Summary and Findings of the 2006 BLM Forest Lands Report

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***Abstract**: In 2006, the Bureau of Land Management (BLM) contracted with the Forest Service Forest Inventory and Analysis Program (FIA) to assist in the preparation of a report specific to all forest lands under the administration of the BLM. The BLM requested that the FIA provide information on the extent and general conditions of BLM-managed forests and woodlands, within certain statistical reliability parameters.*

The report focused on the 33 million acres of forest land managed by the BLM outside of Alaska by using data gathered from more than 2,500 FIA plots. The analysis included information on the extent of forest land (total acres of occurrence and general location), trees per acre, stand size, stand age, volume and biomass, basal area, stand density index (SDI), and number of snags (standing dead trees). Specific findings include:

- *An increase in BLM forest acres from 55 million, as determined in a 2005 report, to 69 million today.*
- *The high tree densities in many forest types*
- *The expansion of pinyon and juniper woodlands in historical nonforest areas*
- *The unbalanced age class distributions in the aspen and lodgepole pine forest types*
- *The differing sampling intensities in the States*

An upcoming BLM publication will highlight some specific data findings of interest and provide some interpretations of the information to BLM field offices for land use planning.

Keywords: Forest, inventory, FIA, BLM.

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In: McWilliams, Will; Moisen, Gretchen; Czaplewski, Ray, comps. 2009. 2008 Forest Inventory and Analysis (FIA) Symposium; October 21-23, 2008: Park City, UT. Proc. RMRS-P-56CD. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 1 CD.

Introduction

Background

The Bureau of Land Management (BLM), an agency within the U.S. Department of the Interior (DOI), administers more than 253 million surface acres[3] of public land in the western United States, including Alaska. About 69 million acres, or 27%, are classified as forested.

The BLM manages these forest lands according to the principles of multiple use and sustained yield as required by the Federal Land Policy and Management Act of 1976 and the Oregon and California Railroad Act of 1937, which covers forest lands in western Oregon. National priorities for these forests include maintaining and restoring forest health, salvaging dead and dying timber, providing high-quality wildlife and fish habitat, and providing economic opportunities in rural communities by making timber and other forest products, including biomass, available from vegetation management treatments.

The last nationwide inventory taken of BLM forest lands occurred in 2001 and only addressed acres of forest land in the predominant forest types; it did not address any condition of these forest lands. In spring 2006, the BLM contracted with the U.S. Department of Agriculture's Forest Service (FS) Forest Inventory and Analysis Program (FIA) to prepare the *BLM Forest Lands Report –2006* (hereinafter referred to as the "*Report*"; Bottomley and Menlove 2006), specific to forest lands under the administration of the BLM. According to the BLM, the FIA program would provide data that are the best combination of availability, consistency, accuracy, and comprehensiveness for BLM forest lands.

The BLM desired information related to the extent and general conditions, with statistical reliability measures, of the forest lands under its jurisdiction. The *Report* did not separate BLM forest lands by resource management objective or legal status (e.g., congressionally designated wilderness areas). While some of the terminology used in the *Report* reflected the early history of the FIA program focusing on wood supply (e.g., timberlands), no suitability or availability of BLM forest lands for commercial wood products were implied in the *Report*.

Figure 1 illustrates the broad distribution of BLM forest lands within 13 conterminous western States and Alaska. Figures 2a and 2b illustrate two extremes in BLM land status patterns, large forested landscapes and small isolated forest tracts. These land status situations, particularly broad distribution of BLM forest lands and the small isolated forest tracts, present challenges with data consolidation and analysis efforts.

[3] The BLM Forest Lands Report–2006 reported a total of 261 million acres according to the most recent data at that time. According to the 2008 BLM Public Land Statistics report, the number of surface acres managed by the BLM was reduced to 253 million because of land tenure changes.

