2. Ponderosa Pine Ecological Series

Table 02-1. Full and short names for the ecological types in the Ponderosa Pine Ecological Series.

Ecological Type Code	Name	Plant Association Code	Short Name
FD02	Ponderosa pine/Arizona fescue–Eutroboralfs–Gentle slopes and mesas, 8,400-10,100 ft	PIPO/FEAR2	Ponderosa pine/Arizona fescue–Light-colored clay soils
FD03	Ponderosa pine/bitterbrush–Moderately deep to shallow Haploborolls–Gentle convex mesas and ridges, 8,300-9,400 ft	PIPO/PUTR2	Ponderosa pine/bitterbrush–Dark soils with no clay layer

The Southwestern Ponderosa Pine (*Pinus ponderosa*) Series is a new name for the *Pinus ponderosa* Series of Peet (1978a), Donart and others (1978), Layser and Schubert (1979), Hess (1981-1986), Hess and Wasser (1982), Mauk and Henderson (1984), Alexander (1985-1988, in part), Komárková (1986-1988), DeVelice and others (1986), Fitzhugh and others (1987), Larson and Moir (1989), and Muldavin and others (1990). Southwestern Ponderosa Pine is considered a climatic series by Moir (1983), and it differs from the (Northwestern) *Pinus ponderosa* Series of Hoffman and Alexander (1976), Pfister and others (1977), Steele and others (1981), and Cooper and others (1987). Ponderosa pine stands in the Black Hills and western Great Plains seem to be in yet a different Series.

Stands of this series form distinctive patterns on aerial photographs. Individual pine trees are often visible. Stands are moderate to large in size and are often isodiametric to elliptic in shape.

Vegetation, Climate, Soils

Stands are typically very patchy, necessitating different silvicultural approaches from the usual stand-based approaches (Myers 1974). The term *substand* refers to the trees that occupy a specific microsite; *patch* is often applied to the same concept (Covington and Sackett 1992).

Many ponderosa stands in the UGB and throughout the Southwest (DeVelice and others 1986) have been logged, protected from fire, and heavily grazed, so it is difficult to find a completely undisturbed stand. This means that nonlinear models must be used to relate pine canopy cover and grass production, for example (McPherson 1992).

Tree productivity is low (as in pine/fescue types) to moderate (as in pine/bitterbrush types) in the UGB (see Youngblood and Mauk 1985, Hess and Alexander 1986). The UGB is apparently colder and possibly drier than the norm for pine/fescue in the Southwest. Ponderosa pine can be managed using even-aged management, shelterwood systems, or by small clearcut and small group-selection systems (Mauk and Henderson 1984, Youngblood and Mauk 1985). These sites have naturally low stand density and low site quality for ponderosa pine (Komárková and others 1988). Site preparation might be required in many cases; tree stocking reductions may be necessary for rocky sites (Mauk and Henderson 1984, Youngblood and Mauk 1985).

Alexander (1986) reported that there is a "serious imbalance" in age-class distribution in central Colorado ponderosa pine stands, with about 60% of the stands in the mature, declining class, 1% in seedling- sapling class, and 27% nonstocked, without trees. Much of this "imbalance" is apparently due to the sporadic patchy natural regeneration of ponderosa pine, long-term protection from fire, and the ability of many sites to support only open-canopy forests of ponderosa pine (Alexander 1986). Regeneration is difficult to obtain in *any* stand, especially on disturbed soils (Hess and Alexander 1986).

After as much as 35 years of moderate grazing by cattle and conservative partial timber harvest, Currie and Gary (1978b) found very little erosion (<7 mm) on nearly flat sites where soils are derived from granite.

The water-use pattern and phenology of mountain muhly seem to be well coordinated with known requirements for ponderosa pine seedling survival. Seeding understory species that stabilize soils encourages artificial or natural regeneration of pine seedlings. Ponderosa pine seedlings survive best in fine soils where conifer litter is less than 1 cm deep, with sparse ground cover and some shade, or ground cover of kinnikinnick (ARUV) or mountain muhly and no shade. Mountain muhly, a common native grass, was often associated with kinnikinnick, which seems to serve as a nurse plant for pine seedlings (Potter and others 1982).

Table 02-2. Climate and Soils.		
Characteristic	**Values**	**References**
Precipitation zone	480 mm/yr (350-680 mm/yr) 19 in/yr (14-26 in/yr) about two-thirds of it during the growing season, April-September	Sampson 1925, Johnson 1953, Pearson 1967, Potter and others 1982, Youngblood and Mauk 1985, Biondi and others 1994-1996, local data
Air temperature	Annual: 4.6°C (40.3°F) July: 17°C (11-29°C) 63°F (52-84°F) January: 5°C (-9°C to 2°C) 23°F (16-36°F)	Youngblood and Mauk 1985
Organic matter in upper 10 cm of soil	mean 25-75% in unmodified stands	Graham and others (1994)
Needle litter accumulation	mature stand: 900-1,400 lb/ac/yr	Sackett (1980)

Timber Management

Standard shelterwood and seed-tree even-aged cutting methods are appropriate for this type. Group selection and group shelterwood mimic natural standard configurations. Individual-tree selection is usually not appropriate because of the likelihood of sporadic representation of age or size classes (Komárková and others 1988, Larson and Moir 1989). Thinning may be necessary to meet management needs, improve wildlife habitat, reduce fire hazard, or simulate natural fire (Ronco and others 1985). A two-cut shelterwood method is most appropriate for converting even-aged, old-growth stands to managed even-aged stands (Alexander and Edminster 1980).

Cutting methods and strategies in Front Range ponderosa pine, which are more productive than those in the UGB, are described and summarized in Myers (1974) and Alexander (1986). Most stands are rapidly self-thinning. Clearcutting is not recommended; clearcutting or severe thinning (reduction to <15% tree density) negatively affects wildlife numbers and diversity (Szaro and Balda 1979). Selective cutting methods, such as an irregular-strip shelterwood system, consistently improve bird population densities (Szaro and Balda 1979).

Dwarf mistletoe (*Arceuthobium vaginatum* ssp. *cryptopodum*) is fairly common in ponderosa pine trees in the southwest (Hanks and others 1983, Mathiasen and Blake 1984) and on the eastern slope of Colorado (Hess and Alexander 1986, Merrill and others 1987), but is uncommon in the UGB (Heidmann 1983).

Timber production may be limited by the occurrence of dwarf mistletoe. Complete removal of infected trees in both the overstory and understory has been advocated by some as the only effective treatment of dwarf mistletoe in mature stands (Heidmann 1983). Bird species abundance and richness is positively correlated with dwarf mistletoe abundance in ponderosa pine forests, especially cavity-nesting birds, so treatment of ponderosa pine to lessen effects of dwarf mistletoe may not be justified if done for wildlife habitat purposes (Bennetts and others 1996).

Removal of sagebrush, which competes with ponderosa pine for water, may provide an opportunity for greater pine reproduction if a pine seed source is available (Callaway and others 1996). Unfortunately, valuable bitterbrush would probably be removed as well.

Partial cutting increases the shrub and herbaceous layers, improving both habitat diversity and forage production (Hess and Alexander 1986).

Fire

Prescribed burning has little immediate impact on the overstory, but reduces the weight of litter and duff, especially in old-growth substands. Prescribed burning can be an effective tool for reducing fuels (Sackett 1980, Covington and Sackett 1992). Immediately after fire, organic nitrogen in the form of NH_4 (NH_4-N) increases, most in old-growth substands and least in sapling substands, though it declines substantially within one year after burning, directly correlated with increases in NO_3-N (Covington and Sackett 1992).

After a burn, most understory species reproduce by seed from surviving plants (Vose and White 1987). Prescribed burning can stimulate good tree seedling crops under the right conditions. Many of these seedlings are very vigorous, probably as a result of nutrients released by the fire (Harris and Covington 1983, Sackett 1984). Buried-seed populations were not a significant source for revegetation (Vose and White 1987). Prescribed burning can increase long-term production of forage grasses, and also typically increases their nutrient content and digestibility (Clary 1978, Andariese and Covington 1986). After a prescribed fire, Arizona fescue and mountain muhly fail to flower the first year in both sawtimber and pole stands. In contrast, muttongrass (POFE) and bottlebrush (ELEL5) both show no change in phenology after burning (White and others 1991). Fall burning increases grass understory production over the long term, but there are no increases the first two to three years. Grasses that are affected

include Arizona fescue (FEAR2), mountain muhly, muttongrass, and bottlebrush squirreltail, all of which are common in our ponderosa pine forests (Andariese and Covington 1986).

