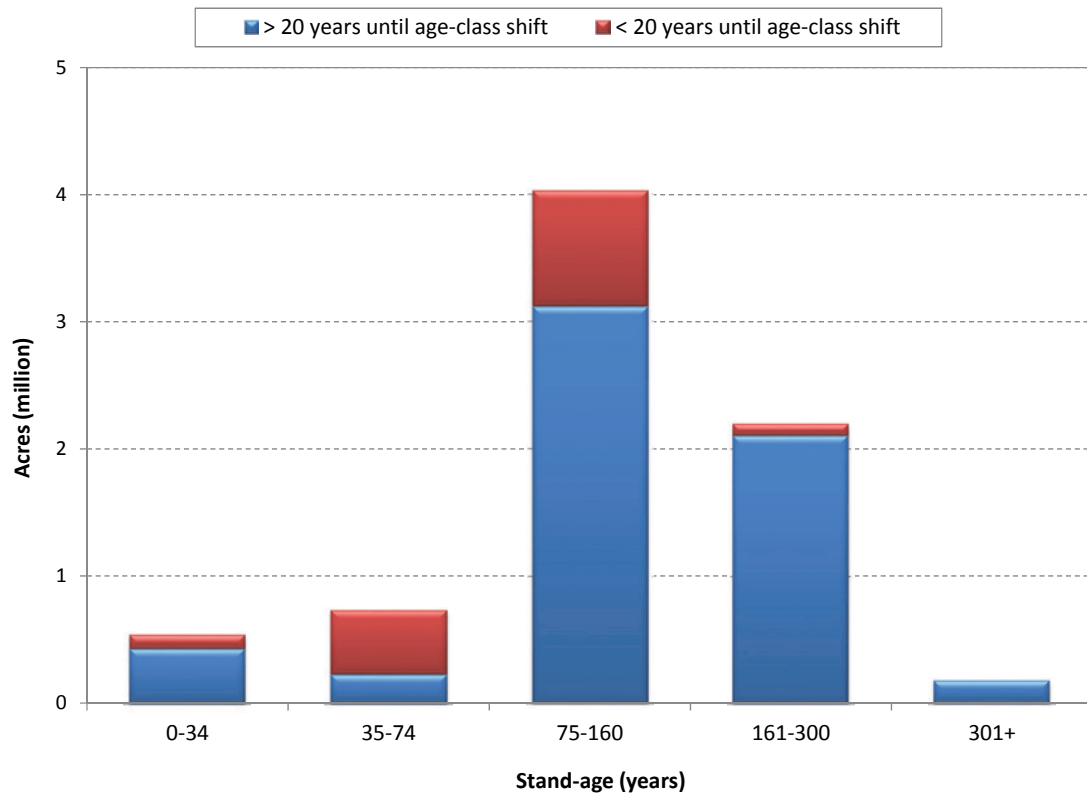


Figure 33—Estimated acres of pinyon/juniper woodland by stand-age class. The red portion of the bar reflects portion of the current estimate that will move into an older age-class within the next 20 years, barring any major disturbance, Nevada, 2004–2013.

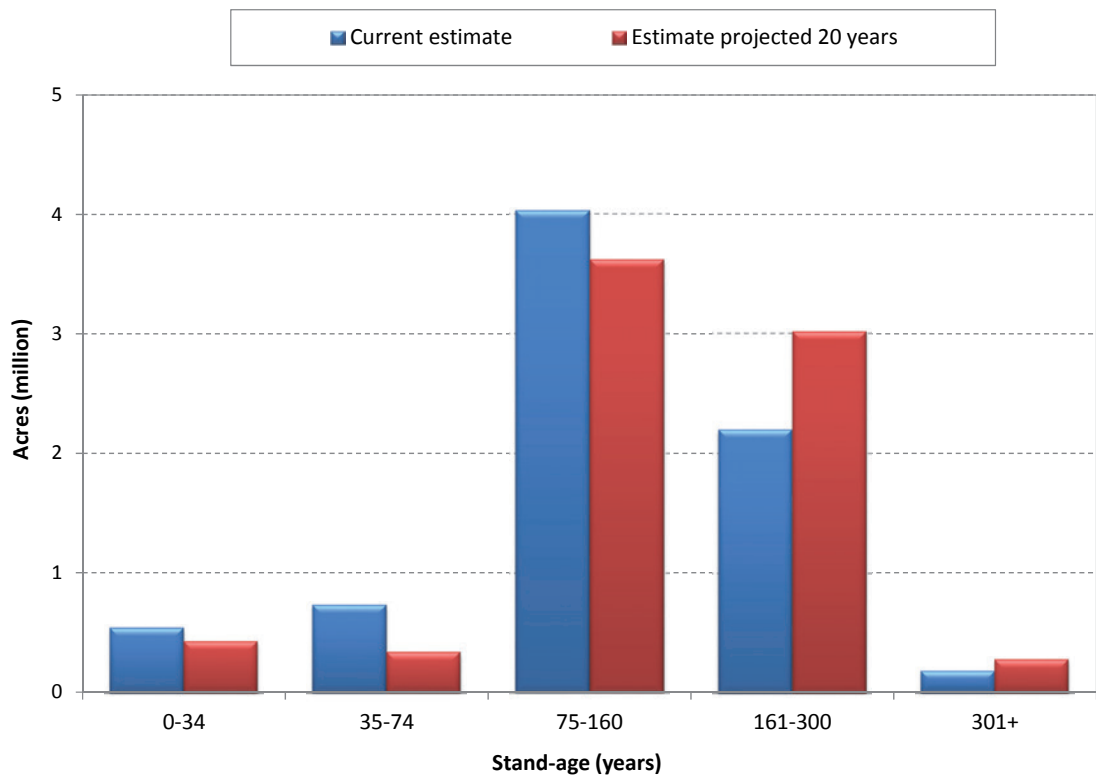


Figure 34—Current and projected estimates of pinyon/juniper woodland by stand-age class. Red bars reflect estimated acres in 20 years, barring any major disturbance, Nevada, 2004–2012.

Other Resources In Nevada's Forests

Snags as Wildlife Habitat

Standing dead trees, or snags, provide important habitat in the forested ecosystems of Nevada. Countless organisms utilize snags at some point in their life history, including bacteria, fungi, insects, rodents, cavity-nesting birds, bats, mustelids, and black bears. The height, diameter, species, condition, and spatial placement of standing dead trees are important variables to species as they consider a snag for nesting, roosting, or denning. Individual tree data collected by IWFIA can be used to estimate the number and distribution of suitable snags for a variety of wildlife species.

Nevada's cavity-nesting birds are especially dependent on snags for both nesting and foraging activities. There are a handful of bird species that act as primary excavators of nest sites in this system. These birds create a cavity during one breeding season, but often abandon it and create a new cavity the following year. The old cavities are then occupied by secondary cavity-nesting birds, as well as a suite of mammalian species. Secondary cavity-nesters do not excavate their own nest sites and are dependent on primary excavators for their cavities. The suitability of an old cavity for a secondary nester often depends on the species of primary excavator that created it.

To illustrate how FIA data can be used to quantify snags important as wildlife habitat, we estimated the number of snags in Nevada that met the diameter preferences for three important primary excavators by tree species, forest type, and stand age. The hairy woodpecker (*Picoides villosus*), red-naped sapsucker (*Sphyrapicus nuchalis*), and northern flicker (*Colaptes auratus*) create different sized openings and cavities and are also relatively abundant and widespread throughout the different forest types of Nevada. Therefore they provide suitable nest sites for a wide variety of secondary nesting species. Suitability was based on mean diameters found to be used by these birds (Dobkin et al. 1995; Flack 1976; Martin et al. 2004; McClelland et al. 1979).

There are an estimated 51.3 million snags in Nevada that meet the diameter preferences of the hairy woodpecker (≥ 10 inches d.b.h. or d.r.c.). The most abundant tree species contributing to this bird's nesting sites are Utah juniper (20.8 million snags), singleleaf pinyon (16.8 million), and curlleaf mountain mahogany (6.5 million) (fig. 35). Over 30 million snags meet the diameter preferences of the red-naped sapsucker (≥ 12 inches d.b.h. or d.r.c.). Utah juniper contributes the majority of these snags with 13 million snags, followed by singleleaf pinyon (9.8 million) and curlleaf mountain mahogany (3 million). An estimated 17.2 million suitable northern flicker snags (≥ 14 inches d.b.h. or d.r.c.) are found in Nevada forests. The most common species of these larger snags are the same as the smaller snags (7.7 million Utah juniper, 5.6 million singleleaf pinyon, and 1.5 million curlleaf mountain mahogany). The pinyon/juniper forest-type group contains by far the most snags meeting all three diameter preferences in Nevada (fig. 36). The

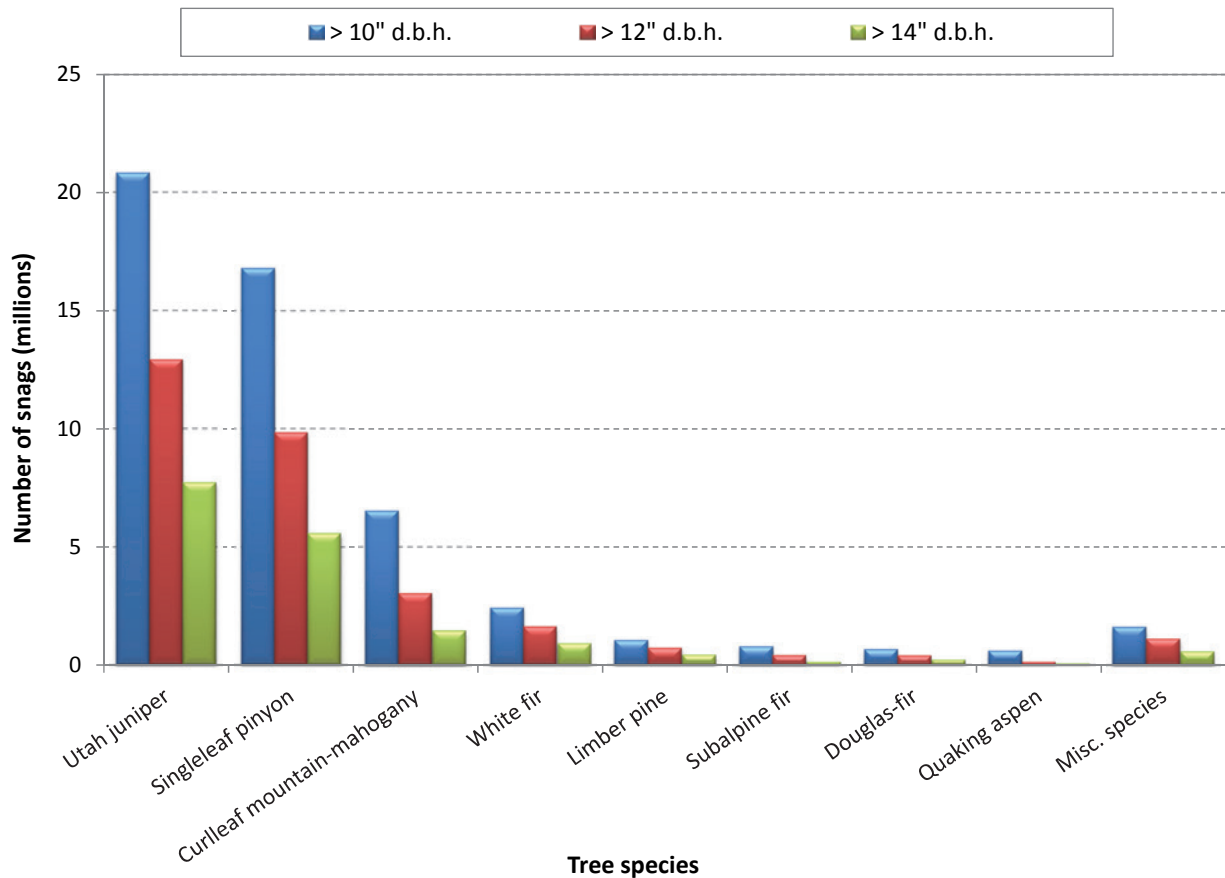


Figure 35—Estimated number of snags that meet diameter preferences of common cavity nesting birds by diameter class and tree species. The “Misc. species” category includes Great Basin bristlecone pine, California red fir, lodgepole pine, Rocky Mountain juniper, whitebark pine, ponderosa pine, western white pine, Jeffery pine, and Engelmann spruce. Nevada, 2004–2013.

nonstocked group is next in snag abundance for all species, followed by the woodlands hardwoods group type.

A plurality (33.2 percent) of snags meeting all three cavity nesting bird diameter preferences (>14 inches d.b.h. or d.r.c.) in Nevada are found in forests with stand ages of 121 to 180 years old (fig. 37), followed by 181 to 240 years old (21.4 percent) and 0 to 60 years old (18.4 percent). Nonstocked woodland type holds most of the snags found in the 0- to 60-year old age class. The nonstocked forest type often includes areas disturbed by wildfire, disease, timber harvest, and insect infestations. Nonstocked forests are given a stand-age designation of zero.

Variables other than snag size dimensions and numbers need to be considered when predicting suitable wildlife habitat for cavity-nesting birds. Proximity to forest edge and stand density of live trees is important to many of these species. The state of decay of a tree and its distance to foraging also play a role in nest site suitability. FIA data can address many of these factors and there are current efforts to build predictive models for these species by using data collected by our crews. These models can be valuable tools for Federal and State land managers, as much of the forests containing suitable snags occur on public lands.

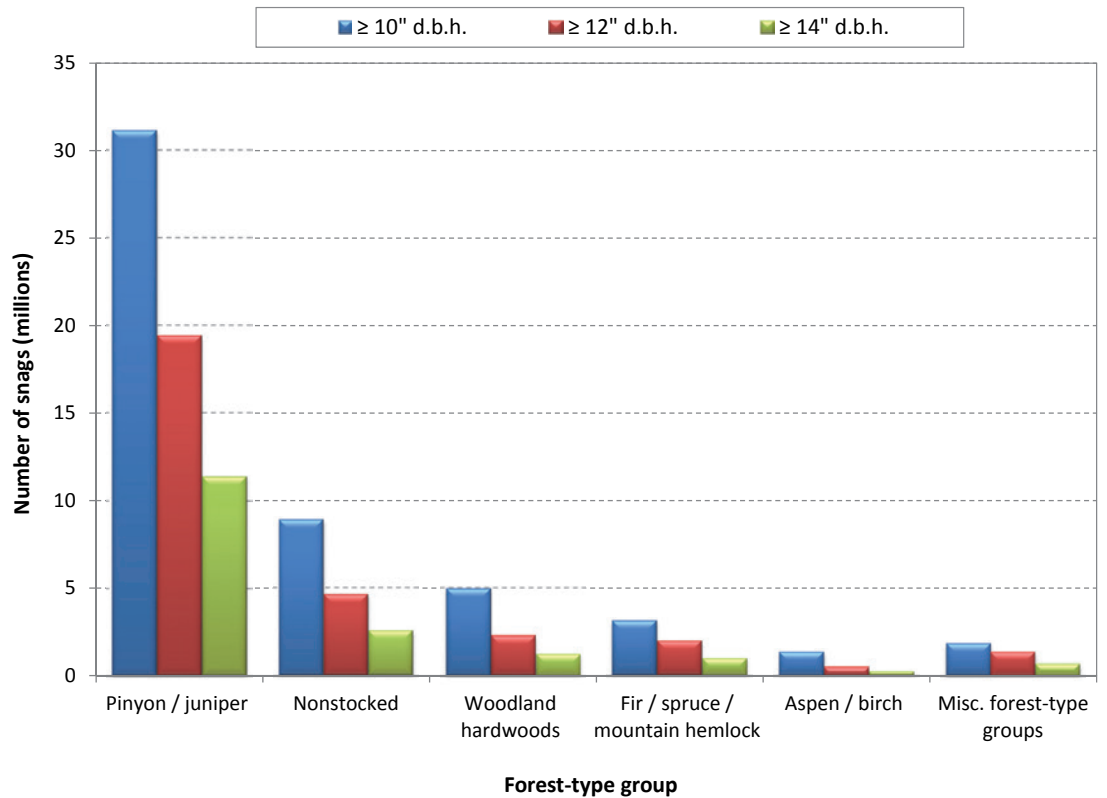


Figure 36—Estimated number of snags that meet diameter preferences of common cavity nesting birds by diameter class and forest-type group. The “Misc. forest-type groups” include the other western softwoods, Douglas-fir, lodgepole pine, and ponderosa pine groups. Nevada, 2004–2013.

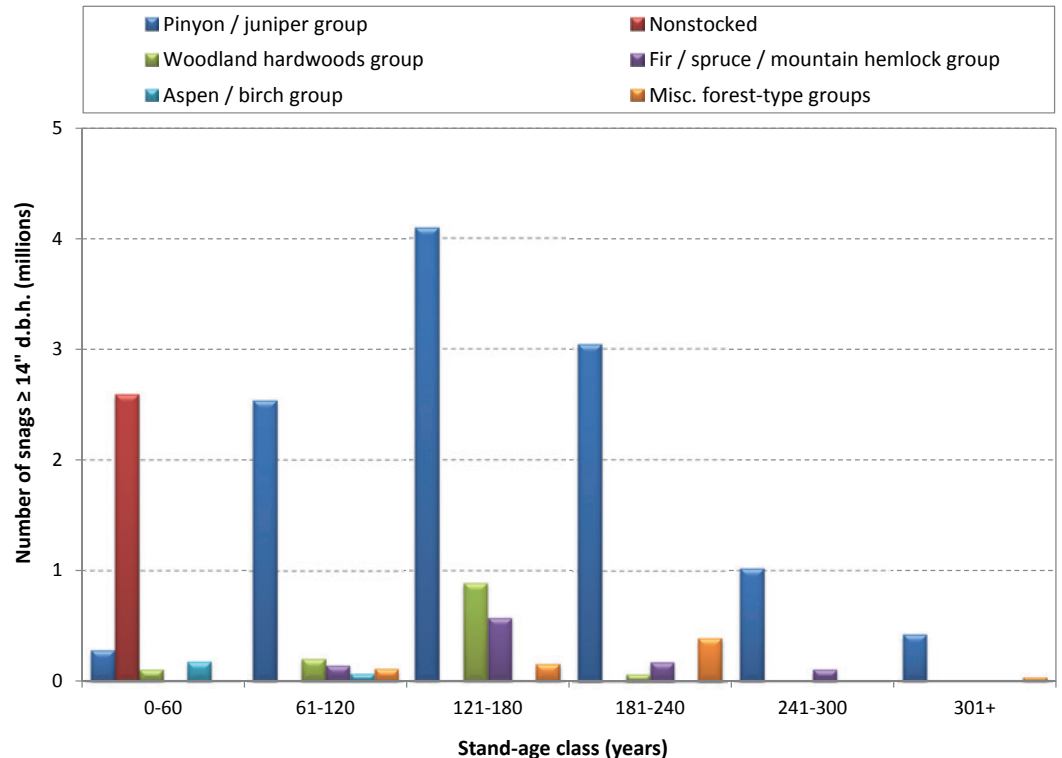


Figure 37—Estimated number of snags that meet all diameter preferences of common cavity nesting birds by stand-age class and forest-type group. The “Misc. forest-type groups” include the other western softwoods, Douglas-fir, lodgepole pine, and ponderosa pine groups. Nevada, 2004–2013.

Understory Vegetation

The structure and composition of understory vegetation represents the diversity, productivity, and habitat quality of forest ecosystems. FIA collects understory vegetation data using two distinct protocols that characterize overall vegetation structure as well as species composition. Under the vegetation structure protocol, field crews record the percent cover by height class occupied by each of four plant growth habits: forbs, graminoids, shrubs, and understory trees (defined as less than 5 inches diameter or trees of any size that are species not on the IWFIA species list). Under the species composition protocol, height class, growth habit, and percent cover are recorded for plant species that individually occupy at least either 5 percent (for plots measured before 2011) or 3 percent (for plots measured in 2011 or later) of the subplot area (USDA Forest Service 2010, 2011). If more than four species occupy more than the minimum cover requirement (5 or 3 percent), only the four most abundant species per growth habit are recorded.

Figure 38 depicts the average percent cover of each plant growth habit within six of Nevada's most abundant forest-type groups. Understory trees cover more area than the other three growth habits on all forest-type groups except nonstocked, where it has the lowest cover. Shrubs have the second highest average cover for

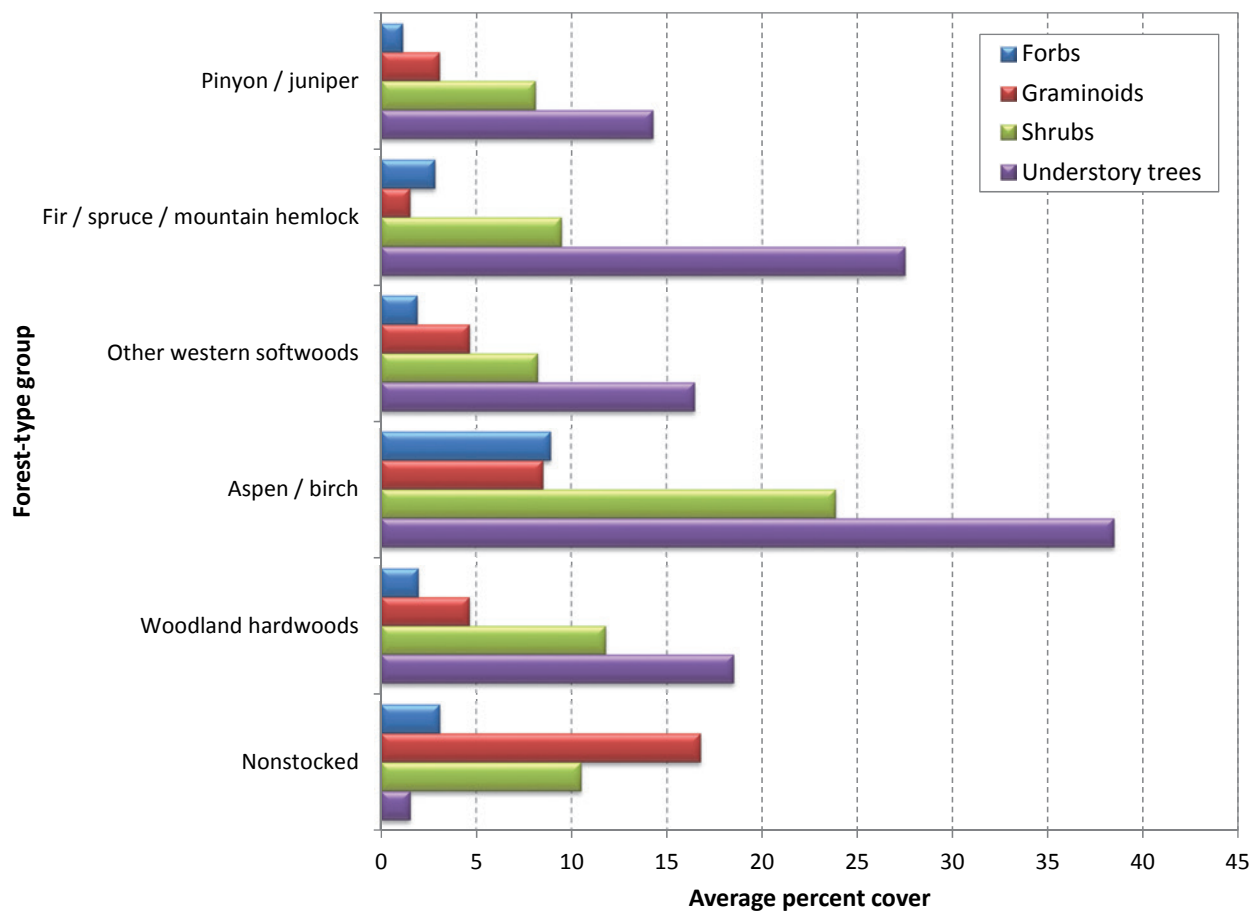


Figure 38—The average percent cover of the four understory vegetation growth habits, by the six most abundant forest-type groups. Nevada, 2004–2013.

all forest-type groups, but in the nonstocked type, shrubs are second to graminoids rather than understory trees. For all stocked forest-type groups, the average cover of both forbs and graminoids was less than 5 percent, except for the aspen/birch group where both were nearly 9 percent.

More than 300 individual plant species were recorded on Nevada's forest inventory plots. The most frequently recorded species within each growth habit are listed in table 7. Singleleaf pinyon in the understory tree growth habit and big sagebrush (*Artemisia tridentata*) in the shrub growth habit were the most commonly encountered species, each occurring on over 30 percent of the forested plots. Cheatgrass (*Bromus tectorum*) was the most commonly recorded graminoid, and arrowleaf balsamroot (*Balsamorhiza sagittata*) was the most common forb. Quaking aspen was the most locally abundant understory species listed, with an average cover of 28.5 percent on plots where it was found. One aspect of recording cover by species is that the taxonomic level is less rigorous than for forest trees. Some groups may be acceptably recorded to the genus level; in other cases, depending on field crews' botanical expertise and the condition or phenology of the plants on the plot, plants may be identified to the species or subspecies. A good example of this is the fourth most frequently recorded graminoid in table 7, bluebunch wheatgrass (*Pseudoroegneria spicata* ssp. *spicata*). The fifth most frequently recorded graminoid was bluebunch wheatgrass at the species level (*P. spicata*). In addition, the other subspecies, *P. spicata* ssp. *inermis*, commonly known as beardless wheatgrass, was also recorded on several plots. If these three taxa were combined, they would comprise the second most frequently recorded graminoid on forest plots. Also, in addition to the most frequently recorded species in

Table 7—The most frequently recorded plant species in each growth habit, along with the number of plots where they occurred and their average percent cover, Nevada, 2004-2013.

Growth habit	Species	Common name	Number of plots	Average cover
Forb	<i>Balsamorhiza sagittata</i>	arrowleaf balsamroot	25	4.6
	<i>Wyethia amplexicaulis</i>	mule-ears	9	11.3
	<i>Thalictrum fendleri</i>	Fendler's meadowrue	9	12.7
	<i>Stenotus acaulis</i>	stemless mock goldenweed	8	3.1
Graminoid	<i>Bromus tectorum</i>	cheatgrass	253	13.8
	<i>Poa secunda</i>	Sandberg bluegrass	115	6.6
	<i>Festuca idahoensis</i>	Idaho fescue	92	6.6
	<i>Pseudoroegneria spicata</i> ssp. <i>spicata</i>	bluebunch wheatgrass	73	7.5
Shrub	<i>Artemisia tridentata</i>	big sagebrush	621	10.4
	<i>Artemisia nova</i>	black sagebrush	305	10.1
	<i>Purshia tridentata</i>	antelope bitterbrush	193	7.6
	<i>Symphoricarpos oreophilus</i>	mountain snowberry	175	9.5
Understory tree	<i>Pinus monophylla</i>	singleleaf pinyon	678	6.5
	<i>Juniperus osteosperma</i>	Utah juniper	239	5.4
	<i>Cercocarpus ledifolius</i>	curlleaf mountain-mahogany	146	9.4
	<i>Populus tremuloides</i>	quaking aspen	82	28.5

the shrub growth habit, big sagebrush, three of its subspecies were encountered: mountain big sagebrush (*A. tridentata* ssp. *vaseyana*), Wyoming big sagebrush (*A. tridentata* ssp. *wyomingensis*), and basin big sagebrush (*A. tridentata* ssp. *tridentata*). These examples show how understory species data can be grouped to address different needs.

Forest Soil Resources in Nevada

Soils on the landscape are the product of five interacting soil forming factors. These are parent material, climate, landscape position (topography), organisms (vegetation, microbes, other soil organisms), and time (Jenny 1994). Many external forces can have a profound influence on forest soil condition. These include agents of change or disturbances to apparent steady-state conditions such as shifts in climate, fire, insect and disease activities, land use activities, and land management actions.

The FIA Phase 3 soil indicator was developed to assess the status and trend of forest soil resources in the United States across all ecoregions, forest types, and land ownership categories (O'Neill et al. 2005). For this report, data were analyzed and are being reported by forest type with some grouping. This forest type stratification not only reflects the influence of forest vegetation on soil properties, but also the interaction of parent material, climate, landscape position, and time with forest vegetation and soil organisms. A complete listing of mean soil properties in Nevada, organized by forest type, is in the Soil Indicator core tables (tables B38a through B41b). These are least-squares means generated by the SAS GLMMIX data analysis software program (SAS Institute, Inc. 2011). There are two sets of tables, one for each soil sampling visit. Each visit corresponds to a cycle of forest health indicator plot measurement and sampling. All soil samples collected in the first sampling cycle in Nevada were collected in 2000 through 2004. The second sampling cycle was done in 2006 and 2010 (and is not yet complete), but there were not as many soil samples collected in the second cycle so some forest-type groups remain underrepresented in the resampling sequence. The total number of plots sampled for soil indicators is listed for each forest-type group in each set of tables. Some of the key soil properties were graphed by forest-type group in Nevada and are highlighted in the discussion below.

Forest soil resource data are presented for five forest type and groupings in Nevada. These are the *Cercocarpus* woodlands forest type (in the woodland hardwoods group); the pinyon/juniper group (including data from the Rocky Mountain juniper, juniper woodland, and pinyon/juniper woodland forest types); a pine grouping consisting of ponderosa pine, lodgepole pine, and limber pine forest types; the white fir forest type (in the spruce/fir/mountain hemlock group); and the aspen forest type (in the aspen/birch group). Most of the soil samples represent the pinyon/juniper group with much smaller sample sizes in the other forest types in Nevada.

Generally, soil moisture tends to increase, while temperature decreases, with elevation and latitude in the Interior West, and forest types tend to reflect this

climatic gradient. *Cercocarpus* and pinyon/juniper woodlands tend to occupy drier low-elevation sites whereas the white fir and pine forests are found in wetter environments at higher elevations. Aspen forests are found at similar elevations to white fir and pine forests. When expressed in terms of megagrams of C per hectare of forest area, soil C stocks (fig. 39, top) generally increase with elevation and/or soil moisture storage (fig. 40, top). Among all forest types, most soil C is stored in the top 10 cm of mineral soil, followed by the 10 to 20 cm increment, followed by forest floor. Overall, the pinyon/juniper group stores the least amount of forest soil C, whereas aspen (found in wetter areas in Nevada) stores the most forest soil C.

As with C, soil N stocks show a pronounced response to climatic gradients in Nevada (fig. 39, bottom). Aspen forests store more N in the mineral soil than any other forest group in Nevada (fig. 39, bottom). Soil Indicator data from other States show that aspen forests store significantly more N than conifer forests, which often intermingle with aspen as forest succession proceeds. High N levels in aspen forest floor and soils lead to lower C/N ratios than those found in forest floor and soils under spruce/fir (data not shown). Low C/N is a good indicator of relative organic matter decomposition rate, and nutrient-rich aspen leaves decompose quickly and easily compared to conifer needles. In all forest types in Nevada, N stocks are lowest in the forest floor component of the soil profile.

Figure 39—Distribution of organic carbon (top) and total nitrogen (bottom) stocks in Mg/ha in the forest floor, 0–10 cm, and 10–20 cm mineral soil depths in five forest-type groups in Nevada. Soil samples were collected in 2000 through 2004 (1st plot visit only) from *Cercocarpus* woodland, pinyon/juniper group (includes Rocky Mountain juniper, juniper woodland, and pinyon/juniper woodland), pine group (includes ponderosa pine, lodgepole pine, and limber pine), white fir, and aspen forest-type groups.