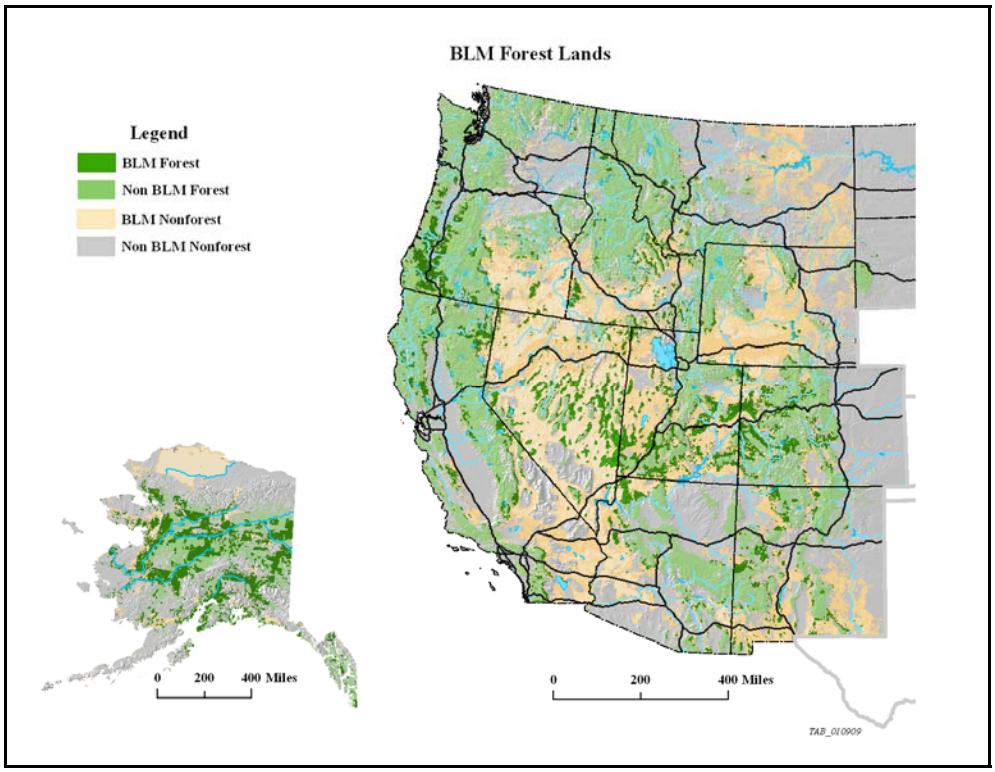

Figure 1: Map of BLM forest lands.

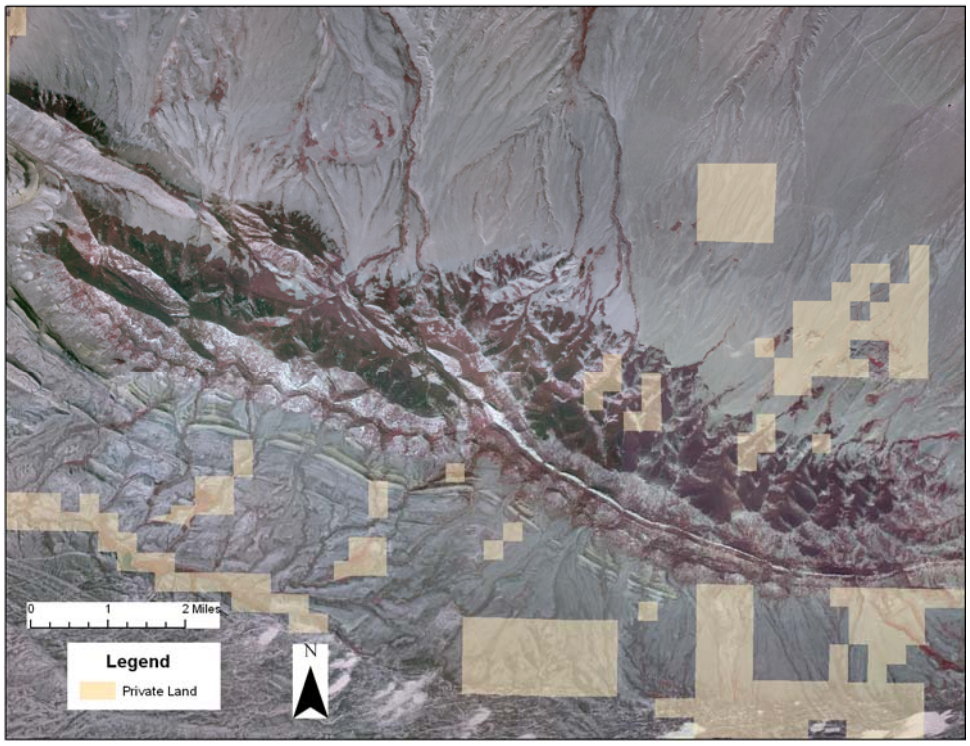

Figure 2a: Aerial photo of an example large landscape of BLM forest lands (Ferris Mountain Range, Wyoming).

