

**INTERNATIONAL CLASSIFICATION OF
ECOLOGICAL COMMUNITIES:
TERRESTRIAL VEGETATION OF THE WESTERN
UNITED STATES**

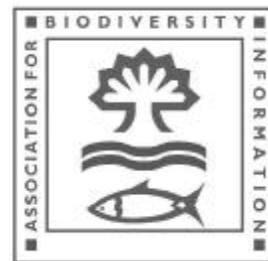
Chihuahuan Desert Subset

Report from
Biological Conservation Datasystem and
Excerpt from Working Draft of May 23, 2000

by
Community Ecology Group

ASSOCIATION FOR BIODIVERSITY INFORMATION/
THE NATURE CONSERVANCY
Western Resource Office
Boulder, CO

This subset of the Western Terrestrial Vegetation Classification covers vegetation alliances attributed to USFS Bailey's 1994 Section 321A. This community classification has been developed in consultation with many individuals and agencies and incorporates information from a variety of publications and other classifications. Comments and suggestions regarding the contents of this subset should be directed to Marion Reid <mreid@tnc.org>.



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Preface

This subset of the Western Terrestrial Vegetation Classification includes descriptions of Vegetation Alliances currently attributed to USFS Bailey's Section 321A. We acknowledge that it is not complete listing of all vegetation alliances that occur in this geographic area and request information on other vegetation types that occur so that we may assign them to these Bailey's Section.

Descriptions of all current alliances and well as lists of vegetation alliances attributed to each state in the Western US are available on the CD "Descriptions of Vegetation Alliances of the Western United States: Final Report 1999" sent to individual state programs of the SW Regional GAP Project.

Acknowledgments

This vegetation classification has been developed in consultation with many individuals and agencies and incorporates information from a variety of publications and other classifications. Comments and suggestions regarding the contents of this subset should be directed to Marion Reid <mreid@tnc.org>.

I. FOREST

I.A.8.N.b. Rounded-crowned temperate or subpolar needle-leaved evergreen forest

I.A.8.N.b.10. PINUS PONDEROSA FOREST ALLIANCE (A.124)

Ponderosa Pine Forest Alliance

ALLIANCE CONCEPT

Environment: These forests typically occur at the lowest elevations of the coniferous forest zone in western ranges. They range over 20 degrees of latitude, from Canada well into northwestern Mexico. These are among the driest forested habitats in the western United States, but quantity and timing of precipitation vary greatly across the range of this vegetation. Generally, these woodlands occur in areas which receive 25-60 cm of precipitation annually, with at least some seasonal drought, but they receive up to 150 cm in foothills of the Sierra Nevada and southern Cascades where summer drought is extreme. East of the Continental Divide and in the Southwest, summer precipitation predominates, whereas western stands receive most of their precipitation from westerly winter storms. Fire is a key factor in maintaining the relatively open canopies characteristic of these stands, but soil drought or infertility may be equally important in some areas. In the absence of fire some of these stands will succeed to other forest types. Elevations decrease with increasing latitude, from less than 1000 m in eastern Washington to over 2500 m in southern Arizona and New Mexico. Within the central Rocky Mountains, *Pinus ponderosa* grows at elevations between 1800 and 2600 m (6000 and 8500 feet) (Mehl 1992). In the Black Hills and northeastern Wyoming, it can be found from 1080 to 2100 m (3600-7000 feet). With increasing precipitation, these forests can occur at lower elevations, and lowland (<1000 m) stands exist in the eastern Great Plains and west of the Cascade-Sierra axis.

Soils are highly variable across the range of this type, and derived from igneous, metamorphic, and sedimentary materials. The most characteristic soil features are good aeration and drainage, circumneutral to slightly acid pH, an abundance of mineral material, and periods of drought during the growing season. Some stands may occur as edaphic climax communities on very skeletal, infertile, and/or excessively drained soils, such as cinder or lava fields. Adjacent vegetation is highly varied across the range of this type, but most commonly these communities grade into semi-arid *Pinus-Juniperus*, *Pinus-Quercus*, or *Pinus ponderosa* woodlands at the lower elevation margins and closed *Abies concolor*, *Picea engelmannii*, or *Pseudotsuga menziesii* forests at the upper elevation margins.

Physiognomy: These are forest stands of needle-leaved evergreen trees of 20-50 m in height. Pacific and southwestern stands often contain larger trees, whereas trees in the central Rocky Mountains are typically less than 30 m in height. Occasional emergent individuals may exceed 50 m in height in Pacific stands. Associated trees are typically needle-leaved evergreen species, but cold-deciduous and broad-leaved evergreen trees may form a subcanopy, particularly in Pacific or southwestern stands. The understory is typically dominated by cespitose graminoids in interior stands, but sclerophyllous or cold-deciduous shrubs are common west of the Sierra-Cascade axis.

Vegetation: The *Pinus ponderosa* Forest Alliance is not as widespread as the *Pinus ponderosa* Woodland Alliance. Associations dominated by either of the varieties, *Pinus ponderosa* var. *ponderosa* and *Pinus ponderosa* var. *scopulorum*, are included in this alliance. The overstory can be closed to moderately open depending upon geographic location and disturbance history. The alliance is characterized by the dominance of *Pinus ponderosa* in the overstory, and in some cases it can be the only mature tree present in the canopy. It may be the only tree species successfully regenerating, but in some stands there can be significant amounts of *Pseudotsuga menziesii* occurring as seedlings and saplings. Other conifers can be present in the canopy, but rarely with any abundance. Associated trees and understory species vary across the range of this alliance.

In the northern Rockies, Blue Mountains and as far east and south as northwestern Montana, central Utah, northern Colorado, and Wyoming, associated tree species may include *Populus tremuloides*, *Betula papyrifera*, *Quercus macrocarpa*, *Juniperus scopulorum*, *Picea glauca*, *Pinus flexilis*, and *Pseudotsuga menziesii*. Most associations have a well-developed shrub layer. Important dominant shrubs include *Arctostaphylos patula*, *A. viscida* (these two only in southwestern Oregon), *Mahonia repens*, *Physocarpus malvaceus*, *Ribes cereum*, *Spiraea betulifolia*, *Symphoricarpos albus*, *S. occidentalis*, *Amelanchier alnifolia*, *Philadelphus lewisii*, *Holodiscus discolor*, and *Symphoricarpos oreophilus*. The herbaceous layer in associations with shrubby understories is typically a mix (sometimes species rich) of perennial forbs and graminoids, averaging 25% to 30% cover, sometimes more. Important graminoids include *Festuca idahoensis*, *Festuca kingii*, *Calamagrostis rubescens*, and *Carex geyeri*. Forbs can include *Achillea millefolium*, *Campanula rotundifolia*, *Balsamorhiza sagittata*, *Galium boreale*, *Clematis columbiana*, *Lupinus argenteus*, *Moehringia macrophylla* (= *Arenaria macrophylla*), *Osmorhiza berteroi* (= *Osmorhiza chilensis*), *Erythronium grandiflorum*, and *Maianthemum racemosum* (= *Smilacina racemosa*). Nonvascular species are present, but not abundant. One association in this alliance has an understory with no

shrub layer, that is dominated by *Carex rossii*, with lesser amount of *Festuca kingii*, *Koeleria macrantha*, *Muhlenbergia montana*, *Achillea millefolium*, *Cerastium arvense*, and *Mertensia lanceolata*.

Forests of the Black Hills and the surrounding region have many similarities with Rocky Mountain stands, but contain unique species assemblages not found elsewhere. Tree associates include *Picea glauca*, *Quercus macrocarpa*, *Populus tremuloides*, *Betula papyrifera*, *Fraxinus pennsylvanica*, and *Juniperus scopulorum*. There is usually a well-developed shrub layer, often 1-2 m tall, with a layer of shorter shrubs underneath. Characteristic shrubs in these eastern stands include *Physocarpus monogynus*, *Amelanchier alnifolia*, *Juniperus communis*, *Spiraea betulifolia*, *Symphoricarpos albus*, *S. occidentalis*, *Shepherdia canadensis*, *Prunus virginiana*, *Arctostaphylos uva-ursi*, *A. adenotricha*, and species of *Ribes* and *Rosa*. Many stands have an herbaceous understory composed of species from the adjacent mixed-grass prairie, including *Carex filifolia*, *Stipa comata*, *Andropogon gerardii*, *Calamovilfa longifolia*, *Schizachne purpurascens*, *Danthonia* spp., and *Schizachyrium scoparium*. Forbs, such as *Balsamorhiza sagittata*, *Maianthemum stellatum*, *Achillea millefolium*, *Campanula rotundifolia*, *Galium boreale*, *Euthamia occidentalis* (= *Solidago occidentalis*) or *Apocynum* spp. may be locally abundant. Mosses and lichens do occur on the forest floor in some stands.

In western Texas, these forests are characterized by a canopy of *Pinus ponderosa* var. *scopulorum* and *Pinus strobiformis*. Other canopy species sometimes present include *Pseudotsuga menziesii* var. *glauca* and *Pinus edulis*. There may be a subcanopy of the broad-leaved deciduous *Quercus gambelii*. Herbs and shrubs are sparse, but may include *Piptochaetium fimbriatum*, *Lonicera albiflora*, *Holodiscus discolor*, *Carex geophila*, *Bromus anomalus*, *Amelanchier utahensis* and *Mahonia repens*. In grassy openings, typical species include *Muhlenbergia dubia*, *Koeleria macrantha*, *Festuca arizonica*, and *Bouteloua curtipendula*.

Dynamics: *Pinus ponderosa* is a drought-resistant, shade-intolerant conifer which usually occurs at lower treeline in the major ranges of the western United States. Historically, ground fires and drought were influential in maintaining open canopy conditions in these forests, and many may have actually been woodlands. With settlement and subsequent fire suppression, stands have become denser than they once were. Presently, many stands contain understories of more shade-tolerant species, such as *Pseudotsuga menziesii* and/or *Abies* spp., which may be affecting fuel loads and may alter future fire regimes.

Establishment is erratic and believed to be linked to periods of adequate soil moisture, good seed crops, and the availability of bare, unshaded mineral substrate. At drier sites, competition from adjacent grassland or shrubland vegetation can strongly affect seedling survival (Burns and Honkala 1990). In the Black Hills and western Sierra Nevada, conditions permit annual regeneration of these trees, and stands tend to be more densely stocked than elsewhere.

Similar Alliances:

- ?? PINUS PONDEROSA WOODLAND ALLIANCE (A.530)
- ?? PINUS PONDEROSA - PSEUDOTSUGA MENZIESII FOREST ALLIANCE (A.134)
- ?? PINUS PONDEROSA WOODED MEDIUM-TALL HERBACEOUS ALLIANCE (A.1495)
- ?? PINUS PONDEROSA WOODED TALL HERBACEOUS ALLIANCE (A.1488)
- ?? PINUS PONDEROSA SPARSELY VEGETATED ALLIANCE (A.1859)
- ?? PINUS PONDEROSA - POPULUS TREMULOIDES FOREST ALLIANCE (A.399)
- ?? PINUS PONDEROSA - PSEUDOTSUGA MENZIESII WOODLAND ALLIANCE (A.533)
- ?? PINUS PONDEROSA TEMPORARILY FLOODED WOODLAND ALLIANCE (A.565)
- ?? PINUS PONDEROSA - QUERCUS GARRYANA WOODLAND ALLIANCE (A.689)

Similar Alliance Comments: The *Pinus ponderosa* Forest Alliance is distinguished from other *Pinus ponderosa* alliances by the singular dominance of *Pinus ponderosa* in closed stands (>60 percent cover) occurring in non-wetland habitats.

Synonymy:

- ?? Interior Ponderosa Pine: 237, in part (Eyre 1980)
- ?? Pacific Ponderosa Pine: 245, in part (Eyre 1980)
- ?? Westside Ponderosa Pine Forest, in part (Holland 1986)
- ?? Ponderosa Pine Series, in part (Sawyer and Keeler-Wolf 1995)
- ?? Interior Ponderosa Pine - Front Range, in part (Mehl 1992)
- ?? Interior Ponderosa Pine - Black Hills, in part (Mehl 1992)
- ?? IA1b. Ponderosa Pine Forest, in part (Allard et al. 1990)
- ?? Ponderosa Pine Series, in part (Diamond 1993)

Comments: Open stands of this alliance can be difficult to distinguish from II.A.4.N.a.32 *Pinus ponderosa* Woodland Alliance (A.530). The woodlands tend to be drier. This is reflected in lesser amounts of mesophytic shrubs such as *Prunus virginiana*, *Mahonia repens*, *Spiraea betulifolia*, and *Symphoricarpos* spp., and an increase in graminoids typical of dry or dry-mesic prairies, such as *Schizachyrium scoparium*, *Bouteloua gracilis*, *Pseudoroegneria spicata*, and *Festuca idahoensis*. A few relatively mesic woodland associations can be very difficult to separate from forest associations. The classification status of all associations currently placed in the *Pinus ponderosa* Forest Alliance to be reviewed and verified.

ALLIANCE DISTRIBUTION

Range: The *Pinus ponderosa* Forest Alliance is not as widespread as the *Pinus Ponderosa* Woodland Alliance. The forests occur in scattered locations from northern California, eastern Oregon and Washington, across the northern Rockies of Idaho,

Wyoming and Montana, and into the Black Hills. They are also reported from central Utah and Colorado. East of the Rocky Mountains, they extend locally into western South Dakota, western Nebraska, and high elevations of west Texas. In the eastern part of its range, these forests contain a mixture of woodland and forest communities, with the former probably predominating at most low elevation sites. The alliance may reach into southern British Columbia as well. *Pinus ponderosa* grows in Mexico, but the presence of the *Pinus ponderosa* Forest Alliance has not been established.

States: CA,CO,ID,MT,NE,OR,SD,TX,UT,WA,WY

TNC Ecoregions: 10:C, 21:C, 24:C, 25:C, 26:C, 27:C, 9:C

USFS Ecoregions: 321A:CC, 331A:CC, 331D:CC, 331F:C?, 331G:CC, 332C:CC, 342I:CC, M242C:CC, M261A:CC, M261D:CC, M261G:CC, M313B:CC, M331B:CC, M331I:CC, M332A:CC, M332B:CC, M332D:CC, M332E:CC, M332G:CC, M333A:CC, M333B:CC, M333D:CC, M334A:CC

ALLIANCE SOURCES

Edition: 99-05-23

References: Alexander et al. 1986, Allard 1990, Atzet and Wheeler 1984, Atzet et al. 1996, Barbour and Major 1977, Burgess and Northington 1979, Burns et al. 1990, Clausnitzer and Zamora 1987, Cooper and Pfister 1985, Cooper et al. 1987, Daubenmire 1952, Daubenmire and Daubenmire 1968, DeVelice et al. 1986, Diamond 1993, Eyre 1980, Faber-Langendoen et al. 1996, Fisher and Clayton 1983, Franklin and Dyrness 1973, Franklin et al. 1972, Hall 1973, Hansen and Hoffman 1988, Head 1959, Hess 1981, Hess and Alexander 1986, Hoffman 1976, Hoffman and Alexander 1987, Holland 1986, Johnson and Clausnitzer 1992, Johnson and Simon 1987, Johnston 1987, Lynn et al. n.d., Madany and West 1984, Mclean 1970, Mehl 1992, Palmer 1929, Peet 1975, Peet 1981, Pfister et al. 1977, Progulske and Shideler 1974, Roberts 1980, Rummell 1951, Sawyer and Keeler-Wolf 1995, Schuller and Evans 1986, Steele et al. 1981, Terwilliger et al. 1979, Thilenius 1972, Tiedemann and Klock 1977, Tisdale and McLean 1957, Volland 1976, Washington Natural Heritage Program n.d., Wasser and Hess 1982, Williams and Lillybridge 1985, Williams and Lillybridge 1990, Williams and Smith 1990, Wyoming Natural Diversity Database 1990, Youngblood and Mauk 1985, Zamora 1983

I.A.8.N.c. Conical-crowned temperate or subpolar needle-leaved evergreen forest

I.A.8.N.c.17. ABIES CONCOLOR FOREST ALLIANCE (A.152)

White Fir Forest Alliance

ALLIANCE CONCEPT

Environment: These forests occur in mountain or foothill environments from the Siskiyou region of southwestern Oregon to the southern Rocky Mountain states. In Pacific Coast stands, these forests occur at relatively low elevations (370-1500 m) with most of the precipitation occurring as winter rain or snow. Southward in the Sierra Nevada, and throughout the southern Rocky Mountains, these forests occur at middle to high elevations (1200-3150 m) of major mountain ranges. Annual precipitation ranges from over 200 cm in the northern Sierra Nevada and Siskiyou Mountains to 75 cm or less in the southern Rocky Mountains. Summer "monsoonal" rainfall contributes substantial moisture in the southern Rocky Mountains and is minimal in the Sierra Nevada, which has dry summers. *Abies concolor*-dominated forests occupy a variety of topo-edaphic positions, such as lower and middle slopes of ravines, upper slopes at higher elevations, canyon sideslopes, along stream terraces, ridgetops, and north- and east-facing slopes which burn somewhat infrequently. Parent materials and soils are highly variable and nondefinitive for these forests. Temperature and moisture regimes appear to be the key factors in their distribution. Ecotones between *Abies concolor* forests and other vegetation types are complex. In the southern Rockies, *Pseudotsuga menziesii* forests occupy drier sites, *Abies lasiocarpa* forests occur on cooler sites, *Picea pungens* forests and woodlands are found in adjacent riparian or cool, moist locations, and *Pinus ponderosa* woodlands occupy the more xeric sites.

Physiognomy: These are closed, medium-statured to tall (20-50 m in height), multi-storied forests of needle-leaved evergreen trees. Occasionally, a subcanopy of broad-leaved evergreen or cold-deciduous trees may be present. Many densely stocked stands may have a somewhat depauperate understory, but more open stands often have a well-developed ericaceous or cold-deciduous shrub layer. The herbaceous layer is usually dominated by shade-tolerant forbs, but sod-forming or cespitose graminoids may also be common.

Vegetation: The species composition of associations in this alliance varies somewhat across the distribution of the alliance. In associations of southern Oregon and northwestern California, these are mixed conifer forests, in which *Abies concolor* is always present in either the canopy or in the tree regeneration layer. Other conifers, such as *Calocedrus decurrens*, *Pinus lambertiana*, *P. ponderosa*, *Pseudotsuga menziesii* are usually present in the canopy or understory. *Lithocarpus densiflorus* may occur in small stands or as scattered individuals throughout these forests. A distinctive group of cold-deciduous or sclerophyllous broad-leaved trees are sometimes common in these stands, including *Arbutus menziesii*, *Quercus kelloggii*, *Q. chrysolepis*, *Q. sadleriana*, and *Castanopsis chrysophylla*. Ericaceous or cold-deciduous shrubs are common, particularly in young or somewhat open stands. Recurrent species include *Amelanchier alnifolia*, *Arctostaphylos patula*, *A. uva-ursi*,

Ceanothus velutinus, *Gaultheria shallon*, *Holodiscus discolor*, *Mahonia nervosa*, *M. piperiana*, *Symphoricarpos mollis*, *S. albus*, *Q. vacciniifolia*, *Toxicodendron diversilobum*, *Rubus ursinus*, and *Vaccinium spp.* The herb layer is typically dominated by shade-tolerant forbs or ferns, including *Pyrola picta*, *Orthilia secunda*, *Chimaphila umbellata*, *Achlys triphylla*, *Polystichum munitum*, *Pteridium aquilinum*, and *Maianthemum stellatum*. Graminoids include *Bromus vulgaris*, *Elymus glaucus*, and *Festuca californica*.

In the Sierra Nevada and southern California ranges, these forests form an upper elevation phase of the mixed conifer forests of middle elevations. *Abies concolor* is typically dominant, but other conifers commonly present include *Pinus ponderosa*, *P. jeffreyi*, *P. lambertiana*, *P. monophylla*, *P. contorta*, *Calocedrus decurrens*, *Pseudotsuga menziesii*, *Abies magnifica*, and *Abies X shastensis*. Common hardwood associates include *Cornus nuttallii* and *Quercus kelloggii*. Ericaceous or cold-deciduous shrubs include *Arctostaphylos patula*, *A. nevadensis*, *Castanopsis sempervirens*, *Ceanothus prostratus*, *C. integerrimus*, *Rubus parviflorus*, *Prunus emarginata*, and *Salix scouleriana*. On the eastern slope of the Sierra Nevada, *Purshia tridentata* and *Artemisia tridentata* may be common. The herbaceous layer is composed largely of forbs, including *Asarum hartwegii*, *Clintonia uniflora*, *Lupinus latifolius*, *Adenocaulon bicolor*, *Sarcodes sanguinea*, and *Osmorhiza berteroi* (= *Osmorhiza chilensis*).

As in the Pacific Northwest, associations in the *Abies concolor* Forest Alliance in the southern Rocky Mountains and Colorado Plateau regions are mixed conifer forests of montane elevations. As many as seven conifers can be found growing together in the same stands. The successful reproduction of *Abies concolor* is always diagnostic, and often it is one of the codominant species in the canopy. Common conifer associates include *Pseudotsuga menziesii*, *Pinus ponderosa*, *Pinus flexilis*, *Pinus strobiformis*, *Abies lasiocarpa var. lasiocarpa*, *A. lasiocarpa var. arizonica*, *Juniperus scopulorum*, *Picea engelmannii*, and *P. pungens*. *Populus tremuloides* is occasionally present. The composition and proportions of these species is dependent upon the temperature and moisture relationships of the site, and the successional status of the stand (DeVelice et al. 1986, Muldavin et al. 1996). A tall-shrub or low-tree layer composed of cold-deciduous species may also be present, including *Acer glabrum*, *A. grandidentatum*, *Robinia neomexicana*, *Quercus gambelii*, or *Juglans major*. Locally abundant low to mid-stature shrubs include *Paxistima myrsinites*, *Vaccinium myrtillus*, *Mahonia repens*, *Symphoricarpos oreophilus*, *Juniperus communis*, *Jamesia americana*, *Arctostaphylos uva-ursi*, *Rubus parviflorus*, and *Holodiscus dumosus*. The herbaceous layer can either be graminoid or forb dominated. Important forbs include *Erigeron eximius*, *Geranium richardsonii*, *Thalictrum fendleri*, *Lathyrus lanszwertii*, *Pseudocymopterus montanus*, *Thermopsis rhombifolia*, *Valeriana arizonica*, *Maianthemum spp.* (= *Smilacina spp.*), and *Pteridium aquilinum*. Important graminoids include *Festuca arizonica*, *Bromus canadensis*, *Carex foenea*, *Carex rossii*, *Koeleria macrantha*, and *Poa fendleriana*.

Dynamics: In Oregon, the majority of these forests now have closed canopies, where in the past a moderately high fire frequency (20-30 years) formerly maintained an open forest of many conifers. With fire suppression, *Abies concolor* tends to replace many of the important conifers at lower elevation sites (Chappell et al. 1997). At higher elevations, the stands are naturally more closed and burn less frequently. Forb, shrub, and wildlife diversity varies greatly with the substrate (Chappell et al. 1997). In California and the southern Rockies, frequent ground fires restricted these forests to rather moist or less fire-prone areas. With fire suppression, *Abies concolor* has vigorously colonized many sites which were formerly occupied by open *Pinus ponderosa* woodlands. These invasions have dramatically changed the fuel load and potential behavior of fire in these forests. In particular, the potential for high-intensity crown fires has increased. In some areas of the Pacific ranges, hot, stand-replacing fires lead to establishment of dense chaparral thickets which germinate from buried seed. Such stands are highly competitive with coniferous forest species and may slow forest reestablishment.

Similar Alliances:

- ?? ABIES CONCOLOR GIANT FOREST ALLIANCE (A.103)
- ?? ABIES AMABILIS - ABIES CONCOLOR FOREST ALLIANCE (A.160)
- ?? ABIES CONCOLOR - POPULUS TREMULOIDES FOREST ALLIANCE (A.419)
- ?? ABIES CONCOLOR WOODLAND ALLIANCE (A.553)
- ?? ABIES CONCOLOR - ABIES X SHASTENSIS FOREST ALLIANCE (A.151)

Similar Alliance Comments: The *Abies concolor* Forest Alliance is distinguished from the similar alliances by the relatively closed tree canopy (>60 percent cover on average), and the dominance of *Abies concolor*. The *Abies concolor* Giant Forest is distinguished in that it has a tree canopy averaging over 50 m in height. In the *Abies amabilis* - *Abies concolor* Forest, and the *Abies concolor* - *Abies x shastensis* Forest Alliances, *A. concolor* shares canopy dominance with either *Abies amabilis* or *Abies x shastensis*. Alliance. In addition, the ranges of distribution of these three alliances overlap only in the region of the Klamath/Siskiyou Mountains of southwestern Oregon.

Synonymy:

- ?? Mixed conifer forest (*Abies-Pinus-Pseudotsuga*), # 5, in part (Kuchler 1964)
- ?? Sierra Nevada Mixed Conifer: 243, in part (Eyre 1980)
- ?? White Fir: 211, in part (Eyre 1980)
- ?? Interior Douglas-fir: 210, in part (Eyre 1980)
- ?? Spruce-Fir-Douglas-fir (*Picea-Abies-Pseudotsuga*), # 19, in part (Kuchler 1964)

Comments: Associations dominated by the Pacific form, *Abies concolor* var. *lowiana*, and the Rocky Mountain form, *A. concolor* var. *concolor*, are both contained in this alliance. Floristic and ecological differences may warrant splitting this alliance into two alliances, roughly corresponding to the Oregon and California distribution versus the Colorado Plateau and southern Rocky Mountains distribution. In addition, several associations currently placed in the *Abies concolor* Forest Alliance appear to be riparian associations, with seasonal flooding. These associations should be moved into an alliance within a formation representing riparian types. However, there is not currently a "riparian" *Abies concolor* alliance in the NVCS. Many associations have been identified in this alliance in California (Sawyer and Keeler-Wolf 1995). At present, none of them have been incorporated into the NVCS.

ALLIANCE DISTRIBUTION

Range: This forest alliance occurs in two major geographic regions. A Pacific coastal range extends from southern Oregon to southern California. A second interior range occurs from the highlands of western Arizona east to the Colorado Plateau and southern Rocky Mountains of Utah, Colorado and New Mexico. *Abies concolor* is found in the mountain ranges of northern Baja California, Mexico, but it is unknown whether the alliance occurs there.

States: AZ,CA,CO,NM,NV?,OR,UT

TNC Ecoregions:

USFS Ecoregions: 311:C, 313E:CC, 321A:CC, 331I:CC, 331J:CC, M242B:CC, M242C:CC, M261A:CC, M261D:CC, M261G:CC, M313A:CC, M313B:CC, M331C:CC, M331D:CC, M331E:CC, M331F:CC, M331G:CC, M341C:CC

ALLIANCE SOURCES

Edition: 98-07-15

References: Alexander et al. 1984, Alexander et al. 1987, Atzet and McCrimmon 1990, Atzet and Wheeler 1984, Atzet et al. 1996, Baker 1986, Baker 1989, Chappell et al. 1997, Conard and Radosovich 1982, DeVelice 1983, DeVelice and Ludwig 1983, DeVelice et al. 1986, Edwards 1987, Eyre 1980, Fitzhugh et al. 1987, Franklin and Dyrness 1973, Freeman and Dick-Peddie 1970, Heinze et al. 1962, Hopkins 1979, Johnston 1984, Johnston 1987, Kuchler 1964, Larson and Moir 1987, Madany and West 1984, Mauk and Henderson 1984, Moir and Ludwig 1979, Muldavin et al. 1986, Muldavin et al. 1987, Muldavin et al. 1996, Osborn et al. 1998, Pfister 1972, Roberts et al. 1992, Sawyer and Keeler-Wolf 1995, Szaro 1989, Volland 1976, Youngblood and Mauk 1985

I.A.8.N.c.22. PSEUDOTSUGA MENZIESII FOREST ALLIANCE (A.157)

Douglas-fir Forest Alliance

ALLIANCE CONCEPT

Environment: Forest associations within this alliance occur in two major distributions. The first is along the northwest Pacific slope in low elevation valleys of western Oregon and Washington, in scattered dry sites of the Olympics and western Cascades, and along the eastern slope of the Oregon and Washington Cascades. The second major distribution is in the Rocky Mountains, extending from the Okanogan Highlands and Blue Mountains of eastern Washington and Oregon south and east into the mountains of the Great Basin and into the Rocky Mountains from Montana south into northern Mexico.

The Pacific Northwest region has mild winter temperatures, cool to hot summers, and receives 75-250 cm of annual precipitation in a Mediterranean pattern of winter rain followed by summer drought. The majority of the precipitation falls as rain, but snowfall can be abundant at montane elevations. These forests occur along low to moderate elevation (0-1300 m) mountain slopes and valley margins, with an increasing affinity for moist topographic positions away from the coast and southward. They occupy sites where soil drought is induced by site features (shallow soils, sunny aspect) or local rain shadow effects that lessen precipitation. Generally these forests are in drier sites or zones than *Pseudotsuga menziesii* - *Abies grandis* forests but more moist sites or zones than *Pinus ponderosa* - *Pseudotsuga menziesii* woodlands. Contiguous vegetation is often *Quercus* spp. woodlands and savannas, chaparral, or annual grasslands at the xeric margin, and closed *Sequoia sempervirens*, or *Tsuga heterophylla* forests at the mesic margin.

Pseudotsuga menziesii forests found in the Rocky Mountains occur under a comparatively drier and more continental climate regime, and at higher elevations than in the Pacific Northwest. Elevations range from less than 1000 m in the northern Rocky Mountains to nearly 2900 m in the southern Rockies and plateaus of the southwest. Lower elevation stands typically occupy protected northern exposures or mesic ravines and canyons, often on steep slopes. At higher elevations, these forests occur primarily on southerly aspects or ridgetops. Precipitation ranges from 50-100 cm with moderate snowfall and with a greater proportion falling during the growing season. Monsoonal summer rains can contribute a significant proportion of the annual precipitation in Arizona, New Mexico, and Colorado. Adjacent vegetation is typically dominated by *Pinus ponderosa* or *Pinus flexilis* (in Idaho and Montana) on drier, warmer sites; *Picea* spp. on more moist sites; *Abies concolor* (in New Mexico and Arizona) or *Abies lasiocarpa* at higher, cooler sites. Montane grasslands and meadows may also occur in patches within these forests, or on adjacent dry slopes.

Soils are highly variable across the range of this alliance and derived from diverse parent materials. *Pseudotsuga menziesii* forests are reported by most studies (Lillybridge et al. 1995, Steele et al. 1981, Pfister et al. 1977, Mauk and Henderson 1984)

to show no particular affinities to geologic substrates. Rock types can include marine sediments in northern California and Oregon, glacial deposits in the Puget Sound, extrusive volcanics in the Cascades and Columbia Basin, and sedimentary rocks in the central and southern Rockies and the Colorado Plateau. The soils are typically slightly acidic (pH 5.0-6.0), well drained, and well aerated. They can be derived from moderately deep colluvium or shallow jointed bedrock, and are usually gravelly or rocky.

Physiognomy: These forests are characterized by a multi-tiered needle-leaved evergreen tree canopy up to 50 meters high, with between 60-100% cover. A sparse subcanopy of cold-deciduous or evergreen trees is often present, particularly in northwestern coastal stands. Downed wood may also be abundant in older stands. Shrub cover is dominated by ericaceous or cold-deciduous species and can be dense, especially in moist stands. The herbaceous understory is composed of either shade-tolerant forbs and ferns in the northern Rockies and Pacific Northwest, or mesophytic to xerophytic forbs and grasses in drier stands.

Vegetation: This alliance includes evergreen forests dominated by *Pseudotsuga menziesii* occurring in mountain ranges of all western U.S. states, as well as the Pacific Northwest coast and interior valleys, northern Mexico, and western Texas. In the Pacific ranges the dominant species is *Pseudotsuga menziesii* var. *menziesii*, while *Pseudotsuga menziesii* var. *glauca* is the dominant in forests of the Rocky Mountains, south to Mexico. Currently this alliance includes 49 associations, occurring in 12 states or provinces. Associated species vary with geographic location, and warrants separate discussion.

On the eastside of the Cascades and east into the northern and southern Rocky Mountains, these forests are dominated by *Pseudotsuga menziesii* in the canopy and almost always in the tree regeneration layer. *Pinus ponderosa* is an important seral species occurring in many associations, either as older seral remnants or codominating in the canopy. Other trees that can be present to abundant (but which are typically seral) include *Larix occidentalis* in the northern Rockies, *Populus tremuloides*, (in the southern Rockies and south into New Mexico and Arizona), *Pinus strobiformis* (in New Mexico and Arizona), and *Pinus contorta* (throughout much of the alliance's range). Species of *Abies* and *Picea* do not commonly occur in this alliance, but are present in some stands.

Understories in *Pseudotsuga menziesii* forests are varied; many associations have well developed shrub layers, usually less than 2 m in height, but in some cases up to 5 m. Dominant species in some associations in the northern Rockies include *Acer glabrum*, *Arctostaphylos uva-ursi*, *Linnaea borealis*, *Mahonia repens*, *Paxistima myrsinites*, *Physocarpus malvaceus*, *Symphoricarpos albus*, *S. oreophilus*, *Spiraea betulifolia*, *Vaccinium cespitosum*, and *V. membranaceum*. Further south into southern Wyoming, Colorado and into the southern part of the range, other shrubs become the dominant or diagnostic species, although some shrubs are found throughout the range (e.g. *Arctostaphylos uva-ursi* and *Mahonia repens*). Important species include *Acer grandidentatum*, *Amelanchier alnifolia*, *Arctostaphylos patula*, *Jamesia americana*, *Physocarpus monogynus*, *Quercus arizonica*, *Q. gambelii*, *Q. rugosa*, *Q. X pauciloba*, and *Q. hypoleucoides*.

The herbaceous layer can be sparse, or if the shrub layer is not abundant, can have a relatively species-rich layer, usually graminoid-dominated. Important or dominant species include the graminoids *Bromus ciliatus*, *Calamagrostis rubescens*, *Carex geyeri*, *Carex rossii*, *Festuca arizonica*, *Festuca occidentalis*, *Bromus ciliatus*, *Luzula parviflora*, *Muhlenbergia montana*, and *M. virescens*; and the forbs *Arnica cordifolia*, *Osmorhiza berteroi*, *Thalictrum occidentale*, *Viola adunca*, and species of many other genera, including *Lathyrus*, *Penstemon*, *Erigeron*, *Lupinus*, *Fragaria*, *Vicia*, *Arenaria*, *Galium*, and others.

In the low elevation forests of western Washington and Oregon (west of the Cascade crest) the canopy is semi-open to closed. *Pseudotsuga menziesii* dominates with little or no *Tsuga heterophylla* or *Thuja plicata*. *Abies grandis* is codominant on some sites, and *Pinus contorta* can also codominate. *Salix scouleriana* and *Arbutus menziesii* are common but subordinate. There is a well developed understory of deciduous or evergreen shrubs, or graminoids. *Holodiscus discolor*, *Symphoricarpos albus*, or *Rosa gymnocarpa* are typical dominant species and diagnostic. Other shrubs that may dominate or codominate include *Gaultheria shallon*, *Rhododendron macrophyllum*, *Vaccinium ovatum*, *Mahonia piperiana*, *M. nervosa*, *Corylus cornuta*, *Symphoricarpos mollis*. In the herbaceous layer *Festuca occidentalis*, and *Melica subulata* are diagnostic species which are often dominant or codominant. *Bromus vulgaris*, *Festuca subuliflora*, and *Elymus glaucus* are also very common.

Dynamics: Successional relationships in this alliance are complex. *Pseudotsuga menziesii* is less shade-tolerant than many northern or montane trees such as *Tsuga heterophylla*, *Abies concolor*, *Picea engelmannii*, or *Thuja plicata*, and seedlings compete poorly in deep shade. At drier locales, seedlings may be favored by moderate shading, such as by a canopy of *Pinus ponderosa*, which helps to minimize drought stress. In some locations, much of these forests have been logged or burned during European settlement, and present-day stands are second-growth forests dating from fire, logging, or other stand replacing disturbances (Mauk and Henderson 1984, Chappell et al. 1997). *Pseudotsuga menziesii* forests were probably subject to a moderate severity fire regime in pre-settlement times, with fire-return intervals of 30-100 years. Many of the important tree species in these forests are fire-adapted (*Populus tremuloides*, *Pinus ponderosa*, *Pinus contorta*, *Larix occidentalis*) (Pfister et al. 1977), and fire-induced reproduction of *Pinus ponderosa* can result in its continued codominance in *Pseudotsuga menziesii* forests (Steele et al. 1981). Seeds of the shrub *Ceanothus velutinus* can remain dormant in forest stands of 200 years (Steele et al. 1981) and germinate abundantly after fire, competitively suppressing conifer seedlings. Some stands may have higher tree-stem density than historically, due largely to fire suppression. Fire suppression has also lead to the succession of *Pinus ponderosa* woodlands or *Quercus* spp. woodlands to *Pseudotsuga menziesii* forests.

Similar Alliances:

- ?? PSEUDOTSUGA MENZIESII - ARBUTUS MENZIESII FOREST ALLIANCE (A.159)
- ?? PSEUDOTSUGA MENZIESII - LITHOCARPUS DENSIFLORUS FOREST ALLIANCE (A.106)
- ?? PSEUDOTSUGA MENZIESII GIANT FOREST ALLIANCE (A.108)
- ?? PSEUDOTSUGA MENZIESII - ACER MACROPHYLLUM FOREST ALLIANCE (A.427)
- ?? PSEUDOTSUGA MENZIESII - TSUGA HETEROPHYLLA FOREST ALLIANCE (A.107)
- ?? PSEUDOTSUGA MENZIESII - QUERCUS GARRYANA WOODLAND ALLIANCE (A.688)
- ?? PSEUDOTSUGA MENZIESII TEMPORARILY FLOODED WOODLAND ALLIANCE (A.568)
- ?? PSEUDOTSUGA MENZIESII WOODLAND ALLIANCE (A.552)
- ?? PINUS PONDEROSA WOODLAND ALLIANCE (A.530)
- ?? PINUS PONDEROSA - PSEUDOTSUGA MENZIESII WOODLAND ALLIANCE (A.533)

Similar Alliance Comments: Vegetation in the *Pseudotsuga menziesii* Forest Alliance is distinguished from similar alliances by the closed forest (> 60 percent cover) canopy, occurrence on non-wetland sites, and the dominance (sometimes in the regeneration layer) of *Pseudotsuga menziesii* in non-giant (< 50 m in height), forests. Other alliances that contain *Pseudotsuga menziesii* as a dominant component include I.C.3.N.A.47 *Pseudotsuga menziesii* - *Acer macrophyllum* Forest Alliance (A.427), I.A.8.N.a.6 *Pseudotsuga menziesii* - *Lithocarpus densiflorus* Forest Alliance (A.106), I.A.8.N.a.7 *Pseudotsuga menziesii* - *Tsuga heterophylla* Forest Alliance (A.107), I.A.8.N.a.8 *Pseudotsuga menziesii* Giant Forest Alliance (A.108), I.A.8.N.b.20 *Pinus ponderosa* - *Pseudotsuga menziesii* Forest Alliance (A.134), I.A.8.N.c.24 *Pseudotsuga menziesii* - *Arbutus menziesii* Forest Alliance (A.159), II.A.4.N.b.9 *Pseudotsuga menziesii* Woodland Alliance (A.552), II.A.4.N.a.35 *Pinus ponderosa* - *Pseudotsuga menziesii* Woodland Alliance (A.533), II.C.3.N.a.20 *Pseudotsuga menziesii* - *Quercus garryana* Woodland Alliance (A.688), II.A.4.N.d.8 *Pseudotsuga menziesii* Temporarily Flooded Woodland Alliance (A.568), and II.A.4.N.a.32 *Pinus ponderosa* Woodland Alliance (A.530).

Synonymy:

- ?? IA1a. Douglas Fir - Pine Forest, in part (Allard 1990)
- ?? Douglas Fir-Pine Series, in part (Diamond 1993)
- ?? Interior Douglas-fir: 210, in part (Eyre 1980)
- ?? Douglas-fir Series, in part (Sawyer and Keeler-Wolf 1995)

Comments: This alliance is derived from a series concept, where the presence of *Pseudotsuga menziesii* is diagnostic if other more shade-tolerant conifers are absent (presumes dominance of *Pseudotsuga menziesii* if some form of disturbance or extreme edaphic conditions do not limit its regeneration). In the Pacific ranges, the dominant taxon is *Pseudotsuga menziesii* var. *menziesii*, while *Pseudotsuga menziesii* var. *glauca* is the dominant in forests of the Rocky Mountains south into Mexico.

ALLIANCE DISTRIBUTION

Range: This montane and coastal alliance includes evergreen forests dominated by *Pseudotsuga menziesii* occurring from Vancouver Island south through the Cascades and coastal ranges of northern California, through the Rocky Mountains, the Nevada-Utah mountains, the Arizona-New Mexico mountains, to extreme western Texas and northern Mexico.

States: AZ,BC,CA,CO,ID,MT,MXCH?,NM,OR,TX,UT,WA,WY

TNC Ecoregions: 10:C, 21:C, 26:C, 9:C

USFS Ecoregions: 242A:CC, 313B:CC, 313C:CC, 313D:C?, 313E:CC, 315A:??, 321A:CC, 331A:CC, 331D:CC, 331J:CC, 341B:CC, 342A:CC, 342B:CC, 342C:CC, 342E:CC, M242A:CC, M242B:CC, M242C:CC, M261A:CC, M313A:CC, M313B:CC, M331A:CC, M331B:CC, M331D:CC, M331E:CC, M331F:CC, M331G:CC, M331H:CC, M331I:CC, M331J:CC, M332A:CC, M332B:CC, M332C:CC, M332D:CC, M332E:CC, M332F:CC, M332G:CC, M333A:CC, M333C:CC, M333D:CC, M341B:CC, M341C:CC

ALLIANCE SOURCES

Edition: 99-05-22

References: Agee and Kertis 1987, Agee and Wasem 1987, Alexander and Ronco 1987, Alexander et al. 1984, Alexander et al. 1987, Allard 1990, Atzet and Wheeler 1984, Atzet et al. 1996, Bachrach 1951, Bader 1932, Bassett et al. 1987, Blackhawk Coal Company 1981, Bourgeron et al. 1993, Boyce 1977, Brayshaw 1965, Bunin 1975, Burns and Honkala 1990, Chappell 1994, Clausnitzer and Zamora 1987, Cole 1982, Collins et al. 1984, Cooper 1975, Cooper et al. 1987, Daubenmire 1952, Daubenmire and Daubenmire 1968, DeVelice et al. 1986, Del Moral and Long 1977, Diamond 1993, Douglas 1971, Dyrness et al. 1974, Eyre 1980, Fisher and Clayton 1983, Fitzhugh et al. 1987, Fonda and Bernardi 1976, Franklin and Dyrness 1973, Franklin et al. 1979, Franklin et al. 1988, Freeman and Dick-Peddie 1970, Galatowitch and Bourgeron 1985, Giese 1975, Graybosch and Buchanan 1983, Green and Klinka 1994, Hall 1973, Hemstrom et al. 1987, Henderson et al. 1986, Henderson et al. 1989, Hess 1981, Hess and Alexander 1986, Hess and Wasser 1982, Hoffman 1976, Hoffman and Alexander 1980, Holland 1986, Horton 1971, Johnson 1985, Johnson and Clausnitzer 1992, Johnson and Simon 1987, Johnston 1984, Johnston 1987, Johnston and Hendzel 1985, Keammerer 1974, Kittel et al. 1994, Komarkova et al. 1988, Krajina 1969, Larson 1974, Larson and Moir 1986, Larson and Moir 1987, Lesica and DeVelice 1992, Mauk and Henderson 1984, Mclean

1970, Moir and Ludwig 1979, Muldavin 1994, Muldavin et al. 1992, Murphy 1982, Ogilvie 1962, Olson and Gerhart 1982, Osborn et al. 1998, Oswald 1966, Peet 1975, Peet 1981, Pfister et al. 1977, Reed 1976, Roberts 1980, Roberts et al. 1992, Sawyer and Keeler-Wolf 1995, Shepherd 1975, Spies et al. 1990, Steele and Geier-Hayes 1995, Steele et al. 1981, Steele et al. 1983, Terwilliger et al. 1979, Tiedemann and Terwillinger 1978, Tisdale and McLean 1957, Topik 1989, Topik et al. 1986, Topik et al. 1988, Vories 1974, Washington Natural Heritage Program n.d., Wasser and Hess 1982, Williams and Lillybridge 1983, Williams and Lillybridge 1985, Williams and Lillybridge 1990, Williams and Smith 1990, Youngblood and Mauk 1985, Youngblood and Mueggler 1981, Zamora 1983

I.A.8.N.c.28. CUPRESSUS ARIZONICA FOREST ALLIANCE (A.163)

Arizona Cypress Forest Alliance

ALLIANCE CONCEPT

Environment: This alliance includes relict forests that are restricted to local, mesic sites in mountains in southeastern Arizona, and a site in southwestern New Mexico. Elevation ranges from 1220-2000 m depending on aspect. Climate is arid to semi-arid with temperatures rarely falling below freezing. Annual precipitation has a bimodal distribution with about half of the 50 cm mean annual precipitation occurring in July through September during the late summer monsoon, and most of the rest falling during the winter months. Where sites have less precipitation or warmer aspects, soil moisture is usually augmented by a spring or stream. Stands of *Cupressus arizonica* forest occur primarily on north and east-facing mountain slopes and canyons, and along drainages where both summer and winter temperatures are moderate. Sites range from gentle alluvial toeslopes to steep canyon and mountain slopes (3-60%). Stands are generally small and found in "cool" pockets within warm Madrean evergreen woodland or chaparral where local edaphic conditions permit a shallow water table. Substrate is derived from a variety of parent materials, but soils are generally rocky or gravelly loams or sandy loams. *Cupressus arizonica* has been also been reported growing on drier sites at elevations above 2050 m, but stands are sparse and stunted, and resemble a sparse shrub savanna (Parker 1980a).

Physiognomy: Vegetation included in this alliance has a moderately dense to dense evergreen tree canopy (35-100% cover), 5-20 m tall dominated by needle-leaved evergreen trees. Often there are tall- and short-shrub layers dominated by broad-leaved evergreen species with broad-leaved deciduous and needle-leaved species present ranging from 0.5-5 m tall. The herbaceous layer is typically sparse and dominated by perennial graminoids, with annual forbs and grasses present seasonally.

Vegetation: Forests included in this alliance occur locally on mesic mountain slope and in drainages in southeastern Arizona and southwestern New Mexico. These forests have an overstory canopy dominated by the needle-leaved, evergreen tree, *Cupressus arizonica*. The broad-leaved tree, *Quercus hypoleucoides*, codominates some stands. Other common trees include the conifers *Juniperus deppeana*, *J. monosperma*, *Pinus edulis* and *Pinus edulis* var. *fallax* (= *Pinus fallax*), and broad-leaved evergreen oaks such as *Quercus dunnii* (= *Quercus chrysolepis* var. *palmeri*), *Q. oblongifolia*, and *Q. arizonica*. Total tree canopy cover is over 50%. The shrub layer is dense and very diverse, often with over 12 species occurring. *Quercus turbinella*, a deciduous broad-leaved shrub, is the most important and a diagnostic species. Other shrubs may include *Arctostaphylos pungens*, *A. pringlei*, *Ceanothus fendleri*, *Cercocarpus montanus*, *Purshia mexicana* (= *Cowania mexicana*), *Fendlera rupicola*, *Fraxinus anomala*, *Garrya wrightii*, *Nolina microcarpa*, *Prunus virginiana* and *Rhus ovata*. The herbaceous layer is typically sparse (<5% cover) because of shading by overstory, but may be moderately dense depending on the density of the woody canopies and moisture. It is dominated by diverse graminoids such as *Bouteloua curtipendula*, *Poa fendleriana*, *Carex geophila*, *Koeleria macrantha*, *Piptochaetium pringlei* (= *Stipa pringlei*), *Elymus elymoides*, *Schizachyrium scoparium*, *Muhlenbergia longiligula* and *Muhlenbergia richardsonis*. *Senecio neomexicanus* and *Galium* spp. are typical of the sparse forb layer. Carmichael et al. (1978) described stands in the Mazatzal Mountains with average cover of *Cupressus arizonica*, *Quercus turbinella*, and 11 other shrubs being 37%, 26% and 10%, respectively, for total average cover of 73%.

Dynamics: Stands occur on a variety of substrates which indicates that other factors, most likely climatic conditions, restrict the distribution of this alliance. The cool, moist conditions required by *Cupressus arizonica* are not common in southern Arizona. Few occurrences of this alliance have been documented. Brown (1982) considers these stands to be relictual. Parker (1980b) thinks *Cupressus arizonica* is a stable, terminal element of limited environments where it now occurs. Its life history resembles that of a pioneer species with additional characteristics that allow it to persist. A trait that leads to persistence is that *C. arizonica* is very long-lived. The extrapolated ages of individuals from one stand averaged 317 years with the oldest tree being 456 years (Parker 1980b). Also, known stands tend to be mature with little regeneration, and seedlings are able to germinate and grow in the shade of mature trees. Pioneer traits are that it is a prolific seed producer (estimated 0.1-1 million seeds per tree) and intolerant of ground litter (Parker 1980b). The two stands with a significant number of seedlings had both been disturbed, one by logging and one by flood. Moist, mineral soil is the ideal seedbed for *C. arizonica*. Parker (1980b) found the number of seedlings decreases with increased litter layer depth.

Fire appears to be important for *Cupressus arizonica* stand regeneration. Carmichael et al. (1978) reports fire opens *C. arizonica* seed cones. Although *C. arizonica* is found in areas that are protected from fire and is a non-sprouter with limited

fire adaptation, fire removes accumulations of ground litter that prevent seedling establishment (Parker 1980a, 1980b). Parker (1980b) suggested that fire suppression may have limited reproduction, especially in habitats that do not flood, and that current fire suppression policies be eliminated in areas where *C. arizonica* occurs.

Similar Alliances:

Similar Alliance Comments: There are other rare *Cupressus* spp. alliances, but none with *Cyperus arizonica*.

Synonymy:

- ? *Cupressus arizonica* association. within the Relict Conifer Forest and Woodland Cypress Series (123.52) *Cupressus arizonica* association (Brown et al. 1979)
- ? Cypress Canyon. within the Relict Conifer Forest and Woodland Cypress Series (123.52) *Cupressus arizonica* association (Niering and Lowe 1984)
- ? *Cupressus arizonica/Quercus hypoleucoides* Habitat Type. within the Relict Conifer Forest and Woodland Cypress Series (123.52) *Cupressus arizonica* association (Bassett et al. 1987)
- ? *Cupressus arizonica/Quercus turbinella* Habitat Type. within the Relict Conifer Forest and Woodland Cypress Series (123.52) *Cupressus arizonica* association (Bassett et al. 1987)

Comments: Woodland stands dominated by *Cupressus arizonica* ssp. *nevadensis* and *Cupressus arizonica* ssp. *stephensonii* occur in southern California and Baja California, Mexico (Griffin and Critchfield 1976, Barbour and Majors 1977). Both woodland types were classified and described as associations in Reid et al. (1994). These woodlands are currently not included in this alliance or any other. Stands dominated by *Cupressus arizonica* with significantly less than 60% cover are not currently classified.

ALLIANCE DISTRIBUTION

Range: Forests included in this alliance occur locally on mesic slopes and drainages in sub-Mogollon Arizona in the Blue Range, Dragoon, Santa Catalina, Mazatzal and Chiricahua mountains, and in one location in southwest New Mexico near Cooks Peak, in the Black Range. Its range extends into northern Mexico along the Sierra Madre Occidentale in Chihuahua and Sonora. The alliance may also occur in the Big Bend region of Texas and Mexico (Parker 1980a, 1980b).

States: AZ,NM

TNC Ecoregions:

USFS Ecoregions: 321A:CC

ALLIANCE SOURCES

Edition: 98-06-05

References: Barbour and Major 1977, Bassett et al. 1987, Brown 1982, Carmichael et al. 1978, Griffin and Critchfield 1976, Larson and Moir 1986, Niering and Lowe 1984, Parker 1980, Reid et al. 1994

I.A.8.N.c.29. PICEA ENGELMANNII FOREST ALLIANCE (A.164)

Engelmann's Spruce Forest Alliance

ALLIANCE CONCEPT

Environment: These are upper montane or subalpine forests occurring in the Oregon Cascades, northern Rockies and south into Arizona and New Mexico. Overall, they are found in similar elevational ranges as *Abies lasiocarpa*, but occur on sites either too cold or too dry for *A. lasiocarpa* dominance. Precipitation across the range of distribution is variable, and ranges from 65 cm to roughly 100 cm. Timing of precipitation varies somewhat as well, but summer drought is relatively uncommon. Snowpacks are deep and late-lying and summers are cool. In much of Montana and Wyoming, the predominance of *Picea engelmannii* forest associations is characteristic of relatively warm, dry mountain ranges, usually those in the rain shadow of some more massive and moister mountain ranges. Summer frosts are characteristic, especially in sites where cold air pools. Elevations increase with decreasing latitude, ranging from less than 970 to 1800 m in the Cascades, from 900 m to well over 3200 m in the northern Rockies Of Montana, Idaho and Wyoming, and up to 3350 m in the Colorado Rockies.

Picea engelmannii forests can often be found in locations with cold air drainage or ponding, or where snowpacks linger late into the summer, such as north-facing slopes. They can extend down in elevation below the subalpine zone in places where cold air ponding occurs. Sites where these forests are found include gentle to very steep mountain slopes, high elevation ridgetops and upper slopes, plateaulike surfaces, basins, alluvial terraces, well-drained benches, and inactive stream terraces. All aspects and slopes are represented, but northerly and easterly aspects predominate, and southerly aspects are found only at higher elevations of where these forests occur in a given region. Parent materials and geologic substrates include granitics, quartzite, limestone, glacial moraines, sandstone, alluvium and alluvium mixed with ash, basalt, and colluvium of various sources. Soils can be gravelly or rocky, are fine to coarse textured, relatively shallow, and have little surface bare ground or rock. Duff layers can be thick, and moss or lichen cover can be high.

These forests, with *Abies lasiocarpa* forests, form a matrix type in subalpine areas of the Rocky Mountains and abut other forest types at the zonal boundaries or at atypical microhabitats. Adjacent zonal forest types include *Pinus albicaulis*, *Pinus aristata* or *Pinus flexilis* woodlands at the upper elevation boundary and *Pseudotsuga menziesii* at the lower zonal boundary.

Adjacent wet sites support wet meadows or riparian plant communities. Large seral stands of *Populus tremuloides* or *Pinus contorta* are typical in the subalpine zone, resulting from fire or logging disturbance.

Physiognomy: These are forests dominated by needle-leaved evergreen trees up to 45 m in height and of high cover (60-100%). Although cold-deciduous trees are relatively rare, they can be prominent in some regional variants or seral stands. Stands may be so tightly stocked that little light reaches the forest floor and understory layers are depauperate. In stands with somewhat more open canopies, a moderately dense shrub layer may be present, dominated by ericaceous or cold-deciduous species. The herbaceous layer is dominated by perennial forbs or sod-forming graminoids, and herbaceous cover increases with increasing light availability and/or soil moisture. There is often significant cover of mosses and sometimes lichens on the forest floor and on downed woody material.

Vegetation: These subalpine forests are characterized by a canopy varying from 20 to 45 m in height typically dominated by *Picea engelmannii*. In early to mid-successional stands, other conifers can be dominant or codominant, but *Picea engelmannii* (or *Picea engelmannii* X *glauca* hybrids in Montana) are the most abundant seedlings and saplings.

In the northern Rockies and Cascades other important conifers can include *Pseudotsuga menziesii*, *Larix occidentalis*, *Pinus contorta*, *Abies lasiocarpa*, and *Pinus flexilis*. On the east side of the Divide, only *Pseudotsuga* and *Pinus contorta* are important, but in northwestern Wyoming and Utah *Pinus flexilis* or *Pinus albicaulis* can codominate stands at higher elevations. The shrub layer is often absent, but when present can be dominated by ericaceous, cold-deciduous or evergreen species such as *Vaccinium cespitosum*, *Vaccinium scoparium*, *Physocarpus malvaceus*, *Linnaea borealis*, *Ribes montigenum*, *Shepherdia canadensis*, *Spiraea betulifolia*, or *Symphoricarpos albus*. The herbaceous layer can be either depauperate or species-rich, and is often dominated by perennial forbs. Important to dominant species include *Clintonia uniflora*, *Aralia nudicaulis*, *Actaea rubra*, *Arnica cordifolia*, *Cornus canadensis*, *Thalictrum occidentale*, *Osmorhiza berteroi* (= *Osmorhiza chilensis*), *Epilobium angustifolium*, *Orthilia secunda*, *Galium triflorum*, *Astragalus miser*, *Achillea millefolium*, and *Maianthemum stellatum*. Graminoids can include *Calamagrostis rubescens*, *Carex rossii*, and *Oryzopsis asperifolia*. One association has a depauperate understory, with only mosses having significant cover, such as *Hypnum revolutum*.

In the Colorado Rocky Mountains, and Arizona and New Mexico, these forests are typically somewhat drier, and often occur at the higher elevation margins of the subalpine zone, on sites too cold or dry for *Abies lasiocarpa* to dominate. Important, but usually seral, tree species include *Abies lasiocarpa*, *Pinus contorta*, *Pseudotsuga menziesii*, and *Populus tremuloides*. Other southern trees in these stands include *Pinus flexilis*, *Pinus aristata*, *Pinus strobiformis*, *Picea pungens*, *Abies concolor*, and *Abies lasiocarpa* var. *arizonica*. Many of these somewhat drier associations do not have a significant shrub layer. When shrubs are present they can include *Vaccinium myrtillus*, *Holodiscus dumosus*, *Physocarpus monogynus*, *Lonicera utahensis*, *Jamesia americana*, *Acer glabrum*, *Juniperus communis* and *Ribes* spp. In many of these southern *Picea engelmannii* forest associations the herbaceous layer is usually more prominent than the shrub layer, and can vary from dense and species rich to somewhat depauperate and dominated by mosses. Important graminoids include *Carex foenea*, *Leymus triticoides*, *Bromus richardsonii*, *Trisetum spicatum*, *Festuca brachyphylla*, and *Luzula* spp. Important perennial forbs include *Arnica cordifolia*, *Campanula rotundifolia*, *Maianthemum stellatum*, *Oreochrysum parryi*, *Geranium richardsonii*, *Ligusticum porteri*, *Polemonium pulcherrimum*, *Trifolium dasyphyllum*, *Trifolium parryi*, *Erigeron eximius*, and species of *Lathyrus*, *Fragaria*, *Viola*, *Senecio*, *Arenaria*, and *Penstemon*. As in the northern Rockies, one association in the southern part of the alliance is lacking shrub or herbaceous layers and is dominated by mosses, but the species are not documented in the literature.

Dynamics: *Picea engelmannii* can be very long-lived, reaching 500 years of age. *Abies lasiocarpa* decreases in importance relative to *Picea engelmannii* with increasing distance from the region of Montana and Idaho where maritime air masses influence the climate. Fire is an important disturbance factor, but fire regimes have a long return interval and so are often stand-replacing. *Picea engelmannii* can rapidly recolonize and dominate burned sites, or can succeed other species such as *Pinus contorta* or *Populus tremuloides*. Due to great longevity, *Pseudotsuga menziesii* may persist in stands of this alliance for long periods without regeneration. Old-growth characteristics in *Picea engelmannii* forests will include treefall and windthrow gaps in the canopy, with large downed logs, rotting woody material, tree seedling establishment on logs or on mineral soils unearthed in root balls, and snags.

Picea engelmannii is susceptible to infestations by the spruce beetle, *Dendroctonus rufipennis*, or the spruce budworm, *Choristoneura occidentalis*, which can cause high mortality during outbreaks. In the Southwest, dwarf mistletoe, *Arceuthobium microcarpum*, is a common cause of mortality for the species.

Similar Alliances:

?? PICEA ENGELMANNII TEMPORARILY FLOODED FOREST ALLIANCE (A.179)

?? PICEA ENGELMANNII SEASONALLY FLOODED FOREST ALLIANCE (A.191)

?? PICEA ENGELMANNII SATURATED FOREST ALLIANCE (A.204)

?? ABIES LASIOCARPA FOREST ALLIANCE (A.168)

?? PSEUDOTSUGA MENZIESII FOREST ALLIANCE (A.157)

?? PICEA ENGELMANNII SEASONALLY FLOODED WOODLAND ALLIANCE (A.572)

Similar Alliance Comments: The *Picea engelmannii* Forest Alliance is distinguished by the dominance of *Picea engelmannii* in the tree canopy and its successful regeneration in the understory. Other conifers can be present in the canopy,

but are not dominant in the regeneration layer. Also, these are non-wetland forests. Both the *Abies lasiocarpa* and *Pseudotsuga menziesii* Forest Alliances can have a significant (to dominant) component of *Picea engelmannii* in the canopy, but the latter species is usually not regenerating successfully. Many other forest alliances in the west can have *Picea engelmannii* occurring in them.

Synonymy:

? Engelmann Spruce - Subalpine Fir: 206, in part (Eyre 1980)

? *Picea* series, in part (Pfister et al. 1977)

Comments: This alliance is based upon a series concept, in which *Picea engelmannii* is the only successfully regenerating conifer in associations in the alliance. It is usually the dominant species in the tree canopy as well. There are likely to be other associations in which *Picea engelmannii* is a dominant species that are currently placed into other forest alliances, because *P. engelmannii* is not successfully regenerating. These will need review to refine the concept of this alliance.

ALLIANCE DISTRIBUTION

Range: These forests comprise a substantial part of the subalpine forests of the Rocky Mountains from the Oregon Cascades east and south in Idaho, western Montana, Utah, Wyoming, Colorado, Arizona and New Mexico. They also occur in California, but are very rare in that state (6 documented stands). They have not been reported for Nevada or Washington, but may occur in those states.

States: AZ, CA?, CO, ID, MT, NM, OR, UT, WY

TNC Ecoregions: 26:C, 9:C

USFS Ecoregions: 321A:CC, 331D:CC, 331J:C?, 342A:CC, M242C:CC, M313A:CC, M313B:CC, M331A:CC, M331B:CC, M331D:CC, M331E:CC, M331F:CC, M331G:CC, M331J:CC, M332B:CC, M332C:CC, M332D:CC, M332E:CC, M332G:CC, M333B:CC, M333C:CC, M333D:CC, M341C:CC

ALLIANCE SOURCES

Edition: 99-05-23

References: Alexander et al. 1984, Alexander et al. 1987, Billings 1969, Cooper 1975, DeVelice 1983, DeVelice and Ludwig 1983, DeVelice et al. 1986, Dix and Richards 1976, Eyre 1980, Fisher and Clayton 1983, Fitzhugh et al. 1987, Henderson et al. 1977, Hess 1981, Hess and Alexander 1986, Hess and Wasser 1982, Hoffman 1976, Johnston 1984, Johnston 1987, Komarkova et al. 1988, Kovalchik 1987, Larson and Moir 1987, Mauk and Henderson 1984, Moir and Ludwig 1979, Muldavin et al. 1996, Peet 1975, Peet 1981, Pfister 1972, Pfister et al. 1977, Reed 1976, Roberts 1980, Rominger and Paulik 1983, Shepherd 1975, Steele et al. 1981, Steele et al. 1983, Steen and Dix 1974, Terwilliger et al. 1979, Wasser and Hess 1982, Youngblood and Mauk 1985

I.B.2.N.b. Montane or boreal cold-deciduous forest

I.B.2.N.b.1. ACER GRANDIDENTATUM MONTANE FOREST ALLIANCE (A.265)

Bigtooth Maple Montane Forest Alliance

ALLIANCE CONCEPT

Environment: Vegetation within this alliance occurs in relatively moist lower montane areas of the southern and central Rocky Mountains, and in the Trans-Pecos of Texas. Stands of this type have been reported from north-central Utah (Kunzler et al. 1981), southern Idaho (Caicco 1983), and in western Texas (Diamond 1993). These forests occur from 1300 to 1800 m in elevation, and annual precipitation generally exceeds 40 cm with a large proportion falling during the growing season. The alliance can occur on all aspects but is best developed on north-facing valleys or canyons which have moderate insolation and favorable soil moisture.

The *Acer grandidentatum* Montane Forest Alliance appears to grade into mountain brush types in Utah and Idaho. *Acer grandidentatum* occurs on a variety of soils in that region, but approaches tree stature only on well-developed, bottomland soils. In Trans-Pecos Texas, vegetation within this alliance is reported from 1300-1800 m elevation in the Guadalupe and Chisos mountains, where it is largely confined to moist canyon habitats.

Physiognomy: This alliance is characterized by a closed canopy of tall cold-deciduous or broad-leaved evergreen shrubs or short trees 6-8 m in height. Short evergreen shrubs may also be present. The herbaceous understory is typically sparse and comprised of annual or perennial graminoids and forbs.

Vegetation: These forests are dominated by a dense canopy of *Acer grandidentatum*, often occurring with *Quercus spp.*, and *Juniperus spp.* Other associated species vary across the geographic range of these forests. In the mountains of western Texas, associated tree and tall-shrub species include *Quercus muehlenbergii*, *Q. gravesii*, *Q. grisea*, *Q. rugosa*, *Ostrya knowltonii*, *Arbutus xalapensis*, *Cupressus arizonica*, *Juniperus deppeana*, *Pinus edulis*, and *Pinus ponderosa var. scopulorum*. In central Rocky Mountain stands, tree and shrub associates include *Quercus gambelii*, *Prunus virginiana*, *Amelanchier alnifolia*, *Physocarpus malvaceus*, *Artemisia tridentata*, *Paxistima myrsinites*, *Symphoricarpos spp.*, and *Populus tremuloides*. Shrub

and herb strata are relatively sparse. Forests in this alliance grade to slightly less mesic mixed evergreen-deciduous forests, woodlands, or brushfields on adjacent hillsides.

Dynamics: In southern stands, these communities are typically associated with protected topographic positions with relatively moist soils and lower fire frequencies than surrounding hillsides. Further north in the Rocky Mountains, these types appear to be maintained by periodic fire which prevents the encroachment of coniferous forest.

Similar Alliances:

?? ACER GRANDIDENTATUM - QUERCUS BUCKLEYI - QUERCUS MUEHLENBERGII FOREST ALLIANCE (A.215)

?? ARBUTUS XALAPENSIS - ACER GRANDIDENTATUM - QUERCUS SPP. FOREST ALLIANCE (A.368)

Similar Alliance Comments: Communities in the *Acer grandidentatum* Montane Forest Alliance are distinguished by being high elevation forests which occur from the Trans-Pecos Mountains, north into the central Rocky Mountains, usually at elevations over 1200 m. Although *Arbutus xalapensis* may be present in southern stands, it is not codominant in these communities. Lowland forests of the Edwards Plateau dominated by *Acer grandidentatum* are classified in I.B.2.N.a.3 *Acer grandidentatum* - *Quercus buckleyi* - *Quercus muehlenbergii* Forest Alliance (A.215). Similar forests of mixed deciduous-evergreen composition are classified in I.C.2.N.a.1 *Arbutus xalapensis* - *Acer grandidentatum* - *Quercus spp.* Forest Alliance (A.368).

Synonymy:

?? Bigtooth Maple-Oak Series, in part (Diamond 1993)

Comments:

ALLIANCE DISTRIBUTION

Range: This alliance is reported from canyons of Trans-Pecos Texas. It also occurs in Idaho, Utah, and southwestern Wyoming, where it becomes more widespread. The alliance is likely to also occur in canyon habitats of Arizona and New Mexico.

States: ID,TX,UT,WY

TNC Ecoregions: 21:C, 24:C

USFS Ecoregions: 321A:CC, 342:C, M313B:CC, M331D:CC

ALLIANCE SOURCES

Edition: 98-04-02

References: Allard 1990, Allman 1952, Caicco and Wellner 1983, Christensen 1955, Diamond 1993, Freeman and Dick-Peddie 1970, Gehlbach 1967, Kunzler et al. 1981, Ream 1960, Ream 1964

I.B.2.N.d. Temporarily flooded cold-deciduous forest

I.B.2.N.d.25. POPULUS TREMULOIDES TEMPORARILY FLOODED FOREST ALLIANCE (A.300)

Quaking Aspen Temporarily Flooded Forest Alliance

ALLIANCE CONCEPT

Environment: Forests included in this alliance occur extensively in the western U.S., northern Great Plains and extend in the western Great Lakes area. Elevations range from 600 to 3230 m. Climate is temperate with a relatively long growing season, typically cold winters and often deep snow. Mean annual precipitation is greater than 38 cm and typically greater than 50 cm, except in semi-arid environments. Most of these temporarily flooded stands are found in riparian zones. Some may occur near lakes where the ground is flooded or saturated for a short time in the spring or on upland slope below seepage areas. Distribution of these forests is primarily limited by adequate soil moisture required to meet its high evapotranspiration demand (Mueggler 1988). Secondly, its range is limited by the length of the growing season or low temperatures (Mueggler 1988). Topography is variable. Sites are typically gently sloping but are found on steep slopes near upland seeps. Aspect varies according to the limiting factors. Stands at high elevations or northern latitudes are restricted by cold temperatures and found on warmer southern aspects. At lower elevations and southern latitudes stands are restricted by lack of moisture and are found on cooler north aspects and mesic microsites. The soils are typically deep and well developed with rock often absent from the soil. Soils are typically mesic or hydric, poorly drained, and fine textured, consisting of silts and clays, often with an organic surface layer. Many are gleyed and would be classified as wetland soils. However, some the alluvial soils are coarser so soil texture ranges from clay to sandy loams. Parent materials are variable and may include sedimentary, metamorphic or igneous rocks, but it appears to grow best on limestone, basalt, and calcareous or neutral shales (Mueggler 1988).

Physiognomy: Vegetation included in this alliance has a moderately dense to dense tree canopy dominated by cold-deciduous, broad-leaved trees. Evergreen needle-leaved trees may be present, but do not codominate the tree canopy. The understory is variable. Sparse to dense tall- and short-shrub layers may be present and are typically dominated by deciduous

broad-leaved species; however, a scale-leaved short shrub dominates the understory of some stands. Sparse to dense tall or short herbaceous layers may also be present and may be dominated by perennial forbs or graminoids.

Vegetation: Vegetation included in this widespread forest alliance occurs in temporarily flooded sites in the western U.S. to the western Great Lakes area. Stands have a somewhat closed to closed canopy of trees to 5-20 m tall, that is dominated or codominated by the cold-deciduous, broad-leaved tree, *Populus tremuloides*. Other broad-leaved trees, such as *Populus balsamifera ssp. trichocarpa*, *Populus balsamifera ssp. balsamifera*, *Quercus macrocarpa* and *Betula papyrifera* may be present to codominant depending on geography and topography. Several species of conifer trees may also be present in the tree canopy. Conifers include *Abies concolor*, *Abies lasiocarpa*, *Picea engelmannii*, *Picea pungens*, *Pinus contorta*, *Pinus ponderosa* and *Pseudotsuga menziesii*. Conifer species may contribute up to 25% of the tree canopy before the stand is reclassified as a mixed stand.

Because of the open growth form of *P. tremuloides* enough light can penetrate for lush understory development depending on available soil moisture and other factors. The understory structure may be complex with multiple shrub and herbaceous layers, or simple with just a herbaceous layer.

In the western U.S. common tree associates include *Populus balsamifera ssp. trichocarpa* in the northern Rocky Mountains (Cooper and Heidel 1997). One or more of the conifer trees listed above are often scattered in the canopy or understory of stands occurring in the montane and subalpine zones. If present the tall shrub layer may be dominated by *Quercus gambelii*, *Amelanchier alnifolia*, *Alnus incana*, *Betula occidentalis*, *Betula nana*. *Prunus virginiana* or *Salix* species such as *Salix bebbiana*, *Salix drummondiana*, *Salix monticola* or many others. Common short shrubs include *Cornus sericea*, *Ribes montigenum*, *Rosa woodsii*, *Symphoricarpos albus* and *S. oreophilus*. The dwarf-shrubs, *Mahonia repens* and *Vaccinium myrtilloides* are common. The herbaceous layer may have lush and diverse, dominated by graminoids or tall forbs. Other common graminoids may include *Bromus ciliatus*, *Bromus carinatus*, *Calamagrostis canadensis*, *Carex foenea*, *Carex hoodii*, *Elymus glaucus*, *Elymus trachycaulus* and *Festuca thurberi*. Forbs may include *Achillea millefolium*, *Aster engelmannii*, *Delphinium occidentale*, *Equisetum arvense*, *Fragaria virginiana*, *Geranium richardsonii*, *Ligusticum porteri*, *Maianthemum stellatum*, *Mertensia arizonica*, *Osmorhiza occidentalis*, *Senecio bigelovii var. bigelovii*, *Thalictrum occidentale*, *Veratrum californicum* and many others. Exotic grasses such as the perennial *Poa pratensis* and the annual *Bromus tectorum* species are often common in stands disturbed by grazing.

In the northern Great Plains and western Great Lakes areas, these stands have a moderate to closed tree canopy that is dominated by *Populus tremuloides* with *Populus balsamifera* codominant. More open stands have a prominent shrub layer containing species such as *Alnus incana*, *Cornus sericea*, and *Salix* spp. Little information was available for stands in the northern Great Plains and midwestern U.S.

Dynamics: Stands in this alliance often originate and likely are maintained by stand-replacing disturbances such as crown fire, disease and windthrow, or clearcutting by man and beaver. The stems of these thin-barked, clonal trees are easily killed by ground fires. They can quickly and vigorously resprout in densities of up to 30,000 stems per hectare (Knight 1993). Stands are favored by fire in the conifer zone (Mueggler 1988). The stems are relatively short-lived (100-150 years) and individual stands will be succeed to longer-lived conifer forest if undisturbed. With adequate disturbance a clone may live many centuries. Although *Populus tremuloides* produces abundant seeds, seedling survival is rare because the long warm, moist conditions required to establish are rare in the habitats where it occurs.

Similar Alliances:

?? POPULUS TREMULOIDES SEASONALLY FLOODED FOREST ALLIANCE (A.340)

Similar Alliance Comments: There are currently 18 alliances with *Populus tremuloides* as a dominant or codominant species. Many of the stands in these alliances are floristically similar. One of the alliances is a wooded herbaceous, one is a shrubland and one is a woodland. Of the 15 remaining forest alliances, three are separated by temporarily or seasonally flooded hydrologic regimes. Most of the alliances are mixed stands with *Populus tremuloides* codominant with other broadleaf or conifer tree species.

Synonymy:

?? Aspen: 217, in part (Eyre 1980)

?? Aspen series, in part (Sawyer and Keeler-Wolf 1995)

?? Aspen Forest, in part (Holland 1986)

?? *Populus tremuloides* Riparian/Wetland Forests and Woodlands, in part (Chappell et al. 1997)

Comments: Clarification is needed as to why some associations were included in this alliance instead of the seasonally flooded alliance. Stands in this alliance also had wetland soils (gleyed, hydric, organic muck) as well as better drained "upland" soils. It is not clear if the *Populus tremuloides* - *Populus balsamifera* alliances also included *P. balsamifera ssp. trichocarpa* or just *P. balsamifera ssp. balsamifera*. Little information was available on stands occurring in the northern Great Plains and western Great Lakes areas. Also, the sole reference cited for the *Populus tremuloides* Canyon Formation Association does not mention *Populus tremuloides*. Stands in California need association level description.

ALLIANCE DISTRIBUTION

Range: Forests included in this alliance have been described from across the western and southwestern U.S., northern Great Plains, and extend into the western Great Lakes area from California to Michigan. Its northern extent is in Canada in Saskatchewan, Manitoba, and Ontario.

States: CA,CO,ID,MB,MI,MN,MT,ND?,NM,NV,ON,OR,SK,UT,WA,WI?

TNC Ecoregions: 34:C, 35:C, 47:P, 48:C

USFS Ecoregions: 212Ib:CCC, 212Ja:CPP, 212Mb:CPP, 212Na:CP?, 212Nb:CPP, 212Nc:CP?, 222Na:CCC, 251Aa:CCC, 321A:CC, 331I:CC, 342B:CC, 342C:C?, M242C:CC, M331F:CC, M331G:CC, M331H:CC, M332A:C?, M332B:CC, M332C:CC, M332D:C?, M332G:CC, M333A:CC, M333B:CC, M333C:CC

ALLIANCE SOURCES

Edition: 98-09-09

References: Cooper and Heidel 1997, Cooper and Pfister 1981, Evans 1989, Evenden 1990, Eyre 1980, Faber-Langendoen et al. 1996, Freeman and Dick-Peddie 1970, Hansen 1991, Hansen et al. 1990, Hansen et al. 1995, Hoffman and Alexander 1980, Johnston and Hendzel 1985, Kagan 1985, Kettler and McMullen 1996, Kittel et al. 1994, Kittel et al. 1995, Kittel et al. 1997, Klimas 1988, Kovalchik 1987, Manning and Padgett 1991, Manning and Padgett 1995, Mueggler 1988, Mueggler and Campbell 1986, Osborn et al. 1998, Padgett 1982, Padgett et al. 1988, Padgett et al. 1989, Powell 1988, Richard et al. 1996, Van Auken and Bush 1988, Washington Natural Heritage Program n.d., Watson 1912

I.B.2.N.d.28. SAPINDUS SAPONARIA TEMPORARILY FLOODED FOREST ALLIANCE (A.303)

Wing-leaf Soapberry Temporarily Flooded Forest Alliance

ALLIANCE CONCEPT

Environment: Vegetation types within this alliance occur at lower elevations, 1100 to 1500 m, in the American Southwest. Detailed information on landforms, soils, and adjacent vegetation was not available.

Physiognomy: This alliance is dominated by broad-leaved, rounded crown, cold-deciduous trees. The tree subcanopy is open to moderately dense, with percent cover at an average of 80.7 percent (Szaro 1989). The tall- and low-shrub layers are present with moderate to dense cover. The vine layer was significant (25-60 percent cover) and present in all of the stands (Szaro 1989). The herbaceous layer is present but percent cover was not available.

Vegetation: Vegetation types within this alliance are classified as temporarily flooded, cold-deciduous forests. The tree subcanopy can range from open to dense with 60-100% cover of *Sapindus saponaria* and *Juglans major*. Other trees present in the tree subcanopy can include *Arbutus xalapensis* (= *Arbutus texana*) or *Juniperus deppeana*. The tall- and short-shrub layers are present with 25-60% cover and can include *Mahonia fremontii* (= *Berberis fremontii*), *Celtis laevigata* var. *reticulata* (= *Celtis reticulata*), *Morus microphylla*, *Prunus serotina*, *Rhus trilobata* and *Ptelea trifoliata* ssp. *angustifolia* (= *Ptelea angustifolia*). The vine layer is typically present with 25-60% cover and is dominated by *Vitis arizonica*. The herbaceous layer is present, but there was no available percent cover given. Common herbaceous species include *Bouteloua curtipendula*, *Brickellia brachyphylla*, *Chenopodium album*, *Croton pottsii*, *Phaseolus wrightii*, and *Elymus elymoides* ssp. *elymoides* (= *Sitanion hystrix*) (Szaro 1989).

