APPENDIX E—HABITAT GAP VEGETATION DESCRIPTIONS

"The Southwest Regional Gap Analysis Project (SWReGAP) is an update of the Gap Analysis Program's mapping and assessment of biodiversity for the five-state region encompassing Arizona, Colorado, Nevada, New Mexico, and Utah. It is a multi-institutional cooperative effort coordinated by the U.S. Geological Survey Gap Analysis Program. The primary objective of the update is to use a coordinated mapping approach to create detailed, seamless GIS maps of land cover, all native terrestrial vertebrate species, land stewardship, and management status, and to analyze this information to identify those biotic elements that are underrepresented on lands managed for their long term conservation or are gaps" (http://fws-nmcfwru.nmsu.edu/swregap/).

This appendix provides land cover descriptions for the Southwest Regional GAP Analysis Project.

Willow along the Jordan River, Jordan River Corridor Sub-Watershed

LANDCOVER DESCRIPTIONS
FOR
THE SOUTHWEST REGIONAL GAP ANALYSIS PROJECT

Compiled by NatureServe
10 September, 2004

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DEVELOPED AND AGRICULTURE COVER TYPES

N21—DEVELOPED, OPEN SPACE—LOW INTENSITY
Source: NLCD draft legend, 25 July, 2003
Description: *Open Space:* Includes areas with a mixture of some construction materials, but mostly vegetation in the form of lawn grasses. Impervious surfaces account for less than 20 percent of total cover. These areas most commonly include large-lot single-family housing units, parks, golf courses, and vegetation planted in developed sesttings for recreation, erosion control, or aesthetic purposes. *Developed, Low intensity*: Includes areas with a mixture of constructed materials and vegetation. Impervious surfaces account for 20-49 percent of total cover. These areas most commonly include single-family housing units.

N22—DEVELOPED, MEDIUM –HIGH INTENSITY
Source: NLCD draft legend, 25 July, 2003
Description: *Developed, Medium Intensity*: Includes areas with a mixture of constructed materials and vegetation. Impervious surface accoutns for 50-79 percent of the total cover. These areas most commonly include single-family housing units. *Developed, High Intensity*: Includes highly developed areas where people reside or work in high numbers. Examples include apartment complexes, row houses and commercial/industrial. Impervious surfaces account for 80 to 100 percent of the total cover.

N80—AGRICULTURE
Source: NLCD draft legend, 25 July, 2003
Description: Agriculture—unable to make distinction between N81 and N82.

OTHER COVER TYPES

N11—OPEN WATER
Source: NLCD draft legend, 25 July, 2003
Description: All areas of open water, generally with less than 25% cover of vegetation or soil.

N31—BARREN LANDS
Source: NLCD draft legend, 25 July, 2003
Description: (Rock/Sand/Clay)-Barren areas of bedrock, desert pavement, scarps, talus, slides, volcanic material, glacial debris, sand dunes, strip mines, gravel pits and other accumulation of earthen material. Generally, vegetation accounts for less than 15% of total cover.

ALTERED OR DISTURBED LAND COVER TYPES

D01—DISTURBED, NON-SPECIFIC
Source: SWReGAP/NatureServe
Description: Generic Human Alteration, not alteration type specified

D02—RECENTLY BURNED
Source: SWReGAP/NatureServe
Description: Burned vegetation visible on imagery for time of image acquisition (1999-2001).

D03—RECENTLY MINED OR QUARRIED
Source: SWReGAP/NatureServe
Description: 2 hectare or greater, open pit mining or quarries visible on imagery.

D04—INVASIVE SOUTHWEST RIPARIAN WOODLAND AND SHRUBLAND
Source: SWReGAP/NatureServe
Description: Tamarix spp. Semi-Natural Temporarily Flooded Shrubland Alliance (A842), or Elaegnus angustifolus Semi-Natural Woodland Alliance (A3566).

D06—INVASIVE PERENNIAL GRASSLAND
Source: SWReGAP/NatureServe
Description: Pennisetum spp., Bromus inermis, Poa pratensis, Eragrostis lehmannianna, Thinopyrum intermedium (A2567), Pennisetum spp., Bromus inermis, Poa pratensis, Eragrostis lehmannianna, Thinopyrum intermedium (A3561), or Poa pratensis Semi-Natural Herbaceous Alliance (A1382). Includes Agropyron cristatum.

D07—INVASIVE PERENNIAL FORBLAND
Source: SWReGAP/NatureServe
Description: Melilotus officinalis?, M. albus? Centaurea spp.?

D08—INVASIVE ANNUAL GRASSLAND
Source: SWReGAP/NatureServe
Description: Avena spp., Bromus spp., Schismus spp.

D09—INVASIVE ANNUAL AND BIENNIAL FORBLAND
Source: SWReGAP/NatureServe
Description: Salsola spp., Kochia scoparia, Halogeton glomeratum

D10—RECENTLY LOGGED AREAS
Source: SWReGAP/NatureServe
Description: 2 hecatare or greater, areas clear-cut or greater than 50% thinned

D11—RECENTLY CHAINED PINYON-JUNIPER AREAS
Source: SWReGAP/NatureServe
Description: 2 hectare or greater, areas of chained P-J

D14—DISTURBED, OIL WELL
Source: SWReGAP/NatureServe
Description: Disturbed vegetation in proximity to dispersed oil wells

NATURAL LAND COVER TYPES / ECOLOGCIAL SYSTEM DESCRIPTIONS

NLCD Barren Lands Types

(Rock/Sand/Clay)-Barren areas of bedrock, desert pavement, scarps, talus, slides, volcanic material, glacial debris, sand dunes, strip mines, gravel pits and other accumulation of earthen material. Generally, vegetation accounts for less than 15% of total cover.

S001 NORTH AMERICAN ALPINE ICE FIELD

Division 300, Barren, CES300.728

Spatial Scale & Pattern: Large Patch **Classification Confidence:** high

Required Classifiers: Natural/Semi-natural, Non-vegetated (<10% vasc.), Upland

Diagnostic Classifiers: Alpine/AltiAndino [Alpine/AltiAndino], Ice Fields / Glaciers, Glaciated, Alpine Slopes

Non-Diagnostic Classifiers: Mediterranean [Mediterranean Xeric-Continental], Temperate [Temperate Continental]

Concept Summary: Widespread ecological system is composed of unvegetated landscapes of annual/perennial ice and snow at the highest elevations, where snowfall exceeds melting. The primary ecological processes include snow retention, wind desiccation, and permafrost. The snowpack/ice field never melts or if so, then for only a few weeks. The alpine substrate/ice field ecological system is part of the alpine mosaic consisting of alpine tundra dry meadow, wet meadow, fell-fields, and dwarf-shrubland.

DISTRIBUTION

Ecological Divisions: 104, 105, 204, 306
TNC Ecoregions: 20:C, 3:C, 69:C, 7:C, 70:C, 71:P, 76:C, 77:P, 78:C, 79:C, 9:C
Subnations/Nations: AB:c, AK:c, BC:c, CO:c, ID:c, MT:c, OR:c, WA:c, WY:c

CONCEPT

- **California community types:**
- Alpine Snowbank Margin (91.300.00)
- Alpine Snow and Ice Habitat (92.000.00)
- Alpine Snowfield (92.100.00)
- Alpine Glacier (92.200.00)

SOURCES

References: Meidinger and Pojar 1991, Neely et al. 2001
Last updated: 20 Feb 2003 **Stakeholders:** WCS, MCS, CAN
Concept Author: NatureServe Western Ecology Team **LeadResp:** WCS

S002 ROCKY MOUNTAIN ALPINE BEDROCK AND SCREE

Division 306, Barren, CES306.809

Spatial Scale & Pattern: Large Patch **Classification Confidence:** medium

Required Classifiers: Natural/Semi-natural, Non-vegetated (<10% vasc.), Upland

Diagnostic Classifiers: Alpine/AltiAndino [Alpine/AltiAndino], Talus (Substrate), Rock Outcrops/Barrens/Glades, Oligotrophic Soil, Very Shallow Soil, Alpine Slopes

Non-Diagnostic Classifiers: Temperate [Temperate Continental], Glaciated, Unconsolidated

Concept Summary: This ecological system is restricted to the highest elevations of the Rocky Mountains, from Alberta and British Columbia south into New Mexico, west into the highest mountain ranges of the Great Basin. It is composed of barren and sparsely vegetated alpine substrates, typically including both bedrock outcrop and scree slopes, with nonvascular- (lichen) dominated communities. Exposure to desiccating winds, rocky and sometimes unstable substrates, and a short growing season limit plant growth. There can be sparse cover of forbs, grasses, lichens and low shrubs.

DISTRIBUTION

Range: Restricted to the highest elevations of the Rocky Mountains, from Alberta and British Columbia south into New Mexico, west into the highest mountain ranges of the Great Basin.
Ecological Divisions: 304, 306
TNC Ecoregions: 11:C, 19:C, 20:C, 21:C, 68:C, 7:C, 8:C, 9:C
Subnations/Nations: AB:c, AZ:c, BC:c, CO:c, ID:c, MT:c, NM:c, NV:c, OR:c, UT:c, WA:c, WY:c

CONCEPT

Alliances and Associations:

- AQUILEGIA CAERULEA HERBACEOUS ALLIANCE (A.1603)
  Aquilegia caerulea - Cirsium scopulorum Scree Herbaceous Vegetation (CEGL001938)
- CIRSIUM SCOPULORUM HERBACEOUS ALLIANCE (A.1608)
  Cirsium scopulorum - Polemonium viscosum Herbaceous Vegetation (CEGL001959)
- CLAYTONIA MEGARHIZA HERBACEOUS ALLIANCE (A.1626)
  Claytonia megarhiza Herbaceous Vegetation (CEGL001878)
- IVESIA CRYPTOCAULIS SPARSELY VEGETATED ALLIANCE (A.2513)
  Ivesia cryptocaulis Alpine Sparse Vegetation (CEGL002735)
- POLEMONIUM VISCOSUM HERBACEOUS ALLIANCE (A.1631)
  Polemonium viscosum Herbaceous Vegetation (CEGL001928)
- SENECIO TARAXACOIDES HERBACEOUS ALLIANCE (A.1634)
  Senecio taraxacoides - Oxyria digyna Herbaceous Vegetation (CEGL001932)

SOURCES

References: Anderson 1999, Canadian Rockies Ecoregional Plan 2002, Cooper et al. 1997, Komarkava 1980, Komarkova 1976, Meidinger and Pojar 1991, Neely et al. 2001, Nelson 1998, Willard 1963
Last updated: 20 Feb 2003 **Stakeholders:** WCS, MCS, CAN
Concept Author: NatureServe Western Ecology Team **LeadResp:** WCS

S003 MEDITERRANEAN CALIFORNIA ALPINE BEDROCK AND SCREE

Division 206, Barren, CES206.899

Spatial Scale & Pattern: Large Patch **Classification Confidence:** medium
Required Classifiers: Natural/Semi-natural, Non-vegetated (<10% vasc.), Upland
Diagnostic Classifiers: Alpine/AltiAndino [Alpine/AltiAndino], Ridge/Summit/Upper Slope, Temperate [Temperate Oceanic], Nonvascular, Alpine Mosaic

Non-Diagnostic Classifiers: Herbaceous, Moss/Lichen (Nonvascular), Cliff (Landform), Hillslope bedrock outcrop, Peak, Periglacial boulderfield, Pinnacle, Ridgetop bedrock outcrop, Rockfall avalanche, Summit, Talus (Landform), Glaciated, Periglacial, Very Shallow Soil, Landslide, Avalanche, W-Landscape/High Intensity

Concept Summary: This system occurs in limited alpine environments mostly concentrated in the Sierra Nevada, but also on Mount Shasta and as far south as the Peninsular Ranges and White Mountains. Alpine elevations begin around 3500 m (10,600 feet) in the southern mountain ranges and 2700 m (8200 feet) in the southern Cascades. These are barren and sparsely vegetated alpine substrates, typically including both bedrock outcrops and scree slopes, with nonvascular (lichen)-dominated communities. This also encompasses a limited area of "alpine desert" with unstable sandy substrates and scattered individuals of *Astragalus* spp., *Arabis* spp., *Draba* spp., and *Oxytropis* spp., which mostly fall to the east of the Sierra Nevada crest. Exposure to desiccating winds, rocky and sometimes unstable substrates, and a short growing season limit plant growth.

DISTRIBUTION

Range: Concentrated in the Sierra Nevada, but also on Mount Shasta and as far south as the Peninsular Ranges and White Mountains. Alpine elevations begin around 3500 m (10,600 feet) in the southern mountain ranges and 2700 m (8200 feet) in the southern Cascades.
Ecological Divisions: 206
TNC Ecoregions: 12:C, 16:P, 5:C
Subnations/Nations: CA:c, MXBC:p, NV:c, OR:p

CONCEPT

- **California community types:**

- Alpine and Talus Scree Slope (91.200.00)
- Wet Alpine Talus and Scree Slope (91.210.00)
- Dry Alpine Talus and Scree Slope (91.220.00)

SOURCES

References: Barbour and Major 1988, Holland and Keil 1995, Sawyer and Keeler-Wolf 1995
Last updated: 17 Mar 2003 **Stakeholders:** WCS
Concept Author: P. Comer, T. Keeler-Wolf **LeadResp:** WCS

S004 ROCKY MOUNTAIN ALPINE FELL-FIELD

Division 306, Herbaceous, CES306.811

Spatial Scale & Pattern: Large Patch **Classification Confidence:** medium
Required Classifiers: Natural/Semi-natural, Vegetated (>10% vasc.), Upland
Diagnostic Classifiers: Alpine/AltiAndino [Alpine/AltiAndino], Herbaceous, Ridge/Summit/Upper Slope, Oligotrophic Soil, Very Shallow Soil, Mineral: W/ A-Horizon <10 cm, Very Short Disturbance Interval, W-Patch/High Intensity, Cushion plants, Alpine Slopes

Non-Diagnostic Classifiers: Patterned ground (undifferentiated), Saddle, Temperate [Temperate Continental], Glaciated, Ustic, W-Landscape/Medium Intensity

Concept Summary: This ecological system is found discontinuously at alpine elevations throughout the Rocky Mountains, west into the mountainous areas of the Great Basin. These are wind-scoured fell-fields that are free of snow in the winter, such as ridgetops and exposed saddles, exposing the plants to severe environmental stress. Soils on these windy unproductive sites are shallow, stony, low in organic matter, and poorly developed; wind deflation often results in a gravelly pavement. Most fell-field plants are cushioned or matted, frequently succulent, flat to the ground in rosettes and often densely haired and thickly cutinized. Plants cover is 15-50%, while exposed rocks make up the rest. Fell-fields are usually within or adjacent to alpine tundra dry meadows.

DISTRIBUTION

Range: Found discontinuously at alpine elevations throughout the Rocky Mountains, west into the mountainous areas of the Great Basin.
Ecological Divisions: 304, 306
TNC Ecoregions: 11:C, 20:C, 21:C, 68:P, 7:C, 8:C, 9:C
Subnations/Nations: AB:c, BC:c, CO:c, ID:c, MT:c, NM:c, NV:c, OR:c, UT:c, WA:c, WY:c

CONCEPT

Alliances and Associations:

- GEUM ROSSII HERBACEOUS ALLIANCE (A.1645)
  Geum rossii - Minuartia obtusiloba Herbaceous Vegetation (CEGL001965)
- MINUARTIA OBTUSILOBA HERBACEOUS ALLIANCE (A.1630)
  Minuartia obtusiloba Herbaceous Vegetation (CEGL001919)
- PARONYCHIA PULVINATA DWARF-SHRUBLAND ALLIANCE (A.1085)
  Paronychia pulvinata - Silene acaulis Dwarf-shrubland (CEGL001976)
- PHLOX PULVINATA HERBACEOUS ALLIANCE (A.1651)
  Phlox pulvinata - Trifolium dasyphyllum Herbaceous Vegetation (CEGL001980)
  Phlox pulvinata Herbaceous Vegetation [Provisional] (CEGL002740)
- POTENTILLA SIERRAE-BLANCAE HERBACEOUS ALLIANCE (A.1652)
  Potentilla sierrae-blancae Herbaceous Vegetation (CEGL001982)
- RUBUS IDAEUS SSP. STRIGOSUS SHRUBLAND ALLIANCE (A.927)
  Rubus idaeus Scree Shrubland (CEGL001134)
- SIBBALDIA PROCUMBENS HERBACEOUS ALLIANCE (A.1635)
  Sibbaldia procumbens - Polygonum bistortoides Herbaceous Vegetation (CEGL001933)
- SILENE ACAULIS HERBACEOUS ALLIANCE (A.1636)
  Silene acaulis Herbaceous Vegetation (CEGL001934)

SOURCES

References: Bamberg 1961, Bamberg and Major 1968, Canadian Rockies Ecoregional Plan 2002, Cooper et al. 1997, Komarkava 1980, Komarkova 1976, Meidinger and Pojar 1991, Neely et al. 2001, Willard 1963
Last updated: 20 Feb 2003 **Stakeholders:** WCS, CAN
Concept Author: NatureServe Western Ecology Team **LeadResp:** WCS

S006 ROCKY MOUNTAIN CLIFF AND CANYON

Division 306, Barren, CES306.815

Spatial Scale & Pattern: Large Patch **Classification Confidence:** medium
Required Classifiers: Natural/Semi-natural, Non-vegetated (<10% vasc.), Upland
Diagnostic Classifiers: Canyon, Cliff (Landform), Ridgetop bedrock outcrop, Talus (Substrate), Rock Outcrops/Barrens/Glades, Oligotrophic Soil, Very Shallow Soil, Landslide

Non-Diagnostic Classifiers: Montane [Upper Montane], Montane [Montane], Montane [Lower Montane], Lowland [Foothill], Butte, Escarpment, Temperate [Temperate Continental], Long (>500 yrs) Persistence

Concept Summary: This ecological system is found from foothill to subalpine elevations and includes barren and sparsely vegetated landscapes (generally <10% plant cover) of steep cliff faces, narrow canyons, and smaller rock outcrops of various igneous, sedimentary, and metamorphic bedrock type. Also included are unstable scree and talus slopes that typically occur below cliff faces. There may be small patches of dense vegetation, but it typically includes scattered trees and/or shrubs. Characteristic trees includes *Pseudotsuga menziesii, Pinus ponderosa, Pinus flexilis, Populus tremuloides, Abies concolor, Abies lasiocarpa,* or *Pinus edulis* and *Juniperus* spp. at lower elevations. There may be scattered shrubs present such as species of *Holodiscus, Ribes, Physocarpus, Rosa, Juniperus,* and *Jamesia americana, Mahonia repens, Rhus trilobata,* or *Amelanchier alnifolia*. Soil development is limited as is herbaceous cover.

Comments: Very broad elevation range (<3350 m) for system - consider dividing into foothills/montane and subalpine?

DISTRIBUTION

Range: Rocky Mountains.
Ecological Divisions: 306
TNC Ecoregions: 20:C, 21:C, 25:C, 68:C, 7:C, 8:C, 9:C
Subnations/Nations: AB:c, AZ:c, BC:c, CO:c, ID:c, MT:c, NM:c, OR:c, TX:c, UT:c, WA:c, WY:c

CONCEPT

Alliances and Associations:

- ABIES CONCOLOR WOODLAND ALLIANCE (A.553)
  Abies concolor / Holodiscus dumosus Scree Woodland (CEGL000889)
  Abies concolor / Jamesia americana Scree Woodland (CEGL000890)
- ABIES LASIOCARPA WOODLAND ALLIANCE (A.559)
  Abies lasiocarpa / Holodiscus dumosus Scree Woodland (CEGL000918)
  Abies lasiocarpa / Salix brachycarpa Scree Woodland (CEGL000922)
  Abies lasiocarpa / Salix glauca Scree Woodland (CEGL000923)
  Abies lasiocarpa / Saxifraga bronchialis Scree Woodland (CEGL000924)
  Abies lasiocarpa Scree Woodland (CEGL000925)
- ALETES ANISATUS HERBACEOUS ALLIANCE (A.1639)
  Aletes anisatus - Scutellaria brittonii Scree Herbaceous Vegetation (CEGL001948)
- ATHYRIUM AMERICANUM HERBACEOUS ALLIANCE (A.1625)
  Athyrium americanum Herbaceous Vegetation (CEGL001849)
- CAREX NARDINA HERBACEOUS ALLIANCE (A.1299)
  Carex nardina Scree Herbaceous Vegetation (CEGL001812)
- HEUCHERA BRACTEATA HERBACEOUS ALLIANCE (A.1646)
  Heuchera bracteata - Heuchera parvifolia var. nivalis Herbaceous Vegetation (CEGL001971)
- JAMESIA AMERICANA SHRUBLAND ALLIANCE (A.2566)
  Jamesia americana Rock Outcrop Shrubland (CEGL002783)
- LOWLAND TALUS SPARSELY VEGETATED ALLIANCE (A.1847)
  Scree - Talus Black Hills Sparse Vegetation (CEGL002307)
- OPEN CLIFF SPARSELY VEGETATED ALLIANCE (A.1836)
  Igneous - Metamorphic Black Hills Butte Sparse Vegetation (CEGL005283)
  Pinus ponderosa Limestone Cliff Sparse Vegetation (CEGL002055)
- PICEA ENGELMANNII SPARSELY VEGETATED ALLIANCE (A.556)
  Picea engelmannii / Saxifraga bronchialis Scree Sparse Vegetation (CEGL000893)
- PINUS CONTORTA WOODLAND ALLIANCE (A.512)
  Pinus contorta Scree Woodland (CEGL000766)

- PINUS FLEXILIS WOODLAND ALLIANCE (A.540)
  Pinus flexilis / Scree Woodland (CEGL000815)
- PINUS PONDEROSA WOODLAND ALLIANCE (A.530)
  Pinus ponderosa / Ribes inerme Scree Woodland (CEGL000876)
- POPULUS TREMULOIDES WOODLAND ALLIANCE (A.610)
  Populus tremuloides / Physocarpus malvaceus - Amelanchier alnifolia Scree Woodland (CEGL000945)
- PSEUDOTSUGA MENZIESII WOODLAND ALLIANCE (A.552)
  Pseudotsuga menziesii / Holodiscus dumosus Scree Woodland (CEGL000902)
  Pseudotsuga menziesii Scree Woodland (CEGL000911)
- RIBES CEREUM SHRUBLAND ALLIANCE (A.923)
  Ribes cereum / Leymus ambiguus Shrubland (CEGL001124)
- ROCK OUTCROP SPARSELY VEGETATED ALLIANCE (A.1838)
  Granite - Metamorphic Black Hills Rock Outcrop Sparse Vegetation (CEGL002295)
- RUBUS IDAEUS SSP. STRIGOSUS SHRUBLAND ALLIANCE (A.927)
  Rubus idaeus Scree Shrubland (CEGL001134)
- SAXIFRAGA RIVULARIS HERBACEOUS ALLIANCE (A.1633)
  Saxifraga rivularis Herbaceous Vegetation (CEGL001930)

SOURCES

References: Andrews and Righter 1992, Canadian Rockies Ecoregional Plan 2002, Hess and Wasser 1982, Neely et al. 2001, Peet 1981

Last updated: 20 Feb 2003 **Stakeholders:** WCS, MCS, CAN

Concept Author: NatureServe Western Ecology Team **LeadResp:** WCS

S007 SIERRA NEVADA CLIFF AND CANYON

Division 206, Barren, CES206.901

Spatial Scale & Pattern: Large Patch **Classification Confidence:** medium

Required Classifiers: Natural/Semi-natural, Non-vegetated (<10% vasc.), Upland

Diagnostic Classifiers: Canyon, Cliff (Substrate), Talus (Substrate), Rock Outcrops/Barrens/Glades, Mediterranean [Mediterranean Xeric-Oceanic]

Non-Diagnostic Classifiers: Montane [Upper Montane], Montane [Montane], Montane [Lower Montane], Lowland [Foothill], Forest and Woodland (Treed), Shrubland (Shrub-dominated), Moss/Lichen (Nonvascular), Cliff (Landform), Ridge/Summit/Upper Slope, Very Shallow Soil, Landslide, Needle-Leaved Tree, Broad-Leaved Evergreen Shrub, Graminoid, Nonvascular, Canyon Mosaic

Concept Summary: Found from foothill to subalpine elevations throughout the Sierra Nevada and nearby mountain ranges, these are barren and sparsely vegetated areas (<10% plant cover) of steep cliff faces, narrow canyons, and smaller rock outcrops of various igneous, sedimentary, and metamorphic bedrock. This system also includes unstable scree and talus slopes typically occurring below cliff faces. Scattered vegetation may include *Abies magnifica*, *Pseudotsuga menziesii*, *Pinus contorta var. murrayana*, *Pinus ponderosa*, *Pinus jeffreyi*, *Populus tremuloides*, or *Pinus monophylla*, *Juniperus osteosperma*, and *Cercocarpus ledifolius* at lower elevations. There may be shrubs including species of *Arctostaphylos* or *Ceanothus*. Soil development is limited as is herbaceous cover.

