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Stereo Photo Series for Quantifying Natural Fuels

Volume X: Sagebrush With Grass and Ponderosa Pine-Juniper Types in Central Montana

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ABSTRACT

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Two series of single and stereo photographs display a range of natural conditions and fuel loadings in sagebrush with grass and ponderosa pine-juniper types in central Montana. Each group of photos includes inventory information summarizing vegetation composition, structure, and loading; woody material loading and density by size class; forest floor depth and loading; and various site characteristics. The natural fuels photo series is designed to help land managers appraise fuel and vegetation conditions in natural settings.

Keywords: Woody material, biomass, fuel loading, natural fuels, Missouri Breaks, mixed-conifer, ponderosa pine, *Pinus ponderosa*, creeping juniper, *Juniperus horizontalis*, Rocky Mountain juniper, *Juniperus scopulorum*, Douglas-fir, *Pseudotsuga menziesii*, mountain big sagebrush, *Artemisia tridentata* ssp. *vaseyana*, Wyoming big sagebrush, *Artemisia tridentata* ssp. *wyomingensis*.

COOPERATORS

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WHAT IS THE NATURAL FUELS PHOTO SERIES?

The first phase of the natural fuels photo series was a collection of six volumes, each representing a region of the United States. Additional phases of the natural fuels photo series included new volumes (Volumes VII, VIII, IX, and Hawaii) and supplemental volumes (Volumes IIa, Va, and VIa). Volume I included sites in mixed-conifer, western juniper, sagebrush, and grassland ecosystems in the interior Pacific Northwest. Volume II included sites in black and white spruce ecosystems in Alaska, and volume IIa included sites in hardwood ecosystems undergoing succession to spruce. Volume III included sites in lodgepole pine, quaking aspen, and gambel oak ecosystems in the Rocky Mountains. Volume IV included sites in pinyon-juniper, sagebrush, and chaparral ecosystems in the Southwest. Volume V included sites in red and white pine, northern tallgrass prairie, and mixed oak ecosystems in the Midwest, and volume Va included sites in jack pine ecosystems. Volume VI included sites in longleaf pine, pocosin, and marsh grass ecosystems in the Southeast, and volume VIa included sites in sand hill, sand pine scrub, and white pine-invaded hardwood ecosystems. Volume VII included sites in Oregon white oak, California deciduous oak, and mixed-conifer with shrub ecosystems in Washington, Oregon, and California. Volume VIII included sites in hardwood, pitch pine, and red spruce/balsam fir ecosystems in the Northeast. Volume IX included sites in oak-juniper ecosystems in southern Arizona and New Mexico. An unnumbered volume included grassland, shrubland, woodland, and forest ecosystems in Hawaii.

Generally, sites include wide-angle and stereo-pair photographs supplemented with information on living and dead fuels, vegetation, and stand structure and composition within the area visible in the photographs (fig. 1). This volume (Volume X) continues the natural fuels photo series and includes sites in sagebrush with grass, and ponderosa pine-juniper ecosystems in central Montana. The sites in this volume provide a basis for appraising and describing woody material, vegetation, and stand conditions in many sagebrush with grass and ponderosa pine-juniper ecosystems throughout Montana.

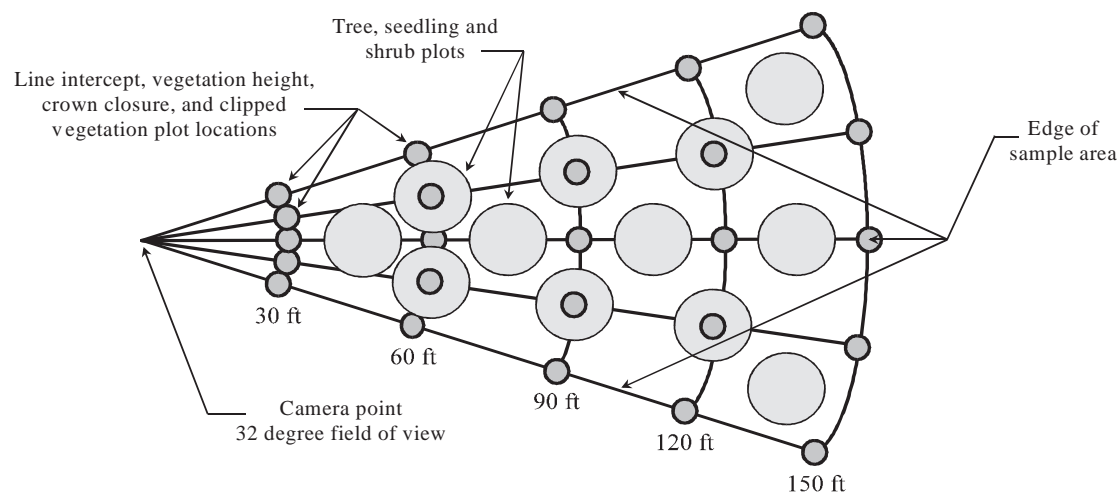


Figure 1--Photo series sample area layout. Forty random azimuth line transects (one at each point on the 30- and 150-foot arcs, and two at each point on the 60-, 90-, and 120-foot arcs) and 12 clipped vegetation plots (two to three per arc) were located within the sample area. Trees, shrubs, and seedlings were inventoried on 12 systematically located sample plots.

WHY IS THE PHOTO SERIES NEEDED?

These photo series are land management tools that can be used to assess landscapes through appraisal of living and dead woody material and vegetation (i.e., fuels) and stand characteristics. Once an assessment has been completed, stand treatment options, such as prescribed fire or harvesting, can be planned and implemented to better achieve desired effects while minimizing negative impacts on other resources.

The photo series has application in several branches of natural resource science and management. Inventory data such as these can be used as inputs for evaluating animal and insect habitat, nutrient cycling, and microclimate, for example. Fire managers will find these data useful for predicting fuel consumption, smoke production, fire behavior, and fire effects during wildfires and prescribed fires. In addition, the photo series can be used to appraise carbon sequestration, an important factor in predictions of future climate, and to link remotely sensed signatures to live and dead fuels on the ground.

Ground inventory procedures that directly measure site conditions (e.g., fuel loading and arrangement, vegetation structure and composition, etc.) exist for most ecosystem types and are useful when a high degree of accuracy is required. Ground inventory is time consuming and expensive, however. Photo series can be used to make quick, easy, and inexpensive determinations of fuel quantities and stand conditions when less precise estimates are acceptable.

HOW WAS THE PHOTO SERIES DEVELOPED?

Sites photographed for the series in this volume were selected to represent a range of conditions in sagebrush with grass and ponderosa pine-juniper forest ecosystems in the Missouri Breaks region of central Montana. The sagebrush with grass sites represent a range of shrub coverage, species composition, and shrub size conditions and are ordered by total aboveground biomass. The ponderosa pine-juniper sites show a range of woodland and forested stand conditions and are ordered by tree density. Photographs were taken, and fuel loading, stand structure, and composition data were collected by using the procedures of Maxwell and Ward (1980) as a guide.

PHOTOGRAPHS

Stereo-pair photographs are included in this guide. The three-dimensional image obtained by viewing the photographs with a stereoscope will improve the ability of the land manager to appraise natural fuel, vegetation, and stand structure conditions. A larger wide-angle photograph has been included for additional comparisons. The marker in these photographs is a 1-foot square, and the pole is painted in contrasting colors at 1-foot intervals to provide scale. The pole is 30 feet from the camera. The summary data relate to the field of view of the stereo-pair photographs but are based on measurements taken in the sample area only (see fig. 1). No sampling occurs in the foreground between the camera and the sign.

PHOTOGRAPH AND INFORMATION ARRANGEMENT

The photographs and accompanying data summaries are presented as single sites organized into two series. Each site is arranged to occupy two facing pages. The upper page contains a wide-angle (50mm) photograph and general site and stand information. For the ponderosa pine-juniper series, the upper page includes information on understory vegetation and dead and down woody material loading and density by size class. The lower page

includes the stereo-pair photographs and summaries of the overstory tree, sapling, and shrub structure and composition. The sagebrush with grass series also includes vegetation, litter, and woody material loading by size class. The ponderosa pine-juniper series also includes forest floor information along with juniper biomass and structure information.

SITE AND STAND INFORMATION

The camera point of each site was located with a global positioning system receiver using the WGS-84 datum. Aspect and slope were measured with a compass and clinometer, respectively. Ecological community classification (to the association level; NatureServe 2006), an indicator of current vegetation composition, was assigned for all sites. In addition, Society of American Foresters (SAF; Eyre 1980) and Society for Range Management (SRM; Shiflet 1994) cover type, indicators of current vegetation composition were assigned for all ponderosa pine-juniper and sagebrush with grass sites, respectively. Shrub, forb, and graminoid species coverage along with mineral soil exposure, was estimated by using line intercept transects (Canfield 1941). The listing of understory species was not meant to be a complete vegetation inventory and may represent only a portion of the actual species richness of the sampled areas.

For the ponderosa pine-juniper series, tree and seedling species present at a site are listed in order of abundance. Crown closure was measured with a forest densitometer (95 systematically located points). Tree and seedling composition and density were determined either by a total inventory of the sample area, or estimated by using twelve 0.005-acre circular plots; all trees less than 4.5 feet tall were considered seedlings.

UNDERSTORY VEGETATION

Graminoid and forb heights were measured at 25 points located systematically throughout the sample area; shrub height was calculated as an average of all shrubs measured in 12 systematically located 0.005-acre circular plots. Understory vegetation biomass was determined by sampling 12 square, clipped vegetation plots (10.76 square feet each) located systematically throughout the sample area (fig. 1). All live and dead understory vegetation (except *Juniperus* spp.) within each square plot were clipped at ground level, separated, and returned to the laboratory for oven drying. Understory vegetation and other collected material was oven dried at a minimum of 158 °F for at least 48 hours before weighing and determination of area loading. Where present, *Prunus virginiana* was considered a shrub and measured in twelve 0.005-acre circular plots; biomass was calculated from a growth-form-based allometric equation (tall shrubs; Brown 1976).

FOREST FLOOR INFORMATION

For the ponderosa pine-juniper series, litter and duff depth were calculated as the average of measurements taken every 5 feet between the 30- and 150-foot arcs of the three center transects for a total of 75 measurements (fig. 1). The depth of the litter and duff was calculated as an average of the depth only where litter or duff was encountered during sampling (null values, or points where litter or duff were absent, are not included in the average). Therefore, the depths reported for litter and duff are not unit-wide averages, and do not necessarily sum to total depth. Loading was calculated from depth and bulk density values derived from field measurements or through collection of material in twelve 10.76-square-foot plots.¹ Constancy, an indicator of how consistently the various forest floor components occur in the sample area, is expressed as a percentage of

¹ Forest floor bulk density values used for each material type appear under “Notes to Users” for each series.

the total number of measurements. The amount of exposed mineral soil at each site for the ponderosa pine-juniper series can be estimated by subtracting the constancy of the total forest floor from 100 percent. For the sagebrush with grass series, litter loading was determined through collection of material in twelve 10.76-square-foot plots.

SELECTED SHRUB AND TREE SPECIES

For the sagebrush with grass series, individual plants of selected shrub and tree species were measured in circular plots or, if shrub density was low, in the entire sample area. Selected tree and shrub species included *Pseudotsuga menziesii*, *Juniperus scopulorum*, *Artemisia tridentata*, and *Sarcobatus vermiculatus*. The density and percentage of all stems that were dead is based on the number of plants rooted in circular plots ranging from 0.0001-acre to 0.005-acre each (or in the entire sample area if shrub density was low). Crown area was calculated from crown breadth (i.e., the average of the maximum crown diameter, and the widest point perpendicular to the maximum crown diameter). Basal diameter was measured above the root collar. Height is given as the average and maximum height of all sampled individuals of a given species. Cover was estimated by using line intercept transects (Canfield 1941). *Pseudotsuga menziesii* biomass was estimated by using species-specific allometric equations (Brown 1978) and includes the mass of foliage and branches less than 3 inches diameter. Shrub biomass was determined by sampling 12 square clipped vegetation plots located systematically throughout the sample area.

