United States Department of Agriculture

# Nevada Photo-Based Inventory Pilot (NPIP) Resource Estimates (2004–2005)


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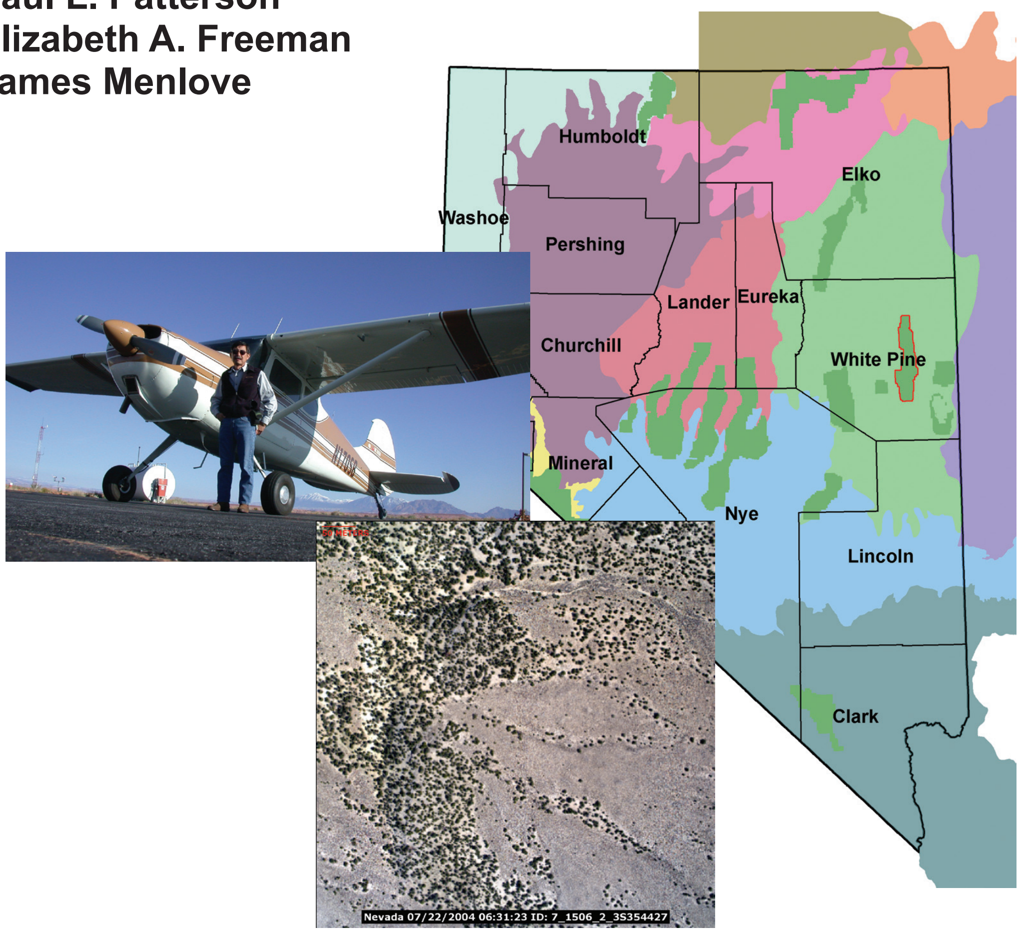


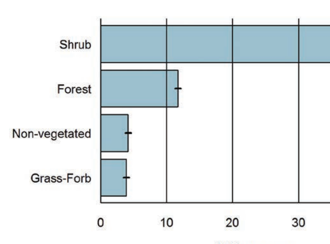


| Sizeclass | Acres | Error (%) |
|---|---|---|
| Nonforest | 51,543,869 | 0.82 |
| Seedlings/Saplings | 1,087,147 | 18.33 |
| 5 inch diameter and greater | 10,130,172 | 3.54 |
| Nonstocked | 527,695 | 22.39 |
| Total | 63,288,883 | -- |


Forest Service

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## Abstract

The complex nature of broad-scale, strategic-level inventories, such as the Forest Inventory and Analysis program (FIA) of the USDA Forest Service, demands constant evolution and evaluation of methods to get the best information possible while continuously increasing efficiency. The State of Nevada is predominantly comprised of nonforested Federal lands with a small proportion of forest land dominated by non-commercial, woodland tree species. In 2004, a pilot study named the Nevada Photo-Based Inventory Pilot (NPIP) was initiated for Nevada using large-scale aerial photography to obtain ancillary information for inventory of forest land and lands not traditionally sampled by FIA, such as rangelands and riparian areas. Objectives of the pilot included development of photo-sampling protocol, statistical estimators, quality control procedures, and cost analyses. This report augments FIA's standard forest reporting by providing new estimates on both forest and nonforest components of Nevada's landscape to include area by cover type, prevalence of non-traditional elements such as disturbance and riparian, and an in-depth analysis of cover distributions. In addition, 250-m (820-ft) resolution maps of species' distributions, live tree cover, and vegetation condition type are also provided.

**Keywords:** photo-based inventory, Nevada, photo interpretation, quality control, large-scale aerial photography (LSP), species distribution maps, cover

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# Contents

# Introduction

Current budget declines along with the complexity of broad-scale, strategic-level inventories, such as the U.S. Department of Agriculture, Forest Service, Forest Inventory and Analysis (FIA) program, demand constant evaluation and evolution of methods to get the best information possible and to continually increase efficiency. In 2004, Interior West (IW)-FIA launched a photo-based inventory pilot in the State of Nevada, referred to as NPIP, to test the use of GPS-controlled, large-scale aerial photography (LSP) for enhancing FIA's existing annual inventory procedures. The purpose was to explore new information that could be gained from inexpensive LSP of forest land and lands not traditionally sampled by FIA, such as rangelands and riparian areas.

Inherent to a comprehensive vegetation inventory are species whose life-form properties are difficult to measure using traditional forestry methods. Land in the Interior Western United States poses a challenge given the prevalence of sparse canopy woodland. Other regions in the United States have similar situations, including: black spruce and willow in the Alaskan region, chaparral and alder in the Pacific Northwestern region, shrub-form hawthorn and serviceberry in the Northern Central region, and mangrove swamps in the Southern region. A national species list has been completed, but still needed is some type of alternative measurement for species that must be accounted for but do not require intensive volume related measures. Examples of these so-called "cover species" are: Tamarisk, Russian Olive, Evergreen oak or chaparral, and non-native tropical species.

A convergence of several issues, efforts, and needs over the 5 years previous to 2004 led to this Nevada project. Over the past 20 years, FIA has gradually expanded from a "productive timberland" inventory to an "all forest land" inventory. Throughout this transition, the organization worked toward improving definitions of "tree" and "forestland," as well as with its own responsibility for answering a multitude of questions about this "all forest land." In 1994, Region 4 of the National Forest System (NFS) expressed the need for strategic-level information based on FIA's sample grid on nonforest areas of National Forests. This led to the collection of a subset of FIA information on nonforest plots on the Bridger-Teton and Humboldt-Toiyabe National Forests. In 1998, the Bureau of Land Management (BLM) Rangeland Health Assessment Protocols were developed, and pilot projects launched in southern Colorado by the BLM and National Resources Conservation Service (Pellant and others 1999; Spaeth and others 1999). By 2000, IW-FIA was making maps of forest attributes at the State and national scales using models and other spatial layers (Ruefenacht and others 2004; Blackard 2005; Blackard and others 2008). A year later, a national FIA task group was formed to develop "consistent forestland definitions and inventory" and to resolve definitions associated with stocking versus cover, and species versus form versus use issues. Concurrently, the Remote Sensing Applications Center (RSAC), IW-FIA, and Region 1 of the NFS investigated the potential of using soft-copy photogrammetry to complement the field sample (Caylor and others 2002). In 2003, the Criteria and Indicators for Sustainable Rangelands was published (O'Brien and others 2003). In 2004, IW-FIA developed new strategies to test and evaluate indicators for assessing rangeland status and health. Simultaneously, IW-FIA prepared to start annual inventory in Nevada after a lag of almost 20 years due to delayed funding.

Nevada is 84% publicly owned and only 14% forested with less than 10 million total acres of forest land. The State was a prime test area because of consistently delayed funding and because it is predominantly nonforested Federal lands, with the small amount of forest land dominated by woodland tree species. Woodland tree species are typically open-grown, slow-growing, and have large crowns, easily identifiable from above. These features provided a basis for analyzing alternative inventory methodologies to the traditional field sampling procedures.

One objective of this project was to develop several inter-related procedures, including: photo-sampling protocol, statistical estimators, quality control procedures, and methods to determine cost efficiencies. The pilot production work included acquisition and processing of the large-scale aerial photography, photo interpretation of sample locations, and organization of interpreted data. Previous reports have documented the photo sample procedures (Frescino and others 2009) and estimation equations (Patterson 2012). This report presents results from NPIP, including photo-based estimates of all vegetation types, map products, and repeatability results.

# Methods

## Data

The sample area includes 63 million acres of the State of Nevada, including water but excluding land with restricted air space, such as land administered by the Department of Defense. The restricted area covers approximately 11 percent of the total area of the State. Global Positioning System- (GPS) controlled aerial photographs were acquired in 2004 and 2005, coincident with the FIA field data collected in the respective years. The survey design followed the systematic sampling design of the national FIA program (Reams and others 2005), consisting of one plot per regularly spaced hexagon distributed nationwide, each representing approximately 6,000 acres.

The State was pre-stratified into three initial strata using an existing, pixel-based, 250-m (820-ft) resolution map of predicted timberland forest, woodland forest, and nonforest lands (Blackard 2009; figure 1). Photos were acquired for all FIA locations within the timberland and woodland strata, totaling 1,455 plots, and one-tenth of the FIA locations within the nonforest stratum, totaling 877 plots, resulting in an overall total of 2,332 plots.

The NPIP sample design consisted of a dot grid within a 250-m (820-ft) radius circle covering approximately 20 ha (48 acres) of land. A total of 49 points per plot represented about 1 acre each (figure 2), the center point of which coincided with the FIA field plot center. Point generation and photo interpretation were accomplished using the Digital Mylar Image Sampler tool developed by the Remote Sensing Applications Center (RSAC) (Clark and others 2004). Each point was assigned a condition class, defined as an area of homogenous vegetation having similar characteristics (USDA 2006), and an object class identifying the object in the photograph the point fell on (Frescino and others 2009).

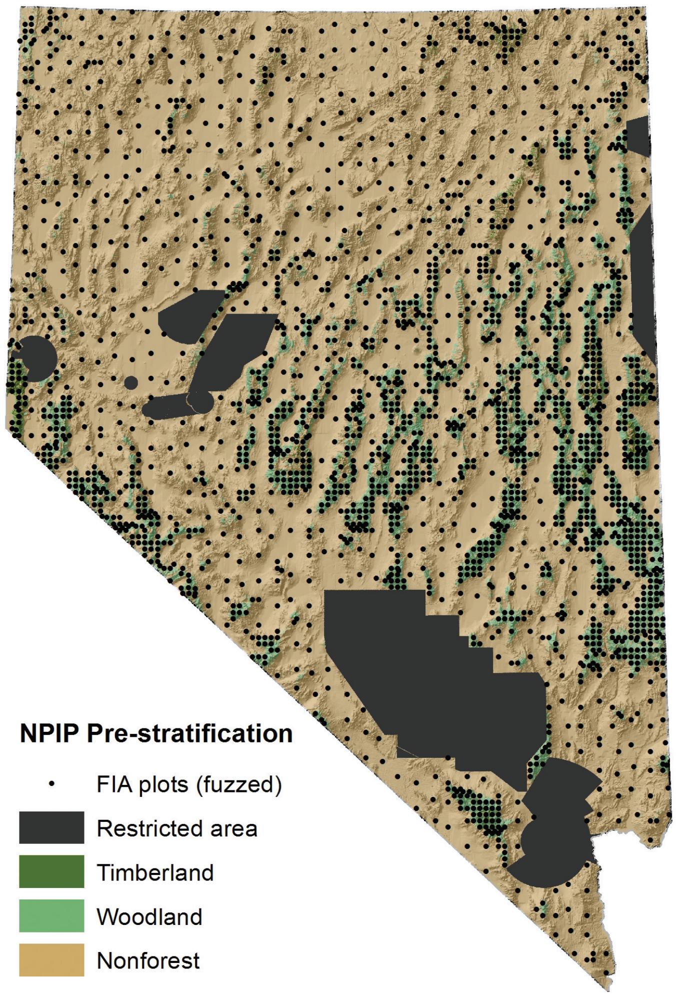


**Figure 1**—Pre-stratification layer for NPIP sample design and estimation (Blackard and others 2004).

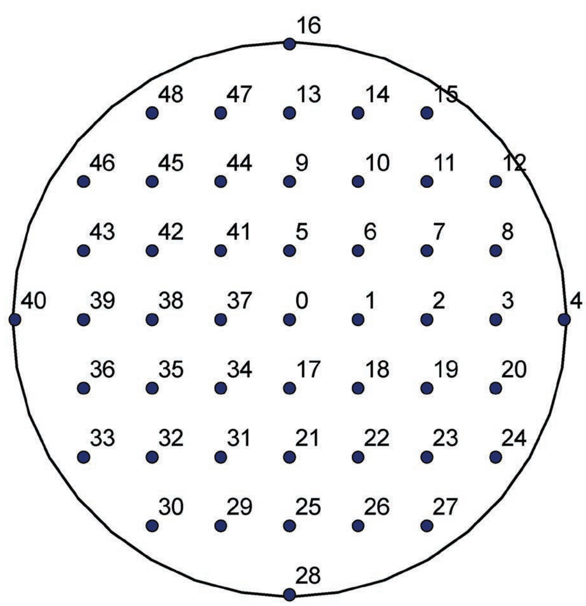


**Figure 2**—NPIP plot design. The center point (0) is located at the theoretical center point of an FIA plot.

The photo estimates in this report are based on the interpreted objects (table 1), categorized by the condition in which the objects fell (table 2). Condition characteristics and delineation methods were based on FIA's field inventory procedures (USDA Forest Service 2013), where separate conditions represent distinct changes occurring across the landscape in one or more of the following attributes: condition class status, condition type (forest and nonforest), stand size class, regeneration status, tree density, owner group, or reserved status (table 2). The first four attributes are distinguishable on an image. The last two attributes are not visible on a photograph and were

**Table 1**—Object definitions.

| Object | Object type | Description |
|---|---|---|
| Engelmann spruce | Tree | *Picea engelmanii* |
| Subalpine fir | Tree | *Abies lasiocarpa* |
| White fir | Tree | *Abies concolor, Abies grandis* |
| California red fir | Tree | *Abies magnifica* |
| Douglas-fir | Tree | *Pseudotsuga menziesii* |
| Great Basin bristlecone pine | Tree | *Pinus longaeva* |
| Limber pine | Tree | *Pinus flexilis* |
| Ponderosa pine | Tree | *Pinus ponderosa* |
| Jeffrey pine | Tree | *Pinus jeffreyi* |
| Washoe pine | Tree | *Pinus washoensis* |
| Sugar pine | Tree | *Pinus lambertiana* |
| Whitebark pine | Tree | *Pinus albicaulis* |
| Incense-cedar | Tree | *Calocedrus decurrens* |
| Quaking aspen | Tree | *Populus tremuloides* |
| Black cottonwood | Tree | *Populus trichocarpa* |
| Pinyon spp. | Tree | *Pinyon* spp. (*Pinus edulis, Pinus discolor*, *Pinus monophylla*) |
| Juniper spp. | Tree | *Juniper* spp. (*Juniperus osteosperma*, *Juniperus scopulorum*, etc.) |
| Mountain-mahogany | Tree | *Cercocarpus ledifolius* |
| Gambel oak | Tree | *Quercus gambelii* |
| Other tree | Tree | Other non-tally tree species (not in list above) |
| Standing dead | Tree | Dead trees greater than 4.5 inches in height |
| Down dead | Tree | Down dead trees or stems |
| Mortality | Tree | Trees that died within the last 5 years (Orange/Yellow color) |
| Sage complex | Shrub | Sage species (Artemisia spp.) |
| Other shrub | Shrub | Non-sage shrub species |
| Dry herbaceous | Other veg | A grass or forb living in dry conditions |
| Wet herbaceous | Other veg | A grass or forb living in moist conditions |
| Agriculture | Other veg | Managed vegetation for agricultural use |
| Pasture | Other veg | Managed vegetation for grazing use |
| Litter | Other veg | Organic debris on forest floor |
| Other vegetation | Other veg | Other vegetation not described above |
| Soil or rock | Barren | Bare soil or rock cover |
| Built (structure) | Barren | Cultural structure (business, residential, other human activity) |
| Improved road | Barren | Roads or rights-of-way regularly maintained for long-term use |
| Unimproved road | Barren | Road not regularly maintained for long-term use |
| Water | Barren | Streams and canals more than 30 ft. wide; lakes and reservoirs more than 1 acre |
| Other barren | Barren | Other barren land cover not described above |
| Snow or ice | Unknown | Snow or ice cover preventing view of object |
| Shadow | Unknown | Shadow preventing view of object |
| Other unknown | Unknown | Other phenomenon preventing view of object |
| Off photo | Unknown | Point falls off the photo |

**Table 2**—Condition attributes. Owner group and reserved status were defined based on ArcGIS data extraction procedures.

| Condition attribute | Definition |
|---|---|
| Condition class status | A classification of the land based on the current vegetation status. |
| Forest/Nonforest type | A classification of forest or non-forest land based on the vegetation or vegetation communities that constitute the majority of cover on the site. Non-forest types include land use classes, such as cropland and developed lands. |
| Stand size class | A classification of forest land based on the predominant size class of all live trees. |
| Regeneration status | A classification of regeneration—natural or artificial. |
| Tree crown density | A classification of forest land based on tree crown cover. |
| Owner group | A classification of a land ownership. |
| Reserved status | An identification of land withdrawn by law(s) prohibiting the management of land for the production of wood products. |
| Disturbance* | The presence of a natural or human-caused disturbance. |
| Treatment* | The presence of a human-caused forest treatment. |

*Ancillary information for condition. Not used for delineation.

attributed using ArcGIS data extraction methods following the photo interpretation. Condition class status designates the forest and nonforest types, among others; stand size and regeneration status are only applied to forest conditions; and all other attributes are applied to both forest and nonforest conditions. The delineation of a condition based on the tree density attribute was slightly different than the FIA's field inventory procedures, where a different condition is indicated based on a relative difference of over 50 percent density. Here, conditions are defined based on different categories of tree density characterizing the stand (Frescino and others 2009). Two other non-delineating condition attributes were recorded as ancillary information based on observations from the image: disturbance and treatment. Disturbance and treatments may not affect the entire condition, but the area affected must still be at least 1 acre in size and have a significant impact to the stand. These impacts may lead to changes in other condition-defining variables, but the boundaries do not necessarily coincide with condition boundaries. For more details, see Frescino and others (2009) or USDA (2013).

Another category of condition class status is riparian land. One of the objectives of NPIP was to take advantage of the large plot size to capture riparian land types. The current sample design and plot size of FIA does not adequately sample unique or less frequent linear features, such as riparian areas. Our classification system was designed to further identify riparian land types rather than using the field protocols from FIA's forest inventory. Photo interpreters chose from three different riparian classes. These classes help to distinguish between defining riparian land based on FIA's traditional field protocol versus using methods unique to NPIP. A riparian class with no associated type indicated that the area fully met the definition and size criteria of an FIA condition: greater than 1 acre in size and at least 120 ft wide (USDA, FS 2005).

According to the FIA manual, an area may also be defined as riparian if it is <120 ft wide but ≥30 ft wide and has at least one forest condition with a shared segment of at least 120 ft. For NPIP, a riparian class with Type B represented this scenario. A riparian class of Type A was added to the photo-based procedure to represent areas similar to the Type B criteria but being adjacent to only nonforest conditions. For more details, see Frescino and others (2009).

It is also important to note costs and logistics associated with acquiring and interpreting these photos. The Aerial Photography Field Office maintains a vehicle for acquiring large-scale imagery in both film and direct-to-digital acquisition. For this project, costs per plot at the time of data collection follow and are based on collection of three photos (triplicates) per plot or stereo coverage. It cost $120 to capture a plot in triplicate if acquisition was processed directly to digital format, plus an additional $20 per triplicate for scanning if not direct to digital; printing the triplicate cost $10. Photo interpretation cost $80 per plot, assuming a photo-interpreter can complete more than one plot per hour on average. Finally, quality control and quality assessment activities are estimated to cost $30 per plot to include quality checks and field validation. This brings the total to approximately $260 per photo-plot, contrasted to the average cost of $2000 per field plot.

## Repeatability

Frescino and others (2009) provided details on quality control measures spanning photo-interpreter training, data compilation and edit checking, field validation, and interpreter repeatability. Here, we focus strictly on quality assessment, or repeatability and consistency between photo interpreters. Because White Pine County was used as a pilot area, plots had been photo interpreted by many interpreters, so these plots have been excluded from this repeatability analysis. Outside White Pine County, only two photo interpreters were used. For a repeatability analysis between these two interpreters, a random subset of 10 percent of the plots (188 plots) was selected. Of these, 118 plots originally interpreted by interpreter 1 were re-interpreted by interpreter 2, and 70 plots originally interpreted by interpreter 2 were re-interpreted by interpreter 1. These plots were assessed at their unedited and edited levels. Error matrices were used to compare both object and condition level plot data for several classes. A program was developed in R (R Core Team 2013) to generate the error matrices and produce summary statistics on the repeatability between photo interpreters.

## Estimation Strategies

Three classes of population characteristics are of interest for this inventory:

1. Area of land classified as being in a particular condition; for example, proportion of land in pinyon/juniper forest type or proportion of land that is privately owned and in pinyon/juniper forest type
2. Percent cover by an object type across the landscape; for example, percent cover by bare ground or the percent cover by pinyon trees
3. Percentage of a condition that is occupied by a particular attribute; for example, percentage of bare ground in the pinyon/juniper forest type or the percentage of pinyon/juniper forest type covered by Juniper trees

Historically, FIA derives the properties of estimators based on the finite sampling paradigm, i.e., under the assumption of a finite population. However, this approach has the theoretical difficulties of specifying what the population unit is and whether area is subdivided into distinct non-overlapping population units. A different approach is to construct an estimator and derive its properties using the infinite sampling paradigm where the probability sample is a set of points from a continuous population (Cordy 1993). From an infinite sampling perspective, the NPIP sample is a set of clusters of sample points (the clusters are the photo-interpreted points within each photo-plot), with the clusters centered on the FIA plot centers. From this perspective, determining the probability of selection for a population element is difficult, more so for photo-plots that straddle a stratum boundary. Instead, one can consider the photo-plot as a support region for a measurement assigned to the FIA plot center, where a support region is the region over which the measurement is calculated (e.g., the proportion of bare ground on a photo-plot is the measurement assigned to the photo-plot center and is calculated on the support region of the photo-plot). In this case, the sample is the collection of FIA plot centers, and the 49 photo-interpreted points within each photo-plot comprise a separate point sample of the support region. An advantage of using a support region is that the independent samples from each stratum are maintained. The disadvantage is that the value assigned to the FIA plot center is an average of the attribute of interest over the entire support region and does not reflect the exact measure at that point. Patterson (2012) used Stevens and Urquhart's (2000) results on support regions, along with Cordy's (1993) extension of the Horvitz-Thompson estimator for an infinite universe, to construct unbiased estimators and unbiased estimated variances for the NPIP study.

For the purpose of estimation, the FIA quasi-systematic sample is treated as a simple random sample (Bechtold and Patterson 2005). We treat the NPIP sample as a pre-stratified sample, with a simple random sample within each stratum. For each 250-m (820-ft) radius photo-plot that was co-located with an FIA plot location, a systematic grid of 49 points was located within each photo-plot. Cochran (1977) shows that systematic sampling has a smaller variance than simple random sampling when units within systematic samples have greater variability than the population as a whole. We assume the systematic grid that was located within each photo-plot does not coincide with any systematic land feature within the photo-plot; hence, treating the systematic sample as a simple random sample produces a conservative estimate of the variance.