Dynamics: Brown (1982) states that the mixed broad-leaved series reflects a contraction of the formerly widespread, Early Tertiary mixed mesophytic forest. These riparian forests are vernaly adapted to Early Tertiary climates and have retreated to pockets where the warm temperate (ancient) climate persists. Brown also states that these communities have been reduced in distribution and size due to the alteration of stream flow in the American Southwest.

Similar Alliances:

?? SAPINDUS SAPONARIA WOODLAND ALLIANCE (A.627)

Similar Alliance Comments: The *Sapindus saponaria* woodland alliance differs from the forest alliance mainly due to the structure of the overlapping canopy. The canopy in the woodland alliance is open with crowns not usually touching. Whereas, the forest alliance's canopy typically consists of overlapping crowns.

Synonymy:

?? Warm-Temperate Wetlands; Interior and Californian Riparian Deciduous Forests and Woodlands; Mixed Broadleaf Series (Brown 1982)

Comments:

ALLIANCE DISTRIBUTION

Range: This forest alliance has been described for Arizona and southwestern New Mexico. It could potentially occur east to Kansas and Louisiana, south to northern Mexico, and north to southeastern Colorado.

States: NM

TNC Ecoregions:

USFS Ecoregions: 321A:??, M313A:CC

ALLIANCE SOURCES

Edition: 98-03-01

References: Brown 1982, Szaro 1989

I.B.2.N.d.34. PLATANUS WRIGHTII TEMPORARILY FLOODED FOREST ALLIANCE (A.309)

Arizona Sycamore Temporarily Flooded Forest Alliance

ALLIANCE CONCEPT

Environment: Vegetation types within this forest alliance are closed riparian forests located along perennial or seasonally intermittent streams in the American Southwest. Stands occur in narrow stream valleys, on gently sloping alluvial terraces. Elevations range from 600 to 1800 m. These vegetation types require reliable surface flow during the winter-spring months, they are periodically inundated during spring runoff and generally are found along small, perennial streams. The parent material of stands found on the Gray Ranch in New Mexico is described as rhyolite alluvium, a gravelly alluvium deposited among boulders. The soils are depositional and silty loams in texture.

According to Brown (1982) the present distribution of the winter-deciduous, mixed broad-leaved forests, such as *Platanus wrightii* alliance, reflects a contraction of the formerly widespread, Early Tertiary mixed mesophytic forest. These riparian forests are vernal adapted to Early Tertiary climates and have retreated to pockets where the warm temperate (ancient) climate persists. In Arizona, occurrences coincide approximately with the Mogollon Escarpment (Kearney 1969).

Physiognomy: The tree canopy is dominated by a broad-leaved, cold-deciduous tree, up to 35 m tall. The overstory is typically dense, averaging 77 percent cover in some stands (Szaro 1989). The emergent tree layer is typically 30 percent cover. The tree subcanopy cover ranges from 30-40 percent. The tall- and short-shrub layers are present in moderate amounts (25-60 percent cover). The herbaceous layer contains both forbs and graminoids; percent cover was not available. Percent cover for the vine stratum is a maximum of 40 percent (Szaro 1989).

Vegetation: Vegetation types within this alliance are characterized as temporarily flooded, cold-deciduous, forests. *Platanus wrightii* dominates the tree stratum ranging from 75-100% cover. *Fraxinus velutina* and *Juglans major* are common codominants. *Populus fremontii* often is an emergent tree from the canopy. The tree subcanopy ranges from 40-60% cover. Species often include *Celtis laevigata* var. *reticulata*, *Prosopis velutina*, *Quercus arizonica*, *Quercus emoryi*, *Robinia neomexicana*, and *Salix gooddingii*. The shrub layer is often present and contains any number of the following: *Rhus trilobata*, *Toxicodendron radicans*, *Amorpha fruticosa*, and *Baccharis salicifolia*. The herbaceous layer is common (no percent cover data) and can include *Aristida* spp., *Bouteloua curtipendula*, *Carex* spp., *Eriogonum* spp., *Gutierrezia sarothrae*, *Muhlenbergia* spp., *Elymus elymoides*, and *Sporobolus cryptandrus*. The vine stratum is dominated by *Vitis arizonica*.

Dynamics: Brown (1982) states that this alliance is now greatly reduced in distribution because of the reduction in stream flow in the American Southwest. Occurrences require reliable surface flow during the winter-spring months, they are periodically inundated during spring runoff and generally are found along small, perennial streams.

Similar Alliances:

?? PLATANUS WRIGHTII TEMPORARILY FLOODED WOODLAND ALLIANCE (A.643)

Similar Alliance Comments: *Platanus wrightii* temporarily flooded woodland differs by having a more open tree canopy, whereas this alliance is characterized by closed canopies.

Synonymy:

?? Wetlands: Interior and Californian Riparian Deciduous Warm Temperate Wetlands, in part (Brown 1982)

?? Forest Type: *Platanus wrightii* series, in part (Bassett et al. 1987)

?? Temperate Riparian Deciduous Forest Biome: Mixed Broadleaf Series, in part (Pase and Layser 1977)

?? Arizona Cypress: 240, in part (Eyre 1980)

Comments:

ALLIANCE DISTRIBUTION

Range: This alliance is common throughout lower elevations (<1800 m) in Arizona, New Mexico, California, Baja California and northern Mexico.

States: AZ,NM

TNC Ecoregions:

USFS Ecoregions: 321A:CC, M313A:CC

ALLIANCE SOURCES

Edition: 98-04-15

References: Bourgeron et al. 1993, Bourgeron et al. 1995, Brown 1982, Dick-Peddie 1993, Eyre 1980, Hickman 1993, Kartesz 1994, Kearney et al. 1969, Pase and Layser 1977, Sawyer and Keeler-Wolf 1995, Szaro 1989, Willis 1939

I.B.2.N.d.37. POPULUS DELTOIDES SSP. WISLIZENI TEMPORARILY FLOODED FOREST ALLIANCE (A.312)

Rio Grande Cottonwood Temporarily Flooded Forest Alliance

ALLIANCE CONCEPT

Environment: Vegetation types within this alliance are found along moderately large rivers that are below 1800 m in elevation, typically on relatively new sandbars. Sites where stands occur vary from point bars and other depositional features (early seral stands) to alluvial terraces (mature stands) that may be several meters away from the channel, and several meters above the high water mark. Although *Populus deltoides* ssp. *wislizeni* is typically found along streams and within floodplains, it can also be found a considerable distance from the river because of its ability to tap into a water table that is near the surface (Irvine and West 1979). Soils are derived from alluvium and are deep, stratified sandy loams with cobbles. Point bars within the channels are composed of fresh alluvial sands and gravels. Adjacent upland vegetation can include *Pinus edulis*-*Juniperus osteosperma* woodlands and *Sarcobatus vermiculatus* scrub.

Physiognomy: This alliance is dominated by tall (20-35 m), broad-leaved, deciduous, single-stemmed trees. The canopy is moderate to dense, 60-100% cover. The tall-shrub layer (present in some stands) is dominated by multi-stemmed, tall (2-5 m) shrubs. The graminoid cover ranges from 25-60% cover. The vine layer is present in some stands; cover is unknown. Forb cover was not available.

Vegetation: Communities within this alliance are characterized as cold-deciduous, temporarily flooded forests. The tree and shrub layers are dominated by *Populus deltoides* ssp. *wislizeni* with cover varying from 15 to 85% cover. Older, more mature stands will be characterized by a few, large (up to 1 m diameter at breast height) trees with less canopy but larger basal areas. Other trees occasionally present include *Populus angustifolia* and *Populus X acuminata*. The understory has a shrub layer of varying cover, in the New Mexico stands characterized by *Juniperus monosperma*, *Forestiera pubescens* var. *pubescens* (= *Forestiera neomexicana*), *Fallugia paradoxa*, *Baccharis salicifolia* (= *Baccharis glutinosa*), *Baccharis sarothroides*, and *Gutierrezia sarothrae*. The liana, *Clematis ligusticifolia* may be present in some stands. The herbaceous layer is generally sparse to moderate and many stands have introduced grass species. Graminoids present in relatively undisturbed stands may include *Muhlenbergia asperifolia*, *Muhlenbergia emersleyi*, *Eleocharis palustris*, and *Distichlis spicata*. Forb cover is sparse.

Dynamics: Water regulation remains the biggest threat to this alliance. Water regulation alters the timing and duration of seasonal flooding events which subsequently affects the community structure. With the lack of seasonal flooding, exotic species become established and if allowed to persist, can dominate riparian communities. Cattle grazing and human recreation, such as camping and off road vehicles, also threaten these communities by damaging the areas and leaving them open to exotics.

Similar Alliances:

?? POPULUS DELTOIDES TEMPORARILY FLOODED FOREST ALLIANCE (A.290)

?? POPULUS DELTOIDES TEMPORARILY FLOODED WOODLAND ALLIANCE (A.636)

Similar Alliance Comments:

Synonymy:

?? Cottonwood - Willow: 235, in part (Eyre 1980)

Comments:

ALLIANCE DISTRIBUTION

Range: This alliance is a riparian woodland occurring in southern New Mexico and Arizona at relatively low elevations. It is likely to occur elsewhere within the range of distribution of *Populus deltoides* ssp. *wislizeni*, but is not presently in the classification.

States: AZ,NM

TNC Ecoregions:

USFS Ecoregions: 321A:PP, M313A:CP, M313B:CP

ALLIANCE SOURCES

Edition: 98-04-01

References: Dick-Peddie et al. 1984, Eyre 1980, Irvine and West 1979, Willis 1939

I.B.2.N.d.38. POPULUS FREMONTII TEMPORARILY FLOODED FOREST ALLIANCE (A.313)

Fremont Cottonwood Temporarily Flooded Forest Alliance

ALLIANCE CONCEPT

Environment: Vegetation types within this alliance occur mainly in dry, hot areas of the southwestern United States. The climate of this region is typically hot and arid. There is great fluctuation in precipitation between wet and dry years, but the annual average is 19.8 cm. Periodic droughts can result in the rivers becoming dry, while spring flooding results in very high

water tables and much deposition of silt and sands. Stands of this alliance occur primarily along the valley floors of large rivers in central and southern New Mexico, from 1500 to near 2100 m elevation. They are also reported from relatively flat floodplains along low-gradient rivers in Arizona. The deposition of alluvial materials by tributaries is the primary formative agent for these floodplains. On the Rio Grande, from the vicinity of Albuquerque south, the river drops an average of 1.5 m per 0.6 km.

These vegetation types are found on the most mesic or hydric of floodplain sites along these rivers. Soils are somewhat alkaline, and derived from alluvial materials, deposited in stratified layers of clays, sands, silts and gravels. Soil textures are variable, but clays are reported to be the most common. Water tables are high throughout the year, with surface flooding during the spring months.

Physiognomy: The tree stratum is dominated by broad-leaved, deciduous, tall (20-35 m), single stemmed trees. The canopy is dense; crowns overlap, generally with 60-100 percent cover. These stands form extensive gallery forests. The shrub layer is present, typically with <15 percent cover. The herbaceous layer is sparse to nonexistent.

Vegetation: These riparian cottonwood forests are characterized in mature stands by a dense canopy of the broad-leaved, deciduous tree *Populus fremontii*, with heights of 20 to 25 m. Cover is variable, depending upon the age of the stand, but averages well over 60% and occasionally is over 90%. A smaller (to 15 m tall), broad-leaved deciduous tree, *Salix gooddingii*, is usually present with low cover (averaging <15%). Broad-leaved, deciduous shrubs are found scattered in the understory, but total cover of this layer is typically less than 10%. *Amorpha fruticosa* is the only shrub found under the dense tree canopy, while *Baccharis salicifolia* and *Salix exigua* are more commonly found near the riverbanks or under less dense canopies. The herbaceous layer is sparse; in the spring the perennial forb *Anemopsis californica* is the dominant species. The perennial graminoids *Distichlis spicata* and *Juncus balticus* are usually present, but not abundant. Litter layers on the ground surface are thick, ranging from 2 to 15 cm deep.

Dynamics: *Populus fremontii* requires particular flood regime characteristics for germination and establishment (Stromberg et al. 1991). Stands dominated by this species can occur on relatively flat floodplains along low-gradient rivers.

Similar Alliances:

?? POPULUS FREMONTII SEASONALLY FLOODED WOODLAND ALLIANCE (A.654)

?? POPULUS FREMONTII TEMPORARILY FLOODED WOODLAND ALLIANCE (A.644)

Similar Alliance Comments: The *Populus fremontii* seasonally and temporarily flooded woodlands differ due to the structure of the tree canopy, which is closed in this alliance (>60 percent cover).

Synonymy:

?? Interior and Californian Riparian Deciduous Forests Series, in part (Brown 1982)

?? Cottonwood - Willow: 235, in part (Eyre 1980)

Comments: Further inventory and classification work is needed for all *Populus fremontii* communities. This is hindered by the alteration of species structure and composition that has occurred in most remaining stands because of hydrologic alterations, exotic species invasions, grazing, and other human impacts.

ALLIANCE DISTRIBUTION

Range: Communities within this alliance are described for central New Mexico, mainly along the Rio Grande River corridor, and southern and central Arizona. The alliance likely also occurs in California, Colorado, Nevada, and Utah, and possibly in northern Mexico.

States: AZ,CA?,CO?,NM,NV?

TNC Ecoregions:

USFS Ecoregions: 321A:CC, 322A:CC, 341:?, M313A:CC, M313B:C?, M331F:??

ALLIANCE SOURCES

Edition: 98-04-15

References: Campbell and Dick-Peddie 1964, Eyre 1980, Henry 1981, Muldavin et al. 1993, Reid et al. 1994, Stromberg 1993, Szaro 1989, Watson 1912

I.B.2.N.d.39. SALIX BONPLANDIANA TEMPORARILY FLOODED FOREST ALLIANCE (A.314)

Red Willow Temporarily Flooded Forest Alliance

ALLIANCE CONCEPT

Environment: Vegetation types within the *Salix bonplandiana* Temporarily Flooded Forest Alliance are found along streams and arroyos in the American Southwest. They occur on rocky soils and disturbed areas such as severely scoured rivers and heavily grazed areas. Flooding episodes are brief, occurring during the growing season. The water table is usually well below the soil surface. Elevation ranges from 850 to 1195 m. Soils and adjacent upslope vegetation information for this alliance was not available.

Physiognomy: Stands within this alliance are comprised of a tree canopy dominated by broad-leaved deciduous trees that reach heights between 15-20 m. The total overstory cover averaged 67 percent (Szaro 1989). The understory is dominated by forbs with a 60-100 percent cover.

Vegetation: Communities within the *Salix bonplandiana* alliance are characterized as cold-deciduous forest. *Salix bonplandiana* dominates the tree canopy with 67% cover (Szaro 1989). Szaro (1989) also states that these stands occur with the following community types: *Acer negundo*-mixed deciduous, *Alnus oblongifolia*, *Fraxinus pennsylvanica*, *Platanus wrightii* - *Fraxinus pennsylvanica*, and *Populus fremontii* - *Fraxinus pennsylvanica*. The understory was dense (60-100% cover), primarily *Baccharis salicifolia* with a fair regeneration of *Salix bonplandiana* as evidenced by sapling and seedling numbers.

Dynamics: No information available.

Similar Alliances:

Similar Alliance Comments:

Synonymy:

?? Warm Temperate Wetland Series (Brown 1982)

Comments:

ALLIANCE DISTRIBUTION

Range: This alliance is described from Arizona and southwestern New Mexico (Szaro 1989). *Salix bonplandiana* extends south into Central America.

States: AZ

TNC Ecoregions:

USFS Ecoregions: 321A:??

ALLIANCE SOURCES

Edition: 98-03-01

References: Brown 1982, Dick-Peddie 1993, Martin and Hutchins 1980, Szaro 1989

I.C.2.N.a. Mixed broad-leaved evergreen - cold-deciduous forest

I.C.2.N.a.1. ARBUTUS XALAPENSIS - ACER GRANDIDENTATUM - QUERCUS SPP. FOREST ALLIANCE (A.368)

Xalapa Madrone - Bigtooth Maple - Oak species Forest Alliance

ALLIANCE CONCEPT

Environment:

Physiognomy:

Vegetation:

Dynamics:

Similar Alliances:

Similar Alliance Comments:

Synonymy:

?? IA3a. Bigtooth Maple - Oak Forest, in part (Allard 1990)

?? Bigtooth Maple-Oak Series, in part (Diamond 1993)

Comments:

ALLIANCE DISTRIBUTION

Range: This alliance is found in Texas and in the Mexican states of Chihuahua, Coahuila, and Nuevo León.

States: TX

TNC Ecoregions: 21:C, 24:C

USFS Ecoregions: 321A:CC, M313B:CC

ALLIANCE SOURCES

Edition: 96-10

References: Allard 1990, Diamond 1993

I.C.3.N.a. Mixed needle-leaved evergreen - cold-deciduous forest

I.C.3.N.a.12. PINUS CEMBROIDES - QUERCUS GRAVESII FOREST ALLIANCE (A.392)

Mexican Pinyon - Chisos Red Oak Forest Alliance

ALLIANCE CONCEPT

Environment: This alliance includes mixed forests of high elevations (above 5000 feet) of the Chisos Mountains, possibly extending into Mexico.

Physiognomy:

Vegetation: Characteristically, these forests are dominated by a mixture of evergreen *Pinus spp.* (*Pinus cembroides*, *Pinus arizonica*), evergreen *Juniperus spp.* (*Juniperus deppeana*, *Juniperus flaccida*, *Juniperus erythrocarpa*), evergreen *Quercus spp.* (*Quercus grisea*, *Quercus tardifolia*), and deciduous *Quercus spp.* (*Quercus gravesii*, *Quercus graciliformis*).

Dynamics:

Similar Alliances:

Similar Alliance Comments:

Synonymy:

?? Pinyon Pine - Oak Series, in part (Diamond 1993)

?? Pinyon - Juniper: 239, in part (Eyre 1980)

Comments:

ALLIANCE DISTRIBUTION

Range: These forests occur on canyon slopes at high elevations in the Chisos Mountains of Trans-Pecos Texas, possibly extending into the Mexican state of Coahuila (?).

States: MXCO?,TX

TNC Ecoregions: 24:C

USFS Ecoregions: 321A:CC

ALLIANCE SOURCES

Edition: 96-10

References: Diamond 1993, Eyre 1980, Plumb 1992, Taylor et al. 1944, Warnock 1970, Wauer 1971

II. WOODLAND

II.A.2.N.a. Temperate broad-leaved evergreen woodland

II.A.2.N.a.2. QUERCUS GRISEA WOODLAND ALLIANCE (A.478)

Gray Oak Woodland Alliance

ALLIANCE CONCEPT

Environment: Woodlands included in this alliance occur on moderate to steep rocky slopes in canyons and on mountains in Trans-Pecos Texas, southwestern New Mexico and southeastern Arizona. Elevations range from 1280 to 2350 meters. Climate is semi-arid with hot summers and winters with the possibility of snow. Mean annual precipitation is approximately 48 cm, but is highly variable with drought years not uncommon. Typically one-third of the annual precipitation occurs in late winter and two-thirds between July and October often as high-intensity convective storms. Drought during May through June is common. Sites occur on moderate to steep rocky slopes in canyons and on mountain sides, and in canyon bottoms on all aspects. Soils and parent material are highly variable, but are often shallow, gravelly loams derived from andesite, quartz monzonite, rhyolite, alluvium or colluvium. Adjacent vegetation above these stands is often woodlands or forests dominated by *Juniperus deppeana*, *Pinus ponderosa*, *P. leiophylla*, *P. edulis* or *Pseudotsuga menziesii*. At lower elevations, shrub or tree savannas, or shrublands dominated by some of the same species is likely.

Physiognomy: Vegetation in these woodlands is dominated by a moderately dense cover of broad-leaved evergreen trees. A sparse to moderately dense mixed shrub layer is present. The graminoid layer is sparse to moderately dense and dominated by medium-tall warm-season bunchgrasses. The forb layer is generally sparse, but may have high species diversity. Cacti or rosette shrub succulents are commonly present.

Vegetation: Stands included in this woodland alliance occur in canyons and alluvial and colluvial slopes of mountains from Trans-Pecos, Texas to southeastern Arizona. These encinal woodlands are dominated by the broad-leaved evergreen tree, *Quercus grisea* and which is typically 3-15 m tall. Other common trees may include *Juniperus deppeana*, *J. monosperma*, *Pinus discolor*, *P. edulis*, *Quercus arizonica*, *Q. emoryi* and *Q. gravesii* in Texas. There is usually a moderate shrub layer from 1-3 m tall. Characteristic shrub and dwarf-shrub species include *Agave spp.*, *Arctostaphylos pungens*, *Brickellia spp.*,

Cercocarpus montanus, *Dasyilirion wheeleri*, *Ericameria laricifolia*, *Garrya wrightii*, *Gutierrezia sarothrae*, *Nolina microcarpa*, *Opuntia imbricata*, *O. phaeacantha*, *Quercus turbinella*, *Rhus trilobata*, *Yucca baccata*, *Y. schottii* and juvenile tree species.

The graminoid and forb layers are sparse to moderately dense often with high species diversity. The graminoid layer is dominated the medium-tall bunchgrasses such as *Bouteloua curtipendula*, *Muhlenbergia emersleyi* and *Schizachyrium cirratum*, but can be very diverse. Other common graminoids may include *Aristida* spp. *Bouteloua gracilis*, *Koeleria macrantha*, *Leptochloa dubia*, *Muhlenbergia dubia*, *M. longiligula*, *M. pauciflora*, *Panicum bulbosum* and *Piptochaetium fimbriatum*. The usually sparse, but often diverse forb layer may include *Artemisia* spp., *Croton fruticosus*, *Dichondra brachypoda*, *Geranium caespitosum*, *Macroptilium gibbosifolium*, *Sphaeralcea* spp. *Viguiera dentata* and many others.

Dynamics: All species of *Quercus* in these stands resprout profusely after fire (McPherson 1992). More study is needed to understand the effects of altered fire regimes on the vegetation.

Similar Alliances:

?? JUNIPERUS DEPPEANA WOODLAND ALLIANCE (A.534)

?? PINUS PONDEROSA WOODLAND ALLIANCE (A.530)

?? PINUS CEMBROIDES WOODLAND ALLIANCE (A.510)

?? ARBUTUS XALAPENSIS - ACER GRANDIDENTATUM - QUERCUS SPP. FOREST ALLIANCE (A.368)

?? QUERCUS ARIZONICA WOODLAND ALLIANCE (A.482)

Similar Alliance Comments: Similar alliances that have associations with *Quercus grisea* as a nominal species include II.A.4.N.a.32 *Pinus ponderosa* Woodland Alliance (A.530), II.A.4.N.a.36 *Juniperus deppeana* Woodland Alliance (A.534), II.A.4.N.a.12 *Pinus cembroides* Woodland Alliance (A.510), II.A.2.N.a.6 *Quercus arizonica* Woodland Alliance (A.482), and I.C.2.N.a.1 *Arbutus xalapensis* - *Acer grandidentatum* - *Quercus* spp. Forest Alliance (A.368).

Synonymy:

?? IB3a. Gray Oak Woodland (Allard 1990)

?? Gray Oak - Oak Series (Diamond 1993)

?? *Quercus grisea*/*Bouteloua curtipendula* Habitat Type (Larson and Moir 1986)

?? *Quercus grisea*/*Cercocarpus montanus* Habitat Type (Larson and Moir 1986)

?? *Quercus arizonica*/*Rhus trilobatus* Habitat Type. includes *Quercus grisea* and its hybrids to *Q. arizonica* (Bassett et al. 1987)

?? Evergreen Woodlands and Savannas. includes *Quercus grisea* and its hybrids to *Q. arizonica* (Dick-Peddie and Moir 1970)

Comments: A closely related alliance (II.A.2.N.a.6 *Quercus arizonica* Woodland Alliance (A.482)) is hard to distinguish from the *Quercus grisea* Woodland Alliance where sympatric because of taxonomic difficulties between the dominant *Quercus* species and similar habitats (Muldavin et al. 1994). Bassett et al. (1987) include hybrids between *Quercus arizonica* and *Quercus grisea* in their *Quercus arizonica* / *Rhus trilobata* Habitat Type.

Some riparian stands in canyon bottoms are dense enough to be classified as forests (plot EM17 in Bourgeron et al. 1993).

ALLIANCE DISTRIBUTION

Range: Woodlands included in this alliance occur in the mountains of southern Trans-Pecos Texas, New Mexico, and southeastern Arizona. It may also be found in the Mexican states of Chihuahua (?), Coahuila (?), and Sonora (?).

States: AZ,NM,TX

TNC Ecoregions: 21:C, 24:C

USFS Ecoregions: 313C:CC, 313E:CC, 321A:CC, M313A:CC, M313B:CC

ALLIANCE SOURCES

Edition: 98-08-04

References: Allard 1990, Bassett et al. 1987, Bourgeron et al. 1993, Bourgeron et al. 1995, Brown 1982, Diamond 1993, Dick-Peddie 1993, Dick-Peddie and Moir 1970, Gehlbach 1967, Gelbach 1967, Larson and Moir 1986, McPherson 1992, Muldavin and Melhop 1992, Muldavin et al. 1994, Plumb 1992

II.A.2.N.a.6. QUERCUS ARIZONICA WOODLAND ALLIANCE (A.482)

Arizona White Oak Woodland Alliance

ALLIANCE CONCEPT

Environment: Woodlands included in this alliance occur on moderate to steep rocky slopes in canyons and on mountains in southwestern New Mexico and southeastern Arizona. Elevations range from 1400 to 2200 meters. Climate is semi-arid with hot summers and winters with the possibility of snow. Mean annual precipitation is approximately 48 cm, but is highly variable with drought years not uncommon. Typically a third of precipitation occurs in late winter and two thirds in July through October often as high intensity convective storms. Drought during May-June is common. Sites occur on moderate to steep rocky slopes in canyons and on mountain sides, and in canyon bottoms on all aspects. Soil and parent material is highly

variable, but is often a gravelly loam derived from andesite, quartz monzonite, rhyolite or alluvium. Adjacent vegetation above these stands is often woodlands or forests dominated by *Juniperus deppeana*, *Pinus ponderosa*, *P. leiophylla*, *P. edulis* or *Pseudotsuga menziesii*. At lower elevations, shrub or tree savannas, or shrublands dominated by some of the same species, is likely.

Physiognomy: Vegetation in this woodland alliance is dominated by moderately dense cover of broad-leaved evergreen trees. A sparse to moderately dense mixed-shrub layer is present. The graminoid layer is sparse to moderately dense and dominated by medium-tall, warm-season bunchgrasses. The forb layer is generally sparse, but may have high species diversity. Cacti or rosette shrub succulents are commonly present.

Vegetation: Stands included in this woodland alliance occur in canyons and piedmont slopes of mountains in southwestern New Mexico and southeastern Arizona. These encinal woodlands are dominated by the broadleaf evergreen tree, *Quercus arizonica* and are typically 3-15 m tall. Other common trees may include *Juniperus deppeana*, *J. monosperma*, *Pinus discolor*, *P. edulis*, *Quercus emoryi*, *Q. grisea* and *Q. hypoleucoides*. Riparian woodlands may also have *Fraxinus velutina* present. There is usually a moderate shrub layer from 1-3 m tall. Characteristic shrub and dwarf-shrub species include *Agave spp.*, *Arctostaphylos pungens*, *Brickellia spp.*, *Cercocarpus montanus*, *Dasyllirion wheeleri*, *Ericameria laricifolia*, *Garrya wrightii*, *Gutierrezia sarothrae*, *Nolina microcarpa*, *Opuntia imbricata*, *O. phaeacantha*, *Quercus turbinella*, *Rhus spp.*, *Yucca baccata*, *Y. schottii* and juvenile tree species. The graminoid and forb layers are sparse to moderately dense, often with high species diversity. The graminoid layer is dominated by medium-tall bunchgrasses such as *Bouteloua curtipendula* or *Muhlenbergia emersleyi*, but can be very diverse. Other common graminoid species may include *Koeleria macrantha*, *Leptochloa dubia*, *Muhlenbergia dubia*, *M. longiligula*, *M. pauciflora*, *Panicum bulbosum*, *Piptochaetium fimbriatum* and *Schizachyrium cirratum*. The usually sparse, but often diverse forb layer may include *Artemisia spp.*, *Croton fruticulosus*, *Dichondra brachypoda*, *Geranium caespitosum*, *Macroptilium gibbosifolium*, *Viguiera dentata* and many others.

Dynamics: All species of *Quercus* in these stands resprout profusely after fire (McPherson 1992). More study is needed to understand the effects of altered fire regimes on the vegetation.

Similar Alliances:

?? PINUS EDULIS - (JUNIPERUS SPP.) WOODLAND ALLIANCE (A.516)

?? PSEUDOTSUGA MENZIESII FOREST ALLIANCE (A.157)

?? PINUS DISCOLOR WOODLAND ALLIANCE (A.538)

?? PINUS LEIOPHYLLA WOODLAND ALLIANCE (A.542)

?? PINUS PONDEROSA WOODLAND ALLIANCE (A.530)

Similar Alliance Comments: The *Pinus edulis* alliance includes an association where *Quercus arizonica* is a codominant tree canopy species. The other similar alliances have associations with *Q. arizonica* as the dominant understory species.

Synonymy:

?? *Quercus arizonica*/*Muhlenbergia emersleyi* Habitat Type (Larson and Moir 1986)

?? Encinal Series, in part (Dick-Peddie 1993)

?? *Quercus arizonica*/*Muhlenbergia emersleyi* Habitat Type, in part (Bassett et al. 1987)

?? *Quercus arizonica* Series, in part (Muldavin et al. 1994)

?? *Quercus arizonica*/*Piptochaetium fimbriatum* Habitat Type, in part (Bassett et al. 1987)

?? *Quercus arizonica*/*Rhus trilobata* Habitat Type, in part (Bassett et al. 1987)

Comments: A closely related alliance, the *Quercus grisea* Woodland Alliance, is hard to distinguish from the *Q. arizonica* Woodland Alliance where sympatric because of taxonomic difficulties between the dominant *Quercus* species and other similar habitats (Muldavin et al. 1994). Bassett et al. (1987) include hybrids between *Q. arizonica* and *Q. grisea* in their *Q. arizonica* / *Rhus trilobata* Habitat Type. Some stands in canyon bottoms are dense enough to be classified as forests (plot 91EM115 in Muldavin et al. 1994).

ALLIANCE DISTRIBUTION

Range: Woodlands included in this alliance occur in mountains of southern New Mexico and southeastern Arizona. It may also be found in the Mexican states of Chihuahua and Sonora.

States: AZ,NM

TNC Ecoregions:

USFS Ecoregions: 313C:C?, 313E:CC, 321A:CC, M313A:CC

ALLIANCE SOURCES

Edition: 98-08-04

References: Bassett et al. 1987, Bourgeron et al. 1993, Bourgeron et al. 1995, Brown 1982, Dick-Peddie 1993, Larson and Moir 1986, McPherson 1992, Muldavin 1994

II.A.2.N.a.7. QUERCUS EMORYI WOODLAND ALLIANCE (A.483)

Emory Oak Woodland Alliance

ALLIANCE CONCEPT

Environment: Woodlands included in this alliance occur in the lower foothill zone of isolated mountain ranges in Trans-Pecos, Texas, southwestern New Mexico, and southeastern Arizona. Elevations range from 1350 to 2200 m. Climate is semi-arid with hot summers and periods of cold weather in the winters with the possibility of snow. Mean annual precipitation is approximately 43 cm, but is highly variable with drought years not uncommon. Typically, one third of the annual precipitation occurs in late winter and two thirds in July through October, often as high intensity convective storms. Severe drought occurs from May through June. Stands occur in canyon and valley bottoms, draws, at the base of north aspect alluvial slopes and on colluvial mountain slopes where deep subsurface moisture is available to support the trees. One stand described by Bourgeron *et al.* (1993) occurs at the edge of a playa. Sites are nearly flat to moderately sloping (3-30%), but slopes may reach 80% in some communities. Soil and parent material is highly variable, but is often a silty, sandy, gravelly or cobbly loam derived from andesite, rhyolite, granite, alluvium or colluvium. Adjacent vegetation at higher elevations is often woodlands or forests dominated by *Juniperus deppeana*, *P. discolor*, or *P. edulis*. Near riparian areas, *Juglans major* forests are adjacent to the *Quercus emoryi* woodlands. At lower elevations, shrub or tree savannas or shrublands dominated by some of the species mentioned above are adjacent.

Physiognomy: Vegetation in this woodland alliance is dominated by a moderately dense cover of broad-leaved evergreen trees. A sparse to moderately dense mixed-shrub layer is present. The graminoid layer is sparse or, more typically, moderately dense and dominated by medium-tall, warm-season bunchgrasses. The forb layer is generally sparse, but may have high species diversity. Cacti or rosette shrub succulents are commonly present. Sparse to moderately dense cover of xeromorphic succulent and broad-leaved shrubs and scattered evergreen trees are often present.

Vegetation: Stands included in this woodland alliance occur in canyons and piedmont slopes of mountains in southwestern New Mexico and southeastern Arizona. These encinal woodlands are dominated by the broadleaf evergreen tree, *Quercus emoryi* and are typically 3-15 m tall. Other common trees may include *Juniperus deppeana*, *J. monosperma*, *Pinus cembroides*, *P. discolor*, *P. edulis*, *Quercus arizonica* and *Q. grisea*. Riparian woodlands may also have *Juglans major* present. Tree species from mesic, subirrigated stands in Texas may also have *Quercus gravesii*, *Q. graciliformis*, *Celtis laevigata* var. *reticulata* and *Acer grandidentatum*. There is usually a moderate shrub layer from 1-3 m tall. Characteristic shrub species include *Agave* spp., *Arctostaphylos pungens*, *Brickellia* spp., *Cercocarpus montanus*, *Dasyllirion wheeleri*, *Ericameria laricifolia*, *Garrya wrightii*, *Mimosa aculeaticarpa* var. *biuncifera* (= *Mimosa biuncifera*), *Nolina microcarpa*, *Opuntia imbricata*, *O. phaeacantha*, *Quercus turbinella*, *Rhus* spp. *Yucca baccata*, *Y. schottii* and juvenile tree species.

The graminoid and forb layers are sparse to moderately dense often with high species diversity. The graminoid layer is dominated the medium-tall bunchgrasses such as *Bouteloua curtipendula*, *Muhlenbergia emersleyi*, *Piptochaetium fimbriatum*, *Schizachyrium cirratum* or *Sporobolus flexuosus*. This layer is very diverse. Other common graminoid species may include *Bothriochloa barbinodis*, *Koeleria macrantha*, *Leptochloa dubia*, *Muhlenbergia dubia*, *M. longiligula*, *M. pauciflora* and *Panicum bulbosum*. The usually sparse, but often diverse forb layer may include species of *Artemisia*, *Croton*, *Geranium*, *Glandularia*, *Macroptilium*, *Mirabilis*, *Phaseolus*, *Sphaeralcea*, *Viguiera* and many others. These woodland stands often occur as a mosaic with patches of grasslands dominated by mid-grasses distributed across the landscape.

Dynamics: Stands included in this alliance are typically a late successional stage woodland, and altered fire regimes (failed fire suppression followed by increased intensity and extent of fire) may be reducing the number of stands. Grazing impacts and timber harvest are also reducing the range (Muldavin *et al.* 1998). More study is needed to understand the effects of altered fire regimes on the vegetation.

Similar Alliances:

?? PINUS LEIOPHYLLA WOODLAND ALLIANCE (A.542)

?? PINUS PONDEROSA WOODLAND ALLIANCE (A.530)

?? PINUS CEMBROIDES WOODLAND ALLIANCE (A.510)

Similar Alliance Comments: Similar alliances that have associations with *Quercus emoryi* as a diagnostic species include II.A.4.N.a.44 *Pinus leiophylla* Woodland Alliance (A.542), II.A.4.N.a.32 *Pinus ponderosa* Woodland Alliance (A.530), and II.A.4.N.a.12 *Pinus cembroides* Woodland Alliance (A.510).

Synonymy:

?? IB3e. Emory Oak Woodland (Allard 1990)

?? Emory Oak Series (Diamond 1993)

?? Western Live Oak: 241, in part (Eyre 1980)

?? *Quercus emoryi*/*Bouteloua curtipendula* Habitat Type, in part (Bassett *et al.* 1987)

?? *Quercus emoryi*/*Dasyllirion wheeleri* Habitat Type, in part (Bassett *et al.* 1987)

?? *Quercus emoryi*/*Arctostaphylos pungens* Habitat Type, in part (Bassett *et al.* 1987)

Comments: Some stands in canyon bottoms are dense enough to be classified as forests (plot 91EM17 in Muldavin *et al.* 1994). Other stands have a sparse tree layer. Bassett *et al.* (1987) report that at lower elevations these woodland stands

become savannas. More work is needed to clarify the classification of these stands. Additionally, more compositional information is needed to fully describe associations in this alliance.

ALLIANCE DISTRIBUTION

Range: Woodlands included in this alliance occur in the mountains of Trans-Pecos Texas (west to the Davis and Chisos mountains), southern New Mexico, and southeastern Arizona. Stands may also be found in the mountains of the northern Mexican states of Coahuila, Chihuahua, and Sonora.

States: AZ,NM,TX

TNC Ecoregions: 21:C, 24:C

USFS Ecoregions: 313C:CC, 321A:CC, M313A:CC, M313B:CC

ALLIANCE SOURCES

Edition: 98-08-04

References: Allard 1990, Anderson 1985, Anderson et al. 1985, Bassett et al. 1987, Bourgeron et al. 1993, Bourgeron et al. 1995, Brown 1982, Diamond 1993, Dick-Peddie 1993, Eyre 1980, Hinckley 1944, Muldavin et al. 1998, Palmer 1929, Reid et al. 1994, Texas Parks and Wildlife Department 1990b, Warren et al. 1992, Wentworth 1982

II.A.4.N.a. Rounded-crowned temperate or subpolar needle-leaved evergreen woodland

II.A.4.N.a.12. PINUS CEMBROIDES WOODLAND ALLIANCE (A.510)

Mexican Pinyon Woodland Alliance

ALLIANCE CONCEPT

Environment: This alliance consists of pinyon - juniper woodlands occurring at 1500-2000 meters (5000-6500 feet) elevation. These woodlands occur on steep, rocky slopes, mesas, and higher elevation canyons, mostly associated with igneous substrates.

Physiognomy:

Vegetation: *Pinus cembroides* is the dominant pine. Other typical tree species include *Juniperus deppeana*, *Juniperus flaccida*, *Juniperus erythrocarpa*, *Quercus grisea*, and *Quercus emoryi*. Shrub and herbaceous species include *Mimosa dysocarpa*, *Agave lechuguilla*, *Salvia regla*, *Muhlenbergia emersleyi*, *Muhlenbergia montana*, *Piptochaetium pringlei*, and *Bouteloua curtipendula*.

Dynamics:

Similar Alliances:

Similar Alliance Comments:

Synonymy:

?? Pinyon Pine - Oak Series, in part (Diamond 1993)

?? Pinyon - Juniper: 239, in part (Eyre 1980)

Comments: *Pinus edulis* and *Pinus remota* also occur in similar habitats in the Trans-Pecos Mountains in combination with various *Quercus spp.* and *Juniperus spp.* *Pinus spp.* dominance in western Texas montane forests seems to vary with major mountain range and elevation (Diamond 1993).

ALLIANCE DISTRIBUTION

Range: This alliance consists of pinyon - juniper woodlands in the Davis and Chisos mountains of Trans-Pecos Texas, and possibly extending into the Mexican state of Coahuila (?).

States: MXCO?,TX

TNC Ecoregions: 24:C

USFS Ecoregions: 321A:CC

ALLIANCE SOURCES

Edition: 94-11

References: Diamond 1993, Eyre 1980, Palmer 1929, Plumb 1988, Warnock 1977, Wauer 1971

II.A.4.N.a.18. PINUS EDULIS - (JUNIPERUS SPP.) WOODLAND ALLIANCE (A.516)

Pinyon - (Juniper species) Woodland Alliance

ALLIANCE CONCEPT

Environment: Stands included in this woodland alliance occur in the foothills and the lower montane zone in the southern Rocky Mountains; mountains, mesas, piedmonts and canyons in the Chihuahuan and Sonoran Deserts and the Colorado

Plateau; and breaks and escarpments in the southern Great Plains. Elevations range from 1500-2440 m. Climate is semi-arid with drought not uncommon. Summers are generally hot, and winters range from mild with cold periods and occasional snows in southern New Mexico and Arizona to the more typical extended periods of freezing temperatures. The seasonality of precipitation varies from east to west with summer rain more common in the southern and eastern portion of the woodland's range and winter precipitation more common in the western portion of the range. The mean annual precipitation ranges from 30 to 46 cm. Stands typically occur on nearly level to steep (to 80%), rocky slopes on hillsides and ridgetops. Aspect does not seem important except in elevational extremes for a given latitude where low elevation stands are restricted to the more mesic north slopes and canyons and high elevations stands occur on south aspects. Sites are typically dry with shallow, rocky, calcareous and alkaline soils. Other sites include eroded "badlands", lava flows, scree slopes, and deep sands. Soil textures range from sandy loam to clay, and are typically derived from limestone, sandstone or shale. Other parent materials include andesite, basalt, granite, quartzite, monzonite, rhyolite and mixed alluvium.

Adjacent vegetation at higher elevations is typically woodlands or forests dominated by *Pinus ponderosa*. Adjacent vegetation at lower elevations is often *Juniperus* spp. dominated woodlands and savannas, *Artemisia* spp. dominated shrublands, or grasslands.

Physiognomy: Vegetation included in this alliance has a moderately sparse to moderately dense tree canopy that is typically 3-10 m tall. Stands are either solely dominated by evergreen needle-leaved trees or may be codominated by broad-leaved or scale-leaved evergreen trees. A sparse to moderately dense shrub layer may be present. If present, the shrub layer ranges from a single species to a diverse mixture of broadleaf and microphyllous, deciduous or evergreen shrubs that are usually less than 3 m tall. A sparse to moderate ground layer dominated by perennial graminoids is usually present. Perennial forbs and cacti are often scattered throughout the stands. Annual forbs and grasses may be seasonally present.

Vegetation: Woodlands included in this alliance occur on dry sites in the lower montane zone in the southern Rocky Mountains; mountains, mesas and canyons in the Chihuahuan and Sonoran Deserts, and the Colorado Plateau; and breaks in the southern Great Plains. Stands have a moderately sparse to moderately dense tree canopy typically 3-12 m tall. Mature individuals range from 2-3 m tall "scrub" to large trees up to 21 m tall. Moderately sparse stands have an open canopy with trees distributed in patches, whereas the tree crowns touch in the moderately dense stands. The upper canopy may be solely dominated by the evergreen needle-leaf tree, *Pinus edulis*, but more commonly is codominated by one of several species of *Juniperus* or *Quercus* depending on geography. On the Colorado Plateau, *Juniperus osteosperma* may codominate, whereas *J. monosperma* codominates in the eastern part of the woodland's range. At higher elevations, *Juniperus scopulorum* may be present and in the far southern extent, Madrean evergreen woodland species co-occur. These species include *J. deppeana*, *J. erythrocarpa* and the encinals, *Quercus arizonica*, *Q. grisea*, *Q. X pauciloba*.

The understory ranges from a relatively rich mixture of evergreen and/or deciduous shrubs, to a sparse to moderately dense herbaceous layer dominated by perennial grasses (with or without shrubs), to no vegetation at all. Most commonly the understory is sparse and has a patchy distribution. Characteristic shrubs and dwarf-shrubs include *Artemisia tridentata*, *Cercocarpus montanus*, *C. ledifolius*, *Coleogyne ramosissima*, *Ephedra viridis*, *Gutierrezia sarothrae*, *Lycium pallidum*, *Opuntia* spp. *Purshia mexicana*, *Purshia tridentata*, *Rhus trilobata* and *Quercus gambelii*. Shrubs restricted to warmer southern latitudes include *Agave* spp. *Arctostaphylos pungens*, *Dasyllirion wheeleri*, *Garrya* spp., *Nolina microcarpa*, *Quercus turbinella* and *Yucca baccata*. The herbaceous layer is sparse to moderately dense, ranging from 1 to 30% cover. Perennial graminoids are the most abundant species, particularly *Bouteloua curtipendula*, *B. gracilis*, *B. hirsuta*, *Aristida* spp., *Festuca arizonica*, *Koeleria macrantha*, *Muhlenbergia* spp. *Oryzopsis hymenoides*, *O. micrantha*, *Poa fendleriana*, *Pseudoroegneria spicata* and *Stipa* spp. *Andropogon hallii* occurs as an understory species in rare, deep sands habitats. Many forb species occur, but few have much cover. Commonly present forbs include species of *Artemisia*, *Eriogonum*, *Heterotheca*, *Mirabilis*, *Penstemon*, *Phlox*, *Senecio* and *Zinnia*. Annual grasses and forbs are seasonally present.

Dynamics: *Pinus edulis* is extremely drought-tolerant and slow-growing (Powell 1988, Little 1987, Muldavin et al. 1998). It is also non-sprouting and may be killed by fire (Wright et al. 1979). The effect of a fire on a stand is largely dependent on the tree height and density, fine fuel load on the ground, weather conditions, and season (Wright et al. 1979, Dwyer and Pieper 1967). Trees are more vulnerable in open stands where fires frequently occur in the spring, the relative humidity is low, wind speeds are over 10-20 mph, and there is adequate fine fuels to carry fire (Fischer and Bradley 1987, Wright et al. 1979). Under other conditions, burns tend to be spotty with low tree mortality. Large trees are generally not killed unless fine fuels, such as tumbleweeds, have accumulated beneath the tree to provide ladder fuels for the fire to reach the crown. Closed-canopy stands rarely burn because they typically do not have enough understory or wind to carry a fire.

Altered fire regimes, cutting trees for fencing, and improper grazing by livestock have significant impacts on the quality of sites. Grazing by livestock can modify the fire regime by removing the fine fuels that carry fire. Fire, livestock grazing, and trampling by recreationalists and vehicles disturb cryptogamic soil crusts that help maintain soil structure, reduce soil erosion, provide habitat for plants and preserve biological diversity (Ladyman and Muldavin 1996). More study is needed to understand and manage these woodlands ecologically.

Similar Alliances:

?? PINUS EDULIS FOREST ALLIANCE (A.135)

?? JUNIPERUS MONOSPERMA WOODLAND ALLIANCE (A.504)

?? JUNIPERUS SCOPULORUM WOODLAND ALLIANCE (A.506)

?? JUNIPERUS DEPPEANA WOODLAND ALLIANCE (A.534)

Similar Alliance Comments: Similar alliances include I.A.8.N.b.21 *Pinus edulis* Forest Alliance (A.135), II.A.4.N.a.6 *Juniperus monosperma* Woodland Alliance (A.504), II.A.4.N.a.8 *Juniperus scopulorum* Woodland Alliance (A.506), and II.A.4.N.a.36 *Juniperus deppeana* Woodland Alliance (A.534). Forest stands are similar to the woodland stands except for a higher density of trees and typically a sparser understory. *Pinus edulis* Woodland Alliance stands are separated from stands in the similar *Juniperus spp.* woodland alliances by the dominance or codominance of *Pinus edulis*. Associations placed in the alliances defined for *Juniperus spp.* do not have significant cover of *Pinus edulis* trees.

Synonymy:

?? Pinyon - Juniper: 239, in part (Eyre 1980)

?? *Pinus edulis* Series, in part (Francis 1986)

?? Colorado Pinyon-One Seeded Juniper Series, in part (Dick-Peddie 1993)

?? Colorado Pinyon-Alligator Juniper Series, in part (Dick-Peddie 1993)

?? Colorado Pinyon-Utah Juniper Series, in part (Dick-Peddie 1993)

?? Colorado Pinyon-Rocky Mountain Juniper Series, in part (Dick-Peddie 1993)

?? Colorado Pinyon-Mixed Juniper Series, in part (Dick-Peddie 1993)

Comments: The *Pinus edulis* forest stands are not well differentiated from the woodland stands. They occur on less xeric sites within woodlands such as on north aspects and at higher elevation sites. Only one association currently exists, and more work is needed to clarify the differences between these two alliances.

The literature often describes *Pinus edulis* and *Juniperus spp.* vegetation types as one woodland type (P/J woodland). Both *Pinus edulis*-dominated associations and those codominated with *Juniperus spp.* are included in this alliance. More work is needed to clarify boundaries between this alliance and the *Juniperus spp.* alliances that may have scattered *Pinus edulis* trees. Also, a sparsely vegetated alliance may need to be developed because some *Pinus edulis* stands do not have enough cover to be classified as woodlands. See Francis (1986) for examples.

ALLIANCE DISTRIBUTION

Range: Stands included in this woodland alliance are common on the Colorado Plateau and extend north into the Uinta Mountains, south in the northern mountains of the Sonoran and Chihuahuan deserts and east to lower montane zone of the southern Rocky Mountains. The alliance is also found on mesas and breaks of the southern Great Plains as far as the Panhandle of Oklahoma and into western Texas.

States: AZ,CA,CO,NM,NV,OK,TX?,UT

TNC Ecoregions: 21:C, 24:C, 27:C

USFS Ecoregions: 313A:CC, 313B:CC, 313D:CC, 313E:CC, 315A:CC, 321A:CC, 322A:??, 331I:CC, 331J:CC, 341B:C?, 341C:CC, 341F:C?, M313A:CC, M313B:CC, M331E:CC, M331F:CC, M331G:CC

ALLIANCE SOURCES

Edition: 98-08-17

References: Baker 1980, Baker 1982, Baker 1983, Baker 1984, Baker and Kennedy 1985, Barnes 1987, Bassett et al. 1987, Brown 1982, Burns and Honkala 1990, Clements 1904, DeLeuw, Cather & Company 1977, Dick-Peddie 1993, Dick-Peddie n.d., Donart et al. 1978, Dwyer and Pieper 1967, Erdman 1962, Erdman 1969, Erdman 1970, Erdman et al. 1969, Everett 1987, Eyre 1980, Fischer and Bradley 1987, Francis 1986, Galatowitch and Bourgeron 1985, Harmon 1980, Heinze et al. 1962, Hess and Wasser 1982, Holm 1927, Isaacson 1967, Jameson and Reid 1965, Jameson et al. 1962, Johnston 1984, Johnston 1987, Kennedy 1983, Ladyman and Muldavin 1996, Larson and Moir 1986, Larson and Moir 1987, Little 1987, Marr et al. 1973, Marr et al. 1979, Mason et al. 1967, Medina 1986, Moir 1963, Moir and Carleton 1987, Moir and Ludwig 1979, Muldavin 1994, Muldavin and Melhop 1992, Muldavin et al. 1998, Northcutt 1978, Pieper 1968, Pieper and Lymbery 1983, Powell 1988, Rogers 1950, Rogers 1953, Shantz 1906, Steinhoff 1978, Tiedeman 1978, USDA Forest Service 1985, USDA Soil Conservation Service 1978, USDI Bureau of Indian Affairs 1979, United States Forest Service 1981, United States Forest Service 1982, United States Forest Service 1983, United States Forest Service 1985, Vories 1974, Warren et al. 1982, Wells 1970a, Wright et al. 1973, Wright et al. 1979, Zimmerman 1978

II.A.4.N.a.25. PINUS REMOTA WOODLAND ALLIANCE (A.523)

Papershell Pinyon Woodland Alliance

ALLIANCE CONCEPT

Environment: Woodlands in this alliance occur at low to moderate elevations (2500-5000 feet). This alliance occurs as isolated stands, mostly associated with limestone geology.

Physiognomy:

Vegetation: Woodlands in this alliance are dominated by *Pinus remota*. *Quercus spp.* and *Juniperus spp.* often share dominance in the open canopy, with the species varying geographically. Associated species in the Trans-Pecos include

Quercus mohriana, *Juniperus pinchotii*, *Yucca elata*, *Bouteloua curtipendula*, *Bouteloua gracilis*, and *Agave lechuguilla*. Associates in the Edwards/Stockton Plateau are *Juniperus ashei*, *Quercus pungens* var. *vaseyana*, *Quercus fusiformis*, and perhaps *Quercus buckleyi* and *Quercus laceyi*.

Dynamics:

Similar Alliances:

Similar Alliance Comments:

Synonymy:

?? Pinyon Pine-Oak Series, in part (Diamond 1993)

?? Pinyon - Juniper: 239, in part (Eyre 1980)

Comments: *Pinus remota* is related to *Pinus cembroides* and is sometimes submerged into it.

ALLIANCE DISTRIBUTION

Range: This alliance is endemic to the Glass and Del Norte mountains of the Trans-Pecos, and eastward to the Stockton and Edwards Plateau in Texas and adjacent provinces of Mexico (Coahuila, Nuevo León, and northern Chihuahua)

States: TX

TNC Ecoregions: 24:C, 29:C

USFS Ecoregions: 315D:CC, 321A:CC, 321B:CC

ALLIANCE SOURCES

Edition: 95-01

References: Diamond 1993, Eyre 1980

II.A.4.N.a.32. PINUS PONDEROSA WOODLAND ALLIANCE (A.530)

Ponderosa Pine Woodland Alliance

ALLIANCE CONCEPT

Environment: These woodlands typically occur at the lower treeline/ ecotone between grassland or shrubland and more mesic coniferous forest. They occur across 20 degrees of latitude, from Canada well into northwest Mexico. These are among the driest wooded habitats in the western United States, but quantity and timing of precipitation vary greatly across the range of the alliance. Generally, these woodlands occur in areas which receive 25-60 cm of precipitation annually, with at least some seasonal drought. East of the Continental Divide, and in the Southwest, summer precipitation predominates, whereas western stands receive most their precipitation from westerly winter storms. Monsoonal summer rains can contribute a substantial proportion to the annual precipitation totals in Arizona, New Mexico, Utah and Colorado. Elevations decrease with increasing latitude, from less than 1000 m eastern Washington to over 2750 m in southern Arizona and New Mexico. Stands occur at low elevations (< 1000 m) in the eastern Great Plains and west of the Cascade-Sierra axis.

Fire is a key factor in maintaining the open canopies characteristic of these woodlands, but soil drought or infertility may be equally important in some areas. Soils are highly variable across the range of the alliance, and derived from igneous, metamorphic, and sedimentary materials. The most characteristic soil features are good aeration and drainage, coarse textures, circumneutral to slightly acid pH, an abundance of mineral material, and periods of drought during the growing season. Some stands may occur as edaphic climax communities on very skeletal, infertile, and/or excessively drained soils, such as pumice, cinder or lava fields, and scree slopes. All slopes and aspects are represented, but many associations occur on moderately steep to very steep slopes or ridgetops. Adjacent vegetation is highly varied across the range of this type, but most commonly these communities grade into semi-arid steppe grasslands or shrublands at the lower elevation margins and closed forests of *Abies grandis*, *Abies concolor*, *Pseudotsuga menziesii* or *Populus tremuloides* at the upper elevation margins or adjacent more mesic sites. Adjacent drier sites can be dominated by *Juniperus scopulorum* or *Juniperus occidentalis* woodlands.

Physiognomy: These are open woodland stands of needle-leaved evergreen trees of 10-50 m in height. Pacific and southwestern stands often contain taller trees, whereas stands in the northern Great Plains are typically less than 15 m in height. Associated trees are primarily needle-leaved evergreen species, but cold-deciduous and broad-leaved evergreen trees may form a subcanopy, particularly in Pacific or southwestern stands. The understory is often shrubby, with either tall or short layers, and sclerophyllous or cold-deciduous species dominate. Where there is no shrub layer, grassy understories are common, but perennial forbs are important in some stands. Mosses and lichens can be conspicuous in some stands. Thick litter and duff layers occur, as do rock outcrops on steep slopes.

Vegetation: The *Pinus ponderosa* Woodland Alliance is one of the most widespread wooded alliances in the western United States; there are currently over 50 plant associations in this alliance. They are found throughout the western half of the U.S. and southwestern Canada on dry/dry-mesic to xeric sites. Associations dominated by either *Pinus ponderosa* var. *ponderosa* or *Pinus ponderosa* var. *scopulorum* are included. Average tree canopy cover in associations in the alliance can be somewhat variable, ranging from 20% to 70%. Structurally, these are open woodlands or savannas with large, open growth-form *Pinus ponderosa* trees (generally) as the only canopy dominant. The understory may include dense stands of shrubs or be

dominated by grasses, sedges, or herbaceous species, although many of the associations are named for dominant shrub species. Existing stands usually have younger cohorts of *Pinus ponderosa* present and may be less open than in the past. Other trees may occasionally be present. Associated trees and understory species vary widely across the range of this alliance.

In the southern Rocky Mountains and the mountains of southern Arizona and New Mexico, associated trees include *Pseudotsuga menziesii*, *Abies concolor*, *Picea pungens*, *Pinus strobiformis*, *P. edulis*, *P. discolor*, *P. cembroides*, *P. flexilis*, *Juniperus scopulorum*, and *Populus tremuloides*. In far southern stands, *Juniperus deppeana* may also be common. None of these is ever abundant, and successful regeneration is uncommon. The shrub stratum may be conspicuous to absent, but where shrubs are present they are primarily cold-deciduous species. Common species include *Arctostaphylos uva-ursi*, *Arctostaphylos pungens*, *Artemisia tridentata*, *Cercocarpus montanus*, *Ceanothus greggii*, *C. fendleri*, *Juniperus communis*, *Purshia mexicana*, *Purshia tridentata*, *Quercus gambelii*, *Q. arizonica*, *Q. emoryi*, *Q. grisea*, *Q. hypoleucoides*, *Q. X pauciloba*, and species of *Ribes* and *Symphoricarpos*. Some associations have insignificant shrub layers, and grassy understory herbaceous layers. The cover of the herbaceous stratum tends to vary inversely with the cover of the shrub stratum. Where there is a significant herbaceous layer, it is usually dominated by sod-forming or caespitose graminoids, including *Bouteloua gracilis*, *Carex geyeri*, *Festuca arizonica*, *F. kingii*, *Muhlenbergia virescens*, *Muhlenbergia montana*, *Pseudoroegneria spicata*, or *Stipa comata*. In western Texas and Oklahoma other associated species include *Piptochaetium fimbriatum*, *Piptochaetium pringlei*, *Stipa lobata*, *Bothriochloa barbinodis* var. *barbinodis*, *Schizachyrium scoparium* ssp. *neomexicanum*, *Muhlenbergia rigida*, and *Panicum bulbosum*.

In the interior Pacific Northwest of eastern Oregon and Washington, and as far east as northwestern Montana, associated tree species may include *Pseudotsuga menziesii*, *Abies grandis*, *Cercocarpus ledifolius*, *Pinus contorta*, *Larix occidentalis*, *Juniperus occidentalis*, and *Quercus garryana*. As in the southern Rockies, none of these trees are ever abundant in the canopy, but in some stands one or more may be successfully regenerating, particularly *Abies grandis* or *Pseudotsuga menziesii*. A shrub layer may be prominent or nearly absent, depending on location and disturbance history. When present, shrub associates include *Arctostaphylos patula*, *Arctostaphylos nevadensis*, *Ceanothus velutinus*, *Cercocarpus ledifolius*, *Purshia tridentata*, *Artemisia tridentata*, *Artemisia arbuscula*, *Artemisia nova*, *Amelanchier alnifolia*, and *Ribes* spp. The herbaceous layer in shrubby *Pinus ponderosa* woodlands is typically dominated by caespitose graminoids, including *Carex geyeri*, *Carex rossii*, *Carex pensylvanica*, *Koeleria macrantha*, *Oryzopsis hymenoides*, *Pseudoroegneria spicata*, *Poa secunda*, *Elymus elymoides*, *Festuca idahoensis*, and *Stipa occidentalis*. Some associations do not have a significant shrub layer, and the herbaceous layer is either grassy or composed primarily of perennial forbs. Many species could be listed, but dominant or diagnostic species include many of the previously mentioned taxa, plus *Festuca campestris*, *Oryzopsis asperifolia*, *Aspidotis densa*, *Wyethia mollis*, *Balsamorhiza sagittata*, *Achillea millefolium*, *Sedum stenopetalum*, *Maianthemum racemosum* (= *Smilacina racemosa*), *Vicia americana*, and species of many other genera, such as *Erigeron*, *Lupinus*, *Fragaria*, *Lathyrus*, *Heterotheca*, *Arenaria*, and *Antennaria*.

Woodlands of the Black Hills and the surrounding region have many similarities with Rocky Mountain stands, but have unique species assemblages not found elsewhere. Tree associates include *Picea glauca*, *Quercus macrocarpa*, *Populus tremuloides*, *Betula papyrifera*, and *Juniperus scopulorum*. Characteristic shrubs in these eastern stand include *Rhus trilobata*, *Physocarpus monogynus*, *Symphoricarpos albus*, *S. occidentalis*, *Shepherdia canadensis*, *Arctostaphylos uva-ursi*, and *Rosa* spp. Many stands have an herbaceous understory composed of species from the adjacent mixed-grass prairie, including *Carex filifolia*, *Stipa comata*, *Andropogon gerardii*, *Calamovilfa longifolia*, *Danthonia* spp., and *Schizachyrium scoparium*. In southwestern North Dakota, communities within this alliance do not cover large contiguous tracts. They are interrupted by other types of vegetation, usually grasslands (Potter and Green 1964).

In the far west, these woodlands occur in summer dry valleys and foothills from southern Oregon to central California. This description is general; many associations occur in California that have not been incorporated here. Typical tree associates include *Calocedrus decurrens*, *Pinus sabiniana*, *P. lambertiana*, *P. attenuata*, *Pseudotsuga menziesii*, *Quercus kelloggii*, *Q. agrifolia*, *Q. chrysolepis*, *Q. garryana*, and *Aesculus californica*. The understory typically contains sclerophyllous or cold-deciduous shrub species from adjacent chaparral communities, including *Arctostaphylos patula*, *Arctostaphylos viscida*, *Ceanothus cuneatus*, *Toxicodendron diversilobum*, *Frangula californica* ssp. *californica* (= *Rhamnus californica*), and *Symphoricarpos* spp. The herbaceous layer is typically sparse due to litter accumulation, and is dominated by xerophytic forbs and grasses.

Dynamics: *Pinus ponderosa* is a drought-resistant, shade-intolerant conifer which usually occurs at lower treeline in the major ranges of the western United States. Historically, ground fires and drought were influential in maintaining open-canopy conditions in these woodlands. With settlement and subsequent fire suppression, stands have become more dense. Presently, many stands contain understories of more shade-tolerant species, such as *Pseudotsuga menziesii* and/or *Abies* spp., as well as younger cohorts of *Pinus ponderosa*. These altered stand structures have affected fuel loads and alter fire regimes. Pre-settlement fire regimes were primarily frequent (5-15 year return intervals), low-intensity ground fires triggered by lightning strikes or deliberately set fires by Native Americans. With fire suppression and increased fuel loads, fire regimes are now less frequent and often become intense crown fires which can kill mature *Pinus ponderosa*.

Establishment is erratic and believed to be linked to periods of adequate soil moisture and good seed crops, as well as fire frequencies which allow seedlings to reach sapling size. Longer fire intervals have resulted in many stands having dense subcanopies of overstocked and unhealthy young *Pinus ponderosa*.

Similar Alliances:

- ?? PINUS PONDEROSA FOREST ALLIANCE (A.124)
- ?? PINUS PONDEROSA - PSEUDOTSUGA MENZIESII FOREST ALLIANCE (A.134)
- ?? PINUS PONDEROSA WOODED MEDIUM-TALL HERBACEOUS ALLIANCE (A.1495)
- ?? PINUS PONDEROSA WOODED TALL HERBACEOUS ALLIANCE (A.1488)
- ?? PINUS PONDEROSA SPARSELY VEGETATED ALLIANCE (A.1859)
- ?? PINUS PONDEROSA - POPULUS TREMULOIDES FOREST ALLIANCE (A.399)
- ?? PINUS PONDEROSA - PSEUDOTSUGA MENZIESII WOODLAND ALLIANCE (A.533)
- ?? PINUS PONDEROSA TEMPORARILY FLOODED WOODLAND ALLIANCE (A.565)
- ?? PINUS PONDEROSA - QUERCUS GARRYANA WOODLAND ALLIANCE (A.689)

Similar Alliance Comments: The *Pinus ponderosa* Woodland Alliance is distinguished by the singular dominance of *Pinus ponderosa* in open stands (25-60 percent cover) occurring in non-wetland habitats and exhibiting an obvious woodland physiognomy. Closed forests dominated by *Pinus ponderosa* are found in the I.A.8.N.b.10 *Pinus ponderosa* Forest Alliance (A.124). The presence of significant amounts of *Pseudotsuga menziesii* may make it difficult to separate some stands from communities in the II.A.4.N.a.35 *Pinus ponderosa - Pseudotsuga menziesii* Woodland Alliance (A.533). The abundance of graminoids typically found in dry and dry-mesic prairies is one diagnostic feature to separate many elements within this woodland alliance from those within *Pinus ponderosa* Forest Alliance. However, some woodland elements are relatively mesic and contain mesophytic shrubs. The classification status and diagnostic characteristics for these elements need to be further elucidated.

Synonymy:

- ?? Interior Ponderosa Pine: 237, in part (Eyre 1980)
- ?? Pacific Ponderosa Pine: 245, in part (Eyre 1980)
- ?? Upland Coast Range Ponderosa Pine forest, in part (Holland 1986)
- ?? Westside Ponderosa Pine Forest, in part (Holland 1986)
- ?? *Pinus ponderosa / Bouteloua gracilis - Schizachyrium scoparium* woodland association, in part (Hoagland 1997)
- ?? Ponderosa Pine Series, in part (Diamond 1993)

Comments: Taxonomists recognize two varieties of *Pinus ponderosa*, a Pacific form, *Pinus ponderosa* var. *ponderosa*, and an interior form *Pinus ponderosa* var. *scopulorum*. Associations dominated by either variety are included in this alliance. The abundance of graminoids typically found in dry and dry-mesic prairies is one diagnostic feature to separate many elements within this woodland alliance from those within *Pinus ponderosa* Forest Alliance. A few relatively mesic woodland associations can be very difficult to separate from forest associations. The classification status of all associations currently placed in the *Pinus ponderosa* Forest Alliance to be reviewed and verified.

ALLIANCE DISTRIBUTION

Range: These woodlands occur in every western state west of the Great Plains, as well as in British Columbia, Canada. East of the Rocky Mountains, they extend locally into North and South Dakota, Nebraska, Oklahoma and Texas. *Pinus ponderosa* grows in Mexico, but the presence of the *Pinus ponderosa* Woodland Alliance has not been established.

States: AZ,BC,CA,CO,ID,MT,ND,NE,NM,NV,OK,OR,SD,TX,UT,WA,WY

TNC Ecoregions: 10:C, 19:C, 20:C, 21:C, 22:C, 24:C, 25:C, 26:C, 27:C, 9:C

USFS Ecoregions: 313A:CC, 313B:CC, 313C:CC, 313D:CC, 313E:CC, 315A:CC, 321A:CC, 331A:CC, 331D:CC, 331E:C?, 331F:CC, 331G:CC, 331I:CC, 331J:CC, 332C:CP, 341F:CC, 341G:CC, 342B:CC, 342C:CC, 342I:CC, M242C:CC, M261A:CC, M261G:CC, M313A:CC, M313B:CC, M331B:CC, M331D:CC, M331E:CC, M331F:CC, M331G:CC, M331I:CC, M331J:CC, M332A:CC, M332B:CC, M332D:CC, M332G:CC, M333A:CC, M333B:CC, M333C:CC, M333D:CC, M334:C, M341A:C?, M341C:CC

ALLIANCE SOURCES

Edition: 99-05-22

References: Alexander 1985, Alexander et al. 1984, Alexander et al. 1986, Alexander et al. 1987, Bader 1932, Barbour and Major 1977, Barrows et al. 1977, Bassett et al. 1987, Blackburn 1969, Boyce 1977, Brayshaw 1965, Brown 1971, Bunin 1975, Clary 1969, Clary 1978, Clausnitzer and Zamora 1987, Cooper and Pfister 1985, Cooper et al. 1985, Cooper et al. 1987, Costello 1944, Costello 1954, Costello and Schwan 1946, Currie 1975, Daubenmire 1952, Daubenmire 1970, Daubenmire and Daubenmire 1968, DeVelice 1983, DeVelice and Ludwig 1983, DeVelice et al. 1986, Dealy 1971, Dealy 1975, Diamond 1993, Dixon 1935, Donart et al. 1978, Dyrness 1960, Eyre 1980, Faber-Langendoen et al. 1996, Fisher and Clayton 1983, Fitzhugh et al. 1987, Francis 1986, Franklin and Dyrness 1973, Ganskopp 1979, Graybosch and Buchanan 1983, Hall 1967, Hall 1973, Hanks et al. 1983, Hansen 1985, Hansen and Hoffman 1988, Hanson and Ball 1928, Harmon 1980, Helm 1977, Hess 1981, Hess and Alexander 1986, Hess and Wasser 1982, Hoagland 1997, Hoffman 1976, Hoffman

and Alexander 1987, Holland 1986, Hopkins 1979, Johannessen 1961, Johnson 1945, Johnson 1953, Johnson 1956, Johnson 1985, Johnson and Clausnitzer 1992, Johnson and Klipple 1946, Johnson and Niederhof 1941, Johnson and Reid 1958, Johnson and Reid 1964, Johnson and Simon 1985, Johnson and Simon 1987, Johnston 1987, Johnston and Hendzel 1985, Kahler 1973, Komarkova et al. 1988, Kooiman and Linhart 1986, Larson 1974, Larson and Moir 1986, Larson and Moir 1987, Lindsey 1951, Livingston 1947, Livingston 1949, Luti 1953, Lynn et al. n.d., MacCracken et al. 1983, Marr et al. 1973, Mauk and Henderson 1984, Mayo 1971, Mclean 1970, Mehl 1992, Merkle 1962, Moir and Ludwig 1979, Moir et al. 1973, Montana Natural Heritage Program n.d., Muldavin et al. 1992, Nichol 1937, Peet 1975, Peet 1981, Pfister 1977, Pfister et al. 1977, Potter and Green 1964, Progulske and Shideler 1974, Roberts 1980, Roberts et al. 1992, Rogers 1950, Rogers 1953, Rowdabaugh 1978, Sawyer and Keeler-Wolf 1995, Schmoll 1935, Shepherd 1975, Sherman 1969, Smith 1967, Somers et al. 1980, Steele et al. 1981, Steinhoff 1978, Strong et al. 1978, Swift 1974, Terwilliger et al. 1979, Thilenius 1971, Thilenius 1972, Tisdale and McLean 1957, United States Forest Service 1983, Volland 1976, Warren and Treadwell 1980, Washington Natural Heritage Program n.d., Wasser and Hess 1982, Watson 1912, Williams and Lillybridge 1983, Williams and Lillybridge 1985, Williams and Lillybridge 1990, Williams and Smith 1990, Wirsing and Alexander 1975, Wright et al. 1973, Youngblood and Mauk 1985, Zamora 1983

II.A.4.N.a.36. JUNIPERUS DEPPEANA WOODLAND ALLIANCE (A.534)

Alligator Juniper Woodland Alliance

ALLIANCE CONCEPT

Environment: Stands included in this woodland alliance occur south of the Mogollon Rim in Arizona and in southern New Mexico and Trans Pecos, Texas. Elevations range from 1400-2100 m. Climate is semi-arid with drought not uncommon. Summers are generally hot and winters mild with cold periods and occasional snows. The mean annual precipitation ranges from 40 to 48 cm. Stands typically occur on nearly level, elevated and valley plains, to steep, rocky alluvial and colluvial slopes of canyons, ridges, bajadas, hillsides, mesas, and mountains. Aspect is variable and does not seem important except in elevational extremes for a given latitude where low elevation stands are restricted to the less xeric north slopes and high elevations stands occur on south aspects. Soils are typically dry, shallow, cobbly, gravelly or sandy loams, but some stands occur on heavy clay soils. Parent materials include andecite, rhyolite, limestone, basalt, colluvium and alluvium.

Adjacent vegetation at higher elevations is typically woodlands or forests dominated by *Pinus* and *Quercus* spp. Adjacent vegetation at lower elevations is often *Juniperus* savannas, *Arctostaphylos* dominated shrublands or *Bouteloua* dominated grasslands.

Physiognomy: Vegetation included in this alliance has a moderately sparse to moderately dense tree canopy that is typically 5-15 m tall. Stands are either solely dominated by evergreen needle-leaved trees, or they may be codominated by broad-leaved or scale-leaved evergreen trees. A sparse to moderately dense shrub layer may be present as a diverse mixture of broadleaf and microphyllous, deciduous or evergreen shrubs that are usually less than 3 m tall. Cacti and stem succulents are often present. A sparse to moderate layer that is dominated by perennial graminoids is usually present. Perennial forbs may be scattered. Annual forbs and grasses may be seasonally present.

Vegetation: Woodlands included in this alliance occur on dry sites in the mountains and foothills in Arizona south of the Mogollon Rim, southern New Mexico, Trans-Pecos Texas, and northern Mexico. Stands have a moderately sparse to moderately dense tree canopy typically 5-15 m tall. Mature individuals can grow up to 30 m tall. Moderately sparse stands have an open canopy with trees distributed in patches resembling a savanna, whereas the tree crowns touch in the moderately dense stands. The upper canopy is either dominated by the Madrean, scale-leaf evergreen tree, *Juniperus deppeana*, or, more commonly, occurs in mixed stands with *J. monosperma*, *J. erythrocarpa*, or the Madrean, broad-leaf evergreen species such as *Quercus grisea*, *Q. emoryi*, or *Q. arizonica*. Near the Mogollon Rim, *J. osteosperma* may be a codominant. Of note is the lack of or only occasional presence of *Pinus edulis* or *Pinus edulis* var. *fallax* (= *Pinus fallax*).

The shrub layer is typically sparse with a relatively rich mixture of evergreen and/or deciduous shrubs, 0.5-5m tall. However, stands with a chaparral layer of *Arctostaphylos pungens*, *A. pringlei* or *Quercus turbinella* may be moderately dense (25-50%). Other shrubs and dwarf-shrubs may include *Agave* spp., *Ceanothus greggii*, *Cercocarpus montanus*, *Dasyllirion wheeleri*, *Fallugia paradoxa*, *Garrya wrightii*, *Gutierrezia* spp. *Nolina microcarpa*, *Opuntia* spp., *Prosopis* spp., *Quercus emoryi*, *Q. grisea*, *Rhus trilobata* and *Yucca* spp. depending on geography. Scattered cacti are common and include species such as *Escobaria vivipara* var. *vivipara* (= *Coryphantha vivipara*), *Opuntia imbricata*, *O. phaeacantha*, *O. spinosior*, and *Sclerocactus intertextus*

The herbaceous layer is sparse to moderately dense, ranging from 1 to 50% cover. Perennial graminoids are the most abundant species, particularly *Bouteloua curtipendula*, *B. gracilis*, *B. hirsuta*, *Aristida* spp., *Cyperus sphaerolepis* (= *Cyperus rusbyi*), *Eragrostis intermedia*, *Hilaria belangeri*, *Koeleria macrantha*, *Lycurus phleoides*, *Muhlenbergia emersleyi*, *Panicum obtusum*, *Schizachyrium cirratum*, and *Stipa* spp. Many forb species occur, but few have much cover. Commonly present forbs include species of *Artemisia*, *Astragalus*, *Chaetopappa*, *Dalea*, *Eriogonum*, *Penstemon*, *Polygala*, *Physalis*, *Sida*, *Solanum* and *Zinnia*. Annual grasses and forbs are seasonally present.

Dynamics: *Juniperus deppeana* is a slow growing, drought tolerant, long-lived tree that will resprout if cut or top-killed killed by fire (Muldavin 1998, Lamb 1975, Wright et al. 1972). Although fire rarely kills *Juniperus deppeana*, fire will reduce the size of the tree and allow grass to grow under it (Wright 1972). Large trees do not generally burn unless fine fuels, such as tumble weeds, have accumulated beneath the tree to provide ladder fuels for the fire to reach the crown. Closed canopy stands rarely burn because they typically do not have enough understory or wind to carry a fire.

Altered fire regimes, fence post cutting, and grazing by improper livestock have significant impacts on the quality of sites. Grazing by livestock can modify the fire regime by removing the fine fuels that carry fire. Fire, livestock grazing, and trampling by recreationalists and vehicles disturb cryptogamic soil crusts that help maintain soil structure, reduce soil erosion, provide habitat for plants and preserve biological diversity (Ladyman and Muldavin 1996). More study is needed to understand and manage these woodlands ecologically.

Similar Alliances:

?? PINUS EDULIS - (JUNIPERUS SPP.) WOODLAND ALLIANCE (A.516)

?? JUNIPERUS MONOSPERMA WOODLAND ALLIANCE (A.504)

?? POPULUS ANGUSTIFOLIA TEMPORARILY FLOODED WOODLAND ALLIANCE (A.641)

?? ARBUTUS XALAPENSIS - ACER GRANDIDENTATUM - QUERCUS SPP. FOREST ALLIANCE (A.368)

?? QUERCUS GRISEA WOODLAND ALLIANCE (A.478)

Similar Alliance Comments: The II.A.4.N.a.18 *Pinus edulis* Woodland Alliance (A.516) may include stands where *Juniperus deppeana* is present and possibly codominant. However, stands included in this alliance have only occasional *Pinus edulis* trees. *Juniperus deppeana* may be present in stands included in the II.A.4.N.a.6 *Juniperus monosperma* Woodland Alliance (A.504), but it will not codominate as *Juniperus monosperma* does in stands in this alliance. *Juniperus deppeana* may be codominant in stands in at least one association in the remaining alliances except for the II.A.2.N.a.2 *Quercus grisea* Woodland Alliance (A.478) where *Juniperus deppeana* is the diagnostic understory species for the association. *Quercus grisea* may be present in *Juniperus deppeana* woodland stands and, other than relative dominance, the difference between the alliances is unclear.

Synonymy:

?? Pinyon - Juniper: 239, in part (Eyre 1980)

?? Colorado Pinyon-Mixed Juniper Series, in part (Dick-Peddie 1993)

?? Border Pinyon-Mixed Juniper Series, in part (Dick-Peddie 1993)

?? *Juniperus deppeana* Series. within the Madrean Open Conifer Woodland Alliance Group (Muldavin 1994)

Comments: Stands described in several associations in this alliance do not have enough tree cover to be classified as woodlands. Data from references do not support the woodland classification (< 25% cover of tree canopy) (Muldavin et al. 1994, Bourgeron et al. 1993, Bassett et al. 1987, Larsen and Moir 1986). Sparsely vegetated or herbaceous *Juniperus deppeana* alliances may need to be created to classify the stands with sparse tree layers.

ALLIANCE DISTRIBUTION

Range: Stands included in this woodland alliance occur on rocky slopes across most of southern Arizona, southern New Mexico, and Trans-Pecos Texas. It is also found in the northern Mexican states of Chihuahua, Coahuila, and Sonora.

