

SETTING THE STAGE FOR DESIRED CONDITION DIALOGUE

DESIRED CONDITION WORK SHOP

PURPOSE OF WORKSHOP

Initiate a Desired Condition dialogue related to ponderosa pine and dry mixed conifer forest types to guide landscape-scale restoration and inform Forest Plan revision in Region 3.

OBJECTIVES OF WORKSHOP

1. Begin a dialogue about desired conditions for Forest vegetation types
2. Share the Forest Service's Desired Condition perspective
 - a. Share the current Desired Conditions for ponderosa pine and dry mixed conifer.
 - b. Explain why they are important to our landscape scale restoration efforts.
3. Present a clear picture of Desired Conditions and gain a common understanding through field visits that illustrate Desired Conditions, function, and processes.
4. Hear social and scientific perspectives about desired conditions from others interested parties.
5. Explain how the Desired Conditions will be used in Forest Plan revision, and landscape and small scale project development.
6. Explain how the Desired Conditions can be used as a measure of success.

OVERVIEW OF DESIRED CONDITION

The desired conditions describe tree species compositions, densities, structural and age-class distributions, as well as spatial distribution of trees. Specific to some of the forest types (ponderosa pine and dry mixed conifer), the composition, location, and amount of grass/forb/shrub openings (the degree of openness) is described, as are the dimensions, spatial distributions, amounts and densities of snags, down logs, woody debris, and various natural processes such as nutrient cycling, trophic interactions, fire, insect, and diseases. Because the desired conditions incorporated forest dynamics – the spatial and temporal changes resulting from vegetation growth and succession and periodic resetting of these by natural and human-caused disturbances such as fire, wind, insects, diseases, and tree harvests – they describe forest and woodlands as shifting mosaics of different vegetation structural (age) classes and/or successional stages. This dynamic is described at three spatial scales (fine scale, mid-scale and landscape scale) and incorporate six forest ages classes (seedling, saplings, young, mid-aged, mature, and old forest). Refer to Tables 1 and 2 for comparisons of current and desired forest conditions for ponderosa pine and dry mixed conifer by characteristic and function.

SCIENTIFIC BASIS OF DESIRED CONDITION

The process used to develop the desired conditions involved syntheses of scientific information on habitats of native plants and animals, their food webs, the ecologies of the dominant over story and understory vegetation and the types, frequencies, and intensities of natural and anthropogenic disturbances typical of the forest types. As a result of (1) the synthetic process used to develop the desired conditions, (2) the breadth of ecological knowledge on the composition, structure, and ecological function included in the syntheses, and (3) the incorporation of natural disturbances that shaped the historic conditions within ecosystems, the desired conditions fall within the range of natural conditions of each forest type. This suggests that the desired conditions are both attainable and sustainable. Natural conditions provide a good estimate of a functioning and sustainable system and are a powerful basis for evaluating desired condition.

BENEFITS OF DESIRED CONDITION

Desired conditions describe the characteristics necessary to restore and sustain ecosystems including structure, composition, landscape patterns, and processes and provide for habitats of native wildlife species including the Mexican spotted owl and the northern goshawk. They promote ecosystem functionality, hydrological function, reduce fire hazard, and provide for abundant and well-distributed old growth as a sustainable forest component.

RELATIONSHIP BETWEEN FOREST PLANS AND DESIRED CONDITION

Desired conditions are the foundation of current Forest Plan development. They describe the goals and outcomes of forest management and ecological, social, and economic attributes that a forest can achieve over time. Desired conditions guide the development of future projects and activities and establish a means for determining the consistency of projects with Forest Plans. Desired conditions, together with the other Plan components, constitute a framework for sustainability and should clearly articulate management intent over the life of the Plan.

ADAPTIVE NATURE OF DESIRED CONDITION

Desired conditions are a work in progress and will change over time as new scientific information is developed and as we adapt them to new monitoring information from ongoing efforts such as the Four Forest Restoration Initiative.

