Appendix B. Vegetation Conditions and Management Practices

This appendix describes the current (2011) and desired structural future conditions for the 14 major PNVTs on the forests and provides a graphic representation of age classes and an expanded description of old growth. It also describes the management practices that may be used to obtain those conditions.

Forestwide Vegetation Conditions

PNVTs

The Apache-Sitgreaves NFs can be divided into 14 major PNVTs (potential natural vegetation types) (see table 13 below). PNVTs are coarse-scale groupings of ecosystem types that share similar geography, vegetation, and historic ecosystem disturbances such as fire, drought, and grazing by native species. PNVTs represent the vegetation type and characteristics that would occur when natural disturbance regimes and biological processes prevail. It is important not to confuse PNVTs with existing vegetation types. The PNVT mapping (located in the Apache-Sitgreaves NFs' GIS database) was derived from the forests' terrestrial ecosystem survey mapping. This mapping is intended to be used for mid- and landscape-scale planning. It is important to validate the PNVTs at the project and activity level.

Table 13. Apache-Sitgreaves NFs' PNVTs and NFS acres

PNVT[a]	Size (acres)
Wetland/cienega riparian areas	17,900
Montane willow riparian forest	4,808
Cottonwood-willow riparian forest	15,876
Mixed broadleaf deciduous riparian forest	9,657
Ponderosa pine forest	602,206
Dry mixed conifer forest	147,885
Wet mixed conifer forest	177,995
Spruce-fir forest	17,667
Madrean pine-oak woodland	394,927
Piñon-juniper woodland	222,166
Semi-desert grassland	106,952
Great Basin grassland	185,523
Montane/subalpine grasslands	51,559
Interior chaparral	55,981

[a] Water, urban, and quarry account for 4,250 acres. Total Apache-Sitgreaves NFs land is 2,015,352 acres.

The following charts depict the current (based on data derived in 2011) and desired future conditions for each of the forests' PNVTs at a forestwide level[1]. Different combinations of vegetation state percentages may exist at the project or activity level. Based on site-specific conditions and capabilities, the expectation is that some projects would move certain vegetation states toward desired percentages more than other projects; collectively, they would move toward desired percentages shown at the forestwide level. This information will be useful to measure progress toward desired vegetation conditions across the entire Apache-Sitgreaves NFs over time.

Wetland/Cienega Riparian Areas

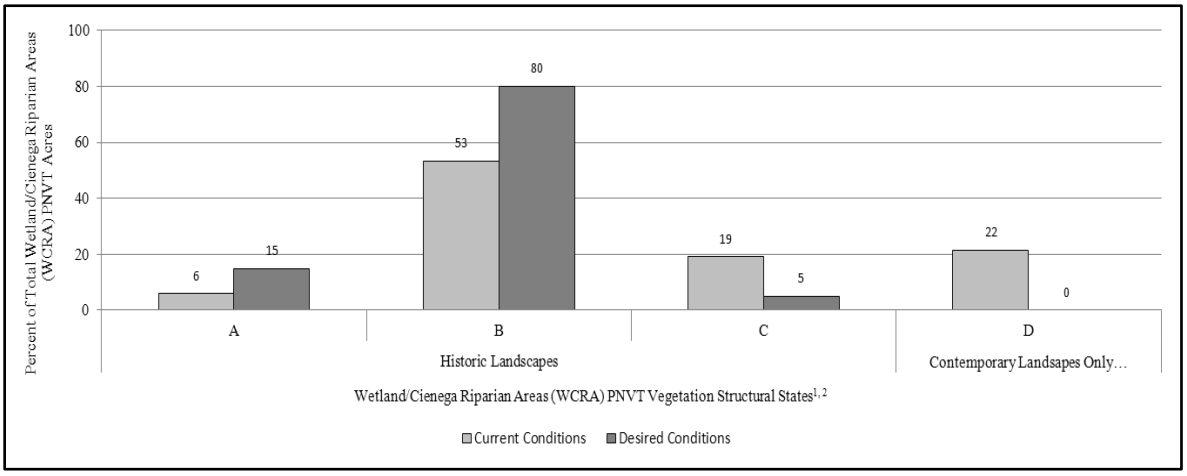

Figure 13. Wetland/Cienega Riparian Areas Woody Overstory Vegetation Condition

The figure above depicts the wetland/cienega riparian areas PNVT woody overstory vegetation structural states. At 17,900 acres (approximately 0.9 percent of the forests), this PNVT ranks 10th in size out of the 14 PNVTs on the Apache-Sitgreaves NFs. The vegetation structural states are

State A - Herbaceous vegetation regeneration, recently burned, sparsely vegetated; with < 10 percent tree or shrub canopy cover; early successional development

State B - Perennial herbaceous vegetation, with < 10 percent tree or shrub canopy cover; mid successional development

State C - Shrubs, and seedling and sapling size (< 5″ diameter) trees with open (< 30 percent) or closed (≥ 30) canopy cover, with perennial herbaceous vegetation understory; mid successional development

State D - Shrubs, small size (5–9.9" diameter), medium size (10–19.9" diameter), and large to very large size (> 20" diameter) trees with open (< 30 percent) or closed (≥ 30) canopy cover, with herbaceous vegetation understory; late successional development; not part of the historic conditions or within historic range of variability, found on contemporary landscapes only.

The wetland/cienega riparian areas PNVT has a 36 percent or low departure rating from desired conditions and reference conditions making it the 7th and 9th most departed PNVT, respectively,

[1] Percentages shown on the graphs for each structural state are rounded to the nearest whole number. Consequently, in some cases, the total percentage for all structural states may add up to slightly more than 100.

on the Apache-Sitgreaves NFs. Desired conditions were provided by the Forest Service Southwestern Regional Office; reference condition was derived from LANDFIRE (2003).

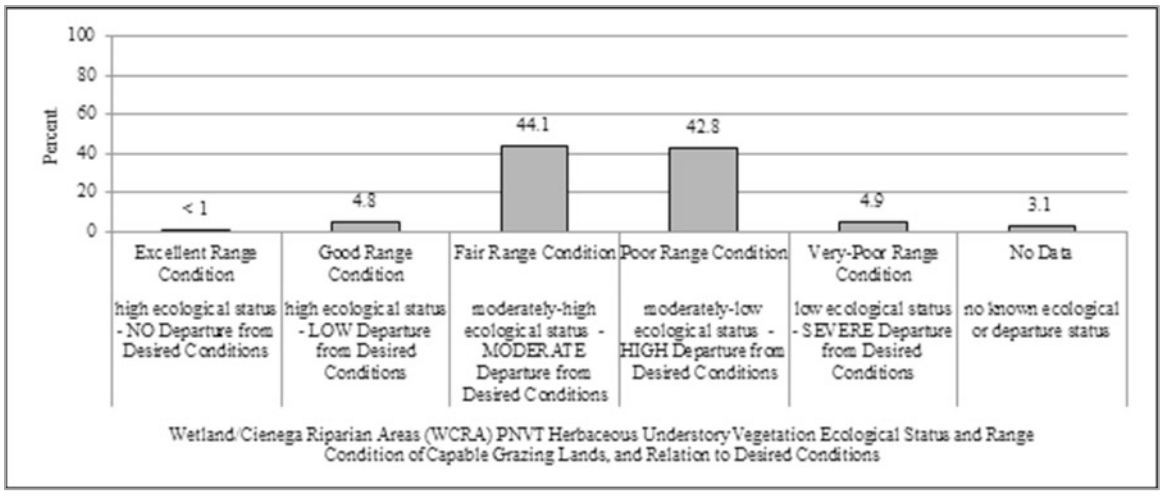

Figure 14. Wetland/Cienega Riparian Areas Herbaceous Understory Vegetation Condition

The figure above depicts the wetland/cienega riparian areas PNVT's current herbaceous understory vegetation ecological status[2] and range condition[3] of the lands capable[4] of supporting

[2] Ecological status is the degree of similarity between the existing vegetation (all components and their characteristics) and existing soil conditions when compared to the potential natural plant community and the desired soil condition on a site. The present state of a TES map unit stated in terms of specific values or potentials with respect to species composition, ground cover, and soil characteristics. Ecological status is often evaluated on the basis of similarity indices between current conditions and the potential natural plant community (Forest Service, 1999). Ecological status ratings are high, moderately-high, moderate-low, and low (FSH 2209.21, Southwestern Region).

[3] Range condition is the present state of vegetation of a range site in relation to the climax (potential natural) plant community for that site. It is an expression of the relative degree to which the kinds, proportions, and amounts of plants in a plant community resemble that of the climax plant community for the site (Forest Service, 1999). The adjective descriptions of range condition are excellent, good, fair, poor, and very-poor (FSH 2209.21, Southwestern Region). According to Holechek et al. (1989), range condition is measured in degrees of departure from climax; excellent range condition would represent climax and very-poor range condition would represent the greatest departure from climax. The relationship between ecological status and range condition are excellent and good range condition represents high ecological status, signifying no or low departure from desired conditions; fair range condition represents moderately-high ecological status, signifying moderate departure from desired conditions; poor range condition represents moderately-low ecological status, signifying high departure from desired conditions; and very-poor range conditions represent low ecological status, signifying severe departure from desired conditions.

Range condition, as evaluated and ranked by the Forest Service, is a subjective expression of the status or health of the vegetation and soil relative to the combined potential to produce a sound and stable biotic community. Soundness and stability are evaluated relative to a standard that encompasses the composition, density, and vigor of the vegetation and physical characteristics of the soil (FSH 2209.21.40, Southwestern Region Supplement, page 3 of 46). Although the *Allotment Analysis Handbook* (FSH 2209.21, Southwestern Region) was officially removed from the directive system, this definition is used because the above information was derived (collected, calculated, and evaluated) using the procedures outlined in the FSH 2209.21, Southwestern Region Supplement, over a number of years.

livestock grazing and departure from desired conditions. Roughly 48 percent of capable grazing lands do not meet desired conditions.

Montane Willow Riparian Forest

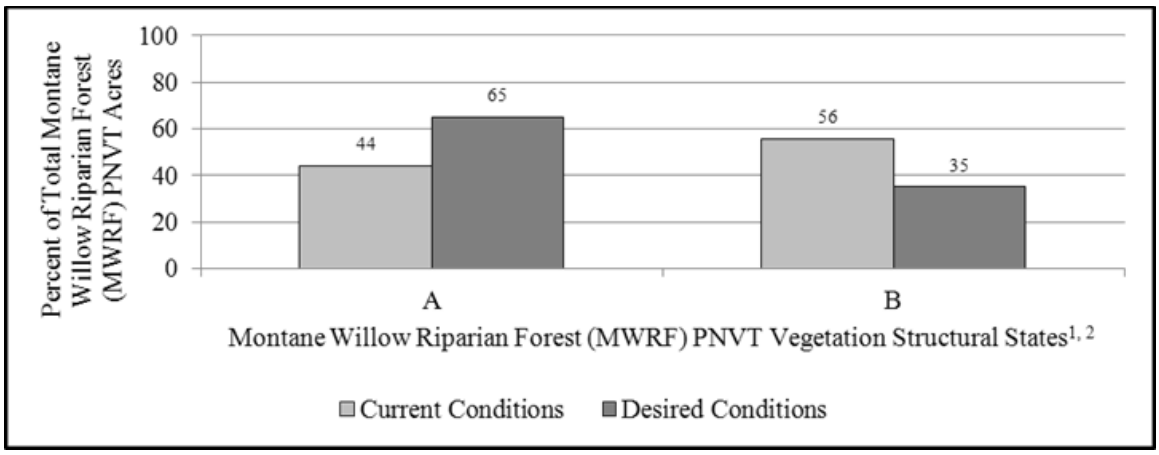

Figure 15. Montane Willow Riparian Forest Overstory Vegetation Condition

The figure above depicts the montane willow riparian forested PNVT overstory vegetation structural states. At 4,808 acres (approximately 0.2 percent of the forests), this PNVT is the smallest on the Apache-Sitgreaves NFs. The vegetation structural states are

> State A - Herbaceous vegetation regeneration, recently burned, and shrubs, and seedling and sapling size (< 5" diameter) trees with open (< 30 percent) canopy cover; early successional development.

[4] According to the Forest Service (1999), capable areas are fully capable areas plus potentially capable areas. Fully capable areas are those areas which can be used by grazing animals under proper management without long term damage to the soil resource or plant communities. Typically, this land is stable for livestock grazing. Vegetative ground cover is maintaining site productivity and producing a minimum of 100 pounds of dried forage per acre per year. Soil loss, as judged by available techniques, is within tolerance levels. Potentially capable areas are those areas which could be used by grazing animals under proper management but where soil stability is impaired or range developments are not adequate under existing conditions to obtain necessary grazing animal distribution. These areas are not capable of being fully or adequately utilized by grazing animals. Generally, these areas have impaired soil stability, lack of water, steep terrain, and lack of access and/or there is insufficient vegetative ground cover to protect the soil, but if treated, developed, or properly managed, could be reclassified as fully capable. An example of potentially capable range is heavily timbered or woodland areas where the tree canopy cover exceeds natural conditions and the area is producing very little forage as a result of that condition. With silvicultural treatment to return to natural fire cycle conditions, areas presently classified as potentially capable may be returned and sustained as fully capable areas. Timbered areas in potentially capable condition may have sufficient cover and litter to protect the soil. Woodland areas may or may not have sufficient cover and litter to protect the soil. Usually, land in this category producing less than 100 pounds of dried forage per acre per year is considered potentially capable until the forested or woodland stand is opened up. Transitional range created by silvicultural treatments will not be allocated for ungulate grazing on a term basis. It should only be considered as surplus forage for a short period of time and dealt with on an annual basis. When determining grazing capacity in the potentially capable class, assignments of conservative allowable use of the forage resource must be made. Rationale for assigned allowable forage use levels will be documented. Where fully capable range is isolated by potentially capable or no capability range, allowable use should be set and managed at zero because access to them may cause accelerated erosion in potentially capable or no capability areas (Forest Service, 1999).

State B - Shrubs, seedling and sapling, small size (5–9.9" diameter) trees with closed (≥ 30 percent) canopy cover, and medium size (10–19.9" diameter), and large to very large (> 20" diameter) size trees with open or closed canopy cover; mid- to late-successional development.