States: AZ,NM,TX

TNC Ecoregions: 21:C, 24:C

USFS Ecoregions: 313C:CC, 321A:CC, M313A:CC, M313B:CC

ALLIANCE SOURCES

Edition: 98-08-17

References: Ahlstrand 1979, Anderson 1985, Bassett et al. 1987, Bourgeron et al. 1993, Bourgeron et al. 1995, Dick-Peddie 1993, Eyre 1980, Gardner 1951, Gehlbach 1967, Ladyman and Muldavin 1996, Lamb 1975, Larson and Moir 1986, Moir and Carleton 1987, Muldavin 1994, Muldavin et al. 1998, Palmer 1929, Peet 1988, Souders 1985, USDA Forest Service 1984, USDA Forest Service 1985, United States Forest Service 1985, Warnock 1974, Warnock 1977, Woodin and Lindsey 1954, Wright 1972

II.A.4.N.a.38. JUNIPERUS OSTEOSPERMA WOODLAND ALLIANCE (A.536)

Utah Juniper Woodland Alliance

ALLIANCE CONCEPT

Environment: Vegetation within the *Juniperus osteosperma* Woodland Alliance is distributed across the Intermountain West from the eastern Sierra Nevada to the central and southern Rocky Mountains. Stands along the Bighorn Range in WY are near the eastern side of the Rockies. The alliance usually occupies semi-arid, lower to middle mountain slopes of the many mountain ranges and plateaus of the region, occurring between 1000 and 2650 m in elevation. Average annual precipitation is usually between 25 to 50 cm, but the seasonal distribution varies across the range of the alliance. Generally, winter precipitation in the form of westerly storms is maximal along the northwest edge of the range and summer moisture

increases to the east and south. Distribution of the alliance is also correlated with "thermal belts" which occur above the areas of cold air drainage in high intermountain basins. Adjacent vegetation is usually *Artemisia* shrub-steppe at the lower elevation margin and montane and subalpine coniferous vegetation at the upper margin. Communities in this alliance are often closely associated with *Pinus edulis* or *Pinus monophylla* woodlands. *Juniperus osteosperma* usually forms monotypic stands on drier or colder sites than where the pines occur.

Physiognomy: These are sparse to somewhat dense woodlands (25-70% cover), dominated by scale-leaved evergreen trees of low stature (< 20 m in height). Needle-leaved evergreen trees or tall shrubs are often present and may be codominant. Generally, evergreen or cold-deciduous shrubs occupy the interstices between trees, interspersed with cespitose graminoids. In total, the ground layer is usually of low to moderate cover (20-40%).

Vegetation: These communities are characterized by an open canopy of *Juniperus osteosperma*, quite often in association with *Pinus monophylla* or *P. edulis*. The majority of these stands occur in dry ranges or plateaus of the Colorado Plateau or Great Basin. *Cercocarpus ledifolius* is a common associate in these interior stands. Less common tree associates include *Pinus ponderosa*, *P. flexilis*, *P. aristata*, or *Pseudotsuga menziesii*, where these communities grade into montane coniferous forest, or *Juniperus scopulorum*, and *J. monosperma* in the central and southern Rockies. Widespread shrub associates include *Artemisia tridentata*, *A. arbuscula*, *A. nova*, *Symphoricarpos oreophilus*, *Amelanchier alnifolia*, *Cercocarpus intricatus*, *C. montanus*, *Chrysothamnus* spp., *Quercus gambelii*, *Prunus virginiana*, and *Purshia tridentata*. The herbaceous layer is usually somewhat sparse and dominated by cespitose perennial grasses, including *Pseudoroegneria spicata*, *Festuca idahoensis*, *Hilaria jamesii*, *Oryzopsis hymenoides*, *Elymus elymoides*, and *Stipa* spp. Some stands in rocky terrain may lack an understory entirely.

Dynamics: *Juniperus osteosperma* is a very slow-growing, long-lived tree and stands appear somewhat static over time compared to more productive forests. *Juniperus osteosperma* stands have always been widespread, but were formerly restricted to certain habitats (rocky ridges, etc.). These woodlands are expanding into adjacent steppe grasslands in many areas, reportedly in connection with livestock grazing and altered fire regimes (Blackburn 1967). *J. osteosperma* is the first to invade adjacent *Artemisia nova* shrublands, but is eventually succeeded by *Pinus monophylla*. Jameson et al. (1962) inferred a similar relationship between *J. osteosperma* and *Pinus edulis* in the Grand Canyon. They noted that individuals of *J. osteosperma* were older and even-aged, while *P. edulis* occupied all age classes. Many of these communities have been severely impacted by past range practices of chaining, tilling, and reseeding with exotic forage grasses. Although the dominant trees appear to regenerate after such disturbances, the effects on understory species are poorly known.

Similar Alliances:

?? JUNIPERUS OSTEOSPERMA WOODED HERBACEOUS ALLIANCE (A.1502)

Similar Alliance Comments: This alliance has a variable, but generally more dense canopy than similar stands in the *Juniperus osteosperma* Wooded Herbaceous Alliance. A herbaceous understory may or may not be present.

Synonymy:

?? Utah Juniper Series, in part (Sawyer and Keeler-Wolf 1995)

Comments: The low elevation woody vegetation of the Great Basin has been traditionally lumped into *Pinus monophylla* (Singleleaf Pinyon) or Pinyon-Juniper woodlands, and further classification work is needed to differentiate true woodlands from wooded herbaceous stands. Many stands described as woodlands have less than 20% cover in the tree layer (Blackburn et al. 1968, Blackburn et al. 1969), and may actually fit better in the *Juniperus osteosperma* Wooded Herbaceous Alliance. While the amount of literature available for pinyon-juniper vegetation is large, relatively little classification work has been done for these vegetation types. Further inventory, and review of the classification, of pinyon-juniper woodlands and wooded herbaceous communities is needed for the entire west.

ALLIANCE DISTRIBUTION

Range: These woodlands are distributed across the Great Basin and Colorado Plateau from the central rocky Mountains of central Wyoming and western Colorado, through southern Idaho, Utah, and Nevada to the northern Mojave region of California. A second substantial range occurs along interior slopes the transverse ranges of southern California.

States: AZ,CA,CO,ID,MT,NM,NV,UT,WY

TNC Ecoregions: 10:C, 6:?

USFS Ecoregions: 313A:CC, 313B:CC, 313C:CC, 321A:??, 341D:CC, 342A:CC, 342B:CC, 342D:CC, 342F:CC, 342G:CC, M313A:CC, M313B:CC, M331A:CC, M331B:CC, M331D:CC, M332E:CC, M341:C

ALLIANCE SOURCES

Edition: 99-05-02

References: Baker 1983, Baker 1984, Baker and Kennedy 1985, Blackburn 1967, Blackburn 1969, Blackburn et al. 1968, Blackburn et al. 1968c, Blackburn et al. 1969, Blackburn et al. 1971, Bradley 1964, Brotherson and WE 1983, Caicco and Wellner 1983, Clary et al. 1974, Dalen and Snyder 1987, Dastrup 1963, Despain 1973, Donart et al. 1978, Everett 1987, Isaacson 1967, Jameson et al. 1962, Johnsen 1962, Johnson and Pfister 1982, Johnston 1987, Jones 1989, Kline 1973, Knight et al. 1987, Komarkova et al. 1988, Koniak 1985, Larson and Moir 1986, Larson and Moir 1987, Lesica and DeVelice 1992, Marriott and Jones 1989, Milton and Purdy 1983, Moir and Carleton 1987, Rust 1999, Sawyer and Keeler-Wolf 1995, USDA

Forest Service 1985, United States Forest Service 1983, United States Forest Service 1985, Warren n.d., West et al. 1978, Wight 1965, Wight and Fisser 1968

II.A.4.N.a.40. PINUS DISCOLOR WOODLAND ALLIANCE (A.538)

Border Pinyon Woodland Alliance

ALLIANCE CONCEPT

Environment: Stands included in this woodland alliance occur in mountains below the Mogollon Rim in southeastern Arizona, southwestern New Mexico and northern Mexico. Elevations range from 1680-2415 m. Climate is semi-arid. Summers are generally hot and winters mild with cold periods and occasional snows. The mean annual precipitation ranges from 45-50 cm, mostly occurring during the Arizona monsoon season from July - September. Sites are typically on moderate to very steep, rocky, slopes of foothills and mountains and on ridgetops. Sites also occur in cool microsites of canyons, washes and along drainages. Aspect is variable, but stands are typically on the less xeric north slopes. Soils are shallow, lithic, gravelly loams derived from colluvium and residuum. Parent materials include alluvium, andecite, limestone, rhyolite and tuff.

Adjacent vegetation at higher elevations is typically woodlands or forests dominated by *Pinus ponderosa*, *P. engelmannii*, *P. leiophylla* with a subcanopy of *Quercus* spp. Adjacent vegetation at lower elevations is often woodlands or savannas dominated by *Pinus discolor*, *Pinus edulis* or *Juniperus* spp. or chaparral dominated by *Arctostaphylos* spp., or *Quercus turbinella*.

Physiognomy: Vegetation included in this alliance has an open tree canopy that is typically 5-10 m tall, but may reach 15 m. A sparse to moderately dense tree subcanopy is typically present. The canopy is dominated by evergreen needle-leaved trees with the subcanopy dominated by broad-leaved or scale-leaved evergreen trees. Broadleaf deciduous trees may be present in some stands. A sparse to dense shrub layer may be present and is typically dominated by broadleaf evergreen shrubs that are usually less than 5 m tall. A sparse to moderately dense layer dominated by perennial graminoids is usually present. Perennial forbs have sparse cover. Annual forbs and grasses may be seasonally present.

Vegetation: Woodlands included in this alliance occur in the mountains and foothills in southeastern Arizona, southwestern New Mexico and northern Mexico. Stands typically have a moderately sparse upper tree canopy, typically 5-10 m tall, and may have a sparse to moderately dense subcanopy. The upper canopy is dominated by the Madrean, evergreen, needle-leaf tree, *Pinus discolor* which can grow up to 15 m tall. Scattered *P. ponderosa* or *P. leiophylla* may be present in higher elevation stands. The subcanopy is a mixture of trees such as *Juniperus deppeana*, *J. erythrocarpa*, *J. monosperma* or Madrean encinals such as *Quercus arizonica*, *Q. emoryi*, *Q. grisea*, *Q. hypoleucoides*, *Q. rugosa* and hybrids of *Q. arizonica* and *Q. grisea*.

The shrub layer is sparse to moderately dense depending on the density of the tree canopy. It can be a relatively rich mixture of deciduous or evergreen broad-leaf, microphyllous and rosette leaved shrubs, 0.5-5 m tall. The layer includes xeric shrubs such as *Agave palmeri*, *Arctostaphylos pringlei*, *A. pungens*, *Cercocarpus montanus*, *Dasylyrion wheeleri*, *Garrya wrightii*, *Nolina microcarpa*, *Opuntia* spp., *Ptelea trifoliata*, *Quercus gambelii*, *Q. turbinella*, *Q. toumeyi*, *Rhus trilobata*, *Yucca baccata*, *Y. schottii* and immature individuals named in the tree canopy. The herbaceous layer is sparse to moderately dense, ranging from 1 to 40% cover. Perennial graminoids are the most abundant species, particularly *Muhlenbergia emersleyi* or *Piptochaetium fimbriatum*. Other common graminoids include *Aristida orcuttiana*, *Bouteloua curtipendula*, *B. gracilis*, *Cyperus fendlerianus*, *Eragrostis intermedia*, *Koeleria macrantha*, *Muhlenbergia longiligula*, *Muhlenbergia monticola* and *Schizachyrium cirratum*. Forbs are typically sparse. Some of the more common forbs include *Artemisia ludoviciana*, *Artemisia carruthii*, *Cheilanthes fendleri*, *Chenopodium graveolens* (= *Chenopodium incisum*), *Ageratina herbacea* (= *Eupatorium herbaceum*), *Hedeoma hyssopifolia*, *Geranium caespitosum*, *Senecio neomexicanus*, *Thalictrum fendleri*, and *Viguiera* spp.

Dynamics: Stands are typically small and naturally patchy, and reflect the late successional stage of Sierra Madrean woodlands and savannas. This is a highly diverse alliance with a preponderance of Sierra Madrean elements that have a restricted distribution in the U.S. Grazing, and to a lesser degree fuelwood harvest, continue to impact stands. Altered fire regimes (failed fire suppression followed by increased intensity and extent of fire) may be reducing the number of stands.

Similar Alliances:

?? PINUS LEIOPHYLLA WOODLAND ALLIANCE (A.542)

?? PINUS ENGELMANNII WOODLAND ALLIANCE (A.539)

?? JUNIPERUS DEPPEANA WOODLAND ALLIANCE (A.534)

Similar Alliance Comments: Except for the lack of *Pinus leiophylla* and *P. engelmannii* and the dominance of *Pinus discolor*, stands included in this alliance have similar understory and habitat as these and other Madrean evergreen woodlands.

Synonymy:

?? *Pinus discolor*/*Muhlenbergia emersleyi* (Bassett et al. 1987)

?? *Pinus discolor*-*Nolina microcarpa*-*Muhlenbergia emersleyi* Habitat Type (Willing 1987)

Comments: Confusion over the taxonomic treatments of *Pinus discolor* D.K. Bailey & Hawksworth and related taxa *P. cembroides* Zuccarri and *P. remota* (Little) D.K. Bailey & Hawksworth has caused confusion in the classification of their respective woodland alliances. USDA PLANTS Database (1998) and Kartesz (1994) both use D.K. Bailey and Hawksworth's (1979) treatment, and list the above three names as accepted species. However, Kral's treatment in Flora of North America (1993) is based on Little (1971) includes *Pinus remota* and *P. discolor* within *P. cembroides* Zuccarini (var. *remota* Little and var. *bicolor* Little, respectively). Currently, *Pinus remota* woodlands have been described from the Glass and Del Norte mountains of the Trans-Pecos and the Edwards Plateau in central Texas. The *Pinus cembroides* stands have been reported from the Chicos and Davis mountains of the Trans-Pecos, extending into Coahuila, Mexico. *Pinus discolor* woodlands have been reported from several mountain ranges in southwestern New Mexico and southeastern Arizona below the Mogollon Rim and include the Animas, Peloncillos, Santa Catalina, Chiricahua, Mule, Dagoon, and Huachuaca mountains. The woodlands are predicted to occur throughout the Borderlands of New Mexico, Arizona and Mexico (Muldavin et al. 1998). It has been suggested in the BCD association records that the *Pinus discolor* associations be renamed *Pinus cembroides* associations, but it is not known whether the trees in these associations were misidentified or if there is a problem with the current taxonomy.

ALLIANCE DISTRIBUTION

Range: Stands included in this woodland alliance occur on mountain slopes and stream terraces from the Mogollon Rim in Arizona, to southwestern New Mexico into the northern Mexican states of Chihuahua and Sonora. It possibly occurs in the Trans-Pecos region of Texas and Mexico.

States: AZ?,MXCH?,NM

TNC Ecoregions:

USFS Ecoregions: 321A:CC

ALLIANCE SOURCES

Edition: 98-09-01

References: , Bailey and Hawksworth 1979, Bassett et al. 1987, Bourgeron et al. 1993, Bourgeron et al. 1995, Kartesz 1994, Kral 1993, Little 1971, Moir 1979, Muldavin et al. 1998, Willing 1987

II.A.4.N.a.41. PINUS ENGELMANNII WOODLAND ALLIANCE (A.539)

Apache Pine Woodland Alliance

ALLIANCE CONCEPT

Environment: Stands included in this woodland alliance occur in mountains below the Mogollon Rim in southeastern Arizona, southwestern New Mexico and northern Mexico. Elevations range from 1700-2400 m. Climate is semi-arid. Summers are generally warm and winters mild with cold periods and occasional snows. The mean annual precipitation ranges from 40 to 66 cm, mostly occurring during the Arizona monsoon season during July - September. Sites range from cool dry-mesic to warm xeric on rocky, moderate to steep mountain slopes, benches and terraces. Aspect varies with elevation where low elevation stands are restricted to the less xeric north and northeastern slopes and high elevation stands occur on south aspects. Soils range from moderately deep alluvium to shallow, lithic colluvium and residuum. Parent materials may include andecite, granite, rhyolite, sandstone and alluvium.

Adjacent vegetation at higher elevations or cooler sites is typically woodlands or forests dominated by *Pinus ponderosa* or *Picea engelmannii* with a subcanopy of *Quercus* spp. Adjacent vegetation below these stands or on drier sites is often woodlands dominated by *Pinus leiophylla*, *P. discolor*, *Pinus edulis* or *Juniperus* spp.

Physiognomy: Vegetation included in this alliance has an open tree canopy that is 15-25 m tall. A sparse to moderately dense tree subcanopy is generally present. The canopy is dominated by evergreen needle-leaved trees with the subcanopy dominated by broad-leaved or scale-leaved evergreen trees. A sparse to dense shrub layer may be present. It is typically dominated by broadleaf evergreen shrubs usually less than 5 m tall. A sparse to moderately dense herbaceous layer that is dominated by perennial graminoids is often present. Perennial forbs may be diverse, but have sparse cover. Annual forbs and grasses may be seasonally present.

Vegetation: Woodlands included in this alliance occur in the mountains of southeastern Arizona, southwestern New Mexico and northern Mexico. Stands typically have an open tree canopy 15-25 m tall, dominated by the Madrean, evergreen, needle-leaf tree, *Pinus engelmannii* which can grow to 35 m tall. *Pinus leiophylla* may codominate in seral stands. Scattered *Pseudotsuga menziesii* or *Pinus ponderosa* may be present in higher elevation stands. The subcanopy is dominated by Madrean broadleaf evergreen trees such as *Quercus rugosa* at high elevations on south slopes, *Q. emoryi* at lower elevations, or more typically *Quercus hypoleucoides* with a mixture of small trees which may include *Quercus arizonica*, *Juniperus deppeana*, *Pinus discolor* or *P. edulis*.

The shrub layer is typically moderately dense to dense depending on the density of the tree canopy. It is often dominated by some of the same *Quercus* species that made up the tree subcanopy especially *Q. hypoleucoides* and *Q. rugosa*, but may include other shrubs like *Agave parryi*, *Arbutus arizonica*, *Ceanothus fendleri*, *Garrya wrightii*, *Quercus gambelii*, *Q. turbinella*, *Q. toumeyii*, *Rhus trilobata* and *Yucca schottii*. The herbaceous layer is typically sparse but may range to 40%

cover. Perennial graminoids are the most abundant species, particularly *Muhlenbergia longiligula* with lesser amounts of *Muhlenbergia emersleyi*, *Panicum bulbosum* and *Piptochaetium fimbriatum*. Other frequent graminoids include *Aristida orcuttiana*, *Bromopsis porteri*, *Carex geophila*, *Koeleria macrantha* and *Poa fendleriana*. Many forb species can occur, but few have much cover. Some of the more common forbs include *Artemisia ludoviciana*, *Cheilanthes fendleri*, *Erigeron neomexicanus*, *Hedeoma hyssopifolia*, *Hieracium fendleri*, *Senecio neomexicanus*, *Solidago wrightii*, and *Thalictrum fendleri*.

Dynamics: Stands are typically small and reflect the late successional stage of Sierra Madrean woodland savanna. They are very high in grass and forb diversity, with a preponderance of Sierra Madrean elements that have a restricted distribution in the U.S. Grazing and to a lesser degree timber harvest continue to impact the alliance throughout its range.

Similar Alliances:

Similar Alliance Comments: The *Pinus engelmannii* Woodland Alliance is similar to other Madrean evergreen woodlands, but is separated by the dominance of *Pinus engelmannii*.

Synonymy:

? *Pinus engelmannii* Series, in part (Muldavin et al. 1996)

Comments: The alliance is not well known. More study is needed for more a complete description.

ALLIANCE DISTRIBUTION

Range: Stands included in this woodland alliance occur on mountain slopes, benches and terraces in southeastern Arizona and southwestern New Mexico. Here they are at the northern edge of their range and occur sporadically, but they are more common in the northern Mexican states of Chihuahua and Sonora.

States: AZ,MXCH?,NM

TNC Ecoregions:

USFS Ecoregions: 321A:CC

ALLIANCE SOURCES

Edition: 98-08-27

References: Bassett et al. 1987, Bourgeron et al. 1993, Bourgeron et al. 1995, Kral 1993, Muldavin et al. 1987, Muldavin et al. 1992, Muldavin et al. 1996

II.A.4.N.a.44. PINUS LEIOPHYLLA WOODLAND ALLIANCE (A.542)

Chihuahuan Pine Woodland Alliance

ALLIANCE CONCEPT

Environment: Stands included in this woodland alliance occur in mountains below the Mogollon Rim in southeastern Arizona, southwestern New Mexico and northern Mexico. Elevations range from 1500-2200 m. Climate is semi-arid. Summers are generally hot and winters mild with cold periods and occasional snows. The mean annual precipitation is approximately 60 cm, mostly occurring during the Arizona monsoon season during July - September. Sites range from mesic, nearly level washes, stream terraces and toeslopes to very steep, rocky, xeric, mountain slopes. Aspect is variable and is important only in elevational extremes for a given latitude where low elevation stands are restricted to the less xeric north slopes and high elevations stands occur on south aspects. Soils range from moderately deep alluvium to shallow, lithic colluvium and residuum. Parent materials include andecite, granite, rhyolite, sandstone and alluvium.

Adjacent vegetation at higher elevations is typically woodlands or forests dominated by *Pinus ponderosa*, *P. engelmannii* with a subcanopy of *Quercus* spp. Adjacent vegetation below these stands is often woodlands or savannas dominated by *Pinus discolor*, *P. edulis* or *Juniperus* spp., or chaparral dominated by *Arctostaphylos* spp. or *Q. turbinella*.

Physiognomy: Vegetation included in this alliance has an open tree canopy that is typically up to 25 m tall. A sparse to moderately dense tree subcanopy is typically present. The canopy is dominated by evergreen needle-leaved trees with the subcanopy dominated by broad-leaved or scale-leaved evergreen trees. Broadleaf, deciduous trees may be present in some stands. A sparse to dense shrub layer may be present, typically dominated by broadleaf evergreen shrubs less than 5 m tall. A sparse to moderately dense herbaceous layer, dominated by perennial graminoids, is often present. Perennial forbs have sparse cover. Annual forbs and grasses may be seasonally present.

Vegetation: Woodlands included in this alliance occur in the mountains and foothills of southeastern Arizona, southwestern New Mexico and northern Mexico. Stands typically have a moderately sparse upper tree canopy typically 10-20 m tall with a moderately dense subcanopy. The upper canopy is dominated by the Madrean, evergreen, needle-leaf tree, *Pinus leiophylla* which can grow up to 25 m tall. Scattered *P. ponderosa* or *Pseudotsuga menziesii* may be present in higher elevation stands. The subcanopy is a mixture of trees such as *Juniperus deppeana*, *J. monosperma*, *P. discolor*, or Madrean encinals such as *Quercus arizonica*, *Q. emoryi* or *Q. hypoleucoides*. Mesic semiriparian sites may include scattered individuals of *Cupressus arizonica*, *Juglans major*, *Fraxinus velutina*, *Platanus wrightii* or *Prunus serotina*. The shrub layer is typically sparse depending on the density of the tree canopy. It can be a relatively rich mixture of deciduous or evergreen broad-leaf, microphyllous and rosette leaved shrubs, 0.5-5m tall. The layer includes xeric shrubs such as *Agave palmeri*, *A. parryi*,

Arbutus arizonica, *Arctostaphylos pungens*, *A. pringlei*, *Ceanothus fendleri*, *Fallugia paradoxa*, *Garrya wrightii*, *Nolina microcarpa*, *Opuntia* spp., *Quercus rugosa*, *Q. turbinella*, *Q. toumeyii*, *Rhus aromatica*, *Yucca schottii* and immature individuals named above as part of the tree canopy. The herbaceous layer is sparse to moderately dense, ranging from 1 to 50% cover. Perennial graminoids are the most abundant species, particularly *Aristida orcuttiana*, *Cyperus* spp., *Koeleria macrantha*, *Muhlenbergia emersleyi*, *Muhlenbergia longiligula*, *Panicum bulbosum*, *Piptochaetium fimbriatum*, *Schizachyrium cirratum*, and *Piptochaetium pringlei* (= *Stipa pringlei*). Many forb species can occur, but few have much cover. Some of the more common forbs include *Artemisia ludoviciana*, *Brickellia lemmonii*, *Erigeron neomexicanus*, *Gnaphalium arizonicum*, *Gnaphalium canescens* (= *Gnaphalium wrightii*), *Penstemon barbatus*, *Senecio neomexicanus*, and *Solidago wrightii*.

Dynamics: Stands are typically small and reflect the late successional stage of Sierra Madrean woodland savanna. They are very high in grass and forb diversity, with a preponderance of Sierra Madrean elements that have a restricted distribution in the U.S. Grazing, and to a lesser degree timber harvest continue to impact the association throughout its range.

Similar Alliances:

Similar Alliance Comments: The *Pinus leiophylla* Woodland Alliance is similar to other Madrean evergreen woodlands, but is separated by the dominance of *Pinus leiophylla*.

Synonymy:

?? *Pinus leiophylla* Series (Muldavin et al. 1996)

Comments:

ALLIANCE DISTRIBUTION

Range: Stands included in this woodland alliance occur on mountain slopes and stream terraces from the Mogollon Rim in Arizona to southwestern New Mexico into the northern Mexican states of Chihuahua and Sonora.

States: AZ, MXCH?, NM

TNC Ecoregions:

USFS Ecoregions: 321A:CC, M313A:CC

ALLIANCE SOURCES

Edition: 98-08-27

References: Bassett et al. 1987, Bourgeron et al. 1993, Bourgeron et al. 1995, Kral 1993, Muldavin et al. 1987, Muldavin et al. 1992, Muldavin et al. 1996

II.A.4.N.a.5. JUNIPERUS ERYTHROCARPA WOODLAND ALLIANCE (A.503)

Roseberry Juniper Woodland Alliance

ALLIANCE CONCEPT

Environment: Stands included in this woodland alliance occur in Arizona, south of the Mogollon Rim into southwestern New Mexico and just into Trans Pecos, Texas. Elevations range from 1100-1500 m. Climate is semi-arid with drought not uncommon. Summers are hot and winters are mild with cold periods and occasional snows. The mean annual precipitation ranges from 40 to 50 cm with approximately two thirds occurring during the Arizona monsoon season from July-Sept, often as high intensity convective storms. May and June are typically dry. Stands typically occur on nearly level to steep, rocky slopes. Sites include dry hillslopes, dissected pediments, toeslopes and elevated plains, alluvial fans and valleys. Soils are typically shallow, rocky, calcareous, alkaline, coarse textured, and derived from alluvium, but includes heavy clays on valley sites. These woodlands often occur in association with *Bouteloua* species-dominated grasslands.

Physiognomy: Vegetation included in this alliance has a moderately sparse to moderately dense tree canopy that is typically 3-8 m tall. Stands are either solely dominated by evergreen needle-leaved trees, or may be codominated by broad-leaved or scale-leaved evergreen trees. A sparse to moderately dense shrub layer may be present or absent. If present it may be a diverse mixture of broadleaf and microphyllous, deciduous or evergreen shrubs usually less than 3 m tall. Cacti and stem succulents are often present. A sparse to moderate layer that is dominated by perennial graminoids is usually present. Perennial forbs may be scattered. Annual forbs and grasses may be seasonally present.

Vegetation: Woodlands included in this alliance occur on dry sites in Arizona south of the Mogollon Rim, extreme southwestern New Mexico and the western edge of Texas. The sparse to moderately dense tree canopy may occur up to 8 m tall, but is typically 3-5 m tall and dominated by the evergreen scale-leaf tree, *Juniperus erythrocarpa*. In Arizona stands, *J. osteosperma* or *Parkinsonia microphylla* may also be present. The shrub layer is sparse to moderately dense, or absent. If present it may be a diverse mixture of broadleaf and microphyllous, deciduous or evergreen shrubs usually less than 3 m tall. Cacti and stem succulents are often present. Common shrubs include *Quercus turbinella*, *Canotia holacantha*, *Acacia greggii*, *Berberis* spp., *Calliandra eriophylla*, *Q. emoryi*, *Q. grisea*, *Mimosa dysocarpa*, *Nolina microcarpa*, *Opuntia* spp., *Prosopis velutina*, *Rhus trilobata*, *Yucca baccata* and *Y. elata*. The herbaceous layer is sparse to moderately dense depending on the shrub cover. It is dominated by perennial graminoids such as *Bouteloua chondrosioides*, *B. curtispindula*, *B. gracilis*, *B. eriopoda*, *Muhlenbergia emersleyi*, *M. porteri*, *M. setifolia*, *M. torreyi*, *Poa fendleriana*, *Schizachyrium cirratum*,

Schizachyrium sanguineum var. *hirtiflorum*, *Schizachyrium scoparium*, *Lycurus* sp., *Bothriochloa barbinodis*, *Eragrostis intermedia*, *Aristida* spp. and on clay soils, *Hilaria belangeri*. Scattered perennial forbs include species of *Eriogonum*, *Machaeranthera* and *Sphaeralcea*. Annual grasses and forbs such as *Bromus* and *Erodium* are seasonally present.
Dynamics: *Juniperus erythrocarpa* will re-sprout after being cut or burned which allows quick recovery after fires (Kral 1993).

Similar Alliances:

? JUNIPERUS PINCHOTII WOODLAND ALLIANCE (A.505)

Similar Alliance Comments: A similar alliance is II.A.4.N.a.7 *Juniperus pinchotii* Woodland Alliance. *Juniperus pinchotii* is closely related to *Juniperus erythrocarpa*, but they are geographically separate with *Juniperus pinchotii* mostly occurring from western Texas to southwestern Oklahoma. However, there are sympatric populations at Big Bend, Texas, that hybridize (Adams 1993).

Synonymy:

? *Juniperus erythrocarpa*/*Canotia holacantha* Habitat Type (Bassett et al. 1987)

? *Juniperus erythrocarpa*/*Quercus turbinella* Habitat Type (Bassett et al. 1987)

Comments: In Flora of North America, *Juniperus erythrocarpa* of the southwestern United States is segregated as *Juniperus coahuilensis* (Kral 1993).

ALLIANCE DISTRIBUTION

Range: Stands included in this woodland alliance occur on rocky slopes across most of southern Arizona into southwestern New Mexico and Trans-Pecos Texas. It also occurs in northern Mexico.

States: AZ,NM,TX

TNC Ecoregions: 21:C, 24:C

USFS Ecoregions: 313C:CC, 321A:CC

ALLIANCE SOURCES

Edition: 98-08-17

References: Bassett et al. 1987, Donart et al. 1978, Kral 1993, Moir and Carleton 1987, USDA Forest Service 1985

II.A.4.N.a.6. JUNIPERUS MONOSPERMA WOODLAND ALLIANCE (A.504)

One-seed Juniper Woodland Alliance

ALLIANCE CONCEPT

Environment: Stands included in this woodland alliance occur from eastern Arizona to western Texas and the Panhandle of Oklahoma and in the foothills in the southern Rocky Mountains. Stands also occur in the mountains, mesas, plateaus, piedmonts, canyons, escarpments, and other geographic breaks in the southern Great Plains. Elevations range from 1200-2100 m. Climate is semi-arid with drought not uncommon. Summers are generally hot, and winters range from mild with cold periods and occasional snows in southern New Mexico and Arizona to cold with extended periods of freezing temperatures. The mean annual precipitation ranges from 30 to 48 cm. Stands occur on nearly level surfaces to steep, rocky slopes in canyons, on hillsides, and on mesa tops, but also occur on stream terraces and on deep sands. Aspect does not seem important except in elevational extremes for a given latitude. Low elevation stands are restricted to the more mesic north slopes, whereas high elevation stands occur on south aspects. Sites are typically dry with shallow, rocky, calcareous, alkaline soils. Soil textures range from sandy loam to clay soils typically derived from limestone, sandstone or shale. Other parent materials include basalt, granite, dolomite, siltstone and mixed alluvium.

Adjacent vegetation at higher elevations is typically woodlands or forests dominated by *Pinus* and *Quercus* spp. Adjacent vegetation at lower elevations includes *Juniperus* savannas or *Artemisia* dominated shrublands or grasslands.

Physiognomy: Vegetation included in this alliance has a moderately sparse to moderately dense tree canopy that is typically 2-7 m tall. Stands are solely dominated by scale-leaved evergreen trees. Broad-leaved and needle-leaved evergreen trees may be present, but do not codominate. A sparse to moderately dense shrub layer may be present as a diverse mixture of broadleaf and microphyllous, deciduous or evergreen shrubs that are usually less than 3 m tall. Cacti and stem succulents are often present. A sparse to moderate layer that is dominated by perennial graminoids is usually present. Perennial forbs may be scattered. Annual forbs and grasses may be seasonally present.

Vegetation: Woodlands included in this alliance occur on dry sites in the foothills of the southern Rocky Mountains and in desert mountains, plateaus, mesas, canyons, and breaks from eastern Arizona to the southwestern Great Plains. Stands typically have a moderately sparse to moderately dense tree canopy typically 2-7 m tall. Mature individuals range from 2-3 m tall "scrub" to large trees up to 12 m tall. Moderately sparse stands have an open canopy with trees distributed in patches, resembling a savanna, whereas the tree crowns touch in the moderately dense stands. The upper canopy is often solely dominated by the evergreen scale-leaf tree, *Juniperus monosperma*, but one of two broad-leaf species *Quercus gambelii* and *Q. mohriana* may codominate. Occasional *Pinus edulis* trees may also be present. At higher elevations, *Juniperus*

scopulorum may be present, and in the southern extent, Madrean evergreen woodland elements such as *Juniperus deppeana* and *J. erythrocarpa* may be present, but not codominant.

The understory ranges from a relatively rich mixture of evergreen and/or deciduous shrubs, to a sparse or moderately dense herbaceous layer dominated by perennial grasses (with or without shrubs), to no vegetation at all. Most commonly the understory is sparse and has a patchy distribution. Characteristic shrubs and dwarf-shrubs include *Agave lechuguilla*, *Artemisia bigelovii*, *A. tridentata*, *Cercocarpus montanus*, *Dasyllirion wheeleri*, *Fallugia paradoxa*, *Gutierrezia sarothrae*, *Krascheninnikovia lanata*, *Larrea tridentata*, *Nolina microcarpa*, *Opuntia* spp., *Quercus turbinella*, *Q. X pauciloba*, *Rhus trilobata* and *Yucca* spp. depending on geography. The herbaceous layer is sparse to moderately dense, ranging from 1 to 40% cover. Perennial graminoids are the most abundant species, particularly *Bouteloua curtipendula*, *B. eriopoda*, *B. gracilis*, *B. hirsuta*, *Aristida* spp., *Erioneuron pilosum*, *Hilaria jamesii*, *Muhlenbergia* spp., *Oryzopsis hymenoides*, *O. micrantha*, *Schizachyrium scoparium*, *Sporobolus* spp., and *Stipa* spp. *Andropogon hallii* occurs with *Artemisia filifolia* as the understory in rare, deep sands habitats. Many forb species can occur, but few have much cover. Commonly present forbs include species of *Artemisia*, *Dalea*, *Eriogonum*, *Heterotheca*, *Hymenoxys*, *Mirabilis*, *Penstemon*, *Phlox*, *Physalis*, *Pediemelum* (= *Psoralea*) and *Zinnia*. Annual grasses and forbs are seasonally present.

Dynamics: *Juniperus monosperma* is extremely drought-tolerant. It is also non-sprouting and may be killed by fire (Wright et al. 1979). The effect of fire on a stand is largely dependent on the tree height and density, fine fuel load on the ground, weather conditions, and season (Wright et al. 1979, Dwyer and Pieper 1967). Trees are more vulnerable in open stands where fires frequently occur in the spring, the relative humidity is low, wind speeds are over 10-20 mph, and there is adequate fine fuels to carry fire (Fischer and Bradley 1987, Wright et al. 1979). Under other conditions, burns tend to be spotty with low tree mortality. Large trees are generally not killed unless fine fuels, such as tumbleweeds, have accumulated beneath the tree to provide ladder fuels for the fire to reach the crown. Closed-canopy stands rarely burn because they typically do not have enough understory or wind to carry a fire. Altered fire regimes, cutting trees for fencing, and improper grazing by livestock have significant impacts on the quality of sites. Grazing by livestock can modify the fire regime by removing the fine fuels that carry fire. *Juniperus monosperma* invasion into grasslands has occurred in places. Control efforts by chaining and prescribed burning have mixed results. More study is needed to understand and manage these woodlands ecologically.

Similar Alliances:

?? PINUS EDULIS FOREST ALLIANCE (A.135)

?? PINUS EDULIS - (JUNIPERUS SPP.) WOODLAND ALLIANCE (A.516)

?? JUNIPERUS DEPPEANA WOODLAND ALLIANCE (A.534)

Similar Alliance Comments: Similar alliances include I.A.8.N.b.21 *Pinus edulis* Forest Alliance (A.135), II.A.4.N.a.18 *Pinus edulis* Woodland Alliance (A.516), and II.A.4.N.a.36 *Juniperus deppeana* Woodland Alliance (A.534). Some stands in the similar alliances may have *Juniperus monosperma* present as a codominant, but *Pinus edulis* or *Juniperus deppeana* are only occasional in stands in the *Juniperus monosperma* Woodland Alliance.

Synonymy:

?? Pinyon - Juniper: 239, in part (Eyre 1980)

?? *Juniperus monosperma* - *Schizachyrium scoparium* woodland association, in part (Hoagland 1997)

?? Oneseed Juniper Series, in part (Diamond 1993)

?? Oneseed Juniper Series. Dick-Peddie (1993) classified all the *Juniperus monosperma* stands in (Dick-Peddie 1993)

Comments: In the Texas classification (Diamond 1993) the Oneseed Juniper Series is described as a shrubland.

ALLIANCE DISTRIBUTION

Range: Woodlands included in this alliance occur on dry sites on mesas, mountains, foothills, canyons, plateaus and plains from eastern Arizona to western Texas and the Panhandle of Oklahoma, and north into southern Colorado. It may also occur in southern Utah.

States: AZ,CO,NM,OK,TX,UT?

TNC Ecoregions: 20:C, 21:C, 24:C, 27:C, 28:C, 32:?, 33:?

USFS Ecoregions: 313A:CC, 313B:CC, 313D:CC, 313E:CC, 315A:CC, 315B:CC, 321A:CC, 331I:CC, 331J:CC, M313A:CC, M313B:CC, M331F:CC, M331G:CC, M331I:CC, M331J:CC

ALLIANCE SOURCES

Edition: 98-08-17

References: Adams 1979, Anderson et al. 1985, Baker 1984, Barnes 1987, Bassett et al. 1987, Baxter 1977, Diamond 1993, Dick-Peddie 1987, Dick-Peddie 1993, Dick-Peddie et al. 1984, Dick-Peddie n.d., Donart et al. 1978, Dwyer and Pieper 1967, Eyre 1980, Fitzhugh et al. 1987, Francis 1986, Gelbach 1967, Hendricks 1934, Hoagland 1997, Johnsen 1962, Johnston 1984, Johnston 1987, Ladyman and Muldavin 1996, Larson and Moir 1986, Larson and Moir 1987, Lindsey 1951, Moir 1983, Moir and Carleton 1987, Muldavin and Melhop 1992, Muldavin et al. 1998, Nelson and Redders 1982, New Mexico Environmental Institute 1971, Pettit et al. 1980, Pieper 1968, Pieper and Lymbery 1983, Pieper et al. 1971, Rogers 1953, Terwilliger et al. 1979, USDA Forest Service 1983, USDA Forest Service 1985, USDA Soil Conservation Service 1978,

United States Forest Service 1981, United States Forest Service 1985, Van Devender et al. 1984, Wells 1970, Woodin and Lindsey 1954, Wright 1972, Wright and Bailey 1982, Wright et al. 1973

II.A.4.N.a.7. JUNIPERUS PINCHOTII WOODLAND ALLIANCE (A.505)

Redberry Juniper Woodland Alliance

ALLIANCE CONCEPT

Environment: This alliance includes evergreen short woodlands or shrublands on slopes, often over gypsum or caliche-influenced soils.

Physiognomy:

Vegetation: Common associates include *Ziziphus obtusifolia*, *Prosopis glandulosa*, *Quercus mohriana*, *Quercus pungens*, *Quercus havardii*, *Dalea formosa*, *Yucca spp.*, *Bouteloua gracilis*, *Bouteloua curtipendula*, *Tridens spp.*, *Sporobolus spp.*, and *Hilaria mutica*. These woodlands often occur within a grassland-shrubland matrix.

Dynamics:

Similar Alliances:

Similar Alliance Comments:

Synonymy:

? *Juniperus pinchotii* / *Bouteloua (curtipendula, hirsuta)* woodland association? (Hoagland 1997)

? Redberry Juniper - Midgrass Series (Diamond 1993)

Comments: Although this vegetation ranges in physiognomy from a low stature woodland to a shrubland, it is treated as a woodland.

ALLIANCE DISTRIBUTION

Range: This alliance occurs primarily in the Trans-Pecos and Rolling Plains of Texas, but ranges into Oklahoma.

States: OK, TX

TNC Ecoregions: 24:C, 28:C, 33:C

USFS Ecoregions: 315C:CP, 321A:CC

ALLIANCE SOURCES

Edition: 94-11

References: Adams 1979, Diamond 1993, Hoagland 1997

II.A.4.N.a.8. JUNIPERUS SCOPULORUM WOODLAND ALLIANCE (A.506)

Rocky Mountain Juniper Woodland Alliance

ALLIANCE CONCEPT

Environment: Stands included in this woodland alliance occur on dry rocky slopes in the northern and central Rocky Mountains, the Black Hills, and on escarpments and other topographic breaks in the western Great Plains. Elevations range from 650 to 2650 m. Climate is semi-arid, continental with most of the 40-60 cm annual precipitation occurring during the growing season. Sites are typically found on moderate to very steep slopes (35-170%) of rock and boulder outcrops in foothill and montane zone in the mountains, and on bluffs along major drainages, escarpments and badlands in the western plains. The stands occur on all aspects, but several associations are restricted to northerly or southerly aspects. Soils are shallow to moderately deep, stony, and typically coarse textured loams but range from loamy sand to clay. Stands in this alliance grow more robust on calcareous soils (Eyre 1980). Parent material may include limestone, granite, gneiss, schist, sandstone, scoria or shale. Exposed bedrock is common and many stands have over 50% bare soil. Soil pH ranges from slightly acid to alkaline.

Adjacent vegetation at higher elevations is woodlands and forests dominated by *Pinus ponderosa*, *P. flexilis* or *Pseudotsuga menziesii*. Adjacent vegetation at lower elevations includes shrublands dominated *Artemisia* spp., *Cercocarpus*, spp., or *Purshia tridentata*, riparian woodlands dominated by *Pseudotsuga menziesii*, or dry prairie. The transition can be abrupt or an extended ecotone where the woodlands grade into a savanna.

Physiognomy: Vegetation included in this alliance has a sparse to moderately dense tree canopy that is typically 2-5 m tall. Stands are solely dominated by evergreen scale-leaved trees. Scattered evergreen needle-leaved or deciduous broad-leaved trees may be present, but they never codominate. A sparse to moderately dense shrub layer may be present as a mixture of broadleaf and microphyllous, deciduous shrubs that are usually less than 2 m tall. Cacti are often present. A sparse to moderately dense herbaceous layer dominated by perennial graminoids is usually present. Perennial forbs may be scattered. Annual forbs and grasses may be seasonally present.

Vegetation: Woodlands in this alliance are found on dry, rocky slopes in the northern and central Rocky Mountains and east into the western Great Plains on topographic breaks. Stands have a sparse to dense canopy of evergreen trees, usually 2-8 m tall. The stands are dominated by *Juniperus scopulorum*, a small, scale-leaf tree that is typically under 10 m tall, but can

reach up to 20 m. Scattered individuals of *Pinus ponderosa* or *Pseudotsuga menziesii* may be present in the tree canopy, but are never codominant. In the plains stands the deciduous broadleaf tree, *Fraxinus pennsylvanica*, may be present.

The understory varies from sparse under closed canopies to a moderately dense layer of shrubs (0.5-2 m tall) or graminoids in open stands. The shrub layer may include several species, but is often dominated by a single species on a given aspect. The dominant shrub species are *Artemisia nova*, *A. tridentata*, *Cercocarpus ledifolius*, *C. montanus*, *Prunus virginiana* and *Purshia tridentata*. Common, but less abundant shrubs include *Chrysothamnus nauseosus*, *Physocarpus monogynus*, *Rhus trilobata*, *Ribes* spp., *Rubus deliciosus* and *Symphoricarpos* spp. Scattered dwarf-shrubs such as *Artemisia frigida* or *Leptodactylon pungens* are frequently present. The herbaceous layer is dominated by graminoids typical of dry habitats. These species include *Bouteloua gracilis*, *Carex rossii*, *Festuca idahoensis*, *Festuca kingii*, *Leymus ambiguus*, *Muhlenbergia montana*, *Oryzopsis hymenoides*, *Oryzopsis micrantha*, *Poa secunda*, *Pseudoroegneria spicata*, *Schizachyrium scoparium* and *Stipa comata*. Perennial forbs are sparse, but may be fairly diverse. The most common forbs are *Achillea millefolium*, *Artemisia ludoviciana*, *Eriogonum umbellatum*, *Campanula rotundifolia*, *Galium boreale*, *Helianthus pumilus*, *Heterotheca villosa*, *Heuchera bracteata*, *Maianthemum stellatum*, *Penstemon virens*, *Potentilla fissa*, and *Senecio integerrimus*. The fern *Cystopteris fragilis* and the cactus *Opuntia polyacantha* are often present. In some stands mosses and lichens cover up to 72% of the ground. Annual grasses and forbs are seasonally present.

Dynamics: Woodlands in this alliance are considered to be edaphic or topographic climax communities (Tiedemann et al. 1987, Hansen et al. 1984). *Juniperus scopulorum* is a long-lived species. Hansen and Hoffman (1988) found most trees in stands they sampled to be over 120 years, with some individuals older than 360 years. Fire can be used to control *Juniperus scopulorum* stands on rangeland because the species will not resprout after being burned (Fischer and Bradley 1987, Wright et al. 1979). Young individuals are most vulnerable to fire (Fischer and Bradley 1987, Wright et al. 1979). The effect of a fire on a stand is largely dependent on the tree height and density, fine fuel load on the ground, weather conditions, and season (Wright et al. 1979, Dwyer and Pieper 1967). Trees are more vulnerable in open stands where fires frequently occur in the spring, the humidity is low, wind speeds are over 10-20 mph, and there is adequate fine fuels to carry fire (Fischer and Bradley 1987, Wright et al. 1979). Under other conditions, burns tend to be spotty with low tree mortality. Large trees are generally not killed unless fine fuels, such as tumbleweeds, have accumulated beneath the tree to provide fuel ladders for the fire to reach the crown. Closed-canopy stands rarely burn because they typically do not have enough understory or wind to carry a fire.

Altered fire regimes, cutting trees for fencing, and improper grazing by livestock have significant impacts on the quality of sites. Grazing by livestock can modify the fire regime by removing the fine fuels that carry fire. Fire, livestock grazing, and trampling by hikers and vehicles disturb cryptogamic soil crusts that help maintain soil structure, reduce soil erosion, provide habitat for plants and preserve biological diversity (Ladyman and Muldavin 1996). More study is needed to understand and manage these woodlands.

Similar Alliances:

?? JUNIPERUS SCOPULORUM TEMPORARILY FLOODED WOODLAND ALLIANCE (A.563)

?? JUNIPERUS OSTEOSPERMA WOODLAND ALLIANCE (A.536)

?? JUNIPERUS VIRGINIANA WOODLAND ALLIANCE (A.545)

Similar Alliance Comments: Stands in the II.A.4.N.d.3 *Juniperus scopulorum* Temporarily Flooded Woodland Alliance (A.563) are found in riparian habitats which are more mesic than stands in this alliance and have an understory dominated by the facultative riparian shrub *Cornus sericea*.

The II.A.4.N.a.38 *Juniperus osteosperma* Woodland Alliance (A.536) has associations very similar to the *Juniperus scopulorum* / *Artemisia nova* Woodland Association that has been described from only one plot on the lower, southern slopes of the Pryor Mountains (DeVelice and Lesica 1993).

The II.A.4.N.b.2 *Juniperus virginiana* Woodland Alliance (A.545) is similar because, in stands located in the eastern extent of this alliance, *Juniperus scopulorum* is replaced by *Juniperus virginiana* and introgressant hybrids of the two species.

Synonymy:

?? IB1d. Rocky Mountain Juniper Woodland (Allard 1990)

?? Rocky Mountain Juniper Series (Diamond 1993)

?? Rocky Mountain Juniper: 220, in part (Eyre 1980)

?? *Juniperus scopulorum* Series, in part (Johnston 1987)

?? *Juniperus scopulorum* Series, in part (Hess 1981)

Comments: At their upper elevational limit, *Juniperus scopulorum* communities may merge with woodlands and forests dominated by *Pinus* species. The dominance of *Juniperus scopulorum* is a diagnostic feature that can usually be used to separate communities within this alliance from other wooded communities. At lower elevations, the boundary between *Juniperus scopulorum* woodlands and communities that are dominated by *Artemisia* spp., or dry prairie, may be difficult to distinguish, as the ecotone may be quite broad. On the upper elevation margins, pine woodlands and forests often merge with this alliance. The dominance of *Juniperus scopulorum* is a diagnostic feature that can usually be used to separate communities within this alliance from other wooded communities. At the lower elevation edges of this alliance it may be

difficult to distinguish where *Juniperus scopulorum* Alliance ends and communities that are dominated by *Artemisia* spp. or dry prairie begin.

ALLIANCE DISTRIBUTION

Range: Stands included in this woodland alliance occur on dry slopes in the foothills and lower elevations of the northern and southern Rocky Mountains and the Black Hills. The vegetation extends east to breaks, badlands and canyon slopes in the Great Plains in western Nebraska and the Dakotas and may extend south to escarpments in the panhandle of Texas. *Juniperus scopulorum* trees also occur in Puget Sound in northwestern Washington and British Columbia, Canada, but associations have not been described there.

States: CO,MT,ND,NE,SD,TX,WY

TNC Ecoregions: 21:C, 25:C, 26:C, 27:C

USFS Ecoregions: 315B:CC, 315C:CC, 321A:CC, 331D:CC, 331E:C?, 331F:CC, 331G:CC, 331H:CC, 332C:CC, 342A:CC, M331A:CC, M331B:C?, M331I:CC, M332D:CC, M332E:CC

ALLIANCE SOURCES

Edition: 98-08-17

References: Allard 1990, Badaracco 1971, Bighorn Coal Mine n.d., Brown 1971, Burns and Honkala 1990, Burns et al. 1990, Cooper et al. 1995, DeVelice 1992, DeVelice et al. 1995, Diamond 1993, Dwyer and Pieper 1967, Eyre 1980, Faber-Langendoen et al. 1996, Fischer and Bradley 1987, Francis 1983, Goodding 1923, Hansen 1985, Hansen and Hoffman 1988, Hansen et al. 1984, Hess 1981, Hess and Alexander 1986, Jennings 1978, Jennings 1979, Johnston 1987, Ladyman and Muldavin 1996, Lesica and DeVelice 1992, Moran 1981, Ramaley 1909, Steele et al. 1983, Strong 1980, Terwilliger et al. 1979, Tiedemann et al. 1987, Wasser and Hess 1982, Wells 1965, Wells 1970, Wells 1970a, Wright et al. 1979

II.A.4.N.b. Conical-crowned temperate or subpolar needle-leaved evergreen woodland

II.A.4.N.b.10. ABIES CONCOLOR WOODLAND ALLIANCE (A.553)

White Fir Woodland Alliance

ALLIANCE CONCEPT

Environment: These montane woodlands occur in mountain or foothill environments from southeastern Oregon to the southern Rocky Mountain states. They occur at middle elevations (1200-3200 m) of major mountain ranges. Annual precipitation ranges from 40-80 cm with a substantial proportion falling as winter snow. Summer "monsoonal" rainfall is important in the southern Rocky Mountains and decreases westward. Temperature and moisture regimes appear to be the key factors in distribution of these woodlands. Sometimes, they are associated with moist topo-edaphic positions such as ravines, in other cases with scree slopes where soils are confined to small pockets within the rocks. Edaphic conditions (such as on the scree) or frequent fires are important factors maintaining the open nature of these woodlands (DeVelice et al. 1986). All slopes and aspects are represented within this alliance. Soils are highly variable and non-definitive for these woodlands, but are generally more skeletal and well-drained than soils supporting *Abies concolor* forests. These woodlands may occupy somewhat marginal sites for *Abies concolor* communities. Adjacent vegetation is often closed forests dominated by *A. concolor*, *Pseudotsuga menziesii*, or *Pinus ponderosa*, or non-forested communities dominated by *Artemisia* spp., *Purshia tridentata*, or cespitose graminoids.

Physiognomy: These are open, multi-storied woodlands of needle-leaved evergreen trees, with canopy heights varying from 20 to 50 m. There may be a well-developed ericaceous or cold-deciduous shrub layer. The herbaceous layer is usually dominated by forbs, but cespitose graminoids may also be common.

Vegetation: These woodlands are characterized by the importance of *Abies concolor* in the upper canopy, but they are typically mixed conifer woodlands, with several species important. Stands dominated by the Pacific taxon, *Abies concolor* var. *lowiana*, and the Rocky Mountain taxon, *Abies concolor* var. *concolor*, are both contained in this alliance. From Utah and Colorado southward, common conifer associates in these woodlands include *Pseudotsuga menziesii*, *Pinus ponderosa*, *Abies lasiocarpa* var. *lasiocarpa*, *Abies lasiocarpa* var. *arizonica*, *Juniperus scopulorum*, *Picea engelmannii*, and *Picea pungens*. *Populus tremuloides* is a typical hardwood associate, and *Cercocarpus ledifolius* may be common in some stands. Stands located on vegetated scree slopes usually have either *Pinus flexilis* or *Pseudotsuga menziesii* as codominant conifers, while the shrub and herbaceous layers will be sparse. Locally abundant low to mid-stature shrubs include *Robinia neomexicana*, *Mahonia repens*, *Symphoricarpos oreophilus*, *Juniperus communis*, and *Arctostaphylos uva-ursi*. Understory herbs include *Festuca arizonica*, *Poa fendleriana*, *Danthonia parryi*, *Carex foenea*, *Leymus triticoides*, *Galium triflorum*, *Muhlenbergia montana*, and *Elymus elymoides*. Vegetated scree will rarely have an herbaceous layer, and shrubs are scattered through the rocky substrates. Important species in these stands include *Jamesia americana*, *Holodiscus dumosus*, *Juniperus communis*, and *Ribes* spp.

In southeastern Oregon stands, common tree associates include *Pinus ponderosa*, *P. jeffreyi*, *P. contorta*, *P. lambertiana*, *Pseudotsuga menziesii*, and *Calocedrus decurrens*. The most important shrub species is *Purshia tridentata*, but other species may include *Arctostaphylos patula*, *A. nevadensis*, *Ceanothus velutinus*, *C. cordulatus*, *Artemisia tridentata*, and *Vaccinium spp.* The herb layer is typically dominated by shade-tolerant forbs, including *Pyrola picta*, *Orthilia secunda*, and *Chimaphila umbellata*.

Dynamics: *Abies concolor* is a climax tree species in most of the areas where it occurs; it is sufficiently shade-tolerant to establish and persist under closed canopy conditions in the absence of disturbance. Fire suppression has led to vigorous regeneration of the species in most places it occurs. Historically, frequent ground fires may have served to maintain the open nature of these woodlands (DeVelice et al. 1986), as *Abies concolor* is relatively susceptible to fire. With fire suppression, many stands have increased fuel loads and dense stands of young trees in the understory, conditions that are conducive to highly destructive fires.

Similar Alliances:

- ?? ABIES CONCOLOR GIANT FOREST ALLIANCE (A.103)
- ?? ABIES AMABILIS - ABIES CONCOLOR FOREST ALLIANCE (A.160)
- ?? ABIES CONCOLOR - POPULUS TREMULOIDES FOREST ALLIANCE (A.419)
- ?? ABIES CONCOLOR FOREST ALLIANCE (A.152)
- ?? ABIES CONCOLOR - ABIES X SHASTENSIS FOREST ALLIANCE (A.151)

Similar Alliance Comments: Woodlands in the *Abies concolor* Woodland Alliance are distinguished from the similar alliances by the relatively open tree canopy (<60 percent cover on average), and the dominance of *Abies concolor*. In addition, the range of distribution of the *Abies concolor* Giant Forest, *Abies amabilis* - *Abies concolor* Forest, and the *Abies concolor* - *Abies x shastensis* Forest Alliances do not overlap with the *A. concolor* Woodland Alliance.

Synonymy:

- ?? *Abies concolor* Series, in part (Johnston 1987)
- ?? White Fir: 211. in part, Pacific coastal stands (Eyre 1980)
- ?? Interior Douglas-fir: 210. in part, southwestern stands (Eyre 1980)
- ?? Spruce-Fir-Douglas-fir (*Picea-Abies-Pseudotsuga*), # 19, in part (Kuchler 1964)

Comments: Associations dominated by the Pacific form, *Abies concolor* var. *lowiana*, and the Rocky Mountain form, *A. concolor* var. *concolor*, are both contained in this alliance.

ALLIANCE DISTRIBUTION

Range: This alliance occurs in two major areas. A western range is centered in eastern Oregon. A second interior range occurs from the Colorado Plateau region of northern Arizona north and east to the southern Rocky Mountains of Utah, Colorado, and New Mexico.

States: AZ,CA?,CO,NM,OR,UT

TNC Ecoregions:

USFS Ecoregions: 313E:CC, 321A:CC, 331J:CC, M242C:CC, M261G:CC, M313A:CC, M313B:CC, M331D:CC, M331F:CC, M331G:CC, M341C:CC

ALLIANCE SOURCES

Edition: 98-07-16

References: Alexander et al. 1984, DeVelice et al. 1986, Dealy 1971, Fitzhugh et al. 1987, Johnston 1984, Johnston 1987, Kuchler 1964, Larson and Moir 1987, Moir and Ludwig 1979, Youngblood and Mauk 1985

II.A.4.N.c. Cylindrical-crowned temperate or subpolar needle-leaved evergreen woodland

II.A.4.N.c.1. ABIES LASIOCARPA WOODLAND ALLIANCE (A.559)

Subalpine Fir Woodland Alliance

ALLIANCE CONCEPT

Environment: These upper montane or subalpine woodlands occur in many of the mountainous areas of the western United States. They are found in cool and relatively dry climate regimes. In the Olympic and Cascade ranges, they occupy areas with pronounced rainshadow effects, where precipitation is more limited than in the surrounding areas. Henderson et al. (1989) report annual precipitation of less than 20 cm where these woodlands occur in the Olympics. In areas with higher precipitation totals, these woodlands will be found at the lower elevational limits for *Abies lasiocarpa* to successfully occupy a site, on droughty substrates such as scree slopes or lava fields, or on southerly or westerly slopes and ridgetops. Snowpacks can be deep, but often melt quickly, and summers are cool. Summer frosts are characteristic, especially in sites where cold air pools. Elevations range from 1300 to 1950 m in the Olympics and eastern Cascades, and increase with decreasing latitude (from roughly 2200 m in central Idaho to over 3200 m in Utah, Colorado and New Mexico). In some locations where there is

cold-air drainage, these woodlands extend down in elevation into the montane zone, where they will occupy dry stream terraces or toeslopes. Parent materials and soils are variable across the distribution of the alliance. Parent materials include ash, tuff, lava, basalt, granitics, colluvium and talus (of various rock types), but often are non-calcareous. Soils are typically shallow, poorly developed, with significant amounts of rock and gravel in the profile. Adjacent forest vegetation types include *Abies lasiocarpa* or *Picea engelmannii* forests, *Pinus albicaulis* or *Abies amabilis* forests at the upper elevation boundary and *Pseudotsuga menziesii*, *Abies grandis*, or *Tsuga heterophylla* at the lower zonal boundary. Wetter sites adjoining wet meadows often support forests of *Picea engelmannii*, *Pinus contorta*, or riparian plant communities.

Physiognomy: These woodlands are dominated by needle-leaved evergreen trees up to 30 m in height and of low to moderate cover (20-60 percent). Although cold-deciduous trees are relatively rare, they can be prominent in some regional variants or seral stands. A moderately dense shrub layer is usually present, dominated by ericaceous or, less commonly, cold-deciduous species. The herbaceous layer is dominated by perennial forbs or sod-forming graminoids. In some regions, a nonvascular layer covers the ground surface, dominated by mosses.

Vegetation: Older stands of these woodlands are characterized by *Abies lasiocarpa* as the dominant tree species in an open tree canopy, often with *Picea engelmannii*. Total canopy cover averages <60%, but some stands may have somewhat higher cover. In younger stands, other conifers can be important or even dominant, but *Abies lasiocarpa* is always present in the regeneration layer. In the Pacific Northwest, tree associates include *Tsuga heterophylla*, *T. mertensiana*, *Pseudotsuga menziesii*, *Pinus albicaulis*, *P. contorta*, and *Chamaecyparis nootkatensis*. In the eastern Cascades and northern Rockies, other occasionally present conifers include *Pinus albicaulis*, *Pinus contorta*, *Picea glauca*, *Pseudotsuga menziesii*, *Larix occidentalis*, and *L. lyallii*. Cold-deciduous trees, such as *Populus tremuloides*, are very infrequently present. In the central and southern Rockies, *Abies lasiocarpa*, *Picea engelmannii*, *Pseudotsuga menziesii* and *Pinus contorta* are the major trees in these woodlands.

Most associations in this alliance have well-developed shrub layers, with the herbaceous layer being relatively depauperate and sparse. The shrub layer is typically less than 2 m in height, and can be up to 80% in cover, although in some stands may be under 20%, a reflection of dry conditions. Important to dominant species include *Phyllodoce empetrifomis*, *Vaccinium scoparium*, *V. membranaceum*, *V. myrtilus*, *Juniperus communis*, *Shepherdia canadensis*, *Paxistima myrsinites*, and *Rhododendron albiflorum*. Vegetated scree slopes or lava fields will typically have a scattered shrub layer. Important species in these associations include *Salix brachycarpa*, *Salix glauca*, *Holodiscus dumosus*, *Juniperus communis*, *Acer circinatum* (in Oregon), and *Ribes spp.* (in Colorado and New Mexico). The herbaceous layer in most associations is relatively depauperate. One exception is in the Olympics where there is a lush forb layer, dominated by *Lupinus arcticus ssp. subalpinus* (up to 40% cover, Henderson et al. 1989), with lesser amounts of *Arnica cordifolia*, *Orthilia secunda*, *Lomatium martindalei*, *Hieracium albiflorum*, and *Valeriana sitchensis*. Important forbs in the Rocky Mountains from Idaho and Montana south into New Mexico include *Arnica cordifolia*, *Arnica latifolia*, *Epilobium angustifolium*, *Galium triflorum*, *Orthilia secunda*, *Polemonium pulcherrimum*, *Saxifraga bronchialis*, and species of *Thalictrum*, *Pedicularis*, *Lupinus* and *Fragaria*. Graminoids are rarely important in these woodlands. Where these woodlands occur on sites with some soil development, there may be a nonvascular layer on the ground surface, composed primarily of mosses (Henderson et al. 1989, Steele et al. 1981). Epiphytic lichens are common in the Olympics.

Dynamics:

Similar Alliances:

- ?? ABIES LASIOCARPA TEMPORARILY FLOODED FOREST ALLIANCE (A.177)
- ?? ABIES LASIOCARPA SEASONALLY FLOODED FOREST ALLIANCE (A.190)
- ?? ABIES LASIOCARPA - LARIX LYALLII FOREST ALLIANCE (A.421)
- ?? ABIES LASIOCARPA - POPULUS TREMULOIDES FOREST ALLIANCE (A.422)
- ?? ABIES LASIOCARPA FOREST ALLIANCE (A.168)
- ?? ABIES LASIOCARPA - PINUS ALBICAULIS WOODLAND ALLIANCE (A.560)
- ?? PICEA ENGELMANNII FOREST ALLIANCE (A.164)
- ?? PSEUDOTSUGA MENZIESII FOREST ALLIANCE (A.157)
- ?? PICEA ENGELMANNII SPARSELY VEGETATED ALLIANCE (A.556)
- ?? PSEUDOTSUGA MENZIESII WOODLAND ALLIANCE (A.552)
- ?? PINUS CONTORTA WOODLAND ALLIANCE (A.512)

Similar Alliance Comments: The *Abies lasiocarpa* Woodland Alliance is distinguished from the similar *Abies lasiocarpa* alliances by 1) not including riparian forests which occur along streams or on mesic slopes, 2) being of woodland physiognomy with the tree canopy averaging <60 percent cover, or 3) by having *Abies lasiocarpa* being the predominant conifer in the tree regeneration layer. The similar *Picea engelmannii* and *Pseudotsuga menziesii* alliances differ in being 1) either strongly dominated by *Picea engelmannii* or *Pseudotsuga menziesii* with little *Abies lasiocarpa* (if any) in the tree canopy or regeneration layer, or 2) by having a closed forest physiognomy, where tree canopy cover is usually >60 percent.

Synonymy:

- ?? *Abies lasiocarpa*-*Picea engelmannii* Series, in part (Johnston 1987)
- ?? Western spruce-fir forest (*Picea-Abies*), # 14, in part (Kuchler 1964)

?? Southwestern spruce-fir forest (*Picea-Abies*), # 20, in part (Kuchler 1964)

?? Engelmann Spruce - Subalpine Fir: 206, in part (Eyre 1980)

Comments: This alliance is based upon a series concept, in which *Abies lasiocarpa* may not be the dominant tree canopy species, but is always present in the regeneration layer, and it is assumed would dominate the site should "climax" conditions be reached. Several associations in this alliance occur on scree slopes. They have been poorly sampled, and may prove with further data to be sparsely vegetated types that should be moved into the Sparse Vegetation Class of the NVCS.

ALLIANCE DISTRIBUTION

Range: These subalpine woodlands have been reported from scattered locations, from southern British Columbia, Canada, the Olympic Peninsula of Washington, east into the northern Rocky Mountains, and south into the southern Rocky Mountains of Arizona and New Mexico. It is likely they occur throughout the range of *Abies lasiocarpa*.

States: AZ,BC,CO,ID,MT,NM,NV?,OR,UT,WA,WY

TNC Ecoregions:

USFS Ecoregions: 313A:CC, 321A:CC, 341B:CC, M242A:CC, M242B:CC, M242C:CC, M313A:CC, M313B:C?, M331A:CC, M331B:C?, M331D:CC, M331E:CC, M331F:C?, M331I:C?, M332A:CC, M332B:CC, M332C:CC, M332D:CC, M332E:CC, M332F:CC, M332G:CC, M333A:CC, M333B:CC, M333C:CC, M333D:CC, M341C:CC

ALLIANCE SOURCES

Edition: 98-07-06

References: Baker 1984, Brockway et al. 1983, Daubenmire and Daubenmire 1968, DeVelice et al. 1986, Eyre 1980, Fitzhugh et al. 1987, Henderson 1981, Henderson et al. 1986, Henderson et al. 1989, Hess 1981, Hess and Wasser 1982, Johnson and Clausnitzer 1992, Johnston 1984, Johnston 1987, Komarkova 1986, Kovalchik 1993, Kuchler 1964, Larson and Moir 1987, Mauk and Henderson 1984, Mclean 1970, Moir and Ludwig 1979, Peet 1975, Peet 1981, Pfister et al. 1977, Roach 1952, Roberts 1980, Steele et al. 1981, Steele et al. 1983, Williams and Lillybridge 1983, Williams and Lillybridge 1985, Williams and Smith 1990, Youngblood and Mauk 1985

II.B.2.N.b. Temporarily flooded cold-deciduous woodland

II.B.2.N.b.11. PLATANUS WRIGHTII TEMPORARILY FLOODED WOODLAND ALLIANCE (A.643)

Arizona Sycamore Temporarily Flooded Woodland Alliance

ALLIANCE CONCEPT

Environment: Vegetation types within this alliance are riparian woodlands located along perennial streams and on adjacent terraces in the American Southwest. In Arizona, occurrences coincide approximately with the Mogollon Escarpment (Kearney 1969). Elevation ranges from 600 to 1800 m. Soils are silty or sandy, shallow, with large cobbles. The surface water is present for brief periods during the growing season, but the water table usually lies well below the soil surface.

Physiognomy: The tree canopy is dominated by a broad-leaved, cold-deciduous tree, from 3 to 15 m tall with an understory of tree seedlings and shrubs from 0.5 to 3 m tall. Percent cover was not given (Anderson et al. 1985).

Vegetation: Vegetation types within this alliance are characterized as temporarily flooded, cold-deciduous woodlands. *Platanus wrightii* dominates the tree subcanopy. Other characteristic species can include *Fraxinus pennsylvanica*, *Juglans major*, *Juniperus monosperma*, *Prosopis velutina*, *Celtis laevigata* var. *reticulata*, and *Quercus arizonica*. Other associated species in the tree subcanopy or tall-shrub strata are *Alnus oblongifolia*, *Salix bonplandiana*, and *Populus fremontii*. The herbaceous layer is common (no percent cover data) and can include *Bouteloua curtipendula*, *Oenothera elata* ssp. *hookeri* (= *Oenothera hookeri*), *Marrubium vulgare*, *Choisya dumosa* var. *arizonica* (= *Choisya arizonica*), *Datura wrightii* (= *Datura meteloides*), and *Muhlenbergia emersleyi*. The vine stratum is dominated by *Vitis arizonica* (Anderson et al. 1985).

Dynamics: Anderson et al. (1985) state that this woodland type is very sensitive to even moderate levels of livestock grazing. Grazing can inhibit reproduction of the dominant tree species due to their high palatability.

Similar Alliances:

?? PLATANUS WRIGHTII TEMPORARILY FLOODED FOREST ALLIANCE (A.309)

Similar Alliance Comments: *Platanus wrightii* temporarily flooded forest differs due to the structure of the vegetation. The canopy consists of trees with overlapping crowns. The woodland alliances are defined as open stands of trees with crowns not usually touching.

Synonymy:

?? Wetlands: Interior and Californian Riparian Deciduous Warm Temperate Wetlands, in part (Brown 1982)

?? Forest Type: *Platanus wrightii* series, in part (Bassett et al. 1987)

?? Temperate Riparian Deciduous Forest Biome: Mixed Broadleaf Series, in part (Pase and Layser 1977)

?? Arizona Cypress: 240, in part (Eyre 1980)

Comments:

ALLIANCE DISTRIBUTION

Range: This alliance is presently reported in the classification only from low elevations (<1800 m) in Arizona. It probably also occurs in New Mexico, California, Baja California and northern Mexico, but there are currently no communities classified from these regions.

States: AZ

TNC Ecoregions:

USFS Ecoregions: 313C:CC, 321A:CC, 322B:CC

ALLIANCE SOURCES

Edition: 98-04-29

References: Anderson et al. 1985, Brown 1982, Eyre 1980, Kartesz 1994, Kearney et al. 1969, Pase and Layser 1977, Szaro 1989

II.B.2.N.b.12. POPULUS FREMONTII TEMPORARILY FLOODED WOODLAND ALLIANCE (A.644)

Fremont Cottonwood Temporarily Flooded Woodland Alliance

ALLIANCE CONCEPT

Environment: Woodlands included in this riparian alliance are found in floodplains and on lower alluvial terraces along the perennial streams that occur in the southern deserts. Elevations range from 400-2500 m. range from 670-1500 m. Climate is arid to semi-arid with hot summers and typically mild winters, but with freezing temperatures not uncommon in northern stands. Mean annual precipitation ranges from 15-28 cm, but can vary greatly from year to year. Drought is not uncommon. Annual precipitation has bimodal distribution with the proportion of summer precipitation decreasing westward (Barbour and Major 1977). At the Jornada Experimental Range in southwestern New Mexico, about two-thirds of the annual precipitation occurs in July through October and a third during the winter months. At Tucson, Arizona about half of the annual rain falls in July to October with the balance during the winter months. In southern California the precipitation is mostly winter and the mean annual precipitation may be less than 15 cm in the deserts. The most arid season is late spring and early summer. The summer rain often occurs as high-intensity convective storms.

Stands are restricted to the floodplains and corridors of perennial streams by the arid upland environment. This vegetation type is dependent on a subsurface water supply and varies considerably with the water table levels. Major flood events and consequent flood scour, overbank deposition of water and sediments, and stream meandering are important factors that shape these woodlands. These woodlands occur as small isolated stands or as linear bands that parallel stream channels. Sites are flat to gently sloping and occur in lower canyons in desert mountains, alluvial fans and valleys. Substrates are generally well-drained, coarse-textured soils derived from stratified alluvium composed of sand, loam, gravel and cobbles. The soils may be slightly alkaline and saline.

Adjacent stands include other riparian and semi-riparian shrublands and woodlands, desertscrub, montane scrub and montane forests.

Physiognomy: The tree stratum is dominated by broad-leaved, deciduous, tall (10-25 m), single-stemmed tree. The canopy is open to dense (25-60 percent) depending on the stand. The tree subcanopy is dominated by multi-stemmed, broad-leaved shrubs. The herbaceous layer is sparse and often dominated by introduced hay grasses.

Vegetation: This alliance contains woodlands classified as temporarily flooded. The canopy is dominated with open stands of *Populus fremontii* generally forming 30-70% cover; individuals may be scattered or occur in groves. This species may reach 30 m in height and 2 m in diameter. Other woody species that may occur in the canopy/subcanopy include *Populus deltoides* ssp. *wislizeni*, *Baccharis salicifolia*, *Salix lasiolepis*, *Salix exigua*, *Salix amygdaloides*, *Salix gooddingii*, *Fraxinus berlandieriana*, *Fraxinus velutina*, *Celtis laevigata* var. *reticulata*, *Juglans microcarpa*, *Prosopis pubescens*, *Prosopis glandulosa*, or *Prosopis velutina*. The understories of most examples have been considerably altered by grazing and other factors, thus the composition and cover of the native understory is difficult to ascertain, but frequently consists of shrubs and small trees (1-5 m tall) of the above species. The herbaceous stratum varies in composition and coverage, but is characterized by mixed annuals and short-lived perennials.

Dynamics: This alliance is dependent on a subsurface water supply and varies considerably with the water table levels. Major flood events and consequent flood scour, overbank deposition of water and sediments, and stream meandering are important factors that shape these woodlands.

Similar Alliances:

?? POPULUS FREMONTII SEASONALLY FLOODED WOODLAND ALLIANCE (A.654)

?? POPULUS FREMONTII TEMPORARILY FLOODED FOREST ALLIANCE (A.313)

Similar Alliance Comments: The similar alliances, II.B.2.N.c.7 *Populus fremontii* Seasonally Flooded Woodland Alliance (A.654) and I.B.2.N.d.38 *Populus fremontii* Temporarily Flooded Forest Alliance (A.313), differ either in flood regime (seasonally versus temporarily flooded) or in canopy closure.

Synonymy:

- ?? IIA7d. Western Cottonwood - Willow Riverfront Forest, in part (Allard 1990)
- ?? Cottonwood-Willow Series, in part (Diamond 1993)
- ?? Cottonwood - Willow: 235, in part (Eyre 1980)
- ?? Broadleaf Cottonwood-Mixed Deciduous Series. included in the Montane Riparian Vegetation Type (Dick-Peddie 1993)
- ?? Cottonwood Series. included in the Floodplain Riparian Vegetation Type (Dick-Peddie 1993)
- ?? Cottonwood-Willow Series. included in the Floodplain Riparian Vegetation Type (Dick-Peddie 1993)
- ?? Fremont Cottonwood series, in part (Sawyer and Keeler-Wolf 1995)
- ?? Central Coast Cottonwood-Sycamore Riparian Forest (#61210), in part (Holland 1986)
- ?? Southern Cottonwood-Willow Riparian Forest (#61330), in part (Holland 1986)
- ?? Great Valley Cottonwood Riparian Forest (#61410), in part (Holland 1986)
- ?? Great Valley Mixed Riparian Forest (#61420), in part (Holland 1986)
- ?? Modoc-Great Basin Cottonwood-Willow Riparian Forest (#61610), in part (Holland 1986)
- ?? Mojave Riparian Forest (#61700), in part (Holland 1986)
- ?? Sonoran Cottonwood-Willow Riparian Forest (#61810), in part (Holland 1986)
- ?? Cotton-Willow Series. included in the Sonoran Riparian Deciduous Forest (Brown 1982)

Comments: This vegetation is dependent on a subsurface water supply and varies considerably with the water table levels. Major flood events and consequent flood scour, overbank deposition of water and sediments, and stream meandering are important factors that shape these woodlands. Woodlands in this alliance once occupied the floodplains and riverbanks of most perennial waterways within the range of *Populus fremontii* but have mostly been replaced by disturbance types dominated by exotic species. The II.B.2.N.c.7 *Populus fremontii* Seasonally Flooded Woodland Alliance (A.654) differs due to constancy of surface water and depth to water table.

This alliance is poorly studied; further inventory and classification work are needed for all *Populus fremontii* communities. This is hindered by the alteration of species structure and composition that has occurred in most remaining stands because of hydrologic alterations, exotic species invasions, grazing, and other human impacts.

ALLIANCE DISTRIBUTION

Range: Riparian woodlands included in this alliance are reported from western Texas to southern California and in southwestern Utah. It is also found in the Mexican states of Chihuahua and Coahuila, and likely found in southern Nevada.

States: AZ,CA?,MXCH?,MXSO?,NM,TX,UT

TNC Ecoregions: 24:C

USFS Ecoregions: 321A:CC, 322B:C?, M313A:CC, M313B:C?

ALLIANCE SOURCES

Edition: 98-05-04

References: Allard 1990, Boles and Dick-Peddie 1983, Brown 1982, Campbell and Dick-Peddie 1964, Diamond 1993, Diamond et al. 1992, Dick-Peddie 1993, Eyre 1980, Holland 1986, Metcalfe 1902, Muldavin 1987, New Mexico Natural Heritage Program n.d., Sawyer and Keeler-Wolf 1995, Stromberg 1993, Stromberg 1995, Szaro 1989, The Nature Conservancy 1992, Webb and Brotherson 1988

II.B.2.N.b.5. PROSOPIS GLANDULOSA TEMPORARILY FLOODED WOODLAND ALLIANCE (A.637)

Honey Mesquite Temporarily Flooded Woodland Alliance

ALLIANCE CONCEPT

Environment:

Physiognomy:

Vegetation:

Dynamics:

Similar Alliances:

- ?? PROSOPIS (GLANDULOSA, VELUTINA) WOODLAND ALLIANCE (A.661)
- ?? PROSOPIS GLANDULOSA WOODLAND ALLIANCE (A.611)
- ?? PROSOPIS GLANDULOSA SHRUBLAND ALLIANCE (A.1031)
- ?? PROSOPIS GLANDULOSA SHRUB HERBACEOUS ALLIANCE (A.1550)

Similar Alliance Comments: II.B.3.N.a.2 *Prosopis (glandulosa, velutina)* Woodland Alliance (A.661); II.B.2.N.a.11 *Prosopis glandulosa* Woodland Alliance (A.611); III.B.3.N.a.4 *Prosopis glandulosa* Shrubland Alliance (A.1031); and V.A.7.N.m.3 *Prosopis glandulosa* Shrub Herbaceous Alliance (A.1550).