Fall burning in ponderosa pine reduces fire hazard, accelerates nutrient mobilization, and reduces forest floor interception of precipitation (Covington and Sackett 1984). A prescribed burn in November after a significant moisture event exposes mineral soil for an improved pine seedbed, increases soil moisture, and leads to a 20× increase in number of pine seed germinating (Haase 1986). Direct seeding of ponderosa pine is rarely successful, as a result of seasonal drought, intensified by clay soils and competing vegetation (Rietveld and Heidmann 1976, Heidmann and others 1977). Graham and others (1994) recommend that 6-14 tons/ac of coarse woody debris be left on the surface after timber harvest, to maintain forest productivity. In a ponderosa pine stand in northern Arizona, Sackett (1984) estimated that there was >15 tons/ac of woody material <1 in. diameter (of which 6.2 tons/ac is humus). Woody material >1 in. adds another 7.2 tons/ac, for a total of >22 tons/ac of woody material.

Research projects on the effects of fire in northern Arizona found the Composite Fire Interval in ponderosa pine stands was 4.9 years between 1540 and 1876 (Dieterich 1980, also see DeVelice and others 1986 and Stein 1988). The stands inferred to exist in 1876, presumably the product of a natural fire regime, were described as follows:

> "Most of the stands were open and park-like. Grass and needles were the primary fire-carrying medium, and fire intensities, even on high fire-danger days, would have been relatively low. Sparse ground fuels would account for the fact that fires could move through an area without causing appreciable damage to the residual trees. Many of the trees that had previously sustained fire scars would have been skipped by the fire because of the discontinuity in the light surface fuels.
>
> "Condition of the forest floor in an area where fires were burning at 2- to 4-year intervals would be in marked contrast to what is found today. Ample moisture of mineral soil and an increase in available nutrients would have encouraged establishment of natural pine regeneration as well as production of biomass from native grasses and forbs. Ashes and charcoal would have been incorporated in the mineral soil. Seedling mortality would have been high because of competition for moisture, frost heaving, and successive surface fires.
>
> "A precarious balance probably existed between mortality and survival of growing stock needed to perpetuate the ponderosa pine type in this area. However, the uneven-age character of the pine stands existing today is testimony to the fact that survival materially exceeded mortality as the stands began to come under management and protection in the early 1900's.
>
> "In contrast to the stand conditions that existed under the influence of a natural fire regime, the current stand conditions reflect long-established land management policies designed to protect the areas from wildfire. This protection, in the absence of extensive prescribed burning programs, has resulted in (1) an increase of growing stock to the extent that many areas are now heavily overstocked (Schubert 1974); (2) a significant buildup of natural and activity fuels (Sackett 1980); and (3) an apparent reduction in the distribution and density of native grasses because of increased shading and accumulation of pine litter" (Dieterich 1980, after Cooper 1960 and others).

So the natural fire regime included both frequent, localized, patchy surface fires about every 2 to 4 years (Dieterich 1980, Dieterich and Swetnam 1984, Fitzhugh and others 1987), and stand-replacing fires about every 30 to 50 years (Dieterich 1980, Stein 1988). Stand-replacing fires were usually of greater spatial extent (Fitzhugh and others 1987). Natural regeneration in southwestern ponderosa pine is infrequent, with non-regenerating periods of 25 to 40 years common (Komárková and others 1988). Patches of regeneration often coincide with areas of recent fuel buildup following the death of a few trees and the burning of the resultant fuel (Dieterich 1980). If such a fire creates a favorable seedbed immediately preceding a rare period of favorable seed-producing conditions, then seedlings may become established (White 1985). Under natural, pre-settlement fire frequencies and intensities, the ponderosa pine forest was composed of widespread patches of pines (DeVelice and others 1986) which were multi-aged and genetically variable (Torick and others), with sharp peaks of recruitment every 3-4 decades (White 1985). Dieterich (1979) gives a photographic guide to assessing recovery potential of ponderosa pine trees.

Protection of ponderosa pine stands from fire has considerably disrupted this pattern. Our ponderosa pine stands now support many more stems, especially young stems (DeVelice and others 1986), and are generally more susceptible to insects, dwarf mistletoe, and fire. Stand density has increased throughout the 20th century because of successful regeneration pulses and active fire control (Biondi 1996). Further discussion of fire ecology can be found within the individual type descriptions that follow.

Range Management

Forage productivity is typically moderate to high in stands. Livestock graze these stands because of their accessibility, highly palatable forage (browse species such as Arizona fescue, mountain muhly, and bitterbrush), and cover (shade) in or behind the trees. See *Festuca*

arizonica in the Species section for more details. Throughout the Southwest, pine-bunchgrass ranges are important sources of summer forage for livestock (Fitzhugh and others 1987). Paulsen (1975) recommends a maximum forage utilization of 30-40%; stocking rates range from 4-12 ac/AUM on ranges in good condition, to 25-30 ac/AUM on ranges in fair condition (most UGB ranges), to > 40 ac/AUM on ranges in poor condition. Johnson and Reid (1958) found that "moderately grazed" pine-bunchgrass ranges had utilization of <35% on Arizona fescue and <33% on mountain muhly. In Johnson's (1953) "moderate" use pasture, utilization of "palatable grass and sedge species" in the pine-bunchgrass type was 35% (18-40%) over a six-year period. Johnson and Reid (1964) developed a nomograph for interpreting range condition class of pine-bunchgrass ranges, using two factors: percentage of maximum leaf height of *Muhlenbergia montana*, and basal density of desirable plant species.

Table 02-3. Some average quantities in pastures of various conditions in ponderosa pine-Arizona fescue stands in central Colorado. Leaf heights are of mountain muhly. Table quantities are presented as average (minimum-maximum) (Johnson and Reid 1964).

	Condition Class			
Factor	Excellent	Good	Fair	Poor
Bare soil, %	21 (2-34)	32 (17-44)	35 (17-62)	41 (11-62)
Litter, %	36 (24-56)	34 (18-53)	30 (6-58)	25 (10-48)
Leaf height, in	5.25 (4.4-5.8)	4.07 (3.3-5.1)	3.25 (2.0-4.3)	2.65 (1.8-3.5)

Glendening (1944) found that the major factors limiting grazing on pine-bunchgrass ranges in northern Arizona were:

1. Distance from water. Use of large areas >2 mi from natural water sources is impractical, unless water can be developed in those areas.
2. Steepness and length of slope. On slopes of 20% that are a mile or more long, grazing will usually be light, but a narrow fringe at the bottom of a steep slope will be used. "Range areas greater than ½ mi from slope bottom where gradient is steeper than 40% should be excluded from grazing capacity estimates."
3. Trails and other access routes. Within timbered areas, cattle use will be concentrated in narrow belts bordering the main trails.
4. Density of timber stand. Use is usually inversely correlated with canopy closure. "Use of timbered areas should be encouraged during early summer and again in the fall to make use of [forbs]. Cattle should be moved immediately following the first killing frost."
5. Season of use. Mountain muhly is used more in season-long pastures, but Arizona fescue is used more heavily "in the early summer when muhly is dormant and fescue is green."
6. Range condition. Desirable forage grasses such as Arizona fescue and mountain muhly area used much more heavily on ranges in fair and poor condition, than on ranges in excellent or good condition; and yet these grasses are in short supply on fair and poor-condition ranges.

According to Glendening (1944), use by cattle on Arizona fescue should be ≤ 12%, and use by cattle on mountain muhly should be ≤ 25%, in order to maintain range in good or better condition. However, if ranges in poor condition are usually grazed every year they may be unable to recover at these rates.

Cover of the tallest ponderosa pine canopy is a good predictor of forage production, which is generally highest in open stands (Spreitzer 1986). Spreitzer (1986) and Bojorquez Tapia and others (1990) provide equations for predicting understory production. Clary and Pearson (1969) measured the utilization of various species by cattle as compared with the utilization on bottlebrush squirreltail (*Elymus elymoides*).