DESIRED CONDITION EXPRESSED AS A RANGE ACROSS THE REGION

Desired condition characteristics are expressed in ranges, as opposed to traditional target metrics, to account for natural variation in composition and structure that occurs within a

vegetation type as well as for social and economic considerations. Desired conditions will vary somewhat within a vegetation type due to spatial variability in soils, elevation, or aspect.

Table 1: Comparison of Current and Desired Condition by Forest Characteristic (Ponderosa Pine and Dry Mixed Conifer Forest Types)		
Characteristic	Current condition	Desired condition
Species composition	<p><u>PP type</u>: ponderosa pine and other minor species, little if any oak and other shade intolerant species</p> <p><u>Dry MC type</u>: species composition shifting towards shade-tolerant species (white-fir, blue spruce). Shade intolerant species becoming sub-dominant.</p>	<p><u>PP type</u>: ponderosa pine is dominant, but other shade intolerant species are present depending on appropriate local site conditions (ie: juniper species, oak and other hardwood species)</p> <p><u>Dry MC type</u>: dominated by shade intolerant species (ponderosa pine, Douglas-fir, white pine, aspen), other species present but are sub-dominant</p>
Forest tree density	Most sites > 80 sq ft of ba/acre	<p><u>PP type</u>: 20-80 sq ft of ba/acre</p> <p><u>Dry MC type</u>: 40-125 sq ft of ba/acre</p>
Spatial distribution	Typically even to random spacing, little in the way of tree groups	Groups of trees separated by forest openings
Forest openings occupied by grass/forb/shrub vegetation	Typically few openings with limited grass/forb/shrub vegetation	Openings are generally from 30% to 60% of the area occupied by grass/forb/shrub veg: 10% and 70% representing the extremes
Tree ages	Primarily single- and two- aged forests = even-aged	All ages present, young, mid and old = uneven-aged
Habitats, biodiversity and food webs	Typically little biodiversity, primarily conifer tree cover, limited understory herbaceous/shrub composition due to closed canopy	Much greater biodiversity, multiple tree species; oak, aspen, and other hardwoods and broad number of herbaceous grass/forb/shrub species due to openings
Snags/acre, down woody material	Typically < 2/acre, generally greater than 7 tons per acre	<p>1-2 Snags/Acre 18 inches DBH</p> <p><u>PP type</u>: 3-7 tons per acre</p> <p><u>Dry MC type</u>: 5-15 tons per acre</p>

Note we are not likely to achieve desired condition in one treatment. It may take many years or even decades depending on how departed current condition is from desired.

Table 2: Comparison of Current and Desired Condition by Forest Function (Ponderosa Pine)		
Characteristic	Current Condition	Desired Condition
Fire Behavior/frequency and effects Surface fire, Crown fire potential passive and active	Fires infrequent become uncharacteristic resulting in active crown fire on a large scale (high mortality): limited nutrient cycling	Fires frequent, primarily surface fire, do not spread between tree groups as crown fire (low mortality): promotes nutrient cycling
Hydrologic function	Typically little precipitation penetration of closed canopy, most lost to evaporation and transpiration	Precipitation reaching the forest floor, improved infiltration, surface flow, soil moisture, herbaceous cover.
Visual attributes	Limited visual diversity due to dense even-aged continuous tree stands, limited viewing opportunities.	Improved visual diversity due to openness between the groups of trees. Greater variety due to tree age diversity and density variation
Sustainability and resilience	Limited resilience to insects, diseases, uncharacteristic fire, climate variability, change, and other stressors. Not sustainable over time	Increased resilience to insects, diseases, uncharacteristic fire, and climate variability, change and other stressors. Sustainable over time.

ATTACHMENT A

Ponderosa Pine Forest Desired Conditions

General Description

The ponderosa pine forest vegetation community includes two sub-types: Ponderosa pine bunchgrass and ponderosa pine Gambel oak. The ponderosa pine forest vegetation community generally occurs at elevations ranging from approximately 5,000 to 9,000 feet. It is dominated by ponderosa pine and commonly includes other species such as oak, juniper, and pinyon. More infrequently species such as aspen, Douglas-fir, white fir, and blue spruce may also be present, and may occur as individual trees.

This forest vegetation community typically occurs with an understory of grasses and forbs although it sometimes includes shrubs.