DISTRIBUTION

Range: Found from foothill to subalpine elevations throughout the Sierra Nevada and nearby mountain ranges.

Ecological Divisions: 206

TNC Ecoregions: 12:C, 4:C, 5:C

Subnations/Nations: CA:c, NV:c, OR:c

CONCEPT

- **California community types:**
- Curlleaf Mountain-Mahogany Woodland and Scrub (76.200.00)
- Low Elevation Rock Outcrop (99.900.04)
- Upper Elevation Rock Outcrop (99.900.05)

SOURCES

References: Barbour and Major 1988, Holland and Keil 1995, Sawyer and Keeler-Wolf 1995
Last updated: 17 Mar 2003 **Stakeholders:** WCS
Concept Author: P. Comer, T. Keeler-Wolf **LeadResp:** WCS

S008 WESTERN GREAT PLAINS CLIFF AND OUTCROP

Division 303, Barren, CES303.665

Spatial Scale & Pattern: Small Patch **Classification Confidence:** medium
Required Classifiers: Natural/Semi-natural, Non-vegetated (<10% vasc.), Upland
Non-Diagnostic Classifiers: Cliff (Landform), Very Shallow Soil, Ustic, Flood Scouring, W-Patch/High Intensity

Concept Summary: This system includes cliffs and outcrops throughout the Western Great Plains Division. Substrate can range from sandstone and limestone, which can often form bands in the examples of this system. Vegetation is restricted to shelves, cracks and crevices in the rock. However, this system differs from Western Great Plains Badlands (CES303.663) in that often the soil is slightly developed and less erodible, and some grass and shrub species can occur at greater than 10%. Common species in this system include short shrubs such as *Rhus trilobata* and *Artemisia longifolia* and mixedgrass species such as *Bouteloua curtipendula* and *Bouteloua gracilis* and *Calamovilfa longifolia*. Drought and wind erosion are the most common natural dynamics affecting this system.

DISTRIBUTION

Range: This system ranges throughout the Western Great Plains Division from northern Texas to southern Canada.
Ecological Divisions: 303
TNC Ecoregions: 26:C, 27:C, 28:C, 29:C, 33:C, 37:P, 66:P, 67:P
Subnations/Nations: CO:c, KS:c, MB:p, MT:c, ND:c, NE:c, NM:c, OK:c, TX:c

CONCEPT

Alliances and Associations:

- ADIANTUM CAPILLUS-VENERIS SATURATED HERBACEOUS ALLIANCE (A.1683)
  Adiantum capillus-veneris - Thelypteris ovata var. lindheimeri Herbaceous Vegetation (CEGL004514)
- ARENARIA HOOKERI BARRENS HERBACEOUS ALLIANCE (A.1642)
  Arenaria hookeri Barrens Herbaceous Vegetation (CEGL001951)
- ARTEMISIA LONGIFOLIA SPARSELY VEGETATED ALLIANCE (A.1874)
  Artemisia longifolia - Calamovilfa longifolia Sparse Vegetation (CEGL001521)
- LESQUERELLA (GORDONII, OVALIFOLIA) HERBACEOUS ALLIANCE (A.1619)
  Lesquerella (gordonii, ovalifolia) - Schizachyrium scoparium Herbaceous Vegetation (CEGL004917)
- OPEN CLIFF SPARSELY VEGETATED ALLIANCE (A.1836)
  Limestone Butte Sparse Vegetation (CEGL002296)
  Sandstone Butte Sparse Vegetation (CEGL002297)
  Sandstone Dry Cliff Sparse Vegetation (CEGL002045)
  Sandstone Great Plains Dry Cliff Sparse Vegetation (CEGL005257)
  Sandstone Great Plains Xeric Butte - Bluff Sparse Vegetation (CEGL002290)
- ROCK OUTCROP SPARSELY VEGETATED ALLIANCE (A.1838)
  Shale Barren Slopes Sparse Vegetation (CEGL002294)
  Siltstone - Sandstone Rock Outcrop Sparse Vegetation (CEGL002047)
- SEDUM NUTTALLIANUM SPARSELY VEGETATED ALLIANCE (A.1846)
  Sedum nuttallianum - Selaginella peruviana Granitic Outcrop Sparse Vegetation (CEGL004396)

Environment: This system is includes cliff and outcrops throughout the Western Great Plains Division with substrate ranging from sandstone to limestone. Areas of shelves, cracks, and crevices accumulated materials and allow soils to develop enough to support more vegetation.

Vegetation: Short shrubs and mixedgrass species dominate the vegetation of this system. Common species include *Rhus trilobata, Artemisia longifolia, Bouteloua curtipendula* and *Bouteloua gracilis,* and *Calamovilfa longifolia,* although species can vary somewhat with substrate and exposure.

Dynamics: Drought and wind erosion are the major influences affecting this system.

SOURCES

Last updated: 05 Mar 2003 **Stakeholders:** MCS, WCS
Concept Author: S. Menard and K. Kindscher **LeadResp:** MCS

S009 INTER-MOUNTAIN BASINS CLIFF AND CANYON
Division 304, Barren, CES304.779

Spatial Scale & Pattern: Large Patch **Classification Confidence:** medium
Required Classifiers: Natural/Semi-natural, Non-vegetated (<10% vasc.), Upland
Diagnostic Classifiers: Cliff (Landform), Rock Outcrops/Barrens/Glades

Non-Diagnostic Classifiers: Montane [Upper Montane], Montane [Montane], Montane [Lower Montane], Lowland [Foothill], Lowland [Lowland], Canyon, Rockfall avalanche, Ridge/Summit/Upper Slope, Sideslope, Toeslope/Valley Bottom, Sedimentary Rock, Metamorphic Rock, Igneous Rock, Temperate [Temperate Continental], Very Shallow Soil

Concept Summary: This ecological system is found from foothill to subalpine elevations and includes barren and sparsely vegetated landscapes (generally <10% plant cover) of steep cliff faces, narrow canyons, and smaller rock outcrops of various igneous, sedimentary, and metamorphic bedrock types. Also included are unstable scree and talus slopes that typically occur below cliff faces. Widely scattered trees and shrubs may include *Abies concolor, Pinus edulis, Pinus flexilis, Pinus monophylla, Juniperus* spp., *Artemisia tridentata, Purshia tridentata, Cercocarpus ledifolius, Ephedra* spp., *Holodiscus discolor*, and other species often common in adjacent plant communities.

DISTRIBUTION

Ecological Divisions: 304
TNC Ecoregions: 11:C, 18:C, 4:?, 6:C
Subnations/Nations: CA:c, ID:c, NV:c, OR:c, UT:c, WA:c, WY:c

CONCEPT

Alliances and Associations:

- CERCOCARPUS INTRICATUS SPARSELY VEGETATED ALLIANCE (A.2543)
  Cercocarpus intricatus Slickrock Sparse Vegetation (CEGL002977)
- CERCOCARPUS MONTANUS SPARSELY VEGETATED ALLIANCE (A.2544)
  Cercocarpus montanus Rock Pavement Sparse Vegetation (CEGL002978)
- CRATAEGUS RIVULARIS TEMPORARILY FLOODED SHRUBLAND ALLIANCE (A.2597)
  Crataegus rivularis Shrubland (CEGL002889)
- GLOSSOPETALON SPINESCENS SHRUBLAND ALLIANCE (A.1032)
  Glossopetalon spinescens var. aridum / Pseudoroegneria spicata Shrubland (CEGL001100)
- JUNIPERUS OSTEOSPERMA WOODLAND ALLIANCE (A.536)
  Juniperus osteosperma / Cercocarpus intricatus Woodland (CEGL000733)
- LEYMUS SALINUS SSP. SALMONIS SPARSELY VEGETATED ALLIANCE (A.1258)
  Leymus salinus Shale Sparse Vegetation (CEGL002745)
- PINUS MONOPHYLLA - (JUNIPERUS OSTEOSPERMA) WOODLAND ALLIANCE (A.543)
  Pinus monophylla - Juniperus osteosperma / Sparse Understory Woodland (CEGL000829)
- WOODED BEDROCK SPARSELY VEGETATED ALLIANCE (A.2546)
  Pinus ponderosa Slickrock Sparse Vegetation (CEGL002972)

SOURCES

References: Knight 1994
Last updated: 20 Feb 2003 **Stakeholders:** WCS, MCS
Concept Author: NatureServe Western Ecology Team **LeadResp:** WCS

S010 COLORADO PLATEAU MIXED BEDROCK CANYON AND TABLELAND
Division 304, Barren, CES304.765

Spatial Scale & Pattern: Matrix **Classification Confidence:** low
Required Classifiers: Natural/Semi-natural, Non-vegetated (<10% vasc.), Upland
Diagnostic Classifiers: Montane [Lower Montane], Lowland [Foothill], Shrubland (Shrub-dominated), Ridge/Summit/Upper Slope, Sedimentary Rock, Temperate [Temperate Xeric], Alkaline Soil, Aridic

Non-Diagnostic Classifiers: Moss/Lichen (Nonvascular), Cliff (Substrate), Talus (Substrate)

Concept Summary: The distribution of this ecological system is centered on the Colorado Plateau where it is comprised of barren and sparsely vegetated landscapes (generally <10% plant cover) of steep cliff faces, narrow canyons, and open tablelands of predominantly sedimentary rocks, such as sandstone, shale, and limestone. Some eroding shale layers similar to Inter-Mountain Basins Shale Badland (CES304.789) may be interbedded between the harder rocks. The vegetation is characterized by very open tree canopy or scattered trees and shrubs with a sparse herbaceous layer. Common species includes *Pinus edulis, Pinus ponderosa, Juniperus* spp., *Cercocarpus intricatus*, and other short-shrub and herbaceous species, utilizing moisture from cracks and pockets where soil accumulates.

Comments: Geographically restricted and distinct from the related, but broader Inter-Mountain Basins Cliff and Canyon (CES304.779). Shale areas are not extensive as in shale badlands.

DISTRIBUTION

Range: Colorado Plateau.
Ecological Divisions: 304
TNC Ecoregions: 18:C, 19:C, 20:?
Subnations/Nations: AZ:c, CO:c, NM:c, UT:c

CONCEPT

Alliances and Associations:

- CERCOCARPUS INTRICATUS SPARSELY VEGETATED ALLIANCE (A.2543)
  Cercocarpus intricatus Slickrock Sparse Vegetation (CEGL002977)
- CERCOCARPUS MONTANUS SPARSELY VEGETATED ALLIANCE (A.2544)
  Cercocarpus montanus Rock Pavement Sparse Vegetation (CEGL002978)
- EPHEDRA TORREYANA SPARSELY VEGETATED ALLIANCE (A.2571)
  Ephedra torreyana - (Atriplex canescens, Atriplex confertifolia) Sparse Vegetation (CEGL005801)
- JUNIPERUS OSTEOSPERMA WOODLAND ALLIANCE (A.536)
  Juniperus osteosperma / Artemisia nova / Rock Woodland (CEGL000729)
  Juniperus osteosperma / Cercocarpus intricatus Woodland (CEGL000733)
- PINUS EDULIS - (JUNIPERUS SPP.) WOODLAND ALLIANCE (A.516)
  Pinus edulis - Juniperus osteosperma / Cercocarpus intricatus Woodland (CEGL000779)
- SANDSTONE SPARSELY VEGETATED ALLIANCE (A.2568)
  Atriplex canescens - (Ephedra viridis) / (Muhlenbergia porteri) Sandstone Sparse Vegetation [Provisional] (CEGL002927)
- WOODED BEDROCK SPARSELY VEGETATED ALLIANCE (A.2546)
  Pinus ponderosa Slickrock Sparse Vegetation (CEGL002972)

Environment: This system includes limestone escarpments and plateaus occurring in a relatively narrow band of unvegetated or sparsely vegetated badlands formed by the red beds of Claron (Wasatch) Formation along the eastern edge of the Pausaugunt Plateau (Bryce Canyon) and the western edge of the Markagunt Plateau (Cedar Breaks National Monument) (Graybosch and Buchanan 1983). It includes areas of which often 90% of the exposed surface consists of barren rock. It forms, or includes, areas of fixed bedrock forming the vertical or near-vertical parts on the plateau faces. The rocks forming such areas are predominantly limestone-capped plateaus. These areas are highly erodible and form the basic scenic structure of Bryce Canyon and Cedar Breaks national parks. The area is generally too steep to allow any significant soil development. Scattered plants obtain a precarious foothold in the crevices of the rocks. Knolls may form at the base of the cliffs.

This ecological system also includes sandstone and shale escarpments, which form, or include, areas of fixed bedrock forming the vertical or near-vertical parts of canyon walls and plateau faces. The scenic cliffs of the East Tavaputs area, e.g., the Book Cliffs are excellent examples of this. The rocks forming such areas are dominantly sandstone and shale with some limestone and marlstone. These areas are unstable and rocks are frequently rolling down onto the talus slopes below (often forming Inter-Mountain Basins Shale Badland (CES304.789)). The area is generally too steep to allow any significant soil development. Scattered plants obtain a precarious foothold in the crevices of the rocks. Knolls may form at the base of the cliffs. The larger drainages (e.g., East Fork Parachute Creek) plunge several hundred feet at this escarpment, which creates scenic and lush hanging gardens. Many of these escarpments are over 1000 feet in height and provide excellent habitat for cliff-nesting birds such as peregrine falcons and golden eagles.

The Claron limestone, a Tertiary deposit, is divisible into Red Eocene beds and White Oligocene beds, which differ somewhat in presence or absence of pigmentation in the form of iron and manganese oxides, and in amounts of sand

and conglomerates in the limestone (Graybosch and Buchanan 1983). The Claron Formation is characterized by a rapid rate of erosion, largely a function of creep resulting from winter freeze-thaw activity and wash away by summer thunderstorm runoff (Graybosch and Buchanan 1983). Freeze-thaw cycles are most pronounced on south-facing slopes. Soil development is limited. Infiltration rates are low and runoff high.

Vegetation: For the most part, this system is sparsely vegetated. Small patches of scattered trees and shrubs may occur. These small vegetated patches are usually dominated by conifer trees, and may include *Abies concolor, Juniperus scopulorum, Picea pungens, Pinus flexilis, Pinus longaeva, Pinus ponderosa*, and *Pseudotsuga menziesii*. If a shrub layer exists it may include *Acer glabrum, Amelanchier utahensis, Arctostaphylos patula, Ceanothus martinii, Cercocarpus montanus, Cercocarpus intricatus, Juniperus communis, Mahonia repens, Purshia tridentata, Ribes cereum*, and *Gutierrezia sarothrae*. Grasses and forbs, if present, may include *Astragalus kentrophyta, Cirsium arizonicum, Clematis columbiana, Leymus salinus, Eriogonum panguicense, Achnatherum hymenoides*, and *Linum kingii*.

This ecological system is noted for its high rate of endemic species of forbs, especially in Bryce Canyon. Nine of the eleven endemic species occur in the *Pinus longaeva* community, three are found in the *Pinus ponderosa - Arctostaphylos patula* plant association, and two occur in the mixed conifer type. Species that occur only in the *Pinus longaeva* type have the narrowest geographic distributions, although *Eriogonum panguicense var. panguicense* is an exception (Graybosch and Buchanan 1983). Within Bryce Canyon, most of these endemics are restricted to the Claron Formation (Graybosch and Buchanan 1983). The majority of endemic species found in southern Utah are restricted to substrates derived from a specific geologic formation (Welsh 1979). Welsh notes that most of these taxa are found in areas of exposed parent material. The distribution of endemic species in Utah is not a random one; fine-textured substrates support more species than coarser ones, and desert and foothill vegetation is richer in endemic species than montane communities (Welsh 1978, 1979).

Dynamics: This ecological system has a naturally high rate of erosion. Fires are infrequent and not an important ecological process.

SOURCES

References: Graybosch and Buchanan 1983, LaMarche and Mooney 1972, Shute and West 1977, Thorne Ecological Institute 1973a, Welsh 1979, Welsh and Chatterly 1985

Last updated: 20 Feb 2003 **Stakeholders:** WCS

Concept Author: NatureServe Western Ecology Team **LeadResp:** WCS

S011 INTER-MOUNTAIN BASINS SHALE BADLAND

Division 304, Shrubland, CES304.789

Spatial Scale & Pattern: Large Patch **Classification Confidence:** medium

Required Classifiers: Natural/Semi-natural, Vegetated (>10% vasc.), Upland

Diagnostic Classifiers: Lowland [Lowland], Badlands, Badland, Alkaline Soil, Shale and Mudstone, Silt Soil Texture, Clay Soil Texture

Non-Diagnostic Classifiers: Shrubland (Shrub-dominated), Moss/Lichen (Nonvascular), Temperate [Temperate Continental], Aridic, Very Short Disturbance Interval, Broad-Leaved Shrub, Dwarf-Shrub, Semi-Shrub

Concept Summary: This widespread ecological system of the Intermountain western U.S. is composed of barren and sparsely vegetated substrates (<10% plant cover) typically derived from marine shales, but also including substrates derived from siltstones and mudstones (clay). Landforms are typically rounded hills and plains that form a rolling topography. The harsh soil properties and high rate of erosion and deposition are driving environmental variables supporting sparse dwarf-shrubs, e.g., *Atriplex corrugata, Atriplex gardneri, Artemisia pedatifida*, and herbaceous vegetation.

DISTRIBUTION

Range: Intermountain western U.S.

Ecological Divisions: 304, 306

TNC Ecoregions: 10:C, 11:C, 12:?, 18:C, 19:C, 20:C, 21:C, 6:P, 9:C

Subnations/Nations: AZ:c, CA:c, CO:c, ID:c, MT:c, NM:c, NV:c, OR:c, UT:c, WA:?, WY:c

CONCEPT

Alliances and Associations:

- ACHNATHERUM HYMENOIDES HERBACEOUS ALLIANCE (A.1262)
  Achnatherum hymenoides Shale Barren Herbaceous Vegetation (CEGL001651)
- ARTEMISIA BIGELOVII SHRUBLAND ALLIANCE (A.1103)
  Artemisia bigelovii / Achnatherum hymenoides Shrubland (CEGL000990)
- ARTEMISIA PEDATIFIDA SHRUBLAND ALLIANCE (A.1127)
  Artemisia pedatifida - Atriplex gardneri Shrubland (CEGL001525)
  Artemisia pedatifida / Elymus elymoides Shrubland (CEGL001450)
  Artemisia pedatifida / Festuca idahoensis Shrubland (CEGL001526)
  Artemisia pedatifida / Pascopyrum smithii Shrubland (CEGL001451)
  Artemisia pedatifida / Pseudoroegneria spicata Shrubland (CEGL001527)
- ARTEMISIA PYGMAEA SHRUBLAND ALLIANCE (A.1106)
  Artemisia pygmaea / Elymus elymoides - Achnatherum hymenoides Shrubland (CEGL001436)
- ATRIPLEX CORRUGATA DWARF-SHRUBLAND ALLIANCE (A.1109)
  Atriplex corrugata Dwarf-shrubland (CEGL001437)
- ATRIPLEX CUNEATA SHRUBLAND ALLIANCE (A.871)
  Atriplex cuneata - Frankenia jamesii / Sporobolus airoides Shrubland (CEGL001316)
- ATRIPLEX GARDNERI DWARF-SHRUBLAND ALLIANCE (A.1110)
  Atriplex gardneri - Picrothamnus desertorum Dwarf-shrubland (CEGL001439)
  Atriplex gardneri / Achnatherum hymenoides Dwarf-shrubland (CEGL001444)
  Atriplex gardneri / Artemisia tridentata Dwarf-shrubland (CEGL001440)
  Atriplex gardneri / Leymus salinus Dwarf-shrubland (CEGL001442)
  Atriplex gardneri / Monolepis nuttalliana Dwarf-shrubland (CEGL001443)
  Atriplex gardneri / Pascopyrum smithii Dwarf-shrubland (CEGL001445)
  Atriplex gardneri / Pleuraphis jamesii Dwarf-shrubland (CEGL001441)
  Atriplex gardneri / Xylorhiza venusta Dwarf-shrubland (CEGL001446)
  Atriplex gardneri Dwarf-shrubland (CEGL001438)
- ATRIPLEX OBOVATA DWARF-SHRUBLAND ALLIANCE (A.1108)
  Atriplex obovata Dwarf-shrubland [Placeholder] (CEGL001789)
- ERIOGONUM CORYMBOSUM DWARF-SHRUBLAND ALLIANCE (A.1126)
  Eriogonum corymbosum / Leymus salinus Dwarf-shrubland (CEGL001343)
- LEYMUS SALINUS SSP. SALMONIS SPARSELY VEGETATED ALLIANCE (A.1258)
  Leymus salinus Shale Sparse Vegetation (CEGL002745)
- PAINTED DESERT SPARSELY VEGETATED ALLIANCE (A.2545)
  Atriplex obovata Badland Sparse Vegetation (CEGL002928)
  Ephedra nevadensis / Lichens Sparse Vegetation [Provisional] (CEGL002976)
  Eriogonum corymbosum Badlands Sparse Vegetation (CEGL002979)
- PSEUDOROEGNERIA SPICATA SPARSELY VEGETATED ALLIANCE (A.1876)
  Pseudoroegneria spicata - Eriogonum brevicaule Sparse Vegetation (CEGL001667)

SOURCES

References: DeVelice and Lesica 1993, Knight 1994, Knight et al. 1987

Last updated: 20 Feb 2003 **Stakeholders:** WCS

Concept Author: NatureServe Western Ecology Team **LeadResp:** WCS

S012 INTER-MOUNTAIN BASINS ACTIVE AND STABILIZED DUNE

Division 304, Barren, CES304.775

Spatial Scale & Pattern: Large Patch **Classification Confidence:** medium

Required Classifiers: Natural/Semi-natural, Non-vegetated (<10% vasc.), Upland

Diagnostic Classifiers: Dune (Landform), Dune field, Dune (Substrate), Temperate [Temperate Continental], Sand Soil Texture, Aridic, W-Landscape/High Intensity

Non-Diagnostic Classifiers: Lowland [Lowland], Shrubland (Shrub-dominated), Woody-Herbaceous, Dune (undifferentiated)

Concept Summary: This ecological system occurs in the Intermountain basins and is composed of unvegetated to moderately vegetated (generally <10% plant cover, but up to 30%), active and stabilized dunes and sandsheets. Species occupying these environments are often adapted to the shifting, coarse-textured substrate (usually quartz sand) and form patchy or open grasslands, shrublands or steppe composed of *Achnatherum hymenoides, Artemisia*

filifolia, Artemisia tridentata ssp. tridentata, Atriplex canescens, Ephedra spp., *Coleogyne ramosissima, Ericameria nauseosa, Leymus flavescens, Prunus virginiana, Psoralidium lanceolatum, Purshia tridentata, Sporobolus airoides, Tetradymia tetrameres,* or *Tiquilia* spp. This system is distinguished by its generally low vegetative cover and distinct eolian geomorphic features.