Overgrazing in ponderosa pine-Arizona fescue stands can threaten pine regeneration (Dayton and others 1937, Currie and others 1978a), eliminate fescue, cause erosion, and result in invasion by weeds and other undesirable plants such as pingue and snakeweed (Hanks and others 1983, DeVelice and others 1986). Damage to ponderosa pine seedlings is greatest under heavy grazing intensities. Damage to ponderosa pine seedlings is greatest with season-long grazing systems or rotation systems before July 25; damage is least with rotation systems after July 25 (Currie and others 1978a). Pine-bunchgrass range that has been heavily grazed for more than 20 years does not improve after a change to a more conservative grazing system, or even total rest (Currie 1976), probably because important plants such as Arizona fescue, oatgrass, and mountain muhly have been eliminated.

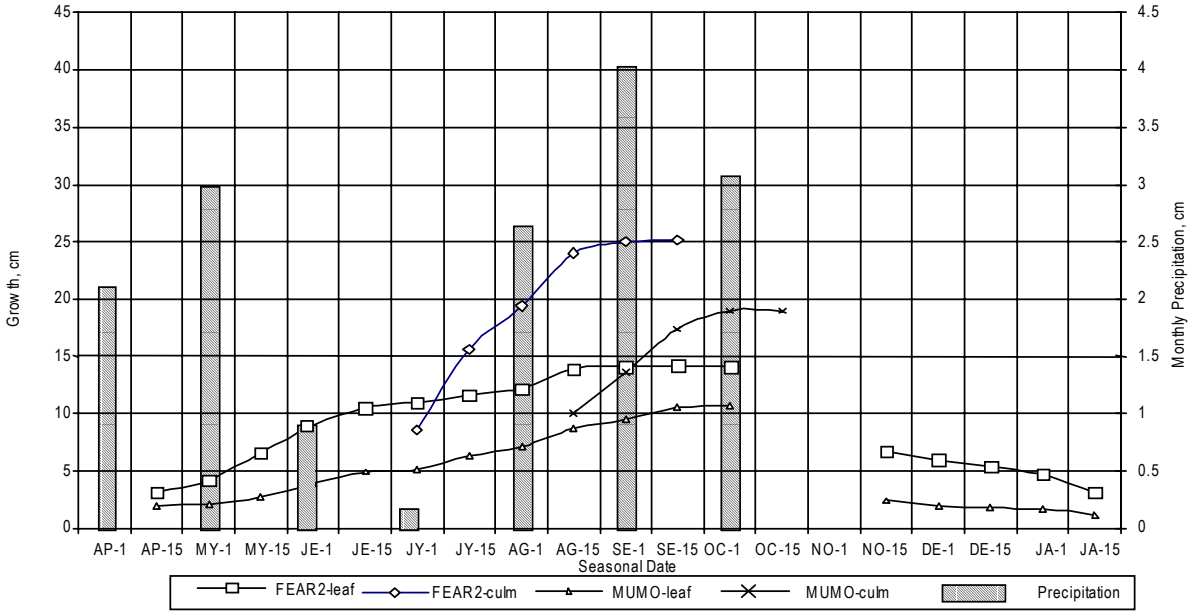

Fig. 02-1. Growth of Arizona fescue (FEAR2) and mountain muhly (MUMO) in ponderosa pine stands in northern Arizona (Pearson 1967).

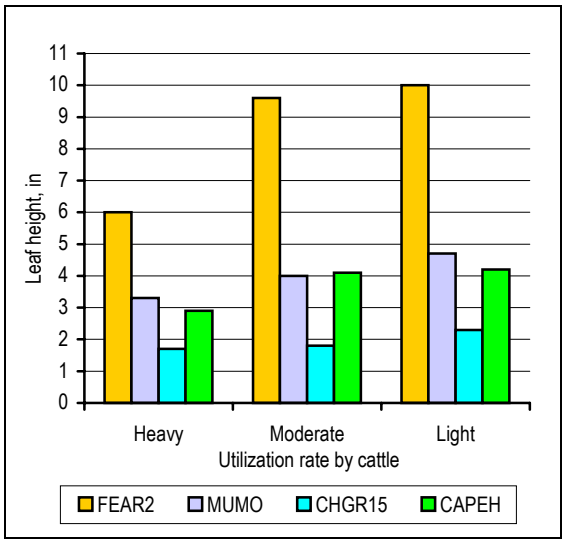

Fig. 02-2. Average heights of four graminoid species at three different grazing intensities (Johnson 1953).

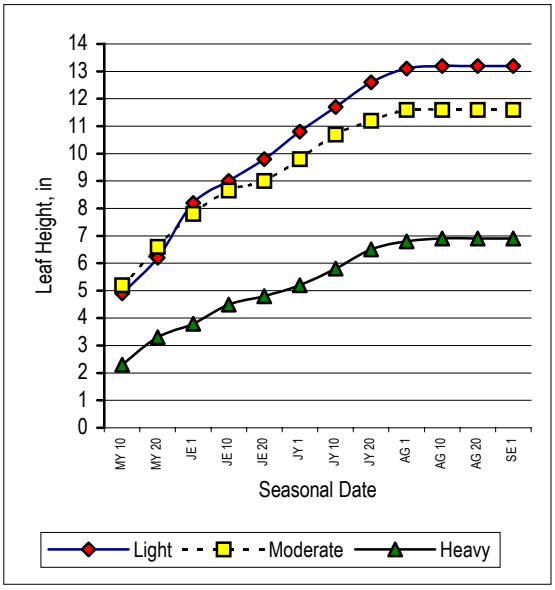

Figure 02-3. Growth in height of Arizona fescue (FEAR2) leaves in a ponderosa pine stand in east-central Colorado in three pastures with different cattle use intensities (Johnson 1953).

Table 02-4. Utilization of various graminoid species by cattle, when the utilization of bottlebrush squirreltail (ELEL5) is 20% (Clary and Pearson 1969).

Species	Utilization, %
Bottlebrush squirreltail (ELEL5)	20
Kentucky bluegrass (POPR)	39
Arizona fescue (FEAR2)	33
Mountain muhly (MUMO)	31
Sedge (CAREX)	24
Muttongrass (POFE)	23
Blue grama (CHGR15)	17
Prairie junegrass (KOMA)	13

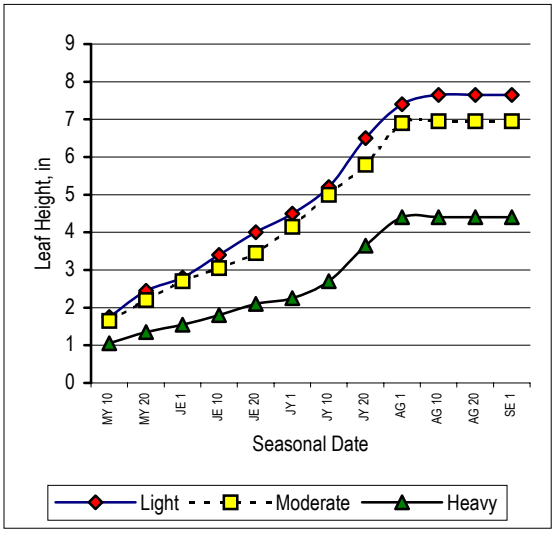

Figure 02-4. Growth in height of mountain muhly (MUMO) leaves in a ponderosa pine stand in east-central Colorado in three pastures with different cattle use intensities (Johnson 1953).

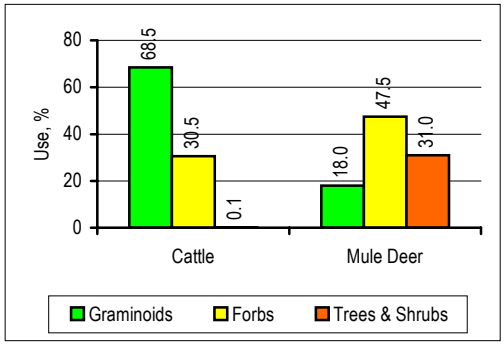

Fig. 02-5. Diet overlap between cattle and mule deer in ponderosa pine-Arizona fescue stands in central Colorado (Currie and others 1977).