Landscape Scale Desired Conditions (an assemblage of mid-scale units)

At the landscape scale, the ponderosa pine forest vegetation community is composed of trees from structural stages ranging from young to old. Old growth is well distributed in the landscape and occurs as groups of old trees mixed with groups of younger trees, or occasionally as larger groups comprised of mostly old trees. The forest contains various stages of development (even temporary openings or groups of very young trees) to provide future old growth groups within the landscape. Forest appearance is variable but generally uneven-aged and open; occasional areas of even-aged structure are present. The forest arrangement is in individual trees, small clumps, and groups of trees interspersed within variably-sized openings of grass/forbs/shrubs vegetation associations similar to historic patterns.

Openings typically range from 10 percent in more productive sites to 70 percent in the less productive sites. Size, shape, number of trees per group, and number of groups per area are variable across the landscape. In the Gambel oak sub-type, all sizes and ages of oak trees are present. Denser tree conditions exist in some locations such as north facing slopes and canyon bottoms.

The ponderosa pine forest vegetation community is composed predominantly of vigorous trees, but declining trees are a component and provide for snags, top-killed, lightning- and fire-scarred trees, and coarse woody debris (>3 inch diameter), all well-distributed throughout the landscape. Ponderosa pine snags are typically 18 inches or greater at DBH and average 1 to 2 snags per acre. In the Gambel oak subtype, large oak snags (>10 inches) are a well-distributed component. Downed logs (>12 inch 5 diameter at mid-point, >8 feet long) average 3 logs per acre within the forested area of the landscape.

Coarse woody debris, including downed logs, ranges from 3 to 10 tons per acre. The composition, structure, and function of vegetative conditions are resilient to the frequency, extent and severity of disturbances and climate variability. The landscape is a functioning ecosystem that contains all its components, processes, and conditions that result from

endemic levels of disturbances (e.g. insects, diseases, fire, and wind), including snags, downed logs, and old trees. Grasses, forbs, shrubs, and needle cast (fine fuels), and small trees maintain the natural fire regime. Organic ground cover and herbaceous vegetation provide protection of soil, moisture infiltration, and contribute to plant and animal diversity and to ecosystem function. Frequent, low severity fires (Fire Regime I) are characteristic in this type, including throughout goshawk home ranges. Natural and anthropogenic disturbances are sufficient to maintain desired overall tree density, structure, species composition, coarse woody debris, and nutrient cycling.

Mid-Scale Desired Conditions (an assemblage 'of fine scale units)

At the mid-scale the ponderosa pine forest vegetation community is characterized by variation in the size and number of tree groups depending on elevation, soil type, aspect, and site productivity. The more biologically productive sites contain more trees per group and more groups per area, resulting in less space between groups. Openings typically range from 10 percent in more productive sites to 70 percent in the less productive sites. Tree density within forested areas generally ranges from 20 to 80 square foot basal area per acre.

The mosaic of tree groups generally comprises an uneven-aged forest with all age classes present. Infrequently patches of even-aged forest structure are present. Disturbances sustain the overall age and structural distribution.

Fires burn primarily on the forest floor and do not spread between tree groups as crown fire.

Forest structure in the wild land urban interface (WUI)¹ can have smaller, more widely spaced groups of trees than in the non-WUI areas.

Forest conditions in goshawk post-fledging family areas (PFAs) are similar to general forest conditions except these forests contain 10 to 20 percent higher basal area in mid-aged to old tree groups than in goshawk foraging areas and the general forest. Goshawk nest areas have forest conditions that are multi-aged but are dominated by large trees with relatively denser canopies than other areas in the ponderosa pine type.

Fine Scale Desired Conditions (up to 10 acres)

Trees typically occur in irregularly shaped groups and are variably-spaced with some tight clumps.

Crowns of trees within the mid-aged to old groups are interlocking or nearly interlocking. Openings surrounding tree groups are variably-shaped and comprised of a grass/forb/shrub mix. Some openings contain individual trees. Trees within groups are of similar or variable ages and may contain species other than ponderosa pine. Size of tree groups typically is less than 1 acre, but averages .5 acres. Groups at the mid-aged to old stages consist of 2 to approximately 40 trees per group.