WOODY MATERIAL

Measurement techniques used for inventorying dead and down woody material were patterned after the planar intersect method outlined by Brown (1974) and described by Maxwell and Ward (1980). Forty transects of random azimuth starting at 25 systematically located points within the sample area were used to determine woody material loading and density (fig. 1). Woody material data are reported by size classes that correspond to timelag fuel classes used in fire behavior modeling (see, for example, Burgan and Rothermel 1984).² Woody material in 10-hour, and 100-hour-and-larger size classes was tallied on transects that were 10 feet and 30 feet long, respectively. The decay class and the actual diameter at the point of intersection were measured for all pieces >3 inches in diameter. All woody material less than or equal to 3 inches in diameter was considered sound. Woody material loading and woody material density were calculated from relationships that use number of pieces intersected and transect length (and wood specific gravity for loading) developed by Brown (1974) and Safranyik and Linton (1987), respectively. Woody material loading in the 1-hour size class (and the 10-hour and 100-hour size classes for many of the sites) was determined by collecting, oven drying, and weighing all pieces in twelve 10.76-square-foot plots. When woody material >3 inches in diameter was scarce, a total inventory within the sample area was conducted to determine loading and density estimates. Measurements were taken to determine log volume, and wood specific gravities were applied to the volume to calculate loading.

SAPLINGS AND TREES

Overstory tree and sapling composition and density were determined either by a total inventory of the sample area, or were estimated by using twelve 0.005-acre circular plots located systematically throughout the sample area (fig. 1). Tree measurement data were summarized by diameter

² 1-, 10-, 100- and 1,000-hour timelag fuels are defined as woody material ≤ 0.25 inch, 0.26-1.0 inch, 1.1-3.0 inches, and >3.0 inches in diameter, respectively.

at breast height (d.b.h.)³ size class and by tree status (live, dead, or all trees). The two most abundant tree species for each size class are listed with their relative density. Height to crown base (reported as ladder fuel height in previous photo series volumes) was defined as the height of the lowest, continuous live or dead branch material of the tree canopy, and height to live crown was defined as the height of the lowest continuous live branches of the tree canopy. Live crown mass (branchwood and foliage) was calculated from species- and size-specific allometric equations (Brown 1978, Jenkins et al. 2003). *Juniperus scopulorum* with a single-stemmed form was considered a tree.

JUNIPER BIOMASS

Juniperus scopulorum and *J. horizontalis* in the Missouri Breaks region of central Montana have a diverse morphology, from prostrate shrub to tree form, and are reported to hybridize (Fassett 1944, 1945), making them difficult to identify to the species level. Therefore, all juniper with a multi-stemmed form were combined, regardless of species, and characterized by height class to distinguish between the low stature juniper form (≤ 3 feet tall) and the more upright form (> 3 feet tall). Biomass was collected in six systematically located 10.76-square-foot plots for each height class represented at each site. All juniper vegetation that occupied the space defined by a vertical projection of the plot edges was clipped, separated into live and dead components, and weighed. A subsample of plots was further separated into size classes including foliage and live and dead fine twigs less than or equal to 0.25 inch, 0.26- to 1.0-inch twigs, and greater than 1.0 inch diameter stem and branch material. Biomass for each height class was calculated by multiplying the square footage occupied by each size/status class and the average loading per square foot for that size/status class for each site.

USING THE PHOTO SERIES

The natural fuels photo series is a tool for quickly and inexpensively evaluating a variety of fuel and vegetation conditions. Because of its ease of use, however, care must be taken when evaluating field sites to compare only with photo series sites that are appropriate matches. It is acceptable, however, to use the data from more than one site from the photo series when evaluating a site in the field (e.g., woody material loading from one site in the photo series and tree density from another site in the photo series to best match the conditions of a given field site).

Make a visual inventory of the site by observing fuel and stand conditions within the field of view and comparing them with the stereo-pair photographs as follows, remembering that the data tables relate to the area behind the sign in the stereo-pair photographs:

- Observe each fuel and vegetation characteristic (e.g., 1.0- to 3.0-inch woody material loading).
- Select a photo series site (or sites) that nearly matches (or brackets) the observed characteristics.
- Obtain the quantitative value for the characteristic being estimated from the data summary accompanying the selected photo series site, or interpolate a value between sites.
- Repeat these steps for each size class or stand characteristic of interest.

The total biomass or stand condition can then be calculated by summing the estimates. If a site being inventoried has areas with obvious differences in woody material or stand conditions, the user should make separate determinations for each area and then weight and cumulate the loading for the whole site.

³ D.b.h. is measured 4.5 feet above the ground.

Characteristics not distinguishable in the photographs are forest floor depth, loading, and bulk density, and proportions of sound and rotten woody material. If values for these characteristics are desired in the inventory, they must be derived from independent sampling or observations.

The 20 National Fire-Danger Rating System fuel models (Burgan 1988, Deeming et al. 1977) and the 13 original (Albini 1976) or 40 new (Scott and Burgan 2005) fire behavior fuel models are general and broadly applied. Each photo series encompasses a wider range of conditions, and individual sites represent fuel characteristics at greater resolution than can be gained by using fuel models; consequently, we chose not to assign one of these existing fuel models to individual sites in this photo series. The photo series was designed to provide sufficient fuel and vegetation data from which managers could generate their own customized fuel models.

METRIC CONVERSIONS

1 inch (in) = 2.54 centimeters	1 pound (lb) = 0.4536 kilogram	1 ton/acre = 0.2242 kilogram/square meter
1 foot (ft) = 0.3048 meter	1 ton = 907.2 kilograms	1 ton/acre = 2241.7023 kilograms/hectare
1 square foot = 0.0929 square meter	(Degrees Fahrenheit - 32) × (5/9) = Degrees Celsius	1 ton·acre ⁻¹ ·inch ⁻¹ = 8.8256 kilograms/cubic meter
1 acre (ac) = 4046.9 square meters	1 pound/acre (lb/ac) = 1.1209 kilograms/hectare	1 ton·acre ⁻¹ ·inch ⁻¹ = 8825.6 grams/cubic meter
1 acre = 0.4047 hectare	1 pound/acre = 1.1209 E-04 kilograms/square meter	1 ton·acre ⁻¹ ·inch ⁻¹ = 8.8256E-03 grams/cubic centimeter

SPECIES LIST

Scientific and common species names are from NRCS (2006).

SCIENTIFIC NAME

COMMON NAME

TREES:

<i>Juniperus scopulorum</i> Sarg.	Rocky Mountain juniper
<i>Pinus ponderosa</i> P. & C. Lawson var. <i>scopulorum</i> Englem.	Interior ponderosa pine
<i>Prunus virginiana</i> L.	Chokecherry
<i>Pseudotsuga menziesii</i> (Mirb.) Franco var. <i>glauca</i> (Beissn.) Franco	Rocky Mountain Douglas-fir

SHRUBS:

<i>Artemisia tridentata</i> Nutt. ssp. <i>vaseyana</i> (Rydb.) Beetle	Mountain big sagebrush
<i>Artemisia tridentata</i> Nutt. ssp. <i>wyomingensis</i> Beetle & Young	Wyoming big sagebrush
<i>Chrysothamnus</i> spp. Nutt.	Rabbitbrush
<i>Juniperus</i> spp.	Juniper
<i>Juniperus horizontalis</i> Moench	Creeping juniper
<i>Potentilla</i> spp.	Cinquefoil
<i>Rhus trilobata</i> Nutt.	Skunkbush sumac
<i>Ribes</i> spp.	Currant
<i>Rosa woodsii</i> Lindl.	Wood's rose
<i>Sarcobatus vermiculatus</i> (Hook.) Torr.	Greasewood
<i>Symphoricarpos albus</i> (L.) Blake	Common snowberry

GRAMINOIDS:

<i>Bouteloua gracilis</i> (Willd. ex Kunth) Lag. ex Griffith	Blue grama
<i>Bromus japonicus</i> Thunb. ex Murr.	Japanese brome
<i>Carex</i> spp.	Sedge
<i>Elymus lanceolatus</i> (Scribn. & J.G. Sm.) Gould	Thickspike wheatgrass
<i>Festuca idahoensis</i> Elmer	Idaho fescue
<i>Koeleria macrantha</i> (Ledeb.) J.A. Schultes	Prairie junegrass
<i>Muhlenbergia</i> spp.	Muhly
<i>Nassella viridula</i> (Trin.) Barkworth	Green needlegrass
<i>Pascopyrum smithii</i> (Rydb.) A Love	Western wheatgrass
<i>Poa secunda</i> J. Presl	Sandberg bluegrass
<i>Pseudoroegneria spicata</i> (Pursh) A. Love	Bluebunch wheatgrass

SCIENTIFIC NAME

COMMON NAME

FORBS:

<i>Achillea millefolium</i> L.	Common yarrow
<i>Allium</i> spp.	Onion
<i>Antennaria</i> spp.	Pussytoes
<i>Arabis</i> spp.	Rockcress
<i>Artemisia ludoviciana</i> Nutt.	White sagebrush
<i>Aster</i> spp.	Aster
<i>Chenopodium</i> spp.	Goosefoot
<i>Cirsium</i> spp.	Thistle
<i>Collomia linearis</i> Nutt.	Tiny trumpet
<i>Comandra umbellata</i> (L.) Nutt.	Bastard toadflax
<i>Fragaria</i> spp.	Strawberry
<i>Fragaria vesca</i> L.	Woodland strawberry
<i>Geum triflorum</i> (Pursh)	Old man's whiskers or prairie smoke
<i>Halogeton glomeratus</i> (Bieb.) C.A. Mey.	Saltlover
<i>Helianthus</i> L.	Sunflower
<i>Lactuca</i> L.	Lettuce
<i>Lepidium</i> spp.	Pepperweed
<i>Lupinus</i> spp.	Lupine
<i>Medicago sativa</i> L.	Alfalfa
<i>Melilotus officinalis</i> (L.) Lam	Yellow sweetclover
<i>Opuntia polycantha</i> Haw.	Plains pricklypear
<i>Psoralea</i> spp.	Scurfpea
<i>Ratibida columnifera</i> (Nutt.) Woot. & Standl.	Upright prairie coneflower
<i>Sisymbrium</i> spp.	Hedgemustard
<i>Solidago</i> spp.	Goldenrod
<i>Solidago velutina</i> DC.	Threenerve goldenrod
<i>Sphaeralcea coccinea</i> (Nutt.) Rydb.	Scarlet globemallow
<i>Taraxacum officinale</i> G.H. Weber ex Wiggers	Common dandelion
<i>Thermopsis montana</i> Nutt.	Mountain goldenbanner
<i>Thlaspi arvense</i> L.	Field pennycress
<i>Tragopogon dubius</i> Scop.	Yellow salsify
<i>Trifolium</i> spp.	Clover
<i>Vicia americana</i> Muhl. ex Willd.	American vetch

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**SAGEBRUSH WITH GRASS
PHOTO SERIES**

A SERIES OF 11 SITES
SG 01 THROUGH SG 11

NOTES TO USERS:

1. Sites in the sagebrush with grass series are arranged in order of increasing total aboveground biomass
2. A list of scientific and common species names can be found on page 8.
3. Photographs were taken in July 2003, 2004, and 2005. Sampling was performed in July and August 2003, 2004, and August 2005.
4. The marker in these photographs is a 1-foot square, and the pole is painted in contrasting colors at 1-foot intervals. The pole is 30 feet from the camera.
5. Forest floor and woody material loading, and understory biomass are reported in tons per acre. The designation of “na” indicates cases where data are missing or “not available.”
6. Although this series predominantly covers *Artemisia tridentata* (big sagebrush) with grass types, two sites (SG02, SG07) are dominated by *Sarcobatus vermiculatus* (greasewood).