Wildlife Management

These stands may be very important parts of the transitional and light-winter range for mule deer for forage, browse, and cover (Currie and others 1977), especially stands which include bitterbrush or aspen. They are used more sparingly by elk, and are very important for raptors and a wide variety of birds, ground mammals, and squirrels. They are preferred habitat for the mountain cottontail (Hess and Alexander 1986). Mule deer and elk tend to use areas less if they are also grazed by cattle; after cattle are introduced, elk tend to use closed forests more than before (Wallace and Krausman 1987). Currie and others (1977) provide the above chart (Fig. 02-5) illustrating the small diet overlap between mule deer and cattle. Elk prefer to use burned areas for a few years following a fire, then shift to use patterns more like pre-burn. Deer use increases substantially on burned areas, but use of unburned areas continues as before (Kruse 1972).

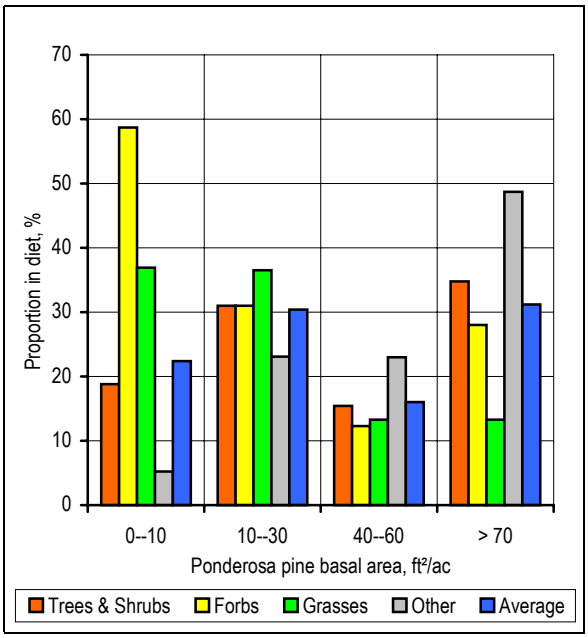

Fig. 02-6. Use of forage by mule deer is affected by tree density (basal area) (Currie and others 1977).

In April, May, and October mule deer prefer to forage on ponderosa pine, bluegrass, sun sedge, smooth brome, and pasque flower (*Pulsatilla*); fringed sage is also enjoyed in April. In June, July, and August mule deer prefer rose, mountain mahogany, geranium, horse cinquefoil (*Potentilla hippiana*), strawberry, smooth brome, and dandelion (Fig. 02-7, Currie and others 1977).

Bird species abundance and richness is positively correlated with an abundance of dwarf mistletoe in ponderosa pine forests, especially for cavity-nesting birds (Bennetts and others 1996). Fewer birds and bird species occur in stands during summers following winters which were very cold or produced heavy snowfall (Szaro and Balda 1982-1986). Bird density is greater in lightly or moderately cut stands than in untreated stands, and stand density seems to be more important than weather effects (Szaro and Balda 1982-1986). Retention of habitat components such as snags is very important to wildlife habitat management (Cunningham and others 1980).

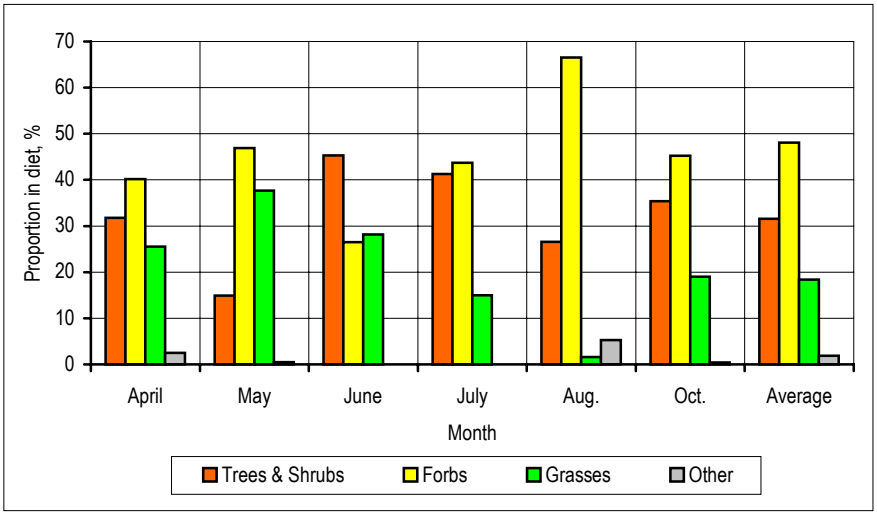

Fig. 02-7. Seasonal variation in mule deer diets in ponderosa pine-Arizona fescue stands in central Colorado (Currie and others 1977).

Sparse stands of the same cold, dry pine/fescue type in the UGB are an important component of a low-elevation bighorn sheep winter range, intermediate range, and summer-lambing range west of Saguache near the UGB. Within the winter range and summer-lambing range, fescue (*Festuca arizonica*) and mountain muhly (*Muhlenbergia montana*) are major components of the bighorn diets that occur in pine/fescue stands (Shepherd 1975). Carnivores such as coyote, gray fox, and bobcat directly benefit from management of ponderosa pine stands that provide more denning sites and cover for stalking. Carnivores also benefit indirectly from management actions that increase grasses and forbs, especially if downed trees and slash are left for cover, which benefits prey populations (Turkowski 1980).

Recreation, Roads & Trails, Scenery

Sites of this series are generally suitable for roads and trails because soils are stable except on steep slopes (rare). Road and trail construction should be avoided where aspen shares dominance on deeper, loamier, less-coarse soils on steep slopes. Sites are generally suitable for construction on less steep slopes with coarse soils. Stands are generally suitable for dispersed camping and developed recreation of various kinds, especially on relatively gentle slopes where closed stands alternate in a mosaic with openings. These stands have moderate to high scenic value, especially where aspen shares dominance.

Once Arizona fescue is removed from a site by overgrazing, soil loss proceeds rapidly, but there is little topsoil on many of these sites. Mountain muhly is more durable but less important as a soil binder. Seed of both species is expensive and difficult to obtain for revegetation purposes. Direct seeding of ponderosa pine is rarely successful because of seasonal drought that is intensified by clay soils and competing vegetation (Rietveld and Heidmann 1976, Heidmann and others 1977).

Key to Ecological Types in the Ponderosa Pine Series

1. Bitterbrush (PUTR2) present and >1% cover, often >10%. Big sagebrush (ARTR2) usually present. Dark-surface soils (Haploborolls) with surface coarse fragments <15%. Lower elevations, <9,400 ft..... FD03
1. Bitterbrush absent. Big sagebrush usually absent, sometimes up to 65%. Light-colored soils (Eutroboralfs) with surface coarse fragments averaging 15% (1-55%). Higher elevations, up to 10,500 ft FD02

Table 02-5. Characteristics of Ecological Types within Ecological Series 2 in the Upper Gunnison Basin.
Numbers are shown in form *Average (Minimum-Maximum)*

Code Short Name	No. Samples	Elevation, ft	Avg. Aspect, °M (r) Slope, %	Soil Coarse, %	Depth, cm Mollic, cm	Surface: Coarse, % Bare, %	Cover, %: Trees Shrubs Gramin. Forbs	Total Live Cover, % No. Species TLC/NS, %
FD02 Ponderosa pine/Arizona fescue–Light-colored clay soils	8	9,270 (8,460-10,060)	178 (0.48) 14 (3-42)	51 (29-67)	83 (60-143) 11 (8-14)	11 (2-19) 13 (1-52)	42 (1-69) 12 (0-67) 37 (12-57) 13 (2-32)	103.6 (48.0-138.2) 30 (24-38) 3.6 (1.4-5.7)
FD03 Ponderosa pine/bitterbrush–Dark soils with no clay layer	11	8,969 (8,360-9,400)	136 (0.38) 19 (3-36)	53 (24-84)	58 (38-115) 19 (6-30)	14 (1-40) 5 (1-14)	39 (10-56) 29 (8-48) 40 (6-70) 16 (2-50)	124.5 (62.0-177.0) 28 (12-47) 5.6 (1.6-14.8)

Ponderosa pine/Arizona fescue–Eutroboralfs–Gentle slopes and mesas, 8,400-10,100 ft

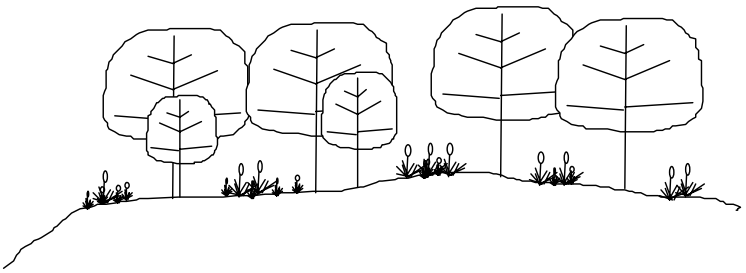

Figure 02-8. Cross-section of vegetation structure of *Ponderosa pine/Arizona fescue–Light-colored clay soils*. Aspects are southerly, and slope angles average 14%.