¹ Note – each Forest needs to provide the definition for WUI that they are using.

See photos below.



Photo 1: All tree ages represented; old growth as groups of old trees mixed with groups of younger trees. (ponderosa pine)



Photo 2: A group of old trees made up of two clumps; trees are variably spaced within the group and have interlocking crowns (ponderosa pine)

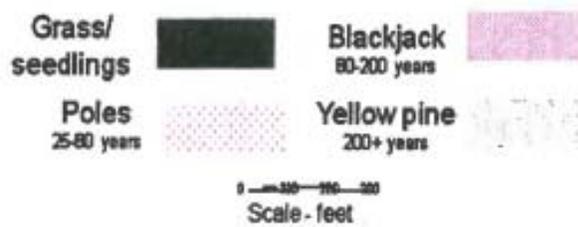
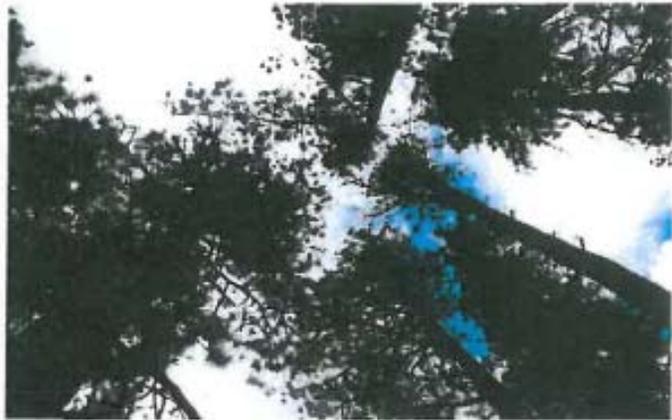
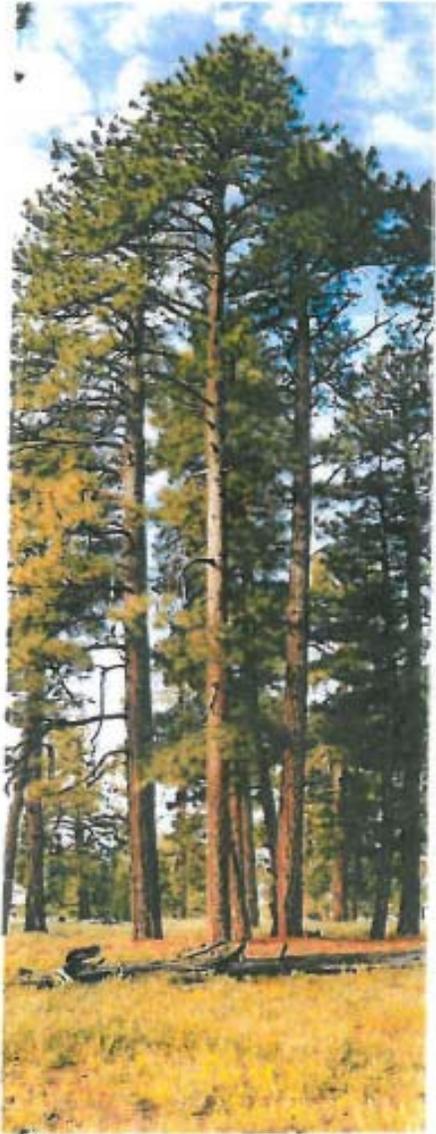


Figure 1: Gus Pearson Natural Area: Historic condition.