SG 01 SAGEBRUSH WITH GRASS

12



SITE INFORMATION

Site location: N 47° 32' 16.8" W 108° 52' 41.7"
Elevation: 2,996 ft Aspect: -- Slope: 0%

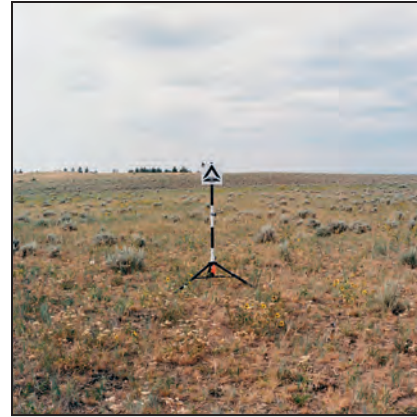
Association: Wyoming big sagebrush / western
wheatgrass shrub herbaceous vegetation

SRM cover type: Sagebrush-grass

Species (% cover): *Poa secunda* (7), *Artemisia tridentata*
ssp. *wyomingensis* (2), *Pascopyrum smithii* (2), *Vicia*
americana (1), *Achillea millefolium* (1), *Sphaeralcea*
coccinea (1), *Nasella viridula* (1), *Helianthus* spp. (1),
Lepidium spp. (t), *Comandra umbellata* (t), *Opuntia*
polycantha (t), *Medicago sativa* (t), *Halogeton*
glomeratus (t), *Collomia linearis* (t), *Allium* spp. (t)

Exposed mineral soil (coverage): 58%

Total aboveground biomass: 0.53 tons/ac



SELECTED SHRUB AND TREE SPECIES

	Density (plants/ac)	Dead (% of plants)	Avg crown breadth (ft)	Avg crown area (ft ²)	Avg basal diameter (in)	Avg height (ft)	Max height (ft)	Coverage (percentage)	Biomass (tons/ac)
<i>Artemisia tridentata</i> ssp. <i>wyomingensis</i>	1,105	2	1.1	1.3	1.1	0.9	1.6	2	0.23

VEGETATION

	Lifeform		
	Shrub	Forb	Graminoid
Coverage (percent)	2	5	10
Avg height (ft)	0.9	0.5	0.5
Live biomass (tons/ac)	0.19	--	--
Dead biomass (tons/ac)	0.04	--	--
Total biomass (tons/ac)	0.23	0.05	0.11

LITTER AND WOODY MATERIAL

Diameter (in)	Loading (tons/ac)
	Total
Litter	0.04
≤ 0.25	0.02
0.26 - 1.0	0.08
1.1 - 3.0	0.00
Total	0.14

SG 02 SAGEBRUSH WITH GRASS

14



SITE INFORMATION

Site location: N 47° 37' 43.5" W 108° 37' 33.5"
Elevation: 2,293 ft Aspect: -- Slope: 0%

Association: Black greasewood / western wheatgrass
shrub herbaceous vegetation

SRM cover type: Sagebrush-grass

Species (% cover): *Sarcobatus vermiculatus* (18),
Muhlenbergia spp. (5), *Pascopyrum smithii* (5),
Opuntia polycantha (3), *Sisymbrium* spp. (1),
Artemisia tridentata ssp. *wyomingensis* (t),
Pseudoroegneria spicata (t), *Bromus japonicus* (t)

Exposed mineral soil (coverage): 61%

Total aboveground biomass: 1.29 tons/ac



SELECTED SHRUB AND TREE SPECIES

	Density (plants/ac)	Dead (% of plants)	Avg crown breadth (ft)	Avg crown area (ft ²)	Avg basal diameter (in)	Avg height (ft)	Max height (ft)	Coverage (percentage)	Biomass (tons/ac)
<i>Sarcobatus vermiculatus</i>	3,907	0	1.9	3.7	na	1.8	3.4	18	0.75

VEGETATION

	Lifeform		
	Shrub	Forb	Graminoid
Coverage (percent)	19	1	16
Avg height (ft)	1.8	0.7	1.1
Live biomass (tons/ac)	--	--	--
Dead biomass (tons/ac)	--	--	--
Total biomass (tons/ac)	0.75	0.01	0.13

LITTER AND WOODY MATERIAL

Diameter (in)	Loading (tons/ac)
	Total
Litter	0.02
≤ 0.25	0.19
0.26 - 1.0	0.19
1.1 - 3.0	0.00
Total	0.40

SG 03 SAGEBRUSH WITH GRASS

16



SITE INFORMATION

Site location: N 47° 32' 16.5" W 108° 52' 41.6"
Elevation: 3,017 ft Aspect: -- Slope: 0%

Association: Wyoming big sagebrush / western
wheatgrass shrub herbaceous vegetation

SRM cover type: Sagebrush-grass

Species (% cover): *Artemisia tridentata* ssp.
wyomingensis (24), *Poa secunda* (3), *Pascopyrum*
smithii (2), *Vicia americana* (1), *Nassella viridula* (1),
Opuntia polycantha (t), *Collomia linearis* (t), *Bromus*
japonicus (t), *Sphaeralcea coccinea* (t), *Medicago*
sativa (t), *Commandra umbellata* (t), *Allium* spp. (t)

Exposed mineral soil (coverage): 32%

Total aboveground biomass: 1.93 tons/ac



SELECTED SHRUB AND TREE SPECIES

	Density (plants/ac)	Dead (% of plants)	Avg crown breadth (ft)	Avg crown area (ft ²)	Avg basal diameter (in)	Avg height (ft)	Max height (ft)	Coverage (percentage)	Biomass (tons/ac)
<i>Artemisia tridentata</i> ssp. <i>wyomingensis</i>	4,075	5	0.7	0.5	1.1	0.7	1.8	24	1.55

VEGETATION

	Lifeform		
	Shrub	Forb	Graminoid
Coverage (percent)	24	1	6
Avg height (ft)	0.7	0.4	0.4
Live biomass (tons/ac)	1.10	--	--
Dead biomass (tons/ac)	0.45	--	--
Total biomass (tons/ac)	1.55	0.02	0.08

LITTER AND WOODY MATERIAL

Diameter (in)	Loading (tons/ac)
	Total
Litter	0.06
≤ 0.25	0.11
0.26 - 1.0	0.11
1.1 - 3.0	0.00
Total	0.28

SG 04 SAGEBRUSH WITH GRASS

18



SITE INFORMATION

Site location: N 47° 38' 09.2" W 108° 40' 01.8"
Elevation: 2,791 ft Aspect: SW Slope: 5%

Association: Wyoming big sagebrush / western
wheatgrass shrub herbaceous vegetation

SRM cover type: Sagebrush-grass

Species (% cover): *Pseudoroegneria spicata* (28),
Melilotus officinalis (10), *Bromus japonicus* (6),
Pascopyrum smithii (5), *Sarcobatus vermiculatus* (3),
Vicia americana (3), *Artemisia tridentata* ssp.
wyomingensis (2), *Carex* spp. (2), *Trifolium* spp. (2),
Achillea millefolium (2), *Nassella viridula* (1),
Opuntia polyacantha (1), *Sisymbrium* spp. (1),
Thermopsis montana (1), *Koeleria macrantha* (1),
Muhlenbergia spp. (1), *Rhus trilobata* (1),
Taraxacum officinale (t)

Exposed mineral soil (coverage): 4%

Total aboveground biomass: 2.24 tons/ac



SELECTED SHRUB AND TREE SPECIES

	Density (plants/ac)	Dead (% of plants)	Avg crown breadth (ft)	Avg crown area (ft ²)	Avg basal diameter (in)	Avg height (ft)	Max height (ft)	Coverage (percentage)	Biomass (tons/ac)
<i>Artemisia tridentata</i> ssp. <i>wyomingensis</i>	491	4	1.7	3.3	1.4	1.7	3.7	2	0.20
<i>Juniperus scopulorum</i>	51	0	4.9	5.3	3.2*	8.7	13	3	0.98

*Diameter at breast height

VEGETATION

	Lifeform		
	Shrub	Forb	Graminoid
Coverage (percent)	8	19	74
Avg height (ft)	1.6	1.4	1.2
Live biomass (tons/ac)	--	--	--
Dead biomass (tons/ac)	--	--	--
Total biomass (tons/ac)	0.30	0.07	0.66

LITTER AND WOODY MATERIAL

Diameter (in)	Loading (tons/ac)
	Total
Litter	0.19
≤ 0.25	0.01
0.26 - 1.0	0.03
1.1 - 3.0	0.00
Total	0.23

SG 05 SAGEBRUSH WITH GRASS

20



SITE INFORMATION

Site location: N 47° 31' 45.6" W 108° 52' 33.2"
Elevation: 3,036 ft Aspect: -- Slope: 0%

Association: Wyoming big sagebrush / western
wheatgrass shrub herbaceous vegetation

SRM cover type: Sagebrush-grass

Species (% cover): *Artemisia tridentata* ssp.
wyomingensis (10), *Juniperus horizontalis* (6),
Elymus lanceolatus (3), *Pascopyrum smithii* (3),
Poa secunda (2), *Medicago sativa* (1), *Comandra*
umbellata (1), *Sphaeralcea coccinea* (1), *Vicia*
americana (1), *Allium* spp. (t), *Bromus japonicus* (t),
Halogeton glomeratus (t), *Opuntia polycantha* (t),
Collomia linearis (t)

Exposed mineral soil (coverage): 73%

Total aboveground biomass: 2.65 tons/ac



SELECTED SHRUB AND TREE SPECIES

	Density (plants/ac)	Dead (% of plants)	Avg crown breadth (ft)	Avg crown area (ft ²)	Avg basal diameter (in)	Avg height (ft)	Max height (ft)	Coverage (percentage)	Biomass (tons/ac)
<i>Artemisia tridentata</i> ssp. <i>wyomingensis</i>	23,775	28	0.8	0.6	0.9	0.6	1.5	10	1.67
<i>Juniperus horizontalis</i>	na	na	na	na	na	1.6	2.6	6	0.31

VEGETATION

	Lifeform		
	Shrub	Forb	Graminoid
Coverage (percent)	16	4	8
Avg height (ft)	0.6	0.3	0.6
Live biomass (tons/ac)	1.15	--	--
Dead biomass (tons/ac)	0.83	--	--
Total biomass (tons/ac)	1.98	0.02	0.18

LITTER AND WOODY MATERIAL

Diameter (in)	Loading (tons/ac)
	Total
Litter	0.08
≤ 0.25	0.14
0.26 - 1.0	0.25
1.1 - 3.0	0.00
Total	0.47

SG 06 SAGEBRUSH WITH GRASS

22



SITE INFORMATION

Site location: N 47° 33' 01.4" W 108° 49' 48.3"
Elevation: 2,840 ft Aspect: NW Slope: 13%

Association: Wyoming big sagebrush / western
wheatgrass shrub herbaceous vegetation

SRM cover type: Sagebrush-grass

Species (% cover): *Artemisia tridentata* ssp.
wyomingensis (21), *Pseudoroegneria spicata* (na),
Pascopyrum smithii (na), *Poa secunda* (na), *Bromus*
japonicus (na), *Opuntia polycantha* (t), *Achillea*
millefolium (na), *Vicia americana* (na), *Collomia*
linearis (na), *Medicago sativa* (na), *Tragopogon*
dubius (na), *Sphaeralcea coccinea* (na)

Exposed mineral soil (coverage): 8%

Total aboveground biomass: 3.07 tons/ac



SELECTED SHRUB AND TREE SPECIES

	Density (plants/ac)	Dead (% of plants)	Avg crown breadth (ft)	Avg crown area (ft ²)	Avg basal diameter (in)	Avg height (ft)	Max height (ft)	Coverage (percentage)	Biomass (tons/ac)
<i>Artemisia tridentata</i> ssp. <i>wyomingensis</i>	6,776	14	1.2	1.3	1.2	1.2	2.4	21	1.72