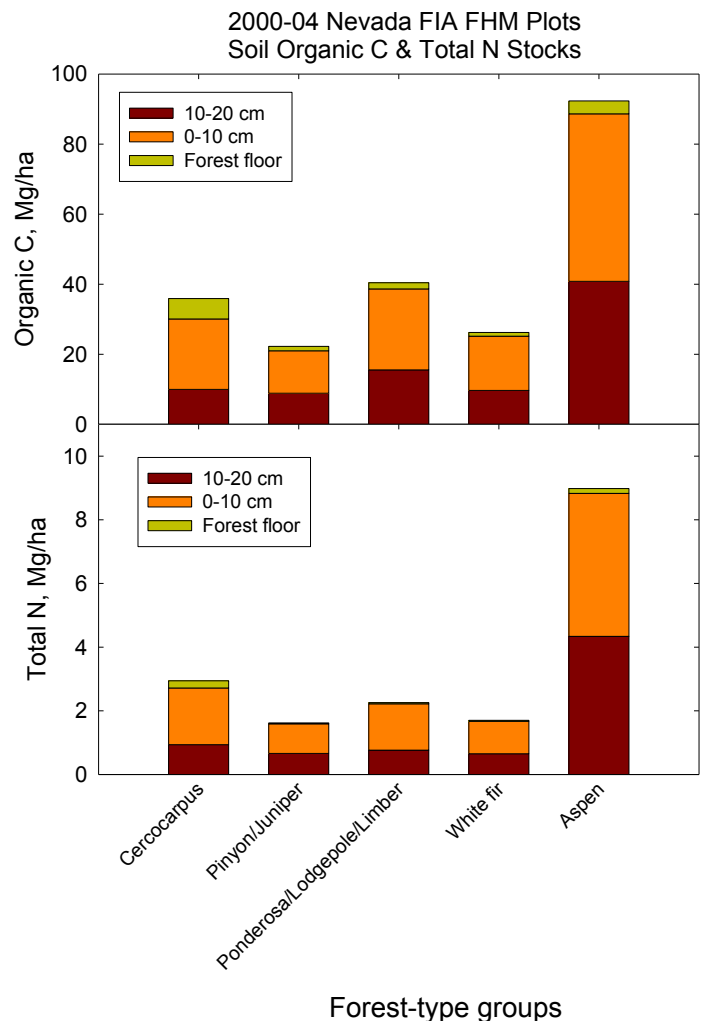
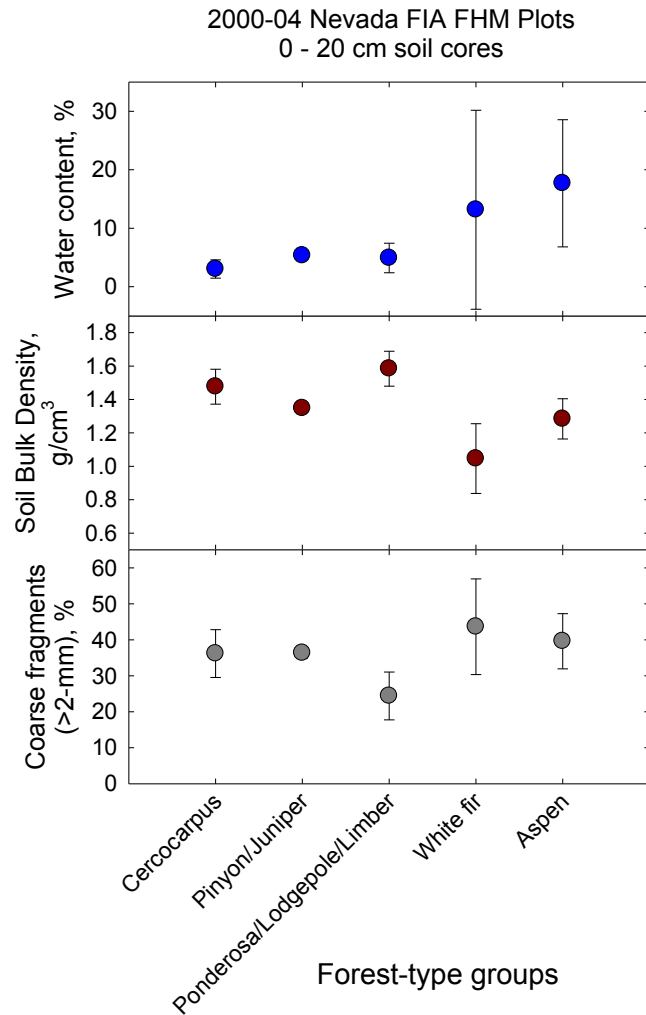


Figure 40—Soil water content (top), bulk density (middle), and coarse fragment (>2-mm) content (bottom) of the top 20-cm of mineral soil in five forest-type groups in Nevada.



Soil bulk density (weight of soil per unit volume) influences many other soil properties including porosity and water-holding capacity. In forest soils, bulk density tends to be controlled by soil organic matter (SOM) content where bulk density decreases exponentially with increasing SOM (O'Neill et al. 2005). In Nevada forests, the lowest soil bulk densities tend to be found under white fir and aspen (fig. 40, middle), and these forests have the highest organic C concentrations (fig. 41, top). Since Nevada's forests tend to be found in more rocky, mountainous terrain, soil coarse fragment content in all forest types is appreciable (fig. 40, bottom).

It is important to distinguish among forms of C in soils because the organic forms participate in a wide array of biogeochemical reactions including serving as substrate for microbial decomposition, thus contributing to atmospheric CO₂. Inorganic forms (stored as carbonate minerals such as calcite [CaCO₃]) tend to be more biologically inert, but can be dissolved during physical, chemical, and biologically mediated mineral weathering reactions. In Nevada, significant amounts of soil C are stored in carbonate minerals under all forest types (fig. 41, top). The highest concentrations of soil organic C are found under aspen forests (fig. 41, top). Soil N concentrations tend to track organic C concentrations with the largest soil N concentrations found under aspen (fig. 41, bottom).

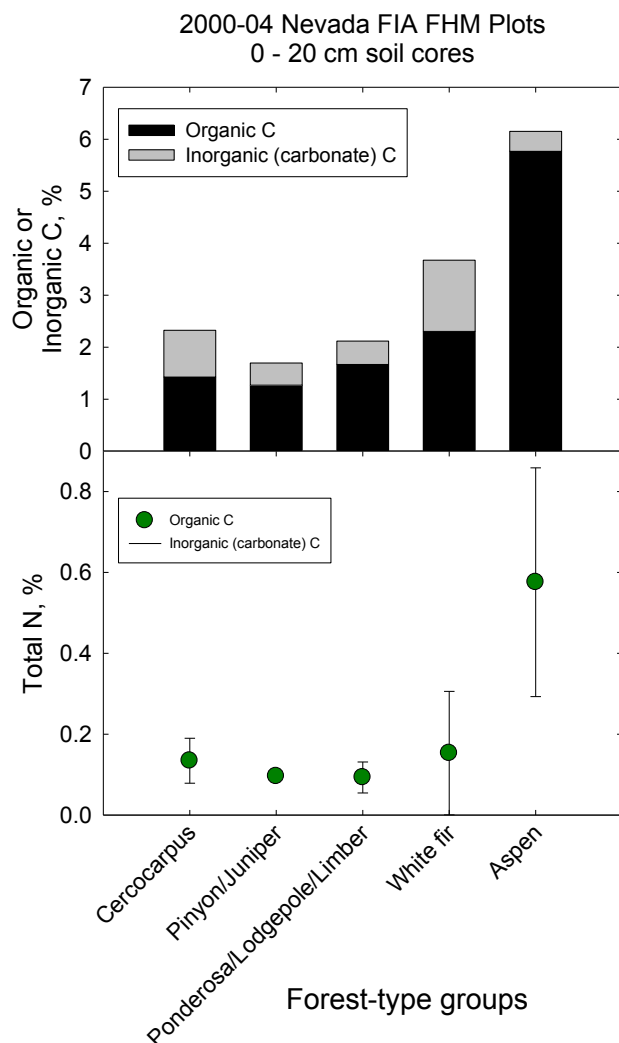


Figure 41—Carbon forms (organic, carbonate) (top) and total nitrogen (bottom) in the top 20-cm of mineral soil in five forest-type groups in Nevada.

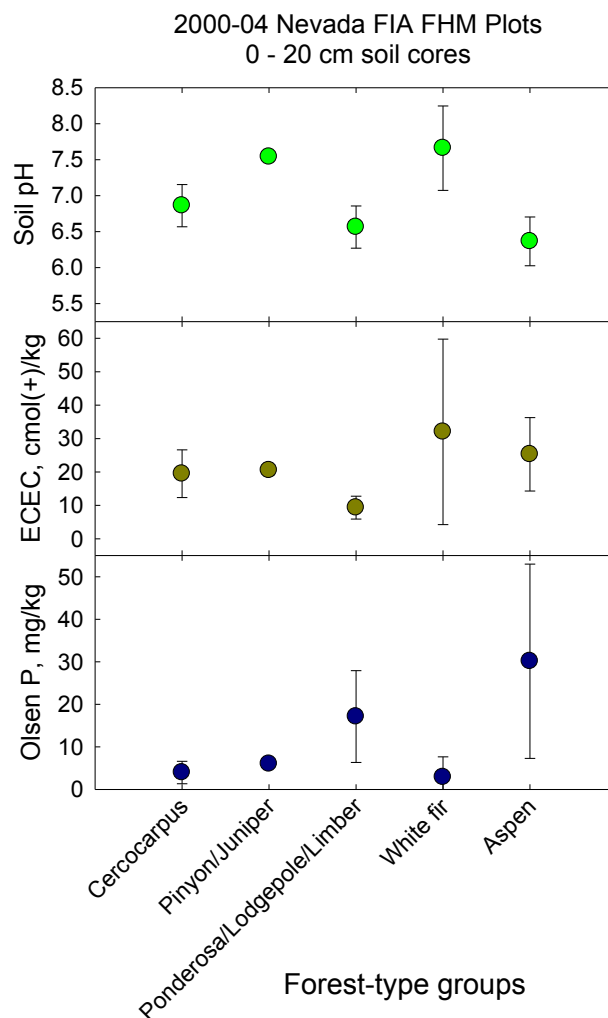
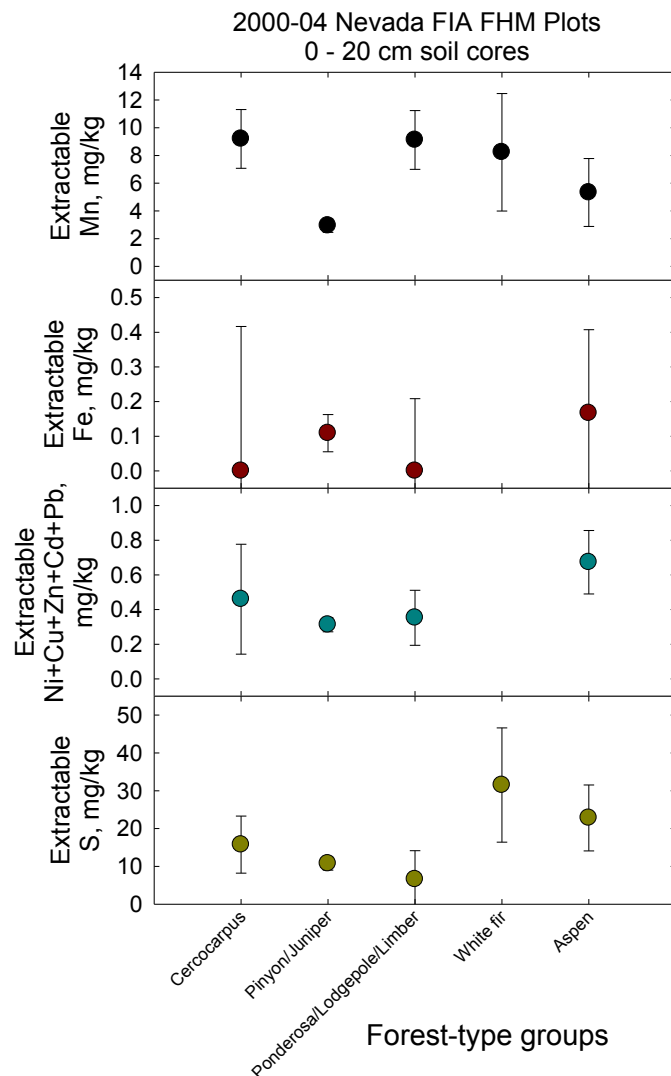


Figure 42—Soil pH (top), effective cation exchange capacity (ECEC) (middle), and Olsen (pH 8.5, 0.5 M NaHCO₃) extractable P (bottom) in the top 20-cm of mineral soil in five forest-type groups in Nevada.

Soil pH is often closely related to the presence of carbonate minerals in soils. Thus, the higher pH forest soils are found under pinyon/juniper and white fir (fig. 42, top). These are the same forest-type groups with relatively high amounts of soil carbonates (fig. 41, top), although the white fir soil dataset in Nevada is very limited. These carbonate-rich soils are alkaline. All the forest soils in Nevada except those under lodgepole pine store appreciable amounts of exchangeable base cations as evidenced by the relatively high effective cation exchange capacities (ECEC) of these soils (fig. 42, middle). The lower-elevation and higher pH soils under *Cercocarpus* woodland, the pinyon/juniper group, and white fir tend to have low levels of bicarbonate-extractable P (fig. 42, bottom). Lodgepole pine soils are also low in bicarbonate-extractable P. Bicarbonate-extractable P is used as a measure of bioavailable P for plant uptake. Aspen soils contain the highest amounts of bicarbonate-extractable P reflecting the rapid turnover of P-rich aspen leaves.

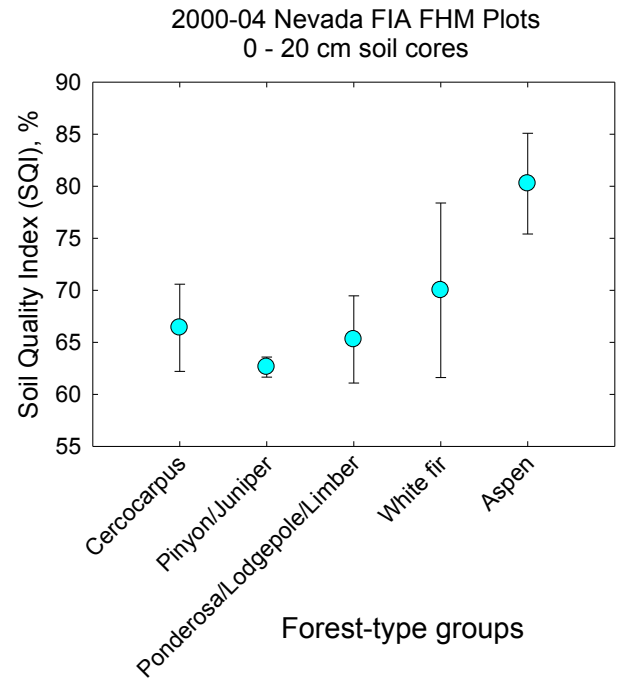
The 1 M NH₄Cl extractant used to measure exchangeable cations (Na, K, Mg, Ca, and Al) is also useful for extracting the most bioavailable forms of heavy

Figure 43—1 M NH_4Cl -extractable Mn (top), extractable Fe (2nd graph), extractable heavy metals (Ni+Cu+Zn+Cd+Pb) (3rd graph), and extractable S (bottom) in the top 20-cm of mineral soil in five forest-type groups in Nevada.



metals such as Mn, Fe, Ni, Cu, Zn, Cd, and Pb, and can also be used to extract bioavailable S. High levels of extractable metals tend to be found in acid soils, but since the forest soils of Nevada are slightly acid to alkaline (fig. 42, top), extractable metal levels are low (fig. 43). Manganese is a plant-essential trace element, but it can cause phytotoxicity effects at high levels. Extractable Mn levels in the forest soils of Nevada are adequate to meet plant nutritional needs, but not high enough to be toxic to plant roots (fig. 43, top). Pinyon/juniper soils contain the lowest levels of extractable Mn in Nevada. Extractable Fe levels are very low in Nevada forest soils (fig. 43, 2nd graph), but are probably sufficient for forest vegetation nutritional requirements. Possibly, Fe-deficiency might be noted in some forest vegetation on very alkaline soils. Extractable levels of the heavy metals Ni, Cu, Zn, Cd, and Pb were summed and plotted by forest type (fig. 43, 3rd graph). Extractable levels of these elements are too low to be toxic to forest vegetation and are too low to be of any risk to the broader environment. Extractable levels of S are probably adequate for forest vegetation nutritional needs (fig. 43, bottom). Highest S concentrations were found in white fir and aspen soils. The higher extractable S levels under aspen probably reflect the rapid turnover of nutrient-rich aspen leaves.

Figure 44—Soil quality index (SQI) in the top 20-cm of mineral soil in five forest-type groups in Nevada.



The Soil Quality Index (SQI) concept integrates 19 measured physical and chemical properties into a single value that serves as a means of tracking overall soil quality in time and space (Amacher et al. 2007). Lower values indicate increased risk of soils-related forest health decline. Spatial changes in SQI on the landscape can be used to identify areas of higher or lower overall soil quality, and trends over time can be used to track potential declines in overall soil condition and thus provide an alert to potential declines in soils-related forest health. The highest SQI forest soils in Nevada are found under aspen forests (fig. 44). This reflects the overall higher OM content and higher productivity (higher nutrient content) of these soils. Aspen soils tend to have the highest nutrient content (especially N and K) and have the highest SQI values. This is also closely tied to the large effect of soil moisture in controlling overall forest productivity. Pinyon/juniper and lodgepole pine forests have the lowest SQI values. Throughout the Interior West, lodgepole pine tends to occupy the lower pH, lower organic matter content, and lower nutrient content (less productive) soils.

Issues in Nevada's Forests

Mountain-Mahogany in Nevada

The woodland hardwoods forest-type group is the second-most abundant forest cover in Nevada (tables B4, B5) after the pinyon/juniper group. Although the woodland hardwoods group is approximately 10 percent of the area of the pinyon/juniper group, it represents an important cover type at higher elevations in Nevada. Of the approximately 737,800 acres occupied by this type, 92.7 percent is dominated by curlleaf mountain-mahogany, the balance being primarily represented by

Gambel oak and one mesquite plot (fig. 9). The large majority of the woodlands hardwood forest-type group occurs within the Nevada-Utah Mountains Semidesert-Coniferous Forest-Alpine Meadow ecoprovince (figs. 3 and 9). Unless otherwise noted in this section, the discussion of mountain-mahogany will be based on the characterization of the woodland hardwood group.

Curlleaf mountain-mahogany has a distribution roughly centered on the Great Basin but extending north to central Montana, south to Mexico, east to the Big Horn Mountains in Wyoming, and nearly to the Pacific coast (Preston 1968). Despite this large geographic extent, the vast majority of curlleaf mountain-mahogany-dominated stands occur in Nevada, Utah, and southern Idaho (<http://www.fs.fed.us/database/feis/plants/tree/cerled/all.html>). Although there is little commercial importance for the species, it provides critical winter browse and cover for ungulate species (Davis and Brotherson 1991). For a woodland forest species that occupies such vast expanses in the Western United States, relatively little study has focused on its population dynamics and ecology (*sensu* Ex et al. 2011).

Given its characterization as a woodland forest-type group, it is interesting to speculate where curlleaf mountain-mahogany stands would fall in comparison to the more conspicuous pinyon/juniper forest-type group. A frequency distribution of acreage over 1,000-foot elevation bins indicated that, except for the 7,000- to 8,000-foot bin, where 30 percent hardwoods and approximately 40 percent pinyon/juniper occurred, there is very little overlap in the habitats (fig. 45). Indeed, the peak of the woodland hardwoods forest-type group is nearly 2,000 feet higher than the pinyon/juniper group. This suggests the majority of curlleaf mountain-mahogany stands do not co-occur with pinyon/juniper species; rather, they occupy a higher elevation niche, likely providing connectivity between low elevation woodlands (i.e., Great Basin pinyon/juniper) and high elevation coniferous forests common in Nevada such as aspen, white fir, Engelmann spruce, bristlecone pine, etc. Interestingly, the geographic distribution of curlleaf mountain-mahogany overlaps almost entirely with the range of Great Basin bristlecone pine (figs. 9 and 11).

Within the woodland hardwoods forest-type group, curlleaf mountain-mahogany occupies the largest acreage between 8,000 and 9,000 feet and on south and east aspects (fig. 46). In fact, the peak in acreage for both south and east aspects occurs in a much higher elevation range than the north aspect owing to increased solar radiation. Presumably on south and east slopes, curlleaf mountain-mahogany is more competitive in the dry, high light environment than on more northerly slopes where conifers would out-compete the mahogany.

Curlleaf mountain-mahogany has the highest specific gravity of any species in the Interior West (Miles and Smith 2009) making increment cores for age determination infeasible. As a result, stem ages are calculated using a linear model (Brotherson et al. 1980) before stand age is estimated. The age distribution of the woodland hardwoods forest-type group corroborates, generally, the longevity of these hardwood species (Schultz et al. 1990), peaking at 150 years old. The age distribution of the forest-type group is strongly unimodal with the exception of the youngest stands (0- to 20-year class in fig. 47) which were dominated by deciduous oak woodland that accounted for just over 45,000 acres (57 percent of

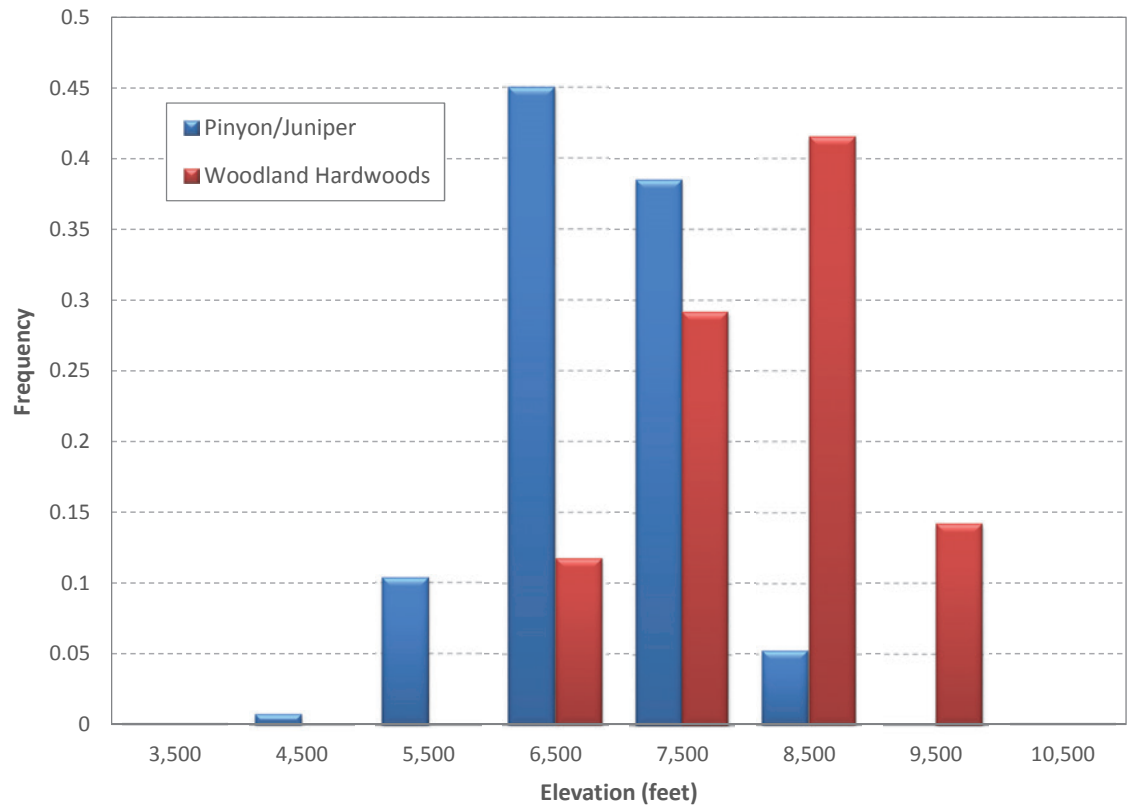


Figure 45—Frequency distribution of acreage for the pinyon/juniper and woodland hardwoods forest-type groups, Nevada, 2004–2013.

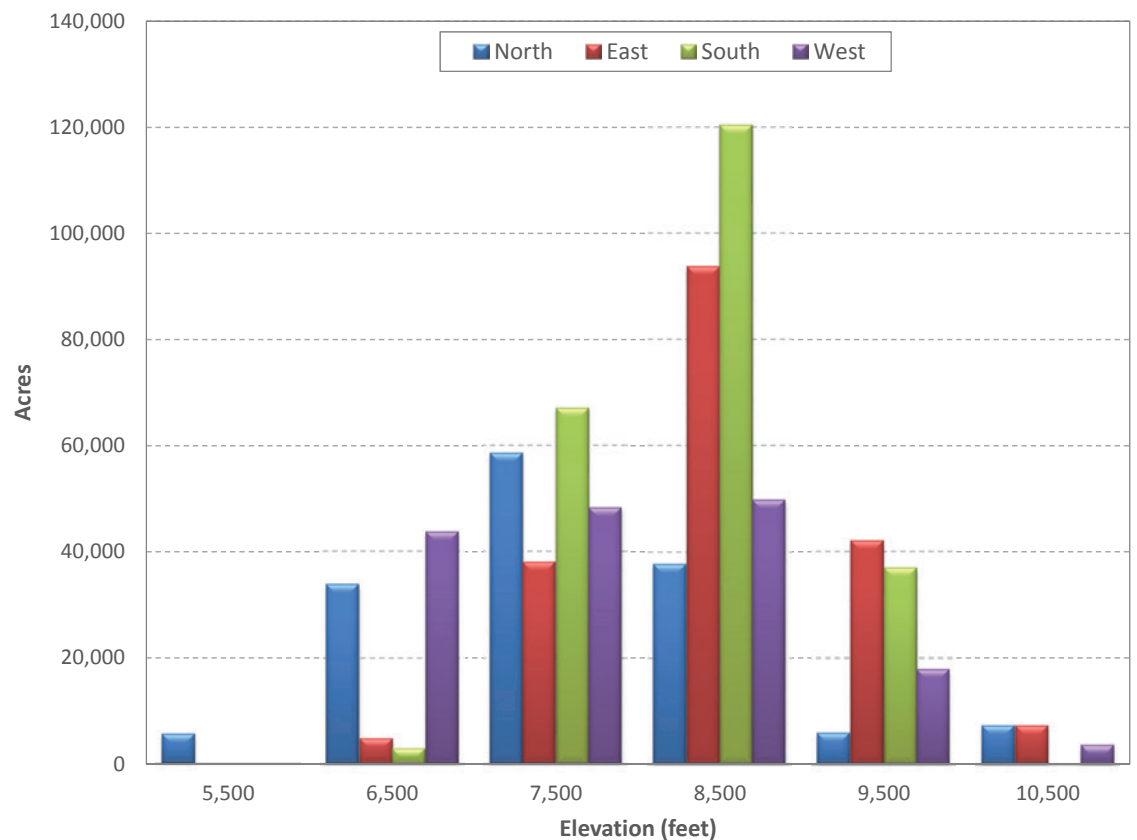


Figure 46—Acreage of the woodland hardwoods forest-type group by elevation and aspect, Nevada, 2004–2013.

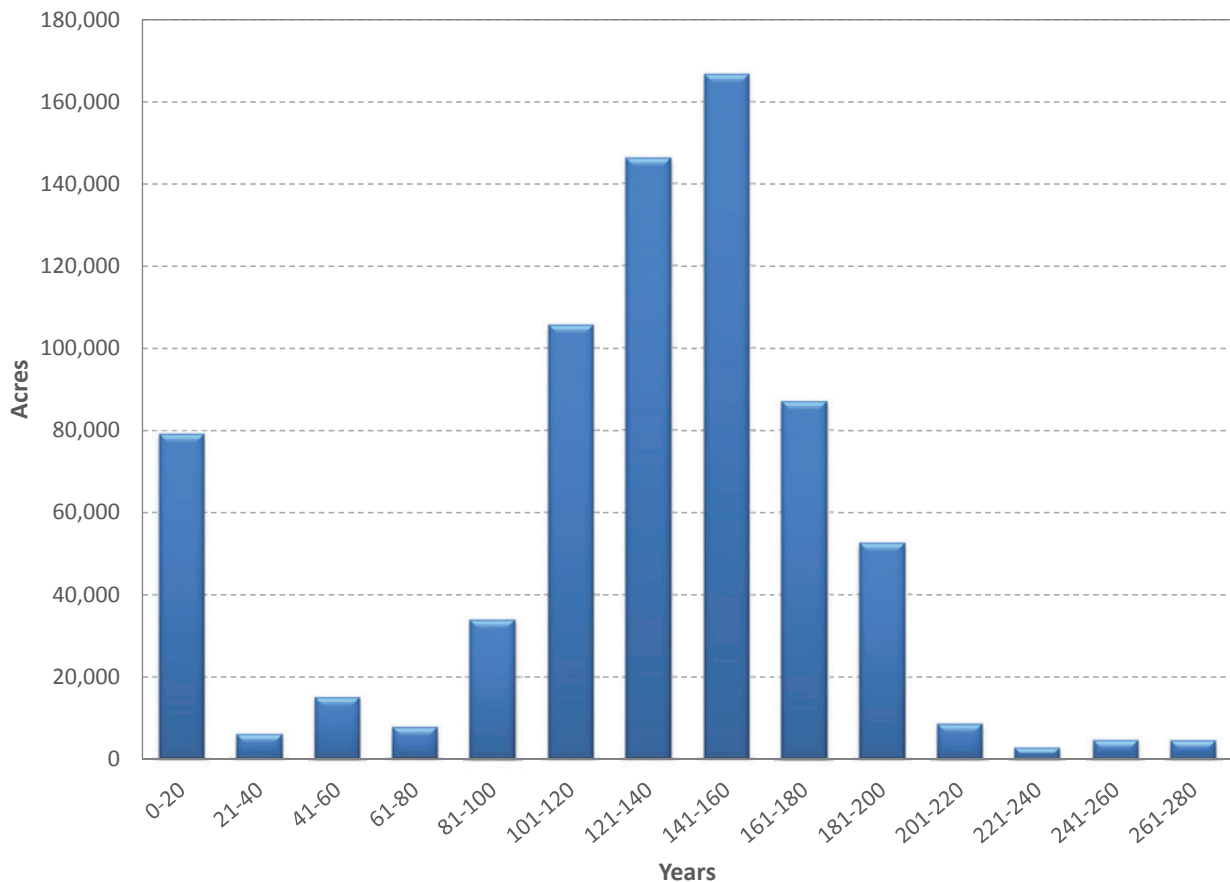


Figure 47—Acreage of the woodland hardwoods forest-type group by 20-year age classes, Nevada, 2004–2013.

the age class). Part of the reason curlleaf mountain-mahogany stands exhibit such longevity has to do with their low rates of disturbance. In Nevada, 97 percent of the woodland hardwoods acreage was not affected by any primary disturbance (table B8). Small acreages of the woodland hardwoods forest-type group were affected by disease (4,500), fire (11,600), and weather (6,000).

Although curlleaf mountain-mahogany stands are characterized as woodlands, they can carry a substantial amount of stocking. Expectedly, low elevation stands carry lower amounts of live basal area than high elevation stands (fig. 48). However, the highest stocking rates are at 8,000 to 9,000 feet, and more than 120 square feet of basal area per acre is not uncommon up to 10,000 feet in elevation. While the woodland hardwoods forest-type group was the second most abundant in terms of acreage, it ranked third (behind the fir/spruce/mountain hemlock forest-type group) in terms of net volume of live trees (table B13).

Damage to Live Trees

Damage agents are recorded for live trees 5 inches in diameter (d.b.h. or d.r.c.) or greater. Between 2004 and 2013, IWFIA assigned damage codes that represent a wide range of biotic, abiotic, and anthropogenic agents. These codes fall within eight distinct categories: insects, disease, fire, animals, abiotic, competition, human activity, and other, which includes defects to tree form. Damage

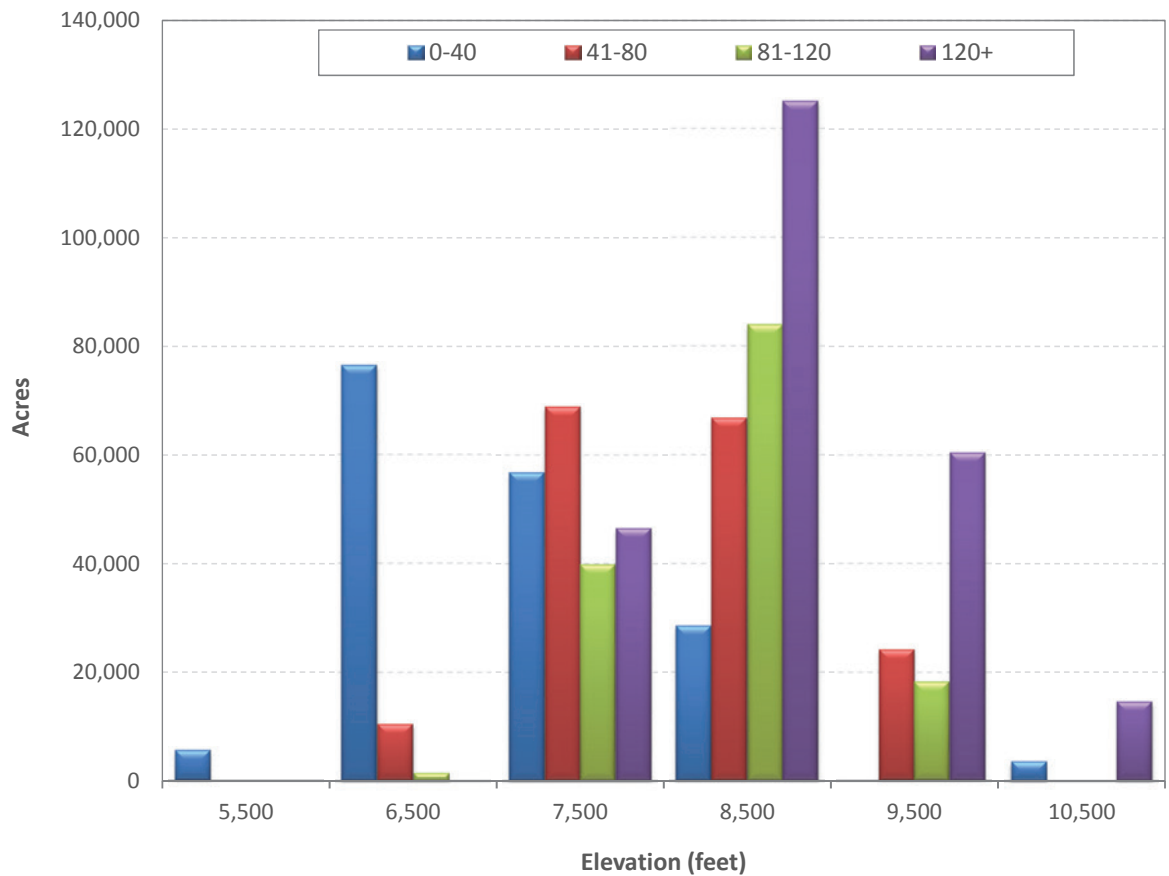


Figure 48—Acreage of the woodlands hardwood forest-type group by stocking classes (square feet per acre) and elevation, Nevada, 2004–2013.

agents are often confused with mortality agents (see section *Forest Change Components: Growth, Mortality and Removals* in the “Overview of Nevada’s Forests” chapter). Because mortality agents are recorded only for trees that recently died, not all damage agents are potential mortality agents and there is only partial overlap between the two agent lists.