Ponderosa pine/Arizona fescue–Light-colored clay soils occurs within the lower elevations of the Montane zone in the southern and southeastern parts of the Gunnison Basin. Found throughout southern Colorado, northern New Mexico and Arizona, and in southeastern Utah, on gentle benches, flats, and mesa tops, it may also occasionally be found on gentle slopes and mesa tops within deep rainshadows. While ponderosa pine (PIPO) and Arizona fescue (FEAR2) characterize this type, big sagebrush (ARTR2) and mountain muhly (MUMO) are often present. Ponderosa pine forms a moderately sparse but never dense canopy, rarely more than 60% cover by trees. Douglas-fir and bitterbrush are absent. Stands are clumpy, with patches of pine regeneration alternating with patches of gravel and Arizona fescue. Shrubs vary from none to a few.

Ecotones are usually to one of the Douglas-fir (PSME) types on adjacent northerly slopes, or to one of the sagebrush types. This type is almost never adjacent to riparian areas.

Pinus ponderosa/Festuca arizonica (Glendening 1944) is the classic pine-bunchgrass type found throughout the Southwestern United States (Clary 1978, De Velice and others 1985, Radloff 1983, Hanks and others 1983, and so forth). *Ponderosa pine/Arizona fescue–Light-colored clay soils* is related to the common Southwestern ponderosa pine/Arizona fescue type, but seems to be somewhat less productive in the UGB. *Ponderosa pine/bitterbrush–Dark soils with no clay layer* has a similar tree layer, but also has a conspicuous layer of bitterbrush under and around the trees. *Douglas-fir/wax currant-Arizona fescue–Coarse thin-dark soils–Steep* is related, but includes Douglas-fir reproduction, and is found on steeper, more northerly slopes with thinner, darker soils.

Late-seral conditions support conspicuous bunchgrasses such as Arizona fescue, mountain muhly, or junegrass. Arizona fescue is highly palatable to cattle and elk. This grass rarely forms a closed stand, often occurring in conjunction with patches of gravel interspersed among groups of pine, and it may be quite sparse. Arizona fescue dominates a site largely through its dense root mat, which is present even between plants as much as 2 m (7.5 ft) apart. Arizona fescue is an obligate outcrosser, however, which means that plants 2-3 m (7.5-10 ft) apart are unlikely to pollinate one another, and such a stand of fescue will eventually disappear. Once the roots die, soil loss ensues.

The palatable grass species and gentle slopes attract cattle, but sites in the UGB often produce little forage, possibly due to cold, dry conditions in these deep rainshadows. Sites of the same ecological type outside the Gunnison Basin produce higher forage values. Cattle grazing can significantly deplete the grasses from these sites. Moderately heavy to heavy grazing by cattle, sheep, deer, or elk tends to decrease palatable grasses such as Arizona fescue, mountain muhly, and junegrass while increasing sagebrush cover. Other disturbance factors such as roads, trails, recreation, and wildlife use have little effect on the vegetation, especially on gentle slopes.

The stands are fair for deer and elk hiding cover, fair to poor as forage and browse. Elk and mule deer use both community types mainly for cover during moderate winters, less in spring and fall, and rarely during hard winters. Horizontal obstruction is moderately low. Sage grouse mainly use these sites as summer range. Their seasonal preference for nesting sites in spring and summer is low for both community types.

Table 02-6. Wildlife values (relative to the whole UGB) for the principal wildlife species using *Ponderosa pine/Arizona fescue–Light-colored clay soils*.			
	Sage Grouse	Mule Deer	Elk
CT	Season–Preference	Season–Preference	Season–Preference
A, B	Spring: Low Nesting: Low Summer: Low	Winter, Mild: Moderate (Cover) Winter, Severe: Low Spring/Fall: Moderately Low	Winter, Mild: Moderate (Cover) Winter, Severe: Low Spring/Fall: Moderately Low

Summary of Ecological Type Characteristics

1. Explanation of symbols is found in Appendix C. Percentages in [brackets] indicate the percentage of plots sampled that have that characteristic.

NUMBER OF SAMPLES	8, soil descriptions from 4 of these (total 8)
ELEVATION	9,270 ft (8,460-10,060 ft); 2,825 m (2,578-3,066 m)
AVERAGE ASPECT	178°M (r = 0.48)
LITHOLOGY	Igneous, for example tuff, basalt, breccia, rhyolite
FORMATIONS[1]	All Tertiary volcanics
LANDFORMS	Soil creep slopes [80%]
SLOPE POSITIONS	Footslopes and backslopes [80%]
SLOPE SHAPES	Linear [60%] both horizontally and vertically
SLOPE ANGLE	14.5% (3-42%)
SOIL PARENT MATERIAL	Colluvium [80%]
COARSE FRAGMENTS	12.5% (7-19%) cover on surface, 51.1% (29-67%) by volume in soil
SOIL DEPTH	83 cm (60-143 cm); 32.8 in (24-56 in)
MOLLIC THICKNESS	11 cm (8-14 cm); 4.1 in (3-6 in)
TEXTURE	Loamy surface (clay loam-sandy loam-loam); more clayey subsurface (clay-sandy clay loam-clay loam)
SOIL CLASSIFICATION	Eutroboralfs [75%] or Argiborolls [25%]
TOTAL LIVE COVER	103.6% (48.0-138.2%)
NUMBER OF SPECIES	30.0 (24-38)
TOTAL LIVE COVER/NO. SPECIES	3.6% (1.4-5.7%)
CLIMATE	In locations of deep rainshadow, either in deep-rainshadow macroclimates such as the Cochetopa Creek watershed, or else just east of large mountain masses, microclimate dry to very dry, low precipitation. Warm to very warm, moderately to highly exposed to sun, slightly exposed to wind.
WATER	Very dry microclimate, but vegetation cover and coarse fragments hold some moisture through the season on better-condition sites. No permanent water on or near sites.

Key to Community Types

1. Arizona fescue always present and >15% cover. Mountain muhly sometimes >20% cover. Total graminoid cover >30% ..... **A**
1. Arizona fescue absent or <10% cover. Mountain muhly always <20% cover. Total graminoid cover <30%..... **B**

Description of Community Types

A *Ponderosa pine-Arizona fescue-mountain muhly* has conspicuous Arizona fescue in the understory, and often mountain muhly as well. Sagebrush is inconspicuous. Total graminoid cover is >30%.

B *Ponderosa pine-big sagebrush-sparse*. Big sagebrush is sometimes prominent. All graminoids are sparse, but sometimes mountain muhly is conspicuous. Total graminoid cover is <30%.

Table 02-7. Community types within *Ponderosa pine/Arizona fescue–Light-colored clay soils*.