DISTRIBUTION

Range: Occurs in the Intermountain basins.
Ecological Divisions: 304
TNC Ecoregions: 10:C, 11:C, 19:C, 6:C
Subnations/Nations: AZ:c, MT:c, NM:p, NV:c, OR:c, UT:c, WA:c, WY:c

CONCEPT

Alliances and Associations:

- ACHNATHERUM HYMENOIDES HERBACEOUS ALLIANCE (A.1262)
  Achnatherum hymenoides - Psoralidium lanceolatum Herbaceous Vegetation (CEGL001650)
  Achnatherum hymenoides - Sporobolus contractus Herbaceous Vegetation (CEGL001652)
- ARTEMISIA FILIFOLIA SHRUBLAND ALLIANCE (A.816)
  Artemisia filifolia - Ephedra (torreyana, viridis) Shrubland (CEGL002786)
- ELYMUS LANCEOLATUS HERBACEOUS ALLIANCE (A.1242)
  Elymus lanceolatus - Phacelia hastata Herbaceous Vegetation (CEGL001745)
- EPHEDRA CUTLERI SHRUBLAND ALLIANCE (PROPOSED)
- EPHEDRA TORREYANA SHRUBLAND ALLIANCE (A.2572)
  Ephedra torreyana - Achnatherum hymenoides Hummock Shrubland (CEGL005802)
- ERICAMERIA NAUSEOSA SHRUBLAND ALLIANCE (A.835)
  Ericameria nauseosa / Leymus flavescens / Psoralidium lanceolatum Shrubland (CEGL001329)
  Ericameria nauseosa Sand Deposit Sparse Shrubland (CEGL002980)
- LEYMUS FLAVESCENS HERBACEOUS ALLIANCE (A.1237)
  Leymus flavescens Herbaceous Vegetation (CEGL001563)
- PINUS PONDEROSA SPARSELY VEGETATED ALLIANCE (A.1859)
  Pinus ponderosa / Achnatherum hymenoides Sparse Vegetation (CEGL001490)
- POPULUS ANGUSTIFOLIA TEMPORARILY FLOODED FOREST ALLIANCE (A.310)
  Populus angustifolia Sand Dune Forest (CEGL002643)
- PSOROTHAMNUS POLYDENIUS SHRUBLAND ALLIANCE (A.1039)
  Psorothamnus polydenius var. polydenius / Achnatherum hymenoides Shrubland (CEGL001353)
- PURSHIA TRIDENTATA SHRUBLAND ALLIANCE (A.825)
  Purshia tridentata - Artemisia tridentata ssp. tridentata Shrubland (CEGL001054)
  Purshia tridentata - Ericameria nauseosa Shrubland (CEGL001056)
  Purshia tridentata / Achnatherum hymenoides Shrubland (CEGL001058)
  Purshia tridentata / Prunus virginiana Shrubland (CEGL001060)
- REDFIELDIA FLEXUOSA HERBACEOUS ALLIANCE (A.2505)
  Redfieldia flexuosa - (Psoralidium lanceolatum) Herbaceous Vegetation (CEGL002917)
- ROCK OUTCROP SPARSELY VEGETATED ALLIANCE (A.1838)
  Redbeds (Siltstone, Sandstone, Gypsum) Sparse Vegetation (CEGL005261)
- SARCOBATUS VERMICULATUS SHRUBLAND ALLIANCE (A.1041)
  Sarcobatus vermiculatus Dune Shrubland (CEGL001364)
- TETRADYMIA TETRAMERES SPARSELY VEGETATED ALLIANCE (A.2525)
  Tetradymia tetrameres Dune Sparse Vegetation (CEGL002759)

SOURCES

References: Anderson 1999, Bowers 1982, Fryberger et al. 1990, Knight 1994, Pineada et al. 1999
Last updated: 20 Feb 2003 **Stakeholders:** WCS
Concept Author: NatureServe Western Ecology Team **LeadResp:** WCS

S013 INTER-MOUNTAIN BASINS VOLCANIC ROCK AND CINDER LAND

Division 304, Barren, CES304.791

Spatial Scale & Pattern: Large Patch **Classification Confidence:** medium
Required Classifiers: Natural/Semi-natural, Non-vegetated (<10% vasc.), Upland
Diagnostic Classifiers: Cinder cone, Lava flow (undifferentiated), Lava, Cinder, Basalt, Temperate [Temperate Continental]

Non-Diagnostic Classifiers: Montane, Lowland, Shrubland (Shrub-dominated), Herbaceous, Dune (Substrate), Igneous Rock, Very Shallow Soil, Sand Soil Texture, Aridic, W-Landscape/Medium Intensity

Concept Summary: This ecological system occurs in the Intermountain western U.S. and is limited to barren and sparsely vegetated volcanic substrates (generally <10% plant cover) such as basalt lava (malpais), basalt dikes with associated colluvium, basalt cliff faces and uplifted "backbones," tuff, cinder cones or cinder fields. It may occur as large-patch, small-patch and linear (dikes) spatial patterns. Vegetation is variable and includes a variety of species depending on local environmental conditions, e.g., elevation, age and type of substrate. At montane and foothill elevations scattered *Pinus ponderosa, Pinus flexilis,* or *Juniperus* spp. trees may be present. Shrubs such as *Ephedra* spp., *Atriplex canescens, Eriogonum corymbosum, Eriogonum ovalifolium*, and *Fallugia paradoxa* are often present on some lava flows and cinder fields. Species typical of sand dunes such as *Andropogon hallii* and *Artemisia filifolia* may be present on cinder substrates.

DISTRIBUTION

Range: Occurs in the Intermountain western U.S. and is limited to barren and sparsely vegetated volcanic substrates.
Ecological Divisions: 304
TNC Ecoregions: 11:C, 18:C, 19:C, 20:C, 21:C, 4:C, 6:C, 8:C, 9:C
Subnations/Nations: AZ:c, ID:c, NM:c, NV:c, OR:c, UT:c

CONCEPT

Alliances and Associations:

- AA LAVA BED SPARSELY VEGETATED ALLIANCE (A.2569)
  Pinus ponderosa - (Populus tremuloides) / Fallugia paradoxa - (Holodiscus dumosus) Lava Bed Sparse Vegetation (CEGL002929)
- ANDROPOGON HALLII HERBACEOUS ALLIANCE (A.1193)
  Andropogon hallii Colorado Plateau Herbaceous Vegetation (CEGL002785)
- ARTEMISIA FILIFOLIA SHRUBLAND ALLIANCE (A.816)
  Artemisia filifolia - Ephedra (torreyana, viridis) Shrubland (CEGL002786)
- ARTEMISIA TRIDENTATA SSP. VASEYANA SHRUBLAND ALLIANCE (A.831)
  Artemisia tridentata ssp. vaseyana / Poa secunda Shrubland (CEGL001029)
- EPHEDRA NEVADENSIS SHRUBLAND ALLIANCE (A.857)
  Ephedra nevadensis Basalt Shrubland [Provisional] (CEGL002936)
- ERIOGONUM CORYMBOSUM SPARSELY VEGETATED ALLIANCE (A.2573)
  Eriogonum corymbosum Cinder Sparse Vegetation (CEGL005803)
- ERIOGONUM FASCICULATUM SHRUBLAND ALLIANCE (A.868)
  Eriogonum fasciculatum Rock Outcrop Shrubland (CEGL001260)
- ERIOGONUM OVALIFOLIUM VAR. DEPRESSUM DWARF-SHRUBLAND ALLIANCE (A.1082)
  Eriogonum ovalifolium var. depressum Dwarf-shrubland (CEGL001401)
- FALLUGIA PARADOXA SHRUBLAND ALLIANCE (A.2575)
  Fallugia paradoxa - (Atriplex canescens, Ephedra torreyana) Cinder Shrubland (CEGL005806)
- JUNIPERUS MONOSPERMA WOODED HERBACEOUS ALLIANCE (A.2576)
  Juniperus monosperma Cinder Wooded Herbaceous Vegetation (CEGL005807)
- PINUS FLEXILIS WOODLAND ALLIANCE (A.540)
  Pinus flexilis / Purshia tridentata Woodland (CEGL000814)
- PINUS PONDEROSA WOODLAND ALLIANCE (A.530)
  Pinus ponderosa / Andropogon hallii Woodland (CEGL005808)
  Pinus ponderosa / Cinder Woodland (CEGL002998)
- PURSHIA TRIDENTATA SHRUB TALL HERBACEOUS ALLIANCE (A.1517)
  Purshia tridentata / Pseudoroegneria spicata - Leymus cinereus Shrub Herbaceous Vegetation (CEGL001497)
- TIQUILIA HISPIDISSIMA DWARF-SHRUBLAND ALLIANCE (A.1101)
  Tiquilia latior / Sporobolus airoides Dwarf-shrubland [Provisional] (CEGL005809)

Dynamics: This ecological system is relatively young (geologically speaking). Lichens are the primary erosion process in this system and therefore soil buildup is a slow process. Lichens are susceptible to changes in air quality (Brodo et. al. 2001) and are considered a good indication of the health of air quality.

SOURCES

References: Barbour and Billings 2000, Coles et al. 2003, Day and Wright 1985, Thomas et al. 2003c, Tisdale et al. 1965

Last updated: 20 Feb 2003 **Stakeholders:** WCS

Concept Author: NatureServe Western Ecology Team **LeadResp:** WCS

S014 INTER-MOUNTAIN BASINS WASH

Division 304, Barren, CES304.781

Spatial Scale & Pattern: Linear **Classification Confidence:** medium

Required Classifiers: Natural/Semi-natural, Non-vegetated (<10% vasc.), Upland, Wetland

Diagnostic Classifiers: Lowland [Lowland], Shrubland (Shrub-dominated), Wash, Toeslope/Valley Bottom, Alkaline Soil, Xeromorphic Shrub, Sarcobatus vermiculatus, Riverine / Alluvial

Non-Diagnostic Classifiers: Temperate [Temperate Continental], Saline Substrate Chemistry, Deep (>15 cm) Water

Concept Summary: This barren and sparsely vegetated (generally <10% plant cover) ecological system is restricted to intermittently flooded streambeds and banks that are often lined with *Sarcobatus vermiculatus, Ericameria nauseousa*, *Fallugia* paradoxa and/or *Artemisia cana ssp. cana* (in more northern and mesic stands). *Grayia spinosa* may also dominate in the Great Basin. Shrubs often form a continuous or intermittent linear canopy in and along drainages but do not extend out into flats. Typically it includes patches of saltgrass meadow where water remains for the longest periods. Soils are generally less alkaline than those found in the playa system. Desert scrub species, e.g., *Acacia greggii, Prosopis* spp., that are common in the Mojave, Sonoran and Chihuahuan desert washes, are not present. This type can occur in limited portions of the southwest Great Plains.

Comments: Compare with Inter-Mountain Basins Greasewood Flat (CES304.780); should it include nonsparse shrublands?

DISTRIBUTION

Range: This system occurs thoughout the Intermountain western U.S. extending east into the western Great Plains.

Ecological Divisions: 303, 304, 306

TNC Ecoregions: 10:C, 11:C, 19:C, 20:C, 26:C, 4:C, 6:C, 8:C, 9:C

Subnations/Nations: AZ:c, CA:c, CO:c, ID:c, MT:c, NV:c, OR:c, UT:c, WA:c, WY:c

CONCEPT

Alliances and Associations:

- DISTICHLIS SPICATA INTERMITTENTLY FLOODED HERBACEOUS ALLIANCE (A.1332)
  Distichlis spicata - (Scirpus nevadensis) Herbaceous Vegetation (CEGL001773)
  Distichlis spicata - Lepidium perfoliatum Herbaceous Vegetation (CEGL001772)
  Distichlis spicata Herbaceous Vegetation (CEGL001770)
  Distichlis spicata Mixed Herb Herbaceous Vegetation (CEGL001771)
- ERICAMERIA NAUSEOSA SHRUBLAND ALLIANCE (A.835)
  Ericameria nauseosa / Bromus tectorum Semi-natural Shrubland (CEGL002937)
- GRAYIA SPINOSA SHRUBLAND ALLIANCE (A.1038)
  Grayia spinosa / Poa secunda Shrubland (CEGL001351)
- HORDEUM BRACHYANTHERUM TEMPORARILY FLOODED HERBACEOUS ALLIANCE (A.2585)
  Hordeum brachyantherum Herbaceous Vegetation (CEGL003430)
- SARCOBATUS VERMICULATUS INTERMITTENTLY FLOODED SHRUB HERBACEOUS ALLIANCE (A.1554)
  Sarcobatus vermiculatus / Pascopyrum smithii - (Elymus lanceolatus) Shrub Herbaceous Vegetation (CEGL001508)
- SARCOBATUS VERMICULATUS INTERMITTENTLY FLOODED SHRUBLAND ALLIANCE (A.1046)
  Sarcobatus vermiculatus - Atriplex parryi / Distichlis spicata Shrubland (CEGL002764)
  Sarcobatus vermiculatus - Psorothamnus polydenius Shrubland (CEGL002763)
  Sarcobatus vermiculatus / Achnatherum hymenoides Shrubland (CEGL001373)
  Sarcobatus vermiculatus / Atriplex confertifolia - (Picrothamnus desertorum, Suaeda moquinii) Shrubland (CEGL001371)
  Sarcobatus vermiculatus / Atriplex gardneri Shrubland (CEGL001360)
  Sarcobatus vermiculatus / Distichlis spicata Shrubland (CEGL001363)
  Sarcobatus vermiculatus / Elymus elymoides - Pascopyrum smithii Shrubland (CEGL001365)
  Sarcobatus vermiculatus / Elymus elymoides Shrubland (CEGL001372)
  Sarcobatus vermiculatus / Ericameria nauseosa Shrubland (CEGL001362)

Sarcobatus vermiculatus / Leymus cinereus Shrubland (CEGL001366)
Sarcobatus vermiculatus / Nitrophila occidentalis - Suaeda moquinii Shrubland (CEGL001369)
Sarcobatus vermiculatus / Suaeda moquinii Shrubland (CEGL001370)
Sarcobatus vermiculatus Shrubland (CEGL001357)

- SARCOBATUS VERMICULATUS INTERMITTENTLY FLOODED SPARSELY VEGETATED ALLIANCE (A.1877)
  Sarcobatus vermiculatus / Sporobolus airoides Sparse Vegetation (CEGL001368)

- **California community types:**
- Greasewood Scrub (36.400.00)

SOURCES

References: Knight 1994, West 1983b
Last updated: 20 Feb 2003 **Stakeholders:** WCS, MCS
Concept Author: NatureServe Western Ecology Team **LeadResp:** WCS

S015 INTER-MOUNTAIN BASINS PLAYA

Division 304, Barren, CES304.786

Spatial Scale & Pattern: Large Patch **Classification Confidence:** medium
Required Classifiers: Natural/Semi-natural, Non-vegetated (<10% vasc.), Upland, Wetland
Diagnostic Classifiers: Lowland [Lowland], Playa, Temperate [Temperate Xeric], Alkaline Soil, Saline Substrate Chemistry, Aridic, Depressional, Alkaline Water, Saline Water Chemistry, Caliche Layer, Impermeable Layer, Intermittent Flooding

Non-Diagnostic Classifiers: Shrubland (Shrub-dominated), Herbaceous, Dwarf-Shrub, Forb, Graminoid, Clay Subsoil Texture

Concept Summary: This ecological system is composed of barren and sparsely vegetated playas (generally<10% plant cover) found in the Intermountain western U.S. Salt crusts are common throughout, with small saltgrass beds in depressions and sparse shrubs around the margins. These systems are intermittently flooded. The water is prevented from percolating through the soil by an impermeable soil sub-horizon and is left to evaporate. Soil salinity varies greatly with soil moisture and greatly affects species composition. Characteristic species may include *Allenrolfea occidentalis, Sarcobatus vermiculatus, Grayia spinosa, Puccinellia lemmonii, Leymus cinereus, Distichlis spicata*, and/or *Atriplex* spp.

Comments: Need to incorporate material from Oregon and Idaho, Wyoming? See Jimmy's Columbia Plateau systems list for associations of playas.

DISTRIBUTION

Range: This system occurs thoughout the Intermountain western U.S. extending east into the southwestern Great Plains.
Ecological Divisions: 304
TNC Ecoregions: 10:C, 11:C, 19:C, 6:C
Subnations/Nations: CA:c, CO:c, ID:c, NV:c, OR:c, UT:c, WA:p, WY:c

CONCEPT

Alliances and Associations:

- (SARCOCORNIA UTAHENSIS) - (ARTHROCNEMUM SUBTERMINALE) SEMIPERMANENTLY FLOODED HERBACEOUS ALLIANCE (A.1676)
  (Sarcocornia utahensis) - (Arthrocnemum subterminale) Seasonally Flooded Herbaceous Vegetation [Placeholder] (CEGL003120)
- ALLENROLFEA OCCIDENTALIS SHRUBLAND ALLIANCE (A.866)
  Allenrolfea occidentalis / Atriplex gardneri Shrubland (CEGL000989)
  Allenrolfea occidentalis Shrubland (CEGL000988)
- ARTEMISIA PAPPOSA SHRUBLAND ALLIANCE (A.2551)
  Artemisia papposa / Danthonia californica - Festuca idahoensis Shrubland (CEGL002991)
- ATRIPLEX SPINIFERA SHRUBLAND ALLIANCE (A.865)
  Atriplex spinifera Shrubland [Placeholder] (CEGL003015)
- CHRYSOTHAMNUS ALBIDUS SHRUBLAND ALLIANCE (A.834)
  Chrysothamnus albidus / Puccinellia nuttalliana Shrubland (CEGL001328)
- DISTICHLIS SPICATA INTERMITTENTLY FLOODED HERBACEOUS ALLIANCE (A.1332)
  Distichlis spicata - (Scirpus nevadensis) Herbaceous Vegetation (CEGL001773)

Distichlis spicata - Lepidium perfoliatum Herbaceous Vegetation (CEGL001772)
Distichlis spicata Herbaceous Vegetation (CEGL001770)
Distichlis spicata Mixed Herb Herbaceous Vegetation (CEGL001771)

- GRAYIA SPINOSA SHRUBLAND ALLIANCE (A.1038)
  Grayia spinosa / Achnatherum hymenoides Shrubland (CEGL001350)
  Grayia spinosa / Achnatherum thurberianum Shrubland (CEGL002681)
- HORDEUM JUBATUM TEMPORARILY FLOODED HERBACEOUS ALLIANCE (A.1358)
  Hordeum jubatum Herbaceous Vegetation (CEGL001798)
- KRASCHENINNIKOVIA LANATA DWARF-SHRUBLAND ALLIANCE (A.1104)
  Krascheninnikovia lanata / Poa secunda Dwarf-shrubland (CEGL001326)
- LEYMUS CINEREUS HERBACEOUS ALLIANCE (A.1204)
  Leymus cinereus - Pascopyrum smithii Herbaceous Vegetation (CEGL001483)
- LEYMUS CINEREUS INTERMITTENTLY FLOODED HERBACEOUS ALLIANCE (A.1329)
  Leymus cinereus - Distichlis spicata Herbaceous Vegetation (CEGL001481)
  Leymus cinereus Bottomland Herbaceous Vegetation (CEGL001480)
- LEYMUS TRITICOIDES TEMPORARILY FLOODED HERBACEOUS ALLIANCE (A.1353)
  Leymus triticoides - Carex spp. Herbaceous Vegetation (CEGL001571)
  Leymus triticoides - Poa secunda Herbaceous Vegetation (CEGL001572)
- PLUCHEA SERICEA SEASONALLY FLOODED SHRUBLAND ALLIANCE (A.798)
  Pluchea sericea Seasonally Flooded Shrubland [Placeholder] (CEGL003080)
- POA SECUNDA SEASONALLY FLOODED HERBACEOUS ALLIANCE (A.1410)
  Poa secunda - Muhlenbergia richardsonis Herbaceous Vegetation (CEGL002755)
  Puccinellia lemmonii - Poa secunda Seasonally Flooded Herbaceous Vegetation (CEGL001658)
- SARCOBATUS VERMICULATUS INTERMITTENTLY FLOODED SHRUB HERBACEOUS ALLIANCE (A.1554)
  Sarcobatus vermiculatus / Pascopyrum smithii - (Elymus lanceolatus) Shrub Herbaceous Vegetation (CEGL001508)
- SARCOBATUS VERMICULATUS INTERMITTENTLY FLOODED SHRUBLAND ALLIANCE (A.1046)
  Sarcobatus vermiculatus - Atriplex parryi / Distichlis spicata Shrubland (CEGL002764)
  Sarcobatus vermiculatus - Psorothamnus polydenius Shrubland (CEGL002763)
  Sarcobatus vermiculatus / Achnatherum hymenoides Shrubland (CEGL001373)
  Sarcobatus vermiculatus / Artemisia tridentata Shrubland (CEGL001359)
  Sarcobatus vermiculatus / Atriplex confertifolia - (Picrothamnus desertorum, Suaeda moquinii) Shrubland (CEGL001371)
  Sarcobatus vermiculatus / Distichlis spicata Shrubland (CEGL001363)
  Sarcobatus vermiculatus / Elymus elymoides - Pascopyrum smithii Shrubland (CEGL001365)
  Sarcobatus vermiculatus / Elymus elymoides Shrubland (CEGL001372)
  Sarcobatus vermiculatus / Ericameria nauseosa Shrubland (CEGL001362)
  Sarcobatus vermiculatus / Leymus cinereus Shrubland (CEGL001366)
  Sarcobatus vermiculatus / Nitrophila occidentalis - Suaeda moquinii Shrubland (CEGL001369)
  Sarcobatus vermiculatus Shrubland (CEGL001357)
- SARCOBATUS VERMICULATUS INTERMITTENTLY FLOODED SPARSELY VEGETATED ALLIANCE (A.1877)
  Sarcobatus vermiculatus / Sporobolus airoides Sparse Vegetation (CEGL001368)
- SPARTINA GRACILIS SEASONALLY FLOODED HERBACEOUS ALLIANCE (A.1407)
  Spartina gracilis Herbaceous Vegetation (CEGL001588)
- SPOROBOLUS AIROIDES INTERMITTENTLY FLOODED HERBACEOUS ALLIANCE (A.1331)
  Sporobolus airoides - Distichlis spicata Herbaceous Vegetation (CEGL001687)
- SUAEDA MOQUINII INTERMITTENTLY FLOODED SHRUBLAND ALLIANCE (A.941)
  Suaeda moquinii Shrubland (CEGL001991)

SOURCES

References: Knight 1994, Nachlinger et al. 2001
Last updated: 20 Feb 2003 **Stakeholders:** WCS
Concept Author: NatureServe Western Ecology Team **LeadResp:** WCS

S016 NORTH AMERICAN WARM DESERT BEDROCK CLIFF AND OUTCROP

Division 302, Barren, CES302.745

Spatial Scale & Pattern: Large Patch **Classification Confidence:** medium
Required Classifiers: Natural/Semi-natural, Non-vegetated (<10% vasc.), Upland
Diagnostic Classifiers: Canyon, Cliff (Landform), Rock Outcrops/Barrens/Glades, Temperate [Temperate Xeric]

Non-Diagnostic Classifiers: Montane [Upper Montane], Montane [Montane], Montane [Lower Montane], Lowland [Foothill], Lowland [Lowland], Rockfall avalanche, Ridge/Summit/Upper Slope, Sideslope,

Toeslope/Valley Bottom, Granitic Rock, Sedimentary Rock, Metamorphic Rock, Igneous Rock, Tropical/Subtropical [Tropical Xeric], Very Shallow Soil

Concept Summary: This ecological system is found from subalpine to foothill elevations and includes barren and sparsely vegetated landscapes (generally <10% plant cover) of steep cliff faces, narrow canyons, and smaller rock outcrops of various igneous, sedimentary, and metamorphic bedrock types. Also included are unstable scree and talus slopes that typically occur bellow cliff faces. Species present are diverse and may include *Bursera microphylla, Fouquieria splendens, Nolina bigelovii, Opuntia bigelovii*, and other desert species, especially succulents. Lichens are predominant lifeforms in some areas. May include a variety of desert shrublands less than 2 ha (5 acres) in size from adjacent areas.