The IWFIA program has used a regionally defined damage protocol since 1981, which has remained consistent, with only minor modifications to the damage categories. In 2013 the FIA program implemented a nationally consistent protocol for non-lethal damage to trees. A vast majority of the damage categories used in the national protocol directly correspond to the Interior West regional categories, ensuring that trends in damaging agents can be tracked over space and time.

Individual trees can be assigned up to three damage agents, in decreasing order of their perceived impact on the tree. The protocol is based on a threshold system where only trees with serious damage are assigned damage agent codes. The general rule is that damage to a tree should be recorded when it will cause at least one of the following:

- Prevent the tree from living to maturity, or surviving 10 more years if already mature.

- Prevent the tree from producing marketable products.
- Reduce (or has seriously reduced) the quality of potential marketable products from the tree.

From these rules, two general groups of damage agents can be inferred. First, agents that are likely to prevent a tree from living to maturity or surviving for 10 years after the inventory date, which are those related to insects, disease, fire, and abiotic effects (drought, flooding, wind, etc.). Second, agents that preclude or affect merchantability are more likely to be problems with tree form, such as forks, broken tops, or bole scars and fall within the other category. The second group may or may not affect tree survival so that not all trees with damages recorded are expected to die, and some of those with poor merchantability may live to typical upper ages for their species.

From 2004 to 2013, the Nevada annual inventory tallied 34,919 live trees at least 5 inches diameter (d.b.h. or d.r.c.). Of those, 17.7 percent had at least one damage agent (primary damage), 2.8 percent had a secondary damaging agent, and 0.3 percent had a tertiary damaging agent (table 8). A 22 percent difference in recorded damage existed between the timber and woodland species. Primary damage was recorded on over one-third of the timber species, about 37.8 percent; 13 percent had secondary damage and 3 percent had tertiary damage (see Appendix D for definitions of timber and woodland species). Fewer than half of the woodland species had primary damage (16.1 percent), about two percent had secondary damage, and less than one percent had tertiary damage. Although the proportion of trees with a primary damaging agent was different between the timber and woodland species, the distribution of the primary damage agent for both was dominated primarily by form (other damage agent group), followed by disease and insects (table 8). The following discussion focuses only on the primary damage agents.

Table 8—Percentage of timber trees, woodland trees, and all tallied trees assigned to each damage agent group for primary damaging agents, Nevada, 2004–2013.

Damage agent group	Annual inventory (2004-2013)		
	Timber	Woodland	All species
No damage	62.20%	83.90%	82.30%
Insects	1.99%	1.24%	1.29%
Diseases	8.79%	5.17%	5.44%
Fire	0.16%	0.16%	0.16%
Animals	0.35%	0.23%	0.24%
Abiotic	1.25%	0.45%	0.51%
Competition	0.70%	0.26%	0.29%
Human	0.00%	0.57%	0.53%
Other (form)	24.57%	8.05%	9.26%
All damage agent groups	100.0%	100.0%	100.0%

Woodland species accounted for 32,359 of the tallied trees and 84 percent had no damage. The largest damage group, other, occurred in nearly 8 percent of all woodland trees and approximately 50 percent of those had a damage agent specifically related to form. Within the other category nearly half (49 percent) of the trees exhibited an open wound defined as covering at least 20 percent of bole circumference (USDA Forest Service 2013). Thirty-five percent of the woodland trees had dead tops and about 11 percent had some other general damage. The second largest damage group for woodland species was disease at about 5 percent. Within the disease group nearly 56 percent was noted as dwarf mistletoe. Almost 29 percent of the disease group exhibited some sort of stem decay such as conks or fungal fruiting bodies. Sixty-seven percent of the insect damage category included any evidence of insect activity. Approximately 12 percent of woodland trees with insect damage was attributed to defoliators and 12 percent attributed to general disease.

Timber species accounted for 2,560 of the tallied trees and nearly two-thirds (about 62 percent) had no damage. Like the woodland trees, form was the most commonly recorded damage, recorded for one-quarter of timber trees (about 25 percent). Four damage agents were most common in the form group: sweep/taper accounted for about 33 percent, forked below merchantable accounted for about 23 percent, open wound accounted for about 21 percent, and 16 percent was noted as dead top. The second most common damage agent group, disease, was dominated by cankers, which accounted for about 56 percent, and stem decays, which accounted for another 32 percent. Insect damage within timber trees was dominated by mountain pine beetle (57 percent). Other insect damage included 16 percent attributed to general disease, 14 percent to general insect damage, and 12 percent to defoliators.

Cheatgrass in Nevada's Forests

Cheatgrass (*Bromus tectorum*) is a non-native annual grass that has invaded and displaced native vegetation throughout the Interior West. Cheatgrass grows and produces seeds earlier than most native species, thus gaining a competitive advantage for the limited resources in the arid environments of Nevada and other States. The fine fuels created by cheatgrass alter fire frequency in the areas where it is found in abundance. These fuels can perpetuate the spread of the species by creating new areas to invade after a fire disturbance. Both public and private land managers are interested in understanding the spatial and temporal patterns of cheatgrass and any other information that can be used to mitigate infestation. Cheatgrass is not listed as noxious by the State of Nevada. However, FIA field crews document this species in the understory vegetation procedure if it reaches a threshold of 5 percent (for plots measured before 2011) or 3 percent (for plots measured in 2011 or later) ground cover. In addition, only those areas with a forested condition present on a plot have understory vegetation recorded (USDA Forest Service 2010, 2011). Therefore, the data do not reflect trace amounts of cheatgrass or cheatgrass

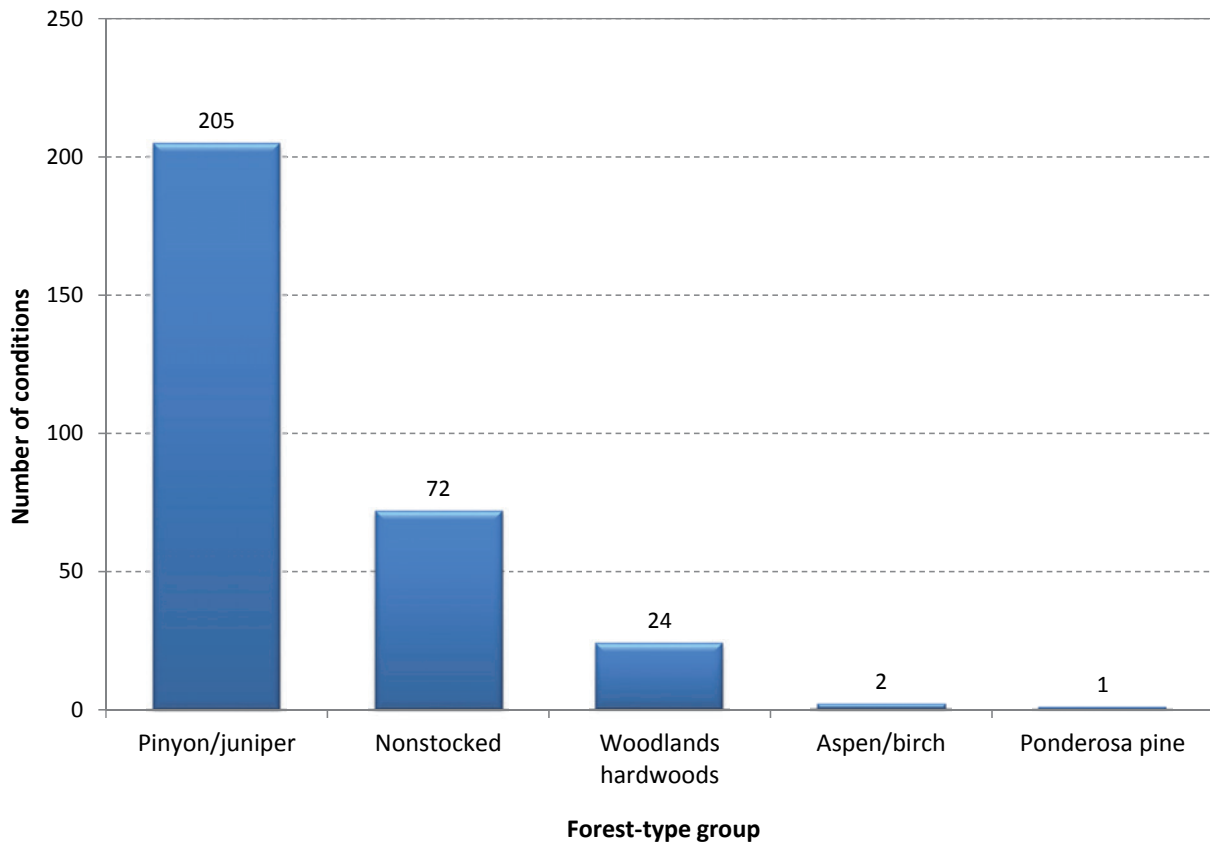


Figure 49—Number of forested conditions infested with cheatgrass by forest-type group, Nevada, 2004–2013.

on nonforest portions of plots. A summary of the extent and characteristics of plots infested with cheatgrass in Nevada is presented below.

Cheatgrass was measured at 3 percent or greater cover on 304 conditions (plots or parts of plots) in Nevada (fig. 49). The pinyon/juniper forest-type group held by far the most records of cheatgrass at 205, which represents 67.4 percent of the total number of cheatgrass detections in Nevada. The nonstocked group had the next highest number of records with 72 (23.7 percent), followed by the woodland hardwoods group with 24 records (7.9 percent). All other forest-type groups combined had a total of three records of cheatgrass occurrence, accounting for less than 1 percent of the total number of incidences of cheatgrass on forested lands.

Most of the cheatgrass sampled occurred on plots at 6,000 to 6,999 feet in elevation, with the 5,000 to 5,999 feet elevation class having the next highest number of occurrences (fig. 50). The woodland hardwoods group had more infested forest in the higher elevation classes than in lower classes. This is likely due to the inclusion of *Cercocarpus* woodland in this group. These woodlands can occur at higher elevations than other woodland hardwood forest types.

In stark contrast to species officially listed as noxious in Nevada, cheatgrass is not found in abundance in any timber forest types. With the exception of one occurrence in aspen and one in Jeffrey pine, all plots having cheatgrass with the threshold percent ground cover were found in either nonstocked or woodland forest types—the vast majority within the pinyon/juniper group. The forest types in

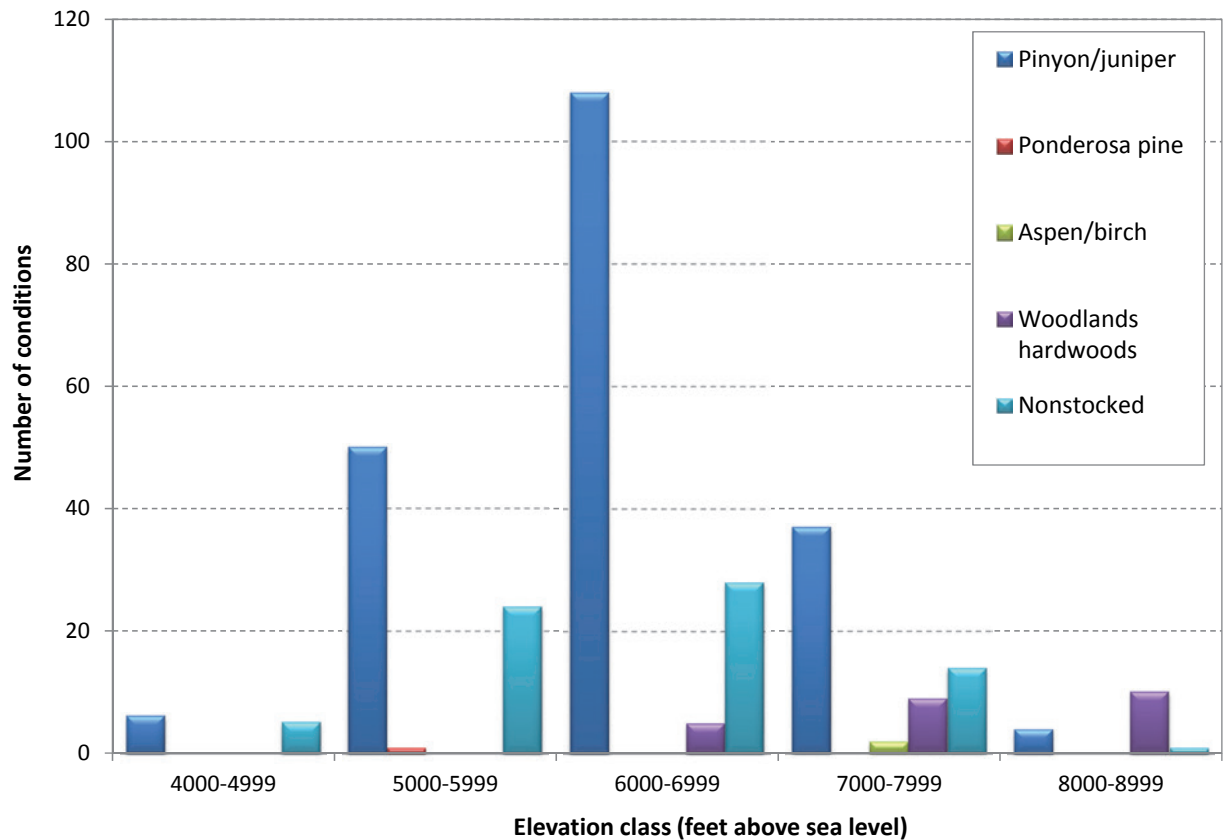


Figure 50—Number of forested conditions infested with cheatgrass (>3 or 5 percent cover) by elevation class and forest-type group, Nevada 2004–2013.

this group often occur in areas that have lower soil moisture and understory species diversity than higher elevation sites. These may be factors that affect an area’s susceptibility to invasion. Other possible factors include the type, level, and frequency of disturbance (natural and human-induced) in these areas.

The pattern of cheatgrass incidence across the elevation gradient may be driven by a corresponding moisture gradient. Plots located at higher elevations typically have more soil moisture, lower temperatures, and a shorter growing season. These factors may impede the introduction and/or establishment of cheatgrass in these areas.

Cheatgrass presents a threat to western ecosystems and a challenge to those that manage the lands where it has established a population. FIA data can be used to identify areas infested and/or most susceptible to infestation. This information can also be used to test cheatgrass models currently being developed or refine those already being implemented.

Fires in Nevada’s Forests

Wildland fire is perhaps the most important forest-related topic in the western United States. A century of fire suppression has led to a buildup of fuels and stand densification, which contributes to uncharacteristically large and intense fires (Reinhardt et al. 2008). Forests that burn intensely may experience slow regeneration, but others

may recover relatively quickly. As FIA continues annual inventory over time, it will be possible to assess trends in fire effects over large areas.

FIA plot data alone can be used to produce population-scale estimates for the effects of fire on forests at State or regional scales. However, use of FIA plot data in conjunction with the products produced by the Monitoring Trends in Burn Severity (MTBS; Eidenshink et al. 2007) program makes it possible to do analyses that are not possible with either dataset separately. MTBS data provide fire boundary information and classifications of fire severity within those boundaries. FIA data provide ground truth for the remotely sensed MTBS classifications, thereby allowing additional interpretation of MTBS severity classes.

In the Western States, the MTBS program maps all fires larger than 1,000 acres. This analysis is based on fire perimeters identified by the MTBS program that occurred between 1984 and 2012 and FIA plot data collected in Nevada between 2004 and 2013. Burned versus unburned plots were classified using a geometric intersection of MTBS fire perimeters and FIA plot locations. The Identity function in ArcGIS (ESRI 2011) assigned fire-specific MTBS attributes, including fire identifiers, fire start date, and fire size, to all FIA plot locations that fell within fire perimeters. The attributes of multiple fires were assigned to plots that fell within overlapping fire perimeters (i.e., plots locations that burned more than once). Plots that fell within MTBS fire perimeters and were measured after any fire date were designated as having been burned, i.e., as postfire plots, while those that were measured prior to the earliest fire date were designated as unburned and considered prefire plots. For analysis of prefire and postfire forest attributes, we used all available measurements of plots on the FIA base grid, regardless of whether those plot measurements are used in current population estimates. For the analysis of percent forest and nonforest, only plot measurements for the most recent evaluation (measured from 2004 to 2013) were used. Non-sampled plots and non-sampled portions of plots were excluded from our analysis so that the proportion of forest and non-forest areas summed to 100 percent.

Ideally, estimation of prefire to postfire change would be based on remeasurement of plots with at least one prefire and one postfire visit. Because Nevada's forest inventory only includes the first full cycle (10 years) of annual inventory, no remeasurements of plots are available. For the current analysis, we used space-for-time substitution by using the MTBS perimeters collectively to establish the sampling frame, and then we compared plots that were measured prefire to plots measured postfire as two quasi-independent samples separated by the occurrence of fire. For these comparisons, we used basal area (square feet per acre) of live and standing dead trees, and density (trees per acre) of seedlings and saplings, at post-fire versus prefire plots. Time since fire was calculated as the difference between plot measurement date and the most recent fire start date.

The MTBS program delineated 898 fire perimeters from 822 different fires and burned just over 9.9 million acres in Nevada between 1984 and 2012. This acreage represents the sum of all the burned areas; in actuality, some areas burned multiple times during this time period. Accounting for overlapping fire perimeters, the total area burned between 1984 and 2012 is just over 8.1 million acres. These

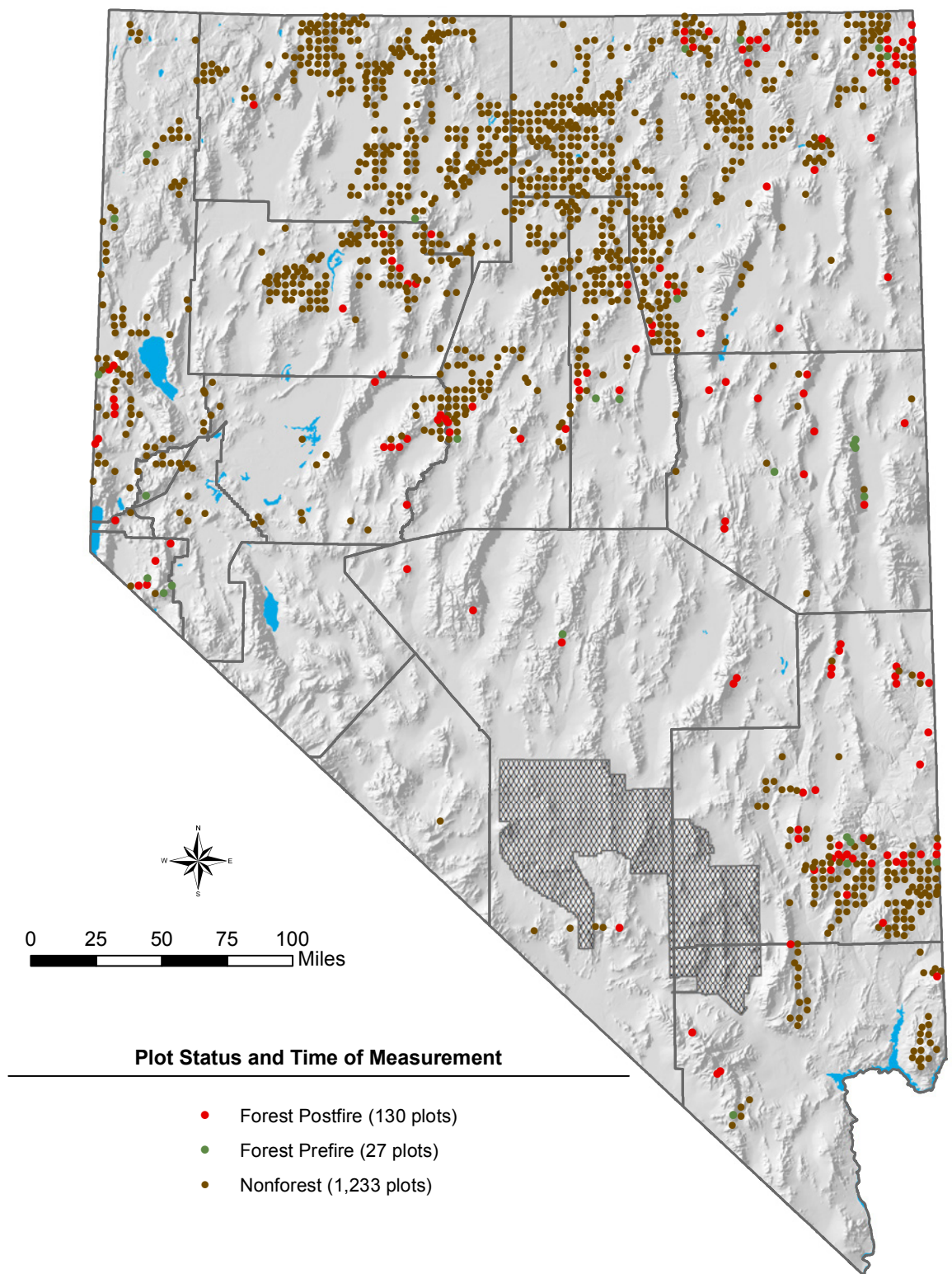


Figure 51—Distribution of FIA plots within MTBS burn perimeters, Nevada, 2004–2013. Cross-hatched area not sampled. (Note: plot locations are approximate; some plot locations on private land were randomly swapped.)

fire perimeters ranged in size from about 3 acres to 303,000 acres, with an average size of about 12,000 acres. These fire perimeters include 12 percent (1,390 plots) of all the FIA plots in Nevada (11,339) (fig. 51). The FIA area estimate from the sampled portions of these plots is 8.3 million acres, about 10 percent of which is

Table 9—Total land area, forest land area, and nonforest land inside fire perimeters mapped 1984 to 2012, by ownership, Nevada, 2004–2013.

Ownership	Land status		All lands
	Forest	Nonforest	
----- thousand acres -----			
National Forests	151.9	295.7	447.6
Bureau of Land Management	634.9	5,386.4	6,021.3
U.S. Fish and Wildlife Service	4.5	155.0	159.6
Department of Defense or Energy	6.0	12.0	18.1
Undifferentiated private	38.2	1,639.9	1,678.1
Total	835.7	7,489.1	8,324.8

forest land and 90 percent is nonforest (table 9). Of the total area burned by these fires, the largest proportion was on Bureau of Land Management land at 72 percent, and includes 76 percent of the forest land inside fire perimeters. The second highest proportion of total land area burned was held by private landowners at 20 percent and includes nearly 5 percent of the burned forest land. The third highest proportion was on National Forest land at 5 percent, including 18 percent of the burned forest land (table 9). Between 1984 and 2012 there were 18 fires over 100,000 acres in size that occurred in Nevada. The largest fire was the Southern Nevada Complex (Duzak), which burned 302,000 acres in Nevada in 2005.

Time since fire for the postfire forest plots ranged from almost immediately postfire to more than 29 years in Nevada (fig. 52). Over 85 percent of plot visits occurred within 15 years of the most recent fire. This is because the majority of the fire acreage in Nevada's MTBS data occurred since 1998, as shown in figure 53. The 4 years with the largest fire acreages are 1999, 2005, 2006, and 2007, all of which are within 15 years of plot measurements in 2004 through 2013.

Figure 54 shows the distribution of average live basal area for postfire plots at time of measurement. Live basal area calculations include all live trees at least 5 inches in diameter and larger (d.b.h. or d.r.c.). Just over one-half of the plots (57 percent) measured after the occurrence of fire had no live basal area present, indicating all trees were killed by fire. Given the slow growth and long regeneration times of most forest trees in Nevada, the live basal found in postfire plots is interpreted as being from trees that survived fire, because new regeneration is unlikely to grow quickly enough to cross the 5-inch threshold.

The increase in standing dead basal area after fire indicates that trees are not completely consumed by fire (fig. 55). On average, live basal area at postfire plots was about 28 percent of the live basal area at prefire plots. Standing dead basal area for postfire plots was a little over three times that at prefire plots. The amount of standing dead basal area at postfire plots does not balance with decreases in live basal area at postfire plots. This likely reflects some degree of consumption, as well as killed trees that have fallen.

Figure 56 shows the change in basal area for live and standing dead trees 5 inches diameter and greater, and trees per acre for seedlings and saplings less than 5 inches diameter, with increasing time since fire, for Nevada. Postfire plots that

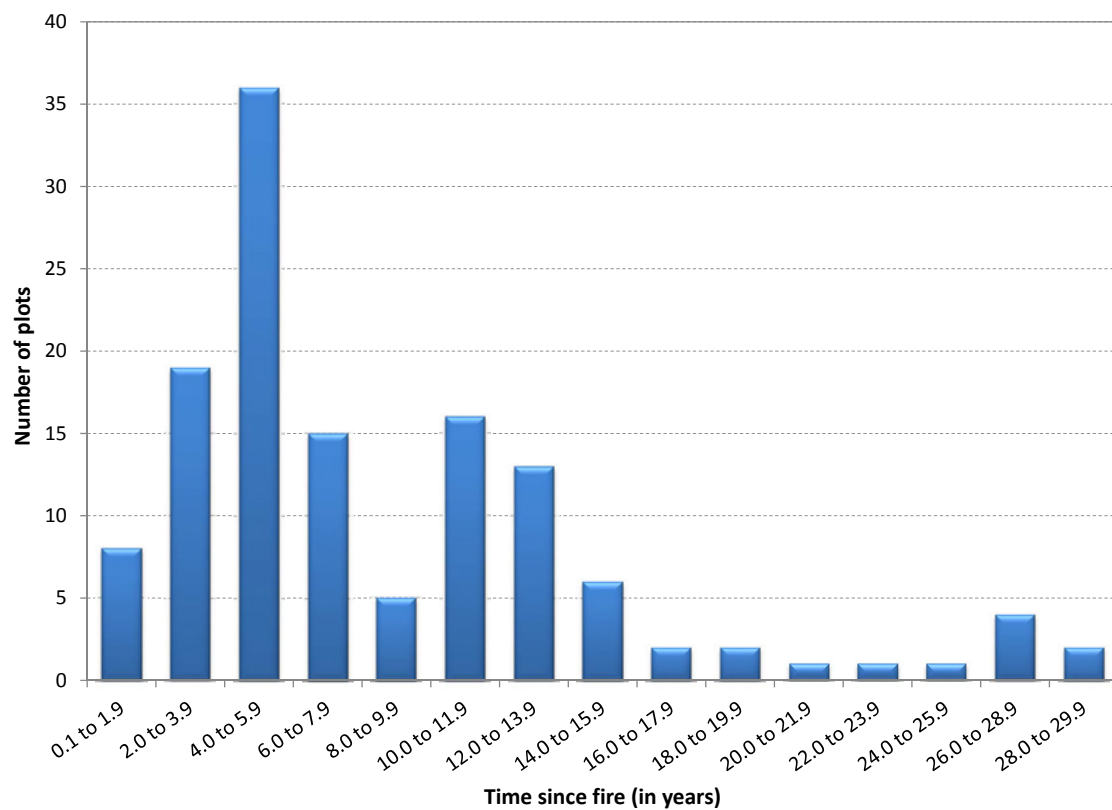


Figure 52—Number of years between fire and plot visit for postfire plots, Nevada, 2004–2013 and MTBS, 1984–2012.

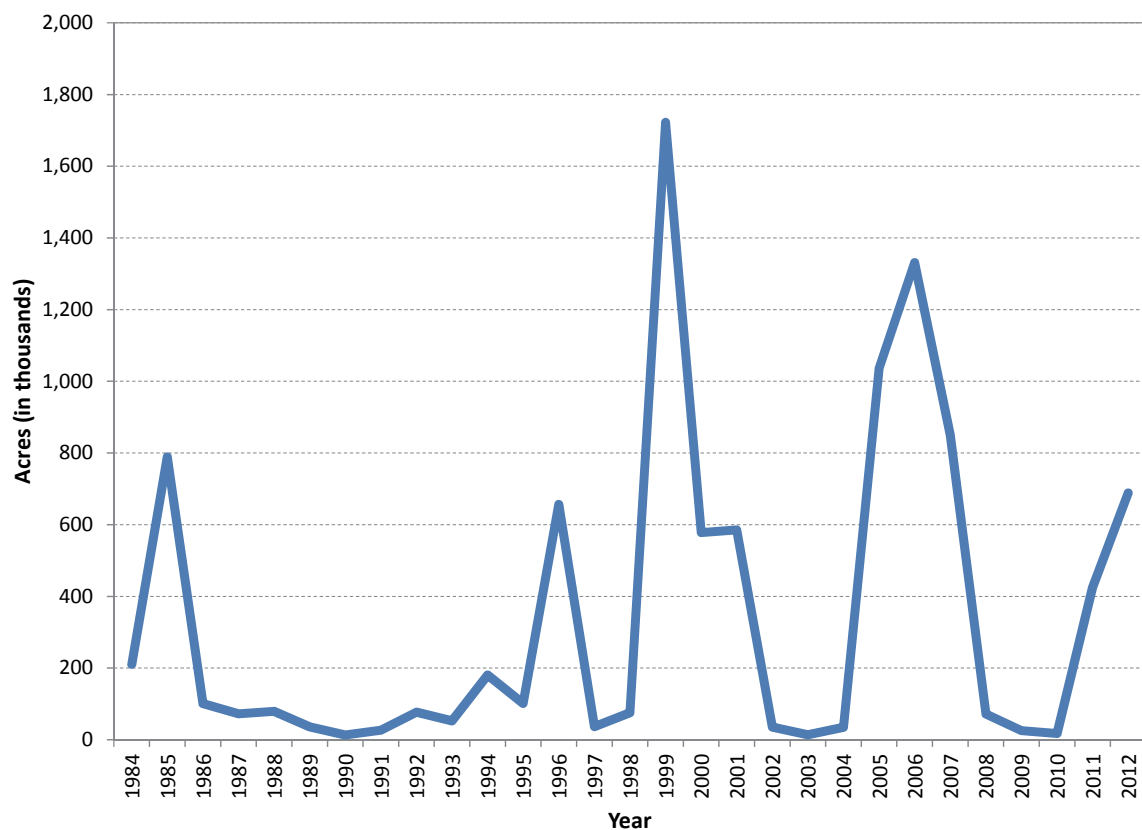


Figure 53—Nevada fires 1984–2012, total acres by year.

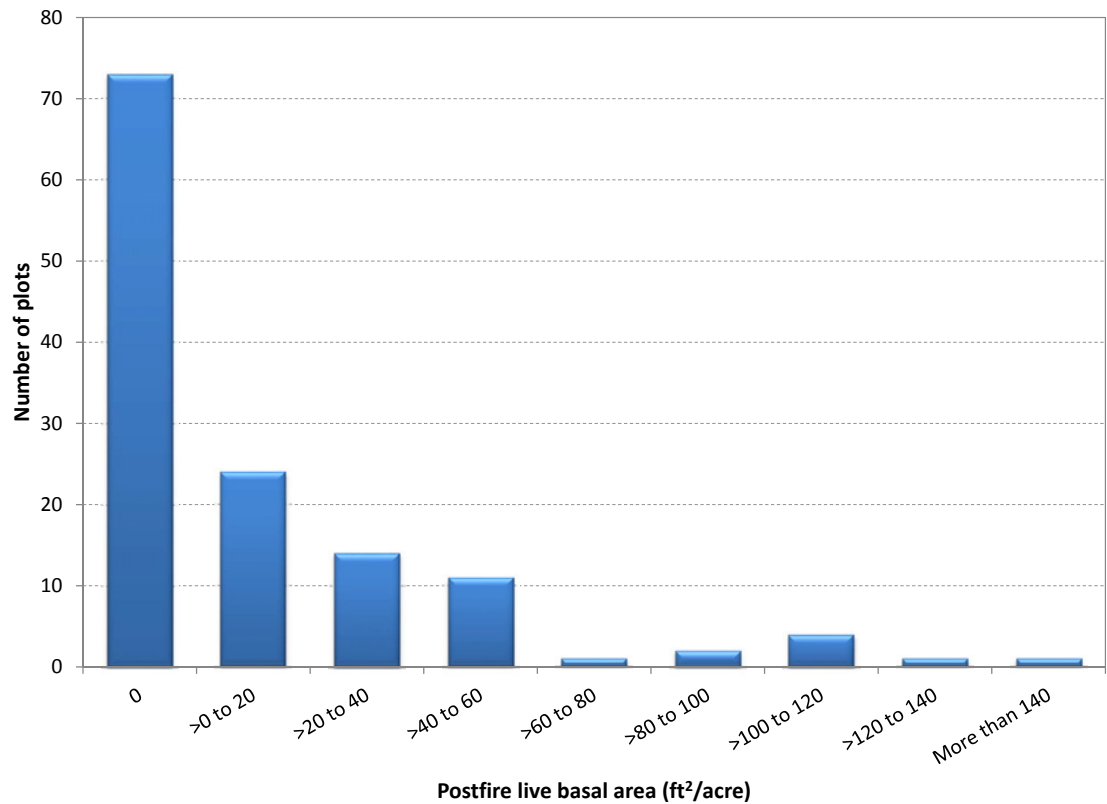


Figure 54—Distribution of average live basal area for postfire plots at time of measurement, Nevada, 2004–2013 and MTBS, 1984–2012.