VEGETATION

	Lifeform		
	Shrub	Forb	Graminoid
Coverage (percent)	21	2	8
Avg height (ft)	1.5	0.6	0.6
Live biomass (tons/ac)	1.23	--	--
Dead biomass (tons/ac)	0.49	--	--
Total biomass (tons/ac)	1.72	0.01	0.25

LITTER AND WOODY MATERIAL

Diameter (in)	Loading (tons/ac)
	Total
Litter	0.39
≤ 0.25	0.23
0.26 - 1.0	0.47
1.1 - 3.0	0.00
Total	1.09

SG 07 SAGEBRUSH WITH GRASS



SITE INFORMATION

Site location: N 47° 37' 47.5" W 108° 37' 23.6"
Elevation: 2,293 ft Aspect: -- Slope: 0%

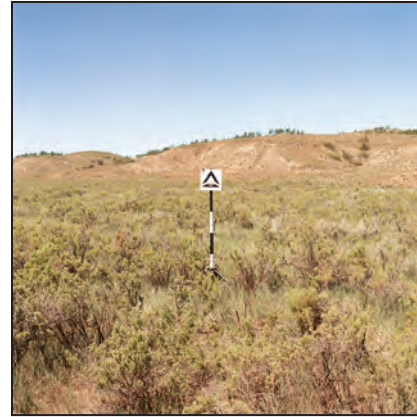
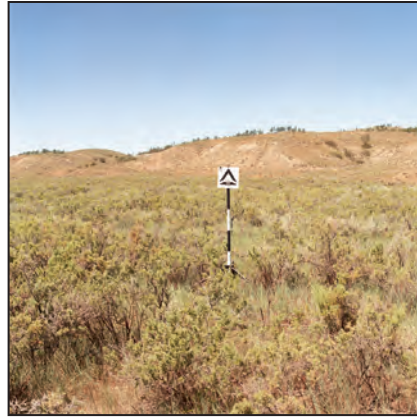
Association: Black greasewood / western wheatgrass
shrub herbaceous vegetation

SRM cover type: Sagebrush-grass

Species (% cover): *Pascopyrum smithii* (48),
Sarcobatus vermiculatus (20), *Artemisia tridentata*
ssp. *wyomingensis* (5), *Vicia americana* (2),
Sisymbrium spp. (1), *Achillea millefolium* (t), *Melilotus*
officinalis (t), *Trifolium* spp. (t), *Opuntia polycantha* (t),
Koeleria macrantha (t), *Pseudoroegneria spicata* (t)

Exposed mineral soil (coverage): 19%

Total aboveground biomass: 3.86 tons/ac



SELECTED SHRUB AND TREE SPECIES

	Density (plants/ac)	Dead (% of plants)	Avg crown breadth (ft)	Avg crown area (ft ²)	Avg basal diameter (in)	Avg height (ft)	Max height (ft)	Coverage (percentage)	Biomass (tons/ac)
<i>Artemisia tridentata</i> ssp. <i>wyomingensis</i>	1,694	0	1.3	1.7	na	1.7	2.9	5	0.54
<i>Sarcobatus vermiculatus</i>	3,840	1	1.8	3.0	na	2.2	3.9	20	2.10

VEGETATION

	Lifeform		
	Shrub	Forb	Graminoid
Coverage (percent)	25	5	49
Avg height (ft)	2.5	1.0	1.4
Live biomass (tons/ac)	--	--	--
Dead biomass (tons/ac)	--	--	--
Total biomass (tons/ac)	2.64	0.13	0.71

LITTER AND WOODY MATERIAL

Diameter (in)	Loading (tons/ac)
	Total
Litter	0.03
≤ 0.25	0.13
0.26 - 1.0	0.16
1.1 - 3.0	0.06
Total	0.38



SITE INFORMATION

Site location: N 47° 33' 00.6" W 108° 49' 46.5"
 Elevation: 2,870 ft Aspect: -- Slope: 2%

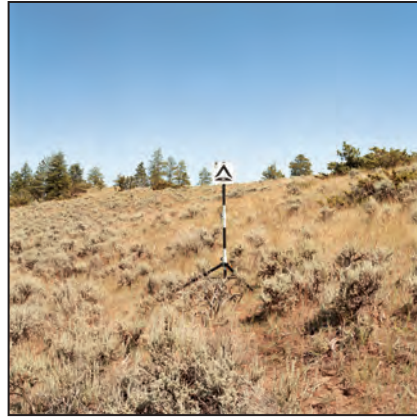
Association: Wyoming big sagebrush / western wheatgrass shrub herbaceous vegetation

SRM cover type: Sagebrush-grass

Species (% cover): *Pseudoroegneria spicata* (40), *Artemisia tridentata* ssp. *wyomingensis* (11), *Pascopyrum smithii* (8), *Juniperus horizontalis* (7), *Rosa woodsii* (3), *Bromus japonicus* (2), *Koeleria macrantha* (2), *Symphoricarpos albus* (2), *Achillea millifolium* (2), *Rhus trilobata* (2), *Melilotus officinalis* (1), *Solidago velutina* (t), *Taraxacum officinale* (t), *Sisymbrium* spp. (t)

Exposed mineral soil (coverage): 18%

Total aboveground biomass: 5.03 tons/ac



SELECTED SHRUB AND TREE SPECIES

	Density (plants/ac)	Dead (% of plants)	Avg crown breadth (ft)	Avg crown area (ft ²)	Avg basal diameter (in)	Avg height (ft)	Max height (ft)	Coverage (percentage)	Biomass (tons/ac)
<i>Artemisia tridentata</i> ssp. <i>wyomingensis</i>	2,516	1	1.3	1.7	na	1.3	2.7	11	0.73
<i>Juniperus horizontalis</i>	na	0	na	na	na	2.0	3.4	7	2.82

VEGETATION

	Lifeform		
	Shrub	Forb	Graminoid
Coverage (percent)	24	3	53
Avg height (ft)	1.1	0.4	0.9
Live biomass (tons/ac)	--	--	--
Dead biomass (tons/ac)	--	--	--
Total biomass (tons/ac)	3.78	0.01	0.14

LITTER AND WOODY MATERIAL

Diameter (in)	Loading (tons/ac)
	Total
Litter	0.23
≤ 0.25	0.26
0.26 - 1.0	0.25
1.1 - 3.0	0.36
Total	1.10

SG 09 SAGEBRUSH WITH GRASS

28



SITE INFORMATION

Site location: N 44° 54' 37.0" W 113° 21' 15.5"
Elevation: 7,560 ft Aspect: NNE Slope: 5%

Association: Mountain big sagebrush / western
wheatgrass shrubland

SRM cover type: Sagebrush-grass

Species (% cover): *Artemisia tridentata* ssp.
vaseyana (63), *Pseudotsuga menziesii* (1), *Festuca*
idahoensis (na), *Lupinus* spp. (na)

Exposed mineral soil (coverage): 6%

Total aboveground biomass: 5.35 tons/ac



SELECTED SHRUB AND TREE SPECIES

	Density (plants/ac)	Dead (% of plants)	Avg crown breadth (ft)	Avg crown area (ft ²)	Avg basal diameter (in)	Avg height (ft)	Max height (ft)	Coverage (percentage)	Biomass (tons/ac)
<i>Artemisia tridentata</i> ssp. <i>vaseyana</i>	12,660	8	1.9	3.2	1.3	2.0	2.6	63	3.21
<i>Pseudotsuga menziesii</i>	18	0	4.3	11.2	1.1*	6.6	9.0	1	0.07

*Diameter at breast height

VEGETATION

	Lifeform		
	Shrub	Forb	Graminoid
Coverage (percent)	63	6	37
Avg height (ft)	2.0	0.4	0.5
Live biomass (tons/ac)	2.08	--	--
Dead biomass (tons/ac)	1.13	--	--
Total biomass (tons/ac)	3.21	0.08	0.51

LITTER AND WOODY MATERIAL

Diameter (in)	Loading (tons/ac)
	Total
Litter	0.91
≤ 0.25	--*
0.26 - 1.0	0.50
1.1 - 3.0	0.07
Total	1.48

*Included with litter

SG 10 SAGEBRUSH WITH GRASS

30



SITE INFORMATION

Site location: N 44° 55' 01.0" W 113° 21' 01.9"
Elevation: 7,345 ft Aspect: NE Slope: 8%

Association: Mountain big sagebrush / western
wheatgrass shrubland

SRM cover type: Sagebrush-grass

Species (% cover): *Artemisia tridentata* ssp.
vaseyana (53), *Festuca idahoensis* (na),
Lupinus spp. (na)

Exposed mineral soil (coverage): 6%

Total aboveground biomass: 7.47 tons/ac



SELECTED SHRUB AND TREE SPECIES

	Density (plants/ac)	Dead (% of plants)	Avg crown breadth (ft)	Avg crown area (ft ²)	Avg basal diameter (in)	Avg height (ft)	Max height (ft)	Coverage (percentage)	Biomass (tons/ac)
<i>Artemisia tridentata</i> ssp. <i>vaseyana</i>	8,103	9	1.5	2.0	1.3	1.7	2.6	53	4.49

VEGETATION

	Lifeform		
	Shrub	Forb	Graminoid
Coverage (percent)	53	7	23
Avg height (ft)	1.7	0.3	0.5
Live biomass (tons/ac)	2.58	--	--
Dead biomass (tons/ac)	1.91	--	--
Total biomass (tons/ac)	4.49	0.11	0.15

LITTER AND WOODY MATERIAL

Diameter (in)	Loading (tons/ac)
	Total
Litter	2.18
≤ 0.25	--*
0.26 - 1.0	0.50
1.1 - 3.0	0.04
Total	2.72

* Included with litter

SG 11 SAGEBRUSH WITH GRASS

32



SITE INFORMATION

Site location: N 45° 18' 50.0" W 113° 01' 39.5"
Elevation: 7,440 ft Aspect: SE Slope: 5%

Association: Mountain big sagebrush / western
wheatgrass shrubland

SRM cover type: Sagebrush-grass

Species (% cover): *Artemisia tridentata* ssp.
vaseyana (66), *Festuca idahoensis* (na),
Carex spp. (na), *Lupinus* spp. (na)

Exposed mineral soil (coverage): 1%

Total aboveground biomass: 9.53 tons/ac



SELECTED SHRUB AND TREE SPECIES

	Density (plants/ac)	Dead (% of plants)	Avg crown breadth (ft)	Avg crown area (ft ²)	Avg basal diameter (in)	Avg height (ft)	Max height (ft)	Coverage (percentage)	Biomass (tons/ac)
<i>Artemisia tridentata</i> ssp. <i>vaseyana</i>	11,141	2	1.7	3.1	1.4	2.5	4.1	66	5.50

VEGETATION

	Lifeform		
	Shrub	Forb	Graminoid
Coverage (percent)	66	14	25
Avg height (ft)	2.5	0.6	0.4
Live biomass (tons/ac)	2.77	--	--
Dead biomass (tons/ac)	2.73	--	--
Total biomass (tons/ac)	5.50	0.15	0.18

LITTER AND WOODY MATERIAL

Diameter (in)	Loading (tons/ac)
	Total
Litter	2.59
≤ 0.25	--*
0.26 - 1.0	1.00
1.1 - 3.0	0.11
Total	3.70

* Included with litter

**PONDEROSA PINE-JUNIPER
PHOTO SERIES**

A SERIES OF 12 SITES
PPJ 01 THROUGH PPJ 12

NOTES TO USERS:

1. Sites are arranged in order of increasing density of trees >4 inches d.b.h.
2. A list of scientific and common species names can be found on page 8.
3. Photographs were taken in July 2003, 2004, and 2005. Sampling was performed in July and August 2003, 2004, and August 2005.
4. The marker in these photographs is a 1-foot square, and the pole is painted in contrasting colors at 1-foot intervals. The pole is 30 feet from the camera.
5. Bulk density values used for calculating forest floor loading from depth:

Material type	Litter bulk density	Duff bulk density
	<i>Tons·acre⁻¹·inch⁻¹</i>	<i>Tons·acre⁻¹·inch⁻¹</i>
Ponderosa pine	3.40	7.55
Juniper	4.98	12.01
Moss	2.84	12.10
Grass	0.30	6.39

6. Forest floor and woody material loading, and understory biomass are reported in tons per acre. The designation of “na” indicates cases where data are missing or “not available.”
7. A distinction is made between rotten and sound woody material for pieces larger than 3 inches in diameter.
8. Depth values reported for surface material, duff, and total forest floor are not unit-wide averages (null values, or points where litter or duff are absent, are not included in average), and, as such, the total forest floor depth is not the sum of surface material and duff depths.
9. Juniper biomass for each height class was calculated by multiplying the square footage occupied by each size/status class and the average loading per square foot.
10. Juniper biomass summarized in the sapling and tree table consists solely of the single stemmed form *Juniperus scopulorum*.
11. Juniper biomass summarized in the juniper shrub biomass table is assumed to consist of the multistemmed form *Juniperus horizontalis*. Loading values represent the total amount of material for plants in each height category (i.e., material from 0 to 3 ft above the ground is included in the value reported for the > 3-ft tall category).
12. Shrub biomass, coverage, and height summarized in the understory vegetation table consists of shrub species found at each site and includes *Juniperus horizontalis*.



