

**Field Stop #1 – Udall Park – Wet Mixed Conifer and Dry Mixed Conifer
Apache - Sitgreaves National Forest**

Purpose of Visit:

- Discuss classification and ecological differences between dry mixed conifer & wet mixed conifer forest types.
- Discuss the ecological processes associated with frequent fire/dry mixed conifer forest types.
- Discuss the concepts and various aspects of the wet mixed conifer desired conditions including: spatial scales for analysis and management.
- Discuss current conditions vs. desired conditions. Discuss the concepts and various aspects of the desired conditions including the degree of structural openness; the grass forb/shrub matrix; the size (area, number of trees), shape, and spacing of tree groups; the diversity and interspersions of tree structure (age and size) and composition, and the sustainability of the desired conditions.
- Discuss how key elements of the desired conditions relate to natural disturbances.
- View a dry mixed conifer forest site where the tree species composition and function has changed over time as a result of fire suppression.
- Discuss the value of the wet and dry mixed conifer desired conditions for wildlife habitat and food webs. Discuss the value of implementing the desired conditions for wildlife habitat and food webs in the dry mixed conifer.

Background:

- These sites represent contrasting wet and dry mixed conifer forests growing on highly-productive sites. This area has had fire exclusion since the early 1900's.
- Past management: Jim Y
- Discussion of what we know about mixed conifer forests: classification, ecology, and fire regimes.

Natural fire regimes of Southwestern forest types. Fire frequency refers to the mean number of years between fires, and fire severity relates to the effect of the fire on dominant overstory vegetation. Infrequent-fire forests (wet mixed-conifer and spruce-fir) are included for comparison to frequent-fire forests.

Forest Type (sub-type)	Fire Regime ¹		Fire Type ²	Forest Structure	Serai Species	Climax Species
	Fire Frequency	Fire Severity				
Ponderosa pine (all sub-types)	<u>Regime I</u> 0-35 years	Low	Surface	Uneven-aged, grouped, open	Dominant: ponderosa pine	Dominant: ponderosa pine
Dry mixed-conifer (warmer/drier)	<u>Regime I (common)</u> 0-35 years	Low	Surface	Uneven-aged, grouped, open	Dominant: ponderosa pine Subdominant: aspen and/or oak (in sub-stand scale patches)	Shade-intolerant species under fire dis-climax historic conditions. Dominant: ponderosa pine Subdominant: Douglas-fir and Southwestern white pine or
	<u>Regime III (rare)</u> 35-100+ years	Mixed	Mixed	Uneven-aged, patched, open		

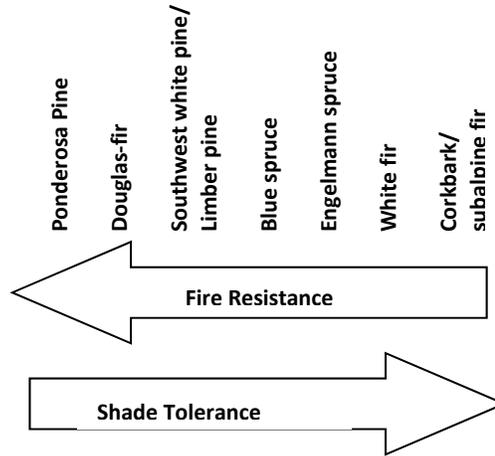
Wet mixed-conifer (cooler/wetter)	<u>Regime III (common)</u> 35-100+ years	Mixed	Mixed	Uneven-aged, patched, closed	Dominant (depending on habitat type): aspen or Douglas-fir	Shade tolerant species. Dominant (depending on habitat type): white fir and/or blue spruce
	<u>Regime IV (rare)</u> 35-100+ years	High	Stand-replacing	Even-aged, closed		
Spruce-fir (mixed, lower sub-alpine)	<u>Regime III and/or IV</u> 35-100+ years	Mixed / High	Mixed/stand-replacing	Even-aged, closed	Dominant (depending on habitat type): aspen or Douglas-fir	Shade tolerant species. Dominant (depending on habitat type): Engelmann spruce and/or white fir Shade tolerant species.
Spruce-fir (upper sub-alpine)	<u>Regime V</u> 200+ years	High	Stand-replacing	Even-aged, closed	Dominant (depending on habitat type): aspen, Douglas-fir, or Engelmann spruce	Dominant: Engelmann spruce and corkbark fir or sub-alpine fir

¹Schmidt et al. (2002)

²The Nature Conservancy (2006)



Relative shade and fire tolerance of common conifer tree species in mixed conifer and spruce-fir forests



Montane Forest Characteristics



Open forest

Trees aggregated in small groups, or random

Closed forest

Trees aggregated in large patches



Biophysical Site
Conditions

General Dry MC Reference Conditions:

Historical forest structural characteristics of dry mixed-conifer forests of the Southwest, arranged parent material and average tree density.