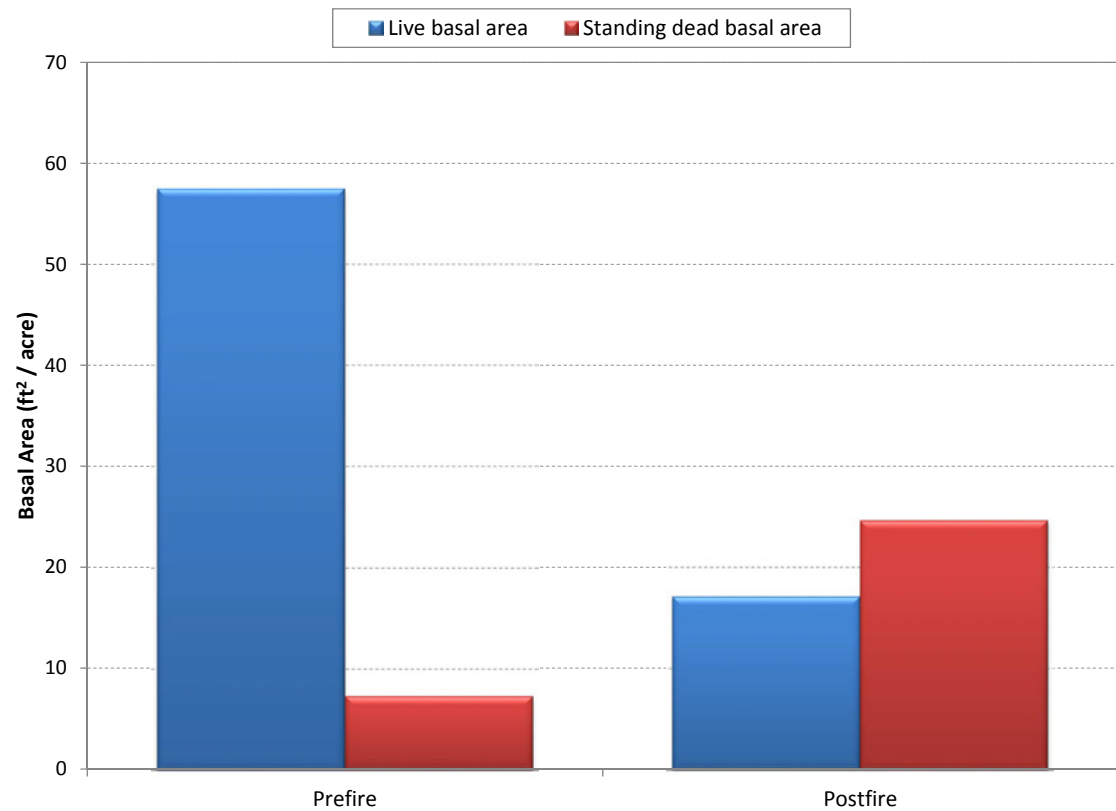


Figure 55—Estimates of prefire and postfire live and standing-dead average basal area per acre, Nevada, 2004–2013 and MTBS, 1984–2012.

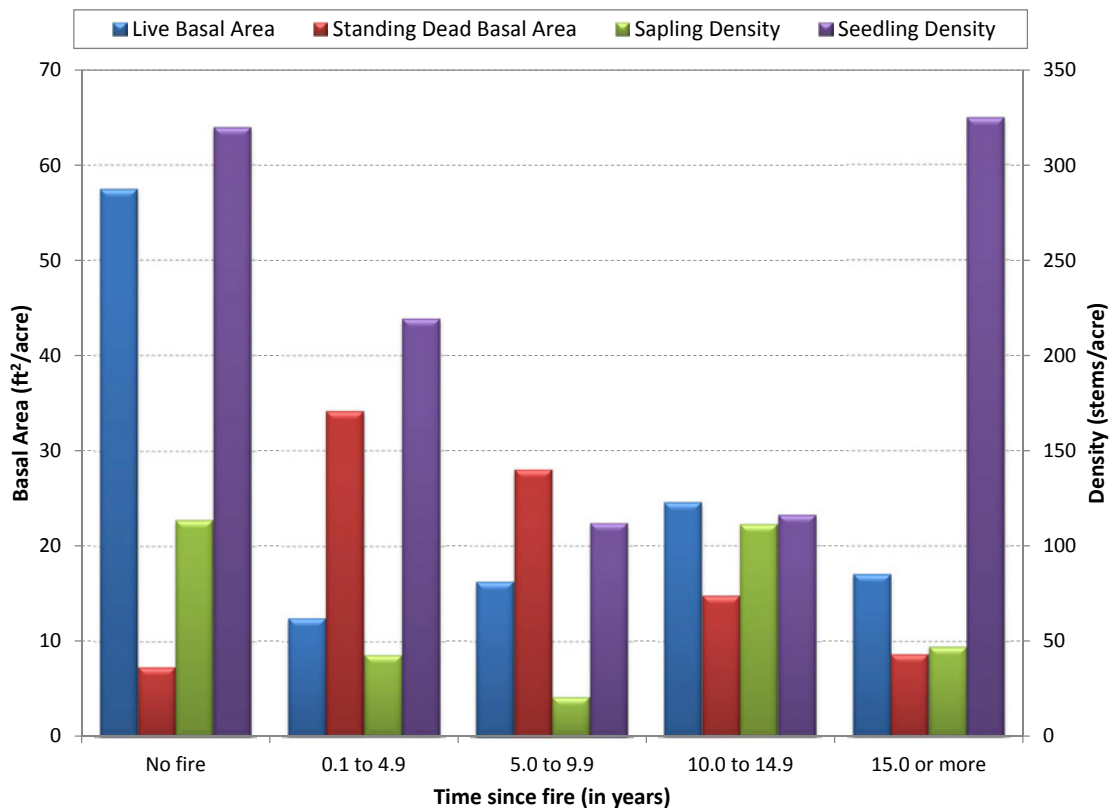


Figure 56—Average live basal area, dead basal area, sapling density, and seedling density for plots inside burned-area perimeters at 5-year postfire intervals, Nevada, 2004–2013 and MTBS 1984–2012.

burned fewer than 5 years prior to measurement have about 21 percent of the live basal area observed at prefire plots. Postfire standing dead basal area is more than three times the standing dead basal area at unburned plots, and it then gradually decreases over time. However, even at plots that burned more than 15 years prior to measurement, standing dead basal area is about one-third of that observed at recently burned plots, suggesting that postfire snag longevity can often be greater than 15 years.

Although the patterns of live and dead basal area in figure 56 show relatively consistent trends over time, the values for seedlings and saplings density do not show a clear pattern. This is likely an artifact of the small sample size. Using data from all eight Interior West States, with many more fire perimeters and forested plots, Shaw et al. (in review) found clear indications of recruitment from the seedling class to the sapling class with increasing time since fire. As the Nevada annual inventory transitions into remeasurement, it should be possible to assess regeneration trends more precisely within the State.

The analyses in this section should be considered only a first approximation of fire effects on Nevada's forests. Although the results are generally consistent with expectations, more information will be needed to assess long-term trends. However, the data confirm that within fire boundaries there is variation in fire effects, both in terms of mortality and regeneration. As annual FIA inventory proceeds, the postfire future of Nevada's forests will be known more precisely.

Forest Resources by Selected Ownerships and Management Areas

As described in the section *Forest Land Ownership* of the “Overview of Nevada’s Forests” chapter in this report, the USDI Bureau of Land Management (BLM), the Nevada Division of Forestry (NDF), and the Humboldt-Toiyabe National Forest all requested forest land estimates for their ownerships and management areas.

Bureau of Land Management Forests by Nevada BLM Districts

Management areas for the Bureau of Land Management are BLM Districts and are displayed with forested plots on BLM land by district in figure 57. Note the non-colored area in the northwestern portion of the State (showing forested BLM plots in dark gray), which is administered by the California BLM; and a small area in north central Elko County (with no forested BLM plots), which is administered by the Idaho BLM. Also note that the Carson City District extends into California, with no plots for this inventory in California. Table 10 (a–i) shows selected land and forest attributes for BLM land by Nevada BLM Districts. Data for Districts designated as “Other” are from Nevada plots on BLM land in areas other than those administered by the Nevada BLM. Also, estimates for the Carson City District are restricted to the portion in Nevada. Table 10a shows the total FIA sampled area estimate for BLM at 47.8 million acres, or 71 percent of Nevada’s sampled area. Although the BLM manages the most forest land in Nevada, at 6.7 million acres, only 14 percent of BLM land in Nevada is forested. The Ely District has the most BLM land (11.4 million acres), the most BLM forest land (3.6 million acres), and the highest percentage of forest on BLM land (31 percent). The least BLM forest land and the lowest percentage of forest on BLM land are found in the Southern Nevada District (78,000 acres, 2 percent).

The most abundant forest land classification for BLM forests in Nevada is unreserved, unproductive forest land, making up 90 percent of Nevada’s BLM forest land (table 10b). Percentages of unreserved, unproductive forest land by district range from 99 percent of BLM forest land in the Battle Mountain, Carson City, and Elko Districts to 64 percent in the Southern Nevada District. Most Districts have a small amount of timberland present. Reserved BLM forest land in Nevada occurs on BLM-managed wilderness areas; there are 22 BLM wilderness areas at least partially within the Ely District, and all of them have at least one forested plot, giving the Ely District the majority of BLM reserved forest land in Nevada.

Table 10c shows the distribution of forest-type groups on BLM forest land across Districts. The most abundant forest-type group overall, and on every District, is the pinyon/juniper group at 87 percent for all BLM forest land, with a high of 92 percent on the Battle Mountain District, and a low of 77 percent on the Winnemucca District (only 60 percent on “Other” districts). The next most abundant is nonstocked at 7 percent, which is also the second most common forest-type group on every District. Field crews assign field forest types to nonstocked stands.

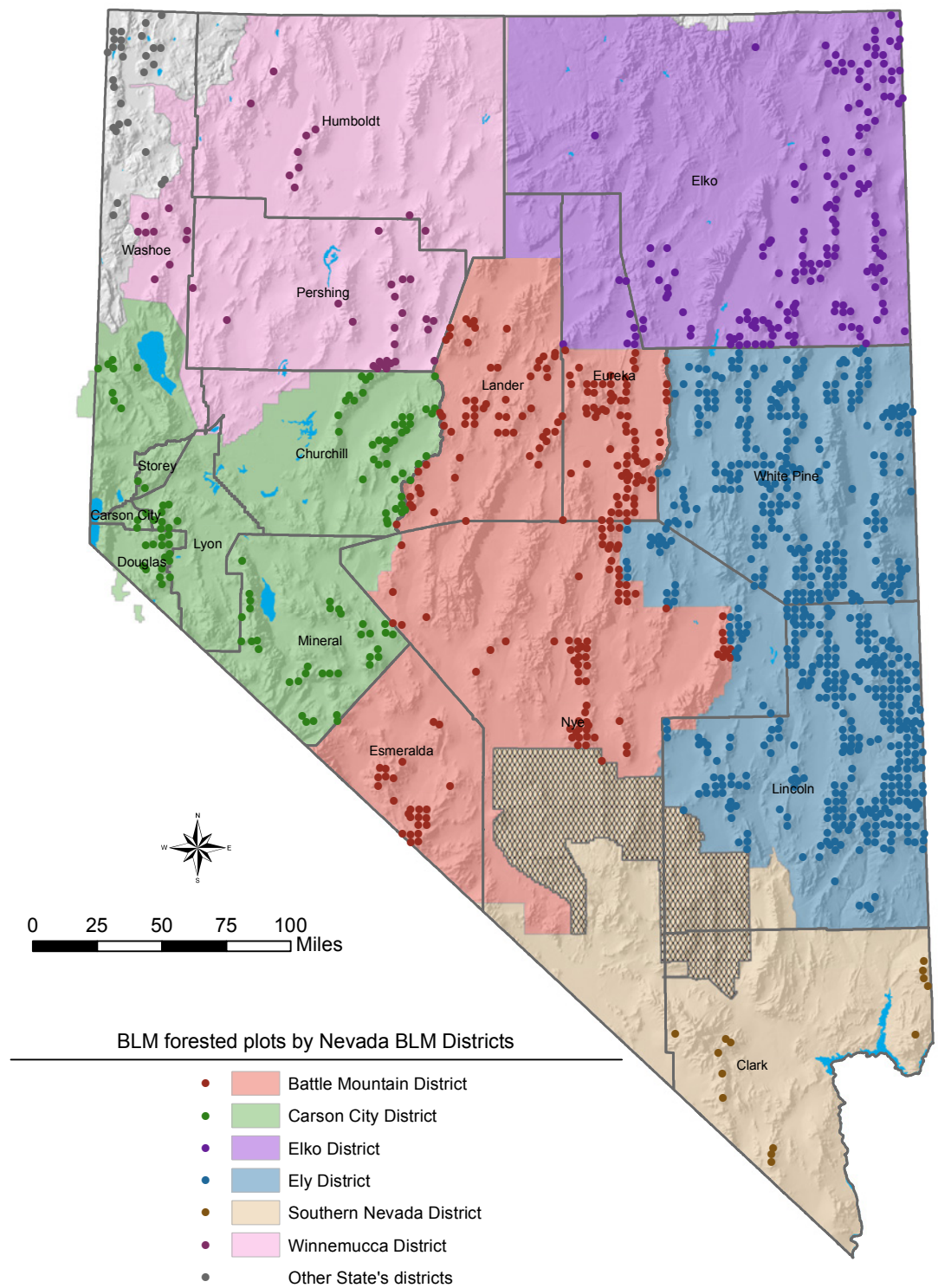


Figure 57—Nevada Bureau of Land Management (BLM) Districts, showing forested plots on BLM land. Background shows shaded relief and county boundaries, with county names. Cross-hatched area not sampled. (Note: plot locations are approximate.)

Table 10—Forest resource tables for Bureau of Land Management lands, Nevada, 2004–2013.

a. Sampled area by land/water class and BLM District.

Land or water class	BLM District					All Districts
	Battle Mountain District	Carson City District	Elko District	Ely District	Southern Nevada District	Winnemucca District
<i>thousand acres</i>						
Accessible forest	1,250.2	581.9	833.0	3,562.8	77.5	224.0
Nonforest	9,185.9	4,444.9	6,711.0	7,884.4	3,429.7	8,151.5
Noncensus water	6.0	6.1	6.0	—	—	—
Census water	—	12.1	—	—	—	6.1
All classes	10,442.2	5,045.0	7,550.0	11,447.2	3,507.2	8,375.6
					1,418.6	47,785.8

b. Area of forest land by forest land classification and BLM District.

Forest land classification	BLM District					All Districts
	Battle Mountain District	Carson City District	Elko District	Ely District	Southern Nevada District	Winnemucca District
<i>thousand acres</i>						
Timberland	7.0	6.1	5.6	11.9	—	18.8
Reserved forest land	—	—	—	538.5	27.9	25.3
Unreserved, unproductive forest land	1,243.2	575.8	827.4	3,012.3	49.6	179.9
All forest land	1,250.2	581.9	833.0	3,562.8	77.5	224.0
					131.0	6,660.5

c. Area of forest land by forest-type group and BLM District.

Forest-type group	BLM District					All Districts
	Battle Mountain District	Carson City District	Elko District	Ely District	Southern Nevada District	Winnemucca District
<i>thousand acres</i>						
Pinyon / juniper group	1,150.8	502.1	680.1	3,126.3	65.4	172.9
Douglas-fir group	—	—	—	6.0	—	—
Ponderosa pine group	—	—	—	0.6	—	—
Fir / spruce / mountain hemlock group	—	—	5.6	47.8	—	—
Other western softwoods group	—	6.1	—	17.9	—	—
Aspen / birch group	12.9	—	6.0	4.5	—	6.7
Woodland hardwoods group	43.3	15.1	43.4	168.6	6.1	1.5
Nonstocked	43.3	58.6	97.8	191.1	6.1	42.9
All forest-type groups	1,250.2	581.9	833.0	3,562.8	77.5	224.0
					131.0	6,660.5

Table 10—Continued.

d. Number of live trees (1 inch diameter and greater) on forest land by species group and BLM District.

Species group	BLM District					All Districts
	Battle Mountain District	Carson City District	Elko District	Ely District	Southern Nevada District	Winnemucca District
Softwood species groups	<i>thousand trees</i>					
Douglas-fir	—	—	—	1,578.4	—	—
Ponderosa and Jeffrey pine	38.0	—	—	326.4	—	—
True fir	—	—	1,782.6	18,053.7	—	—
Woodland softwoods	225,995.7	85,096.4	151,745.9	884,085.9	8,140.6	17,418.4
Other western softwoods	—	673.0	687.0	4,237.6	—	376.0
All softwoods	226,033.6	85,769.4	154,215.6	908,281.9	8,140.6	17,794.5
Hardwood species groups						
Cottonwood and aspen	10,109.8	—	743.1	7,502.6	—	—
Woodland hardwoods	33,282.2	7,600.6	5,002.0	81,250.8	474.1	5,279.6
All hardwoods	43,391.9	7,600.6	5,745.0	88,753.4	474.1	8,369.8
All species groups	269,425.6	93,370.0	159,960.6	997,035.3	8,614.8	26,164.3
						14,057.4
						1,568,627.8

e. Number of standing dead trees (5 inches diameter and greater) on forest land by species group and BLM District.

Species group	BLM District					All Districts
	Battle Mountain District	Carson City District	Elko District	Ely District	Southern Nevada District	Winnemucca District
Softwood species groups	<i>thousand trees</i>					
Douglas-fir	—	—	—	503.1	—	—
Ponderosa and Jeffrey pine	38.0	—	—	—	—	—
True fir	38.0	—	268.7	1,619.0	—	—
Woodland softwoods	8,513.0	6,068.1	9,529.3	40,532.7	938.9	2,447.2
Other western softwoods	38.0	—	33.6	575.0	—	36.5
All softwoods	8,626.9	6,068.1	9,831.5	43,229.7	938.9	2,483.6
Hardwood species groups						
Cottonwood and aspen	458.5	—	—	361.9	—	40.3
Woodland hardwoods	2,086.9	856.1	1,563.8	9,049.0	291.8	—
All hardwoods	2,545.3	856.1	1,563.8	9,410.9	291.8	40.3
All species groups	11,172.3	6,924.2	11,395.3	52,640.6	1,230.7	2,523.9
						216.1
						86,102.9

Table 10—Continued.

h. Average annual net growth of live trees (5 inches diameter and greater) on forest land by species group and BLM District.

Species group	BLM District						All Districts
	Battle Mountain District	Carson City District	Elko District	Ely District	Southern Nevada District	Winnemucca District	
Softwood species groups	<i>million cubic feet</i>						
Douglas-fir	—	—	—	-0.53	—	—	-0.53
Ponderosa and Jeffrey pine	0.01	—	—	0.07	—	—	0.08
True fir	-0.05	—	-0.03	0.12	—	—	0.04
Woodland softwoods	4.08	-0.35	-0.73	6.13	-0.04	-0.98	8.42
Other western softwoods	—	0.02	0.02	-0.63	—	0.02	-0.50
All softwoods	4.04	-0.33	-0.74	5.17	-0.04	-0.96	7.51
Hardwood species groups							
Cottonwood and aspen	0.22	—	0.03	0.02	—	0.00	0.26
Woodland hardwoods	0.21	-0.22	0.06	0.67	0.01	0.01	0.75
All hardwoods	0.42	-0.22	0.08	0.69	0.01	0.01	1.02
All species groups	4.46	-0.55	-0.66	5.86	-0.03	-0.96	8.52

i. Average annual mortality of trees (5 inches diameter and greater) on forest land by species group and BLM District.

Species group	BLM District						All Districts
	Battle Mountain District	Carson City District	Elko District	Ely District	Southern Nevada District	Winnemucca District	
Softwood species groups	<i>million cubic feet</i>						
Douglas-fir	—	—	—	0.66	—	—	0.66
Ponderosa and Jeffrey pine	—	—	—	—	—	—	—
True fir	0.05	—	0.14	0.57	—	—	0.76
Woodland softwoods	2.07	3.14	3.73	10.25	0.24	1.58	21.01
Other western softwoods	—	—	—	0.98	—	—	1.01
All softwoods	2.12	3.14	3.88	12.45	0.24	1.58	23.44
Hardwood species groups							
Cottonwood and aspen	0.00	—	—	—	—	0.00	0.01
Woodland hardwoods	0.05	0.28	0.09	0.08	—	—	0.51
All hardwoods	0.05	0.28	0.09	0.08	—	0.00	0.51
All species groups	2.17	3.42	3.97	12.53	0.24	1.58	23.95

Ninety-four percent of the nonstocked forest types on BLM forest land were assigned field forest types in the pinyon/juniper group; the remainder were western juniper (in the other western softwood group) and forest types in the woodland hardwoods group. Next most abundant is the woodland hardwoods group, which is present in every District, but is surpassed in abundance in some Districts by other forest-type groups that are less common Statewide. The Ely District contains all of the forest-type groups found on BLM forest land in Nevada.

In terms of species groups, the most dominant is the woodland softwood species group. This group is dominant on all BLM Districts and contains all of the individual species that are found Statewide. By far the most common species in the group are Utah juniper (found on all Districts) and singleleaf pinyon (all Districts except "Other"), with smaller amounts of Rocky Mountain juniper (on the Battle Mountain, Elko, and Ely Districts) and a few common or two-needle pinyons on a single plot on the Ely District.

The next most abundant species group is woodland hardwoods, which is composed primarily of curlleaf mountain-mahogany, found on every District, and a small amount of Gambel oak on the Ely District. Other species groups found on BLM forest land in Nevada are true firs (consisting only of white fir), the other western softwoods (including western juniper, limber pine, Great Basin bristlecone pine, and whitebark pine), cottonwood and aspen (only represented by quaking aspen), ponderosa and Jeffrey pines (only ponderosa pine on BLM forests), and the Douglas-fir group (only Douglas-firs in Nevada).

The relative abundance of species groups, including the dominance of woodland softwoods, depends on whether the estimate is number of live trees, number of standing dead trees, live biomass, or live volume (table 10[d, e, f, and g, respectively]). The woodland softwoods group makes up 80 to 90 percent of the attribute estimated. Relative abundance is particularly variable for the hardwood groups, because these groups have many smaller trees on BLM forest land in Nevada; all trees count equally in numbers of trees, larger trees have more biomass and volume than smaller trees, and the smallest trees (less than 5 inches diameter) have no volume calculated.

Overall, mortality (23.95 million cubic feet) is high compared to net growth (8.52 million cubic feet) on BLM forest land in Nevada, although net growth is still positive (table 10[h–i]). Net growth is, however, negative for some species groups and BLM Districts, and mortality is lower on the Battle Mountain District and for hardwood species groups. This shows that mortality is variable, both spatially and between species. It should be noted that within tables 10h and 10i the estimates for some cells are derived from a small sample, sometimes a single plot. Readers should also be aware that the estimates in table 10e, number of standing dead trees, and those in table 10i, mortality of trees, are not derived from the same set of trees. Although there is overlap between these tables, not all standing dead trees qualify as mortality trees and not all mortality trees qualify as standing dead trees.

State and Private Forests by Nevada Division of Forestry Regions

Management areas for the Nevada Division of Forestry (NDF) are groups of counties designated as Regions and displayed with forested State and private plots in figure 58. Table 11(a–i) shows selected land and forest attributes for State and private land by NDF Regions. Table 11a shows the total FIA sampled area estimate for State and private at 10.5 million acres, or 15 percent of Nevada’s sampled area. State and private lands in Nevada are estimated to be about 4 percent forested (0.4 million acres). The Northern Region contains the most State and private land (5.6 million acres) and the most State and private forest land at 0.2 million acres. State and private lands are most forested in the Western Region (4.4 percent forested) and the Northern Region (3.8 percent forested). The Southern Region has both the least State and private forest land (30,000 acres) and the lowest percentage of forest on State and private lands (3.1 percent).

The most abundant forest land classification for State and private forests in Nevada is unreserved, unproductive forest land, making up 87 percent of Nevada’s State and private forest land (table 11b). The percentage of unreserved, unproductive forest land is 100 percent in the Southern Region, 88 percent in the Northern Region, and 83 percent in the Western Region. Nearly 9 percent of the State and private forest land in Nevada qualifies as timberland, and is located in the Western and Northern Regions. Reserved forest land on State and private lands in Nevada are exclusively on State Parks: Lake Tahoe Nevada State Park in the Western Region and Cave Lake State Park in the Northern Region.

Table 11c shows the distribution of forest-type groups on State and private forest land across NDF Regions. The most abundant forest-type group overall, and in every Region, is the pinyon/juniper group at 73 percent for all State and private forest land, with 80 percent in the Southern Region, 77 percent in the Northern Region, and 67 percent in the Western Region. The next most abundant is nonstocked at 9 percent, most abundant in the Western Region, but also present in the Northern Region. Field crews assign field forest types to nonstocked stands. Eighty-six percent of the nonstocked forest types on State and private forest land were assigned field forest types in the pinyon/juniper group; the remainder were Jeffrey pine (in the ponderosa pine group). Next most abundant is the woodland hardwoods group at 6 percent, found mostly in the Northern Region, with some in the Southern Region. The pinyon/juniper and woodland hardwoods are the only forest-type groups found on State and private forest land in the Southern Region. Other forest-type groups found in the Western and/or Northern Regions are the aspen/birch group, the ponderosa pine group, the fir/spruce/mountain hemlock group, the lodgepole pine group, and the elm/ash/cottonwood group.

The dominant species group on State and private forest land in Nevada is the woodland softwood group, which also dominates all three NDF Regions. It consists primarily of singleleaf pinyon and Utah juniper, with a small amount of Rocky Mountain juniper in the Northern Region. The relative dominance of woodland softwoods depends on whether the estimate is number of live trees, number of standing dead trees, live biomass, or live volume (table 11[d, e, f, and g,

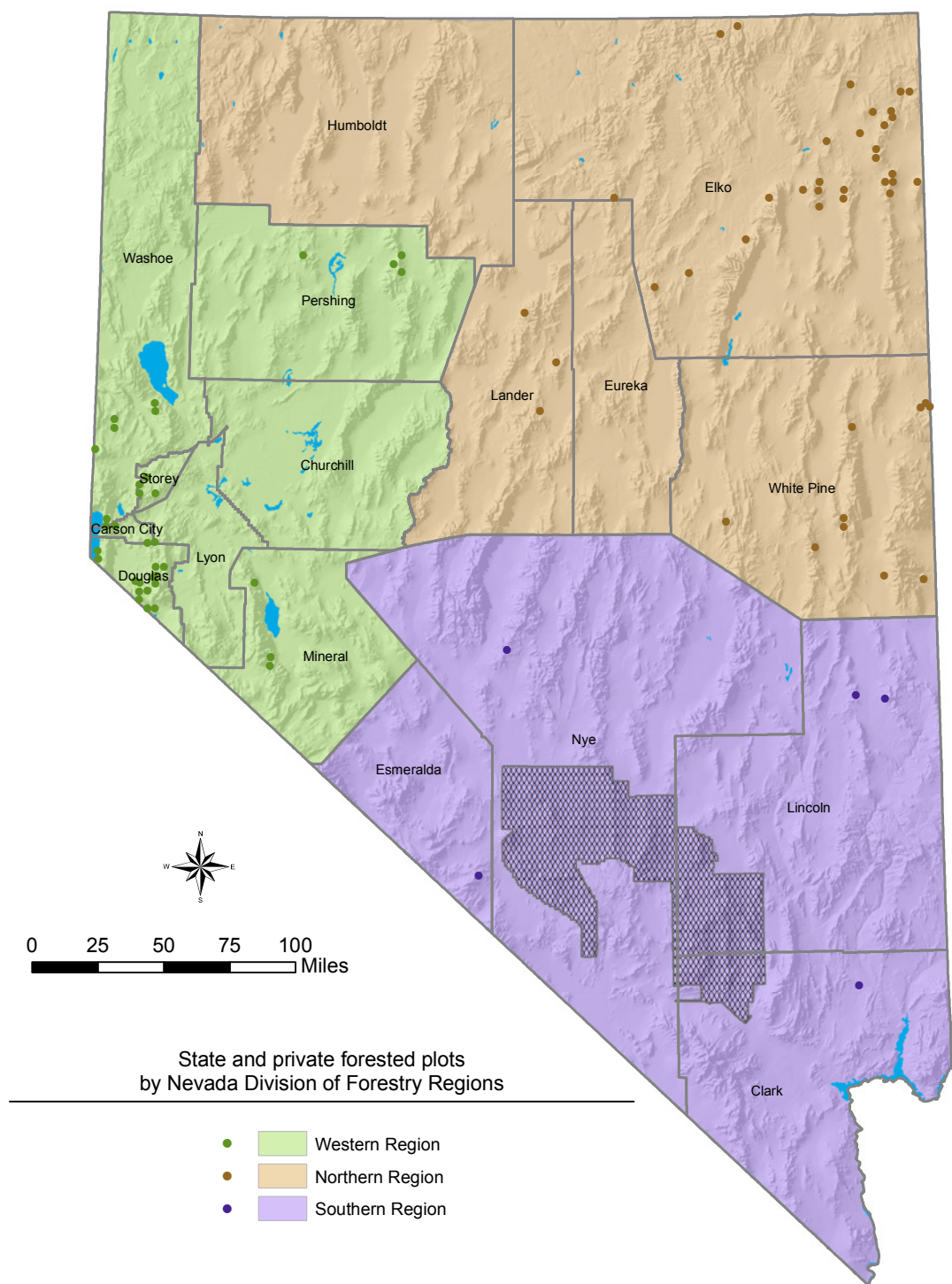


Figure 58—Nevada Division of Forestry Regions, showing forested plots on State and private lands. Background shows shaded relief and county boundaries, with county names. Cross-hatched area not sampled. (Note: plot locations are approximate; some plot locations on private land were randomly swapped.)

Table 11—Forest resource tables for State and private lands, Nevada, 2004–2013.

a. Area of sampled land by land/water class and Nevada Division of Forestry Region.

Land or water class	NDF Region			All Regions
	Western Region	Northern Region	Southern Region	
----- <i>thousand acres</i> -----				
Accessible forest	173.5	212.9	30.1	416.5
Nonforest	3,525.0	5,327.5	946.1	9,798.6
Noncensus water	24.4	1.5	—	25.9
Census water	210.1	12.0	—	222.1
All classes	3,933.1	5,553.9	976.2	10,463.2

b. Area of forest land by forest land classification and Nevada Division of Forestry Region.

Forest land classification	NDF Region			All Regions
	Western Region	Northern Region	Southern Region	
	----- <i>thousand acres</i> -----			
Timberland	17.8	18.5	—	36.3
Reserved forest land	11.2	6.0	—	17.2
Unreserved, unproductive forest land	144.5	188.4	30.1	363.0
All forest land	173.5	212.9	30.1	416.5

c. Area of forest land by forest-type group and Nevada Division of Forestry Region.

Forest-type group	NDF Region			All Regions
	Western Region	Northern Region	Southern Region	
	----- <i>thousand acres</i> -----			
Pinyon / juniper group	116.8	164.5	24.2	305.6
Ponderosa pine group	12.2	—	—	12.2
Fir / spruce / mountain hemlock group	5.6	4.5	—	10.1
Lodgepole pine group	4.2	—	—	4.2
Elm / ash / cottonwood group	—	3.4	—	3.4
Aspen / birch group	1.4	15.2	—	16.6
Woodland hardwoods group	—	19.3	5.9	25.2
Nonstocked	33.2	6.0	—	39.2
All forest-type groups	173.5	212.9	30.1	416.5

d. Number of live trees (1 inch diameter and greater) on forest land by species group and Nevada Division of Forestry Region.

Species group	NDF Region			All Regions
	Western Region	Northern Region	Southern Region	
Softwood species groups	----- <i>thousand trees</i> -----			
Ponderosa and Jeffrey pine	973.4	—	—	973.4
True fir	1,179.0	2,797.5	—	3,976.5
Western white pine	487.8	—	—	487.8
Incense-cedar	39.5	—	—	39.5
Lodgepole pine	303.6	—	—	303.6
Woodland softwoods	14,652.8	33,157.6	3,537.8	51,348.2
Other western softwoods	—	71.9	—	71.9
All softwoods	17,636.0	36,026.9	3,537.8	57,200.8

Table 11—Continued.

Hardwood species groups				
Cottonwood and aspen	940.8	15,053.4	—	15,994.2
Woodland hardwoods	157.9	6,783.1	623.0	7,564.0
All hardwoods	1,098.7	21,836.5	623.0	23,558.2
All species groups	18,734.7	57,863.5	4,160.9	80,759.0

e. Number of standing dead trees (5 inches diameter and greater) on forest land by species group and Nevada Division of Forestry Region.

Species group	NDF Region			All Regions
	Western Region	Northern Region	Southern Region	
Softwood species groups	----- thousand trees -----			
Ponderosa and Jeffrey pine	39.5	—	—	39.5
True fir	—	35.9	—	35.9
Woodland softwoods	2,921.3	1,384.4	87.7	4,393.3
Other western softwoods	—	143.7	—	143.7
All softwoods	2,960.7	1,564.1	87.7	4,612.4
Hardwood species groups				
Cottonwood and aspen	—	617.5	—	617.5
Woodland hardwoods	—	376.9	—	376.9
All hardwoods	—	994.4	—	994.4
All species groups	2,960.7	2,558.4	87.7	5,606.8

f. Aboveground dry weight of live trees (1 inch diameter and greater) on forest land by species group and Nevada Division of Forestry Region.

Species group	NDF Region			All Regions
	Western Region	Northern Region	Southern Region	
Softwood species groups	----- thousand tons -----			
Ponderosa and Jeffrey pine	540.4	—	—	540.4
True fir	282.7	125.8	—	408.5
Western white pine	12.1	—	—	12.1
Incense-cedar	2.4	—	—	2.4
Lodgepole pine	27.2	—	—	27.2
Woodland softwoods	1,109.8	1,769.4	174.4	3,053.6
Other western softwoods	—	34.9	—	34.9
All softwoods	1,974.6	1,930.1	174.4	4,079.1
Hardwood species groups				
Cottonwood and aspen	78.3	255.2	—	333.5
Woodland hardwoods	2.2	174.2	7.8	184.1
All hardwoods	80.4	429.4	7.8	517.6
All species groups	2,055.1	2,359.5	182.2	4,596.8

g. Net volume of live trees (5 inches diameter and greater) on forest land by species group and Nevada Division of Forestry Region.