SITE AND STAND INFORMATION

Site location: N 47° 31' 45.1" W 108° 52' 16.1"
 Elevation: 3,025 ft Aspect: N Slope: 5%

Association: Ponderosa pine/ Rocky Mountain juniper woodland

SAF cover type: Interior ponderosa pine

Trees (% of stems): *Pinus ponderosa* (100)
 Crown closure: 2%

Seedlings (% of stems): None
 Density: 0/ac

Understory (% cover): *Juniperus* spp. (36), *Nassella viridula* (6), *Artemisia tridentata* ssp. *wyomingensis* (2), *Pascopyrum smithii* (2), *Symphoricarpos albus* (2), *Rosa woodsii* (1), *Rhus trilobata* (1), *Ribes* spp. (1)

UNDERSTORY VEGETATION

	Lifeform		
	Graminoid	Forb	Shrub
Coverage (percentage)	10	1	43
Height (ft)	1.1	0.5	2.0
Biomass (tons/ac)	0.06	0.01	3.28

WOODY MATERIAL

Diameter (in)	Loading in tons/ac (density in pieces/ac)		
	Sound	Rotten	Total
≤ 0.25	0.31	--	0.31
0.26 - 1.0	0.37	--	0.37
1.1 - 3.0	0.00	--	0.00
> 3.0	0.00 (0)	0.00 (0)	0.00 (0)
Total	0.68	0.00	0.68



SAPLINGS AND TREES

	Size class (diameter at breast height)				
	Saplings (≤ 4 in)	4 - 9 in	9 - 16 in	> 16 in	> 4 in
Most common species (percentage of stems)	--	--	<i>Pinus ponderosa</i> (100)	--	<i>Pinus ponderosa</i> (100)
Second most common species (percentage of stems)	--	--	--	--	--
Tree density (stems/ac)	0	0	7	0	7
Live	0	0	7	0	7
Dead	0	0	0	0	0
Avg d.b.h. (in)	--	--	11.6	--	11.6
Live	--	--	11.6	--	11.6
Dead	--	--	--	--	--
Avg height (ft)	--	--	30.0	--	30.0
Live	--	--	30.0	--	30.0
Dead	--	--	--	--	--
Avg height to crown base (ft)	--	--	5.5	--	5.5
Live	--	--	5.5	--	5.5
Dead	--	--	--	--	--
Avg height to live crown (ft)	--	--	6.0	--	6.0
Live crown mass (tons/ac)	0.00	0.00	0.76	0.00	0.76

JUNIPER SHRUB BIOMASS

Loading (tons/ac)	Height of plants		
	≤ 3 ft tall	> 3 ft tall	All
Live: Foliage & ≤ 0.25 in	0.85	0.11	0.96
0.26 - 1.0 in	1.21	0.15	1.36
> 1.0 in	0.16	0.02	0.18
Subtotal	2.22	0.28	2.50
Dead: ≤ 0.25 in	0.06	0.01	0.07
0.26 - 1.0 in	0.28	0.04	0.32
> 1.0 in	0.00	0.00	0.00
Subtotal	0.34	0.05	0.39
All: ≤ 0.25 in	0.91	0.12	1.03
0.26 - 1.0 in	1.49	0.19	1.68
> 1.0 in	0.16	0.02	0.18
Grand total	2.56	0.33	2.89

FOREST FLOOR

	Depth (in)	Loading (tons/ac)	Constancy (%)
Litter	0.3	0.34	52
Duff	0.0	0.00	0
Total	0.3	0.34	52



SITE AND STAND INFORMATION

Site location: N 47° 31' 44.0" W 108° 52' 16.6"
 Elevation: 3,031 ft Aspect: N Slope: 1%

Association: Ponderosa pine / Rocky Mountain juniper woodland

SAF cover type: Interior ponderosa pine

Trees (% of stems): *Juniperus scopulorum* (94), *Pinus ponderosa* (6)
 Crown closure: 2%

Seedlings (% of stems): None
 Density: 0/ac

Understory (% cover): *Juniperus* spp. (15), *Pascopyrum smithii* (11), *Artemisia tridentata* ssp. *wyomingensis* (8), *Bromus japonicus* (2), *Medicago sativa* (2)

UNDERSTORY VEGETATION

	Lifeform		
	Graminoid	Forb	Shrub
Coverage (percentage)	15	4	23
Height (ft)	0.7	0.5	1.6
Biomass (tons/ac)	0.13	0.03	3.13

WOODY MATERIAL

Diameter (in)	Loading in tons/ac (density in pieces/ac)		
	Sound	Rotten	Total
≤ 0.25	0.11	--	0.11
0.26 - 1.0	0.09	--	0.09
1.1 - 3.0	0.00	--	0.00
> 3.0	0.00 (0)	0.00 (0)	0.00 (0)
Total	0.20	0.00	0.20



SAPLINGS AND TREES

	Size class (diameter at breast height)				
	Saplings (≤ 4 in)	4 - 9 in	9 - 16 in	> 16 in	> 4 in
Most common species (percentage of stems)	<i>Juniperus scopulorum</i> (100)	<i>Pinus ponderosa</i> (50)	--	--	<i>Pinus ponderosa</i> (50)
Second most common species (percentage of stems)	--	<i>Juniperus scopulorum</i> (50)	--	--	<i>Juniperus scopulorum</i> (50)
Tree density (stems/ac)	115	14	0	0	14
Live	72	14	0	0	14
Dead	43	0	0	0	0
Avg d.b.h. (in)	1.1	6.4	--	--	6.4
Live	1.1	6.4	--	--	6.4
Dead	1.2	--	--	--	--
Avg height (ft)	6.4	12.0	--	--	12.0
Live	6.7	12.0	--	--	12.0
Dead	5.8	--	--	--	--
Avg height to crown base (ft)	1.4	2.0	--	--	2.0
Live	0.9	2.0	--	--	2.0
Dead	2.4	--	--	--	--
Avg height to live crown (ft)	1.4	3.0	--	--	3.0
Live crown mass (tons/ac)	0.20	0.46	0.00	0.00	0.46

JUNIPER SHRUB BIOMASS

Loading (tons/ac)	Height of plants		
	≤ 3 ft tall	> 3 ft tall	All
Live: Foliage & ≤ 0.25 in	0.31	0.35	0.66
0.26 - 1.0 in	0.20	0.26	0.46
> 1.0 in	0.17	0.42	0.59
Subtotal	0.68	1.03	1.71
Dead: ≤ 0.25 in	0.09	0.11	0.20
0.26 - 1.0 in	0.10	0.05	0.15
> 1.0 in	0.00	0.09	0.09
Subtotal	0.19	0.25	0.44
All: ≤ 0.25 in	0.40	0.46	0.86
0.26 - 1.0 in	0.30	0.31	0.61
> 1.0 in	0.17	0.51	0.68
Grand total	0.87	1.28	2.15

FOREST FLOOR

	Depth (in)	Loading (tons/ac)	Constancy (%)
Litter	0.5	0.30	24
Duff	0.7	0.91	12
Total	0.9	1.21	25



SITE AND STAND INFORMATION

Site location: N 47° 31' 37.9" W 108° 52' 55.0"
 Elevation: 3,020 ft Aspect: NE Slope: < 5%

Association: Ponderosa pine / Rocky Mountain juniper woodland

SAF cover type: Interior ponderosa pine

Trees (% of stems): *Juniperus scopulorum* (87), *Pinus ponderosa* (13)
 Crown closure: 8%

Seedlings (% of stems): None
 Density: 0/ac

Understory (% cover): *Juniperus* spp. (72), *Rosa woodsii* (11), *Pascopyrum smithii* (3), *Rhus trilobata* (2), *Elymus lanceolatus* (2), *Collomia linearis* (1), *Ribes* spp. (1)

UNDERSTORY VEGETATION

	Lifeform		
	Graminoid	Forb	Shrub
Coverage (percentage)	6	5	87
Height (ft)	0.7	0.6	2.1
Biomass (tons/ac)	0.07	0.03	10.27

WOODY MATERIAL

Diameter (in)	Loading in tons/ac (density in pieces/ac)		
	Sound	Rotten	Total
≤ 0.25	0.28	--	0.28
0.26 - 1.0	0.63	--	0.63
1.1 - 3.0	0.00	--	0.00
> 3.0	0.00 (0)	0.00 (0)	0.00 (0)
Total	0.91	0.00	0.91



SAPLINGS AND TREES

	Size class (diameter at breast height)				
	Saplings (≤ 4 in)	4 - 9 in	9 - 16 in	> 16 in	> 4 in
Most common species (percentage of stems)	<i>Juniperus scopulorum</i> (96)	<i>Pinus ponderosa</i> (100)	<i>Pinus ponderosa</i> (100)	--	<i>Pinus ponderosa</i> (100)
Second most common species (percentage of stems)	<i>Pinus ponderosa</i> (4)	--	--	--	--
Tree density (stems/ac)	181	7	7	0	14
Live	181	7	7	0	14
Dead	0	0	0	0	0
Avg d.b.h. (in)	2.1	8.5	10.8	--	9.7
Live	2.1	8.5	10.8	--	9.7
Dead	--	--	--	--	--
Avg height (ft)	8.2	22.0	28.0	--	25.0
Live	8.2	22.0	28.0	--	25.0
Dead	--	--	--	--	--
Avg height to crown base (ft)	2.5	3.0	3.0	--	3.0
Live	2.5	3.0	3.0	--	3.0
Dead	--	--	--	--	--
Avg height to live crown (ft)	4.9	5.0	5.0	--	5.0
Live crown mass (tons/ac)	1.05	0.40	0.66	0.00	1.06

JUNIPER SHRUB BIOMASS

Loading (tons/ac)	Height of plants		
	≤ 3 ft tall	> 3 ft tall	All
Live: Foliage & ≤ 0.25 in	1.69	0.79	2.48
0.26 - 1.0 in	1.15	0.98	2.13
> 1.0 in	0.56	1.01	1.57
Subtotal	3.40	2.78	6.18
Dead: ≤ 0.25 in	1.07	0.65	1.72
0.26 - 1.0 in	0.92	0.67	1.59
> 1.0 in	0.00	0.61	0.61
Subtotal	1.99	1.93	3.92
All: ≤ 0.25 in	2.76	1.44	4.20
0.26 - 1.0 in	2.07	1.65	3.72
> 1.0 in	0.56	1.62	2.18
Grand total	5.39	4.71	10.10