The montane willow riparian forested PNVT has a 21 percent or low departure rating from desired conditions and reference conditions making it the 10th and 12th most departed PNVT, respectively, on the Apache-Sitgreaves NFs. Desired conditions were provided by the Forest Service Southwestern Regional Office; reference conditions were derived from LANDFIRE (2007e).

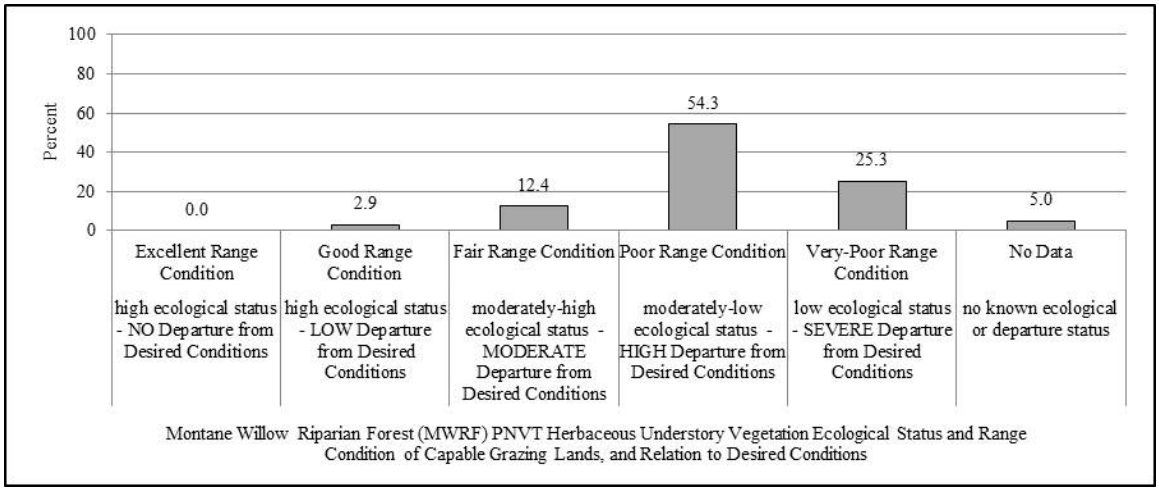

Figure 16. Montane Willow Riparian Forest Herbaceous Understory Vegetation Condition

The figure above depicts the montane willow riparian forested PNVT's current herbaceous understory vegetation ecological status[2] and range condition[3] of the lands capable[4] of supporting livestock grazing and departure from desired conditions. Roughly 80 percent the capable grazing lands do not meet desired conditions.

Cottonwood-Willow Riparian Forest

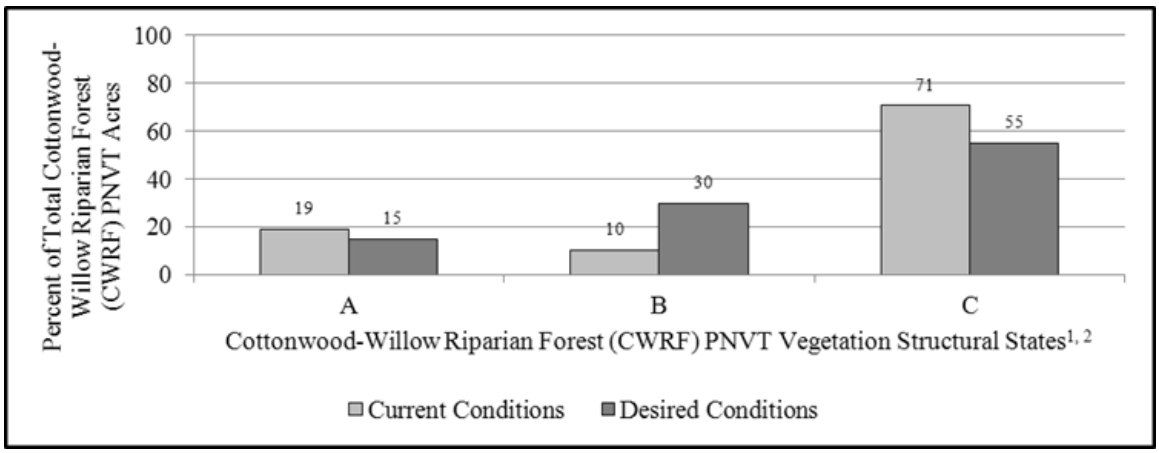

Figure 17. Cottonwood-Willow Riparian Forest Overstory Vegetation Condition

The figure above depicts the cottonwood-willow riparian forested PNVT overstory vegetation structural states. At 15,876 acres (approximately 0.8 percent of the forests), this PNVT ranks 12th in size out of the 14 PNVTs on the Apache-Sitgreaves NFs. The vegetation structural states are

> State A - Herbaceous vegetation dominated with shrubs, seedling and sapling size (< 5" diameter) trees with open (< 30 percent) or closed (≥ 30 percent) canopy cover; early successional development.
>
> State B - Tall shrubs and small size (5–9.9" diameter) trees with open or closed canopy cover; mid successional development.
>
> State C - Medium size (10–19.9" diameter) and large to very large (> 20" diameter) size trees with open or closed canopy cover; late successional development.

The cottonwood-willow riparian forested PNVT has a 20 percent or no departure rating from desired conditions and reference conditions making it the 11th and 13th most departed PNVT, respectively, on the Apache-Sitgreaves NFs. Desired conditions were provided by the Forest Service Southwestern Regional Office; reference conditions were derived from LANDFIRE (2007d).

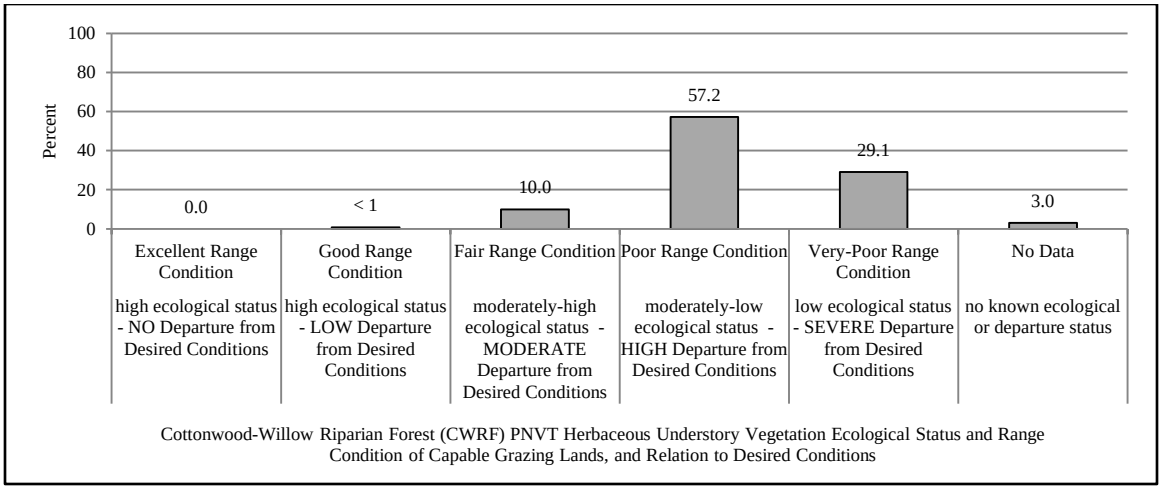

Figure 18. Cottonwood-Willow Riparian Forest Herbaceous Understory Vegetation Condition

The figure above depicts the cottonwood-willow riparian forested PNVT's current herbaceous understory vegetation ecological status[2] and range condition[3] of the lands capable[4] of supporting livestock grazing and departure from desired conditions. Roughly 86 percent of the capable grazing lands do not meet desired conditions.

Mixed Broadleaf Deciduous Riparian Forest

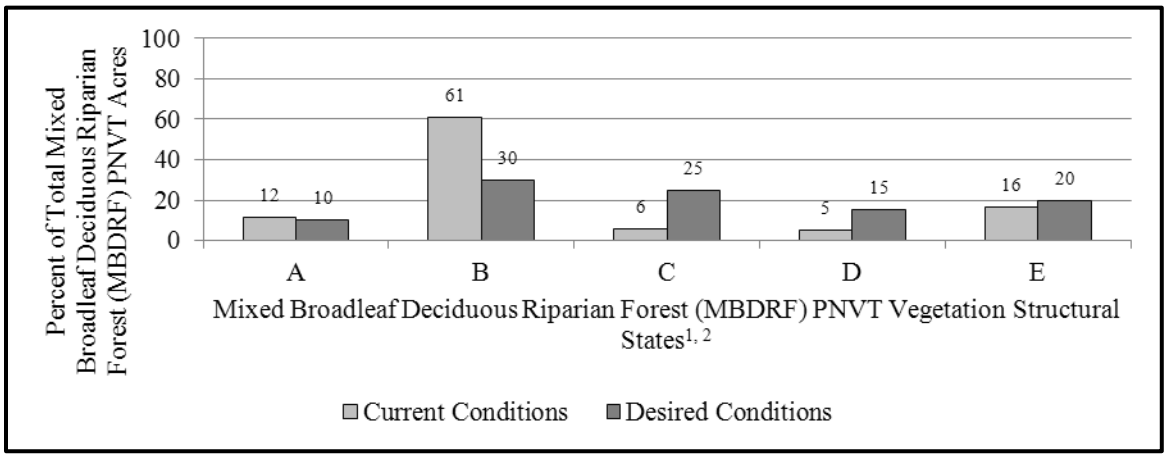

Figure 19. Mixed Broadleaf Deciduous Riparian Forest Overstory Vegetation Condition

The figure above depicts the mixed broadleaf deciduous riparian forested PNVT overstory vegetation structural states. At 9,657 acres (approximately 0.5 percent of the forests), this PNVT ranks 13th in size out of the 14 PNVTs on the Apache-Sitgreaves NFs. The vegetation structural states are

> State A - Herbaceous vegetation regeneration, recently burned, sparsely vegetated; with < 10 percent tree or shrub canopy cover; early successional development

State B - Shrubs, seedling and sapling size (< 5" diameter), small size (5–9.9" diameter), and medium size (10–19.9" diameter) trees with closed (> 30 percent) canopy cover; mid-successional development.

State C - Shrubs, seedling and sapling, and small size trees with open (< 30 percent) canopy cover; mid-successional development.

State D - Shrubs, medium size, and large to very large size (> 20" diameter) trees with open canopy cover; late successional development.

State E - Shrubs, and large to very large size trees with closed canopy cover; late successional development.

The mixed broadleaf deciduous riparian forested PNVT has a 33 percent or low departure rating from desired conditions and reference conditions making it the 8th and 9th most departed PNVT, respectively, on the Apache-Sitgreaves NFs. Desired conditions were provided by the Forest Service Southwestern Regional Office; reference conditions were derived from LANDFIRE (2007d).

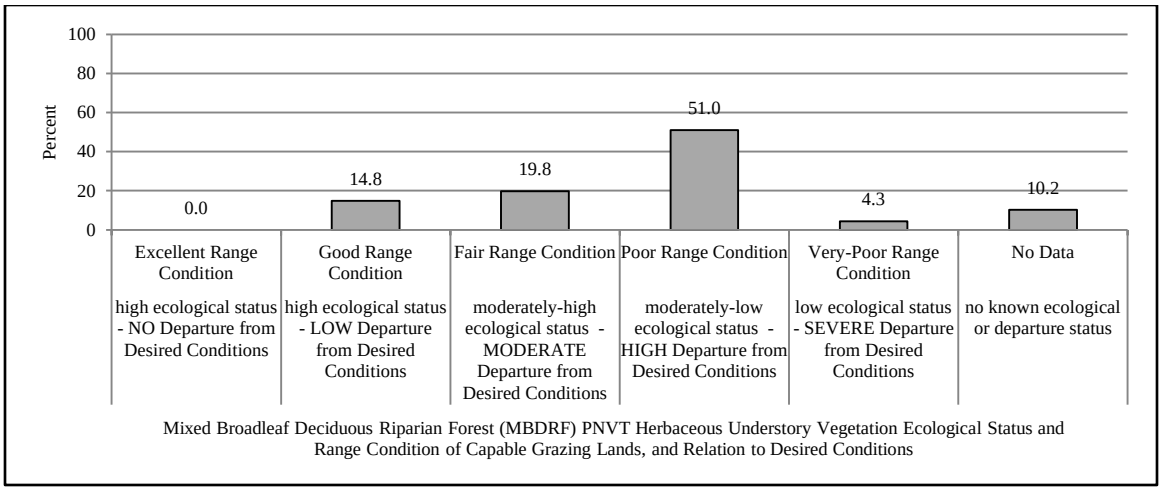

Figure 20. Mixed Broadleaf Deciduous Riparian Forest Herbaceous Understory Vegetation Condition

The figure above depicts the mixed broadleaf deciduous riparian forested PNVT's current herbaceous understory vegetation ecological status[2] and range condition[3] of the lands capable[4] of supporting livestock grazing and departure from desired conditions. Roughly 54 percent of the capable grazing lands do not meet desired conditions.