Location	Parent Material	Elev. ft	Size/Age Reported	Ref. date	TPA			BA (ft ² /ac)			Citation
					range	average	stderr	range	average	stderr	
AZ-Coconino, S. Francisco Peaks-E	Basalt	8318	Age	1892		20.9	3.4		39.6	3.9	Heinlein et al. 2005
AZ-Coconino, S. Francisco Peaks-W	Basalt	8318	Age	1876		21.0	1.7		54.0	6.1	Heinlein et al. 2005
AZ-A-S, Sitgreaves (max) ^a	Basalt	6300	Size	1910		31.0			66.9		Woolsey 1911
AZ-Coconino, S. Francisco Peaks	Basalt	9200	Age	1876		65.1	6.8		77.9	12.8	Cocke et al. 2005
AZ-A-S, Apache, Blue & White Mts. ^b	Basalt	8950	Size	1912		68.7			84.4		Greenamyre 1913
CO-San Juan, Middle Mtn.	Granitic	8520	Size	1870	51-59	57.3	4.0	43-60	47.9	4.6	Fulé et al. 2009
NM-Santa Fe, Jemez (max) ^a	Limestone	7013	Size	1910		35.6			91.2		Woolsey 1911
AZ-N. Kaibab, Kaibab Plateau ^c	Limestone	7500	Size	1909		45.3			60.7		Lang and Stewart 1910
NM-Lincoln, Alamo (max) ^a	Limestone	8650	Size	1910		46.5			97.9		Woolsey 1911
NM-Gila, Gila ^a	Limestone	9055	Age/Size	1890		65.6					Moore et al. 2004
NM-Santa Fe, Jemez ^a	Limestone	7825	Age/Size	1890	66-112	88.8	23.2				Moore et al. 2004
AZ-N. GCNP ¹ , Little Park	Limestone	8640	Age	1880		98.3	5.8		76.7	9.1	Fulé et al. 2003
AZ-N. GCNP, Swamp Ridge	Limestone	8143	Age	1879	36-151	99.4	5.2	65-235	124.1	7.8	Fulé et al. 2002
CO-Uncompahgre, Uncompahgre Plateau	Shale	8000	Size	1875	30-110	60		25-130	70		Binkley et al. 2008

Minimum tree DBH recorded = 3.5in.^a, 4in.^b, 6in.^c

¹Grand Canyon National Park

From: A management framework for restoring resiliency and sustainability of frequent-fire forests in the Southwest, USDA Forest Service, in draft 2012.

Udall Park Site –Wet (infrequent fire) Mixed Conifer
Plant Association (site classification)

Engelmann spruce/Sprucefir fleabane (*Picea engelmannii/Erigeron eximius*)

(Formerly: *Engelmann spruce/Forest fleabane PIEN/EREX*)

Synonyms: *Picea pungens*-P. *Engelmannii/Erigeron superbus* (Moir and Ludwig 1979).

Code(s) typic phase 0 04 31 0

Key Criteria

*Engelmann spruce and Douglas-fir are climax dominants. Other mixed conifer species are present as minor climax and/or seral trees. Herbage coverage ranges from 19 to 102%. Spruce fir fleabane is present along with other dominant forbs. Ponderosa pine and corkbark fir may be accidental species.

Structure

The overstory is a moderate to dense cover of mixed coniferous trees. Engelmann spruce and Douglas-fir codominate. White fir and southwestern white pine are sometimes abundant as reproduction but never in larger size classes. Corkbark fir is also present as reproduction, but rarely as a mature tree. Blue spruce can be present throughout the elevation range of most slopes and aspects. Stands without blue spruce mostly occur on steep northeast-facing mid to upper slopes above 9,000 feet (2743 m). Where blue spruce is absent, graminoids cover = <14%, forb cover = <30%, and total herb cover = <45%. Also, on gentle slopes sprucefir fleabane increases to 20% cover. Where blue spruce is a minor climax tree, herbaceous cover is greater in all three categories. (Fitzhugh et al. 1987). Mathiasen et al. (1986) reported a mean site index for Douglas-fir of 76.2 +/-17.0 (N = 28 stands). Stockability = 1.

Location

This type occurs on gentle to steep slopes on all aspects; also lower slopes of canyon drainages; elevations range from 8,850 [>8,100' in canyons] to 10,000' (2,655 to 3,000 m); widespread throughout mountains from central Arizona to southwestern and central New Mexico into the Jemez Mountains of northern New Mexico and into southern Colorado.

Adjacent plant associations

In White Mountains, moister sites support PIEN/SECA while PSME/BRCI may be intermixed. Other stands at lower elevations and drier sites may support ABCO/MUVI, PIPU/FEAR, ABCO/Sparse or PIPU/EREX4.

Also see

ABBI/EREX4 if corkbark fir has common reproduction and is surviving. ABCO/EREX4 or ABCO/ACGL if blue spruce is minor as regeneration relative to white fir and Douglas-fir in mature stands. PIPU/EREX4.

Trees & Life History Traits

*Engelmann spruce	C	blue spruce (<i>Picea pungens</i>)	s
Douglas-fir (<i>Pseudotsuga menziesii</i>)	C	southwestern white pine (<i>Pinus strobiformis</i>)	
aspen (<i>Populus tremuloides</i>)	[early to mid-seral]	[south]	s
white fir (<i>Abies concolor</i>)	c	limber pine (<i>Pinus flexilis</i>)	[north] s

Shrubs

Poorly represented (<5% cover):	Rocky Mountain maple (<i>Acer glabrum</i>)
thimbleberry (<i>Rubus parviflorus</i>)	mountain ninebark (<i>Physocarpus monogynus</i>)