FOREST FLOOR

	Depth (in)	Loading (tons/ac)	Constancy (%)
Litter	0.4	1.23	61
Duff	0.5	2.87	49
Total	0.6	4.10	84



SITE AND STAND INFORMATION

Site location: N 47° 31' 36.4" W 108° 52' 50.6"
 Elevation: 3,035 ft Aspect: N Slope: 9%

Association: Ponderosa pine / Rocky Mountain juniper woodland

SAF cover type: Interior ponderosa pine

Trees (% of stems): *Pinus ponderosa* (100)
 Crown closure: 10%

Seedlings (% of stems): None
 Density: 0/ac

Understory (% cover): *Juniperus* spp. (8), *Artemisia tridentata* ssp. *wyomingensis* (8), *Pascopyrum smithii* (4), *Nassella viridula* (4), *Poa secunda* (4), *Psoralea* spp. (1), *Achillea millefolium* (1)

UNDERSTORY VEGETATION

	Lifeform		
	Graminoid	Forb	Shrub
Coverage (percentage)	13	3	16
Height (ft)	0.6	0.6	0.8
Biomass (tons/ac)	0.18	0.01	2.11

WOODY MATERIAL

Diameter (in)	Loading in tons/ac (density in pieces/ac)		
	Sound	Rotten	Total
≤ 0.25	0.05	--	0.05
0.26 - 1.0	0.10	--	0.10
1.1 - 3.0	0.03	0.01	0.04
> 3.0	0.10 (14)	0.01 (7)	0.11 (21)
Total	0.28	0.02	0.30



SAPLINGS AND TREES

	Size class (diameter at breast height)				
	Saplings (≤ 4 in)	4 - 9 in	9 - 16 in	> 16 in	> 4 in
Most common species (percentage of stems)	<i>Pinus ponderosa</i> (100)	<i>Pinus ponderosa</i> (100)	<i>Pinus ponderosa</i> (100)	--	<i>Pinus ponderosa</i> (100)
Second most common species (percentage of stems)	--	--	--	--	--
Tree density (stems/ac)	7	36	14	0	50
Live	7	36	14	0	50
Dead	0	0	0	0	0
Avg d.b.h. (in)	1.3	6.4	11.3	--	7.8
Live	1.3	6.4	11.3	--	7.8
Dead	--	--	--	--	--
Avg height (ft)	7.0	21.2	27.5	--	23.0
Live	7.0	21.2	27.5	--	23.0
Dead	--	--	--	--	--
Avg height to crown base (ft)	3.0	4.0	6.0	--	4.6
Live	3.0	4.0	6.0	--	4.6
Dead	--	--	--	--	--
Avg height to live crown (ft)	3.0	5.0	6.0	--	5.3
Live crown mass (tons/ac)	0.01	1.14	1.44	0.00	2.58

JUNIPER SHRUB BIOMASS

Loading (tons/ac)	Height of plants		
	≤ 3 ft tall	> 3 ft tall	All
Live: Foliage & ≤ 0.25 in	0.36	0.00	0.36
0.26 - 1.0 in	0.22	0.00	0.22
> 1.0 in	0.02	0.00	0.02
Subtotal	0.60	0.00	0.60
Dead: ≤ 0.25 in	0.06	0.00	0.06
0.26 - 1.0 in	0.03	0.00	0.03
> 1.0 in	0.00	0.00	0.00
Subtotal	0.09	0.00	0.09
All: ≤ 0.25 in	0.42	0.00	0.42
0.26 - 1.0 in	0.25	0.00	0.25
> 1.0 in	0.02	0.00	0.02
Grand total	0.69	0.00	0.69

FOREST FLOOR

	Depth (in)	Loading (tons/ac)	Constancy (%)
Litter	na	0.06	na
Duff	--	0.00	0
Total	na	0.06	na

PPJ 05 PONDEROSA PINE - JUNIPER



SITE AND STAND INFORMATION

Site location: N 47° 31' 39.6" W 108° 52' 49.2"
 Elevation: 3,027 ft Aspect: W Slope: 5%

Association: Ponderosa pine / Rocky Mountain juniper woodland

SAF cover type: Interior ponderosa pine

Trees (% of stems): *Pinus ponderosa* (100)
 Crown closure: 37%

Seedlings (% of stems): None
 Density: 0/ac

Understory (% cover): *Juniperus* spp. (79), *Rosa woodsii* (13),
Symphoricarpos albus (6), *Carex* spp. (6), *Achillea millefolium* (2),
Ribes spp. (1), *Antennaria* spp. (1), *Artemisia tridentata* ssp. *wyomingensis* (1)

UNDERSTORY VEGETATION

	Lifeform		
	Graminoid	Forb	Shrub
Coverage (percentage)	10	5	99
Height (ft)	0.7	0.6	1.8
Biomass (tons/ac)	0.06	0.14	10.03

WOODY MATERIAL

Diameter (in)	Loading in tons/ac (density in pieces/ac)		
	Sound	Rotten	Total
≤ 0.25	0.05	--	0.05
0.26 - 1.0	0.15	--	0.15
1.1 - 3.0	0.16	--	0.16
> 3.0	0.00 (0)	0.00 (0)	0.00 (0)
Total	0.36	0.00	0.36



SAPLINGS AND TREES

	Size class (diameter at breast height)				
	Saplings (≤ 4 in)	4 - 9 in	9 - 16 in	> 16 in	> 4 in
Most common species (percentage of stems)	--	<i>Pinus ponderosa</i> (100)	<i>Pinus ponderosa</i> (100)	<i>Pinus ponderosa</i> (100)	<i>Pinus ponderosa</i> (100)
Second most common species (percentage of stems)	--	--	--	--	--
Tree density (stems/ac)	0	29	43	7	79
Live	0	29	43	7	79
Dead	0	0	0	0	0
Avg d.b.h. (in)	--	6.2	12.4	17.5	10.6
Live	--	6.2	12.4	17.5	10.6
Dead	--	--	--	--	--
Avg height (ft)	--	21.0	32.5	37.0	28.7
Live	--	21.0	32.5	37.0	28.7
Dead	--	--	--	--	--
Avg height to crown base (ft)	--	3.0	5.8	9.0	5.1
Live	--	3.0	5.8	9.0	5.1
Dead	--	--	--	--	--
Avg height to live crown (ft)	--	6.5	9.0	9.0	8.1
Live crown mass (tons/ac)	0.00	0.88	5.40	1.79	8.07

JUNIPER SHRUB BIOMASS

Loading (tons/ac)	Height of plants		
	≤ 3 ft tall	> 3 ft tall	All
Live: Foliage & ≤ 0.25 in	1.15	0.24	1.39
0.26 - 1.0 in	1.18	0.30	1.48
> 1.0 in	1.26	1.02	2.28
Subtotal	3.59	1.56	5.15
Dead: ≤ 0.25 in	0.59	0.38	0.97
0.26 - 1.0 in	1.76	1.16	2.92
> 1.0 in	0.55	0.34	0.89
Subtotal	2.90	1.88	4.78
All: ≤ 0.25 in	1.74	0.62	2.36
0.26 - 1.0 in	2.94	1.46	4.40
> 1.0 in	1.81	1.36	3.17
Grand total	6.49	3.44	9.93

FOREST FLOOR

	Depth (in)	Loading (tons/ac)	Constancy (%)
Litter	0.8	2.05	93
Duff	1.4	5.91	57
Total	1.6	7.96	93



SITE AND STAND INFORMATION

Site location: N 47° 33' 01.1" W 108° 49' 48.4"
 Elevation: 2,851 ft Aspect: N Slope: 18%

Association: Ponderosa pine / Rocky Mountain juniper woodland

SAF cover type: Interior ponderosa pine

Trees (% of stems): *Juniperus scopulorum* (81),
Pseudotsuga menziesii (13), *Pinus ponderosa* (6)
 Crown closure: 22%

Seedlings (% of stems): None
 Density: 0/ac

Understory (% cover): *Juniperus* spp. (87), *Pseudoroegneria spicata* (11), *Symphoricarpus albus* (6), *Rosa woodsii* (3), *Rhus trilobata* (2), *Solidago velutina* (1)

UNDERSTORY VEGETATION

	Lifeform		
	Graminoid	Forb	Shrub
Coverage (percentage)	13	1	98
Height (ft)	1.0	1.0	3.0
Biomass (tons/ac)	0.03	0.03	3.63

WOODY MATERIAL

Diameter (in)	Loading in tons/ac (density in pieces/ac)		
	Sound	Rotten	Total
≤ 0.25	0.39	--	0.39
0.26 - 1.0	0.18	--	0.18
1.1 - 3.0	0.09	--	0.09
> 3.0	0.85 (58)	0.39 (39)	1.24 (97)
Total	1.51	0.39	1.90



SAPLINGS AND TREES

	Size class (diameter at breast height)				
	Saplings (≤ 4 in)	4 - 9 in	9 - 16 in	> 16 in	> 4 in
Most common species (percentage of stems)	<i>Juniperus scopulorum</i> (92)	<i>Pseudotsuga menzeisii</i> (44)	--	--	<i>Pseudotsuga menzeisii</i> (44)
Second most common species (percentage of stems)	<i>Pseudotsuga menzeisii</i> (5)	<i>Juniperus scopulorum</i> (33)	--	--	<i>Juniperus scopulorum</i> (33)
Tree density (stems/ac)	637	151	0	0	151
Live	570	151	0	0	151
Dead	67	0	0	0	0
Avg d.b.h. (in)	1.9	6.4	--	--	6.4
Live	2.0	6.4	--	--	6.4
Dead	1.7	--	--	--	--
Avg height (ft)	9.6	20.0	--	--	20.0
Live	9.6	20.0	--	--	20.0
Dead	9.0	--	--	--	--
Avg height to crown base (ft)	0.3	0.6	--	--	0.6
Live	0.2	0.6	--	--	0.6
Dead	0.6	--	--	--	--
Avg height to live crown (ft)	1.3	2.1	--	--	2.1
Live crown mass (tons/ac)	3.15	4.32	0.00	0.00	4.32

JUNIPER SHRUB BIOMASS

Loading (tons/ac)	Height of plants		
	≤ 3 ft tall	> 3 ft tall	All
Live: Foliage & ≤ 0.25 in	0.94	0.44	1.38
0.26 - 1.0 in	0.84	0.34	1.18
> 1.0 in	0.50	0.07	0.57
Subtotal	2.28	0.85	3.13
Dead: ≤ 0.25 in	0.14	0.04	0.18
0.26 - 1.0 in	0.22	0.08	0.30
> 1.0 in	0.00	0.00	0.00
Subtotal	0.36	0.12	0.48
All: ≤ 0.25 in	1.08	0.48	1.56
0.26 - 1.0 in	1.06	0.42	1.48
> 1.0 in	0.50	0.07	0.57
Grand total	2.64	0.97	3.61

FOREST FLOOR

	Depth (in)	Loading (tons/ac)	Constancy (%)
Litter	0.5	1.61	89
Duff	0.6	2.49	40
Total	0.7	4.30	89

PPJ 07 PONDEROSA PINE - JUNIPER



SITE AND STAND INFORMATION

Site location: N 47° 35' 33.5" W 108° 42' 46.4"
 Elevation: 2,660 ft Aspect: NW Slope: 45%

Association: Ponderosa pine / Rocky Mountain juniper woodland

SAF cover type: Interior ponderosa pine

Trees (% of stems): *Pseudotsuga menziesii* (49), *Juniperus scopulorum* (48), *Pinus ponderosa* (3)
 Crown closure: 74%