Species group	NDF Region			All Regions
	Western Region	Northern Region	Southern Region	
Softwood species groups ----- <i>million cubic feet</i> -----				
Ponderosa and Jeffrey pine	31.0	—	—	31.0
True fir	18.1	7.0	—	25.1
Western white pine	0.7	—	—	0.7

Table 11—Continued.

Incense-cedar	0.2	—	—	0.2
Lodgepole pine	1.7	—	—	1.7
Woodland softwoods	69.6	98.6	11.3	179.5
Other western softwoods	—	1.9	—	1.9
All softwoods	121.3	107.5	11.3	240.0
Hardwood species groups				
Cottonwood and aspen	4.6	7.0	—	11.6
Woodland hardwoods	0.1	7.8	0.3	8.2
All hardwoods	4.7	14.8	0.3	19.8
All species groups	126.0	122.3	11.5	259.8

h. Average annual net growth of live trees (5 inches diameter and greater) on forest land by species group and Nevada Division of Forestry Region.

Species group	NDF Region			All Regions
	Western Region	Northern Region	Southern Region	
Softwood species groups	<i>million cubic feet</i>			
Ponderosa and Jeffrey pine	0.46	—	—	0.46
True fir	0.23	0.07	—	0.30
Western white pine	0.02	—	—	0.02
Incense-cedar	0.01	—	—	0.01
Lodgepole pine	0.08	—	—	0.08
Woodland softwoods	-1.41	0.16	0.13	-1.11
Other western softwoods	—	0.01	—	0.01
All softwoods	-0.62	0.24	0.13	-0.24
Hardwood species groups				
Cottonwood and aspen	0.05	0.36	—	0.41
Woodland hardwoods	0.00	0.05	0.00	0.06
All hardwoods	0.05	0.41	0.00	0.47
All species groups	-0.56	0.65	0.14	0.22

i. Average annual mortality of trees (5 inches diameter and greater) on forest land by species group and Nevada Division of Forestry Region.

Species group	NDF Region			All Regions
	Western Region	Northern Region	Southern Region	
Softwood species groups	<i>million cubic feet</i>			
Ponderosa and Jeffrey pine	0.09	—	—	0.09
True fir	—	—	—	—
Western white pine	—	—	—	—
Incense-cedar	—	—	—	—
Lodgepole pine	—	—	—	—
Woodland softwoods	2.08	0.67	0.02	2.78
Other western softwoods	—	—	—	—
All softwoods	2.18	0.67	0.02	2.88
Hardwood species groups				
Cottonwood and aspen	—	—	—	—
Woodland hardwoods	—	0.04	—	0.04
All hardwoods	—	0.04	—	0.04
All species groups	2.18	0.72	0.02	2.92

respectively]). The group makes up 64 percent of live trees, 82 percent of dead trees, 66 percent of the live biomass, and 69 percent of the live volume. The cottonwood and aspen species group (consisting of quaking aspen, along with a small component of black cottonwood in the Northern Region) and the woodland hardwoods group (curlleaf mountain-mahogany in the Western and Northern Regions, screwbean mesquite and honey mesquite in the Southern Region) are the next most dominant species groups in terms of numbers of live or standing dead trees. When comparing live biomass and volume, where larger trees have larger values, the next most dominant species groups are ponderosa and Jeffrey pines (only Jeffrey pine on State and private forest land), and true firs (white fir and California red fir). Other species groups found on State and private forest land in Nevada are other western softwoods (Great Basin bristlecone pine), lodgepole pine, and incense-cedar.

Overall, mortality (2.92 million cubic feet) is high compared to net growth (0.22 million cubic feet) on State and private forest land in Nevada, although net growth is still positive (table 11[h-i]). Net growth is, however, negative for the woodland softwoods species group and the Western Region. Mortality is lowest in the Southern Region and for hardwood species groups. This shows that mortality is variable, both spatially and between species. It should be noted that within tables 11h and 11i the estimates for some cells are derived from a small sample, sometimes a single plot. Readers should also be aware that the estimates in table 11e, number of standing dead trees, and those in table 11i, mortality of trees, are not derived from the same set of trees. Although there is overlap between these tables, not all standing dead trees qualify and mortality trees and not all mortality trees qualify as standing dead trees.

National Forest Service Forests by Humboldt-Toiyabe NF Eco-Units

The Humboldt-Toiyabe National Forest (HTNF) eco-units (combinations of Ranger Districts) were chosen as National Forest Service (NFS) management areas. These are displayed with NFS forested plots in figure 59. Because substantial portions of the East Sierra and Sierra Nevada eco-units are in California, these two units were combined to form a “Greater Sierra” unit for this report, which only includes the Nevada portions. Note the dark gray plots located outside of the colored HTNF eco-units. These plots are either (1) plots not within the HTNF, that is, in the Inyo National Forest and the Lake Tahoe Basin, or (2) plots in White Pine County that were measured before the 2006 land exchanges. Table 12 (a-i) shows selected land and forest attributes for National Forest land by Humboldt-Toiyabe eco-units. Data for eco-units designated as “Other” are from Nevada plots on NFS land in areas outside the current boundaries of the HTNF. National Forests manage nearly 9 percent of the sampled land (5.8 million acres) and 30 percent of the forest land (3.2 million acres) in Nevada. National Forests have the highest percentage of forest land of any ownership in Nevada at 55 percent (table 12a). The Central Mountains eco-unit has the most NFS forest land at 1.2 million acres (58 percent forested), and the Eastern Mountains eco-unit has the highest percentage of NFS forest land at 79 percent (0.8 million acres). The Ruby Mountains eco-unit has the

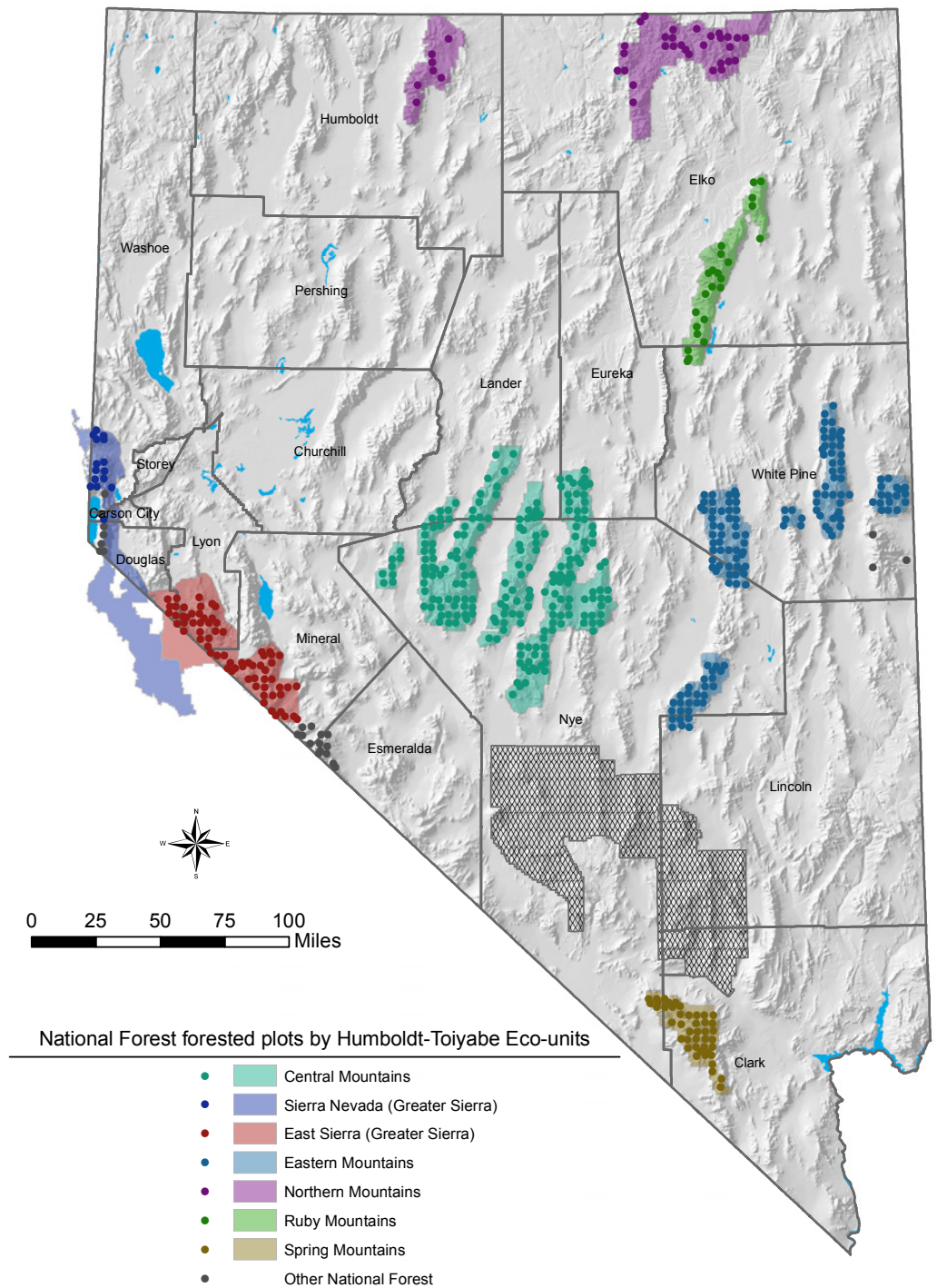


Figure 59—Humboldt-Toiyabe National Forest eco-units, showing forested plots on National Forest lands. Background shows shaded relief and county boundaries, with county names. Cross-hatched area not sampled. (Note: plot locations are approximate.)

least NFS forest land at 0.1 million acres (30 percent forested), and the Northern Mountains eco-unit has the lowest percentage of NFS forest land with 18 percent (under 0.2 million acres).

The unreserved, unproductive forest land classification is the most abundant on Nevada's NFS forests, at 66 percent of the total (table 12b). The only eco-units

Table 12—Forest resource tables for National Forest Service lands, Nevada, 2004–2013.

a. Area of sampled land by land/water class and Humboldt-Toiyabe eco-unit.

Land or water class	Humboldt-Toiyabe eco-unit						All eco-units
	Central Mountains	Greater Sierra	Eastern Mountains	Northern Mountains	Ruby Mountains	Spring Mountains	Other
----- thousand acres -----							
Accessible forest	1,227.2	440.4	819.0	183.5	107.4	253.1	142.6
Nonforest	872.1	306.3	216.0	846.9	249.1	83.5	54.4
Noncensus water	—	—	—	1.5	—	—	—
Census water	—	5.7	—	—	—	—	—
All classes	2,099.4	752.3	1,035.0	1,031.9	356.5	336.6	197.0
							5,808.6

b. Area of forest land by forest land classification and Humboldt-Toiyabe eco-unit.

Forest land classification	Humboldt-Toiyabe eco-unit						All eco-units
	Central Mountains	Greater Sierra	Eastern Mountains	Northern Mountains	Ruby Mountains	Spring Mountains	Other
----- thousand acres -----							
Timberland	3.0	24.9	18.3	51.5	7.1	—	43.9
Reserved Forestland	133.4	23.8	402.3	51.7	39.8	253.1	21.8
Unreserved, unproductive forest land	1,090.9	391.6	398.5	80.3	60.5	—	76.9
All forest land	1,227.2	440.4	819.0	183.5	107.4	253.1	142.6
							3,173.3

c. Area of forest land by forest type group and Humboldt-Toiyabe eco-unit.

Forest-type group	Humboldt-Toiyabe eco-unit						All eco-units
	Central Mountains	Greater Sierra	Eastern Mountains	Northern Mountains	Ruby Mountains	Spring Mountains	Other
----- thousand acres -----							
Pinyon / juniper group	1,042.4	359.1	560.2	8.8	30.2	175.8	72.7
Douglas-fir group	—	—	6.0	—	—	—	—
Ponderosa pine group	—	9.8	—	—	—	6.1	18.7
Fir / spruce / mountain hemlock group	—	9.7	33.1	16.9	—	21.2	15.4
Lodgepole pine group	—	8.4	—	—	—	—	6.6
Other western softwoods group	19.9	7.0	46.6	12.1	12.1	—	—
Elm / ash / cottonwood group	—	2.8	—	—	—	—	—
Aspen / birch group	30.9	11.2	16.8	96.5	33.3	—	—
Woodland hardwoods group	120.7	21.4	130.6	36.3	24.3	36.4	26.0
Nonstocked	13.3	10.9	25.8	12.9	7.5	13.6	3.3
All forest-type groups	1,227.2	440.4	819.0	183.5	107.4	253.1	142.6
							3,173.3

Table 12—Continued.

d. Number of live trees (1 inch diameter and greater) on forest land by species group and Humboldt-Toiyabe eco-unit.

Species group	Humboldt-Toiyabe eco-unit						All eco-units
	Central Mountains	Greater Sierra	Eastern Mountains	Northern Mountains	Ruby Mountains	Spring Mountains	
----- thousand trees -----							
Softwood species groups							
Douglas-fir	—	—	1,003.5	—	—	—	1,003.5
Ponderosa and Jeffrey pine	—	890.8	—	—	—	1,603.6	2,188.9
True fir	—	3,421.0	14,824.3	8,311.6	—	7,142.5	3,924.3
Western white pine	—	1,529.3	—	—	—	—	39.5
Engelmann and other spruces	—	—	2,749.6	—	—	—	1,568.7
Incense-cedar	—	67.5	—	—	—	—	2,749.6
Lodgepole pine	—	2,590.0	—	—	—	—	67.5
Woodland softwoods	210,536.1	59,550.9	137,681.1	1,137.3	5,399.1	44,140.8	4,656.9
Other western softwoods	4,919.3	4,249.3	5,210.3	5,928.5	3,567.3	401.2	10,018.9
All softwoods	215,455.4	72,298.8	161,468.8	15,377.3	8,966.4	53,288.1	2,171.5

Hardwood species groups							
Cottonwood and aspen	26,828.7	5,918.4	11,569.6	74,977.9	22,327.8	—	20,409.9
Woodland hardwoods	58,693.8	6,372.6	52,525.1	4,790.8	3,127.8	19,534.1	53,288.1
All hardwoods	85,522.6	12,291.0	64,094.6	79,768.7	25,455.6	19,534.1	4,508.2
All species groups	300,978.0	84,589.8	225,563.4	95,146.0	34,422.0	72,822.2	8,785.1

All species groups	300,978.0	84,589.8	225,563.4	95,146.0	34,422.0	72,822.2	13,293.2

All species groups	300,978.0	84,589.8	225,563.4	95,146.0	34,422.0	72,822.2	299,959.8

All species groups	300,978.0	84,589.8	225,563.4	95,146.0	34,422.0	72,822.2	847,224.6

e. Number of standing dead trees (5 inches diameter and greater) on forest land by species group and Humboldt-Toiyabe eco-unit.

Species group	Humboldt-Toiyabe eco-unit						All eco-units
	Central Mountains	Greater Sierra	Eastern Mountains	Northern Mountains	Ruby Mountains	Spring Mountains	
----- <i>thousand trees</i> -----							
Softwood species groups							
Douglas-fir	—	—	107.8	—	—	—	107.8
Ponderosa and Jeffrey pine	—	—	—	—	—	36.5	115.4
True fir	—	70.2	1,809.4	2,102.0	—	255.3	4,935.0
Western white pine	—	101.2	—	—	—	—	101.2
Engelmann and other spruces	—	—	35.9	—	—	—	35.9
Lodgepole pine	—	67.5	—	—	—	—	422.7
Woodland softwoods	6,853.8	2,497.1	6,582.1	33.6	317.4	3,841.5	20,372.7
Other western softwoods	147.2	58.8	949.3	1,633.9	—	36.5	2,904.6
All softwoods	7,001.0	2,794.8	9,484.5	3,769.5	317.4	4,169.8	28,995.4
Hardwood species groups							
Cottonwood and aspen	769.1	101.2	1,050.7	2,350.4	100.7	—	4,372.2
Woodland hardwoods	3,400.6	653.2	3,310.8	996.3	662.4	1,422.4	10,734.4
All hardwoods	4,169.7	754.4	4,361.5	3,346.7	763.1	1,422.4	15,106.6
All species groups	11,170.7	3,549.2	13,846.0	7,116.2	1,080.5	5,592.2	44,101.9

Table 12—Continued.

f. Aboveground dry weight of live trees (1 inch diameter and greater) on forest land by species group and Humboldt-Toiyabe eco-unit.

Species group	Humboldt-Toiyabe eco-unit						All eco-units
	Central Mountains	Greater Sierra	Eastern Mountains	Northern Mountains	Ruby Mountains	Spring Mountains	
----- <i>thousand tons</i> -----							
Softwood species groups							
Douglas-fir	—	—	34.6	—	—	—	34.6
Ponderosa and Jeffrey pine	—	324.5	—	—	—	324.3	478.6
True fir	—	472.0	717.1	659.0	—	693.5	577.5
Western white pine	—	19.6	—	—	—	—	48.2
Engelmann and other spruces	—	—	737.4	—	—	—	—
Incense-cedar	—	2.8	—	—	—	—	—
Lodgepole pine	—	442.1	—	—	—	—	159.3
Woodland softwoods	10,773.7	4,156.8	5,614.4	91.0	420.3	1,815.2	586.1
Other western softwoods	283.6	247.1	2,287.4	381.2	208.2	90.7	124.1
All softwoods	11,057.4	5,665.0	9,390.8	1,131.2	628.5	2,923.7	1,973.9
Hardwood species groups							
Cottonwood and aspen	545.0	197.5	585.2	910.5	98.4	—	28.1
Woodland hardwoods	1,307.9	121.1	1,407.5	254.5	216.5	224.6	216.5
All hardwoods	1,852.9	318.7	1,992.7	1,165.0	314.9	224.6	244.6
All species groups	12,910.3	5,983.6	11,383.5	2,296.2	943.4	3,148.2	2,218.5
							38,883.7

g. Net volume of live trees (5 inches diameter and greater) on forest land by species group and Humboldt-Toiyabe eco-unit.

Species group	Humboldt-Toiyabe eco-unit						All eco-units
	Central Mountains	Greater Sierra	Eastern Mountains	Northern Mountains	Ruby Mountains	Spring Mountains	
----- million cubic feet -----							
Softwood species groups							
Douglas-fir	—	—	1.5	—	—	—	1.5
Ponderosa and Jeffrey pine	—	18.7	—	—	—	18.3	64.3
True fir	—	28.5	39.3	44.9	-	40.9	190.2
Western white pine	—	1.0	—	—	—	—	4.1
Engelmann and other spruces	—	—	50.2	—	—	—	50.2
Incense-cedar	—	0.2	—	—	—	—	0.2
Lodgepole pine	—	28.0	—	—	—	—	37.1
Woodland softwoods	707.7	277.8	333.9	6.4	24.6	99.0	1,490.6
Other western softwoods	15.9	11.5	128.0	21.5	10.5	5.0	199.7
All softwoods	723.6	365.7	552.9	72.8	35.1	163.3	2,037.8
Hardwood species groups							
Cottonwood and aspen	21.0	11.3	26.8	26.4	1.6	—	87.0
Woodland hardwoods	60.8	5.3	67.7	15.4	12.7	9.7	182.2

Table 12—Continued.

All hardwoods	81.7	16.6	94.5	41.8	14.3	9.7	10.6	269.2
All species groups	805.4	382.3	647.4	114.6	49.4	172.9	135.0	2,307.0

h. Average annual net growth of live trees (5 inches diameter and greater) on forest land by species group and Humboldt-Toiyabe eco-unit.

Species group	Humboldt-Toiyabe eco-unit							All eco-units
	Central Mountains	Greater Sierra	Eastern Mountains	Northern Mountains	Ruby Mountains	Spring Mountains	Other	
----- million cubic feet -----								
Softwood species groups								
Douglas-fir	—	—	0.01	—	—	—	—	0.01
Ponderosa and Jeffrey pine	—	0.43	—	—	—	0.11	0.66	1.19
True fir	—	0.63	-0.22	-2.79	—	0.39	0.88	-1.11
Western white pine	—	-0.24	—	—	—	—	0.01	-0.23
Engelmann and other spruces	—	—	0.52	—	—	—	—	0.52
Incense-cedar	—	0.08	—	—	—	—	—	0.08
Lodgepole pine	—	-0.56	—	—	—	—	-0.49	-1.05
Woodland softwoods	4.80	1.72	1.87	-0.09	0.24	0.30	0.36	9.20
Other western softwoods	0.08	0.00	0.57	-0.70	0.13	0.05	-0.47	-0.34
All softwoods	4.88	2.06	2.74	-3.58	0.37	0.86	0.95	8.27
Hardwood species groups								
Cottonwood and aspen	0.33	0.16	0.38	0.51	-0.04	—	—	1.34
Woodland hardwoods	0.35	-0.06	0.50	-0.05	0.05	0.10	0.07	0.95
All hardwoods	0.68	0.10	0.88	0.46	0.01	0.10	0.07	2.29
All species groups	5.56	2.16	3.62	-3.12	0.38	0.96	1.01	10.56

i. Average annual mortality of trees (5 inches diameter and greater) on forest land by species group and Humboldt-Toiyabe eco-unit.

Species group	Humboldt-Toiyabe eco-unit							All eco-units
	Central Mountains	Greater Sierra	Eastern Mountains	Northern Mountains	Ruby Mountains	Spring Mountains	Other	
----- million cubic feet -----								
Softwood species groups								
Douglas-fir	—	—	—	—	—	—	—	—
Ponderosa and Jeffrey pine	—	—	—	—	—	—	—	—
True fir	—	0.03	0.99	3.74	—	0.00	0.01	4.76
Western white pine	—	0.25	—	—	—	—	—	0.25
Engelmann and other spruces	—	—	—	—	—	—	—	—
Incense-cedar	—	—	—	—	—	—	—	—
Lodgepole pine	—	0.82	—	—	—	—	0.56	1.39
Woodland softwoods	2.68	0.54	1.71	0.15	0.08	0.36	0.00	5.52
Other western softwoods	0.11	0.17	0.12	1.16	—	—	0.54	2.10
All softwoods	2.79	1.81	2.81	5.05	0.08	0.36	1.12	14.02
Hardwood species groups								
Cottonwood and aspen	0.23	0.03	0.23	0.52	0.09	—	—	1.10
Woodland hardwoods	0.29	0.10	0.14	0.16	0.05	0.01	0.00	0.76
All hardwoods	0.53	0.13	0.37	0.67	0.15	0.01	0.00	1.86
All species groups	3.32	1.94	3.18	5.73	0.23	0.37	1.12	15.88

where unreserved, unproductive forest land is not the most common classification are the Spring Mountains, which are considered 100 percent reserved due to their status as the Spring Mountain National Recreation Area (SMNRA); and the Eastern Mountains, which have slightly more reserved forest land. Other than the SMNRA, Nevada's NFS reserved forest land is on its 25 NFS-administered Wilderness areas, all of which have forested plots. About 29 percent of Nevada's NFS forest land is reserved. Less than 5 percent of the NFS forest land is classified as timberland, with the most area in the Northern Mountains eco-unit (nearly 52,000 acres). The only eco-units with more timberland than reserved forest land are the Greater Sierra and "Other."

Table 12c shows the distribution of forest-type groups on NFS forest land across HTNF eco-units. The most abundant forest-type group is the pinyon/juniper group, which is present on all eco-units and the most common on most, except for the Northern Mountains and Ruby Mountains eco-units. The second most abundant forest-type group is the woodland hardwoods, also present on all eco-units, and the secondary forest-type group on most. The third most abundant forest-type group on NFS forest land Statewide is the aspen/birch group, the most common on the Northern Mountains and Ruby Mountains eco-units, but absent on the Spring Mountains and "Other" NFS areas. Other forest-type groups found on NFS forest land in Nevada are other western softwoods, fir/spruce/mountain hemlock, non-stocked, ponderosa pine, lodgepole pine, Douglas-fir, and elm/ash/cottonwood. Nine of the 10 forest-type groups can be found on the Greater Sierra eco-unit.

The dominant species group on NFS forest land in Nevada is the woodland softwood group, which also dominates all eco-units, except for the Northern Mountains and the Ruby Mountains. It consists primarily of singleleaf pinyon and Utah juniper, with smaller amounts of Rocky Mountain juniper in the Eastern Mountains and the Spring Mountains. Woodland softwoods in the Northern Mountains eco-unit consist entirely of Rocky Mountain juniper. The relative dominance of other species groups depends on whether the estimate is number of live trees, number of standing dead trees, live biomass, or live volume (table 12[d, e, f, and g, respectively]). The woodland hardwoods group is the second most abundant in some estimates. It occurs on all eco-units, consisting of curlleaf mountain-mahogany with some Gambel oak on the Spring Mountains. Also occurring on all eco-units is the other western softwoods group, which consists of limber pine (found on all eco-units), whitebark pine (on the Greater Sierra, Northern Mountains, Ruby Mountains, and "Other" eco-units), Great Basin bristlecone pine (on the Eastern Mountains and Spring Mountains), western juniper (on the Greater Sierra and "Other" eco-units), and mountain hemlock (found only on the Greater Sierra eco-unit). Other important species groups are the true firs group and the cottonwood and aspen group. The true firs group on NFS forest land in Nevada consists of white fir (on every eco-unit where the group is found), California red fir (on the Greater Sierra and "Other" eco-units), and subalpine fir (only on the Northern Mountains eco-unit). The cottonwood and aspen group occurs on every eco-unit except the Spring Mountains and consists of quaking aspen in all of them, along with some black cottonwood in the Greater Sierra eco-region. Other

species groups occurring less frequently and in small numbers include ponderosa and Jeffrey pines (Jeffrey pine in the Greater Sierra, ponderosa pine in the Spring Mountains, and both species in the “Other” areas), lodgepole pine, Engelmann and other spruces, western white pine, Douglas-fir, and incense-cedar.

Overall, mortality (15.88 million cubic feet) is high relative to net growth (10.56 million cubic feet) on NFS forest land in Nevada, although net growth is still positive (table 12[h-i]). Net growth is, however, negative for the Northern Mountains eco-unit and for several species groups. Mortality is relatively lower than overall in most eco-units other than the Northern Mountains and “Other,” and for the woodland softwood species group. This shows that mortality is variable, both spatially and between species. It should be noted that within tables 12h and 12i, the estimates for some cells are derived from a small sample, sometimes a single plot. Readers should also be aware that the estimates in table 12e, number of standing dead trees, and those in table 12i, mortality of trees, are not derived from the same set of trees. Although there is overlap between these tables, not all standing dead trees qualify as mortality trees and not all mortality trees qualify as standing dead trees.

Comparisons Between Nevada’s Periodic and Annual Forest Inventories

One purpose of Nevada’s annual forest inventory is to provide information about changes in forest attributes over time. Prior to the implementation of the annual inventory, two plot-based periodic inventories were conducted in Nevada. One Statewide periodic inventory was conducted between 1978 and 1982 (Born et al. 1992), and another was conducted on the Humboldt and Toiyabe National Forests between 1994 and 1997. If the definitions and methods used during the periodic inventories were compatible with those used during the annual inventory, we could quantify trends over the past 30 years. However, the sampling and field procedures used during the periodic inventories were different enough from those of the annual inventory to preclude reliable trend analysis. Therefore, direct comparisons of periodic and annual inventories in their entirety are not recommended and may even produce misleading results (Goeking 2015). This section describes the primary differences between the periodic and annual inventories; presents an appropriate method for comparing periodic and annual inventory data at plots that were measured during both inventories, or co-located plots; and summarizes some changes in forest attributes that have occurred at co-located plots.

The primary differences between Nevada’s periodic and annual forest inventories pertain to the plot design, sample design, and operational definitions used during field data collection. The periodic inventories of the 1970s, 1980s, and 1990s used a variable-radius plot design with varying numbers of subplots. In contrast, the plot design of the annual inventory consists of four fixed-radius subplots, as described in the *Plot Configuration* section of this report’s “Inventory Methods” chapter. Sample designs also changed appreciably, from samples that sometimes targeted specific ownership groups and sometimes used intensified grids, to a spatially representative plot grid with consistent sample intensity across all forest types

and management categories. The vast majority of plots in the 1978 to 1982 inventory were located on lands managed by the Bureau of Land Management, while the 1994 to 1997 inventory sampled only the Humboldt and Toiyabe National Forests. Nevada's periodic inventories also used an operational definition of "tree" that differentiated between tree-form and shrub-form trees. For example, pinyons that were less than 6 feet tall and were not expected to eventually produce a straight, 8-foot trunk section were not considered to be trees and were not measured, so they were not included in volume-based estimates such as biomass, growth, and mortality. In contrast, the annual inventory identifies trees strictly by their species, regardless of growth form. Therefore, trees on many woodland plots in the current annual inventory would not have been measured under previous definitions.

Due to these differences in forest inventories over time, users of FIA data should be aware of appropriate methods of evaluating trends and avoid inappropriate methods. Examples of inappropriate comparisons between periodic and annual inventories range from comparing the tree volume on a specific forest type to directly comparing the total area of forest land. Instead, an appropriate method of quantifying trends is to first identify forest plots that were measured during both periodic and annual inventories, and then assess trends at only those plots. FIA refers to such plot locations as co-located plots. Although different plot designs were used during the periodic and annual measurements of co-located plots, each plot design allows estimation of volume, growth, and mortality per acre as well as stand-level variables such as forest type. Therefore, comparisons of multiple measurements at co-located plots are useful for quantifying trends in attributes on a per-acre basis, such as volume, mortality, growth, biomass, and number of trees per acre.

This section presents the results of two analyses of co-located plot data collected during periodic versus annual inventories. The first analysis compares data collected at co-located plots that were measured once between 1994 and 1997 and again after 2004. The second analysis compares co-located plot measurements from 1978 to 1982 to those from 2004 to 2013. Because none of the plots measured between 1978 and 1982 were remeasured during the 1990s, it was not possible to evaluate trends throughout all three inventory periods. Figure 60 shows the distribution of all plots in the 1978 to 1982 inventory, all plots in the 1994 to 1997 inventory, all plots in the annual inventory, and the plots that were co-located between each of the annual inventory and each of the periodic inventories. Because the two periodic inventories were conducted on different ownership groups, the slightly different magnitudes of the results reported here reflect not only temporal differences, but also differences related to land management and other geographic factors associated with the different land ownership groups that were targeted during the two periodic inventories.

The analysis of change between the 1990s and the annual inventory consisted of 406 co-located plots that were measured during both periods. The results of that analysis have been presented by Goeking (2015) and are summarized here. The 1994 to 1997 inventory underrepresented pinyon/juniper forest types and, to a lesser extent, overrepresented the following forest-type groups: aspen/birch, fir/

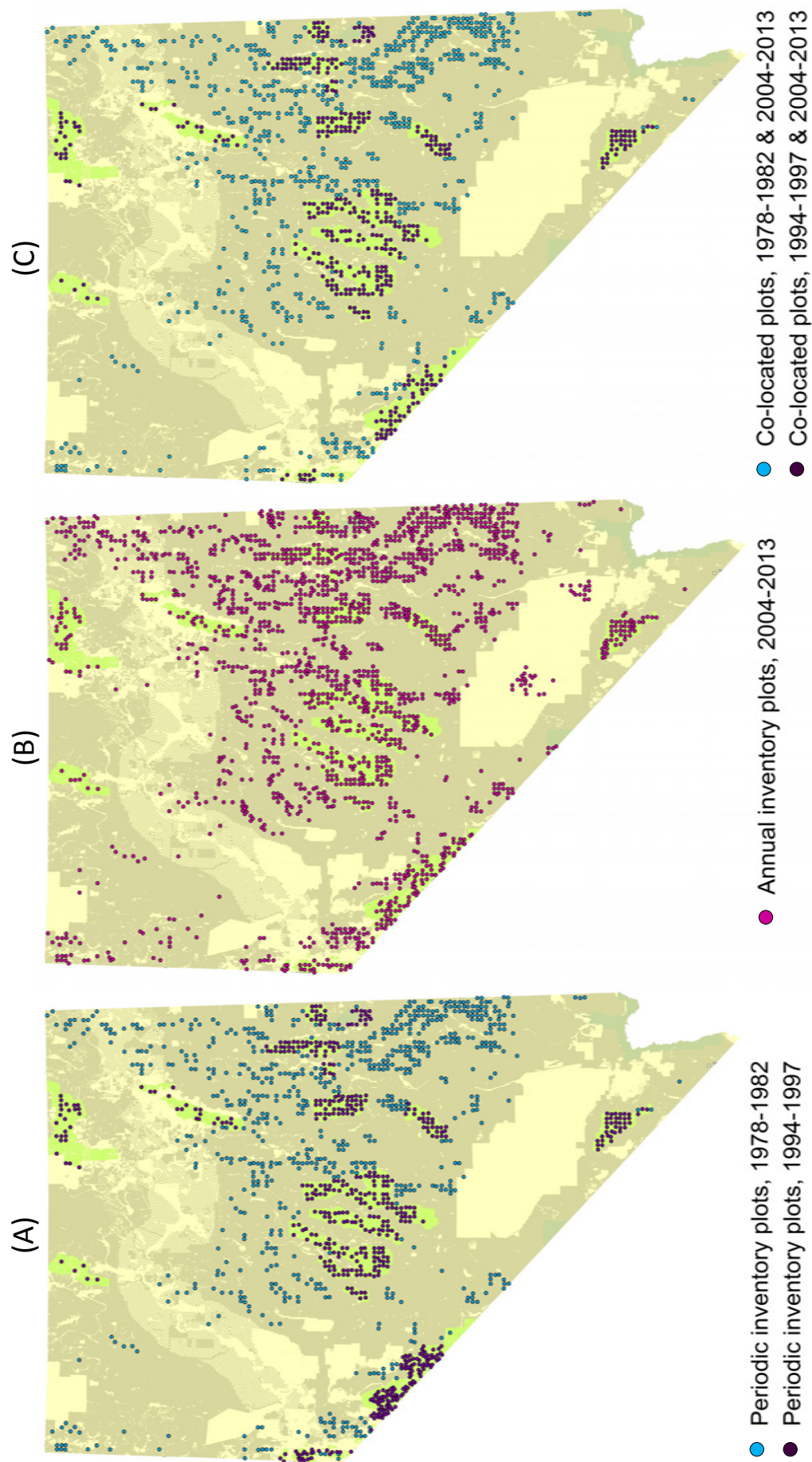


Figure 60—Approximate locations of periodic inventory plots measured in 1978–1982 and 1994–1997 (A), annual inventory plots measured in 2004–2013 (B), and co-located plots measured during one of the periodic inventories and again during the annual inventory (C).

spruce/mountain hemlock, ponderosa pine, and woodland hardwoods. Average annual tree mortality at co-located plots increased from 1.2 to 6.5 cubic feet per acre per year, and net growth decreased from 5.4 to 1.7 cubic feet per acre, although this change was not statistically significant. Because net growth equals gross growth minus mortality, the change in net growth likely reflects the large increase in mortality accompanied by an increase in gross growth. Over this same time period, both live and dead net volume per acre increased. In contrast to the results from co-located plots, a comparison of all plots in both inventories indicated no change in live net volume (Goeking 2015), thus demonstrating that comparing periodic to annual inventories in their entirety may produce misleading results. The second analysis consisted of 765 co-located plots that were measured during both the 1978 to 1982 inventory and the annual inventory. The results showed the same patterns as those from the first comparison: increases in live volume, dead volume, and mortality, and a decrease in net growth. Mortality increased from an average of 0.3 to 5.2 cubic feet per acre per year, while net growth decreased from 4.7 to -0.2 cubic feet per acre per year. Note that a negative value of net growth indicates that, on average, mortality exceeded gross growth.