Synonymy:

Comments:

ALLIANCE DISTRIBUTION

Range: This alliance is found in Texas, Arizona (?), New Mexico (?), and the Mexican states of Chihuahua and Coahuila.

States: AZ?,MXCH,MXCO,NM?,TX

TNC Ecoregions: 24:C

USFS Ecoregions: 321A:CC

ALLIANCE SOURCES

Edition: 97-10

References:

II.B.2.N.b.8. SALIX GOODDINGII TEMPORARILY FLOODED WOODLAND ALLIANCE (A.640)

Goodding's Willow Temporarily Flooded Woodland Alliance

ALLIANCE CONCEPT

Environment: Woodlands in this alliance occur as isolated pockets in mesic desert canyons and along rocky floodplains of small, intermittent streams and is often associated with seeps and springs.

Physiognomy:

Vegetation: Woodlands in this alliance are dominated by *Salix gooddingii*. Composition varies with soil moisture and flooding regime. Among the canopy species that may be present are *Sapindus saponaria* var. *drummondii*, *Juglans microcarpa*, *Celtis laevigata* var. *reticulata*, *Populus fremontii*, *Ungnadia speciosa*, *Prosopis glandulosa*, and *Quercus pungens*.

Dynamics:

Similar Alliances:

Similar Alliance Comments:

Synonymy:

?? Velvet Ash-Willow Series (Diamond 1993)

Comments: This alliance has a limited distribution. Remaining examples have had many large trees removed, contain exotic species, and have been impacted by overgrazing. Disruption of the natural flooding regime, through damming, water diversions, and stream channelization, is also a major threat to these woodlands.

ALLIANCE DISTRIBUTION

Range: This alliance is found in the Trans-Pecos of western Texas and possibly in New Mexico (?). It is also found in the Mexican states of Chihuahua and Coahuila.

States: NM?,TX

TNC Ecoregions: 24:C

USFS Ecoregions: 321A:CC

ALLIANCE SOURCES

Edition: 93

References: Diamond 1993

II.B.2.N.b.9. POPULUS ANGUSTIFOLIA TEMPORARILY FLOODED WOODLAND ALLIANCE (A.641)

Narrowleaf Cottonwood Temporarily Flooded Woodland Alliance

ALLIANCE CONCEPT

Environment: Vegetation types in this alliance occur in narrow to wide valleys, 10-150 m, having variable gradients (1-16 percent) and moderately steep stream channels (2-5 percent gradient). Elevation ranges from below 1650 m in Wyoming to 2600 m in Colorado. Stands occur on narrow benches along narrow stream channels and on large floodplains along broad, meandering rivers. This alliance usually occurs between 0.5-2 m above the stream channel. Water tables usually fluctuate enough for distinct mottles to form. Available water capacity appears low in many stands.

Soils are highly permeable with large amounts of coarse fragments in the subsurface horizons. The soil textures are fine sandy loams, clay loams, silty clay loams, and silty clay. Soils are frequently reworked by floods and beavers. Peat deposits, if present, are thin.

Kittel et al. (1994, 1995, 1996) reported *Pinus edulis-Juniperus osteosperma* woodlands, *Pinus ponderosa-Quercus gambelii* forests, *Quercus gambelii* scrub, and *Artemisia tridentata* and *Chrysothamnus spp.* shrublands as occurring on adjacent hillslopes.

Physiognomy: The tree canopy is open with crowns not usually touching, generally 25-60 percent cover. The tree layer is dominated by 5-10 m tall, broad-leaved deciduous, single stemmed trees. The tall-shrub layer consists of multi-branched, broad-leaved deciduous shrubs. The short-shrub layer is very dense, often reaching 100 percent cover. The forb layer is equally as dense. The stands in Arizona and New Mexico contain a vine layer of 25-60 percent cover. The graminoid layer was sparse to non-existent in all stands.

Vegetation: Associations within this alliance are defined as cold-deciduous, temporarily flooded woodlands. The tree canopy is typically open and dominated by *Populus angustifolia* with 20-70% cover. Other trees can include *Acer negundo*, *Juniperus scopulorum*, *Picea pungens*, *Pinus ponderosa* and *Picea engelmannii* in the Rocky Mountains. The shrub layer can be very dense and diverse with 10-80% cover of *Cornus sericea*, *Alnus incana*, *Amelanchier utahensis*, *Rosa woodsii*, *Acer glabrum*, *Quercus gambelii*, *Salix* species, *Crataegus rivularis*, or *Lonicera involucrata*. The shrub layer in stands in Arizona and New Mexico also consist of *Juniperus deppeana*, *Brickellia californica*, and *Alnus oblongifolia*. The forb layer includes 0-50% cover of *Maianthemum stellatum*, *Heracleum maximum* (= *Heracleum lanatum*), *Achillea millefolium*, and *Osmorhiza depauperata*. Graminoid cover is insignificant. In New Mexico and Arizona, a significant vine component is present, with cover of 25-60%, consisting mainly of *Vitis arizonica*, *Parthenocissus quinquefolia* (= *Parthenocissus inserta*), *Clematis ligusticifolia*, and *Humulus lupulus* var. *lupuloides* (= *Humulus americanus*).

Dynamics: Cottonwood woodlands grow within an alluvial environment that is continually changing due to the ebb and flow of the river. Riparian vegetation is constantly being "re-set" by flooding disturbance. Cottonwood communities are early, mid or late seral, depending on the age class of the trees and the associated species of the stand. Mature cottonwood stands do not regenerate in place, but regenerate by "moving" up and down a river reach. Over time, a healthy riparian area supports all stages of cottonwood communities.

The process of cottonwood regeneration is well documented. Periodic flooding events can leave sandbars of bare, mineral substrate. Cottonwood seedlings germinate and become established on newly-deposited, moist sandbars. In the absence of large floods in subsequent years, seedlings begin to trap sediment. In time, the sediment accumulates and the sandbar rises. The young forest community is then above the annual flood zone of the river channel.

In this newly elevated position, with an absence of excessive browsing, fire, and agricultural conversion, this cottonwood community can grow into a mature riparian forest. At the same time, the river channel continually erodes stream banks and creates fresh, new surfaces for cottonwood establishment. This results in a dynamic patchwork of different age classes, plant associations and habitats (The Nature Conservancy 1996).

As cottonwoods mature, other tree species may become established. If the land surface is subject to reworking by the river, the successional processes will start over with erosion and subsequent flooding deposition. If the land surface is not subject to alluvial processes, for example a high terrace, the cottonwoods will be replaced by upland shrub or tree species from adjacent areas.

Similar Alliances:

?? POPULUS ANGUSTIFOLIA TEMPORARILY FLOODED FOREST ALLIANCE (A.310)

Similar Alliance Comments: The *Populus angustifolia* temporarily flooded forest alliance differs in vegetation structure. The forest alliances are distinguished from the woodlands mainly due to overlapping crowns in the canopy, generally forming 60-100 percent cover.

Synonymy:

?? Deciduous Forest Series, in part (Johnston 1987)

?? Cottonwood - Willow: 235, in part (Eyre 1980)

Comments:

ALLIANCE DISTRIBUTION

Range: This alliance is widespread in the lower to mid-montane floodplains and streams of the Rocky Mountains, Great Plains, Great Basin and the American Southwest.

States: AZ,CO,ID,MT,NM,NV?,OR,SD,UT,WY

TNC Ecoregions: 10:C, 26:C, 27:C

USFS Ecoregions: 311:C, 313E:CC, 321A:CC, 331D:CC, 331G:C?, 331I:CC, 331J:CC, 341B:CC, 341F:CC, 341G:CC, 342A:CC, 342B:CC, 342D:CC, 342F:CC, M313A:CC, M313B:CC, M331A:CC, M331B:CC, M331D:CC, M331F:CC, M331G:CC, M331H:CC, M331I:CC, M331J:CC, M332B:CC, M332C:CC, M332D:CC, M341B:CC

ALLIANCE SOURCES

Edition: 98-04-01

References: Baker 1986, Baker 1989, Bassett et al. 1987, Beidleman 1954, Boles and Dick-Peddie 1983, Cooper and Cottrell 1990, DeLeuw, Cather & Company 1977, Durkin et al. 1994, Durkin et al. 1995, Eyre 1980, Freeman and Dick-Peddie 1970, Girard et al. 1997, Hansen 1991, Hansen et al. 1995, Hess 1981, Hess and Alexander 1986, Hess and Wasser 1982, Johnston 1987, Keammerer 1974, Kittel and Lederer 1993, Kittel et al. 1994, Kittel et al. 1995, Kittel et al. 1996, Kittel et al. 1997, Komarkova 1986, Laurenzi et al. 1983, Marriott and Jones 1989, Muldavin et al. 1993, Olson and Gerhart 1982, Osborn et al. 1998, Padgett and Manning 1988, Padgett et al. 1988, Padgett et al. 1989, Ramaley 1942, Richard et al. 1996, Woodbury et al. 1961, Youngblood et al. 1985, Youngblood et al. 1985b

II.B.2.N.c. Seasonally flooded cold-deciduous woodland

II.B.2.N.c.2. SALIX EXIGUA SEASONALLY FLOODED WOODLAND ALLIANCE (A.649)

Sandbar Willow Seasonally Flooded Woodland Alliance

ALLIANCE CONCEPT

Environment: Seasonally flooded interdune ponds in quartz sand. These ponds are flooded throughout most of the growing season in most years. Following flooding soils remain relatively saturated.

Physiognomy:

Vegetation: Seasonally flooded interdune ponds dominated by an open canopy of *Salix exigua*. Other species that may be present include *Baccharis neglecta*, *Baccharis salicina*, *Scirpus maritimus*, *Scirpus tabernaemontani*, *Eustoma exaltatum*, *Pluchea odorata* var. *odorata*, *Xanthium strumarium*, and the rare species *Cyperus onerosus*.

Dynamics:

Similar Alliances:

Similar Alliance Comments:

Synonymy:

Comments:

ALLIANCE DISTRIBUTION

Range: This alliance is found in Texas.

States: TX

TNC Ecoregions: 24:C

USFS Ecoregions: 321A:CC

ALLIANCE SOURCES

Edition: 96-10

References:

II.B.2.N.c.7. POPULUS FREMONTII SEASONALLY FLOODED WOODLAND ALLIANCE (A.654)

Fremont Cottonwood Seasonally Flooded Woodland Alliance

ALLIANCE CONCEPT

Environment: Vegetation types within this alliance occur primarily on relatively flat floodplains (3-5 percent slope) along low-gradient rivers. Stands are found as gallery forests along perennial or seasonally intermittent streams and springs. They typically occupy the more mesic or hydric areas of the floodplain. Elevations range from 400 to 2000 m. Soils are derived from alluvial materials, deposited in stratified layers of clays, sands, silts, and gravels. Soil textures are variable but mainly sandy. Surface water is present for extended periods during the growing season, but is absent by the end of the growing season. The water table after flooding ceases is variable, extending from saturated to well below the ground surface. Adjacent upland communities are typically pinyon-juniper or oak shrublands.

Physiognomy: The tree stratum is dominated by broad-leaved, deciduous, tall (10-25 m), single stemmed trees. The canopy is typically open 25-60 percent) depending on the stand. The shrub layer, when present, is typically dominated by multi-stemmed cold-deciduous shrubs; percent cover data are not available. The herbaceous layer is dominated by one or two graminoid species ranging from 25-60 percent cover.

Vegetation: Communities within this alliance are classified as seasonally flooded woodlands. The canopy is dominated by open stands of *Populus fremontii* generally forming 30-70% cover. *Salix geyeriana* commonly occurs in the shrub layer in the Nevada stands. In New Mexico, the herbaceous layer is dominated by *Muhlenbergia rigens* with 30% cover (Bourgeron et al. 1995). No other information on species composition is available.

Dynamics:

Similar Alliances:

?? POPULUS FREMONTII TEMPORARILY FLOODED WOODLAND ALLIANCE (A.644)

?? POPULUS FREMONTII TEMPORARILY FLOODED FOREST ALLIANCE (A.313)

Similar Alliance Comments: The similar *Populus fremontii* alliances differ either in flood regime (seasonally versus temporarily flooded) or in canopy closure.

Synonymy:

?? Interior and Californian Riparian Deciduous Forests Series, in part (Brown 1982)

?? Cottonwood - Willow: 235, in part (Eyre 1980)

Comments: This alliance is poorly studied; further inventory and classification work is needed for all *Populus fremontii* communities. This is hindered by the alteration of species structure and composition that has occurred in most remaining stands because of hydrologic alterations, exotic species invasions, grazing, and other human impacts.

ALLIANCE DISTRIBUTION

Range: This alliance is presently reported only from Nevada and New Mexico. Given the range of *Populus fremontii*, the alliance may occur in other southwestern states, or in northern Mexico.

States: NM,NV

TNC Ecoregions:

USFS Ecoregions: 321A:CC, 322A:CC, 341E:CC, 341F:C?, 341G:C?, M313A:CC

ALLIANCE SOURCES

Edition: 98-04-01

References: Blackburn et al. 1969, Bourgeron et al. 1993, Eyre 1980

II.C.2.N.a. Mixed broad-leaved evergreen - cold-deciduous woodland

II.C.2.N.a.1. QUERCUS FUSIFORMIS - CELTIS LAEVIGATA WOODLAND ALLIANCE (A.663)

Plateau Oak - Sugarberry Woodland Alliance

ALLIANCE CONCEPT

Environment: This alliance contains mixed woodlands that occupy river- or stream-associated sites.

Physiognomy: Canopy closure is variable, from open to closed. These forests often have the aspect of gallery forests, occurring as narrow bands along rivers or streams in regions with unforested adjacent slopes.

Vegetation: *Quercus fusiformis* is usually dominant, but other important species may include *Celtis laevigata* var. *reticulata*, *Carya illinoensis*, *Fraxinus texensis*, *Fraxinus berlandieriana*, *Ulmus crassifolia*, *Quercus macrocarpa*, *Juniperus ashei*, and *Diospyros texana*. More mesic floodplains are dominated by *Carya illinoensis* - *Celtis laevigata* woodlands or *Celtis laevigata* - *Ulmus crassifolia* woodlands. Adjacent slopes are dominated by *Juniperus ashei* or *Acacia* spp.

Dynamics:

Similar Alliances:

Similar Alliance Comments:

Synonymy:

?? IB3c. Plateau Live Oak Woodland, in part (Allard 1990)

?? Plateau Live Oak-Netleaf Hackberry Series, in part (Diamond 1993)

Comments:

ALLIANCE DISTRIBUTION

Range: This alliance is found primarily within the Edwards Plateau, South Texas Plains, and eastern Trans-Pecos of Texas.

States: TX

TNC Ecoregions: 24:?, 29:C, 30:C

USFS Ecoregions: 315D:CC, 315E:CC, 321A:??

ALLIANCE SOURCES

Edition: 97-11

References: Allard 1990, Amos and Gehlbach 1988, Diamond 1993, Ford and Van Auken 1982

III. SHRUBLAND

III.A.2.N.c. Sclerophyllous temperate broad-leaved evergreen shrubland

III.A.2.N.c.27. QUERCUS HAVARDII SHRUBLAND ALLIANCE (A.780)

Havard Oak Shrubland Alliance

ALLIANCE CONCEPT

Environment: This alliance includes evergreen shrublands on stabilized dunes.

Physiognomy:

Vegetation: Composition varies with precipitation and with the depth and degree of dune stabilization. In the Trans-Pecos large areas of degraded sand sheet are dominated by nearly continuous stands of *Quercus havardii*, while a few areas of open destabilized dunes are present. In the northern portion of the range, large areas of open grassland with scattered patches of *Quercus havardii* occur with *Schizachyrium scoparium* ssp. *neomexicanum*, *Andropogon gerardii* (= *Andropogon gerardii* var. *chrysocomus*), *Panicum virgatum*, *Sporobolus cryptandrus*, *Sporobolus giganteus*, *Calamovilfa gigantea*, *Yucca campestris*, *Prosopis glandulosa* var. *glandulosa*, and *Artemisia filifolia* (Diamond 1993). In western Oklahoma, these shrublands include as associates *Quercus mohriana* and *Quercus prinoides*.

Dynamics:

Similar Alliances:

? ANDROPOGON HALLII HERBACEOUS ALLIANCE (A.1193)

Similar Alliance Comments: Related herbaceous communities often occurring in close proximity or interdigitated with those in this alliance include those found in the V.A.5.N.a.3 *Andropogon hallii* Herbaceous Alliance (A.1193).

Synonymy:

? *Quercus havardii* / *Sporobolus cryptandrus* - *Schizachyrium scoparium* shrubland association (Hoagland 1997)

? Havard Shin Oak-Tallgrass Series (Diamond 1993)

? Shinoak (Shinnery) Series (Dick-Peddie 1993)

? Mohrs (Shin) Oak: 67, in part (Eyre 1980)

Comments: The types in northern Texas and Oklahoma may best be defined as herbaceous vegetation with shrubs. Literature on Oklahoma types describe this vegetation as a grassland with scattered shrubs.

ALLIANCE DISTRIBUTION

Range: This alliance is found on stabilized dunes in the Panhandle, High Plains, and far northeastern Trans-Pecos (Monahans-Kermit Sand Hills) in Texas and in westernmost counties of Oklahoma (Ellis, Roger Mills, Beckham, and Woodward counties).

States: OK, TX

TNC Ecoregions: 24:C, 28:C, 30:C, 33:P

USFS Ecoregions: 311A:PP, 315B:CC, 321A:CC

ALLIANCE SOURCES

Edition:

References: Butler 1987, Diamond 1993, Dick-Peddie 1993, Eyre 1980, Hoagland 1997, Texas Parks and Wildlife Department 1996, Wiedeman and Penfound 1960

III.A.2.N.c.28. QUERCUS INTRICATA SHRUBLAND ALLIANCE (A.781)

Coahuila Scrub Oak Shrubland Alliance

ALLIANCE CONCEPT

Environment: This alliance includes shrublands dominated by *Quercus intricata*, occurring on rocky slopes at middle to high elevations (4500-6500 feet; 1370-1980 m). These shrublands are typically less than two meters tall, are commonly associated with limestone, and often border, or occur as inclusions, in pinyon - oak - juniper woodlands.

Physiognomy:

Vegetation: This alliance includes shrublands dominated by *Quercus intricata*. Associated shrubs can include *Salvia regla*, *Salvia lycioides*, *Salvia roemeriana*, *Rhus trilobata*, *Rhus virens* var. *virens*, *Ptelea trifoliata* ssp. *pallida* var. *confinis*, *Gymnosperma glutinosum*, and *Garrya ovata*, as well as large succulents and semi-succulents such as *Nolina erumpens*, *Opuntia* spp., and *Agave havardiana*. These shrublands can have scattered individuals of *Arbutus xalapensis* or *Arbutus arizonica*. Common herbaceous associates include *Muhlenbergia emersleyi*, *Bouteloua curtipendula*, *Bouteloua gracilis*, and *Muhlenbergia rigida*.

Dynamics:

Similar Alliances:**Similar Alliance Comments:****Synonymy:**

- ?? Scrub Oak-Mountain Mahogany Series, in part (Diamond 1993)
- ?? Oak Scrub, in part (Plumb 1988)
- ?? Interior Chaparral, "Choahuilan" Chaparral, in part (Brown 1982)

Comments:**ALLIANCE DISTRIBUTION**

Range: These shrublands are reported from the Sierras Mojada and San Marcos Mountains of Coahuila, Mexico, the Florida and Guadalupe mountains of southern New Mexico, and the Chisos Mountains in Texas (Brown 1982).

States: MXCO?,TX

TNC Ecoregions: 24:C

USFS Ecoregions: 321A:CC

ALLIANCE SOURCES

Edition: 96-09

References: Brown 1982, Diamond 1993, Plumb 1988, Wauer 1971

III.A.2.N.c.30. QUERCUS PUNGENS SHRUBLAND ALLIANCE (A.783)

Sandpaper Oak Shrubland Alliance

ALLIANCE CONCEPT

Environment: *Quercus pungens* shrublands are typically found on steep, rocky slopes, often sheltered slopes in canyons, at middle to high elevations (3500-8700 feet, 1060-2650 m). These shrublands are often, but not always, associated with calcareous substrates.

Physiognomy:

Vegetation: This alliance includes evergreen shrublands where *Quercus pungens* forms thickets with other desert shrubs. Important shrub associates can include *Rhus virens*, *Rhus trilobata*, *Rhus microphylla*, *Fraxinus greggii*, *Ceanothus greggii*, *Quercus mohriana*, *Quercus turbinella*, *Sophora secundiflora*, *Fendlera rupicola*, *Forsellesia spp.*, *Salvia pinguifolia*, *Garrya ovata*, and *Garrya wrightii*. Groundcover is typically sparse with scattered grasses, forbs, and ferns. Some typical herbaceous components include *Bouteloua curtipendula*, *Aristida spp.*, *Astrolepis sinuata ssp. sinuata* (= *Notholaena sinuata*), and *Notholaena standleyi*. Shrublands in this alliance are small in extent and occur in a matrix of succulent desert scrub and semi-desert grassland.

Dynamics:**Similar Alliances:**

- ?? QUERCUS TURBINELLA SHRUBLAND ALLIANCE (A.793)
- ?? QUERCUS MOHRIANA SHRUBLAND ALLIANCE (A.782)
- ?? CERCOCARPUS MONTANUS SHRUBLAND ALLIANCE (A.896)

Similar Alliance Comments: Similar alliances include the III.A.2.N.c.40 *Quercus turbinella* Shrubland Alliance (A.793), the III.A.2.N.c.29 *Quercus mohriana* Shrubland Alliance (A.782), and the III.B.2.N.a.3 *Cercocarpus montanus* Shrubland Alliance (A.896). Desert scrub oak species tend to have much phenotypic variation within species and also tend to hybridize, leading to difficulties in field identification. More work is needed to make better distinctions between these alliances.

Synonymy:

- ?? Scrub Oak-Mountain Mahogany Series, in part (Diamond 1993)

Comments:**ALLIANCE DISTRIBUTION**

Range: This alliance is found in the mountains of the Trans-Pecos Texas and south to the mountains of northern Mexico in Chihuahua and Coahuila.

States: TX

TNC Ecoregions: 21:C, 24:C

USFS Ecoregions: 321A:CC, M313B:CC

ALLIANCE SOURCES

Edition:

References: Diamond 1993, Powell 1988, Texas Parks and Wildlife Department 1990a

III.A.2.N.c.36. ARCTOSTAPHYLOS PUNGENS SHRUBLAND ALLIANCE (A.789)

Mexican Manzanita Shrubland Alliance

ALLIANCE CONCEPT

Environment: This alliance include relict forest forests that are restricted to local, mesic sites in mountains in southeastern Arizona and a site in southwestern New Mexico. Elevation range from 1050-2300 m depending on aspect. Climate is arid to semi-arid with temperature rarely falling below freezing. Annual precipitation has a bimodal distribution with about half to a third of the highly variable mean annual precipitation occurring in July through September during the late summer monsoon, and most of the rest falling during the winter months. Soils are gravelly with rocks. Parent material includes rhyolite, granite and quartzite.

Physiognomy: Vegetation included in this alliance has a moderately dense to dense cover dominated by sclerophyllous evergreen broad-leaved shrubs (74% cover), 1-2 m tall. Scattered needle-leaved and broad-leaved evergreen trees, 2-5 m tall, are often present. The herbaceous layer is sparse and dominated by perennial graminoids, with annual forbs and grasses present seasonally.

Vegetation: Shrublands included in this alliance occur on dry mountain slopes in southeastern Nevada and southwestern New Mexico. Stands have a moderately dense canopy dominated by the sclerophyllous evergreen shrub, *Arctostaphylos pungens*. Other characteristic shrubs include *Cercocarpus ledifolius*, *Robinia neomexicana*, *Garrya flavescens*, *Ephedra viridis*, *Quercus arizonica*, *Quercus turbinella*, *Amelanchier utahensis*, *Mahonia fremontii* (= *Berberis fremontii*), and *Ceanothus greggii*. Understory species include *Mahonia repens*, *Castilleja* sp., *Calochortus flexuosus*, *Delphinium parishii*, *Eriogonum wrightii* and *Lomatium macdougalii*. Bourgeron et al. (1993) described a stand in southwestern New Mexico where canopy cover of *Arctostaphylos pungens*, *Nolina microcarpa*, *Garrya wrightii*, *Pinus discolor*, *Quercus hypoleucoides* and *Quercus rugosa* was 70%, 3%, 1%, 1%, 3% and 1%, respectively. Herbaceous cover of *Muhlenbergia emersleyi* and *Macroptilium gibbosifolium* (= *Phaseolus heterophyllus*) totaled only 2%.

Dynamics: *Arctostaphylos pungens* is a fire-adapted species that reproduces prolifically from heat-scarified seeds after fires (Carmichael et al. 1978). Armstrong (1969) considers these shrublands a fire disclimax. Prior to a fire, the *Arctostaphylos pungens* shrubland he described was a *Pinus monophylla* / *Juniperus osteosperma* woodland because of the numerous stumps present. He believed the lack of tree regeneration was caused by the low rainfall and re-occurring fires. Bourgeron et al. (1993) suggest that this a seral phase of the *Pinus discolor* / *Quercus hypoleucoides* woodland.

Similar Alliances:

- ?? QUERCUS EMORYI WOODLAND ALLIANCE (A.483)
- ?? JUNIPERUS DEPPEANA WOODLAND ALLIANCE (A.534)
- ?? PINUS EDULIS - (JUNIPERUS SPP.) WOODLAND ALLIANCE (A.516)
- ?? PINUS PONDEROSA WOODLAND ALLIANCE (A.530)

Similar Alliance Comments: The similar alliances have woodland associations with *Arctostaphylos pungens* as a diagnostic understory species.

Synonymy:

- ?? Pointleaf Manzanita Plant Association, in part (Carmichael et al. 1978)

Comments: Stands describe by Carmichael et al. (1978) in Arizona need to be included in the range of this alliance.

ALLIANCE DISTRIBUTION

Range: Shrublands included in this alliance occur on mountain slopes in Virgin Mountains in extreme southeastern Nevada to the Gray Ranch in extreme southwestern New Mexico. It likely occurs in adjacent Mexico.

States: NM,NV

TNC Ecoregions:

USFS Ecoregions: 321A:CC, 342B:CC, M313A:CC

ALLIANCE SOURCES

Edition: 98-06-05

References: Armstrong 1969, Bourgeron et al. 1993, Carmichael et al. 1978

III.A.2.N.c.39. QUERCUS TOUMEYI SHRUBLAND ALLIANCE (A.792)

Toumey's Oak Shrubland Alliance

ALLIANCE CONCEPT

Environment: Shrublands included in this alliance occur in the foothills zone of isolated desert mountain ranges in extreme southwestern New Mexico and southeastern Arizona. Elevations range from 1500-1800 m. Most of the mean annual precipitation of approximately 14 cm occurs during the summer months as convectional thunderstorms and during winter as occasional rains. Late spring and early summer are typically dry. Summers are hot and winters can have periods of cold weather and occasional snows. Stands occur on nearly level to moderately steep (to 30%), rocky foothill slopes. Aspects are

south to southwest. Soils are gravelly loams and clay loam derived from andesite or rhyolite, with high amounts of surface gravel and rocks (typically over 40%). Adjacent upland vegetation is typically woodlands dominated by species *Pinus* and *Quercus*. Vegetation at lower elevations is likely to be desert grasslands.

Physiognomy: Vegetation in this shrubland alliance is dominated by a moderately dense cover of a broad-leaved evergreen shrub. Scattered evergreen needle-leaved and scaled-leaved trees may be present. The graminoid layer is sparse to moderately dense and dominated by medium-tall warm-season bunchgrasses. The forb layer is generally sparse, but may have high species diversity. Cacti or rosette shrub succulents are commonly present.

Vegetation: Stands included in this alliance have a sparse to moderately dense woody layer dominated by the broad-leaved evergreen shrubs, *Quercus toumeyi* and *Q. emoryi*, which occasionally reach small tree size. Occasional individuals of the evergreen, needle-leaved tree *Pinus discolor* or the scale-leaved tree *Juniperus deppeana* may occur. Several other shrubs may be present, particularly succulents such as *Agave palmeri*, *Arctostaphylos pungens*, *Dasyllirion wheeleri*, *Nolina microcarpa*, *Opuntia imbricata*, *Rhus* spp. and *Yucca baccata*. Cover of this layer ranges from 15-30%.

The herbaceous layer is sparse to moderately sparse, ranging from 5% to 20% cover. Perennial grasses are the most abundant species, particularly *Bouteloua curtipendula*, *B. hirsuta*, *Muhlenbergia* spp. and *Schizachyrium cirratum*. Many forb species can occur, but have less than 1% cover. Common forbs include *Allium cernuum*, *Artemisia ludoviciana*, *Macroptilium gibbosifolium*, *Sida neomexicana* and *Trichostema arizonicum*.

Dynamics: Little information is available on ecology of this vegetation. Altered fire regimes, fuelwood harvest and grazing are significant impacts leading to decline of high quality sites.

Similar Alliances:

? PINUS DISCOLOR WOODLAND ALLIANCE (A.538)

Similar Alliance Comments: The similar alliance has a very similar shrub understory, but has at least 25% canopy cover of the tree *Pinus discolor*.

Synonymy:

? *Pinus discolor/Quercus toumeyi* Habitat Type. Similar, but dominated by the tree *Pinus discolor*. (Bassett et al. 1987)

Comments: This alliance is similar to the *Pinus discolor / Quercus toumeyi* Woodland Habitat Type of Bassett et al. (1987), but lacks a woodland canopy of *P. discolor*. More work is needed to understand the ecological relationships between stands in these two alliances. The *Quercus toumeyi / Muhlenbergia emersleyi* Shrubland Association may need further review, as *Muhlenbergia emersleyi* was not dominant in the data of any of the three plots that were reviewed.

ALLIANCE DISTRIBUTION

Range: Stands included in this alliance are regionally confined to the Borderlands area of southwestern New Mexico and southeastern Arizona, stretching into the very northern Sierra Madre Occidentale, Mexico. It is currently only described from the Animas and Peloncillo Mountains.

States: AZ?,MXCH?,NM

TNC Ecoregions:

USFS Ecoregions: 321A:CC

ALLIANCE SOURCES

Edition: 98-08-04

References: Bassett et al. 1987, Bourgeron et al. 1993, Bourgeron et al. 1995, Muldavin et al. 1998, Reid et al. 1994, Willing 1987

III.A.2.N.c.40. QUERCUS TURBINELLA SHRUBLAND ALLIANCE (A.793)

Turbinella Live Oak Shrubland Alliance

ALLIANCE CONCEPT

Environment: Shrublands included in this alliance occurs in the foothills and lower slopes of isolated desert mountain ranges and canyons from Nevada to western Texas. Elevations range from 850-1800 m. Climate is semi-arid. From one-half to two-thirds of the 40-65 cm mean annual precipitation occurs during July-September as the result of convectional thunderstorms. The balance occurs during winter as occasional rains. Late spring and early summer are typically dry. Summers are hot and winters can have periods of cold weather and occasional snows. Stands occur on nearly level to steep (to 80%), rocky slopes on all aspects. Soils are typically deep, coarse textured, and poorly developed. Texture vary from cobbly and gravelly loamy sand to gravelly loam. Parent materials are varied and include weathered granite, schist, diabase, sandstone, shale, limestone, slate, gneiss, quartzite, monzonite and basalt. Occasionally stands occur on fine-textured soil that may be too warm for *Juniperus* (Carmichael et al. 1987). Leaf litter occasionally accumulates 2-8 cm deep (Warren and Treadwell 1980). Litter layers affect soil development, rates of erosion, and fire regimes and behavior (Kemp 1965).

Vegetation at higher elevations is often woodlands dominated by species of *Quercus*, *Pinus* or *Juniperus*. At lower elevations there is desert scrub dominated by species of *Acacia*, *Mimosa*, *Prosopis* or *Encelia*.

Physiognomy: Vegetation in this shrubland alliance is dominated by a moderately dense cover of broad-leaved evergreen shrubs. The graminoid layer is sparse to moderately dense and dominated by medium-tall warm-season bunchgrasses. The forb layer is generally sparse, but may have high species diversity. Cacti or rosette shrub succulents are commonly present. **Vegetation:** Stands included in this alliance typically have a moderately dense to dense woody layer typically about 2 m tall, but can reach 5 m. The canopy is dominated by the broad-leaved evergreen sclerophyllous shrub, *Quercus turbinella*, which occasionally reaches small tree size. These shrubs often have a patchy distribution and form thickets with grass growing between the shrubs. Individual trees may be present such as the evergreen, needle-leaved *Pinus edulis* or *P. monophylla*, the scale-leaved *Juniperus osteosperma* or *J. monosperma* or the broad-leaved *Quercus arizonica* or *Q. emoryi*. Shrubs that may also occur include *Agave palmeri*, *Arctostaphylos pungens*, *Ceanothus greggii*, *Cercocarpus montanus*, *Coleogyne ramosissima*, *Dasylyrion wheeleri*, *Garrya wrightii*, *Mimosa* spp., *Nolina microcarpa*, *Opuntia* spp., *Rhus* spp. and *Yucca baccata*.

The herbaceous layer is sparse to moderately dense, ranging from 5 to 40% cover. Perennial grasses are the most abundant species, particularly *Bouteloua curtipendula*, *B. eriopoda*, *Aristida* spp., *Eragrostis* spp., *Leptochloa dubia*, and *Muhlenbergia* spp. Many forb and fern species can occur, but have little cover. Common forbs include *Artemisia ludoviciana*, *Croton fruticulosus*, *Datura* spp. and *Eriogonum wrightii*. Ferns include species of *Cheilanthes*, *Pellaea* and *Astrolepis*. Annual grasses and forbs are seasonally present and often includes the exotic species *Bromus rubrens* and *Bromus tectorum*.

Dynamics: Most of the species in these chaparral stands have some adaptation to fire. The root systems are well developed and draw moisture from a large volume of soil allowing for rapid resprouting after fire. Non-sprouting species, such as species of *Ceanothus* and *Arctostaphylos*, require fire to scarify the numerous seeds in the seed bank before they will germinate (Carmichael et al. 1978). Recovery after fire can occur in as little as 5-11 years, and some stands are fire-induced climax and need fire to maintain them (Carmichael et al. 1978). Altered fire regimes, fuelwood harvest, and grazing by livestock have significant impacts on the quality of sites. More study is needed to understand and manage these shrublands.

Similar Alliances:

- ?? CUPRESSUS ARIZONICA FOREST ALLIANCE (A.163)
- ?? JUNIPERUS ERYTHROCARPA WOODLAND ALLIANCE (A.503)
- ?? JUNIPERUS MONOSPERMA WOODLAND ALLIANCE (A.504)
- ?? ARCTOSTAPHYLOS GLAUCA - QUERCUS (DUMOSA, DUNNII, TURBINELLA, WISLIZENI) SHRUBLAND ALLIANCE (A.758)
- ?? QUERCUS (DUMOSA, DUNNII, TURBINELLA, WISLIZENI) SHRUBLAND ALLIANCE (A.775)

Similar Alliance Comments: Three similar alliances, I.A.8.N.c.28 *Cupressus arizonica* Forest Alliance (A.163), II.A.4.N.a.5 *Juniperus erythrocarpa* Woodland Alliance (A.503), and II.A.4.N.a.6 *Juniperus monosperma* Woodland Alliance (A.504), have an association where *Quercus turbinella* is dominant in the understory. Two other similar alliances, III.A.2.N.c.5 *Arctostaphylos glauca* - *Quercus (dumosa, dunnii, turbinella, wislizenii)* Shrubland Alliance (A.758) and III.A.2.N.c.22 *Quercus (dumosa, dunnii, turbinella, wislizenii)* Shrubland Alliance (A.775), are California chaparral that have a mixed-oak canopy where *Quercus turbinella* is potentially dominant.

Synonymy:

- ?? Scrub Oak-Mountain Mahogany Series, in part (Diamond 1993)
- ?? Mountain-mahogany--Mixed Shrub Series, in part (Dick-Peddie 1993)
- ?? *Quercus turbinella* Series (includes the *Quercus turbinella/Bouteloua curtipendula* Plant Association. within the Broadleaf Evergreen Interior Chaparral Group (Muldavin et al. 1994)

Comments: Stands described by Warren et al. (1982) have a very sparse vegetation layer (1-10 percent and 10-25 percent) and would be better classified as a sparsely vegetated alliance. Wells (1960) does not support the *Quercus turbinella* - *Ephedra viridis* Shrubland (CEGL000980). Perhaps *Garrya flavescens* was supposed to be codominant.

ALLIANCE DISTRIBUTION

Range: The distribution of shrublands included in this alliance is centered in Arizona below the Mogollon Rim, extending north and west into Utah, Nevada and likely southeastern California, and east into southern New Mexico, western Texas and possibly Oklahoma. It also likely occurs in northern Mexico.

States: AZ,NM,NV,TX,UT

TNC Ecoregions: 24:C

USFS Ecoregions: 313A:CC, 313C:CC, 321A:CC, 322A:CC, M341C:CC

ALLIANCE SOURCES

Edition: 98-08-04

References: Brown 1978, Brown 1982, Carmichael et al. 1978, Diamond 1993, Dick-Peddie 1993, Kemp 1965, Muldavin and Melhop 1992, Muldavin et al. 1994, Texas Parks and Wildlife Department 1990a, Warren and Treadwell 1980, Warren et al. 1982, Wells 1960

III.A.4.N.a. Lowland microphyllous evergreen shrubland

III.A.4.N.a.25. PSOROTHAMNUS SCOPARIUS SHRUBLAND ALLIANCE (A.837)

Broom Smokebush Shrubland Alliance

ALLIANCE CONCEPT

Environment: These shrublands are described from sandy areas in the White Sands Missile Range in Tularosa Basin in south-central New Mexico. Elevations range from approximately 1200-1600 m. Climate is arid to semi-arid with most of the annual precipitation occurring during the late summer and fall, often as high intensity convective storms. Stands are typically found on sandy plains. Substrate is sand. Stands may help stabilize wind is caused blowouts and shifting sands. It is not know if this alliance occurs on active dunes or gypsum substrates.

Physiognomy: Vegetation included in this alliance has layer of xeromorphic deciduous shrubs that is less than 2 m tall. The herbaceous layer is typically sparse and dominated by perennial grasses, with scatter perennial forbs. Annual forbs and grasses are present seasonally.

Vegetation: Shrublands in this alliance has been reported in sandy areas in the Tularosa Basin in southern New Mexico. Stands have a sparse to dense cover of shrubs 1-2m tall, dominated by *Psorothamnus scoparius* with the understory dominated by the perennial grass *Sporobolus flexuosus*. No other information is available on the species composition of this alliance.

Dynamics: Large clumps of these shrubs help stabilize blowing sands. Oils in glands on leaves may make it unpalatable to livestock (Warnock 1974)..

Similar Alliances:

Similar Alliance Comments:

Synonymy:

Comments: This alliance is based on one stand sampled on the White Sands Missile Range in New Mexico that was classified as a *Psorothamnus scoparius* / *Sporobolus flexuosus* Shrubland. There is very little information available upon which to base this description.

ALLIANCE DISTRIBUTION

Range: Shrublands included in this Chihuahuan Desert alliance have been reported in sandy areas on the White Sands Missile Range in southern New Mexico but may occur in similar habitats in adjacent western Texas, southeastern Arizona and Mexico.

States: NM

TNC Ecoregions:

USFS Ecoregions: 313E:CC, 321A:CC

ALLIANCE SOURCES

Edition: 98-10-13

References: Muldavin and Melhop 1992, Neher and Bailey 1976, Warnock 1974

III.A.4.N.a.4. ARTEMISIA FILIFOLIA SHRUBLAND ALLIANCE (A.816)

Sand Sage Shrubland Alliance

ALLIANCE CONCEPT

Environment: Shrublands included in this alliance occur on sandy sites in the central and southern Great Plains into the Chihuahuan Desert. Elevations range from 1300 to 1600 m. The climate is semi-arid to arid, and mean annual precipitation ranges from 20-65 cm. Sites include flat to moderately sloping hummocky or rolling terrain to active dunes. Stands can occur on any aspect. The soils are sand or loamy sand, primarily of eolian origin and are well drained to excessively well drained. Water retention and nutrient availability of the soils are low because water infiltrates rapidly and percolates deeply into the coarse-textured substrate, and is therefore only available to deep-rooted plants. In southwestern Kansas and southeastern Colorado, this alliance is found downwind of major waterways where alluvial sand is blown (Johnston 1987). In Texas these shrublands occur on sandy soils in the Rolling and High Plains and on gypsum dunes in the Trans-Pecos (Dick-Peddie 1993).

Adjacent vegetation varies by geographic location but is generally grasslands dominated by shortgrass and midgrass prairie species such as *Bouteloua gracilis*, *Hilaria jamesii*, *Calamovilfa canadensis* and *Stipa comata*. In desert areas it is surrounded by Chihuahuan Desert scrub dominated by *Larrea tridentata*.

Physiognomy: Vegetation included in this alliance has a sparse to moderately dense cover of microphyllous evergreen shrubs less than 1.5 m tall. The sparse to moderately dense graminoid layer is dominated by tall, medium-tall or short bunchgrasses. Forb cover is generally sparse. Scattered broad-leaved, deciduous tall shrubs may be present.

Vegetation: This alliance includes *Artemisia filifolia*-dominated shrublands that occur on sandy sites in the central and southern Great Plains (extending as far north as the Black Hills), and the Chihuahuan Desert. The vegetation is characterized

by a sparse to moderately dense woody layer approximately 1 m tall that is dominated by the microphyllous evergreen shrub *Artemisia filifolia*. These shrubs usually do not grow as clumps but as individuals with the interstices most often dominated by a sparse to moderately dense layer of tall, mid- or short grasses (Bruner 1939, Steinauer 1989, Ramaley 1939, Dick-Peddie 1993). Some stands have *Prunus angustifolia* as a codominant in the shrub layer. This species often grows taller than *Artemisia filifolia* and may form thickets (McGregor and Barkley 1986).

Species composition will vary with geography, disturbance, and soils. Associated shrubs and dwarf-shrubs may also include *Opuntia* spp. and *Yucca glauca*. In northern stands *Artemisia frigida* is more common, and in desert areas stands may include *Dalea lanata*, *Psoralea scoparius*, *Tiquilia hispidissima* or *Yucca elata*. Some of the most abundant graminoids in the sparse to moderately dense herbaceous layer are *Andropogon hallii*, *Bouteloua gracilis*, *Bouteloua curtipendula*, *Calamovilfa longifolia*, *Oryzopsis hymenoides*, *Schizachyrium scoparium* or *Sporobolus cryptandrus*. *Carex inops* ssp. *heliophila*, *Carex duriuscula* (= *Carex eleocharis*), and *Stipa comata* are more common in the northern stands, and *Bouteloua brevisetata*, *Bouteloua eriopoda*, *Bouteloua trifida*, *Sporobolus flexuosus*, *Sporobolus giganteus* and *Sporobolus nealleyi* are restricted to southern stands. Forbs are typically not abundant in these communities. Associated species include *Calylophus serrulatus*, *Heterotheca villosa* var. *villosa*, *Helianthus petiolaris*, *Ipomoea leptophylla*, *Lathyrus polymorphus*, *Lepidium montanum*, *Lygodesmia juncea*, *Mentzelia* spp., *Penstemon buckleyi*, and *Psoralidium lanceolatum*. Communities associated with gypsum dunes have many gypsophiles or gypsum endemics.

Dynamics: These shrublands occur as any one of several stages in a successional sequence. Drought or overgrazing this alliance will reduce vegetation cover and can allow the wind to cause blowouts or active dunes (Ramaley 1939). Ramaley describes the succession in Colorado from loose sand to a sandhills - mixed community dominated by *Muhlenbergia pungens*. It then may proceed to an *Artemisia filifolia* (sand sage) community or skip this stage, and succeed to the sand prairie, late seral community dominated by *Stipa comata*, *Calamovilfa longifolia*, and *Andropogon hallii*. This can happen relatively quickly with adequate precipitation and rest from grazing. Ramaley (1939) also reported that unless protected from overgrazing and fires, the sand sage community will not succeed into the sand prairie community. However, in regions with marginal precipitation, such as occurs over much of eastern Colorado, the sand sage community may be the last successional stage (Ramaley 1939).

A 10-year grazing study on sand sage pastures in Colorado by Sims et al. (1976) and Dahl and Norris (1965) found that *Bouteloua gracilis* abundance increased with increasing cattle grazing, whereas *Calamovilfa longifolia* and *Stipa comata* decreased. With heavy grazing, *Artemisia filifolia* density increased because of seedling recruitment. This may be due to decreased competition with grasses. In the lightly grazed treatments, *Stipa comata* abundance more than doubled and the *Artemisia filifolia* density decreased slightly. Weaver and Albertson (1956) reported *Artemisia filifolia* and *Sporobolus cryptandrus* both increasing with grazing in sandhills of Oklahoma.

In Colorado, fire frequency and extent are thought to be low in stands of this alliance, because sand sage areas are usually surrounded by other communities that are too moist or too sparse to carry a fire well (Ramaley 1939). In the Great Plains, Wright and Bailey (1980) reported that after fire *Artemisia filifolia* will resprout and will also reproduce vigorously as seedlings. The shrubs *Prunus angustifolia* and *Rhus* spp. also vigorously resprouted after fire (Jackson 1965). Generally, however, fire reduces the vegetation cover that protects stands in this alliance from blowouts.

Timing and amount of growing-season precipitation can greatly affect species abundance from year to year. Normal to wet springs with a dry summer often result in biomass being dominated by cool-season species such as *Stipa comata*. A year with a dry spring and normal to wet summer results in biomass being dominated by warm-season species such as *Andropogon hallii* and *Calamovilfa longifolia*. Similarly, timing of grazing can have the same result. Forb abundance and diversity can be very high during summers with significantly higher than average precipitation. *Panicum virgatum*, *Sorghastrum nutans*, and *Prunus pumila* var. *besseyi* are present in low abundance in good condition stands in Colorado but are often eliminated by heavy grazing (USDA Soil Conservation Service 1978).

Similar Alliances:

?? ANDROPOGON HALLII HERBACEOUS ALLIANCE (A.1193)

?? CALAMOVILFA LONGIFOLIA HERBACEOUS ALLIANCE (A.1201)

Similar Alliance Comments: Stands in the two similar alliances, V.A.5.N.a.3 *Andropogon hallii* Herbaceous Alliance (A.1193) and V.A.5.N.a.11 *Calamovilfa longifolia* Herbaceous Alliance (A.1201), often contain *Artemisia filifolia* and occur in similar habitats; however, physiognomic differences (i.e. shrub canopy < 25%) can usually be used to classify stands. Stands with sparse cover of both *Artemisia filifolia* and graminoids still pose classification problems.

Synonymy:

?? Sand Sage Community. Colorado (Ramaley 1939)

?? Sandsage Prairie. Colorado (Kuchler 1974)

?? Sandsage-Midgrass Series. Texas (Diamond 1993)

?? *Artemisia filifolia* Series #303. Texas (Johnston 1987)

?? Sand Sagebrush. New Mexico (Dick-Peddie 1993)

?? *Artemisia filifolia* / *Sporobolus cryptandrus* - *Schizachyrium scoparium* shrubland association. New Mexico (Hoagland 1997)

Comments: Communities within this alliance are characterized by sparse to moderate vegetation cover and dominance by *Artemisia filifolia* and tall, medium, or short grasses. Communities in two graminoid-dominated alliances, V.A.5.N.a.3 *Andropogon hallii* Herbaceous Alliance (A.1193) and V.A.5.N.a.11 *Calamovilfa longifolia* Herbaceous Alliance (A.1201), often contain *Artemisia filifolia*, however, physiognomic differences (i.e. the amount of shrub canopy) can usually be used to classify stands. Stands that have moderate amounts of *Artemisia filifolia* and a greater amount of vegetation cover may still pose classification problems. These stands may be somewhere in between this shrubland alliance and herbaceous alliances. Stands described by Ramaley (1939) are dominated by *Artemisia filifolia*, but have cover (10%) that is too sparse to be classified as a shrubland. Stands in the *Artemisia filifolia* dune shrubland association are also sparse and may be better classified as sparsely vegetated type.

Range site descriptions (USDA Soil Conservation Service 1978) for good-condition stands in Colorado describe *Artemisia filifolia* as occurring in low abundance, suggesting that good condition stands would be classified as herbaceous communities with a shrub component. Stands that are impacted by heavy grazing have *Artemisia filifolia* in greater abundance.

ALLIANCE DISTRIBUTION

Range: This alliance occurs on sandy sites in the Great Plains and Chihuahuan Desert from the Black Hills in southwestern South Dakota south to Trans-Pecos Texas and southern New Mexico.

States: CO,KS,NE,NM,OK,SD,TX,WY

TNC Ecoregions: 24:C, 25:C, 27:C, 28:C, 29:P

USFS Ecoregions: 313E:CC, 315A:C?, 315B:CC, 315C:CC, 321A:CC, 331C:CC, 331H:CC, 331I:CC, 332E:CC, M313B:CC

ALLIANCE SOURCES

Edition: 98-01-01

References: Aldous and Shantz 1924, Bruner 1931, Bunin 1985, Costello and Turner 1944, Dahl and Norris 1965, Daley 1972, Diamond 1993, Dick-Peddie 1993, Dick-Peddie n.d., Evans 1964, Faber-Langendoen et al. 1996, Garrison et al. 1977, Great Plains Flora Association 1986, Green 1969, Hoagland 1997, Jackson 1965, Johnston 1987, Kuchler 1974, Maxwell and Brown 1968, McGregor and Barkley 1986, McMahan et al. 1984, Muldavin and Melhop 1992, Ramaley 1916, Ramaley 1939, Rogers 1950, Rogers 1953, Savage 1937, Sims et al. 1976, Steinauer 1989, USDA Soil Conservation Service 1978, Weaver and Albertson 1956, Wright 1980

III.A.4.N.b. Intermittently flooded microphyllous shrubland

III.A.4.N.b.3. BACCHARIS SAROTHOIDES INTERMITTENTLY FLOODED SHRUBLAND ALLIANCE (A.840)

Rosinbush Intermittently Flooded Shrubland Alliance

ALLIANCE CONCEPT

Environment: This shrubland alliance is found on alluvial terraces, flats and sand bars in central and south-central Arizona. Stands are restricted to the corridors of intermittent drainages and floodplains from 670-1070 m in elevation. Soils are generally sandy, frequently with many cobbles and boulders. These relatively mesic shrublands utilize moisture from the water table and are dependent on intermittent flooding of washes to supplement the soil moisture and maintain the ground water levels.

Physiognomy: Vegetation in this alliance is dominated by microphyllous shrubs, with drought-deciduous woody species occasionally present. The herbaceous layer is typically sparse.

Vegetation: These southwestern shrublands are restricted to areas along intermittent drainages and floodplains. Stands are typically a dense thicket (60-80% canopy cover) of deciduous shrubs and trees up to 4 m tall. The dominant diagnostic species is the microphyllous shrub, *Baccharis sarothroides*, which grows up to 2 m. Codominants may include two tall shrub/tree species, *Parkinsonia microphylla* and *Prosopis glandulosa*, and the shrub *Baccharis salicifolia*. Other associated woody species include *Populus* spp., *Chilopsis linearis*, *Quercus turbinella*, *Celtis pallida*, *Acacia greggii* and *Ambrosia ambrosioides*. The herbaceous layer is sparse, but may include *Mentzelia multiflora*, *Polanisia dodecandra* ssp. *trachysperma*, *Eriogonum* spp. and *Sporobolus* spp.

Dynamics: The distribution of *Baccharis sarothroides* is restricted to sites where groundwater is accessible. It is dependent on intermittent flooding to recharge groundwater, raise the water table and maintain soil moisture (Willis 1939). However, desert plants with shallow root systems will also occur in this habitat with *Baccharis sarothroides*. Species of the exotic shrub *Tamarix* have invaded many of these xeroriparian habitats and may be dominant in stands that used to be primarily native shrubs and small trees (Brown et al. 1977).

Similar Alliances:**Similar Alliance Comments:****Synonymy:**

?? Arroyo Margin Woodland, in part (Niering and Lowe 1984)

?? Desert Broom - Foothill Paloverde - Mesquite Association, in part (Warren and Treadwell 1980)

Comments:**ALLIANCE DISTRIBUTION**

Range: This shrubland alliance has been described from the Sonoran Desert in central and south-central Arizona. It may also occur in southwestern New Mexico, southern California and adjacent Mexico.

States: AZ

TNC Ecoregions:

USFS Ecoregions: 313:C, 321A:CC, 322B:CC

ALLIANCE SOURCES

Edition: 98-05-18

References: Brown et al. 1977, Niering and Lowe 1984, Warren and Treadwell 1980, Willis 1939

III.A.5.N.a. Broad-leaved and microphyllous evergreen extremely xeromorphic subdesert shrubland

III.A.5.N.a.13. MORTONIA SEMPERVIRENS SHRUBLAND ALLIANCE (A.859)

Rio Grande Saddlebush Shrubland Alliance

ALLIANCE CONCEPT

Environment: Shrublands included in this alliance occur in southeastern Arizona growing on north and east facing slopes of limestone mountains at 1460-1630 m in elevation. Climate is generally semi-arid with warm summers and cool winters. Approximately two-thirds of the 41 cm mean annual precipitation falls during the summer and early fall. The winter precipitation has high year-to-year variation. The cooler north and east aspects create relatively mesic sites necessary for the abundant growth of *Mortonia sempervirens*.

Adjacent vegetation includes desert grasslands dominated by *Elyonurus barbiculmis*, *Heteropogon contortus* and *Bouteloua* spp. at lower elevations and other desertscrub stands dominated by *Cercocarpus montanus*, *Rhus virens* var. *choriophylla*, *Acacia neovernicosa* or *Parthenium incanum*.

Physognomy: Vegetation in this alliance is dominated by xeromorphic, broad-leaved and microphyllous evergreen shrubs.

Vegetation: Vegetation in this alliance occurs on limestone slopes in southeastern Arizona and has a shrub layer that is dominated by evergreen species. These shrublands may have high diversity of woody species, but are usually dominated by *Mortonia sempervirens*. At sites in the Mule Mountains, Wentworth (1982) recorded 58 shrubby species in 29 quadrats. *Mortonia sempervirens* ssp. *scabrella* had a mean canopy cover of 11.4%. Two other diagnostic species are *Dasyllirion wheeleri* and *Quercus pungens* with 2.6% and 4.0% cover, respectively. Other common shrubs include *Aloysia wrightii*, *Parthenium incanum*, *Rhus virens* var. *choriophylla*, *Cercocarpus montanus* var. *paucidentatus* (= *Cercocarpus breviflorus*), *Nolina* spp. and *Fouquieria splendens*. The sparse to moderately dense herbaceous layer (mean cover of 13%) is dominated by a variety of grasses such as *Bouteloua curtipendula*, *Bouteloua eriopoda*, *Aristida purpurea* var. *nealleyi* (= *Aristida glauca*), *Tridens muticus*, *Stipa eminens* and *Muhlenbergia emersleyi*. Frequent forbs include *Bahia absinthifolia* and *Astrolepis sinuata* ssp. *sinuata* (= *Notholaena sinuata*).

Dynamics:**Similar Alliances:****Similar Alliance Comments:****Synonymy:**

?? Chihuahuan Desertscrub, mesic phase (Wentworth 1982)

Comments:**ALLIANCE DISTRIBUTION**

Range: Shrublands included in this alliance have been described from the Mule Mountains of southeastern Arizona. These may also occur on other limestone hills in southern Arizona, adjacent New Mexico and Chihuahua and Sonora, Mexico.

States: AZ

TNC Ecoregions:

USFS Ecoregions: 321A:CC

ALLIANCE SOURCES

Edition: 98-04-01

References: Wentworth 1982

III.A.5.N.a.15. FLOURENSIA CERNUA SHRUBLAND ALLIANCE (A.861)

Tarbush Shrubland Alliance

ALLIANCE CONCEPT

Environment: Shrublands in this Chihuahuan Desert alliance occur in basins, mesas, plains, piedmonts, around playas and rarely, on steep mountain slopes. Elevations range from 1300 to 1650 meters. Climate is semi-arid with hot summers. Mean annual precipitation is approximately 22 cm, but is highly variable with drought not uncommon. Annual precipitation is distributed bimodally with about one third occurring in late winter and two thirds in July through October often as high intensity convective storms. These shrublands commonly occur as bands on alluvial flats and plains below the slopes of hills and mesas, or in patches above grassy swales and along drainages that dissect the plains, piedmonts and mesas within the *Larrea tridentata* dominated desertscrub. Rarely, stands will occur on steep, rocky slopes in a transition zone between *Larrea tridentata* dominated desertscrub and upland desert grasslands. Most stands occur on nearly level to gently sloping sites on all aspects. Soils are shallow to moderately deep, fine-textured silt or clay loams, often calcareous, and sometimes with caliche or argillic horizons. On steeper slopes soils may be very stony. Groundcover is relatively low. Johnson (1961) described stands where mean cover of bare soil, rock and litter was 61%, 20%, and 7%, respectively.

Physiognomy: Vegetation included in this alliance has sparse to moderately dense cover of broad-leaved and microphyllous, evergreen shrub less than 1 m tall. The sparse to moderately dense herbaceous layer is dominated by perennial graminoids. Annual grasses and forbs are present seasonally.

Vegetation: This Chihuahuan Desert alliance includes extensive shrublands found on desert alluvial flats, plains and mesas in southern New Mexico, western Texas and southeastern Arizona. The sparse to moderately dense woody layer is generally less than 1 m tall. It consists of evergreen broad-leaved and microphyllous xeromorphic shrubs and is dominated by *Flourensia cernua*. Common woody associates include *Larrea tridentata*, *Prosopis glandulosa*, *Krameria lanceolata*, *Koeberlinia spinosa*, *Opuntia imbricata*, *Atriplex canescens* and *Acacia* spp. On rocky upland sites *Aloysia wrightii*, *Dasyliirion wheeleri*, *Parthenium incanum*, *Yucca baccata* and *Opuntia engelmannii* may also be present. The sparse to moderately dense herbaceous layer is dominated by grasses such as *Bouteloua curtipendula*, *Bouteloua gracilis*, *Erioneuron pulchellum*, *Hilaria mutica*, *Muhlenbergia porteri*, *Sporobolus airoides*, and *Stipa eminens*. Common forbs may include *Croton texensis*, *Dyssodia* spp., *Eriogonum wrightii*, *Machaeranthera pinnatifida* and *Zinnia* spp. Johnson (1961) reported cover values for low land stands in New Mexico where *Flourensia cernua*, *Larrea tridentata*, *Erioneuron pulchellum*, total perennial cover and total annual cover that were 19%, 5%, 8%, 32%, and 10%, respectively. Muldavin et al. (1994) described a rocky upland stand with 11 species of shrubs. Cover values of *Flourensia cernua*, *Aloysia wrightii*, total shrubs, *Bouteloua curtipendula*, *B. eriopoda*, and total perennial grasses were 8%, 2%, 13%, 7%, 5% and 16%, respectively.

Dynamics: *Flourensia cernua* has increased in this century (Muldavin 1998). Livestock grazing favors *Flourensia cernua* over grasses because the shrub is unpalatable to livestock and relatively shallow rooted, and therefore competes strongly with grasses for soil moisture (Muldavin 1998). Severe droughts and overgrazing early in this century have likely contributed to these changes in the vegetation. Buffington and Herbel (1965) report that *Larrea tridentata* has displaced many stands of *Flourensia cernua* and cite that it may be because *Larrea tridentata* only competes with grasses during the shrub's seedling stage. Muldavin (1998) states that stands with no graminoid layer are unlikely to develop one, but stands with a graminoid layer are likely to maintain it if not overgrazed. Impermeable caliche and argillic horizons are not uncommon on these sites. These layers restrict deep percolation of soil-water and may favor the shallower root grasses and shrubs like *Flourensia cernua* over more deeply rooted shrubs like *Larrea tridentata* and *Prosopis* spp. (McAuliffe 1995).

Similar Alliances:

?? LARREA TRIDENTATA SHRUBLAND ALLIANCE (A.851)

Similar Alliance Comments: III.A.5.N.a.5 *Larrea tridentata* Shrubland Alliance (A.851) includes *Larrea tridentata* - *Flourensia cernua* Shrubland (CEGL001270) in which *Flourensia cernua* may codominate but not dominate the stand.

Synonymy:

- ?? *Flourensia cernua* Association (153.214). included within the Chihuahuan Desertscrub Creosote-Tarbush Series (Brown 1982)
- ?? Creosote-Tarbush, in part (Leopold and Krausman 1988)
- ?? Creosote-Tarbush Shrub, in part (McMahan et al. 1984)
- ?? Creosote-tarbush association (in part). included within Creosote Series of the Chihuahuan Desert Region (Donart et al. 1978)
- ?? *Larrea tridentata*-*Flourensia cernua*/*Erioneuron pulchellum* Vegetation Type. in part, included in Creosote-Mixed Shrub Series of the Chihuahuan Desert Scrub (Dick-Peddie 1993)

Comments:

ALLIANCE DISTRIBUTION

Range: Shrublands included in this Chihuahuan Desert alliance occur in southern New Mexico, Trans-Pecos Texas, and southeastern Arizona. It likely occurs in the Mexican states of Coahuila (?) and Chihuahua (?).

States: AZ,NM,TX?

TNC Ecoregions: 24:C

USFS Ecoregions: 321A:CC

ALLIANCE SOURCES

Edition: 98-06-22

References: Brown 1982, Buffington and Herbel 1965, Dick-Peddie 1993, Donart et al. 1978, Johnson 1961, Leopold and Krausman 1988, McAuliffe 1995, McMahan et al. 1984, Muldavin and Mehlhop 1992, Muldavin and Melhop 1992, Muldavin et al. 1994, Muldavin et al. 1998, Stein and Ludwig 1979

III.A.5.N.a.16. POLIOMINTHA INCANA SHRUBLAND ALLIANCE (A.862)

Hoary Rosemary-mint Shrubland Alliance

ALLIANCE CONCEPT

Environment: Stands included in this shrubland alliance have been reported from sandy sites in the north-central and south-central New Mexico. Climate is semi-arid. Mean annual precipitation is about 20 cm. Summers are hot and winters are cold. The elevations range from 1250-1850 m. Stands are found in deep sand and dune areas. Sites are flat to undulating, occurring on all aspects. The soils are well-drained, moderately deep sands. Adjacent vegetation consists of sparse shrublands dominated by *Artemisia filifolia*, *Chrysothamnus nauseosus* or *Prosopis glandulosa*, woodlands dominated by *Pinus edulis* and *Juniperus* spp., or xeric grasslands dominated by *Bouteloua* and *Sporobolus* spp.

Physiognomy: Vegetation included in this alliance has a sparse shrub layer dominated by xeromorphic, broad-leaved and microphyllous evergreen shrubs. A sparse herbaceous layer is dominated by perennial grasses.

Vegetation: Stands included in this shrubland alliance have been described from sandy areas in the Tularosa Basin in south-central New Mexico and in north-central New Mexico. Stands have a sparse woody layer dominated by the xeromorphic evergreen shrub *Poliomintha incana* with *Artemisia filifolia* present to codominating. The herbaceous layer is typically sparse and may be dominated by graminoids or forbs.

Two major habitats, stabilized and shifting sands, produce stands with different associated species. Stabilized deep sand sites described by Dick-Peddie et al. (1984) were found on hillsides in northern New Mexico, and had scattered *Juniperus monosperma* and *Pinus edulis* trees. Common shrubs and dwarf-shrubs present may include *Gutierrezia sarothrae*, *Brickellia californica*, *Chrysothamnus nauseosus* ssp. *bigelovii*, and the cacti, *Opuntia phaeacantha* and *Opuntia polyacantha*. The sparse herbaceous layer is dominated by the perennial grasses *Bouteloua gracilis*, *Sporobolus cryptandrus* and *Schizachyrium scoparium*.

In the sandy areas in the Chihuahuan Desert, it is often found in disturbed sites near the edge of dunes. There stands have a sparse understory that may be dominated by annual forbs such as *Chamaesyce parryi* that are seasonally present to abundant in wet years and stands with an herbaceous layer dominated by perennial graminoids like *Sporobolus flexuosus*. Weedy annual forbs like *Amaranthus* spp., *Dimorphocarpa wislizeni* (= *Dithyrea wislizeni*), and the exotic *Conyza canadensis* are common.

Dynamics: *Poliomintha incana* is a sand-adapted species that avoids burial by shifting sands by rapidly growing its meristems (Bowers 1982).

Similar Alliances:

?? ARTEMISIA FILIFOLIA SHRUBLAND ALLIANCE (A.816)

?? SPOROBOLUS FLEXUOSUS HERBACEOUS ALLIANCE (A.1268)

Similar Alliance Comments: Stands in the similar alliances are dominated by species that may codominate stands in this alliance.

Synonymy:

?? Bushmint-Sandsage Scrub (Dick-Peddie et al. 1984)

?? *Poliomintha incana* Series (Muldavin et al. 1998)

Comments: Muldavin et al. (1998) described two community types, *Poliomintha incana* / Sparse and *Poliomintha incana* / *Sporobolus flexuosus*, that were included in this alliance description, but are without association-level descriptions. Further work is necessary to complete the classification and description of stands in this alliance.

ALLIANCE DISTRIBUTION

Range: Stands included in this minor shrubland alliance occur on sandy sites sporadically in the Chihuahuan Desert and north into north central New Mexico. The alliance is also likely to occur in northern Mexico.

States: NM

TNC Ecoregions:

USFS Ecoregions: 331J:CC

ALLIANCE SOURCES

Edition: 98-10-01

References: Bowers 1982, Dick-Peddie et al. 1984, Muldavin et al. 1994, Muldavin et al. 1998

III.A.5.N.a.17. FOUQUIERIA SPLENDENS SHRUBLAND ALLIANCE (A.863)

Ocotillo Shrubland Alliance

ALLIANCE CONCEPT

Environment: Shrublands in this alliance are found from the Trans-Pecos of western Texas and in the Chihuahuan Desert portions of New Mexico, Arizona, and northern Mexico. Elevations range from 1350 and 1650 m. These shrublands typically occur above the *Larrea tridentata* dominated desertscrub plains, then grade into the semi-desert grasslands at higher elevations. The alliance is found on various desert habitats, often in areas with rock outcroppings, boulders, and loose rocks on warmer southern aspects. Substrate is alluvium - mixed igneous soils with intermediate water holding capacity. Parent materials include limestone and rhyolite. Soils are shallow, lithic, coarse textured, loams or clay loams. Ground cover is dominated by gravel and rock.

Physiognomy: Vegetation in this alliance has a sparse to moderately dense woody layer that is dominated by broad-leaved and microphyllous evergreen xeromorphic shrubs. The sparse herbaceous layer is dominated by graminoids, if present.

Vegetation: Stands of this alliance occur in upland shrublands of the Chihuahuan Desert. *Fouquieria splendens* is a diagnostic or dominant species in the sparse to moderately dense, tall shrub layer (to 5 m tall). Bourgeron et al. (1993) described one stand in this alliance with total shrub and *Fouquieria splendens* canopy cover of 8% and 3%, respectively. Other characteristic shrubs include *Acacia* spp., *Prosopis glandulosa*, *Dasyllirion* spp., *Yucca torreyi*, *Y. elata*, *Nolina* spp. *Parthenium incanum* and *Petrophyton caespitosum*. *Larrea tridentata* is common at lower elevation sites. A sparse graminoid layer is occasionally present and is often dominated by *Bouteloua curtipendula* or *B. hirsuta* with *Aristida* spp., *B. eriopoda*, *B. ramosa* or *Erioneuron pilosum*. Forb cover is generally sparse and may include species of *Asclepias*, *Astragalus* and *Eriogonum*. Cacti include *Opuntia imbricata* and *Coryphantha* spp.

Dynamics:

Similar Alliances:

Similar Alliance Comments:

Synonymy:

? *Fouquieria splendens* - mixed shrub association (Brown 1982)

? Yucca-Ocotillo (McMahan et al. 1984)

Comments: Bourgeron et al. (1995) classified this alliance as deciduous subdesert scrub with succulents. Shrub cover in stands in this alliance may be too sparse to classify as a shrubland.

ALLIANCE DISTRIBUTION

Range: Stands of this alliance occur in the Chihuahuan Desert in Trans-Pecos Texas, southern New Mexico, and southeastern Arizona. It is also found in the Mexican states of Chihuahua, Durango, and Zacatecas.

States: NM, TX

TNC Ecoregions: 24:C, 28:C

USFS Ecoregions: 315B:CC, 315C:CC, 321A:CC

ALLIANCE SOURCES

Edition: 98-08-30

References: Bourgeron et al. 1993, Bourgeron et al. 1995, Brown 1982, McMahan et al. 1984, Muldavin and Melhop 1992, Rzedowski 1981, Tamsitt 1954

III.A.5.N.a.4. DASYLIRION LEIOPHYLLUM - (AGAVE LECHUGUILLA, VIGUIERA STENOLOBA) SHRUBLAND ALLIANCE (A.850)

Smooth Sotol - (Lechuguilla, Skeletonleaf Goldeneye) Shrubland Alliance

ALLIANCE CONCEPT

Environment:

Physiognomy:

Vegetation: This alliance includes desert shrublands characterized by *Dasyllirion leiophyllum*, often with codominant *Agave lechuguilla* and/or *Viguiera stenoloba*. Associated species can include *Acacia greggii*, *Dalea formosa*, *Bernardia obovata*, *Bouteloua* spp., *Chamaesyce* sp., *Dasyllirion leiophyllum*, *Agave lechuguilla*, *Bouteloua ramosa*, *Krameria erecta* (= *Krameria glandulosa*), *Leucophyllum frutescens*, *Mimosa aculeaticarpa* var. *biuncifera*, *Aristida* spp., and *Erioneuron* spp.

Dynamics:

Similar Alliances:**Similar Alliance Comments:****Synonymy:**

?? Lechuguilla-Sotol Series (Diamond 1993)

?? Viguiera-Lechuguilla-Grass (Leopold and Krausman 1988)

?? Lechuguilla-Grass-Viguiera (Plumb 1988)

Comments: Formation placement is uncertain. Two of the three nominal species are leaf-succulents, but associated shrubs include shrubs with a wide variety of xeromorphic adaptations, including succulence, microphyllly, sclerophyllly, and drought deciduousness.

ALLIANCE DISTRIBUTION

Range: These shrublands occur in the Trans-Pecos of western Texas, as well as on the Stockton Plateau, and possibly in portions of the Edwards Plateau. It is also found in the Mexican states of Chihuahua and Coahuila.

States: TX

TNC Ecoregions: 24:C

USFS Ecoregions: 315D:PP, 321A:CC, 321B:CC

ALLIANCE SOURCES

Edition: 97-10

References: Diamond 1993, Leopold and Krausman 1988, Plumb 1988

III.A.5.N.a.5. LARREA TRIDENTATA SHRUBLAND ALLIANCE (A.851)**Creosotebush Shrubland Alliance****ALLIANCE CONCEPT**

Environment: Shrublands included in this widespread southwestern desert alliance cover vast areas of from west Texas to southeastern California. Elevations range from 1600 m to below sea level. Climate is semi-arid to arid with hot summers. Potential for freezing winter temperatures depends on latitude and elevation. Desert precipitation varies greatly from year-to-year. At the Jornada Experimental Range in southwestern New Mexico, annual precipitation ranged from 7-45 cm with a mean of 23 cm (Herbel *et al.* 1972). Amount and season of annual precipitation also varies with geography. Mean annual precipitation ranges from 23 cm distributed bimodally with half occurring during the late summer monsoons and half in the winter in southwestern New Mexico, to 15 cm or less of mostly winter precipitation in southeastern California. The proportion of summer precipitation decreases from the eastern to the western deserts (Barbour and Major 1977). Sites include lower bajadas, intermountain basins. Sites are generally flat or on gentle to moderate slopes of lower bajadas and intermountain basins. Substrate is usually sandy or gravelly alluvium, or eolian sand derived from limestone and metamorphic rocks. Soils are typically shallow, well drained, and have low salinity. Soil texture is generally coarse, but may include gravelly clay loams.

These shrublands may be bisected by arroyo riparian shrublands and woodlands dominated by *Prosopis*, grade into grasslands dominated by *Bouteloua gracilis*, *Sporobolus airoides*, *Hilaria mutica*, or be part of a matrix of other desert and upland shrublands dominated by *Ambrosia dumosa*, *Atriplex* spp., *Ephedra nevadensis*, *Prosopis* spp. or active dunes.

Physiognomy: Vegetation included in this alliance has a sparse to moderately dense layer of microphyllous and broad-leaved evergreen shrubs less than 2 m tall. If present, understory vegetation may include sparse to moderately dense cover of dwarf-shrubs, cacti, rosette succulents, annual and perennial forbs and grasses.

Vegetation: Shrublands included in this widespread southwestern desert alliance occur on mesas, plains, valleys, bajadas and low hills from west Texas to southern California. The open stands have a sparse to moderately dense layer (<50% cover) of the xeromorphic microphyllous and broad-leaved evergreen shrubs, dominated by *Larrea tridentata*. Many different shrubs, dwarf-shrubs, cacti, grasses and forbs may codominate or form typically sparse understories in stands in the 27 different associations. Stands in the Chihuahuan Desert are typically codominated by *Flourensia cernua*, *Acacia constricta* or *Acacia neovermicos* with scattered individuals of *Atriplex canescens*, *Fouquieria splendens*, *Koeberlinia spinosa* and *Prosopis glandulosa*. Characteristic woody understory includes *Agave lechuguilla*, *Euphorbia antisiphilitica*, *Jatropha dioica* var. *graminea*, *Celtis pallida*, *Lycium* spp., *Opuntia schottii*, *Parthenium incanum* and *Tiquilia* spp. The herbaceous layer may be absent to moderately dense. Common perennial grasses may include *Bouteloua gracilis*, *Bouteloua eriopoda*, *Hilaria mutica*, *Muhlenbergia porteri*, *Scleropogon brevifolius*, *Sporobolus airoides* or *Sporobolus flexuosus*. The forbs, such as *Baileya multiradiata*, *Chamaesyce* spp., *Croton texensis* and *Dimorphocarpa wislizeni* (= *Dithyrea wislizeni*), may be present, but typically are sparse. In areas of recent desertscrub expansion *Yucca elata*, *Perezia nana* and *Erioneuron pulchellum* are more common (Dick-Peddie 1993).

In the Sonoran and Mojave deserts typical codominants include *Ambrosia dumosa*, *Atriplex confertifolia*, *Atriplex hymenelytra*, *Encelia farinosa*, *Ephedra nevadensis*, *Fouquieria splendens*, *Grayia spinosa*, *Lycium andersonii* or *Opuntia basilaris*. The understory is typically sparse but may be seasonally abundant with ephemerals. Species such as *Chamaesyce*

spp., *Eriogonum inflatum*, *Erioneuron pulchellum*, *Aristida spp.*, *Cryptantha spp.*, *Nama spp.*, *Phacelia spp.*, *Stipa speciosa*, and the exotic annual grass *Bromus rubens* may be present.

Dynamics:

Similar Alliances:

?? LYCIUM BERLANDIERI - LARREA TRIDENTATA SHRUBLAND ALLIANCE (A.1058)

Similar Alliance Comments: There is only one other alliance, III.C.3.N.b.2 *Lycium berlandieri* - *Larrea tridentata* Shrubland Alliance (A.1058), with *Larrea tridentata* as a codominant which could be distinguished by the codominance of *Lycium berlandieri*. However, there are 27 associations within this alliance, many with the codominant or understory species that are diagnostic species in another alliance. Because *Larrea tridentata* is so ubiquitous in the southwestern deserts it is often difficult to separate stands in these closely related alliances. For example, stands in the *Larrea tridentata* / *Prosopis glandulosa* Shrubland may be similar to stands in the *Prosopis glandulosa* Shrubland Alliance with a *Larrea tridentata*-dominated understory. There are several other associations included in this alliance where a switch in the relative abundance in the codominant species could change the assignment of the association to an alliance.

Synonymy:

- ?? Creosotebush Series (Dick-Peddie 1993)
- ?? Creosotebush-Mixed Shrub Series (Dick-Peddie 1993)
- ?? Chihuahuan Desertscrub (Brown 1982)
- ?? Sonoran Desertscrub (Brown 1982)
- ?? Mojave Desertscrub (Brown 1982)
- ?? Creosote Series, in part (Diamond 1993)
- ?? Creosote-Mariola Series, in part (Diamond 1993)
- ?? Creosote bush series, in part (Sawyer and Keeler-Wolf 1995)
- ?? Creosote bush-white bursage series, in part (Sawyer and Keeler-Wolf 1995)
- ?? Mojave creosote bush scrub (34100 in part), in part (Holland 1986)
- ?? Sonoran creosote bush scrub (33100 in part), in part (Holland 1986)

Comments: Many stands in this shrubland alliance do not have enough shrub cover to be classified as a shrubland and would be better classified in a sparsely vegetated alliance.

ALLIANCE DISTRIBUTION

Range: This widespread southwestern desert shrubland alliance includes stands in the Chihuahuan, Sonoran, Mojave, and Colorado deserts, from western Texas to southern Nevada and southeastern California and south into northern Mexico in the Mexican states of Baja California, Chihuahua, Coahuila, Durango, Nuevo León, San Luis Potosi, and Sonora.

States: AZ,CA,MXCH,MXCO,NM,NV,TX

TNC Ecoregions: 21:C, 24:C, 28:C

USFS Ecoregions: 313E:CC, 315A:CC, 321A:CC, 322A:CC, 322B:CC, M313B:CC

ALLIANCE SOURCES

Edition: 98-06-11

References: Annable 1985, Armstrong 1969, Beatley 1976, Bradley 1964, Bradley 1967, Brown 1982, Diamond 1993, Dick-Peddie 1993, Dick-Peddie n.d., Donart et al. 1978, Faden 1977, Gible 1950, Herbel et al. 1972, Holland 1982, Holland 1986, Johnson 1961, Kurzius 1981, Leary and Peterson 1984, Leopold and Krausman 1988, Muldavin and Melhop 1992, Muldavin et al. 1998, Peterson 1984, Plumb 1988, Plumb 1991, Plumb 1992, Rzedowski 1981, Sawyer and Keeler-Wolf 1995, Schramm 1982, Shields et al. 1959, Steward 1982, Van Devender and Everitt 1977, Warren et al. 1982, Wells 1961, Yang 1970

III.A.5.N.b. Facultatively deciduous extremely xeromorphic subdesert shrubland

III.A.5.N.b.10. ATRIPLEX POLYCARPA SHRUBLAND ALLIANCE (A.873)

Cattle-spinach Shrubland Alliance

ALLIANCE CONCEPT

Environment: Shrublands in this alliance occur in desert valleys, basins, playas, bajadas, foothills and plains in southern New Mexico, Nevada and southern California. Climate is arid to semi-arid with hot summers. Sites are generally flat to gently sloping and moderately saline, but the alliance also occurs on rolling to hilly fans and slopes. Other characteristics vary by site and region. In the Chihuahuan Desert (1200 to 1500 m elevation), annual precipitation has a bimodal distribution with about half the precipitation occurring during the late summer months. Sites occur on lower foothills and plains. Soils are fine-textured, alkaline and typically saline. The presence of *Suaeda moquinii* may indicate these sites are more saline than stands in more arid sites in the Mojave Desert. Little is known about the stands the Chihuahuan Desert.