Seedlings (% of stems): *Pseudotsuga menziesii* (91), *Juniperus* spp. (9)
 Density: 185/ac

Understory (% cover): *Prunus virginiana* (15), *Juniperus* spp. (3), *Achillea millefolium* (1)

UNDERSTORY VEGETATION

	Lifeform		
	Graminoid	Forb	Shrub
Coverage (percentage)	23	1	21
Height (ft)	0.5	0.5	3.1
Biomass (tons/ac)	0.04	<0.01	0.30

WOODY MATERIAL

Diameter (in)	Loading in tons/ac (density in pieces/ac)		
	Sound	Rotten	Total
≤ 0.25	0.29	--	0.29
0.26 - 1.0	0.86	--	0.86
1.1 - 3.0	0.65	--	0.65
> 3.0	0.33 (19)	0.49 (34)	0.82 (53)
Total	2.13	0.49	2.62



SAPLINGS AND TREES

	Size class (diameter at breast height)				
	Saplings (≤ 4 in)	4 - 9 in	9 - 16 in	> 16 in	> 4 in
Most common species (percentage of stems)	<i>Juniperus scopulorum</i> (57)	<i>Pseudotsuga menziesii</i> (83)	<i>Pinus ponderosa</i> (50)	--	<i>Pseudotsuga menziesii</i> (75)
Second most common species (percentage of stems)	<i>Pseudotsuga menziesii</i> (43)	<i>Juniperus scopulorum</i> (17)	<i>Pseudotsuga menziesii</i> (50)	--	<i>Pinus ponderosa</i> (13)
Tree density (stems/ac)	1,023	201	67	0	268
Live	704	201	67	0	268
Dead	319	0	0	0	0
Avg d.b.h. (in)	2.0	5.5	10.6	--	6.8
Live	2.0	5.5	10.6	--	6.8
Dead	1.9	--	--	--	--
Avg height (ft)	11.5	26.6	34.8	--	28.6
Live	12.4	26.6	34.8	--	28.6
Dead	9.5	--	--	--	--
Avg height to crown base (ft)	1.8	3.4	9.8	--	5.0
Live	1.7	3.4	9.8	--	5.0
Dead	2.2	--	--	--	--
Avg height to live crown (ft)	5.4	10.1	16.5	--	11.7
Live crown mass (tons/ac)	3.87	4.73	5.47	0.00	10.20

JUNIPER SHRUB BIOMASS

Loading (tons/ac)	Height of plants		
	≤ 3 ft tall	> 3 ft tall	All
Live: Foliage & ≤ 0.25 in	0.03	0.00	0.03
0.26 - 1.0 in	0.01	0.00	0.01
> 1.0 in	0.00	0.00	0.00
Subtotal	0.04	0.00	0.04
Dead: ≤ 0.25 in	0.01	0.00	0.01
0.26 - 1.0 in	0.00	0.00	0.00
> 1.0 in	0.00	0.00	0.00
Subtotal	0.01	0.00	0.01
All: ≤ 0.25 in	0.04	0.00	0.04
0.26 - 1.0 in	0.01	0.00	0.01
> 1.0 in	0.00	0.00	0.00
Grand total	0.05	0.00	0.05

FOREST FLOOR

	Depth (in)	Loading (tons/ac)	Constancy (%)
Litter	0.5	1.75	95
Duff	0.9	6.68	76
Total	1.2	8.43	95



SITE AND STAND INFORMATION

Site location: N 47° 06' 58.0" W 108° 35' 43.9"
 Elevation: 3,206 ft Aspect: SE Slope: 5%

Association: Ponderosa pine / Rocky Mountain juniper woodland

SAF cover type: Interior ponderosa pine

Trees (% of stems): *Pinus ponderosa* (100)
 Crown closure: 38%

Seedlings (% of stems): *Pinus ponderosa* (100)
 Density: 14/ac

Understory (% cover): *Juniperus* spp. (16), *Carex* spp. (4),
Collomia linearis (1), *Achillea millefolium* (1),
Chenopodium spp. (1), *Opuntia polycantha* (t),
Antennaria spp. (t), *Arabis* spp. (t)

UNDERSTORY VEGETATION

	Lifeform		
	Graminoid	Forb	Shrub
Coverage (percentage)	7	3	16
Height (ft)	0.5	0.4	0.7
Biomass (tons/ac)	0.04	0.02	0.82

WOODY MATERIAL

Diameter (in)	Loading in tons/ac (density in pieces/ac)		
	Sound	Rotten	Total
≤ 0.25	0.12	--	0.12
0.26 - 1.0	0.35	--	0.35
1.1 - 3.0	0.36	--	0.36
> 3.0	0.28 (10)	0.03 (5)	0.31 (15)
Total	1.11	0.03	1.14



SAPLINGS AND TREES

	Size class (diameter at breast height)				
	Saplings (≤ 4 in)	4 - 9 in	9 - 16 in	> 16 in	> 4 in
Most common species (percentage of stems)	<i>Pinus ponderosa</i> (100)	<i>Pinus ponderosa</i> (100)	<i>Pinus ponderosa</i> (100)	--	<i>Pinus ponderosa</i> (100)
Second most common species (percentage of stems)	--	--	--	--	--
Tree density (stems/ac)	94	94	65	0	159
Live	65	87	58	0	145
Dead	29	7	7	0	14
Avg d.b.h. (in)	2.9	7.0	10.3	--	8.4
Live	3.0	7.1	10.0	--	8.3
Dead	2.8	5.8	12.9	--	9.4
Avg height (ft)	7.7	27.4	32.1	--	29.3
Live	8.0	28.5	32.5	--	30.1
Dead	7.0	14.0	29.0	--	21.5
Avg height to crown base (ft)	2.5	7.3	8.1	--	7.7
Live	2.2	7.3	8.4	--	7.7
Dead	3.1	8.0	6.0	--	7.0
Avg height to live crown (ft)	4.2	13.9	14.5	--	14.2
Live crown mass (tons/ac)	0.42	3.43	4.51	0.00	7.94

JUNIPER SHRUB BIOMASS

Loading (tons/ac)	Height of plants		
	≤ 3 ft tall	> 3 ft tall	All
Live: Foliage & ≤ 0.25 in	0.31	0.00	0.31
0.26 - 1.0 in	0.18	0.00	0.18
> 1.0 in	0.08	0.00	0.08
Subtotal	0.56	0.00	0.56
Dead: ≤ 0.25 in	0.20	0.00	0.20
0.26 - 1.0 in	0.05	0.00	0.05
> 1.0 in	0.00	0.00	0.00
Subtotal	0.25	0.00	0.25
All: ≤ 0.25 in	0.51	0.00	0.51
0.26 - 1.0 in	0.23	0.00	0.23
> 1.0 in	0.08	0.00	0.08
Grand total	0.82	0.00	0.82

FOREST FLOOR

	Depth (in)	Loading (tons/ac)	Constancy (%)
Litter	0.7	1.89	85
Duff	0.8	4.90	85
Total	1.3	6.79	93



SITE AND STAND INFORMATION

Site location: N 47° 31' 50.3" W 108° 52' 30.3"
 Elevation: 2,979 ft Aspect: N Slope: 10%

Association: Ponderosa pine / Rocky Mountain juniper woodland

SAF cover type: Interior ponderosa pine

Trees (% of stems): *Pinus ponderosa* (92), *Juniperus scopulorum* (6), *Pseudotsuga menziesii* (2)
 Crown closure: 56%

Seedlings (% of stems): *Pinus ponderosa* (98), *Pseudotsuga menziesii* (2)
 Density: 1,306/ac

Understory (% cover): *Juniperus* spp. (32), *Carex* spp. (19), *Antennaria* spp. (1)

UNDERSTORY VEGETATION

	Lifeform		
	Graminoid	Forb	Shrub
Coverage (percentage)	27	2	29
Height (ft)	0.5	0.5	1.0
Biomass (tons/ac)	0.09	0.01	1.15

WOODY MATERIAL

Diameter (in)	Loading in tons/ac (density in pieces/ac)		
	Sound	Rotten	Total
≤ 0.25	0.15	--	0.15
0.26 - 1.0	0.32	--	0.32
1.1 - 3.0	0.28	--	0.28
> 3.0	0.55 (34)	2.07 (63)	2.62 (97)
Total	1.30	2.07	3.37



SAPLINGS AND TREES

	Size class (diameter at breast height)				
	Saplings (≤ 4 in)	4 - 9 in	9 - 16 in	> 16 in	> 4 in
Most common species (percentage of stems)	<i>Pinus ponderosa</i> (89)	<i>Pinus ponderosa</i> (96)	<i>Pinus ponderosa</i> (100)	--	<i>Pinus ponderosa</i> (97)
Second most common species (percentage of stems)	<i>Juniperus scopulorum</i> (9)	<i>Pseudotsuga menzeisii</i> (4)	--	--	<i>Pseudotsuga menzeisii</i> (3)
Tree density (stems/ac)	462	181	101	0	282
Live	419	167	101	0	268
Dead	43	14	0	0	14
Avg d.b.h. (in)	1.1	6.9	11.3	--	8.5
Live	1.0	7.0	11.3	--	8.6
Dead	1.8	5.6	--	--	5.6
Avg height (ft)	8.1	29.2	41.7	--	33.7
Live	7.9	30.3	41.7	--	34.6
Dead	10.2	16.5	--	--	16.5
Avg height to crown base (ft)	1.8	10.3	14.8	--	11.9
Live	1.7	10.8	14.8	--	12.3
Dead	2.5	4.0	--	--	4.0
Avg height to live crown (ft)	2.9	12.7	20.4	--	15.6
Live crown mass (tons/ac)	0.59	6.35	10.17	0.00	16.52

JUNIPER SHRUB BIOMASS

Loading (tons/ac)	Height of plants		
	≤ 3 ft tall	> 3 ft tall	All
Live: Foliage & ≤ 0.25 in	0.40	0.01	0.41
0.26 - 1.0 in	0.24	0.01	0.25
> 1.0 in	0.19	0.01	0.20
Subtotal	0.83	0.03	0.86
Dead: ≤ 0.25 in	0.13	<0.01	0.13
0.26 - 1.0 in	0.14	<0.01	0.14
> 1.0 in	0.00	0.00	0.00
Subtotal	0.27	<0.01	0.27
All: ≤ 0.25 in	0.53	0.01	0.54
0.26 - 1.0 in	0.38	0.01	0.39
> 1.0 in	0.19	0.01	0.20
Grand total	1.10	0.03	1.13

FOREST FLOOR

	Depth (in)	Loading (tons/ac)	Constancy (%)
Litter	0.7	2.16	96
Duff	1.3	9.18	92
Total	1.9	11.34	99

PPJ 10 PONDEROSA PINE - JUNIPER



SITE AND STAND INFORMATION

Site location: N 47° 31' 39.3" W 108° 52' 49.3"
Elevation: 3,029 ft Aspect: NE Slope: 10%
Association: Ponderosa pine / Rocky Mountain juniper woodland
SAF cover type: Interior ponderosa pine
Trees (% of stems): <i>Pinus ponderosa</i> (98), <i>Juniperus scopulorum</i> (2)
Crown closure: 67%
Seedlings (% of stems): <i>Pinus ponderosa</i> (80), <i>Pseudotsuga menziesii</i> (20)
Density: 36/ac
Understory (% cover): <i>Juniperus</i> spp. (48), <i>Carex</i> spp. (4), <i>Symphoricarpus albus</i> (3), <i>Solidago</i> spp. (2)

UNDERSTORY VEGETATION

	Lifeform		
	Graminoid	Forb	Shrub
Coverage (percentage)	12	6	52
Height (ft)	0.7	0.4	1.2
Biomass (tons/ac)	0.06	0.02	2.92