DISTRIBUTION

Ecological Divisions: 302
TNC Ecoregions: 17:C, 22:C, 23:C, 24:C
Subnations/Nations: AZ:c, CA:c, MXBC:c, MXBS:c, MXCH:c, MXSO:c, NM:c, NV:c, TX:c

CONCEPT

Alliances and Associations:

- FOUQUIERIA SPLENDENS SHRUBLAND ALLIANCE (A.863)
  Fouquieria splendens / Bouteloua hirsuta Shrubland (CEGL001377)
  Fouquieria splendens Shrubland [Placeholder] (CEGL004452)
- LARREA TRIDENTATA SHRUBLAND ALLIANCE (A.851)
  Larrea tridentata - Jatropha dioica var. graminea Shrubland (CEGL004566)
  Larrea tridentata - Opuntia schottii Shrubland (CEGL004567)
- OPUNTIA BIGELOVII SHRUBLAND ALLIANCE (A.877)
  Opuntia bigelovii Shrubland [Placeholder] (CEGL003065)

SOURCES

References: Barbour and Major 1988, Dick-Peddie 1993, MacMahon 1988, MacMahon and Wagner 1985, Shreve and Wiggins 1964, Thomas et al. 2003a
Last updated: 20 Feb 2003 **Stakeholders:** WCS, SCS, LACD
Concept Author: NatureServe Western Ecology Team **LeadResp:** WCS

S017 NORTH AMERICAN WARM DESERT BADLAND

Division 302, Barren, CES302.743

Spatial Scale & Pattern: Small Patch **Classification Confidence:** low
Required Classifiers: Natural/Semi-natural, Non-vegetated (<10% vasc.), Upland
Diagnostic Classifiers: Badlands, Badland, Alkaline Soil, Shale and Mudstone, Silt Soil Texture, Clay Soil Texture

Non-Diagnostic Classifiers: Lowland [Lowland], Shrubland (Shrub-dominated), Moss/Lichen (Nonvascular), Tropical/Subtropical [Tropical Xeric], Temperate [Temperate Xeric], Aridic, Very Short Disturbance Interval

Concept Summary: This ecological system is restricted to barren and sparsely vegetated (generally <10% plant cover) substrates typically derived from marine shale or mudstone (badlands and mudhills). The harsh soil properties and high rate of erosion and deposition are driving environmental variables supporting sparse shrubs and dwarf-shrubs e.g., *Atriplex hymenelytra*, and herbaceous vegetation.

DISTRIBUTION

Ecological Divisions: 302
TNC Ecoregions: 17:C, 22:P, 23:P, 24:C
Subnations/Nations: AZ:c, MXCH:p, MXSO:p, NM:c, TX:p

CONCEPT

Alliances and Associations:

- ATRIPLEX HYMENELYTRA SHRUBLAND ALLIANCE (A.872)
  Atriplex hymenelytra Shrubland (CEGL001317)
- CLEOME ISOMERIS - EPHEDRA CALIFORNICA - ERICAMERIA LINEARIFOLIA SHRUBLAND ALLIANCE (A.819)
  Cleome isomeris - Ephedra californica - Ericameria linearifolia Shrubland [Placeholder] (CEGL003056)

• **California community types:**
• Gypsum (99.900.02)
• Mud hills (99.900.03)

SOURCES

References: Thomas et al. 2003a
Last updated: 20 Feb 2003 **Stakeholders:** WCS, SCS, LACD
Concept Author: NatureServe Western Ecology Team **LeadResp:** WCS

S018 NORTH AMERICAN WARM DESERT ACTIVE AND STABILIZED DUNE
Division 302, Barren, CES302.744

Spatial Scale & Pattern: Large Patch **Classification Confidence:** medium
Required Classifiers: Natural/Semi-natural, Non-vegetated (<10% vasc.), Upland
Diagnostic Classifiers: Dune (Landform), Dune field, Dune (Substrate), Temperate [Temperate Xeric], Sand Soil Texture, W-Landscape/High Intensity

Non-Diagnostic Classifiers: Lowland [Lowland], Shrubland (Shrub-dominated), Herbaceous, Dune (undifferentiated), Tropical/Subtropical [Tropical Xeric], Gypsiferous, Aridic

Concept Summary: This ecological system occurs across the warm deserts of North America and is composed of unvegetated to sparsely vegetated (generally <10% plant cover) active dunes and sandsheets derived from quartz or gypsum sands. Common vegetation includes *Ambrosia dumosa*, *Abronia villosa*, *Eriogonum deserticola*, *Larrea tridentata*, *Pleuraphis rigida*, *Poliomintha* spp., *Prosopis* spp., *Psorothamnus* spp., *Artemisia filifolia*, and *Rhus microphylla*. Dune "blowouts" and subsequent stabilization through succession are characteristic processes.

DISTRIBUTION

Range: Occurs across the warm deserts of North America.
Ecological Divisions: 302
TNC Ecoregions: 17:C, 22:C, 23:C, 24:C
Subnations/Nations: AZ:c, CA:c, MXBC:c, MXBS:c, MXCH:c, MXSO:c, NM:c, NV:c, TX:c

CONCEPT

Alliances and Associations:
- ABRONIA VILLOSA SPARSELY VEGETATED ALLIANCE (A.1852)
  Abronia villosa Sparse Vegetation [Placeholder] (CEGL003001)
- ARTEMISIA FILIFOLIA SHRUBLAND ALLIANCE (A.816)
  Artemisia filifolia - Psorothamnus scoparius - Dalea lanata Gypsum Dune Shrubland (CEGL004561)
  Artemisia filifolia / Andropogon hallii - Achnatherum hymenoides Gypsum Dune Shrubland (CEGL004559)
  Artemisia filifolia / Sporobolus flexuosus Shrubland (CEGL001547)
  Artemisia filifolia / Sporobolus giganteus Shrubland (CEGL001078)
- CLEOME ISOMERIS - EPHEDRA CALIFORNICA - ERICAMERIA LINEARIFOLIA SHRUBLAND ALLIANCE (A.819)
  Cleome isomeris - Ephedra californica - Ericameria linearifolia Shrubland [Placeholder] (CEGL003056)
- ERIOGONUM DESERTICOLA SPARSELY VEGETATED ALLIANCE (A.1856)
  Eriogonum deserticola Sand Dune Sparse Vegetation (CEGL001962)
- HELIOTROPIUM CONVOLVULACEUM SPARSELY VEGETATED ALLIANCE (A.1853)
  Heliotropium convolvulaceum - Psoralidium lanceolatum - Polanisia jamesii Sparse Vegetation (CEGL004581)
- HELIOTROPIUM RACEMOSUM SPARSELY VEGETATED ALLIANCE (A.1854)
  Heliotropium racemosum - Chamaesyce sp. Sparse Vegetation (CEGL004582)
- POLIOMINTHA INCANA SHRUBLAND ALLIANCE (A.862)
  Poliomintha incana / Muhlenbergia pungens Shrubland (CEGL002672)
- PROSOPIS GLANDULOSA SHRUBLAND ALLIANCE (A.1031)
  Prosopis glandulosa / Atriplex canescens Shrubland (CEGL001382)
  Prosopis glandulosa / Sporobolus flexuosus Shrubland (CEGL001386)
- PSOROTHAMNUS POLYDENIUS SHRUBLAND ALLIANCE (A.1039)
  Psorothamnus polydenius var. polydenius / Achnatherum hymenoides Shrubland (CEGL001353)
- PSOROTHAMNUS SPINOSUS INTERMITTENTLY FLOODED SHRUBLAND ALLIANCE (A.2520)
  Psorothamnus spinosus Shrubland [Placeholder] (CEGL002701)
- SPOROBOLUS FLEXUOSUS HERBACEOUS ALLIANCE (A.1268)
  Sporobolus flexuosus - Dasyochloa pulchella Herbaceous Vegetation (CEGL001693)

Sporobolus flexuosus - Paspalum setaceum Herbaceous Vegetation (CEGL001694)
Sporobolus flexuosus - Sporobolus contractus Herbaceous Vegetation (CEGL001696)

- **California community types:**
- Cismontane and Desert Interior Dunes (22.000.00)
- Active Desert Dunes and Sand Fields (22.010.00)
- Desert Sand-verbena (22.100.00)
- Stabilized and Partially Stabilized Desert Dunes (22.300.00)
- Stabilized and Partially Stabilized Desert Sand Fields (22.400.00)
- San Joaquin Valley Dunes (22.500.00)
- Sonoran Dune Scrub (33.010.02)
- Creosote Bush - Big Galleta (33.010.13)
- Creosote Bush - Big Galleta - Anderson's Wolfberry (33.010.14)
- Big Galleta (41.030.01)
- Big Galleta - Rayless Goldenhead (41.030.02)
- Big Galleta - Cooper's Goldenbush (41.030.03)
- Big Galleta - Downy Dalea (41.030.04)
- Desert Needlegrass Grassland (41.090.00)
- Indian Ricegrass (41.120.00)
- Mesquite Dune Scrub (61.510.01)

SOURCES

References: Bowers 1982, Bowers 1984, Holland and Keil 1995, MacMahon 1988, Powell and Turner 1974, Thomas et al. 2003a

Last updated: 20 Feb 2003 **Stakeholders:** WCS, SCS

Concept Author: NatureServe Western Ecology Team **LeadResp:** WCS

S019 NORTH AMERICAN WARM DESERT VOLCANIC ROCKLAND

Division 302, Barren, CES302.754

Spatial Scale & Pattern: Large Patch **Classification Confidence:** medium

Required Classifiers: Natural/Semi-natural, Non-vegetated (<10% vasc.), Upland

Diagnostic Classifiers: Lava, Cinder, Basalt, Tropical/Subtropical [Tropical Xeric], Temperate [Temperate Xeric]

Non-Diagnostic Classifiers: Montane [Upper Montane], Montane [Montane], Montane [Lower Montane], Lowland [Foothill], Lowland [Lowland], Shrubland (Shrub-dominated), Ridge/Summit/Upper Slope, Sideslope, Toeslope/Valley Bottom, Aridic

Concept Summary: This ecological system occurs across the warm deserts of North America and is restricted to barren and sparsely vegetated (<10% plant cover) volcanic substrates such as basalt lava (malpais) and tuff. Vegetation is variable and includes a variety of species depending on local environmental conditions, e.g., elevation, age and type of substrate. Typically scattered *Larrea tridentata*, *Atriplex hymenelytra*, or other desert shrubs are present.

DISTRIBUTION

Range: Occurs across the warm deserts of North America.

Ecological Divisions: 302

TNC Ecoregions: 17:C, 22:C, 23:C, 24:C

Subnations/Nations: AZ:c, CA:c, MXBC:c, MXCH:c, MXSO:c, NM:c, NV:c, TX:c

CONCEPT

Alliances and Associations:

- ALOYSIA WRIGHTII SHRUBLAND ALLIANCE (A.1035)
  Aloysia wrightii / Perityle staurophylla Shrubland (CEGL001280)
- OPUNTIA BIGELOVII SHRUBLAND ALLIANCE (A.877)
  Opuntia bigelovii Shrubland [Placeholder] (CEGL003065)

SOURCES

References: Barbour and Major 1988, Brown 1982, Dick-Peddie 1993, Thomas et al. 2003a

Last updated: 20 Feb 2003 **Stakeholders:** WCS, SCS

Concept Author: NatureServe Western Ecology Team **LeadResp:** WCS

S020 NORTH AMERICAN WARM DESERT WASH

Division 302, Woody Wetland, CES302.755

Spatial Scale & Pattern: Linear **Classification Confidence:** medium

Required Classifiers: Natural/Semi-natural, Vegetated (>10% vasc.), Wetland

Diagnostic Classifiers: Lowland [Lowland], Shrubland (Shrub-dominated), Toeslope/Valley Bottom, Tropical/Subtropical [Tropical Xeric], Temperate [Temperate Xeric], Riverine / Alluvial, Intermittent Flooding

Non-Diagnostic Classifiers: Sideslope, Short (50-100 yrs) Persistence

Concept Summary: This ecological system is restricted to intermittently flooded washes or arroyos that dissect bajadas, mesas, plains and basin floors throughout the warm deserts of North America. Although often dry, the intermittent fluvial processes define this system, which are often associated with rapid sheet and gully flow. This system occurs as linear or braided strips within desert scrub- or desert grassland-dominated landscapes. The vegetation of desert washes is quite variable ranging from sparse and patchy to moderately dense and typically occurs along the banks, but may occur within the channel. The woody layer is typically intermittent to open and may be dominated by shrubs and small trees such as *Acacia greggii, Brickellia laciniata, Baccharis sarothroides, Chilopsis linearis, Fallugia paradoxa, Hymenoclea salsola, Hymenoclea monogyra, Juglans microcarpa, Prosopis* spp., *Psorothamnus spinosus, Prunus fasciculata, Rhus microphylla, Salazaria mexicana,* or *Sarcobatus vermiculatus*.

DISTRIBUTION

Range: Restricted to intermittently flooded washes or arroyos that dissect bajadas, mesas, plains and basin floors throughout the warm deserts of North America.

Ecological Divisions: 302

TNC Ecoregions: 17:C, 22:C, 23:C, 24:C

Subnations/Nations: AZ:c, CA:c, MXBC:c, MXCH:c, MXSO:c, NM:c, NV:c, TX:c

CONCEPT

Alliances and Associations:

- (A.0)
  Baccharis emoryi Shrubland [Provisional] (CEGL002974)
- ACACIA GREGGII SHRUBLAND ALLIANCE (A.1036)
  Acacia greggii - Parkinsonia microphylla Shrubland (CEGL001340)
- BACCHARIS SALICIFOLIA - BACCHARIS NEGLECTA SEASONALLY FLOODED SHRUBLAND ALLIANCE (A.987)
  Baccharis salicifolia - Baccharis neglecta / Eustoma exaltatum Shrubland (CEGL004590)
- BACCHARIS SALICIFOLIA INTERMITTENTLY FLOODED SHRUBLAND ALLIANCE (A.933)
  Baccharis salicifolia / Muhlenbergia rigens Shrubland (CEGL004572)
- BACCHARIS SAROTHROIDES INTERMITTENTLY FLOODED SHRUBLAND ALLIANCE (A.840)
  Baccharis sarothroides - Baccharis salicifolia Shrubland (CEGL001160)
  Baccharis sarothroides - Parkinsonia microphylla Shrubland (CEGL001159)
- BACCHARIS SERGILOIDES INTERMITTENTLY FLOODED SHRUBLAND ALLIANCE (A.2531)
  Baccharis sergiloides Shrubland [Placeholder] (CEGL002953)
- BRICKELLIA LACINIATA INTERMITTENTLY FLOODED SHRUBLAND ALLIANCE (A.940)
  Brickellia laciniata - Hymenoclea monogyra Shrubland (CEGL001953)
- CHILOPSIS LINEARIS INTERMITTENTLY FLOODED SHRUBLAND ALLIANCE (A.1044)
  Chilopsis linearis / Brickellia laciniata Shrubland (CEGL004933)
  Chilopsis linearis Shrubland (CEGL001164)
- ENCELIA VIRGINENSIS SHRUBLAND ALLIANCE (A.860)
  Encelia virginensis Shrubland (CEGL001335)
- EPHEDRA CALIFORNICA INTERMITTENTLY FLOODED SHRUBLAND ALLIANCE (A.2536)
  Ephedra californica Shrubland [Placeholder] (CEGL002958)
- ERICAMERIA PANICULATA INTERMITTENTLY FLOODED SHRUBLAND ALLIANCE (A.2509)
  Ericameria paniculata Shrubland [Placeholder] (CEGL002706)
- FORESTIERA PUBESCENS TEMPORARILY FLOODED SHRUBLAND ALLIANCE (A.969)
  Forestiera pubescens Mojave Desert Shrubland [Provisional] (CEGL002959)
- GRAYIA SPINOSA INTERMITTENTLY FLOODED SHRUBLAND ALLIANCE (A.1045)
  Grayia spinosa - Lycium andersonii Shrubland (CEGL001347)
  Grayia spinosa - Lycium pallidum Shrubland (CEGL001348)
- HYMENOCLEA MONOGYRA SHRUBLAND ALLIANCE (A.1034)
  Hymenoclea monogyra Thicket Shrubland (CEGL001169)

- HYMENOCLEA SALSOLA SHRUBLAND ALLIANCE (A.2512)
  Hymenoclea salsola - (Ambrosia eriocentra) Shrubland (CEGL002702)
  Hymenoclea salsola - Salazaria mexicana Shrubland (CEGL002703)
- HYPTIS EMORYI INTERMITTENTLY FLOODED SHRUBLAND ALLIANCE (A.2537)
  Hyptis emoryi Shrubland [Placeholder] (CEGL002960)
- JUGLANS MICROCARPA TEMPORARILY FLOODED SHRUBLAND ALLIANCE (A.945)
  Juglans microcarpa / Cladium mariscus ssp. jamaicense Shrubland (CEGL004593)
  Juglans microcarpa / Sorghastrum nutans Shrubland (CEGL004594)
  Juglans microcarpa Shrubland (CEGL001103)
- LEPIDOSPARTUM SQUAMATUM INTERMITTENTLY FLOODED SHRUBLAND ALLIANCE (A.838)
  Lepidospartum squamatum Intermittently Flooded Shrubland [Placeholder] (CEGL003060)
- PANICUM BULBOSUM TEMPORARILY FLOODED HERBACEOUS ALLIANCE (A.1356)
  Panicum bulbosum - Alopecurus aequalis Herbaceous Vegetation (CEGL001653)
  Panicum bulbosum - Lycurus phleoides Herbaceous Vegetation (CEGL001654)
- PROSOPIS (GLANDULOSA, VELUTINA) WOODLAND ALLIANCE (A.661)
  Prosopis (glandulosa var. torreyana, velutina) Woodland [Placeholder] (CEGL003082)
- PROSOPIS GLANDULOSA SHRUB HERBACEOUS ALLIANCE (A.1550)
  Prosopis glandulosa / Bouteloua eriopoda Shrub Herbaceous Vegetation (CEGL001510)
- PROSOPIS GLANDULOSA SHRUBLAND ALLIANCE (A.1031)
  Prosopis glandulosa - Atriplex spp. Shrubland (CEGL002193)
  Prosopis glandulosa / Atriplex canescens Shrubland (CEGL001382)
  Prosopis glandulosa / Bouteloua gracilis Shrubland (CEGL001383)
  Prosopis glandulosa / Mixed Grasses Shrubland (CEGL001384)
  Prosopis glandulosa / Muhlenbergia porteri Shrubland (CEGL001511)
  Prosopis glandulosa / Sporobolus airoides Shrubland (CEGL001385)
  Prosopis glandulosa var. glandulosa / Bouteloua gracilis - Buchloe dactyloides Shrubland (CEGL003877)
  Prosopis glandulosa var. torreyana Shrubland (CEGL001381)
- PROSOPIS GLANDULOSA TEMPORARILY FLOODED WOODLAND ALLIANCE (A.637)
  Prosopis glandulosa Temporarily Flooded Woodland (CEGL004934)
- PROSOPIS GLANDULOSA WOODLAND ALLIANCE (A.611)
  Prosopis glandulosa / Bouteloua curtipendula - Nassella leucotricha Woodland (CEGL002133)
- PROSOPIS PUBESCENS SHRUBLAND ALLIANCE (A.1042)
  Prosopis pubescens Shrubland (CEGL001387)
- PROSOPIS VELUTINA SHRUBLAND ALLIANCE (A.1043)
  Prosopis velutina - Acacia greggii Shrubland (CEGL001388)
- PRUNUS FASCICULATA INTERMITTENTLY FLOODED SHRUBLAND ALLIANCE (A.2519)
  Prunus fasciculata Shrubland [Placeholder] (CEGL002704)
- PSOROTHAMNUS SPINOSUS INTERMITTENTLY FLOODED SHRUBLAND ALLIANCE (A.2520)
  Psorothamnus spinosus Shrubland [Placeholder] (CEGL002701)
- RHUS MICROPHYLLA SHRUBLAND ALLIANCE (A.1040)
  Rhus microphylla / Bouteloua curtipendula Shrubland (CEGL001354)
- SAPINDUS SAPONARIA TEMPORARILY FLOODED FOREST ALLIANCE (A.303)
  Sapindus saponaria - Juglans major Forest (CEGL000557)
- VIGUIERA RETICULATA INTERMITTENTLY FLOODED SHRUBLAND ALLIANCE (A.2539)
  Viguiera reticulata Shrubland [Placeholder] (CEGL002962)

- **California community types:**
- Scalebroom Scrub (32.070.00)
- California Buckwheat - Scalebroom (32.070.01)
- Scalebroom - Hairy Yerba Santa - Chaparral Yucca (32.070.02)
- Scalebroom / Mixed Ephemeral Herbs (32.070.03)
- Creosote Bush Wash Scrub (33.010.06)
- Creosote Bush - Cheesebush (33.010.08)
- Creosote Bush - Cheesebush - Woolly Brickellia (33.010.15)
- Catclaw Acacia Thorn Scrub (33.040.00)
- Catclaw Acacia-wash association (33.040.01)
- Catclaw Acacia Savanna (33.040.02)
- Catclaw Acacia / Desert Lavender (33.040.03)
- Catclaw Acacia / Cheesebush (33.040.04)
- Catclaw Acacia - Cheesebush - Virgin River Encelia (33.040.05)
- Catclaw Acacia - Desert Sunflower (33.040.06)
- Catclaw Acacia - Desert Almond (33.040.07)
- Catclaw Acacia - Woolly Bursage (33.040.08)

- Catclaw Acacia - Blue Sage (33.040.09)
- Catclaw Acacia - Sweetbush (33.040.10)
- Catclaw Acacia/Naked buckwheat (33.040.11)
- Desert Lavender Wash Scrub (33.190.00)
- Cheesebush - wash association (33.200.01)
- Cheesebush - California Buckwheat (33.200.02)
- Cheesebush - Blackstem Rabbitbrush (33.200.03)
- Cheesebush - Shadscale (33.200.04)
- Cheesebush - Sweetbush (33.200.05)
- Cheesebush - Woolly Bursage (33.200.06)
- Cheesebush - Woolly Brickellia (33.200.07)
- Cheesebush - Spiny Senna (33.200.08)
- Mojave Wash Scrub (33.213.00)
- Desert Almond Scrub (33.300.00)
- Desert Almond (33.300.01)
- Desert Almond - Bladder Sage (33.300.02)
- Desert Almond - Skunkbrush (33.300.03)
- Desert Almond - Stansbury's Antelope Bush (33.300.04)
- Desert Almond - Woolly Bursage (33.300.05)
- Desert Almond - Net-veined Viguiera - (Utah Mortonia) (33.300.06)
- Bladder Sage (33.310.01)
- Blue Palo Verde - Ironwood - Smoke Tree Woodland (61.530.00)
- Blue Palo Verde Woodland (61.540.00)
- Blue Palo Verde Wash Woodland (61.540.01)
- Blue Palo Verde / Desert Lavender (61.540.02)
- Desert-willow Woodland (61.550.00)
- Desert-willow / Cheesebush (61.550.02)
- Desert-willow - Desert Almond - Cheesebush (61.550.03)
- Desert-willow - Desert Almond (61.550.04)
- Desert-willow - Blue Sage (61.550.05)
- Desert-willow - Desert Sunflower (61.550.06)
- Desert-willow - Blackstem Rabbitbrush (61.550.07)
- Ironwood Woodland (61.560.01)
- Ironwood / Desert Lavender (61.560.02)
- Smoke Tree Woodland and Scrub (61.570.00)
- Smoketree Wash Woodland (61.570.01)
- Smoketree - Cheesebush - Sweetbush (61.570.02)
- Smoketree / California Ephedra (61.570.03)
- Smoketree - Desert Lavender - Catclaw Acacia (61.570.04)
- Mulefat Scrub (63.510.00)
- Arrow Weed Scrub (63.710.00)
- Sandy to Cobbly wash bottom (99.900.01)

SOURCES

References: Barbour and Major 1988, Brown 1982, Dick-Peddie 1993, MacMahon 1988, Muldavin et al. 2000b, Szaro 1989, Thomas et al. 2003a

Last updated: 20 Feb 2003 **Stakeholders:** WCS, SCS

Concept Author: NatureServe Western Ecology Team **LeadResp:** WCS

S021 NORTH AMERICAN WARM DESERT PAVEMENT

Division 302, Barren, CES302.750

Spatial Scale & Pattern: Large Patch **Classification Confidence:** medium

Required Classifiers: Natural/Semi-natural, Non-vegetated (<10% vasc.), Upland

Diagnostic Classifiers: Lowland [Lowland], Desert Pavement, Tropical/Subtropical [Tropical Xeric], Temperate [Temperate Xeric], W-Landscape/High Intensity

Non-Diagnostic Classifiers: Shrubland (Shrub-dominated), Toeslope/Valley Bottom, Aridic

Concept Summary: This ecological system occurs throughout much of the warm deserts of North America and is composed of unvegetated to very sparsely vegetated (<2% plant cover) landscapes, typically flat basins where

extreme temperature and wind develop ground surfaces of fine to medium gravel coated with "desert varnish." Very low cover of desert scrub species such as *Larrea tridentata* or *Eriogonum fasciculatum* is usually present. However, ephemeral herbaceous species may have high cover in response to seasonal precipitation, including *Chorizanthe rigida, Eriogonum inflatum,* and *Geraea canescens*.