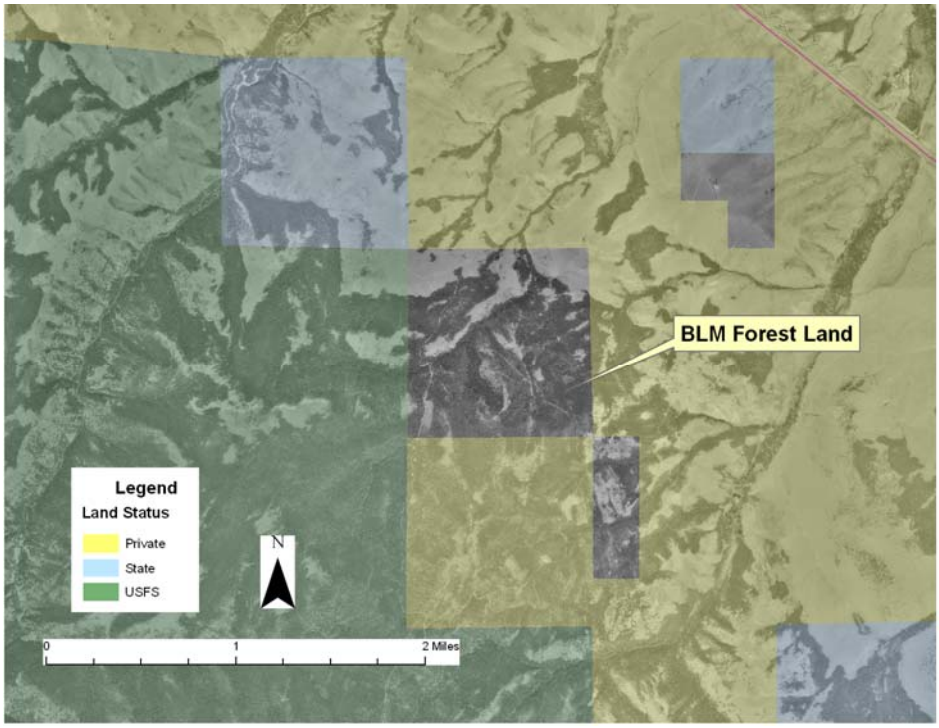

Figure 2b: Map of an example small forested BLM land tract (Fringe of Medicine Bow National Forest, Wyoming).

Data Consolidation Techniques

Because it was necessary to acquire data from several FIA units, two major methods were used. First, data from States within the Interior West FIA unit (IWFIA) were queried from the local IW-FIA FIADB version 1.0 database, by using the most recent inventories through 2005. Second, data from States in the Pacific Northwest and North Central FIA units were downloaded from the public DataMart FIADB version 2.1 data download site (since replaced by FIADB version 3.0 DataMart) by using the 2004 inventory year. When calculating standard errors, the local IW-FIA version 2.1 database was used for Interior West States. Queries from the different database structures were carefully constructed so that the results were compatible, and could be compiled in Microsoft Access databases and Microsoft Excel pivot tables.

In addition to the standard FIA variables that were used, several additional variables were calculated. For forest type, an alternate was used where, if the forest type was "nonstocked," the field forest type was assigned. In this way, the "nonstocked" stand-size class could be assigned to different forest types. Also, a stand density index (SDI) was calculated for each plot condition using the summation method and compared using the summation SDI maximum values for forest types as described in Shaw (2000). This also allowed the calculation of

condition-based trees-per-acre values, which were then used to construct classes by trees-per-acre.

Report Format

BLM forest lands were classified by forest type. The ten most common forest types were then analyzed for the following: extent (total acres of occurrence and general location), trees per acre, stand size, stand age, volume and biomass, basal area, SDI, and number of snags (standing dead trees) given. The *Report* was organized to discuss each of these above items in the above order. An additional section dealt with individual States and discussed the following items: forest land by type, years of data collection, volume estimates, gross growth and mortality rates (IWFIA only) and causes of mortality (IWFIA only). Standard errors were calculated for acres of forest and net live tree volume.