WOODY MATERIAL

Diameter (in)	Loading in tons/ac (density in pieces/ac)		
	Sound	Rotten	Total
≤ 0.25	0.04	--	0.04
0.26 - 1.0	0.40	--	0.40
1.1 - 3.0	0.40	--	0.40
> 3.0	0.08 (10)	1.38 (34)	1.46 (29)
Total	0.92	1.38	2.30



SAPLINGS AND TREES

	Size class (diameter at breast height)				
	Saplings (≤ 4 in)	4 - 9 in	9 - 16 in	> 16 in	> 4 in
Most common species (percentage of stems)	<i>Pinus ponderosa</i> (96)	<i>Pinus ponderosa</i> (100)	<i>Pinus ponderosa</i> (100)	--	<i>Pinus ponderosa</i> (100)
Second most common species (percentage of stems)	<i>Juniperus scopulorum</i> (4)	--	--	--	--
Tree density (stems/ac)	173	209	94	0	303
Live	159	209	94	0	303
Dead	14	0	0	0	0
Avg d.b.h. (in)	2.9	5.8	12.4	--	7.8
Live	2.9	5.8	12.4	--	7.8
Dead	2.6	--	--	--	--
Avg height (ft)	9.9	26.5	42.5	--	31.4
Live	10.0	26.5	42.5	--	31.4
Dead	9.0	--	--	--	--
Avg height to crown base (ft)	2.6	6.3	9.9	--	7.4
Live	2.5	6.3	9.9	--	7.4
Dead	3.3	--	--	--	--
Avg height to live crown (ft)	3.9	11.3	17.8	--	13.3
Live crown mass (tons/ac)	1.03	5.54	11.83	0.00	17.37

JUNIPER SHRUB BIOMASS

Loading (tons/ac)	Height of plants		
	≤ 3 ft tall	> 3 ft tall	All
Live: Foliage & ≤ 0.25 in	0.81	0.01	0.82
0.26 - 1.0 in	0.75	0.01	0.76
> 1.0 in	0.43	0.01	0.44
Subtotal	1.99	0.03	2.02
Dead: ≤ 0.25 in	0.34	0.01	0.35
0.26 - 1.0 in	0.51	0.01	0.52
> 1.0 in	0.00	0.00	0.00
Subtotal	0.85	0.02	0.87
All: ≤ 0.25 in	1.15	0.02	1.17
0.26 - 1.0 in	1.26	0.02	1.28
> 1.0 in	0.43	0.01	0.44
Grand total	2.84	0.05	2.89

FOREST FLOOR

	Depth (in)	Loading (tons/ac)	Constancy (%)
Litter	1.2	4.05	96
Duff	1.5	10.35	85
Total	2.6	14.40	96

PPJ 11 PONDEROSA PINE - JUNIPER



SITE AND STAND INFORMATION

Site location: N 47° 06' 57.9" W 108° 35' 27.6"
 Elevation: 3,312 ft Aspect: W Slope: 5%

Association: Ponderosa pine / Rocky Mountain juniper woodland

SAF cover type: Interior ponderosa pine

Trees (% of stems): *Pinus ponderosa* (100)
 Crown closure: 40%

Seedlings (% of stems): *Pinus ponderosa* (100)
 Density: 152/ac

Understory (% cover): *Juniperus* spp. (28), *Collomia linearis* (2), *Opuntia polyacantha* (1)

UNDERSTORY VEGETATION

	Lifeform		
	Graminoid	Forb	Shrub
Coverage (percentage)	1	2	28
Height (ft)	0.7	0.3	0.4
Biomass (tons/ac)	<0.01	<0.01	0.69

WOODY MATERIAL

Diameter (in)	Loading in tons/ac (density in pieces/ac)		
	Sound	Rotten	Total
≤ 0.25	0.22	--	0.22
0.26 - 1.0	0.59	--	0.59
1.1 - 3.0	0.69	--	0.69
> 3.0	0.20 (10)	0.55 (39)	0.75 (49)
Total	1.70	0.55	2.25



SAPLINGS AND TREES

	Size class (diameter at breast height)				
	Saplings (≤ 4 in)	4 - 9 in	9 - 16 in	> 16 in	> 4 in
Most common species (percentage of stems)	<i>Pinus ponderosa</i> (100)	<i>Pinus ponderosa</i> (100)	<i>Pinus ponderosa</i> (100)	--	<i>Pinus ponderosa</i> (100)
Second most common species (percentage of stems)	--	--	--	--	--
Tree density (stems/ac)	823	289	36	0	325
Live	700	267	36	0	303
Dead	123	22	0	0	22
Avg d.b.h. (in)	2.0	5.8	11.1	--	6.4
Live	2.1	5.8	11.1	--	6.4
Dead	2.0	5.4	--	--	5.4
Avg height (ft)	10.8	21.9	35.0	--	23.3
Live	10.8	22.8	35.0	--	24.3
Dead	10.7	10.0	--	--	10.0
Avg height to crown base (ft)	3.8	7.3	10.0	--	7.6
Live	3.9	7.3	10.0	--	7.6
Dead	3.3	7.0	--	--	7.0
Avg height to live crown (ft)	5.2	11.7	15.0	--	12.1
Live crown mass (tons/ac)	2.48	7.03	3.46	0.00	10.49

JUNIPER SHRUB BIOMASS

Loading (tons/ac)	Height of plants		
	≤ 3 ft tall	> 3 ft tall	All
Live: Foliage & ≤ 0.25 in	0.57	0.00	0.57
0.26 - 1.0 in	0.05	0.00	0.05
> 1.0 in	0.00	0.00	0.00
Subtotal	0.62	0.00	0.62
Dead: ≤ 0.25 in	0.07	0.00	0.07
0.26 - 1.0 in	0.00	0.00	0.00
> 1.0 in	0.00	0.00	0.00
Subtotal	0.07	0.00	0.07
All: ≤ 0.25 in	0.64	0.00	0.64
0.26 - 1.0 in	0.05	0.00	0.05
> 1.0 in	0.00	0.00	0.00
Grand total	0.69	0.00	0.69

FOREST FLOOR

	Depth (in)	Loading (tons/ac)	Constancy (%)
Litter	0.7	2.20	96
Duff	0.8	5.15	84
Total	1.4	7.35	96

PPJ 12 PONDEROSA PINE - JUNIPER



SITE AND STAND INFORMATION

Site location: N 47° 07' 00.0" W 108° 35' 32.3"
 Elevation: 3,303 ft Aspect: W Slope: 2%

Association: Ponderosa pine / Rocky Mountain juniper woodland

SAF cover type: Interior ponderosa pine

Trees (% of stems): *Pinus ponderosa* (100)
 Crown closure: 56%

Seedlings (% of stems): *Pinus ponderosa* (100)
 Density: 36/ac

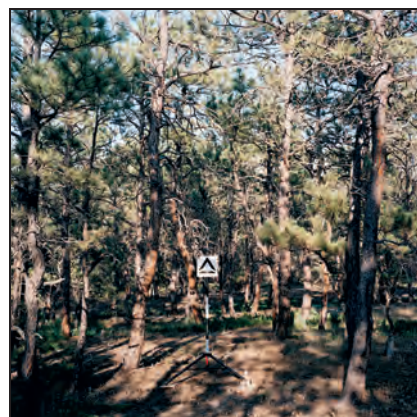
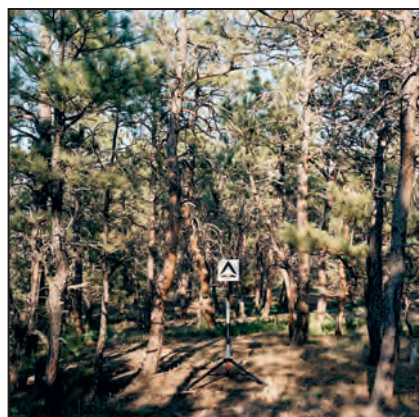
Understory (% cover): *Juniperus* spp. (9), *Collomia linearis* (1), *Carex* spp. (na)

UNDERSTORY VEGETATION

	Lifeform		
	Graminoid	Forb	Shrub
Coverage (percentage)	1	1	9
Height (ft)	0.5	0.2	0.6
Biomass (tons/ac)	0.01	<0.01	0.21

WOODY MATERIAL

Diameter (in)	Loading in tons/ac (density in pieces/ac)		
	Sound	Rotten	Total
≤ 0.25	0.24	--	0.24
0.26 - 1.0	0.37	--	0.37
1.1 - 3.0	0.28	--	0.28
> 3.0	0.85 (19)	0.00 (0)	0.85 (19)
Total	1.74	0.00	1.74



SAPLINGS AND TREES

	Size class (diameter at breast height)				
	Saplings (≤ 4 in)	4 - 9 in	9 - 16 in	> 16 in	> 4 in
Most common species (percentage of stems)	<i>Pinus ponderosa</i> (100)	<i>Pinus ponderosa</i> (100)	<i>Pinus ponderosa</i> (100)	--	<i>Pinus ponderosa</i> (100)
Second most common species (percentage of stems)	--	--	--	--	--
Tree density (stems/ac)	130	332	14	0	346
Live	108	325	14	0	339
Dead	22	7	0	0	7
Avg d.b.h. (in)	3.1	6.9	12.0	--	7.1
Live	3.1	6.9	12.0	--	7.1
Dead	2.6	4.4	--	--	4.4
Avg height (ft)	12.7	26.7	34.5	--	27.0
Live	13.3	27.0	34.5	--	27.3
Dead	9.7	13.0	--	--	13.0
Avg height to crown base (ft)	4.6	6.5	7.5	--	6.5
Live	4.7	6.5	7.5	--	6.6
Dead	4.3	6.0	--	--	6.0
Avg height to live crown (ft)	6.9	13.8	18.0	--	14.0
Live crown mass (tons/ac)	0.79	12.12	1.68	0.00	13.80

JUNIPER SHRUB BIOMASS

Loading (tons/ac)	Height of plants		
	≤ 3 ft tall	> 3 ft tall	All
Live: Foliage & ≤ 0.25 in	0.16	0.00	0.16
0.26 - 1.0 in	0.04	0.00	0.04
> 1.0 in	0.00	0.00	0.00
Subtotal	0.20	0.00	0.20
Dead: ≤ 0.25 in	0.01	0.00	0.01
0.26 - 1.0 in	<0.01	0.00	<0.01
> 1.0 in	0.00	0.00	0.00
Subtotal	0.01	0.00	0.01
All: ≤ 0.25 in	0.17	0.00	0.17
0.26 - 1.0 in	0.04	0.00	0.04
> 1.0 in	0.00	0.00	0.00
Grand total	0.21	0.00	0.21

FOREST FLOOR

	Depth (in)	Loading (tons/ac)	Constancy (%)
Litter	0.7	2.42	100
Duff	0.7	4.55	92
Total	1.3	6.97	100

Ottmar, Roger D.; Vihnanek, Robert E.; Wright, Clinton S. 2007. Stereo photo series for quantifying natural fuels. Volume X: sagebrush with grass and ponderosa pine-juniper types in central Montana. Gen. Tech. Rep. PNW-GTR-719. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 59 p.

Two series of single and stereo photographs display a range of natural conditions and fuel loadings in sagebrush with grass and ponderosa pine-juniper types in central Montana. Each group of photos includes inventory information summarizing vegetation composition, structure, and loading; woody material loading by size class; forest floor depth and loading; and various site characteristics. The natural fuels photo series is designed to help land managers appraise fuel and vegetation conditions in natural settings.

Keywords: Woody material, biomass, fuel loading, natural fuels, Missouri Breaks, mixed-conifer, ponderosa pine, *Pinus ponderosa*, creeping juniper, *Juniperus horizontalis*, Rocky Mountain juniper, *Juniperus scopulorum*, Douglas-fir, *Pseudotsuga menziesii*, mountain big sagebrush, *Artemisia tridentata* ssp. *vaseyana*, Wyoming big sagebrush, *Artemisia tridentata* ssp. *wyomingensis*.