Mosaic of tree ages across the landscape with a well developed grass forb/shrub component and variable tree group sizes and spacing. All tree ages present. (ponderosa pine)



Photos 3 and 4: Interlocking or nearly interlocking crowns in groups of mid-age to old trees (ponderosa pine)

Dry Mixed-Conifer (Frequent-fire) Forests Desired Conditions

General Description

The dry mixed-conifer forest vegetation community is transitional with increasing elevation between ponderosa pine and wet mixed-conifer forests and generally occurs at elevations ranging from approximately 5,500 to 9,500 feet, depending upon aspect. It is very common for dry mixed-conifer forest types to occupy the north-facing slopes, and ponderosa pine forests the south-facing slopes at the lower elevations of the range. At the upper elevations of the range, this is often reversed, with dry mixed-conifer forests occupying south slopes, while wetter mixed conifer types are found on the north-facing slopes. Dry mixed-conifer forests are dominated by mainly shade intolerant trees such as ponderosa pine, southwestern white pine, limber pine, quaking aspen, and Gambel oak, with a lesser presence of shade tolerant species such as white fir and blue spruce. Mid-tolerant species such as Douglas-fir are common. Aspen may occur as individual trees or small groups, but typically does not form a seral forest cover type. This forest vegetation community typically occurs with open grass-forb-shrub interspaces.

Landscape-scale conditions (10,000 + acres)

At the landscape scale, the dry mixed-conifer vegetation community is a mosaic of forest conditions composed of structural stages ranging from young to old trees. Forest appearance is variable but generally uneven-aged and open; occasional patches of even-aged structure are present. The forest arrangement is in small clumps and groups of trees interspersed within variably-sized open grass-forb-shrub interspaces similar to historic patterns. Openings typically range from 10 percent in more productive sites to 50 percent in the less productive sites. Size, shape, number of trees per group, and number of groups per area are variable across the landscape. Where they naturally occur, groups of aspen and all structural stages of oak are present. Denser tree conditions exist in some locations such as north facing slopes and canyon bottoms.

Old growth occurs throughout the landscape, generally in small areas as individual old growth components, or as clumps of old growth. Old growth components include old trees, dead trees (snags), downed wood (coarse woody debris) and structural diversity. The location of old growth shifts on the landscape over time as a result of succession and disturbance (tree growth and mortality).

The dry mixed-conifer forest vegetation community is composed predominantly of vigorous trees, but declining trees are a component and provide for snags, top-killed, lightning- and fire-scarred trees, and coarse woody debris (>3 inch diameter), all well-distributed throughout the landscape. Snags are typically 18 inches or greater at DBH and average 3 per acre. Downed logs (>12 inch diameter at mid-point, >8 feet long) average 3 per acre within the forested area of the landscape. Coarse woody debris, including downed logs, ranges from 8 to 16 tons per acre.

The composition, structure, and function of vegetative conditions are resilient to the frequency, extent, severity of disturbances, and to climate variability. The landscape is a

functioning ecosystem that contains all its components, processes, and conditions that result from endemic levels of disturbances (e.g. insects, diseases, fire, and wind), including snags, downed logs, and old trees. Grasses, forbs, shrubs, needle cast (fine fuels), and small trees maintain the natural fire regime. Organic ground cover and herbaceous vegetation provide protection of soil, moisture infiltration, and contribute to plant and animal diversity and to ecosystem function. Frequent, low severity fires (Fire Regime I) are characteristic, including throughout goshawk home ranges. Natural and anthropogenic disturbances are sufficient to maintain desired overall tree density, structure, species composition, coarse woody debris, and nutrient cycling.

Mid-scale conditions (100 -1,000 acres)

At the mid-scale the dry mixed conifer forest vegetation community is characterized by variation in the size and number of tree groups depending on elevation, soil type, aspect, and site productivity. The more biologically productive sites contain more trees per group and more groups per area. Openings typically range from 10 percent in more productive sites to 50 percent in the less productive sites. Tree density within forested areas generally ranges from 40 to 125 square foot basal area per acre.

The mosaic of tree groups generally comprises an uneven-aged forest with all age classes and structural stages. Occasionally small patches (generally less than 50 acres) of even-aged forest structure are present. Disturbances sustain the overall age and structural distribution.

Fires burn primarily on the forest floor and do not spread between tree groups as crown fire.