In California there are several different habitats for the xerophytic shrublands within this alliance that are controlled by salt and water concentrations. Elevations range from 75 below sea level to 1500 m. Winter rain makes up the majority of the annual precipitation. In the Mojave Desert, there are two major sites where this alliance occurs within the *Larrea tridentata* elevation zone, moderately saline valley bottoms and extremely xeric upland sites (Barbour and Major 1977). Peterson (1984) described sites where *Atriplex polycarpa*-dominated shrublands occur in patches up to 120 ha. The saline sites occur on better drained, moderately saline, alkaline soils. Soil texture is sandy clay loams derived from alluvium and volcanic rocks. These sites often occur on mounds that are about 1 m above the more saline phreatophyte dominated alkali flats and playas, but are below the *Larrea tridentata* dominated shrublands (Peterson 1984, Barbour and Major 1977). Stands on extremely xeric upland sites occur on sites too dry for *Larrea tridentata* and often have low shrub density. Substrates are coarse sandy soils derived from alluvium (Barbour and Major 1977). Stands have also been reported from saline, valley bottom sites in the San Joaquin and Imperial valleys, dunes sites derived from old beach deposits near lakes in the Central Valley, and along washes in Nevada (Beatley 1976, Holland 1986).

Adjacent stands are typically *Larrea tridentata*-dominated desertscrub.

Physiognomy: Vegetation included in this alliance has a sparse to moderately dense woody layer dominated by the facultative deciduous and microphyllous evergreen shrubs. The usually sparse herbaceous layer has a few perennial species of grasses and forbs with sometimes abundant cover of seasonally present annual grasses and forbs.

Vegetation: Stands included in this alliance is found desert valleys, basins and bajadas in southern New Mexico, Nevada and southern California. The vegetation has a sparse to moderately dense woody layer usually less than 1 m tall, but occasionally over 2 m tall in mixed-shrub stands. *Atriplex polycarpa*, a facultative deciduous xeromorphic shrub, is the dominant species and may occur in nearly pure stands. Other characteristic shrubs may include *Larrea tridentata*, *Ambrosia dumosa* and *Hymenoclea salsola*. Perennial graminoids such as *Distichlis spicata*, *Hilaria mutica* and *Sporobolus* spp. may be present and abundant in some habitats. Exotic annual grasses may dominate the understory in stands in California. Secondary species vary widely depending on site characteristics and geographic location.

Whitfield and Anderson (1938) describe *Atriplex polycarpa* dominated stands in the Chihuahuan Desert where other characteristic shrubs include *A. canescens*, *A. confertifolia*, *Ambrosia dumosa*, *Larrea tridentata*, *Gutierrezia sarothrae*, the phreatophyte, *Suaeda moquinii*, and perennial grasses such as *Sporobolus airoides*, *Hilaria mutica*, *Sporobolus cryptandrus* and *Muhlenbergia porteri*. The perennial grass cover is possible because of the late summer rains. In the Mojave Desert, grass cover is sparse. In Death Valley (Peterson 1984) described stands with 10% aerial cover of *Atriplex polycarpa* and 1% or less of *Ambrosia dumosa*, *Larrea tridentata* and *Hymenoclea salsola*. Total shrubs cover was 13%. In addition to *Atriplex polycarpa*, stands in the California Central Valley include a variety of dune, playa or uplands species such as *Distichlis spicata*, *Ephedra californica*, *Eriogonum fasciculatum*, *Hymenoclea salsola*, *Cleome isomeris* (= *Isocoma acradenia*), *Isomeris arborea* and *Prosopis glandulosa* (Sawyer and Keeler-Wolf 1995).

Dynamics: *Atriplex polycarpa* is a facultative phreatophyte and occurs on moderately saline (< 2%) just above the water table or xeric non-saline upland sites (Barbour and Major 1977). It has limited salt tolerance and is very drought tolerant (Barbour and Major 1977). These two factors interact to control water stress in plants and define habitat boundaries.

Similar Alliances:

?? ATRIPLEX (LENTIFORMIS, POLYCARPA) SHRUBLAND ALLIANCE (A.864)

?? ATRIPLEX HYMENELYTRA SHRUBLAND ALLIANCE (A.872)

Similar Alliance Comments: Shrublands in both of these similar alliances may have significant cover of *Atriplex polycarpa*.

Synonymy:

?? Allscale series, in part (Sawyer and Keeler-Wolf 1995)

?? Salton Sea Saltbush, in part (Barbour and Major 1977)

?? San Joaquin Saltbush, in part (Barbour and Major 1977)

?? Relictual Interior Dunes (23200). included within Stabilized Interior Dunes (Holland 1986)

?? Valley saltbush scrub (36221). included within Chenopod Scrubs (Holland 1986)

?? Sierra-Tehachapi saltbush (36310). included within Chenopod Scrubs (Holland 1986)

?? Interior Coast Range saltbush scrub (36320). included within Chenopod Scrubs (Holland 1986)

?? Saltbush Series within the Sonoran Desertscrub, in part (Brown 1982)

?? Desert Saltbush Scrub (36310 in part). included within Chenopod Scrubs (Holland 1986)

?? Saltbush subclimax, in part (Whitfield and Anderson 1938)

Comments: Brown (1982) describes stands in the Saltbush Series that are dominated by *Atriplex polycarpa*. No *Atriplex polycarpa* associations have yet been described in Arizona by ecologists. The stands described by Peterson (1984) are too sparse to be classified as shrublands. Little other quantitative data were available.

ALLIANCE DISTRIBUTION

Range: This alliances includes shrublands from valleys and basins in the Chihuahuan, Mojave and Sonoran deserts, and in the southern part of the Great Central Valley of California.

States: CA,NM,NV

TNC Ecoregions:

USFS Ecoregions: 321A:CC, 322:?

ALLIANCE SOURCES

Edition: 98-06-18

References: Barbour and Major 1977, Beatley 1976, Faden 1977, Holland 1986, Peterson 1984, Sawyer and Keeler-Wolf 1995, Whitfield and Anderson 1938

III.A.5.N.b.6. ATRIPLEX CANESCENS SHRUBLAND ALLIANCE (A.869)

Fourwing Saltbush Shrubland Alliance

ALLIANCE CONCEPT

Environment: Shrublands included in this alliance occur on lowland and upland sites throughout much the arid and semi-arid western U.S. with elevations ranging from 75 m below sea level to 2400 m. Lowland sites include alluvial flats, drainage terraces, playas, washes and interdune basins. Upland sites include bluffs, gentle to moderately steep sandy or rocky slopes. Stands occur on all aspects. Soils are variable with depths ranging from shallow to moderately deep, textures ranging from sands to loams to clay. The lowland sites may be moderately saline or alkaline. Bare ground usually dominates the ground surface. Francis (1986) described stands in northwestern New Mexico with approximately 80% bare soils and 15% litter. In the Great Basin/Mojave Desert transition zone, Beatley (1993) found these shrublands occurred within a mosaic of *Atriplex confertifolia* or *Lycium andersonii* - *Grayia spinosa* dominated shrublands, but were associated with sandy soils. Adjacent vegetation includes *Bouteloua gracilis* dominated uplands in the Great Plains to various desert shrublands in the southern deserts.

Physiognomy: Vegetation included in this alliance has a sparse to moderately dense layer of facultatively deciduous, extremely xeromorphic shrubs up to 2 m in height. A sparse graminoid layer may be present.

Vegetation: Shrublands included in this alliance occur across the western United States on arid and semi-arid sites. Very little is known about its expression in the Midwest. Stands have a sparse to moderately dense shrub canopy up to approximately 1.5 m tall that is dominated by the facultatively deciduous, xeromorphic shrub, *Atriplex canescens*. Other associated shrubs may include *Artemisia tridentata*, *Krascheninnikovia lanata*, *Purshia mexicana*, *Psoralea polydenius*, *Ephedra viridis*, *Parthenium confertum*, *Sarcobatus vermiculatus* and species of *Chrysothamnus* and *Lycium*. Dwarf-shrubs such as *Gutierrezia sarothrae* or *Eriogonum* spp. may be common in some stands. Warm season medium-tall and short grasses dominate the sparse to moderately dense graminoid layer. The species present depend on geographic range of the grasses, alkalinity/salinity and past land use. Species may include *Bouteloua gracilis*, *Distichlis spicata*, *Elymus elymoides*, *Hilaria jamesii*, *Hilaria mutica*, *Oryzopsis hymenoides*, *Pascopyrum smithii*, *Sporobolus airoides*, *Sporobolus cryptandrus* and *Sporobolus wrightii*. Forb cover is generally sparse, but annual forbs such as *Calycoseris parryi* may be abundant in wet years. Common forbs include species of *Sphaeralcea*, *Dalea*, *Cymopterus*, *Chenopodium*, *Kochia*, *Iva*, *Picradeniopsis* and *Ratibida*. Cacti from the genus *Opuntia* are associated species in some stands. Trees are typically not present, but occasionally scattered *Juniperus* may be present.

Dynamics: *Atriplex canescens* is tolerant of saline or alkaline soils, but is not restricted to those soils. Therefore is not a reliable indicator of those conditions (USDA 1937). This shrub is considered good forage for deer and many classes of livestock because it is highly nutritious and palatable (USDA 1937).

Similar Alliances:

?? PROSOPIS GLANDULOSA SHRUBLAND ALLIANCE (A.1031)

?? BOUTELOUA ERIOPODA MICROPHYLOUS EVERGREEN SHRUB HERBACEOUS ALLIANCE (A.1545)

Similar Alliance Comments: Both III.B.3.N.a.4 *Prosopis glandulosa* Shrubland Alliance (A.1031) and V.A.7.N.j.2 *Bouteloua eriopoda* Microphyllous Evergreen Shrub Herbaceous Alliance (A.1545) include an association with *Atriplex canescens* as a nominal species.

Synonymy:

?? Chihuahuan Desertscrub, Saltbush Series, *Atriplex canescens* Association (Brown 1982)

?? *Atriplex canescens* Series (Dick-Peddie 1993)

?? Fourwing saltbush series (Sawyer and Keeler-Wolf 1995)

?? *Sarcobatus vermiculatus* Shrublands (Chappell et al. 1997)

?? Saltbush series in the Chihuahuan Desert Region, Saltbush series and (Donart et al. 1978)

?? Mesquite-Saltbush Series, in part (Diamond 1993)

?? Alkali Sacaton-Fourwing Saltbush Series, in part (Diamond 1993)

Comments: Shrublands in this alliance can grade into grasslands dominated by *Sporobolus airoides* or *Hilaria mutica*, or occur within a matrix of other desert shrublands. Further review of this alliance is necessary before comparisons can be made with other vegetation types. Some of the stands referenced, such as in Francis (1986), may not have enough vegetation cover to be classified as shrublands.

ALLIANCE DISTRIBUTION

Range: Shrublands included in this alliance occur primarily in arid and semi-arid areas the southwestern U.S. from west Texas to southern and eastern California and into Chihuahua, Mexico. They also are found in the western Great Plains to the Great Basin, from western Kansas, Colorado, and Wyoming to Utah, Nevada and eastern Oregon.

States: AZ,CA,CO,KS,NM,NV,OR,TX,UT,WY

TNC Ecoregions: 19:C, 24:C, 27:C, 28:?, 29:?

USFS Ecoregions: 313A:CC, 313B:CC, 315A:CC, 321A:CC, 322A:CC, 331H:CC, 331I:CC, 341B:CC, 342B:CC, 342C:C?, 342G:C?, M313B:CC

ALLIANCE SOURCES

Edition: 98-04-15

References: Aldous and Shantz 1924, Baker 1984, Beatley 1976, Beatley 1993, Betancourt and Devender 1981, Branson and Owen 1970, Branson et al. 1976, Brown 1982, Bureau of Reclamation 1976, Culver et al. 1996, Diamond 1993, Dick-Peddie 1993, Dick-Peddie n.d., Dix 1974, Donart et al. 1978, Faber-Langendoen et al. 1996, Francis 1986, Hyder et al. 1966, Ibrahim et al. 1972, Johnston 1987, Klipple and Costello 1960, Lusby et al. 1963, Maxwell 1975, Miller et al. 1977, Muldavin and Melhop 1992, Peterson 1984, Price 1981, Roberts et al. 1992, Sawyer and Keeler-Wolf 1995, Shaw et al. 1989, Shute and West 1977, USDA Forest Service 1937, USDA Soil Conservation Service 1978, USDA Soil Conservation Service n.d., USDI Bureau of Indian Affairs 1979, USDI Bureau of Land Management 1979, Vest 1962, Warren et al. 1982, Welsh 1957, West and Ibrahim 1968, West et al. 1972

III.B.2.N.a. Temperate cold-deciduous shrubland

III.B.2.N.a.27. QUERCUS GAMBELII SHRUBLAND ALLIANCE (A.920)

Gambel's Oak Shrubland Alliance

ALLIANCE CONCEPT

Environment: Shrublands included in this alliance occur in the foothills and lower slopes of isolated desert mountain ranges, mesas and canyons from Nevada to western Texas as well as in the lower montane zone of the southern Rocky Mountains, Uinta Mountains and Wasatch Plateau. Elevations range from 1550-2950 m. Climate is semi-arid. Summers are generally hot and winters range from mild with cold periods and occasional snows in the southern part of its range to extended periods of freezing temperatures in the northern part of its range. The seasonality of precipitation varies, but most of the 35-70 cm mean annual precipitation occurs during the growing season. Stands typically occur on nearly level to steep (to 80%), rocky slopes on upper slopes and ridgetops, but some stands occur in canyon bottoms and along drainages. Aspect does not seem important except in the southern range extent where stands are restricted to the more mesic north slopes. Soils are generally deep, coarse textured, and well drained. Soil texture is typically a cobbly and gravelly loamy sand and gravelly loams, but the alliance also occurs on well drained clay soil. Parent materials are varied and include quartzite, monzonite, shale and alluvium. Adjacent vegetation at higher elevations is typically conifer woodlands or forests dominated by *Pinus ponderosa*, *Pinus contorta*, or *Psuedotsuga menziesii*, but *Populus tremuloides* forests are also common in the northern part of its range. Adjacent vegetation below these stands is often medium tall grasslands in southeastern Colorado or shrublands dominated by *Artemisia* spp. in western Colorado,

Physiognomy: Vegetation in this shrubland alliance is characterized by a moderately dense cover of broad-leaved deciduous shrubs. The graminoid layer is sparse to moderately dense and dominated by medium-tall bunchgrasses. The forb layer is generally sparse, but may have high species diversity. Annual grasses and forbs are seasonally present.

Vegetation: Shrublands included in this alliance occur in the lower montane zone in the Southern Rocky Mountains, Wasatch Plateau, Uinta Mountains; and mesas, desert mountains and canyons in the Chihuahua and Sonoran deserts, Colorado Plateau and southern plains. Stands have a moderately dense to dense woody layer typically 2-5 m tall, but can also occur as 1 m tall clumps to small trees over 5 m tall. The canopy is dominated by the broad-leaved deciduous shrub, *Quercus gambelii*, which occasionally reaches small tree size. Stands range from dense thickets with little understory to relatively mesic mixed-shrublands with a rich understory of shrubs, grasses and forbs. These shrubs often have a patchy distribution with grass growing in between. Scattered trees are occasionally present in stands and typically include species of *Pinus* or *Juniperus*. Characteristic shrubs that may co-occur include *Amelanchier alnifolia*, *Amelanchier utahensis*, *Artemisia tridentata*, *Cercocarpus montanus*, *Ptelea trifoliata*, *Prunus virginiana*, *Robinia neomexicana*, *Rosa* spp., *Symphoricarpos oreophilus* and *S. rotundifolius*. The herbaceous layer is sparse to moderately dense, ranging from 1 to 40% cover. Perennial graminoids are the most abundant species, particularly *Bouteloua curtipendula*, *B. eriopoda*, *B. gracilis*, *Aristida* spp., *Carex inops*, *Carex geyeri*, *Elymus arizonicus*, *Eragrostis* spp., *Festuca* spp., *Koeleria macrantha*, *Muhlenbergia* spp. and *Stipa* spp. Many forb and fern species can occur, but none have much cover. Commonly present forbs include *Achillea millefolium*, *Artemisia* spp., *Geranium* spp., *Maianthemum stellatum*, *Thalictrum fendleri* and *Vicia americana*. Ferns include species of *Cheilanthes* and *Woodsia*. Annual grasses and forbs are seasonally present.

Dynamics: The distribution of *Quercus gambelii* was studied by Neilson and Wullstein (1983) in respect to climatic patterns. They found the species to be limited by seedling mortality from severe spring frosts and summer drought. The northern extent of the species is in alignment with the winter polar front that runs along the boundary between southern Wyoming and Colorado and Utah. Its western range limit aligns with the westward extent of summer moisture from the Arizona monsoon, which approximates the western Arizona border. Reproducing stands in northern Utah that exist north of the summer monsoon moisture are restricted to more mesic sites. Seedling recruitment is more common in the southern part of its range than the northern (Neilson and Wullstein 1983).

Quercus gambelii is a fire-adapted species (Clary and Tiedemann 1992). The root systems are well developed and draw moisture from a large volume of soil allowing for rapid resprouting after fire. Muldavin et al. (1998) reported that in the Organ Mountains in southwestern New Mexico after a severe fire, *Quercus gambelii* resprouted into a dense thicket that excluded both herbaceous understory and conifer species. They suggested frequent small cool fires would favor the establishment of conifers and maintain an herbaceous understory. *Quercus gambelii* shrubs also resprout vigorously after stems are killed with almost all herbicides or removed by chaining or cut for firewood (Clary and Tiedemann 1992). Altered fire regimes, fuelwood harvest and grazing by livestock have significant impacts to the quality of sites. More study is needed to understand and manage these shrublands ecologically.

Similar Alliances:

- ?? ABIES CONCOLOR FOREST ALLIANCE (A.152)
- ?? PSEUDOTSUGA MENZIESII FOREST ALLIANCE (A.157)
- ?? ACER GRANDIDENTATUM MONTANE FOREST ALLIANCE (A.265)
- ?? POPULUS TREMULOIDES TEMPORARILY FLOODED FOREST ALLIANCE (A.300)
- ?? PINUS DISCOLOR WOODLAND ALLIANCE (A.538)
- ?? PINUS EDULIS - (JUNIPERUS SPP.) WOODLAND ALLIANCE (A.516)
- ?? PINUS ENGELMANNII WOODLAND ALLIANCE (A.539)
- ?? PINUS MONOPHYLLA - (JUNIPERUS OSTEOSPERMA) WOODLAND ALLIANCE (A.543)
- ?? PINUS PONDEROSA WOODLAND ALLIANCE (A.530)
- ?? JUNIPERUS MONOSPERMA WOODLAND ALLIANCE (A.504)

Similar Alliance Comments: All of the similar alliances, I.A.8.N.c.17 *Abies concolor* Forest Alliance (A.152, I.A.8.N.c.22 *Pseudotsuga menziesii* Forest Alliance (A.157), I.B.2.N.b.1 *Acer grandidentatum* Montane Forest Alliance (A.265), I.B.2.N.d.25 *Populus tremuloides* Temporarily Flooded Forest Alliance (A.300), II.A.4.N.a.40 *Pinus discolor* Woodland Alliance (A.538), II.A.4.N.a.18 *Pinus edulis* Woodland Alliance (A.516), II.A.4.N.a.41 *Pinus engelmannii* Woodland Alliance (A.539), II.A.4.N.a.45 *Pinus monophylla* Woodland Alliance (A.543), II.A.4.N.a.32 *Pinus ponderosa* Woodland Alliance (A.530), and II.A.4.N.a.6 *Juniperus monosperma* Woodland Alliance (A.504), have at least one association with *Quercus gambelii*, either codominant in the canopy or dominant in the understory.

Synonymy:

- ?? *Quercus gambelii* Series (Johnston 1987)
- ?? Oak Scrub Series, *Quercus gambelii* Association. included within the Great Basin Montane Scrub (Brown 1982)
- ?? Mixed shrub community. included within the Great Basin Montane Scrub ()

Comments:

ALLIANCE DISTRIBUTION

Range: Shrublands included in this alliance occur in lower montane and canyon habitats throughout southern and western Colorado, Utah, Arizona, New Mexico, western Texas, and likely northern Mexico and south central Wyoming.

States: AZ,CO,NM,TX,UT

TNC Ecoregions: 20:C, 21:C, 24:C, 27:C

USFS Ecoregions: 313A:CC, 313E:CC, 321A:CC, 331I:CC, 331J:CC, 341B:CC, M313A:CC, M313B:CC, M331D:CC, M331F:CC, M331G:CC, M331H:CC, M331I:CC, M341B:CC, M341C:CC

ALLIANCE SOURCES

Edition: 98-08-12

References: Anderson et al. 1985, Baker 1982, Blackhawk Coal Company 1981, Boucek 1986, Brown 1982, Cedar Creek Associates Inc. 1987, Christensen 1949, Christensen 1955, Clary 1992, Dillinger 1970, Ellis and Hackney 1981, Erdman 1962, Evans 1926, Evans 1936, Ferchau 1973, Forsling and Storm 1929, Hanson and Ball 1928, Hess and Wasser 1982, Hinckley 1944, Hoffman and Alexander 1980, Johnston 1987, Keammerer and Peterson 1981, Kittel et al. 1994, Komarkova et al. 1988, Kunzler et al. 1981, Livingston 1947, Livingston 1949, McKell 1950, Muldavin 1994, Muldavin and Melhop 1992, Muldavin et al. 1998, Neilson and Wullstein 1983, Osborn et al. 1998, Ream 1960, Schmoll 1935, Thorne Ecological Institute 1973, USDA Soil Conservation Service 1978, Vories 1974, Warren and Treadwell 1980, Warren et al. 1982, Watson 1912

III.B.2.N.a.28. QUERCUS X PAUCILOBA SHRUBLAND ALLIANCE (A.921)

Wavyleaf Oak Shrubland Alliance

ALLIANCE CONCEPT

Environment:

Physiognomy:

Vegetation:

Dynamics:

Similar Alliances:

Similar Alliance Comments:

Synonymy:

Comments: The single association in this alliance, the *Quercus X pauciloba* / *Cercocarpus montanus* Shrubland Association, is very poorly documented. There is only one reference source presently known for this association, Muldavin and Mehlhop (1992). The information in this reference did not provide adequate information from which to develop a description of the *Quercus X pauciloba* Shrubland Alliance, or to verify its validity. It is uncertain at present whether the *Quercus X pauciloba* / *Cercocarpus montanus* Shrubland Association is a valid type. Until further data are collected from inventory efforts, or further documentation is provided by other, as yet unreviewed, literature sources, this association and alliance will not be described. An additional problem is that the New Mexico Natural Heritage Program presently places all stands dominated by the hybrid *Quercus X pauciloba* into the *Quercus turbinella* Shrubland Alliance (A.793). Classification issues between the two taxa of *Quercus* need to be resolved.

Should the reader have information or data available which verifies or describes either the association or the alliance, please provide that information to the Regional Ecologists of TNC's Western Conservation Science Department.

ALLIANCE DISTRIBUTION

Range: This alliance is found in Colorado (?) and New Mexico.

States: CO?,NM

TNC Ecoregions:

USFS Ecoregions: 315A:CC, 321A:CC, 331I:??, M313B:CC, M331F:CC

ALLIANCE SOURCES

Edition: 99-05-01

References: Muldavin and Melhop 1992

III.B.2.N.a.29. RHUS VIRENS VAR. CHORIOPHYLLA SHRUBLAND ALLIANCE (A.922)

Evergreen Sumac Shrubland Alliance

ALLIANCE CONCEPT

Environment: Shrublands included in this alliance occur in southeastern Arizona growing on north and east facing mountain slopes at 1600-1900 m in elevation. Climate is generally semi-arid with warm summers and cool winters. Approximately two-thirds of the 412 mm mean annual precipitation falls during the late summer and early fall during the monsoon season. The winter precipitation has higher year-to-year variation than the monsoon. Typically, sites are on moderately steep to steep rocky slopes (40-60 %). On lower elevation sites, stands are restricted to mesic topographic positions. Soils are calcareous, derived from the limestone parent material.

Physiognomy: Vegetation in this alliance is dominated by xeromorphic, broad-leaved evergreen and deciduous shrubs. The sparse herbaceous layer is dominated by medium-tall perennial graminoids. Scattered trees and cacti may be present.

Vegetation: Vegetation included in this alliance occurs on limestone slopes in southeastern Arizona. Stands have a moderately dense, diverse layer of broad-leaf deciduous and evergreen shrubs 2-3 m tall. The dominant, consistent species are *Rhus virens* var. *choriophylla*, an evergreen shrub, and *Cercocarpus montanus* var. *paucidentatus*, a deciduous shrub. Other characteristic shrubs include *Quercus pungens*, *Mortonia sempervirens* ssp. *scabrella*, *Nolina* spp., *Ceanothus greggii*, *Nolina* spp. and *Dasyllirion wheeleri*. The usually sparse understory is dominated by graminoids such as *Bouteloua curtipendula*, *Muhlenbergia emersleyi*, *Aristida purpurea* var. *nealleyi* (= *Aristida glauca*), and *Eragrostis intermedia* with forbs like *Viguiera dentata*, *Verbesina rothrockii* and *Notholaena* spp. Scattered trees such as *Pinus discolor* may be present. Wentworth (1982) describes stands where mean canopy cover of *Rhus virens* var. *choriophylla*, *Cercocarpus montanus* var. *paucidentatus*, *Quercus pungens*, *Mortonia sempervirens* ssp. *scabrella*, *Nolina* spp. *Dasyllirion wheeleri* and total shrub cover were 8%, 5%, 8%, 7%, 4%, 3%, and 39%, respectively.

Dynamics:

Similar Alliances:**Similar Alliance Comments:****Synonymy:**

?? *Cercocarpus* Scrub (Wentworth 1982)

Comments:**ALLIANCE DISTRIBUTION**

Range: Shrublands included in this alliance have been described from the Mule Mountains of southeastern Arizona. They likely occur in similar limestone habitats in other mountains and hills in southern Arizona, adjacent New Mexico and Chihuahua and Sonora, Mexico.

States: AZ

TNC Ecoregions:

USFS Ecoregions: 321A:CC

ALLIANCE SOURCES

Edition: 98-06-25

References: Wentworth 1982, Wentworth 1985

III.B.2.N.a.3. CERCOCARPUS MONTANUS SHRUBLAND ALLIANCE (A.896)

Alderleaf Mountain-mahogany Shrubland Alliance

ALLIANCE CONCEPT

Environment: Shrublands included in this alliance are found on prairie breaks and on slopes of foothills, mountains and canyons throughout much of the western U.S. Elevations range from 1000 to 3000 m. Climate is semi-arid. Summers are hot and winters are typically cold, with freezing temperatures and snow common, however, stands on the southwestern U.S. may have mild winter temperatures. Mean annual precipitation ranges from 24 to 55 cm with precipitation occurring bimodally during the winter and late summer with a droughty period in late spring/early summer. The late summer rain often occurs as high-intensity thunderstorms. Sites are variable but are generally xeric and rocky with moderate to very steep slopes or on ridges. Stands are found on various aspects, but typically the higher elevation and northern sites are on warmer, southern exposures, and lower elevation and southern stands are restricted to more mesic north slopes. Substrates are typically thin, well drained, poorly developed, lithic soils with abundant rock outcrops. Soil textures range from sandy loam to clay. Soils range from slightly acid to slightly alkaline depending on parent material. Parent material includes alluvium, colluvium and residuum from igneous, metamorphic or sedimentary rocks such as granite, gneiss, limestone, quartz monzonite, rhyolite, sandstone, schist and shale.

Adjacent vegetation at higher elevations includes woodland and forests dominated by species of *Juniperus*, *Quercus*, *Pinus* or *Pseudotsuga menziesii*. At lower elevations there are often grasslands or shrub savannas dominated by mid- or short grasses species of *Aristida*, *Bouteloua*, *Elymus*, *Muhlenbergia*, *Pseudoroegneria* or *Stipa*. In southern stands lower elevation vegetation includes woodlands dominated by *Pinus edulis* and *Juniperus* spp.

Physiognomy: Vegetation included in this alliance has a moderately sparse to moderately dense cover of broad-leaved deciduous shrub 2 m tall. The sparse to moderately dense herbaceous layer is usually less than 1 m. tall and dominated by graminoids. Some stands have herbaceous layers dominated by perennial forbs, but generally forb cover is sparse. Annuals are seasonally present.

Vegetation: Vegetation included in this alliance occurs in the western Great Plains, Rocky Mountains, Colorado Plateau and mountains in the Chihuahuan Desert. The sparse to moderately dense shrub layer is 1-2 m tall and is dominated by the cold-deciduous, broad-leaved shrub, *Cercocarpus montanus*. Occasional trees such as *Juniperus* spp., *Quercus* spp., *Pinus edulis*, *P. ponderosa* or *Pseudotsuga menziesii* may be scattered in some stands. Shrub cover is generally denser on northern aspects and increases with elevation. Lower elevation stands grade into shrub savannas with decreasing elevation. The herbaceous layer is sparse to moderately dense depending on the density of the shrub layer and soil moisture. It is dominated by perennial graminoids or forbs with annuals present seasonally. Associated species vary with location. In the western Great Plains *Rhus trilobata* and *Artemisia frigida* are common woody species. The herbaceous layer is sparse to moderately dense and is dominated by the warm season, perennial midgrass, *Bouteloua curtipendula*. *Aristida purpurea*, *Elymus elymoides*, *Oryzopsis hymenoides*, *O. micrantha* and *Stipa comata* may also be present. Common forbs are *Artemisia ludoviciana*, *Aster oblongifolius* and *Hedeoma hispida*.

Stands in the Rocky Mountain foothills are similar, but with the graminoid layer usually dominated by the cool season, perennial mid grasses, *Elymus lanceolatus* ssp. *lanceolatus*, *Stipa comata* or *Stipa neomexicana*. In addition to *Artemisia frigida* and *Rhus trilobata*, associated shrubs and dwarf-shrubs may include *Purshia tridentata*, *Ribes cereum* and *Quercus gambelii* in the southern stands. Other associated species such as *Bouteloua gracilis*, *Poa* spp., *Allium textile*, *Artemisia ludoviciana*, *Astragalus parryi*, *Eriogonum umbellatum* and *Helianthus pumilus* are common in the herbaceous layer.

Colorado Plateau stands have associated shrubs like *Amelanchier* spp., *Holodiscus dumosus*, *Mahonia repens*, and *Quercus gambelii*. The herbaceous layer is often dominated by *Pseudoroegneria spicata* or *Oryzopsis hymenoides*, with the exotic annual *Bromus tectorum* common on degraded sites.

In the Chihuahuan Desert montane scrublands, the dominant species may be a different subspecies, *Cercocarpus montanus* var. *paucidentatus*. Associated shrubs and dwarf-shrubs include Madrean elements such as *Agave parryi*, *Ceanothus greggii*, *Dasyllirion leiophyllum*, *Dasyllirion wheeleri*, *Ericameria laricifolia*, *Garrya flavescens*, *Garrya wrightii*, *Petrophyton caespitosum*, *Quercus grisea* (shrub form), *Q. turbinella*, *Yucca baccata* and shrubby species of *Opuntia*, sometimes forming a mixed cold-deciduous/evergreen stand. Occasional trees like *Quercus arizonica*, *Q. gambelii* and other *Quercus* spp. and conifers such as *Juniperus deppeana* may be present. The herbaceous layer is sparse on the very rocky sites to moderately dense, and usually is dominated by perennial grasses such as *Muhlenbergia pauciflora*, *Muhlenbergia montana*, *Muhlenbergia emersleyi*, *Aristida temipes*, *Bothriochloa barbinodis*, *Bouteloua curtipendula*, *Bouteloua gracilis*, *Eragrostis intermedia*, *Koeleria macrantha* and *Lycurus phleoides*. Forbs may be diverse and include *Artemisia ludoviciana*, *Eriogonum jamesii*, *Hedeoma plicata*, *Heliomeris longifolia*, *Heliomeris multiflora*, *Mirabilis multiflora* and *Viguiera dentata*.

Dynamics: *Cercocarpus montanus* is a dominant understory species in several woodland and forests dominated by *Juniperus deppeana*, *J. monosperma*, *J. osteosperma*, *J. scopulorum*, *Pinus edulis*, *P. ponderosa*, *Pseudotsuga menziesii*, *Quercus gambelii*, *Q. grisea*, and *Q. X pauciloba*. *Cercocarpus montanus* stands often occur in the more xeric habitat below these woodland and forest stands. In xeric habitats studied by Greenwood and Brotherson (1978), *C. montanus* sites had significantly more rock than the *Pinus edulis* and *J. osteosperma* sites. Brotherson et al. (1984) suggested that stands are moisture-limited because stands on southern aspects were always higher in elevation than stands on northern aspects. They also found that the *C. montanus* stands were more likely to occur on northern slopes than on southern in central Utah. However, *C. montanus* did not typically occur with mesic shrubs like *Symphoricarpos oreophilus* and *Amelanchier alnifolia*. There is often a broad *C. montanus* shrub/herbaceous ecotone between these shrublands and grasslands. Ecological factors that control shrub densities such as fire and drought need more investigation. Unlike other species of *Cercocarpus*, *C. montanus* is a fire-resistant species because it can resprout from the base after a fire has killed the top (Cronquist et al. 1997). In the southern portion of its range *C. montanus* functions as an evergreen shrub by retaining leaves during mild winters and losing them during cold winters (Dick-Peddie 1993).

C. montanus is preferred winter range browse for deer (Hoffman and Alexander 1987, Roughton 1966, 1972). Stands can also produce significant forage that can be utilized by grazing livestock provided the slopes are not too steep (Hoffman and Alexander 1987). More information is needed on the effects of livestock grazing and wildlife browsing on the structure and function of these shrublands.

Similar Alliances:

- ?? CERCOARPUS MONTANUS SHRUB HERBACEOUS ALLIANCE (A.1538)
- ?? CERCOARPUS MONTANUS WOODLAND ALLIANCE (A.587)
- ?? CERCOARPUS MONTANUS - ERIOGONUM FASCICULATUM SHRUBLAND ALLIANCE (A.848)
- ?? BOUTELOUA GRACILIS HERBACEOUS ALLIANCE (A.1282)

Similar Alliance Comments: Similar alliances include V.A.7.N.g.6 *Cercocarpus montanus* Shrub Herbaceous Alliance (A.1538), II.A.5.N.a.2 *Cercocarpus montanus* Woodland Alliance (A.587), and III.A.5.N.a.2 *Cercocarpus montanus* - *Eriogonum fasciculatum* Shrubland Alliance (A.848). These alliances all have a woody layer dominated or codominated by *Cercocarpus montanus*. Stands in this alliance only include shrublands dominated by *Cercocarpus montanus*.

Stands in this alliance can be similar to stands in the V.A.5.N.e.9 *Bouteloua gracilis* Herbaceous Alliance (A.1282) and *Schizachyrium scoparium* - *Bouteloua gracilis* Herbaceous Alliance. This alliance often grades into II.A.4.N.a.32 *Pinus ponderosa* Woodland Alliance (A.530) or I.A.8.N.b.10 *Pinus ponderosa* Forest Alliance (A.124).

Synonymy:

- ?? Scrub Oak-Mountain Mahogany Series, in part (Diamond 1993)
- ?? Mountain Mahogany Series. included within Interior Chaparral (Brown 1982)
- ?? Mountain Mahogany-Mixed Shrub Series. included within the Montane Scrubland Vegetation Type (Dick-Peddie 1993)
- ?? *Cercocarpus montanus* - *Rhus aromatica* / *Bouteloua curtipendula* Plant Association. *Rhus aromatica* is a synonym for *R. tridentata* (Johnston 1987)
- ?? *Cercocarpus montanus* / *Bouteloua curtipendula* Habitat Type. *Rhus aromatica* is a synonym for *R. tridentata* (Hoffman and Alexander 1987)
- ?? *Cercocarpus montanus* (Mountain Mahogany) Series. *Rhus aromatica* is a synonym for *R. tridentata* (Muldavin et al. 1998)

Comments: Stands in this alliance appear to be separated from stands in the V.A.7.N.g.6 *Cercocarpus montanus* Shrub Herbaceous Alliance (A.1538) by the density of the shrub layer alone. Stands in the shrub herbaceous alliance have only been described from southwestern New Mexico but may occur throughout the range of *Cercocarpus montanus*.

A *Cercocarpus montanus* / *Stipa neomexicana* Shrubland has been described from the Colorado Front Range foothills by the Colorado Natural Heritage Program but has not yet been included in the national vegetation classification (S. Kettler pers. comm.).

ALLIANCE DISTRIBUTION

Range: These shrublands occur in breaks, canyons, foothills and mountains in the western Great Plains, Black Hills, Central and Southern Rocky Mountains, Colorado Plateau, and Chihuahuan Desert, from South Dakota to Utah and south into Mexico.

States: CO,NE,NM,SD,TX,UT,WY

TNC Ecoregions: 21:C, 24:C, 25:C, 26:C, 27:C

USFS Ecoregions: 313E:CC, 315A:??, 321A:CC, 331F:CC, 331J:CC, 341B:C?, 341C:CC, 342G:CC, M313A:CC, M313B:CC, M331F:CC, M331I:CC, M334A:CP

ALLIANCE SOURCES

Edition: 98-10-13

References: Baker 1982, Baker 1983, Baker and Kennedy 1985, Bourgeron et al. 1993, Bourgeron et al. 1995, Brotherson and Brotherson 1979, Brotherson et al. 1984, Brown 1982, Diamond 1993, Dick-Peddie 1993, Faber-Langendoen et al. 1996, Greenwood and Brotherson 1978, Hess 1981, Hess and Wasser 1982, Hoffman and Alexander 1987, Johnson 1950, Johnston 1987, Muldavin 1994, Muldavin and Melhop 1992, Muldavin et al. 1998, Nixon 1977, Roughton 1966, Roughton 1972, Shaw et al. 1989, Thilenius 1971, Wasser and Hess 1982

III.B.2.N.a.31. ROBINIA NEOMEXICANA SHRUBLAND ALLIANCE (A.924)

New Mexico Locust Shrubland Alliance

ALLIANCE CONCEPT

Environment: Shrublands included in this alliance have been described in south-central New Mexico, but it likely occurs in southeastern Arizona, Trans Pecos Texas and adjacent Mexico. Climate is arid to semi-arid. Precipitation varies with elevation. *Robinia neomexicana* is considered a semi-riparian species by Dick-Peddie (1993). Thickets occur along drainages in canyons at lower elevations (1500-2000 m). On upland sites it is restricted to cooler north aspects at lower montane elevations, but may occur on any aspects at higher montane elevations. Sites are nearly level to moderately steep slopes. Substrate ranges from alluvial deposits on stream terraces to colluvial slopes. Adjacent stands may include xeric grasslands, other shrublands, riparian forests, montane conifer forests and encinal woodlands.

Physiognomy: Vegetation included in this alliance has a moderate to dense layer of extremely xeromorphic deciduous shrubs that is less than 5 m tall. The herbaceous layer is typically sparse and dominated by perennial forbs, with annual forbs present seasonally.

Vegetation: Vegetation included in this shrubland alliance occurs in lower montane conifer and upper woodlands in mountains in southern New Mexico and may occur in adjacent states and Mexico. Stands have a dense to moderately dense woody layer to 5 m tall that is dominated by the deciduous shrub, *Robinia neomexicana*. *Quercus gambelii* may be present, but does not codominate. The understory may be dominated by mesic forbs like *Thalictrum fendleri*, but little other information is available. Stands in the montane conifer zone are considered seral may have seedlings of *Pinus ponderosa*, *Abies concolor* or conifer species that are colonizing the stand.

Dynamics: *Robinia neomexicana* dominated stands occur along riparian corridors and as patches of montane upland scrub. Dick-Peddie (1993) wrote that *R. neomexicana* and a common associate, *Quercus gambelii* form persistent seral thickets in disturbed areas within conifer forests. The species is a common understory species in *Abies concolor* or *Quercus gambelii* dominated woodlands (Dick-Peddie 1993).

Similar Alliances:

?? ABIES CONCOLOR WOODLAND ALLIANCE (A.553)

?? QUERCUS GAMBELII SHRUBLAND ALLIANCE (A.920)

Similar Alliance Comments: In the similar alliances, stands have an understory dominated by *Robinia neomexicana*.

Synonymy:

?? Oak-Locust Successional Series. only mixed stands of *Quercus gambelii* and *Robinia neomexicana* (Dick-Peddie 1993)

Comments: No stand level information was available to describe this alliance, so it was based on more general information and the assumption that *Robinia neomexicana*-dominated shrublands occur both along riparian areas and in upland montane woodlands. It is reported in the understory in both habitats, as well as growing in thickets in a riparian area (Szaro 1989, Dick-Peddie 1993, Muldavin et al. 1994, K. A. Schulz pers. comm.). More investigation is needed to classify stands in this alliance.

ALLIANCE DISTRIBUTION

Range: Shrublands included in this alliance occur on foothill and mountain slopes and along drainages in southwestern New Mexico and likely in Trans-Pecos Texas, Arizona, southern Utah, and northern Mexico.

States: NM

TNC Ecoregions:

USFS Ecoregions: 321A:CC

ALLIANCE SOURCES

Edition: 98-10-13

References: Dick-Peddie 1993, Kearney et al. 1969, Muldavin and Melhop 1992, Muldavin et al. 1994, Szaro 1989, Wallmo 1955, Whittaker and Niering 1964

III.B.2.N.c. Intermittently flooded cold-deciduous shrubland

III.B.2.N.c.2. BACCHARIS SALICIFOLIA INTERMITTENTLY FLOODED SHRUBLAND ALLIANCE (A.933)

Seep-willow Intermittently Flooded Shrubland Alliance

ALLIANCE CONCEPT

Environment:

Physiognomy:

Vegetation:

Dynamics:

Similar Alliances:

Similar Alliance Comments:

Synonymy:

?? Apache-plume Series, in part (Diamond 1993)

Comments:

ALLIANCE DISTRIBUTION

Range: This alliance is found in Trans-Pecos Texas.

States: TX

TNC Ecoregions: 24:C

USFS Ecoregions: 321A:CC

ALLIANCE SOURCES

Edition: 96-10

References: Diamond 1993

III.B.2.N.c.3. FALLUGIA PARADOXA INTERMITTENTLY FLOODED SHRUBLAND ALLIANCE (A.934)

Apache-plume Intermittently Flooded Shrubland Alliance

ALLIANCE CONCEPT

Environment:

Physiognomy:

Vegetation:

Dynamics:

Similar Alliances:

Similar Alliance Comments:

Synonymy:

?? Apache-plume Series, in part (Diamond 1993)

?? Apache Plume Series, in part (Dick-Peddie 1993)

Comments:

ALLIANCE DISTRIBUTION

Range: This alliance is found in Trans-Pecos Texas.

States: TX

TNC Ecoregions: 24:C

USFS Ecoregions: 321A:CC

ALLIANCE SOURCES

Edition:

References: Diamond 1993, Dick-Peddie 1993, Texas Parks and Wildlife Department 1990a

III.B.2.N.c.7. RHUS TRILOBATA INTERMITTENTLY FLOODED SHRUBLAND ALLIANCE (A.938)

Ill-scented Sumac Intermittently Flooded Shrubland Alliance

ALLIANCE CONCEPT

Environment: Vegetation types within this shrubland alliance form linear bands on rocky, well-drained benches and toeslopes in the foothills and mountains. Elevations range from 600 m in New Mexico to 2000 m in Colorado. Types occur at the bottom of cliffs and on toeslopes in very narrow, steep (>50 percent), rocky river reaches having little floodplain development due to bedrock confinement. They often occur as a narrow band on rocky, well-drained benches located between the high-water line and the upland slopes in moderately wide valleys and along narrow reaches of larger rivers.

Soil textures are shallow sandy loam or loamy sands over coarse alluvium or bedrock. Stands located in southwestern New Mexico are located on rhyolite layers over intrusive rocks (Henry 1981). Soil pH is typically neutral (pH 7.7) (Komarkova 1986). The substrate is usually exposed, but surface water can be present for variable periods without detectable seasonal periodicity.

Salix exigua shrublands typically occur as a narrow band within the channel below the height of the *Rhus trilobata* types. Along wider sections of river, *Populus angustifolia* forests or *Alnus incana*-*Betula occidentalis* shrublands can occur on adjacent floodplains and terraces in Colorado (Kittel et al. 1998).

Physiognomy: This alliance is dominated by broad-leaved, cold-deciduous shrublands. The short-shrub stratum, 1-2 m tall, can form small to large clumps or thickets. The herbaceous layer is sparse.

Vegetation: Vegetation types within this alliance are characterized as intermittently flooded, cold-deciduous shrublands. Types are characterized by a dense shrub layer dominated by up to 60% cover of *Rhus trilobata*. Other shrubs can include *Prunus serotina*, *Ribes aureum*, *Salix eriocephala* var. *ligulifolia*, *Salix exigua*, *Berberis fendleri*, *Rosa woodsii*, *Juniperus monosperma*. The herbaceous layer is typically sparse due to shading, but can be composed of any of the following: *Muhlenbergia montana*, *Pseudoroegneria spicata*, *Calamovilfa longifolia*, *Carex filifolia*, *Festuca idahoensis* or *Schizachyrium scoparium*.

Dynamics: The Colorado *Rhus trilobata* plant association appears to be late-seral because it occurs at or above the high-water mark of the channel. *Rhus trilobata* can tolerate well-drained, rocky soils by remaining close to the river. This shrub species has roots that penetrate the water table through cracks in the bedrock or into areas where the roots can take advantage of summer rainfall events. This type appears to be a non-obligate riparian plant association because it occurs on the driest sites within a riparian zone and also occurs on uplands on the eastern slope (Kittel et al. 1998).

Similar Alliances:

?? RHUS TRILOBATA SHRUB HERBACEOUS ALLIANCE (A.1537)

Similar Alliance Comments: This alliance is not reliant on presence of surface water or depth to groundwater.

Synonymy:

?? *Rhus aromatica* spp. *trilobata* Series (Johnston 1987)

Comments:

ALLIANCE DISTRIBUTION

Range: This alliance has been described from the Yampa and San Miguel river basins in Colorado, the Burro and Peloncillo mountains in southwestern New Mexico, western Montana, northwestern Wyoming, and southeastern North Dakota. It likely occurs throughout the American Southwest and Colorado Plateau regions.

States: CO, ID, NM

TNC Ecoregions:

USFS Ecoregions: 321A:CC, 341B:CC, M331:C

ALLIANCE SOURCES

Edition: 98-03-01

References: Hansen and Hoffman 1988, Henry 1981, Johnston 1987, Kartesz 1994, Kittel and Lederer 1993, Kittel et al. 1998, Komarkova 1986, Mueggler and Stewart 1980, Osborn et al. 1998, Tweit and Houston 1980

III.B.2.N.c.9. BRICKELLIA LACINIATA INTERMITTENTLY FLOODED SHRUBLAND ALLIANCE (A.940)

Splitleaf Brickelbush Intermittently Flooded Shrubland Alliance

ALLIANCE CONCEPT

Environment: Shrublands in this alliance occur within and along drainages that dissect bajadas and mesas in the Chihuahuan Desert. Stands are restricted by the arid climate to arroyo riparian zones and adjacent flood plains. The best examples of this community occur in lower portions of arroyos where the streambed widens. This community is dependent

on the intermittent flows/flooding of the channel to supplement soil moisture. Soils are well-drained sandy or gravelly alluvium.

Physiognomy: This arroyo riparian shrubland is dominated by cold-deciduous shrubs.

Vegetation: Stands of this alliance occur along drainages in the Chihuahuan Desert. They typically have a moderate to dense shrub layer that is dominated by *Brickellia laciniata*. Other common shrubs include *Hymenoclea monogyra*, *Fallugia paradoxa*, *Rhus microphylla* and *Baccharis salicifolia* in floodplains. Information is not available on a herbaceous layer.

Dynamics: The arroyo riparian shrublands in this alliance are dependent on the intermittent flows/flooding of the channel to supplement soil moisture.

Similar Alliances:

?? HYMENOCLEA MONOGYRA SHRUBLAND ALLIANCE (A.1034)

?? RHUS MICROPHYLLA SHRUBLAND ALLIANCE (A.1040)

?? FALLUGIA PARADOXA INTERMITTENTLY FLOODED SHRUBLAND ALLIANCE (A.934)

?? BACCHARIS SALICIFOLIA INTERMITTENTLY FLOODED SHRUBLAND ALLIANCE (A.933)

?? BACCHARIS SALICIFOLIA - BACCHARIS NEGLECTA SEASONALLY FLOODED SHRUBLAND ALLIANCE (A.987)

Similar Alliance Comments: Shrublands in both this alliance and the similar alliances, III.B.3.N.a.7 *Hymenoclea monogyra* Shrubland Alliance (A.1034), III.B.3.N.a.13 *Rhus microphylla* Shrubland Alliance (A.1040), III.B.2.N.c.3 *Fallugia paradoxa* Intermittently Flooded Shrubland Alliance (A.934), III.B.2.N.c.2 *Baccharis salicifolia* Intermittently Flooded Shrubland Alliance (A.933), and III.B.2.N.e.2 *Baccharis salicifolia* - *Baccharis neglecta* Seasonally Flooded Shrubland Alliance (A.987), may have significant abundance of *Hymenoclea monogyra*, *Rhus microphylla*, or *Fallugia paradoxa* in the shrub layer. However, in this alliance *Brickellia laciniata* is dominant.

Synonymy:

?? Brickelbush Series. part of Arroyo Riparian Vegetation Type (Dick-Peddie 1993)

?? Burrobush Series. part of Arroyo Riparian Vegetation Type (Dick-Peddie 1993)

Comments: Shrublands in both this alliance and others may also have significant abundance of *Hymenoclea monogyra*, *Rhus microphylla*, or *Fallugia paradoxa* in the shrub layer. However, in this alliance *Brickellia laciniata* is dominant. Stands included in this alliance are poorly known and need further investigation.

ALLIANCE DISTRIBUTION

Range: This southwestern alliance is found along drainages in the Chihuahuan Desert in southern New Mexico and adjacent western Texas. Stands of this alliance may also occur in southeastern Arizona and in the Mexican states of Coahuila (?) and Chihuahua (?).

States: NM, TX

TNC Ecoregions: 24:C

USFS Ecoregions: 321A:CC

ALLIANCE SOURCES

Edition: 98-08-21

References: Dick-Peddie 1993, Muldavin and Melhop 1992

III.B.2.N.d. Temporarily flooded cold-deciduous shrubland

III.B.2.N.d.16. JUGLANS MAJOR TEMPORARILY FLOODED SHRUBLAND ALLIANCE (A.957)

Arizona Walnut Temporarily Flooded Shrubland Alliance

ALLIANCE CONCEPT

Environment: Vegetation within this alliance occurs in and adjacent to streambeds in the American Southwest. They typically are found along rubble-bottomed perennial and near-perennial streams, dry rocky ravines, arroyos, and streambeds from approximately 700 to 2300 m (Brown 1982, Elias 1987). No other information is available.

Physiognomy: The woody canopy is dominated by 8-15 m tall, broad-leaved, deciduous shrubs and small trees. The canopy averaged 75.4 percent (Szaro 1989). The understory is dominated by short shrubs (1-2 m) and vines with percent cover between 25-60 percent. A graminoid stratum is present, percent cover is unknown.

Vegetation: Vegetation stands within this alliance are characterized as temporarily flooded, cold-deciduous shrublands. *Juglans major* dominates the tall-shrub layer with an average of 75% cover (Szaro 1989). *Acer negundo* codominants in nearly all of the Arizona stands. Generally, *Juglans major* could occur with any of the following codominant trees or tall shrubs: *Sapindus saponaria*, *Platanus wrightii*, *Platanus occidentalis*, *Pinus edulis*, or *Quercus spp.* Other important shrubs and vines include *Frangula californica* (= *Rhamnus californica*), *Rhus glabra*, *Rhus trilobata*, and *Vitis arizonica*. Common

graminoid species are *Bouteloua curtipendula*, *Bouteloua gracilis*, and *Carex spp.* Forb cover was reported by Szaro (1989) to be sparse and typically weedy.

Dynamics: Brown (1982) states that the mixed broad-leaved types, of which *Juglans major* is included, are relictual communities. The present distribution reflects a contraction of the formerly widespread, Early Tertiary mixed mesophytic forest. These riparian forests are vernal adapted to Early Tertiary climates and have retreated to pockets where the warm temperate climate persists.

Similar Alliances:

Similar Alliance Comments:

Synonymy:

?? Warm-Temperate: Interior and Californian Riparian Deciduous Forests and Woodlands (Brown 1982)

?? Temperate Riparian Deciduous Forest Biome; Mixed Broadleaf Series (Pase and Layser 1977)

Comments: The nominal species of this alliance, *Juglans major* can have growth-forms of tall shrubs or short trees. The associations in this alliance are currently classified as shrublands, but may be better placed into a tree-dominated formation.

ALLIANCE DISTRIBUTION

Range: Communities within this alliance occur throughout southern Arizona and the southwestern "bootheel" of New Mexico. Given the range of the nominal species, it is likely the alliance also occurs in Mexico (Elias 1987).

States: NM

TNC Ecoregions:

USFS Ecoregions: 321A:CC, M313A:CC

ALLIANCE SOURCES

Edition: 98-04-30

References: Brown 1982, Elias 1987, Freeman and Dick-Peddie 1970, Henry 1981, Kearney et al. 1969, Pase and Layser 1977, Szaro 1989

III.B.2.N.d.4. JUGLANS MICROCARPA TEMPORARILY FLOODED SHRUBLAND

ALLIANCE (A.945)

Little Walnut Temporarily Flooded Shrubland Alliance

ALLIANCE CONCEPT

Environment: Little information is available about the environmental factors related to this alliance. It is found primarily along intermittently to temporarily flooded low-elevation (below 1500 m) streambeds and stream margins in desert canyons and valleys. Stream gradients were reported by Szaro (1989) to be 8 to 9 m per kilometer, fairly low gradients. The headwaters of these streams are in montane areas, and even when the streambed is dry, it is usually subirrigated. Following monsoonal rains, the streambed can be shallowly inundated for several weeks at a time. In western Texas and the Edwards Plateau, this alliance occurs on limestone cobbles or flat-bedded limestone streambeds. New Mexico sites are reported to be bouldery or gravelly.

Physiognomy: This alliance consists of structurally variable broad-leaved, deciduous shrublands. The woody vegetation varies in both height and density, and from shrubby growth to well-developed small trees. The canopy of the woody plants may be dense, to somewhat open or consist of widely scattered individuals. Woody vines are common in some stands, and most have an herbaceous layer, usually dominated by graminoids.

Vegetation: This alliance is composed of structurally and compositionally variable riparian shrublands, with *Juglans microcarpa* being the most abundant and characteristic woody species. Other woody shrubs and small trees that can be present can include *Celtis laevigata* var. *reticulata*, *Fallugia paradoxa*, *Fraxinus velutina*, *Ostrya knowltonii*, *Chilopsis linearis*, *Brickellia laciniata*, *Salix gooddingii*, *Salix nigra*, *Platanus occidentalis*, *Ungnadia speciosa*, and *Quercus spp.* The understory, particularly in the Texas examples, is composed primarily of perennial grasses typical of adjacent upland vegetation, such as *Leptochloa dubia*, *Bothriochloa barbinodis* var. *barbinodis*, *Bouteloua curtipendula*, *Schizachyrium scoparium* ssp. *neomexicanum*, and *Andropogon gerardii*. *Cladium mariscus* ssp. *jamaicense* is the graminoid dominant in one association in Texas. Woody vines, such as *Vitis arizonica* can be important in stands in New Mexico.

Dynamics: *Juglans microcarpa* is shade intolerant. Young individuals direct much of their energy into developing a large, deep taproot, which permits the walnut to survive the periods of extreme drought that are common.

Similar Alliances:

Similar Alliance Comments:

Synonymy:

?? Netleaf Hackberry - Little Walnut Series, in part (Diamond 1993)

?? Little Walnut Series, in part (Dick-Peddie 1993)

?? *Juglans microcarpa* Community Type, in part (Szaro 1989)

Comments: The structure of these communities can vary substantially. Classification needs to be resolved with WCS; placement is probably better in intermittently flooded.

ALLIANCE DISTRIBUTION

Range: This alliance has been reported from the Trans-Pecos and Edwards Plateau regions of Texas and from a few scattered localities in southern New Mexico. It is also found in the Mexican state of Coahuila.

States: NM, TX

TNC Ecoregions: 21:C, 24:C, 29:C

USFS Ecoregions: 315D:CC, 321A:CC, 321B:CC, M313B:CC

ALLIANCE SOURCES

Edition: 98-08-13

References: Diamond 1993, Dick-Peddie 1993, Szaro 1989

III.B.2.N.e. Seasonally flooded cold-deciduous shrubland

III.B.2.N.e.2. BACCHARIS SALICIFOLIA - BACCHARIS NEGLECTA SEASONALLY FLOODED SHRUBLAND ALLIANCE (A.987)

Seep-willow - Rooseveltweed Seasonally Flooded Shrubland Alliance

ALLIANCE CONCEPT

Environment:

Physiognomy:

Vegetation:

Dynamics:

Similar Alliances:

?? SALIX EXIGUA SEASONALLY FLOODED WOODLAND ALLIANCE (A.649)

Similar Alliance Comments: In wetter interdune swales, a related willow-dominated community occurs, *Salix exigua* / *Baccharis salicifolia* - *Baccharis neglecta* / *Scirpus* spp. Woodland (CEGL004587) of the II.B.2.N.c.2 *Salix exigua* Seasonally Flooded Woodland Alliance (A.649).

Synonymy:

Comments:

ALLIANCE DISTRIBUTION

Range: This alliance is currently only defined for western Texas (Trans-Pecos), but its range likely extends to the west.

States: TX

TNC Ecoregions: 24:C

USFS Ecoregions: 321A:CC

ALLIANCE SOURCES

Edition: 96-10

References:

III.B.3.N.a. Extremely xeromorphic deciduous subdesert shrubland without succulents

III.B.3.N.a.10. ACACIA NEOVERNICOSA SHRUBLAND ALLIANCE (A.1037)

Trans-Pecos Wattle Shrubland Alliance

ALLIANCE CONCEPT

Environment: Shrublands included in this Chihuahuan Desert alliance occur on lower foothills of mountains, mesas and piedmont hills and ridges in southern New Mexico, western Texas, and southeastern Arizona. Elevation ranges from 1280 to 1930 m. Climate is arid to semi-arid with most of the approximately 20 cm of annual precipitation occurring during monsoon months of July to September. Sites are on moderate to steep slopes mostly on southern aspects. Soils are generally shallow and rocky. In the Tularosa Basin, footslopes of hills and mountains soil are coarse and loamy over shallow bedrock, whereas on colluvial hills and ridges, soils are shallow, well-developed, clayey and covered with colluvium (Muldavin 1998). Muldavin et al. (1994) described a stand growing on a moderately steep, southwestern slope in the Organ Mountains. Parent material was derived from rhyolite.

Physiognomy: Vegetation in this alliance has sparse to dense short-shrub layer dominated by xeromorphic deciduous shrubs with a sparse to moderate graminoid layer dominated by medium-tall grasses. Forbs are very sparse.

Vegetation: Vegetation in this Chihuahuan Desert alliance occurs on mountains, hills and alluvial slopes from Trans-Pecos Texas and New Mexico to southeastern Arizona and adjacent Mexico. Stands have sparse to dense cover of shrubs 1-2m tall, dominated by *Acacia neovernicensa*. It may occur in nearly pure stands of *Acacia* at middle elevations, but generally the shrub layer is very diverse. Other characteristic shrubs include *Aloysia wrightii*, *Atriplex canescens*, *Dasyllirion wheeleri*, *Ericameria laricifolia*, *Flourensia cernua*, *Parthenium incanum*, *Prosopis glandulosa* and *Yucca baccata*. Grasses are generally sparse, but *Bouteloua curtipendula*, *Muhlenbergia porteri*, *Stipa* spp. and a few shortgrass species such as *Bouteloua eriopoda* and *Bouteloua gracilis* may grow abundantly, especially at higher elevation sites. At middle elevation grasses are more patchy, often found growing under shrubs. At lower elevations, *Larrea tridentata* and other Chihuahuan desertscrub species intermix. Cacti, such as *Opuntia imbricata*, *O. phaeacantha* and *Mammillaria* spp. are also common. Scattered forbs may include *Acourtia wrightii*, *Artemisia ludoviciana*, *Margaranthus solanaceus* and the fern *Notholaena standleyi*.

Dynamics: The nitrogen-fixing ability of *Acacia neovernicensa* allow it to colonize harsh environments well (Muldavin et al. 1998). Livestock impacts on this shrubland are generally limited because of poor forage potential and rough terrain (Muldavin et al. 1998).

Similar Alliances:

?? BOUTELOUA HIRSUTA - BOUTELOUA GRACILIS - BOUTELOUA ERIPODA SHRUB HERBACEOUS ALLIANCE (A.1548)

Similar Alliance Comments: Stands included in V.A.7.N.m.1 *Bouteloua hirsuta - Bouteloua gracilis - Bouteloua eriopoda* Shrub Herbaceous Alliance (A.1548) are open grasslands with a sparse shrub layer that may be dominated by *Acacia neovernicensa* or other shrubs. Stands in this alliance may also have a graminoid layer, but the shrub layer is denser.

Synonymy:

?? Chihuahuan Desertscrub of Calcareous Alluvium (Wentworth 1982)

?? Viscid Acacia Series ()

?? *Acacia neovernicensa/Bouteloua-B.eriopoda-Panicum obtusum* vegetation type. included within the Shrub-Mixed Grass Series (Dick-Peddie 1993)

Comments: *Acacia neovernicensa* is closely related to and may hybridize with *Acacia constricta* and *Acacia schottii*. The three species occur in similar habitats, but *Acacia constricta* is most typical along the Rio Grande in gravelly soils and *Acacia schottii* is most common on gypsiferous soils (Diamond 1993).

ALLIANCE DISTRIBUTION

Range: Stands in this Chihuahuan Desert alliance are found on piedmont hills and mountain ridges of the Tularosa Basin east to the Guadalupe Mountains in southern New Mexico, west to southeastern Arizona, and south to Trans-Pecos Texas and the northern Mexico states of Chihuahua, Coahuila and Sonora.

States: AZ,NM,TX?

TNC Ecoregions: 24:C

USFS Ecoregions: 321A:CC

ALLIANCE SOURCES

Edition: 98-08-21

References: Diamond 1993, Dick-Peddie 1993, Muldavin and Melhop 1992, Muldavin et al. 1994, Muldavin et al. 1998, Wentworth 1982

III.B.3.N.a.13. RHUS MICROPHYLLA SHRUBLAND ALLIANCE (A.1040)

Little-leaf Sumac Shrubland Alliance

ALLIANCE CONCEPT

Environment: Shrublands in this Chihuahuan alliance occur on upland and basin sites in southern New Mexico. Elevation ranges from 1250 to 1500 m; the climate is semi-arid with approximately two-thirds of the highly variable annual precipitation falling July through October. These shrublands are found on several landforms and substrates. Bourgeron et al. (1993) described it on gullied ancient river terraces. These "badlands" were composed of decomposed rhyolite tuff and alluvium. Ground cover was 30% bareground, 15% gravel, 5% rock, 45% litter, 2% basal vegetation and 3% moss. This stand grades into *Larrea tridentata*-dominated plains below and semi-desert grasslands at higher elevations. Muldavin et al. (1998) described communities in this alliance from sandy sites in the Tularosa basin and Sacramento foothills, and on silty soils on upland piedmont swales. Sites are flat to moderately sloping, often with a cooler northwest aspect.

Physiognomy: Shrublands in this alliance are dominated by extremely xeromorphic deciduous shrubs. Succulents are not present in significant amounts. Graminoids can have moderate cover in some stands, but forbs are typically sparse.

Vegetation: Vegetation in this Chihuahuan alliance occurs on upland sites in southern New Mexico. There is a sparse to moderately dense short shrub layer, dominated by the xeromorphic deciduous shrub, *Rhus microphylla*. The herbaceous layer is very sparse in some stands to luxuriant in others, and is typically dominated by perennial bunchgrasses. Bourgeron et al. (1993) described one stand with shrub canopy covers of 15%, 5%, and 1% for *Rhus microphylla*, *Fallugia paradoxa* and *Parthenium incanum*, with scattered *Nolina microcarpa*, *Yucca baccata*, and *Y. elata*. Graminoid canopy cover was sparse with 2% *Bouteloua curtipendula*, and lesser cover of *Aristida purpurea* var. *longiseta*, *Bouteloua eriopoda* and *B. hirsuta*. Forbs were also sparse with 1% canopy cover each of *Pectis filipes* and *Croton* spp., and <1% total canopy cover of 10 other forb species. Muldavin et al. (1998) reports stands of *Rhus microphylla* with dense graminoid understories of *Sporobolus wrightii* or *Oryzopsis hymenoides*, along with other sand-adapted and sand-tolerant species.

Dynamics:

Similar Alliances:

Similar Alliance Comments:

Synonymy:

? *Rhus microphylla* Series (Muldavin et al. 1998)

Comments: Muldavin et al. (1998) reports 3 new associations for this alliance in southern New Mexico. These types have yet to be added to the U.S. National Vegetation Classification.

ALLIANCE DISTRIBUTION

Range: Shrublands in this Chihuahuan Desert alliance occur in southern New Mexico from the Gray Ranch (southwestern "bootheel" of New Mexico) to the Tularosa Basin and the foothills of the Sacramento Mountains. They may also be found in adjacent southeastern Arizona, and Chihuahua and Sonora, Mexico.

States: NM

TNC Ecoregions:

USFS Ecoregions: 321A:CC

ALLIANCE SOURCES

Edition: 98-03-24

References: Bourgeron et al. 1993, Bourgeron et al. 1995, Muldavin et al. 1998

III.B.3.N.a.15. PROSOPIS PUBESCENS SHRUBLAND ALLIANCE (A.1042)

American Screwbean Shrubland Alliance

ALLIANCE CONCEPT

Environment: Shrublands included in this alliance occur in floodplains of a large river basin in the Chihuahuan Desert. Elevation ranges from 1100-1300 m. Climate is arid to semi-arid. Temperature is hot in summer and is frequently below freezing in winter. At the nearby Jornada Experimental Range in southwestern New Mexico, annual precipitation ranged from 7-45 cm with mean annual precipitation of 23 cm (Herbel et al. 1972). Drought is not uncommon. The precipitation has a bimodal distribution with about two-thirds falling during July to October and a third during the winter months. The summer precipitation often occurs as high-intensity convective storms. The driest period is in late spring and early summer. Sites are typically upper terraces along perennial streams. Slope is level to gentle. According to Campbell and Dick-Peddie (1964) these shrublands are the most xeric condition of the phreatophyte vegetation in the Rio Grande Basin. *Prosopis pubescens* is able to reach deep groundwater; however, the presence of *Distichlis spicata* usually indicates a relatively shallow water table of less than 1.5 m. Spring floods may or may not reach individual stands every year. Soils are not described in detail, but are probably deep, river-deposited silts over stratified layers of coarser-textured materials, such as sand and gravels. Some sites have moderate to high soil salinity.

Upland, these shrublands may grade into a matrix of desert shrubland dominated by *Larrea tridentata* or *Ambrosia* spp. or possibly desert grasslands dominated by species of *Sporobolus*, *Bouteloua* or *Hilaria*. *Prosopis pubescens* shrubs also grow in more mesic habitats closer to the water source, and occur with some of the mesic gallery forest species such as *Populus fremontii* or *Salix* spp. More recently, this adjacent mesic community is more likely to be a thicket of the exotic shrub/small tree, *Tamarix chinensis*.

Holland (1986) reported *Prosopis pubescens*-dominated woodlands/forests from sites along the lower Colorado River in California and Arizona. Sites include washes, streambanks, alkali sinks or outwash plains with groundwater near the surface. These woodlands are poorly known.

Physiognomy: Vegetation included in this alliance has a moderate to dense layer of extremely xeromorphic deciduous tall shrubs that are usually less than 5 m tall. There is also a sparse short-shrub layer (<2 m tall). The herbaceous layer is typically sparse and dominated by graminoids, with annual forbs present seasonally. Succulents are not present.

Vegetation: Vegetation included in this desert riparian alliance are described from the Rio Grande Basin in southwestern New Mexico. The structure and composition of the *Prosopis pubescens* phreatophyte shrubland is not well-described. The canopy consists the broad-leaved, deciduous thorny shrub *Prosopis pubescens*, which may reach heights of 10 meters. Cover

of this species is highly variable, but typically is over 30% and up to 60%. There is a shorter shrub layer, also composed of broad-leaved, deciduous species, including *Baccharis salicifolia*, *Lycium andersonii*, *Rhus trilobata*, *Suaeda suffrutescens* and *Pluchea sericea*. Total cover of this shorter layer (<2 m tall) is less than 15%. The most common species in the herbaceous layer are the perennial grasses *Distichlis spicata* and *Sporobolus airoides*. There is also a component of weedy, annual forbs, many of them introduced. Holland (1986) reported *Prosopis pubescens*-dominated riparian woodlands/forests in California. *Prosopis glandulosa* or *Prosopis velutina* may be also be present. The understory is dominated by annual and perennial grasses with scattered *Atriplex* shrubs. Other characteristic species include *Atriplex canescens*, *A. lentiformis*, *A. polycarpa*, *Celtis laevigata* var. *reticulata*, *Lycium* spp., *Parkinsonia florida*, *Sarcostemma* spp., and *Suaeda moquinii* (= *Suaeda torreyana*).

Dynamics: Locally, groves of *Populus fremontii*, *Salix* spp. and *Prosopis pubescens* that occur in wide, flat floodplains are known as "bosques". The age of the stands and moisture conditions within these bosques determine the canopy composition and cover. Stands dominated solely by *P. pubescens* are the furthest from the river, or have deeper water tables. Stands nearest the river are dominated by *P. fremontii* and *Salix* spp. Stands transitional from *P. pubescens* to *Populus fremontii* dominated stands are closer the river or having shallow water tables, and typically have a mixture of *Tamarix chinensis* and *Prosopis pubescens* in the canopy. If sufficient moisture is available for extended periods, *T. chinensis* can outcompete the *P. pubescens* and become completely dominant. Most stands of this alliance have been invaded by the exotic small tree *Tamarix chinensis*, which either codominates with or has nearly eliminated *P. pubescens*. Only the most xeric of sites, where flooding is very infrequent and the water table is too deep for *T. chinensis* to tap, still support stands dominated solely by screwbean (Reid et al. 1994).

Similar Alliances:

Similar Alliance Comments: Stands in the *Baccharis sarothrae*, *Acacia greggii* and *Parkinsonia* spp.-dominated alliances, may have similar species composition to stands in the *Prosopis pubescens* Shrubland Alliance, but they are not dominated by *Prosopis pubescens*.

Synonymy:

?? Mesquite Series. in both the Arroyo Riparian and Closed Basin-Playa-Alkali Sink Riparian Vegetation Types (Dick-Peddie 1993)

?? Mesquite - scrub series. from the Chihuahuan Desert Region of the Desert Shrub Formation. (Donart et al. 1978)

?? Mesquite bosques series. from the Riparian Region of the Woodland Formation (Donart et al. 1978)

?? Mesquite Bosque. Element Code 61820 (Holland 1986)

?? Mesquite series, in part (Sawyer and Keeler-Wolf 1995)

?? Sonoran Deciduous Swamp and Riparian Scrub. *Prosopis pubescens* - *Prosopis juliflora torreyana* - *Pluchea sericea* association (Brown 1982)

?? Mesquite series. *Prosopis pubescens* is listed as an associate for some stands. (Sawyer and Keeler-Wolf 1995)

Comments: Classification of *Prosopis pubescens* dominated stands needs clarification. Because *Prosopis pubescens* can be both a shrub and a tree, there may be confusion in classifying a given stand. For example, what characteristic separates a *Prosopis* arroyo riparian woodland from a shrubland. More research needs to be done to determine if the stands of *Prosopis pubescens* dominated woodland/forest described by Holland (1986) should be classified in this alliance or the *Prosopis (glandulosa, velutina)* Woodland Alliance.

ALLIANCE DISTRIBUTION

Range: Shrublands included in this alliance occur primarily along drainages in the Chihuahuan Desert. It was described in the Rio Grande River valley in southwestern New Mexico and likely occurs in Trans-Pecos Texas, southern Arizona, and adjacent northern Mexico. It may also occur along the lower Colorado River in California and southwestern Arizona.

States: NM

TNC Ecoregions:

USFS Ecoregions: 321A:CC

ALLIANCE SOURCES

Edition: 98-05-19

References: Barbour and Major 1977, Brown 1982, Brown et al. 1977, Campbell and Dick-Peddie 1964, Dick-Peddie 1993, Donart et al. 1978, Herbel et al. 1972, Holland 1986, Metcalfe 1902, Reid et al. 1994, Sawyer and Keeler-Wolf 1995, Smith and Douglas 1989, Stromberg 1995

III.B.3.N.a.16. PROSOPIS VELUTINA SHRUBLAND ALLIANCE (A.1043)

Velvet Mesquite Shrubland Alliance

ALLIANCE CONCEPT

Environment: Shrublands included in this alliance occur in the Chihuahuan and Sonoran deserts. Elevation ranges from 400 to 1520 m. Climate is arid to semi-arid. Summers are hot. Winter temperature are generally mild with freezing temperature

more common in the higher elevation Chihuahuan Desert. Precipitation varies with geography. Mean annual precipitation ranges from about 22 cm in southeastern New Mexico at the Jornada Experimental Range to 28 cm at Tucson, Arizona, but can vary greatly from year to year. At the Jornada Experimental Range, annual precipitation ranged from 7-45 cm with drought not uncommon (Herbel et al.). Annual precipitation has bimodal distribution with the proportion of summer precipitation decreasing westward (Barbour and Major 1977). At the Jornada Experimental Range, about two-thirds of the annual precipitation occurs in July through October and a third during the winter months. At Tucson, Arizona, about half of the annual rain falls in July to October with the balance during the winter months. The most arid season is late spring and early summer. The summer rain often occurs as high-intensity convective storms. Sites include sandy plains, mesas, bajadas, drainage terraces and channels, floodplains and rocky slopes. Although *Prosopis velutina* is deep rooted, tapping water tables as deep as 50 m (Burgess 1995), it typically occurs on shallow water tables, especially along arroyos. Sites are generally flat or on gentle to moderate south-facing slopes. Parent material is usually sandy or gravelly alluvium, or eolian sand derived from limestone and metamorphic rocks. Substrates are generally coarse-textured, but may include gravelly clay loams. Some sites are moderately saline. These shrublands may grade into grasslands dominated by *Bouteloua gracilis*, *Sporobolus airoides*, *Hilaria mutica* or be surrounded by a matrix of desert shrublands dominated by *Larrea tridentata* or *Ambrosia* spp.

Physiognomy: Vegetation included in this alliance has a moderate to dense layer of xeromorphic deciduous shrubs that is less than 5 m tall. The herbaceous layer may be sparse to moderately dense and is dominated by graminoids, with annual forbs present seasonally. Succulents may also be present.

Vegetation: Shrublands included in this alliance covers extensive areas of sandy plains, bajadas and mesas across southwestern New Mexico and southeastern Arizona, invading open grasslands and often forming thickets. It also occurs as arroyo riparian vegetation where it forms a tall, often dense shrub canopy. Stands have a moderate to dense (30-80%) canopy cover of woody layer dominated by the xeromorphic deciduous shrub/small tree, *Prosopis velutina*. Frequent riparian scrub codominants are *Acacia greggii*, *Celtis laevigata* ssp. *reticulata*. These shrublands often have a diverse shrub layer. Other common woody species include *Acacia constricta*, *Chilopsis linearis*, *Ericameria laricifolia*, *Gutierrezia sarothrae*, *Hymenoclea salsola*, *Isocoma tenuisecta*, *Juniperus monosperma*, *Larrea tridentata*, *Mimosa aculeaticarpa* var. *biuncifera* (= *Mimosa biuncifera*), and *Rhus* spp. The herbaceous layer has sparse to moderate (to 60%) cover of perennial medium-tall and short perennial grasses. Characteristic perennial grasses include *Aristida* spp., *Bouteloua curtipendula*, *B. eriopoda*, *Erioneuron pulchellum*, *Elymus elymoides*, *Hilaria belangeri*, *Muhlenbergia porteri*, and *Sporobolus* spp. Annual grasses are present, but have sparse cover. Forbs are also sparse, but may include species of *Datura*, *Mentzelia*, *Polanisia* and *Rumex*. Succulents are often present and may include *Agave* spp. *Ferocactus wislizeni*, *Opuntia acanthocarpa*, *O. engelmannii*, *O. leptocaulis*, *O. imbricata*, *O. phaeacantha*, *O. spinosior*, *Yucca baccata* or *Y. elata* depending on geography.

Dynamics: Shrublands dominated by *Prosopis* spp. have replace large areas of desert grasslands especially those formerly dominated by *Bouteloua eriopoda* in Trans Pecos Texas, southern New Mexico and southeastern Arizona (Hennessy et al. 1983, York and Dick-Peddie 1969). Studies on the Jornada Experimental Range suggest that combinations of drought, overgrazing by livestock, wind and water erosion, seed dispersal by livestock, fire suppression, shifting dunes and changes in the seasonal distribution of precipitation have caused this recent, dramatic shift in vegetation physiognomy (Buffington and Herbel 1965, Gibbens et al. 1983, Herbel et al. 1972, Hennessy et al. 1983, Humphrey 1974, McLaughlin and Bowers 1982, McPherson 1995, Schlesinger et al. 1990).

Prosopis and other shrubs have extensive root systems that allow them to exploit deep soil water that is unavailable to shallower rooted grasses and cacti (Burgess 1995). This strategy works well except on sites that have well-developed argillic or calcic soil horizons that limit infiltration and storage of winter moisture in the deeper soil layers (McAuliffe 1995). McAuliffe found *Prosopis velutina* invasion on these sites limited to a few, small individuals. This has implications in plant geography and grassland revegetation work in the southwestern U.S.

Similar Alliances:

?? PROSOPIS (GLANDULOSA, VELUTINA) WOODLAND ALLIANCE (A.661)

Similar Alliance Comments: The *Prosopis (glandulosa, velutina)* Woodland Alliance is reported from California and southwestern Arizona, but is poorly known. Both alliances include stands that are dominated or codominated by *Prosopis velutina*. However, the stand structure is different, one is a shrubland the other a woodland.