The temporal differences between photo acquisition dates were not taken into account in the estimation process, so the estimates are a blending of conditions in 2004 and 2005. All the population characteristics can be stated in terms of proportions; for example, if $R$ is the region of interest (e.g., a state, county, or ecoregion), then the area of land classified as being in condition $c$ is equal to $||R||P_c$, where $P_c$ is the proportion of area classified as being in condition $c$ and $||R||$is the area of $R$.

The next two subsections are devoted to stating the estimators and estimated variances used for estimating the proportion of land by characteristic or type and the proportion of land within a condition that has a particular attribute. For details of the justifications of the stated statistical properties, see Patterson (2012).

### *Characteristics of Interest: Proportion of Condition or Cover*

In this section, we cover estimation of the proportion of a region $R$ that is classified as being in condition $c$ or the proportion of $R$ that is covered by object $o$. Suppose $R$ has been partitioned into $H$ subregions, $R_1, R_2, \ldots, R_H$ and an independent sample $S(R_h)$ of size $n_h$ is drawn from each $R_h$. A photo-plot is centered on each point $s_{hi}$ in $S(R_h)$ and a sample of size $m_{hi}$ is drawn from each photo-plot. For most photo-plots, $m_{hi}$ is equal to 49; for some photo-plots, location errors mean the photo-plot is not totally contained on the photo and $m_{hi}$ is less than 49. Let $s_{hij}$ be the *jth* point of the *ith* photo-plot in stratum $h$, and define the following two attributes of the sample:

$$y_{chij} = \begin{cases} 1, & \text{if } s_{hij} \text{ is in condition } c \\ 0, & \text{otherwise} \end{cases}, \text{ and}$$

$$y_{ohij} = \begin{cases} 1, & \text{if } s_{hij} \text{ falls on object } o \\ 0, & \text{otherwise} \end{cases}.$$

Let

$$p_{chi} = \frac{1}{m_{hi}} \sum_{j=1}^{m_{hi}} y_{chij} \quad \text{and} \quad \bar{p}_{ch} = \frac{1}{n_h} \sum_{i=1}^{n_h} p_{chi}, \qquad [1]$$

then an unbiased estimator of $P_c$ is given by

$$\hat{P}_c = \sum_{h=1}^{H} W_h \bar{p}_{ch}, \text{ where } W_h = \|R_h\| / \|R\|. \qquad [2]$$

An unbiased estimator of the $V(\hat{P}_c)$ variance of the estimator $\hat{P}_c$ is given by

$$\hat{V}(\hat{P}_c) = \sum_{h=1}^{H} W_h^2 \frac{1}{n_h(n_h - 1)} \left[ \sum_{i=1}^{n_h} (p_{chi} - \bar{p}_{ch})^2 \right] \qquad [3]$$

with the usual form used for calculation.

$$\hat{V}(\hat{P}_c) = \sum_{h=1}^{H} W_h^2 \frac{1}{n_h(n_h - 1)} \left[ \sum_{i=1}^{n_h} p_{chi}^2 - \frac{1}{n_h} \left( \sum_{i=1}^{n_h} p_{chi} \right)^2 \right]. \qquad [4]$$

### *Characteristics of Interest: Percent Cover within Condition*

The proportion of the condition $c$ covered by attribute $o$ is denoted by $P_{o \subset c}$. Since spatial distribution of condition $c$ is unknown, $P_{o \subset c}$ is the ratio of the proportion that is both classified as condition $c$ and covered by object $o$ to the proportion that is classified as condition $c$, that is $P_{o \subset c} = P_{o|c}/P_c$. Let $s_{hij}$ be the *jth* point of the *ith* photo-plot in stratum $h$ and define

$$y_{o|chij} = \begin{cases} 1, & \text{if } s_{hij} \text{ is in domain } c \text{ and falls on object } o \\ 0, & \text{otherwise} \end{cases}, \text{ note } y_{o|chij} = y_{chij} y_{ohij}.$$

An estimator of $P_{o \subset c}$ is given by

$$\hat{P}_{o \subset c} = \frac{\hat{P}_{o|c}}{\hat{P}_c}, \qquad [5]$$

where

$$\hat{P}_{o|c} = \sum_{h=1}^{H} W_h \bar{p}_{o|ch}, \text{ with } \bar{p}_{o|ch} = \frac{1}{n_h}\sum_{i=1}^{n_h} p_{o|chi} \text{ and } p_{o|chi} = \frac{1}{m_{hi}}\sum_{j=1}^{m_{hi}} y_{o|chij}. \qquad [6]$$

An approximate variance is calculated using Taylor linearization (see Sarndal and others 1992: 172-175 and bottom p. 177-178).

$$Var(\hat{P}_{o\subset c}) = \frac{1}{P_c^2}\left[Var(\hat{P}_{o|c}) + P_{o\subset c}^2 Var(\hat{P}_c) - 2P_{o\subset c} Cov(\hat{P}_{o|c}, \hat{P}_c)\right]$$

An estimate of the approximate variance is obtained by estimating all the unknown quantities, that is

$$\hat{V}(\hat{P}_{o\subset c}) = \frac{1}{\hat{P}_c^2}\left[\hat{V}(\hat{P}_{o|c}) + \hat{P}_{o\subset c}^2 Var(\hat{P}_c) - 2\hat{P}_{o\subset c}\hat{C}(\hat{P}_{o|c}, \hat{P}_c)\right] \qquad [7]$$

where

$$\hat{C}(\hat{P}_{o|c}, \hat{P}_c) = \sum_{h=1}^{H} W_h^2 \frac{1}{n_h(n_h-1)}\left[\sum_{i=1}^{n_h}(p_{o|chi} - \bar{p}_{o|ch})(p_{chi} - \bar{p}_{ch})\right] \qquad [8]$$

which for computational proposes can be expressed as

$$\hat{C}(\hat{P}_{o|c}, \hat{P}_c) = \sum_{h=1}^{H} W_h^2 \frac{1}{n_h(n_h-1)}\left[\sum_{i=1}^{n_h} p_{o|chi}p_{chi} - \frac{1}{n_h}\sum_{i=1}^{n_h} p_{o|chi}\sum_{j=1}^{n_h} p_{chi}\right]. \qquad [9]$$

These equations have been incorporated into FIESTA (Forest Inventory Estimation for Analysis; Frescino and others 2012), a user-friendly R package that supports the production of estimates for forest resources based on procedures from Bechtold and Patterson (2005). FIESTA was developed as an alternative data retrieval and reporting tool that is functional within the R environment, allowing customized applications and compatibility with other R-based analyses. FIESTA generates estimates and percent sample errors of the estimates for area, population totals, and ratios while allowing user-defined boundaries, stratification schemes, and data filters. Estimates reported here were generated using the FIESTA package.

In the results reported here, the term "standard error" refers to the square root of the estimated variance of an estimator. The term "percent standard error" refers to 100 times the ratio of the standard error and the estimator. It is important to remember that the results we report are error "estimates"; for example, estimated standard error. However, for simplicity's sake, the "estimated" is not included in the descriptions.

## Mapping Methodology

Maps were derived by modeling a number of response variables derived from the photo-plots, as functions of a set of 250-m (820-ft) resolution remotely sensed and topographic variables. We used the R package ModelMap (Freeman 2009) for model building and map production. The ModelMap package uses the randomForest package to construct models, and applies these models to spatially explicit predictor data layers. The response variables included two discrete variables of condition type groups, one continuous variable of percent live tree cover, and eight binary response variables of presence/absence for individual species or objects having high prevalence in the sample population, including: sagebrush, other shrub species, juniper, pinyon pine, mountain-mahogany, white fir, quaking aspen, and limber pine. In the case of the discrete variables of condition type groups, the type was determined from the condition having the majority of cover on a plot and then grouped into more general classes. Only plots with ≥55 percent homogenous cover of a condition type or type group were used for building the model. The percent cover of live trees for each plot is equal to the number of points with live tree cover on the plot divided by the total number of sampled points on the plot. In the case of the species or object presence variables, a species or object was classified as present if species or object occurred at one or more sampled points on a plot.

The predictor data set consisted of 16 raster layers of multi-temporal, remotely sensed imagery and digital topographic data for the State of Nevada. The remotely sensed imagery consisted of 250-m (820-ft) resolution, 16-day, cloud-free composites of Moderate Resolution Imaging Spectroradiometer (MODIS) imagery for spring, summer, and fall of 2005, including the visible-red (RED) and near-infrared (NIR) bands and two vegetation indices: normalized difference vegetation index (NDVI) and enhanced vegetation index (EVI). Three different dates of each variable were used as a multitemporal approach to capture phenological differences that may occur among seasons. The topographic variables used were derived from the 90-m resolution, National Elevation Dataset produced from the United States Geological Survey (Gesch and others 2009). Elevation (meters) was re-sampled to a 250-m (820-ft) pixel size using the nearest neighbor algorithm in ArcMap (ESRI 2009). Slope (percent) and aspect (degrees) were derived from this 250-m (820-ft) elevation product using ArcGIS, and aspect northing and easting variables were calculated using sine and cosine functions, respectively, to convert aspect from a circular variable to a linear variable.

Random forests models were run using the R package ModelMap (Freeman 2009) following explorations into the effectiveness of down-sampling for stratified designs and unbalanced prevalence (Freeman and others 2012). Map accuracy metrics for the binary species distribution maps included Percent Correctly Classified (PCC), sensitivity, specificity, and Kappa statistics, with thresholding based on maximizing Kappa (Freeman and Moisen 2008). Error matrices from the out-of-bag (OOB) predicted, and observed values, along with Kappa and user and producer's errors, are presented with the discrete maps of condition types, while the continuous cover maps are accompanied by measures of root mean square error.

## Results

### Photo-Based Estimates

We first present estimates of acres or proportion of land by the condition attributes: condition class status, riparian within condition class status, forest and nonforest types, stand density and size class, owner and reserved status, and disturbance. We did not find any instances of a change in condition based on regeneration status, so this attribute was dismissed from the analysis. This may be a function of the ability of the photo-interpreter to see such changes or that it is a rare occurrence in the State of Nevada. Two other condition-based attributes were recorded based on observations from the photo: disturbance and treatment. We also saw little evidence of treatments, so we did not report those results. The next set of analyses focus on percent cover of specific objects the photo points fell on. These analyses capture percent cover by condition attributes and illustrate distributions of cover within conditions. For example, a forest condition may encompass several nonforest objects within its area, and conversely, a nonforest condition may contain forest objects within its area.

### *Condition Class Status and Riparian Types*

The majority of the non-restricted land of the State of Nevada (63,288,883 acres) was classified as nonforest, constituting more than 80 percent of the land (figure 3). This is similar to findings from past assessments in which nonforest lands were also estimated as covering over 80 percent of the land (Born and others 1992). Estimated acres and associated percent standard error by condition class status category, including the riparian classes, are presented in table 3. Here, we see that, of the 11.7 million acres of forest land, more than 27,000 acres are estimated as forested riparian lands, and of the 51.4 million acres of nonforest land, more than 81,000 acres are considered nonforest riparian land. The Type A riparian condition class added 31 plots to the 17 plots that would have been sampled using only Type B classification used for FIA's field protocol. This added approximately 26,000 acres to the total riparian estimate (table 3).

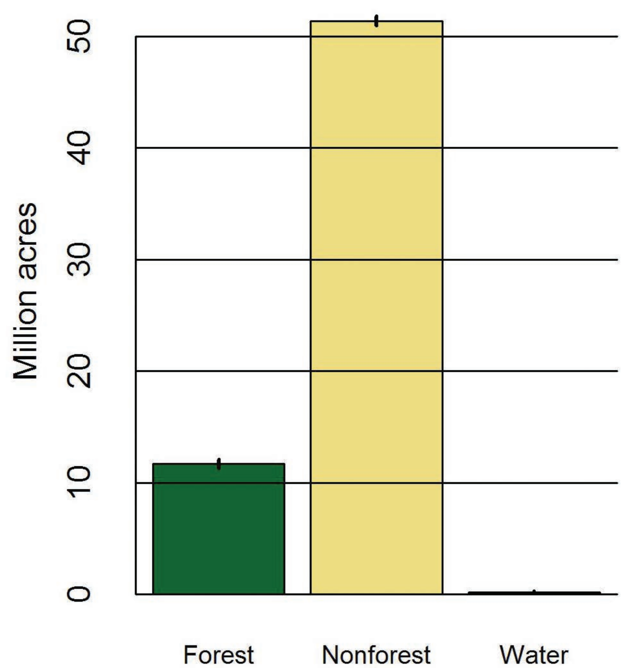


**Figure 3**—Area, in million acres, by condition class status across the State of Nevada. One standard error is indicated on each bar.

**Table 3**—Estimated acres and percent standard error by condition class status and riparian type on all lands; Nevada, 2004–2005.

| Condition class | Condition subclass | Acres | Percent standard error |
|---|---|---|---|
| Forest total | | 11,719,094 | 3.58 |
| | Forest | 11,691,265 | 3.59 |
| | Forest riparian | 13,753 | 63.38 |
| | Forest riparian (Type A) | 4,201 | 46.09 |
| | Forest riparian (Type B) | 9,875 | 66.70 |
| Nonforest total | | 51,370,692 | 0.83 |
| | Nonforest natural | 50,846,659 | 0.87 |
| | Nonforest developed | 442,640 | 28.76 |
| | Nonforest riparian | 16,464 | 74.07 |
| | Nonforest riparian (Type A) | 22,143 | 33.21 |
| | Nonforest riparian (Type B) | 42,786 | 54.79 |
| Noncensus water total | | 15,511 | 49.55 |
| Census water total | | 183,586 | 52.64 |
| Total | | 63,288,883 | — |

### *Forest/Nonforest Type*

Forest and nonforest condition types characterize the ecosystem community that constitutes the majority cover of the site. The nonforest condition types include categories such as cropland and developed land. Figure 4 displays the number of acres estimated for four high-level condition types across the State of Nevada. It is obvious that the dominant vegetation group in Nevada consists of shrub life forms, estimated at more than 40 million acres, in correspondence with the majority of land estimated as a nonforest condition class previously examined (see Appendix, table A.1 for estimates and associated percent standard error). Figure 5 displays the acreage, in more detail, of all ecological condition types for Nevada. Again, the shrub condition types have the highest acreage followed by the pinyon-juniper type, covering more than 8 million acres of total land (Appendix, table A.2). Figure 6 displays the same information with different groupings (Appendix, table A.3).

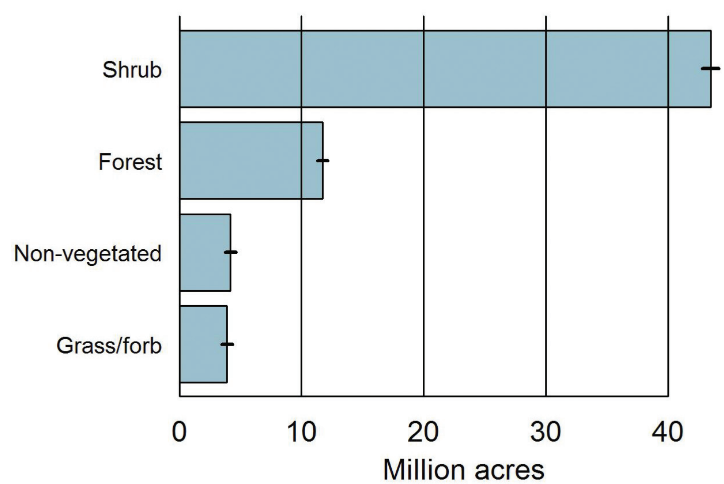


**Figure 4**—Area, in million acres, by vegetation condition type group across the State of Nevada. One standard error is indicated on each bar.

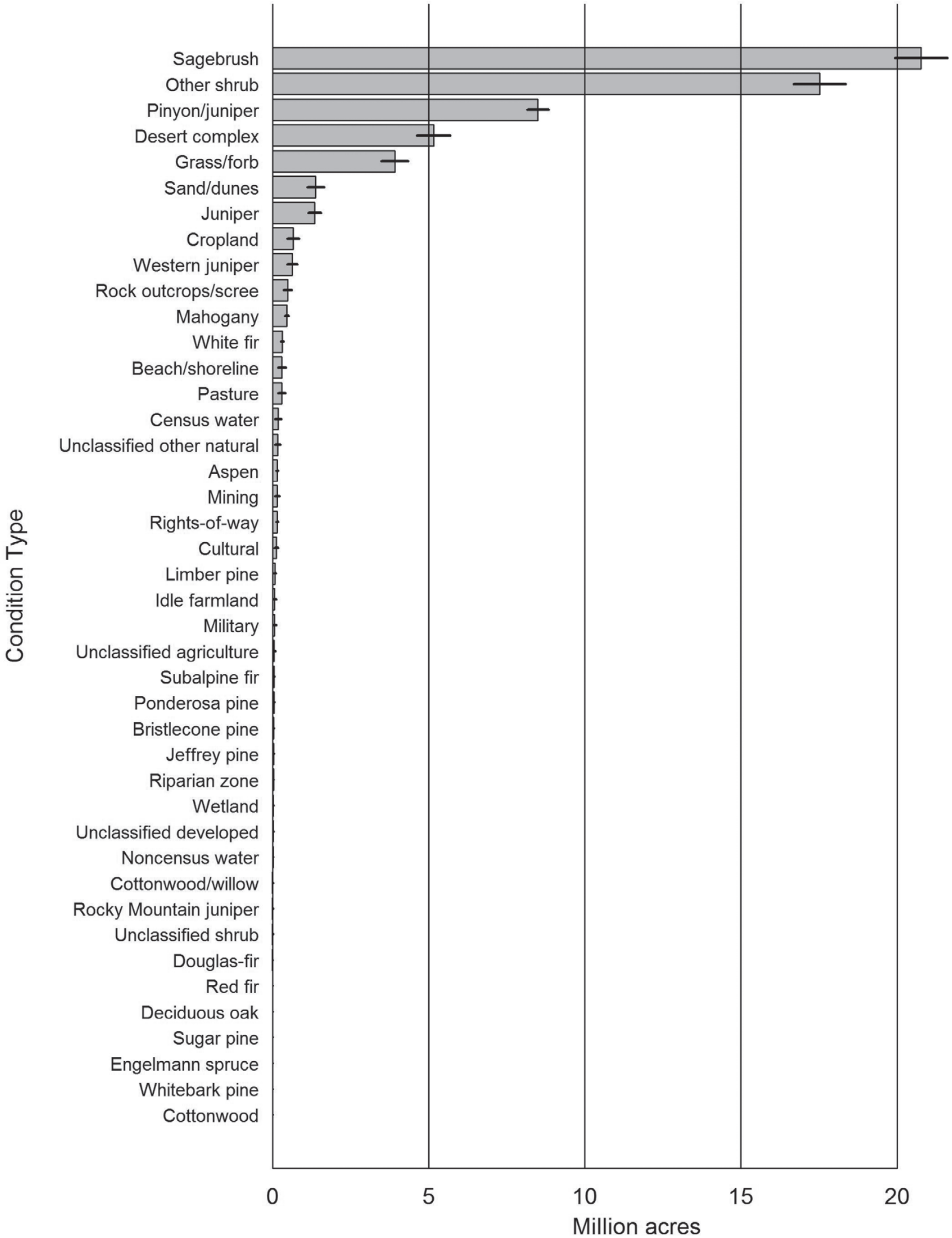


**Figure 5**—Area, in million acres, by condition type across the State of Nevada. One standard error is indicated on each bar.

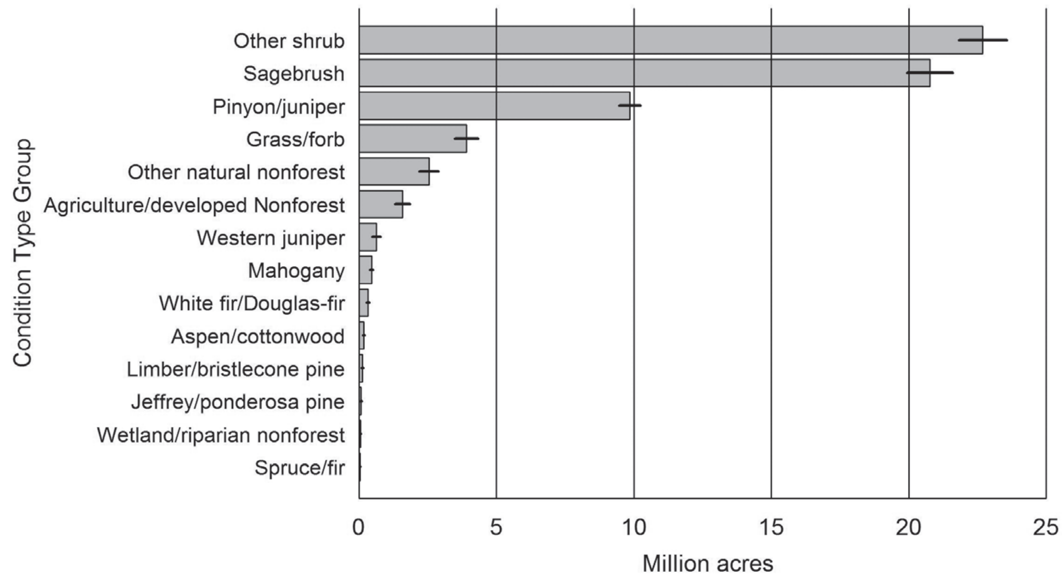


**Figure 6**—Area, in million acres, by condition type group across the State of Nevada. One standard error is indicated on each bar.

### *Tree Crown Density and Size Class*

A classification of tree crown density was assigned to a condition and used to distinguish different forested conditions (figure 7). The categories represent average percent canopy cover of trees within the defined condition. An additional category of "Nonstocked" designates land that was once forested but currently has less than 10 percent cover of trees, such as areas that were burned or harvested. Most of the forested lands in Nevada have less than 50 percent cover of trees, with less than 300,000 acres supporting greater than 75 percent cover of trees (Appendix, table A.4).

The stand size class of the stand was difficult to determine from aerial photographs. The FIA field method classifies a stand into one of six classes based on the

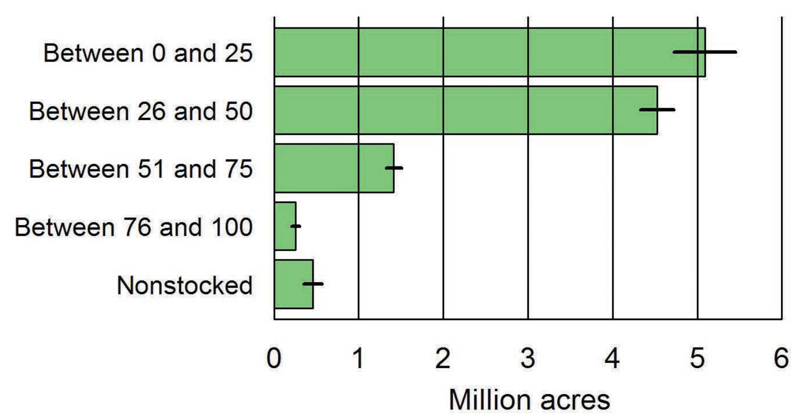


**Figure 7**—Area, in million acres, by tree density class (percent cover) across the State of Nevada. One standard error is indicated on each bar.

size of the majority of trees in the stand. Because it is difficult to make this distinction from a photo, only three categories were used to identify the stand as mature trees 5 inches diameter (DIA) and greater, a young stand of seedlings and saplings (less than 5 inches DIA), or a nonstocked site that was once forested but currently has less than 10 percent cover of trees. Table 4 shows acres of land by stand-size category. More than 85 percent of the forested stands in Nevada are ≥5 inches DIA, but seedlings and saplings occupy more than 1 million acres of land. These latter lands are often considered encroachment areas where forest lands are "encroaching" the nonforest shrub lands along the foothills of the mountain ranges.

**Table 4**—Estimated acres and percent standard error by size class on all lands; Nevada, 2004–2005.

| Size class | Acres | Percent standard error |
|---|---|---|
| Nonforest | 51,543,869 | 0.82 |
| Seedlings/Saplings | 1,087,147 | 18.33 |
| 5 inch diameter and greater | 10,130,172 | 3.54 |
| Nonstocked | 527,695 | 22.39 |
| Total | 63,288,883 | — |

### *Owner and Reserved Status*

Two other condition-defining attributes are land owner group and reserved status. These attributes were determined using the most current geospatial layers available at the time of sampling (2004–2005). An owner category was extracted at each photo point, and conditions were assigned based on a grouping of four classes: Forest Service, Other Federal, State and Local Government, and Private Land. The original owner category was kept for ancillary information of owner status and included in the analysis. Acres of land across the non-restricted areas of Nevada, by owner group and reserved status, are provided in table 5. Most of Nevada's land is non-reserved and administered by non-Forest Service Federal agencies, with the Bureau of Land Management making up nearly 70% of this area. Figure 8 shows the distribution of condition type groups by reserved status. The reserved land has more timber and woodland condition types than the nonreserved land (Appendix, table A.5).