Fine-scale conditions (< 10acres)

Trees typically occur in irregularly shaped groups and are variably-spaced with some tight clumps. Crowns of trees within the mid-aged to old groups are interlocking or nearly interlocking. Openings surrounding tree groups are variably-shaped and comprised of open grass-forb-shrub interspaces. Some openings contain individual trees or snags. Trees within groups are of similar or variable ages and one or more species. Size of tree groups typically is less than 0.25 acre, but occasional patches may be 1 acre or greater). Groups at the mid-age to old stages consist of 2 to 70+ trees per group. A spectrum of group sizes is desired. Where the understory plant composition is dominated by grasses and forbs, fire severity is lesser and tree groups are smaller in size. Where the understory plant composition is dominated by shrubs, fire severity is greater and tree groups are larger in size.

Wet (Infrequent Fire) Mixed Conifer Forests

General Description

The Wet Mixed Conifer forest vegetation community generally occurs at elevations ranging from approximately 5,500 to 10,000 feet. Tree species composition varies depending on seral stage, elevation, and moisture availability. It can be composed of early and mid-seral species such as aspen, Douglas fir, New Mexico locust, southwestern white pine and limber pine, and late seral species such as maple, white fir and blue spruce. Ponderosa pine may be present in minor proportions. The absence of Engelmann spruce and/or corkbark fir distinguishes wet mixed conifer from the spruce-fir forest. Disturbances typically occur at two temporal and spatial scales; large scale infrequent disturbances (mostly fire) and small scale frequent disturbances (fire, insect, disease, wind). This forest has an understory of a wide variety of shrubs, grasses, and forbs depending on soil type, aspect, elevation, disturbance, and other factors.

Landscape Scale Desired Conditions:

The Wet Mixed Conifer forest vegetation community is a mosaic of structural and seral stages ranging from young trees through old. The landscape arrangement is an assemblage of variably-sized and aged groups and patches of trees and other vegetation associations similar to historic patterns. Tree groups and patches are comprised of variable species composition depending on forest seral stages. An approximate balance of seral stages is present across the landscape, each seral stage characterized by distinct dominant species composition and biophysical conditions. Old growth is well-distributed in the landscape. Canopies are generally more closed than in dry mixed conifer. An understory consisting of native grass, forbs, and/or shrubs is present.

The Wet Mixed Conifer forest vegetation community is composed predominantly of vigorous trees, but older declining trees are a component and provide for snags, top-killed, lightning- and fire-scarred trees, and coarse woody debris, all well-distributed throughout the landscape. Number of snags and the amount of downed logs (>12 inch diameter at mid-point, >8 feet long) and coarse woody debris (>3 inch diameter) vary by seral stage.

The composition, structure, and function of vegetative conditions are resilient to the frequency, extent and severity of disturbances and climate variability. The forest landscape is a functioning ecosystem that contains all its components, processes, and conditions that result from endemic levels of disturbances (e.g. insects, diseases, wind, and fire), including snags, downed logs, and old trees. Organic ground cover and herbaceous vegetation provide protection of soil, moisture infiltration, and contribute to plant and animal diversity and to ecosystem function. Mixed severity fire (Fire Regime III) is characteristic. High severity fires (Fire Regime IV & V) rarely occur. Natural and anthropogenic disturbances are sufficient to maintain desired overall tree density, structure, species composition, coarse woody debris, and nutrient cycling.

Mid-Scale Desired Conditions:

At the mid-scale, the size and number of groups and patches vary depending on disturbance, elevation, soil type, aspect, and site productivity. Patch sizes vary but are frequently in the hundreds of acres, with rare disturbances in the thousands of acres. Groups and patches of tens of acres or less are relatively common. A mosaic of groups and patches of trees, primarily even-aged, and variable in size, species composition, and age is present. Grass, forb, shrub openings created by disturbance, may comprise 10 to 100 percent of the mid-scale area depending on the disturbances and on time since disturbance. Aspen is occasionally present in large patches.

Density ranges from 20 to 180 square foot basal area per acre depending upon time since disturbance and seral stages of groups and patches. Snags 18 inches or greater at DBH range from 1 to 5 snags per acre, with the lower range of snags of this size associated with early seral stages and the upper range associated with late seral stages. Snag density in general (>8 inches DBH) averages 20 per acre. Coarse woody debris, including downed logs, vary by seral stage, with averages ranging from 5 to 20 tons per acre for early-seral stages; 20 to 40 tons per acre for mid-seral stages; and 35 tons per acre or greater for late-seral stages.