To investigate changes for individual tree species, we quantified live basal area, dead basal area, mean annual growth, and mean annual mortality, as measured at co-located plots in 1994 to 1997 and again in 2004 to 2013, for the four most commonly tallied tree species in Nevada: curlleaf mountain-mahogany, quaking aspen, singleleaf pinyon, and Utah juniper. Because 5-needle pines provide important high-altitude habitat and are species of concern to managers, they were also analyzed as a group. The 5-needle pine group includes the following species, in decreasing order of abundance on co-located FIA plots: limber pine, whitebark pine, Great Basin bristlecone pine, and western white pine. These species were analyzed in aggregate because none of them was present at enough co-located plots for a single-species analysis. Figure 61 shows that all species, except for the group of 5-needle pines, showed positive net growth during both inventory periods. Curlleaf mountain-mahogany and Utah juniper both showed slightly higher net growth in 2004 to 2013 than in 1994 to 1997. Quaking aspen, singleleaf pinyon, and the 5-needle pines had lower net growth during the annual inventory, and these decreases in net growth appear to be attributable to increased mortality. In 2004 to 2013, all species except Utah juniper had more live basal area per acre, and all species had more dead basal area per acre, than in 1994 to 1997 (fig. 62). Given the recent negative net growth of 5-needle pines (fig. 61), we could expect that 5-needle pines will have less live basal area and more dead basal area during the second cycle of Nevada's annual inventory.

The caveat of the co-located plot analysis presented here is that results cannot be scaled to the entire State and cannot overcome the limitations of the periodic sample design. For example, if the periodic inventory under-sampled a particular forest type, an analysis of co-located plots will still underrepresent that forest type and will instead exhibit trends that occurred on forest types that were sampled more representatively. Nonetheless, it provides an indication of the direction of change in Nevada's forests. As Nevada's forest inventory continues into its second

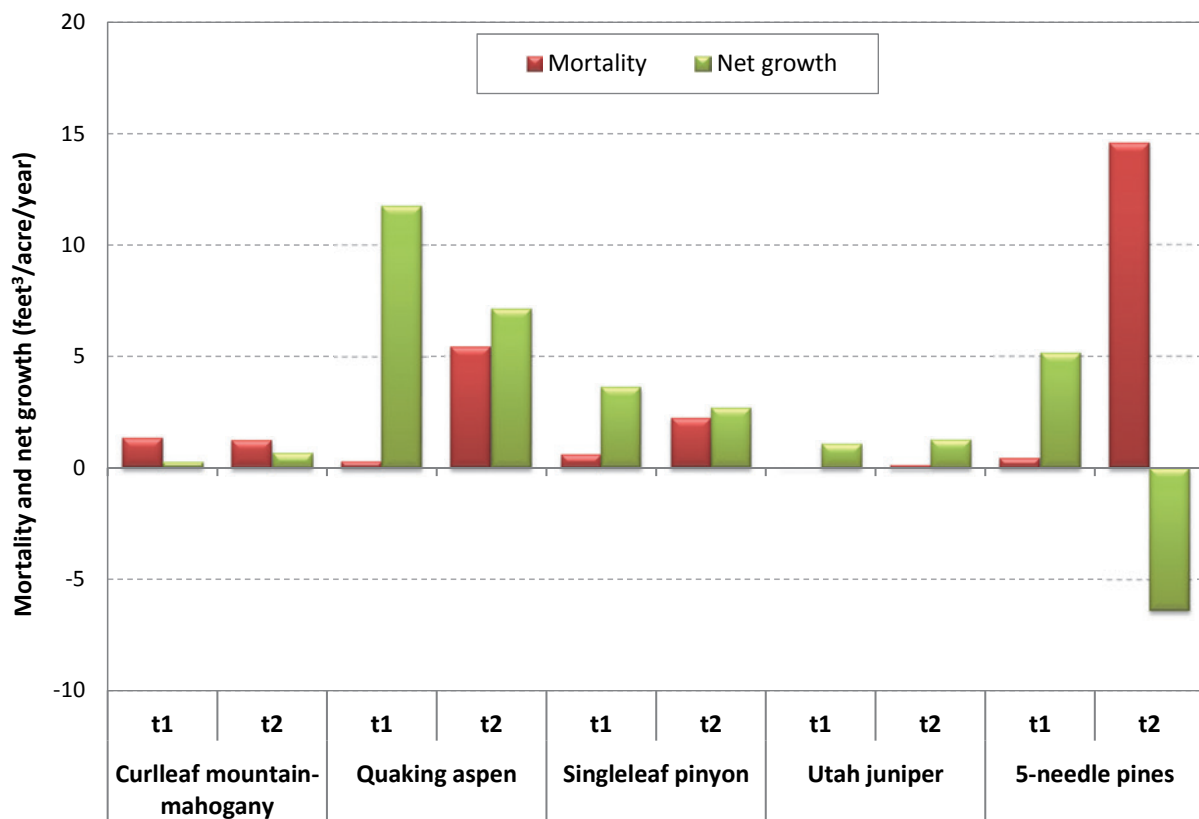


Figure 61—Mean annual mortality and mean annual net growth for major tree species of Nevada, as measured at co-located plots that were measured during the 1994–1997 inventory (t1) and again between 2004 and 2013 (t2).

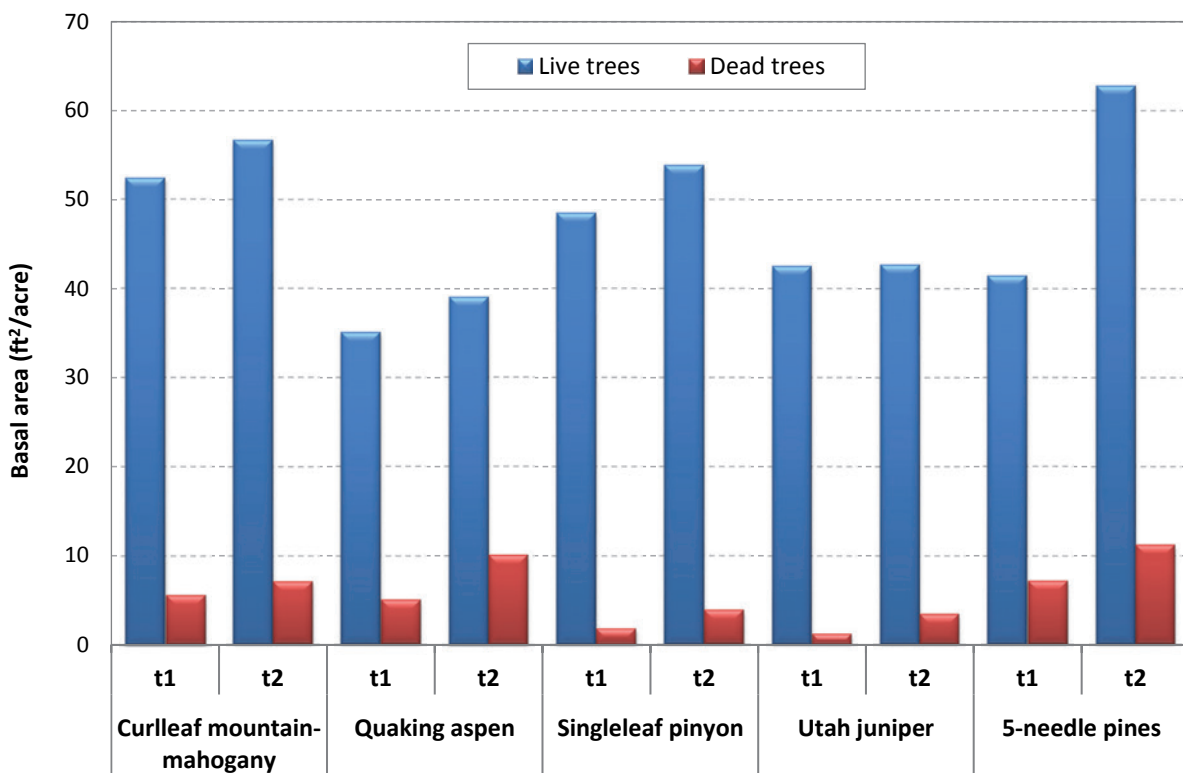


Figure 62—Mean basal area for major tree species of Nevada, as measured at co-located plots that were measured during the 1994–1997 inventory (t1) and again between 2004 and 2013 (t2).

cycle and plots are remeasured at a consistent 10-year interval, FIA's ability to quantify trends in forest attributes will expand from analyses of co-located periodic plots to robust Statewide estimates of change based on the spatially representative annual plot grid.

Conclusions

As might be expected, based on the prevailing climate, our inventory results show that Nevada is relatively sparsely forested at 16 percent and those forests can be best characterized as woodland. Woodland softwoods, primarily Utah juniper and singleleaf pinyon, and woodland hardwoods, mostly curleaf mountain-mahogany, dominate the forest on the lower slopes and basins of Nevada. Eighty-eight percent of the forest land is in either the pinyon/juniper or woodland hardwoods forest-type group (81 percent and 7 percent, respectively), and about the same proportion of tree counts are in the woodland softwood or woodland hardwood species groups (75 percent and 12 percent, respectively). Woodland hardwoods are less important in terms of volume, growth, and mortality because of the large numbers of small trees. However, numerous mountain ranges of the Great Basin, as well as the eastern edges of the Sierra Nevada, also contain pockets of relatively high forest diversity, which are locally important. This inventory recorded 14 individual non-woodland forest types containing 17 non-woodland tree species at higher elevations in Nevada. In general, Nevada's forests are important local resources, as opposed to being a raw material that is exported elsewhere.

Mortality rates in the current inventory are higher than in previous inventories, primarily due to recent increases in insect activity and fires. Several important non-woodland trees species in Nevada are currently experiencing negative net growth.

The current inventory gives the best Statewide picture of forest resources that has ever been reported. Although previous inventories have some limitations with respect to providing baselines for comparison, analysis of plots common to multiple inventories suggests that live and dead woody biomass continue to accumulate at the State scale. This is not unexpected, because despite occasional disturbances, utilization is relatively low. The combination of recovery processes following 19th and 20th century extraction; woodland range expansion, whether created by altered disturbance regimes or other factors favorable to tree growth; and the relatively unhindered growth of undisturbed forests all point to the possibility of increasing forest biomass in Nevada's future. However, projection is difficult in the face of highly variable factors such as weather and disturbance rates. Continued inventory into the coming remeasurement cycle will permit us to monitor changes in forest characteristics as they occur.

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Appendix A: Standard Forest Inventory and Analysis Terminology

Average annual mortality—The average annual volume of trees 5.0 inches d.b.h./d.r.c. and larger that died from natural causes.

Average annual net growth—Average annual net change in volume of trees 5.0 inches d.b.h./d.r.c. and larger in the absence of cutting (average annual gross growth minus average annual mortality).

Basal area (BA)—The cross-sectional area of a tree stem/bole (trunk) at the point where diameter is measured, inclusive of bark. BA is calculated for trees 1.0 inch and larger in diameter, and is expressed in square feet. For timber species, the calculation is based on diameter at breast height (d.b.h.); for woodland species, it is based on diameter at root collar (d.r.c.).

Biomass—The quantity of wood fiber, for trees 1.0 inch d.b.h./d.r.c. and larger, expressed in terms of oven-dry weight. It includes above-ground portions of trees: bole/stem (trunk), bark, and branches. Biomass estimates can be computed for live and/or dead trees.

Board-foot volume—A unit of measure indicating the amount of wood contained in an unfinished board 1 foot wide, 1 foot long, and 1 inch thick. Board-foot volume is computed for the sawlog portion of a sawtimber-size tree; the sawlog portion includes the part of the bole on a sawtimber-size tree from a 1-foot stump to a minimum sawlog top of 7 inches diameter outside bark (d.o.b.) for softwoods, or 9 inches d.o.b. for hardwoods. **Net board-foot volume** is calculated as the gross board-foot volume in the sawlog portion of a sawtimber-size tree, less deductions for cull (note: board-foot cull deductions are limited to rotten/missing material and form defect—referred to as the **merchantability factor—board-foot**). Board-foot volume estimates are computed in both Scribner and International 1/4-inch rule, and can be calculated for live and/or dead (standing or down) trees.

Census water—Streams, sloughs, estuaries, canals, and other moving bodies of water 200 feet wide and greater, and lakes, reservoirs, ponds, and other permanent bodies of water 4.5 acres in area and greater.

Coarse woody debris—Down pieces of wood leaning more than 45 degrees from vertical with a diameter of at least 3.0 inches and a length of at least 3.0 feet.

Condition class—The combination of discrete landscape and forest attributes that identify, define, and stratify the area associated with a plot. Such attributes include reserved status, owner group, forest type, stand-size class, stand origin, and tree density.

Crown class—A classification of trees based on dominance in relation to adjacent trees in the stand as indicated by crown development and amount of sunlight received from above and the sides.

Crown cover (canopy cover)—The percentage of the ground surface area covered by a vertical projection of plant crowns. Tree crown cover for a sample site includes the combined cover of timber and woodland trees 1.0 inch d.b.h./d.r.c. and larger. Maximum crown cover for a site is 100 percent; overlapping cover is not double counted.

Cubic-foot volume (merchantable)—A unit of measure indicating the amount of wood contained in a cube 1-by-1-by-1 foot. Cubic-foot volume is computed for the merchantable portion of timber and woodland species; the merchantable portion for timber species includes that part of a bole from a 1-foot stump to a minimum 4-inch top d.o.b, or above the place(s) of diameter measurement for any woodland tree with a single 5.0-inch stem or larger or a cumulative (calculated) d.r.c. of at least 5.0 inches to the 1.5-inch ends of all branches. **Net cubic-foot volume** is calculated as the gross cubic-foot volume in the merchantable portion of a tree, less deductions for cull.

Diameter at breast height (d.b.h.)—The diameter of a tree bole/stem (trunk) measured at breast height (4.5 feet above ground), measured outside the bark. The point of diameter measurement may vary for abnormally formed trees.

Diameter at root collar (d.r.c.)—The diameter of a tree stem(s) measured at root collar or at the point nearest the ground line (whichever is higher) that represents the basal area of the tree, measured outside the bark. For multi-stemmed trees, d.r.c. is calculated from an equation that incorporates the individual stem diameter measurements. The point of diameter measurement may vary for woodland trees with stems that are abnormally formed. With the exception of seedlings, woodland stems qualifying for measurement must be at least 1.0 inch in diameter or larger and at least 1.0 foot in length.

Diameter class—A grouping of tree diameters (d.b.h. or d.r.c.) into classes of a specified range. For some diameter classes, the number referenced (e.g., 4 inches, 6 inches, 8 inches) is designated as the midpoint of an individual class range. For example, if 2-inch classes are specified (the range for an individual class) and even numbers are referenced, the 6-inch class would include trees 5.0 to 6.9 inches in diameter.

Diameter outside bark (d.o.b.)—Tree diameter measurement inclusive of the outside perimeter of the tree bark. The d.o.b. measurement may be taken at various points on a tree (e.g., breast height, tree top) or log, and is sometimes estimated.

Field plot/field location—A reference to the sample site or plot; an area containing the field location center and all sample points. A field location consists of four subplots and four microplots.

- **Subplot**—A 1/24-acre fixed-radius area (24-foot horizontal radius) used to sample trees 5.0 inches d.b.h./d.r.c. and larger and understory vegetation.

- **Microplot**—A 1/300-acre fixed-radius plot (6.8-foot radius), located 12 feet from the center of each subplot at an azimuth of 90 degrees, used to inventory seedlings and saplings.

Fixed-radius plot—A circular sample plot of a specified horizontal radius: 1/300 acre = 6.8-foot radius (microplot); 1/24 acre = 24.0-foot radius (subplot).

Forest land—Land that has at least 10 percent cover of live tally tree species of any size, or land formerly having such tree cover, and not currently developed for a nonforest use. The minimum area for classification as forest land is 1 acre. Roadside, stream-side, and shelterbelt strips of trees must be at least 120 feet wide to qualify as forest land. Unimproved roads and trails, streams and other bodies of water, or natural clearings in forested areas are classified as forest if less than 120 feet in width or 1 acre in size. Grazed woodlands, reverting fields, and pastures that are not actively maintained are included if the above qualifications are satisfied.

Forest type—A classification of forest land based on the species forming a plurality of live-tree stocking.

Forest-type groups—A group of similar forest types.

Gross growth—The annual increase in volume of trees 5.0 inches d.b.h. and larger in the absence of cutting and mortality. Gross growth includes survivor growth, ingrowth, growth on ingrowth, growth on removals before removal, and growth on mortality prior to death.

Growing-stock trees—A live timber species, 5.0 inches d.b.h. or larger, with less than 2/3 (67 percent) of the merchantable volume cull, and containing at least one solid 8-foot section, now or prospectively, reasonably free of form defect, on the merchantable portion of the tree.

Growing-stock volume—The cubic-foot volume of sound wood in growing-stock trees at least 5.0 inches d.b.h. from a 1-foot stump to a minimum 4-inch top d.o.b. to the central stem.

Hardwood trees—Dicotyledonous trees, usually broadleaf and deciduous.

Inventory year—The year in which a plot was scheduled to be completed. Within each subpanel, all plots have the same inventory year. Inventory year may differ from measurement year.

Land use—The classification of a land condition by use or type.

Litter—The uppermost layer of organic debris on a forest floor; that is, essentially the freshly fallen, or only slightly decomposed material, mainly foliage, but also bark fragments, twigs, flowers, fruits, and so forth. Humus is the organic layer, unrecognizable as to origin, immediately beneath the litter layer from which it is derived. Litter and humus together are often termed duff.

Logging residue/products—

- **Bolt**—A short piece of pulpwood; a short log.
- **Industrial wood**—All commercial roundwood products, excluding fuelwood.
- **Logging residue**—The unused sections within the merchantable portions of sound (growing-stock) trees cut or killed during logging operations.

- **Mill or plant residue**—Wood material from mills or other primary manufacturing plants that is not used for the mill’s or plant’s primary products. Mill or plant residue includes bark, slabs, edgings, trimmings, miscuts, sawdust, and shavings. Much of the mill and plant residue is used as fuel and as the raw material for such products as pulp, palletized fuel, fiberwood, mulch, and animal bedding. Mill or plant residue includes bark and the following components:

- **Coarse residue**—Wood material suitable for chipping, such as slabs, edgings, and trim.

- **Fine residue**—Wood material unsuitable for chipping, such as sawdust and shavings.

- **Pulpwood**—Roundwood, whole-tree chips, or wood residues that are used for the production of wood pulp.

- **Roundwood**—Logs, bolts, or other round sections cut from trees.

Mapped-plot design—A sampling technique that identifies (delineates or maps) and separately classifies distinct “conditions” on the field location sample area. Each condition must meet minimum size requirements. At the most basic level, condition class delineations include forest land, nonforest land, and water. Forest land conditions can be further subdivided into separate condition classes if there are distinct variations in reserved status, owner group, forest type, stand-size class, stand origin, and stand density, given that each distinct area meets minimum size requirements.

Measurement year—The year in which a plot was completed. Measurement year may differ from inventory year.

Merchantable portion—For trees measured at d.b.h. and 5.0 inches d.b.h. and larger, the merchantable portion (or “merchantable bole”) includes the part of the tree bole from a 1-foot stump to a 4.0-inch top (d.o.b.). For trees measured at d.r.c., the merchantable portion includes all qualifying segments above the place(s) of diameter measurement for any tree with a single 5.0-inch stem or larger or a cumulative (calculated) d.r.c. of at least 5.0 inches to the 1.5-inch ends of all branches; sections below the place(s) of diameter measurement are not included. Qualifying segments are stems or branches that are a minimum of 1 foot in length and at least 1.0 inch in diameter; portions of stems or branches smaller than 1.0 inch in diameter, such as branch tips, are not included in the merchantable portion of the tree.

Mortality tree—For the first annual measurement, all standing or down dead trees 5.0 inches d.b.h./d.r.c. and larger that were alive within the previous 5 years (this applies to all plots in the current Nevada inventory); for subsequent plot measurements, all standing or down dead trees 5.0 inches d.b.h./d.r.c. and larger that were alive in the previous inventory.

National Forest System (NFS) lands—Public lands administered by the Forest Service, U.S. Department of Agriculture, such as National Forests, National Grasslands, and some National Recreation Areas.

National Park lands—Public lands administered by the Park Service, U.S. Department of the Interior, such as National Parks, National Monuments, National Historic Sites (such as National Memorials and National Battlefields), and some National Recreation Areas.

Noncensus water—Portions of rivers, streams, sloughs, estuaries, and canals that are 30 to 200 feet wide and at least 1 acre in size; and lakes, reservoirs, and ponds 1 to 4.5 acres in size. Portions of rivers and streams not meeting the criteria for census water, but at least 30 feet wide and 1 acre in size, are considered noncensus water. Portions of braided streams not meeting the criteria for census water, but at least 30 feet in width and 1 acre in size, and more than 50 percent water at normal high-water level are also considered noncensus water.

Nonforest land—Land that does not support, or has never supported, forests, and lands formerly forested where tree regeneration is precluded by development for other uses. Includes areas used for crops, improved pasture, residential areas, city parks, improved roads of any width and adjoining rights-of-way, power line clearings of any width, and noncensus water. If intermingled in forest areas, unimproved roads and nonforest strips must be more than 120 feet wide, and clearings, etc., must be more than 1 acre in size, to qualify as nonforest land.

Nonstocked stand—A formerly stocked stand that currently has less than 10 percent stocking, but has the potential to again become 10 percent stocked. For example, recently harvested, burned, or windthrow-damaged areas.

Other Federal lands—Public lands administered by Federal agencies other than the Forest Service, U.S. Department of Agriculture, or the Bureau of Land Management, U.S. Department of the Interior.

Other public lands—Public lands administered by agencies other than the Forest Service, U.S. Department of Agriculture. Includes lands administered by other Federal, State, county, and local government agencies, including lands leased by these agencies for more than 50 years.

Other wooded land—Land that has 5 to 9 percent cover of live tally tree species of any size, or land formerly having such tree cover, and not currently developed for a nonforest use. The minimum area for classification as other wooded land is 1 acre. Roadside, stream-side, and shelterbelt strips of trees must be at least 120 feet wide to qualify as forest land. Unimproved roads and trails, streams and other bodies of water, or natural clearings in wooded areas are classified as other wooded if less than 120 feet in width or 1 acre in size. Grazed woodlands, reverting fields, and pastures that are not actively maintained are included if the above qualifications are satisfied. Not measured after 2012.

Poletimber-size trees—For trees measured at d.b.h., softwoods 5.0 to 8.9 inches d.b.h., and hardwoods 5.0 to 10.9 inches d.b.h. For trees measured at d.r.c., all live trees 5.0 to 8.9 inches d.r.c.

Primary wood processing plants—An industrial plant that processes roundwood products, such as sawlogs, pulpwood bolts, or veneer logs.

Private lands—All lands not owned or managed by a Federal, State, or other public entity, including lands owned by corporations, trusts, or individuals, as well as Tribal lands.

Productive forest land—Forest land capable of producing 20 cubic feet per acre per year of wood from trees classified as a timber species (see Appendix D) on forest land classified as a timber forest type (see Appendix C).

Productivity—The potential yield capability of a stand calculated as a function of site index (expressed in terms of cubic-foot growth per acre per year at age of culmination of mean annual increment). Productivity values for forest land provide an indication of biological potential. Timberland stands are classified by the potential net annual growth attainable in fully stocked natural stands. For FIA reporting, Productivity Class is a variable that groups stand productivity values into categories of a specified range. Productivity is sometimes referred to as “yield” or “mean annual increment.”

Removals—The net volume of sound (growing-stock) trees removed from the inventory by harvesting or other cultural operations (such as timber-stand improvement), by land clearing, or by changes in land use (such as a Wilderness designation).

Reserved land—Land withdrawn from management for production of wood products through statute or administrative designation; examples include Wilderness areas and National Parks and Monuments.

Sampling error—A statistical term used to describe the accuracy of the inventory estimates. Expressed on a percentage basis in order to enable comparisons between the precision of different estimates, sampling errors are computed by dividing the estimate into the square root of its variance.

Sapling—A live tree 1.0-4.9 inches d.b.h./d.r.c.

Sawlog portion—The part of the bole of sawtimber-size trees between a 1-foot stump and the sawlog top.

Sawlog top—The point on the bole of sawtimber-size trees above which a sawlog cannot be produced. The minimum sawlog top is 7 inches d.o.b. for softwoods, and 9 inches d.o.b. for hardwoods.

Sawtimber-size trees—Softwoods 9.0 inches d.b.h. and larger and hardwoods 11.0 inches and larger.

Sawtimber volume—The growing-stock volume in the sawlog portion of sawtimber-size trees in board feet.

Seedlings—Live trees less than 1.0 inch d.b.h./d.r.c.

Site index—A measure of forest productivity for a timberland tree/stand. Expressed in terms of the expected height (in feet) of trees on the site at an index age of 50 years (or 80 years for aspen and cottonwood). Calculated from height-to-age equations.

Site tree—A tree used to provide an index of site quality. Timber species selected for site index calculations must meet specified criteria with regards to age, diameter, crown class, and damage.

Snag—A standing dead tree.

- Softwood trees**—Coniferous trees, usually evergreen, having needle- or scale-like leaves.
- Stand**—A community of trees that can be distinguished from adjacent communities due to similarities and uniformity in tree and site characteristics, such as age-class distribution, species composition, spatial arrangement, structure, etc.
- Stand density**—A relative measure that quantifies the relationship between trees per acre, stand basal area, average stand diameter, and stocking of a forested stand.
- Stand density index (SDI)**—A widely used measure developed by Reineke (1933) and is an index that expresses relative stand density based on a comparison of measured stand values with some standard condition; **relative stand density** is the ratio, proportion, or percent of absolute stand density to a reference level defined by some standard level of competition. For FIA reporting, the SDI for a site is usually presented as a percentage of the maximum SDI for the forest type. Site SDI values are sometimes grouped into SDI classes of a specified percentage range. Maximum SDI values vary by species and region.
- Standing dead tree**—To qualify as a standing dead tally tree, dead trees must be at least 5.0 inches in diameter, have a bole that has an unbroken actual length of at least 4.5 feet, and lean less than 45 degrees from vertical as measured from the base of the tree to 4.5 feet. Portions of boles on dead trees that are separated greater than 50 percent (either above or below 4.5 feet) are considered severed and are included in Down Woody Material (DWM) if they otherwise meet DWM tally criteria. For western woodland species with multiple stems, a tree is considered down if more than 2/3 of the volume is no longer attached or upright; cut and removed volume are not considered. For western woodland species with single stems to qualify as a standing dead tally tree, dead trees must be at least 5.0 inches in diameter, be at least 1.0 foot in unbroken actual length, and lean less than 45 degrees from vertical.
- Stand-size class**—A classification of forest land based on the predominant diameter size of live trees presently forming the plurality of live-tree stocking. Classes are defined as follows:
- **Sawtimber stand (Large-tree stand)**—A stand at least 10 percent stocked with live trees, in which half or more of the total stocking is from live trees 5.0 inches or larger in diameter, and with sawtimber (large tree) stocking equal to or greater than poletimber (medium tree) stocking.
 - **Poletimber stand (Medium-tree stand)**—A stand at least 10 percent stocked with live trees, in which half or more of the total stocking is from live trees 5.0 inches or larger in diameter, and with poletimber (medium tree) stocking exceeding sawtimber (large tree) stocking.
 - **Sapling/seedling stand**—A stand at least 10 percent stocked with live trees, in which half or more of the total stocking is from live trees less than 5.0 inches in diameter.
 - **Nonstocked stand**—A formerly stocked stand that currently has less than 10 percent stocking, but has the potential to again become 10 percent stocked. For example, recently harvested, burned, or windthrow-damaged areas.

Stocking—An expression of the extent to which growing space is effectively utilized by live trees.

Timber species—Tally tree species traditionally used for industrial wood products. These include all species of conifers, except pinyon and juniper. Diameters for timber species are measured at breast height (d.b.h.).

Timber-stand improvement—A term comprising all intermediate cuttings or treatments, such as thinning, pruning, release cutting, girdling, weeding, or poisoning, made to improve the composition, health, and growth of the remaining trees in the stand.

Timberland—Unreserved forest land capable of producing 20 cubic feet per acre per year of wood from trees classified as a timber species (see Appendix D) on forest land designated as a timber forest type (see Appendix C).

Unproductive forest land—Forest land not capable of producing 20 cubic feet per acre per year of wood from trees classified as a timber species (see Appendix D) on forest land designated as a timber forest type and all forest lands designated as a woodland forest type (see Appendix C).

Unreserved forest land—Forest land not withdrawn from management for production of wood products through statute or administrative designation.

Wilderness area—An area of undeveloped land currently included in the Wilderness System, managed to preserve its natural conditions and retain its primeval character and influence.

Woodland species—Tally tree species that are not usually converted into industrial wood products. Common uses of woodland trees are fuelwood, fenceposts, and Christmas trees. These species include pinyon, juniper (except for western juniper, *Juniperus occidentalis*), mesquite, locust, mountain-mahogany (*Cercocarpus* spp.), Rocky Mountain maple, bigtooth maple, desert ironwood, and most Intermountain oaks. Because most woodland trees are extremely variable in form, diameter is measured at root collar (d.r.c.).

Note: For the FIA national glossary please go to
<http://fiadocumentation.fia.unlv.edu/fia/index.htm>.

Appendix B: Standard Forest Resource Tables

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Table B1—Percentage of plot area by land status, Nevada, 2004–2013.

Land status	Percentage of sample
Accessible forest land	
Unreserved forest land	
Timberland	0.4
Unproductive	12.7
Total unreserved forest land	13.1
Reserved forest land	
Productive	0.4
Unproductive	2.1
Total reserved forest land	2.5
Total accessible forest land	15.6
Nonforest and other areas	
Nonforest land	82.9
Water	0.6
Census	0.5
Non-Census	0.1
Total nonforest and other areas	83.5
Non-response	
Access denied	0.4
Hazardous conditions	0.3
Other	0.2
Total non-response	0.9
All land	100.0

All table cells without observations in the inventory sample are indicated by —.
Table value of 0.0 indicates the percentage rounds to less than 0.1 percent. Columns and rows may not add to their totals due to rounding.

Table B2—Area of accessible forest land, in thousand acres, by owner class and forest land status, Nevada, 2004–2013.

Owner class	Unreserved forests			Reserved forests		
	Timberland	Unproductive	Total	Productive	Unproductive	All forest land
Forest Service						
National Forest	148.7	2,098.6	2,247.3	154.2	771.9	3,173.3
Other Federal						
National Park Service	—	—	—	35.9	43.9	79.7
Bureau of Land Management	67.6	6,001.1	6,068.7	42.5	549.3	6,660.5
U.S. Fish and Wildlife Service	—	—	—	1.5	107.2	108.7
Department of Defense or Energy	—	138.5	138.5	—	—	138.5
State and local government						
State	3.8	—	3.8	11.2	6.0	21.0
Private						
Undifferentiated private	32.5	363.0	395.5	—	—	395.5
All owners	252.5	8,601.3	8,853.8	245.2	1,478.3	10,577.3

All table cells without observations in the inventory sample are indicated by —. Table value of 0.0 indicates the acres round to less than 0.1 thousand acres. Columns and rows may not add to their totals due to rounding.

Table B3—Area of accessible forest land, in thousand acres, by forest-type group and productivity class, Nevada, 2004–2013.