Alaska

BLM forest lands in Alaska were not included in the analysis of plot data because FIA plot data have only been collected in coastal Alaska, whereas the BLM manages large areas of forest land in the Alaskan interior. However, an assessment of BLM forest lands in the Alaskan interior was conducted for the *Report* through remote sensing by using a map developed by the USDA Forest Service–Forest Inventory and Analysis Program & Remote Sensing Applications Center (RSAC; Ruefenacht et al. 2008). With the RSAC map, the IWFIA was able to estimate that there were about 36 million forested acres in Alaska on BLM lands in 14 different forest cover types. However, the lack of plot data prevented including the BLM forest lands in Alaska in the majority of the following analysis.

Findings

On the basis of 2,521 FIA plots, 48 different forest types were reported on BLM forest land in the contiguous United States. The 10 most common types discussed in the *Report* account for 93% of the forest land acres across all States and the majority of forest land in each of the States. Table 1 shows the estimated acres of these 10 forest types.

Table 1: Area estimates for the 10 most common and all other forest types on BLM lands in the contiguous United States.

Forest type		Acreage
Pinyon-Juniper Woodland		16,034,527
Juniper Woodland		6,152,507
Douglas-fir (all)		2,653,015
Coastal Douglas-fir	(1,496,756)	
Noncoastal Douglas-fir	(1,156,259)	
Western Juniper		1,947,558
Ponderosa Pine		1,072,133
Deciduous Oak Woodland		964,765
Cercocarpus Woodland		642,001
Aspen		367,837
Lodgepole Pine		359,306
All other forest types		2,431,203
Totals		32,624,853

Major findings from the *Report* include: (1) a large increase in BLM forest acres from estimates in previous reports, (2) high tree densities in many forest areas, (3) expansion of pinyon and juniper species in historical grass and shrub lands, (4) unbalanced age class distribution in the aspen and lodgepole pine forest types, and (5) the differing sampling intensities by State. Each of these findings is discussed in the following sections.

Large Increase in Acreage

In 2005, the BLM had estimated the total forest land under its jurisdiction at 55.1 million acres, according to 2001 data. The *Report* provided a new estimate of 69.1 million acres, a 25% increase. Table 2 provides a comparison, by State, of these two estimates.

Table 2: BLM Forest Lands. Comparison of 2005 and 2006 estimates. (Note that all acreages are in thousands.)

State	2005 Acreage	2006 Acreage
Alaska	28,279	36,447
Arizona	1,074	1,893
California	2,208	1,449
Colorado	4,110	5,076
Eastern States	0	0
Idaho	892	945
Montana	810	1,325
Nevada	6,274	7,831
New Mexico	985	1,121
Oregon	3,341	3,789*
Utah	6,073	7,825
Washington	50	79
Wyoming	1,004	1,290
Totals	**55,100**	**69,070**

Three key factors account for the majority of this 14 million acre increase.

- Attaining better remote sensing data, particularly in Alaska, resulted in an increase of total forest land from 28.3 million acres to 36.4 million acres, an increase of more than 8 million acres.

- The 2005 estimate relied heavily on FIA estimates for the 2002 RPA, which used a sampling protocol of 10% crown cover for woodlands instead of the 5% crown cover protocol used in the data analysis of the *Report.* Reducing the percent crown cover requirement to 5% resulted in an estimated increase of about 3.3 million acres land classified as forest.

- Changing methodologies in the FIA program (e.g., minimum criteria standards for heights and diameters and appropriate species) over the years have resulted in including acreages in several forest types that were not in the above-mentioned RPA, but are included in the *Report*. These include a large portion of the deciduous oak woodland (1.0 million acres), *Cercocarpus* woodland (0.6 million acres), and mesquite (0.3 million acres). These methodology changes resulted in an estimated increase of approximately 2 million acres.

Future BLM forest land calculations are anticipated to result in a reduction from the 69 million acres, primarily due to the ongoing land tenure adjustments in Alaska. Additionally, changes in the FIA program sampling and measurement protocols (particularly those related to species and minimum crown cover criteria) will also cause either increases or decreases in the calculation of BLM forested acres. For example, elimination of lands with 5–9% forest crown cover would reduce the total forest land base by about 10%.

Although there is a large increase in the estimated amount of BLM forest land, little or no effect on the BLM's Forest and Woodland Management program is anticipated. Whether BLM lands are classified as forest or nonforest has no significance regarding annual appropriations from Congress. Nor does this classification automatically allow or restrict any particular use activity (such as timber harvesting). Decisions on appropriate management activities that may occur on any of these lands are made through individual land use plans and are not influenced by classification as forest or nonforest by the FIA.