Herbs

Abundant (>25% cover) to luxuriant (>50% cover):	Arizona peavine (<i>Lathyrus lanszwertii</i> var <i>arizonica</i>)
fringed brome (<i>Bromus ciliatus</i>)	sprucefir fleabane (<i>Erigeron eximius</i>)
dryspike sedge (<i>Carex foenea</i>)	nodding ragwort (<i>Senecio biglovii</i>)
Rocky Mountain trisetum (<i>Trisetum montanum</i>)	stray false Solomon seal (<i>Maianthemum stellatum</i>)
Richardson geranium (<i>Geranium richardsonii</i>)	

Fendler meadowrue (*Thalictrum fendleri*)
mountain thermopsis (*Thermopsis rhombifolia* var
montana)
Parry goldenrod (*Solidago parryi*)
bluntseed sweetroot (*Osmorhiza depauperata*)
Porter licoriceroot (*Ligusticum porteri*)
American vetch (*Vicia americana*)

Virginia strawberry (*Fragaria virginiana* var
virginiana)
alpine false springparsley (*Pseudocymopterus*
montanus)
Canadian white violet (*Viola canadensis*)
western brackenfern (*Pteridium aquilinum*)

Brief Plant ID Notes

Sprucefir fleabane is often difficult to identify in the field because of its short flowering season and close resemblance (basal leaves) to other species. The mix of forbs may be the most useful in recognizing this plant association.

Synonymy

dryspike sedge (*Carex foenea*) = fony sedge
Arizona peavine (*Lathyrus lanszwertii* var *arizonica* = *Lathyrus arizonica*)
starry false Solomon seal (*Maianthemum stellatum* = *Smilacina stellata*)
mountain thermopsis (*Thermopsis rhombifolia* var *montana* = *Thermopsis montana*)
Parry goldenrod (*Solidago parryi* = *Haplopappus parryi* = *Oreochrysum parryi*)
bluntseed sweetroot (*Osmorhiza depauperata*) = sweetcicily (*O. obtusa*)
Virginia strawberry (*Fragaria virginiana* var *virginiana*) = wild strawberry (*F. ovalis*)

Terrestrial Ecosystem Climate Class

Life Zone Class: 7 (subalpine forest)
Elevational Subzone: 0 (typical)
Climate Class: LSC (low sun cold)

Fire Ecology

Fire scars at bases of some trees indicated ground fires have occurred in some stands. Extensive aspen stands are probably the results of past “stand replacement” fires.

Reforestation

Cutting will probably favor Douglas-fir at the expense of both spruces (Muldavin et al. 1996). Heavy removal of overstory will first favor aspen followed by in-seeding of Douglas-fir and spruce. Engelmann spruce regenerates readily under cover. Experience has demonstrated that logging has resulted in establishment of white fir, western brackenfern and dryspike sedge (Fitzhugh et al. 1987.) Engelmann spruce and Douglas-fir seedlings have a high probability for survival. Most site preparation can enhance tree survival; however, high intensity mechanical methods are usually detrimental because of establishment of sod forming sedges and western brackenfern.

Revegetation Considerations

Natural revegetation is usually rapid due to rich herbaceous cover and presence of aspen.

Comments

Forage resource value rating for cattle in early seral conditions is high, and in late seral is medium to low. High cover and forage values make this excellent habitat for wildlife. This type can have high scenic potential when adjoining meadows, trails, or roads. It has potential for aspen management, and is important for snow retention. Locations along drainages enhance the importance of this plant association for watershed and fisheries management.
Budworm Susceptibility = 1.5.

Reference(s)

Fitzhugh et al. 1987, Mathiasen et al. 1986, Muldavin et al. 1996, USFS 1986, USFS 1987a

Udall Park Site –Dry (frequent fire) Mixed Conifer
Plant Association (site classification)

Blue spruce/Arizona fescue (*Picea pungens*/*Festuca arizonica*)

CODE(S) TYPIC PHASE 0 06 09 0

KEY CRITERIA

The overstory may contain varying mixtures of other species, but ***blue spruce** and Douglas-fir are codominant in the overstory. Ponderosa pine is a common seral tree, often persisting in late succession. Shrubs, although present, are usually scarce. The undergrowth is dominated by various bunch grasses with sedges often present; dominant graminoids such as Arizona fescue and screwleaf muhly are well represented (>5% cover).

STRUCTURE

Blue spruce and Douglas-fir are climax codominants, both reproducing successfully. Ponderosa pine is a early- or mid- seral tree and may codominant in older stands. Where white fir is present, its regeneration will be less than that of blue spruce. Aspen, if present, is found only locally in small short lived clones. All sizes and ages of conifers may be present and stands are well stocked (stockability = 1). Shrubs are minor. The ground vegetation is strongly herbaceous cover with bunch grasses dominating.

Timber productivity for this plant association is moderate for blue spruce, ponderosa pine and Douglas-fir. Limited average site index data for Douglas-fir is 48, N=4. Average site index for ponderosa pine may range from 50 to 60.

LOCATION

This type occurs on all slopes and aspects in elevations ranging from 7,560' to 9,120' (2,304 to 2,770 m). Above 9,000' (2,743 m), it is found on southerly aspects and in all positions on the slope. Below 8,300 feet (2,530 m), it occurs on northerly aspects of lower slopes. It is known from the White Mountains of Arizona, Mogollon and Jemez Mountains of New Mexico and the San Juan Mountains of New Mexico and Colorado.