DISTRIBUTION

Range: Occurs throughout much of the warm deserts of North America.
Ecological Divisions: 302
TNC Ecoregions: 17:C, 23:C, 24:C
Subnations/Nations: AZ:c, CA:c, MXCH:c, MXSO:c, NM:c, NV:c, TX:c

CONCEPT

Alliances and Associations:

- AMBROSIA DELTOIDEA SHRUBLAND ALLIANCE (A.852)
  Ambrosia deltoidea / Simmondsia chinensis Shrubland (CEGL000953)
- AMBROSIA DUMOSA DWARF-SHRUBLAND ALLIANCE (A.1102)
  Ambrosia dumosa - Larrea tridentata var. tridentata Dwarf-shrubland (CEGL000956)
- ERIOGONUM FASCICULATUM SHRUBLAND ALLIANCE (A.868)
  Eriogonum fasciculatum - Purshia glandulosa Shrubland (CEGL001259)
  Eriogonum fasciculatum Shrubland (CEGL001258)

SOURCES

References: Barbour and Major 1988, MacMahon 1988, Thomas et al. 2003a
Last updated: 20 Feb 2003 **Stakeholders:** WCS, SCS
Concept Author: NatureServe Western Ecology Team **LeadResp:** WCS

S022 NORTH AMERICAN WARM DESERT PLAYA

Division 302, Barren, CES302.751

Spatial Scale & Pattern: Large Patch **Classification Confidence:** medium
Required Classifiers: Natural/Semi-natural, Non-vegetated (<10% vasc.), Upland, Wetland
Diagnostic Classifiers: Lowland [Lowland], Playa, Tropical/Subtropical [Tropical Xeric], Temperate [Temperate Xeric], Alkaline Soil, Aridic, Depressional, Alkaline Water, Saline Water Chemistry, Caliche Layer, Impermeable Layer, Intermittent Flooding

Non-Diagnostic Classifiers: Shrubland (Shrub-dominated), Woody-Herbaceous, Dwarf-Shrub, Forb, Graminoid, Clay Subsoil Texture

Concept Summary: This system is composed of barren and sparsely vegetated playas (generally <10% plant cover) found across the warm deserts of North America, extending into the extreme southern end of the San Joaquin Valley in California. Playas form with intermittent flooding, followed by evaporation, leaving behind a saline residue. Salt crusts are common throughout, with small saltgrass beds in depressions and sparse shrubs around the margins. Subsoils often include an impermeable layer of clay or caliche. Large desert playas tend to be defined by vegetation rings formed in response to salinity. Given their common location in wind-swept desert basins, dune fields often form downwind of large playas. In turn, playas associated with dunes often have a deeper water supply. Species may include *Allenrolfea occidentalis, Suaeda* spp., *Distichlis spicata, Eleocharis palustris, Oryzopsis* spp., *Sporobolus* spp., *Tiquilia* spp., or *Atriplex* spp. Ephemeral herbaceous species may have high cover periodically. Adjacent vegetation is typically Sonora-Mojave Mixed Salt Desert Scrub (CES302.749), Chihuahuan Mixed Salt Desert Scrub (CES302.017), Gulf of California Coastal Mixed Salt Desert Scrub (CES302.015), Baja California del Norte Gulf Coast Ocotillo-Limberbush-Creosotebush Desert Scrub (CES302.014), or Chihuahuan Creosotebush Basin Desert Scrub (CES302.731).

DISTRIBUTION

Range: Found across the warm deserts of North America, extending into the extreme southern end of the San Joaquin Valley in California.
Ecological Divisions: 302
TNC Ecoregions: 17:C, 22:C, 23:C, 24:C
Subnations/Nations: AZ:c, CA:c, MXBC:c, MXCH:c, MXSO:c, NM:c, NV:c, TX:c

CONCEPT

Alliances and Associations:

- (SARCOCORNIA UTAHENSIS) - (ARTHROCNEMUM SUBTERMINALE) SEMIPERMANENTLY FLOODED HERBACEOUS ALLIANCE (A.1676)
  (Sarcocornia utahensis) - (Arthrocnemum subterminale) Seasonally Flooded Herbaceous Vegetation [Placeholder] (CEGL003120)
- ALLENROLFEA OCCIDENTALIS SHRUBLAND ALLIANCE (A.866)
  Allenrolfea occidentalis Shrubland (CEGL000988)
- ATRIPLEX (LENTIFORMIS, POLYCARPA) SHRUBLAND ALLIANCE (A.864)
  Atriplex (lentiformis, polycarpa) Shrubland [Placeholder] (CEGL003016)
- ATRIPLEX POLYCARPA SHRUBLAND ALLIANCE (A.873)
  Atriplex polycarpa / Pleuraphis mutica Shrubland (CEGL001319)
  Atriplex polycarpa Shrubland (CEGL001318)
- ATRIPLEX SPINIFERA SHRUBLAND ALLIANCE (A.865)
  Atriplex spinifera Shrubland [Placeholder] (CEGL003015)
- BOUTELOUA BREVISETA SPARSELY VEGETATED ALLIANCE (A.1870)
  Bouteloua breviseta Sparse Vegetation (CEGL004609)
- SESUVIUM VERRUCOSUM TEMPORARILY FLOODED SPARSELY VEGETATED ALLIANCE (A.1865)
  Sesuvium verrucosum Sparse Vegetation (CEGL004595)

- **California community types:**
- Great Valley Iodine Bush Scrub (36.110.00)
- Saltgrass - Iodine Bush (36.120.01)
- Bush Seepweed - Iodine Bush (36.120.02)
- Alkali Sacaton - Iodine Bush (36.120.03)
- Iodine Bush (36.120.04)
- Great Valley Bush Seepweed Scrub (36.200.01)
- Desert Bush Seepweed Scrub (36.200.02)
- Bush Seepweed - Fourwing Saltbush (36.200.04)
- Desert Sink Scrub (36.700.00)
- Saltgrass - Alkali Rabbitbrush (41.200.04)
- Saltgrass - Alkali Heath - Jaumea (41.200.07)
- Mesquite Dry Lake (61.510.03)
- Playa (99.900.07)

SOURCES

References: Barbour and Major 1988, Brown 1982, Dick-Peddie 1993, Holland and Keil 1995, Muldavin et al. 2000b, Thomas et al. 2003a

Last updated: 20 Feb 2003 **Stakeholders:** WCS, SCS

Concept Author: NatureServe Western Ecology Team **LeadResp:** WCS

NLCD Deciduous Forest Types

Areas dominated by trees generally greater than 5 meters tall, and greater than 20% of total vegetation cover. More than 75 percent of the tree species shed foilage simulaneously in response to seasonal change.

S023 ROCKY MOUNTAIN ASPEN FOREST AND WOODLAND

Division 306, Forest and Woodland, CES306.813

Spatial Scale & Pattern: Large Patch **Classification Confidence:** medium

Required Classifiers: Natural/Semi-natural, Vegetated (>10% vasc.), Upland

Diagnostic Classifiers: Forest and Woodland (Treed), Long Disturbance Interval, F-Patch/Medium Intensity, F-Landscape/Medium Intensity, Broad-Leaved Deciduous Tree, Populus tremuloides

Non-Diagnostic Classifiers: Montane [Upper Montane], Montane [Montane], Temperate [Temperate Continental], Mesotrophic Soil, Shallow Soil, Mineral: W/ A-Horizon <10 cm, Ustic

Concept Summary: This widespread ecological system is more common in the southern and central Rocky Mountains, but occurs throughout much of the western U.S. and north into Canada, in the montane and subalpine

zones. Elevations generally range from 1525 to 3050 m (5000-10,000 feet), but occurrences can be found at lower elevations in some regions. Distribution of this ecological system is primarily limited by adequate soil moisture required to meet its high evapotranspiration demand, and secondarily is limited by the length of the growing season or low temperatures. These are upland forests and woodlands dominated by *Populus tremuloides* without a significant conifer component (<25% relative tree cover). The understory structure may be complex with multiple shrub and herbaceous layers, or simple with just an herbaceous layer. The herbaceous layer may be dense or sparse, dominated by graminoids or forbs. Associated shrub species include *Symphoricarpos* spp., *Rubus parviflorus*, *Amelanchier alnifolia*, and *Arctostaphylos uva-ursi*. Occurrences of this system originate and are maintained by stand-replacing disturbances such as avalanches, crown fire, insect outbreak, disease and windthrow, or clearcutting by man or beaver, within the matrix of conifer forests.

DISTRIBUTION

Range: More common in the southern and central Rocky Mountains, but occurs throughout much of the western U.S. and north into Canada, in the montane and subalpine zones. Elevations generally range from 1525 to 3050 m (5000-10,000 feet), but occurrences can be found at lower elevations in some regions.
Ecological Divisions: 204, 206, 304, 306
TNC Ecoregions: 1:P, 11:C, 12:P, 18:C, 19:C, 20:C, 21:P, 25:C, 3:C, 4:P, 5:P, 7:C, 8:C, 81:P, 9:C
Subnations/Nations: AB:c, AZ:c, BC:c, CA:c, CO:c, ID:c, MT:c, NM:c, NV:c, OR:c, SD:c, UT:c, WA:c, WY:c

CONCEPT

Alliances and Associations:

- POPULUS TREMULOIDES FOREST ALLIANCE (A.274)
  Populus tremuloides / Acer glabrum Forest (CEGL000563)
  Populus tremuloides / Amelanchier alnifolia - Symphoricarpos oreophilus / Bromus carinatus Forest (CEGL000566)
  Populus tremuloides / Amelanchier alnifolia - Symphoricarpos oreophilus / Calamagrostis rubescens Forest (CEGL000567)
  Populus tremuloides / Amelanchier alnifolia - Symphoricarpos oreophilus / Tall Forbs Forest (CEGL000568)
  Populus tremuloides / Amelanchier alnifolia - Symphoricarpos oreophilus / Thalictrum fendleri Forest (CEGL000569)
  Populus tremuloides / Amelanchier alnifolia / Pteridium aquilinum Forest (CEGL000565)
  Populus tremuloides / Amelanchier alnifolia / Tall Forbs Forest (CEGL000570)
  Populus tremuloides / Amelanchier alnifolia / Thalictrum fendleri Forest (CEGL000571)
  Populus tremuloides / Amelanchier alnifolia Forest (CEGL000564)
  Populus tremuloides / Artemisia tridentata Forest (CEGL000572)
  Populus tremuloides / Bromus carinatus Forest (CEGL000573)
  Populus tremuloides / Calamagrostis rubescens Forest (CEGL000575)
  Populus tremuloides / Carex geyeri Forest (CEGL000579)
  Populus tremuloides / Carex rossii Forest (CEGL000580)
  Populus tremuloides / Carex siccata Forest (CEGL000578)
  Populus tremuloides / Ceanothus velutinus Forest (CEGL000581)
  Populus tremuloides / Corylus cornuta Forest (CEGL000583)
  Populus tremuloides / Festuca thurberi Forest (CEGL000585)
  Populus tremuloides / Heracleum sphondylium Forest (CEGL000586)
  Populus tremuloides / Hesperostipa comata Forest (CEGL000608)
  Populus tremuloides / Juniperus communis / Carex geyeri Forest (CEGL000588)
  Populus tremuloides / Juniperus communis / Lupinus argenteus Forest (CEGL000589)
  Populus tremuloides / Juniperus communis Forest (CEGL000587)
  Populus tremuloides / Ligusticum filicinum Forest (CEGL000591)
  Populus tremuloides / Lonicera involucrata Forest (CEGL000592)
  Populus tremuloides / Lupinus argenteus Forest (CEGL000593)
  Populus tremuloides / Mahonia repens Forest (CEGL000594)
  Populus tremuloides / Osmorhiza occidentalis Forest (CEGL000595)
  Populus tremuloides / Prunus virginiana Forest (CEGL000596)
  Populus tremuloides / Pteridium aquilinum Forest (CEGL000597)
  Populus tremuloides / Rubus parviflorus Forest (CEGL000602)
  Populus tremuloides / Rudbeckia occidentalis Forest (CEGL000603)
  Populus tremuloides / Salix scouleriana Forest (CEGL000604)
  Populus tremuloides / Sambucus racemosa Forest (CEGL000605)
  Populus tremuloides / Shepherdia canadensis Forest (CEGL000606)
  Populus tremuloides / Spiraea betulifolia Forest (CEGL000607)
  Populus tremuloides / Symphoricarpos albus Forest (CEGL000609)
  Populus tremuloides / Symphoricarpos oreophilus / Bromus carinatus Forest (CEGL000611)
  Populus tremuloides / Symphoricarpos oreophilus / Calamagrostis rubescens Forest (CEGL000612)

Populus tremuloides / Symphoricarpos oreophilus / Carex rossii Forest (CEGL000613)
Populus tremuloides / Symphoricarpos oreophilus / Festuca thurberi Forest (CEGL000614)
Populus tremuloides / Symphoricarpos oreophilus / Tall Forbs Forest (CEGL000615)
Populus tremuloides / Symphoricarpos oreophilus / Thalictrum fendleri Forest (CEGL000616)
Populus tremuloides / Symphoricarpos oreophilus / Wyethia amplexicaulis Forest (CEGL000617)
Populus tremuloides / Symphoricarpos oreophilus Forest (CEGL000610)
Populus tremuloides / Tall Forbs Forest (CEGL000618)
Populus tremuloides / Thalictrum fendleri Forest (CEGL000619)
Populus tremuloides / Vaccinium myrtillus Forest (CEGL000620)
Populus tremuloides / Wyethia amplexicaulis Forest (CEGL000622)

- POPULUS TREMULOIDES TEMPORARILY FLOODED FOREST ALLIANCE (A.300)
  Populus tremuloides / Quercus gambelii / Symphoricarpos oreophilus Forest (CEGL000598)
  Populus tremuloides / Ribes montigenum Forest (CEGL000600)
- POPULUS TREMULOIDES WOODLAND ALLIANCE (A.610)
  Populus tremuloides / Symphoricarpos albus / Elymus glaucus Woodland (CEGL000946)

Environment: Climate is temperate with a relatively long growing season, typically cold winters and deep snow. Mean annual precipitation is greater than 15 inches and typically greater than 20 inches, except in semi-arid environments where occurrences are restricted to mesic microsites such as seeps or large snow drifts. Distribution of this ecological system is primarily limited by adequate soil moisture required to meet its high evapotranspiration demand (Mueggler 1988). Secondarily, its range is limited by the length of the growing season or low temperatures (Mueggler 1988). Topography is variable, sites range from level to steep slopes. Aspect varies according to the limiting factors. Occurrences at high elevations are restricted by cold temperatures and are found on warmer southern aspects. At lower elevations occurrences 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. Soil texture ranges from sandy loam to clay 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).

Vegetation: Occurrences have a somewhat closed canopy of trees of 5-20 m tall that is dominated by the cold-deciduous, broad-leaved tree *Populus tremuloides*. Conifers that may be present but never codominant include *Abies concolor, Abies lasiocarpa, Picea engelmannii, Picea pungens, Pinus ponderosa,* and *Pseudotsuga menziesii*. Conifer species may contribute up to 15% of the tree canopy before the occurrence is reclassified as a mixed occurrence. Because of the open growth form of *Populus tremuloides*, enough light can penetrate for lush understory development. Depending on available soil moisture and other factors like disturbance, the understory structure may be complex with multiple shrub and herbaceous layers, or simple with just an herbaceous layer. The herbaceous layer may be dense or sparse, dominated by graminoids or forbs.

Common shrubs include *Acer glabrum, Amelanchier alnifolia, Artemisia tridentata, Juniperus communis, Prunus virginiana, Rosa woodsii, Shepherdia canadensis, Symphoricarpos oreophilus,* and the dwarf-shrubs *Mahonia repens* and *Vaccinium* spp. The herbaceous layers may be lush and diverse. Common graminoids may include *Bromus carinatus, Calamagrostis rubescens, Carex siccata (= Carex foenea), Carex geyeri, Carex rossii, Elymus glaucus, Elymus trachycaulus, Festuca thurberi,* and *Hesperostipa comata*. Associated forbs may include *Achillea millefolium, Eucephalus engelmannii (= Aster engelmannii), Delphinium* spp., *Geranium viscosissimum, Heracleum sphondylium, Ligusticum filicinum, Lupinus argenteus, Osmorhiza berteroi (= Osmorhiza chilensis), Pteridium aquilinum, Rudbeckia occidentalis, Thalictrum fendleri, Valeriana occidentalis, Wyethia amplexicaulis,* and many others. Exotic grasses such as the perennials *Poa pratensis* and *Bromus inermis* and the annual *Bromus tectorum* are often common in occurrences disturbed by grazing.

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

SOURCES

References: Bartos 1979, Bartos and Cambell 1998, Bartos and Mueggler 1979, Canadian Rockies Ecoregional Plan 2002, Comer et al. 2002, DeByle and Winokur 1985, DeVelice et al. 1986, Henderson et al. 1977, Hess and Wasser 1982, Johnston and Hendzel 1985, Keammerer 1974a, Mueggler 1988, Neely et al. 2001, Powell 1988a, Tuhy et al. 2002, Youngblood and Mauk 1985

Last updated: 20 Feb 2003 **Stakeholders:** WCS, MCS, CAN

Concept Author: NatureServe Western Ecology Team **LeadResp:** WCS

S024 ROCKY MOUNTAIN BIGTOOTH MAPLE RAVINE WOODLAND

Division 306, Forest and Woodland, CES306.814

Spatial Scale & Pattern: Large Patch **Classification Confidence:** low

Required Classifiers: Natural/Semi-natural, Vegetated (>10% vasc.), Upland

Diagnostic Classifiers: Colluvial slope, Ravine, Stream terrace (undifferentiated), Toeslope, Mineral: W/ A-Horizon <10 cm, Unconsolidated, Broad-Leaved Deciduous Tree, Acer grandidentatum

Non-Diagnostic Classifiers: Montane [Montane], Montane [Lower Montane], Forest and Woodland (Treed), Toeslope/Valley Bottom, Temperate [Temperate Continental], Mesotrophic Soil, Landslide

Concept Summary: This ecological system occurs in cool ravines, on toeslopes and slump benches associated with riparian areas in the northern and central Wasatch Range and Tavaputs Plateau extending into southern Idaho, as well as in scattered localities in southwestern Utah, central Arizona and New Mexico and the Trans-Pecos of Texas. Substrates are typically rocky colluvial or alluvial soils with favorable soil moisture. These woodlands are dominated by *Acer grandidentatum* but may include mixed stands codominated by *Quercus gambelii* or with scattered conifers. Some stands may include *Acer negundo* or *Populus tremuloides* as minor components. It also occurs on steeper, north-facing slopes at higher elevations, often adjacent to Rocky Mountain Gambel Oak-Mixed Montane Shrubland (CES306.818) or Rocky Mountain Aspen Forest and Woodland (CES306.813).

DISTRIBUTION

Range: Occurs in the northern and central Wasatch Range and Tavaputs Plateau extending into southern Idaho, as well as in scattered localities in southwestern Utah, central Arizona and New Mexico and the Trans-Pecos of Texas.

Ecological Divisions: 302, 304?, 306

TNC Ecoregions: 18:?, 21:P, 24:C, 9:C

Subnations/Nations: NM:p, TX:c, UT:c

CONCEPT

Alliances and Associations:

- ABIES CONCOLOR FOREST ALLIANCE (A.152)
  Abies concolor / Acer grandidentatum Forest (CEGL000241)
- ACER GRANDIDENTATUM MONTANE FOREST ALLIANCE (A.265)
  Acer grandidentatum - Quercus gravesii Forest (CEGL004548)
  Acer grandidentatum - Quercus muehlenbergii Forest (CEGL004547)
  Acer grandidentatum / Calamagrostis rubescens Forest (CEGL000558)
  Acer grandidentatum / Quercus gambelii Forest (CEGL000559)

SOURCES

References: Gehlbach 1967, Ream 1964

Last updated: 20 Feb 2003 **Stakeholders:** WCS, SCS

Concept Author: NatureServe Western Ecology Team **LeadResp:** WCS

NLCD Evergreen Forest Types

Areas dominated by trees generally greater than 5 meters tall, and greater than 20% of total vegetation cover. More than 75 percent of the tree species maintain their leaves all year. Canopy is never without green foliage.

S025 ROCKY MOUNTAIN SUBALPINE-MONTANE LIMBER-BRISTLECONE PINE WOODLAND

Division 306, Forest and Woodland, CES306.819

Spatial Scale & Pattern: Large Patch **Classification Confidence:** medium

Required Classifiers: Natural/Semi-natural, Vegetated (>10% vasc.), Upland

Diagnostic Classifiers: Ridge/Summit/Upper Slope, Calcareous, Very Shallow Soil, Mineral: W/ A-Horizon <10 cm, Aridic, W-Patch/High Intensity, W-Landscape/High Intensity, Needle-Leaved Tree, Pinus flexilis, P. aristata, Upper Treeline

Non-Diagnostic Classifiers: Montane [Upper Montane], Montane [Montane], Montane [Lower Montane], Forest and Woodland (Treed), Temperate [Temperate Continental], Alkaline Soil, Moderate (100-500 yrs) Persistence

Concept Summary: This ecological system occurs throughout the Rocky Mountains on dry, rocky ridges and slopes near upper treeline above the matrix spruce-fir forest. It extends down to the lower montane in the central and northern Rocky Mountains and northeastern Great Basin mountains where dominated by Pinus flexilis , particularly along the Front Range north into Canada. Sites are harsh, exposed to desiccating winds with rocky substrates and a short growing season that limit plant growth. Higher elevation occurrences are found well into the subalpine - alpine transition on wind-blasted, mostly west-facing slopes and exposed ridges. Calcareous substrates are important for *Pinus flexilis*-dominated communities in the northern Rocky Mountains and possibly elsewhere. The open tree canopy is often patchy and is strongly dominated by *Pinus flexilis* or *Pinus aristata* with the latter restricted to southern Colorado and northern New Mexico and San Francisco Mountains in Arizona. In the northern Rockies and northern Great Basin, *Pinus albicaulis* is found in some occurrences. Other trees such as *Juniperus* spp., *Pinus contorta, Pinus ponderosa*, or *Pseudotsuga menziesii* are occasionally present. *Arctostaphylos uva-ursi, Cercocarpus ledifolius, Juniperus communis, Mahonia repens, Purshia tridentata, Ribes montigenum*, or *Vaccinium* spp. may form an open shrub layer in some stands. The herbaceous layer, if present, is generally sparse and composed of xeric graminoids, such as *Calamagrostis purpurascens, Festuca arizonica, Festuca idahoensis, Festuca thurberi*, or *Pseudoroegneria spicata*, or more alpine plants.