Ponderosa Pine Forest

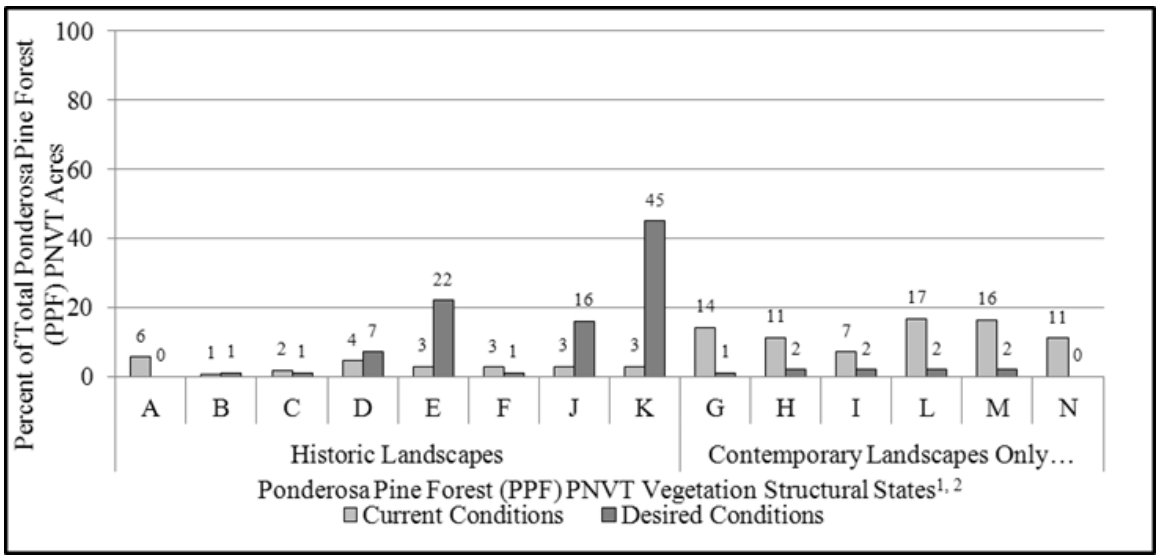

Figure 21. Ponderosa Pine Forest Overstory Vegetation Condition

The figure above depicts the ponderosa pine forested PNVT overstory vegetation structural states. At 602,206 acres (approximately 30 percent of the forests), this PNVT is the largest on the Apache-Sitgreaves NFs. The vegetation structural states are

State A - Recently burned, grass, forb and shrub types with < 10 percent tree canopy cover; early successional development.

State B - Seedling and sapling size (< 5" diameter) trees with open (< 30 percent) canopy cover; all tree types; early successional development.

State C - Small size (5–9.9" diameter) trees, with open canopy cover; all tree types; mid-successional development.

State D - Medium size (10–19.9" diameter) trees, single storied, with open canopy cover; all tree types; late successional development.

State E - Large to very large size (≥ 20" diameter) trees, single storied, with open canopy cover; all tree types; late successional development.

State F - Seedling and sapling size trees with closed (≥ 30 percent) canopy cover; all tree types; early successional development.

State G - Small size trees, with closed canopy cover; all tree types; mid-successional development; not part of the reference condition, found on contemporary landscapes only.

State H - Medium size trees, single storied, with closed canopy cover; all shade tree types; late successional development; not part of the reference condition, found on contemporary landscapes only.

State I - Large to very large size trees, single storied, with closed canopy cover; all tree types; late successional development; not part of the reference condition, found on contemporary landscapes only.

State J - Medium size trees, multistoried, with open canopy cover; all tree types; late successional development.

State K - Large to very large size trees, multistoried, with open canopy cover; all tree types; late successional development.

State L - Medium size trees, multistoried, with closed canopy cover; all tree types; late successional development; not part of the reference condition, found on contemporary landscapes only.

State M - Large to very large size trees, multistoried, with closed canopy cover; tree types; late successional development; not part of the reference condition, found on contemporary landscapes only.

State N - Recently burned, grass, forb, and shrub types with < 10 percent tree canopy cover; uncharacteristic early successional development due to fire; not part of the reference condition, found on contemporary landscapes only.

The ponderosa pine forested PNVT has a 77 percent or high departure rating from desired conditions and a 94 percent or severe departure rating from reference conditions making it the 2nd and 1st most departed PNVT, respectively, on the Apache-Sitgreaves NFs. Desired conditions were provided by the Forest Service Southwestern Regional Office; reference conditions were derived from the Nature Conservancy (Smith, 2006a).

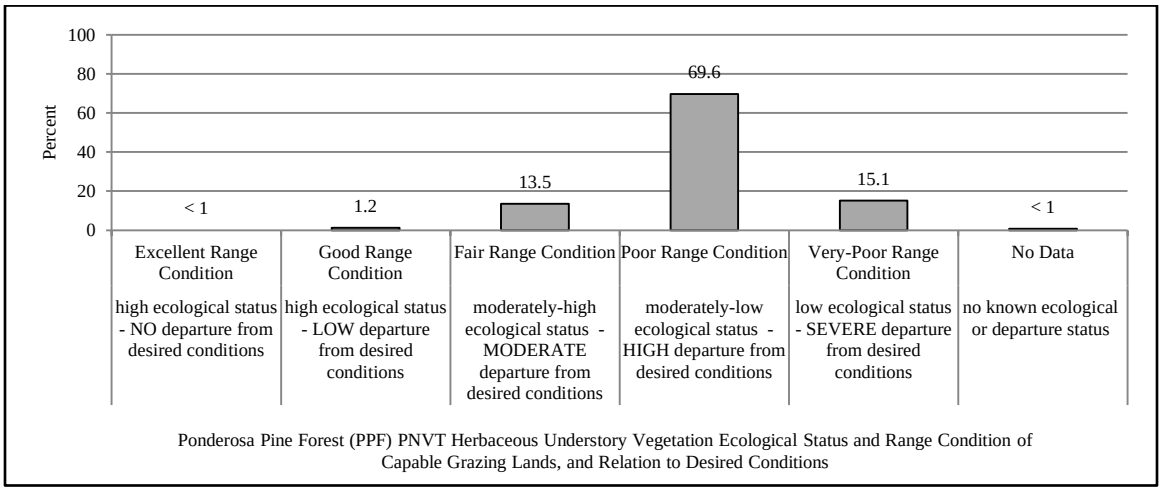

Figure 22. Ponderosa Pine Forest Herbaceous Understory Vegetation Condition

The figure above depicts the ponderosa pine forested PNVT's current herbaceous understory vegetation ecological status[2] and range condition[3] of the lands capable[4] of supporting livestock grazing and departure from desired conditions. Roughly 85 percent of capable grazing lands do not meet desired conditions.

Dry Mixed Conifer Forest

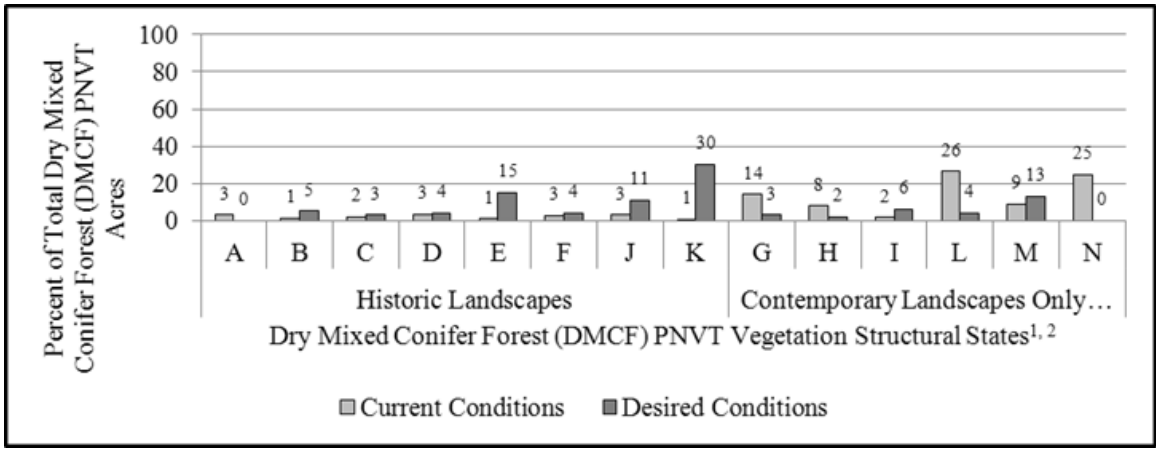

Figure 23. Dry Mixed Conifer Forest Overstory Vegetation Condition

The figure above depicts the dry mixed conifer forested PNVT overstory vegetation structural states. At 147,885 acres (approximately 7 percent of the forests), this PNVT ranks 6th in size out of the 14 PNVTs on the Apache-Sitgreaves NFs. The vegetation structural states are

State A - Recently burned, grass, forb and shrub types with < 10 percent tree canopy cover; early successional development.

State B - Seedling and sapling size (< 5" diameter) trees with open (< 30 percent) canopy cover; all tree types; early successional development.

State C - Small size (5–9.9" diameter) trees, with open canopy cover; all tree types; mid-successional development.

State D - Medium size (10–19.9" diameter) trees, single storied, with open canopy cover; all tree types; late successional development.

State E - Large to very large size (≥ 20" diameter) trees, single storied, with open canopy cover; all tree types; late successional development.

State F - Seedling and sapling size trees with closed (≥ 30 percent) canopy cover; all tree types; early successional development.

State G - Small size trees, with closed canopy cover; all tree types; mid-successional development; not part of the reference condition, found on contemporary landscapes only.

State H - Medium size trees, single storied, with closed canopy cover; all shade tree types; late successional development; not part of the reference condition, found on contemporary landscapes only.

State I - Large to very large size trees, single storied, with closed canopy cover; all tree types; late successional development; not part of the reference condition, found on contemporary landscapes only.

State J - Medium size trees, multistoried, with open canopy cover; all tree types; late successional development.

State K - Large to very large size trees, multistoried, with open canopy cover; all tree types; late successional development.

State L - Medium size trees, multistoried, with closed canopy cover; all tree types; late successional development; not part of the reference condition, found on contemporary landscapes only.

State M - Large to very large size trees, multistoried, with closed canopy cover; tree types; late successional development; not part of the reference condition, found on contemporary landscapes only.

State N - Recently burned, grass, forb, and shrub types with < 10 percent tree canopy cover; uncharacteristic early successional development due to fire; not part of the reference condition, found on contemporary landscapes only.

The dry mixed conifer forested PNVT has a 67 percent or high departure rating from desired conditions and a 77 percent or high departure rating from reference conditions making it tied with Great Basin grassland for the 3rd most departed PNVT from desired conditions and 3rd most departed PNVT from reference conditions on the Apache-Sitgreaves NFs. Desired conditions were provided by the Forest Service Southwestern Regional Office; reference conditions were derived from LANDFIRE (2007a).

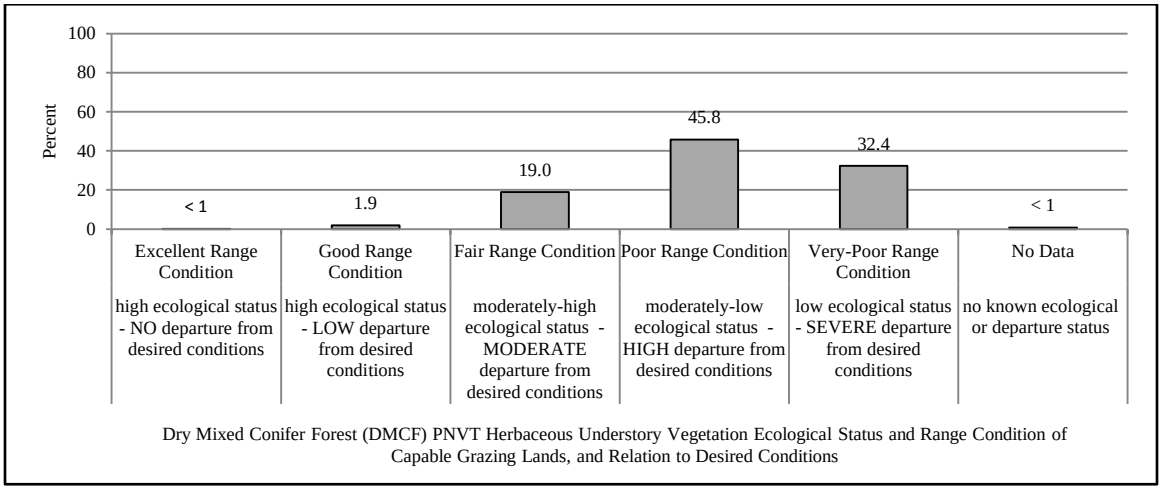

Figure 24. Dry Mixed Conifer Forest Herbaceous Understory Vegetation Condition

The figure above depicts the dry mixed conifer forested PNVT's current herbaceous understory vegetation ecological status[2] and range condition[3] of the lands capable[4] of supporting livestock grazing and departure from desired conditions. Roughly 78 percent of capable grazing lands do not meet desired conditions.

Wet Mixed Conifer Forest

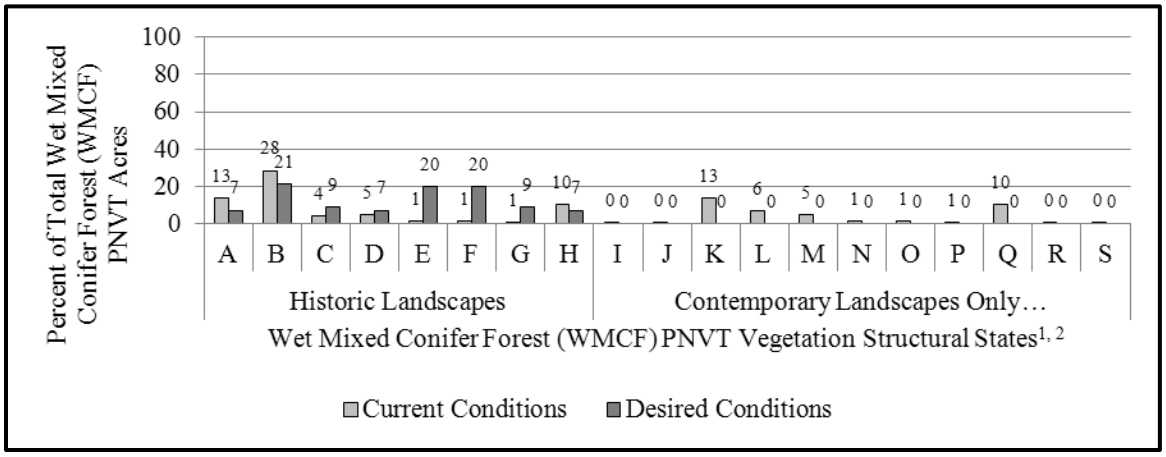

Figure 25. Wet Mixed Conifer Forest Overstory Vegetation Condition

The figure above depicts the wet mixed conifer forested PNVT overstory vegetation structural states. At 177,995 acres (approximately 9 percent of the forests), this PNVT ranks 5th in size out of the 14 PNVTs on the Apache-Sitgreaves NFs. The vegetation structural states are

State A - Recently burned, grass, forb and shrub types, with < 10 percent tree canopy cover; early successional development with aspen regeneration.