ADJACENT PLANT ASSOCIATIONS

Drier sites support PSMEG/MUVI2 and PIPO/FEAR2; ABCO/FEAR2; on more moist sites: PIPU/EREX4, PIPU/CAFO3, and PIPU/COSES.

TREES & LIFE HISTORY TRAITS

blue spruce (<i>Picea pungens</i>)	C	white fir (<i>Abies concolor</i>)	c
Douglas-fir (<i>Pseudotsuga menziesii</i>)	C	aspen (<i>Populus tremuloides</i>)	s
ponderosa pine (<i>Pinus ponderosa</i>)	S	southwestern white pine (<i>Pinus strobiformis</i>)	s

SHRUBS

Scarce (<1% cover):	thimbleberry (<i>Rubus parviflorus</i>)
whitestem gooseberry (<i>Ribes inerme</i>)	whortleleaf snowberry (<i>Symphoricarpos oreophilus</i>)
wax currant (<i>Ribes cereum</i>)	
common juniper (<i>Juniperus communis</i>)	

HERBS

Abundant (>25% cover) sometimes luxuriant (>50% cover):	dryspike sedge (<i>Carex foenea</i>)
Arizona fescue (<i>Festuca arizonica</i>)	Ross sedge (<i>Carex rossii</i>)
mountain muhly (<i>Muhlenbergia montana</i>)	Parry danthonia (<i>Danthonia parryi</i>)
	fringed brome (<i>Bromus ciliatus</i>)

prairie junegrass (*Koeleria macrantha*)
bottlebrush squirreltail (*Elymus elymoides*)
beautiful fleabane (*Erigeron formosissimus*)
wooly cinquefoil (*Potentilla hippiana*)
mutton grass (*Poa fendleriana*)
screwleaf muhly (*Muhlenbergia virescens*)
Virginia strawberry (*Fragaria virginiana* ssp.
virginiana)
woodland strawberry (*Fragaria vesca* ssp.

americana)
western yarrow (*Achillea millefolium*)
pussytoes spp. (*Antennaria* spp.)
Parry goldenrod (*Solidago parryi*)
peavines (*Lathyrus* spp.)
beardlip penstemon (*Penstemon barbatus*)
“mountain parsley” (*Pseudocymopterus montana*)
Wooton ragwort (*Senecio wootonii*)
New Mexico groundsel (*Senecio neomexicana*)

CRYPTOGAMS

Mosses cover rock and bare soil. Little bare ground occurs due to moss plus litter cover.

BRIEF PLANT ID NOTES

Arizona fescue is a cool season, perennial bunchgrass with tightly rolled, narrow leaf blades and a multi-flowered panicle with somewhat flattened spikelets.

SYNONYMY

Virginia strawberry (*Fragaria virginiana* ssp. *virginiana* = *F. ovalis*)
western yarrow (*Achillea millefolium* var. *occidentalis* = *A. lanulosa*)
Parry goldenrod (*Solidago parryi* = *Haplopappus parryi* = *Oreochrysum parryi*)
sprucefir fleabane (*Erigeron eximius*) = forest fleabane (*E. superbus*)
bottlebrush squirreltail (*Elymus elymoides* = *Sitanion hystrix*)

TERRESTRIAL ECOSYSTEM CLIMATE CLASS

Life Zone Class: 6 (mixed conifer forest), **Elevational Subzone:** 0 (typic), **Climate Class:** LSC (low sun cold)

FIRE ECOLOGY

Presence of ponderosa pine and aspen stands scattered throughout the type is indicative of past fire occurrence. However, aspen may be absent from many stands and, where present, is found in small short-lived clones.

The dominance of many meadow species such as Arizona fescue and open, park-like forest structure suggest a high fire frequency in the past. Unpublished data at the Rocky Mountain Station indicates that most coniferous forests with grassy understories in the Southwest had as high fire frequencies as reported for PIPO/FEAR2. Cessation of understory burns during this century have resulted in: 1.) Increasing proportions of blue spruce and white fir in regeneration; 2.) Higher tree densities; 3.) Cessation of ponderosa pine regeneration; and 4.) Conversion of sun-loving herbs and graminoids to shade tolerant species such as dryspike sedge and sprucefir fleabane (Allen *et al.* 1995).

REFORESTATION

Timber harvest methods: heavy overstory removal encourages conifer regeneration. Clearcutting favors aspen and ponderosa pine. Tree seedlings should be planted promptly following disturbance to avoid grass competition. Heavy shelterwood cutting favors ponderosa pine and blue spruce regeneration. Seed tree harvest method is sometimes successful for regenerating ponderosa pine. Selection removal favors the more shade tolerant species, i.e. blue spruce. Light shelter favors Douglas-fir and blue spruce.

Although tree planting can be highly successful, grass competition, frost heaving, and lack of shade may make artificial reforestation extremely difficult. Recommended species for planting are ponderosa pine, Douglas-fir, and blue spruce. Planting success can be enhanced by high to low intensity burning and mechanical site preparation methods.

REVEGETATION CONSIDERATIONS: Natural revegetation after disturbance is usually rapid.

COMMENTS

PIPU/FEAR2 is the warmest and driest of the blue spruce forests.