CT	No. Samples	Elevation, ft Slope, %	Coarse, % Depth, cm Mollic Depth, cm	Surface Coarse, % Bare, % Seral Stage	Lr	Layer Height, m	Avg Lyr Cvr %	Cover, %: Trees Shrubs Gramin. Forbs	No. Species Total Live Cover, % TLC/NS, %	Obstruction %: 1.5-2.0 m 1.0-1.5 m 0.5-1.0 m 0.0-0.5 m Total<2m
A. Ponderosa pine-Arizona fescue-mountain muhly	5	9,514 (8,900-10,060) 17.6 (3-42)	53 (29-67) 88 (60-143) 11 (8-14)	12 (7-16) 6 (1-10) PN	T1 T2 T3 S1 S2 GF M L	15 (4-25) 8 (2.0-10) 2.3 (0.1-4.0) 1.1 (0.3-2.0) 0.3 (0.0-0.8) 0.2 (0.0-0.6) 0.0 0.0	48.4 4.8 1.4 13.3 0.2 41.4 0.2 1.2	50 (37-69) 6 (1-12) 49 (37-57) 13 (4-32)	30 (26-34) 118 (101-138) 4.0 (3.4-5.1)	30 (0-65) 27 (5-60) 25 (5-65) 47 (10-80) 32 (5-68)
B. Ponderosa pine-big sagebrush-sparse	3	8,863 (8,460-9,370) 9.2 (6-11)	45 (45-45) 69 (69-69) 8 (8-8)	10 (2-19) 26 (1-52) EM	*			28 (1-50) 23 (0-67) 17 (12-27) 12 (2-23)	30 (24-38) 80 (48-138) 3.0 (1.4-5.7)	25 25 25 50 31

*. Unknown: measurements were not taken in this CT.

Table 02-8. Resource Values for *Tree juniper–Coarse dark soils–Steep southerly*. Resource values were calculated from the numbers in Table 02-7, relative to the whole UGB.

The numbers in this table can be translated: 0 = Very Low, 1 = Low, 2 = Moderately Low, 3 = Moderate, 4 = Moderately High, 5 = High, and 6 = Very High.

	Community Type	
Resource Value	**A**	**B**
Potential Cattle Forage Production	3-4	2
Grazing Suitability	3-4	2
Timber Suitability	2	1-2
Potential Timber Production	3	2-3
Developed Recreation	3-4	3
Dispersed Recreation	3-4	3
Scenic	3	3
Road & Trail Stability	4	4
Construction Suitability	4	3
Deer & Elk Hiding Cover	3	3
Deer & Elk Forage & Browse	2	1
Sage Grouse Cover	3	3
Sage Grouse Lek Potential	0-1	0-1
Sage Grouse Nesting/Brood Potential	0-1	0-1
Sage Grouse Summer Potential	0-1	0-1
Need for Watershed Protection	1	1
Soil Stability	4-5	4
Risk of Soil Loss-Natural	1	1
Risk of Soil Loss-Management	1-2	1-2
Risk of Permanent Depletion-Range	3-4	3-4
Risk of Permanent Depletion-Wildlife	2	2
Resource Cost of Management	2-3	2-3
Cost of Rehabilitation	3	3

A typical ponderosa pine/Arizona fescue–mountain muhly stand, above Cochetopa Park in the southeast corner of the UGB. Relatively late seral, Community Type A. Ponderosa pine 69% cover, mountain muhly 26%, Arizona fescue 25%, wax currant 8%. Characteristic vegetation of a dry, rainshadow, cool microclimate. Coarse Fragment Cover = 14%, Total Live Cover = 138%, Coarse Fragments in Soil = 51. Soil sampled as a Typic Argiboroll, Clayey-Skeletal, Mixed. North Pass Quadrangle, elevation 10,060 ft, 42% 127° (SE) slope. September 14, 1994.

Table 02-9. Common Species in *Ponderosa pine/Arizona fescue–Light-colored clay soils*, where Characteristic cover > 10% or Constancy > 20%. "–" means that the species is not found. Dead cover is not listed. Ccv = Characteristic Cover, Con = Constancy. If Avc = Average Cover, then these are related using the formula Avc = Ccv•100%/Con.

		COMMUNITY TYPE			
		A	B	C	
		Ccv(Con)	Ccv(Con)	Ccv(Con)	
Code	Species	N = 3	2	3	Common Name
	TREES				
JUSC2	Juniperus scopulorum	55 (100)	23 (100)	16 (100)	Rocky Mountain juniper
PSME	Pseudotsuga menziesii	T (67)	T (50)	T (33)	Douglas-fir
	SHRUBS				
ARTR2	Artemisia tridentata	8 (100)	14 (100)	6 (100)	big sagebrush
CHVI8	Chrysothamnus viscidiflorus	– –	6 (50)	4 (67)	Douglas rabbitbrush
ECTR	Echinocereus triglochidiatus	T (33)	T (50)	– –	hedgehog cactus
GUSA2	Gutierrezia sarothrae	T (67)	T (50)	T (67)	broom snakeweed
PUTR2	Purshia tridentata	1 (67)	3 (50)	1 (67)	antelope bitterbrush
RHART	Rhus aromatica ssp. trilobata	T (33)	T (50)	T (33)	skunkbrush
RIIN2	Ribes inerme	T (33)	– –	T (67)	whitestem currant
SYRO	Symphoricarpos rotundifolius	1 (33)	T (50)	3 (67)	mountain snowberry
	GRAMINOIDS				
ACHY	Achnatherum hymenoides	T (67)	1 (100)	8 (100)	Indian ricegrass
ACPI2	Achnatherum pinetorum	2 (33)	1 (100)	2 (67)	pine needlegrass
CAGE	Carex geophila	1 (33)	– –	1 (67)	dryland sedge
CAPEH	Carex pensylvanica ssp. heliophila	10 (33)	– –	– –	sun sedge
CHGR15	Chondrosum gracile	5 (100)	20 (100)	2 (67)	blue grama
ELEL5	Elymus elymoides	7 (100)	11 (100)	3 (100)	bottlebrush squirreltail
FEAR2	Festuca arizonica	1 (67)	4 (100)	3 (33)	Arizona fescue
HECO26	Hesperostipa comata	T (67)	– –	– –	needle-and-thread
JUSA	Juncus saximontanus	– –	– –	15 (33)	Rocky Mountain rush
KOMA	Koeleria macrantha	2 (67)	9 (50)	– –	prairie junegrass
MUMO	Muhlenbergia montana	T (33)	T (50)	T (67)	mountain muhly
PASM	Pascopyrum smithii	– –	– –	1 (67)	western wheatgrass
PIMI7	Piptatherum micranthum	8 (100)	1 (50)	1 (33)	littleseed ricegrass
POFE	Poa fendleriana	20 (100)	6 (100)	8 (67)	muttongrass
	FORBS				
ANSE4	Androsace septentrionalis	T (33)	– –	T (33)	northern rock-jasmine
ARFR4	Artemisia frigida	1 (67)	2 (100)	1 (67)	fringed sagewort
BOFE	Boechera fendleri	– –	T (50)	1 (33)	false-arabis
CALI4	Castilleja linariifolia	– –	1 (50)	T (33)	Wyoming paintbrush
CHDO	Chaenactis douglasii	– –	T (50)	T (33)	pincushion
CHENO	Chenopodium	1 (33)	– –	1 (33)	goosefoot
EREA	Erigeron eatonii	– –	1 (50)	T (33)	Eaton fleabane
PECA4	Penstemon caespitosus	– –	T (50)	T (67)	beardtongue
PHHO	Phlox hoodii	– –	3 (50)	1 (100)	Hood's phlox
PHRO4	Physaria rollinsii	– –	– –	T (67)	Rollins' twinpod
	GROUND COVER				
BARESO	bare soil	6 (100)	10 (100)	12 (100)	
LITTER	litter and duff	44 (100)	37 (100)	31 (100)	
GRAVEL	gravel 0.2-10 cm	4	20	15	
COBBLE	cobble 10-25 cm	17 (67)	6 (100)	15 (100)	
STONES	stone > 25 cm	30 (100)	5 (100)	14 (100)	
MOSSON	moss on soil	3 (33)	– –	1 (33)	
LICHENS	lichens on soil	–	–	–	

Ponderosa pine/bitterbrush–Moderately deep to shallow Haploborolls–
Gentle convex mesas and ridges, 8,300-9,400 ft

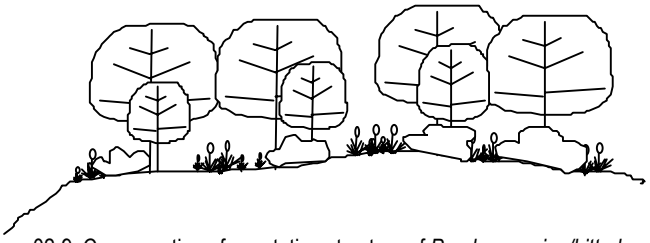

Figure 02-9. Cross-section of vegetation structure of *Ponderosa pine/bitterbrush–Dark soils with no clay layer*. Aspects are non-northerly, and slopes average 19%.