**Table 5**—Acres by owner group and reserved status on all lands; Nevada, 2004–2005.

| | Reserved status | | |
|---|---|---|---|
| Owner group | Nonreserved | Reserved | Total |
| Forest Service | 4,947,180 | 804,710 | 5,751,890 |
| Bureau of Land Management | 41,916,978 | 999,920 | 42,916,898 |
| Other Federal | 635,352 | 3,208,840 | 3,844,192 |
| State and local government | 207,098 | 83,610 | 290,708 |
| Other | 9,884,235 | 44,712 | 9,928,947 |
| Total | 57,590,843 | 5,141,793 | 63,732,636 |

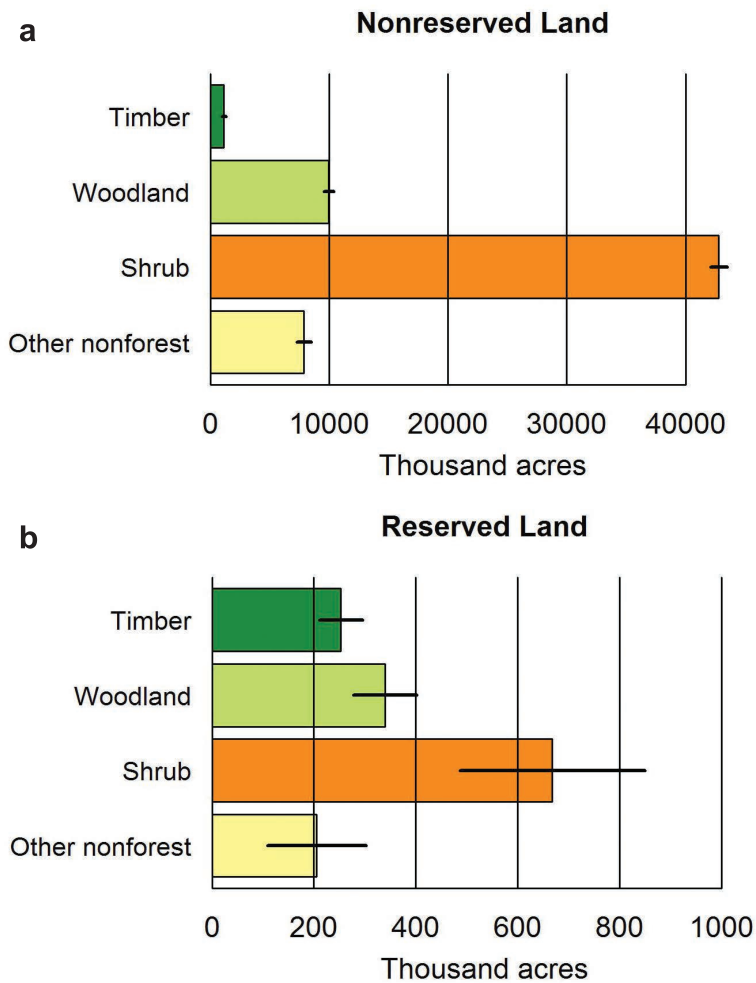


**Figure 8**—Acres of condition type groups by reserved status: a. is Nonreserved land and b. is Reserved land. Notice the difference of scale. One standard error is indicated on each bar.

### *Disturbance*

A disturbance class was assigned to a condition similar to FIA field protocol, if the affected area was greater than 1 acre in size, with >25 percent of the trees damaged or >50 percent of an individual species damaged. The disturbance classes were grouped into broad categories of Stress (insect/disease/drought), Fire, and Other to represent disturbances that can be distinguished from an aerial photograph. Table 6 shows disturbance classes by condition class for the State of Nevada. Although the majority of disturbances occur on forest lands, several acres of fire were identified and estimated on nonforest lands.

**Table 6**–Estimated acres (percent standard error) disturbance and condition class group on all lands; Nevada, 2004–2005. Stress indicates insect, disease, or drought disturbance.

| Disturbance | Condition class Forest | Condition class Nonforest | Noncensus water | Water | Total |
|---|---|---|---|---|---|
| None | 10,977,159 (3.65) | 51,302,173 (0.84) | 15,511 (49.55) | 183,586 (52.64) | 62,478,429 (0.23) |
| Stress | 74,158 (24.99) | — | — | — | 74,158 (24.99) |
| Fire | 641,366 (19.77) | 69,211 (91.13) | — | — | 710,577 (19.91) |
| Other | 25,719 (41.77) | — | — | — | 25,719 (41.77) |
| Total | 11,718,402 (3.58) | 51,371,383 (0.83) | 15,511 (49.55) | 183,586 (52.64) | 63,288,883 (—) |

### *Cover*

Each sample point was attributed with the type of object the point fell on, including either a tree object or a non-tree object. Figure 9 displays the total estimated percent cover for each object included in the pilot inventory for the entire State of Nevada (see Appendix, table A.6, for estimates with associated percent sample error). The figure is separated into tree objects (figure 9a; includes timber and woodland trees) and non-tree objects (figure 9b; includes shrubs, other vegetation, and barren objects). Considering the different scales, it is clear that, once again, the non-tree objects dominate the landscape of the State, with pinyon and juniper woodland species as the dominant cover for trees.

Figure 10 shows four different groupings of the photo-interpreted objects for the State of Nevada. The first grouping (figure 10a) is very broad, categorizing the objects into vegetated or non-vegetated classes; non-vegetated classes include soil or rock, man-made roads or structures, and water. This category makes up more than 45 percent of object types sampled in Nevada. The second grouping (figure 10b) separates the objects into four broad categories: tree, shrub, other veg and barren. Again, the barren or non-vegetated objects occupy more than 45 percent of the landscape while the vegetated objects are composed of mainly shrubs and other vegetation with less than 10 percent as trees. The third grouping (figure 10c) distinguishes the tree category as softwood or hardwood, while the forth grouping (figure 10d) differentiates the trees into timber, woodland, dead trees, and other trees; the shrubs into sagebrush and other shrubs; the other vegetation into herbaceous and other categories; and the barren into non-vegetated and water categories (Appendix, tables A.7-A.10).

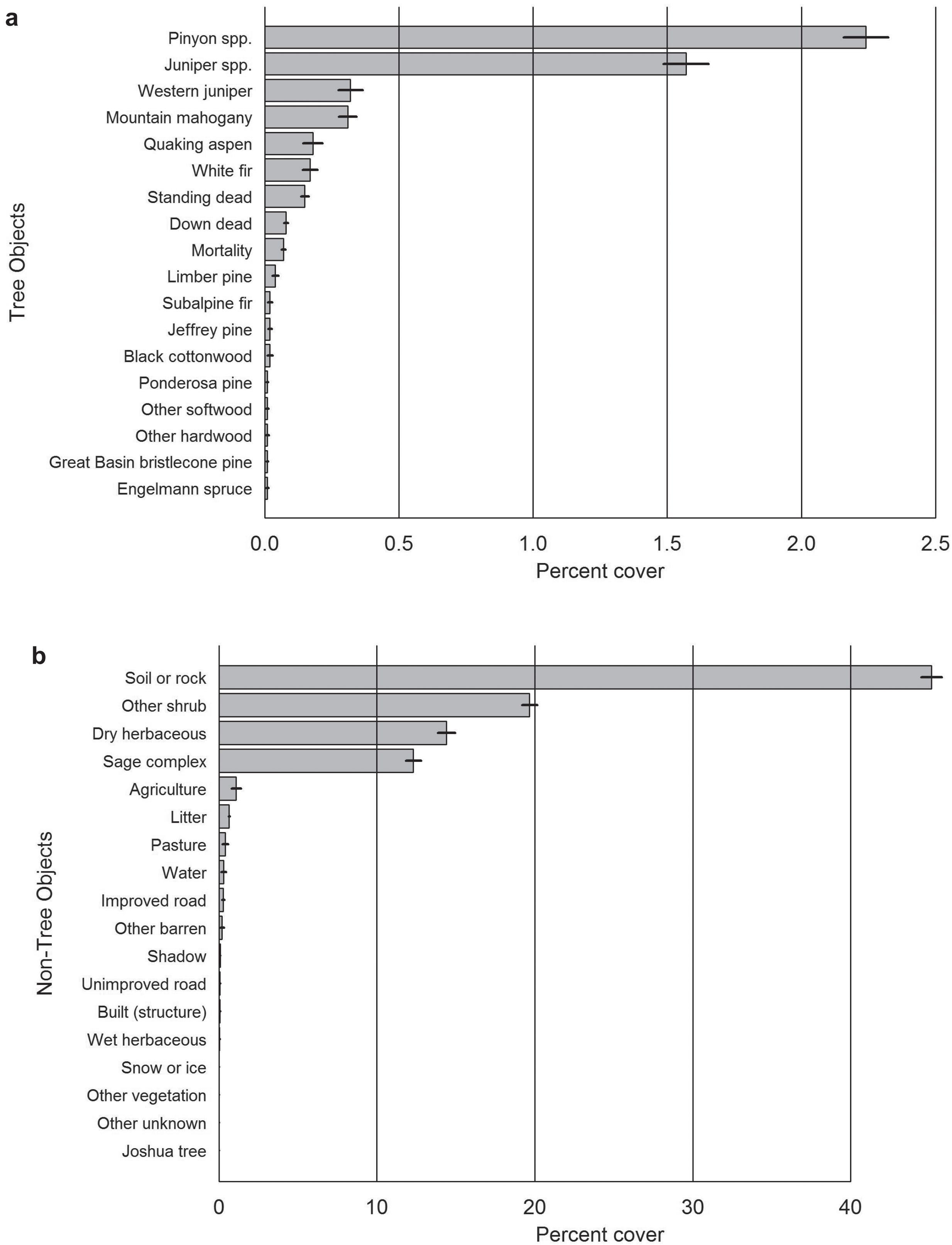


**Figure 9**—Total percent cover of photo-interpreted objects across the State of Nevada: a. is Tree objects and b. is Non-tree objects. Notice the difference in scale. One standard error is indicated on each bar.

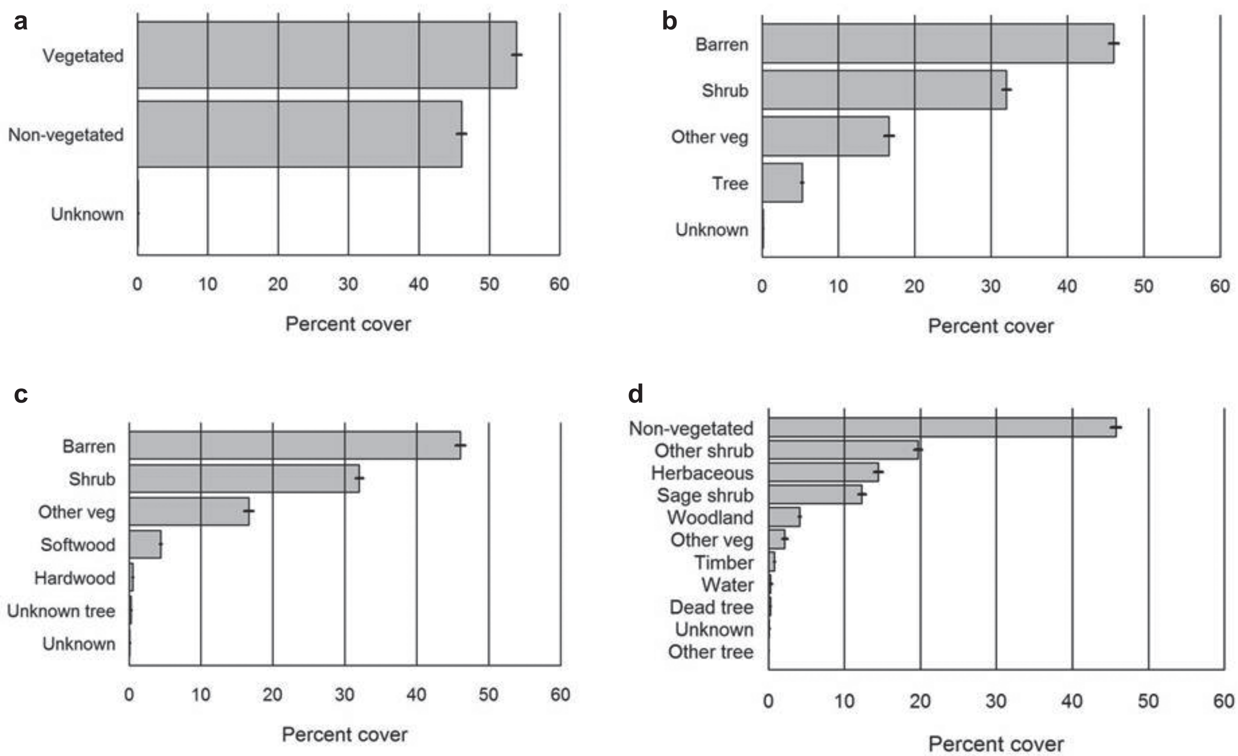


**Figure 10**—Total percent cover of photo-interpreted objects across the State of Nevada grouped in different classes: a. is two categories plus unknown; b. is four categories plus unknown distinguishing barren, shrubs, other vegetated, tree, and unknown; c. is six categories plus unknown; and d. is 10 categories plus unknown. One standard error is indicated on each bar.

## *Cover by Condition Attributes*

The previous section presented estimates characterizing the entire State of Nevada, excluding restricted space. The following section looks closer at the distribution of the sampled attributes within specific estimated categories. Figure 11 shows the general composition of tree attributes within the forest condition types sampled across the State. From this figure, we can also visualize the diversity of trees within these specific types in Nevada. For example, the Douglas-fir condition type is characterized by having just over 10 percent live tree cover, which is composed of four different tree species—white fir, Douglas-fir, limber pine, and pinyon pine—plus an additional 4 percent cover of mortality trees (see Appendix, tables A.11a and A.11b for estimates and percent sample error). Figure 12 displays the composition of non-tree attributes within the sampled nonforest condition types for the State (see Appendix, tables A.12a and A.12b for estimates and percent standard errors, respectively). Tables A.13 and and A.14 present the estimates and percent standard errors of tree attributes within the nonforest conditions and the non-tree attributes within the forest conditions.

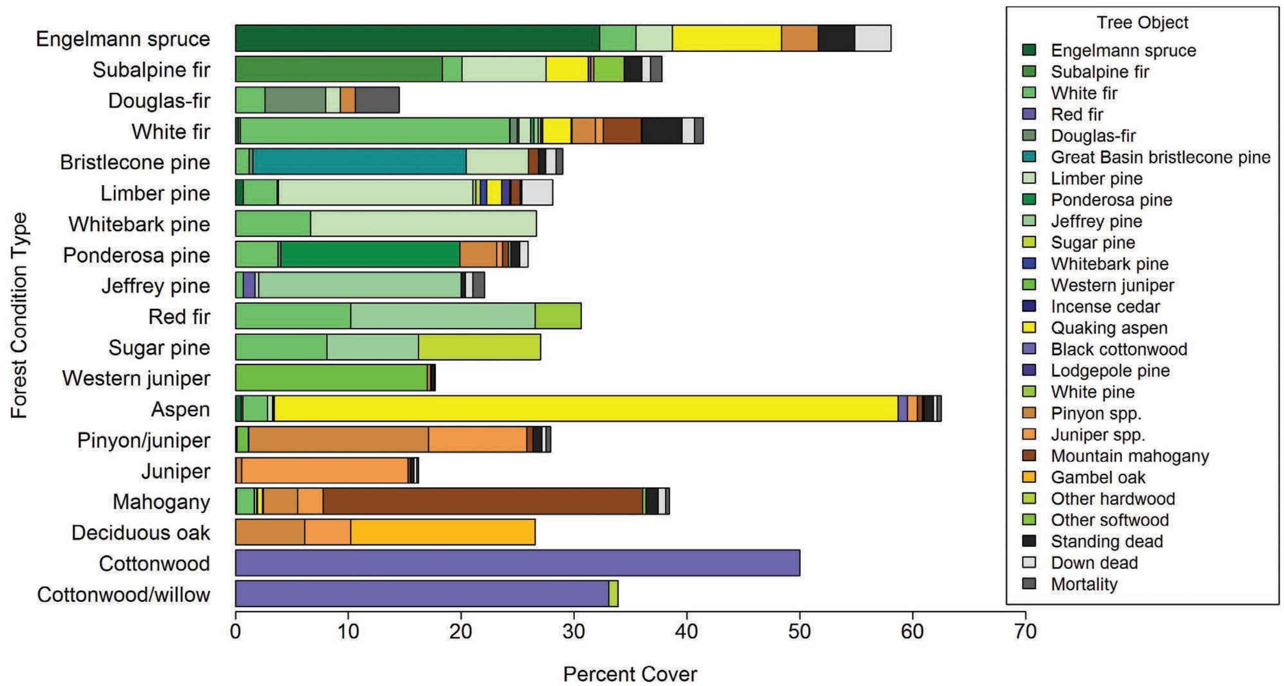


**Figure 11**—Percent cover of tree objects within forest condition types across Nevada.

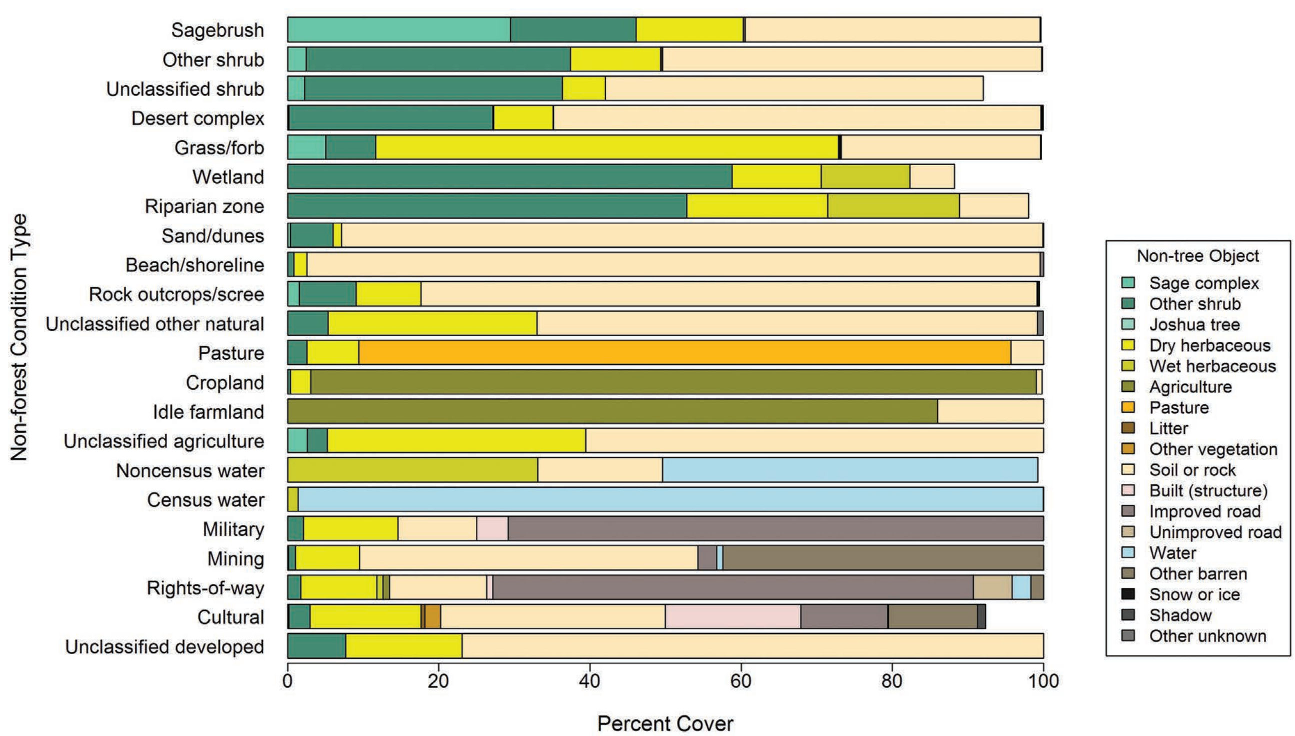


**Figure 12**—Percent cover of non-tree attributes within non-forest condition types across Nevada.

Figure 13 represents another picture of the composition of vegetation across Nevada, displaying the distribution of sampled attribute groups within each forested condition type (figure 13a) and nonforest condition (figure 13b). Just looking at the Douglas-fir condition type again, we can see that along with the approximate 14 percent of live plus missing tree cover mentioned above, an estimated 3 percent of the attributes within this condition type are categorized as other shrub, 51 percent as herbaceous nonforest, 8 percent as other vegetation, and 23 percent as non-vegetated.

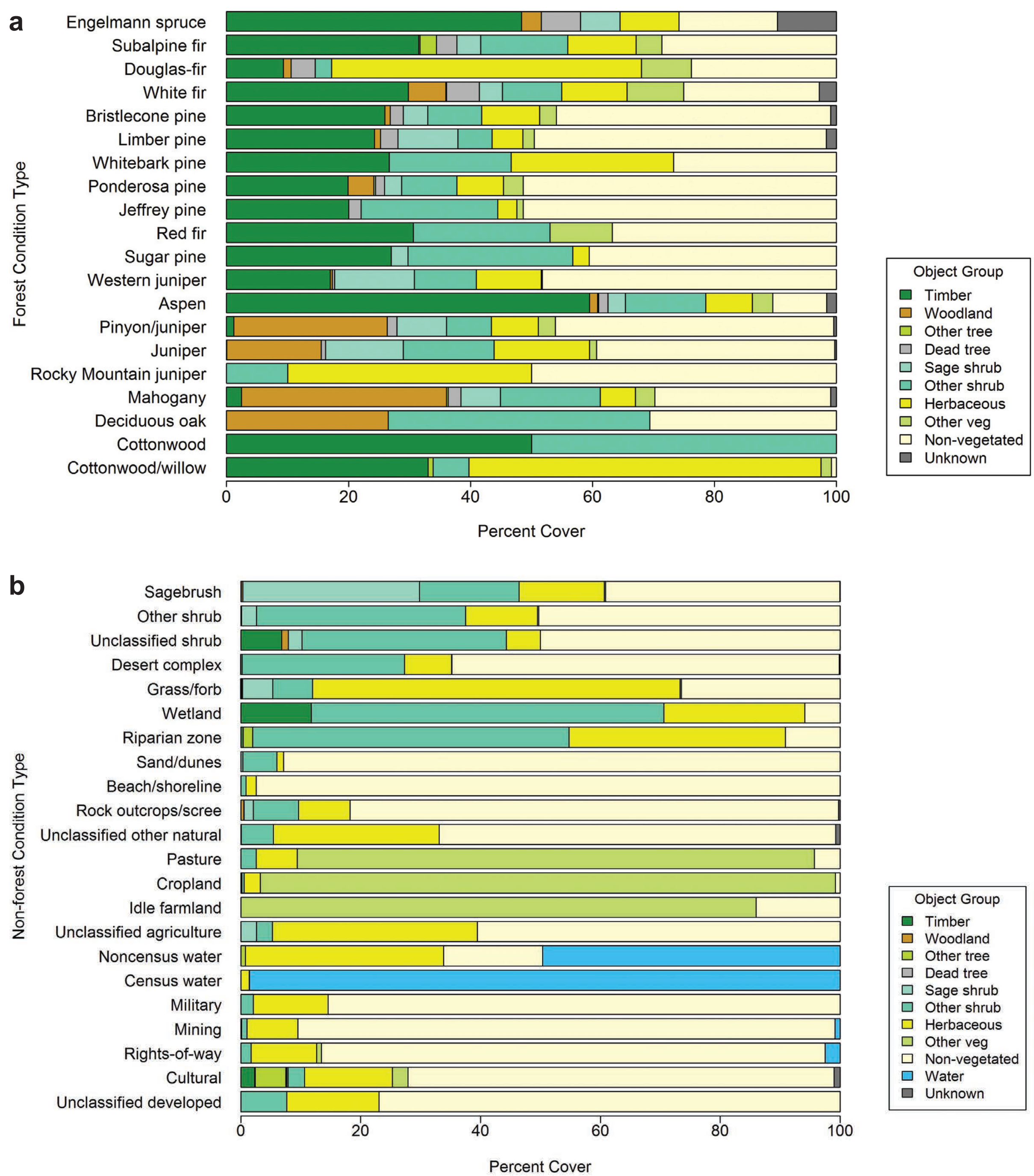


**Figure 13**—Percent cover of object groups within estimated condition types across Nevada: a. is forest condition types and b. is non-forest condition types.