High SDIs For Many Tree Species

The *Report* dealt with each of the 10 most common forest types on BLM land and determined the range of and average of trees per acre and basal area per acre. However, given the variety of tree species involved, as well as the variety of stand ages, Stand Density Index (SDI) was chosen as the metric to evaluate tree density. Therefore, the range and average SDI for each of these forest types was determined. Table 3 summarizes SDI information in the *Report* by forest types.

Table 3: Stand Density Index information on BLM lands for major forest types.

Forest type	Total acres (thousands)	Percentage of acres				Acres of Concern (thousands)
		<25% SDI_{max}	25–35% SDI_{max}	>35% SDI_{max}	>60% SDI_{max}	
Pinyon-Juniper	16,035	32	15	52	21	8,338
Combined Juniper	6,153	58	11	31	11	1,907
Coastal DF	1,497	10	6	85	40	1,272
Noncoastal DF	1,156	33	25	42	14	486
Western Juniper	1,948	79	12	9	2	175
Ponderosa Pine	1,072	50	17	33	16	354
Deciduous Oak	965	71	12	17	6	164
Cercocarpus	642	42	17	41	16	263
Aspen	368	51	20	30	13	110
Lodgepole Pine	359	28	4	69	14	248
Totals (includes rounding errors)	**30,195**					**13,318**

One major finding from the data was that more than 40% (13.3 of 32.6 million acres) of the BLM forested lands in the contiguous 48 States are at, or are exceeding, full site occupancy (greater than 35% of SDI_{max}). This high tree density can lead to massive die-offs in forested landscapes when droughts create a shortage of water and too many trees are competing for that resource. The intense competition for water can also predispose these trees to insect and disease predation as their ability to fight off these damaging agents is reduced because of water stress.

Expansion of Pinyon and Juniper Forest Types

Another issue on many BLM lands is the expansion of coniferous trees into what are considered historical grass and shrub lands. For a number of reasons, such as lack of fire, livestock grazing, or cyclic wet periods, there has been an evident trend of trees establishing and growing in areas that, as determined by earlier historical photography, were grass or shrub lands. While the FIA does not directly measure expansion by trees into nonforested areas, the intent of the *Report* was to provide information that may be helpful in understanding the extent of this vegetation change on BLM lands.

The pinyon–juniper, combined juniper, and western juniper forest types seldom exist in even-aged stands because these tree species tend to accumulate gradually on a site. As a result, stands in these forest types often have individual trees that are much older, as well as much younger, than the age determined for a specific stand. However, it may be reasonable to assume that stands that are recently established in otherwise shrub and grassland ecosystems should contain no trees significantly older than the trees present. Therefore, the percentages in each of these forest types in the younger age classes that have no recorded live-tree age of more than 150 years should give an approximation of the degree to which the pinyon and juniper stands could be considered expansion since the beginning of European settlement in the West. Conversely, those stands with trees present that are 150 years old and older give an approximation of the extent of historical woodlands.

From the FIA data analyzed, of the 24 million acres of BLM forest land in either a pinyon or juniper forest type, approximately 12.1 million acres (50%) have both a stand age of 150 years or younger and contain no trees older than 150 years. This indicates that a substantial portion of pinyon and juniper forests may be expanding into historical shrub or grasslands, although unknown portions are regeneration of disturbed stands.

The remaining 50% of the pinyon and juniper forest type has at least some trees that existed on these sites before the interruption of disturbance processes that keep many arid areas in shrub and grass species, including the exclusion of fire. These stands could therefore potentially be considered historical woodlands; however, in many instances they may have been less dense in the past.

Unbalanced Age Class Distribution Concerns with Aspen and Lodgepole Pine Forest Types

The FIA inventory methodology was not considered adequate to provide accurate measurements of recent outbreaks in stand mortality from insects and disease on BLM forest lands, particularly since at least two States (New Mexico and Wyoming) have had no FIA data since 2001. These States were not added to the annual inventory system (see next section for more information) at the time of

this report. Additionally, two States (Idaho and Nevada) had only two annual inventory cycles. However, collected data, even if a little dated, can provide very useful information related to the risk of stands to pending mortality, particularly if the forest stands are reaching the end of their usual life expectancy. For example, two of the major forest types evaluated—aspen and lodgepole pine—have relativity short life spans of 150 (Howard 1996) and 150–200 years (Anderson 2003), respectively. Additionally, both forest types have a usually natural even-aged stand development habit, which places added focus on stand age, because most of the trees in these even-aged stands are approximately the same age.