Livestock and wildlife: The PIPU/FEAR2 plant association is productive, providing grasses for cattle and elk and forbs for sheep and deer. Forage value rating for cattle in early seral stage is high; late seral is low. As timber stands mature, Arizona fescue and mountain muhly decrease under the closing canopy. Interspersed openings remain productive. **Wildlife:** Aspen is important for wildlife cover and forage. PIPU/FEAR2 is usually a relatively poor site for aspen; therefore, in some areas, it may be necessary to perpetuate the aspen by harvesting or burning.

PIPU/FEAR2 plant associations exhibit high visual quality when adjoining meadows or roads (diversity of trees).

Budworm susceptibility: 1.

References: Allen *et al.* 1995, DeVelice *et al.* 1986, Fitzhugh *et al.* 1987, Johnston 1987, Pavek 1993, USFS 1986, 1987a

Discussion: where does this dry mixed conifer stand fit in the context of DCs, resilience and sustainability?

Field Stop #2, ERI Discussion – Dry Mixed Conifer, Apache – Sitgreaves National Forest

Purpose of Visit:

This stop is within an area of detailed study where fire scars have been collected as well as extensive field data. This information will be discussed as part of providing additional information into the ecological processes with frequent fire/dry mixed conifer forests. Items to discuss are:

- Utilizing collected fire scar data; a preliminary assessment of the fire history for the area will be presented.
- Utilizing stand data and reconstruction modeling, an overview of the presettlement structural conditions and changes linked to the disruption of the fire regime and historical timber harvesting.
- How the desired conditions relate to the science.

Background:

- Historical treatment for the area (management history); to be discussed on site. (Gail Richardson / Black Mesa)
- An overview of the study area, data collection, and subsequent analysis. (Dr. Dave Huffman)

Study Site Information; Presentation and Discussion; Dr. Dave H. – handouts provided.

Field Stop #3, Demo Mark, and Owl Management Dry Mixed Conifer, Apache – Sitgreaves National Forest

Purpose of Visit:

1. Look at and discuss a 16 acre marked, but not cut, stand where the desired conditions have been implemented.
2. Look at and have a discussion about MSO habitat and stand conditions.

This stop is a 16 acre demonstration mark where the desired conditions have been applied. Items to discuss are:

- Concepts and various aspects of the desired conditions (focus on the concepts and objectives of achieving the DC's, not on the details [this tree vs. that tree] of the mark).
- Forest entomology/pathology as they relate to implementation of the treatment prescription.
- Desired forest species composition for dry mixed conifer forests and relationships to ecological function.
- What went into achieving the desired conditions thru the mark (how the area was marked).

This stop will also provide a backdrop for a discussion of Spotted Owl management and the new recovery plan.

- Characteristics of dry mixed conifer and pine oak forests used by owls.
- Reasons behind habitat use.

Demonstration Area review:

Walk thru demonstration area (demo mark) in small groups and look at post treatment conditions to be accomplished thru mark.

- Spatial patterns
- Fine scale dispersion of tree groups
- Openings and opportunity for regeneration, grass/forb/shrub development; size, shape, and dispersion.
- How conditions relate to the desired ranges specified in the desired conditions.
- Discuss Forest entomology/pathology (reference and current conditions).
 - Understand how biological forest disturbance agents function in reference condition and contemporary forest landscapes.
 - Discuss implications for forest resilience and sustainability

Discussion of Owl management:

- Walk down into the draw below the marked area to look at threshold habitat.
- Discuss owl management and recovery plan.

Background:

Pretreatment Conditions

Rim Lakes Dry Mixed Conifer Site Classification/Demo Mark Information

White fir/Screwleaf muhly (*Abies concolor/Muhlenbergia virescens*)

CODE(S) TYPIC PHASE 0 01 06 0

KEY CRITERIA

***White fir** and Douglas-fir codominate but white fir may be poorly represented in the overstory. Ponderosa pine is a major seral tree usually having scattered old individuals in the overstory with sparse reproduction beneath. Southwestern white pine is often represented by young and advanced regeneration in the understory. Blue spruce may be accidental and is present in smaller size classes. Corkbark fir, Engelmann spruce, junipers and riparian tree species are absent. In the understory, coverage of shrubs is less than 5%. Gambel oak is a major shrub. ***Screwleaf muhly** dominates the grasses with more than 1% cover. In shaded microsites, screwleaf muhly may be reduced and other graminoids more strongly expressed. Forbs are also prominent in the herb layer.

STRUCTURE

White fir and Douglas-fir are the dominant forest species. White fir may be poorly represented (<5% cover) in the overstory. Both may be present in all age classes, if lacking in larger sizes, they will be well represented as regeneration. Ponderosa pine may be present as sparse regeneration and scattered old individuals as well. Southwestern white pine may be present in smaller age classes. In the understory, shrubs, except for Gambel oak, are minor or poorly represented (<5% cover). Both grasses and forbs are prominent in the herbaceous layer. Relative proportions of species vary with ground conditions.

Timber productivity is moderate for Douglas-fir, ponderosa pine, and southwestern white pine. Site index data are not available. Stockability = 1. Grass production is high in early seral stages. Shading due to canopy closure substantially decreases forage production.

LOCATION

This type occurs on ridges down to midslopes, all aspects, especially south; elevations range from 8,000' to 9,200' (2500 to 2800 m) and is known from the White Mountains of Arizona, and the Black Range and Mogollon Mountains of New Mexico.