State B - Seedling and sapling (< 5" diameter), small (5–9.9" diameter), medium (10–19.9" diameter), large to very large (≥ 20" diameter) size trees, with open (> 10 percent and ≤ 30 percent) or closed (> 30 percent) canopy cover, consisting of all aspen, deciduous tree mix, and evergreen-deciduous mix tree types; with a plurality of shade intolerant tree types.

State C - Seedling and sapling, and small size trees, with open or closed canopy cover; with a plurality of shade tolerant tree types.

State D - Medium size trees, single or multistoried, with open or closed canopy cover; with a plurality of mixed shade tolerant tree types; with aspen regeneration.

State E - Large to very large size trees, single storied, with closed canopy cover; with a plurality of shade tolerant tree types; with aspen regeneration.

State F - Large to very large size trees, multistoried, with closed canopy cover; with a plurality of mixed shade tolerant tree types; with aspen regeneration.

State G - Seedling and sapling, and small size trees, with open canopy cover; shade intolerant tree types; with aspen regeneration.

State H - Medium size trees, single or multistoried, with open or closed canopy cover; with a plurality of mixed shade tolerant tree types.

State I - Large to very large size trees, single storied, with open canopy cover; with a plurality of shade tolerant tree types; not part of the reference condition, found on contemporary landscapes only.

State J - Large to very large size trees, multistoried, with open canopy cover; with a plurality of shade tolerant tree types; not part of the reference condition, found on contemporary landscapes only.

State K - Recently burned, grass, forb and shrub types, with < 10 percent tree canopy cover; early successional development; this state exists with elk and no aspen regeneration; not part of the reference condition, found on contemporary landscapes only.

State L - Seedling and sapling, and small size trees, with closed canopy cover; with a plurality of mixed shade tolerant tree types; this state exists with elk and no aspen regeneration; not part of the reference condition, found on contemporary landscapes only.

State M - Medium size trees, single or multistoried, with open or closed canopy cover; with a plurality of mixed shade tolerant tree types; this state exists with elk and no aspen regeneration; not part of the reference condition, found on contemporary landscapes only.

State N - Large to very large size trees, single storied, with open canopy cover; with a plurality of shade tolerant tree types; this state exists with elk and no aspen regeneration; not part of the reference condition, found on contemporary landscapes only.

State O - Large to very large size trees, multistoried, with closed canopy cover; with a plurality of mixed shade tolerant tree types; state exists with elk and no aspen regeneration; not part of the reference condition, found on contemporary landscapes only.

State P - Seedling and sapling, and small size trees, with open canopy cover; with a plurality of shade tolerant tree types; this state exists with elk and no aspen regeneration; not part of the reference condition, found on contemporary landscapes only.

State Q - Medium size trees, single or multistoried, with open or closed canopy cover; with a plurality of shade tolerant tree types; this state exists with elk and no aspen regeneration; not part of the reference condition, found on contemporary landscapes only.

State R - Large to very large size trees, single storied, with open canopy cover; with a plurality of mixed shade tolerant tree types; this state exists with elk and no aspen regeneration; not part of the reference condition, found on contemporary landscapes only.

State S - Large to very large size trees, multistoried, with open canopy cover; with a plurality of shade tolerant tree types; this state exists with elk and no aspen regeneration; not part of the reference condition, found on contemporary landscapes only.

The wet mixed conifer forested PNVT has a 54 percent or moderate departure rating from desired conditions and a 61 percent or high departure rating from reference conditions making it tied with montane/subalpine grasslands for the 7th most departed PNVT for desired conditions and 7th most departed PNVT from reference conditions on the Apache-Sitgreaves NFs. Desired conditions were provided by the Forest Service Southwestern Regional Office; reference conditions were derived from the Nature Conservancy (Smith, 2006b).

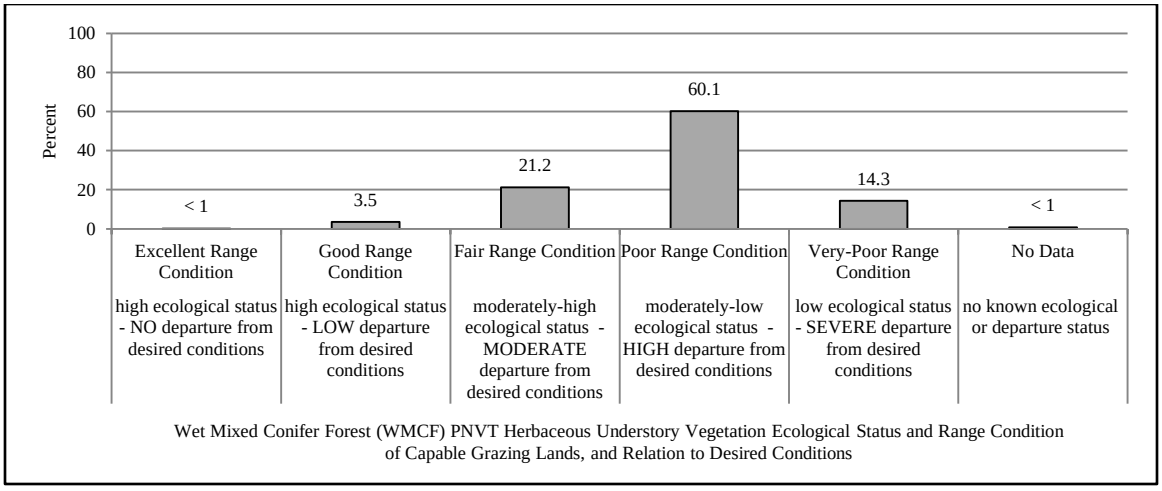

Figure 26. Wet Mixed Conifer Forest Herbaceous Understory Vegetation Condition

The figure above depicts the wet mixed conifer forested PNVT's current herbaceous understory vegetation ecological status[2] and range condition[3] of the lands capable[4] of supporting livestock grazing and departure from desired conditions. Roughly 74 percent of capable grazing lands do not meet desired conditions.

Spruce-Fir Forest

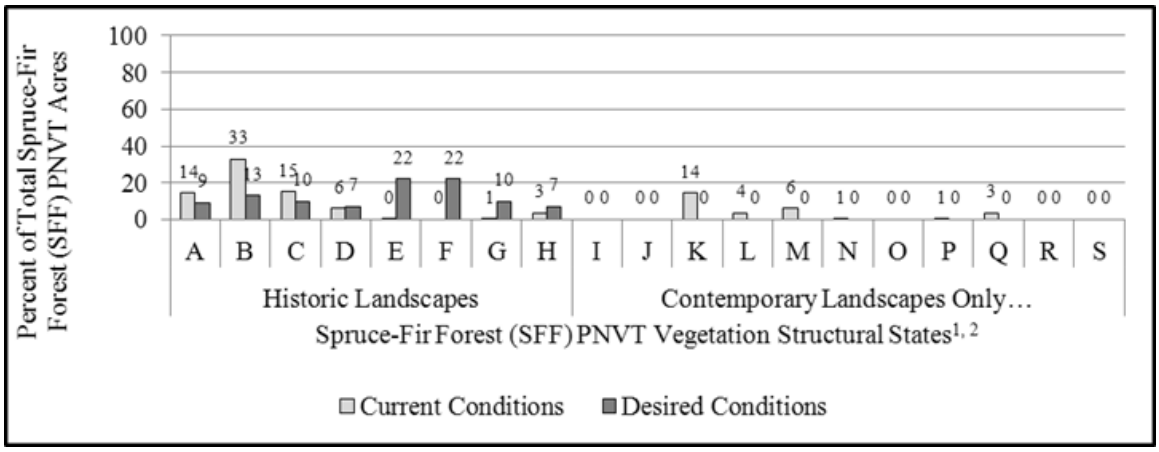

Figure 27. Spruce-Fir Forest Overstory Vegetation Condition

The figure above depicts the spruce-fir forested PNVT overstory vegetation structural states. At 17,667 acres (approximately 0.9 percent of the forests), this PNVT ranks 11th in size out of the 14 PNVTs on the Apache-Sitgreaves NFs. The vegetation structural states are

State A - Recently burned, grass, forb and shrub types, with < 10 percent tree canopy cover; early successional development with aspen regeneration.

State B - Seedling and sapling (< 5" diameter), small (5–9.9" diameter), medium (10–19.9" diameter), large to very large (≥ 20" diameter) size trees, with open (> 10 percent and ≤ 30 percent) or closed (> 30 percent) canopy cover, consisting of all aspen, deciduous tree mix, and evergreen-deciduous mix tree types; with a plurality of shade intolerant tree types.

State C - Seedling and sapling, and small size trees, with open or closed canopy cover; with a plurality of shade tolerant tree types.

State D - Medium size trees, single or multistoried, with open or closed canopy cover; with a plurality of mixed shade tolerant tree types; with aspen regeneration.

State E - Large to very large size trees, single storied, with closed canopy cover; with a plurality of shade tolerant tree types; with aspen regeneration.

State F - Large to very large size trees, multistoried, with closed canopy cover; with a plurality of mixed shade tolerant tree types; with aspen regeneration.

State G - Seedling and sapling, and small size trees, with open canopy cover; shade intolerant tree types; with aspen regeneration.

State H - Medium size trees, single or multistoried, with open or closed canopy cover; with a plurality of mixed shade tolerant tree types.

State I - Large to very large size trees, single storied, with open canopy cover; with a plurality of shade tolerant tree types; not part of the reference condition, found on contemporary landscapes only.

State J - Large to very large size trees, multistoried, with open canopy cover; with a plurality of shade tolerant tree types; not part of the reference condition, found on contemporary landscapes only.

State K - Recently burned, grass, forb and shrub types, with < 10 percent tree canopy cover; early successional development; this state exists with elk and no aspen regeneration; not part of the reference condition, found on contemporary landscapes only.

State L - Seedling and sapling, and small size trees, with closed canopy cover; with a plurality of mixed shade tolerant tree types; this state exists with elk and no aspen regeneration; not part of the reference condition, found on contemporary landscapes only.

State M - Medium size trees, single or multistoried, with open or closed canopy cover; with a plurality of mixed shade tolerant tree types; this state exists with elk and no aspen regeneration; not part of the reference condition, found on contemporary landscapes only.

State N - Large to very large size trees, single storied, with open canopy cover; with a plurality of shade tolerant tree types; this state exists with elk and no aspen regeneration; not part of the reference condition, found on contemporary landscapes only.

State O - Large to very large size trees, multistoried, with closed canopy cover; with a plurality of mixed shade tolerant tree types; state exists with elk and no aspen regeneration; not part of the reference condition, found on contemporary landscapes only.

State P - Seedling and sapling, and small size trees, with open canopy cover; with a plurality of shade tolerant tree types; this state exists with elk and no aspen regeneration; not part of the reference condition, found on contemporary landscapes only.

State Q - Medium size trees, single or multistoried, with open or closed canopy cover; with a plurality of shade tolerant tree types; this state exists with elk and no aspen regeneration; not part of the reference condition, found on contemporary landscapes only.

State R - Large to very large size trees, single storied, with open canopy cover; with a plurality of mixed shade tolerant tree types; this state exists with elk and no aspen regeneration; not part of the reference condition, found on contemporary landscapes only.

State S - Large to very large size trees, multistoried, with open canopy cover; with a plurality of shade tolerant tree types; this state exists with elk and no aspen regeneration; not part of the reference condition, found on contemporary landscapes only.

The spruce-fir forested PNVT has a 59 percent or moderate departure rating from desired conditions and a 62 percent or high departure rating from reference conditions making it the 6th most departed PNVT, respectively, on the Apache-Sitgreaves NFs. Desired conditions were provided by the Forest Service Southwestern Regional Office; reference conditions were derived from the Nature Conservancy (Smith, 2006c).

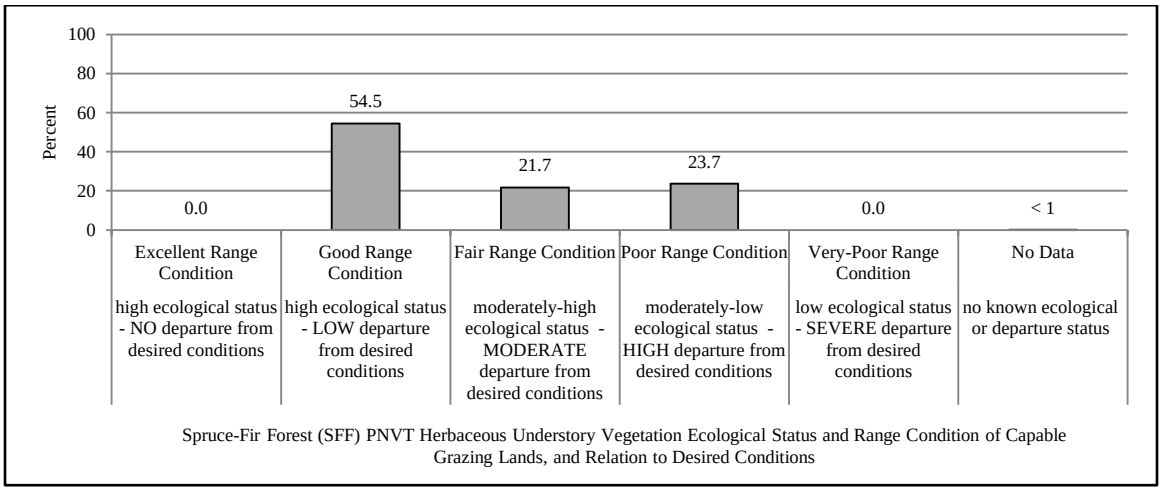

Figure 28. Spruce-Fir Forest Herbaceous Understory Vegetation Condition

The figure above depicts the spruce-fir forested PNVT's current herbaceous understory vegetation ecological status[2] and range condition[3] of the lands capable[4] of supporting livestock grazing and departure from desired conditions. Roughly 24 percent of capable grazing lands do not meet desired conditions.