See Appendix tables A.15a and A.15b for estimates and associated percent sample error for forested condition types. Figure 14 focuses on a few different condition types and shows the attributes sampled by vegetation category for that condition type (Appendix, table A.14).

Figure 15 shows the proportion of conditions in each stand-size class as discernable from aerial photographs by forest condition type classes in Nevada. The seedlings/saplings stand-size class is often associated with regeneration in areas previously forested and disturbed or encroachment of tree-land into rangeland or alpine areas. More than 40 percent of the area estimated as spruce/fir condition types were classified as seedlings/saplings, which consist of trees less than 5 inches diameter. An estimated 27 percent of the Western juniper condition type is classified as seedlings/saplings compared to only about 8 percent of the area meeting these conditions is within the pinyon/juniper condition type (See Appendix, table A.16).

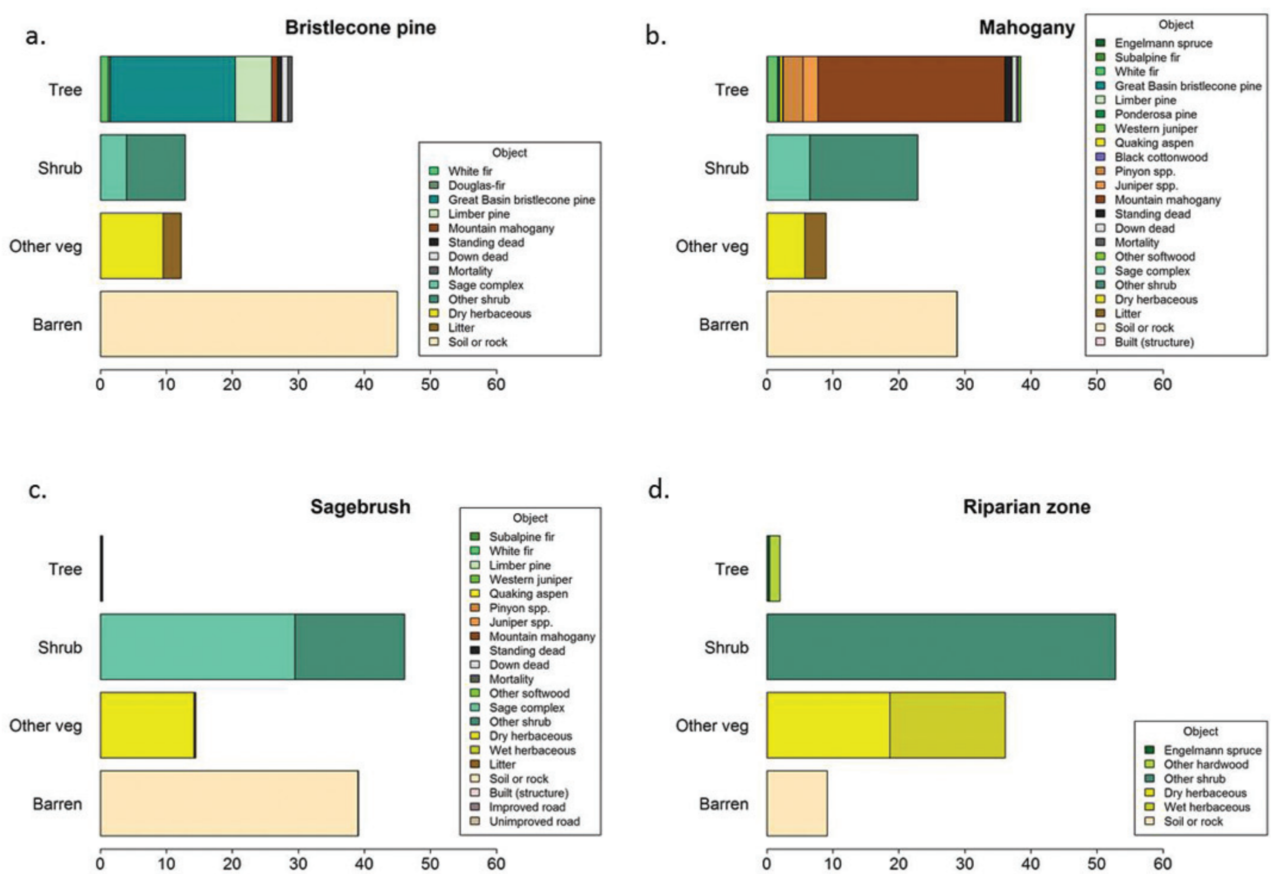


**Figure 14**—Percent cover of objects within estimated condition types across Nevada, categorized by vegetative groups: a. is Bristlecone pine condition, b. is Mahogany woodland condition, c. is Sage shrub condition, and d. is Riparian zone condition.

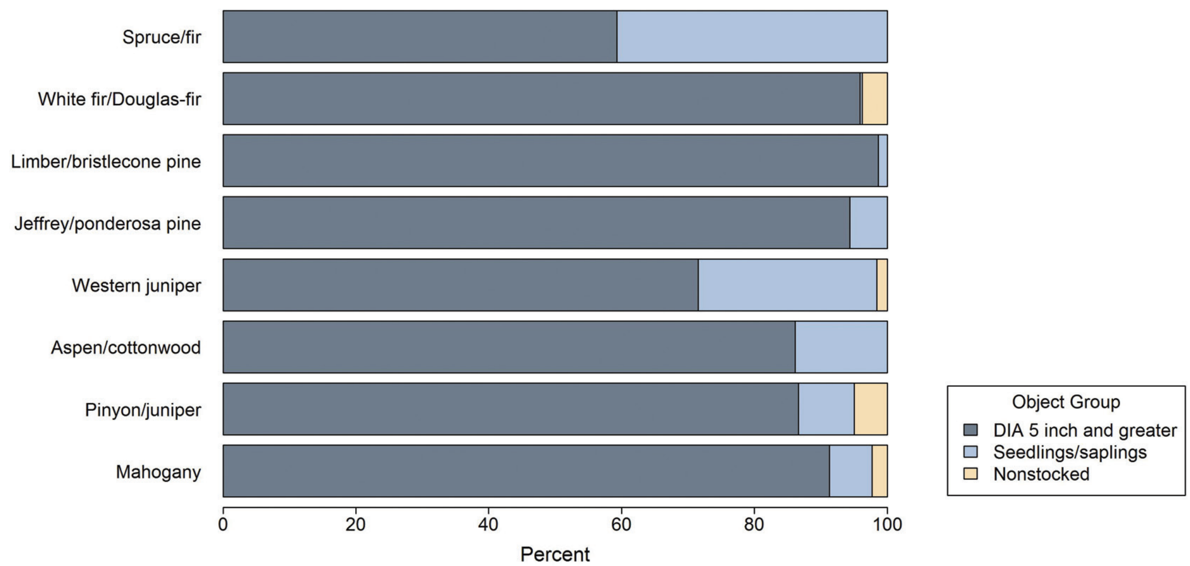


**Figure 15**—Percent of stand-size condition classes within forest condition types on forest land across Nevada. The stand-size class represents the majority of the stand as: 1) mature trees 5 inches diameter (DIA) and greater; 2) young trees less than 5 inches DIA (Seedlings/Saplings); 3) or Nonstocked, once forested but currently less than 10 percent cover of trees.

Figure 16 (Appendix, table A.17) shows the distribution of crown density condition classes within the forest condition type classes. More than 40 percent of the aspen/cottonwood condition type has greater than 75 percent density of crown cover. All of the other forested types have less than 75 percent cover for the vast majority (>80 percent) of conditions. The distribution of disturbance classes within forest condition types across Nevada are shown in figure 17. The Jeffrey/ponderosa pine condition type class has the highest percentage of fire disturbance, with almost 10 percent of its area being identified as having burned. The disturbance category identifying insect/disease/drought affected about 5 percent of conditions in the spruce/fir and

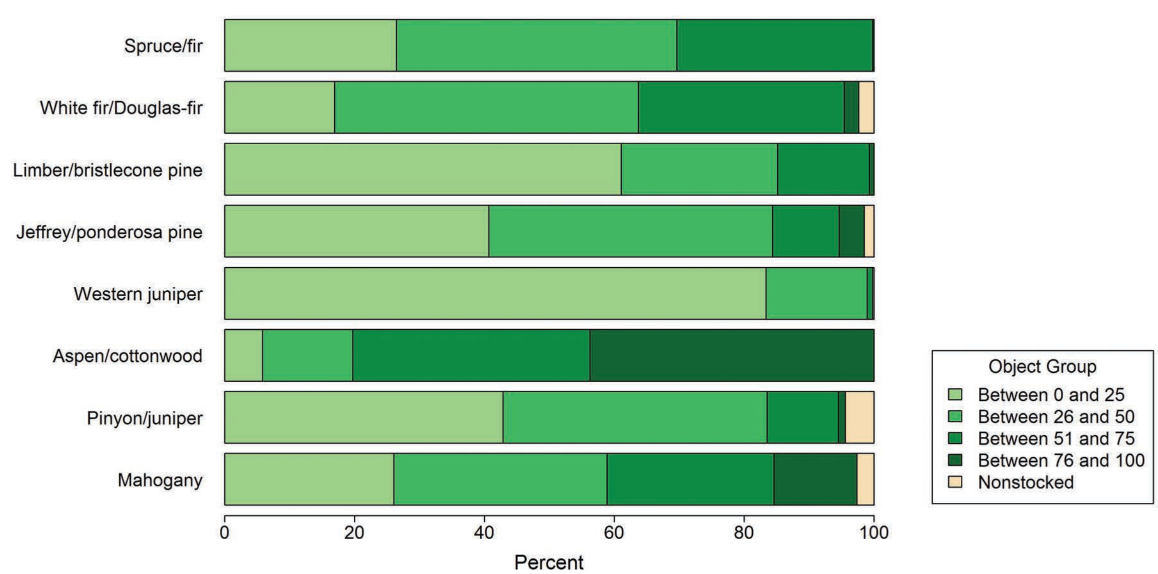


**Figure 16**—Percent crown density condition classes within forest condition types on all lands across Nevada.

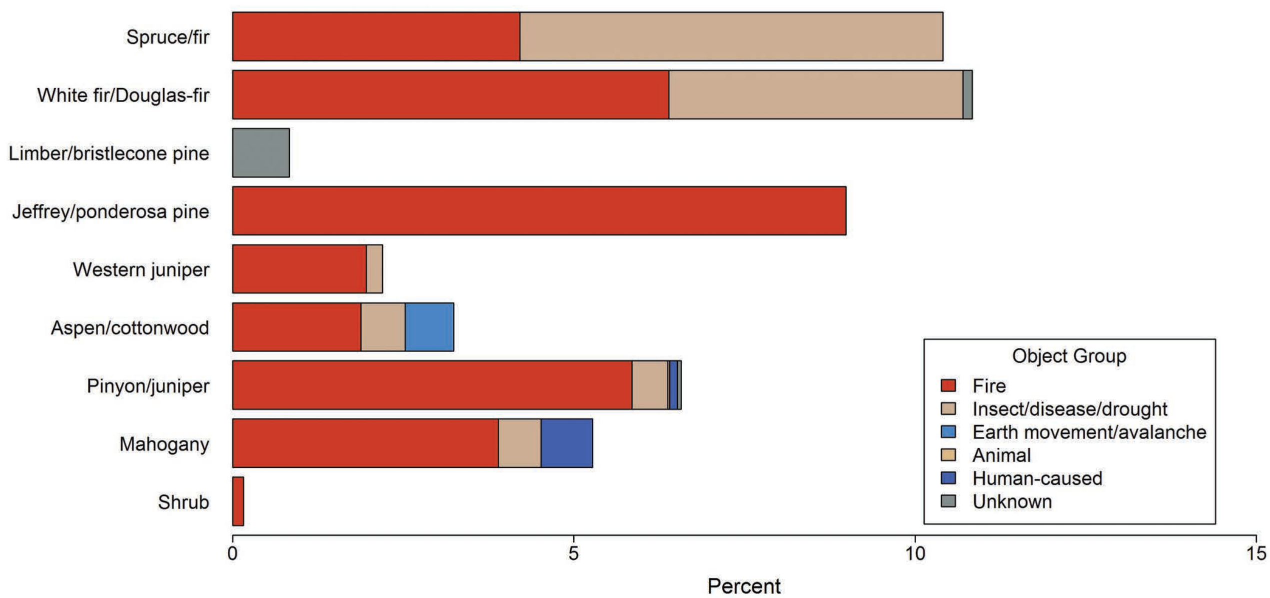


**Figure 17**—Percent disturbance condition classes within condition types on all lands across Nevada.

White fir/Douglas-fir condition type classes. Both the pinyon/juniper and mahogany condition types were found to have small amounts of human-caused disturbances (Appendix, table A.18).

### *Estimates by County and Ecoregion*

This section presents a general picture of individual estimation units of counties and ecoregions within the State of Nevada (Figure 18). Figure 19 shows estimates of condition type groups by county or county groups. Here, we see that White Pine County and the county group consisting of Carson, Douglas, and Story Counties have the highest proportion of forest condition types for the State, whereas Humboldt county has the lowest proportion of forest condition types. The size (in acres) and number of plots sampled is shown in table 7 for a perspective on proportion. See Appendix table A.19 for estimates and associated sample errors.

Although county boundaries are the typical estimation unit for FIA, it is often more useful to look at more ecological boundaries, such as the U.S. Forest Service Ecological Subregions (ECOMAP Sections; Cleland et al. 2007; Figure 17). Figure 20 shows the same condition type groups as above by ECOMAP Sections within the boundaries of Nevada, with the acres and number of plots by section displayed in table 8 (Appendix, table A.20). The Owyhee Uplands and Eastern Basin and Range Sections were combined to obtain a sufficient number of sample plots. The Sierra Nevada section has the greatest proportion of forest condition types, while the Northeastern Great Basin section has the lowest proportion.

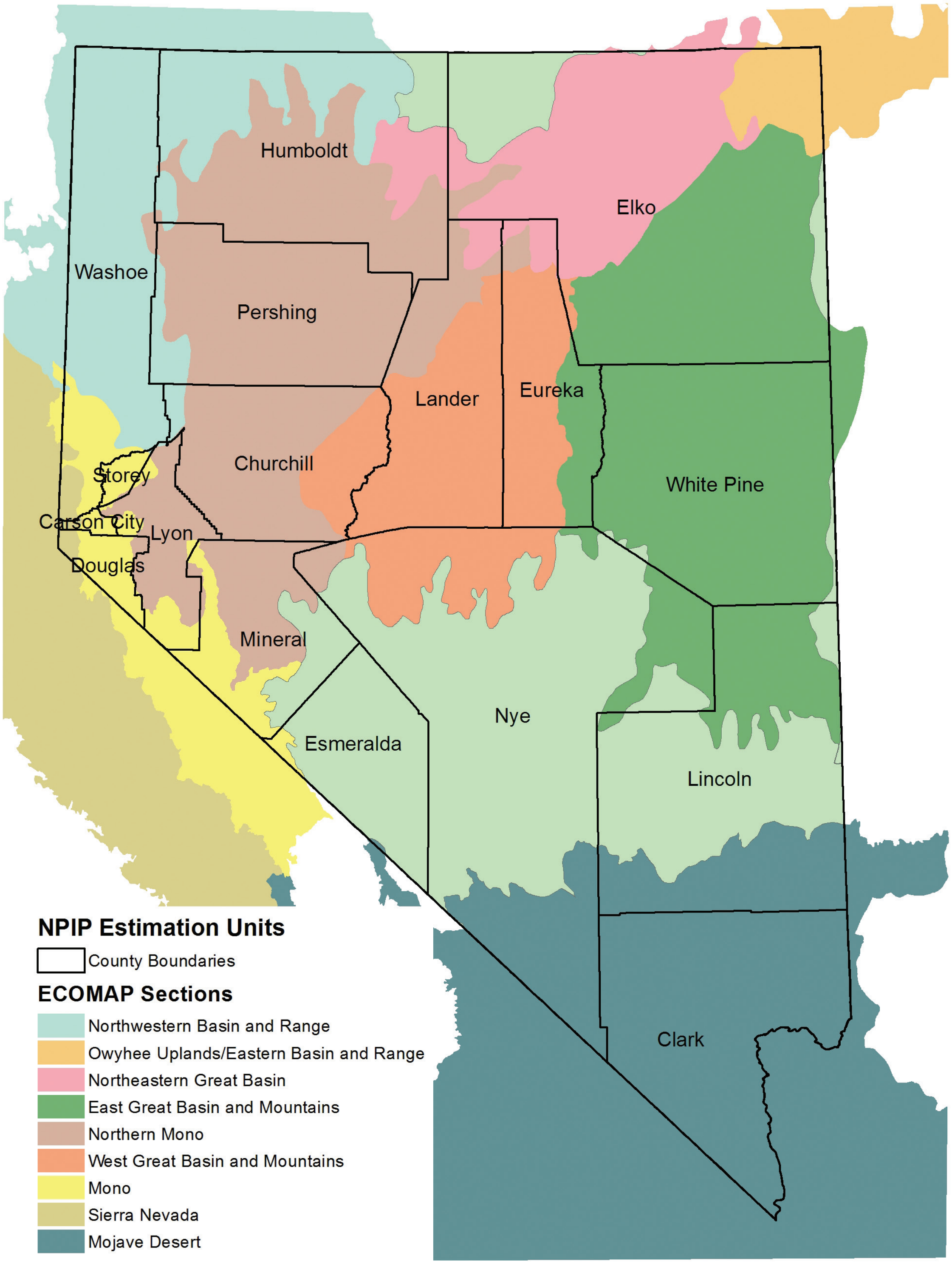


**Figure 18**—NPIP estimation units of county boundaries and ECOMAP Sections (Cleland 2007).

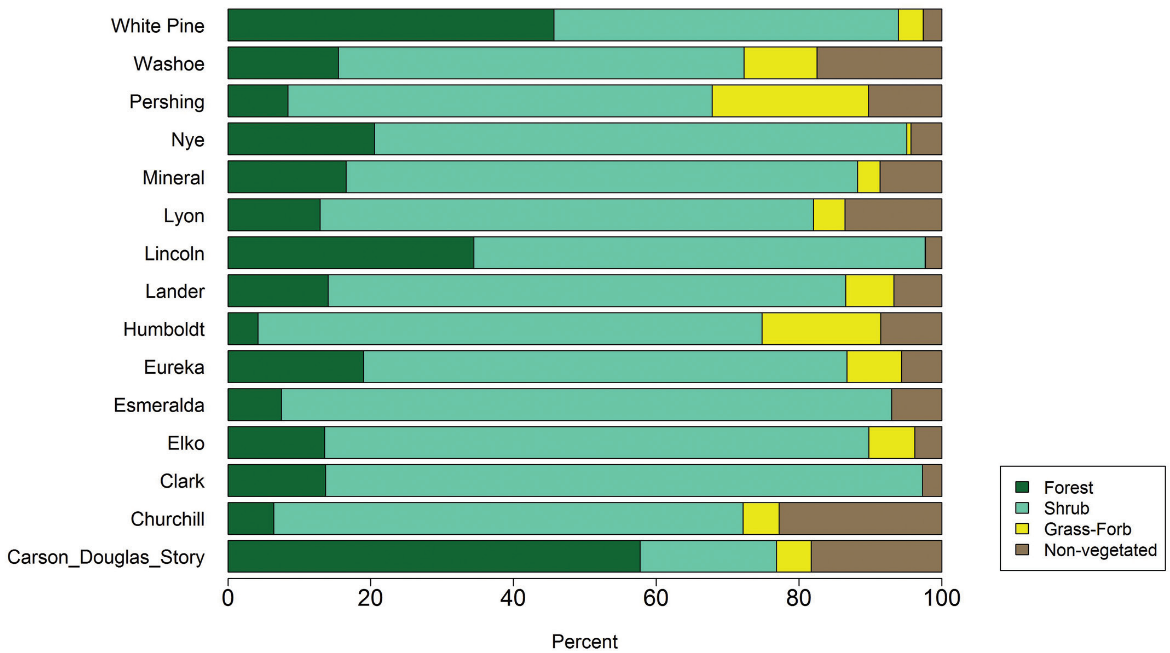


**Figure 19**—Percent condition type groups by county or county group.

**Table 7**—Acres and number of FIA sample plots by county estimation unit,

| County | Acres | # of plots |
|---|---|---|
| Carson_Douglas_Storey | 650,885 | 46 |
| Churchill | 3,215,464 | 42 |
| Clark | 5,158,968 | 109 |
| Elko | 11,009,873 | 291 |
| Esmeralda | 2,296,992 | 65 |
| Eureka | 2,675,171 | 116 |
| Humboldt | 6,180,980 | 111 |
| Lander | 3,532,479 | 112 |
| Lincoln | 6,807,660 | 340 |
| Lyon | 1,295,517 | 49 |
| Mineral | 2,440,303 | 110 |
| Nye | 11,647,096 | 387 |
| Pershing | 3,883,165 | 78 |
| Washoe | 4,187,005 | 110 |
| White Pine | 5,693,898 | 364 |

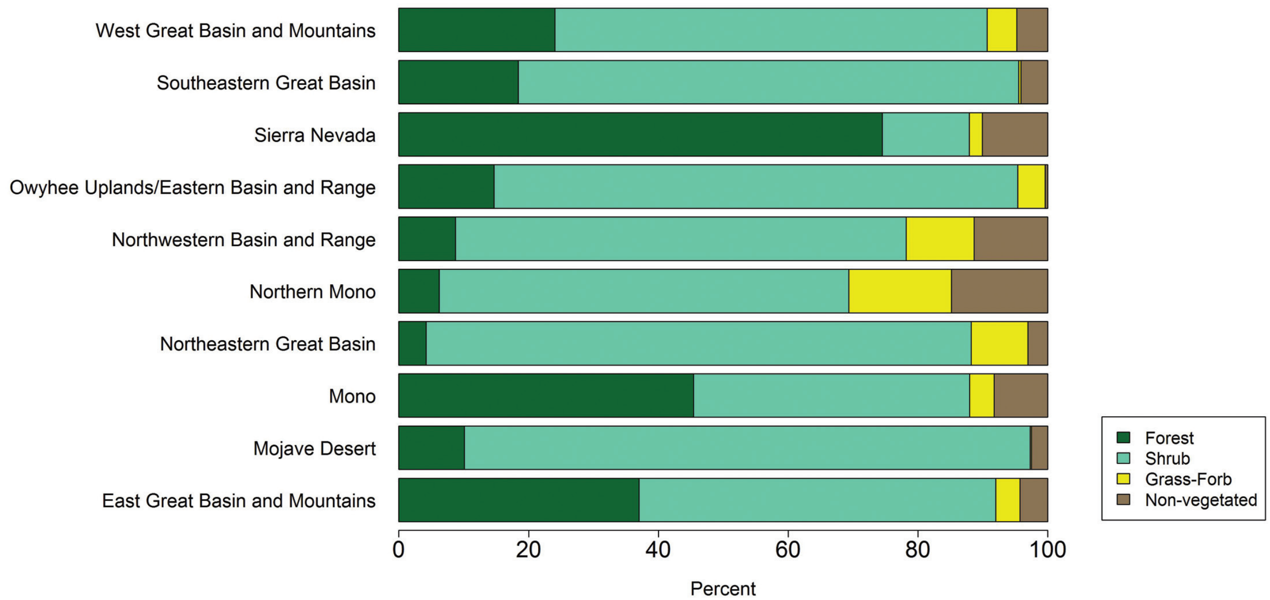

**Figure 20**—Percent condition type groups by Cleland ECOMAP Sections (Cleland 2007).

**Table 8**—Acres and number of FIA sample plots by Cleland ECOMAP Sections.

| Ecosection | Acres | # of plots |
|---|---|---|
| West Great Basin and Mountains | 6,638,902 | 298 |
| Southeastern Great Basin | 13,584,709 | 425 |
| Sierra Nevada | 231,853 | 28 |
| Owyhee Uplands/Eastern Basin and Range | 2,283,025 | 46 |
| Northwestern Basin and Range | 5,937,030 | 125 |
| Northern Mono | 12,535,938 | 220 |
| Northeastern Great Basin | 4,983,660 | 103 |
| Mono | 2,200,925 | 153 |
| Mojave Desert | 8,636,213 | 155 |
| East Great Basin and Mountains | 13,733,774 | 777 |

## Map Products

The percent live tree cover response variable was modeled with continuous random forest models, while the condition type group variables were modeled with categorical random forest models using the randomForest package (Liaw and Wiener 2002) in R (R Core Team 2013). We used the suggested randomForest default values for the number of trees (ntree) and the number of predictor variables randomly sampled to test the number of potential predictors for each split in each decision tree (mtry). When looking at the number of trees to use in the forest, we examined graphs of OOB error as a function of number of trees to verify that the default of 500 trees was sufficient for each model. The number of predictors to test at each split defaults to the square root of the total number of predictor variables for categorical models and to one-third the number of predictors for continuous models.