Synonymy:

?? Mesquite Series. in both the Arroyo Riparian and Closed Basin-Playa-Alkali Sink Riparian Vegetation Types (Dick-Peddie 1993)

?? Mesquite - scrub series. from the Chihuahuan Desert Region of the Desert Shrub Formation. (Donart et al. 1978)

?? Mesquite bosques series. from the Riparian Region of the Woodland Formation (Donart et al. 1978)

?? Mesquite series, in part (Sawyer and Keeler-Wolf 1995)

?? Mesquite Series. within the Sonoran Riparian and Oasis Forests (Brown 1982)

Comments: Classification of *Prosopis velutina*-dominated stands needs clarification. Because *Prosopis velutina* can have both shrub and tree growth-forms, there may be confusion classifying a given stand. For example, what characteristic separates a *Prosopis velutina* arroyo riparian shrubland from a *Prosopis velutina* "bosque" or riparian woodland. Some arroyo riparian stands in Arizona are similar to stands in the *Baccharis sarothroides*, *Acacia greggii* and *Parkinsonia* spp.-

dominated alliances as far a species composition and separated mainly by dominance. Also, the formation that this alliance is classified in does not allow succulents. However, many stands in this alliance have a fairly consistent presence of succulents, usually species of *Opuntia* and *Yucca*.

ALLIANCE DISTRIBUTION

Range: Shrublands included in this alliance occur on sandy plains and mesas in southwestern New Mexico and southern Arizona in the Chihuahuan and Sonoran deserts. The alliance likely occurs in adjacent northern Mexico.

States: AZ,NM

TNC Ecoregions:

USFS Ecoregions: 313A:CC, 321A:CC

ALLIANCE SOURCES

Edition: 98-05-26

References: Anderson et al. 1985, Barbour and Major 1977, Brown et al. 1977, Burgess 1995, Campbell and Green 1968, DeOliviera 1961, Hennessy et al. 1983, Herbel et al. 1972, Humphrey 1974, McAuliffe 1995, McLaughlin and Asdall 1980, McLaughlin and Bowers 1982, McPherson 1995, Schlesinger et al. 1990, Smith and Douglas 1989, Stromberg 1995, Szaro 1989, Warren et al. 1987, Warren et al. 1992, Whitfield and Anderson 1938, Willis 1939, York and Dick-Peddie 1969

III.B.3.N.a.4. PROSOPIS GLANDULOSA SHRUBLAND ALLIANCE (A.1031)

Honey Mesquite Shrubland Alliance

ALLIANCE CONCEPT

Environment: Shrublands included in this alliance occur from southwestern Oklahoma to southern Texas, and west to southern Nevada. Elevation ranges from 360-1600 m. Climate is arid to semi-arid, with hot summers and freezing temperatures not uncommon during the winter. Precipitation varies with geography. At the Jornada Experimental Range in southwestern New Mexico, annual precipitation ranged from 7-45 cm with mean annual precipitation of about 23 cm (Herbel et al. 1972). The precipitation has a bimodal distribution with about two-thirds of the precipitation falling during July to October and a third falling during the winter months. Farther west the proportion of summer precipitation decreases and winter precipitation dominates (Barbour and Major 1977). Sites include sandy plains, gypsum hills, coppice dunes, and terraces along intermittent drainages. They are generally flat or gently sloping, and this vegetation occurs on all aspects. Substrate is usually sandy or gravelly alluvium, but may be composed of eolian sands. Parent materials include andesite and rhyolite. Soils are generally coarse-textured, but may include gravelly clay loams. Some sites are moderately saline. These shrublands may grade into grasslands dominated by *Bouteloua gracilis*, *Sporobolus airoides*, *Hilaria mutica* or may be surrounded by a matrix of desertscrub dominated by *Larrea tridentata* or *Ambrosia* spp.

Physiognomy: Vegetation included in this alliance has a moderate to dense layer of extremely xeromorphic deciduous shrubs that are less than 5 m tall. The herbaceous layer is typically sparse and dominated by graminoids, with annual forbs present seasonally. Succulents are often present.

Vegetation: Shrublands included in this alliance cover extensive areas of sandy plains and valleys, gypsum hills and dunes from southwestern Oklahoma to south Texas and across southern New Mexico and southeastern Arizona, invading open grasslands and often forming thickets. In western Arizona and other dry portions of its range, the vegetation occurs as arroyo riparian and dune vegetation types. Stands have moderate to dense cover dominated by the xeromorphic deciduous shrub, *Prosopis glandulosa*. The diversity of other species can vary greatly with geography and substrate, with dune communities the most depauperate and riparian arroyos the most diverse. Other characteristic shrubs include *Acacia greggii*, *Artemisia filifolia*, *Atriplex canescens*, *Chilopsis linearis*, *Ericameria laricifolia*, *Gutierrezia sarothrae*, *Krascheninnikovia lanata*, *Larrea tridentata*, *Lycium berlandieri* and *Ziziphus obtusifolia*. Succulents may include *Opuntia acanthocarpa*, *O. leptocaulis*, *O. imbricata*, *O. phaeacantha*, *Yucca baccata*, *Y. elata* and *Y. glauca*. Depending on geography, substrate and land-use history, the graminoid layer can be moderately dense to insignificant. Characteristic perennial grasses include *Aristida* spp., *Bouteloua curtipendula*, *B. eriopoda*, *B. gracilis*, *Buchloe dactyloides*, *Hilaria jamesii*, *Hilaria mutica*, *Muhlenbergia porteri*, *Sporobolus flexuosus* and *Sporobolus wrightii*. Sparse annual grasses such as *Aristida adscensionis*, *Bouteloua barbata* and *Erioneuron pulchellum* may be present. Forb cover is also sparse, but it can be relatively diverse. Common forbs include species of *Chenopodium*, *Croton*, *Eriogonum*, *Euphorbia*, *Solanum* and *Zinnia*. In more saline areas, shrubs are sparser and grasses and forbs are more common and include *Sporobolus airoides*, *Distichlis spicata* and *Sesuvium verrucosum*. Bourgeron et al. (1993) described several stands at the Gray Ranch with canopy cover for *Prosopis glandulosa* and perennial grasses (dominated by *Bouteloua* spp.) ranging from 10-30% and 3-55%, respectively.

Dynamics: Shrublands dominated by *Prosopis glandulosa* have replaced large areas of desert grasslands, especially those formerly dominated by *Bouteloua eriopoda*, in Trans-Pecos Texas, southern New Mexico and southeastern Arizona (Hennessy et al. 1983, York and Dick-Peddie 1969). Studies on the Jornada Experimental Range suggest that combinations of drought, overgrazing by livestock, wind and water erosion, seed dispersal by livestock, fire suppression, shifting dunes, and changes in the seasonal distribution of precipitation have caused this recent, dramatic shift in vegetation physiognomy

(Buffington and Herbel 1965, Gibbens et al. 1983, Herbel et al. 1972, Hennessy et al. 1983, Humphrey 1974, McLaughlin and Bowers 1982, McPherson 1995, Schlesinger et al. 1990).

Prosopis spp. and other shrubs have extensive root systems that allow them to exploit deep soil water that is unavailable to shallower rooted grasses and cacti (Burgess 1995). This strategy works well, except on sites that have well-developed argillic or calcic soil horizons that limit infiltration and storage of winter moisture in the deeper soil layers (McAuliffe 1995). McAuliffe (1995) found *Prosopis spp.* invasion on these sites to be limited to a few, small individuals. This has implications in plant geography and grassland revegetation work in the southwestern United States.

Similar Alliances:

- ?? PROSOPIS GLANDULOSA WOODLAND ALLIANCE (A.611)
- ?? PROSOPIS GLANDULOSA TEMPORARILY FLOODED WOODLAND ALLIANCE (A.637)
- ?? PROSOPIS (GLANDULOSA, VELUTINA) WOODLAND ALLIANCE (A.661)
- ?? PROSOPIS GLANDULOSA SHRUB HERBACEOUS ALLIANCE (A.1550)

Similar Alliance Comments: Although stand structure is different, all the similar alliances include stands that are dominated or codominated by *Prosopis glandulosa*. Some arroyo riparian stands in Arizona are similar to stands in the *Baccharis sarothrae*, *Acacia greggii*, and *Parkinsonia spp.*-dominated alliances.

Synonymy:

- ?? Mesquite Series. in both the Arroyo Riparian and Closed Basin-Playa-Alkali Sink Riparian Vegetation Types (Dick-Peddie 1993)
- ?? Mixed Shrub Series. includes *Prosopis glandulosa/Gutierrezia sarothrae*/SMF-F (dunes) association within the Plains-Mesa Sand Scrub Vegetation Type (Dick-Peddie 1993)
- ?? Mesquite - scrub series. from the Chihuahuan Desert Region of the Desert Shrub Formation (Donart et al. 1978)
- ?? Mesquite bosques series. from the Riparian Region of the Woodland Formation (Donart et al. 1978)
- ?? *Prosopis glandulosa* shrubland series. from the Riparian Region of the Woodland Formation (Hoagland 1997)
- ?? Bluegrama-Buffalograss Series, in part (Diamond 1993)
- ?? Mesquite-Granjeno Series. in part? (Diamond 1993)
- ?? Mesquite-Huisache Series. in part? (Diamond 1993)
- ?? Mesquite-Saltbush Series, Mesquite-Sandsage Series. in part? (Diamond 1993)
- ?? Mesquite (southern type): 68, in part (Eyre 1980)
- ?? Mesquite (western type): 242, in part (Eyre 1980)

Comments: Classification of *Prosopis glandulosa*-dominated stands needs clarification. Because *Prosopis glandulosa* can have both shrub and tree growth forms, there may be confusion classifying a given stand. For example, what characteristic separates a *Prosopis* arroyo riparian woodland from a shrubland? Currently, mesquite coppice dunes, which may be better classified in a sparsely vegetated alliance, are included in this alliance. Also, the formation in which this alliance is classified does not allow succulents. However, many stands in this alliance have a fairly consistent presence of succulents, usually species of *Opuntia* and *Yucca*.

ALLIANCE DISTRIBUTION

Range: Shrublands included in this alliance are found in southwestern Oklahoma, western and southern Texas, west across the Chihuahuan and Sonoran deserts and into southern Nevada. The alliance likely occurs in adjacent northern Mexico.

States: AZ,MXNU,MXTM,NM,NV,OK,TX

TNC Ecoregions: 24:C, 28:P, 29:?, 30:C, 31:C, 33:P

USFS Ecoregions: 311A:PP, 313A:C?, 313E:CC, 315A:CC, 315B:CP, 315C:CP, 315E:CC, 321A:CC, 321B:CP, 322:C, 341A:CC

ALLIANCE SOURCES

Edition: 98-05-19

References: Beatley 1976, Bourgeron et al. 1993, Bourgeron et al. 1995, Bowers 1984, Brown 1982, Buffington and Herbel 1965, Burgess 1995, Diamond 1993, Dick-Peddie 1993, Donart et al. 1978, Eyre 1980, Gardner 1951, Gibbens et al. 1983, Hennessy et al. 1983, Herbel et al. 1972, Hoagland 1997, Humphrey 1974, McAuliffe 1995, McLaughlin and Bowers 1982, McPherson 1995, Muldavin and Melhop 1992, Smith and Douglas 1989, Stromberg 1995, Warren and Anderson 1985, Warren and Treadwell 1980, Warren et al. 1981, York and Dick-Peddie 1969

III.B.3.N.a.8. ALOYSIA WRIGHTII SHRUBLAND ALLIANCE (A.1035)

Wright's Beebrush Shrubland Alliance

ALLIANCE CONCEPT

Environment: Shrublands in this Chihuahuan Desert alliance occur on lower foothills of mountains and piedmont hills and ridges in southern New Mexico, western Texas, and southeastern Arizona. Elevation ranges from 1280 to 1930 m. Soils on

the footslopes of hills are coarse, loamy, and shallow. On hills and ridges, the soils are clayey and shallow, covered by rocky colluvium.

Physiognomy: Vegetation in this alliance has short-shrub layer dominated by xeromorphic deciduous shrubs.

Vegetation: Shrublands in this Chihuahuan Desert alliance occur on hills and alluvial slopes from Trans-Pecos Texas and New Mexico to southeastern Arizona and adjacent Mexico. Stands have a sparse to dense cover of shrubs 1-2m tall, dominated by *Aloysia wrightii* with the understory dominated by *Perityle staurophylla*. No other information is available on the species composition of this alliance.

Dynamics:

Similar Alliances:

Similar Alliance Comments:

Synonymy:

Comments: This alliance is based on one stand sampled on the White Sands Missile Range in New Mexico that was classified as a *Aloysia wrightii* / *Perityle staurophylla* Shrubland. There is very little information available upon which to base this description.

ALLIANCE DISTRIBUTION

Range: Shrublands in this Chihuahuan Desert alliance have been described from White Sands Missile Range in the Tularosa Basin in southern New Mexico. The alliance may be more widespread because *Aloysia wrightii* ranges from western Texas to Nevada.

States: NM

TNC Ecoregions:

USFS Ecoregions: 313E:CC, 321A:CC

ALLIANCE SOURCES

Edition: 98-05-22

References: Muldavin and Melhop 1992, Neher and Bailey 1976, Wentworth 1982

III.B.3.N.b. Intermittently flooded extremely xeromorphic deciduous subdesert shrubland

III.B.3.N.b.1. CHILOPSIS LINEARIS INTERMITTENTLY FLOODED SHRUBLAND ALLIANCE (A.1044)

Sweet Desertwillow Intermittently Flooded Shrubland Alliance

ALLIANCE CONCEPT

Environment: Shrublands within this southwestern desert alliance occur within and along drainages that dissect bajadas, mesas and plains in the Chihuahuan, Mojave and southern Great Basin deserts usually below 1600 m in elevation. They are restricted by the arid climate to arroyo riparian zones and adjacent floodplains. The best examples of this community occur in lower portions of the arroyo where the streambed widens. This community is dependent on the intermittent flows/flooding of the channel to supplement soil moisture. In western Texas, these shrublands occur on cobble beds of intermittently flooded streams. In southern Nevada, stands are surrounded by Mojave desertscrub dominated by *Larrea tridentata* or *Coleogyne ramosissima*. In western Texas, stands are surrounded by Chihuahuan desertscrub dominated by *Larrea tridentata*.

Physiognomy: This arroyo riparian shrubland is dominated by xeromorphic deciduous shrubs. The herbaceous layer is absent or has sparse cover of annual grasses.

Vegetation: Stands of this alliance occur along drainages in the Chihuahuan, Mojave and southern Great Basin deserts. Stands have a 2- to 5-m tall woody layer that is dominated by the xeromorphic, cold-deciduous shrub, *Chilopsis linearis*. Other characteristic shrubs may include *Acacia greggii*, *Baccharis salicifolia*, *Baccharis pteronioides*, *Brickellia laciniata*, *Fallugia paradoxa*, *Hymenoclea monogyra*, *Indigofera lindheimeriana*, *Platanus occidentalis* or *Salix nigra*. The usually sparse herbaceous layer is dominated by annual grasses such as *Bouteloua barbata*.

Dynamics: These arroyo riparian shrublands in this alliance are dependent on the intermittent flows/flooding of the channel to supplement soil moisture.

Similar Alliances:

?? BACCHARIS SALICIFOLIA INTERMITTENTLY FLOODED SHRUBLAND ALLIANCE (A.933)

?? BRICKELLIA LACINIATA INTERMITTENTLY FLOODED SHRUBLAND ALLIANCE (A.940)

Similar Alliance Comments: Related alliances include III.B.2.N.c.2 *Baccharis salicifolia* Intermittently Flooded Shrubland Alliance (A.933) and III.B.2.N.c.9 *Brickellia laciniata* Intermittently Flooded Shrubland Alliance (A.940). The relationship of these alliances to the *Chilopsis linearis* Intermittently Flooded Shrubland Alliance needs clarification. Shrublands in both

this alliance and the others may also have significant abundance of *Hymenoclea monogyra*, *Rhus microphylla*, or *Fallugia paradoxa* in the shrub layer. However, in this alliance, *Chilopsis linearis* is dominant.

Synonymy:

?? Desertwillow, in part (Plumb 1988)

?? Mojave Wash Scrub, in part (Holland 1986)

Comments: *Chilopsis linearis* is a common shrub in vegetation along ephemeral, intermittently flooded streams across the southwestern United States, and it occurs in stands within many different alliances. The definition and appropriate circumscription of this alliance in Nevada and California is uncertain. More survey and description work are needed throughout this species' range. Many riparian shrublands in the southern deserts have been invaded by the exotic *Tamarix* spp. (Brown et al. 1977). This phreatophyte needs habitats with shallow water tables (Smith 1989). Once established, *Tamarix* shrubs are very hard to eliminate (Smith 1989).

ALLIANCE DISTRIBUTION

Range: Shrublands included in this alliance occur along drainage channels in western Texas, southern Nevada, southern California, and the Mexican state of Coahuila. Stands likely occur in southern New Mexico and Arizona, and Sonora, Mexico.

States: CA,NM?,NV,TX

TNC Ecoregions: 24:C, 29:C

USFS Ecoregions: 315D:CC, 321A:CC, 321B:CC, 322A:CC

ALLIANCE SOURCES

Edition: 99-05-17

References: Armstrong 1969, Brown et al. 1977, Holland 1986, Plumb 1988, Smith and Douglas 1989

III.C.3.N.b. Mixed evergreen - deciduous subdesert shrubland

III.C.3.N.b.2. LYCIUM BERLANDIERI - LARREA TRIDENTATA SHRUBLAND ALLIANCE (A.1058)

Silver Desert-thorn - Creosotebush Shrubland Alliance

ALLIANCE CONCEPT

Environment: A shrubland in this alliance was described from the east-facing slope of Bishop's Cap Peak (elevation 1465 m) in southwestern New Mexico. It occurred on ledges below limestone cliffs in a habitat common in other limestone areas in the northern Chihuahuan Desert, and may occur elsewhere (Devender and Everitt 1977). Climate is arid to semi-arid with hot summers. Freezing temperatures may occur during the winter. Mean annual precipitation is approximately 28 cm. Precipitation can vary greatly from year to year with drought not uncommon. Annual precipitation has bimodal distribution with about a third of the annual precipitation occurring in late winter and two-thirds in July through October. The summer rain often occurs as high-intensity convective storms. The most arid season is late spring and early summer. The rocky, calcareous, alkaline soils are derived from limestone.

Physiognomy: Vegetation included in this alliance has a moderately dense shrub layer (42% cover) that is dominated by xeromorphic, mixed evergreen and deciduous shrubs up to 2m tall. The herbaceous layer is sparse.

Vegetation: Vegetation in this Chihuahuan Desert alliance is found at the base of limestone cliffs. It is moderately dense (50% cover), and is dominated by xeromorphic deciduous and microphyllous evergreen shrubs to 2 m tall. Stands are codominated by *Lycium berlandieri* and *Larrea tridentata* with 15% and 11% canopy cover, respectively (Van Devender and Everitt 1977). Other common shrubs include *Atriplex canescens*, *Aloysia wrightii*, *Ephedra aspera*, *Flourensia cernua* and *Menodora scabra* with 5.7%, 5.4%, 2%, 2% and 0.6% canopy cover, respectively. The herbaceous layer is usually sparse. The grass, *Muhlenbergia porteri* and the forb, *Bahia absinthifolia* are common perennials. Annuals are seasonally present.

Dynamics:

Similar Alliances:

?? LARREA TRIDENTATA SHRUBLAND ALLIANCE (A.851)

Similar Alliance Comments: *Larrea tridentata* is common in both alliances, however, stands in the similar alliance are not codominated by *Lycium berlandieri*.

Synonymy:

?? Mixed Scrub Series, in part (Brown 1982)

Comments: Vegetation included in this alliance is poorly known. More investigation is needed to fully describe its structure and range.

ALLIANCE DISTRIBUTION

Range: Shrublands in this northern Chihuahuan Desert alliance are described from southwestern New Mexico. It potentially occurs in adjacent Texas and Chihuahua, Mexico.

States: NM

TNC Ecoregions:

USFS Ecoregions: 321A:CC

ALLIANCE SOURCES

Edition: 98-06-10

References: Brown 1982, Van Devender and Everitt 1977

IV. DWARF-SHRUBLAND

IV.A.2.N.a. Extremely xeromorphic evergreen subdesert dwarf-shrubland

IV.A.2.N.a.5. TIQUILIA HISPIDISSIMA DWARF-SHRUBLAND ALLIANCE (A.1101)

Rough Tiquilia Dwarf-shrubland Alliance

ALLIANCE CONCEPT

Environment: These dwarf-shrublands are found on gypsum-influenced soils of the Trans-Pecos and Tularosa Basin in western Texas and in south-central New Mexico. Elevations range from approximately 1000-2000 m. Climate is semi-arid with most of the annual precipitation occurring during the late summer and fall, often as high-intensity convective storms. Stands are typically found on gypsum outcrops in alluvial basins and on southern aspect hillslopes, and in interdune flats in the gypsum dunes. Substrate ranges from wind-blown gypsum dunes to nearly bare gypsum deposits, and plant species composition varies accordingly. These shrublands occur within a matrix of xeromorphic shrubland and may form landscape mosaics with other gypsum-tolerant associations in alternately wet and dry habitats.

Physiognomy: Vegetation included in this alliance has a sparse to dense xeromorphic evergreen dwarf-shrub layer. Scattered to sparse tall- and short-shrub layers may also be present. The sparse to dense herbaceous layer is often dominated by perennial warm-season grasses, but forbs may dominate some stands. Annual grasses and forbs are seasonally present. Cacti are present in some stands.

Vegetation: This alliance is a semi-evergreen dwarf desert shrubland on gypsum-influenced soils of the Trans-Pecos in western Texas and south-central New Mexico. Sites are typically hot and dry, and hence vegetation cover is usually sparse. However, the dwarf-shrub layer can range from sparse to dense and is dominated by *Tiquilia hispidissima* (= *Coldenia hispidissima*) with a mixture of other gypsophilic and non-gypsophilic species. Other dwarf-shrubs may include *Krameria lanceolata*, *Nama carnosum* or *Gutierrezia sarothrae*. A sparse shrub layer may be present with scattered *Artemisia filifolia*, *Atriplex canescens*, *Ephedra torreyana*, *Yucca elata*, and *Yucca torreyi*. The sparse to dense herb layer may be dominated by the perennial graminoids *Sporobolus nealleyi*, *Sporobolus airoides*, *Bouteloua breviseta*, and the forb *Mentzelia humilis*. Other herbaceous species may include *Bouteloua trifida*, *Anulocaulis gypsogenus*, *Calylophus hartwegii*, *Gaillardia multiceps*, *Nerisyrenia linearifolia*, *Sartwellia flaveriae*, *Selinocarpus lanceolatus*, *Thelesperma megapotamicum*, along with several cactus species.

Dynamics: The harsh gypsum substrate limits many species from occurring in these stands. Many of the plants that do occur are gypsophiles or gypsum endemics, although several common, non-gypsophilic, drought-tolerant species such *Atriplex canescens*, *Gutierrezia sarothrae*, or *Ephedra torreyana* may be present. Burgess and Northington (1977) report *Sporobolus nealleyi*, *Tiquilia hispidissima*, and *Opuntia polyacantha* as dominant on crusted gypsum ridges but not on unstable gypsum dunes.

Similar Alliances:

?? LARREA TRIDENTATA SHRUBLAND ALLIANCE (A.851)

Similar Alliance Comments: Two associations in the similar alliance III.A.5.N.a.5 *Larrea tridentata* Shrubland Alliance (A.851) list *Tiquilia hispidissima* as a diagnostic understory species.

Synonymy:

?? Rough Tiquilia Series. equivalent (Diamond 1993)

?? Gypsophilous Shrub, in part (Henrickson et al. 1985)

Comments: Some *Tiquilia hispidissima* stands may be too sparse to be classified as shrublands. Stand data are needed to determine if a sparsely vegetated alliance is needed.

ALLIANCE DISTRIBUTION

Range: Stands included in this alliance are found in western Texas and south-central New Mexico. The alliance is also found in the Mexican states of Coahuila, San Luis Potosí, and possibly Chihuahua (?), Nuevo Leon (?), and Zacatecas (?).

States: NM, TX
TNC Ecoregions: 24:C
USFS Ecoregions: 321A:CC

ALLIANCE SOURCES

Edition: 94-11

References: Burgess and Klein n.d., Burgess and Northington 1977, Diamond 1993, Dick-Peddie 1993, Henrickson et al. 1985, Muldavin and Melhop 1992, Muldavin et al. 1992, Muldavin et al. 1998, Powell and Turner 1974, Warnock 1974

IV.A.2.N.b. Facultatively deciduous subdesert dwarf-shrubland

IV.A.2.N.b.1. ATRIPLEX OBOVATA DWARF-SHRUBLAND ALLIANCE (A.1108)

New Mexico Saltbush Dwarf-shrubland Alliance

ALLIANCE CONCEPT

Environment: Stands of this alliance are found on alluvial flats in northwestern and south central New Mexico and west Texas. Typically, areas have been severely degraded by erosion and may resemble "badlands". Climate is semi-arid with most of the highly variable precipitation falling in July and August. In northwestern New Mexico, mean annual precipitation ranges from 22-32 cm and elevation is approximately 1830 m (Francis 1986). Soils are shallow, poorly developed, and alkaline. Textures range from fine sandy loams to silty clay loams in New Mexico to gypsiferous saline clays in Texas (Francis 1986, Henrickson 1977, TNC 1997).

Physiognomy: Vegetation in this alliance is dominated by sparse to moderate cover of facultatively deciduous dwarf-shrubs, often with a sparse perennial graminoid layer.

Vegetation: Vegetation included in this minor alliance is found on alluvial flats in northwestern and south-central New Mexico, and in west Texas. It has a sparse to locally moderately dense dwarf shrub layer of *Atriplex obovata*. Scattered shrubs, such as *Opuntia imbricata*, *Opuntia leptocaulis* and *Prosopis glandulosa* and a sparse herbaceous layer may also be present. In northwestern New Mexico data from Francis (1986) show mean total plant cover at 19% with 5% mean litter and 90% mean bare ground. Canopy cover of *Atriplex obovata* ranges from 6-22%, and the perennial grass, *Sporobolus airoides* dominates the sparse herbaceous layer with 4% mean cover (Francis 1986). Other minor species include the grasses, *Sporobolus cryptandrus*, *Hilaria jamesii*, *Bouteloua gracilis* and *Elymus elymoides*; and the scattered cacti, *Opuntia polyacantha* and *Opuntia imbricata* (Francis 1986). Where this alliance is known to occur in Texas, *Suaeda mexicana* and *Coryphantha ramillosa* are often present and after rains, annuals such as *Tidestromia carnosa* may be locally abundant.

Dynamics: Grazing has significantly impacted much of the vegetation in the Rio Puerco basin of northwestern New Mexico, which has had a long history of settlement and heavy livestock use. With proper livestock management and time, palatable species such as *Sporobolus airoides* may increase, and *Opuntia* spp. may decline (Francis 1986).

Similar Alliances:

?? HILARIA JAMESII DWARF-SHRUB HERBACEOUS ALLIANCE (A.1572)

Similar Alliance Comments: *Atriplex obovata* may also occur in V.A.8.N.a.8 *Hilaria jamesii* Dwarf-shrub Herbaceous Alliance (A.1572), but the abundance is less and the herbaceous layer is generally denser with higher diversity.

Synonymy:

?? *Atriplex obovata*/*Sporobolus airoides* - *S. cryptandrus* Plant Community 26 (Francis 1986)

Comments: Vegetation in this alliance may be too sparse to be classified as a dwarf-shrubland. Further study is needed throughout its range, especially to assess the effects of livestock grazing on vegetation structure.

ALLIANCE DISTRIBUTION

Range: Communities in this alliance are described from the southeastern part of the Colorado Plateau in the upper Rio Puerco watershed in northwestern New Mexico; the Trans-Pecos region in Brewster County, western Texas; and south-central New Mexico. The alliance likely also occurs in Arizona, Utah, and Chihuahua, Mexico.

States: MXCO?, NM, TX

TNC Ecoregions: 24:C

USFS Ecoregions: 313B:CC, 321A:CC, 321B:CC, M313A:CC

ALLIANCE SOURCES

Edition: 98-09-24

References: Francis 1986, Henrickson 1974, Henrickson 1977, Reid et al. 1994, Welsh et al. 1987

V. HERBACEOUS VEGETATION

V.A.5.N.a. Tall sod temperate grassland

V.A.5.N.a.3. ANDROPOGON HALLII HERBACEOUS ALLIANCE (A.1193)

Sand Bluestem Herbaceous Alliance

ALLIANCE CONCEPT

Environment: Stands of this alliance occur on sand deposits in the Great Plains. The climate is semi-arid and continental, with annual precipitation ranging from 46-61 cm. Elevations are generally between 1000 and 1600 m. Sites where this alliance is found are usually on gentle to steep slopes but sometimes on flat ground (Tolstead 1942, Steinauer 1989). The soils are sand, loamy sand, or sandy loam, and they can be poorly to moderately well-developed (Johnston 1987, Steinauer 1989). There is little runoff or evaporation because moisture quickly sinks into the coarse soil. Soil near the surface is consequently dry throughout much of the year, but moisture is present deeper in the soil profile. This favors deep-rooting species such as *Andropogon hallii* and *Calamovilfa longifolia* (Barnes and Harrison 1982). In the northern and western extent, adjacent grasslands dominated by *Pascopyrum smithii* or *Bouteloua* spp. occur on fine-textured soils. In western Texas, these grasslands form mosaics with *Quercus havardii* shrublands.

Physiognomy: Vegetation included in this alliance has a moderate to dense herbaceous layer (0.5-1.5 m tall) that is dominated by tall grasses and mid grasses, with short grasses common in the western portion of its range. There is a usually a sparse forb layer. Widely scattered low shrubs may also be present.

Vegetation: This alliance is found on sandy sites in the Great Plains from the U.S.-Canadian border south to Texas. It is dominated by tall and midgrass species, with shortgrass species becoming important in the western portion of its range. The dominant species range from 0.5-1.5 m in height. *Andropogon hallii* is usually dominant or codominant. *Calamovilfa longifolia* is present to codominant in most stands north of the South Dakota-Nebraska border. *Stipa comata*, *Koeleria macrantha*, *Schizachyrium scoparium*, *Bouteloua gracilis*, *Bouteloua hirsuta*, *Eragrostis trichodes*, *Pascopyrum smithii*, and *Sporobolus cryptandrus* are typical grasses in stands of this alliance. Upland sedges are also very common, especially *Carex filifolia*, *Carex inops* ssp. *heliophila*, and *Carex duriuscula* (= *Carex eleocharis*). Although graminoids are overwhelmingly dominant, several species of forbs can be found in many stands of this alliance. Some of the more common forbs are *Ambrosia psilostachya*, *Psoraleum* spp., *Ipomoea leptophylla*, *Liatris punctata*, and *Tradescantia occidentalis*. There are widely scattered low shrubs, including *Rosa* spp., *Prunus pumila* var. *besseyi*, and *Yucca glauca*. In west Texas, common associates on deep sands include *Panicum havardii*, *Sporobolus giganteus*, and *Calamovilfa longifolia*.

Dynamics: Wind is a dominant factor that shapes the landscape where this alliance occurs. Wind sometimes scours sand and vegetation from small areas and creates blowouts. These bare spots are initially colonized by species that are relatively uncommon in this alliance, such as *Redfieldia flexuosa*, *Muhlenbergia pungens*, *Yucca glauca*, and *Oryzopsis hymenoides*. Eventually, these blowouts succeed to one of the communities in the *Andropogon hallii* Herbaceous Alliance (A.1193) (Tolstead 1942, Harrison 1980, Ramaley 1939, Savage 1937). Tolstead (1942) cites Nebraska pioneer accounts that dunes were less vegetated than at present; and blowouts and stands were more common before cattle ranching. Fire frequency and extent are also thought to have declined since settlement because of fuel removal by livestock grazing and fire control (Burzlaff 1962, Wolf 1972). Consequently, active dunes and large blowouts are less common now, as are the pioneer plant species *Redfieldia flexuosa*, *Andropogon hallii* and *Yucca glauca* (Harrison 1980).

These grasslands provide excellent summer forage and need careful management to prevent grazing out desirable species. Tolstead (1942) found that *Andropogon hallii* and *Eragrostis trichodes* are less common on pastures that receive year-round grazing. Generally, overgrazing this alliance decreases the cover of species of *Andropogon*, *Calamovilfa*, *Eragrostis*, and *Stipa*, and increases the cover of *Bouteloua gracilis*, *Bouteloua hirsuta*, *Muhlenbergia pungens*, *Oryzopsis hymenoides*, and *Sporobolus cryptandrus* (Tolstead 1942, Harrison 1980, Ramaley 1939, Savage 1937). Overgrazing also kills out desirable shrubs especially *Amorpha canescens* and *Prunus pumila* var. *besseyi* (Ryan 1994). This grassland responds rapidly to management. Deferment of grazing in the late spring and summer favors warm-season grasses like *Andropogon hallii*, *Bouteloua hirsuta*, *Bouteloua gracilis*, *Calamovilfa longifolia*, *Eragrostis trichodes*, *Koeleria macrantha*, and *Schizachyrium scoparium*.

Drought also causes declines in cover of all species, especially tall grasses, and can make the grassland more vulnerable to blowouts. Savage (1937) found large declines in tallgrass cover on sandy sites during drought in 1935. He ranked the cause of damage by decreasing effect: heat, drought, and, to a much lesser extent, grazing and then soil blowing. Ramaley (1939) reports that in Colorado there is marginally enough precipitation to maintain this alliance. Drought causes retrogression to mixed sandhill, sand sage, or blow-out communities, which increases *Muhlenbergia pungens*, *Artemisia filifolia* and *Oryzopsis hymenoides*. Grazing during droughts increases the intensity of the damage (Ramaley (1939).

Similar Alliances:

?? ARTEMISIA FILIFOLIA SHRUBLAND ALLIANCE (A.816)

?? CALAMOVILFA LONGIFOLIA HERBACEOUS ALLIANCE (A.1201)

Similar Alliance Comments: Stands within the III.A.4.N.a.4 *Artemisia filifolia* Shrubland Alliance (A.816) may be similar both floristically and environmentally to stands in this alliance, but structurally they have greater than 25 percent canopy cover of *Artemisia filifolia*. This alliance has elements that are very similar to elements in the V.A.5.N.a.11 *Calamovilfa longifolia* Herbaceous Alliance (A.1201). This similarity is most pronounced in the northern portion of the range of *Andropogon hallii* Herbaceous Alliance, e.g. the Dakotas and Montana.

Synonymy:

- ? *Andropogon hallii* herbaceous series. Oklahoma (Hoagland 1996)
- ? Sand Prairie Community. Colorado (Ramaley 1939)
- ? *Andropogon hallii* Series. Colorado (Johnston 1987)
- ? USDA-NRCS Deep Sand Range Sites #15,16,19. Colorado (USDA Soil Conservation Service n.d.)
- ? Postclimax Grasses on Dunes. South Dakota (Tolstead 1941)
- ? Tall Grasses of the Dunes. Nebraska (Tolstead 1942)
- ? Bunchgrass Community. Nebraska (Weaver and Albertson 1956)
- ? Sand-hills Mixed Type. Colorado (Weaver and Albertson 1956)

Comments: Stands dominated by *Calamovilfa longifolia* and with *Andropogon hallii* present to moderately abundant present difficult classification questions. Diagnostic species or environmental characteristics need to be further elaborated to classify such stands into one of these alliances.

Kettler (pers. comm. 1998) as cited by Comer et al. (1999) suggested that this alliance may not occur in Colorado, and that the *Andropogon hallii* stands in Colorado would be better classified in an *Artemisia filifolia* / *Andropogon hallii* community, because of the consistent presence of that shrub in stands in the Colorado sandhills.

ALLIANCE DISTRIBUTION

Range: Grasslands in this alliance occur on sandy sites in the Great Plains in Texas, Oklahoma, Kansas, Colorado, Nebraska and Montana. It may also occur in South Dakota, North Dakota, and Canada in southern Saskatchewan and southern Manitoba.

States: KS,MB,MT,ND,NE,OK,SD,SK,TX

TNC Ecoregions: 24:C, 26:C, 27:C, 33:C, 35:C, 37:C

USFS Ecoregions: 251Aa:CCC, 251Ab:CCC, 315A:CP, 315B:CP, 321A:CC, 331B:CP, 331C:CC, 331E:CC, 331G:CC, 331H:CC, 331I:CC

ALLIANCE SOURCES

Edition: 98-01-01

References: Barnes and Harrison 1982, Bruner 1931, Burgess 1965, Burzlaff 1962, Comer et al. 1999, Culwell and Scow 1982, Drake and Faber-Langendoen 1997, Faber-Langendoen et al. 1996, Harrison 1980, Hirsch 1985, Hoagland 1996, Hoagland 1997, Johnston 1987, Keeler et al. 1980, Kinscher pers. comm., Kuchler 1974, Looman 1980, Pool 1913, Ramaley 1939, Ross et al. 1973, Ryan et al. 1994, Savage and Runyon 1937, Steinauer 1989, Texas Parks and Wildlife Department 1996, Tolstead 1941, Tolstead 1942, USDA Soil Conservation Service 1978, Weaver and Albertson 1956, Wolfe 1973

V.A.5.N.b. Tall bunch temperate grassland

V.A.5.N.b.3. SPOROBOLUS WRIGHTII HERBACEOUS ALLIANCE (A.1205)

Wright's Dropseed Herbaceous Alliance

ALLIANCE CONCEPT

Environment: Stands of this grassland alliance occur in swales and various lowlands sites. Elevation ranges from 1220-1600 m. Slopes are typically flat to gentle with any aspect. Climate is semi-arid with most of the 25-43 cm of annual precipitation falling during the late summer and early fall monsoon period. Precipitation may concentrate in these lowland sites from upland runoff during the typically high intensity convection storms common during the monsoon season.

Bourgeron *et al.* (1993) described four stands in this alliance where ground cover ranged from 20-80% bare soil, 20-80% litter and 3-35% basal vegetation. These soils were derived from clay alluvium and ranged in texture from silty clay loams to clays. Stromberg (1993) reported these grasslands occur on a variety of sites. From river banks, sandy washes and floodplains to upland areas "where microtopography or edaphic conditions allowed for accumulation of water". They may also be found in lower salinity sites within depressional wetlands such as bolsons and playas. Typically the soils are derived from alluvium and are fine textured, nonalkaline, and deep with high moisture holding capacity. The sandy wash sites presumably have coarser substrates. These grasslands often occur on sites that have a high water table or are subject to periodic flooding.

Physiognomy: Vegetation in this alliance has a moderately dense graminoid layer dominated by a tall bunchgrasses. A sparse layer of medium-tall grasses may be also be present. Woody species are uncommon in stands of this alliance.

Vegetation: Stands of this semi-desert grassland alliance occur in swales and lowlands, including riparian zones. These grasslands have a moderate to dense, tall graminoid layer typically dominated by the tall bunchgrass *Sporobolus wrightii*,

with small amounts of mid grasses. The other characteristic grasses may include *Panicum obtusum*, *Panicum hallii*, *Digitaria californica* (= *Trichachne californica*), *Hilaria mutica*, *Sporobolus airoides* and *Bouteloua gracilis*. While some stands have moderately high cover of *Ambrosia psilostachya*, forb cover is generally sparse, but is often high in species diversity. Scattered shrubs such as *Prosopis* spp. are not uncommon. Near riparian woodlands, trees such as *Populus fremontii*, *Fraxinus pennsylvanica*, *Celtis laevigata* var. *reticulata* (= *Celtis reticulata*) and *Juglans* spp. may occasionally be present. Bourgeron et al. (1993) described several stands of this alliance and recorded the canopy cover of graminoids to range from 30% to 70%. *Sporobolus wrightii* canopy cover ranged from 30% to 65%. Other common grasses included *Panicum obtusum*, *Muhlenbergia richardsonis* and *Eragrostis* spp. Common forbs included *Portulaca pilosa*, *Datura ferox*, *Mentzelia pumila*, *Solanum elaeagnifolium*, *Amaranthus palmeri*, *Sphaeralcea hastulata*. Occasionally, scattered shrubs such as *Artemisia dracuncululus*, *Chilopsis linearis* or *Mimosa aculeaticarpa* var. *biuncifera* were present.

Dynamics: Enhanced soil moisture from the slope position and the high water-holding capacity of the fine-textured soil promotes abundant grass growth. The high grass cover further enhances soil moisture by reducing evaporation from the soil and increasing water infiltration. These conditions promote well-developed soils (Muldavin et al. 1998).

Similar Alliances:

? SPOROBOLUS WRIGHTII SATURATED HERBACEOUS ALLIANCE (A.1435)

Similar Alliance Comments: Stands in both this alliance and the V.A.5.N.m.8 *Sporobolus wrightii* Saturated Herbaceous Alliance (A.1435) are dominated by *Sporobolus wrightii*, but the other grows in saline marshes and is semipermanently flooded. These saline marshes have been described from the lower Rio Grande valley in Texas.

Synonymy:

? Sacaton-Scrub Series, in part (Brown 1982)

? *Sporobolus airoides* and *S. wrightii* Series, in part (Muldavin et al. 1998)

Comments: Muldavin (1998) described and classified *Sporobolus airoides* and *Sporobolus wrightii* grasslands together in the *Sporobolus airoides* and *Sporobolus wrightii* Series because both species occur sympatrically or in similar habitats in the Tularosa Basin. There is evidence of *Sporobolus* individuals hybridizing by the production of plants with intermediate characteristics of both species. More research needs to be done to resolve this. These once extensive semi-riparian grasslands of the Chihuahuan Desert have experienced significant declines throughout their range. Livestock grazing and manipulations by land managers have resulted in fragmentation of habitat and loss of biodiversity within stands (Milford and Muldavin 1997).

ALLIANCE DISTRIBUTION

Range: Grasslands included in this alliance occur in southern New Mexico, Trans-Pecos Texas, southeastern Arizona, and the Mexican states of Chihuahua and Sonora.

States: AZ,MXCH,MXSO?,NM,TX?

TNC Ecoregions: 24:?

USFS Ecoregions: 313E:CC, 315A:CC, 321A:CC, M313B:CC

ALLIANCE SOURCES

Edition: 98-05-15

References: Bourgeron et al. 1993, Bourgeron et al. 1995, Brown 1982, Milford and Muldavin 1997, Muldavin and Melhop 1992, Muldavin et al. 1998, Stromberg 1993, Wood et al. 1998

V.A.5.N.c. Medium-tall sod temperate or subpolar grassland

V.A.5.N.c.16. SCHIZACHYRIUM CIRRATUM HERBACEOUS ALLIANCE (A.1221)

Texas Bluestem Herbaceous Alliance

ALLIANCE CONCEPT

Environment:

Physiognomy:

Vegetation:

Dynamics:

Similar Alliances:

Similar Alliance Comments:

Synonymy:

Comments:

ALLIANCE DISTRIBUTION

Range: This alliance is known from the Trans-Pecos of western Texas.

States: TX

TNC Ecoregions: 24:C
USFS Ecoregions: 321A:CC, M313B:CC

ALLIANCE SOURCES

Edition: 94-11

References:

V.A.5.N.c.20. SCHIZACHYRIUM SCOPARIUM - BOUTELOUA CURTIPENDULA HERBACEOUS ALLIANCE (A.1225)

Little Bluestem - Sideoats Grama Herbaceous Alliance

ALLIANCE CONCEPT

Environment: Communities within this alliance are most commonly found on slopes but can occur on level ground (Hanson and Whitman 1938, Hansen et al. 1984, Johnston 1987). Loam and silt soils appear to be the most common (Johnston 1987, Hansen and Hoffman 1988). However, in the southwest of this alliance's range some communities are predominantly on sandy soils (Weaver and Albertson 1956). Communities in the central and western portions of this alliance's range usually occur on medium to deep soils. In the far western extent stands occur on nearly level to steep slopes with shallow sandy or rocky soils derived from sandstone or limestone. Communities in the eastern portion of this alliance's range are found almost exclusively on steep south- or west-facing slopes (Curtis 1959, MNNHP 1993). These slopes have thinner soils, greater insolation, and greater runoff than surrounding areas. These factors inhibit the growth of taller grasses and woody species and allow the midgrass communities to be maintained (Umbanhowar 1992). Most of these sites are small. Many sites supporting stands of this alliance are underlain by limestone or chalk deposits.

Physiognomy: Across its range, this alliance is dominated by mid grasses. The vegetation cover can be moderately sparse to dense. Tall grasses and short grasses contribute substantially to the vegetation cover in most communities. The proportions of these two lifeforms are typically negatively correlated with each other and vary with the specific community and site.

Vegetation: This alliance is mainly in the Great Plains, but extends eastward to the Mississippi River and even beyond on dry sites. Across its range, the vegetation is dominated by midgrasses. The vegetation cover can be moderately sparse to dense (Kuchler 1974, Thilenius et al. 1995). Tallgrasses and shortgrasses contribute substantially to the vegetation cover in most communities. The proportions of these two lifeforms are typically negatively correlated with each other and vary with the specific community and site. The tallgrasses are more prevalent on sandier soils and on moderate or gentle lower slopes. The shortgrasses tend to be more common on flat uplands or steep slopes with heavier soils (Weaver and Albertson 1956). The dominant species are the nominal species, *Schizachyrium scoparium* and *Bouteloua curtipendula*. *Bouteloua gracilis* and *Bouteloua hirsuta* are common associates across this alliance's range. Other graminoids that are present to codominant are *Aristida purpurea*, *Andropogon gerardii*, *Andropogon hallii* (on sandier soils), *Buchloe dactyloides* (in the south and west of this alliance's range), *Calamovilfa longifolia* (on sandier soils), *Carex duriuscula* (= *Carex eleocharis*), *Carex inops* ssp. *heliophila*, and *Carex filifolia* (all three Carices in the north), *Koeleria macrantha*, *Muhlenbergia cuspidata*, *Pascopyrum smithii*, *Pseudoroegneria spicata* (in the northwest), *Sporobolus cryptandrus*, *Sporobolus compositus* var. *compositus* (in the south), *Sporobolus heterolepis* (in the east), *Stipa spartea*, and *Stipa comata* (in the north). There are a great number of forbs that occur in communities of this alliance, although they do not make up a large part of the herbaceous canopy. *Amorpha canescens*, *Aster oblongifolius*, *Aster ericoides*, *Ambrosia psilostachya*, *Dalea purpurea*, *Echinacea angustifolia*, *Gaura coccinea*, *Liatris punctata*, *Lygodesmia juncea*, *Ratibida columnifera*, and *Sphaeralcea coccinea*, are found in many communities in this alliance. Shrubs are not abundant, but *Symphoricarpos occidentalis*, *Yucca glauca*, *Artemisia frigida*, and *Rosa* spp. may be scattered among the herbaceous species.

Dynamics: Fire is important to prevent the invasion of woody species into stands. However, fire is not as important as in more mesic grasslands, because drought conditions slow encroachment by woody species.

Similar Alliances:

- ?? BOUTELOUA GRACILIS HERBACEOUS ALLIANCE (A.1282)
- ?? BOUTELOUA HIRSUTA HERBACEOUS ALLIANCE (A.1285)
- ?? PASCOPYRUM SMITHII HERBACEOUS ALLIANCE (A.1232)
- ?? SCHIZACHYRIUM SCOPARIUM - SORGHASTRUM NUTANS HERBACEOUS ALLIANCE (A.1198)
- ?? BOUTELOUA CURTIPENDULA HERBACEOUS ALLIANCE (A.1244)

Similar Alliance Comments: In general, the abundance or dominance of *Schizachyrium scoparium* and *Bouteloua curtipendula* are good indicators of this alliance. Classification problems may arise where these species are codominant with others. This alliance is very widespread, and communities within it may be confused with those in several other alliances. These include the V.A.5.N.e.12 *Bouteloua hirsuta* Herbaceous Alliance (A.1285) in the Southwest, the V.A.5.N.e.9 *Bouteloua gracilis* Herbaceous Alliance (A.1282) in the West, the V.A.5.N.c.27 *Pascopyrum smithii* Herbaceous Alliance (A.1232) in the North and East, and the V.A.5.N.a.8 *Schizachyrium scoparium* - *Sorghastrum nutans* Herbaceous Alliance (A.1198) in the East.

Synonymy:

- ?? ID5a. Western Bluestem-Grama Grassland (Allard 1990)
- ?? Sideoats-Grama Series, in part (Diamond 1993)
- ?? T5b1a11a. *Schizachyrium scoparium*, in part (Foti et al. 1994)
- ?? T5b1a11c. *Bouteloua curtipendula*, in part (Foti et al. 1994)
- ?? Mixed prairie [*Stipa-Bouteloua* association], in part (Bruner 1931)
- ?? Bluestem-grama Prairie; Chalkflat Prairie; Cedar Hills Prairie, in part (Kuchler 1974)
- ?? Xeric Limestone Prairies, in part (Baskin et al. 1994)

Comments: Several elements from east of the Mississippi River which were formerly in this alliance have been moved to V.A.6.N.q. (Bedrock temperate or subpolar grassland with a sparse tree layer).

ALLIANCE DISTRIBUTION

Range: This alliance is found mainly in the Great Plains, but extends from the foothills of the Rocky Mountains eastward to the Mississippi River and beyond on dry sites, possibly as far as to Georgia, Tennessee and Virginia. It is found in Canada in Saskatchewan and Manitoba, and in New Mexico, Colorado, Wyoming, Montana, Kansas, Nebraska, South Dakota, North Dakota, Minnesota, Iowa, Missouri, Illinois, Wisconsin, Arkansas, Kentucky, Oklahoma, and Texas.

States: CO,IA,IL,IN,KS,MB,MN,MO,MT,ND,NE,NM?,OK,SD,SK,TX,WI,WY

TNC Ecoregions: 20:C, 21:C, 24:C, 25:C, 26:C, 27:C, 28:C, 29:C, 32:C, 33:C, 34:C, 35:C, 36:C, 37:C, 38:C, 39:C, 40:C, 45:C, 46:C, 47:C, 48:C, 59:C

USFS Ecoregions: 222Aa:CCC, 222Ab:CCC, 222Ac:CCC, 222Ad:CCC, 222Ae:CCC, 222Af:CCC, 222Ag:CCC, 222Ah:CCC, 222Aj:CCC, 222Ak:CCC, 222Al:CCC, 222Am:CCC, 222An:CCC, 222Ap:CCC, 222Eh:CCC, 222Ek:CCC, 222Ka:CCC, 222Ke:CCC, 222Kh:CCC, 222Lb:CCC, 222Lc:CCC, 222Ld:CCC, 222Le:CCC, 222Lf:CCC, 222Ma:CCC, 222Md:CCC, 222Me:CCC, 222Na:CCC, 231B:CC, 231Eb:CCC, 231G:CC, 251Aa:CCC, 251Ab:CCC, 251Ba:CCC, 251Bb:CCC, 251Bc:CCC, 251Bd:CCC, 251Bf:CCC, 251Ca:CCC, 251Cd:CCC, 251Ce:CCC, 251Cg:CCC, 251Ch:CCC, 251Cm:CCC, 251Cn:CCC, 251Cp:CC?, 251Da:CCC, 251Ea:CCC, 251Eb:CCC, 251F:CC, 251G:C?, 255A:CC, 255Ba:CCC, 255C:CC, 311A:CC, 315A:CC, 315B:CC, 315D:CC, 321A:CC, 331B:CC, 331C:CP, 331E:C?, 331F:CC, 331G:CC, 331I:CC, 332C:CP, 332D:C?, 332E:CC, M222Aa:CCC, M222Ab:CCC, M231A:CC, M313B:CC, M331F:CC

ALLIANCE SOURCES

Edition: 99-01-18

References: Allard 1990, Baskin et al. 1994, Bourgeron et al. 1993, Bruner 1931, Curtis 1959, Diamond 1993, Faber-Langendoen et al. 1996, Foti et al. 1994, Hansen 1985, Hansen and Hoffman 1988, Hansen et al. 1984, Hanson and Whitman 1938, Hoagland 1997, Johnston 1987, Kuchler 1974, Lauver et al. 1997, Leidolf and McDaniel 1998, Minnesota Natural Heritage Program 1993, Nelson 1985, Nelson 1987, Terwilliger et al. 1979, Thilenius et al. 1995, USDA Soil Conservation Service 1978, Umbanhowar 1992, Weaver and Albertson 1956

V.A.5.N.c.27. PASCOPYRUM SMITHII HERBACEOUS ALLIANCE (A.1232)

Western Wheatgrass Herbaceous Alliance

ALLIANCE CONCEPT

Environment: Grasslands included in this alliance occur across the Great Plains, on several different soil types (Hanson and Whitman 1938, Johnston 1987, USFS 1992). The soil is most often clay or clay loam, however it can be loam or sandy loam. In the eastern and central part of this alliance's range, these communities can be found on flat or rolling uplands, hillslopes, or along streams or depressions. In the western part of this alliance's range, communities are found where local conditions are wetter than the average. This includes such areas as the base of slopes or along rivers or streams (Weaver and Albertson 1956, Jones 1992).

Physiognomy: This is an herbaceous alliance, dominated by short to mid-height graminoids. Mid grasses are the dominant vegetation in most examples of this alliance, although short grasses and sedges can be codominant. The vegetation tends to be denser where the mid grasses are predominant and more open where shorter graminoids are abundant. The mid grasses grow to 0.5-1.0 m on favorable sites, while the short grasses and sedges are less than 0.5 m tall. Both forb and shrub species are minor in this alliance. If shrubs are present, they are typically less than 1 m in height.

Vegetation: This alliance is common and widespread in the Great Plains, especially the northern portions, and parts of the Great Basin. These communities range from dry or dry-mesic to wet-mesic. Mid grasses are the dominant vegetation in most communities, although short grasses and sedges can be codominant. The vegetation tends to be denser where the mid grasses are predominant and more open where shorter graminoids are abundant (e.g., Hansen and Hoffman 1988, USFS 1992). The mid grasses grow to 0.5-1.0 m on favorable sites, while the short grasses and sedges are less than 0.5 m tall (Weaver and Albertson 1956). The most abundant midgrass is *Pascopyrum smithii*. Common associates include *Stipa comata*, *Elymus trachycaulus*, *Nassella viridula*, *Koeleria macrantha*, *Schizachyrium scoparium*, *Stipa spartea*, and *Poa spp.* In the drier communities of this alliance *Bouteloua gracilis* is the most common short grass. Other short graminoids typically found in the drier communities include *Carex inops ssp. heliophila*, *Carex duriuscula* (= *Carex eleocharis*), *Carex filifolia*, and *Bouteloua curtipendula* (in the northern portion of this alliance's range), *Aristida purpurea* and *Buchloe dactyloides* (in the southern half of this alliance's range). In the wetter communities within this alliance *Distichlis spicata*, *Hordeum jubatum*, *Elymus trachycaulus*, and *Iva annua* are common. Forbs and shrubs are generally minor components of communities within this alliance. If shrubs are present they are rarely taller than 1 m. Some forbs that are usually scattered about are *Gaura coccinea*, *Sphaeralcea coccinea*, *Amorpha canescens*, *Astragalus spp.*, and *Tragopogon dubius*. Shrubs include *Symphoricarpos occidentalis*, *Artemisia cana*, *Artemisia frigida*, and *Opuntia spp.*

Dynamics: *Pascopyrum smithii* is rhizomatous and is tolerant of moderate grazing. If severely over-grazed, *Pascopyrum smithii* will decline and may be replaced by less desirable warm season grasses and exotic species such as *Poa pratensis*.

Similar Alliances:

- ?? STIPA COMATA - BOUTELOUA GRACILIS HERBACEOUS ALLIANCE (A.1234)
- ?? PASCOPYRUM SMITHII INTERMITTENTLY FLOODED HERBACEOUS ALLIANCE (A.1328)
- ?? PASCOPYRUM SMITHII TEMPORARILY FLOODED HERBACEOUS ALLIANCE (A.1354)
- ?? BOUTELOUA GRACILIS HERBACEOUS ALLIANCE (A.1282)
- ?? STIPA COMATA BUNCH HERBACEOUS ALLIANCE (A.1270)
- ?? DISTICHLIS SPICATA - (HORDEUM JUBATUM) TEMPORARILY FLOODED HERBACEOUS ALLIANCE (A.1341)

Similar Alliance Comments: These stands will most likely be similar to stands within the *Bouteloua gracilis* Herbaceous Alliance, *Stipa comata* Herbaceous Alliance, or *Distichlis spicata* - (*Hordeum jubatum*) Temporarily Flooded Herbaceous Alliance.

Synonymy:

- ?? *Elytrigia smithii* Series, in part (Johnston 1987)

Comments: *Pascopyrum smithii* is a common constituent in many communities in the Great Plains. Its presence in so many communities can make it difficult to distinguish communities within this alliance from other dry-mesic midgrass communities in other alliances. The dominance of *Pascopyrum smithii* is typically a good diagnostic feature. Stands that have other species as codominants or even dominants may be difficult to classify. These stands will most likely be similar to stands within the *Bouteloua gracilis* Herbaceous Alliance, *Stipa comata* Herbaceous Alliance, *Distichlis spicata* - (*Hordeum jubatum*) Temporarily Flooded Herbaceous Alliance, or *Distichlis spicata* Intermittently Flooded Herbaceous Alliance. Associations in this alliance differ from those in the *Stipa comata* - *Bouteloua gracilis* alliance in having cover of *P. smithii* exceeding that of *S. comata*. In some stands of this association, *Distichlis spicata* may dominate, but contribution of at least 25% of the canopy cover by *P. smithii* is diagnostic; stands with <25% of the cover contributed by *P. smithii* belong to the *Distichlis spicata* alliance. In general a stand must have at least 25% cover of *Pascopyrum smithii* to be included in this alliance.

ALLIANCE DISTRIBUTION

Range: Grasslands included in this alliance are found in the western Great Plains, from New Mexico north into Colorado, Wyoming and Montana, as well as Kansas north into Saskatchewan and Manitoba. It is also found in scattered locations in Idaho and Utah, and possibly Alberta, Canada.

States: AB,CO,ID,KS,MB,MT,ND,NE,NM,SD,SK,UT,WY

TNC Ecoregions: 26:C, 27:C, 34:C, 35:C, 9:C

USFS Ecoregions: 251Aa:CCC, 315A:CC, 331D:CC, 331E:CC, 331F:CC, 331G:CC, 331H:CC, 331I:CC, 332:C, 342F:CC, M313B:CC, M331A:CC, M331F:CC, M332D:C?, M332E:CC

ALLIANCE SOURCES

Edition: 98-02-02

References: Baker 1983, Baker and Kennedy 1985, Bear Creek Uranium Mine Application n.d., Boutton et al. 1980, Branson et al. 1961, Branson et al. 1964, Branson et al. 1965, Bujakiewicz 1975, Bunin 1985, Cacek 1973, Christensen and Welsh 1963, Costello 1944, Culwell and Scow 1982, DeVelice et al. 1991, Dick-Peddie n.d., Donart et al. 1978, Faber-Langendoen et al. 1996, Hadley 1965, Hansen 1985, Hansen 1991, Hansen and Hoffman 1988, Hanson 1957, Hanson and Ball 1928, Hanson and Dahl 1957, Hanson and Smith 1928, Hanson and Whitman 1938, Hanson et al. 1931, Hyder et al. 1966, Johnston 1987, Jones 1992, Kahler 1973, Keammerer and Stoecker 1975, Marr and Buckner 1974, Moir 1969,

Muldavin and Melhop 1992, Mutel 1976, Ramaley 1916, Ramaley 1919, Ramaley 1927, Ramaley 1942, Rogers 1950, Shanks 1977, Shantz 1906, Shantz 1911, Shantz 1923, Stoecker-Keammerer Consultants n.d., USDA Soil Conservation Service 1978, United States Forest Service 1992, Vestal 1913, Vestal 1914, Vestal 1919, Weaver and Albertson 1956, Western Resources Development Corporation n.d., Wooten 1980

V.A.5.N.c.33. PANICUM OBTUSUM HERBACEOUS ALLIANCE (A.1238)

Vine-mesquite Herbaceous Alliance

ALLIANCE CONCEPT

Environment: Grasslands included in this alliance occur in swales and playas in the southern Great Plains and the Chihuahuan Desert. Elevations range from 1300 to 1600 meters. Climate is arid to semi-arid with hot summers. Freezing temperatures may occur during winter. Mean annual precipitation decreases from Oklahoma to southwestern New Mexico. It is approximately 22 cm at the Jornada Experimental Range, but is highly variable with drought not uncommon. Annual precipitation is distributed bimodally with about one-third occurring in late winter and two thirds in July through October, often as high intensity convective storms. These grasslands commonly occur in swales and playas, and along drainages that dissect the plains, piedmonts and mesas. Sites are nearly level to gently sloping and receive excess run-off from the surrounding landscape. Soils are deep, silty clays, often gravelly. Soils are derived from gravelly or silty alluvium. Groundcover is relatively low. Bourgeron et al. (1993) described stands where mean cover of bare soil, rock, litter, and basal vegetation ranged from 60-90%, 0-30%, 0-1% and 10-30%, respectively. Stands are surrounded by a matrix of desert shrublands, *Quercus* savannas, and upland grasslands.

Physiognomy: Vegetation included in this alliance has a moderately dense graminoid layer dominated by medium-tall perennial bunchgrasses. Shortgrasses and forbs may codominate. Scattered cacti may be present.

Vegetation: Vegetation included in this grassland alliance occurs in basins and swales within the Chihuahuan Desert and the southern Great Plains. Stands have a sparse to moderately dense graminoid layer (20-50% cover) of medium-tall perennial bunchgrasses and are usually dominated by *Panicum obtusum*, or *Panicum hallii* or *Panicum hirsutum*. The shortgrass, *Buchloe dactyloides* and the perennial forb, *Helianthus ciliaris*, may codominate some stands. Characteristic graminoids include *Bouteloua gracilis*, *Bouteloua curtipendula*, *Cyperus* spp., *Eragrostis intermedia*, *Scleropogon brevifolius* and the annual *Aristida adscensionis*. The usually sparse forb layer may reach 20% cover. Common forbs include *Hoffmannseggia glauca*, *Grindelia squarrosa*, *Proboscidea* spp., *Solanum* spp., *Sphaerophysa salsula* and *Zinnia grandiflora*. Scattered *Opuntia phaeacantha* are present in some stands.

Dynamics:

Similar Alliances:

?? HILARIA MUTICA INTERMITTENTLY FLOODED HERBACEOUS ALLIANCE (A.1330)

?? SPOROBOLUS WRIGHTII HERBACEOUS ALLIANCE (A.1205)

Similar Alliance Comments: Similar alliances, V.A.5.N.i.3 *Hilaria mutica* Intermittently Flooded Herbaceous Alliance (A.1330) and V.A.5.N.b.3 *Sporobolus wrightii* Herbaceous Alliance (A.1205), include stands where *Panicum obtusum* is a codominant species.

Synonymy:

?? *Panicum obtusum* herbaceous series. in part? (Hoagland 1997)

Comments: Some stands described by Bourgeron et al. (1993) have only 1-3 percent *Panicum obtusum*. A more appropriate alliance classification may be *Panicum obtusum* - *Panicum hallii* - *Panicum hirsutum* Herbaceous Alliance.

ALLIANCE DISTRIBUTION

Range: Grasslands included in this alliance occur in swales and playas in the southern Great Plains in Oklahoma and Texas, and in the Chihuahuan Desert in western Texas and southern New Mexico. It also likely occurs in southeastern Arizona and in the Mexican states of Chihuahua and Coahuila.

States: NM,OK,TX

TNC Ecoregions: 24:C, 28:C, 29:P, 30:P

USFS Ecoregions: 315A:CP, 315B:CP, 315C:CP, 321A:CC

ALLIANCE SOURCES

Edition: 98-03-13

References: Bourgeron et al. 1993, Bourgeron et al. 1995, Hoagland 1997

V.A.5.N.c.36. SPOROBOLUS AIROIDES SOD HERBACEOUS ALLIANCE (A.1241)

Alkali Sacaton Sod Herbaceous Alliance

ALLIANCE CONCEPT

Environment: Vegetation included in this alliance has been described from the Tularosa Basin in the northern Chihuahuan Desert. The annual precipitation is approximately 20 cm. Climate is arid to semi-arid at higher elevations, with two-thirds of the highly variable annual precipitation occurring from July to October. Elevation for the Tularosa Basin ranges from 1185 to 2730 m. Muldavin *et al.* (1992) reported the stand occurred in a playa. No other information is available.

Physiognomy: Vegetation included in this alliance has a graminoid layer dominated by medium-tall bunchgrasses and short sod grasses.

Vegetation: Vegetation in this alliance has been described from the Tularosa Basin in the northern Chihuahuan Desert. It is characterized by a graminoid layer of medium-tall and short grasses that form a sod. The codominant species are *Sporobolus airoides* and *Bouteloua gracilis*. No other information is available about vegetation in this alliance.

Dynamics:

Similar Alliances:

?? SPOROBOLUS AIROIDES HERBACEOUS ALLIANCE (A.1267)

?? SPOROBOLUS AIROIDES INTERMITTENTLY FLOODED HERBACEOUS ALLIANCE (A.1331)

Similar Alliance Comments: This alliance is separated by the atypical sod-forming growth form of stands that are codominated by *Sporobolus airoides* and *Bouteloua gracilis*. The other alliances have a graminoid layer dominated by *Sporobolus airoides*, but with a bunch grass-dominated growth form or a differing flood regime.

Synonymy:

?? Sacaton Series, in part (Dick-Peddie 1993)

Comments: This alliance has a single plant association that is classified from stands of vegetation only from the White Sands Missile Range, New Mexico. More research is needed to clarify the attributes that separate this alliance from other *Sporobolus airoides* alliance found on the Great Plains.

ALLIANCE DISTRIBUTION

Range: Vegetation in this alliance has been described from the White Sands National Park, in south-central New Mexico. More survey is needed to determine if these grasslands are restricted to the Tularosa Basin in the northern Chihuahuan Desert, or if their range extends beyond into the Great Plains, Colorado Plateau, Great Basin and northern Mexico like other *Sporobolus airoides*-dominated grasslands.

States: NM

TNC Ecoregions:

USFS Ecoregions: 313B:??, 313E:??, 321A:CC

ALLIANCE SOURCES

Edition: 98-04-13

References: Muldavin and Melhop 1992, Neher and Bailey 1976

V.A.5.N.d. Medium-tall bunch temperate or subpolar grassland

V.A.5.N.d.1. BOUTELOUA CURTIPENDULA HERBACEOUS ALLIANCE (A.1244)

Sideoats Grama Herbaceous Alliance

ALLIANCE CONCEPT

Environment: Vegetation in this Chihuahuan Desert alliance generally occurs on rocky slopes on mountains and mesas. Elevations for these semi-desert grasslands are moderate, ranging from 1050 to 1600 meters. Mean annual precipitation is approximately 30 cm, but is highly variable with drought years not uncommon. Typically a third of precipitation occurs in late winter and two thirds in July through October often as high intensity convective storms. These grasslands grade into *Pinus edulis* - *Quercus* - *Juniperus* woodlands at higher elevations and Chihuahuan desert shrublands such as *Prosopis glandulosa*/*Bouteloua eriopoda* stands on dry slopes and lower elevations. Stands may be found on all aspects, but in the drier parts of its range they are restricted to cooler north slopes. Soils are generally rocky and range from shallow to moderately deep. Johnson (1961) measured 34% rock cover in the stand he studied. Bourgeron *et al.* (1993) described a stand with 20% rock, 40% gravel, 5% bareground and 33% litter. Soil textures are typically fine, ranging from silty and clay loams to clays. Rhyolite was reported as parent material for one site.

Physiognomy: Vegetation in this grassland alliance are is dominated by sparse to dense cover of medium-tall bunchgrasses.

Vegetation: Stands of this alliance typically have moderately dense graminoid cover dominated by the medium-tall perennial bunchgrass *Bouteloua curtipendula*, without significant *Schizachyrium scoparium*. Composition varies with abiotic factors and grazing history. *Bouteloua eriopoda* is a characteristic associate on rocky slopes, and *Bouteloua gracilis* is an

associate on deeper soils. Other associates can include *Bothriochloa barbinodis*, *Hilaria belangeri* and *Schizachyrium cirratum*. Johnson (1961) studied a stand of *Bouteloua curtipendula* - *Bothriochloa barbinodis* association and measured total vegetation canopy cover at 61%. Cover for *Bouteloua curtipendula*, *Bothriochloa barbinodis* and *Aristida ternipes* var. *hamulosa* was 42, 13, and 4 %, respectively. Bourgeron et al. (1995) described a *Bouteloua curtipendula* - *Schizachyrium cirratum* stand with canopy cover of 20% *B. curtipendula*, 1% *S. cirratum* and 3% *Nolina microcarpa*. Scattered individuals of *Pinus edulis*, *Quercus* and *Juniperus* may occur in higher elevation stands. At lower elevations and on dry slopes, sparse Chihuahuan desertscrub species may intermix. If shrub or trees are present, the density is always very low.

Dynamics: Rocky substrates can provide crevices with enhanced-moisture microsites for grasses by reducing evaporation, and providing shade (Muldavin 1998). The limited precipitation infiltrates better in coarse soils and is available to deeper-rooted species such as *Bouteloua curtipendula* (Weaver and Albertson 1956).

Similar Alliances:

- ?? BOUTELOUA CURTIPENDULA SHRUB HERBACEOUS ALLIANCE (A.1552)
- ?? HILARIA BELANGERI - BOUTELOUA CURTIPENDULA HERBACEOUS ALLIANCE (A.1214)
- ?? SCHIZACHYRIUM SCOPARIUM - BOUTELOUA CURTIPENDULA HERBACEOUS ALLIANCE (A.1225)
- ?? (JUNIPERUS VIRGINIANA) / SCHIZACHYRIUM SCOPARIUM - (BOUTELOUA CURTIPENDULA) WOODED HERBACEOUS ALLIANCE (A.1919)
- ?? BOUTELOUA ERIOPODA HERBACEOUS ALLIANCE (A.1284)
- ?? BOUTELOUA GRACILIS HERBACEOUS ALLIANCE (A.1282)
- ?? BOUTELOUA HIRSUTA HERBACEOUS ALLIANCE (A.1285)
- ?? BOUTELOUA HIRSUTA - BOUTELOUA GRACILIS - BOUTELOUA ERIOPODA SHRUB HERBACEOUS ALLIANCE (A.1548)

Similar Alliance Comments: Related alliances include V.A.7.N.m.5 *Bouteloua curtipendula* Shrub Herbaceous Alliance (A.1552), V.A.6.N.q.101 (*Juniperus virginiana*) / *Schizachyrium scoparium* - (*Bouteloua curtipendula*) Wooded Herbaceous Alliance (A.1919), V.A.5.N.e.11 *Bouteloua eriopoda* Herbaceous Alliance (A.1284), V.A.5.N.e.9 *Bouteloua gracilis* Herbaceous Alliance (A.1282), V.A.5.N.e.12 *Bouteloua hirsuta* Herbaceous Alliance (A.1285), V.A.5.N.e.2 *Bouteloua ramosa* Herbaceous Alliance (A.1275), V.A.5.N.c.9 *Hilaria belangeri* - *Bouteloua curtipendula* Herbaceous Alliance (A.1214), V.A.5.N.c.20 *Schizachyrium scoparium* - *Bouteloua curtipendula* Herbaceous Alliance (A.1225), and V.A.7.N.m.1 *Bouteloua hirsuta* - *Bouteloua gracilis* - *Bouteloua eriopoda* Shrub Herbaceous Alliance (A.1548). Related alliances have *Bouteloua curtipendula* listed as a dominant or codominant species. They are separated because of different graminoid codominants such as *Schizachyrium scoparium* and/or the presence of a shrub or tree component. *Bouteloua curtipendula* is a widespread species and is codominant in many grassland, shrub and woodland associations throughout the much of the West.

Synonymy:

- ?? Sideoats-Black Grama Series, in part (Diamond 1993)
- ?? *Bouteloua curtipendula* (Sideoats Grama) Series, in part (Muldavin et al. 1998)

Comments:

ALLIANCE DISTRIBUTION

Range: Grasslands in this Chihuahuan alliance occur in Trans-Pecos Texas, across southern New Mexico and southeastern Arizona. The alliance may also be found in the Mexican states of Coahuila and Chihuahua.

States: AZ,NM,OK?,TX

TNC Ecoregions: 21:C, 24:C, 27:C

USFS Ecoregions: 321A:CC, M313B:CC

ALLIANCE SOURCES

Edition: 98-07-30

References: Bourgeron et al. 1993, Bourgeron et al. 1995, Diamond 1993, Johnson 1961, Muldavin and Mehlhop 1992, Muldavin et al. 1998

V.A.5.N.d.16. MUHLENBERGIA EMERSLEYI HERBACEOUS ALLIANCE (A.1259)

Bull Muhly Herbaceous Alliance

ALLIANCE CONCEPT

Environment: This alliance contains montane grasslands occurring in mountain ranges of Trans-Pecos Texas, southern New Mexico and adjacent Mexico. Elevations range from 1800 to 2200 m. Climate is arid to semi-arid. Mean annual precipitation is approximately 30 cm, but is highly variable with drought years not uncommon. Typically, a third of the precipitation occurs in late winter, and two thirds during July through October often as high intensity convective storms. Stands are found on flat areas at high elevations, or on slopes of canyons, foothills, mesas and mountains. Sites are typically on moderate slopes (25-50%) with southerly aspects, but may occur on flat and rolling terrain. On level sites, soils are typically loamy, moderately deep and may have an argillic horizon. On the steeper slopes, soils are shallow and loamy-skeletal (rocky). Parent

materials include Quartz monzonite and Rhyolite. Bourgeron et al. (1993) described the groundcover of a stand where bare soil, gravel, rock and litter was 20%, 10%, 30% and 31%, respectively. These grasslands grade into *Pinus edulis* - *Quercus* - *Juniperus* woodlands at higher elevations and Chihuahuan desert shrublands at lower elevations.

Physiognomy: Vegetation included in this alliance has a sparse to dense graminoid layer dominated by medium-tall perennial bunchgrasses. Occasional evergreen broad-leaved and needle-leaved trees, and sparse cover of shrubs (<10%) is often present. Cover of forbs is also sparse.

Vegetation: Vegetation included in this Chihuahuan alliance occur in open slopes and parks in mountain ranges of Trans-Pecos Texas, southern New Mexico and adjacent Mexico. Stands have a sparse to dense graminoid layer of medium-tall, perennial bunchgrasses. The dominant species is *Muhlenbergia emersleyi*. Codominants are *Bouteloua curtipendula* and *B. hirsuta*. Other characteristic grasses are *Bothriochloa barbinodis*, *Bouteloua gracilis*, *Lycurus phleoides*, *Panicum bulbosum* and many others. Forb cover is sparse, but may have high diversity. Common herbaceous species may include *Macropodium gibbosifolium*, *Commelina dianthifolia*, *Eriogonum wrightii*, *Gnaphalium* spp., *Viguiera* spp. and the moss, *Selaginella* spp. Shrubs are often scattered throughout stands, but rarely exceed 10% cover and are usually less than 5% in cover. The most common shrubs are *Dasyllirion wheeleri*, *Nolina microcarpa*, *Cercocarpus montanus*, *Ericameria laricifolia*, *Garrya wrightii*, *Opuntia imbricata* and *Yucca baccata*. Occasional trees are often present especially at higher elevations. Common tree species include *Juniperus deppeana*, *Pinus edulis* and *Quercus* spp.

Dynamics:

Similar Alliances:

?? BOUTELOUA CURTIPENDULA SHRUB HERBACEOUS ALLIANCE (A.1552)

Similar Alliance Comments: Stands included in both this alliance and V.A.7.N.m.5 *Bouteloua curtipendula* Shrub Herbaceous Alliance (A.1552) may be dominated by *Bouteloua curtipendula* with a sparse shrub component. The lack of significant *Muhlenbergia emersleyi* is key to separating them.

Synonymy:

?? Forest Meadow, in part (Plumb 1988)

Comments: One stand described by Muldavin et al. (1994) had 15% *Dasyllirion wheeleri* and 40% grass cover.

ALLIANCE DISTRIBUTION

Range: Grasslands included in this Chihuahua Desert alliance occur on desert mountain slopes in Trans-Pecos Texas, southern New Mexico, and the Mexican state of Coahuila.

States: MXCO,NM,TX

TNC Ecoregions: 24:C

USFS Ecoregions: 321A:CC

ALLIANCE SOURCES

Edition: 98-07-01

References: Bourgeron et al. 1993, Bourgeron et al. 1995, Muldavin et al. 1994, Plumb 1988

V.A.5.N.d.2. FESTUCA ARIZONICA HERBACEOUS ALLIANCE (A.1245)

Arizona Fescue Herbaceous Alliance

ALLIANCE CONCEPT

Environment: This alliance includes grasslands that occur in the southern Rocky Mountains south to the mountains in the Chihuahuan Desert. Elevations range from 1800-3000 m in forest meadows, mountain parks and valleys in the southern Rocky Mountains and Chihuahuan Desert mountains. The region has a temperate to semi-arid, continental climate. Average annual precipitation is 25-51 cm, with a summer peak in July and August. January is the coldest and driest month, and April is the month of greatest snow accumulation. The region is often subjected to strong northerly and westerly winds, which can remove snow cover and subject plants to severe desiccation. Winter in the southern extent is much milder with only occasional freezes and snowfall. Sites are gentle, to moderately steep (5-30%) slopes with southern and western aspects.

Rocks and boulders are common especially on the steeper slopes. Soils are generally dry, well-drained, shallow to moderately deep and coarse-textured. Parent material includes alluvium, colluvium and residuum from a variety of igneous, metamorphic and sedimentary rocks such as andesite, basalt, cinder, gneiss, granite, sandstone, schist, shale and tuff. The ground surface may have relatively high bare ground and rock cover (to 50% total). Stands are often surrounded by montane and subalpine forest dominated by species of *Abies*, *Picea* and *Pinus*.

Physiognomy: Vegetation included in this alliance has a sparse to moderately dense graminoid layer dominated by medium-tall and short, bunch and sod grasses. Forbs usually have sparse cover (<10%), although degraded sites may exhibit higher cover. Lichen groundcover ranges from 2-12%.

Vegetation: Vegetation in this alliance occurs in montane and subalpine parks, valleys and montane slopes in the mountains of Colorado, New Mexico and west Texas. Stands have a moderately dense herbaceous layer dominated or codominated by the medium-tall perennial bunchgrass, *Festuca arizonica*. Other codominant bunchgrasses include *Muhlenbergia filiculmis*,

Muhlenbergia montana or *Blepharoneuron tricholepis*, and the short sod grass, *Bouteloua gracilis*. Other associated graminoids include perennial bunchgrasses such *Koeleria macrantha*, *Danthonia parryi*, *Elymus elymoides*, *Poa fendleriana*, *Poa secunda*, and the sedges *Carex geyeri*, *Carex obtusata*. Forb cover is usually sparse. Forb species may include *Hymenoxys richardsonii*, *Eriogonum umbellatum*, *Arenaria fendleri*, *Achillea millefolium*, *Antennaria parvifolia*, *Penstemon secundiflorus*, *Vicia americana* and *Castilleja integra*. A sparse dwarf-shrub layer is often present, composed primarily *Artemisia frigida*, *Chrysothamnus* spp., *Gutierrezia sarothrae* and *Symphoricarpos* spp.