ADJACENT PLANT ASSOCIATIONS

ABCO/MUVI adjoins herb rich blue spruce- Douglas-fir stands on moister sites. Dryer upslopes support PIPO/MUVI2 and at higher elevations are various phases of ABCO/QUGA, and lower elevations support PSME/MUVI2 type.

ALSO SEE

PSME/MUVI2 if white fir is accidental; ABCO/FEAR2 (USFS 1986a) if screwleaf muhly is absent; ABCO/QUGA, MUVI2 phase if Gambel oak (as trees or shrubs) >5% cover.

TREES & LIFE HISTORY TRAITS

white fir (<i>Abies concolor</i>)	C	southwestern white pine (<i>Pinus strobiformis</i>)	S
Douglas-fir (<i>Pseudotsuga menziesii</i>)	C	aspen (<i>Populus tremuloides</i>)	[early to mid] s
ponderosa pine (<i>Pinus ponderosa</i>)	S	Gambel oak (<i>Quercus gambelii</i>)	

SHRUBS

Scarce (<1% cover):	orange gooseberry (<i>Ribes pinetorum</i>)
Gambel oak (<i>Quercus gambelii</i>)	wildrose (<i>Rosa</i> spp.)

HERBS

Abundant (>25% cover) to luxuriant (>50% cover):

*screwleaf muhly (<i>Muhlenbergia virescens</i>)	sweetclover vetch (<i>Vicia pulchella</i>)
fringed brome (<i>Bromus ciliatus</i>)	western brackenfern (<i>Pteridium aquilinum</i>)
muttongrass (<i>Poa fendleriana</i>)	mountain thermopsis (<i>Thermopsis rhombifolia</i> var. <i>montana</i>)
Ross sedge (<i>Carex rossii</i>)	Wootton ragwort (<i>Senecio wootonii</i>)
bottlebrush squirreltail (<i>Elymus elymoides</i>)	New Mexico groundsel (<i>Senecio neomexicanus</i>)
silvery lupine (<i>Lupinus argenteus</i>)	Parry goldenrod (<i>Solidago parryi</i>)
grassleaf peavine (<i>Lathyrus graminifolius</i>)	Kentucky bluegrass (<i>Poa pratensis</i>) [on disturbed sites]
Arizona peavine (<i>Lathyrus lanszwertii</i> var. <i>arizonicus</i>)	

BRIEF PLANT ID NOTES

Screwleaf muhly is a robust bunchgrass with spirally curled dead leaf sheaths; individual "clumps" commonly grow to 12 to 18 inches in diameter.

SYNONYMY

bottlebrush squirreltail (*Elymus elymoides* = *Sitanion hystrix*)
Arizona peavine (*Lathyrus lanszwertii* var. *arizonicus* = *L. arizonicus*)

mountain thermopsis (*Thermopsis rhombifolia* var *montana* = *T. montana* = *T. pinetorum*)
Parry goldenrod (*Solidago parryi* = *Haplopappus parryi* = *Oreochrysum parryi*)

TERRESTRIAL ECOSYSTEM CLIMATE CLASS

Life Zone Class:6 (mixed conifer forest)

Elevational Subzone:0 (typical)

Climate Class:HSC (high sun cold)

FIRE ECOLOGY

Fire history is important in the succession of stands in this type (see discussion in PIPO/FEAR2.) With fire exclusion, white fir and Douglas-fir are more dominant and regeneration is dense. The erratic burning characteristics of fire create patchy mosaics of regeneration. Prior to this century, fire was a common thinning agent whether it merely killed younger, smaller trees at low intensities or consumed entire stands from high intensity crown fires. Low intensity surface fires can be a useful management tool to perpetuate ponderosa pine as the primary species.

REFORESTATION

Timber harvest methods: heavy overstory removal methods like clearcutting favor Douglas-fir and ponderosa pine regeneration, and locally in some areas, aspen. Seed tree cuts can be useful to encourage pines, especially in mistletoe infected areas. Lesser degrees of overstory removal such as heavy shelterwood favors the more shade tolerant white fir; while more aggressive shelterwood cuts favor ponderosa pine and Douglas-fir. Individual tree removal usually encourages white fir regeneration.

Site preparation techniques: High to moderate intensity burning may create conditions favorable for suckering of aspen. Low intensity surface fires can be a useful management tool. Low to high intensity mechanical methods such as scalping and pitting should reduce short-term competition from grasses and low shrubs.

REVEGETATION CONSIDERATIONS

Natural revegetation following disturbance is expected to be rapid primarily due to strong response of graminoids and forbs. Following removal of an overstory canopy, competition from rapidly growing shrubs and herbaceous species can present problems for restocking of ponderosa pine.

COMMENTS

Western brackenfern, silvery lupine, and Kentucky bluegrass increase in coverage when sites are disturbed by fire or repeated long-term heavy grazing. In dense pole stands the herbaceous layer is often sparse, but occasional screwleaf muhly clumps may persist.

ABCO/MUVI2 sites are subject to high evaporation, especially during the dry season from May through June; mean annual precipitation (MAP) = 26 - 27"/year.

Timber: This type is well adapted for timber management. Ponderosa pine usually regenerates naturally quite well in open stands. If managed for early seral species, such sites are capable of producing large, high quality ponderosa pine trees.