Comments: This system is distinguished from lower montane and foothill limber pine stands in Wyoming and Montana. This foothill system is found at the lower treeline, below the zone of continuous *Pinus ponderosa* or *Pseudotsuga menziesii* woodlands and forest, and extends out into the eastern portions of these states in the foothill zones of mountain ranges, along rock outcrops, breaks along rivers, and on sheltered sites where soil moisture is slightly higher than surrounding grasslands.

DISTRIBUTION

Range: Occurs throughout the Rocky Mountains on dry, rocky ridges and slopes near upper treeline including Uinta and Northern Wasatch Mountains, and Jarbridge Mountains in northeastern Nevada.
Ecological Divisions: 303, 304, 306
TNC Ecoregions: 20:C, 21:C, 26:C, 68:P, 6:C, 7:C, 8:C, 9:C
Subnations/Nations: AB:c, BC:c, CO:c, ID:c, MT:c, NM:c, NV:c, OR:c, UT:c, WA:c, WY:c

CONCEPT

Alliances and Associations:

- PINUS ALBICAULIS FOREST ALLIANCE (A.132)
  Pinus albicaulis / Vaccinium scoparium Forest (CEGL000131)
- PINUS ALBICAULIS WOODLAND ALLIANCE (A.531)
  Pinus albicaulis / Calamagrostis rubescens Woodland (CEGL000753)
  Pinus albicaulis / Juniperus communis Woodland (CEGL000756)
- PINUS ARISTATA WOODLAND ALLIANCE (A.537)
  Pinus aristata / Festuca arizonica Woodland (CEGL000759)
  Pinus aristata / Festuca thurberi Woodland (CEGL000760)
  Pinus aristata / Juniperus communis Woodland (CEGL002894)
  Pinus aristata / Ribes montigenum Woodland (CEGL000761)
  Pinus aristata / Trifolium dasyphyllum Woodland (CEGL000762)
  Pinus aristata / Vaccinium myrtillus Woodland (CEGL002895)
- PINUS FLEXILIS TEMPORARILY FLOODED WOODLAND ALLIANCE (A.564)
  Pinus flexilis / Dasiphora fruticosa ssp. floribunda / Distichlis spicata Woodland (CEGL000812)
- PINUS FLEXILIS WOODLAND ALLIANCE (A.540)
  Pinus flexilis / Arctostaphylos uva-ursi Woodland (CEGL000802)
  Pinus flexilis / Calamagrostis purpurascens Woodland (CEGL000803)
  Pinus flexilis / Cercocarpus ledifolius Woodland (CEGL000804)

Pinus flexilis / Festuca campestris Woodland (CEGL000806)
Pinus flexilis / Festuca idahoensis Woodland (CEGL000805)
Pinus flexilis / Juniperus communis Woodland (CEGL000807)
Pinus flexilis / Juniperus osteosperma Woodland (CEGL000808)
Pinus flexilis / Juniperus scopulorum Woodland (CEGL000809)
Pinus flexilis / Leucopoa kingii Woodland (CEGL000810)
Pinus flexilis / Mahonia repens Woodland (CEGL000811)
Pinus flexilis / Pseudoroegneria spicata Woodland (CEGL000813)

- PSEUDOTSUGA MENZIESII WOODLAND ALLIANCE (A.552)
  Pseudotsuga menziesii - Pinus flexilis / Leucopoa kingii Woodland (CEGL000906)

SOURCES

References: Baker 1992, Beasley and Klemmedson 1980, Brunstein and Yamaguchi 1992, Canadian Rockies Ecoregional Plan 2002, Knight 1994, Krebs 1972, LaMarche and Mooney 1972, Lanner and Vander Wall 1980, Neely et al. 2001, Ranne 1995, Ranne et al. 1997

Last updated: 20 Feb 2003 **Stakeholders:** WCS, CAN

Concept Author: NatureServe Western Ecology Team **LeadResp:** WCS

S026 INTER-MOUNTAIN BASINS SUBALPINE LIMBER-BRISTLECONE PINE WOODLAND

Division 304, Forest and Woodland, CES304.790

Spatial Scale & Pattern: Large Patch **Classification Confidence:** medium

Required Classifiers: Natural/Semi-natural, Vegetated (>10% vasc.), Upland

Diagnostic Classifiers: Montane [Upper Montane], Montane [Montane], Forest and Woodland (Treed), Ridge, Ridge/Summit/Upper Slope, Temperate [Temperate Continental], Xeric, Pinus longaeva, P. flexilis

Non-Diagnostic Classifiers: Calcareous

Concept Summary: This ecological system extends from the Mojave Desert and Sierra Nevada across thecentral Great Basin to the Central Wasatch and western Uinta mountains. These open woodlands are typically found on high-elevation ridges and rocky slopes above the subalpine forests and woodlands. Site are harsh, exposed to desiccating winds with rocky substrates and a short growing season that limit plant growth. Parent materials include dolomitic, limestone or granitic rocks. Occurrences can be found on all aspects but are more common on southwest exposures on steep convex slopes and ridges between 2530 and 3600 m (8300-12,000 feet). Stands are strongly dominated by *Pinus flexilis* and/or *Pinus longaeva*. *Pinus monophylla* may be present in lower elevation stands. If present, shrub and herbaceous layers are generally sparse and composed of xeric shrubs, graminoids and cushion plants. Associated species may include *Antennaria rosea, Arenaria kingii, Artemisia tridentata, Cercocarpus intricatus, Chamaebatiaria millefolium, Cymopterus cinerarius, Elymus elymoides, Erigeron pygmaeus, Eriogonum ovalifolium, Festuca brachyphylla, Koeleria macrantha, Leptodactylon pungens, Ribes cereum*, or *Ribes montigenum*.

DISTRIBUTION

Range: Extends from the Mojave Desert and Sierra Nevada across the Great Basin to the Central Wasatch and extreme western Uinta mountains.

Ecological Divisions: 304, 306?

TNC Ecoregions: 11:C, 12:C, 18:C, 19:C, 9:?

Subnations/Nations: CA:c, NV:c, UT:c

CONCEPT

Alliances and Associations:

- ABIES CONCOLOR FOREST ALLIANCE (A.152)
  Abies concolor var. concolor - Pinus ponderosa - Pinus longaeva Forest (CEGL002736)
- PINUS FLEXILIS WOODLAND ALLIANCE (A.540)
  Pinus flexilis / Cercocarpus ledifolius Woodland (CEGL000804)
  Pinus flexilis / Festuca idahoensis Woodland (CEGL000805)
  Pinus flexilis / Juniperus communis Woodland (CEGL000807)
  Pinus flexilis / Juniperus osteosperma Woodland (CEGL000808)
  Pinus flexilis / Mahonia repens Woodland (CEGL000811)
- PINUS LONGAEVA WOODLAND ALLIANCE (A.518)
  Pinus longaeva - Pinus flexilis Woodland [Placeholder] (CEGL003073)

- **California community types:**
- Littleleaf Mountain-Mahogany Scrub (76.300.00)
- Bristlecone Pine Woodland (87.140.00)
- Bristlecone Pine (87.140.01)
- Bristlecone Pine / Littleleaf Mountain-mahogany (87.140.02)

Environment: The bristlecone pine-limber pine woodland ecological system denotes some of the driest and windiest sites capable of supporting trees other than *Juniperus*. Sites are typically xeric on exposed, wind-swept rocky slopes and ridges. It can be found on all aspects but is more common on southwest exposures on steep convex slopes and ridges between 8300 and 10,200 feet. It commonly represents a topographic or edaphic climax within the *Abies lasiocarpa* and upper *Pseudotsuga menziesii* zones.

This system occurs on a variety of substrates but is best represented on colluvium derived from limestone and dolomite or Tertiary and Cretaceous sandstone. A characteristic feature is the predominance of bare soil; almost all sites have between 25 and 50% bare ground. Consequently, litter accumulations are slight and intermittent. Most sites are droughty with gravel in the shallow subsurface horizons. Surface textures vary depending upon parent material. Steep slopes, high-intensity summer convection storms, and only partial ground cover for interception often result in severe sheet erosion of fine particles. This usually leads to the development of gravel pavements. Additional erosion can be expected from wind action. High insolation and wind during the winter usually result in reduced snowpack accumulations. However, soils can be expected to freeze.

The sparsity of shrubs, forbs, grasses, and litter in addition to the widely spaced trees usually means that fire does not carry easily. Individual trees may be ignited from lightning, but seldom is an entire occurrence burned.

Dynamics: Natural regeneration of *Pinus flexilis* appears to be closely associated with caching of the large wingless seeds, primarily by Clark's nutcracker (*Nucifraga columbiana*) (Lanner and Vander Wall 1980). Germination of cached seeds often results in the multi-stemmed clumps characteristic of these sites, although the species may produce multiple stems from boles damaged near the ground. Germination and rooting will sometimes be restricted to crevices in rock. *Pinus longaeva* has smaller winged seeds and should be wind disseminated. However, caching by nutcrackers does take place, especially when other *Pinus* species are also available (Dr. Ronal Lanner, USU, pers. comm.). Fires seldom destroy this system due to the sparse nature of the canopy cover of trees and abundant bare ground.

SPATIAL CHARACTERISTICS

Adjacent Ecological Systems: Adjacent vegetation at high elevations includes alpine meadows and shrublands and subalpine forests dominated by *Picea, Abies*, or *Pseudotsuga*. Adjacent montane occurrences are dominated by *Pinus ponderosa, Pinus contorta*, or *Pseudotsuga menziesii*. At lower elevations adjacent vegetation may include *Juniperus*-dominated woodland and savannas; shrublands dominated by species of *Artemisia, Cercocarpus*, or *Purshia tridentata*.

SOURCES

References: Graybosch and Buchanan 1983, Holland and Keil 1995, Lanner and Vander Wall 1980, Nachlinger and Reese 1996

Last updated: 20 Feb 2003 **Stakeholders:** WCS

Concept Author: NatureServe Western Ecology Team **LeadResp:** WCS

S028 ROCKY MOUNTAIN SUBALPINE DRY-MESIC SPRUCE-FIR FOREST AND WOODLAND

Division 306, Forest and Woodland, CES306.828

Spatial Scale & Pattern: Matrix **Classification Confidence:** medium

Required Classifiers: Natural/Semi-natural, Vegetated (>10% vasc.), Upland

Diagnostic Classifiers: Montane [Upper Montane], Forest and Woodland (Treed), Acidic Soil, Ustic, Very Long Disturbance Interval [Seasonality/Summer Disturbance], F-Patch/High Intensity, F-Landscape/High Intensity, Needle-Leaved Tree, Abies lasiocarpa - Picea engelmannii, RM Subalpine Mesic Spruce-Fir, Long (>500 yrs) Persistence

Non-Diagnostic Classifiers: Montane [Montane], Ridge/Summit/Upper Slope, Sideslope, Temperate [Temperate Continental], Mesotrophic Soil, Shallow Soil, Mineral: W/ A-Horizon >10 cm, W-Patch/Medium Intensity, W-Landscape/Low Intensity

Concept Summary: Engelmann spruce and subalpine fir forests comprise a substantial part of the subalpine forests of the Cascades and Rocky Mountains from southern British Columbia east into Alberta, south into New Mexico and the Intermountain region. They are the matrix forests of the subalpine zone, with elevations ranging from 1525 to 3355 m (5000-11,000 feet). Sites within this system are cold year-round, and precipitation is predominantly in the form of snow, which may persist until late summer. Snowpacks are deep and late-lying, and summers are cool. Frost is possible almost all summer and may be common in restricted topographic basins and benches. Despite their wide distribution, the tree canopy characteristics are remarkably similar, with *Picea engelmannii* and *Abies lasiocarpa* dominating either mixed or alone. *Pinus contorta* is common in many occurrences and patches of pure *Pinus contorta* are not uncommon, as well as mixed conifer/*Populus tremuloides* stands. In some areas, such as Wyoming, *Picea engelmannii*-dominated forests are on limestone or dolomite, while nearby codominated spruce-fir forests are on granitic or volcanic rocks. Xeric species may include *Juniperus communis, Linnaea borealis, Mahonia repens*, or *Vaccinium scoparium*. Disturbance includes occasional blow-down, insect outbreaks and stand-replacing fire. In the Jarbridge Mountains of northeastern Nevada, *Pinus albicaulis* dominates or codominates stands with *Abies lasiocarpa*.

DISTRIBUTION

Range: Cascades and Rocky Mountains from southern British Columbia east into Alberta, south into New Mexico and the Intermountain region.
Ecological Divisions: 304, 306
TNC Ecoregions: 11:C, 20:C, 21:C, 4:C, 68:C, 7:C, 8:C, 9:C
Subnations/Nations: AB:c, AZ:c, BC:c, CO:c, ID:c, MT:c, NM:c, NV:c, OR:c, UT:c, WA:c, WY:c

CONCEPT

Alliances and Associations:

- ABIES LASIOCARPA FOREST ALLIANCE (A.168)
  Abies lasiocarpa - Picea engelmannii Tree Island Forest (CEGL000329)
  Abies lasiocarpa / Arnica cordifolia Forest (CEGL000298)
  Abies lasiocarpa / Arnica latifolia Forest (CEGL000299)
  Abies lasiocarpa / Calamagrostis rubescens Forest (CEGL000301)
  Abies lasiocarpa / Carex rossii Forest (CEGL000305)
  Abies lasiocarpa / Carex siccata Forest (CEGL000303)
  Abies lasiocarpa / Clintonia uniflora Forest (CEGL000307)
  Abies lasiocarpa / Galium triflorum Forest (CEGL000311)
  Abies lasiocarpa / Jamesia americana Forest (CEGL000312)
  Abies lasiocarpa / Lathyrus lanszwertii var. leucanthus Forest (CEGL000313)
  Abies lasiocarpa / Linnaea borealis Forest (CEGL000315)
  Abies lasiocarpa / Mahonia repens Forest (CEGL000318)
  Abies lasiocarpa / Menziesia ferruginea Forest (CEGL000319)
  Abies lasiocarpa / Osmorhiza berteroi Forest (CEGL000323)
  Abies lasiocarpa / Packera sanguisorboides Forest (CEGL000333)
  Abies lasiocarpa / Pedicularis racemosa Forest (CEGL000325)
  Abies lasiocarpa / Physocarpus malvaceus Forest (CEGL000326)
  Abies lasiocarpa / Ribes (montigenum, lacustre, inerme) Forest (CEGL000331)
  Abies lasiocarpa / Spiraea betulifolia Forest (CEGL000335)
  Abies lasiocarpa / Symphoricarpos albus Forest (CEGL000337)
  Abies lasiocarpa / Thalictrum occidentale Forest (CEGL000338)
  Abies lasiocarpa / Vaccinium caespitosum Forest (CEGL000340)
  Abies lasiocarpa / Vaccinium membranaceum Forest (CEGL000342)
  Abies lasiocarpa / Vaccinium membranaceum Rocky Mountain Forest (CEGL000341)
  Abies lasiocarpa / Vaccinium myrtillus Forest (CEGL000343)
  Abies lasiocarpa / Vaccinium scoparium Forest (CEGL000344)
  Abies lasiocarpa / Xerophyllum tenax Forest (CEGL000346)
- ABIES LASIOCARPA KRUMMHOLZ SHRUBLAND ALLIANCE (A.811)
  Abies lasiocarpa Krummholz Shrubland (CEGL000985)
- ABIES LASIOCARPA WOODLAND ALLIANCE (A.559)
  Abies lasiocarpa / Juniperus communis Woodland (CEGL000919)
  Abies lasiocarpa / Paxistima myrsinites Woodland (CEGL000324)

Abies lasiocarpa / Saxifraga bronchialis Scree Woodland (CEGL000924)
Abies lasiocarpa Scree Woodland (CEGL000925)

- PICEA ENGELMANNII FOREST ALLIANCE (A.164)
  Picea (engelmannii X glauca, engelmannii) / Clintonia uniflora Forest (CEGL000406)
  Picea (engelmannii X glauca, engelmannii) / Juniperus communis Forest (CEGL000410)
  Picea (engelmannii X glauca, engelmannii) / Vaccinium caespitosum Forest (CEGL000416)
  Picea engelmannii / Arnica cordifolia Forest (CEGL000355)
  Picea engelmannii / Clintonia uniflora Forest (CEGL000360)
  Picea engelmannii / Erigeron eximius Forest (CEGL000364)
  Picea engelmannii / Geum rossii Forest (CEGL000366)
  Picea engelmannii / Juniperus communis Forest (CEGL000369)
  Picea engelmannii / Leymus triticoides Forest (CEGL000362)
  Picea engelmannii / Linnaea borealis Forest (CEGL002689)
  Picea engelmannii / Polemonium pulcherrimum Forest (CEGL000373)
  Picea engelmannii / Ribes montigenum Forest (CEGL000374)
  Picea engelmannii / Trifolium dasyphyllum Forest (CEGL000377)
  Picea engelmannii / Vaccinium caespitosum Forest (CEGL000378)
  Picea engelmannii / Vaccinium myrtillus Forest (CEGL000379)
  Picea engelmannii / Vaccinium scoparium Forest (CEGL000381)
- PICEA ENGELMANNII SEASONALLY FLOODED FOREST ALLIANCE (A.191)
  Picea (engelmannii X glauca, engelmannii) / Packera streptanthifolia Forest (CEGL000414)
- PICEA ENGELMANNII TEMPORARILY FLOODED FOREST ALLIANCE (A.179)
  Picea (engelmannii X glauca, engelmannii) / Galium triflorum Forest (CEGL000409)
  Picea engelmannii / Galium triflorum Forest (CEGL000365)

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 occurrences of this system 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.

SOURCES

References: Alexander and Ronco 1987, Alexander et al. 1984a, Alexander et al. 1987, Anderson 1999, Brand et al. 1976, Canadian Rockies Ecoregional Plan 2002, Clagg 1975, Comer et al. 2002, Cooper et al. 1987, Daubenmire and Daubenmire 1968, DeVelice et al. 1986, Fitzgerald et al. 1994, Fitzhugh et al. 1987, Graybosch and Buchanan 1983, Hess and Alexander 1986, Hess and Wasser 1982, Hoffman and Alexander 1976, Hoffman and Alexander 1980, Hoffman and Alexander 1983, Komarkova et al. 1988b, Major et al. 1981, Mauk and Henderson 1984, Mehl 1992, Meidinger and Pojar 1991, Muldavin et al. 1992, Nachlinger et al. 2001, Neely et al. 2001, Peet 1978a, Peet 1981, Pfister 1972, Pfister et al. 1977, Romme 1982, Schaupp et al. 1999, Steele and Geier-Hayes 1995, Steele et al. 1981, Tuhy et al. 2002, Veblen 1986, Whipple and Dix 1979, Youngblood and Mauk 1985

Last updated: 20 Feb 2003 **Stakeholders:** WCS, MCS, CAN

Concept Author: NatureServe Western Ecology Team **LeadResp:** WCS

S029 NORTHERN PACIFIC MESIC SUBALPINE WOODLAND

Division 206, Forest and Woodland, CES206.911

Spatial Scale & Pattern: Large Patch **Classification Confidence:** medium

Required Classifiers: Natural/Semi-natural, Vegetated (>10% vasc.), Upland

Diagnostic Classifiers: Montane [Upper Montane], Temperate [Temperate Oceanic], Udic

Non-Diagnostic Classifiers: Forest and Woodland (Treed), Sideslope

Concept Summary: This system occurs on ridges and rocky slopes around timberline at 2600 m (7900 feet) in the central Sierra Nevada and 2450 m (8000 feet) in the southern Cascades. These woodlands are found on concave or mesic slopes in areas with long-lasting snowpack and better soil development than other drier and more exposed subalpine woodlands. Characteristic species include *Tsuga mertensiana, Abies magnifica, Abies procera, Pinus albicaulis, Juniperus communis*, and *Penstemon davidsonii*, as well as patches of grasses, sedges, and forbs grading into adjacent meadows.

DISTRIBUTION

Range: Occurs on ridges and rocky slopes around timberline at 2600 m (7900 feet) in the central Sierra Nevada and 2450 m (8000 feet) in the southern Cascades.
Ecological Divisions: 204, 206
TNC Ecoregions: 12:C, 4:C, 5:P, 81:P
Subnations/Nations: CA:c, NV:c

CONCEPT

- **California community types:**
- Coastal and Montane Hemlock Forests (84.000.00)
- Mountain Hemlock Forest (84.100.00)
- Mountain Hemlock / Cascade Heather (84.100.01)
- Mountain Hemlock / Parry Rush (84.100.02)
- Mountain Hemlock / Sadler Oak (84.100.03)
- Mountain Hemlock (84.100.04)
- Mountain Hemlock / Dwarf Bilberry (84.100.06)
- Mountain Hemlock / Huckleberry Oak (84.100.07)
- Mountain Hemlock / White-veined Shinleaf (84.100.08)
- Mountain Hemlock / Heartleaf Arnica (84.100.09)
- Mountain Hemlock-Western White Pine / Broad-seeded Rock Cress (84.100.10)
- Mountain Hemlock - Lodgepole Pine Forest (84.110.00)
- Mountain Hemlock - Lodgepole Pine -Western White Pine (84.110.01)
- Mountain Hemlock - Lodgepole Pine / Mountain Heather (84.110.02)
- Mountain Hemlock - Lodgepole Pine / Ross Sedge (84.110.03)
- Mountain Hemlock - Lodgepole Pine - Whitebark Pine (84.110.04)

SOURCES

References: Barbour and Billings 2000, Barbour and Major 1988, Holland and Keil 1995, Potter 1994, Sawyer and Keeler-Wolf 1995
Last updated: 17 Mar 2003 **Stakeholders:** WCS
Concept Author: P. Comer, T. Keeler-Wolf **LeadResp:** WCS

S030 ROCKY MOUNTAIN SUBALPINE MESIC SPRUCE-FIR FOREST AND WOODLAND

Division 306, Forest and Woodland, CES306.830

Spatial Scale & Pattern: Large Patch **Classification Confidence:** medium
Required Classifiers: Natural/Semi-natural, Vegetated (>10% vasc.), Upland
Diagnostic Classifiers: Montane [Upper Montane], Forest and Woodland (Treed), Acidic Soil, Udic, Very Long Disturbance Interval [Seasonality/Summer Disturbance], F-Patch/High Intensity, F-Landscape/Medium Intensity, Abies lasiocarpa - Picea engelmannii, RM Subalpine Dry-Mesic Spruce-Fir, Long (>500 yrs) Persistence

Non-Diagnostic Classifiers: Montane [Montane], Sideslope, Toeslope/Valley Bottom, Temperate [Temperate Continental], Mesotrophic Soil, Shallow Soil, Mineral: W/ A-Horizon >10 cm

Concept Summary: This is a high-elevation system of the Rocky Mountains, dominated by *Picea engelmannii* and *Abies lasiocarpa*. Occurrences are typically found in locations with cold-air drainage or ponding, or where snowpacks linger late into the summer, such as north-facing slopes and high-elevation ravines. They can extend down in elevation below the subalpine zone in places where cold-air ponding occurs; northerly and easterly aspects predominate. These forests are found on gentle to very steep mountain slopes, high-elevation ridgetops and upper slopes, plateaulike surfaces, basins, alluvial terraces, well-drained benches, and inactive stream terraces. Mesic understory shrubs include *Rhododendron albiflorum, Amelanchier alnifolia, Rubus parviflorus, Ledum glandulosum, Phyllodoce empetriformis*, and *Salix* spp. Herbaceous species include *Actaea rubra, Maianthemum stellatum, Cornus canadensis, Erigeron eximius, Saxifraga bronchialis, Luzula glabrata var. hitchcockii*, or *Calamagrostis canadensis*. Disturbances include occasional blow-down, insect outbreaks and stand-replacing fire.