The extent of aspen decline and die-off on BLM lands was not evaluated in the *Report*. However, a predisposing condition (stand age) was evaluated. Figure 3 shows the present age class distribution of BLM aspen stands. From these data, it is apparent that a large percentage (50%) of the aspen forests are at or approaching life expectancy. These data indicate that the majority of BLM aspen stands are at or approaching a high risk from either aspen decline or aspen die-off.

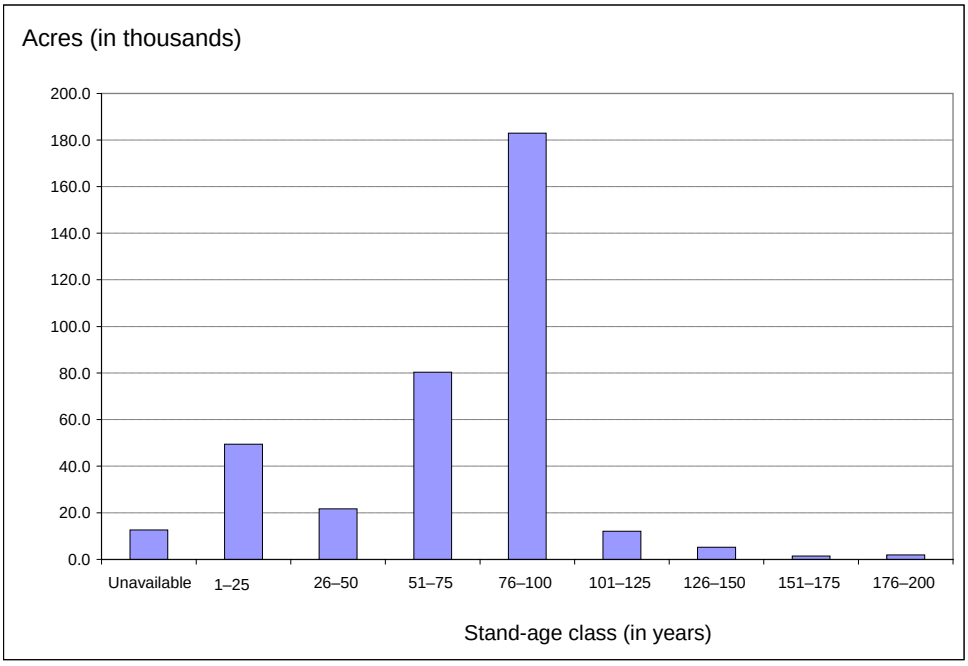

Figure 3: Area of aspen forest by stand-age class, BLM land.

The lodgepole pine forest cover type has a similar unbalanced age class distribution, as shown in Figure 4. This condition could also predispose these stands to large-scale mountain pine beetle mortality.

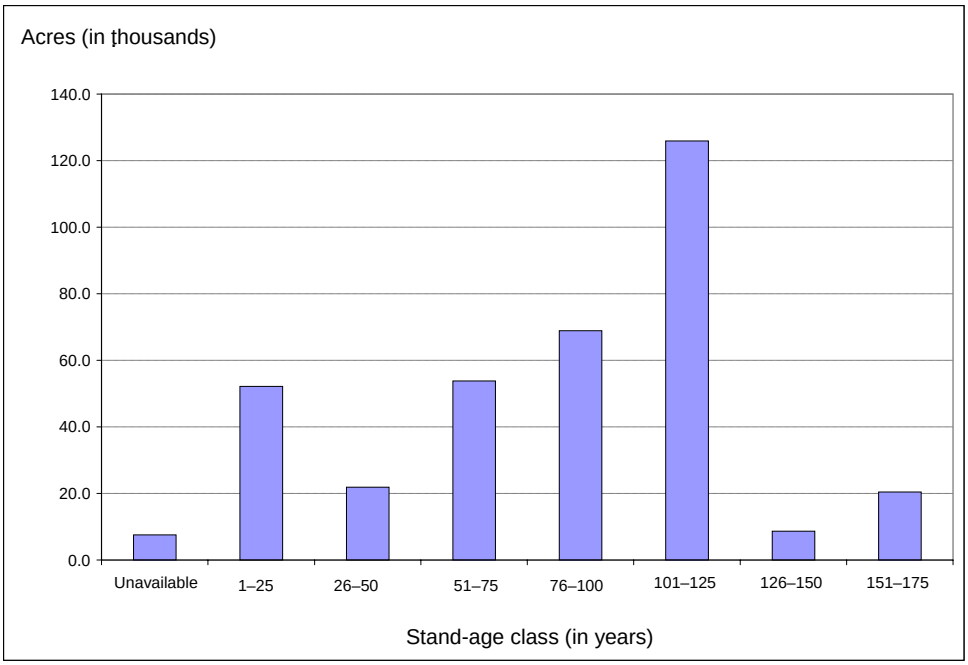

Figure 4: Area of lodgepole pine forest by stand-age class, BLM land.