Forest-type group	Site-productivity class (cubic feet/acre/year)							Total all classes
	0-19	20-49	50-84	85-119	120-164	165-224	225+	
Pinyon / juniper group	8,573.1	—	—	—	—	—	—	8,573.1
Douglas-fir group	—	6.0	11.9	—	—	—	—	17.9
Ponderosa pine group	—	34.7	15.7	—	—	—	—	50.4
Fir / spruce / mountain hemlock group	24.0	106.5	32.6	25.5	5.6	—	—	194.2
Lodgepole pine group	-	19.2	—	—	—	—	—	19.2
Other western softwoods group	84.7	60.6	—	—	—	—	—	145.3
Elm / ash / cottonwood group	—	6.2	—	—	—	—	—	6.2
Aspen / birch group	99.1	113.2	17.2	6.0	—	—	—	235.5
Woodland hardwoods group	737.8	—	—	—	—	—	—	737.8
Nonstocked	560.8	26.7	1.4	8.8	—	—	—	597.7
All forest-type groups	10,079.5	373.0	78.8	40.3	5.6	—	—	10,577.3

All table cells without observations in the inventory sample are indicated by —. Table value of 0.0 indicates the acres round to less than 0.1 thousand acres. Columns and rows may not add to their totals due to rounding.

Table B4—Area of accessible forest land, in thousand acres, by forest-type group, ownership group, and land status, Nevada, 2004-2013.

Forest-type group	Forest Service			Other Federal			State and local government			Undifferentiated private		
	Timber-land	Other forest land		Timber-land	Other forest land		Timber-land	Other forest land		Timber-land	Other forest land	All forest land
Pinyon / juniper group	—	2,249.2		—	6,018.4		—	6.0		—	299.6	8,573.1
Douglas-fir group	—	6.0		—	11.9		—	—		—	—	17.9
Ponderosa pine group	24.3	10.3		—	3.6		3.8	—		8.4	—	50.4
Fir / spruce / mountain hemlock group	38.2	58.1		11.6	76.3		—	5.6		4.5	—	194.2
Lodgepole pine group	10.8	4.2		—	—		—	4.2		—	—	19.2
Other western softwoods group	1.4	96.2		24.1	23.6		—	—		—	—	145.3
Elm / ash / cottonwood group	—	2.8		—	—		—	—		3.4	—	6.2
Aspen / birch group	62.3	126.4		13.7	16.5		—	1.4		10.7	4.5	235.5
Woodland hardwoods group	—	395.8		—	316.8		—	—		—	25.2	737.8
Nonstocked	11.7	75.7		18.2	452.9		—	—		5.5	33.7	597.7
All forest-type groups	148.7	3,024.7		67.6	6,919.9		3.8	17.2		32.5	363.0	10,577.3

All table cells without observations in the inventory sample are indicated by —. Table value of 0.0 indicates the acres round to less than 0.1 thousand acres. Columns and rows may not add to their totals due to rounding.

Table B5—Area of accessible forest land, in thousand acres, by forest-type group and stand-size class, Nevada, 2004–2013.

Forest-type group	Stand-size class				All size classes
	Large diameter	Medium diameter	Small diameter	Nonstocked	
Pinyon / juniper group	7,780.3	557.7	235.2	—	8,573.1
Douglas-fir group	11.9	—	6.0	—	17.9
Ponderosa pine group	50.4	—	—	—	50.4
Fir / spruce / mountain hemlock group	171.8	16.2	6.2	—	194.2
Lodgepole pine group	15.0	4.2	—	—	19.2
Other western softwoods group	129.0	5.6	10.8	—	145.3
Elm / ash / cottonwood group	3.2	—	3.0	—	6.2
Aspen / birch group	9.8	102.9	122.8	—	235.5
Woodland hardwoods group	579.6	32.6	125.5	—	737.8
Nonstocked	—	—	—	597.7	597.7
All forest-type groups	8,751.0	719.2	509.5	597.7	10,577.3

All table cells without observations in the inventory sample are indicated by —. Table value of 0.0 indicates the acres round to less than 0.1 thousand acres. Columns and rows may not add to their totals due to rounding.

Table B6—Area of accessible forest land, in thousand acres, by forest-type group and stand-age class, Nevada, 2004–2013.

Forest-type group	Non-stocked	Stand-age class (years)											All classes
		1-20	21-40	41-60	61-80	81-100	101-120	121-140	141-160	161-180	181-200	201+	
Pinyon / juniper group	—	136.8	150.4	394.2	768.0	1,152.9	1,167.1	1,050.6	1,031.3	750.1	587.7	1,384.0	8,573.1
Douglas-fir group	—	—	6.0	—	—	—	—	—	—	—	6.0	6.0	17.9
Ponderosa pine group	—	—	—	6.6	2.8	4.2	13.2	8.4	—	6.2	—	9.0	50.4
Fir / spruce / mountain hemlock group	—	1.5	4.7	6.6	5.7	26.9	13.5	35.9	17.5	27.0	12.0	43.0	194.2
Lodgepole pine group	—	—	—	4.2	—	—	4.2	6.6	—	—	4.2	—	19.2
Other western softwoods group	—	6.1	4.7	—	6.0	—	23.2	10.8	12.1	11.5	4.5	66.5	145.3
Elm / ash / cottonwood group	—	3.0	—	—	—	0.4	2.8	—	—	—	—	—	6.2
Aspen / birch group	—	78.4	38.4	30.2	38.7	30.5	13.2	6.1	—	—	—	—	235.5
Woodland hardwoods group	—	90.4	12.0	15.0	7.7	34.0	105.7	146.3	166.7	87.0	52.5	20.4	737.8
Nonstocked	597.7	—	—	—	—	—	—	—	—	—	—	—	597.7
All forest-type groups	597.7	316.2	216.1	456.7	829.0	1,248.9	1,342.9	1,264.7	1,227.7	881.8	666.9	1,528.8	10,577.3

All table cells without observations in the inventory sample are indicated by —. Table value of 0.0 indicates the acres round to less than 0.1 thousand acres. Columns and rows may not add to their totals due to rounding.

Table B7—Area of accessible forest land, in thousand acres, by forest-type group and stand origin, Nevada, 2004–2013.

Forest-type group	Stand origin		All forest land
	Natural stands	Artificial regeneration	
Pinyon / juniper group	8,573.1	—	8,573.1
Douglas-fir group	17.9	—	17.9
Ponderosa pine group	50.4	—	50.4
Fir / spruce / mountain hemlock group	194.2	—	194.2
Lodgepole pine group	19.2	—	19.2
Other western softwoods group	145.3	—	145.3
Elm / ash / cottonwood group	6.2	—	6.2
Aspen / birch group	235.5	—	235.5
Woodland hardwoods group	737.8	—	737.8
Nonstocked	597.7	—	597.7
All forest-type groups	10,577.3	—	10,577.3

All table cells without observations in the inventory sample are indicated by —. Table value of 0.0 indicates the acres round to less than 0.1 thousand acres.
Columns and rows may not add to their totals due to rounding.

Table B10—Number of live trees (at least 1.0 inch d.b.h./d.r.c.), in thousand trees, on forest land by species group and diameter class, Nevada, 2004–2013.

Species group	Diameter class (inches)															
	1.0- 2.9	3.0- 4.9	5.0- 6.9	7.0- 8.9	9.0- 10.9	11.0- 12.9	13.0- 14.9	15.0- 16.9	17.0- 18.9	19.0- 20.9	21.0- 24.9	25.0- 28.9	29.0- 32.9	33.0- 36.9	37.0+	
Softwood species groups																
Western softwood species groups																
Douglas-fir	2,239	1,344	431	395	323	180	72	216	36	36	72	72	—	—	—	—
Ponderosa and Jeffrey pine	1,745	—	321	773	323	589	661	661	225	182	502	73	36	—	—	—
True fir	28,980	13,735	10,993	6,743	4,321	2,838	2,635	1,454	808	499	465	211	178	34	39	39
Western white pine	1,259	420	169	67	—	102	—	—	—	—	—	39	—	—	—	—
Engelmann and other spruces	896	448	540	433	252	216	252	144	36	36	108	72	—	36	—	—
Incense-cedar	—	—	67	39	—	—	—	—	—	—	—	—	—	—	—	—
Lodgepole pine	2,171	983	529	461	180	113	73	180	67	67	101	—	34	—	—	—
Other western softwoods	9,951	9,305	5,828	4,289	2,798	2,017	1,507	871	796	471	945	291	147	226	186	186
Other																
Woodland softwoods	560,748	385,335	291,428	222,624	167,511	117,588	78,119	52,185	31,915	21,804	19,429	7,452	3,721	1,246	860	860
All softwoods	607,989	411,569	310,307	235,827	175,709	123,642	83,320	55,712	33,884	23,096	21,622	8,211	4,115	1,542	1,085	1,085
Hardwood species groups																
Western hardwood species groups																
Cottonwood and aspen	123,451	34,773	14,572	7,445	2,812	1,112	499	173	72	135	34	—	—	—	—	—
Other																
Woodland hardwoods	133,401	61,264	38,724	30,035	21,461	12,878	9,602	5,444	3,214	1,220	1,517	405	70	44	—	—
All hardwoods	256,852	96,036	53,296	37,480	24,273	13,990	10,101	5,618	3,286	1,355	1,550	405	70	44	—	—
All species groups	864,841	507,605	363,602	273,306	199,981	137,632	93,420	61,329	37,170	24,451	23,173	8,616	4,185	1,586	1,085	1,085

All table cells without observations in the inventory sample are indicated by —. Table value of 0 indicates the number of trees rounds to less than 1 thousand trees. Columns and rows may not add to their totals due to rounding.

Table B11—Number of growing-stock trees (at least 5.0 inches d.b.h./d.r.c.), in thousand trees, on timberland by species group and diameter class, Nevada, 2004–2013.

Species group	Diameter class (inches)												All classes	
	5.0-6.9	7.0-8.9	9.0-10.9	11.0-12.9	13.0-14.9	15.0-16.9	17.0-18.9	19.0-20.9	21.0-24.9	25.0-28.9	29.0-32.9	33.0-36.9		
Softwood species groups														
Western softwood species groups														
Ponderosa and Jeffrey pine	288	524	220	373	412	446	152	73	287	73	—	—	2,847	433
True fir	3,184	1,734	1,240	868	735	449	383	138	34	67	106	39	8,979	3,107
Western white pine	101	67	—	34	—	—	—	—	—	39	—	—	242	13,068
Incense-cedar	—	39	—	—	—	—	—	—	—	—	—	—	39	270
Lodgepole pine	293	225	113	79	39	113	—	34	67	—	34	—	997	1,120
Other western softwoods	802	616	357	462	145	72	148	109	108	—	36	34	2,888	3,374
All softwoods	4,667	3,207	1,929	1,815	1,332	1,079	683	354	497	180	176	73	15,993	21,373
Hardwood species groups														
Western hardwood species groups														
Cottonwood and aspen	3,151	2,718	889	569	180	36	72	—	—	—	—	—	7,615	7,819
All hardwoods	3,151	2,718	889	569	180	36	72	—	—	—	—	—	7,615	7,819
All species groups	7,818	5,924	2,818	2,385	1,512	1,115	755	354	497	180	176	73	23,608	29,191

All table cells without observations in the inventory sample are indicated by —. Table value of 0 indicates the number of trees rounds to less than 1 thousand trees. Columns and rows may not add to their totals due to rounding.

Table B12—Net volume of all live trees (at least 5.0 inches d.b.h./d.r.c.), in million cubic feet, by owner class and forest land status, Nevada, 2004–2013.

Owner class	Unreserved forests		Reserved forests		All forest land
	Timberland	Unproductive	Productive	Unproductive	
		Total		Total	
Forest Service					
National Forest	211.9	1,337.8	261.7	495.6	2,307.0
Other Federal					
National Park Service	—	—	62.5	27.6	90.2
Bureau of Land Management	52.1	2,956.1	63.5	355.8	3,427.5
Fish and Wildlife Service	—	—	0.6	44.5	45.1
Department of Defense or Energy	—	69.0	—	—	69.0
State and local government					
State	9.3	—	21.3	10.4	41.0
Private					
Undifferentiated private	40.4	178.4	—	—	218.8
All owners	313.6	4,541.3	409.7	934.0	6,198.6

All table cells without observations in the inventory sample are indicated by —. Table value of 0.0 indicates the volume rounds to less than 0.1 million cubic feet. Columns and rows may not add to their totals due to rounding.

Table B13—Net volume of all live trees (at least 5.0 inches d.b.h./d.r.c.), in million cubic feet, on forest land by forest-type group and stand-size class, Nevada, 2004–2013.

Forest-type group	Stand-size class				All size classes
	Large diameter	Medium diameter	Small diameter	Nonstocked	
Pinyon / juniper group	4,740.3	186.6	16.0	—	4,942.8
Douglas-fir group	36.1	—	0.0	—	36.2
Ponderosa pine group	92.1	—	—	—	92.1
Fir / spruce / mountain hemlock group	362.3	7.3	1.2	—	370.8
Lodgepole pine group	58.3	1.7	—	—	60.0
Other western softwoods group	235.9	6.8	0.4	—	243.1
Elm / ash / cottonwood group	6.1	—	1.0	—	7.2
Aspen / birch group	17.9	87.7	7.7	—	113.3
Woodland hardwoods group	317.7	7.5	2.4	—	327.6
Nonstocked	—	—	—	5.5	5.5
All forest-type groups	5,866.8	297.5	28.7	5.5	6,198.6

All table cells without observations in the inventory sample are indicated by —. Table value of 0.0 indicates the volume rounds to less than 0.1 million cubic feet. Columns and rows may not add to their totals due to rounding.

Table B14—Net volume of all live trees (at least 5.0 inches d.b.h./d.r.c.), in million cubic feet, on forest land by species group and ownership group, Nevada, 2004–2013.

Species group	Ownership group				All owners
	Forest Service	Other Federal	State and local government	Undifferentiated private	
Softwood species groups					
Western softwood species groups					
Douglas-fir	1.5	33.6	—	—	35.1
Ponderosa and Jeffrey pine	64.3	14.7	6.6	24.4	110.0
True fir	190.2	119.4	17.7	7.4	334.7
Western white pine	4.1	—	0.0	0.7	4.8
Engelmann and other spruces	50.2	6.2	—	—	56.4
Incense-cedar	0.2	—	—	0.2	0.3
Lodgepole pine	37.1	—	1.7	—	38.8
Other western softwoods	199.7	77.8	—	1.9	279.4
Other					
Woodland softwoods	1,490.6	3,258.6	9.8	169.7	4,928.6
All softwoods	2,037.8	3,510.2	35.8	204.2	5,788.1
Hardwood species groups					
Western hardwood species groups					
Cottonwood and aspen	87.0	7.5	4.6	7.0	106.0
Other					
Woodland hardwoods	182.2	114.1	0.7	7.5	304.5
All hardwoods	269.2	121.6	5.2	14.5	410.5
All species groups	2,307.0	3,631.8	41.0	218.8	6,198.6

All table cells without observations in the inventory sample are indicated by —. Table value of 0.0 indicates the volume rounds to less than 0.1 million cubic feet. Columns and rows may not add to their totals due to rounding.

Table B15—Net volume of all live trees (at least 5.0 inches d.b.h./d.r.c.), in million cubic feet, on forest land by species group and diameter class, Nevada, 2004–2013.

Species group	Diameter class (inches)													All classes
	5.0- 6.9	7.0- 8.9	9.0- 10.9	11.0- 12.9	13.0- 14.9	15.0- 16.9	17.0- 18.9	19.0- 20.9	21.0- 24.9	25.0- 28.9	29.0- 32.9	33.0- 36.9	37.0+	
Softwood species groups														
Western softwood species groups														
Douglas-fir	1	2	3	3	2	7	2	1	7	7	—	—	—	35
Ponderosa and Jeffrey pine	0	3	2	7	12	20	8	9	36	9	5	—	—	110
True fir	13	23	30	34	48	36	29	22	31	20	25	7	18	335
Western white pine	0	0	—	1	—	—	—	—	—	3	—	—	—	5
Engelmann and other spruces	1	2	3	4	8	6	2	3	8	9	—	9	—	56
Incense-cedar	0	0	—	—	—	—	—	—	—	—	—	—	—	0
Lodgepole pine	1	3	3	3	2	7	3	4	8	—	5	—	—	39
Other western softwoods	6	15	20	22	24	22	27	18	39	18	10	25	33	279
Other														
Woodland softwoods	255	444	612	684	653	578	452	369	412	220	136	59	54	4,929
All softwoods	277	492	672	758	749	676	523	426	542	286	181	101	105	5,788
Hardwood species groups														
Western hardwood species groups														
Cottonwood and aspen	18	27	22	15	10	3	3	6	1	—	—	—	—	106
Other														
Woodland hardwoods	20	34	43	42	47	36	27	14	26	10	3	2	—	304
All hardwoods	39	61	66	57	57	40	29	20	27	10	3	2	—	411
All species groups	316	553	737	815	806	715	553	446	569	296	184	103	105	6,199

All table cells without observations in the inventory sample are indicated by —. Table value of 0 indicates the volume rounds to less than 1 million cubic feet. Columns and rows may not add to their totals due to rounding.

Table B16—Net volume of all live trees (at least 5.0 inches d.b.h./d.r.c.), in million cubic feet, on forest land by forest-type group and stand origin, Nevada, 2004–2013.

Forest-type group	Stand origin		All forest land
	Natural stands	Artificial regeneration	
Pinyon / juniper group	4,942.8	—	4,942.8
Douglas-fir group	36.2	—	36.2
Ponderosa pine group	92.1	—	92.1
Fir / spruce / mountain hemlock group	370.8	—	370.8
Lodgepole pine group	60.0	—	60.0
Other western softwoods group	243.1	—	243.1
Elm / ash / cottonwood group	7.2	—	7.2
Aspen / birch group	113.3	—	113.3
Woodland hardwoods group	327.6	—	327.6
Nonstocked	5.5	—	5.5
All forest-type groups	6,198.6	—	6,198.6

All table cells without observations in the inventory sample are indicated by —.
Table value of 0.0 indicates the volume rounds to less than 0.1 million cubic feet.
Columns and rows may not add to their totals due to rounding.

Table B17—Net volume of growing-stock trees (at least 5.0 inches d.b.h./d.r.c.), in million cubic feet, on timberland by species group and diameter class, Nevada, 2004–2013.

Species group	Diameter class (inches)														All classes
	5.0- 6.9	7.0- 8.9	9.0- 10.9	11.0- 12.9	13.0- 14.9	15.0- 16.9	17.0- 18.9	19.0- 20.9	21.0- 24.9	25.0- 28.9	29.0- 32.9	33.0- 36.9	37.0+		
Softwood species groups															
Western softwood species groups															
Ponderosa and Jeffrey pine	0	2	1	5	8	13	6	3	23	9	—	—	—	71	
True fir	4	6	10	12	14	14	14	8	3	7	15	—	18	125	
Western white pine	0	0	—	1	—	—	—	—	—	3	—	—	—	4	
Incense-cedar	—	0	—	—	—	—	—	—	—	—	—	—	—	0	
Lodgepole pine	1	2	2	2	1	4	—	2	6	—	5	—	—	25	
Other western softwoods	1	2	3	5	2	2	5	3	4	—	1	—	3	32	
All softwoods	6	12	16	24	26	33	25	17	36	19	22	—	21	258	
Hardwood species groups															
Western hardwood species groups															
Cottonwood and aspen	6	11	8	9	4	1	3	—	—	—	—	—	—	41	
All hardwoods	6	11	8	9	4	1	3	—	—	—	—	—	—	41	
All species groups	12	24	24	33	30	34	28	17	36	19	22	—	21	299	

All table cells without observations in the inventory sample are indicated by —. Table value of 0 indicates the volume rounds to less than 1 million cubic feet. Columns and rows may not add to their totals due to rounding.

Table B18—Net volume of growing-stock trees (at least 5.0 inches d.b.h./d.r.c.), in million cubic feet, on timberland by species group and ownership group, Nevada, 2004–2013.

Species group	Ownership group				All owners
	Forest Service	Other Federal	State and local government	Undifferentiated private	
Softwood species groups					
Western softwood species groups					
Ponderosa and Jeffrey pine	40.5	—	6.4	24.4	71.3
True fir	95.9	22.6	2.8	4.0	125.3
Western white pine	3.5	—	—	0.7	4.2
Incense-cedar	—	—	—	0.2	0.2
Lodgepole pine	24.8	—	—	—	24.8
Other western softwoods	8.7	21.6	—	1.9	32.1
All softwoods	173.3	44.2	9.3	31.1	257.8
Hardwood species groups					
Western hardwood species groups					
Cottonwood and aspen	32.2	2.9	—	5.9	40.9
All hardwoods	32.2	2.9	—	5.9	40.9
All species groups	205.5	47.0	9.3	36.9	298.8

All table cells without observations in the inventory sample are indicated by —. Table value of 0.0 indicates the volume rounds to less than 0.1 million cubic feet. Columns and rows may not add to their totals due to rounding.

Table B19—Net volume of sawtimber trees, in million board feet (International 1/4 inch rule), on timberland by species group and diameter class, Nevada, 2004–2013.

Species group	Diameter class (inches)												All classes
	9.0- 10.9	11.0- 12.9	13.0- 14.9	15.0- 16.9	17.0- 18.9	19.0- 20.9	21.0- 24.9	25.0- 28.9	29.0- 32.9	33.0- 36.9	37.0+		
Softwood species groups													
Western softwood species groups													
Ponderosa and Jeffrey pine	3	20	40	70	31	17	127	48	—	—	—	355	
True fir	31	51	68	70	71	47	15	39	93	—	116	602	
Western white pine	—	4	—	—	—	—	—	24	—	—	—	28	
Lodgepole pine	9	9	6	24	—	13	32	—	27	—	—	120	
Other western softwoods	8	19	7	8	28	15	23	—	3	—	16	127	
All softwoods	52	103	120	172	130	91	196	112	123	—	132	1,231	
Hardwood species groups													
Western hardwood species groups													
Cottonwood and aspen	—	39	20	4	14	—	—	—	—	—	—	77	
All hardwoods	—	39	20	4	14	—	—	—	—	—	—	77	
All species groups	52	142	141	176	144	91	196	112	123	—	132	1,308	

All table cells without observations in the inventory sample are indicated by —. Table value of 0 indicates the volume rounds to less than 1 million board feet. Columns and rows may not add to their totals due to rounding.

Table B20—Net volume of sawlog portion of sawtimber trees, in million cubic feet, on timberland by species group and ownership group, Nevada, 2004–2013.

Species group	Ownership group				All owners
	Forest Service	Other Federal	State and local government	Undifferentiated private	
Softwood species groups					
Western softwood species groups					
Ponderosa and Jeffrey pine	35.5	—	5.6	22.0	63.1
True fir	80.7	18.4	2.4	3.1	104.6
Western white pine	3.0	—	—	0.6	3.6
Lodgepole pine	21.5	—	—	—	21.5
Other western softwoods	8.0	17.8	—	1.8	27.6
All softwoods	148.7	36.2	8.0	27.5	220.4
Hardwood species groups					
Western hardwood species groups					
Cottonwood and aspen	9.9	1.4	—	0.7	12.0
All hardwoods	9.9	1.4	—	0.7	12.0
All species groups	158.5	37.6	8.0	28.3	232.4

All table cells without observations in the inventory sample are indicated by —. Table value of 0.0 indicates the volume rounds to less than 0.1 million cubic feet. Columns and rows may not add to their totals due to rounding.

Table B21—Average annual net growth of all live trees (at least 5.0 inches d.b.h./d.r.c.), in million cubic feet, by owner class and forest land status, Nevada, 2004–2013.

Owner class	Unreserved forests		Reserved forests		All forest land
	Timberland	Unproductive	Productive	Unproductive	
Forest Service					
National Forest	1.2	8.3	-2.1	3.2	10.6
Other Federal					
National Park Service	—	—	-0.8	-2.3	-3.1
Bureau of Land Management	0.2	7.7	-0.5	1.1	8.5
Fish and Wildlife Service	—	—	0.0	-0.3	-0.3
Department of Defense or Energy	—	0.4	—	—	0.4
State and local government					
State	0.2	—	0.3	0.0	0.6
Private					
Undifferentiated private	0.7	-1.1	—	—	-0.4
All owners	2.3	15.4	-3.1	1.7	16.3

All table cells without observations in the inventory sample are indicated by —. Table value of 0.0 indicates the volume rounds to less than 0.1 million cubic feet. Columns and rows may not add to their totals due to rounding.

Table B22—Average annual net growth of all live trees (at least 5.0 inches d.b.h./d.r.c.), in million cubic feet, on forest land by forest-type group and stand-size class, Nevada, 2004–2013.

Forest-type group	Stand-size class				All size classes
	Large diameter	Medium diameter	Small diameter	Nonstocked	
Pinyon / juniper group	28.5	2.6	-1.1	—	29.9
Douglas-fir group	-0.6	—	0.0	—	-0.5
Ponderosa pine group	1.8	—	—	—	1.8
Fir / spruce / mountain hemlock group	-2.4	-0.4	-0.1	—	-2.9
Lodgepole pine group	-1.6	0.1	—	—	-1.5
Other western softwoods group	0.8	0.1	0.0	—	1.0
Elm / ash / cottonwood group	0.1	—	0.0	—	0.1
Aspen / birch group	0.4	2.4	-3.2	—	-0.4
Woodland hardwoods group	1.8	0.1	-1.3	—	0.6
Nonstocked	—	—	—	-11.8	-11.8
All forest-type groups	28.9	5.0	-5.7	-11.8	16.3

All table cells without observations in the inventory sample are indicated by —.
Table value of 0.0 indicates the volume rounds to less than 0.1 million cubic feet.
Columns and rows may not add to their totals due to rounding.

Table B23—Average annual net growth of all live trees (at least 5.0 inches d.b.h./d.r.c.), in million cubic feet, on forest land by species group and ownership group, Nevada, 2004–2013.

Species group	Ownership group				All owners
	Forest Service	Other Federal	State and local government	Undifferentiated private	
Softwood species groups					
Western softwood species groups					
Douglas-fir	0.0	-1.4	—	—	-1.4
Ponderosa and Jeffrey pine	1.2	0.1	0.2	0.3	1.8
True fir	-1.1	-2.6	0.2	0.1	-3.4
Western white pine	-0.2	—	0.0	0.0	-0.2
Engelmann and other spruces	0.5	0.1	—	—	0.6
Incense-cedar	0.1	—	—	0.0	0.1
Lodgepole pine	-1.0	—	0.1	—	-1.0
Other western softwoods	-0.3	-0.5	—	0.0	-0.9
Other					
Woodland softwoods	9.2	8.7	0.0	-1.2	16.8
All softwoods	8.3	4.4	0.5	-0.8	12.4
Hardwood species groups					
Western hardwood species groups					
Cottonwood and aspen	1.3	0.4	0.1	0.4	2.1
Other					
Woodland hardwoods	0.9	0.8	0.0	0.1	1.8
All hardwoods	2.3	1.1	0.1	0.4	3.9
All species groups	10.6	5.5	0.6	-0.4	16.3

All table cells without observations in the inventory sample are indicated by —. Table value of 0.0 indicates the volume rounds to less than 0.1 million cubic feet. Columns and rows may not add to their totals due to rounding.

Table B24—Average annual net growth of growing-stock trees (at least 5.0 inches d.b.h./d.r.c.), in million cubic feet, on timberland by species group and ownership group, Nevada, 2004–2013.

Species group	Ownership group				All owners
	Forest Service	Other Federal	State and local government	Undifferentiated private	
Softwood species groups					
Western softwood species groups					
Ponderosa and Jeffrey pine	1.0	—	0.2	0.3	1.4
True fir	1.2	−0.1	0.0	0.0	1.2
Western white pine	−0.2	—	—	0.0	−0.2
Incense-cedar	—	—	—	0.0	0.0
Lodgepole pine	−1.2	—	—	—	−1.2
Other western softwoods	−0.4	0.2	—	0.0	−0.3
All softwoods	0.2	0.1	0.2	0.3	0.9
Hardwood species groups					
Western hardwood species groups					
Cottonwood and aspen	0.8	0.1	—	0.3	1.2
All hardwoods	0.8	0.1	—	0.3	1.2
All species groups	1.1	0.1	0.2	0.7	2.1

All table cells without observations in the inventory sample are indicated by —. Table value of 0.0 indicates the volume rounds to less than 0.1 million cubic feet. Columns and rows may not add to their totals due to rounding.

Table B25—Average annual mortality of trees (at least 5.0 inches d.b.h./d.r.c.), in million cubic feet, on forest land by owner class and forest land status, Nevada, 2004–2013.

Owner class	Timberland		Unreserved forests		Reserved forests		All forest land
	Unproductive	Total	Unproductive	Productive	Unproductive	Total	
Forest Service							
National Forest	3.2	6.0	9.2	5.4	1.3	6.7	15.9
Other Federal							
National Park Service	—	—	—	1.5	2.7	4.3	4.3
Bureau of Land Management	0.3	20.9	21.2	1.1	1.7	2.8	24.0
Fish and Wildlife Service	—	—	—	—	0.6	0.6	0.6
Department of Defense or Energy	—	0.1	0.1	—	—	—	0.1
State and local government							
State	—	—	—	—	—	—	—
Private							
Undifferentiated private	0.1	2.8	2.9	—	—	—	2.9
All owners	3.6	29.8	33.4	8.0	6.3	14.3	47.7

All table cells without observations in the inventory sample are indicated by —. Table value of 0.0 indicates the volume rounds to less than 0.1 million cubic feet. Columns and rows may not add to their totals due to rounding.

Table B26—Average annual mortality of trees (at least 5.0 inches d.b.h./d.r.c.), in million cubic feet, on forest land by forest-type group and stand-size class, Nevada, 2004–2013.

Forest-type group	Stand-size class				All size classes
	Large diameter	Medium diameter	Small diameter	Nonstocked	
Pinyon / juniper group	14.9	0.8	1.5	—	17.2
Douglas-fir group	0.9	—	—	—	0.9
Ponderosa pine group	0.1	—	—	—	0.1
Fir / spruce / mountain hemlock group	7.2	0.6	0.2	—	7.9
Lodgepole pine group	2.2	—	—	—	2.2
Other western softwoods group	1.0	—	—	—	1.0
Elm / ash / cottonwood group	—	—	—	—	—
Aspen / birch group	0.0	0.3	3.5	—	3.9
Woodland hardwoods group	1.3	0.0	1.3	—	2.7
Nonstocked	—	—	—	12.0	12.0
All forest-type groups	27.5	1.7	6.5	12.0	47.7

All table cells without observations in the inventory sample are indicated by —.
Table value of 0.0 indicates the volume rounds to less than 0.1 million cubic feet.
Columns and rows may not add to their totals due to rounding.

Table B27—Average annual mortality of trees (at least 5.0 inches d.b.h./d.r.c.), in million cubic feet, on forest land by species group and ownership group, Nevada, 2004–2013.

Species group	Ownership group				All owners
	Forest Service	Other Federal	State and local government	Undifferentiated private	
Softwood species groups					
Western softwood species groups					
Douglas-fir	—	1.7	—	—	1.7
Ponderosa and Jeffrey pine	—	—	—	0.1	0.1
True fir	4.8	3.8	—	—	8.6
Western white pine	0.2	—	—	—	0.2
Lodgepole pine	1.4	—	—	—	1.4
Other western softwoods	2.1	1.1	—	—	3.2
Other					
Woodland softwoods	5.5	21.7	—	2.8	30.0
All softwoods	14.0	28.4	—	2.9	45.3
Hardwood species groups					
Western hardwood species groups					
Cottonwood and aspen	1.1	0.0	—	—	1.1
Other					
Woodland hardwoods	0.8	0.5	—	0.0	1.3
All hardwoods	1.9	0.5	—	0.0	2.4
All species groups	15.9	29.0	—	2.9	47.7

All table cells without observations in the inventory sample are indicated by —. Table value of 0.0 indicates the volume rounds to less than 0.1 million cubic feet. Columns and rows may not add to their totals due to rounding.

Table B28—Average annual mortality of growing-stock trees (at least 5.0 inches d.b.h./d.r.c.), in million cubic feet, on timberland by species group and ownership group, Nevada, 2004–2013.

Species group	Ownership group				All owners
	Forest Service	Other Federal	State and local government	Undifferentiated private	
Softwood species groups					
Western softwood species groups					
Ponderosa and Jeffrey pine	—	—	—	0.1	0.1
True fir	0.9	0.3	—	—	1.2
Western white pine	0.2	—	—	—	0.2
Lodgepole pine	1.4	—	—	—	1.4
Other western softwoods	0.5	0.0	—	—	0.6
All softwoods	3.1	0.3	—	0.1	3.5
Hardwood species groups					
Western hardwood species groups					
Cottonwood and aspen	0.1	0.0	—	—	0.1
All hardwoods	0.1	0.0	—	—	0.1
All species groups	3.2	0.3	—	0.1	3.6

All table cells without observations in the inventory sample are indicated by —. Table value of 0.0 indicates the volume rounds to less than 0.1 million cubic feet. Columns and rows may not add to their totals due to rounding.

Table B29—Aboveground dry weight of live trees (at least 1.0 inch d.b.h./d.r.c.), in thousand dry short tons, by owner class and forest land status, Nevada, 2004–2013.

Owner class	Unreserved forests		Reserved forests		All forest land
	Timberland	Unproductive	Productive	Unproductive	
Forest Service					
National Forest	3,768	21,673	4,602	8,841	38,884
Other Federal					
National Park Service	—	—	1,161	505	1,666
Bureau of Land Management	971	53,915	1,155	6,342	62,383
Fish and Wildlife Service	—	—	11	792	804
Department of Defense or Energy	—	1,239	—	—	1,239
State and local government					
State	159	—	338	180	677
Private					
Undifferentiated private	809	3,111	—	—	3,919
All owners	5,707	79,938	7,267	16,660	109,572

All table cells without observations in the inventory sample are indicated by —. Table value of 0 indicates the aboveground tree biomass rounds to less than 1 thousand dry tons. Columns and rows may not add to their totals due to rounding.

Table B30—Aboveground dry weight of live trees (at least 1.0 inch d.b.h./d.r.c.), in thousand dry short tons, on forest land by species group and diameter class, Nevada, 2004–2013.