We modeled two options for condition type. First, we modeled 12 condition type categories, with prevalence ranging from 1% to 55% of the sampled plots, with the rarest category only having 9 sampled plots. Second, we grouped the condition types into four categories: timber, woodland, shrub, and other nonforest. This brought the lowest prevalence categories (timber and other nonforest) up to 6% of the sampled plots, or 130 and 129 plots, respectively. In the case of the presence/absence models, the prevalence is shown in table 1, from Freeman and others (2012). Different modeling strategies were explored to accommodate the unbalanced prevalence of the response variables as well as the different sampling intensities per stratum (Freeman and others 2012).

The map of condition type with four groups is displayed in figure 21.a, with associated accuracy results in table 9. The Kappa value for this map was 0.76 with associated 0.012 standard deviation of Kappa. The map of percent live tree cover is shown in figure 21.b and its associate error is shown in figure 22, with root mean square error of 9.48, Pearson's correlation at 0.85, and Spearman's correlation at 0.86.

**a**

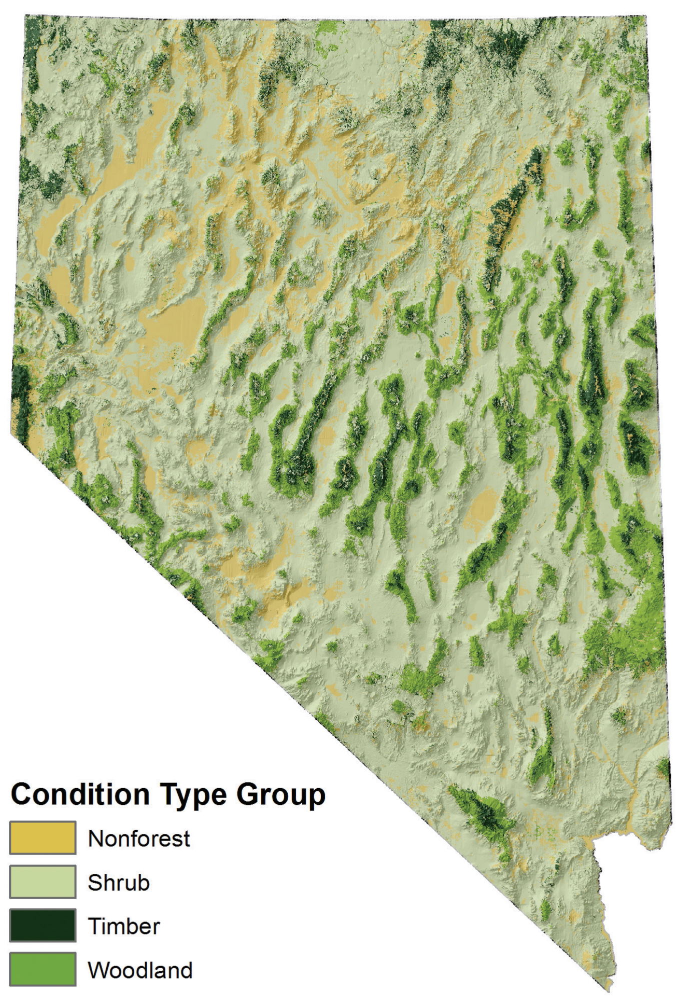


**Figure 21**—Predicted maps from ModelMap: a. is Condition type with 4 groups and b. is percent live tree canopy cover.


Figure 21b

**Table 9**—Accuracy assessment error matrix for condition type map with four grouped categories.

| | Observed | | | | | |
|---|---|---|---|---|---|---|
| | **Nonforest** | **Shrub** | **Timber** | **Woodland** | **Total** | **User** |
| **Predicted** | | | | | | |
| Nonforest | 62 | 14 | 2 | 0 | 78 | 79% |
| Shrub | 54 | 642 | 16 | 66 | 778 | 83% |
| Timber | 1 | 8 | 59 | 14 | 82 | 72% |
| Woodland | 12 | 58 | 53 | 1201 | 1324 | 91% |
| Total | 129 | 722 | 130 | 1281 | 2262 | PCC |
| Producer | 48% | 89% | 45% | 94% | PCC | 87% |

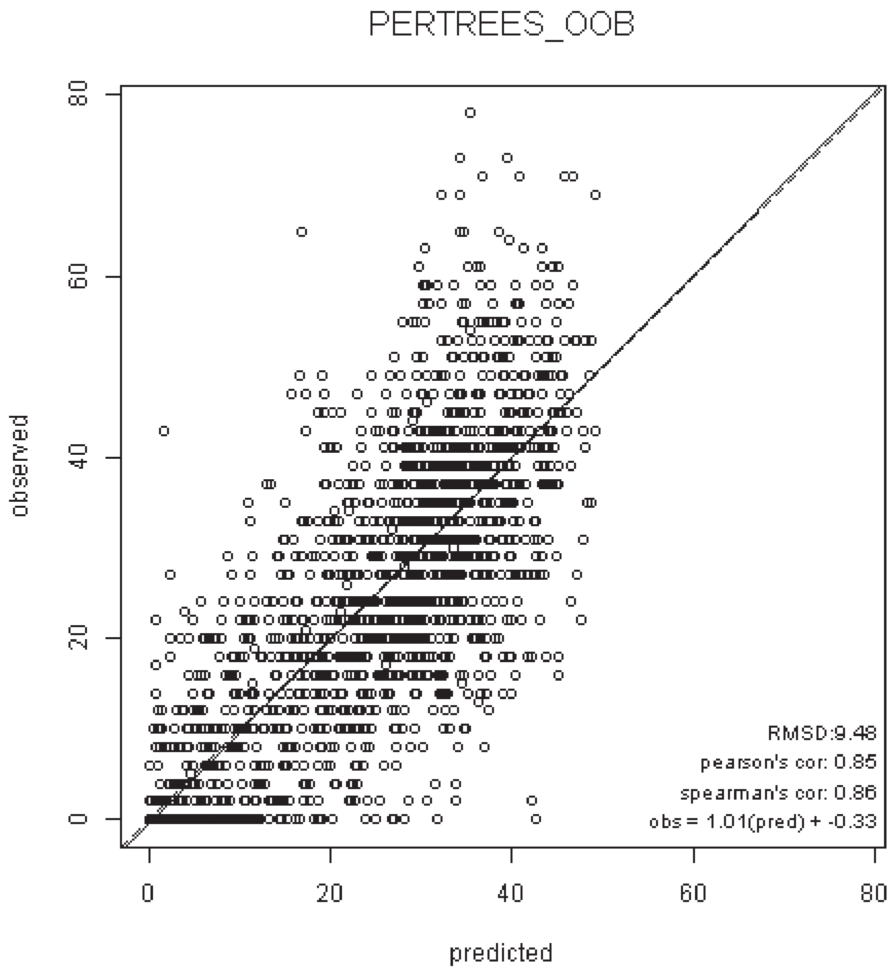


**Figure 22**—Out-of-bag error for predicted live tree cover.

The map with 12 condition type groups and corresponding error matrix is shown in the Appendix figure A.1 and table A.21. The Kappa for this map was 0.64 with 0.013 standard deviation. Figure 23.a and 23.b display maps of presence or species distributions for sage and pinyon pine. Presence (in green) is shown using the threshold based on maximized Kappa (Freeman and Moisen 2008). The threshold value and accuracy metrics for the eight binary, presence/absence models are presented in table 10. Maps of white fir, limber pine, quaking aspen, mountain-mahogany, and other shrub attributes are found in Appendix figure A.2.

## Quality and Accuracy Assessment

A repeatability analysis, or quality assessment, involved a random sample (10 percent) of the photo-plots being interpreted by both interpreters. Error matrices were used to compare both object- and condition-level plot data for several classes. Table 11 shows results for forest type, seedling/sapling class, disturbance class, and percent cover class for tree and non-tree objects.

For accuracy assessment purposes, the only variable collected on FIA field plots that could be directly compared to photo interpretations was forest type. Photo calls agreed with FIA field calls 84.8 percent of the time with a sample error of 1.4 percent.

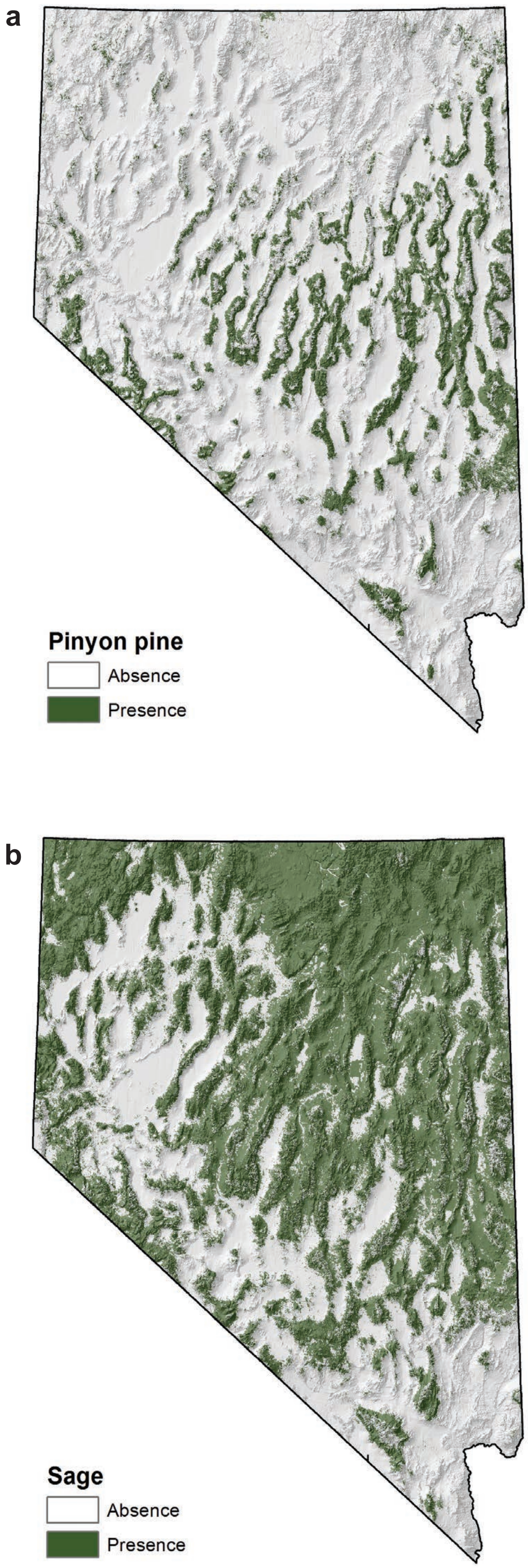


**Figure 23**—Predicted maps of species presence: a. is pinyon pine and b. is sage.

**Table 10**—The threshold used for mapping cut-off and accuracy assessment metrics for binary presence/absence models.

| | Threshold | PCC | Sensitivity | Specificity | Kappa |
|---|---|---|---|---|---|
| Quaking aspen | 0.26 | 0.972 | 0.718 | 0.980 | 0.615 |
| White fir | 0.36 | 0.949 | 0.433 | 0.979 | 0.456 |
| Limber pine | 0.81 | 0.970 | 0.694 | 0.975 | 0.475 |
| Mountain-mahogany | 0.70 | 0.904 | 0.606 | 0.939 | 0.520 |
| Juniper | 0.43 | 0.864 | 0.923 | 0.796 | 0.724 |
| Pinyon pine | 0.54 | 0.889 | 0.896 | 0.881 | 0.778 |
| Sage | 0.58 | 0.701 | 0.763 | 0.601 | 0.364 |
| Other shrub | 0.71 | 0.756 | 0.831 | 0.416 | 0.230 |

**Table 11**—Percent agreement between two photo-interpreters for conditions and object group.

| Condition/Object group | Agreement (%) | Percent standard error |
|---|---|---|
| Forest Type | 90.4 | 3.7 |
| Seedlings/Saplings | 75.4 | 4.4 |
| Disturbance agent | 90.5 | 4.0 |
| Percent cover–trees | 80.1 | 3.5 |
| Percent cover–non-trees | 81.1 | 1.1 |

Interestingly, FIA's Measurement Quality Objectives (MQOs; Patterson and others 2006) require field crews to accurately label forest type on plots no less than 84 percent of the time. Using field calls as truth, photo calls of forest type met these national MQO standards for forest type. It is not surprising that interpreting nonforest types from photos is less consistent. Distinguishing even between the predominant sage and other shrubs can be very challenging. Because of the very broad disturbance classes, repeatability was quite high for this attribute.

## Discussion

It has been more than 20 years since the last comprehensive report of Nevada's forest resources (Born and others 1992), and this report was based on field data collected over 30 years ago. Results presented here provide the most current look at quantity and spatial distribution of forests across the State, as well as the first ever summary of nonforest conditions that dominate this arid landscape. Information from this prototype will be used to investigate the potential for supplementing our traditional reports with photo-based information in the future.

The results illustrate how photo-based observations can augment FIA's standard forest reporting in several ways. First, because of the larger plot footprint, photos are able to capture rare events that might be missed by the smaller field plots or by a smaller number of field plots (Patterson and Finco 2011). Photo-based estimates shown in figure 7 captured 19 different forest types. Though very rare on the landscape, cottonwood, Engelmann spruce, sugar pine, red fir, deciduous oak, and others were detected by these photo approaches. Similarly, riparian habitat is a limited resource type in the West that is extremely important in the arid landscape. Its small linear extent makes it difficult to measure with FIA's systematic sample design. The size of the NPIP photo-plot footprint along with the added Type A riparian class provided an opportunity to sample riparian land more so than would be accomplished from the FIA sample design (figure 24). For FIA field protocol, riparian land that does not meet the standard condition criteria (at least 120 ft wide and at least 1 acre in size)

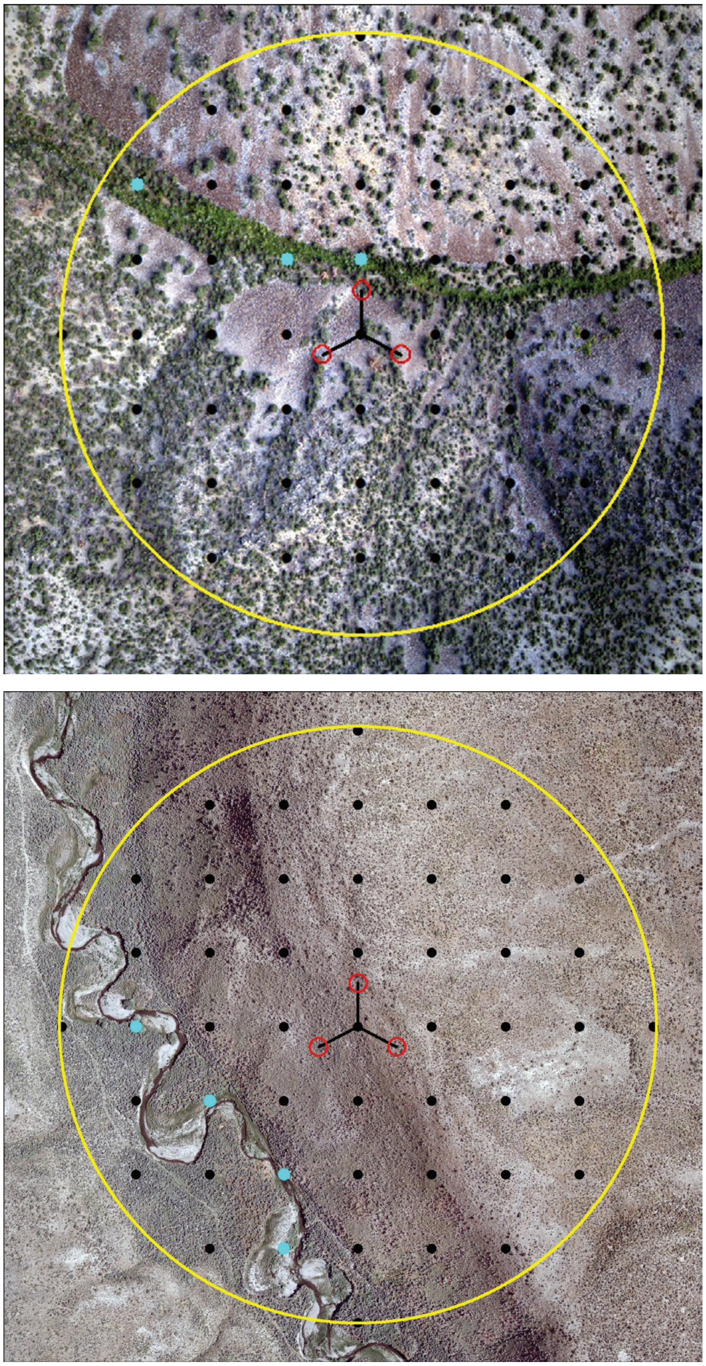

**Figure 24**—NPIP photo plots with riparian lands sampled, adjacent to nonforest conditions, Type A. The NPIP sample plot is in yellow with sample points in black; FIA sample subplots are in red. Highlighted photo sample points are recorded riparian condition type. A. is Forested FIA plot location with riparian vegetation and b. is Nonforest FIA plot location with riparian vegetation.

must be adjacent to another forest condition to be considered riparian. Here, as an all condition inventory, we created a new class to capture riparian areas surrounded by nonforest lands, which accounted for 60 percent of the total riparian plots sampled and added more than 26,000 acres to the total estimate of riparian condition types.

Another rare condition on the landscape is forest disturbance, which is becoming increasingly important to the inventory and monitoring audience. Although it affects only a small percentage of a given forest each year, the cumulative effects through time can be dramatic. It is a complicated phenomenon in that it can impact canopy, understory, and forest floor. While field-based estimates can be constructed, they are limited to forested areas, a less intensive sample, and temporal challenges. The photo-based estimates presented here illustrate observations made on disturbances that can be seen from the air, depicting the distribution of canopy-affecting fire, stress, and other disturbance agents on the different forest types across the State of Nevada.

Another way an aerial photo-based sample can augment FIA's standard reporting is by enabling estimates over nonforest conditions where funding is unavailable for field visits. Area by nonforest condition type and type group provide a new summary of Nevada's nonforest lands, depicting area of the landscape by 26 nonforest conditions, including prevalent conditions such as sage, other shrub, desert complex, and grass forb, as well as rare conditions such as idle farmland, cultural lands, and mining.

Aerial photography gives the interpreter a unique perspective, allowing aerial point sampling of various cover types over the landscape. The overall cover dominance of non-tree objects is quantified, with soil or rock being the predominant feature on the Nevada landscape. Similarly, the tree cover dominance of pinyon and juniper trees is illustrated. While cover estimates alone are interesting, the real value of photo-based estimation is that it enables analyses of the distribution of cover of many different attributes within both the forest and nonforest conditions. Understanding the distribution of tree species within different forest types leads to a better understanding of forest composition. Similarly, estimates of the distribution of cover of non-tree objects within the nonforest conditions of the State are a new addition to knowledge about this landscape.

This pilot provided a photo-based training dataset for mapping forest attributes at the same scale as the remote sensing imagery. FIA field plots measure trees on four 1/20$^{th}$-acre subplots distributed within 1 acre of ground. These data are often used to train models tasked with defining the relationship between truth on the ground and spectral data collected at 30-m, 90-m, 250-m (820-ft), and 500-m resolution. The mismatch between scale of ground data and scale of remotely sensed data can contribute a substantial amount of noise and confusion in predictive models. Here, the 250-m (820-ft) radius plot provided more scale-compatible training data for MODIS-based maps. The resultant maps from the predictive models derived using this photo-based training data are yet another example of new and unique ways to characterize vegetative characteristics. The four 250-m (820-ft) resolution maps of conditions and condition groups, live tree cover, individual tree species, sage, and other shrubs presented here provide a unique opportunity for more integrated analyses of the forest and nonforest components of Nevada's landscape. Applications in wood products, wildlife habitat, water resources, carbon monitoring, insect and disease risk, fire, and others all require spatial depictions of the vegetative composition of an area.

One way to recoup the costs associated with acquiring and interpreting photos is to not send field crews to what are known as "checker" plots, that is, plots that are likely nonforested but the interpreter cannot be sure given available resolution photography. Larger-scale photography can eliminate more nonforested plots from being field visited. For example, in 2004, a simple test was conducted in Nevada where 77 "checker" plots were photo-interpreted. Of these, 51 were determined to have some forest land requiring a field visit. However, twenty-six were determined to be nonforest with no field visit needed. We estimated per photo-plot costs to be $200, which means photo data collection for 77 plots cost $15,400. Field visit of nonforest plots in the Interior Western United States is estimated to be $2000 per plot, yielding a cost savings of $36,600 (Goeking and others 2009).

Integrating large-scale photography and other remote sensing data into the forest inventory observation process holds promise. Schroeder and others (2014) illustrated how a combination of Landsat observations coupled with National Agriculture Imagery Program (NAIP) photography and field observations give the most complete picture of disturbance on the Utah landscape. Cohen and others (2010) developed a Landsat-based observation system for monitoring landscape dynamics using historic Landsat imagery and NAIP photography in an integrative tool called TimeSync. In addition, FIA is in the process of adopting an Image Based Change Estimation (ICE) process wherein land use and land cover change observations are made on FIA plots using two dates of NAIP imagery (Webb and others 2012).

Finally, many interesting research issues arise from integrating photos into the forest inventory observation process. For example, questions about sample design arise such as whether to use two-phase versus two-step sample. The response design is riddled with questions such as appropriate photo-plot size, shape, or configuration; the configuration and number of dots; and other sampling tools such as transects, complete enumeration, or use of automated individual tree crown delineation algorithms. Much needs to be investigated regarding efficiency gains by adding photography, the potential for cost reduction in marginal forest land, the potential for modeling field attributes over photos, and application of nonparametric model-assisted estimation. Large-scale aerial photography offers potential in mapping forest attributes using photos as training data for the next round of FIA map products as well as a baseline for accuracy assessment for existing FIA map products. From an analytical perspective, it should be investigated whether there are FIA variables that might be better sampled from photos rather than from the ground.

## Conclusions

FIA's standard forest reporting can be augmented through the use of observations collected on large-scale aerial photography. Estimates of area by condition in the State of Nevada begin to capture attributes such as rare condition classes (e.g., riparian), disturbance agents, and less common forest types. The estimates targeting nonforest conditions reveal distributions within rangelands not previously seen using traditional forest inventory protocols. Exploring the distribution of cover of particular objects within a variety of conditions helps characterize both forested and nonforest landscapes in new ways. Photo-interpreted data provide an inexpensive source of training data for predictive models and maps of species distribution and cover. Costs of acquiring this valuable information can be offset through reducing the number of field visits to plots, as well as through potential gains in precision of map products.