Differing Sampling Intensities by State

Historically, the FIA has collected inventory data on a State-by-State basis, completing regionally based statewide inventories covering the entire sampling grid for a given State every 7 to 20 or more years. These historical inventories were known as periodic inventories. Beginning in the mid-1990s, the FIA program began making a transition from periodic to annual inventories (Gillespie 1999). The annual inventory samples an evenly distributed 10% to 20% of the sample grid (an annual panel) in each State every year, so that every State's grid is completed every 5 to 10 years. The annual system is better able to detect changes and trends, and efforts are continuing to establish nationally consistent standards for data collection, compilation, and reporting.

As the annual inventory methods were adopted, States were gradually added to the annual system, often while the most recent periodic surveys were being completed in other States. The result is that until all States have at least one full cycle of annual data, land managers with forest lands in more than one State (such as the BLM) will have data where plot intensities and time spans differ from one State to another.

Table 4 provides information on the number of annual cycles each State has had through 2006 and the number of forested acres each FIA plot represents. Percent standard error is provided for the acres of forest land in each State. The percent standard error primarily reflects the acres per plot, with generally lower

values for acres per plot also having low percent standard errors. The major exceptions to that trend are States with few forested plots on BLM land (e.g., North Dakota, South Dakota, and Washington), where the few total plots in the respective States (3, 3, and 5) result in very high percent standard errors (74.63%, 55.72%, and 47.47%). As the number of annual panels increases in each State, percent standard errors will decrease.

Table 4: FIA plots and forest conditions on BLM land at the time of the Report.

State	Total plots	Plots w/ forest conditions	Forested Acres	Acres per plot	Annual Panels	Percent standard error of acres
Arizona	1,192	161	1,893,000	11,758	5	6.98
California	998	104	1,449,000	13,933	4	8.98
Colorado	578	338	5,075,000	15,015	4	4.46
Idaho	412	36	945,000	26,250	2	17.05
Montana	398	75	1,290,000	17,200	3	11.94
Nevada	1,639	293	7,831,000	26,727	2	4.61
New Mexico	2,085	173	1,121,000	6,480	Periodic	6.15
North Dakota	*	3	10,369	3,456	4	74.63
Oregon	899	267	3,789,000	14,191	4	4.38
South Dakota	*	3	25,394	8,465	4	55.72
Utah	2,311	833	7,825,000	9,394	6	2.82
Washington	9	5	79,000	15,800	3	47.47
Wyoming	2,879	230	1,290,000	5,609	Periodic	6.04

* NC-FIA does not assign ownership data to nonforest conditions; therefore, the total number of plots (and the amount of nonforest land) on BLM land is unknown.

In addition, although most of the available data are consistent between FIA units, some variables and summaries of interest were not available in all States or were not completely consistent between States. These different methodologies have direct effects on the *Report*, but predominately on a State basis, and are discussed in more detail in the *Report*.

Next Steps for BLM

The intent of the *Report* was strategic—to give the BLM a broad perspective about the condition of forest lands under its jurisdiction. The *Report* was not intended to be used as the sole source for advocating any particular vegetation treatment or change of condition. Decisions on vegetation management objectives are made at the local level through the BLM's land use planning processes (e.g., resource management plans). The BLM is preparing a publication (Bottomley and Menlove 2009) that will discuss the findings and provide assistance to agency field offices for looking at these potential issues (e.g., high tree densities, pinyon and juniper expansion and densification, and age class distribution issues for aspen and lodgepole pine) raised in the *Report* and determine if these issues are applicable in their specific areas of interest.

Conclusion

FIA data provided an excellent source of information to the BLM for making general statements concerning the condition of the forest lands under its jurisdiction. These general statements, while not site-specific enough to determine specific management activities, are useful for guiding strategic level decisions for the agency.

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