Mixed (Fire Regime III) and high (Fire Regime IV) severity fires and other disturbances maintain desired overall tree density, structure, species composition, coarse woody debris, and nutrient cycling. High severity fires generally do not exceed 1000 acre patches of mortality. Other smaller disturbances occur more frequently.

Forests in the wildland urban interface (WUI)² are dominated by early-seral fire-adapted species growing in an overall more open condition than the general forest. These conditions result in fires that burn primarily on the forest floor and rarely spread as crown fire.

Fine Scale Desired Conditions:

In mid-aged and older forests trees are typically variably-spaced with crowns interlocking (grouped and clumped trees) or nearly interlocking. Trees within groups can be of similar or variable species and ages. Small openings (gaps) are present as a result of disturbances.

² Note – each Forest needs to provide here the definition for WUI that they are using.

Desired Conditions Glossary

Age class is defined as trees that originated within a relatively distinct range of years. Typically the range of years is considered to fall within 20 percent of the average natural maturity (e.g. if 100 years is required to reach maturity, then there would be five 20-year age classes).

Basal area is the cross-sectional area at breast height (4.5 ft above the ground) of trees measured in square feet. Basal area is a way to measure how much of a site is occupied by trees. The cross-sectional area is determined by calculating the tree's radius from its diameter (diameter/2 = radius) and using the formula for the area of a circle ($n \times \text{radius}^2 = \text{cross-sectional area}$). Basal area per acre is the summation of the cross-sectional area of all trees in an acre or in a smaller plot used to estimate basal area per acre.

Diameter at root collar (defined below) is used to calculate the cross-sectional area of multi-stemmed trees such as juniper and oak.

Clump refers to a tight cluster of two or more trees of similar size originating from a common rooting ball. Trees within a clump typically lean away from each other when mature. A clump of trees can exist within a group of trees, but a stand-alone clump of trees can function as a tree group.

Coarse woody debris is woody material on the ground greater than three inches in diameter, including logs.

Declining refers to the senescent (aging) period in the lifespan of plants that includes the presence of dead and/or dying limbs, snag-tops, and other characteristics that indicate the later life-stages of vegetation.

Diameter at breast height (DBH) is the diameter of a tree typically measured at 4.5 feet above ground level.

Even-aged forests are forests that are comprised of one or two distinct age classes of trees. *Uneven-aged forests* are forests that are comprised of three or more distinct age classes of trees, either intimately mixed or in small groups.

Fire regime refers to the patterns of fire that occur over a long period of time across an appropriately scaled area (outlined in Table 1 below) and its immediate effects on the ecosystem in which it occurs. There are five fire regimes which are classified based on frequency (average number of years between fires) and severity (amount of replacement on the dominant overstory vegetation) of the fire. These five regimes are:

Fire regime I – 0 to 35 year frequency and low (surface fires most common, isolated torching can occur) to mixed severity (< 75% of dominant overstory vegetation replaced);

Fire regime II – 0 to 35 year frequency and high severity (> 75% of dominant overstory vegetation replaced);

Fire regime III – 35 to 100+ year frequency and mixed severity;

Fire regime IV – 35 to 100+ year frequency and high severity;

Fire regime V – 200+ year frequency and high severity

Table 1. Recommended scale of fires (in acres) by Fire Regime.

Natural Fire Regime Group	Terrain	
	flat to rolling	steep and dissected
I – 0 to 35 years, low/mixed	500 – 5,000	500 – 2,500
II – 0 to 35 years, replacement	500 – 10,000	500 – 5,000
III – 35 to 200 years, low/mixed	1,000 – 20,000	1,000 – 10,000
IV -35 to 200 years, replacement	20,000 – 500,000	20,000 – 250,000
V – 200 + years, replacement	300,000 – 500,000	200,000 – 300,000
V – 200 + years, any severity	1,000 – 20,000	1,000 – 10,000

From: Interagency Fire Regime Condition Class (FRCC) Guidebook, Version 1.3.0, June 2008

Food web is a set of interconnected food chains within an ecological community linked together to display a full model of all possible feeding relationships of organisms within an ecosystem.