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# Appendix

**Table A.1**—Estimated acres and percent standard error by forest type group on all lands; Nevada, 2004–2005.

| Forest type group | Acres | Percent standard error |
|---|---|---|
| Forest | 11,718,402 | 3.58 |
| Shrub | 43,463,439 | 1.57 |
| Grass/forb | 3,916,176 | 10.90 |
| Other nonforest | 4,190,866 | 10.36 |
| Total | 63,288,883 | — |

**Table A.2**—Estimated acres and percent standard error by forest type and forest type group on all lands; Nevada, 2004–2005.

| Forest type group | Forest type | Acres | Percent standard error |
|---|---|---|---|
| Forest | Aspen | 158,910 | 19.13 |
| Forest | Bristlecone pine | 37,785 | 35.16 |
| Forest | Cottonwood | 231 | 100.00 |
| Forest | Cottonwood/willow | 13,738 | 63.22 |
| Forest | Deciduous oak | 5,651 | 100.00 |
| Forest | Douglas-fir | 8,848 | 62.94 |
| Forest | Engelmann spruce | 3,575 | 61.76 |
| Forest | Jeffrey pine | 33,446 | 36.74 |
| Forest | Juniper | 1,350,752 | 15.08 |
| Forest | Limber pine | 84,868 | 37.56 |
| Forest | Mahogany | 459,343 | 14.04 |
| Forest | Pinyon/juniper | 8,496,691 | 4.07 |
| Forest | Ponderosa pine | 45,887 | 33.81 |
| Forest | Red fir | 5,651 | 100.00 |
| Forest | Rocky Mountain juniper | 12,830 | 72.07 |
| Forest | Subalpine fir | 46,550 | 28.53 |
| Forest | Sugar pine | 4,267 | 74.93 |
| Forest | Western juniper | 633,713 | 24.98 |
| Forest | White fir | 313,934 | 16.24 |
| Forest | Whitebark pine | 1,730 | 100.00 |
| Grass-Forb | Grass/forb | 3,916,176 | 10.90 |
| Nonforest | Beach/shoreline | 301,508 | 41.50 |
| Nonforest | Census water | 183,586 | 52.64 |
| Nonforest | Cropland | 664,600 | 27.51 |
| Nonforest | Cultural | 125,497 | 44.33 |
| Nonforest | Idle farmland | 64,151 | 87.12 |
| Nonforest | Military | 61,585 | 100.00 |
| Nonforest | Mining | 154,279 | 50.91 |
| Nonforest | Noncensus water | 15,511 | 49.55 |
| Nonforest | Pasture | 298,942 | 40.78 |
| Nonforest | Rights-of-way | 154,059 | 18.13 |
| Nonforest | Riparian zone | 29,395 | 47.33 |
| Nonforest | Rock outcrops/scree | 494,492 | 26.25 |
| Nonforest | Sand/dunes | 1,384,340 | 19.35 |
| Nonforest | Unclassified agriculture | 48,754 | 100.00 |
| Nonforest | Unclassified developed | 16,679 | 100.00 |
| Nonforest | Unclassified other natural | 171,679 | 52.34 |
| Nonforest | Wetland | 21,811 | 100.00 |
| Shrub | Desert complex | 5,158,841 | 10.42 |
| Shrub | Other shrub | 17,524,996 | 4.74 |
| Shrub | Sagebrush | 20,769,453 | 4.03 |
| Shrub | Unclassified shrub | 10,149 | 63.67 |
| | Total | 63,288,883 | — |

**Table A.3**—Estimated acres and percent standard error by forest type group on all lands; Nevada, 2004–2005.

| Forest type group | Acres | Percent standard error |
|---|---|---|
| Agriculture/developed nonforest | 1,588,545 | 17.41 |
| Grass/forb | 3,916,176 | 10.90 |
| Sagebrush | 20,769,453 | 4.03 |
| Other shrub/unclassified | 22,693,986 | 3.87 |
| Other natural nonforest | 2,551,115 | 13.58 |
| Wetland-riparian nonforest | 51,206 | 50.47 |
| White fir/Douglas-fir | 332,009 | 15.58 |
| Spruce/fir | 46,550 | 28.53 |
| Limber/bristlecone pine | 124,383 | 27.90 |
| Jeffrey pine/ponderosa pine | 83,600 | 24.19 |
| Western juniper | 633,713 | 24.98 |
| Aspen/cottonwood | 178,530 | 17.97 |
| Mahogany | 459,343 | 14.04 |
| Pinyon/juniper | 9,860,274 | 3.96 |
| Total | 63,288,883 | — |

**Table A.4**—Estimated acres and percent standard error by stand density classes on all lands; Nevada, 2004–2005.

| Crown density | Acres | Percent standard error |
|---|---|---|
| Nonforest | 51,543,869 | 0.82 |
| Between 0 and 25 | 5,089,188 | 7.14 |
| Between 26 and 50 | 4,527,686 | 4.38 |
| Between 51 and 75 | 1,416,262 | 6.38 |
| Between 76 and 100 | 252,572 | 18.98 |
| Nonstocked | 459,305 | 24.13 |
| Total | 63,288,883 | — |

**Table A.5**—Estimated acres and percent standard error by owner class on all lands; Nevada, 2004–2005.

| Owner class | Acres | Percent standard error |
|---|---|---|
| Forest Service | 6,021,413 | 7.20 |
| National Park Service | 522,390 | 32.11 |
| Bureau of Land Management | 45,194,167 | 1.75 |
| Fish and Wildlife Service | 1,042,659 | 23.12 |
| Department of Defense | 222,510 | 49.27 |
| Department of Energy | 62,868 | 100.00 |
| Bureau of Reclamation | 200,150 | 51.31 |
| Nevada State | 367,682 | 38.19 |
| Tribal Land | 887,758 | 26.31 |
| Private | 8,767,287 | 7.11 |
| Total | 63,288,883 | — |

**Table A.6**—Estimated percent cover and percent standard error by attribute class and vegetation group on all lands; Nevada, 2004–2005.

| Veg group | Object | Percent cover | Percent standard error |
|---|---|---|---|
| Tree | Black cottonwood | 0.02 | 47.95 |
| Tree | Down dead | 0.08 | 9.58 |
| Tree | Engelmann spruce | 0.01 | 50.47 |
| Tree | Great Basin bristlecone pine | 0.01 | 37.31 |
| Tree | Incense cedar | 0.00 | 84.97 |
| Tree | Jeffrey pine | 0.02 | 32.25 |
| Tree | Juniper spp. | 1.57 | 5.36 |
| Tree | Limber pine | 0.04 | 28.70 |
| Tree | Mortality | 0.07 | 10.62 |
| Tree | Mountain mahogany | 0.31 | 10.71 |
| Tree | Other hardwood | 0.01 | 60.56 |
| Tree | Other softwood | 0.01 | 40.75 |
| Tree | Pinyon spp. | 2.24 | 3.72 |
| Tree | Ponderosa pine | 0.01 | 29.88 |
| Tree | Quaking aspen | 0.18 | 20.25 |
| Tree | Standing dead | 0.15 | 9.61 |
| Tree | Subalpine fir | 0.02 | 42.69 |
| Tree | Western juniper | 0.32 | 14.38 |
| Tree | White fir | 0.17 | 16.33 |
| Shrub | Other shrub | 19.67 | 2.52 |
| Shrub | Sage complex | 12.31 | 3.95 |
| Other_veg | Agriculture | 1.10 | 26.79 |
| Other_veg | Dry herbaceous | 14.41 | 3.77 |
| Other_veg | Litter | 0.65 | 6.47 |
| Other_veg | Pasture | 0.41 | 45.53 |
| Other_veg | Wet herbaceous | 0.05 | 30.33 |
| Barren | Built (structure) | 0.07 | 33.90 |
| Barren | Improved road | 0.27 | 28.46 |
| Barren | Other barren | 0.21 | 60.79 |
| Barren | Soil or rock | 45.10 | 1.46 |
| Barren | Unimproved road | 0.07 | 17.51 |
| Barren | Water | 0.31 | 49.31 |
| Unknown | Other unknown | 0.01 | 58.96 |
| Unknown | Shadow | 0.09 | 11.46 |
| | Total | 100.00 | — |

**Table A.7**—Estimated percent cover and percent standard error by attribute class on all lands; Nevada, 2004–2005.

| Attribute class | Percent cover | Percent standard error |
|---|---|---|
| Vegetated | 53.85 | 1.23 |
| Non-vegetated | 46.03 | 1.44 |
| Unknown | 0.12 | 12.22 |
| Total | 100.00 | — |

**Table A.8**—Estimated percent cover and percent standard error by attribute class on all lands; Nevada, 2004–2005.

| Attribute class | Percent cover | Percent standard error |
|---|---|---|
| Tree | 5.24 | 2.88 |
| Shrub | 31.99 | 1.70 |
| Other veg | 16.63 | 3.80 |
| Barren | 46.03 | 1.44 |
| Unknown | 0.12 | 12.22 |
| Total | 100.00 | — |

**Table A.9**—Estimated percent cover and percent standard error by attribute class on all lands; Nevada, 2004–2005.

| Attribute class | Percent cover | Percent standard error |
|---|---|---|
| Softwood | 4.42 | 2.95 |
| Hardwood | 0.52 | 9.97 |
| Unknown tree | 0.30 | 6.33 |
| Shrub | 31.99 | 1.70 |
| Other veg | 16.63 | 3.80 |
| Barren | 46.03 | 1.44 |
| Unknown | 0.12 | 12.22 |
| Total | 100.00 | — |

**Table A.10**—Estimated percent cover and percent standard error by attribute class on all lands; Nevada, 2004–2005.

| Attribute class | Percent cover | Percent standard error |
|---|---|---|
| Timber | 0.81 | 8.67 |
| Woodland | 4.12 | 3.09 |
| Other tree | 0.02 | 37.77 |
| Dead tree | 0.30 | 6.33 |
| Sage shrub | 12.31 | 3.95 |
| Other shrub | 19.68 | 2.52 |
| Herbaceous | 14.46 | 3.77 |
| Other veg | 2.17 | 16.42 |
| Non-vegetated | 45.72 | 1.44 |
| Water | 0.31 | 49.31 |
| Unknown | 0.12 | 12.22 |
| Total | 100.00 | — |

**Table A.11a**—Estimated percent cover of tree attributes within forest condition types on all lands; Nevada, 2004–2005.

| | Tree attributes | | | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Forest type | Aspen | Black cot-tonwood | Bristlecone pine | Douglas-fir | Down dead | Engelmann spruce | Gambel oak | Incense cedar | Jeffrey pine | Juniper spp. | Limber pine | Lodgepole pine | Mortality | Mtn ma-hogany | Other hardwood | Other softwood | Pinyon spp. | Ponderosa pine | Red fir | Standing dead | Subalpine fir | Sugar pine | Western juniper | White fir | White pine | Whitebark pine | Total |
| Aspen | 55.41 | 0.81 | 0.00 | 0.00 | 0.36 | 0.51 | 0.00 | 0.00 | 0.07 | 0.88 | 0.44 | 0.00 | 0.36 | 0.44 | 0.07 | 0.07 | 0.00 | 0.07 | 0.00 | 0.80 | 0.15 | 0.00 | 0.00 | 2.20 | 0.00 | 0.00 | 62.65 |
| Bristlecone pine | 0.00 | 0.00 | 18.92 | 0.31 | 0.92 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 5.49 | 0.00 | 0.61 | 0.92 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.61 | 0.00 | 0.00 | 0.00 | 1.22 | 0.00 | 0.00 | 29.00 |
| Cottonwood | 0.00 | 50.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 50.00 |
| Cottonwood/ willow | 0.00 | 33.05 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.84 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 33.89 |
| Deciduous oak | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 16.33 | 0.00 | 0.00 | 4.08 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 6.12 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 26.53 |
| Douglas-fir | 0.00 | 0.00 | 0.00 | 5.26 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 1.32 | 0.00 | 3.95 | 0.00 | 0.00 | 0.00 | 1.32 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 2.63 | 0.00 | 0.00 | 14.47 |
| Engelmann spruce | 9.68 | 0.00 | 0.00 | 0.00 | 3.23 | 32.26 | 0.00 | 0.00 | 0.00 | 0.00 | 3.23 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 3.23 | 0.00 | 0.00 | 3.23 | 0.00 | 0.00 | 0.00 | 3.23 | 0.00 | 0.00 | 58.06 |
| Jeffrey pine | 0.00 | 0.00 | 0.00 | 0.00 | 0.69 | 0.00 | 0.00 | 0.00 | 17.93 | 0.00 | 0.34 | 0.00 | 1.03 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 1.03 | 0.34 | 0.00 | 0.00 | 0.00 | 0.69 | 0.00 | 0.00 | 22.07 |
| Juniper | 0.00 | 0.00 | 0.00 | 0.00 | 0.26 | 0.00 | 0.00 | 0.00 | 0.00 | 14.74 | 0.00 | 0.00 | 0.13 | 0.22 | 0.00 | 0.00 | 0.49 | 0.00 | 0.00 | 0.31 | 0.00 | 0.00 | 0.00 | 0.05 | 0.00 | 0.00 | 16.20 |
| Limber pine | 1.36 | 0.00 | 0.00 | 0.00 | 2.73 | 0.68 | 0.00 | 0.00 | 0.27 | 0.14 | 17.21 | 0.68 | 0.00 | 0.82 | 0.00 | 0.00 | 0.00 | 0.00 | 0.14 | 0.14 | 0.00 | 0.41 | 0.00 | 2.99 | 0.00 | 0.54 | 28.10 |
| Mahogany | 0.43 | 0.08 | 0.03 | 0.00 | 0.68 | 0.05 | 0.00 | 0.00 | 0.00 | 2.27 | 0.20 | 0.00 | 0.33 | 28.31 | 0.00 | 0.31 | 3.02 | 0.03 | 0.00 | 1.06 | 0.03 | 0.00 | 0.05 | 1.57 | 0.00 | 0.00 | 38.42 |
| Pinyon/juniper | 0.01 | 0.00 | 0.01 | 0.00 | 0.41 | 0.00 | 0.00 | 0.00 | 0.00 | 8.69 | 0.00 | 0.00 | 0.38 | 0.54 | 0.00 | 0.00 | 15.94 | 0.01 | 0.00 | 0.77 | 0.00 | 0.00 | 1.00 | 0.12 | 0.00 | 0.00 | 27.90 |
| Ponderosa pine | 0.00 | 0.00 | 0.00 | 0.25 | 0.75 | 0.00 | 0.00 | 0.00 | 0.00 | 0.50 | 0.00 | 0.00 | 0.00 | 0.50 | 0.00 | 0.25 | 3.27 | 15.87 | 0.00 | 0.75 | 0.00 | 0.00 | 0.00 | 3.77 | 0.00 | 0.00 | 25.92 |
| Red fir | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 16.33 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 10.20 | 4.08 | 0.00 | 30.61 |
| Rocky Mountain juniper | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Subalpine fir | 3.86 | 0.26 | 0.00 | 0.00 | 0.77 | 0.00 | 0.00 | 0.00 | 0.00 | 0.26 | 7.24 | 0.00 | 1.03 | 0.00 | 0.00 | 2.57 | 0.00 | 0.00 | 0.00 | 1.54 | 18.92 | 0.00 | 0.00 | 1.80 | 0.00 | 0.00 | 38.27 |
| Sugar pine | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 8.11 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 10.81 | 0.00 | 8.11 | 0.00 | 0.00 | 27.03 |
| Western juniper | 0.00 | 0.00 | 0.00 | 0.00 | 0.04 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.05 | 0.07 | 0.00 | 0.00 | 0.29 | 0.00 | 0.00 | 0.25 | 0.00 | 0.00 | 16.98 | 0.00 | 0.00 | 0.00 | 17.69 |
| White fir | 2.52 | 0.04 | 0.15 | 0.63 | 1.10 | 0.26 | 0.00 | 0.18 | 0.37 | 0.70 | 1.03 | 0.00 | 0.77 | 3.36 | 0.00 | 0.07 | 2.10 | 0.29 | 0.07 | 3.52 | 0.18 | 0.22 | 0.00 | 23.81 | 0.04 | 0.00 | 41.42 |
| Whitebark pine | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 20.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 6.67 | 0.00 | 0.00 | 26.67 |

**Table A.11b**—Percent standard error of estimated cover of tree attributes within forest condition types on all lands; Nevada, 2004–2005.

| Forest type | Tree attributes: Aspen | Black cotton-wood | Bristlecone pine | Douglas-fir | Down dead | Engelmann spruce | Gambel oak | Incense cedar | Jeffrey pine | Juniper spp. | Limber pine | Lodgepole pine | Mortality | Mtn ma-hogany | Other hard-wood | Other soft-wood | Pinyon spp. | Ponderosa pine | Red fir | Standing dead | Sub-alpine fir | Sugar pine | Western juniper | White fir | White pine | Whitebark pine | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Aspen | 8.30 | 101.06 | 0.00 | 0.00 | 51.59 | 86.75 | 0.00 | 0.00 | 101.10 | 84.07 | 51.75 | 0.00 | 58.70 | 63.32 | 101.51 | 98.90 | 0.00 | 98.90 | 0.00 | 46.23 | 72.09 | 0.00 | 0.00 | 49.62 | 0.00 | 0.00 | 6.55 |
| Bristlecone pine | 0.00 | 0.00 | 22.44 | 99.21 | 62.19 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 53.14 | 0.00 | 97.02 | 74.83 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 68.01 | 0.00 | 0.00 | 0.00 | 80.35 | 0.00 | 0.00 | 19.00 |
| Cottonwood | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Cottonwood/ willow | 0.00 | 40.51 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 116.88 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 39.01 |
| Deciduous oak | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Douglas-fir | 0.00 | 0.00 | 0.00 | 49.35 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 100.36 | 0.00 | 49.35 | 0.00 | 0.00 | 0.00 | 111.54 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 111.55 | 0.00 | 0.00 | 29.26 |
| Engelmann spruce | 40.42 | 0.00 | 0.00 | 0.00 | 96.48 | 44.95 | 0.00 | 0.00 | 0.00 | 0.00 | 53.42 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 96.48 | 0.00 | 0.00 | 96.48 | 0.00 | 0.00 | 0.00 | 102.96 | 0.00 | 0.00 | 17.57 |
| Jeffrey pine | 0.00 | 0.00 | 0.00 | 0.00 | 89.33 | 0.00 | 0.00 | 0.00 | 29.14 | 0.00 | 92.75 | 0.00 | 59.45 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 68.94 | 94.61 | 0.00 | 0.00 | 0.00 | 92.75 | 0.00 | 0.00 | 20.02 |
| Juniper | 0.00 | 0.00 | 0.00 | 0.00 | 71.07 | 0.00 | 0.00 | 0.00 | 0.00 | 12.77 | 0.00 | 0.00 | 44.39 | 70.47 | 0.00 | 0.00 | 31.92 | 0.00 | 0.00 | 62.86 | 0.00 | 0.00 | 0.00 | 63.74 | 0.00 | 0.00 | 11.49 |
| Limber pine | 77.09 | 0.00 | 0.00 | 0.00 | 34.90 | 84.84 | 0.00 | 0.00 | 72.52 | 106.48 | 23.70 | 101.90 | 0.00 | 63.94 | 0.00 | 0.00 | 0.00 | 0.00 | 101.91 | 100.44 | 0.00 | 60.26 | 0.00 | 75.10 | 0.00 | 72.33 | 19.99 |
| Mahogany | 66.97 | 100.66 | 100.40 | 0.00 | 42.34 | 100.20 | 0.00 | 0.00 | 0.00 | 21.50 | 51.04 | 0.00 | 30.37 | 9.42 | 0.00 | 89.21 | 19.02 | 99.60 | 0.00 | 34.51 | 100.79 | 0.00 | 100.80 | 25.97 | 0.00 | 0.00 | 8.34 |
| Pinyon/juniper | 49.26 | 58.54 | 100.00 | 0.00 | 9.34 | 0.00 | 0.00 | 0.00 | 0.00 | 4.45 | 100.00 | 0.00 | 11.82 | 12.82 | 70.37 | 58.54 | 3.28 | 70.37 | 0.00 | 10.09 | 0.00 | 0.00 | 13.21 | 27.52 | 0.00 | 0.00 | 2.47 |
| Ponderosa pine | 0.00 | 0.00 | 0.00 | 104.18 | 66.41 | 0.00 | 0.00 | 0.00 | 0.00 | 69.23 | 0.00 | 0.00 | 0.00 | 62.74 | 0.00 | 104.18 | 73.81 | 9.68 | 0.00 | 58.97 | 0.00 | 0.00 | 0.00 | 38.99 | 0.00 | 0.00 | 11.99 |
| Red fir | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Rocky Mountain juniper | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Subalpine fir | 52.90 | 100.97 | 0.00 | 0.00 | 67.69 | 0.00 | 0.00 | 0.00 | 0.00 | 97.32 | 37.85 | 0.00 | 58.55 | 0.00 | 0.00 | 60.20 | 0.00 | 0.00 | 0.00 | 44.62 | 37.41 | 0.00 | 0.00 | 59.88 | 0.00 | 0.00 | 15.76 |
| Sugar pine | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 45.88 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 24.85 | 0.00 | 48.43 | 0.00 | 0.00 | 10.71 |
| Western juniper | 0.00 | 0.00 | 0.00 | 0.00 | 73.90 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 61.72 | 81.87 | 0.00 | 0.00 | 71.07 | 0.00 | 0.00 | 42.62 | 0.00 | 0.00 | 10.77 | 0.00 | 0.00 | 0.00 | 10.58 |
| White fir | 37.76 | 99.73 | 61.17 | 56.59 | 27.26 | 47.65 | 0.00 | 99.57 | 58.04 | 34.00 | 29.97 | 0.00 | 35.92 | 32.00 | 0.00 | 71.33 | 30.55 | 58.68 | 99.59 | 26.18 | 100.71 | 74.11 | 0.00 | 6.35 | 99.73 | 0.00 | 5.19 |
| Whitebark pine | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |

**Table A.12a**—Estimated percent cover of non-tree attributes within nonforest condition types on all lands; Nevada, 2004–2005.

| | Non-tree attribute | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Forest type | Sage shrub | Other shrub | Joshua tree | Dry herb. | Wet herb. | Agri-culture | Pasture | Litter | Other veg | Soil or rock | Built (structure) | Improved road | Unim-proved road | Water | Other barren | Snow or ice | Shadow | Other unknown |
| Beach/shoreline | 0.00 | 0.85 | 0.00 | 1.70 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 97.02 | 0.00 | 0.43 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Census water | 0.00 | 0.00 | 0.00 | 0.00 | 1.40 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 98.54 | 0.06 | 0.00 | 0.00 | 0.00 |
| Cropland | 0.00 | 0.39 | 0.00 | 2.70 | 0.00 | 95.95 | 0.00 | 0.00 | 0.00 | 0.77 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Cultural | 0.19 | 2.80 | 0.00 | 14.84 | 0.00 | 0.00 | 0.00 | 0.56 | 2.07 | 29.33 | 17.75 | 11.64 | 0.09 | 0.00 | 11.93 | 0.00 | 1.03 | 0.00 |
| Desert complex | 0.18 | 27.07 | 0.13 | 7.91 | 0.00 | 0.00 | 0.00 | 0.03 | 0.03 | 64.34 | 0.08 | 0.03 | 0.05 | 0.00 | 0.00 | 0.00 | 0.03 | 0.10 |
| Grass/forb | 5.07 | 6.59 | 0.00 | 61.22 | 0.11 | 0.13 | 0.00 | 0.11 | 0.00 | 26.39 | 0.00 | 0.00 | 0.10 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Idle farmland | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 86.00 | 0.00 | 0.00 | 0.00 | 14.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Military | 0.00 | 2.08 | 0.00 | 12.50 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 10.42 | 4.17 | 70.83 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Mining | 0.15 | 0.91 | 0.00 | 8.47 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 44.74 | 0.00 | 2.49 | 0.00 | 0.83 | 42.41 | 0.00 | 0.00 | 0.00 |
| Noncensus water | 0.00 | 0.00 | 0.00 | 0.00 | 33.09 | 0.00 | 0.00 | 0.00 | 0.00 | 16.54 | 0.00 | 0.00 | 0.00 | 49.63 | 0.00 | 0.00 | 0.00 | 0.00 |
| Other shrub | 2.49 | 34.94 | 0.00 | 11.93 | 0.02 | 0.00 | 0.00 | 0.24 | 0.00 | 50.14 | 0.03 | 0.01 | 0.07 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 |
| Pasture | 0.00 | 2.58 | 0.00 | 6.87 | 0.00 | 0.00 | 86.27 | 0.00 | 0.00 | 4.29 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Rights-of-way | 0.00 | 1.75 | 0.00 | 10.11 | 0.84 | 0.84 | 0.00 | 0.00 | 0.00 | 12.92 | 0.84 | 63.36 | 5.17 | 2.51 | 1.67 | 0.00 | 0.00 | 0.00 |
| Riparian zone | 0.00 | 52.77 | 0.00 | 18.65 | 17.48 | 0.00 | 0.00 | 0.00 | 0.00 | 9.13 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Rock outcrops/scree | 1.56 | 7.50 | 0.00 | 8.61 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 81.49 | 0.02 | 0.00 | 0.00 | 0.00 | 0.00 | 0.26 | 0.00 | 0.00 |
| Sagebrush | 29.49 | 16.61 | 0.00 | 14.19 | 0.02 | 0.00 | 0.00 | 0.25 | 0.00 | 38.99 | 0.02 | 0.03 | 0.06 | 0.00 | 0.00 | 0.01 | 0.00 | 0.01 |
| Sand/dunes | 0.37 | 5.66 | 0.00 | 1.11 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 92.76 | 0.09 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Unclassified agriculture | 2.63 | 2.63 | 0.00 | 34.21 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 60.53 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Unclassified developed | 0.00 | 7.69 | 0.00 | 15.38 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 76.92 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Unclassified other natural | 0.00 | 5.37 | 0.00 | 27.65 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 66.17 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.75 |
| Unclassified shrub | 2.27 | 34.09 | 0.00 | 5.68 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 50.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Wetland | 0.00 | 58.82 | 0.00 | 11.76 | 11.76 | 0.00 | 0.00 | 0.00 | 0.00 | 5.88 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |

**Table A.12b**—Percent standard error of estimated cover of non-tree attributes within nonforest condition types on all lands; Nevada, 2004–2005.

| | **Non-tree attribute** | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Forest type | Sage shrub | Other shrub | Joshua tree | Dry herb. | Wet herb. | Agriculture | Pasture | Litter | Other veg | Soil or rock | Built (structure) | Improved road | Unim-proved road | Water | Other barren | Snow or ice | Shadow | Other unknown |
| Beach/shoreline | 0.00 | 98.05 | 0.00 | 72.45 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 2.05 | 0.00 | 104.37 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Census water | 0.00 | 0.00 | 0.00 | 0.00 | 99.98 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 1.43 | 113.06 | 0.00 | 0.00 | 0.00 |
| Cropland | 0.00 | 67.37 | 0.00 | 65.06 | 0.00 | 2.34 | 0.00 | 0.00 | 0.00 | 55.53 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Cultural | 80.80 | 40.29 | 0.00 | 27.35 | 0.00 | 0.00 | 0.00 | 105.31 | 72.04 | 30.29 | 21.18 | 36.46 | 106.78 | 0.00 | 31.62 | 0.00 | 72.04 | 0.00 |
| Desert complex | 61.38 | 5.17 | 81.69 | 11.34 | 0.00 | 0.00 | 0.00 | 99.60 | 99.60 | 2.33 | 56.84 | 100.00 | 69.92 | 0.00 | 0.00 | 0.00 | 99.60 | 78.51 |
| Grass/forb | 20.37 | 14.56 | 0.00 | 4.03 | 52.75 | 100.00 | 0.00 | 67.69 | 0.00 | 7.80 | 0.00 | 0.00 | 74.26 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Idle farmland | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 19.81 | 0.00 | 0.00 | 0.00 | 121.69 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Military | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Mining | 111.37 | 92.12 | 0.00 | 68.21 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 50.35 | 0.00 | 98.91 | 0.00 | 98.92 | 62.53 | 0.00 | 0.00 | 0.00 |
| Noncensus water | 0.00 | 0.00 | 0.00 | 0.00 | 50.13 | 0.00 | 0.00 | 0.00 | 0.00 | 64.50 | 0.00 | 0.00 | 0.00 | 23.55 | 0.00 | 0.00 | 0.00 | 0.00 |
| Other shrub | 12.22 | 2.52 | 0.00 | 6.84 | 57.27 | 0.00 | 0.00 | 31.65 | 0.00 | 2.25 | 49.83 | 70.75 | 32.20 | 101.37 | 0.00 | 0.00 | 100.00 | 0.00 |
| Pasture | 0.00 | 64.16 | 0.00 | 61.56 | 0.00 | 0.00 | 8.68 | 0.00 | 0.00 | 85.61 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Rights-of-way | 0.00 | 66.80 | 0.00 | 41.44 | 97.55 | 97.55 | 0.00 | 0.00 | 0.00 | 36.77 | 91.34 | 12.81 | 45.81 | 95.81 | 70.20 | 0.00 | 0.00 | 0.00 |
| Riparian zone | 0.00 | 18.09 | 0.00 | 32.19 | 66.27 | 0.00 | 0.00 | 0.00 | 0.00 | 62.50 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Rock outcrops/scree | 53.37 | 26.82 | 0.00 | 26.53 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 3.51 | 103.43 | 0.00 | 0.00 | 0.00 | 0.00 | 91.21 | 0.00 | 0.00 |
| Sagebrush | 2.77 | 4.44 | 0.00 | 5.31 | 56.02 | 0.00 | 0.00 | 24.69 | 0.00 | 2.29 | 56.02 | 59.68 | 31.35 | 0.00 | 0.00 | 96.12 | 100.00 | 100.00 |
| Sand/dunes | 62.41 | 25.52 | 0.00 | 48.53 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 2.01 | 97.41 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Unclassified agriculture | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Unclassified developed | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Unclassified other natural | 0.00 | 47.21 | 0.00 | 52.59 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 18.32 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 84.12 |
| Unclassified shrub | 78.15 | 64.22 | 0.00 | 65.62 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 55.11 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Wetland | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |

**Table A.13a**—Estimated percent cover of tree attributes within nonforest condition types on all lands; Nevada, 2004–2005.

| | Attribute | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Forest type | Quaking aspen | Black cotton-wood | Down dead | Engel-mann spruce | Incense cedar | Jeffrey pine | Juniper spp. | Limber pine | Mort-ality | Mountain-mahogany | Other hard-wood | Other soft-wood | Pinyon spp. | Standing dead | Sub-alpine fir | Sugar pine | Western juniper | White fir |
| Beach/shoreline | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Census water | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Cropland | 0.00 | 0.19 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Cultural | 0.00 | 0.00 | 0.00 | 0.00 | 0.09 | 1.86 | 0.00 | 0.00 | 0.09 | 0.00 | 4.14 | 1.03 | 0.09 | 0.09 | 0.00 | 0.28 | 0.00 | 0.09 |
| Desert complex | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.05 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Grass/forb | 0.00 | 0.03 | 0.04 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.04 | 0.00 | 0.00 | 0.00 | 0.13 | 0.04 | 0.00 | 0.00 | 0.00 | 0.00 |
| Idle farmland | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Military | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Mining | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Noncensus water | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.74 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Other shrub | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.05 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.04 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 |
| Pasture | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Rights-of-way | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Riparian zone | 0.00 | 0.00 | 0.00 | 0.39 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 1.57 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Rock outcrops/scree | 0.00 | 0.00 | 0.02 | 0.00 | 0.00 | 0.00 | 0.35 | 0.00 | 0.02 | 0.00 | 0.00 | 0.00 | 0.14 | 0.02 | 0.00 | 0.00 | 0.00 | 0.00 |
| Sagebrush | 0.04 | 0.00 | 0.01 | 0.00 | 0.00 | 0.00 | 0.11 | 0.00 | 0.01 | 0.02 | 0.00 | 0.00 | 0.09 | 0.01 | 0.00 | 0.00 | 0.05 | 0.01 |
| Sand/dunes | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Unclassified agriculture | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Unclassified developed | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Unclassified other natural | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.07 |
| Unclassified shrub | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 1.14 | 0.00 | 1.14 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 5.68 |
| Wetland | 0.00 | 11.76 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |

**Table A.13b**—Percent standard error of estimated cover of tree attributes within nonforest condition types on all lands; Nevada, 2004–2005.

| | Attribute | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Forest type | Quaking aspen | Black cotton-wood | Down dead | Engel-mann spruce | Incense cedar | Jeffrey pine | Juniper spp. | Limber pine | Mort-ality | Mountain-mahogany | Other hard-wood | Other soft-wood | Pinyon spp. | Stand-ing dead | Sub-alpine fir | Sugar pine | West-ern juniper | White fir |
| Beach/shoreline | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Census water | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Cropland | 0.00 | 94.87 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Cultural | 0.00 | 0.00 | 0.00 | 0.00 | 107.32 | 67.85 | 0.00 | 0.00 | 105.60 | 0.00 | 33.40 | 98.71 | 108.18 | 108.18 | 0.00 | 83.36 | 0.00 | 107.32 |
| Desert complex | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 70.32 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Grass/forb | 0.00 | 99.70 | 85.53 | 0.00 | 0.00 | 0.00 | 103.45 | 0.00 | 91.60 | 103.45 | 0.00 | 0.00 | 97.39 | 85.27 | 0.00 | 0.00 | 0.00 | 0.00 |
| Idle farmland | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Military | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Mining | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Noncensus water | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 110.93 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Other shrub | 52.74 | 0.00 | 100.00 | 0.00 | 0.00 | 0.00 | 33.95 | 0.00 | 0.00 | 45.45 | 0.00 | 100.00 | 39.31 | 85.06 | 0.00 | 0.00 | 69.23 | 0.00 |
| Pasture | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Rights-of-way | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Riparian zone | 0.00 | 0.00 | 0.00 | 108.53 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 109.22 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Rock outcrops/scree | 0.00 | 0.00 | 103.43 | 0.00 | 0.00 | 0.00 | 78.40 | 0.00 | 103.00 | 0.00 | 0.00 | 0.00 | 66.64 | 102.58 | 0.00 | 0.00 | 0.00 | 0.00 |
| Sagebrush | 41.57 | 0.00 | 75.00 | 0.00 | 0.00 | 0.00 | 25.68 | 100.00 | 100.00 | 52.98 | 0.00 | 100.00 | 28.76 | 92.54 | 100.00 | 0.00 | 36.83 | 92.54 |
| Sand/dunes | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Unclassified agriculture | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Unclassified developed | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Unclassified other natural | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 112.65 |
| Unclassified shrub | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 110.67 | 0.00 | 78.14 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 110.67 |
| Wetland | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |

**Table A.14a**—Estimated cover of non-tree attributes within forest condition types on all lands; Nevada, 2004–2005.

| | Non-tree attribute | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Forest type | Built (structure) | Dry herbaceous | Improved road | Joshua tree | Litter | Other barren | Other shrub | Other veg | Sage shrub | Shadow | Snow or ice | Soil or rock | Unimproved road | Wet herbaceous |
| Aspen | 0.00 | 7.48 | 0.00 | 0.00 | 3.38 | 0.00 | 13.10 | 0.00 | 2.86 | 1.61 | 0.00 | 8.77 | 0.00 | 0.15 |
| Bristlecone pine | 0.00 | 9.50 | 0.00 | 0.00 | 2.75 | 0.00 | 8.89 | 0.00 | 3.97 | 0.92 | 0.00 | 44.98 | 0.00 | 0.00 |
| Cottonwood | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 50.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Cottonwood/willow | 0.00 | 48.37 | 0.00 | 0.00 | 1.68 | 0.00 | 5.88 | 0.00 | 0.00 | 0.00 | 0.00 | 0.84 | 0.00 | 9.34 |
| Deciduous oak | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 42.86 | 0.00 | 0.00 | 0.00 | 0.00 | 30.61 | 0.00 | 0.00 |
| Douglas-fir | 0.00 | 51.32 | 0.00 | 0.00 | 7.89 | 0.00 | 2.63 | 0.00 | 0.00 | 0.00 | 0.00 | 23.68 | 0.00 | 0.00 |
| Engelmann spruce | 0.00 | 9.68 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 6.45 | 9.68 | 0.00 | 16.13 | 0.00 | 0.00 |
| Jeffrey pine | 0.34 | 3.10 | 0.00 | 0.00 | 1.03 | 0.00 | 22.41 | 0.00 | 0.00 | 0.00 | 0.00 | 51.03 | 0.00 | 0.00 |
| Juniper | 0.02 | 15.65 | 0.01 | 0.00 | 1.19 | 0.01 | 14.88 | 0.00 | 12.79 | 0.27 | 0.00 | 38.97 | 0.01 | 0.01 |
| Limber pine | 0.00 | 4.91 | 0.00 | 0.00 | 1.90 | 0.00 | 5.59 | 0.00 | 9.85 | 0.54 | 1.09 | 47.88 | 0.00 | 0.14 |
| Mahogany | 0.03 | 5.74 | 0.00 | 0.00 | 3.20 | 0.00 | 16.36 | 0.00 | 6.48 | 0.93 | 0.00 | 28.84 | 0.00 | 0.00 |
| Pinyon/juniper | 0.02 | 7.70 | 0.02 | 0.00 | 2.78 | 0.60 | 7.32 | 0.00 | 8.18 | 0.43 | 0.00 | 44.97 | 0.05 | 0.02 |
| Ponderosa pine | 0.00 | 7.60 | 0.00 | 0.00 | 3.27 | 0.00 | 9.08 | 0.00 | 2.80 | 0.00 | 0.00 | 51.34 | 0.00 | 0.00 |
| Red fir | 0.00 | 0.00 | 0.00 | 0.00 | 10.20 | 0.00 | 22.45 | 0.00 | 0.00 | 0.00 | 0.00 | 36.73 | 0.00 | 0.00 |
| Rocky Mountain juniper | 0.00 | 40.00 | 0.00 | 0.00 | 0.00 | 0.00 | 10.00 | 0.00 | 0.00 | 0.00 | 0.00 | 50.00 | 0.00 | 0.00 |
| Subalpine fir | 0.00 | 11.07 | 0.00 | 0.00 | 4.41 | 0.00 | 14.23 | 0.00 | 3.89 | 0.00 | 0.00 | 28.13 | 0.00 | 0.00 |
| Sugar pine | 0.00 | 2.70 | 0.00 | 0.00 | 0.00 | 0.00 | 27.03 | 0.00 | 2.70 | 0.00 | 0.00 | 40.54 | 0.00 | 0.00 |
| Western juniper | 0.00 | 10.64 | 0.00 | 0.00 | 0.16 | 0.00 | 10.14 | 0.00 | 13.12 | 0.00 | 0.00 | 48.21 | 0.04 | 0.00 |
| White fir | 0.04 | 10.11 | 0.00 | 0.00 | 9.31 | 0.00 | 9.78 | 0.00 | 3.75 | 2.80 | 0.00 | 22.25 | 0.00 | 0.55 |
| Whitebark pine | 0.00 | 26.67 | 0.00 | 0.00 | 0.00 | 0.00 | 20.00 | 0.00 | 0.00 | 0.00 | 0.00 | 26.67 | 0.00 | 0.00 |

Table A.14b—Percent standard error of estimated percent cover of non-tree attributes within forest condition types on all lands; Nevada, 2004–2005.

| | **Attribute** | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Forest type | Built (structure) | Dry herbaceous | Improved road | Joshua tree | Litter | Other barren | Other shrub | Other veg | Sage shrub | Shadow | Snow or ice | Soil or rock | Unimproved road | Wet herbaceous |
| Aspen | 0.00 | 26.74 | 0.00 | 0.00 | 49.84 | 0.00 | 18.66 | 0.00 | 41.58 | 48.87 | 0.00 | 23.10 | 0.00 | 101.44 |
| Bristlecone pine | 0.00 | 33.99 | 0.00 | 0.00 | 55.11 | 0.00 | 28.20 | 0.00 | 65.53 | 73.59 | 0.00 | 14.14 | 0.00 | 0.00 |
| Cottonwood | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Cottonwood/willow | 0.00 | 35.29 | 0.00 | 0.00 | 90.77 | 0.00 | 85.14 | 0.00 | 0.00 | 0.00 | 0.00 | 113.23 | 0.00 | 52.88 |
| Deciduous oak | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Douglas-fir | 0.00 | 49.35 | 0.00 | 0.00 | 84.37 | 0.00 | 42.16 | 0.00 | 0.00 | 0.00 | 0.00 | 78.59 | 0.00 | 0.00 |
| Engelmann spruce | 0.00 | 75.65 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 102.96 | 23.61 | 0.00 | 25.15 | 0.00 | 0.00 |
| Jeffrey pine | 89.36 | 25.80 | 0.00 | 0.00 | 94.60 | 0.00 | 17.90 | 0.00 | 0.00 | 0.00 | 0.00 | 12.21 | 0.00 | 0.00 |
| Juniper | 71.93 | 18.71 | 100.00 | 0.00 | 30.31 | 100.00 | 15.19 | 0.00 | 14.77 | 40.74 | 0.00 | 5.88 | 100.00 | 100.00 |
| Limber pine | 0.00 | 40.53 | 0.00 | 0.00 | 54.10 | 0.00 | 23.15 | 0.00 | 39.27 | 55.22 | 81.59 | 16.87 | 0.00 | 105.81 |
| Mahogany | 100.00 | 15.91 | 0.00 | 0.00 | 18.05 | 0.00 | 16.98 | 0.00 | 21.32 | 38.52 | 0.00 | 11.09 | 0.00 | 0.00 |
| Pinyon/juniper | 29.36 | 5.79 | 69.86 | 100.00 | 5.76 | 99.37 | 5.79 | 58.54 | 7.37 | 15.35 | 0.00 | 2.08 | 18.49 | 38.42 |
| Ponderosa pine | 0.00 | 58.70 | 0.00 | 0.00 | 65.07 | 0.00 | 21.55 | 0.00 | 85.02 | 0.00 | 0.00 | 12.21 | 0.00 | 0.00 |
| Red fir | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Rocky Mountain juniper | 0.00 | 49.53 | 0.00 | 0.00 | 0.00 | 0.00 | 56.60 | 0.00 | 0.00 | 0.00 | 0.00 | 28.30 | 0.00 | 0.00 |
| Subalpine fir | 0.00 | 31.41 | 0.00 | 0.00 | 68.77 | 0.00 | 30.77 | 0.00 | 62.40 | 0.00 | 0.00 | 16.45 | 0.00 | 0.00 |
| Sugar pine | 0.00 | 45.88 | 0.00 | 0.00 | 0.00 | 0.00 | 24.85 | 0.00 | 45.88 | 0.00 | 0.00 | 17.59 | 0.00 | 0.00 |
| Western juniper | 0.00 | 27.90 | 0.00 | 0.00 | 48.11 | 0.00 | 23.65 | 0.00 | 25.46 | 0.00 | 0.00 | 7.99 | 102.47 | 0.00 |
| White fir | 99.73 | 11.84 | 0.00 | 0.00 | 13.63 | 0.00 | 19.39 | 0.00 | 49.28 | 26.41 | 0.00 | 14.87 | 0.00 | 51.41 |
| Whitebark pine | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |

Table A2.15a—Estimated cover of attribute groups within forest type on all lands; Nevada, 2004–2005.

| | Attribute group | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Forest type | Timber | Woodland | Other tree | Dead tree | Sage shrub | Other shrub | Herbaceous | Other veg | Non-vegetated | Water | Unknown |
| Beach/shoreline | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.85 | 1.70 | 0.00 | 97.45 | 0.00 | 0.00 |
| Census water | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 1.40 | 0.00 | 0.06 | 98.54 | 0.00 |
| Cropland | 0.19 | 0.00 | 0.00 | 0.00 | 0.00 | 0.39 | 2.70 | 95.95 | 0.77 | 0.00 | 0.00 |
| Cultural | 2.32 | 0.09 | 5.17 | 0.19 | 0.19 | 2.80 | 14.84 | 2.63 | 70.74 | 0.00 | 1.03 |
| Desert complex | 0.00 | 0.05 | 0.00 | 0.00 | 0.18 | 27.20 | 7.91 | 0.05 | 64.49 | 0.00 | 0.13 |
| Grass/forb | 0.03 | 0.14 | 0.00 | 0.11 | 5.07 | 6.59 | 61.33 | 0.24 | 26.48 | 0.00 | 0.00 |
| Idle farmland | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 86.00 | 14.00 | 0.00 | 0.00 |
| Military | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 2.08 | 12.50 | 0.00 | 85.42 | 0.00 | 0.00 |
| Mining | 0.00 | 0.00 | 0.00 | 0.00 | 0.15 | 0.91 | 8.47 | 0.00 | 89.65 | 0.83 | 0.00 |
| Noncensus water | 0.00 | 0.00 | 0.74 | 0.00 | 0.00 | 0.00 | 33.09 | 0.00 | 16.54 | 49.63 | 0.00 |
| Other shrub | 0.02 | 0.10 | 0.00 | 0.01 | 2.49 | 34.94 | 11.95 | 0.24 | 50.25 | 0.01 | 0.00 |
| Pasture | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 2.58 | 6.87 | 86.27 | 4.29 | 0.00 | 0.00 |
| Rights-of-way | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 1.75 | 10.95 | 0.84 | 83.96 | 2.51 | 0.00 |
| Riparian zone | 0.39 | 0.00 | 1.57 | 0.00 | 0.00 | 52.77 | 36.13 | 0.00 | 9.13 | 0.00 | 0.00 |
| Rock outcrops/scree | 0.00 | 0.49 | 0.00 | 0.07 | 1.56 | 7.50 | 8.61 | 0.00 | 81.52 | 0.00 | 0.26 |
| Sagebrush | 0.10 | 0.22 | 0.00 | 0.02 | 29.49 | 16.61 | 14.21 | 0.25 | 39.09 | 0.00 | 0.02 |
| Sand/dunes | 0.00 | 0.00 | 0.00 | 0.00 | 0.37 | 5.66 | 1.11 | 0.00 | 92.86 | 0.00 | 0.00 |
| Unclassified agriculture | 0.00 | 0.00 | 0.00 | 0.00 | 2.63 | 2.63 | 34.21 | 0.00 | 60.53 | 0.00 | 0.00 |
| Unclassified developed | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 7.69 | 15.38 | 0.00 | 76.92 | 0.00 | 0.00 |
| Unclassified other natural | 0.07 | 0.00 | 0.00 | 0.00 | 0.00 | 5.37 | 27.65 | 0.00 | 66.17 | 0.00 | 0.75 |
| Unclassified shrub | 6.82 | 1.14 | 0.00 | 0.00 | 2.27 | 34.09 | 5.68 | 0.00 | 50.00 | 0.00 | 0.00 |
| Wetland | 11.76 | 0.00 | 0.00 | 0.00 | 0.00 | 58.82 | 23.53 | 0.00 | 5.88 | 0.00 | 0.00 |

**Table A.15b**—Percent standard error of estimated percent cover of attribute groups within forest type on all lands; Nevada, 2004–2005.