Madrean Pine-Oak Woodland

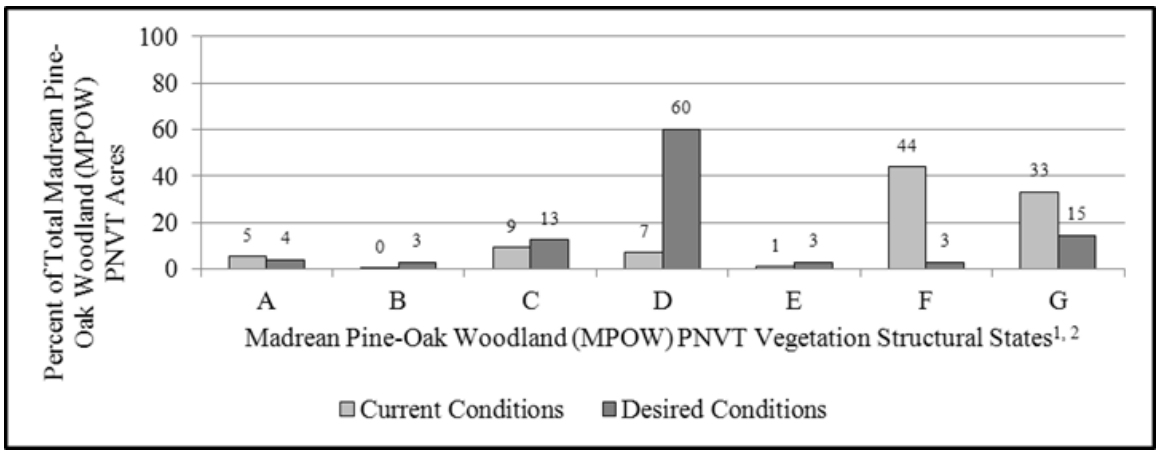

Figure 29. Madrean Pine-Oak Woodland Overstory Vegetation Condition

The figure above depicts the Madrean pine-oak woodland PNVT overstory vegetation structural states. At 394,927 acres (approximately 20 percent of the forests), this PNVT ranks 2nd in size out of the 14 PNVTs on the Apache-Sitgreaves NFs. The vegetation structural states are

State A - Recently burned, grass, forb and shrub types with < 10 percent tree canopy cover; early successional development.

State B - Seedling and sapling size (< 5" diameter) trees with open (< 30 percent) canopy cover; all tree types; early successional development.

State C - Small size (5–9.9" diameter) trees, with open canopy cover; all tree types; mid-successional development.

State D - Medium and large to very large size (≥ 10" diameter) trees, with open canopy cover; all tree types; late successional development.

State E - Seedling and sapling size trees with closed (≥ 30 percent) canopy cover; all tree types; early successional development.

State F - Small size trees, with closed canopy cover; all tree types; mid-successional development.

State G - Medium and large to very large size trees, with closed canopy cover; all tree types; late successional development.

The Madrean pine-oak woodland PNVT has a 61 percent or high departure rating from desired conditions and a 72 percent or high departure rating from reference conditions making it the 4th most departed PNVT, respectively, on the Apache-Sitgreaves NFs. Desired conditions were provided by the Forest Service Southwestern Regional Office; reference conditions were derived from the Nature Conservancy (Schussman and Gori, 2006).

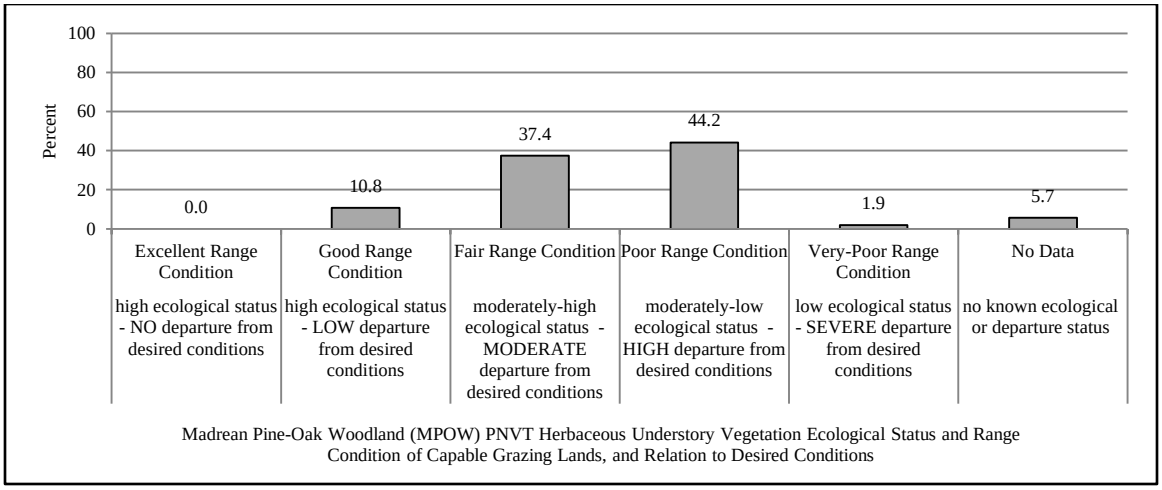

Figure 30. Madrean Pine-Oak Woodland Herbaceous Understory Vegetation Condition

The figure above depicts the Madrean pine-oak woodland PNVT's current herbaceous understory vegetation ecological status[2] and range condition[3] of the lands capable[4] of supporting livestock grazing and departure from desired conditions. Roughly 46 percent of capable grazing lands do not meet desired conditions.

Piñon-Juniper Woodland

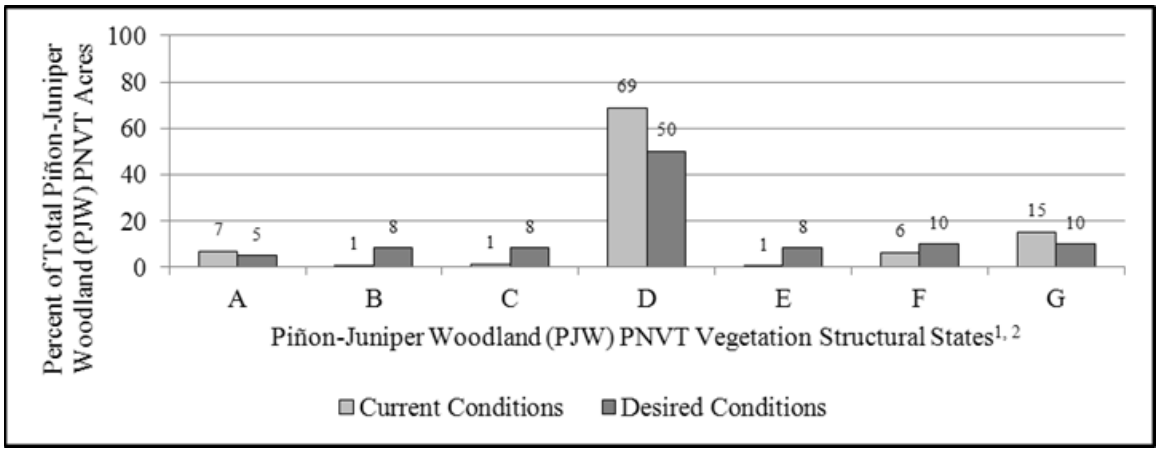

Figure 31. Piñon-Juniper Woodland Overstory Vegetation Condition

The figure above depicts the piñon-juniper woodland PNVT overstory vegetation structural states. At 222,166 acres (approximately 11 percent of the forests), this PNVT ranks 3rd in size out of the 14 PNVTs on the Apache-Sitgreaves NFs. The vegetation structural states are

State A - Recently burned, grass, forb and shrub types with < 10 percent tree canopy cover; early successional development.

State B - Seedling and sapling size (< 5" diameter) trees with open (< 30 percent) canopy cover; all tree types; early successional development.

State C - Small size (5–9.9" diameter) trees, with open canopy cover; all tree types; mid-successional development.

State D - Medium and large to very large size (≥ 10" diameter) trees, with open canopy cover; all tree types; late successional development.

State E - Seedling and sapling size trees with closed (≥ 30 percent) canopy cover; all tree types; early successional development.

State F - Small size trees, with closed canopy cover; all tree types; mid-successional development.

State G - Medium and large to very large size trees, with closed canopy cover; all tree types; late successional development.

The piñon-juniper woodland PNVT has a 28 percent or low departure rating from desired conditions and reference conditions making it the 10th and 11th most departed PNVT, respectively, on the Apache-Sitgreaves NFs. Desired conditions were provided by the Forest Service Southwestern Regional Office; reference conditions were derived from LANDFIRE (2005).

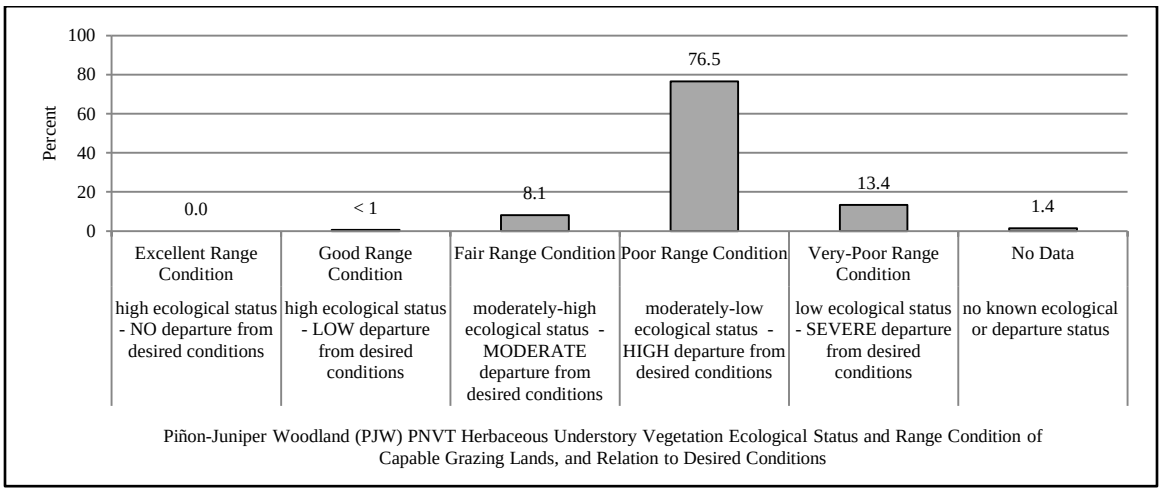

Figure 32. Piñon-Juniper Woodland Herbaceous Understory Vegetation Condition

The figure above depicts the piñon-juniper woodland PNVT's current herbaceous understory vegetation ecological status[2] and range condition[3] of the lands capable[4] of supporting livestock grazing and departure from desired conditions. Roughly 91 percent of capable grazing lands do not meet desired conditions.

Semi-desert Grassland

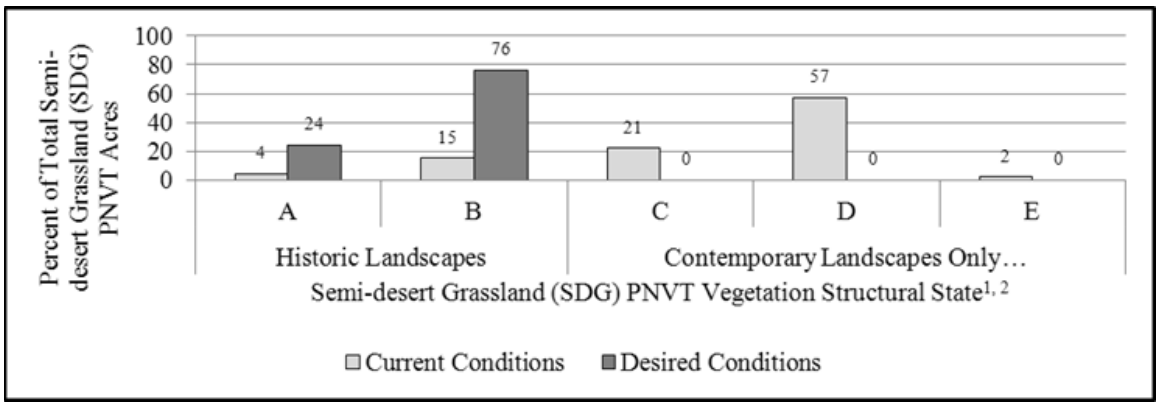

Figure 33. Semi-desert Grassland Woody Overstory Vegetation Condition

The figure above depicts the semi-desert grassland PNVT woody overstory vegetation structural states. At 106,952 acres (approximately 5 percent of the forests), this PNVT ranks 7th in size out of the 14 PNVTs on the Apache-Sitgreaves NFs. The vegetation structural states are

State A - Herbaceous vegetation regeneration, recently burned, sparsely vegetated; with < 10 percent tree or shrub canopy cover; early successional development.

State B - Perennial herbaceous vegetation, with < 10 percent tree or shrub canopy cover; mid-successional development.

State C - Perennial herbaceous vegetation with shrubs, seedling, and sapling size (< 5" diameter), small size (5–9.9" diameter), and medium size (10–19.9" diameter) trees with open (< 30 percent) canopy cover; late successional development; not part of the reference condition, found on contemporary landscapes only.

State D - Shrubs, seedling and sapling, small, medium, and large to very large size (> 20" diameter) trees with closed (≥ 30 percent) canopy cover, and large to very large size trees with open canopy cover with perennial herbaceous vegetation understory, mid-successional development; not part of the reference condition, found on contemporary landscapes only.

State E - Various noxious weeds and invasive nonnative plants makeup a significant portion of the herbaceous vegetation composition; not part of the reference condition, found on contemporary landscapes only.

The semi-desert grassland PNVT has a 79 percent or high departure rating from desired conditions and reference conditions making it the 1st and 2nd most departed PNVT, respectively, on the Apache-Sitgreaves NFs. Desired conditions were provided by the Forest Service Southwestern Regional Office; reference conditions were derived from the Nature Conservancy (Schussman, 2006a).