Foraging areas are the areas that surround the PF As that goshawks use to hunt for prey. They are approximately 5,400 acres in size.

Group refers to an aggregation of two or more trees, typically with interlocking or nearly interlocking crowns at maturity, distinguished from other groups or trees. Groups are often delineated by openings. Size of tree groups is variable depending on forest type and site

conditions and can range from fractions of an acre (a two-tree group) (i.e. ponderosa pine, dry mixed conifer) to many acres (i.e. wet mixed conifer, spruce fir). Trees within groups are typically non-uniformly spaced, some of which may be tightly clumped.

Invasive species are species that are not native to the ecosystem being described. For all ecosystems, the desired condition is that invasive species are rarely present, or are present at levels that do not negatively influence ecosystem function.

Interspaces are areas not currently occupied by trees that occur between groups of trees or between individual trees (Fig. 9). They are generally composed of grass-forb-shrub communities, but could also be areas with rock or exposed mineral soil. Interspaces do not include natural meadows, grasslands, and other non-forested areas (i.e., inclusions in forested landscapes).

Matrix refers to the land cover occurring on greater than 50% of an area. In frequent-fire forests, grass-forb-shrub communities form the background matrix upon which tree groups and individual trees are spatially arranged. It is the most extensive and connected landscape element that plays the dominant role in landscape functioning. The expression of this matrix between tree groups and individual trees is referred to as interspace. The location of tree groups and individual trees on the matrix and the proportion of patches represented by the matrix will change over time due to disturbance.

Nest areas are the areas immediately around a nest that are used by northern goshawks in relation to courtship and breeding activities. They are approximately 30 acres in size and contain multiple groups of large, old trees with interlocking crowns.

Old growth in Southwestern ponderosa pine and dry mixed conifer is different than a traditional definition based on Northwestern temperate conifer forests. Due to differences among Southwest forest types and their natural disturbances, old growth forests can vary in tree size, age classes, presence and abundance of structural elements, stability, and presence of understory (Helms 1998). In frequent fire forest types (e.g. ponderosa pine, dry mixed conifer) old growth in the desired conditions is defined as groups of old trees interspersed with groups of younger trees, but sometimes as patches of old trees. In infrequent fire forest types (spruce-fir, wet mixed conifer), old growth can occur in large patches. Old growth forests typically support communities of plants and animals that associate with or require large old trees. A single old tree is not old growth. Although old trees must be present, "old" is a relative term that varies among species. An *old-growth patch* is a group of trees having similar characteristics and conditions. Old-growth patches may include trees of similar ages and sizes or combinations of ages and sizes, and variable amounts of dead and downed material, dead and spike top trees, but such patches are readily distinguished from adjacent patches having less of these characteristics.

Openings (open areas) are treeless -areas between single trees, groups of trees, or patches of trees that support grass, forb, shrub vegetation and on occasion, tree seedlings. Historically, many seedlings that established in openings between trees were killed by fire, a process that

maintained the natural openness of frequent-fire forest types. Openings in this context are distinct from natural meadows, savannahs, and grasslands.

Patches are areas larger than tree groups in which the vegetation composition and structure are relatively homogeneous. Patches can range in size up to 1,000 acres.

Post-fledging Family Areas (PFAs) are the areas that surround the nest areas. They represent an area of concentrated use by the goshawk family until the time the young are no longer dependent on adults for food. PFAs are approximately 420 acres in size.

Resilience is used to infer the capacity of a system to absorb disturbance and reorganize while undergoing change so as to retain essentially the same function, structure, identity, and feedbacks

(Walker et al. 2004). Forest types are subject to different disturbance regimes that vary in severity, extent, and frequency, therefore the capacity for resilience is displayed through responses consistent with that disturbance regime.

Snags are standing dead or partially dead trees (snag-topped), often missing many or all limbs.

They provide essential wildlife habitat for many species and are important for forest ecosystem function.

Tree (crown) cover is the area covered by the vertically projected tree crowns to the ground, for both single trees and grouped trees.