In west Texas, associated species include *Blepharoneuron tricholepis*, *Allium cernuum*, *Salvia arizonica*, *Achillea millefolium*, *Muhlenbergia minutissima*, *Muhlenbergia filiculmis*, *Muhlenbergia montana*, *Commelina dianthifolia*, *Bouteloua gracilis*, *Artemisia carruthii*, *Elymus elymoides*, *Castilleja* spp., and *Silene* sp. (= *Silene fimbriata*?).

Dynamics: Historically, much of the area where this alliance occurs was heavily grazed by livestock, primarily sheep and cattle (Shepard 1975). Under moderate grazing, the shorter grass, *Muhlenbergia filiculmis* may have had a competitive advantage over the taller and more palatable *Festuca arizonica* (West 1992). Season of use is also important. In stands with both *F. arizonica* and *M. montana*, fall grazing will favor *F. arizonica* over the later blooming *M. montana* (Cleary 1978). The reverse is true if grazing is always limited to late summer. Overgrazing will reduce or eliminate *F. arizonica*, *M. filiculmis*, *M. montana* and the other palatable species, leaving the more grazing tolerant *Bouteloua gracilis* and less palatable plants such as *Hymenoxys*, *Artemisia* and *Chrysothamnus* species to dominate the site (West 1992). Clary (1978) reported that complete natural recovery of montane *Festuca arizonica* range may require over 100 years, based on areas where recovery had reached only the "half-shrub" stage after 10 years. Because of the long time needed for recovery, much of the range may be in a seral state. If the range is properly managed, *Muhlenbergia* and *F. arizonica* grasslands could potentially become more common.

Similar Alliances:

?? MUHLENBERGIA FILICULMIS HERBACEOUS ALLIANCE (A.1288)

?? MUHLENBERGIA MONTANA HERBACEOUS ALLIANCE (A.1260)

Similar Alliance Comments: The *Festuca arizonica* Herbaceous Alliance includes stands where *Muhlenbergia filiculmis* or *Muhlenbergia montana* is codominant with *Festuca arizonica*. Stands in the similar alliances, V.A.5.N.e.15 *Muhlenbergia filiculmis* Herbaceous Alliance (A.1288) and V.A.5.N.d.17 *Muhlenbergia montana* Herbaceous Alliance (A.1260), can be distinguished by the lack of significant cover of *Festuca arizonica*.

Synonymy:

?? Fescue Series, *Festuca*, in part (Dick-Peddie 1993)

?? Habitat types #13 and #35, in part (Shepherd 1975)

?? Fescue Series. includes *Festuca arizonica*-*Muhlenbergia montana* Vegetation Type (Dick-Peddie 1993)

?? *Festuca arizonica* Series. includes *Festuca arizonica*-*Muhlenbergia montana* Vegetation Type (Johnston 1987)

Comments: Stands included in the V.A.5.N.d.2 *Festuca arizonica* Herbaceous Alliance (A.1245) and the V.A.5.N.e.15 *Muhlenbergia filiculmis* Herbaceous Alliance (A.1288) may occur sympatrically and have similar species compositions.

However, stands in the *Festuca arizonica* Herbaceous Alliance are usually found on the upland slopes or swales, whereas stands in the *Muhlenbergia filiculmis* alliance are found on the more mesic and flat valley floor, or flat mesa tops. Impacts of grazing on these stands may reduce the abundance of taller, palatable species such as *Festuca arizonica* and *Muhlenbergia montana*. Some *Muhlenbergia filiculmis* / *Bouteloua gracilis*-dominated stands may be seral stages of *Festuca arizonica* grassland.

ALLIANCE DISTRIBUTION

Range: Grasslands in this alliance are known from the southern Rocky Mountains south into the mountains in the Chihuahuan Desert region from Colorado to Trans-Pecos Texas. They also likely occur on the Mogollon Plateau in Arizona.

States: AZ?, CO, NM?, TX

TNC Ecoregions: 20:C, 21:C, 24:C

USFS Ecoregions: 321A:CC, 331J:CC, M313B:CC, M331G:CC

ALLIANCE SOURCES

Edition: 98-10-21

References: Clary 1978, Currie 1975, Diamond 1993, Dick-Peddie 1993, Johnson 1953, Johnson 1956, Johnson and Niederhof 1941, Johnson and Reid 1958, Johnson and Reid 1964, Johnston 1987, Komarkova 1986, Shanks 1977, Shepherd 1975, Smith 1967, Stewart 1940, Trlica and Hackney 1977, USDA Soil Conservation Service 1978

V.A.5.N.d.23. SCHIZACHYRIUM SCOPARIUM BUNCH HERBACEOUS ALLIANCE (A.1266)

Little Bluestem Bunch Herbaceous Alliance

ALLIANCE CONCEPT

Environment: Grasslands included in this alliance are known only from northwestern Great Plains in east-central Montana and the White Sands Missile Range in south-central New Mexico. Elevations range from 900-1250 m in Montana and 1200-1500 m in New Mexico. Climate is semi-arid to arid. In Montana stands occur on moderately steep slopes in the uplands. Soils are easily eroded, poorly developed, well-drained loams and stony loams that are non-saline and non-alkaline. Parent material is red shale from the Kootenai Formation. Groundcover average 15% bareground and 50% litter (Jorgensen 1979). The New Mexican stands are restricted to swales within wind-deposited gypsum sand dunes at White Sands National Monument and White Sands Missile Range.

Physiognomy: Vegetation included in this alliance has a sparse to moderately dense herbaceous layer dominated by medium-tall bunchgrasses. Sparse forb cover is present also present in this layer. Occasional scattered shrubs and dwarf-shrubs may be present.

Vegetation: Vegetation in this alliance is found in the northwestern Great Plains and gypsum dunes in the northern Chihuahuan Desert. Stands have a sparse to moderate graminoid layer that is dominated by *Schizachyrium scoparium*. Perennial forb richness is high, but canopy cover is low. Shrubs and dwarf-shrubs are rare. Annual forbs and grasses are present seasonally. In Montana, other common species include grasses such as *Pascopyrum smithii*, *Koeleria macrantha*, *Elymus lanceolatus*, *Poa secunda*, *Aristida purpurea*, *Nassella viridula* (= *Stipa viridula*) and *Stipa comata*. Forb species include *Phlox hoodii*, *Linum perenne*, *Tetaneuris acaulis* var. *acaulis* (= *Hymenoxys acaulis*), *Thelesperma subnudum*, *Dalea candida*, *Cerastium beeringianum* and *Solidago missouriensis*. In New Mexico, *Muhlenbergia pungens* often codominates these sparse interdune grasslands. Other species information is not available for the dune stands.

Dynamics: These stands occur on easily disturbed substrates such as gypsum sand dunes and shale outcrops. Disturbance from wind or water appears important in the maintenance the sparse vegetation cover characteristic of these stands.

Similar Alliances:

?? SCHIZACHYRIUM SCOPARIUM - BOUTELOUA CURTIPENDULA HERBACEOUS ALLIANCE (A.1225)

?? SCHIZACHYRIUM SCOPARIUM HERBACEOUS ALLIANCE (A.1240)

Similar Alliance Comments: The graminoids in stands in the similar alliances form a sod, unlike these grasslands that have relatively sparse cover of individual bunchgrasses with bare ground in the interstices.

Synonymy:

?? *Muhlenbergia cuspidata/Andropogon scoparius* Habitat Type, in part (Jorgensen 1979)

Comments: This alliance should be compared the sod-forming *Schizachyrium scoparium*-dominated alliances. This alliance is based on one stand in Montana (Jorgensen 1979), and one stand on White Sands Missile Range (NMNHP Unpublished data). Stands in New Mexico may be sparsely vegetated grasslands. More investigation is needed to better describe these grasslands.

ALLIANCE DISTRIBUTION

Range: This bunchgrass-dominated herbaceous alliance occurs in the northwestern Great Plains of Montana and possibly western North Dakota and Saskatchewan, Canada; and in the northern Chihuahuan Desert in the Tularosa Basin of south-central New Mexico. It may also occur on other gypsum sand dune deposits in the southwestern United States and northern Mexico.

States: MT,ND?,NM,SK?

TNC Ecoregions: 26:C

USFS Ecoregions: 321A:CC, 331D:CC, 331G:C?, M332D:CC

ALLIANCE SOURCES

Edition: 99-02-23

References: Faber-Langendoen et al. 1996, Jorgensen 1979, Muldavin and Melhop 1992, Muldavin et al. 1992

V.A.5.N.d.24. SPOROBOLUS AIROIDES HERBACEOUS ALLIANCE (A.1267)

Alkali Sacaton Herbaceous Alliance

ALLIANCE CONCEPT

Environment: Grasslands included in this alliance occur in the western and southern Great Plains, Great Basin and across the southwestern U.S. from Texas to California. Stands are reported from a variety of lowland sites such as intermittent drainages, terraces, swales, interdune basins and alluvial flats. Elevations range from near sea level to 2100 m, but the alliance occurs primarily from 1000 to 1600 m. Holland (1986) reported *Sporobolus airoides*-dominated communities from saline habitats in the Central Valley and in valleys and lower slopes of transmontane California, from the Modoc Plateau to

the Owens Valley at elevations up to 2100 m. The climate is arid to semi-arid. This alliance is not defined by a flood regime, but the soil often has a high water table because of land position and often impermeable subsurface horizons. Soils are non-saline to moderately saline and usually alkaline. Soil surface textures are sandy to clayey. The soil morphology often includes a claypan, caliche layer or other subsurface horizon that impedes water movement. Parent material is typically alluvium derived from limestone, shale, or sandstone.

Adjacent vegetation varies greatly regionally. In the plains, nearby vegetation is likely grassland-steppe or shrublands dominated by species of *Bouteloua*, *Atriplex* or *Sarcobatus*, or less frequently a woodland dominated by *Pinus edulis* or *Juniperus*. In southern deserts, desertscrub dominated by *Larrea tridentata*, *Flourensia cernua*, *Ambrosia dumosa*, *Prosopis* spp. or *Parkinsonia* spp. often borders these grasslands. On the Colorado Plateau and Great Basin, *Artemisia tridentata* and *Atriplex* spp. shrublands likely surround it. Adjacent vegetation at high elevations may include woodlands dominated by *Juniperus osteosperma* and species of *Pinus*, or Great Basin shrublands. Where this vegetation occurs near riparian areas, adjacent vegetation may include mesic shrublands and forests dominated by species of *Salix* or *Populus*.

Physiognomy: Communities in this alliance have a moderately dense graminoid layer dominated by medium-tall bunchgrasses with smaller densities of shortgrasses and forbs. Widely scattered xeromorphic or halophytic shrubs may also be present.

Vegetation: Vegetation included in this alliance occurs in lowlands primarily in the Great Plains, Great Basin and the southwestern deserts. It is characterized by a sparse to moderately dense graminoid layer of medium-tall bunchgrasses. These grasslands are characteristically dominated by *Sporobolus airoides* in pure and mixed stands. Typical codominant grasses include *Muhlenbergia porteri*, *Panicum obtusum* or *Scleropogon brevifolius*. Not included in this alliance are stands codominated by *Bouteloua gracilis*, *Distichlis spicata*, *Hilaria jamesii* or *Hordeum jubatum*, although these species may be present in small amounts. Other common grasses are *Buchloe dactyloides*, *Pascopyrum smithii*, *Hordeum pusillum* and *Sporobolus cryptandrus*. Forbs and shrubs are typically sparse. Common forb associates are *Chaetopappa ericoides* and species of *Sphaeralcea*, *Machaeranthera*, *Ratibida*, *Aster* and *Helianthus*. In more saline habitats species of *Salicornia* or *Suaeda* may be present. Scattered shrubs may include *Allenrolfea occidentalis*, *Atriplex canescens*, *Chrysothamnus* spp. and *Sarcobatus vermiculatus*. The dwarf-shrub, *Gutierrezia sarothrae* is common in many stands. Some stands have significant amounts of pear and cholla cacti (*Opuntia* spp.). Culver et al. (1996) described stands from southeastern Colorado with the following percent canopy cover: *Sporobolus airoides* (5-42%), *Pascopyrum smithii* (1-11%), *Bouteloua gracilis* (0-11%), *Distichlis spicata* (0-9%), *Hordeum pusillum* (0-5%) and *Aster falcatus* (0-7%). In New Mexico, Francis (1986) reported a nearly pure stand of *Sporobolus airoides* with 14% cover and mixed stands with canopy cover of 7-30% for *Sporobolus airoides*, 2-4% for *Pascopyrum smithii*, and less than 2% each for *Bouteloua gracilis*, *Sporobolus cryptandrus* and *Hilaria jamesii*.

Dynamics: *Sporobolus airoides* will decrease in abundance with increased soil salinity. If a moderate salinity level is maintained, this grass forms hummocks that accumulate sand and gradually lose salinity and moisture. This creates a microhabitat for invasion by salt intolerant species (Ungar 1974, as cited by Johnston 1987).

Similar Alliances:

- ?? SPOROBOLUS AIROIDES INTERMITTENTLY FLOODED HERBACEOUS ALLIANCE (A.1331)
- ?? SPOROBOLUS AIROIDES SOD HERBACEOUS ALLIANCE (A.1241)
- ?? DISTICHLIS SPICATA - (HORDEUM JUBATUM) TEMPORARILY FLOODED HERBACEOUS ALLIANCE (A.1341)
- ?? HILARIA JAMESII HERBACEOUS ALLIANCE (A.1287)
- ?? HORDEUM JUBATUM TEMPORARILY FLOODED HERBACEOUS ALLIANCE (A.1358)

Similar Alliance Comments: Most *Sporobolus airoides* herbaceous associations fall into this alliance. One of the similar alliances, V.A.5.N.i.4 *Sporobolus airoides* Intermittently Flooded Herbaceous Alliance (A.1331), is separated because of an intermittent flood regime. This affects soil moisture and salinity which can alter species composition. Another alliance, V.A.5.N.c.36 *Sporobolus airoides* Sod Herbaceous Alliance (A.1241), is separated by an atypical sod formed by *Sporobolus airoides* and *Bouteloua gracilis*. *Sporobolus airoides* is a wide-ranging western grass species and is a nominal species in several associations with shrubs such as *Atriplex* spp., *Artemisia tridentata* and *Sarcobatus vermiculatus*, and graminoid species such as *Hilaria jamesii* and *Distichlis spicata*. Other similar alliances include V.A.5.N.j.5 *Distichlis spicata* - (*Hordeum jubatum*) Temporarily Flooded Herbaceous Alliance (A.1341), V.A.5.N.e.14 *Hilaria jamesii* Herbaceous Alliance (A.1287), and V.A.5.N.j.22 *Hordeum jubatum* Temporarily Flooded Herbaceous Alliance (A.1358).

Synonymy:

- ?? *Sporobolus airoides* Series (Johnston 1987)
- ?? Tussock Grass, Type 37 (Aldous and Shantz 1924)
- ?? Alkali Meadow, Type 45310, in part (Holland 1986)
- ?? Sacaton Series, in part (Dick-Peddie 1993)
- ?? Alkali Sacaton Series, in part (Sawyer and Keeler-Wolf 1995)
- ?? Valley sacaton grassland, in part (Holland 1986)
- ?? Alkali Sacaton-Fourwing Saltbush Series, in part (Diamond 1993)

Comments: This alliance is found primarily in the western Great Plains. It is largely in the western United States. Classification of types found in California are provisional and need further description. Further survey may locate stands of this alliance in Nevada.

ALLIANCE DISTRIBUTION

Range: This widespread alliance occurs primarily in the western and southern Great Plains, across the southwestern United States from the Chihuahuan Desert into southern and western California, and throughout the Great Basin. It also likely occurs in the adjacent Mexican states of Coahuila, Chihuahua, Sonora, and Baja California.

States: CA?, CO, KS, MT, MXCO, ND, NM, SD, TX

TNC Ecoregions: 26:C, 27:C

USFS Ecoregions: 262:P, 313E:CC, 315A:CC, 315B:CP, 321A:CC, 322:P, 331F:C?, 331G:C?, 331I:CC, 341:P, 342G:P?, M331G:CC, M331I:CC

ALLIANCE SOURCES

Edition: 98-04-17

References: Aldous and Shantz 1924, Bock and Bock 1986, Brown 1982, Burgess and Klein n.d., Burgess and Northington 1977, Cooper 1984, Culver et al. 1996, Diamond 1993, Dick-Peddie 1993, Faber-Langendoen et al. 1996, Faber-Langendoen et al. 1997, Francis 1986, Henrickson 1977, Henrickson et al. 1985, Holland 1986, Johnston 1987, Kartesz 1994, Kittel and Lederer 1993, Lesica and DeVelice 1992, Lindauer 1970, Muldavin and Melhop 1992, Neher and Bailey 1976, Sawyer and Keeler-Wolf 1995, Steward 1982, USDA Soil Conservation Service 1978, Ungar 1968, Ungar 1972, Ungar 1974, Whitfield and Anderson 1938

V.A.5.N.d.25. SPOROBOLUS FLEXUOSUS HERBACEOUS ALLIANCE (A.1268)

Mesa Dropseed Herbaceous Alliance

ALLIANCE CONCEPT

Environment: Grasslands in this Chihuahuan Desert alliance are found in sandy basins and lower piedmonts in southern New Mexico. The climate is semi-arid with most of the annual precipitation of about 35 cm occurs during the summer months as the result of convectional thunderstorms and during winter as occasional rains. Late spring and early summer are typically dry. Summers are hot, and winters can have periods of cold weather and occasional snows. Elevations range from 1200-1580 m. Stands have been found on the edge of a sandy playas bottom where there is a slight slope. *Sporobolus flexuosus* stands generally occur in loose, and/or blowing sands. The soil is derived from sandy alluvium and is classified as a Psamment, with little pedogenic development. The edge of the playa is probably inundated less often than the center of the playa, consequently salinity on the edge could be high. This plant association is presently known from extreme southwestern New Mexico on the Gray Ranch, Hidalgo County. Other possible locations include Texas, but the association has not been documented from there.

Physiognomy: Vegetation in this alliance has a sparse to moderately dense herbaceous layer is dominated by perennial bunchgrasses. A sparse to moderately dense forb layer is often present. Annuals may be seasonally abundant.

Vegetation: Vegetation in this Chihuahuan alliance is found in sandy basins and piedmonts. Stands have a herbaceous layer that averages between 20-40% cover. It is dominated by the perennial bunchgrass, *Sporobolus flexuosus*. Codominates are typically the grasses *Erioneuron pulchellum*, *Paspalum setaceum* and *Sporobolus contractus*. Other graminoids may include *Aristida divaricata*, *Bouteloua eriopoda*, *B. gracilis*, *B. parryi*, *Cyperus esculentus* and *Leptocoma cognatum*. Forbs are moderately sparse, averaging less than 15% total cover. A common perennial forb is *Chamaesyce albomarginata* (= *Euphorbia albomarginata*) with up to 10% cover in one stand. Other species may include *Eriogonum wrightii*, *Hymenopappus flavescens*, *Sida neomexicana* and *Solanum* spp. Annuals may be seasonally abundant during wet years. Sparsely scattered *Yucca elata* shrubs may be present on some stands (Muldavin et al. 1998).

Dynamics: *Sporobolus flexuosus* has replaced *Bouteloua eriopoda* in areas on the Jornada Experimental Range (Hennessy 1983). *Sporobolus flexuosus* is more drought- and grazing-tolerant than *Bouteloua eriopoda* (Muldavin et al. 1998).

Similar Alliances:

? BOUTELOUA GRACILIS HERBACEOUS ALLIANCE (A.1282)

Similar Alliance Comments: The V.A.5.N.e.9 *Bouteloua gracilis* Herbaceous Alliance (A.1282) has one association with *Sporobolus flexuosus* listed as a codominant. This may create classification confusion when *Bouteloua gracilis* is present but not codominant.

Synonymy:

? *Sporobolus flexuosus* Series (Muldavin et al. 1998)

Comments: The V.A.5.N.e.9 *Bouteloua gracilis* Herbaceous Alliance (A.1282) has one association with *Sporobolus flexuosus* listed as a codominant. This may create classification confusion when *Bouteloua gracilis* is present but not codominant.

ALLIANCE DISTRIBUTION

Range: This grassland occurs near sandy playas in the Chihuahuan Desert in southern New Mexico and possibly likely adjacent western Texas. It potentially could be found in southeastern Arizona, and Chihuahua (?) and Sonora (?), Mexico.

States: NM, TX?

TNC Ecoregions: 24:C

USFS Ecoregions: 321A:CC

ALLIANCE SOURCES

Edition: 98-06-02

References: Bourgeron et al. 1993, Bourgeron et al. 1995, Hennessy et al. 1983, Muldavin and Melhop 1992, Muldavin et al. 1998, Reid et al. 1994

V.A.5.N.d.26. SPOROBOLUS NEALLEYI HERBACEOUS ALLIANCE (A.1269)

Nealley's Dropseed Herbaceous Alliance

ALLIANCE CONCEPT

Environment: Vegetation included in this minor alliance occurs on mesas, plains and dunes with gypsiferous soil in New Mexico. Elevations range from 1150-1740 m. Climate is semi-arid to arid with most of the highly variable precipitation falling in late summer and early fall. Mean annual precipitation ranges from 20-32 cm. Soils are shallow, poorly developed, saline, alkaline and gypsiferous. Soil textures range from fine sandy loams to silty clay loams. Plant and litter cover are low, and bare ground is high (90%). Shale and sandstone rock outcrops may also be present. Stands in this alliance are poorly known and have only been described from mesas in the Rio Puerco watershed and gypsum flats and dunes in the White Sands Missile Range (Francis 1986, Muldavin and Mehlhop 1992, Neher and Bailey 1971).

Physiognomy: Vegetation in this alliance has a sparse herbaceous layer of medium-tall, perennial grasses with short grasses or perennial forbs. Scattered shrubs and dwarf-shrubs may also be present.

Vegetation: Vegetation in this minor alliance is restricted to gypsum soils on mesas and plains in the New Mexico. The diagnostic species is the perennial grass, *Sporobolus nealleyi* which dominates or codominates the sparse herbaceous layer, with *Bouteloua eriopoda*, *Calylophus hartwegii* and/or *Leptodactylon* spp. Associated grasses may include *Hilaria jamesii* and *Bouteloua gracilis*. Other frequent forbs include *Psilostrophe tagetina* and *Sphaeralcea coccinea*. In addition, scattered shrubs and dwarf shrubs may be present including *Atriplex canescens*, *Ephedra torreyana*, *Flourensia cernua*, *Krascheninnikovia lanata*, *Gutierrezia sarothrae* and *Lycium pallidum* (Francis 1986, Neher and Bailey 1971).

Dynamics: Grazing has significantly impacted much of the vegetation in this region, which has had a long history of settlement and heavy livestock use. With proper livestock management and time, palatable species such as *Krascheninnikovia lanata* may increase, and *Gutierrezia sarothrae* decline in abundance (Francis 1986).

Similar Alliances:

?? SPOROBOLUS NEALLEYI SHRUB HERBACEOUS ALLIANCE (A.1542)

Similar Alliance Comments: The similar alliance also has *Sporobolus nealleyi* as diagnostic species, however there is also a significant shrub component, which is not found in the *Sporobolus nealleyi* Herbaceous Alliance.

Synonymy:

?? *Sporobolus nealleyi* - *Bouteloua eriopoda* Plant Community. included in the *Sporobolus* subformation (Francis 1986)

Comments: This alliance may be too sparse in cover to be classified as a grassland. Francis (1986) reported the vegetation cover as 8.7% total plant cover with 2.5% litter cover and 88.8% bare ground in the Rio Puerco watershed in northwest New Mexico. Further study is needed, especially on the effects of livestock grazing on vegetation structure.

ALLIANCE DISTRIBUTION

Range: Vegetation in this alliance has been described from the upper Rio Puerco watershed in northwestern New Mexico, and from White Sands Missile Range in southwestern New Mexico. This alliance may occur elsewhere in the southwest where gypsum soils are present.

States: NM

TNC Ecoregions:

USFS Ecoregions: 321A:CC

ALLIANCE SOURCES

Edition: 98-04-01

References: Francis 1986, Muldavin and Melhop 1992, Neher and Bailey 1976, Warnock 1974

V.A.5.N.d.29. STIPA NEOMEXICANA HERBACEOUS ALLIANCE (A.1272)

New Mexico Needlegrass Herbaceous Alliance

ALLIANCE CONCEPT

Environment: Stands of this alliance occur on ridges and upper slopes in the foothills of the Colorado Front Range, on slopes, ridges, and mesa tops on the dissected plains in southeast Colorado and adjacent New Mexico, the steppes of southern Great Plains, the Trans-Pecos region and into southcentral New Mexico. Climate is semi-arid with most of the precipitation falling during the growing season. Elevation ranges from 1350 to 1800 m. Soils are usually derived from shales and are generally alkaline, coarse textured, shallow and rocky often with limestone fragments. This grassland is often found on the cooler northern aspects, but can occur on all aspects on sites with gentle slopes. Short-grass communities dominated by *Bouteloua gracilis* often occur on adjacent lower slopes and plains where soils are generally finer textured. Woodland communities dominated by *Pinus ponderosa* or *Juniperus monosperma* may occur above these grasslands on the larger ridges and in the foothills.

Physiognomy: Vegetation in this alliance has a sparse to dense graminoid layer dominated medium-tall temperate bunchgrasses. An understory of sparse to moderately dense layer of shortgrasses is often present as well as a sparse shrub layer. Forb cover is typically sparse.

Vegetation: Vegetation included in this alliance occurs on rocky ridges and shaley slopes from the Colorado Front Range foothills to southern New Mexico and west Texas. Stands are dominated by a sparse to dense layer of the cool-season, medium-tall bunchgrass, *Stipa neomexicana*. Stands may be nearly pure *Stipa* or mixed with other mid-grasses such as *Bouteloua curtipendula* and *Oryzopsis hymenoides*. Often a sparse to moderately dense shortgrass layer is present that may be dominated by *Bouteloua gracilis*, *B. eriopoda*, *B. hirsuta* or *Aristida* spp. Density of the grass cover may be limited by the size and amount of surface rock at some the rock outcrop sites where it occurs. Scattered shrubs such as *Rhus trilobata* and *Yucca glauca* or in the Trans-Pecos region, *Dasyllirion wheeleri* and *Nolina* spp. are common. In some stands the dwarf-shrub, *Gutierrezia sarothrae* is abundant. Forb cover is generally sparse, but common forbs may include *Evolvulus nuttallianus*, *Musineon divaricatum* and *Dalea* spp.

Dynamics: Heavy grazing by livestock has been shown to reduce the abundance of *Stipa* and favor the short grasses in Canada (Smoliak 1972). Where stands of this vegetation occur on steep rocky slopes, this may not be a big concern because of limited accessibility by livestock. *Stipa neomexicana* is a C3 grass is favored on sites where winter precipitation is generally more abundant. Grasslands dominated by *Stipa neomexicana* integrate with stands dominated by *Juniperus monosperma* on mesa tops in southeast Colorado. Fire suppression and/or grazing may allow *Juniperus monosperma* to invade the grasslands.

Similar Alliances:

?? JUNIPERUS MONOSPERMA WOODLAND ALLIANCE (A.504)

?? JUNIPERUS OSTEOSPERMA WOODLAND ALLIANCE (A.536)

?? BOUTELOUA ERIOPODA HERBACEOUS ALLIANCE (A.1284)

?? BOUTELOUA GRACILIS HERBACEOUS ALLIANCE (A.1282)

?? BOUTELOUA HIRSUTA HERBACEOUS ALLIANCE (A.1285)

Similar Alliance Comments: Each of the similar alliances have an association codominated by *Stipa neomexicana*. The grasslands in the alliance described here are dominated by *Stipa neomexicana* without codominance of *Bouteloua* spp. or a significant woody layer.

Synonymy:

?? *Stipa neomexicana* Series (Muldavin et al. 1998)

?? *Stipa neomexicana* Community (Moir 1969)

?? Grama-Feathergrass Series, in part (Dick-Peddie 1993)

Comments:

ALLIANCE DISTRIBUTION

Range: Grasslands in this alliance occur on ridges and slopes in the foothills of the Colorado Front Range, on slopes, ridges, and mesa tops on the dissected plains in southeast Colorado and adjacent New Mexico, the steppes of southern Great Plains and the Trans-Pecos region of western Texas and south-central New Mexico. Stands may also occur in southeastern Arizona, southeastern Wyoming and Chihuahua, Mexico.

States: CO,NM

TNC Ecoregions: 27:C

USFS Ecoregions: 315A:CC, 321A:CC, 331I:CC, M313B:??, M331I:CC

ALLIANCE SOURCES

Edition: 98-04-01

References: Beavis et al. 1982, Bunin 1985, Moir 1969, Muldavin and Melhop 1992, Muldavin et al. 1998

V.A.5.N.d.6. HILARIA MUTICA HERBACEOUS ALLIANCE (A.1249)

Tobosa Herbaceous Alliance

ALLIANCE CONCEPT

Environment: Grasslands in this alliance occur on rolling plains in central Texas, in swales on mesas, plains and piedmonts, in basins, around playas and on gentle foothill slopes in the Chihuahuan Desert. Elevations range from 1300 to 1650 meters. Climate is arid to semi-arid with hot summers. Freezing temperatures may occur during winter. Mean annual precipitation is approximately 22 cm at the Jornada Experimental Range, but is highly variable with drought not uncommon. Annual precipitation is distributed bimodally with about a third of precipitation occurring in late winter and two-thirds in July through October often as high-intensity convective storms. The most arid season is late spring and early summer. Most stands occur on nearly level to gently sloping sites on all aspects. They sometimes occupy sites that receive excess run-off from the surrounding landscape and hence represent small, internally drained basin bottoms. Although these grasslands may receive additional moisture from overland flow during high-intensity rainstorms, they are not considered flooded. The flooded stands are classified in an intermittently flooded alliance and are flooded for longer periods. Soils are shallow to deep, silt or clay loams, or clays, alkaline, and often calcareous sometimes with caliche or argillic horizons. On steeper slopes soils may be very stony. Soils are derived from gravelly or silty alluvium, or basalt. Groundcover is relatively low and variable. Bourgeron et al. (1993) described stands where mean cover of bare soil, rock and litter ranged from 10-60%, 3-83%, and 3-40%, respectively, and combined bare soil, gravel and rock ranged from 53-93% ground cover. Plant basal cover is less than 5%.

These grasslands most commonly occur in swales and along drainages that dissect the plains, piedmonts and mesas. They are surrounded by a matrix of desert shrublands often dominated by *Larrea tridentata*, and by mixed grasslands. Saline-influenced area grade into *Sporobolus airoides*-dominated grasslands. Rarely, stands will occur on slopes in a transition zone between *Larrea tridentata*-dominated desertscrub and upland desert grasslands.

Physiognomy: Vegetation included in this alliance has a moderately dense graminoid layer dominated by perennial medium-tall bunchgrasses and shortgrasses. The forb layer is sparse. Sparsely scattered cacti and shrubs may be present.

Vegetation: Vegetation included in this grassland alliance occurs on alluvial flats and swales within the Chihuahuan Desert and the southwestern rolling plains and northwestern Edwards Plateau of Texas. Stands have a sparse to moderately dense graminoid layer of perennial medium-tall bunchgrasses that are often codominated by short grasses. This vegetation is often distributed in patches. The bunchgrass, *Hilaria mutica*, usually dominates the stand. Short grasses may include *Bouteloua gracilis*, *Buchloe dactyloides*, *Erioneuron pulchellum*, *Muhlenbergia* spp. and *Scleropogon brevifolius*. Other common mid-grasses include *Aristida* spp., *Bouteloua curtipendula*, *Digitaria californica*, *Eragrostis intermedia*, *Panicum obtusum* and *Sporobolus* spp. The usually sparse perennial forbs may include *Chamaesyce albomarginata*, *Hoffmannseggia glauca*, *Solanum elaeagnifolium*, *Solanum rostratum* and *Talinum aurantiacum*. Scattered shrubs such as *Prosopis glandulosa*, *Opuntia imbricata*, *Nolina microcarpa* and *Larrea tridentata* may be present, but generally have than 10% cover. Annual forbs and grasses are seasonally present and may be abundant in some stands.

Dynamics: Impermeable caliche and argillic horizons are not uncommon on these sites. These layers restrict deep percolation of soil-water and may favor the shallower root grasses over more deeply rooted shrubs like *Larrea tridentata* and *Prosopis* spp. (McAuliffe 1995). *Hilaria mutica* is relatively tolerant of livestock grazing. In west central Arizona, livestock have nearly eliminated all native grasses except *Hilaria mutica* from semi-desert grassland (Brown 1982). Exotic plants invaded, especially exotic annual grasses, such as *Bromus rubens*, and now dominate the landscape. These *Hilaria mutica* grasslands are the result of livestock disturbance and exotic plant invasion and should not be classified as natural. Stands codominated by *Scleropogon brevifolius* are characteristic of sites with past heavy grazing by livestock (Whitfield and Anderson 1938).

Similar Alliances:

?? HILARIA MUTICA INTERMITTENTLY FLOODED HERBACEOUS ALLIANCE (A.1330)

?? HILARIA MUTICA SHRUB HERBACEOUS ALLIANCE (A.1551)

Similar Alliance Comments: Vegetation included in V.A.5.N.i.3 *Hilaria mutica* Intermittently Flooded Herbaceous Alliance (A.1330) and V.A.7.N.m.4 *Hilaria mutica* Shrub Herbaceous Alliance (A.1551) is also dominated by *Hilaria mutica*.

Synonymy:

?? Tobosa Series (Diamond 1993)

?? Tobosa Grass-Scrub Series, *Hilaria mutica* Association (Brown 1982)

?? Tobosa Series (Swales). included within the Plains-Mesa Grassland (Dick-Peddie 1993)

Comments: Most of these stands described by Bourgeron et al. (1993) do not have enough cover to be classified as grasslands. Some of the cover may have been reduced by grazing animals. More study is needed to determine if a sparsely vegetated *Hilaria mutica* alliance is needed. Also, one stand had 10 percent *Opuntia imbricata* plus 6 percent other shrubs and may need to be placed in the shrub herbaceous alliance.

ALLIANCE DISTRIBUTION

Range: Grasslands included in this Chihuahuan Desert alliance occur in central and western Texas, southern New Mexico, southeastern Arizona, and in the Mexican states of Chihuahua and Coahuila.

States: NM, TX

TNC Ecoregions: 24:C, 28:C, 29:C

USFS Ecoregions: 315A:C?, 315D:CC, 321A:CC, 321B:CC

ALLIANCE SOURCES

Edition: 98-03-13

References: Bourgeron et al. 1993, Bourgeron et al. 1995, Brown 1982, Diamond 1993, Dick-Peddie 1993, McAuliffe 1995, Muldavin et al. 1998, Rzedowski 1981, Whitfield and Anderson 1938, Whitfield and Beutner 1938

V.A.5.N.e. Short sod temperate or subpolar grassland

V.A.5.N.e.11. BOUTELOUA ERIOPODA HERBACEOUS ALLIANCE (A.1284)

Black Grama Herbaceous Alliance

ALLIANCE CONCEPT

Environment: Grasslands included in this alliance occur in the Chihuahuan Desert and Colorado Plateau on mesas and plains. In southeastern Colorado and northeastern New Mexico it occurs on mesa slopes and canyonsides. Elevation ranges from 1100-2000 m. The climate is semi-arid with highly variable, bimodal distributed precipitation. Approximately two-thirds of the 20-40 cm mean annual precipitation occurs in the late summer and early fall, usually as localized high-intensity thunderstorms. Soils are generally shallow, well-drained sandy or stony loams to silt-loams. Parent materials include granite, quartz monzonite, limestone and sandstone. These grasslands do not do well on shifting sands.

Physiognomy: Vegetation in this alliance is dominated by perennial short sod grasses. Forbs are generally sparse.

Vegetation: Vegetation in this alliance occurs on mesas and plains in southern Great Plains and Chihuahuan Desert and is dominated or codominated by the perennial, stoloniferous short grass, *Bouteloua eriopoda* with only scattered shrubs or dwarf shrubs. Nearly pure stands occasionally occur on sandy mesas and may not form a sod (Nelson 1934). Usually *B. eriopoda* grows in dense patches with more evenly distributed codominant species such as *B. curtipendula*, *B. gracilis*, *B. hirsuta*, *B. trifida*, *Hilaria jamesii* or *Stipa neomexicana*. Forb cover is sparse but may be diverse including species like *Baileya multiradiata*, *Artemisia ludoviciana*, *Sphaeralcea* spp., *Eriogonum wrightii* and *Senecio flaccidus* var. *flaccidus*. If present, the scattered shrubs and dwarf-shrubs may include *Yucca baccata*, *Yucca elata*, *Opuntia phaeacantha*, *Gutierrezia sarothrae*, *Dasyliirion wheeleri* or *Opuntia imbricata*.

Dynamics: The abundance of *Bouteloua eriopoda*-dominated grasslands has declined significantly in the last 50 years (Buffington and Herbal 1965, Gardner 1950, Hennessy et al. 1983, Herbal et al. 1972, Nelson 1934).

Similar Alliances:

?? BOUTELOUA HIRSUTA - BOUTELOUA GRACILIS - BOUTELOUA ERIOPODA SHRUB HERBACEOUS ALLIANCE (A.1548)

?? BOUTELOUA ERIOPODA DWARF-SHRUB HERBACEOUS ALLIANCE (A.1570)

?? BOUTELOUA ERIOPODA MICROPHYLOUS EVERGREEN SHRUB HERBACEOUS ALLIANCE (A.1545)

?? BOUTELOUA ERIOPODA XEROMORPHIC SHRUB HERBACEOUS ALLIANCE (A.1553)

Similar Alliance Comments: There appears to be significant overlap between V.A.7.N.m.1 *Bouteloua hirsuta* - *Bouteloua gracilis* - *Bouteloua eriopoda* Shrub Herbaceous Alliance (A.1548), V.A.8.N.a.6 *Bouteloua eriopoda* Dwarf-shrub Herbaceous Alliance (A.1570), V.A.7.N.j.2 *Bouteloua eriopoda* Microphyllous Evergreen Shrub Herbaceous Alliance (A.1545), and V.A.7.N.m.6 *Bouteloua eriopoda* Xeromorphic Shrub Herbaceous Alliance (A.1553). These stands also have herbaceous layers dominated or codominated by *Bouteloua eriopoda*, but the stands in the similar alliances have a sparse layer of shrubs or dwarf shrubs.

Synonymy:

?? Grama-Galleta Series. within series (Dick-Peddie 1993)

?? Black Grama Series. within series (Donart et al. 1978)

?? Sideoats Grama-Black Grama Series, in part (Diamond 1993)

Comments: There appears to be significant overlap between V.A.7.N.m.1 *Bouteloua hirsuta* - *Bouteloua gracilis* - *Bouteloua eriopoda* Shrub Herbaceous Alliance (A.1548), V.A.8.N.a.6 *Bouteloua eriopoda* Dwarf-shrub Herbaceous Alliance (A.1570), V.A.7.N.j.2 *Bouteloua eriopoda* Microphyllous Evergreen Shrub Herbaceous Alliance (A.1575), and V.A.7.N.m.6 *Bouteloua eriopoda* Xeromorphic Shrub Herbaceous Alliance (A.1553).

ALLIANCE DISTRIBUTION

Range: Stands included in this alliance are found on the southern Great Plains, Chihuahuan Desert and on the Colorado Plateau from southeastern Colorado, New Mexico, possibly Oklahoma, western Texas, Arizona, and adjacent Chihuahua and Sonora, Mexico.

States: AZ?,NM,TX?

TNC Ecoregions: 24:C, 28:C

USFS Ecoregions: 315A:CC, 321A:CC, M313B:CC

ALLIANCE SOURCES

Edition: 98-08-28

References: Aldous and Shantz 1924, Anderson et al. 1985, Bourgeron et al. 1993, Bourgeron et al. 1995, Buffington and Herbel 1965, DeOliviera 1961, Diamond 1993, Dick-Peddie 1993, Dick-Peddie n.d., Donart et al. 1978, Francis 1986, Gardner 1950, Gardner 1951, Hennessy et al. 1983, Herbel et al. 1972, Johnson 1961, Muldavin and Melhop 1992, Muldavin et al. 1998, Nelson 1934, Stein and Ludwig 1979, Whitfield and Anderson 1938, Whitfield and Beutner 1938

V.A.5.N.e.12. BOUTELOUA HIRSUTA HERBACEOUS ALLIANCE (A.1285)

Hairy Grama Herbaceous Alliance

ALLIANCE CONCEPT

Environment: Grasslands in this alliance occur on the southern Great Plains, slopes of foothills in the southern Rocky Mountains, and on mountain slopes and mesa escarpments in the Chihuahuan Desert. Slopes may be gentle on plains, valleys and mesas tops or very steep in the mountains. Climate is semiarid. Elevation ranges from 1450 to 2000 m. Stands grow on relatively cooler sites at low elevations and warmer sites at high elevations. Ground cover is variable. Bourgeron *et al.* (1993) found bareground, gravel/rock, and litter cover range from 5-50%, 20-60%, and 3-60%, respectively. Soils are sandy - silty loams derived from calcareous limestone, siltstone, igneous (rhyolite) and/or plutonic rocks. In the Chihuahuan Desert mountains, adjacent communities at lower elevations are usually *Bouteloua curtipendula* or *B. eriopoda* dominated. Communities upslope are typically shrublands dominated by *Cercocarpus montanus*. In the plains, grasslands in this alliance occupy rocky hilltops and sandy sites (Weaver and Albertson 1956).

Physiognomy: Communities in this alliance have a sparse to moderately dense graminoid layer dominated by short sod grasses. Midgrasses and sparse scattered shrubs may be also be present.

Vegetation: Grasslands in this alliance occur in the southern Great Plains, on slopes of foothills in the southern Rocky Mountains and on mountain and mesas slopes in the Chihuahuan Desert. Stands have a sparse to moderately dense graminoid layer ranging from 10% to 40% canopy cover. The grass layer is usually dominated by the short grass, *Bouteloua hirsuta*. Codominant grasses may include *Bouteloua curtipendula*, *B. radicata*, *Digitaria californica*, *Eragrostis intermedia*, and *Stipa neomexicana*. Forb cover is generally sparse (less than 10%). Characteristic forbs include *Croton pottsii*, *Eriogonum wrightii*, *Krameria* spp., *Mollugo verticillata*, *Sphaeralcea* spp. and *Zinnia grandiflora*. Sparse scattered shrubs may be present, but rarely make up more than 5% cover. Common shrubs include *Prosopis glandulosa*, *Nolina microcarpa*, *Agave palmeri*, and *Dasyliion wheeleri*. Scattered cacti are also characteristic and often include *Opuntia imbricata*, *O. phaeacantha* and *Coryphantha* spp.

Dynamics: Muldavin et al. (1998) suggest communities in this alliance are weakly associated with relatively mesic sites and disturbance.

Similar Alliances:

?? BOUTELOUA HIRSUTA - BOUTELOUA GRACILIS - BOUTELOUA ERIOPODA SHRUB HERBACEOUS ALLIANCE (A.1548)

?? STIPA NEOMEXICANA HERBACEOUS ALLIANCE (A.1272)

?? BOUTELOUA CURTIPENDULA HERBACEOUS ALLIANCE (A.1244)

Similar Alliance Comments: Similar alliances include V.A.7.N.m.1 *Bouteloua hirsuta* - *Bouteloua gracilis* - *Bouteloua eriopoda* Shrub Herbaceous Alliance (A.1548), V.A.5.N.d.29 *Stipa neomexicana* Herbaceous Alliance (A.1272), and V.A.5.N.d.1 *Bouteloua curtipendula* Herbaceous Alliance (A.1244).

Synonymy:

?? *Bouteloua hirsuta* herbaceous series. This only includes southern Great Plains associations. (Hoagland 1996)

?? *Bouteloua hirsuta* Series. This also includes some of the shrub herbaceous alliances. (Muldavin et al. 1998)

?? *Bouteloua hirsuta* herbaceous series. This also includes some of the shrub herbaceous alliances. (Hoagland 1997)

?? Blue grama-Buffalograss Series. in part? (Diamond 1993)

?? Sideoats Grama-Black Grama Series. in part? (Diamond 1993)

?? Sideoats Grama Series, in part (Diamond 1993)

Comments: *Bouteloua hirsuta* is a widespread grass in the West and is codominant in several grassland, shrubland and woodland associations and one other alliance. The key characteristic of this alliance is the dominance of the shortgrass, *Bouteloua hirsuta*, with only minor amounts of *Bouteloua gracilis* present and the lack of a significant shrub or tree layer.

ALLIANCE DISTRIBUTION

Range: Grasslands in this alliance occur on the plains and slopes of foothills and mesas in Oklahoma, Texas, New Mexico, and southeastern Arizona. The alliance is also found in the Mexican states of Chihuahua and Coahuila.

States: AZ?,MXCH?,NM,OK,TX

TNC Ecoregions: 20:C, 21:C, 24:C, 27:C, 28:C

USFS Ecoregions: 315A:CC, 321A:CC, 331I:CC, M313B:CC, M331F:CC

ALLIANCE SOURCES

Edition: 98-08-22

References: Bourgeron et al. 1993, Bourgeron et al. 1995, Diamond 1993, Hoagland 1997, Muldavin and Melhop 1992, Muldavin et al. 1992, Muldavin et al. 1994, Muldavin et al. 1998, Weaver and Albertson 1956

V.A.5.N.e.14. HILARIA JAMESII HERBACEOUS ALLIANCE (A.1287)

James' Galleta Herbaceous Alliance

ALLIANCE CONCEPT

Environment: This alliance occurs in arid and semi-arid regions in the southwestern U.S. on a variety of land forms such as plains, mesas alluvial flats and bajadas. Soils range from sandy to finer textured and are often shale derived (Weaver and Albertson 1956).

Physiognomy: Vegetation in this alliance has a sparse to moderately dense herbaceous layer is dominated by perennial bunchgrasses. A sparse to moderately dense forb layer is often present. Annuals may be seasonally abundant.

Vegetation: Vegetation included in this southwestern alliance occurs on mesas, plains, alluvial flats and fans. The herbaceous layer has sparse to moderate cover of perennial grasses, dominated by *Hilaria jamesii*, sometimes growing in nearly pure stands. *Hilaria jamesii* usually grows as a bunchgrass, but under favorable conditions produces a sod (West 1972). Total vegetation cover ranges from 14-41% and *Hilaria jamesii* cover ranges from 8-34% (Francis 1986, Dwyer et al. 1973). Other common perennial grasses are *Sporobolus airoides*, *S. cryptandrus*, *Oryzopsis hymenoides* and *Bouteloua gracilis*. The sparse forb layer often includes *Sphaeralcea coccinea* and *Astragalus* spp. Occasional scattered shrubs and dwarf-shrubs species of *Artemisia*, *Atriplex*, *Chrysothamnus* and *Ephedra*, as well as the more frequent *Gutierrezia sarothrae* and *Krascheninnikovia lanata*.

Dynamics: *Hilaria jamesii* is both drought and grazing resistant (Weaver and Albertson 1956, West 1972). In parts of its range it increases under grazing, and in others parts it decreases. The grass is favored in mixed-grass stands because it is only moderately palatable to livestock, but decreases when heavily grazed during drought and in the more arid portions of its range where it is the dominant grass (West 1972). This grass reproduces extensively from scaly rhizomes. These rhizomes make the plant resistant to trampling by livestock and have good soil binding properties (Weaver and Albertson 1956, West 1972).

Similar Alliances:

- ?? HILARIA JAMESII SHRUB HERBACEOUS ALLIANCE (A.1532)
- ?? HILARIA JAMESII DWARF-SHRUB HERBACEOUS ALLIANCE (A.1572)
- ?? ARTEMISIA TRIDENTATA SHRUBLAND ALLIANCE (A.829)
- ?? ARTEMISIA TRIDENTATA SSP. TRIDENTATA SHRUBLAND ALLIANCE (A.830)
- ?? ATRIPLEX CANESCENS SHRUBLAND ALLIANCE (A.869)
- ?? ATRIPLEX CONFERTIFOLIA SHRUBLAND ALLIANCE (A.870)
- ?? KRASCHENINNIKOVIA LANATA DWARF-SHRUBLAND ALLIANCE (A.1104)
- ?? CHRYSOTHAMNUS PARRYI SHRUBLAND ALLIANCE (A.818)
- ?? COLEOGYNE RAMOSISSIMA SHRUBLAND ALLIANCE (A.874)
- ?? ARTEMISIA NOVA DWARF-SHRUBLAND ALLIANCE (A.1105)
- ?? ATRIPLEX GARDNERI DWARF-SHRUBLAND ALLIANCE (A.1110)
- ?? BOUTELOUA ERIPODA HERBACEOUS ALLIANCE (A.1284)
- ?? BOUTELOUA GRACILIS HERBACEOUS ALLIANCE (A.1282)

Similar Alliance Comments: Two of the similar alliances, *Hilaria jamesii* Shrub Herbaceous Alliance and *Hilaria jamesii* Dwarf-Shrub Herbaceous Alliance, have *Hilaria jamesii* as diagnostic groundcover for the alliance. All others have *Hilaria jamesii* as diagnostic groundcover for at least one association in the alliance.

Synonymy:

- ?? *Hilaria jamesii* - *Sporobolus airoides* Plant Community. Plant community #37 (Francis 1986)
- ?? Highland Grass, in part (Nichol 1937)

Comments: Some stands in this alliance do not have enough vegetation cover to be classified as grasslands. Stands described by Francis (1986) averaged less than 15% total vegetation cover and could be classified in a sparsely vegetated alliance.

ALLIANCE DISTRIBUTION

Range: The distribution of this southwestern alliance is centered on the Colorado Plateau region of Colorado, New Mexico, Arizona, and Utah. It may also be found in the shortgrass steppe in eastern Colorado and New Mexico, and the panhandles of Oklahoma and Texas, the Great Basin as far west as east-central California, and north into southwestern Wyoming.

States: AZ,CA?,CO,NM,UT

TNC Ecoregions:

USFS Ecoregions: 313B:CC, 321A:??, M313A:??

ALLIANCE SOURCES

Edition: 98-01-26

References: Cannon 1960, Donart et al. 1978, Francis 1986, Francis and Aldon 1983, Heerwagen 1956, Helm 1981, Jones 1992, Kleiner 1968, Kleiner 1983, Kleiner and Harper 1972, Kleiner and Harper 1977, Marr et al. 1973, Nichol 1937, Stewart et al. 1940, Utah Environmental and Agricultural Consultants 1973, Weaver and Albertson 1956, West et al. 1972

V.A.5.N.e.9. BOUTELOUA GRACILIS HERBACEOUS ALLIANCE (A.1282)

Blue Grama Herbaceous Alliance

ALLIANCE CONCEPT

Environment: Associations included in this semi-arid grassland alliance occur in the Great Plains, Chihuahuan Desert and Colorado Plateau on flat to rolling uplands with a variety of soil types (Heitschmidt *et al.* 1970, Johnston 1987). Surface soils can be sandy loam, loam, silty loam, or loamy clay (Weaver and Albertson 1956, Johnston 1987, Steinauer 1989). Subsoils are often finer than the surface soils and may be somewhat impermeable to water. The upland position and heavy soils result in much of the precipitation running off and dry soil conditions prevail for much of the year. This trend is more pronounced in the northern range of this alliance. In the southern portions of this alliance's range, the greater temperatures and lack of precipitation allow this alliance to occur on coarser soils.

Physiognomy: Stands in this alliance have a graminoid layer dominated by shortgrasses that typically form a sod. Midgrasses may codominate in some communities. Rarely, sparse scattered shrubs may be present. Some ungrazed stands may have a short bunchgrass form.

Vegetation: This is a widespread alliance found across the Great Plains from near the United States-Mexican border to southern Canada. Most of the communities are located in the western and southwestern Great Plains, but one extensive and one restricted community occur in the midwestern U.S. Stands within this alliance are dominated by short grasses with mid grasses present to codominant. Midgrasses are more abundant in the eastern portions of this alliance (Kuchler 1974). Coverage by short grasses is moderate to almost complete. The foliage is typically 7-19 cm tall with flowering stalks reaching 45 cm (Hanson 1951, Weaver and Albertson 1956). Mid grasses are usually dwarfed due to the dry conditions and may not exceed 0.7 m except in especially wet years. Shrubs are very rare except in the southern parts of this alliance's range where scattered desert shrubs may occur (Bruner 1931, Weaver and Albertson 1956). The most abundant species are *Bouteloua gracilis* and *Buchloe dactyloides*. Other common graminoids are *Aristida purpurea*, *Bouteloua curtipendula*, *Bouteloua hirsuta*, *Carex filifolia* (in the northern part of this alliance's range), *Carex inops ssp. heliophila*, *Carex duriuscula* (= *Carex eleocharis*), *Elymus elymoides*, *Hilaria jamesii* (in the south), *Pascopyrum smithii*, *Sporobolus cryptandrus*, *Stipa comata*, and *Stipa neomexicana* (in the southwest). There are a variety of forbs found in stands of this alliance, although they do not contribute greatly to the total vegetation cover. Common forbs include *Astragalus spp.*, *Gaura coccinea*, *Machaeranthera pinnatifida ssp. pinnatifida*, *Opuntia polyacantha*, *Plantago patagonica*, *Psoraleidium tenuiflorum*, *Ratibida columnifera*, and *Sphaeralcea coccinea*.

Dynamics: *Bouteloua gracilis* is an extremely drought and grazing tolerant shortgrass species. It is one of the most widely distributed grasses in the interior western U.S., and is present in many different grassland, shrubland and woodland communities. It evolved with grazing by large herbivores and generally forms a short sod. However, in some stands ungrazed plants develop the upright physiognomy of a bunchgrass.

Similar Alliances:

?? PSEUDOROEGNERIA SPICATA - BOUTELOUA GRACILIS HERBACEOUS ALLIANCE (A.1239)

?? STIPA COMATA - BOUTELOUA GRACILIS HERBACEOUS ALLIANCE (A.1234)

?? BOUTELOUA GRACILIS DWARF-SHRUB HERBACEOUS ALLIANCE (A.1571)

?? PASCOPYRUM SMITHII HERBACEOUS ALLIANCE (A.1232)

?? STIPA COMATA BUNCH HERBACEOUS ALLIANCE (A.1270)

Similar Alliance Comments: Stands within this alliance may be similar to stands in the V.A.5.N.c.27 *Pascopyrum smithii* Herbaceous Alliance (A.1232) and the V.A.5.N.d.27 *Stipa comata* Bunch Herbaceous Alliance (A.1270). Abundance of the diagnostic mid grasses usually serves to differentiate these alliances in Wyoming where their ranges overlap. These alliances all share *Bouteloua gracilis* as a dominant or codominant species in the herbaceous layer and differ mainly in the presence and abundance of mid grasses and shrubs. Other similar alliances include V.A.5.N.c.34 *Pseudoroegneria spicata* - *Bouteloua*

gracilis Herbaceous Alliance (A.1239), V.A.5.N.c.29 *Stipa comata* - *Bouteloua gracilis* Herbaceous Alliance (A.1234), and V.A.8.N.a.7 *Bouteloua gracilis* Dwarf-shrub Herbaceous Alliance (A.1571).

Synonymy:

- ?? *Bouteloua gracilis* herbaceous series (Hoagland 1997)
- ?? Blue grama-Buffalograss Series, in part (Diamond 1993)
- ?? Sideoats Grama-Black Grama Series, in part (Diamond 1993)
- ?? Sideoats Grama Series, in part (Diamond 1993)
- ?? Plains-Mesa Grassland, in part (Dick-Peddie 1993)

Comments: Stands containing *Bouteloua gracilis*, *Carex filifolia* and moderate amounts of *Pascopyrum smithii* or *Stipa comata* may present classification problems. *Bouteloua gracilis* increases with heavy grazing pressure in many western plant communities, often resulting in difficulties in classification.

ALLIANCE DISTRIBUTION

Range: Grasslands in this widespread alliance occur in the Great Plains, Chihuahuan Desert and Colorado Plateau from Saskatchewan, North Dakota and Wyoming, south to Texas, and the Mexican states of Chihuahua and Coahuila, and west to Utah and Arizona.

States: AZ,CO,KS,ND?,NE,NM,OK,SD,SK,TX,UT,WY

TNC Ecoregions: 20:C, 21:C, 24:C, 26:C, 27:C, 28:C, 33:C

USFS Ecoregions: 311A:CC, 313B:CC, 313E:CC, 315A:CC, 315B:CC, 315C:CC, 321A:CC, 331A:C?, 331B:CC, 331C:CC, 331F:CC, 331G:CC, 331H:CC, 331I:CC, 331J:CC, 332E:??, M313A:CC, M313B:CC, M331F:??

ALLIANCE SOURCES

Edition: 98-05-04

References: Albertson and Tomanek 1965, Armstrong 1972, Badaracco 1971, Beavis et al. 1982, Bock and Bock 1986, Bonham and Hannan 1978, Bonham and Lerwick 1976, Bourgeron et al. 1993, Bruner 1931, Bujakiewicz 1975, Clements and Goldsmith 1924, Costello 1944, Costello and Turner 1944, Diamond 1993, Dick-Peddie 1993, Dick-Peddie n.d., Donart et al. 1978, Dwyer and Pieper 1967, Faber-Langendoen et al. 1996, Fink 1907, Fisser 1970, Fisser et al. 1965, Francis 1986, Gardner 1951, Gregg 1963, Heerwagen 1958, Heitschmidt et al. 1970, Hoagland 1997, Hopkins 1951, Jameson 1969, Johnston 1987, Klipple 1964, Knight et al. 1987, Kuchler 1964, Kuchler 1974, Masek 1979, Maxwell 1975, Milchunas et al. 1989, Mitchell 1971, Moir and Trlica 1976, Moulton et al. 1981, Muldavin and Melhop 1992, Mutel 1976, Pieper 1968, Pieper and Lymbery 1983, Pieper et al. 1971, Ramaley 1914, Robbins 1917, Rogers 1950, Rogers 1953, Schroeder 1977, Senft et al. 1983, Shantz 1911, Shantz 1923, Stearns-Roger 1978, Steinauer 1989, Terwilliger et al. 1979, Thilenius 1971, Thilenius and Brown 1990, USDA Soil Conservation Service 1978, Van Pelt 1978, Vestal 1913, Vestal 1914, Weaver and Albertson 1956, Williams 1961, Zimmerman 1967

V.A.5.N.i. Intermittently flooded temperate or subpolar grassland

V.A.5.N.i.3. HILARIA MUTICA INTERMITTENTLY FLOODED HERBACEOUS ALLIANCE (A.1330)

Tobosa Intermittently Flooded Herbaceous Alliance

ALLIANCE CONCEPT

Environment: Grasslands in this desert alliance occur in intermittently flooded depressions and floodplains in the west Texas, southern New Mexico, southeastern Arizona and likely in adjacent Mexico. Elevations range from 1300 to 1450 meters. Climate is arid to semi-arid with hot summers. Freezing temperatures may occur during the winter. Mean annual precipitation is approximately 22 cm at nearby Jornada Experimental Range. Precipitation can vary greatly from year to year with drought not uncommon. Annual precipitation has bimodal distribution with the about a third of the annual precipitation occurring in late winter and two thirds in July through October. The summer rain often occurs as high intensity convective storms. The most arid season is late spring and early summer. Sites are generally flat with stands occurring in depression in basin and plains (playas), and in the floodplains along the drainages that dissect the mesas and piedmonts. These sites receive excess run-off from the surrounding landscape and are intermittently flooded. The flooding is typically caused by locally occurring, summer thunderstorms. Soils are shallow to deep; silt or clay loams, or clays; alkaline; often calcareous and sometimes with caliche or argillic horizons. These soils are non-saline to slightly saline and derived from gravelly or silty alluvium. Ground cover is variable. Johnson (1961) and Bourgeron *et al.* (1993) describe stands where mean cover of bare soil, gravel, and litter ranged from 10-70%, 0-15% and 20-85%, respectively. The high grass and litter cover help maintain the habitat by promoting water infiltration and reducing evaporation (Muldavin 1998).

These grasslands are surrounded by a matrix of desert shrublands often dominated by *Flourensia cernua*, *Larrea tridentata* or *Prosopis* spp. Saline-influenced areas grade into *Sporobolus airoides* dominated grasslands.

Physiognomy: Vegetation included in this alliance has a sparse to moderately dense graminoid layer dominated by medium-tall, perennial bunchgrasses. The forb layer is typically sparse. Scattered cacti or shrub may be present. Annual grasses and forbs are seasonally present to abundant.

Vegetation: Vegetation included in this grassland alliance occurs on flats within the Chihuahuan Desert and has been described from the extreme southwestern New Mexico and southeastern Arizona. Stands have a sparse to dense graminoid layer of mostly medium-tall, perennial bunchgrasses. This vegetation is often distributed in patches. The bunchgrass, *Hilaria mutica* usually dominates the stand with *Panicum obtusum* occasionally codominating. The presence of *Hilaria mutica* is diagnostic of this alliance even if the stand is dominated by *Panicum obtusum*. Other characteristic graminoids may include *Bothriochloa barbinodis*, *Chloris virgata*, *Enneapogon desvauxii*, *Eriochloa lemmonii*, *Panicum hirticaule* and *Sporobolus wrightii*. The usually sparse forb layer may include *Amaranthus palmeri*, *Datura ferox*, *Hoffmannseggia glauca*, *Solanum elaeagnifolium*, *Solanum rostratum* and *Talinum aurantiacum*. Scattered shrubs and cacti such as *Prosopis glandulosa*, *Flourensia cernua* and *Opuntia phaeacantha* may be present, but never more than 10% cover.

Dynamics: Impermeable caliche and argillic horizons are not uncommon on these sites. These layers restrict deep percolation of soil-water and may favor the shallower root grasses over deeper rooted shrubs like *Larrea tridentata* and *Prosopis* spp. (McAuliffe 1995). *Hilaria mutica* is relatively tolerant of livestock grazing. In west central Arizona, livestock have nearly eliminated all native grasses except *Hilaria mutica* from semi-desert grassland (Brown 1982). Exotic plants have invaded, especially exotic annual grasses such as *Bromus rubens*, and now dominate the landscape. These *Hilaria mutica* grasslands are the result from livestock disturbance and exotic plant invasion and should not be classified as natural. Stands codominated by *Scleropogon brevifolius* are characteristic of sites with past heavy grazing by livestock (Whitfield and Anderson 1938).

Similar Alliances:

?? HILARIA MUTICA HERBACEOUS ALLIANCE (A.1249)

?? HILARIA MUTICA SHRUB HERBACEOUS ALLIANCE (A.1551)

?? PANICUM OBTUSUM HERBACEOUS ALLIANCE (A.1238)

Similar Alliance Comments: Vegetation in V.A.5.N.d.6 *Hilaria mutica* Herbaceous Alliance (A.1249) and V.A.7.N.m.4 *Hilaria mutica* Shrub Herbaceous Alliance (A.1551) is separated from this alliance by the significant shrub layer (>10% cover) or by the intermittent flood regime. Stands in this alliance may be codominated or dominated by *Panicum obtusum*, but stands included in the V.A.5.N.c.33 *Panicum obtusum* Herbaceous Alliance (A.1238) do not have any *Hilaria mutica* present.

Synonymy:

?? Tobosa Series, in part (Diamond 1993)

?? Tobosa Grass-Scrub Series, *Hilaria mutica* Association, in part (Brown 1982)

?? Tobosa Series. within the Plains-Mesa Grassland (Dick-Peddie 1993)

?? *Hilaria mutica* Series. within the Plains-Mesa Grassland (Muldavin et al. 1998)

Comments: This alliance needs to be compared to similar ones documented for Texas and its presence in the state confirmed. More information is needed on its composition and dynamics.

ALLIANCE DISTRIBUTION

Range: Grasslands included in this Chihuahuan Desert alliance occur from western Texas, southern New Mexico and southeastern Arizona, and likely occur in the Mexican states of Chihuahua and Coahuila.

States: AZ,NM,TX

TNC Ecoregions: 20:C, 21:C, 24:C, 28:C

USFS Ecoregions: 315A:??, 321A:CC

ALLIANCE SOURCES

Edition: 98-06-24

References: Bourgeron et al. 1993, Bourgeron et al. 1995, Brown 1982, Diamond 1993, Dick-Peddie 1993, Johnson 1961, McAuliffe 1995

V.A.5.N.i.4. SPOROBOLUS AIROIDES INTERMITTENTLY FLOODED HERBACEOUS ALLIANCE (A.1331)

Alkali Sacaton Intermittently Flooded Herbaceous Alliance

ALLIANCE CONCEPT

Environment: Grasslands included in this alliance occur primarily in the southern Great Plains, Chihuahuan Desert and Great Basin. Stands are reported from a variety of lowland sites such as intermittent drainages, swales, playas, interdune basins, salt flats. Elevations range from near sea level to 2100 m. Climate is arid to semi-arid. Soils are typically saline or alkaline. Soil textures are sandy to clayey, often with clay subsoil or claypan that impedes water movement. The environmental factor that defines this alliance in the intermittent flood regime. These grasslands occur on sites that flood

periodically without detectable seasonality, often in response to localized thunderstorms. The unpredictable nature of flooding does not support hydrophytic vegetation or develop hydric soils. On the plains, these grasslands occur in playas and along intermittent drainages. At White Sands Missile Range in the Chihuahuan Desert, Muldavin and Mehlhop (1992) and Neher and Bailey (1976) reported these grasslands occurring in depressions among gypsum ridges and on salt flats. In north-central Nevada, Young *et al.* (1986) found stands in interdune basins on the lake plain above the lake in a large pluvial lake basin. During wet years, these depressions interrupt drainage from the lake plain to the lake and form small ephemeral lakes. **Physiognomy:** Vegetation in this alliance has a moderately dense graminoid layer dominated by medium-tall bunchgrasses with smaller densities of shortgrasses and forbs.

Vegetation: Vegetation in this alliance occurs in lowlands throughout much of the Great Plains, southwestern U.S. and the Great Basin. It is characterized by a moderately dense graminoid layer of medium-tall and short grasses that are codominated by the bunchgrasses *Sporobolus airoides* and *Distichlis spicata*. Other grasses may include *Hordeum jubatum*, *Pascopyrum smithii*, *Leymus* spp. and *Puccinellia nuttalliana*. Forbs and shrubs are typically sparse. Characteristic forbs can include species of *Suaeda*, *Salicornia*, *Ambrosia*, *Chenopodium*, *Lepidium* and *Polygonum*. Scattered shrubs species may include *Allenrolfea occidentalis*, *Atriplex canescens*, *Sarcobatus vermiculatus*, *Chrysothamnus nauseosus* and *Tamarix* spp.

Dynamics: The amount of soil salinity is an important factor that may control species composition and abundance in stands included in this alliance. Ungar (1968, 1972) reported that *Distichlis spicata* is more tolerant of saline and sodic soils than *Sporobolus airoides*. In higher salinity soils, *Sporobolus airoides* drops out completely (Ungar 1972). Soil salinity affects rooting patterns in some plants. Bowman *et al.* (1985) found shallow-rooted *Bouteloua gracilis* growing over saline soil horizons. The rhizomatous nature of *Sporobolus airoides* and *Distichlis spicata* enables them to quickly expand during favorable growing conditions. Stands of this alliance were historically important in spreading floodwaters from uplands, but with vegetation removal and subsequent erosion resulting from heavy grazing, many of these sites have become channelized and cover of *Sporobolus* restricted to the channel (Muldavin *et al.* 1998).

Similar Alliances:

?? SPOROBOLUS AIROIDES HERBACEOUS ALLIANCE (A.1267)

?? SPOROBOLUS AIROIDES SOD HERBACEOUS ALLIANCE (A.1241)

?? DISTICHLIS SPICATA - (HORDEUM JUBATUM) TEMPORARILY FLOODED HERBACEOUS ALLIANCE (A.1341)

Similar Alliance Comments: Both V.A.5.N.d.24 *Sporobolus airoides* Herbaceous Alliance and V.A.5.N.c.36 *Sporobolus airoides* Sod Herbaceous Alliance (A.1241) are separated because they lack an intermittent flood regime. This affects soil moisture and salinity which can alter species composition. The *Sporobolus airoides* Sod Herbaceous Alliance is separated by the atypical sod-forming growth form of *Sporobolus airoides*. The other *Sporobolus airoides* alliance is the most common and diverse with 5 associations. The V.A.5.N.j.5 *Distichlis spicata* - (*Hordeum jubatum*) Temporarily Flooded Herbaceous Alliance (A.1341) has an association with *Sporobolus airoides* as a codominant and a temporarily flooded regime. In general, *Sporobolus airoides* is a wide-ranging western grass species and is a nominal species in several associations with shrubs such as *Atriplex* spp., *Artemisia tridentata* and *Sarcobatus vermiculatus*, and other graminoid species.

Synonymy:

?? *Sporobolus airoides* Series, in part (Johnston 1987)

?? Sacaton Series, in part (Dick-Peddie 1993)

?? Alkali Meadow, in part (Holland 1986)

?? Alkali Sacaton Series, in part (Sawyer and Keeler-Wolf 1995)

?? Valley sacaton grassland, in part (Holland 1986)

?? Alkali Sacaton-Fourwing Saltbush Series, in part (Diamond 1993)

Comments: Only one association is presently placed within this alliance. However, intermittently flooded stands of *Sporobolus airoides*-dominated communities are apparently widespread in the western United States. Further classification work is probably needed to fully understand the diversity of vegetation types within this alliance. Classification of *Sporobolus airoides* types found in California are provisional and need further description. More study is needed to distinguish stands in this alliance from grasslands and shrublands in other similar alliances.

ALLIANCE DISTRIBUTION

Range: This widespread alliance occurs primarily in the western and southern Great Plains, across the southwestern U.S. from the Chihuahuan Desert into southern and western California, and throughout the Great Basin. The alliance is likely to occur in the adjacent Mexican states of Coahuila, Chihuahua, Sonora and Baja California.

States: CA?,NM,TX?,UT

TNC Ecoregions: 24:?

USFS Ecoregions: 321A:CC, 341:C

ALLIANCE SOURCES

Edition: 98-04-17

References: Aldous and Shantz 1924, Barbour and Major 1977, Culver et al. 1996, Diamond 1993, Dick-Peddie 1993, Holland 1986, Johnston 1987, Kartesz 1994, Muldavin and Melhop 1992, Muldavin et al. 1998, Neher and Bailey 1976, Sawyer and Keeler-Wolf 1995, Stromberg 1993, Ungar 1968, Ungar 1972, Young et al. 1986

V.A.5.N.i.5. DISTICHLIS SPICATA INTERMITTENTLY FLOODED HERBACEOUS ALLIANCE (A.1332)

Inland Saltgrass Intermittently Flooded Herbaceous Alliance

ALLIANCE CONCEPT

Environment: Grasslands in this western alliance occur in lowland habitats such as playas, swales and terraces along washes that are intermittently flooded. The flooding is usually the result of highly localized thunderstorms which can flood one basin and leave the next dry. The unpredictable nature of the flooding is the key environmental factor separating this alliance from similar alliances with more predictable flooding regimes. Climate is semi-arid to arid. Soil texture ranges from clay loam to sandy clay (Johnston 1987, Redmann 1972). These soils are deep, saline and alkaline. They generally have an impermeable layer and therefore are poorly drained. When the soil is dry, the surface usually has salt accumulations.

Physiognomy: Vegetation included in this alliance has a sparse to moderately dense graminoid layer dominated by rhizomatous mid-grasses less than 0.5 m tall.

Vegetation: Vegetation included in this alliance occurs in lowland sites throughout much of the semi-arid and arid western U.S. This is an intermittently flooded grassland of playas and intermittent and ephemeral streams. Cover is sparse to dense and is dominated by *Distichlis spicata*, occurring in nearly pure stands. Stands have higher diversity and cover during wet years and near boundaries with other vegetation types. Higher soil salinity favors *Distichlis spicata* over less salt tolerant species. However, very high salinity will dwarf the *Distichlis spicata* and reduce cover. Generally, vegetation height and cover, and species diversity tend to vary inversely with salinity (Ungar 1967, Steinauer 1989). Associated species may be restricted by the level of salinity in the soil. Those from higher soil salinity sites may include the graminoid *Puccinellia nuttalliana* and the forbs, *Salicornia rubra*, *Triglochin maritima* and *Suaeda calceoliformis* (= *Suaeda depressa*). Species from lower salinity sites include the graminoids *Hordeum jubatum*, *Pascopyrum smithii*, *Sporobolus airoides*, *Carex filifolia*, and *Juncus balticus*, and the forbs *Helianthus* spp. and *Aster* spp. (Ungar 1974). Forb cover is generally low. Shrubs are rare, but may include scattered *Atriplex canescens* and *Sarcobatus vermiculatus*.

Dynamics: The intermittent flooding regime combined with high evaporation rate in these dry climates causes accumulations of soluble salts in the soil. Total vegetation cover (density and height), species composition, and soil salinity depend on the amount and timing of precipitation and flooding. Growth-inhibiting salt concentrations are diluted when the soil is saturated allowing the growth of less salt-tolerant species and more robust growth of *Distichlis spicata*. As the saturated soils dry, the salt concentrates until it precipitates on the soil surface (Dodd and Coupland 1966, Ungar 1968). This osmotic stress of growing in alkaline and saline soils is compensated by the accumulation of proline by some halophytic species including *Distichlis spicata*. This aids the plants' water uptake by increasing the osmotic potential of the plant (Shupe et al. 1986). Vegetation forms zones at some saline sites, where species abundance is stratified by salt tolerance (Shupe et al. 1986, Ungar 1969). In playas, the soil salinity at field capacity generally increases from the edge to the center allowing for several different vegetation stands to co-occur (Ungar 1967, 1969, 1970). Microtopography can also affect vegetation structure. Where soil accumulates to form hummocks, less salt- and alkali-tolerant plants can occur (Ungar 1972, Johnson 1987).

Distichlis spicata is rhizomatous and is tolerant of moderate grazing and its roots resist trampling. Although relatively unpalatable, it can provide valuable winter forage for livestock if needed. If grazed heavily, *Distichlis spicata* will decline and may be replaced by less desirable warm-season grasses such as tumblegrass, *Schedonnardus paniculatus* (Costello 1944). Weeds are generally not a problem because few grow well in saline soils.

Similar Alliances:

?? DISTICHLIS SPICATA - (HORDEUM JUBATUM) TEMPORARILY FLOODED HERBACEOUS ALLIANCE (A.1341)

?? DISTICHLIS SPICATA TIDAL HERBACEOUS ALLIANCE (A.1882)

?? HORDEUM JUBATUM TEMPORARILY FLOODED HERBACEOUS ALLIANCE (A.1358)

?? POLYGONUM SPP. - ECHINOCHLOA SPP. TEMPORARILY FLOODED HERBACEOUS ALLIANCE (A.1348)

?? PASCOPYRUM SMITHII TEMPORARILY FLOODED HERBACEOUS ALLIANCE (A.1354)

Similar Alliance Comments: Vegetation in the *Distichlis spicata* - (*Hordeum jubatum*) Temporarily Flooded Herbaceous Alliance has similar vegetation, but is separated mainly by hydrologic regime. *Distichlis spicata* Tidal Herbaceous Alliance also includes vegetation dominated by *Distichlis spicata*, but differs significantly in the flood regime and the suite of characteristic halophytic species. The other similar alliances contain communities that are periodically flooded and have halophytic vegetation, and therefore have floristic and environmental similarities with vegetation in the *Distichlis spicata* Intermittently Flooded Herbaceous Alliance.

Distichlis spicata and *Pascopyrum smithii* often codominate stands of vegetation. Stands included in this alliance are strongly dominated by *Distichlis spicata* and have less than 25% cover of *Pascopyrum smithii*. More evenly mixed stands are included in the *Pascopyrum smithii* - *Distichlis spicata* Herbaceous Vegetation Association in the *Pascopyrum smithii* Temporarily Flooded Herbaceous Alliance.

Synonymy:

- ?? Salt Flat # 34 (USDA Soil Conservation Service n.d.)
- ?? Overland Flow # 36 (USDA Soil Conservation Service n.d.)
- ?? Wet Meadow # 38 (USDA Soil Conservation Service n.d.)
- ?? *Distichlis spicata* Series (Johnston 1987)

Comments: The classification of vegetation in this alliance is difficult for two reasons. First, *Distichlis spicata* is a widespread halophytic grass species that dominates or codominates the herbaceous layer of stands classified into many different associations in several different alliances. This results in many closely related associations in other alliances where this grass is a diagnostic species. Secondly, most of these related alliances have an intermittent, temporary, seasonal or tidal flood regime. These flood regimes sometimes separate vegetation that otherwise is very similar. For example, the flood regime that separates this alliance from the *Distichlis spicata* - (*Hordeum jubatum*) Temporarily Flooded Alliance can be somewhat arbitrary in regions that have large year-to-year variation in precipitation.

ALLIANCE DISTRIBUTION

Range: This alliance includes stands from across the western United States and Saskatchewan. It is found in semi-arid and arid regions with intermittent flooding in the western Great Plains, Intermountain Region and southwestern U.S. from New Mexico to Montana west to Washington, Oregon and California. It also likely occurs in Mexico.

States: AZ,CA,CO,ID,MT,NM,NV,OR,SK,UT,WA,WY

TNC Ecoregions: 26:C, 27:C

USFS Ecoregions: 313D:CC, 315A:CC, 321A:CC, 322A:CC, 322B:CC, 322C:CC, 331A:CC, 331B:CC, 331C:C?, 331D:CC, 331F:CC, 331G:CC, 331H:CC, 331I:CC, 341A:CC, 341B:CC, 341D:CC, 341E:CC, 342A:CC, 342B:CC, 342C:CC, 342F:CC, 342G:CC, 342H:CC, 342I:CC, M332E:CC, M341B:CC

ALLIANCE SOURCES

Edition: 98-04-24

References: Baker 1984, Beatley 1976, Brotherson 1987, Bunin 1985, Copeland 1979, Costello and Turner 1944, Crouch 1961, Daniels 1911, Daubenmire 1970, Franklin and Dyrness 1973, Graham 1937, Griffiths 1902, Hansen 1991, Hansen et al. 1995, Henrickson 1977, Hyder et al. 1966, Johnston 1987, Jones and Walford 1995, Kittel and Lederer 1993, Kittel et al. 1994, Klipple and Costello 1960, Osborn 1974, Ralston 1969, Ramaley 1942, Redmann 1972, Rogers 1950, Rogers 1953, Saul 1974, Shanks 1977, Shupe et al. 1986, Stearns-Roger 1978, Steinauer 1989, Tuhy and Jensen 1982, USDA Soil Conservation Service 1978, USDA Soil Conservation Service n.d., Ungar 1967, Ungar 1968, Ungar 1970, Ungar 1972, Ungar 1974, Ungar et al. 1969, Vestal 1914, Weaver and Albertson 1956

V.A.5.N.j. Temporarily flooded temperate or subpolar grassland

V.A.5.N.j.20. PANICUM BULBOSUM TEMPORARILY FLOODED HERBACEOUS ALLIANCE (A.1356)

Bulb Panicgrass Temporarily Flooded Herbaceous Alliance

ALLIANCE CONCEPT

Environment: Grasslands in this alliance occur in draws and arroyos in southwestern New Mexico. Elevation ranges from 1400-1900 m in areas upland of the Chihuahuan desertscrub. Climate is semi-arid with most of the 25-43 cm of precipitation falling during the late summer and early fall monsoon period. Because stands of this alliances are usually found in draws, these grasslands are temporarily flooded with runoff and gully flow during the typically high intensity convection storms common during the monsoon season. These minor grasslands are restricted to these relatively mesic sites and are tolerant of the disturbance caused by gully erosion. Bourgeron (1993) described a stand in this alliance with ground cover of 5% bare soil, 5% gravel, 25% rock, 60% litter and 5% basal vegetation. The substrate is derived from rhyolite.