Livestock use: The forage value rating for cattle in early seral is high; diminishing to low in late seral due to shading by the overstory.

Wildlife: Mosaics of stands at different successional stages have wildlife benefits.

Budworm susceptibility = 1.5.

REFERENCES

Fitzhugh *et al.* 1987, Stuever 1995, USFS 1986, USFS 1987b

Rim Lakes Wet Mixed Conifer Site – MSO threshold habitat

White fir/sprucefir fleabane (*Abies concolor*/*Erigeron eximius*)
(Formerly: white fir/forest fleabane)

SYNONYMS: ABCO-PSME/EREX (JOHNSTON 1987).

CODE(S) TYPIC PHASE 0 01 03 0

KEY CRITERIA

Complex overstory where ***white fir** and Douglas-fir codominate; blue spruce and limber pine may be important; corkbark fir and Engelmann spruce may occur in frost pockets, ponderosa pine is accidental; and seral communities are dominated by aspen. The shrub component is less important than in the related ABCO/ACGL type. The herb layer is typically luxuriant; species diversity and cover high with sprucefir fleabane up to 30% cover.

STRUCTURE

Under fire exclusion conditions, at late succession, white fir and Douglas-fir are codominant in the overstory forming a closed canopy over a luxuriant understory. Young regeneration of white fir can be dense. Southwestern white pine is a prominent late seral associate. Not able to survive competition from more shade tolerant species, ponderosa pine is only occasionally present. Corkbark fir and Engelmann spruce are found in minor amounts often in frost pockets. The shrub layer is well represented by diverse species and may have coverage from 0 to 60%. Greater cover is expressed by grasses and forbs. Grasses are dominated by fringed brome and cover 6 to 95%. Forbs can cover 6 to 124%. Aspen and New Mexico locust dominate seral stands.

Timber productivity for white fir and Douglas-fir is moderate to good. Average site indices for Douglas-fir are reported as 72+/- 9 (N=28) (USFS 1987) and 81.2 +/-10.8 (N = 52) (Mathiasen *et al.* 1986).

Stockability = 1.

The forage value rating for cattle in early seral conditions is high; diminishing slightly in late seral stages to moderate forage production.

LOCATION

This type occurs on all aspects and on all slopes within elevations ranging from 8,700' to 9,700' (2,650 to 2,960 m) and is found locally in forests of Arizona and southern Utah; widespread in New Mexico and southern Colorado.

ADJACENT PLANT ASSOCIATIONS

Adjoining on drier sites: ABCO/QUGA; on moister sites: ABCO/ACGL; along stream channels: ABLA/JUMA

ALSO SEE

ABCO/ACGL is very similar but has less herb cover and may indicate more cobbly or stony soils. ABCO/RONE, CAFO3 phase usually does not have luxuriant herbs and often occurs on soils with high content of volcanic ash. ABCO/LALAA3 is similar but has a rich legume component (e.g. *Lathyrus* spp.) and ponderosa pine is of greater importance as a seral tree.

TREES & LIFE HISTORY TRAITS

white fir (*Abies concolor*) C

Douglas-fir (*Pseudotsuga menziesii*) C

aspen (*Populus tremuloides*) [early to mid] S

limber pine (*Pinus flexilis*) [in N. NM] s

southwestern white pine (*Pinus strobiformis*) s

SHRUBS

Scarce (<1% cover) to abundant (>25% cover)

Rocky Mountain maple (*Acer glabrum*)
Scouler willow (*Salix scouleriana*)
rockspirea (*Holodiscus dumosus*)
Gambel oak (*Quercus gambelii*)
[<5% cover]

orange gooseberry (*Ribes pinetorum*)
Arizona honeysuckle (*Lonicera arizonica*)
boxleaf myrtle (*Paxistima myrsinites*)
New Mexico locust (*Robinia neomexicana*)
whortleleaf snowberry (*Symphoricarpos oreophilus*)

HERBS

Luxuriant (>50% cover):

fringed brome (*Bromus ciliatus*)
sprucefir fleabane (*Erigeron eximius*)
Arizona valerian (*Valeriana arizonica*) [high cover in VAAR3 Phase]
western yarrow (*Achillea millefolium* var. *occidentalis*)
owlsclaws (*Dugaldia hoopsii*)
Parry goldenrod (*Solidago parryi*)
bittercress ragwort (*Senecio cardamine*)
Sacramento ragwort (*Senecio sacramentanus*)
[Sacramento Mountains]
Arizona peavine (*Lathyrus lanszwertii* var. *arizonicus*)
Richardson geranium (*Geranium richardsonii*)
sharpleaf valerian (*Valeriana acutiloba* var. *acutiloba*)
Virginia strawberry (*Fragaria virginiana* ssp.)

virginiana)
western yarrow (*Achillea millefolium* var. *occidentalis*)
ragweed sagebrush (*Artemisia franseroides*)
Canadian white violet (*Viola canadensis*)
ravine fescue (*Festuca sororia*)
dryspike sedge (*Carex foenea*)
Rocky Mountain trisetum (*Trisetum montanum*)
red baneberry (*Actaea rubra*)
bluntseed sweetroot (*Osmorhiza depauperata*)
Fendler meadowrue (*Thalictrum fendleri*)
feathery false Solomon seal (*Maianthemum racemosum*)
starry false Solomon seal (*Maianthemum stellatum*)
mountain thermopsis (*Thermopsis rhombifolia* var. *montana*)

BRIEF PLANT ID NOTES

The majority of the field season, sprucefir fleabane has a single spatula-shaped basal leaf, often growing in robust patches. Unfortunately this characteristic is common to many plants, especially composites. With a flower, this fleabane is still difficult to distinguish from some other fleabanes. When identifying this association, one often relies on the diversity and luxuriance of the herb understory.