| | Attribute group | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Forest type | Timber | Woodland | Other tree | Dead tree | Sage shrub | Other shrub | Herbaceous | Other veg | Non-vegetated | Water | Unknown |
| Beach/shoreline | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 98.05 | 72.45 | 0.00 | 1.96 | 0.00 | 0.00 |
| Census water | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 99.98 | 0.00 | 113.06 | 1.43 | 0.00 |
| Cropland | 94.87 | 0.00 | 0.00 | 0.00 | 0.00 | 67.37 | 65.06 | 2.34 | 55.53 | 0.00 | 0.00 |
| Cultural | 69.25 | 108.18 | 20.93 | 80.10 | 80.80 | 40.29 | 27.35 | 55.66 | 8.42 | 0.00 | 72.04 |
| Desert complex | 0.00 | 70.32 | 0.00 | 0.00 | 61.38 | 5.21 | 11.34 | 69.92 | 2.32 | 0.00 | 65.61 |
| Grass/forb | 99.70 | 93.28 | 0.00 | 50.35 | 20.37 | 14.56 | 4.03 | 62.59 | 7.75 | 0.00 | 0.00 |
| Idle farmland | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 19.81 | 121.69 | 0.00 | 0.00 |
| Military | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Mining | 0.00 | 0.00 | 0.00 | 0.00 | 111.37 | 92.12 | 68.21 | 0.00 | 7.77 | 98.92 | 0.00 |
| Noncensus water | 0.00 | 0.00 | 110.93 | 0.00 | 0.00 | 0.00 | 50.13 | 0.00 | 64.50 | 23.55 | 0.00 |
| Other shrub | 49.06 | 27.02 | 100.00 | 79.57 | 12.22 | 2.52 | 6.84 | 31.65 | 2.25 | 101.37 | 100.00 |
| Pasture | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 64.16 | 61.56 | 8.68 | 85.61 | 0.00 | 0.00 |
| Rights-of-way | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 66.80 | 43.92 | 97.55 | 6.46 | 95.81 | 0.00 |
| Riparian zone | 108.53 | 0.00 | 109.22 | 0.00 | 0.00 | 18.09 | 40.90 | 0.00 | 62.50 | 0.00 | 0.00 |
| Rock outcrops/scree | 0.00 | 62.58 | 0.00 | 62.43 | 53.37 | 26.82 | 26.53 | 0.00 | 3.51 | 0.00 | 91.21 |
| Sagebrush | 28.78 | 19.64 | 100.00 | 65.26 | 2.77 | 4.44 | 5.30 | 24.69 | 2.29 | 0.00 | 70.41 |
| Sand/dunes | 0.00 | 0.00 | 0.00 | 0.00 | 62.41 | 25.52 | 48.53 | 0.00 | 1.97 | 0.00 | 0.00 |
| Unclassified agriculture | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Unclassified developed | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Unclassified other natural | 112.65 | 0.00 | 0.00 | 0.00 | 0.00 | 47.21 | 52.59 | 0.00 | 18.32 | 0.00 | 84.12 |
| Unclassified shrub | 110.67 | 78.14 | 0.00 | 0.00 | 78.15 | 64.22 | 65.62 | 0.00 | 55.11 | 0.00 | 0.00 |
| Wetland | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |

**Table A.16**—Estimated percent of stand-size condition classes (percent standard error) within condition type groups on all lands; Nevada, 2004–2005. The stand-size class represents the majority of the stand as: 1) mature trees 5 inches diameter (DIA) and greater; 2) young trees less than 5 inches DIA (Seedlings/Saplings); 3) or Nonstocked, once forested but currently less than 10 percent cover of trees.

| | Size class | | |
|---|---|---|---|
| **Forest type class** | **DIA ≥5 inches** | **Seedlings/saplings** | **Nonstocked** |
| Aspen/cottonwood | 86.13 (6.38) | 13.87 (39.65) | 0.00 (0.00) |
| Jeffrey/ponderosa pine | 94.33 (4.03) | 5.67 (66.93) | 0.00 (0.00) |
| Limber/bristlecone pine | 98.61 (1.41) | 1.39 (99.76) | 0.00 (0.00) |
| Mahogany | 91.24 (3.86) | 6.44 (52.05) | 2.31 (68.66) |
| Pinyon/juniper | 86.59 (2.20) | 8.40 (19.83) | 5.01 (22.71) |
| Spruce/fir | 59.22 (23.33) | 40.78 (33.88) | 0.00 (0.00) |
| Western juniper | 71.54 (16.46) | 26.85 (43.94) | 1.61 (70.28) |
| White fir/Douglas-fir | 95.86 (2.37) | 0.35 (100.17) | 3.80 (59.10) |

**Table A.17**—Estimated percent of crown density condition classes (percent standard error) within condition type groups on all lands; Nevada, 2004–2005.

| | Crown density | | | | |
|---|---|---|---|---|---|
| **Forest type class** | **Nonstocked** | **Between 0 and 25** | **Between 26 and 50** | **Between 51 and 75** | **Between 76 and 100** |
| Aspen/cottonwood | 0.00 (0.00) | 5.84 (57.39) | 13.90 (36.33) | 36.38 (22.76) | 43.88 (20.53) |
| Jeffrey/ponderosa pine | 1.53 (91.85) | 40.66 (25.02) | 43.73 (26.14) | 10.21 (66.33) | 3.86 (96.15) |
| Limber/bristlecone pine | 0.00 (0.00) | 61.06 (18.82) | 24.11 (36.44) | 14.09 (48.28) | 0.74 (100.04) |
| Mahogany | 2.64 (61.48) | 26.10 (29.49) | 32.83 (17.60) | 25.62 (22.64) | 12.81 (29.05) |
| Pinyon/juniper | 4.43 (24.48) | 42.92 (5.11) | 40.66 (4.66) | 10.95 (7.31) | 1.04 (34.24) |
| Spruce/fir | 0.00 (0.00) | 25.07 (46.11) | 43.35 (31.95) | 31.32 (43.79) | 0.26 (103.73) |
| Western juniper | 0.24 (102.87) | 83.37 (9.22) | 15.54 (48.91) | 0.86 (102.26) | 0.00 (0.00) |
| White fir/Douglas-fir | 2.33 (73.73) | 16.94 (23.81) | 46.83 (16.26) | 31.63 (21.31) | 2.26 (59.11) |

**Table A.18**—Estimated percent of disturbance condition classes (percent standard error) within condition type groups on all lands; Nevada, 2004–2005.

| | Disturbance | | | | | | |
|---|---|---|---|---|---|---|---|
| **Forest type class** | **Animal** | **Earth movement/ avalanche** | **Fire** | **Human-caused** | **Insect/disease/ drought** | **None** | **Unknown** |
| Aspen/cottonwood | 0.00 (0.00) | 0.71 (99.97) | 1.88 (73.56) | 0.00 (0.00) | 0.65 (72.32) | 96.76 (1.70) | 0.00 (0.00) |
| Jeffrey/ponderosa pine | 0.00 (0.00) | 0.00 (0.00) | 8.98 (72.19) | 0.00 (0.00) | 0.00 (0.00) | 91.02 (7.13) | 0.00 (0.00) |
| Limber/bristlecone pine | 0.00 (0.00) | 0.00 (0.00) | 0.00 (0.00) | 0.00 (0.00) | 0.00 (0.00) | 99.17 (0.87) | 0.83 (103.06) |
| Mahogany | 0.00 (0.00) | 0.00 (0.00) | 3.89 (47.36) | 0.75 (99.99) | 0.63 (71.24) | 94.73 (2.27) | 0.00 (0.00) |
| Other nonforest | 0.00 (0.00) | 0.00 (0.00) | 0.00 (0.00) | 0.00 (0.00) | 0.00 (0.00) | 100.00 (0.00) | 0.00 (0.00) |
| Pinyon/juniper | 0.03 (100.00) | 0.00 (0.00) | 5.85 (20.63) | 0.11 (70.79) | 0.52 (32.39) | 93.43 (1.30) | 0.06 (100.17) |
| Shrub | 0.00 (0.00) | 0.00 (0.00) | 0.16 (91.14) | 0.00 (0.00) | 0.00 (0.00) | 99.84 (0.15) | 0.00 (0.00) |
| Spruce/fir | 0.00 (0.00) | 0.00 (0.00) | 4.21 (99.90) | 0.00 (0.00) | 6.19 (97.90) | 89.59 (8.15) | 0.00 (0.00) |
| Western juniper | 0.00 (0.00) | 0.00 (0.00) | 1.96 (65.81) | 0.00 (0.00) | 0.24 (102.87) | 97.80 (1.36) | 0.00 (0.00) |
| White fir/Douglas-fir | 0.00 (0.00) | 0.00 (0.00) | 6.39 (43.08) | 0.00 (0.00) | 4.31 (42.57) | 89.16 (3.73) | 0.14 (101.15) |

**Table A.19**—Estimated percent of condition type group (percent standard error) by county on all lands; Nevada, 2004–2005.

| FORTYP1NM | Forest | Grass/forb | Non-vegetated | Shrub |
|---|---|---|---|---|
| Carson_Douglas_Story | 57.77 (29.87) | 4.88 (100.00) | 18.27 (93.50) | 19.08 (60.64) |
| Churchill | 6.41 (25.46) | 5.06 (79.55) | 22.76 (35.61) | 65.77 (12.80) |
| Clark | 13.69 (18.84) | 0 | 2.68 (65.03) | 83.63 (3.63) |
| Elko | 13.55 (13.06) | 6.46 (26.33) | 3.77 (32.26) | 76.22 (3.35) |
| Esmeralda | 7.52 (14.80) | 0 | 7.03 (53.80) | 85.46 (4.58) |
| Eureka | 19.00 (17.64) | 7.66 (49.47) | 5.60 (56.93) | 67.75 (8.10) |
| Humboldt | 4.20 (37.53) | 16.66 (20.54) | 8.52 (27.36) | 70.62 (5.74) |
| Lander | 14.03 (16.78) | 6.77 (48.34) | 6.68 (45.81) | 72.53 (6.41) |
| Lincoln | 34.44 (6.82) | 0.02 (65.45) | 2.28 (48.11) | 63.26 (3.96) |
| Lyon | 12.90 (17.86) | 4.43 (68.68) | 13.54 (50.80) | 69.13 (12.17) |
| Mineral | 16.55 (15.89) | 3.14 (73.70) | 8.63 (44.72) | 71.68 (7.13) |
| Nye | 20.54 (4.41) | 0.56 (77.99) | 4.33 (36.07) | 74.57 (2.48) |
| Pershing | 8.42 (33.05) | 21.92 (20.75) | 10.24 (35.11) | 59.43 (9.19) |
| Washoe | 15.47 (22.23) | 10.26 (30.82) | 17.44 (22.77) | 56.82 (9.17) |
| White Pine | 45.69 (6.32) | 3.46 (51.06) | 2.60 (59.34) | 48.25 (6.96) |

**Table A.20**—Estimated percent of condition type group (percent standard error) by Cleland ECOMAP sections on all lands; Nevada, 2004–2005.

| FORTYP1NM | Forest | Grass/forb | Non-vegetated | Shrub |
|---|---|---|---|---|
| East Great Basin and Mountains | 37.01 (4.60) | 3.73 (30.94) | 4.29 (28.86) | 54.97 (3.96) |
| Mojave Desert | 10.08 (17.31) | 0.20 (100.00) | 2.51 (48.16) | 87.21 (2.38) |
| Mono | 45.44 (12.39) | 3.77 (55.96) | 8.26 (55.80) | 42.53 (15.40) |
| Northeastern Great Basin | 4.18 (31.24) | 8.71 (32.67) | 3.05 (45.99) | 84.06 (3.86) |
| Northern Mono | 6.23 (22.23) | 15.80 (15.13) | 14.85 (15.87) | 63.12 (4.99) |
| Northwestern Basin and Range | 8.74 (26.91) | 10.45 (26.37) | 11.35 (24.97) | 69.46 (6.08) |
| Owyhee Uplands/Eastern Basin and Range | 14.65 (38.86) | 4.27 (74.73) | 0.37 (100.00) | 80.71 (7.71) |
| Sierra Nevada | 74.49 (8.52) | 2.04 (71.08) | 10.06 (53.37) | 13.41 (31.43) |
| Southeastern Great Basin | 18.40 (7.21) | 0.31 (96.52) | 4.13 (32.24) | 77.15 (2.38) |
| West Great Basin and Mountains | 24.03 (8.21) | 4.55 (44.14) | 4.77 (39.46) | 66.65 (4.78) |

**Table A.21**—Accuracy assessment error matrix for condition type map with 12 grouped categories.

| | | Agriculture/ developed nonforest | Aspen/ cotton-wood | Grass/ forb | Jeffrey/ ponderosa | Limber/ bristle-cone | Maho-gany | Other natural nonforest | Other shrub | Pinyon/ juniper | Sage-brush | Spruce/ Fir/ Douglas-fir | Western juniper | total | User |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Predicted | Agriculture/developed nonforest | 15 | 0 | 3 | 2 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 21 | 71% |
| | Aspen/cottonwood | 0 | 2 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 1 | 0 | 5 | 40% |
| | Grass/forb | 2 | 0 | 23 | 0 | 0 | 0 | 0 | 2 | 1 | 10 | 0 | 0 | 38 | 61% |
| | Jeffrey/ponderosa | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 2 | 0% |
| | Limber/bristlecone | 0 | 0 | 0 | 0 | 5 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 6 | 83% |
| | Mahogany | 0 | 2 | 0 | 2 | 4 | 21 | 0 | 1 | 2 | 3 | 6 | 0 | 41 | 51% |
| | Other natural nonforest | 1 | 0 | 0 | 0 | 0 | 0 | 23 | 2 | 0 | 1 | 0 | 0 | 27 | 85% |
| | Other shrub | 5 | 0 | 13 | 0 | 1 | 1 | 10 | 264 | 10 | 78 | 0 | 0 | 382 | 69% |
| | Pinyon/juniper | 3 | 1 | 9 | 6 | 0 | 23 | 2 | 15 | 1156 | 47 | 18 | 22 | 1302 | 89% |
| | Sagebrush | 0 | 3 | 13 | 0 | 0 | 3 | 1 | 89 | 48 | 199 | 3 | 7 | 366 | 54% |
| | Spruce/fir/Douglas-fir | 0 | 1 | 0 | 3 | 3 | 2 | 0 | 1 | 1 | 0 | 18 | 0 | 29 | 62% |
| | Western juniper | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 3 | 0 | 8 | 12 | 67% |
| | Total | 27 | 9 | 61 | 13 | 13 | 53 | 36 | 374 | 1219 | 342 | 47 | 37 | 2231 | PCC |
| | Producer | 56% | 22% | 38% | 0% | 38% | 40% | 64% | 71% | 95% | 58% | 38% | 22% | PCC | 78% |

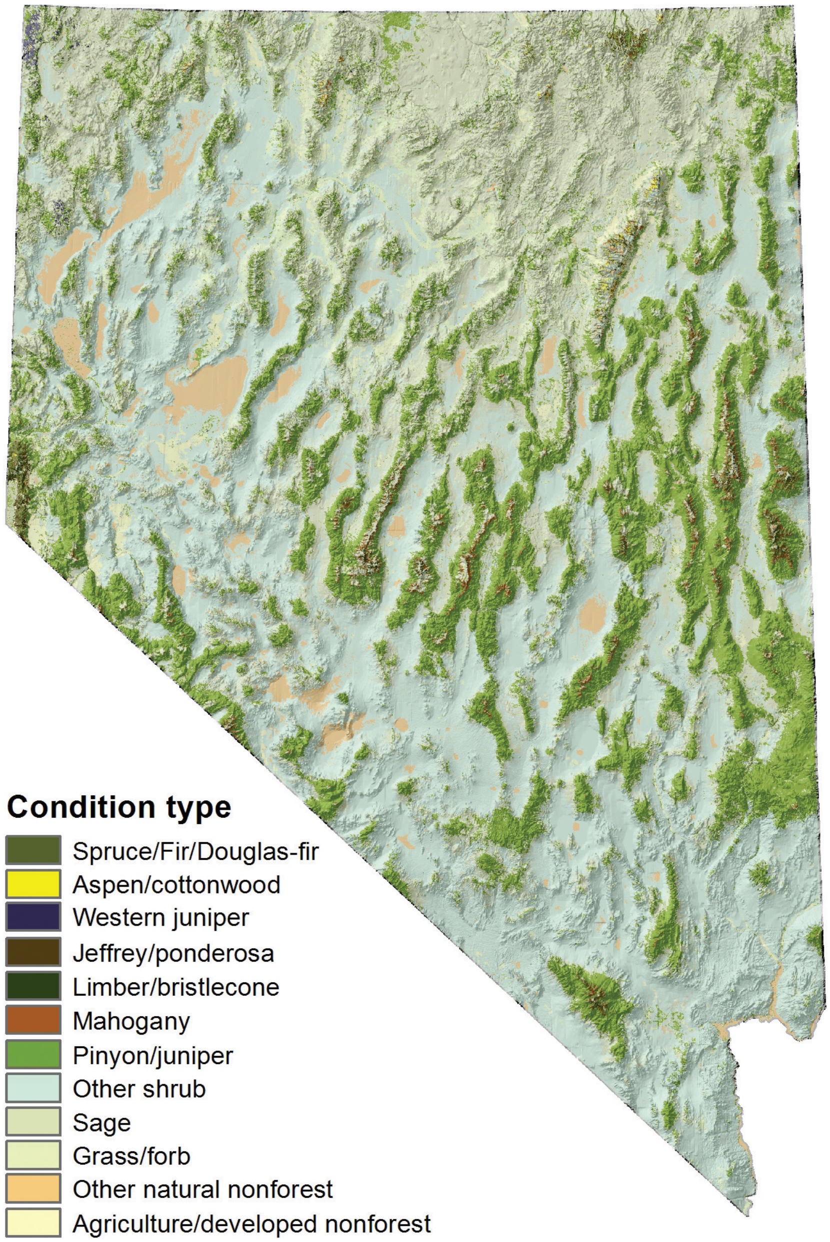


**Figure A.1**–Predicted map of condition type group: 12 classes.

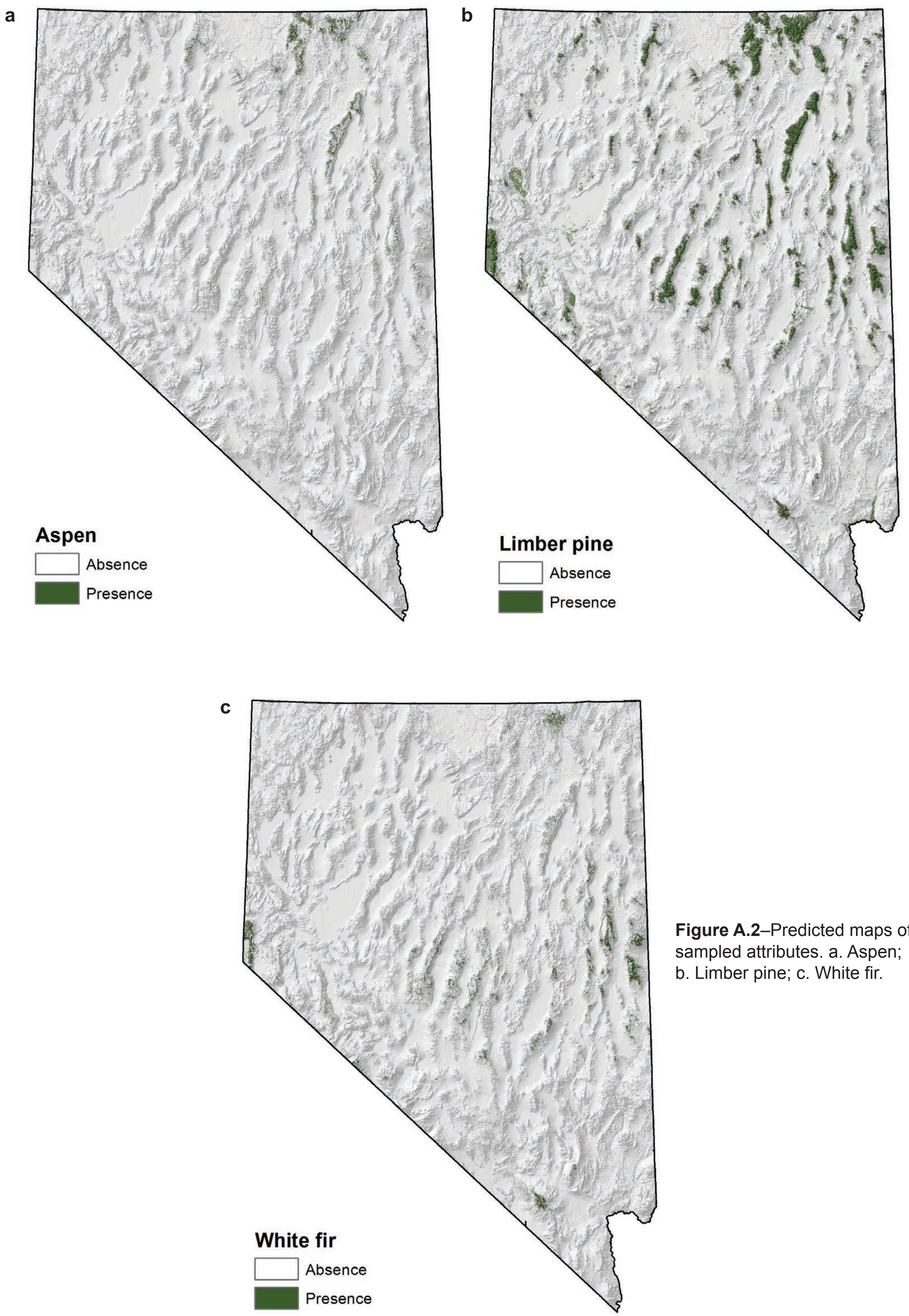


**Figure A.2**–Predicted maps of sampled attributes. a. Aspen; b. Limber pine; c. White fir.

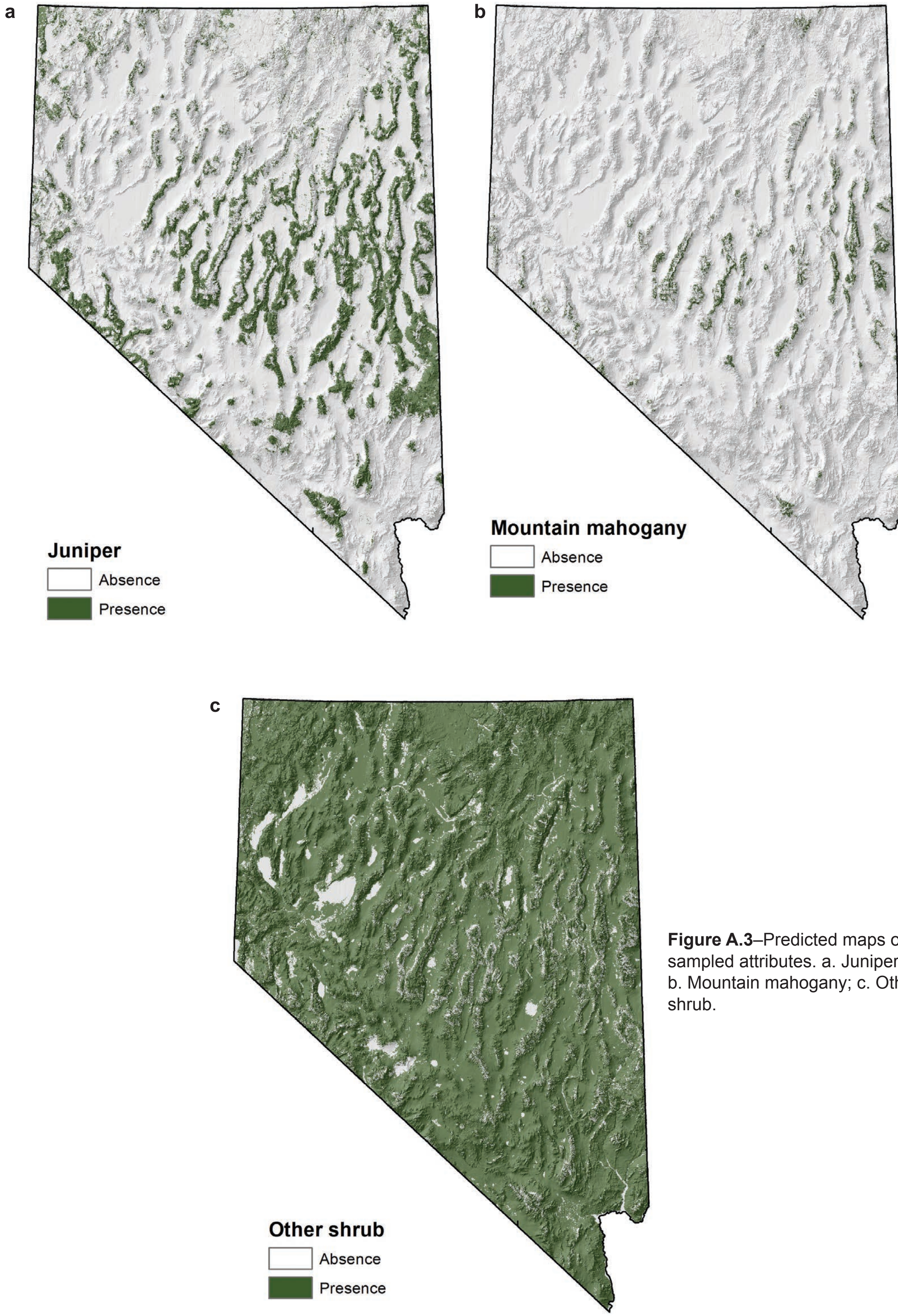


**Figure A.3**–Predicted maps of sampled attributes. a. Juniper; b. Mountain mahogany; c. Other shrub.

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