DISTRIBUTION

Range: High elevations of the Rocky Mountains.
Ecological Divisions: 204, 304, 306
TNC Ecoregions: 11:C, 20:C, 21:C, 4:C, 68:C, 7:C, 8:C, 9:C
Subnations/Nations: AB:c, AZ:c, BC:c, CO:c, ID:c, MT:c, NM:c, NV:c, OR:c, UT:c, WA:c, WY:c

CONCEPT

Alliances and Associations:

- ABIES LASIOCARPA - POPULUS TREMULOIDES FOREST ALLIANCE (A.422)
  Populus tremuloides - Abies lasiocarpa / Amelanchier alnifolia Forest (CEGL000524)
  Populus tremuloides - Abies lasiocarpa / Carex geyeri Forest (CEGL000525)
  Populus tremuloides - Abies lasiocarpa / Juniperus communis Forest (CEGL000527)
- ABIES LASIOCARPA FOREST ALLIANCE (A.168)
  Abies lasiocarpa - Picea engelmannii Ribbon Forest (CEGL000328)
  Abies lasiocarpa / Acer glabrum Forest (CEGL000294)
  Abies lasiocarpa / Actaea rubra Forest (CEGL000295)
  Abies lasiocarpa / Carex geyeri Forest (CEGL000304)
  Abies lasiocarpa / Clematis columbiana var. columbiana Forest (CEGL000306)
  Abies lasiocarpa / Coptis occidentalis Forest (CEGL000308)
  Abies lasiocarpa / Cornus canadensis Forest (CEGL000309)
  Abies lasiocarpa / Erigeron eximius Forest (CEGL000310)
  Abies lasiocarpa / Gymnocarpium dryopteris Forest (CEGL002611)
  Abies lasiocarpa / Luzula glabrata var. hitchcockii Forest (CEGL000317)
  Abies lasiocarpa / Moss Forest (CEGL000321)
  Abies lasiocarpa / Rubus parviflorus Forest (CEGL000332)
  Abies lasiocarpa / Vaccinium membranaceum / Valeriana sitchensis Forest (CEGL002612)
  Abies lasiocarpa / Vaccinium membranaceum Forest (CEGL000342)
  Abies lasiocarpa / Vaccinium membranaceum Rocky Mountain Forest (CEGL000341)
- ABIES LASIOCARPA KRUMMHOLZ SHRUBLAND ALLIANCE (A.811)
  Abies lasiocarpa / Salix brachycarpa Shrubland (CEGL000986)
  Abies lasiocarpa / Salix glauca Shrubland (CEGL000987)
- ABIES LASIOCARPA SEASONALLY FLOODED FOREST ALLIANCE (A.190)
  Abies lasiocarpa / Calamagrostis canadensis Forest (CEGL000300)
  Abies lasiocarpa / Caltha leptosepala ssp. howellii Forest (CEGL000302)
  Abies lasiocarpa / Ledum glandulosum Forest (CEGL000314)
- ABIES LASIOCARPA WOODLAND ALLIANCE (A.559)
  Abies lasiocarpa / Phyllodoce empetriformis Woodland (CEGL000920)
  Abies lasiocarpa / Rhododendron albiflorum Woodland (CEGL000330)
- PICEA ENGELMANNII FOREST ALLIANCE (A.164)
  Picea engelmannii / Acer glabrum Forest (CEGL000354)
  Picea engelmannii / Hypnum revolutum Forest (CEGL000368)
  Picea engelmannii / Maianthemum stellatum Forest (CEGL000415)
  Picea engelmannii / Moss Forest (CEGL000371)
  Picea engelmannii / Packera cardamine Forest (CEGL000375)
  Picea engelmannii / Physocarpus malvaceus Forest (CEGL002676)

SOURCES

References: Alexander and Ronco 1987, Alexander et al. 1984a, Alexander et al. 1987, Anderson 1999, Brand et al. 1976, Canadian Rockies Ecoregional Plan 2002, Clagg 1975, Comer et al. 2002, Cooper et al. 1987, Daubenmire and Daubenmire 1968, DeVelice et al. 1986, Fitzgerald et al. 1994, Graybosch and Buchanan 1983, Hess and Alexander 1986, Hess and Wasser 1982, Hoffman and Alexander 1976, Hoffman and Alexander 1980, Hoffman and Alexander 1983, Komarkova et al. 1988b, Major et al. 1981, Mauk and Henderson 1984, Mehl 1992, Meidinger and Pojar 1991, Muldavin et al. 1996, Neely et al. 2001, Peet 1978a, Peet 1981, Pfister 1972, Pfister et al. 1977, Romme 1982, Schaupp et al. 1999, Steele and Geier-Hayes 1995, Steele et al. 1981, Tuhy et al. 2002, Veblen 1986, Whipple and Dix 1979, Youngblood and Mauk 1985

Last updated: 20 Feb 2003 **Stakeholders:** WCS

Concept Author: NatureServe Western Ecology Team **LeadResp:** WCS

S031 ROCKY MOUNTAIN LODGEPOLE PINE FOREST

Division 306, Forest and Woodland, CES306.820

Spatial Scale & Pattern: Matrix **Classification Confidence:** medium

Required Classifiers: Natural/Semi-natural, Vegetated (>10% vasc.), Upland

Diagnostic Classifiers: Acidic Soil, Very Shallow Soil, Mineral: W/ A-Horizon <10 cm, Ustic, Long Disturbance Interval, F-Patch/High Intensity [Seasonality/Fall Fire], F-Landscape/High Intensity, Needle-Leaved Tree, Pinus contorta, Moderate (100-500 yrs) Persistence

Non-Diagnostic Classifiers: Montane [Upper Montane], Montane [Montane], Forest and Woodland (Treed), Sideslope, Toeslope/Valley Bottom, Temperate [Temperate Continental]

Concept Summary: This system is widespread in upper montane to subalpine elevations of the Rocky Mountains, Intermountain region, and north into the Canadian Rockies. These are subalpine forests where the dominance of *Pinus contorta* is related to fire history and topo-edaphic conditions. Following stand-replacing fires, *Pinus contorta* will rapidly colonize and develop into dense, even-aged stands. Most forests in this ecological system are early to mid-successional forests which developed following fires. Some *Pinus contorta* forests will persist on sites that are too extreme for other conifers to establish. These include excessively well-drained pumice deposits, glacial till and alluvium on valley floors where there is cold air accumulation, warm and droughty shallow soils over fractured quartzite bedrock, and shallow moisture-deficient soils with a significant component of volcanic ash. Soils supporting these forests are typically well-drained, gravelly, have coarse textures, are acidic, and rarely formed from calcareous parent materials. These forests are dominated by *Pinus contorta* with shrub, grass, or barren understories. Sometimes there are intermingled mixed conifer/*Populus tremuloides* stands with the latter occurring with inclusions of deeper, typically fine-textured soils. The shrub stratum may be conspicuous to absent; common species include *Arctostaphylos uva-ursi, Ceanothus velutinus, Linnaea borealis, Mahonia repens, Purshia tridentata, Spiraea betulifolia, Spiraea douglasii, Shepherdia canadensis, Vaccinium caespitosum, Vaccinium scoparium, Vaccinium membranaceum, Symphoricarpos albus,* and *Ribes* spp.

DISTRIBUTION

Range: Upper montane to subalpine elevations of the Rocky Mountains, Intermountain region, and north into the Canadian Rockies.
Ecological Divisions: 304, 306
TNC Ecoregions: 11:C, 18:C, 20:C, 68:C, 7:C, 8:C, 9:C
Subnations/Nations: AB:c, BC:c, CO:c, ID:c, MT:c, NV:c, OR:c, UT:c, WA:c, WY:c

CONCEPT

Alliances and Associations:

- CEANOTHUS VELUTINUS SHRUBLAND ALLIANCE (A.787)
  Ceanothus velutinus Shrubland (CEGL002167)
- PINUS CONTORTA FOREST ALLIANCE (A.118)
  Pinus contorta / Arctostaphylos uva-ursi Forest (CEGL000134)
  Pinus contorta / Arnica cordifolia Forest (CEGL000135)
  Pinus contorta / Calamagrostis rubescens Forest (CEGL000139)
  Pinus contorta / Carex geyeri Forest (CEGL000141)
  Pinus contorta / Carex pensylvanica Forest (CEGL000143)
  Pinus contorta / Carex rossii Forest (CEGL000144)
  Pinus contorta / Ceanothus velutinus Forest (CEGL000145)
  Pinus contorta / Danthonia californica Forest (CEGL000146)
  Pinus contorta / Linnaea borealis Forest (CEGL000153)
  Pinus contorta / Mahonia repens Forest (CEGL000154)
  Pinus contorta / Osmorhiza berteroi Forest (CEGL000155)
  Pinus contorta / Pedicularis racemosa Forest (CEGL000156)
  Pinus contorta / Purshia tridentata / Carex pensylvanica Forest (CEGL000159)
  Pinus contorta / Shepherdia canadensis Forest (CEGL000163)
  Pinus contorta / Spiraea betulifolia Forest (CEGL000164)
  Pinus contorta / Spiraea douglasii Forest (CEGL002604)
  Pinus contorta / Symphoricarpos albus Forest (CEGL000166)
  Pinus contorta / Thalictrum occidentale Forest (CEGL000167)
  Pinus contorta / Vaccinium caespitosum Forest (CEGL000168)
  Pinus contorta / Vaccinium membranaceum Forest (CEGL000170)
  Pinus contorta / Vaccinium membranaceum Rocky Mountain Forest (CEGL000169)
  Pinus contorta / Vaccinium scoparium / Calamagrostis rubescens Forest (CEGL000174)
  Pinus contorta / Vaccinium scoparium Forest (CEGL000172)
  Pinus contorta / Xerophyllum tenax Forest (CEGL000175)
  Pinus contorta var. latifolia / Vaccinium scoparium / Carex inops ssp. inops Forest (CEGL000173)
- PINUS CONTORTA WOODLAND ALLIANCE (A.512)
  Pinus contorta / Achnatherum occidentale Woodland (CEGL000165)
  Pinus contorta / Artemisia tridentata / Elymus elymoides Woodland (CEGL000137)
  Pinus contorta / Artemisia tridentata / Festuca idahoensis Woodland (CEGL000136)
  Pinus contorta / Festuca idahoensis Woodland (CEGL000149)

Pinus contorta / Juniperus communis Woodland (CEGL000764)
Pinus contorta / Purshia tridentata - Ribes cereum Woodland (CEGL000161)
Pinus contorta / Purshia tridentata Woodland (CEGL000765)
Pinus contorta var. latifolia / Purshia tridentata / Achnatherum occidentale ssp. occidentale Woodland (CEGL000162)
Pinus contorta var. latifolia / Purshia tridentata / Festuca idahoensis Woodland (CEGL000160)

Dynamics: *Pinus contorta* is an aggressively colonizing, shade-intolerant conifer which usually occurs in lower subalpine forests in the major ranges of the western United States. Establishment is episodic and linked to stand-replacing disturbances, primarily fire. The incidence of serotinous cones varies within and between varieties of *Pinus contorta*, being most prevalent in Rocky Mountain populations. Closed, serotinous cones appear to be strongly favored by fire, and allow rapid colonization of fire-cleared substrates (Burns and Honkala 1990a). Hoffman and Alexander (1980, 1983) report that in stands where *Pinus contorta* exhibits a multi-aged population structure, with regeneration occurring, there is typically a higher proportion of trees bearing nonserotinous cones.

SOURCES

References: Alexander 1986, Alexander et al. 1987, Anderson 1999, Arno et al. 1985, Barrows et al. 1977, Burns and Honkala 1990a, Canadian Rockies Ecoregional Plan 2002, Despain 1973a, Despain 1973b, Hess and Alexander 1986, Hess and Wasser 1982, Hoffman and Alexander 1976, Hoffman and Alexander 1980, Hoffman and Alexander 1983, Johnson and Clausnitzer 1992, Johnston 1997, Kingery 1998, Mauk and Henderson 1984, Mehl 1992, Meidinger and Pojar 1991, Moir 1969a, Nachlinger et al. 2001, Neely et al. 2001, Pfister et al. 1977, Steele et al. 1981, Whipple 1975, Williams and Smith 1990

Last updated: 20 Feb 2003 **Stakeholders:** WCS, MCS, CAN
Concept Author: NatureServe Western Ecology Team **LeadResp:** WCS

S032 ROCKY MOUNTAIN MONTANE DRY-MESIC MIXED CONIFER FOREST AND WOODLAND

Division 306, Forest and Woodland, CES306.823

Spatial Scale & Pattern: Matrix **Classification Confidence:** medium
Required Classifiers: Natural/Semi-natural, Vegetated (>10% vasc.), Upland
Diagnostic Classifiers: Montane [Montane], Montane [Lower Montane], Forest and Woodland (Treed), Aridic, Intermediate Disturbance Interval, F-Patch/Medium Intensity, F-Landscape/Medium Intensity, Needle-Leaved Tree, RM Montane Mesic Mixed Conifer, Moderate (100-500 yrs) Persistence

Non-Diagnostic Classifiers: Ridge/Summit/Upper Slope, Sideslope, Temperate [Temperate Continental], Mesotrophic Soil, Shallow Soil, Mineral: W/ A-Horizon <10 cm

Concept Summary: This is a highly variable ecological system of the montane zone of the Rocky Mountains. It occurs throughout the southern Rockies, north and west into Utah, Nevada, western Wyoming and Idaho. These are mixed-conifer forests occurring on all aspects at elevations ranging from 1200 to 3300 m. Rainfall averages less than 75 cm per year (40-60 cm) with summer "monsoons" during the growing season contributing substantial moisture. The composition and structure of overstory is dependent upon the temperature and moisture relationships of the site, and the successional status of the occurrence. *Pseudotsuga menziesii* and *Abies concolor* are most frequent, but *Pinus ponderosa* may be present to codominant. *Pinus flexilis* is common in Nevada. *Pseudotsuga menziesii* forests occupy drier sites, and *Pinus ponderosa* is a common codominant. *Abies concolor*-dominated forests occupy cooler sites, such as upper slopes at higher elevations, canyon sideslopes, ridgetops, and north- and east-facing slopes which burn somewhat infrequently. *Picea pungens* is most often found in cool, moist locations, often occurring as smaller patches within a matrix of other associations. As many as seven conifers can be found growing in the same occurrence, and there are a number of cold-deciduous shrub and graminoid species common, including *Arctostaphylos uva-ursi*, *Mahonia repens*, *Paxistima myrsinites*, *Symphoricarpos oreophilus*, *Jamesia americana*, *Quercus gambelii*, and *Festuca arizonica*. This system was undoubtedly characterized by a mixed severity fire regime in its "natural condition," characterized by a high degree of variability in lethality and return interval.

DISTRIBUTION

Range: Occurs throughout the southern Rockies, north and west into Utah, Nevada, western Wyoming and Idaho.
Ecological Divisions: 304, 306
TNC Ecoregions: 11:C, 18:C, 19:C, 20:C, 21:C, 26:C, 6:C, 68:C, 7:C, 8:C, 9:C
Subnations/Nations: AB:p, AZ:c, BC:p, CO:c, ID:c, MT:c, NV:c, OR:c, UT:c, WA:c, WY:c

CONCEPT

Alliances and Associations:

- ABIES CONCOLOR FOREST ALLIANCE (A.152)
  Abies concolor - Pinus ponderosa / Carex inops ssp. inops Forest (CEGL000257)
  Abies concolor - Pinus ponderosa / Cercocarpus ledifolius Forest (CEGL002732)
  Abies concolor - Pinus ponderosa / Symphoricarpos spp. Forest (CEGL000018)
  Abies concolor - Pseudotsuga menziesii / Acer glabrum Forest (CEGL000240)
  Abies concolor - Pseudotsuga menziesii / Erigeron eximius Forest (CEGL000247)
  Abies concolor - Pseudotsuga menziesii / Lathyrus lanszwertii var. leucanthus Forest (CEGL000250)
  Abies concolor - Pseudotsuga menziesii / Vaccinium myrtillus Forest (CEGL000265)
  Abies concolor / Arctostaphylos patula Forest (CEGL000242)
  Abies concolor / Arctostaphylos uva-ursi Forest (CEGL000243)
  Abies concolor / Carex siccata Forest (CEGL000244)
  Abies concolor / Juniperus communis Forest (CEGL000249)
  Abies concolor / Mahonia repens Forest (CEGL000251)
  Abies concolor / Muhlenbergia virescens Forest (CEGL000252)
  Abies concolor / Osmorhiza berteroi Forest (CEGL000253)
  Abies concolor / Physocarpus malvaceus Forest (CEGL000254)
  Abies concolor / Quercus gambelii Forest (CEGL000261)
  Abies concolor / Symphoricarpos oreophilus Forest (CEGL000263)
- ABIES CONCOLOR WOODLAND ALLIANCE (A.553)
  Abies concolor / Cercocarpus ledifolius Woodland (CEGL000885)
  Abies concolor / Festuca arizonica Woodland (CEGL000887)
  Abies concolor / Galium triflorum Woodland (CEGL000888)
  Abies concolor / Leymus triticoides Woodland (CEGL000886)
  Abies concolor / Robinia neomexicana Woodland (CEGL000891)
- PICEA PUNGENS FOREST ALLIANCE (A.165)
  Picea pungens / Arctostaphylos uva-ursi Forest (CEGL000385)
- PICEA PUNGENS WOODLAND ALLIANCE (A.557)
  Picea pungens / Festuca arizonica Woodland (CEGL000895)
- PINUS PONDEROSA - PSEUDOTSUGA MENZIESII FOREST ALLIANCE (A.134)
  Pinus ponderosa - Pseudotsuga menziesii / Carex geyeri Forest (CEGL000211)
  Pinus ponderosa - Pseudotsuga menziesii / Physocarpus malvaceus Forest (CEGL000213)
- PINUS PONDEROSA - PSEUDOTSUGA MENZIESII WOODLAND ALLIANCE (A.533)
  Pinus ponderosa - Pseudotsuga menziesii / Arctostaphylos nevadensis Woodland (CEGL000208)
  Pinus ponderosa - Pseudotsuga menziesii / Arctostaphylos patula Woodland (CEGL000209)
  Pinus ponderosa - Pseudotsuga menziesii / Calamagrostis rubescens Woodland (CEGL000210)
  Pinus ponderosa - Pseudotsuga menziesii / Penstemon fruticosus Woodland (CEGL000212)
  Pinus ponderosa - Pseudotsuga menziesii / Pseudoroegneria spicata ssp. inermis Woodland (CEGL000207)
  Pinus ponderosa - Pseudotsuga menziesii / Purshia tridentata Woodland (CEGL000214)
- PSEUDOTSUGA MENZIESII FOREST ALLIANCE (A.157)
  Pseudotsuga menziesii / Amelanchier alnifolia Forest (CEGL000420)
  Pseudotsuga menziesii / Arctostaphylos patula Forest (CEGL000423)
  Pseudotsuga menziesii / Arctostaphylos uva-ursi - Purshia tridentata Forest (CEGL000426)
  Pseudotsuga menziesii / Arctostaphylos uva-ursi Forest (CEGL000424)
  Pseudotsuga menziesii / Arnica cordifolia Forest (CEGL000427)
  Pseudotsuga menziesii / Bromus ciliatus Forest (CEGL000428)
  Pseudotsuga menziesii / Calamagrostis rubescens Forest (CEGL000429)
  Pseudotsuga menziesii / Carex geyeri Forest (CEGL000430)
  Pseudotsuga menziesii / Carex rossii Forest (CEGL000431)
  Pseudotsuga menziesii / Festuca arizonica Forest (CEGL000433)
  Pseudotsuga menziesii / Jamesia americana Forest (CEGL000438)
  Pseudotsuga menziesii / Juniperus communis Forest (CEGL000439)
  Pseudotsuga menziesii / Juniperus osteosperma Forest (CEGL000440)
  Pseudotsuga menziesii / Linnaea borealis Forest (CEGL000441)
  Pseudotsuga menziesii / Mahonia repens Forest (CEGL000442)
  Pseudotsuga menziesii / Muhlenbergia montana Forest (CEGL000443)
  Pseudotsuga menziesii / Muhlenbergia virescens Forest (CEGL000444)
  Pseudotsuga menziesii / Osmorhiza berteroi Forest (CEGL000445)
  Pseudotsuga menziesii / Paxistima myrsinites Forest (CEGL000446)
  Pseudotsuga menziesii / Physocarpus malvaceus - Linnaea borealis Forest (CEGL000448)
  Pseudotsuga menziesii / Physocarpus malvaceus Forest (CEGL000447)

Pseudotsuga menziesii / Physocarpus monogynus Forest (CEGL000449)
Pseudotsuga menziesii / Quercus arizonica Forest (CEGL000451)
Pseudotsuga menziesii / Quercus gambelii Forest (CEGL000452)
Pseudotsuga menziesii / Quercus hypoleucoides Forest (CEGL000453)
Pseudotsuga menziesii / Quercus rugosa Forest (CEGL000454)
Pseudotsuga menziesii / Quercus X pauciloba Forest (CEGL000455)
Pseudotsuga menziesii / Spiraea betulifolia Forest (CEGL000457)
Pseudotsuga menziesii / Symphoricarpos albus Forest (CEGL000459)
Pseudotsuga menziesii / Symphoricarpos occidentalis Forest (CEGL000461)
Pseudotsuga menziesii / Symphoricarpos oreophilus Forest (CEGL000462)
Pseudotsuga menziesii / Vaccinium caespitosum Forest (CEGL000465)
Pseudotsuga menziesii / Vaccinium spp. Forest (CEGL000464)

- PSEUDOTSUGA MENZIESII WOODLAND ALLIANCE (A.552)

Pseudotsuga menziesii - Pinus flexilis / Leucopoa kingii Woodland (CEGL000906)
Pseudotsuga menziesii / Cercocarpus ledifolius Woodland (CEGL000897)
Pseudotsuga menziesii / Cercocarpus montanus Woodland (CEGL000898)
Pseudotsuga menziesii / Festuca campestris Woodland (CEGL000901)
Pseudotsuga menziesii / Festuca idahoensis Woodland (CEGL000900)
Pseudotsuga menziesii / Holodiscus dumosus Scree Woodland (CEGL000902)
Pseudotsuga menziesii / Juniperus scopulorum Woodland (CEGL000903)
Pseudotsuga menziesii / Leucopoa kingii Woodland (CEGL000904)
Pseudotsuga menziesii / Pseudoroegneria spicata Woodland (CEGL000908)
Pseudotsuga menziesii / Purshia tridentata Woodland (CEGL000909)

Vegetation: This highly variable ecological system is comprised of mixed conifer forests at montane elevations throughout the Intermountain region. The four main alliances in this system are found on slightly different, but intermingled, biophysical environments: *Abies concolor* dominates at higher, colder locations; *Picea pungens* represents mesic conditions; *Pseudotsuga menziesii* dominates intermediate zones. As many as seven conifers can be found growing in the same occurrences, with the successful reproduction of the diagnostic species determining the association type. Common conifers include *Pinus ponderosa, Pinus flexilis, Abies lasiocarpa var. lasiocarpa, Abies lasiocarpa var. arizonica, Juniperus scopulorum*, and *Picea engelmannii*. *Populus tremuloides* is often present as intermingled individuals in remnant aspen clones, or in adjacent patches. The composition and structure of overstory is dependent upon the temperature and moisture relationships of the site, and the successional status of the occurrence (DeVelice et al. 1986, Muldavin et al. 1996).