SYNONYMY

sprucefir fleabane = forest fleabane (*Erigeron eximius* = *E. superbus*)
Parry goldenrod (*Solidago parryi* = *Haplopappus parryi* = *Oreochrysum parryi*)
Arizona peavine (*Lathyrus lanszwertii* var. *arizonicus* = *L. arizonicus*)
sharpleaf valerian (*Valeriana acutiloba* var. *acutiloba* = *V. capitata* var. *acutiloba*)
Virginia strawberry (*Fragaria virginiana* ssp. *virginiana* = *F. ovalis* = *F. canadensis*)
bluntseed sweetroot = sweetcicily (*Osmorhiza depauperata* = *O. obtusa*)
feathery false Solomon seal (*Maianthemum racemosum* = *Smilacina racemosa*)
starry false Solomon seal (*Maianthemum stellatum* = *Smilacina stellata*)
mountain thermopsis (*Thermopsis rhombifolia* var. *montana* = *T. montana* = *T. pinetorum*)
owlsclaws = orange sneezeweed (*Dugaldia hoopsii* = *Helenium hoopsii*)
bluntseed sweetroot = sweetcicily (*Osmorhiza depauperata* = *O. obtusa*)
feathery false Solomon seal (*Maianthemum racemosum* = *Smilacina racemosa*)
Utah serviceberry (*Amelanchier utahensis* ssp. *utahensis* = *A. alnifolia*)
black elderberry (*Sambucus racemosa* ssp. *pubens* var. *melanocarpa* = *Sambucus melanocarpa*)
Canadian brome (*Bromus canadensis* = *Bromopsis ciliata*)

TERRESTRIAL ECOSYSTEM CLIMATE CLASS

Life Zone Class:6 (mixed conifer forest)

Elevational Subzone:+1 (cool wet)

Climate Class:LSC (low sun cold)

PHASES

Muldavin *et al.* (1996) describes a *Valeriana arizonica* (VAAR) Phase occurring along the base of the Mogollon Rim, north central highlands of Arizona; on northerly aspects of lower ravine slopes at about 7,000 feet (2133 m). Similar to the typic phase, the VAAR Phase is distinguished in the understory where sprucefir fleabane is scarce (<1% cover) or is absent and Arizona valerian has high cover.

FIRE ECOLOGY

Fire is presumed to have been a major factor in historic development of stands in this plant association. Fires that are light to moderate intensity, erratic and infrequent tend to result in a diversity of stand structures within the type. Mosaics in forest structure are probably caused by erratic nature of past fires (Muldavin *et al.* 1996). Preliminary findings by Huckaby and Brown (1996) suggest fires are generally less frequent at higher elevations. On an ABCO/EREX4 site (Cosmic Ray), mean fire intervals were 31 +/- 28 years, with a range of 1 to 72 years between fires for the 17th through 19th centuries. For comparison, on a PSME/QUPA4 site (James Ridge) in the same study, the mean fire interval was 7 +/- 5 years, with a range of 2 - 17 years between fires.

Care may be required during logging and prescribed burning to prevent excessive increases in shrub density (Fitzhugh *et al.* 1987).

REFORESTATION

Timber harvest methods: heavy overstory removal favors Douglas-fir regeneration; clear cuts favor aspen and to a lesser degree, Douglas-fir; planting is usually required to assure conifer regeneration. Seed tree cuts are sometimes successful if Douglas-fir is the selected seed tree species. Shelterwood methods are generally successful, heavy cover favoring white fir, light cover favoring Douglas-fir. Successful regeneration of Douglas-fir in open situations is expected to be high; competition from rapidly growing shrubs can be expected following removal of overstory canopy. Lesser degrees of overstory removal such as selection cutting may be more favorable to white fir regeneration.

Site preparation techniques: High to moderate intensity burning may create conditions favorable for suckering of aspen. Low to moderate mechanical methods such as scalping and pitting should reduce short-term competition from grasses and low shrubs. High intensity mechanical methods may cause severe disturbance and drying to these deep, well watered soils.

REVEGETATION CONSIDERATIONS

Natural revegetation following disturbance is expected to be rapid due to recovery of graminoids and forbs and sprouting/suckering of aspen, Rocky Mountain maple or oak.

ABCO/EREX4 type is easily regenerated and is highly productive. Timber production is good where gentle slopes exist.

COMMENTS

This type provides good habitat (forage and cover) for large game, although heavy winter snow accumulations may limit access. Luxuriant understories have high visual appeal in mature stands along roads or bordering meadows. Budworm Susceptibility = 1.7.

REFERENCES

DeVelice *et al.* 1986, Fitzhugh *et al.* 1987, Huckaby & Brown 1996, Johnston 1987, Mathiasen *et al.* 1986, Moir and Ludwig 1979, Muldavin *et al.* 1996, Stuever 1995, Uchytel 1989, USFS 1986, USFS 1987a, USFS 1987b