Ponderosa pine/bitterbrush–Dark soils with no clay layer is a moderately common type on gentle mesas and ridges in the UGB. It is characterized by a moderately sparse to moderately dense canopy of ponderosa pine (PIPO), with a mixed layer of bitterbrush (PUTR2) and big sagebrush (ARTR2) under and around the canopies, and muttongrass (POFE) as well; see Table 02-11 for common species names and codes.

Sometimes aspen (POTR5) shares the canopy with ponderosa pine in moister stands. Douglas-fir and other conifers are absent or <0.1% cover and do not reproduce. Neither lodgepole pine (PICO) nor Thurber fescue (FETH) are present, testifying to the warm character of this type. Ecotones are usually to one of the big sagebrush types on gentler slopes, or to Douglas-fir forests on more protected slopes.

The soils of this type have no Argillic horizon (clay-accumulation layer), and are often shallow to rock (Lithic). The subsurface is always sandier than the surface.

Ponderosa pine/Arizona fescue–Light-colored clay soils, a different but related type, lacks bitterbrush. *Douglas-fir/bitterbrush–Gentle slopes* is more closely related, but has Douglas-fir reproduction. The plant association *Pinus ponderosa/Purshia tridentata* (Youngblood and Mauk 1985) as described here is phase *Festuca arizonica-Muhlenbergia montana*, a different phase (with Arizona fescue, mountain muhly, elk sedge) from the classic *Pinus ponderosa/Purshia tridentata* of Daubenmire (1952), which has Idaho fescue. *Pinus ponderosa/Purshia tridentata* phase *Populus tremuloides-Carex geyeri* is described as new here, and is similar to (maybe the same as) *Pinus ponderosa/Purshia tridentata* described by Hess (1981) from the Colorado Front Range (Peet 1975, Hess and Alexander 1986).

Some stands are suitable for timber production, except where past logging has eliminated pine reproduction, as in community type B.

This type falls into Fire Group 5, the warm, moist ponderosa pine habitat types (Crane 1982). In stands which support bitterbrush (PUTR2), burning favors graminoids and forbs over bitterbrush, improving forage for cattle and elk over deer browse (Hess and Alexander 1986). The presence of kinnikinnick and Oregon-grape in some stands indicates that such stands may have originated as mixed Douglas-fir-ponderosa pine/bitterbrush in which wildfire eliminated the less fire-tolerant Douglas-fir many decades ago.

All stands are suitable for cattle forage. Moderately heavy to heavy grazing by cattle, sheep, deer, elk, antelope, or bighorn sheep tends to increase sagebrush and bare soil. Major disturbance factors include cattle grazing, browsing by deer and elk, campground and housing development. Logging has removed (or partially removed) the overstory in many stands, which leads to invasion by sagebrush and some increases in herbaceous production, particularly of sun-loving species such as Arizona fescue and mountain muhly. Sometimes the increase in production is hard to see, because the stands are then more attractive to cattle and deer.

Most stands have moderate deer hiding cover, moderate deer forage and browse, but low elk forage and browse. Big game use these stands mostly in late fall and spring, but rarely in the winter, where stands are adjacent to their winter range.

Horizontal obstruction is moderately low in most stands, so hiding cover potential for deer and elk is low to moderately low in mild winters. Mule deer and elk use sites for resting and cover during winters (low use). Mule deer use sites for overnight during spring through fall, but elk use is low during this time. The sites are useful for sage grouse mainly as summer range, when their use is moderate; spring and nesting use is low. See Table 02-10 for wildlife preferences by community type.

Scenic value is rated moderate to high, and recreation value is high to moderately high for campground development or hunting.

Table 02-10. Wildlife values (relative to the whole UGB) for the principal wildlife species using *Ponderosa pine/bitterbrush–Dark soils with no clay layer.*			
	Sage Grouse	Mule Deer	Elk
CT	Season–Preference	Season–Preference	Season–Preference
A, B, C	Spring: Low Nesting: Low Summer: Moderate	Winter, Mild: Moderate (Cover, Rest) Winter, Severe: Low Spring/Fall–Moderate: (Overnight)	Winter, Mild: Low (Cover, Rest) Winter, Severe: Low Spring/Fall: Low

Summary of Ecological Type Characteristics

1. Explanation of symbols is found in Appendix A. Percentages in [brackets] indicate the percentage of plots sampled that have that characteristic.

NUMBER OF SAMPLES	11, soil descriptions from 5 of these (total 11)
ELEVATION	8,969 ft (8,360-9,400 ft); 2,734 m (2,548-2,865 m)
AVERAGE ASPECT	136°M (r = 0.38)
LITHOLOGY	Igneous, led by tuff [57%], breccia, granite, gneiss
FORMATIONS[1]	Fish Canyon Tuff - Taf [50%], Tp, Xg, Xfh
LANDFORMS	Mesas, ridges, and soil creep slopes
SLOPE POSITIONS	Mostly shoulders and summits [75%]
SLOPE SHAPES	Convex [67%] to linear horizontally, Linear [67%] to convex vertically
SLOPE ANGLE	19.2% (3-36%)
SOIL PARENT MATERIAL	Various: colluvium, residuum, or colluvium over residuum
COARSE FRAGMENTS	10.2% (1-33%) cover on surface, 52.5% (24-84%) by volume in soil
SOIL DEPTH	58 cm (38-115 cm) = 22.7 in (15-45 in)
MOLLIC THICKNESS	19 cm (6-30 cm) = 7.5 in (2-12 in)
TEXTURE	A variety of surface textures, but always sandier (loamy sand-sandy loam) subsurface
SOIL CLASSIFICATION	Haploborolls [67%], Ustorthents, and Ustochrepts; half of these are Lithic
TOTAL LIVE COVER	124.5% (62.0-177.0%)
NUMBER OF SPECIES	27.8 (12-47)
TOTAL LIVE COVER/NO. SPECIES	5.6% (1.6-14.8%)
CLIMATE	In moderate rainshadow. Warm, moderately exposed to sun, slightly exposed to wind.
WATER	Partially dry microclimate, vegetation cover and coarse fragments hold moisture through the season on better-condition sites. No permanent water on or near sites.

Key to Community Types

1. Ponderosa pine canopy >45% cover. Arizona fescue always present and >10% cover.....**A**
1. Ponderosa pine canopy <45% cover. Arizona fescue absent or <10% cover .....(2)

2. Ponderosa pine canopy 25-45% cover. Muttongrass <20% cover.....**B**
2. Ponderosa pine canopy <25% cover. Muttongrass >20% cover.....**C**

Description of Community Types

A *Ponderosa pine-bitterbrush-sagebrush-Arizona fescue* has a relatively dense pine canopy with 45- 60% cover and a conspicuous layer of bitterbrush underneath. Sagebrush is mixed with the bitterbrush, but sagebrush is always subordinate. Arizona fescue is prominent at 10-20% cover. Muttongrass is absent to inconspicuous, with <5% cover. This community appears to be a bitterbrush-sagebrush-fescue community with ponderosa pine added, apparently as a result of somewhat deeper, less-coarse soils.

B *Ponderosa pine-sagebrush-bitterbrush-muttongrass* has a less-dense pine canopy with 20 to 45% cover, with some bitterbrush; sometimes sagebrush is more prominent. Arizona fescue is absent to inconspicuous, <5% cover. Muttongrass is often prominent, 2 to 20% cover.

C *Ponderosa pine-muttongrass-sparse bitterbrush* has a sparser pine canopy at 10 to 25% cover, and less bitterbrush the other communities, which always has less cover than sagebrush. Muttongrass is prominent at >15% cover.

Table 02-11. Community types within *Ponderosa pine/bitterbrush–Dark soils with no clay layer*.