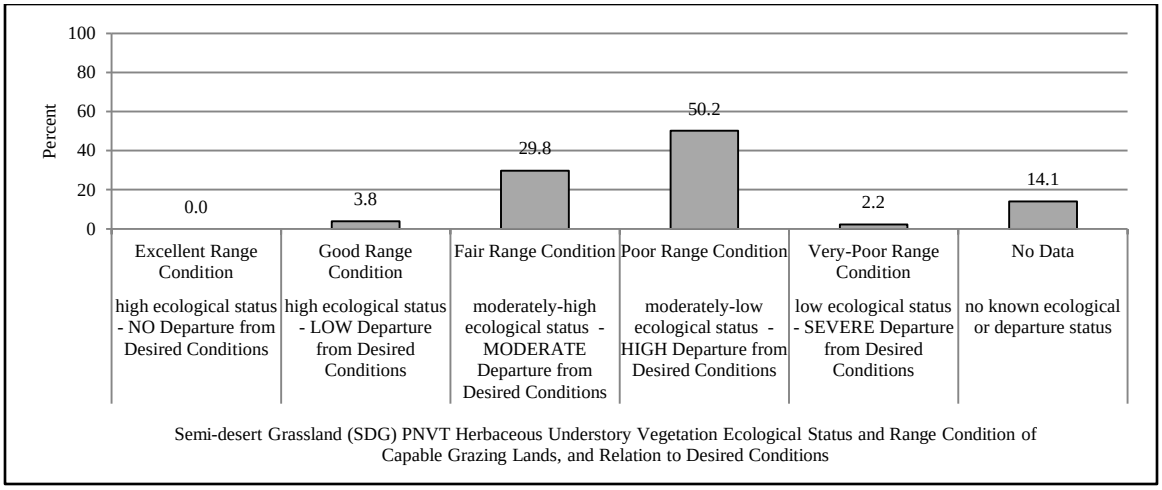

Figure 34. Semi-desert Grassland Herbaceous Understory Vegetation Condition

The figure above depicts the semi-desert grassland PNVT's current herbaceous understory vegetation ecological status[2] and range condition[3] of the lands capable[4] of supporting livestock grazing and departure from desired conditions. Roughly 52 percent of capable grazing lands do not meet desired conditions.

Great Basin Grassland

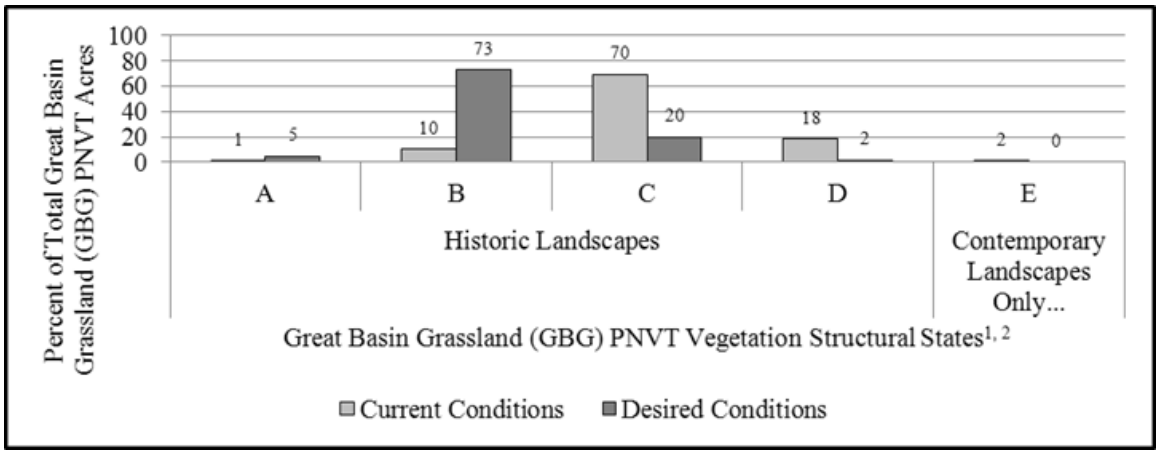

Figure 35. Great Basin Grassland Woody Overstory Vegetation Condition

The figure above depicts the Great Basin grassland PNVT woody overstory vegetation structural states. At 185,523 acres (approximately 9 percent of the forests), this PNVT ranks 4th in size out of the 14 PNVTs on the Apache-Sitgreaves NFs. The vegetation structural states are

State A - Herbaceous vegetation regeneration, recently burned, sparsely vegetated; with < 10 percent tree or shrub canopy cover; early successional development.

State B - Open perennial herbaceous vegetation, with < 10 percent tree or shrub canopy cover; mid-successional development.

State C - Perennial herbaceous vegetation with shrubs, seedling and sapling size (< 5" diameter), small size (5–9.9" diameter), and medium size (10–19.9" diameter) trees with open (< 30 percent) canopy cover; late successional development.

State D - Shrubs, seedling, and sapling, small, medium, and large to very large size (> 20" diameter) trees with closed (≥ 30 percent) canopy cover, and large to very large size trees with open canopy cover with perennial herbaceous vegetation understory, mid-successional development.

State E - Various noxious weeds and invasive nonnative plants makeup a significant portion of the herbaceous vegetation composition; not part of the reference condition, found on contemporary landscapes only.

The Great Basin grassland PNVT has a 67 percent or high departure rating from desired conditions and reference conditions making it tied with dry mixed conifer forest for the 3rd most departed PNVT from desired conditions and 5th most departed PNVT from reference conditions on the Apache-Sitgreaves NFs. Desired conditions were provided by the Forest Service Southwestern Regional Office; reference conditions were derived from LANDFIRE (2007b).

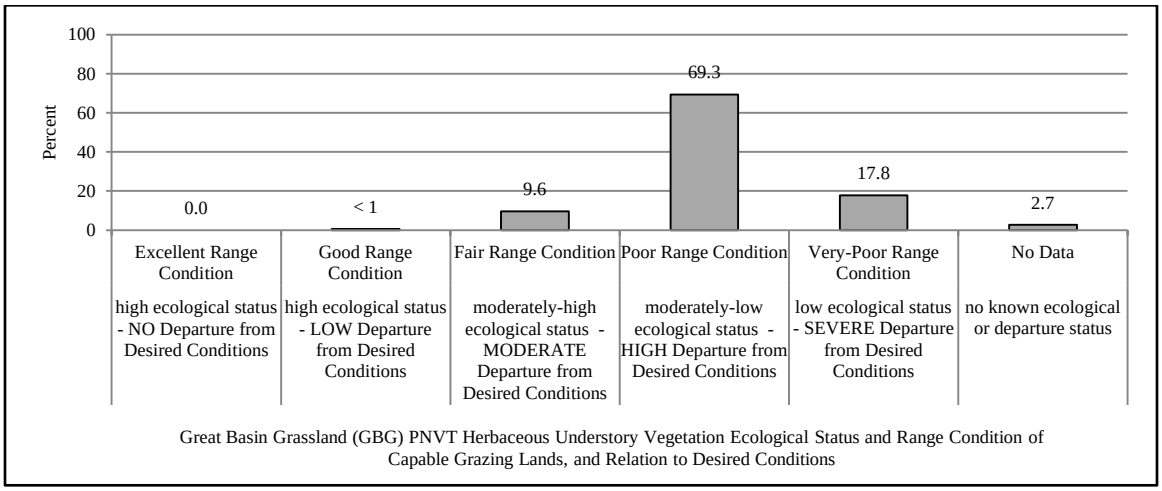

Figure 36. Great Basin Grassland Herbaceous Understory Vegetation Condition

The figure above depicts the Great Basin grassland PNVT's current herbaceous understory vegetation ecological status[2] and range condition[3] of the lands capable[4] of supporting livestock grazing and departure from desired conditions. Roughly 87 percent of capable grazing lands do not meet desired conditions.

Montane/Subalpine Grasslands

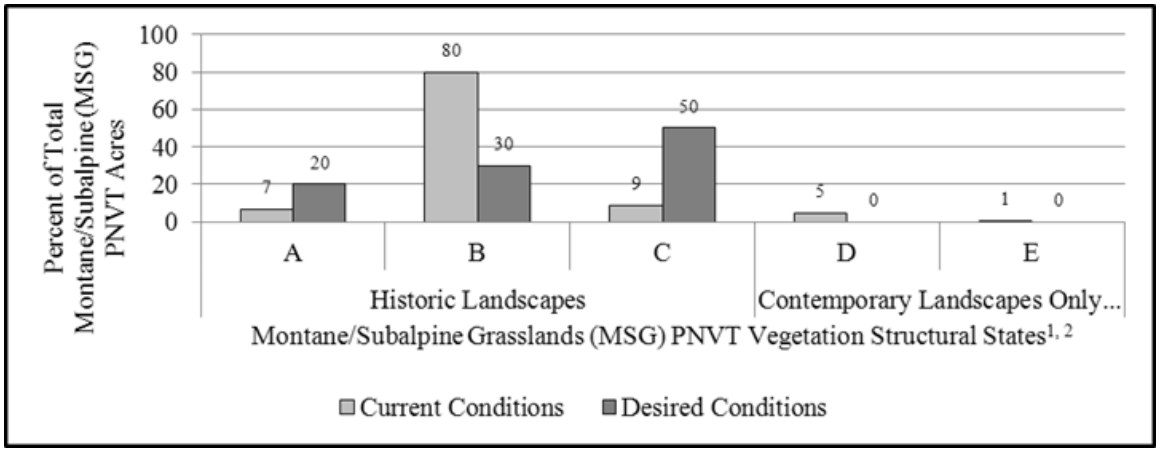

Figure 37. Montane/Subalpine Grasslands Woody Overstory Vegetation Condition

The figure above depicts the montane/subalpine grasslands PNVT woody overstory vegetation structural states. At 51,559 acres (approximately 3 percent of the forests), this PNVT ranks 9th in size out of the 14 PNVTs on the Apache-Sitgreaves NFs. The vegetation structural states are,

State A - Herbaceous vegetation regeneration, recently burned, sparsely vegetated; with < 10 percent tree or shrub canopy cover; early successional development.

State B - Perennial herbaceous vegetation, with < 10 percent tree or shrub canopy cover; mid-successional development.

State C - Perennial herbaceous vegetation, with < 10 percent tree or shrub canopy cover; late successional development.

State D - Shrubs, seedling, and sapling size (< 5" diameter), small size (5–9.9" diameter), medium size (10–19.9" diameter), and large to very large size (> 20" diameter) trees with open (< 30 percent) or closed (≥ 30) canopy cover, with perennial herbaceous vegetation understory; not part of the reference condition, found on contemporary landscapes only.

State E - Various noxious weeds and invasive nonnative plants makeup a significant portion of the herbaceous vegetation composition; not part of the reference condition, found on contemporary landscapes only.

The montane/subalpine PNVT has a 54 percent or moderate departure rating from desired conditions and reference conditions making it tied with wet mixed conifer forest for the 7th most departed PNVT from desired conditions and 8th most departed PNVT from reference conditions on the Apache-Sitgreaves NFs. Desired conditions were provided by the Forest Service Southwestern Regional Office; reference conditions were derived from LANDFIRE (2007c).

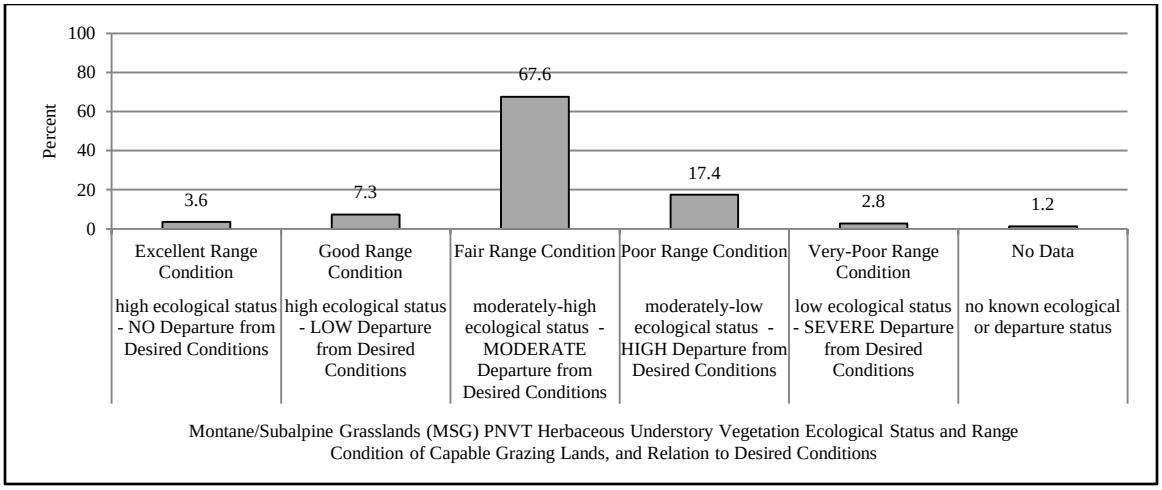

Figure 38. Montane/Subalpine Grasslands Herbaceous Understory Vegetation Condition

The figure above depicts the montane/subalpine Grasslands PNVT's current herbaceous understory vegetation ecological status[2] and range condition[3] of the lands capable[4] of supporting livestock grazing and departure from desired conditions. Roughly 20 percent of capable grazing lands do not meet desired conditions.

Interior Chaparral

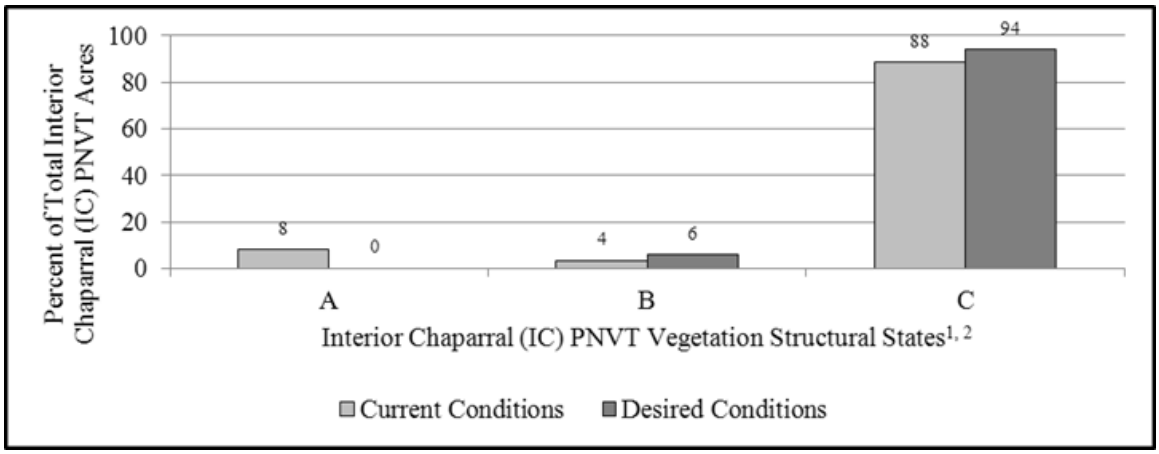

Figure 39. Interior Chaparral Overstory Vegetation Condition

The figure above depicts the interior chaparral PNVT overstory vegetation structural states. At 55,981 acres (approximately 3 percent of the forests), this PNVT ranks 8th in size out of the 14 PNVTs on the Apache-Sitgreaves NFs. The vegetation structural states are

State A - Herbaceous vegetation regeneration, recently burned, sparsely vegetated; with < 10 percent shrub or tree canopy cover; early successional development.