Species group	Diameter class (inches)																All classes
	1.0-2.9	3.0-4.9	5.0-6.9	7.0-8.9	9.0-10.9	11.0-12.9	13.0-14.9	15.0-16.9	17.0-18.9	19.0-20.9	21.0-22.9	23.0-24.9	25.0-26.9	27.0-28.9	29.0+		
Softwood species groups																	
Western softwood species groups																	
Douglas-fir	9	23	16	38	65	59	41	148	35	22	—	131	145	—	—	731	
Ponderosa and Jeffrey pine	2	—	5	47	29	119	210	351	145	153	311	308	—	154	93	1,927	
True fir	72	194	213	388	487	550	768	570	441	365	177	323	217	91	769	5,624	
Western white pine	1	3	4	5	—	19	—	—	—	—	—	—	48	—	—	80	
Engelmann and other spruces	2	5	15	30	39	63	122	93	35	41	—	119	—	132	134	829	
Incense-cedar	—	—	3	2	—	—	—	—	—	—	—	—	—	—	—	5	
Lodgepole pine	9	12	17	44	43	43	33	107	53	62	127	—	—	—	78	629	
Other western softwoods	21	108	119	272	353	391	421	383	467	306	397	284	215	90	1,236	5,063	
Other																	
Woodland softwoods	1,525	3,432	3,912	6,794	9,443	10,633	10,352	9,387	7,421	6,261	4,186	3,134	2,269	1,653	4,756	85,158	
All softwoods	1,640	3,776	4,304	7,621	10,459	11,878	11,946	11,038	8,596	7,211	5,198	4,298	2,895	2,120	7,067	100,046	
Hardwood species groups																	
Western hardwood species groups																	
Cottonwood and aspen	347	654	372	508	402	262	164	53	43	94	19	—	—	—	—	2,918	
Other																	
Woodland hardwoods	639	1,011	334	557	707	681	763	586	438	226	237	184	91	71	81	6,607	
All hardwoods	986	1,665	706	1,065	1,110	943	928	639	481	320	256	184	91	71	81	9,526	
All species groups	2,626	5,440	5,010	8,685	11,569	12,821	12,873	11,678	9,077	7,530	5,454	4,482	2,986	2,192	7,148	109,572	

All table cells without observations in the inventory sample are indicated by —. Table value of 0 indicates the aboveground tree biomass rounds to less than 1 thousand dry tons. Columns and rows may not add to their totals due to rounding.

Table B31—Area of accessible forest land, in thousand acres, by survey unit, county and forest land status, Nevada, 2004-2013.

Survey unit and county	Unreserved forests			Reserved forests			All forest land
	Timberland	Unproductive	Total	Productive	Unproductive	Total	
Nevada							
Churchill	—	212.4	212.4	—	—	—	212.4
Clark	—	55.5	55.5	22.7	324.3	347.0	402.5
Douglas	45.0	186.6	231.6	—	—	—	231.6
Elko	67.5	1,033.9	1,101.4	43.2	37.2	80.4	1,181.8
Esmeralda	—	180.6	180.6	—	29.1	29.1	209.7
Eureka	2.6	492.8	495.4	—	—	—	495.4
Humboldt	14.0	36.5	50.5	4.5	37.9	42.4	92.9
Lander	6.2	471.0	477.3	—	—	—	477.3
Lincoln	—	1,520.4	1,520.4	6.6	334.6	341.2	1,861.6
Lyon	—	159.0	159.0	—	—	—	159.0
Mineral	—	461.6	461.6	—	—	—	461.6
Nye	7.9	1,709.2	1,717.1	23.6	256.9	280.4	1,997.5
Pershing	—	137.9	137.9	—	—	—	137.9
Storey	—	16.2	16.2	—	—	—	16.2
Washoe	61.3	234.8	296.2	28.0	14.5	42.5	338.7
White Pine	31.3	1,670.7	1,702.0	116.6	443.9	560.4	2,262.5
Carson City	16.6	22.1	38.7	—	—	—	38.7
Total	252.5	8,601.3	8,853.8	245.2	1,478.3	1,723.5	10,577.3
All counties	252.5	8,601.3	8,853.8	245.2	1,478.3	1,723.5	10,577.3

All table cells without observations in the inventory sample are indicated by —. Table value of 0.0 indicates the acres round to less than 0.1 thousand acres. Columns and rows may not add to their totals due to rounding.

Table B32—Area of accessible forest land, in thousand acres, by survey unit, county, ownership group and forest land status, Nevada, 2004–2013.

Survey unit and county	Forest Service				Other Federal				State and local government				Undifferentiated private				All forest land
	Timber- land	Other forest land	Timber- land	Other forest land	Timber- land	Other forest land	Timber- land	Other forest land	Timber- land	Other forest land	Timber- land	Other forest land	Timber- land	Other forest land			
Nevada																	
Churchill	—	—	—	212.4	—	—	—	—	—	—	—	—	—	—	—	212.4	
Clark	—	223.7	—	172.8	—	—	—	—	—	—	—	—	—	—	5.9	402.5	
Douglas	32.8	42.5	—	75.7	—	—	3.8	—	—	—	—	—	8.4	68.3	231.6		
Elko	51.2	190.5	5.6	784.5	—	—	—	—	—	—	—	—	10.7	139.2	1,181.8		
Esmeralda	—	53.2	—	149.2	—	—	—	—	—	—	—	—	—	7.3	209.7		
Eureka	—	87.3	2.6	405.5	—	—	—	—	—	—	—	—	—	—	495.4		
Humboldt	7.3	23.8	6.7	55.0	—	—	—	—	—	—	—	—	—	—	92.9		
Lander	1.4	145.8	4.4	309.0	—	—	—	—	—	—	—	—	0.4	16.3	477.3		
Lincoln	—	36.1	—	1,813.8	—	—	—	—	—	—	—	—	—	11.6	1,861.6		
Lyon	—	113.9	—	40.2	—	—	—	—	—	—	—	—	—	4.9	159.0		
Mineral	—	239.4	—	205.6	—	—	—	—	—	—	—	—	—	16.7	461.6		
Nye	7.9	1,201.0	—	783.4	—	—	—	—	—	—	—	—	—	5.3	1,997.5		
Pershing	—	—	—	122.8	—	—	—	—	—	—	—	—	—	15.2	137.9		
Storey	—	—	—	4.6	—	—	—	—	—	—	—	—	—	11.6	16.2		
Washoe	25.0	47.2	36.4	196.7	—	—	—	—	—	—	—	—	—	22.3	338.7		
White Pine	11.9	620.3	11.9	1,572.0	—	—	—	—	—	—	—	—	7.5	32.9	2,262.5		
Carson City	11.1	—	—	16.6	—	—	—	—	—	—	—	—	5.5	5.5	38.7		
Total	148.7	3,024.7	67.6	6,919.9	67.6	6,919.9	3.8	17.2	3.8	17.2	32.5	363.0	32.5	363.0	10,577.3		
All counties	148.7	3,024.7	67.6	6,919.9	67.6	6,919.9	3.8	17.2	3.8	17.2	32.5	363.0	32.5	363.0	10,577.3		

All table cells without observations in the inventory sample are indicated by —. Table value of 0.0 indicates the acres round to less than 0.1 thousand acres. Columns and rows may not add to their totals due to rounding.

Table B33—Area of timberland, in thousand acres, by survey unit, county and stand-size class, Nevada, 2004–2013.

Survey unit and county		Stand-size class				All size classes
		Large diameter	Medium diameter	Small diameter	Nonstocked	
Nevada	Douglas	41.8	—	—	3.3	45.0
	Elko	18.3	24.7	21.5	3.0	67.5
	Eureka	—	—	2.6	—	2.6
	Humboldt	—	7.3	6.7	—	14.0
	Lander	0.4	4.4	—	1.4	6.2
	Nye	—	1.6	6.3	—	7.9
	Washoe	33.1	—	6.1	22.1	61.3
	White Pine	22.4	6.0	3.0	—	31.3
	Carson City	11.1	—	—	5.5	16.6
Total		127.0	44.1	46.1	35.4	252.5
All counties		127.0	44.1	46.1	35.4	252.5

All table cells without observations in the inventory sample are indicated by —. Table value of 0.0 indicates the acres round to less than 0.1 thousand acres. Columns and rows may not add to their totals due to rounding.

Table B34—Area of timberland, in thousand acres, by survey unit, county and stocking class, Nevada, 2004–2013.

Survey unit and county		Stocking class of growing-stock trees					All classes
		Nonstocked	Poorly stocked	Moderately stocked	Fully stocked	Over-stocked	
Nevada	Douglas	—	—	25.4	16.4	3.3	45.0
	Elko	7.5	20.3	32.1	4.5	3.0	67.5
	Eureka	—	—	2.6	—	—	2.6
	Humboldt	—	5.9	6.7	1.5	—	14.0
	Lander	—	—	—	4.4	1.8	6.2
	Nye	—	—	6.3	1.6	—	7.9
	Washoe	1.4	8.9	4.2	24.7	22.1	61.3
	White Pine	—	14.9	10.4	6.0	—	31.3
	Carson City	—	—	5.5	5.5	5.5	16.6
Total		8.9	50.0	93.2	64.7	35.8	252.5
All counties		8.9	50.0	93.2	64.7	35.8	252.5

All table cells without observations in the inventory sample are indicated by —. Table value of 0.0 indicates the acres round to less than 0.1 thousand acres. Columns and rows may not add to their totals due to rounding.

Table B35—Net volume of growing-stock trees (at least 5.0 inches d.b.h./d.r.c.), in million cubic feet, and sawtimber trees, in million board feet (International 1/4 inch rule), on timberland by survey unit, county, and major species group, Nevada, 2004–2013.

Survey unit and county	Growing stock					Sawtimber				
	Major species group					Major species group				
	Pine	Other softwoods	Soft hardwoods	Hard hardwoods	All species	Pine	Other softwoods	Soft hardwoods	Hard hardwoods	All species
(In million cubic feet)										
Nevada										
Douglas	67.3	36.4	—	—	103.7	344.4	196.3	—	—	540.7
Elko	2.4	33.5	17.3	—	53.2	6.4	149.7	14.9	—	171.0
Humboldt	0.6	—	4.7	—	5.3	0.9	—	5.7	—	6.5
Lander	—	—	2.7	—	2.7	—	—	9.1	—	9.1
Nye	0.0	—	0.7	—	0.8	—	—	—	—	—
Washoe	31.1	18.9	—	—	50.0	148.9	84.2	—	—	233.1
White Pine	17.0	27.1	14.5	1.0	59.6	71.7	100.2	43.4	3.8	219.1
Carson City	4.2	19.3	—	—	23.5	21.7	106.6	—	—	128.3
Total	122.5	135.3	39.9	1.0	298.8	594.0	637.0	73.0	3.8	1,307.8
All counties	122.5	135.3	39.9	1.0	298.8	594.0	637.0	73.0	3.8	1,307.8

All table cells without observations in the inventory sample are indicated by —. Table value of 0.0 indicates the volume rounds to less than 0.1 million cubic or board feet. Columns and rows may not add to their totals due to rounding.

Table B36—Average annual net growth of growing-stock trees (at least 5.0 inches d.b.h./d.r.c.), in million cubic feet, and sawtimber trees, in million board feet (International 1/4 inch rule), on timberland by survey unit, county, and major species group, Nevada, 2004–2013.

Survey unit and county	Growing stock					Sawtimber				
	Major species group				All species	Pine	Major species group			
	Other softwoods	Soft hardwoods	Hard hardwoods	Other softwoods			Soft hardwoods	Hard hardwoods		
(In million cubic feet)										
(In million board feet)										
Nevada										
Douglas	0.0	0.9	—	—	1.0	0.9	4.8	—	—	5.7
Elko	0.1	-0.4	0.6	—	0.3	0.2	-1.3	0.2	—	-0.8
Humboldt	0.0	—	0.2	—	0.2	0.0	—	1.3	—	1.3
Lander	—	—	0.1	—	0.1	—	—	0.3	—	0.3
Nye	0.0	—	0.0	—	0.0	—	—	—	—	—
Washoe	-0.6	0.2	—	—	-0.5	-3.4	0.8	—	—	-2.6
White Pine	0.1	0.2	0.3	0.0	0.6	0.7	0.8	6.1	0.1	7.6
Carson City	0.1	0.4	—	—	0.4	0.3	2.1	—	—	2.4
Total	-0.4	1.2	1.2	0.0	2.1	-1.4	7.3	7.9	0.1	13.8
All counties	-0.4	1.2	1.2	0.0	2.1	-1.4	7.3	7.9	0.1	13.8

All table cells without observations in the inventory sample are indicated by —. Table value of 0.0 indicates the volume rounds to less than 0.1 million cubic or board feet. Columns and rows may not add to their totals due to rounding.

Table B37—Sampling errors (in percent) by survey unit and county for area of timberland, volume, average annual net growth, average annual removals, and average annual mortality on timberland, Nevada, 2004–2013.

Survey unit and county	Forest area	Timberland area	Growing stock (on timberland)			Sawtimber (on timberland)				
			Volume	Growth	Removals	Mortality	Volume	Growth	Removals	Mortality
Nevada										
Churchill	7.75	—	—	—	—	—	—	—	—	—
Clark	6.09	—	—	—	—	—	—	—	—	—
Douglas	9.42	33.42	37.34	100.00	—	89.06	39.42	100.00	—	89.90
Elko	5.11	27.35	43.62	100.00	—	65.03	55.27	100.00	—	67.83
Esmeralda	9.83	—	—	—	—	—	—	—	—	—
Eureka	6.20	100.00	—	—	—	—	—	—	—	—
Humboldt	22.64	63.47	73.96	75.31	—	97.78	63.90	94.22	—	—
Lander	6.75	74.99	99.64	99.64	—	—	99.64	99.64	—	—
Lincoln	2.98	—	—	—	—	—	—	—	—	—
Lyon	10.92	—	—	—	—	—	—	—	—	—
Mineral	6.33	—	—	—	—	—	—	—	—	—
Nye	2.70	81.56	83.58	78.75	—	—	—	—	—	—
Pershing	15.66	—	—	—	—	—	—	—	—	—
Storey	55.99	—	—	—	—	—	—	—	—	—
Washoe	11.29	29.60	54.77	100.00	—	100.00	59.76	100.00	—	100.00
White Pine	2.72	41.70	49.25	66.59	—	81.77	49.56	84.81	—	100.00
Carson City	30.40	54.23	86.82	96.33	—	100.00	86.76	95.26	—	—
Total	1.37	14.27	21.40	88.93	—	48.11	23.94	79.94	—	51.85
All counties										
	1.37	14.27	21.40	88.93	—	48.11	23.94	79.94	—	51.85

All table cells without observations in the inventory sample are indicated by —. Sampling errors that exceed 100% are reported as 100%.

Table B38a—Mean water, carbon, and nitrogen contents of forest floor and soil cores by forest type, visit 1, Nevada, 2000–2004.

Forest Type	Soil layer (cm)	Number of plots	Water content ^b (percent)	Organic carbon (percent)	Inorganic carbon (percent)	Total nitrogen (percent)	C/N ratio	Forest floor mass (Mg/ha)	Organic carbon (Mg/ha)	Total nitrogen (Mg/ha)
<i>Cercocarpus</i> woodland	Forest floor	6	5.13	30.88	—	1.125	28.0	19.36	5.838	0.224
	0–10	6	3.56	1.88	0.96	0.168	11.1	—	20.098	1.780
	10–20	6	2.86	1.14	0.85	0.109	10.4	—	9.962	0.938
Pinyon/juniper group ^a	Forest floor	85	7.37	34.43	—	0.734	49.3	3.65	1.251	0.028
	0–10	85	4.48	1.39	0.42	0.107	13.0	—	12.117	0.929
	10–20	85	6.26	1.16	0.43	0.087	13.5	—	8.866	0.663
Ponderosa/lodgepole/limber pine	Forest floor	4	7.62	28.49	—	0.579	52.0	6.64	1.750	0.037
	0–10	4	5.27	2.01	0.43	0.127	15.9	—	23.132	1.456
	10–20	4	4.58	1.38	0.46	0.068	20.3	—	15.523	0.765
White fir	Forest floor	1	10.17	43.82	—	1.488	29.9	2.45	1.074	0.036
	0–10	1	16.44	2.50	0.52	0.164	15.3	—	15.472	1.014
	10–20	1	10.54	2.12	3.60	0.143	14.8	—	9.675	0.653
Aspen	Forest floor	3	46.57	37.98	—	1.536	24.8	10.28	3.672	0.152
	0–10	3	19.49	6.74	0.52	0.632	10.7	—	47.832	4.490
	10–20	3	16.05	4.93	0.29	0.525	9.4	—	40.817	4.338

^a Pinyon/Juniper group includes Rocky Mountain juniper, juniper woodland, and Pinyon/Juniper woodland.^b Water content and forest floor mass are reported on an oven-dry weight basis (105 °C).

Table B38b—Mean water, carbon, and nitrogen contents of forest floor and soil cores by forest type, visit 2, Nevada, 2006–2010.

Forest Type	Soil layer (cm)	Number of plots	Water content ^b (percent)	Organic carbon (percent)	Inorganic carbon (percent)	Total nitrogen (percent)	C/N ratio	Forest floor mass (Mg/ha)	Organic carbon (Mg/ha)	Total nitrogen (Mg/ha)
Pinyon/juniper group ^a	Forest floor	21	5.42	41.66	—	0.895	48.4	4.48	1.801	0.045
	0–10	21	2.67	1.42	0.27	0.098	14.4	—	13.470	0.936
	10–20	21	5.7	1.08	0.34	0.069	15.6	—	9.004	0.579
Ponderosa/lodgepole pine	Forest floor	3	5.43	42.98	—	0.756	57.0	4.99	2.146	0.038
	0–10	3	2.48	0.73	0.14	0.055	13.4	—	15.938	1.079
	10–20	3	0.88	0.92	0.18	0.023	40.1	—	11.877	0.286

^a Pinyon/Juniper group includes Rocky Mountain juniper, juniper woodland, and Pinyon/Juniper woodland.

^b Water content and forest floor mass are reported on an oven-dry weight basis (105 °C).

Table B39a—Mean physical and chemical properties of soil cores by forest type, visit 1, Nevada, 2000–2004.

Forest Type	Soil layer (cm)	Number of plots	SQI ^a (percent)	Bulk density (g/cm ³)	Coarse fragments (percent)	pH		Bray 1 extractable phosphorus (mg/kg)	Olsen extractable phosphorus (mg/kg)
						H ₂ O	CaCl ₂		
<i>Cercocarpus</i> woodland	0–10	6	71	1.40	29.58	6.87	6.31	—	4.8
	10–20	6	62	1.56	42.76	6.85	6.33	6.2	3.3
Pinyon/juniper group	0–10	85	65	1.32	31.87	7.49	6.88	29.5	8.7
	10–20	85	61	1.38	40.87	7.59	7.01	15.6	4.1
Ponderosa/lodgepole/limber pine	0–10	4	65	1.48	21.01	6.49	5.80	87.9	19.6
	10–20	4	66	1.68	27.80	6.64	6.01	99.7	15.0
White fir	0–10	1	70	0.80	22.59	7.50	7.32	—	3.2
	10–20	1	70	1.29	64.70	7.82	7.53	—	2.6
Aspen	0–10	3	81	1.25	42.48	6.37	5.86	226.3	33.6
	10–20	3	79	1.32	36.75	6.36	6.27	165.2	27.1

^a SQI = Soil Quality Index**Table B39b**—Mean physical and chemical properties of soil cores by forest type, visit 2, Nevada, 2006–2010.

Forest Type	Soil layer (cm)	Number of plots	SQI ^a (percent)	Bulk density (g/cm ³)	Coarse fragments (percent)	pH		Bray 1 extractable phosphorus (mg/kg)	Olsen extractable phosphorus (mg/kg)
						H ₂ O	CaCl ₂		
Pinyon/juniper group	0–10	21	64	1.41	29.37	7.08	6.52	33.3	8.8
	10–20	21	61	1.47	40.15	7.08	6.58	18.1	5.0
Ponderosa/lodgepole pine	0–10	3	44	1.97	9.58	6.06	5.25	160.0	39.2
	10–20	3	44	1.52	19.39	5.48	4.98	217.0	59.6

^a SQI = Soil Quality Index

Table B40a—Mean exchangeable cation concentrations in soil cores by forest type, visit 1, Nevada, 2000–2004.

Forest Type	Soil layer (cm)	Number of plots	1 M NH ₄ Cl Exchangeable cations					AI	ECEC cmolc/kg
			Na	K	Mg (mg/kg)	Ca			
Cercocarpus woodland	0–10	6	12	243	224	2887	3	17.84	
	10–20	6	17	159	264	3393	4	21.27	
Pinyon/juniper group	0–10	85	22	360	247	3029	1	19.21	
	10–20	85	40	318	266	3505	1	21.87	
Ponderosa/lodgepole/limber pine	0–10	4	17	213	209	1413	4	9.68	
	10–20	4	12	174	187	1334	2	8.99	
White fir	0–10	1	11	427	1247	4179	39	32.68	
	10–20	1	11	264	1214	4137	2	31.37	
Aspen	0–10	3	17	782	344	4945	1	29.79	
	10–20	3	23	799	302	3355	2	21.48	

Table B40b—Mean exchangeable cation concentrations in soil cores by forest type, visit 2, Nevada, 2006–2010.

Forest Type	Soil layer (cm)	Number of plots	1 M NH ₄ Cl Exchangeable cations					ECEC cmol/kg
			Na	K	Mg	Ca	Al	
Pinyon/juniper group	0–10	21	23	382	243	1984	0	13.60
	10–20	21	87	419	304	2514	0	17.19
Ponderosa/lodgepole pine	0–10	3	2	101	16	339	16	2.27
	10–20	3	10	103	15	236	34	1.99

Table B41a—Mean extractable trace element concentrations in soil cores by forest type, visit 1, Nevada, 2000–2004.

1 M NH ₄ Cl Extractable										
Forest Type	Soil layer (cm)	Number of plots	(mg/kg)							
			Mn	Fe	Ni	Cu	Zn	Cd	Pb	S
Cercocarpus woodland	0–10	6	10.5	0.00	0.16	0.00	0.23	0.05	0.00	15.7
	10–20	6	7.9	0.00	0.01	0.22	0.22	0.02	0.01	15.8
Pinyon/juniper group	0–10	85	3.1	0.15	0.04	0.00	0.01	0.04	0.13	11.8
	10–20	85	2.8	0.07	0.01	0.04	0.09	0.02	0.24	9.8
Ponderosa/lodgepole/limber pine	0–10	4	11.4	0.00	0.00	0.00	0.03	0.08	0.28	6.8
	10–20	4	6.9	0.00	0.00	0.00	0.00	0.06	0.26	6.4
White fir	0–10	1	10.4	—	—	—	—	—	—	32.6
	10–20	1	6.1	—	—	—	—	—	—	30.5
Aspen	0–10	3	6.3	0.33	0.00	0.00	0.06	0.08	0.56	5.5
	10–20	3	4.4	0.00	0.00	0.00	0.05	0.08	0.52	40.2

Table B41b—Mean extractable trace element concentrations in soil cores by forest type, visit 2, Nevada, 2006–2010.

			1 M NH ₄ Cl Extractable							
Forest Type	Soil layer (cm)	Number of plots	(mg/kg)							
			Mn	Fe	Ni	Cu	Zn	Cd	Pb	S
Pinyon/juniper group	0–10	21	3.9	0.25	0.00	—	0.00	0.03	0.11	4.70
	10–20	21	3.6	0.05	0.00	—	0.01	0.01	0.03	2.30
Ponderosa/lodgepole pine	0–10	3	6.7	0.00	0.00	—	0.00	0.15	1.07	0.00
	10–20	3	36.1	0.00	0.00	—	0.26	0.12	0.00	0.00

Appendix C: Nevada Forest-Type Groups and Forest Types, With Descriptions and Timber (T) or Woodland (W) Designations

Forest types are usually named for the predominant species (or group of species) on the condition. In order to determine the forest type, the stocking (site occupancy) of trees is estimated by softwoods and hardwoods. If softwoods predominate, then the forest type will be one of the softwood types and if hardwoods predominate, then the forest type will be one of the hardwood types (Arner and others 2001). Some other special stocking rules apply to individual forest types and are described below.

Associate species are defined as those that regularly form the majority of the non-predominant species stocking of mixed-species conditions. These descriptions are applicable to the current inventory; species importance, including predominance in some cases, will vary for other States or inventory years. When species are listed, they are in decreasing order of overall forest type stocking.

ASPEN/BIRCH GROUP (T)

Aspen

Predominant species: quaking aspen

Associate species: subalpine fir, limber pine, white fir

Other species: curlleaf mountain-mahogany, Rocky Mountain juniper, California red fir, singleleaf pinyon, whitebark pine, incense-cedar, western juniper, lodgepole pine

DOUGLAS-FIR GROUP (T)

Douglas-fir

Predominant species: Douglas-fir

Associate species: none identified

Other species: white fir, Engelmann spruce, limber pine, Great Basin bristlecone pine, quaking aspen

ELM/ASH/COTTONWOOD GROUP (T)

Cottonwood

Predominant species: black cottonwood

Associate species: none identified

Other species: curlleaf mountain-mahogany

Special rules: Stocking of cottonwoods must be at least 50 percent of total stocking.

FIR/SPRUCE/MOUNTAIN HEMLOCK GROUP (T)

Engelmann spruce

Predominant species: Engelmann spruce

Associate species: quaking aspen

Other species: limber pine

Special rules: In order to use Engelmann spruce stocking predominance, subalpine fir stocking must be less than 5 percent of the total. If subalpine fir stocking is 5 percent or more, Engelmann spruce stocking must be at least 75 percent of the total.

Red fir

Predominant species: California red fir

Associate species: none identified

Other species: western white pine, lodgepole pine, western juniper, Jeffrey pine, white fir

Subalpine fir

Predominant species: subalpine fir

Associate species: limber pine

Other species: quaking aspen, whitebark pine

Special rules: In order to use subalpine fir stocking predominance, Engelmann spruce stocking must be less than 5 percent of the total. If Engelmann spruce stocking is 5 percent or more, subalpine fir stocking must be at least 75 percent of the total.

White fir

Predominant species: white fir

Associate species: curlleaf mountain-mahogany, limber pine, Douglas-fir, Rocky Mountain juniper, Great Basin bristlecone pine, ponderosa pine, quaking aspen

Other species: singleleaf pinyon, Utah juniper, Jeffrey pine, Engelmann spruce

LODEPOLE PINE GROUP (T)

Lodgepole pine

Predominant species: lodgepole pine

Associate species: California red fir

Other species: Jeffery pine, whitebark pine, western white pine, limber pine, mountain hemlock, white fir

NONSTOCKED

Nonstocked

Predominant species: most nonstocked conditions have no live-tree stocking. Where live trees are present, they are most often Utah juniper and/or singleleaf pinyon

Associate species: seldom more than one species on a condition.

Other species (complete species list): Utah juniper, singleleaf pinyon, curlleaf mountain-mahogany, western juniper, Jeffrey pine, limber pine

Special rules: Used when all live stocking is less than 10 percent. Implies disturbance, but may be used for sparse stands with no disturbance, especially with woodland species.

OTHER WESTERN SOFWOODS GROUP (T)

Foxtail pine/bristlecone pine

Predominant species: Great Basin bristlecone pine

Associate species: limber pine

Other species: Engelmann spruce, white fir, curlleaf mountain-mahogany, quaking aspen

Special rules: This is mostly an “either/or” forest type. Foxtail pine does not occur in Nevada, so this will always be Great Basin bristlecone pine predominance.

Note: In the previous periodic inventory, Great Basin bristlecone pine was not distinguished from Rocky Mountain bristlecone pine. The species code used for all bristlecone pines in that inventory was retained for Rocky Mountain bristlecone pine. Therefore, species-based reports using Nevada 1989 data may return results for “Rocky Mountain bristlecone pine.” These are almost certainly Great Basin bristlecone pines.

Limber pine

Predominant species: limber pine

Associate species: white fir

Other species: quaking aspen, Great Basin bristlecone pine, Engelmann spruce, Douglas-fir, curlleaf mountain-mahogany, subalpine fir

Western juniper

Predominant species: western juniper

Associate species: none identified

Other species: curlleaf mountain-mahogany, Utah juniper, western white pine, quaking aspen

Whitebark pine

Predominant species: whitebark pine

Associate species: none identified

Other species: quaking aspen, mountain hemlock

PINYON/JUNIPER GROUP (W)

Juniper woodland

Predominant species: Utah juniper

Associate species: none identified

Other species: white fir, western juniper, curlleaf mountain-mahogany

Special rules: Predominance of any combination of junipers other than Rocky Mountain juniper or western juniper, and live pinyons are NOT present.

Pinyon/juniper woodland

Predominant species: singleleaf pinyon, Utah juniper, common or two-needle pinyon

Associate species: curlleaf mountain-mahogany

Other species: white fir, Gambel oak, Rocky Mountain juniper, quaking aspen, ponderosa pine

Special rules: Any combination of pinyons and junipers other than Rocky Mountain juniper or western juniper predominate. Pinyons must be present.

Rocky Mountain juniper

Predominant species: Rocky Mountain juniper

Associate species: none identified

Other species: quaking aspen, ponderosa pine, curlleaf mountain-mahogany, white fir, whitebark pine, subalpine fir

PONDEROSA PINE GROUP (T)

Jeffrey pine

Predominant species: Jeffrey pine

Associate species: white fir

Other species: curlleaf mountain-mahogany, western white pine, whitebark pine, incense-cedar

Ponderosa pine

Predominant species: ponderosa pine

Associate species: none identified

Other species: singleleaf pinyon, white fir, curlleaf mountain-mahogany

WOODLAND HARDWOODS GROUP (W)

***Cercocarpus* (mountain brush) woodland**

Predominant species: curlleaf mountain-mahogany

Associate species: singleleaf pinyon, Utah juniper, white fir, limber pine

Other species: Rocky Mountain juniper, quaking aspen, Great Basin bristlecone pine, Jeffrey pine, western juniper, Douglas-fir

Deciduous oak woodland

Predominant species: Gambel oak

Associate species: singleleaf pinyon

Other species: curlleaf mountain-mahogany, Utah juniper

Mesquite woodland

Predominant species: screwbean mesquite, honey mesquite

Associate species: none identified

Other species: none identified

Appendix D: Tree Species Groups and Tree Species Measured in Nevada's Annual Inventory, With Common Name, Scientific Name, and Timber (T) or Woodland (W) Designation

HARDWOODS

Cottonwood and aspen group (T)

Black cottonwood (*Populus balsamifera*)

Quaking aspen (*Populus tremuloides*)

Woodland hardwoods group (W)

Curlleaf mountain-mahogany (*Cercocarpus ledifolius*)

Gambel oak (*Quercus gambelii*)

Honey mesquite (*Prosopis glandulosa*)

Screwbean mesquite (*Prosopis pubescens*)

SOFTWOODS

Douglas-fir group (T)

Douglas-fir (*Pseudotsuga menziesii*)

Engelmann and other spruces group (T)

Engelmann spruce (*Picea engelmannii*)

Incense-cedar group (T)

Incense-cedar (*Calocedrus decurrens*)

Lodgepole pine group (T)

Lodgepole pine (*Pinus contorta*)

Other western softwoods group (T)

Great Basin bristlecone pine (*Pinus longaeva*)

Limber pine (*Pinus flexilis*)

Mountain hemlock (*Tsuga mertensiana*)

Western juniper (*Juniperus occidentalis*)

Whitebark pine (*Pinus albicaulis*)

Ponderosa and Jeffrey pines group (T)

Jeffrey pine (*Pinus jeffreyi*)

Ponderosa pine (*Pinus ponderosa*)

True fir group (T)

California red fir (*Abies magnifica*)

Subalpine fir (*Abies lasiocarpa*)

White fir (*Abies concolor*)

Western white pine group (T)

Western white pine (*Pinus monticola*)

Woodland softwoods group (W)

Common or two-needle pinyon (*Pinus edulis*)

Rocky Mountain juniper (*Juniperus scopulorum*)

Singleleaf pinyon (*Pinus monophylla*)

Utah juniper (*Juniperus osteosperma*)

Appendix E: Volume and Site Index Equation Sources

Volume

Chittester and MacLean (1984) was used for western juniper volume estimation.

Chojnacky (1985) was used for curlleaf mountain-mahogany, Gambel oak, and singleleaf pinyon volume estimation.

Chojnacky (1988) was used for honey mesquite and screwbean mesquite volume estimation.

Chojnacky (1994) was used for common or two-needle pinyon, Rocky Mountain juniper, and Utah juniper volume estimation.

Edminster and others (1980) was used for Jeffrey pine and ponderosa pine volume estimation.

Edminster and others (1982) was used for quaking aspen volume estimation.

Kemp (1956) was used for black cottonwood, incense-cedar, and mountain hemlock volume estimation.

Myers (1964) was used for Great Basin bristlecone pine, limber pine, lodgepole pine, and whitebark pine volume estimation.

Myers and Edminster (1972) was used for California red fir, Douglas-fir, Engelmann spruce, subalpine fir, and white fir volume estimation.

Site Index

Brickell (1968) was used for Douglas-fir site index estimation.

Brickell (1970) was used for Engelmann spruce, Great Basin bristlecone pine, Jeffrey pine, limber pine, lodgepole pine, ponderosa pine, subalpine fir, western juniper, western white pine, and whitebark pine site index estimation.

Edminster and others (1985) was used for black cottonwood and quaking aspen site index estimation.

Stage (1966, 1969) was used for white fir site index estimation. [Original equations were reformulated by J. Shaw; documentation on file at U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Ogden, UT.]

Equations from RMSTAND (USDA Forest Service 1993) were used for California red fir and mountain hemlock site index estimation.

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