Physiognomy: Vegetation in this alliance is dominated by short, perennial grasses. Forbs are typically sparse.

Vegetation: Stands of this minor alliance occur in draws in areas of Chihuahuan desertscrub in southwestern New Mexico. This semi-desert grassland has a dense graminoid layer that is usually dominated by the perennial bunchgrass *Panicum bulbosum*. *Alopecurus aequalis* and/or *Lycurus phleoides* may codominate with *Panicum bulbosum*. Several other graminoid species are often present, but do not add up to much cover. Forbs are usually very sparse. Scattered shrubs and trees such as *Cercocarpus montanus* and *Fraxinus velutina* may also be present. Bourgeron (1993) described one stand with canopy cover of 20% *Panicum bulbosum*, and 40% *Alopecurus aequalis*. Other graminoids included *Cyperus parishii*, *Eleocharis macrostachya*, *Leptochloa dubia*, *Panicum stramineum*, *Setaria grisebachii*, and others.

Dynamics: Stands of this grassland alliance occur in draws and gullies and are relatively mesic because of temporary flooding due to runoff moisture. They are frequently disturbed by gully erosion from flash flood events.

Similar Alliances:

Similar Alliance Comments:

Synonymy:

Comments: This alliance is poorly known or described. It may have once been more extensive, but with the advent of European settlement, alterations of flood regimes, and grazing it appears to be much reduced in distribution.

ALLIANCE DISTRIBUTION

Range: Grasslands in this alliance have been described from the Gray Ranch in the southwestern corner of New Mexico. These minor grasslands may also be found in adjacent southeastern Arizona, and Chihuahua and Sonora, Mexico.

States: NM, TX?

TNC Ecoregions: 24:?

USFS Ecoregions: 321A:CC

ALLIANCE SOURCES

Edition: 98-03-24

References: Bourgeron et al. 1993, Bourgeron et al. 1995

V.A.5.N.k. Seasonally flooded temperate or subpolar grassland

V.A.5.N.k.61. ELEOCHARIS PALUSTRIS SEASONALLY FLOODED HERBACEOUS ALLIANCE (A.1422)

Creeping Spikesedge Seasonally Flooded Herbaceous Alliance

ALLIANCE CONCEPT

Environment: Plant associations included in this alliance are conspicuous, common emergent associations that occur in shallow, mostly still water throughout the western United States. Elevation ranges from sea level in California to 3050 m in Colorado. Stands occur on a variety of landforms including lake margins, stream terraces, floodplains, gravel bars, and wet basins (ciénegas). Stands occur on sites that are flat, 1 percent slope with all aspects (Crowe and Clausnitzer 1997). Soils vary from Histosols to Entisols. High-elevation stands consistently occur on organic (highly sapric) soils, or on a thick organic horizon that overlays fine to coarse alluvial material. Lower elevation stands occur on fresh alluvial deposits of fine-textured loamy sands, clays, and sandy clays (Kittel et al. 1998). Soil reaction is often alkaline (Hansen et al. 1988). All sites are saturated throughout much of the growing season. Oregon stands are located on soils derived from volcanic (andesite, basalt) or sedimentary parent materials (Crowe and Clausnitzer 1997).

At higher elevation, *Carex aquatilis* or *Carex utriculata* meadows and *Salix wolfii* or *Salix planifolia* shrublands occur within the riparian mosaic. At lower elevation, *Scirpus pungens* often occurs within the stream channel while wet meadow prairies of *Panicum virgatum* and *Sorghastrum nutans* occupy the immediate streambanks and low floodplains.

Physiognomy: This alliance is characterized by a rhizomatous perennial that dominates the graminoid stratum (up to 70 percent cover). The forb layer is sparse (0-20 percent) and contains both aquatic and terrestrial species.

Vegetation: Plant associations within this alliance are classified as seasonally flooded, temperate or subpolar grasslands. *Eleocharis palustris*, a facultative wetland species, dominates the graminoid stratum. Cover ranges from sparse to quite dense (10-80%). *Eleocharis palustris* plant associations occur within a wide elevational range, and the species composition can be quite variable. In the Great Plains stands, co-occurring species often include *Phalaris arundinacea* (= *Phalaroides arundinacea*), *Juncus balticus*, *Carex praegracilis*, *Scirpus pungens*, *Panicum virgatum*, *Carex lanuginosa*, *Spartina pectinata*, and *Scirpus americanus*. Forb cover can also include *Sparganium angustifolium*, *Lemna* spp. and *Potamogeton* spp. (Kittel et al. 1998). *Distichlis spicata* and *Muhlenbergia asperifolia* codominate the graminoid layer in the ciénegas (Arizona and New Mexico). Forb cover is composed of *Berula erecta* and *Rorippa nasturtium-aquaticum*, especially in stands with deep water (Cross 1991).

At higher, montane elevations other graminoids present include *Carex aquatilis*, *Carex utriculata*, *Carex buxbaumii*, *Eleocharis rostellata* and *Deschampsia cespitosa*. Forb cover is typically low, but can be up to 25% in some stands. Common

forb species include *Pedicularis groenlandica*, *Sedum integrifolium* (= *Rhodiola integrifolia*), and *Caltha leptosepala* (Hansen et al. 1995, Kittel et al. 1998).

Crowe and Clausnitzer (1997) state that *Eleocharis palustris* is an aggressive species, typically excluding other species from establishing. In the Oregon stands, associated forbs include *Mentha arvensis*, *Rumex crispus*, *Iris missouriensis*, and *Ranunculus cymbalaria*.

Dynamics: At lower elevations *Eleocharis palustris* plant associations occur well within the active channel and are inundated annually. These early seral communities colonize backwater eddies and shallow edges of slow moving reaches of small and larger rivers. The stands are probably ephemeral, as the eddies and river edges are scoured out each year during high spring flows (Kittel et al. 1998). These communities have also been described as early seral stages by Padgett et al. (1989). Padgett et al. (1989) describe light colored soils for the sites, indicating an early phase of soil development. Kovalchik (1987) reports that the lower elevation plant associations within this alliance frequently form seral communities in ponded sites between stream rehabilitation structures such as loose rock check dams.

In the montane zone, associations within this alliance occur in ponded sites on faster moving streams. If siltation occurs, sites may become dominated by *Carex utriculata*. At higher elevations, the associations appear to be stable. Stands occur near seeps on soils with deep organic layers, often sapric, and are saturated throughout the growing season.

Crowe and Clausnitzer (1997) state that *Eleocharis palustris* is of little to no forage value to livestock and wild ungulates. On seasonally drier sites, ungulate trampling may cause this species to increase (Snyder 1992 as cited in Crowe and Clausnitzer 1997). However, this species does provide seed forage and cover to ducks and geese (Kovalchik 1987).

Similar Alliances:

? ELEOCHARIS PALUSTRIS TEMPORARILY FLOODED HERBACEOUS ALLIANCE (A.1342)

Similar Alliance Comments: The temporarily flooded alliances differ from the seasonally flooded alliances mainly due to the duration of surface water. Temporarily flooded alliances have surface water present briefly during the growing season. Seasonally flooded alliances have surface water present throughout the growing season.

Synonymy:

? *Carex* spp. Series (Johnston 1987)

? Montane, Plains, and Great Basin Marshland Series (Brown 1982)

Comments:

ALLIANCE DISTRIBUTION

Range: This alliance occurs from Oregon to Montana, south to California, Arizona, and New Mexico. The alliance is expected to occur in eastern Washington.

States: AZ,CA?,CO,ID,MT,NE,NV,OR,SD,SK,UT,WA,WY

TNC Ecoregions: 26:C

USFS Ecoregions: 321A:CC, 331D:CC, 331F:CC, 331G:CC, 341A:CC, 341B:CC, 342A:CC, 342B:CC, 342C:CC, 342D:CC, 342G:CC, 342I:C?, M242C:CC, M261G:CC, M331A:CC, M331D:CC, M331E:CC, M331G:CC, M331H:CC, M331I:CC, M332A:CC, M332B:CC, M332C:CC, M332D:CC, M332E:CC, M332F:CC, M332G:CC, M333A:CC, M333B:CC, M333C:CC, M333D:CC, M341B:CC

ALLIANCE SOURCES

Edition: 98-03-01

References: Baker 1983, Baker and Kennedy 1985, Brotherson 1987, Brotherson and Barnes 1984, Brown 1982, Bunin 1985, Cronquist et al. 1977, Cross 1991, Durkin et al. 1995, Ellis et al. 1979, Flowers 1962, Hansen 1991, Hansen et al. 1987a, Hansen et al. 1988, Hansen et al. 1995, Hendrickson and Minckley 1984, Johnston 1987, Kartesz 1994, Kettler and McMullen 1996, Kittel and Lederer 1993, Kittel et al. 1994, Kittel et al. 1998, Kovalchik 1987, Kovalchik 1993, Manning and Padgett 1995, Mutel 1973, Mutel and Marr 1973, Padgett et al. 1988, Padgett et al. 1989, Ramaley 1919, Ramaley 1942, Reid et al. 1994, Sawyer and Keeler-Wolf 1995, Shupe et al. 1986, Stearns-Roger 1978, Stewart 1940, Sturges 1968, Youngblood et al. 1985

V.A.5.N.1. Semipermanently flooded temperate or subpolar grassland

V.A.5.N.1.5. SCIRPUS AMERICANUS SEMIPERMANENTLY FLOODED HERBACEOUS ALLIANCE (A.1432)

Olney Threesquare Semipermanently Flooded Herbaceous Alliance

ALLIANCE CONCEPT

Environment: Plant associations within this alliance are found in marshes and wet meadows throughout North America. They form large "mats" in shallow lakes, reservoirs, and streambanks. *Scirpus americanus* is tolerant of alkali, but does not require it (Cronquist et al. 1977). Associations are found in inundated areas that have the lowest pH (5.9-7.2) and soluble salt concentrations of the halophytic communities (Shupe et al. 1986). The constant water movement and exchange is rapid

enough to prevent salt buildup (Jorgenson 1979). Peat accumulates due to the saturated conditions and clayey soils. Soils are constantly wet, anaerobic, non-saline and non-alkaline (Jorgenson 1979). In the Great Plains, associations can be found where calcium-rich groundwater emerges as springs. These springs are commonly associated with porous bedrock or coarse-textured deposits such as beach or outwash (Richardson et al. 1987).

Physiognomy: This alliance is characterized by rhizomatous, perennial graminoids that can attain heights that range from 5-15 dm. There is typically only one stratum that defines this alliance.

Vegetation: Plant associations within this alliance are classified as semipermanently flooded temperate grasslands. They are dominated by *Scirpus americanus* that forms a dense mat with up to 100% cover and can dwarf smaller plants. Typical herbaceous associates can include *Eleocharis palustris*, *Typha latifolia*, *Equisetum laevigatum*, *Glycyrrhiza lepidota*, *Berula erecta*, and *Carex spp.* (Johnson et al. 1987). In some stands, the following shrubs are present *Betula pumila*, *Pentaphylloides floribunda*, and *Salix spp.* (Faber-Langendoen et al. 1997).

In cienegas in Trans-Pecos Texas (and possibly also in southern New Mexico), *Scirpus americanus* typically dominates the stands, though *Flaveria chlorifolia* or *Helianthus paradoxus* may be locally dominant. Other species include *Samolus ebracteatus ssp. cuneatus*, *Limonium limbatum*, and *Distichlis spicata*. Most examples of this alliance have been heavily altered hydrologically by use of water for irrigation. Elsewhere in Texas it occurs in permanent springs, where species may include *Scirpus americanus*, *Eleocharis macrostachya*, *Fuirena simplex*, *Paspalum distichum*, *Potamogeton illinoensis*, and, in outer zones, *Andropogon gerardii* (Diamond 1993). Finally, *Scirpus americanus*-dominated marshes occur throughout Oklahoma, but are most common in the central and western portions of the state, and in the panhandle (Hoagland 1996).

Dynamics: Shupe et al. (1986) found that *Scirpus americanus* associations were located in the center of the concentric vegetation zones surrounding springs. It occupied the area that was continually inundated by fresh water and had the highest amounts of organic matter accumulation and phosphorus in the soil. Ungar (1972) states that the *Scirpus americanus* associations are a result of poor aeration in standing water which eliminates non-emergent vegetation (Daubenmire 1959), and reduction of salinity that permits only a freshwater marsh community. Sites supporting these associations have extremely high water holding capacity of the soil, likely due to the high organic content and the extensive root and rhizome systems, which makes the soil surface highly absorptive (Ungar 1965).

Similar Alliances:

Similar Alliance Comments:

Synonymy:

? *Scirpus* spp. Series, in part (Johnston 1987)

? Montane, Plains and Great Basin Marshlands, in part (Brown 1982)

? *Scirpus americanus* herbaceous series, in part (Hoagland 1997)

? Saltgrass-Olney Bulrush Series, in part (Diamond 1993)

Comments: There are taxonomic issues between *Scirpus americanus*, *Scirpus pungens*, and *Scirpus olneyi* that need to be understood before descriptions of this alliance can be completed. The associations currently recognized seem to overlap in concept.

ALLIANCE DISTRIBUTION

Range: This alliance is found in the western Great Plains, from Trans-Pecos Texas north into Oklahoma and Nebraska, and in scattered localities throughout the West, ranging from New Mexico north into Montana and west into California. It has not been reported for Washington or Nevada but is likely to occur in both states. *Scirpus americanus* is widely distributed in North and South America (Cronquist et al. 1977).

States: CA,CO,ID,NM,OK,OR,TX,UT

TNC Ecoregions: 20:C, 21:C, 24:C, 27:C, 28:C, 29:C, 31:C, 33:C

USFS Ecoregions: 231Fb:CCC, 311A:CC, 313E:CC, 315A:CC, 315B:CC, 315C:CC, 321A:CC, 331B:CC, 331I:CC, 331J:CC, 332E:CC, 341A:CC, 342B:CC, 342C:CC, 342H:CC, M242C:CC, M313B:CC, M331G:CC, M332F:CC, M332G:C?

ALLIANCE SOURCES

Edition: 98-04-08

References: Baker 1982, Bolen 1964, Brown 1982, Bunin 1985, Cronquist et al. 1977, Daubenmire 1959, Diamond 1993, Faber-Langendoen et al. 1996, Faber-Langendoen et al. 1997, Hoagland 1996, Hoagland 1997, Johnston 1987, Jorgenson 1979, Kartesz 1994, Muldavin et al. 1993, Ramaley 1939, Richardson et al. 1987, Shupe et al. 1986, Stearns-Roger 1978, Steward 1984, Tolstead 1942, Tuhy 1981, Ungar 1965, Ungar 1972

V.A.7.N.e. Medium-tall temperate or subpolar grassland with a sparse needle-leaved or microphyllous evergreen shrub layer

V.A.7.N.e.10. MUHLENBERGIA SETIFOLIA / ARTEMISIA BIGELOVII SHRUB HERBACEOUS ALLIANCE (A.1530)

Curly-leaf Muhly / Bigelow Sagebrush Shrub Herbaceous Alliance

ALLIANCE CONCEPT

Environment: Stands included in this Chihuahuan Desert alliance have been reported from rocky sites in the foothills of south-central New Mexico. Climate is semi-arid. Mean annual precipitation is about 24 cm. Summers are hot and winters have periods of freezing temperatures. The elevations range from 1900-2100 m. Stands are found on moderate to steep slopes, ridges of foothills and mesa escarpments on any aspect. The extremely rocky substrate is often derived from limestone. The soils are shallow, lithic, silty or clay loams with an average of 80% of the groundcover rock or gravel. The soils are relatively mesic because the limited precipitation is held in the fine textured soil above the shallow bedrock and below rocky ground cover. Adjacent vegetation consists of Chihuahuan desertscrub at lower elevations dominated by *Larrea tridentata* and montane woodlands and shrublands at higher elevations.

Physiognomy: Vegetation included in this alliance has sparse shrub layer dominated by microphyllous evergreen shrubs. A sparse to moderately dense herbaceous layer is also present and is dominated by warm season perennial bunchgrasses.

Vegetation: Stands included in this Chihuahuan Desert alliance have been described in the foothills and on mesa escarpments surrounding the Tularosa Basin in south-central New Mexico. Stands have a sparse woody layer dominated by the microphyllous, evergreen shrub, *Artemisia bigelovii*. The sparse to moderately dense herbaceous layer is 0.5-0.8 m tall and dominated by the perennial warm season bunchgrass, *Muhlenbergia setifolia*. Other associated perennial grasses include *Bouteloua curtipendula*, *B. eriopoda*, *B. hirsuta* and *Muhlenbergia pauciflora*. Scattered forbs may be also present.

Dynamics: *Muhlenbergia setifolia* is moderately palatable forage for grazing livestock and may increase in abundance if more palatable forage is preferentially grazed (Muldavin 1998).

Similar Alliances:

?? MUHLENBERGIA SETIFOLIA SHRUB HERBACEOUS ALLIANCE (A.1541)

?? ARTEMISIA BIGELOVII DWARF-SHRUBLAND ALLIANCE (A.1103)

?? BOUTELOUA GRACILIS DWARF-SHRUB HERBACEOUS ALLIANCE (A.1571)

Similar Alliance Comments: Stands in this alliance is very similar to *Muhlenbergia setifolia* Shrub Herbaceous Alliance except the sparse shrub layer is dominated by *Dasyllirion wheeleri* or *Fouquieria splendens* instead of *Artemisia bigelovii*. The difference between the *Artemisia bigelovii* Dwarf-shrubland Alliance and this alliance is the sparser density of *Artemisia bigelovii* and the dominance of *Muhlenbergia setifolia* in the herbaceous layer. Within the *Bouteloua gracilis* Dwarf-shrub Herbaceous Alliance there is the *Artemisia bigelovii* / *Bouteloua gracilis* Dwarf-shrub Herbaceous Vegetation Association. Stands in this association have a sparse dwarf-shrub layer of *Artemisia bigelovii* and have been described by Muldavin (1992) from White Sands Missile Range in south central New Mexico.

Synonymy:

?? *Muhlenbergia setifolia* Series, in part (Muldavin et al. 1998)

Comments: It is unclear why *Muhlenbergia setifolia* / *Artemisia bigelovii* Shrub Herbaceous Alliance is classified separately from the *Muhlenbergia setifolia* Shrub Herbaceous Alliance if both are shrub herbaceous stands. However, *Artemisia bigelovii* is classified as a dwarf-shrub in other alliances. Further investigation is needed to clarify this.

ALLIANCE DISTRIBUTION

Range: Stands included in this alliance occur on rocky sites in the foothills and mesa escarpments in the Chihuahuan Desert. It also likely occurs in northern Mexico.

States: NM

TNC Ecoregions:

USFS Ecoregions: 321A:CC

ALLIANCE SOURCES

Edition: 98-10-01

References: Muldavin and Melhop 1992, Muldavin et al. 1998, Neher and Bailey 1976

V.A.7.N.g. Medium-tall temperate or subpolar grassland with a sparse cold-deciduous shrub layer

V.A.7.N.g.6. CERCOCARPUS MONTANUS SHRUB HERBACEOUS ALLIANCE (A.1538)

Alderleaf Mountain-mahogany Herbaceous Alliance

ALLIANCE CONCEPT

Environment: Shrublands included in this alliance are found on breaks and foothill, mountain and canyon slopes throughout much of the western U.S. Elevations range from 1950 to 2400 m. Climate is semi-arid. Summers are hot and winters are mild. Mean annual precipitation is approximately 24 cm with precipitation occurring bimodally during the winter and late summer with a droughty period in late spring/early summer. The late summer rain often occurs as high-intensity thunderstorms. Sites are variable but are generally xeric and rocky with moderate to very steep slopes. Stands are usually found on southerly aspects. Substrate is typically thin, well drained, poorly developed, lithic soils with abundant rock outcrops. Soils textures range from sandy loam to clay. Soils range from slightly acid to slight alkaline depending on parent material. Parent material includes colluvium and residuum from igneous, metamorphic rocks such as quartz monzonite and rhyolite.

Adjacent vegetation at higher elevations includes woodland and forests dominated by species of *Juniperus*, *Quercus* and *Pinus*. At lower elevations there are often grasslands or shrub savannas dominated by mid- or short grass species of *Bouteloua*, *Muhlenbergia* or *Stipa*, or *Pinus edulis* or *Juniperus*-dominated woodlands.

Physiognomy: Vegetation included in this alliance has sparse cover of broad-leaved deciduous shrubs 2 m tall. The sparse to moderately dense herbaceous layer is usually less than 1 m. tall and dominated by graminoids. Some stands have herbaceous layers dominated by perennial forbs, but generally forb cover is sparse. Annuals are seasonally present.

Vegetation: Vegetation included in this alliance occurs in mountains in the Chihuahuan Desert. The sparse shrub layer is 1-2 m tall and is dominated by the cold-deciduous, broad-leaved shrub, *Cercocarpus montanus*. Occasional trees such as *Juniperus deppeana*, *Pinus edulis*, *Quercus gambelii* and *Q. grisea* may be scattered in some stands. Associated shrubs and dwarf-shrubs include *Agave parryi*, *Ageratina herbacea*, *Dasyllirion wheeleri*, *Ericameria laricifolia*, *Mimosa aculeaticarpa* var. *biuncifera*, *Nolina microcarpa*, *Robinia neomexicana*, *Symphoricarpos oreophilus*, *Yucca baccata* and the shrubby cacti species *Opuntia engelmannii* and *O. imbricata*. The herbaceous layer is sparse on the very rocky sites to moderately dense and usually dominated by perennial grasses such as *Muhlenbergia pauciflora*, *M. emersleyi*, *M. tenuifolia*, *Bothriochloa barbinodis*, *Bouteloua curtipendula*, *B. gracilis*, *Elymus arizonicus*, *Koeleria macrantha*, *Lycurus phleoides*, *Schizachyrium cirratum* and *Stipa lobata*. Forbs may be diverse and include *Artemisia carruthii*, *Artemisia ludoviciana*, *Eriogonum jamesii*, *Eriogonum wrightii*, *Hedeoma plicata*, *Heliomeris longifolia*, *Heliomeris multiflora*, *Mirabilis multiflora*, *Mirabilis oxybaphoides* and *Viguiera dentata*.

Dynamics: *Cercocarpus montanus* is a dominant understory species in several woodland and forests dominated by *Juniperus deppeana*, *J. monosperma*, *J. osteosperma*, *J. scopulorum*, *Pinus edulis*, *P. ponderosa*, *Pseudotsuga menziesii*, *Quercus gambelii*, *Q. grisea* and *Q. X pauciloba*. *Cercocarpus montanus* stands often occur in the more xeric habitat below these woodland and forest stands. In xeric habitats studied by Greenwood and Brotherson (1978), *C. montanus* sites had significantly more rock than the *Pinus edulis* and *J. osteosperma* sites. Brotherson et al. (1984) suggested that stands are moisture-limited because stands on southern aspects were always higher in elevation than stands on northern aspects. In addition the *C. montanus* stands were more likely to occur on northern slopes than on southern in central Utah. However, *C. montanus* did not typically occur with mesic shrubs like *Symphoricarpos oreophilus* and *Amelanchier alnifolia*.

There is often a broad *C. montanus* shrub/herbaceous ecotone between these shrublands and grasslands. Ecological factors that control shrub densities such as fire and drought need more investigation. Unlike other species of *Cercocarpus*, *C. montanus* is a fire-resistant species because it can re-sprout from the base after a fire has killed the top (Cronquist et al. 1997). *C. montanus* is preferred winter range browse for deer (Hoffman and Alexander 1987, Roughton 1966, 1972). Stands can also produce significant forage that is utilized by grazing livestock (Hoffman and Alexander 1987). In the southern portion of its range *C. montanus* functions as an evergreen shrub by retaining leaves during mild winters and losing them during cold winters (Dick-Peddie 1993).

Similar Alliances:

?? CERCOCARPUS MONTANUS SHRUBLAND ALLIANCE (A.896)

?? CERCOCARPUS MONTANUS - ERIOGONUM FASCICULATUM SHRUBLAND ALLIANCE (A.848)

Similar Alliance Comments: The similar alliances all have a woody layer dominated or codominated by *Cercocarpus montanus* that is greater than 25% canopy cover whereas stands in this alliance have a sparse shrub layer dominated by *Cercocarpus montanus* with less than 25% canopy cover.

Stands in this alliance can be similar to stands in the *Bouteloua gracilis* Herbaceous Alliance and *Schizachyrium scoparium* - *Bouteloua gracilis* Herbaceous Alliance. This alliance often grades into *Pinus ponderosa* Woodland Alliance or *Pinus ponderosa* Forest Alliance.

Synonymy:

Comments: Stands in this alliance appear to be separated from stands in the *Cercocarpus montanus* Shrubland Alliance by the density of the shrub layer alone. Stands in the shrub herbaceous alliance have only been described from southwestern New Mexico, but likely occur throughout the range of the *Cercocarpus montanus* Shrubland Alliance.

ALLIANCE DISTRIBUTION

Range: Stands included in this alliance have been described from montane slopes in mountains in the Chihuahuan Desert. Stands likely occur throughout the range of *Cercocarpus montanus* north into the central Rocky Mountains from northern Utah, Wyoming and South Dakota.

States: NM

TNC Ecoregions:

USFS Ecoregions: 321A:CC, M313A:CC

ALLIANCE SOURCES

Edition: 98-10-13

References: Bourgeron et al. 1993, Bourgeron et al. 1995, Brotherson et al. 1984, Cronquist et al. 1997, Dick-Peddie 1993, Greenwood and Brotherson 1978, Hoffman and Alexander 1987, Muldavin 1994, Roughton 1966, Roughton 1972

V.A.7.N.h. Medium-tall temperate grassland with a sparse xeromorphic (often thorny) shrub layer

V.A.7.N.h.3. MUHLENBERGIA SETIFOLIA SHRUB HERBACEOUS ALLIANCE (A.1541)

Curly-leaf Muhly Shrub Herbaceous Alliance

ALLIANCE CONCEPT

Environment: Stands included in this Chihuahuan Desert alliance have been reported from rocky sites in the foothills of south-central New Mexico. Climate is semi-arid. Mean annual precipitation is about 24 cm. Summers are hot and winters have periods of freezing temperatures. The elevations range from 1900-2100 m. Stands are found on moderate to steep slopes, ridges of foothills and mesa escarpments on any aspect. The extremely rocky substrate is often derived from limestone. The soils are shallow, lithic, silty or clay loams with an average of 80% of the groundcover rock or gravel. The soils are relatively mesic because the limited precipitation is held in the fine textured soil above the shallow bedrock and below rocky ground cover. Adjacent vegetation consists of Chihuahuan desertscrub at lower elevations dominated by *Larrea tridentata* and montane woodlands and shrublands at higher elevations.

Physiognomy: Vegetation included in this alliance has a sparse shrub layer dominated by xeromorphic, drought deciduous or evergreen rosette shrubs. A sparse to moderately dense herbaceous layer is present and is dominated by warm season perennial bunchgrasses.

Vegetation: Stands included in this Chihuahuan Desert alliance have been described in the foothills and on mesa escarpments surrounding the Tularosa Basin in south-central New Mexico. Stands have a sparse woody layer of xeromorphic drought-deciduous and evergreen rosette shrubs such as *Fouquieria splendens* or *Dasyllirion wheeleri*. The sparse to moderately dense herbaceous layer is 0.5-0.8 m tall and is dominated by the perennial warm season bunchgrass, *Muhlenbergia setifolia*. Other associated perennial grasses include *Bouteloua curtipendula*, *B. eriopoda*, *B. hirsuta* and *Muhlenbergia pauciflora*. Scattered forbs may be also present. More information is needed to fully describe this alliance.

Dynamics: *Muhlenbergia setifolia* is moderately palatable forage for grazing livestock and may increase in abundance if more palatable forage is preferentially grazed (Muldavin 1998).

Similar Alliances:

?? MUHLENBERGIA SETIFOLIA / ARTEMISIA BIGELOVII SHRUB HERBACEOUS ALLIANCE (A.1530)

?? FOUQUIERIA SPLENDENS SHRUBLAND ALLIANCE (A.863)

Similar Alliance Comments: This alliance is very similar to *Muhlenbergia setifolia* / *Artemisia bigelovii* Shrub Herbaceous Alliance except the sparse shrub layer is dominated by *Artemisia bigelovii* instead of *Dasyllirion wheeleri* or *Fouquieria splendens*. The difference between the *Fouquieria splendens* Shrubland Alliance and this alliance is the sparser density of *F. splendens* and the dominance of *Muhlenbergia setifolia* in the herbaceous layer.

Synonymy:

?? *Muhlenbergia setifolia* Series, in part (Muldavin et al. 1998)

Comments: It is unclear why *Muhlenbergia setifolia* / *Artemisia bigelovii* Shrub Herbaceous Alliance is classified separately from the *Muhlenbergia setifolia* Shrub Herbaceous Alliance if both are shrub herbaceous stands. However, *Artemisia bigelovii* is classified as a dwarf-shrub in other alliances. Further investigation is needed to clarify this.

ALLIANCE DISTRIBUTION

Range: Stands included in this alliance occur on rocky sites in the foothills and mesa escarpments in the Chihuahuan Desert. It also likely occurs in northern Mexico.

States: NM

TNC Ecoregions:

USFS Ecoregions: 321A:CC

ALLIANCE SOURCES

Edition: 98-10-01

References: Muldavin and Melhop 1992, Muldavin et al. 1998, Neher and Bailey 1976

V.A.7.N.h.4. SPOROBOLUS NEALLEYI SHRUB HERBACEOUS ALLIANCE (A.1542)

Nealley's Dropseed Shrub Herbaceous Alliance

ALLIANCE CONCEPT

Environment: This minor alliance includes grasslands that occurs on plains and basins with gypsiferous soil in southern New Mexico. Elevations range from 1160-1500 m. Climate is semi-arid to arid with most of the highly variable precipitation falling in late summer and early fall. Mean annual precipitation ranges from 20-25 cm. Sites are nearly level. Neher and Bailey (1976) described a Gypsum Grassland vegetative group with *Sporobolus nealleyi* that occurred on Holloman and Yesum Series soils, which are shallow to moderately deep, fine sandy loams, slightly calcareous, gypsiferous, mildly alkaline and saline. It is derived from gypsum. Adjacent vegetation includes Chihuahuan Desert scrub dominated by *Larrea tridentata*, coppice dunes dominated by *Prosopis glandulosa*, and sparsely vegetated gypsum dunes.

Physiognomy: Vegetation in this alliance has a sparse herbaceous layer of medium-tall, perennial grasses with scattered shrubs and dwarf-shrubs.

Vegetation: Vegetation in this minor alliance is restricted to gypsum soils on mesas and plains in the northern Chihuahuan Desert. The diagnostic species are the perennial grass, *Sporobolus nealleyi* which dominates herbaceous layer and a sparse shrub layer dominated by *Fouquieria splendens*. There is very little information available about these stands.

Dynamics: Burgess and Northington (1977) report *Sporobolus nealleyi* is dominant with *Tiquilia hispidissima* and *Opuntia polyacantha* on crusted gypsum ridges, but not on unstable gypsum dunes. They do not mention *Fouquieria splendens*.

Similar Alliances:

?? SPOROBOLUS NEALLEYI HERBACEOUS ALLIANCE (A.1269)

?? FOUQUIERIA SPLENDENS SHRUBLAND ALLIANCE (A.863)

Similar Alliance Comments: This alliance is characterized by the presence of *Sporobolus nealleyi* and *Fouquieria splendens* together, which do not codominate in stands in the similar alliances.

Synonymy:

Comments: This alliance is not well known and was described from only three sites at White Sands Missile Range. Neher and Bailey (1971) described a Gypsum Grasslands and Dunes plant community that also includes scattered shrubs and dwarf-shrubs such as *Atriplex canescens*, *Ephedra torreyana* and *Tiquilia hispidissima*. Hendrickson et al. (1985) and Warnock (1974) described a Gypsophilous Scrub community type and Gypsum Outcrops, respectively, that include the diagnostic species in their species lists. More inventory and classification work is required to clarify the distribution and species composition of this alliance.

ALLIANCE DISTRIBUTION

Range: Grasslands included this alliance has been described from the White Sands Missile Range in southern New Mexico. This alliance likely occurs in west Texas and may occur elsewhere in the southwest where gypsum soils are present.

States: NM

TNC Ecoregions:

USFS Ecoregions: 321A:CC

ALLIANCE SOURCES

Edition: 99-03-19

References: Burgess and Northington 1977, Hendrickson et al. 1985, Muldavin and Melhop 1992, Neher and Bailey 1976, Reid 1980, Warnock 1974

V.A.7.N.j. Short temperate or subpolar grassland with a sparse microphyllous evergreen shrub layer

V.A.7.N.j.3. CHRYSOTHAMNUS NAUSEOSUS SHRUB SHORT HERBACEOUS ALLIANCE (A.1546)

Rubber Rabbitbrush Shrub Short Herbaceous Alliance

ALLIANCE CONCEPT

Environment: Vegetation included in this minor alliance has only been described from alluvial flats within the Rio Puerco basin in northwestern New Mexico. Elevation ranged from 2100-2200 m. Climate is semi-arid with most of the highly variable precipitation falling in July and August. Mean annual precipitation ranges from 22-32 cm within the Rio Puerco watershed. Sites are flat to gently sloping occurring on all aspects. Soils are calcareous, shallow to moderately deep, and poorly developed with pH greater than 8.2. Soil textures range from silty loams to silty clay loams (Francis 1986). Bare ground and litter cover ranged from 35-54 % and 16-24%, respectively for the three transects sampled by Francis (1986).

Physiognomy: Vegetation in this alliance has a sparse layer of microphyllous evergreen shrubs (< 2 m tall) with a moderately dense herbaceous layer dominated by perennial medium-tall and short grasses. Perennial forbs are sparse. Annual forbs and grasses may be present seasonally.

Vegetation: Vegetation included in this minor alliance is found on alluvial flats in north-central New Mexico. Stands have a conspicuous sparse woody layer (<2 m tall) that is primarily composed of the microphyllous evergreen shrub, *Chrysothamnus nauseosus*. Overall, the stands are dominated by moderately dense cover of the short sod grass, *Bouteloua gracilis* with *Pascopyrum smithii* also present in smaller amounts. Other shrubs and dwarf-shrubs that may be present are *Artemisia tridentata*, *Gutierrezia sarothrae* or *Chrysothamnus parryi*. Other herbaceous species may include grasses such as *Sporobolus cryptandrus*, *Hilaria jamesii*, *Aristida purpurea*, *Elymus elymoides*, *Schedonnardus paniculatus* and *Oryzopsis hymenoides*. Perennial forbs are sparse. The only forbs listed were species of *Grindelia* and *Sphaeralcea*. Annual forbs and grasses may be present seasonally. Francis (1986) reported canopy cover data from three transects for *Chrysothamnus nauseosus* (5-9%), *Bouteloua gracilis* (24-37%), *Pascopyrum smithii* (2%), and total vegetation (24-37%).

Dynamics: Grazing has significantly impacted much of the vegetation in this region, which has had a long history of settlement and heavy livestock use. With proper livestock management and time, palatable species such as *Pascopyrum smithii*, *Sporobolus cryptandrus*, *Elymus elymoides*, *Schedonnardus paniculatus*, *Oryzopsis hymenoides* and *Artemisia tridentata* may increase, and *Gutierrezia sarothrae* and *Chrysothamnus nauseosus* may decline in abundance (Francis 1986).

Similar Alliances:

?? CHRYSOTHAMNUS NAUSEOSUS SHRUBLAND ALLIANCE (A.835)

Similar Alliance Comments: The shrublands included in the similar alliance have similar species composition, but have 25% or greater cover of shrubs.

Synonymy:

?? *Chrysothamnus* Subformation, in part (Francis 1986)

Comments: This alliance includes stands with two subspecies of *Chrysothamnus nauseosus*: ssp. *bigelovii* and ssp. *graveolens*. Each subspecies is classified in a separate association. Further study is needed on the effects of livestock grazing on vegetation structure in these stands and on the relationship between *Chrysothamnus nauseosus* shrub herbaceous associations and shrubland associations.

ALLIANCE DISTRIBUTION

Range: Vegetation included in this alliance has been described from the upper Rio Puerco watershed in northwestern New Mexico, within the southeastern part of the Colorado Plateau. The dominant species in these stands are widespread and it likely occurs elsewhere.

States: NM

TNC Ecoregions:

USFS Ecoregions: 313B:CC, 321A:??, M313A:??

ALLIANCE SOURCES

Edition: 98-06-12

References: Francis 1986

V.A.7.N.m. Short temperate or subpolar grassland with a sparse xeromorphic (evergreen and/or deciduous) shrub layer

V.A.7.N.m.1. BOUTELOUA HIRSUTA - BOUTELOUA GRACILIS - BOUTELOUA ERIOPODA SHRUB HERBACEOUS ALLIANCE (A.1548)

Hairy Grama - Blue Grama - Black Grama Shrub Herbaceous Alliance

ALLIANCE CONCEPT

Environment:

Physiognomy:

Vegetation:

Dynamics:

Similar Alliances:

?? BOUTELOUA CURTIPENDULA SHRUB HERBACEOUS ALLIANCE (A.1552)

?? BOUTELOUA ERIOPODA XEROMORPHIC SHRUB HERBACEOUS ALLIANCE (A.1553)

?? HILARIA MUTICA SHRUB HERBACEOUS ALLIANCE (A.1551)

Similar Alliance Comments: Similar vegetation has been classified in V.A.7.N.m.5 *Bouteloua curtipendula* Shrub Herbaceous Alliance (A.1552), V.A.7.N.m.6 *Bouteloua eriopoda* Xeromorphic Shrub Herbaceous Alliance (A.1553), and V.A.7.N.m.4 *Hilaria mutica* Shrub Herbaceous Alliance (A.1551).

Synonymy:

?? Viscid Acacia Series (Diamond 1993)

?? Creosotebush Series, in part (Diamond 1993)

?? Spanish Bayonet Series, in part (Diamond 1993)

?? Shrub-Black Grama Series, in part (Dick-Peddie 1993)

?? Shrub-Mixed Grass Series, in part (Dick-Peddie 1993)

Comments: This alliance is provisional until more information is available on the dominant grasses in these sparse shrublands.

ALLIANCE DISTRIBUTION

Range: This alliance is found in Texas, Arizona, New Mexico, and in Mexico.

States: TX

TNC Ecoregions: 24:C

USFS Ecoregions: 321A:CC

ALLIANCE SOURCES

Edition: 96-02

References: Brown 1982, Diamond 1993, Dick-Peddie 1993, Leopold and Krausman 1988, Plumb 1988, Plumb 1992, Warnock 1970, Wauer 1971

V.A.7.N.m.3. PROSOPIS GLANDULOSA SHRUB HERBACEOUS ALLIANCE (A.1550)

Honey Mesquite Shrub Herbaceous Alliance

ALLIANCE CONCEPT

Environment: Vegetation included in this alliance occur in Trans-Pecos Texas, southern New Mexico, and southeastern Arizona. Elevation ranges from 1200-1600 m. Climate is arid to semi-arid. Temperature is hot in summer and is frequently below freezing in winter. At the nearby Jornada Experimental Range in southwestern New Mexico, annual precipitation ranged from 7-45 cm with mean annual precipitation of 23 cm (Herbel et al. 1972). Drought is not uncommon. The precipitation has a bimodal distribution with about two-thirds falling during July-October and a third during the winter months. The summer precipitation often occurs as high intensity convective storms. The driest period is in late spring and early summer. Sites include sandy plains, bajadas, mesas and terraces along intermittent drainages. They are generally flat or gently sloping occurring on all aspects. Substrate is usually sandy or gravelly alluvium. Parent material includes rhyolite. Soils are generally coarse textured such as sandy loams. Muldavin et al. (1993) described the ground cover of a stand with 40% bareground, 25% rock and gravel, and 33% litter. These shrublands may grade into grasslands upslope dominated by *Bouteloua* spp., *Sporobolus* spp., or *Hilaria mutica*, or be surrounded by a matrix of desertscrub dominated by *Larrea tridentata* or *Ambrosia* spp.

Physiognomy: Vegetation included in this alliance has a sparse layer (less than 25% cover) of evergreen or deciduous xeromorphic shrubs that are less than 5 m tall. The sparse to moderately dense graminoid layer is usually less than 0.5 m tall. The graminoid layer always has more cover than the shrub layer. Annual forbs and grasses are present seasonally. Sparse succulent cover is often present.

Vegetation: Vegetation included in this alliance occurs on sandy plains, bajadas, mesas and valleys, in Trans-Pecos Texas, across southern New Mexico, and into southeastern Arizona. Stands have sparse shrub cover (less than 25%) dominated by the xeromorphic deciduous shrub, *Prosopis glandulosa*. Graminoid cover is greater than shrub cover and usually over 25%. The diversity of other species can vary greatly. Other characteristic shrubs may include *Atriplex canescens*, *Gutierrezia sarothrae*, *Krascheninnikovia lanata*, *Lycium* spp. and *Parthenium incanum*. Succulents such as *Opuntia leptocaulis*, *O. imbricata*, *O. phaeacantha*, *Nolina microcarpa*, *Yucca baccata* and *Y. elata* are often present. Characteristic perennial grasses may include *Aristida purpurea*, *Bouteloua curtipendula*, *B. eriopoda*, *B. gracilis*, *Hilaria mutica*, *Muhlenbergia porteri*, *Muhlenbergia richardsonis*, *Panicum obtusum*, *Sporobolus flexuosus* and *Sporobolus wrightii*. Sparse annual grasses may include *Aristida adscensionis*, *Bouteloua barbata* and *Erioneuron pulchellum*. Forb cover is also sparse, but it can be relatively diverse. Common forbs may include species of *Chenopodium*, *Croton*, *Eriogonum*, *Euphorbia*, *Solanum* and *Zinnia*. In more saline areas, shrubs are more sparse and grasses and forbs are more common, including *Sporobolus airoides*, *Distichlis spicata* and *Sesuvium verrucosum*. Bourgeron et al. (1993) described a stand at the Gray Ranch where the canopy cover of *Prosopis glandulosa* and perennial grasses were 12% and 20%, respectively.

Dynamics: *Prosopis glandulosa* has invaded large areas of desert grasslands especially those dominated by *Bouteloua eriopoda* in the Trans-Pecos of Texas, southern New Mexico, and southeastern Arizona (Hennessy et al. 1983, York and Dick-Peddie 1969). Studies on the Jornada Experimental Range suggest that combinations of drought, overgrazing by livestock, wind and water erosion, seed dispersal by livestock, fire suppression, shifting dunes, and changes in the seasonal distribution of precipitation have caused this recent, dramatic shift in vegetation physiognomy (Buffington and Herbel 1965, Gibbens et al. 1983, Herbel et al. 1972, Hennessy et al. 1983, Humphrey 1974, McLaughlin and Bowers 1982, McPherson 1995, Schlesinger et al. 1990).

Prosopis spp. and other shrubs have extensive root systems that allow them to exploit deep soil water that is unavailable to shallower rooted grasses and cacti (Burgess 1995). This strategy works well except on sites that have well-developed argillic or calcic soil horizons that limit infiltration and storage of winter moisture in the deeper soil layers (McAuliffe 1995). McAuliffe (1995) found *Prosopis* spp. invasion on these sites limited to a few, small individuals. This has implications in plant geography and grassland revegetation work in the southwestern U.S.

Similar Alliances:

- ?? PROSOPIS GLANDULOSA WOODLAND ALLIANCE (A.611)
- ?? PROSOPIS GLANDULOSA TEMPORARILY FLOODED WOODLAND ALLIANCE (A.637)
- ?? PROSOPIS (GLANDULOSA, VELUTINA) WOODLAND ALLIANCE (A.661)
- ?? PROSOPIS GLANDULOSA SHRUBLAND ALLIANCE (A.1031)
- ?? BOUTELOUA ERIOPODA HERBACEOUS ALLIANCE (A.1284)
- ?? BOUTELOUA HIRSUTA - BOUTELOUA GRACILIS - BOUTELOUA ERIOPODA SHRUB HERBACEOUS ALLIANCE (A.1548)
- ?? BOUTELOUA ERIOPODA XEROMORPHIC SHRUB HERBACEOUS ALLIANCE (A.1553)
- ?? BOUTELOUA ERIOPODA MICROPHYLOUS EVERGREEN SHRUB HERBACEOUS ALLIANCE (A.1545)

Similar Alliance Comments: Although stand structure is different, all the similar alliances include stands that are dominated or codominated by *Prosopis glandulosa* or *Bouteloua eriopoda*. The closely related alliances, *Prosopis glandulosa* Intermittently Flooded Woodland and *Prosopis glandulosa* Woodland Alliance, are described from stands in Texas. Information on these related alliances from outside of Texas is not available. Bourgeron *et al.* (1993) separated stands included in the *Prosopis glandulosa* Shrubland and *Prosopis glandulosa* Shrub Herbaceous alliances by the abundance's of *Prosopis glandulosa* and *Bouteloua eriopoda*. If the graminoid layer is greater than the shrub layer and the shrub layer is between 10 and 25%, then the stand is classified as a shrub herbaceous alliance. The *Bouteloua eriopoda* alliances have less than 10% cover of shrubs.

Synonymy:

- ?? Mesquite Series. included in both the Arroyo Riparian and Closed Basin-Playa-Alkali Sink Riparian (Dick-Peddie 1993)
- ?? Mixed Shrub Series. includes *Prosopis glandulosa*/*Gutierrezia sarothrae*/*SMF-F* (dunes) (Dick-Peddie 1993)
- ?? Mesquite - scrub series. from the Chihuahuan Desert Region of the Desert Shrub Formation. (Donart et al. 1978)
- ?? Mesquite bosques series. from the Riparian Region of the Woodland Formation (Donart et al. 1978)
- ?? Shrub-Mixed Grass Series. includes *Prosopis glandulosa*-*Microrhamnus ericoides*-*Gutierrezia* (Dick-Peddie 1993)

Comments: Currently, there is only one association included in this alliance, *Prosopis glandulosa* / *Bouteloua eriopoda* Shrub Herbaceous Vegetation (CEGL001510). This description is based on that association. It is not clear if other desert grassland stands dominated by grasses other than *Bouteloua eriopoda* with a sparse shrub layer dominated by *Prosopis glandulosa* would be better classified in this alliance or in another alliance (e.g., the *Hilaria mutica* Shrub Herbaceous Alliance includes the *Prosopis glandulosa* / *Hilaria mutica* Shrub Herbaceous Association). Also, some mesquite coppice dune stands have sparse cover of both *Prosopis glandulosa* and grass cover, and may be better classified in a sparsely vegetated alliance.

ALLIANCE DISTRIBUTION

Range: Shublands included in this alliance occur primarily in the Chihuahuan Desert, from Trans-Pecos Texas to southeastern Arizona. It likely occurs in adjacent northern Mexico.

States: NM

TNC Ecoregions:

USFS Ecoregions: 313A:??, 321A:CC, 331J:??, M313B:??

ALLIANCE SOURCES

Edition: 98-05-19

References: Beatley 1976, Bourgeron et al. 1993, Bourgeron et al. 1995, Buffington and Herbel 1965, Burgess 1995, Diamond 1993, Dick-Peddie 1993, Donart et al. 1978, Gardner 1951, Gibbens et al. 1983, Hennessy et al. 1983, Herbel et al. 1972, Hoagland 1997, Humphrey 1974, McAuliffe 1995, McLaughlin and Bowers 1982, McPherson 1995, Smith and Douglas 1989, Warren and Anderson 1985, York and Dick-Peddie 1969

V.A.7.N.m.4. HILARIA MUTICA SHRUB HERBACEOUS ALLIANCE (A.1551)

Tobosa Shrub Herbaceous Alliance

ALLIANCE CONCEPT

Environment: Grasslands in this desert alliance occur in southwestern New Mexico, southern Arizona and likely in adjacent Mexico. Elevations range from 1100 to 1650 meters. Climate is arid to semi-arid with hot summers. Mean annual precipitation ranges from 22- 28 cm, but can vary greatly from year to year. Drought is not uncommon. Annual precipitation has bimodal distribution with the proportion of summer precipitation decreasing westward (Barbour and Major 1977). At the Jornada Experimental Range in southwestern New Mexico, about a third of the annual precipitation occurs in late winter and two-thirds in July through October. At Tucson, Arizona, about half of the annual rain falls during July to October with the balance during the winter months. The most arid season is late spring and early summer. The summer rain often occurs as high-intensity convective storms. At the higher elevation sites in the Chihuahuan Desert, sites occur on flats and moderate slopes (0-14%) with southern aspects. Soils are sandy to gravelly silt loams derived from gravelly alluvium and andesite. Bourgeron et al. (1993) described groundcover where bare soil, gravel, litter, and basal vegetation were 20-40%, 50%, 0-10% and 3-20% cover, respectively. Stands at the lower elevations occur in the Sonoran Desert on rocky slopes of mountain, hills, and mesas. Sites are on northern aspect, bouldery hillsides with slopes of up to 45%. Soils are gravelly clay with slight caliche coating on soil surface and on the undersides of the basalt gravel and boulders. These stands are surrounded by a matrix of desert shrubland dominated by *Larrea tridentata* or *Prosopis* spp.

Physiognomy: Vegetation included in this alliance has a sparse to moderately dense graminoid layer dominated by medium-tall, perennial bunchgrasses. A conspicuous but sparse layer (10-25% cover) of microphyllous deciduous and evergreen shrubs 1-2 m tall is also present. The forb layer is typically sparse (<5%). Scattered cacti are often present. Annual grasses and forbs are seasonally present to abundant.

Vegetation: Vegetation included in this grassland alliance occurs on flats and slopes of mesas and mountains within the Chihuahuan and Sonoran Desert and has been described from the extreme southwestern New Mexico and south-central Arizona. Stands have a sparse to moderately dense (5-35% cover) graminoid layer of mostly medium-tall perennial bunchgrasses with a sparse shrub layer. This vegetation is often distributed in patches. The bunchgrass, *Hilaria mutica* dominates the potentially diverse graminoid layer. Other characteristic graminoids may include 18 species such as the annuals, *Aristida adscensionis*, *Bouteloua barbata*, *Chloris virgata*, *Eragrostis pectinacea*, *Eriochloa lemmonii* and *Panicum hirticaule*, and the perennials *Bouteloua eriopoda*, *Cyperus esculentus*, *Eragrostis intermedia*, *Muhlenbergia porteri*, *Panicum obtusum* and *Tridens muticus*. The shrub layer consists of clumps and stringers of *Larrea tridentata* and *Prosopis glandulosa* or *Prosopis velutina*. Other common shrubs may include *Parkinsonia microphylla*, *Fouquieria splendens*, *Lycium berlandieri*, *Menodora scabra* and *Zinnia acerosa* (= *Zinnia pumila*). The sparse forbs layer includes species such as *Allionia incarnata*, *Amaranthus palmeri*, *Hoffmannseggia glauca*, *Solanum elaeagnifolium*, *Kallstroemia parviflora* and *Talinum aurantiacum*. Scattered cacti such as *Opuntia engelmannii*, *O. imbricata*, *O. leptophylla*, *O. spinosior* and *Echinocereus pectinatus* may also be present.

Dynamics: Impermeable caliche and argillic horizons are not uncommon on these sites. These layers restrict deep percolation of soil-water and may favor the shallower rooted grasses over more deeply rooted shrubs like *Larrea tridentata* and *Prosopis* spp. (McAuliffe 1995). *Hilaria mutica* is relatively tolerant of livestock grazing. In west-central Arizona, livestock have nearly eliminated all native grasses, except *Hilaria mutica*, from semi-desert grassland (Brown 1982). Exotic plants invaded, especially exotic annual grasses such as *Bromus rubens*, and now dominate the landscape. These *Hilaria mutica* grasslands are the result of livestock disturbance and exotic plant invasion and should not be classified as natural. Stands codominated by *Scleropogon brevifolius* are characteristic of sites with past heavy grazing by livestock (Whitfield and Anderson 1938).

Similar Alliances:

?? HILARIA MUTICA HERBACEOUS ALLIANCE (A.1249)

?? HILARIA MUTICA INTERMITTENTLY FLOODED HERBACEOUS ALLIANCE (A.1330)

?? LARREA TRIDENTATA SHRUBLAND ALLIANCE (A.851)

?? PROSOPIS GLANDULOSA SHRUBLAND ALLIANCE (A.1031)

Similar Alliance Comments: Vegetation in the herbaceous similar alliances is also dominated by *Hilaria mutica*. These stands are separated from those in the similar alliances by their significant shrub layer (>10% cover), and the lack of flooding. The shrubland similar alliances are related by the shared species in the woody layer.

Synonymy:

?? Tobosa Series (Diamond 1993)

?? Tobosa Grass-Scrub Series, *Hilaria mutica-Prosopis julifolia* Association (Brown 1982)

?? Tobosa Grass-Scrub Series, *Hilaria mutica* mixed shrub Association (Brown 1982)

?? Tobosa Series. within the Plains-Mesa Grassland (Dick-Peddie 1993)

?? *Hilaria mutica* Series. within the Plains-Mesa Grassland (Muldavin et al. 1998)

Comments: Stands in this alliance are not well known. Bourgeron et al. (1993) described two stands at the Gray Ranch in New Mexico, and Ferguson (1950) described one stand in south-central Arizona. Two of these stands are too sparse to be classified as grasslands. The Ferguson stand may be better classified in a sparsely vegetated alliance because the grass cover is so low. A gradient of shrub cover may exist in stands with a *Hilaria mutica*-dominated herbaceous layer making classification difficult.

ALLIANCE DISTRIBUTION

Range: Stands included in this alliance occur in the Chihuahuan and Sonoran deserts in southern New Mexico and southern Arizona, and likely occur in Trans-Pecos Texas and the Mexican states of Chihuahua and Coahuila.

States: AZ,NM,TX?

TNC Ecoregions: 24:C

USFS Ecoregions: 321A:CC, 322B:CC

ALLIANCE SOURCES

Edition: 98-06-24

References: Bourgeron et al. 1993, Bourgeron et al. 1995, Brown 1982, Diamond 1993, Dick-Peddie 1993, Ferguson 1950, Johnson 1961, McAuliffe 1995, Whitfield and Anderson 1938

V.A.7.N.m.5. BOUTELOUA CURTIPENDULA SHRUB HERBACEOUS ALLIANCE (A.1552)

Sideoats Grama Shrub Herbaceous Alliance

ALLIANCE CONCEPT

Environment: Vegetation in this Chihuahuan Desert alliance generally occurs on steep rocky slopes on mountains and mesas. Elevations for these semi-desert grasslands range from 1300 to 2000 meters. Mean annual precipitation is approximately 30 cm, but is highly variable with drought years not uncommon. Typically a third of the precipitation occurs in late winter and two thirds in July through October, often as high intensity convective storms. These grasslands grade into *Pinus edulis - Quercus - Juniperus* woodlands at higher elevations and Chihuahuan desert shrublands such as *Prosopis glandulosa/Bouteloua eriopoda* stands on dry slopes and lower elevations. Stands are typically found on south aspects. Soils are generally rocky and range from shallow to moderately deep. Soil texture is typically loamy. Quartz monzonite was reported a parent material for one site.

Physiognomy: Vegetation in this grassland alliance is dominated by sparse to dense cover of medium-tall bunchgrasses with a sparse to moderately dense cover of xeromorphic succulent and broad-leaved shrubs and scattered evergreen trees.

Vegetation: This alliance includes stands with a sparse to moderately dense herbaceous layer with a typically sparse shrub layer. The herbaceous layer is dominated the medium-tall perennial bunchgrass *Bouteloua curtipendula*, but can also be very diverse. Sites described by Muldavin et al. (1994) ranged from 8 to 35% canopy cover of *Bouteloua curtipendula* with 6 to 17 other graminoid species such as *Bothriochloa barbinodis*, *Koeleria macrantha*, *Lycurus phleoides*, *Muhlenbergia pauciflora*, *M. tenuifolia*, *Piptochaetium fimbriatum* and *Stipa lobata*. The diverse forb layer is dominated by the mat-forming species *Selaginella*. Other common forbs include species of *Artemisia*, *Heliomeris*, *Mirabilis*, *Sida* and *Viguiera*. The succulent, *Dasyllirion wheeleri* is the diagnostic species of the potentially diverse shrub layer. Other characteristic shrubs may include *Ageratina herbacea*, *Cercocarpus montanus*, *Ericameria laricifolia*, *Garrya wrightii*, *Quercus turbinella*, *Robinia neomexicana*, *Yucca baccata* and ten other shrubs. Cacti include *Opuntia imbricata* and *O. phaeacantha*. Scattered trees at higher elevations are often present such as *Juniperus deppeana*, *Pinus edulis* and *Quercus* spp. At lower elevations and on dry slopes, sparse Chihuahuan desertscrub species may intermix.

Dynamics: Rocky substrates can provide crevices with enhanced-moisture microsites for grasses by reducing evaporation and providing shade (Muldavin et al. 1998). The limited precipitation infiltrates better in coarse soils and is available to more deeply rooted species like *Bouteloua curtipendula* (Weaver and Albertson 1956).

Similar Alliances:

- ?? BOUTELOUA CURTIPENDULA HERBACEOUS ALLIANCE (A.1244)
- ?? SCHIZACHYRIUM SCOPARIUM - BOUTELOUA CURTIPENDULA HERBACEOUS ALLIANCE (A.1225)
- ?? HILARIA BELANGERI - BOUTELOUA CURTIPENDULA HERBACEOUS ALLIANCE (A.1214)
- ?? MUHLENBERGIA SETIFOLIA SHRUB HERBACEOUS ALLIANCE (A.1541)
- ?? BOUTELOUA ERIOPODA XEROMORPHIC SHRUB HERBACEOUS ALLIANCE (A.1553)

Similar Alliance Comments: These alliances all have *Bouteloua curtipendula* or *Dasyilirion wheeleri* listed as a dominant or codominant species. They are separated because of different graminoid codominants such as *Schizachyrium scoparium* and/or the lack of a shrub component. *Bouteloua curtipendula* is a widespread species and is codominant in many grassland, shrub and woodland associations throughout much of the western US.

Synonymy:

- ?? *Bouteloua curtipendula* Series. Sideoats Grama/Sotal Community Type (Muldavin et al. 1998)
- ?? *Bouteloua curtipendula* Series. *Bouteloua curtipendula* Plant Association (Muldavin et al. 1994)

Comments:**ALLIANCE DISTRIBUTION**

Range: Grasslands included in this Chihuahuan alliance have been described from the Organ Mountains in south-central New Mexico, but likely occur in Trans-Pecos Texas, across southern New Mexico and southeastern Arizona. It may also be found in the Mexican states of Coahuila and Chihuahua.

States: NM

TNC Ecoregions:

USFS Ecoregions: 321A:CC

ALLIANCE SOURCES

Edition: 98-03-20

References: Bourgeron et al. 1995, Diamond 1993, Muldavin 1994, Muldavin and Mehlhop 1992, Muldavin and Melhop 1992, Muldavin et al. 1994, Muldavin et al. 1998, Weaver and Albertson 1956

V.A.7.N.m.6. BOUTELOUA ERIOPODA XEROMORPHIC SHRUB HERBACEOUS ALLIANCE (A.1553)

Black Grama Xeromorphic Shrub Herbaceous Alliance

ALLIANCE CONCEPT

Environment: Stands included in this Chihuahuan and Sonoran Desert alliance generally occur on mountains and mesas. Climate is semi-arid with hot summers and mild winters. Elevation for these semi-desert grasslands ranges from 800 to 1500 meters. Mean annual precipitation ranges from 22-30 cm, but is highly variable with drought years not uncommon. Typically half to two-thirds of the annual precipitation falls in July through October often as high intensity convective storms with the balance occurring during the winter. May and June often experience drought. Stands occur on moderately steep rocky mountain slopes and ridges, nearly level mesa tops, lower slopes of mesa escarpments and sandy alluvium. Aspect is not restricted. Soils are typically rocky, shallow to moderately deep. Soil texture ranges from sandy loam to clay loam. Caliche is present in some stands. Parent materials include basalt and quartz monzonite. These grasslands grade into adjacent desert shrublands dominated by *Prosopis* spp. or *Larrea tridentata*.

Physiognomy: Vegetation in this alliance is dominated by short sod grasses with a sparse xeromorphic shrub layer 1-3 m tall.

Vegetation: Grasslands in this Chihuahuan and Sonoran Desert alliance are dominated by the perennial short grass, *Bouteloua eriopoda* with a sparse xeromorphic shrub canopy dominated by one of the following shrubs *Ayenia microphylla*, *Dasyilirion wheeleri*, *Ephedra torreyana*, *E. trifurca*, *Parthenium incanum* or *Yucca elata*. Other common species may include the shrubs *Krameria grayi*, *Larrea tridentata*, *Opuntia engelmannii*, *Parkinsonia microphylla*, *Prosopis* spp. and grasses like *Bouteloua curtipendula*, *B. gracilis*, *Bothriochloa barbinodis* and *Muhlenbergia porteri*. Forb cover is generally sparse, but may be diverse. Muldavin et al. (1994) described a stand with 17 species. Common forbs include species of *Allionia*, *Ambrosia*, *Boerhavia*, *Chamaesyce*, *Eriogonum*, *Ipomoea*, *Machaeranthera* and *Talinum*.

Dynamics:**Similar Alliances:**

- ?? BOUTELOUA HIRSUTA - BOUTELOUA GRACILIS - BOUTELOUA ERIOPODA SHRUB HERBACEOUS ALLIANCE (A.1548)
- ?? BOUTELOUA ERIOPODA MICROPHYLLOUS EVERGREEN SHRUB HERBACEOUS ALLIANCE (A.1545)
- ?? BOUTELOUA ERIOPODA HERBACEOUS ALLIANCE (A.1284)
- ?? BOUTELOUA ERIOPODA DWARF-SHRUB HERBACEOUS ALLIANCE (A.1570)

Similar Alliance Comments: All the similar alliances have *Bouteloua eriopoda* as characteristic plant species. More information is needed to clarify the differences between stands in this alliance and the similar alliances: V.A.7.N.m.1 *Bouteloua hirsuta* - *Bouteloua gracilis* - *Bouteloua eriopoda* Shrub Herbaceous Alliance (A.1548), V.A.7.N.j.2 *Bouteloua eriopoda* Microphyllous Evergreen Shrub Herbaceous Alliance (A.1545), V.A.5.N.e.11 *Bouteloua eriopoda* Herbaceous Alliance (A.1284), and V.A.8.N.a.6 *Bouteloua eriopoda* Dwarf-shrub Herbaceous Alliance (A.1570).

Synonymy:

? *Bouteloua eriopoda* Series, in part (Muldavin et al. 1998)

? *Bouteloua eriopoda* Series, in part (Muldavin et al. 1994)

? *Bouteloua-Ayenia* Community, in part (Ferguson 1950)

Comments: More information is needed to clarify the differences between stands in this alliance and the similar alliances.

ALLIANCE DISTRIBUTION

Range: Vegetation included in this alliance occurs on mesas and mountain slopes in the Chihuahuan and Sonoran deserts. Stands have been described from the Tularosa Basin in southern New Mexico and in southern Arizona. It also likely occurs in adjacent Trans-Pecos Texas (?) and Chihuahua (?) and Sonora (?), Mexico.

States: AZ,MXCH?,NM,TX?

TNC Ecoregions: 24:C

USFS Ecoregions: 321A:CC, 322B:CC

ALLIANCE SOURCES

Edition: 98-06-16

References: Ferguson 1950, Muldavin and Melhop 1992, Muldavin et al. 1994, Muldavin et al. 1998

V.A.8.N.a. Short temperate or subpolar lowland grassland with a sparse needle-leaved or microphyllous dwarf-shrub layer

V.A.8.N.a.1. KRASCHENINNIKOVIA LANATA DWARF-SHRUB HERBACEOUS ALLIANCE (A.1565)

Winter-fat Dwarf-shrub Herbaceous Alliance

ALLIANCE CONCEPT

Environment: Stands of this alliance are found in the western Great Plains and in the southwestern U.S. Elevations range from 1850-1950 m. Climate is semi-arid with about half the annual precipitation occurring in July-September often as high intensity, convective storms. Sites include plains, alkaline flats, mesas and plateaus, and are typically flat to gentle slope on fine textured and often saline or alkaline soil. Soils are typically shallow to moderate deep, calcareous, alkaline loams or clay loams. Parent material includes sedimentary rock such as shale and sandstone.

Physiognomy: Vegetation included in this alliance is dominated by sparse to moderately dense herbaceous layer dominated by perennial graminoids with moderately sparse evergreen, dwarf-shrub layer. Scattered shrubs and perennial forbs may also be present. Annual grasses and forbs are seasonally present.

Vegetation: Vegetation included in this alliance is found in the western Great Plains, and on alluvial flats and mesas in the southwestern U.S. Stands are dominated by a perennial mid- and short grasses, such as *Bouteloua gracilis* and *Pascopyrum smithii* with a moderately sparse woody layer (10-25% cover) of the evergreen dwarf-shrub, *Krascheninnikovia lanata*. This sparse woody layer distinguishes this alliance from other vegetation types such as *Bouteloua gracilis*-dominated grassland. Other woody vegetation may include *Gutierrezia sarothrae* and scattered *Atriplex canescens*, *Artemisia bigelovii*, *A. frigida*, *A. tridentata*, *Ephedra viridis*, *Opuntia* spp. or *Juniperus monosperma*. In the herbaceous layer other characteristic graminoids may include *Hilaria jamesii*, *Muhlenbergia torreyi*, *Oryzopsis hymenoides*, *Sporobolus airoides* and *S. cryptandrus*. Perennial forbs such as *Sphaeralcea coccinea*, *Chaetopappa ericoides* or *Mentzelia* spp. may be present. Annual forbs and grasses are present seasonally. Annuals include natives like *Plantago* spp. and *Vulpia octoflora*, and exotics such as *Salsola kali* and *Bromus tectorum*.

Dynamics: *Krascheninnikovia lanata* is important range forage. It is highly palatable in the winter and is tolerant of heavy browsing (Daubenmire 1970). Many stands have long histories of grazing impacts and are thought to be in a degraded state (Francis 1986). These stands often have low perennial herbaceous cover (Francis 1986). Francis suggested that his *Ceratoides lanata* - *Gutierrezia sarothrae* / *Bouteloua gracilis* community type represented a degraded *Ceratoides lanata* / *Sporobolus airoides* community type. Francis (1986) also predicts that with protection from grazing, *Gutierrezia sarothrae* cover will decrease and *K. lanata*, *Sporobolus airoides* and *Oryzopsis hymenoides* will increase in cover. Rasmussen and Brotherson (1986) results from research in southern Utah support this conclusion.

Similar Alliances:

? KRASCHENINNIKOVIA LANATA DWARF-SHRUBLAND ALLIANCE (A.1104)

Similar Alliance Comments: *Krascheninnikovia lanata* is also the dominant woody species in stands in the similar alliance.

Synonymy:

? Saltbush Series. in part, *Atriplex canescens-Ceratoides lanata/SMG-F* (Dick-Peddie 1993)

? *Eurotia lanata* Series. includes the *Eurotia lanata/Hilaria jamesii* plant association. (Johnston 1987)

Comments: The vegetation is too sparse (12% herbaceous and 3% shrub cover) in the grazing impacted stands described by Francis (1986) and they may be better classified in a sparsely vegetated alliance. Ungrazed stands described by Rasmussen and Brotherson (1986) fit well within this alliance (25% herbaceous cover and 13% shrub cover), except they are dominated by *Hilaria jamesii* and *Oryzopsis hymenoides* and may need an association level description. Little information for stands from the western Great Plains or the northern Chihuahuan Desert was available. This description was mostly based on stands from Francis (1986) and Rasmussen and Brotherson (1986).

ALLIANCE DISTRIBUTION

Range: Stands in this alliance occur in the western Great Plains the Colorado Plateau and the northern Chihuahuan Desert. It has been reported from in Colorado, Kansas, New Mexico, Arizona, and likely occurs in Utah.

States: AZ,CO,KS?,NM

TNC Ecoregions: 27:C

USFS Ecoregions: 315A:??, 321A:CC, M313B:CC, M331F:??

ALLIANCE SOURCES

Edition: 98-18-13

References: Dick-Peddie 1993, Faber-Langendoen et al. 1996, Francis 1986, Muldavin and Melhop 1992, Muldavin et al. 1992, Shaw et al. 1989, USDA Soil Conservation Service 1978, USDI Bureau of Indian Affairs 1979

V.A.8.N.a.6. BOUTELOUA ERIPODA DWARF-SHRUB HERBACEOUS ALLIANCE (A.1570)

Black Grama Dwarf-shrub Herbaceous Alliance

ALLIANCE CONCEPT

Environment: One stand in this alliance was reported from White Sands Missile Range in the Tularosa Basin of southern New Mexico. Elevations range from 1200-2700 m at White Sands Missile Range. Climate is arid. Mean annual precipitation is 22 cm with over half occurring during the late summer monsoon season often as high-intensity convection storm. More detailed site description information was not available.

Physiognomy: Vegetation included in this alliance has a herbaceous layer dominated by perennial shortgrasses with a sparse dwarf-shrub layer.

Vegetation: Grasslands in this Chihuahuan Desert alliance are dominated by the perennial shortgrass, *Bouteloua eriopoda*. There is also a sparse dwarf-shrub layer dominated by *Artemisia bigelovii*. More detailed description information was not available.

Dynamics:

Similar Alliances:

? BOUTELOUA HIRSUTA - BOUTELOUA GRACILIS - BOUTELOUA ERIPODA SHRUB HERBACEOUS ALLIANCE (A.1548)

? BOUTELOUA ERIPODA MICROPHYLOUS EVERGREEN SHRUB HERBACEOUS ALLIANCE (A.1545)

? BOUTELOUA ERIPODA HERBACEOUS ALLIANCE (A.1284)

? BOUTELOUA ERIPODA XEROMORPHIC SHRUB HERBACEOUS ALLIANCE (A.1553)

? ARTEMISIA BIGELOVII DWARF-SHRUBLAND ALLIANCE (A.1103)

Similar Alliance Comments: All the similar alliances have *Bouteloua eriopoda* listed as characteristic plant species except the *Artemisia bigelovii* Dwarf-shrubland which has the same species in the woody layer, but may not have *Bouteloua eriopoda* dominate the herbaceous layer.

Synonymy:

? Grama Grass-Scrub Series. within Series (Brown 1982)

Comments: The single association included in this alliance is described from only one stand on the White Sands Missile Range. More information is needed to describe stands in this alliance and clarify how it differs from the similar alliances.

ALLIANCE DISTRIBUTION

Range: Vegetation in this alliance occurs in the Chihuahua Desert at White Sands Missile Range in southern New Mexico.

States: NM

TNC Ecoregions:

USFS Ecoregions: 321A:CC

ALLIANCE SOURCES

Edition: 98-07-31

References: Brown 1982, Muldavin and Melhop 1992, Neher and Bailey 1976

V.A.8.N.a.7. **BOUTELOUA GRACILIS DWARF-SHRUB HERBACEOUS ALLIANCE (A.1571)**

Blue Grama Dwarf-shrub Herbaceous Alliance

ALLIANCE CONCEPT

Environment: Two stands in this alliance were reported from White Sands Missile Range in the Tularosa Basin of southern New Mexico. Elevations range from 1200-2700 m at White Sands Missile Range. Climate is semi-arid. Mean annual precipitation is 22 cm with over half occurring during the late summer monsoon season often as high intensity convection storm. More detailed site description information was not available.

Physiognomy: Vegetation in this alliance have a graminoid layer dominated by short grasses and a sparse dwarf-shrub layer.

Vegetation: Vegetation in this Chihuahuan Desert alliance has a sparse to moderately dense graminoid layer dominated by the shortgrass *Bouteloua gracilis* with a sparse dwarf-shrub layer primarily of *Artemisia bigelovii*. The climate is semi-arid. Other information is not available.

Dynamics:

Similar Alliances:

?? ARTEMISIA BIGELOVII DWARF-SHRUBLAND ALLIANCE (A.1103)

?? MUHLENBERGIA SETIFOLIA / ARTEMISIA BIGELOVII SHRUB HERBACEOUS ALLIANCE (A.1530)

?? BOUTELOUA ERIOPODA DWARF-SHRUB HERBACEOUS ALLIANCE (A.1570)

?? JUNIPERUS MONOSPERMA WOODLAND ALLIANCE (A.504)

Similar Alliance Comments: Stands from the *Artemisia bigelovii* Dwarf-shrubland Alliance are described from southeastern Colorado and are geographically separate from the others. The structure and composition of these alliances is similar and needs further examination. Stands from the other similar alliances all occur in New Mexico and share *Artemisia bigelovii* in the sparse dwarf-shrub layer, but have different a graminoid component dominating the herbaceous layer or have a tree layer.

Synonymy:

Comments: The single association included in this alliance is described from only two stands on the White Sands Missile Range. More information is needed to describe stands in this alliance and clarify how it differs from the similar alliances, especially the stands in the *Artemisia bigelovii* Dwarf-shrubland Alliance

ALLIANCE DISTRIBUTION

Range: Grasslands in this alliance occur in the Chihuahuan Desert have been described from the Tularosa Basin in south central New Mexico.

States: NM

TNC Ecoregions:

USFS Ecoregions: 321A:CC

ALLIANCE SOURCES

Edition: 98-07-31

References: Muldavin and Melhop 1992, Muldavin et al. 1992, Neher and Bailey 1976

VII. SPARSE VEGETATION

VII.B.1.N.b. **Montane talus/scree**

VII.B.1.N.b.1. **PERICOME CAUDATA SPARSELY VEGETATED ALLIANCE (A.1848)**

Pericome Sparsely Vegetated Alliance

ALLIANCE CONCEPT

Environment:

Physiognomy:

Vegetation:

Dynamics:

Similar Alliances:
Similar Alliance Comments:
Synonymy:
Comments:

ALLIANCE DISTRIBUTION

Range: This alliance is found in Trans-Pecos Texas.
States: TX
TNC Ecoregions: 24:C
USFS Ecoregions: 321A:CC

ALLIANCE SOURCES

Edition: 96-10
References:

VII.C.1.N.a. Dunes with sparse herbaceous vegetation

VII.C.1.N.a.2. HELIOTROPIUM CONVULVACEUM SPARSELY VEGETATED ALLIANCE (A.1853)

Bindweed Heliotrope Sparsely Vegetated Alliance

ALLIANCE CONCEPT

Environment: This alliance is known from sparsely vegetated quartz sand dunes.

Physiognomy:

Vegetation: Known examples have sparse vegetation consisting primarily of annuals. Most abundant species include *Heliotropium convolvulaceum*, *Psoralidium lanceolatum*, *Polanisia jamesii*, *Helianthus petiolaris*, *Helianthus neglectus*, *Panicum havardii*, *Chamaesyce carunculata* (= *Euphorbia carunculata*), and *Mentzelia sp.* This vegetation varies a great deal from year to year, depending on moisture.

Dynamics:

Similar Alliances:

Similar Alliance Comments:

Synonymy:

?? Havard Shin Oak-Tallgrass Series, in part (Diamond 1993)

Comments: The name and circumscription of this alliance may be changed as further data are available.

ALLIANCE DISTRIBUTION

Range: This alliance is found in eastern Trans-Pecos Texas.
States: TX
TNC Ecoregions: 24:C
USFS Ecoregions: 321A:CC

ALLIANCE SOURCES

Edition: 96-10
References: Diamond 1993, Texas Parks and Wildlife Department 1996

VII.C.1.N.a.3. HELIOTROPIUM RACEMOSUM SPARSELY VEGETATED ALLIANCE (A.1854)

Dune Heliotrope Sparsely Vegetated Alliance

ALLIANCE CONCEPT

Environment: This alliance is known from riverside quartz sand dunes.

Physiognomy:

Vegetation: *Heliotropium racemosum* dominates the sparse vegetation. *Chamaesyce sp.* is also common. Density and composition of the vegetation varies from year to year depending on moisture.

Dynamics:

Similar Alliances:

Similar Alliance Comments:

Synonymy:

Comments: The name and circumscription of this alliance may be changed as further data are available.

ALLIANCE DISTRIBUTION

Range: This alliance is known from riverside quartz sand dunes along the Rio Grande River in Trans-Pecos Texas in the vicinity of Boquillas and in the Mexican state of Coahuila.

States: MXCO,TX

TNC Ecoregions: 24:C

USFS Ecoregions: 321A:CC

ALLIANCE SOURCES

Edition: 96-10

References:

VII.C.2.N.c. Temporarily flooded sand flats

VII.C.2.N.c.2. SESUVIUM VERRUCOSUM TEMPORARILY FLOODED SPARSELY VEGETATED ALLIANCE (A.1865)

Winged Sea-purslane Temporarily Flooded Sparsely Vegetated Alliance

ALLIANCE CONCEPT

Environment:

Physiognomy:

Vegetation:

Dynamics:

Similar Alliances:

Similar Alliance Comments:

Synonymy:

?? Pickleweed-Seepweed Series, in part (Diamond 1993)

Comments:

ALLIANCE DISTRIBUTION

Range: This alliance is found in the Trans-Pecos region of western Texas.

States: TX

TNC Ecoregions: 24:C

USFS Ecoregions: 321A:CC

ALLIANCE SOURCES

Edition: 96-10

References: Burgess and Klein n.d., Diamond 1993, Henrickson 1974

VII.C.3.N.b. Dry slopes

VII.C.3.N.b.2. BOUTELOUA BREVISETA SPARSELY VEGETATED ALLIANCE (A.1870)

Gyp Grama Sparsely Vegetated Alliance

ALLIANCE CONCEPT

Environment:

Physiognomy:

Vegetation:

Dynamics:

Similar Alliances:

Similar Alliance Comments:

Synonymy:

Comments:

ALLIANCE DISTRIBUTION

Range: This alliance is found in the Trans-Pecos region of western Texas.

States: TX

TNC Ecoregions: 24:C

USFS Ecoregions: 321A:CC

ALLIANCE SOURCES

Edition: 96-10

References: Burgess and Klein n.d., Burgess and Northington 1977, Warnock 1974

VII.C.3.N.b.5. TIDESTROMIA CARNOSA SPARSELY VEGETATED ALLIANCE (A.1873)

Fleshy Tidestromia Sparsely Vegetated Alliance

ALLIANCE CONCEPT

Environment:

Physiognomy:

Vegetation:

Dynamics:

Similar Alliances:

Similar Alliance Comments:

Synonymy:

Comments:

ALLIANCE DISTRIBUTION

Range: This alliance occurs in the desert regions of western Texas, and may also be found in the Mexican states of Chihuahua (?) and Coahuila (?).

States: MXCH?,MXCO?,TX

TNC Ecoregions: 24:C

USFS Ecoregions: 321A:CC

ALLIANCE SOURCES

Edition: 96-10

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