State B - Open perennial herbaceous vegetation, with shrubs, seedling, and sapling size (< 5" diameter) and small size (5–9.9" diameter) trees with open (< 30 percent canopy cover; mid successional development.

State C - Shrubs, seedling, and sapling, small, medium size (10–19.9" diameter), and large to very large size (> 20" diameter) trees with closed (≥ 30) canopy cover, and medium and large to very large size (> 20" diameter) trees with open canopy cover and no herbaceous vegetation understory; late successional development.

The interior chaparral PNVT has an 8 percent or no departure rating from desired conditions and reference conditions making it the least departed PNVT, respectively, on the Apache-Sitgreaves NFs. Desired conditions were provided by the Forest Service Southwestern Regional Office; reference conditions were derived from the Nature Conservancy (Schussman, 2006).

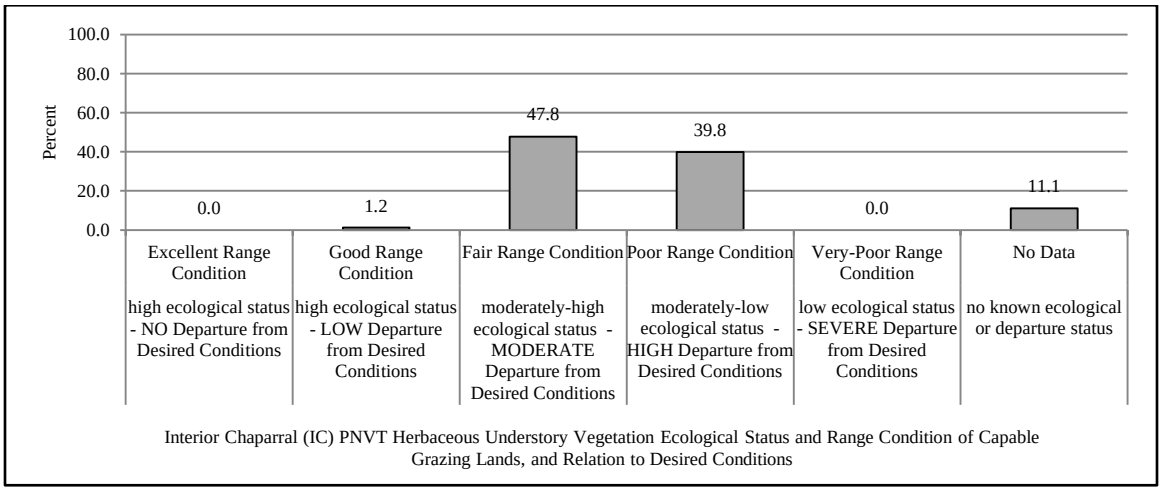

Figure 40. Interior Chaparral Herbaceous Understory Vegetation Condition

The figure above depicts the interior chaparral PNVT's current herbaceous understory vegetation ecological status[2] and range condition[3] of the lands capable[4] of supporting livestock grazing and departure from desired conditions. Roughly 40 percent of capable grazing lands do not meet desired conditions.

Age Classes Typically Occurring on the Apache-Sitgreaves NFs

The figure on the following page provides a graphic representation of ponderosa pine age classes. The four age classes range from 1, the youngest, to 4, the oldest. The four crown vigor classes range from A, the most vigorous, to D, the poorest. Bole diameter is highly dependent upon growing conditions rather than age. In general, class 1 represents trees approximately 4 to 9 inches DBH and 15 to 40 years old, class 2 is approximately 9 to 15 inches DBH and 40 to 75 years, class 3 is 15 to 22 inches DBH and 75 to 130 years, and class 4 is more than 22 inches DBH and more than 130 years old.

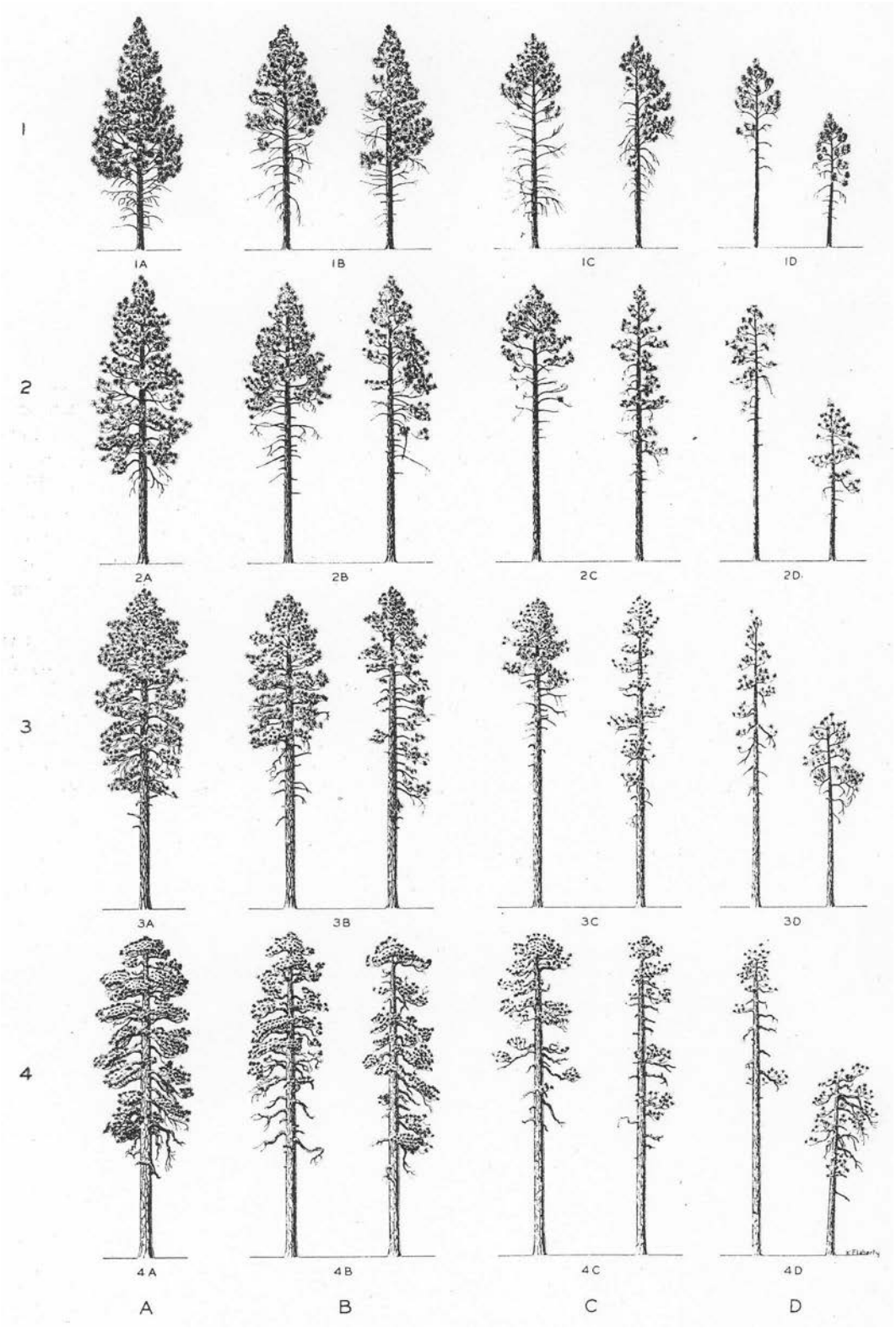

Figure 41. Keen's tree classification for ponderosa pine

Old Growth in the Southwestern Region of the Forest Service

"Old growth" refers to specific habitat components that occur in forests and woodlands: old trees, dead trees (snags), downed wood (coarse woody debris), and structure diversity (Franklin and Spies, 1991; Helms, ed.; 1998; Kaufmann et al., 2007). These important habitat features may occur in small areas, with only a few components, or over larger areas as stands or forests where old growth is concentrated (Kaufmann et al., 2007). In the Southwest, old growth is considered "transitional" (Oliver and Larson, 1996), given that the location of old growth on the landscape shifts over time as a result of succession and disturbance (tree growth and mortality). Some species, notably certain plants, require "old forest" communities that may or may not have old growth components but have escaped significant disturbance for lengths of time necessary to provide the suitable stability and environment.

There is an inverse relationship between the frequency of fire and the contiguity of old growth features (WSDNR, 2005). In frequent fire, all-aged systems (e.g., ponderosa pine, dry mixed conifer, some piñon-juniper types) old growth components can occur individually or in small areas of 0.1 to 1-plus acres (Cooper, 1961; White, 1985), separated spatially from other old growth. In infrequent fire systems (e.g., mixed conifer-aspen, spruce-fir, some piñon-juniper types), old growth components are often concentrated in larger patches, sometimes forming "old growth forest" over tens or hundreds of acres.

Old, and sometimes large, trees are an important component of old growth. It is the decadence (dead tops, dead wood) or structure diversity (flattened crowns, branch characteristics), often associated with old age, that provide essential habitat elements. "Old" is relative to the trees species (Swetnam and Brown, 1992): about 200 years in ponderosa pine (Kaufmann, 1996) and 100 years in aspen. "Large" is also relative to tree species, but it can be roughly divided into two diameter groups: large trees in woodlands and large trees in forests. Large trees in woodlands are approximately 10 inches and greater in diameter (i.e., greater than 25 cm) (Weisz et al., 2012) and consist of piñon, juniper, oak, and other "dwarf" tree species where diameter is measured at the root collar (DRC). Large trees in forests are approximately 20 inches and greater (i.e., greater than 50 cm) and consists of species that dominate montane and subalpine zones, and they are measured at "breast height" (DBH). Large trees are valued for their longevity in providing old growth habitat and for their added ability to enhance structure diversity.

The structure diversity component includes both vertical and horizontal diversity. Vertical diversity is often assessed based on the number of canopy layers. Tree age data is sometimes used as an inference of canopy number (i.e., storiedness) and vice versa. Horizontal diversity can be evaluated using canopy cover and tree stem aggregation statistics, either within or among old growth sites. Structure diversity in old growth is relatively high, but as with the other old growth components, guidelines for structure and age diversity are specific to the PNVT.

Snags are standing dead or partially dead trees that are greater than about 6 feet (2 meters) in height (Helms, ed., 1998). Depending on the species of wildlife, snag diameter for habitat varies upward from 5 inches in diameter (greater than 12 cm) (Ganey, 1999; Harris, 1999; Harrod et al., 1998; Lyon, 1977; McClelland and Frissell, 1975). Management guidelines for the retention and development of snags vary by PNVT and diameter class (Hutto et al., 1993; Thomas et al., 1979). Snags created by fire may not meet habitat needs for some wildlife and are often subject to

separate retention guidelines (Hutto, 2008). Snags created by fire sometimes fall before they become useful as snag habitat.

Coarse woody debris is any woody material on the ground greater than 3 inches (8 cm) at the largest cross section (Brewer, 2008). Like snag guidelines, coarse woody debris guidelines are specific to PNVT and diameter class (Graham et al., 1994).

Vegetation Management Practices

The following table lists various treatment options for use under the uneven-aged and even-aged management systems, as well as intermediate treatments that can be used within either system. See the land management plan glossary for definitions of most silvicultural terms used in the table.

Use of treatment methods listed in the following table requires project level analysis and a NEPA decision document followed by detailed site-specific prescription development and signature by regionally-certified silviculturists. These vegetation management practices are general guidelines. The treatment option chosen for each forest or woodland type and circumstance is determined by a certified silviculturist using guidance in this appendix, a review of applicable technical and scientific literature, and practical experience. Using this knowledge, the silviculturist determines if the practice is relevant to the specific vegetation and site condition. Additional practices may be dictated by other resource goals, particularly in riparian areas.

Forest Service Manual (FSM) 2478.03 (Silvicultural Examinations, Prescriptions, and Evaluations – Policy) requires, in part, that a prescription, detailing the methods, techniques, and timing of silvicultural activities, be prepared prior to initiating any silvicultural treatment on NFS lands.

FSM 5142.1 (Developing Prescribed Fire Burn Plans) requires that a site-specific prescribed fire plan be prepared and approved by a qualified line officer for each prescribed fire in advance of ignition. The prescribed fire plan includes a description of the structure and composition of the vegetation and fuel characteristics and includes resource objective statements that are used to develop the prescribed fire prescription.

Fuels specialists and silviculturists, along with other resource specialists, work together to ensure land management objectives are met. Joint silviculture prescriptions and burn plans may be produced.