CT	No. Samples	Elevation, ft Slope, %	Coarse, % Depth, cm Mollic Depth, cm	Surface Coarse, % Bare, % Seral Stage	Lr	Layer Height, m	Avg Lyr Cvr %	Cover, %: Trees Shrubs Graminoids Forbs	No. Species Total Live Cover, % TLC/NS, %	Obstruction %: 1.5-2.0 m 1.0-1.5 m 0.5-1.0 m 0.0-0.5 m Total<2m
A. Ponderosa pine-bitterbrush-sagebrush-Arizona fescue	3	9,050 (8,870-9,400) 13.7 (3-32)	33 (24-49) 47 (40-62) 28 (25-30)	13 (1-33) 6 (2-14) PN	T1 T2 T3 S1 S2 GF M L	22 (18-25) 15 (6-21) 3.3 (0.1-12) 0.5 (0.2-0.9) 0.1 (0.0-0.4) 0.3 (0.0-1.1) 0.0 0.0	T 49.3 T 13.2 9.4 53.8 0.4 5.4	50 (46-56) 23 (19-26) 43 (33-51) 5 (3-6)	30 (29-32) 120 (109-136) 4.0 (3.4-4.5)	0 0 25 85 28
B. Ponderosa pine-sagebrush-bitterbrush-muttongrass	5	8,920 (8,360-9,340) 22.6 (10-36)	64 (46-84) 64 (38-115) 13 (6-20)	8 (3-17) 4 (1-9) MS	T1 T2 T3 S1 S2 GF M L	Missing 15 (13-20) 5 (1-12) 0.5 (0.3-0.9) 0.1 (0.0-0.3) 0.3 (0.0-1.2) Missing 0.0	M 40.5 3.1 23.9 9.1 45.3 M 0.3	39 (25-52) 33 (14-48) 31 (6-64) 14 (6-18)	35 (21-47) 118 (62-163) 3.8 (1.6-7.2)	24 (0-50) 20 (0-50) 20 (0-40) 49 (35-60) 28 (15-44)
C. Ponderosa pine-muttongrass-sparse bitterbrush	3	* *	* * *	40 * EM		*		29 (10-56) 29 (8-41) 50 (30-70) 32 (2-50)	14 (12-15) 140 (80-177) 10.5 (5.7-14.8)	*

*. Unknown: measurements were not taken in this CT.

Table 02-12. Resource Values for *Ponderosa pine/bitterbrush–Dark soils with no clay layer.*
Resource values were calculated from the numbers in Table 02-11, relative to the whole UGB.

The numbers in this table can be translated: 0 = Very Low, 1 = Low, 2 = Moderately Low, 3 = Moderate, 4 = Moderately High, 5 = High, and 6 = Very High.

	Community Type				Community Type		
Resource Value	**A**	**B**	**C**	**Resource Value**	**A**	**B**	**C**
Potential Cattle Forage Production	2-3	2-3	2	Sage Grouse Lek Potential	1-2	1-2	1
Grazing Suitability	3	3	2	Sage Grouse Nesting/Brood Potential	2-3	2-3	2
Timber Productivity	4 or 1-2[1]	4 or 1-2[1]	4 or 1-2[1]	Sage Grouse Summer Potential	3-4	3-4	3
Timber Suitability	3-4	3-4	3	Need for Watershed Protection	2	3	3
Developed Recreation	3	3	2	Soil Stability	3	2	3
Dispersed Recreation	3	3	2	Risk of Soil Loss-Natural	3	3	4
Scenic	3-4	3-4	3	Risk of Soil Loss-Management	2	3	3
Road & Trail Stability	3	3	2	Risk of Permanent Depletion-Range	3	3	2
Construction Suitability	3	3	1-2	Risk of Permanent Depletion-Wildlife	3	3	2
Deer & Elk Hiding Cover	2-3	2-3	2	Resource Cost of Management	3	3	2
Deer & Elk Forage & Browse	4	3	1-2	Cost of Rehabilitation	2	2	3
Sage Grouse Cover	3-4	3-4	3				

1. For Ponderosa Pine (PIPO)

View in a large, nearly flat (3% slope) ponderosa pine/bitterbrush stand on the upper end of Sapinero Mesa Road. Relatively late seral, Community Type A. Ponderosa pine 46% cover, mountain muhly 22%, Arizona fescue 15%, bitterbrush 13%, big sagebrush 4%. Coarse Fragments Cover = 5%, Total Live Cover = 115%, Coarse Fragments in Soil = 24. Soil sampled as a Lithic Haploboroll, Sandy-Skeletal, Mixed. Gateview Quadrangle, elevation 8,880 ft, 3% 078° (ENE) slope, August 19, 1993.

Table 02-13. Common Species in *Ponderosa pine/bitterbrush–Dark soils with no clay layer*, where Characteristic cover > 10% or Constancy > 20%. "–" means that the species is not found. Dead cover is not listed. Ccv = Characteristic Cover, Con = Constancy. If Avc = Average Cover, then these are related using the formula Avc = Ccv•100%/Con.

		COMMUNITY TYPE			
		A	B	C	
		Ccv(Con)	Ccv(Con)	Ccv(Con)	
Code	Species	N = 3	5	3	Common Name
	TREES				
PIPO	Pinus ponderosa	50 (100)	36 (100)	16 (100)	ponderosa pine
POTR5	Populus tremuloides	– –	3 (80)	40 (33)	quaking aspen
PSME	Pseudotsuga menziesii	T (33)	T (40)	– –	Douglas-fir
	SHRUBS				
AMAL2	Amelanchier alnifolia	1 (33)	T (20)	1 (33)	Saskatoon serviceberry
ARTR2	Artemisia tridentata	6 (100)	11 (100)	27 (67)	big sagebrush
CHNA2	Chrysothamnus nauseosus	2 (33)	1 (40)	– –	rubber rabbitbrush
CHVI8	Chrysothamnus viscidiflorus	1 (67)	3 (40)	– –	Douglas rabbitbrush
JUCO6	Juniperus communis	– –	5 (40)	3 (67)	common juniper
MARE11	Mahonia repens	T (33)	1 (60)	– –	Oregon-grape
PUTR2	Purshia tridentata	16 (100)	10 (100)	7 (100)	antelope bitterbrush
RICE	Ribes cereum	– –	– –	1 (100)	wax currant
ROWO	Rosa woodsii	– –	T (60)	– –	Woods rose
SYRO	Symphoricarpos rotundifolius	T (33)	11 (40)	1 (33)	mountain snowberry
	GRAMINOIDS				
CAGE	Carex geophila	5 (33)	– –	5 (67)	dryland sedge
CAGE2	Carex geyeri	– –	28 (40)	– –	elk sedge
DAPA2	Danthonia parryi	T (67)	1 (20)	– –	Parry oatgrass
ELEL5	Elymus elymoides	1 (100)	2 (60)	8 (67)	bottlebrush squirreltail
FEAR2	Festuca arizonica	25 (100)	3 (40)	– –	Arizona fescue
KOMA	Koeleria macrantha	2 (100)	4 (80)	– –	prairie junegrass
MUMO	Muhlenbergia montana	16 (67)	T (60)	25 (67)	mountain muhly
POFE	Poa fendleriana	1 (67)	9 (100)	20 (100)	muttongrass
	FORBS				
ACLA5	Achillea lanulosa	T (33)	1 (80)	– –	western yarrow
ALLIU	Allium	– –	– –	10 (67)	onion
ANPA4	Antennaria parvifolia	1 (33)	1 (20)	1 (33)	smallleaf pussytoes
ERCO24	Eremogone congesta	– –	2 (40)	25 (67)	desert sandwort
ERCO27	Erigeron concinnus	1 (100)	1 (40)	– –	Navajo fleabane
ERSU2	Erigeron subtrinervis	T (33)	1 (60)	– –	threenerve fleabane
GARA2	Gayophytum ramosissimum	– –	1 (60)	– –	hairstem ground smoke
HEVI4	Heterotheca villosa	– –	8 (20)	13 (67)	hairy golden aster
PECA4	Penstemon caespitosus	1 (67)	9 (40)	– –	beardtongue
	GROUND COVER				
BARESO	bare soil	6 (100)	4 (100)	– –	
LITTER	litter and duff	80 (100)	86 (100)	– –	
GRAVEL	gravel 0.2-10 cm	2	4	–	
COBBLE	cobble 10-25 cm	14 (33)	2 (80)	– –	
STONES	stone > 25 cm	5 (67)	2 (60)	– –	
MOSSON	moss on soil	1 (33)	– –	– –	
LICHENS	lichens on soil	8	1	–	