Table 14. Standard Vegetation Management Practices for Site-Specific Project Planning and Implementation[a]

DESIRED VEGETATION SPECIES COMPOSITION	Gambel oak, Evergreen oak species, quaking aspen, chaparral species, cottonwood, willow, alder, etc.	*See species below*[b]	*See species below*[b]	*See species below*[b]	*See species below*[b]	*See species below*[b]	*See species below*[b]	*See species below*[b]	All Forest and Persistent Woodland Types	Grassland, Meadow, and Savanna Woodland Types
STRUCTURE	DESIRED ONE-AGED, SINGLE-STORIED STAND[c]	DESIRED ONE-AGED, SINGLE-STORIED STAND[c]	DESIRED ONE-AGED, SINGLE-STORIED STAND[c]	DESIRED ONE-AGED, SINGLE-STORIED STAND[c]	DESIRED TWO-AGED, TWO-STORIED STAND (Two age classes, each > 10% BA most of the rotation)	DESIRED UNEVEN-AGED, MULTI-STORIED STAND[d]	DESIRED UNEVEN-AGED, MULTI-STORIED STAND[d]	DESIRED UNEVEN-AGED, MULTI-STORIED STAND[d]	ANY DESIRED ONE-, TWO-, or MULTI-STORIED STAND	DESIRED OPEN (Grassland/meadow < 10% woody canopy cover; savanna woodland 10-30% canopy cover)
FUNCTION	Coppice Regeneration Method (vegetation regeneration function)	Clearcutting Regeneration Method (no trees function for seed/shelter)	Seed Tree Regeneration Method (some trees function for seed only)	Shelterwood Regeneration Method (some trees function for seed/shelter)	Irregular Shelterwood Regeneration Method (function for continuous tree cover)	Single-Tree Regeneration Method (function for continuous tree cover)	Group-Selection Regeneration Method (group size = 2-4 acres)	Irregular Group-Shelterwood Regeneration Method	Intermediate Treatment Methods (tree cover kept between stand formation and regeneration= manage existing stand for desired conditions)	No or Few Trees (eliminate tree encroachment; maintain as predominantly herbaceous vegetation)
SILVICULTURAL MANAGEMENT PRACTICES[e] (options listed are not in any particular order or preference)	Activity Coppice Coppice w/Reserves Prescribed Fire Protection from heavy ungulate browsing Plant hardwood cuttings in riparian sites Protect regeneration from animal damage	Activity ≤ 5% tree cover post harvest: Patch cut Strip cut Stand cut Prescribed Fire Tree Planting 6-10% tree cover post harvest: Patch cut w/Reserves Strip cut w/Reserves Stand cut w/Reserves Prescribed Fire Tree Planting Protect regeneration from animal damage	Activity Preparatory Seed 1-10% tree cover post harvest: Final Removal Final removal w/Reserves Limited Prescribed Fire Fill-in Tree Planting Protect regeneration from animal damage	Activity Preparatory Seed Group Seed Strip Seed Removal Group Removal Strip Removal Final Removal Final Removal w/Reserves Limited Prescribed Fire Fill-in Tree Planting Protect regeneration from animal damage	Activity Preparatory Seed Removal Final Removal Final Removal w/Reserves --- Coppice Regeneration Method: Coppice w/Standards (understory must regenerate vegetatively by suckers/sprouts) --- Over-browsing protection	Activity Single Tree (Individual Tree) Selection Limited Prescribed Fire Activity Group Selection	Group Selection w/Reserves Limited Prescribed Fire Tree Planting Protect regeneration from animal damage	Activity Seed Removal Final Removal Final Removal w/Reserves Limited Prescribed Fire Fill-in Tree Planting Protect regeneration from animal damage	Activity Improvement cuts Free Thinning Low Thinning Liberation Cleaning Weeding Thinning Commercial and Noncommercial Mortality Salvage Sanitation Salvage Prescribed Fire	Activity Grassland Restoration and/or maintenance tree/shrub Cuts Tree Pushing, Chaining Prescribed Fire Careful grazing management for herbaceous vegetation recovery, especially post-fire Intensive animal browsing to maintain herbaceous vegetation cover Herbicide treatments

[a] Standard management practices for certain composition, structure, and function attributes, other than deferral

[b] Ponderosa pine, Rocky Mountain Douglas-fir, blue spruce, Engelmann spruce, southwestern white pine, white fir, subalpine fir, quaking aspen, pine-oak species, Chihuahuan pine, Rocky Mountain juniper, piñon pine, alligator juniper, Utah juniper, one-seed juniper, cottonwood, willow, Arizona cypress, mesquite, etc.

NOTE: Methods and practices listed below will vary by tree species, and those used must be appropriate for the known SILVICS of the desired species.

[c] One-age class composes ≥ 90% of total stand BA for most of the rotation. Age difference between oldest & youngest tree in a class is less than 20% of the rotation.

[d] Three or more distinct age classes

[ec] Daniel et al. (1979). "Principles of Silviculture." McGraw-Hill, New York. Smith, D.M. (1986). "The Practice of Silviculture." John C. Wiley & Sons, New York, Helms, J.A., (ed.). (1998). "The Dictionary of Forestry." The Society of American Foresters.

References

Brewer, D. (2008). Managing Coarse Woody Debris in Fire-adapted Southwestern Forests. Ecological Restoration Institute working paper 21. Northern Arizona University, Flagstaff, AZ. 9 pp.

Cooper, C.F. (1961). Pattern in Ponderosa Pine Forests. *Ecology* 42: 493–499.

Franklin, J.F.; and T.A. Spies. (1991). Ecological definitions of old-growth Douglas-fir forests. Pp. 61–69 in *Wildlife and Vegetation of Unmanaged Douglas-fir Forests*. L.F. Ruggiero, K.B. Aubry, A.B. Carey, and M. Huff, tech. coords. USDA Forest Service Gen. Tech. Rep. PNW-GTR-285. Pacific Northwest Research Station, Portland, OR. 533 pp.

Ganey, J.L. (1999). Snag density and composition of snag populations on two national forests in northern Arizona. *Forest Ecology and Management* 117: 169–178.

Graham, R.T.; A.E. Harvey; M.F. Martin; T.B. Jain; J.R. Tonn; and D.S. Page-Dumroese. (1994). Managing Coarse Woody Debris in Forests of the Rocky Mountains. USDA Forest Service Res. Pap. INT-RP-477. Intermountain Research Station, Ogden, UT. 12 pp.

Harris, R.B. (1999). Abundance and Characteristics of Snags in Western Montana Forests. USDA Forest Service Gen. Tech. Rep. RMRS-GTR-31. Rocky Mountain Research Station, Ft. Collins, CO. 19 pp.

Harrod, R.J.; W.L. Gaines; W.E. Hartl; and A. Camp. (1998). Estimating Historical Snag Density in Dry Forests East of the Cascade Range. USDA Forest Service Gen. Tech. Rep. PNW-GTR-428. Pacific Northwest Research Station, Portland, OR. 16 pp.

Helms, J.A., editor (1998). The Dictionary of Forestry. The Society of American Foresters: Bethesda, MD. 210 pp.

Holechek, J.L.; R.D. Pieper; and C.H. Herbel. (1998). Range management: principles and practices, 3rd ed. Prentice-Hall, Inc. Upper Saddle River, NJ. 542 pp.

Hutto, R.L.; S.J. Hejl; C.R. Preston; and D.M. Finch. (1993). Effects of Silvicultural Treatments on Forest Birds in the Rocky Mountains: Implications And Management Recommendations. Pp. 386-391 in D.M. Finch and P.W. Stangel (eds.), status and management of neotropical migratory birds. USDA Forest Service Gen. Tech. Rep. RM-229. Rocky Mountain Research Station, Ft. Collins, CO.

Hutto, R.L. (2008). The Ecological Importance of Severe Wildfires: Some Like It Hot. *Ecological Applications* 18: 1827–1834.

Kaufmann, M.R. (1996). To live fast or not: growth, vigor, and longevity of old-growth ponderosa and lodgepole pine trees. *Tree Physiology* 16: 139–144.

Kaufmann, M.R.; D. Binkley; P.Z. Fulé; M. Johnson; S.L. Stephens; and T.W. Swetnam. (2007). Defining Old Growth for Fire-Adapted Forests of the Western United States. *Ecology and Society* 12: 15.

LANDFIRE. (2003). Wet grasslands. Draft LANDFIRE Rapid Assessment Model: WGRA. LANDFIRE Project, USDA, Forest Service and USDI, Geologic Survey. 5 pp.

LANDFIRE. (2005). Juniper-pinyon (frequent fire type). Draft LANDFIRE Rapid Assessment Model: JUPI1. LANDFIRE Project, USDA, Forest Service and USDI, Geologic Survey. 8 pp.

LANDFIRE. (2007a). Southern Rocky Mountain dry-mesic montane mixed coniferous forest and woodland. LANDFIRE Biophysical Setting Model, Biophysical Setting: 1510510. LANDFIRE Project, USDA, Forest Service and USDI, Geologic Survey. pp. 42–47.

LANDFIRE. (2007b). Inter-Mountain. Basin semi-desert grassland. LANDFIRE Biophysical Setting Model, Biophysical Setting: 2411350. LANDFIRE Project, USDA, Forest Service and USDI, Geologic Survey. pp. 221–226.

LANDFIRE. (2007c). Southern Rocky Mountain montane subalpine grassland. LANDFIRE Biophysical Setting Model, Biophysical Setting: 1511460. LANDFIRE Project, USDA, Forest Service and USDI, Geologic Survey. pp. 119–224.

LANDFIRE. (2007d). North American warm desert riparian system. LANDFIRE Biophysical Setting Model, Biophysical Setting: 1511551. LANDFIRE Project, USDA, Forest Service and USDI, Geologic Survey. pp. 203–208.

LANDFIRE. (2007e). Montane riparian system. LANDFIRE Biophysical Setting Model, Biophysical Setting: 2411590. LANDFIRE Project, USDA, Forest Service and USDI, Geologic Survey. pp. 203–208.

Lyon, J.L. (1977). Attrition of lodgepole pine snags on the Sleeping Child Burn, Montana. USDA Forest Service Research Note INT-219. Intermountain Forest and Range Experiment Station, Ogden, UT. 4 pp.

McClelland, B.R.; and S.S. Frissell. (1975). Identifying Forest Snags Useful for Hole-Nesting Birds. *Journal of Forestry* 73: 414–417.

Oliver, C.D.; and B.C. Larson. (1996). Forest Stand Dynamics, update addition. New York: John Wiley & Sons. 520 pp.

Schussman, H. (2006). Historical range of variation and state and transition modeling of historical and current landscape conditions for interior chaparral of the Southwestern U.S. Prepared for the USDA Forest Service, Southwestern Region by The Nature Conservancy, Tucson, AZ. 24 pp.

Schussman, H.; and D. Gori. (2006). Historical range of variation and state and transition modeling of historical and current landscape conditions for madrean pine-oak of the Southwestern U.S. Prepared for the USDA Forest Service, Southwestern Region by The Nature Conservancy, Tucson, AZ. 35 pp.

Smith, E. (2006a). Historical range of variation and state and transition modeling of historical and current landscape conditions for ponderosa pine of the Southwestern U.S. Prepared for the USDA Forest Service, Southwestern Region by The Nature Conservancy, Tucson, AZ. 43 pp.

Smith, E. (2006b). Historical range of variation and state and transition modeling of historical and current landscape conditions for mixed conifer of the Southwestern U.S. Prepared for the USDA Forest Service, Southwestern Region by The Nature Conservancy, Tucson, AZ. 31 pp.

Smith, E. (2006c). Historical range of variation and state and transition modeling of historical and current landscape conditions for spruce-fir of the Southwestern U.S. Prepared for the USDA Forest Service, Southwestern Region by The Nature Conservancy, Tucson, AZ. 37 pp.

Swetnam, T.W.; and P.M. Brown. (1992). Oldest Known Conifers in the Southwestern United States: Temporal And Spatial Patterns Of Maximum Age. Pp. 24–38 In Kaufmann, M.R. Moir W.H.; and Bassett, R.L., eds. Old-growth forests in the Southwest and Rocky Mountain regions: The status of our knowledge. USDA Forest Service workshop proceedings, Gen. Tech. Rep. RM-213. Fort Collins, CO. 201 pp.

Thomas, J.W.; R.G. Anderson; C. Master; and E.L. Bull. (1979). Snags. Pp. 60–77 In Thomas, J.W. (tech. ed.), Wildlife Habitats in Managed Forests: The Blue Mountains of Oregon and Washington. USDA Forest Service Agricultural Handbook No. 553. Washington, DC. 512 pp.

Weisz, R.; D. Vandendriesche; and M. Moeur. (February 2012). White Paper O - Overview of How We Created VDDT Models with FVS - Calibrating Natural and Anthropogenic Events in State and Transition Models with FVS: A case study for ponderosa pine forest ecosystems. (One of 16 papers in the regional white paper series titled “The R3 FVS Process for Evaluating the Effects of Vegetation Management Activities in the Forest Plan Revision Process”). USDA Forest Service, Southwestern Region, Regional Office. Albuquerque, NM. Interoffice publication.

White, A.S. (1985). Presettlement Regeneration Patterns in a Southwestern Ponderosa Pine Stand. *Ecology* 66: 589–594.

WSDNR. (2005). Definition and Inventory of Old Growth Forests on DNR-Managed State Lands. Washington State Department of Natural Resources technical report. Olympia, WA. 74 pp.

Appendix C. Communications Sites

The table below displays the designated communications and electronic sites to be administered per Forest Service Manual direction. Most are for Forest Service administration. Future development at all sites should adhere to direction in the "Land Management Plan for the Apache-Sitgreaves National Forests." FSH 2709.11 Chapter 90 provides guidance for communications site management, including definitions of low and high power.

Table 15. Communications sites on the Apache-Sitgreaves National Forests

Site Name	Administrative	Commercial	Low Power (LP) or High Power (HP)
Apache National Forest			
Alpine Heliport	X		LP
Alpine Ranger Station	X		LP
Bear Mountain Lookout	X		LP
Big Lake Lookout and Visitor Center	X		LP
Blue Lookout	X		LP
Escudilla Lookout	X		LP
Nutrioso Communication Site		X	LP
Granville	X		LP
Green's Peak Lookout	X	X	LP
Hannagan Helibase	X		LP
MCI		X	LP
Mitchell Peak	X		LP
P.S. Knoll Lookout	X		LP
Reno Lookout	X		LP
Rose Peak Lookout	X		LP
Sizer Knoll		X	LP
South Mountain	X	X	LP
Springerville Ranger Station	X		LP
Strayhorse	X		LP
Trail Cabin	X		LP
Water Canyon Admin. Site	X		LP
Sitgreaves National Forest			
Brookbank	X	X	LP
Chevelon Butte	X		LP
Chevelon Work Center	X		LP
Deer Springs Lookout	X		LP
Dutch Joe Lookout	X		LP
Gentry Lookout	X		LP
Heber Ranger Station	X		LP

Site Name	Administrative	Commercial	Low Power (LP) or High Power (HP)
Heber Sub-Station	X		LP
Juniper Ridge Lookout	X		LP
Lake Mountain Lookout	X		LP
Lakeside Ranger Station	X		LP
Long Hollow		X	LP
O'Haco Lookout	X		LP
Pinedale Work Center	X		LP
Porter Mountain	X	X	LP, HP[a]
Promontory Lookout	X		LP
Springer Mountain Lookout	X		LP

[a] See the special uses section (guidelines) for additional direction about the high power site at Porter Mountain.