A number of cold-deciduous shrub and graminoid species are found in many occurrences (e.g., *Arctostaphylos uva-ursi, Mahonia repens, Paxistima myrsinites, Symphoricarpos oreophilus, Jamesia americana, Quercus gambelii*, and *Festuca arizonica*). Other important species include *Acer glabrum, Acer grandidentatum, Amelanchier alnifolia, Arctostaphylos patula, Holodiscus dumosus, Jamesia americana, Juniperus communis, Physocarpus monogynus, Quercus arizonica, Quercus rugosa, Quercus X pauciloba, Quercus hypoleucoides, Robinia neomexicana, Rubus parviflorus*, and *Vaccinium myrtillus*. Where soil moisture is favorable, the herbaceous layer may be quite diverse, including graminoids *Bromus ciliatus (= Bromus canadensis), Calamagrostis rubescens, Carex geyeri, Carex rossii, Carex siccata (= Carex foenea), Festuca occidentalis, Koeleria macrantha, Muhlenbergia montana, Muhlenbergia virescens, Poa fendleriana, Pseudoroegneria spicata*, and forbs *Achillea millefolium, Arnica cordifolia, Erigeron eximius, Fragaria virginiana, Linnaea borealis, Luzula parviflora, Osmorhiza berteroi, Packera cardamine (= Senecio cardamine), Thalictrum occidentale, Thalictrum fendleri, Thermopsis rhombifolia, Viola adunca*, and species of many other genera, including *Lathyrus, Penstemon, Lupinus, Vicia, Arenaria, Galium*, and others.

Dynamics: Forests in this ecological system represent the gamut of fire tolerance. Formerly, *Abies concolor* in the Utah High Plateaus were restricted to rather moist or less fire-prone areas by frequent ground fires. These areas experienced mixed fire severities, with patches of crowning in which all trees are killed, intermingled with patches of underburn in which larger *Abies concolor* survived (www.fs.fed.us/database/feis/). With fire suppression, *Abies concolor* has vigorously colonized many sites 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 on drier sites now codominated by *Pinus ponderosa* and *Abies concolor* has increased. Increased landscape connectivity, in terms of fuel loadings and crown closure, has also increased the potential size of crown fires.

Pseudotsuga menziesii forests are the only true ‘fire-tolerant' occurrences in this ecological system. *Pseudotsuga menziesii* forests were probably subject to a moderate-severity fire regime in presettlement 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*) (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 occurrences for 200 years (Steele et al. 1981) and germinate abundantly after fire, competitively suppressing conifer seedlings. Successional relationships in this system are complex. *Pseudotsuga menziesii* is less shade-tolerant than many northern or montane trees such as *Tsuga heterophylla*, *Abies concolor*, *Picea engelmannii*, 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 occurrences are second-growth forests dating from fire, logging, or other occurrence-replacing disturbances (Mauk and Henderson 1984, Chappell et al. 1997).

Picea pungens is a slow-growing, long-lived tree which regenerates from seed (Burns and Honkala 1990a). Seedlings are shallow-rooted and require perennially moist soils for establishment and optimal growth. *Picea pungens* is intermediate in shade tolerance, being somewhat more tolerant than *Pinus ponderosa* or *Pseudotsuga menziesii*, and less tolerant than *Abies lasiocarpa* or *Picea engelmannii*. It forms late-seral occurrences in the subhumid regions of the Utah High Plateaus. It is common for these forests to be heavily disturbed by grazing or fire.

In general, fire suppression has lead to the encroachment of more shade-tolerant, less fire-tolerant species (e.g., climax) into occurrences and an attendant increase in landscape homogeneity and connectivity (from a fuels perspective). This has increased the lethality and potential size of fires.

SOURCES

References: Alexander et al. 1984b, Alexander et al. 1987, Boyce 1977, Bunin 1975c, Burns and Honkala 1990a, Canadian Rockies Ecoregional Plan 2002, Chappell et al. 1997, Comer et al. 2002, Cooper et al. 1987, DeVelice et al. 1986, Fitzhugh et al. 1987, Giese 1975, Heinze et al. 1962, Hess 1981, Hess and Alexander 1986, Hess and Wasser 1982, Hoffman and Alexander 1980, Hoffman and Alexander 1983, Komarkova et al. 1988b, Mauk and Henderson 1984, Muldavin et al. 1996, Nachlinger et al. 2001, Neely et al. 2001, Pfister 1972, Pfister et al. 1977, Steele et al. 1981, Tuhy et al. 2002, Youngblood and Mauk 1985

Last updated: 20 Feb 2003 **Stakeholders:** WCS, MCS

Concept Author: NatureServe Western Ecology Team **LeadResp:** WCS

S033 MEDITERRANEAN CALIFORNIA DRY-MESIC MIXED CONIFER FOREST AND WOODLAND

Division 206, Forest and Woodland, CES206.916

Spatial Scale & Pattern: Matrix **Classification Confidence:** medium

Required Classifiers: Natural/Semi-natural, Vegetated (>10% vasc.), Upland

Diagnostic Classifiers: Montane [Lower Montane], Forest and Woodland (Treed), Mediterranean [Mediterranean Xeric-Oceanic], Ustic, Needle-Leaved Tree

Non-Diagnostic Classifiers: F-Patch/Low Intensity

Concept Summary: These mixed-conifer forests occur on all aspects in lower montane zones (600-1800 m in northern California; 1200-2150 m in southern California). *Pseudotsuga menziesii*, *Calocedrus decurrens*, *Pinus lambertiana*, and *Quercus kelloggii*, *Acer macrophyllum* (in mesic pockets) are most frequent, but *Pinus ponderosa*, *Pinus jeffreyi*, *Pinus attenuata* may codominate in the Sierra Nevada foothills. *Pseudotsuga macrocarpa* is present in this system in the Transverse Ranges of southern California. Historically, frequent and low-intensity fire maintained these woodlands. This system occurs in a variety of topo-edaphic positions, such as upper slopes at higher elevations, canyon sideslopes, ridgetops, and south- and west-facing slopes which burn relatively frequently. Due to fire suppression, 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.

DISTRIBUTION

Range: Lower montane zones (600-1800 m in northern California; 1200-2150 m in southern California).

Ecological Divisions: 206

TNC Ecoregions: 12:C, 14:C, 15:C, 16:C, 5:C

Subnations/Nations: CA:c, NV:c

CONCEPT

- **California community types:**
- Aspen / White Corn-lily (61.111.03)
- Aspen / Big Sagebrush (61.111.06)
- Aspen / Big Sagebrush / Mountain Monardella - Kelloggia (61.111.07)
- Aspen / Mountain Monardella (61.111.08)
- Aspen / Jeffrey Pine (61.111.09)
- Aspen / Woods Rose (61.111.10)
- Sugar Pine - Canyon Live Oak (71.050.02)
- Sugar Pine - Tanoak / Poison-oak (73.100.01)
- Douglas-fir - Ponderosa Pine - Jeffrey Pine / One-sided Bluegrass (82.400.03)
- Douglas-fir - Ponderosa Pine (82.400.04)
- Ponderosa Pine - Incense Cedar - Black Oak (87.015.02)
- Ponderosa Pine - Incense Cedar / Mountain Misery (87.015.03)
- Ponderosa Pine –Incense-cedar /Huckleberry Oak (87.015.05)
- Jeffrey Pine - Douglas-fir / Huckleberry Oak / California Fescue (87.020.02)
- Jeffrey Pine - Incense-cedar / Buckbrush (87.020.04)
- Jeffrey Pine - Incense-cedar / Huckleberry Oak / Bear-grass (87.020.05)
- Jeffrey Pine / Huckleberry Oak (87.020.08)
- Jeffrey Pine / Desert Snowberry / Wheeler Bluegrass (87.020.18)
- Jeffrey Pine/Huckleberry Oak-Pinemat Manzanita/Idaho Fescue (87.020.27)
- Jeffrey Pine-Incense-cedar/Siskiyou mat (87.020.27)
- White Fir - Jeffrey Pine / California Fescue (87.205.04)
- Jeffrey Pine-White fir/Sadler oak (87.205.05)
- Jeffrey Pine - White Fir / Del Norte Iris (87.205.06)
- Sugar Pine/Chinquapin/Huckleberry Oak-Sadler Oak (87.206.01)
- Sugar Pine-Lodgepole Pine/Huckleberry oak-Dwarf Tanbark Oak (87.206.02)
- Sugar Pine-Lodgepole Pine/Huckleberry oak-Pacific Rhododendron (87.206.03)
- Sugar pine-Western White Pine/Huckleberry oak-Dwarf Silktassel (87.206.04)
- White Fir - Sugar Pine Forest (88.510.00)
- White Fir - Sugar Pine (88.510.01)
- White Fir - Sugar Pine - Red Fir (88.510.02)

SOURCES

References: Barbour and Billings 2000, Barbour and Major 1988, Holland and Keil 1995, Sawyer and Keeler-Wolf 1995

Last updated: 17 Mar 2003 **Stakeholders:** WCS

Concept Author: P. Comer, T. Keeler-Wolf **LeadResp:** WCS

S034 ROCKY MOUNTAIN MONTANE MESIC MIXED CONIFER FOREST AND WOODLAND

Division 306, Forest and Woodland, CES306.825

Spatial Scale & Pattern: Large Patch **Classification Confidence:** medium

Required Classifiers: Natural/Semi-natural, Vegetated (>10% vasc.), Upland

Diagnostic Classifiers: Forest and Woodland (Treed), Ravine, Stream terrace (undifferentiated), Toeslope, Mesotrophic Soil, Ustic, Long Disturbance Interval, F-Patch/Low Intensity, F-Landscape/Low Intensity, Needle-Leaved Tree, RM Montane Dry-Mesic Mixed Conifer

Non-Diagnostic Classifiers: Montane [Montane], Montane [Lower Montane], Temperate [Temperate Continental], Shallow Soil, Mineral: W/ A-Horizon <10 cm, Moderate (100-500 yrs) Persistence

Concept Summary: These are mixed-conifer forests of the Rocky Mountains west into the ranges of the Great Basin, occurring predominantly in cool ravines and on north-facing slopes. Elevations range from 1200 to 3300 m. Occurrences of this system are found on cooler and more mesic sites than Rocky Mountain Montane Dry-Mesic Mixed Conifer Forest and Woodland (CES306.823). Such sites include lower and middle slopes of ravines, along

stream terraces, moist, concave topographic positions and north- and east-facing slopes which burn somewhat infrequently. *Pseudotsuga menziesii* and *Abies concolor* are most common canopy dominants, but *Picea engelmannii, Picea pungens*, or *Pinus ponderosa* may be present. This system includes mixed conifer/*Populus tremuloides* stands. A number of cold-deciduous shrub species can occur, including *Acer glabrum, Acer grandidentatum, Alnus incana, Betula occidentalis, Cornus sericea, Jamesia americana, Physocarpus malvaceus, Robinia neomexicana, Vaccinium membranaceum*, and *Vaccinium myrtillus*. Herbaceous species include *Bromus ciliatus, Carex geyeri, Carex rossii, Carex siccata, Muhlenbergia virescens, Pseudoroegneria spicata, Erigeron eximius, Fragaria virginiana, Luzula parviflora, Osmorhiza berteroi, Packera cardamine, Thalictrum occidentale*, and *Thalictrum fendleri*. Naturally occurring fires are of variable return intervals, and mostly light, erratic, and infrequent due to the cool, moist conditions.

Comments: This system will need to be modeled to separate from similar dry-mesic system.

DISTRIBUTION

Range: Rocky Mountains west into the ranges of the Great Basin, occurring predominantly in cool ravines and on north-facing slopes. Elevations range from 1200 to 3300 m.
Ecological Divisions: 304, 306
TNC Ecoregions: 11:C, 18:C, 19:C, 20:C, 21:C, 68:P, 7:C, 8:C, 9:C
Subnations/Nations: AB:p, AZ:c, BC:p, CO:c, ID:c, MT:c, NM:c, NV:c, OR:c, UT:c, WA:c, WY:c

CONCEPT

Alliances and Associations:

- ABIES CONCOLOR FOREST ALLIANCE (A.152)
  Abies concolor - Picea pungens - Populus angustifolia / Acer glabrum Forest (CEGL000255)
  Abies concolor - Pinus ponderosa / Cercocarpus ledifolius Forest (CEGL002732)
  Abies concolor - Pseudotsuga menziesii / Acer glabrum Forest (CEGL000240)
  Abies concolor - Pseudotsuga menziesii / Erigeron eximius Forest (CEGL000247)
  Abies concolor - Pseudotsuga menziesii / Lathyrus lanszwertii var. leucanthus Forest (CEGL000250)
  Abies concolor - Pseudotsuga menziesii / Vaccinium myrtillus Forest (CEGL000265)
  Abies concolor / Acer grandidentatum Forest (CEGL000241)
  Abies concolor / Arctostaphylos patula Forest (CEGL000242)
  Abies concolor / Arctostaphylos uva-ursi Forest (CEGL000243)
  Abies concolor / Carex siccata Forest (CEGL000244)
  Abies concolor / Juglans major Forest (CEGL000248)
  Abies concolor / Mahonia repens Forest (CEGL000251)
  Abies concolor / Muhlenbergia virescens Forest (CEGL000252)
  Abies concolor / Osmorhiza berteroi Forest (CEGL000253)
  Abies concolor / Physocarpus malvaceus Forest (CEGL000254)
  Abies concolor / Quercus gambelii Forest (CEGL000261)
  Abies concolor / Symphoricarpos oreophilus Forest (CEGL000263)
- ABIES CONCOLOR WOODLAND ALLIANCE (A.553)
  Abies concolor / Festuca arizonica Woodland (CEGL000887)
  Abies concolor / Galium triflorum Woodland (CEGL000888)
  Abies concolor / Holodiscus dumosus Scree Woodland (CEGL000889)
  Abies concolor / Jamesia americana Scree Woodland (CEGL000890)
  Abies concolor / Leymus triticoides Woodland (CEGL000886)
  Abies concolor / Robinia neomexicana Woodland (CEGL000891)
- PICEA PUNGENS FOREST ALLIANCE (A.165)
  Picea pungens / Arctostaphylos uva-ursi Forest (CEGL000385)
  Picea pungens / Arnica cordifolia Forest (CEGL000386)
  Picea pungens / Carex siccata Forest (CEGL000387)
  Picea pungens / Erigeron eximius Forest (CEGL000390)
  Picea pungens / Fragaria virginiana ssp. virginiana Forest (CEGL000391)
  Picea pungens / Juniperus communis Forest (CEGL000392)
  Picea pungens / Linnaea borealis Forest (CEGL000393)
  Picea pungens / Lonicera involucrata Forest (CEGL000394)
  Picea pungens / Mahonia repens Forest (CEGL000395)
  Picea pungens / Packera cardamine Forest (CEGL000399)
  Picea pungens / Pseudoroegneria spicata Forest (CEGL000397)
- PICEA PUNGENS TEMPORARILY FLOODED WOODLAND ALLIANCE (A.567)
  Picea pungens / Alnus incana Woodland (CEGL000894)

Picea pungens / Betula occidentalis Woodland (CEGL002637)
Picea pungens / Cornus sericea Woodland (CEGL000388)
Picea pungens / Dasiphora fruticosa ssp. floribunda Woodland (CEGL000396)
Picea pungens / Equisetum arvense Woodland (CEGL000389)
Picea pungens / Rosa woodsii Woodland (CEGL000398)

- PICEA PUNGENS WOODLAND ALLIANCE (A.557)
  Picea pungens / Festuca arizonica Woodland (CEGL000895)
- PSEUDOTSUGA MENZIESII FOREST ALLIANCE (A.157)
  Pseudotsuga menziesii / Acer glabrum Forest (CEGL000418)
  Pseudotsuga menziesii / Acer grandidentatum Forest (CEGL000419)
  Pseudotsuga menziesii / Bromus ciliatus Forest (CEGL000428)
  Pseudotsuga menziesii / Vaccinium membranaceum Forest (CEGL000466)
  Pseudotsuga menziesii / Viola adunca var. adunca Forest (CEGL000467)
- PSEUDOTSUGA MENZIESII TEMPORARILY FLOODED WOODLAND ALLIANCE (A.568)
  Pseudotsuga menziesii / Betula occidentalis Woodland (CEGL002639)
  Pseudotsuga menziesii / Cornus sericea Woodland (CEGL000899)

SOURCES

References: Agree 1982, Alexander et al. 1984a, Alexander et al. 1984b, Alexander et al. 1987, Anderson 1999, Boyce 1977, Bunin 1975c, Comer et al. 2002, Cooper et al. 1987, DeVelice and Ludwig 1983c, DeVelice et al. 1986, Dieterich 1979, Fitzhugh et al. 1987, Fowells 1965, Giese 1975, Heinze et al. 1962, Hess 1981, Hess and Alexander 1986, Hess and Wasser 1982, Hoffman and Alexander 1980, Hoffman and Alexander 1983, Hopkins 1982, Komarkova et al. 1988b, Mauk and Henderson 1984, Moir and Ludwig 1979, Nachlinger et al. 2001, Neely et al. 2001, Parson and DeBenedetti 1979, Pfister 1972, Tuhy et al. 2002, Youngblood and Mauk 1985

Last updated: 20 Feb 2003 **Stakeholders:** WCS, MCS

Concept Author: NatureServe Western Ecology Team **LeadResp:** WCS

S035 MADREAN PINE-OAK FOREST AND WOODLAND

Division 305, Forest and Woodland, CES305.796

Spatial Scale & Pattern: Large Patch **Classification Confidence:** medium

Required Classifiers: Natural/Semi-natural, Vegetated (>10% vasc.), Upland

Diagnostic Classifiers: Montane [Montane], Tropical/Subtropical [Tropical Xeric], Shallow Soil, Xeric, F-Patch/High Intensity, Needle-Leaved Tree, Evergreen Sclerophyllous Shrub, Quercus arizonica, Q. emoryi, Q. grisea, Q. oblongifolia Q. toumeyi, Pinus discolor, P. leiophylla, P. engelmannii

Non-Diagnostic Classifiers: Forest and Woodland (Treed), Ridge/Summit/Upper Slope, Sideslope, Intermediate Disturbance Interval, Xeromorphic Shrub

Concept Summary: This system occurs on mountains and plateaus in the Sierra Madre Occidentale and Sierra Madre Orientale in Mexico, Trans-Pecos Texas, southern New Mexico and southern and central Arizona, from the the Mogollon Rim southeastward to the Sky Islands. These forests and woodlands are composed of Madrean pines (*Pinus arizonica, Pinus engelmannii, Pinus leiophylla* or *Pinus strobiformis*) and evergreen oaks (*Quercus arizonica, Quercus emoryi,* or *Quercus grisea*) intermingled with patchy shrublands on most mid-elevation slopes (1500-2300 m elevation). Other tree species include *Cupressus arizonica, Juniperus deppeana, Pinus cembriodes, Pinus discolorPinus ponderosa* (with Madrean pines or oaks), and *Pseudotsuga menziesii*. Subcanopy and shrub layers may include typical encinal and chaparral species such as *Agave* spp., *Arbutus arizonica, Arctostaphylos pringlei, Arctostaphylos pungens, Garrya wrightii, Nolina* spp., *Quercus hypoleucoides, Quercus rugosa*, and *Quercus turbinella*. Some stands have moderate cover of perennial graminoids such as *Muhlenbergia emersleyi, Muhlenbergia longiligula, Muhlenbergia virescens*, and *Schizachyrium cirratum*. Fires are frequent with perhaps more crown fires than ponderosa pine woodlands, which tend to have more frequent ground fires on gentle slopes.

DISTRIBUTION

Range: Sierra Madre Occidentale and Sierra Madre Orientale in Mexico, Trans-Pecos Texas, southern New Mexico and Arizona, generally south of the Mogollon Rim.

Ecological Divisions: 305

TNC Ecoregions: 22:C

Subnations/Nations: AZ:c, NM:c, nMX:c, TX:c

CONCEPT

Alliances and Associations:

- ARBUTUS XALAPENSIS - ACER GRANDIDENTATUM - QUERCUS SPP. FOREST ALLIANCE (A.368)
  Arbutus xalapensis - Quercus grisea - Juniperus deppeana - Acer grandidentatum - Quercus muehlenbergii Forest (CEGL004504)
  Arbutus xalapensis - Quercus grisea - Juniperus flaccida - Acer grandidentatum - Quercus gravesii Forest (CEGL004553)
- ARCTOSTAPHYLOS PUNGENS SHRUBLAND ALLIANCE (A.789)
  Arctostaphylos pungens Shrubland (CEGL000958)
- CUPRESSUS ARIZONICA FOREST ALLIANCE (A.163)
  Cupressus arizonica / Quercus hypoleucoides Forest (CEGL000352)
  Cupressus arizonica / Quercus turbinella Forest (CEGL000353)
- PINUS DISCOLOR WOODLAND ALLIANCE (A.538)
  Pinus (discolor, cembroides) / Quercus arizonica / Muhlenbergia emersleyi Woodland (CEGL000769)
- PINUS ENGELMANNII WOODLAND ALLIANCE (A.539)
  Pinus engelmannii / Muhlenbergia longiligula Woodland (CEGL000799)
  Pinus engelmannii / Quercus gambelii Woodland (CEGL000800)
  Pinus engelmannii / Quercus hypoleucoides Woodland (CEGL000801)
- PINUS LEIOPHYLLA WOODLAND ALLIANCE (A.542)
  Pinus leiophylla / Piptochaetium fimbriatum Woodland (CEGL000821)
  Pinus leiophylla / Quercus arizonica Woodland (CEGL000822)
  Pinus leiophylla / Quercus emoryi Woodland (CEGL000823)
  Pinus leiophylla / Quercus hypoleucoides Woodland (CEGL000824)
- PINUS PONDEROSA WOODLAND ALLIANCE (A.530)
  Pinus ponderosa / Quercus arizonica Woodland (CEGL000868)
  Pinus ponderosa / Quercus emoryi Woodland (CEGL000869)
  Pinus ponderosa / Quercus grisea Woodland (CEGL000871)
  Pinus ponderosa / Quercus hypoleucoides Woodland (CEGL000872)
- QUERCUS ARIZONICA WOODLAND ALLIANCE (A.482)
  Quercus arizonica / Bouteloua curtipendula Woodland (CEGL000680)
  Quercus arizonica / Muhlenbergia emersleyi Woodland (CEGL000681)
- QUERCUS GAMBELII SHRUBLAND ALLIANCE (A.920)
  Quercus gambelii / Robinia neomexicana / Symphoricarpos rotundifolius Shrubland (CEGL001116)
  Quercus gambelii / Symphoricarpos oreophilus Shrubland (CEGL001117)
- QUERCUS GRISEA WOODLAND ALLIANCE (A.478)
  Quercus grisea / Bouteloua curtipendula Woodland (CEGL000689)
- QUERCUS X PAUCILOBA SHRUBLAND ALLIANCE (A.921)
  Quercus X pauciloba / Cercocarpus montanus Shrubland (CEGL001118)
- ROBINIA NEOMEXICANA SHRUBLAND ALLIANCE (A.924)
  Robinia neomexicana / Thalictrum fendleri Shrubland (CEGL001125)

SOURCES

References: Barbour and Billings 2000, Brown 1982, Brown et al. 1998

Last updated: 20 Feb 2003 **Stakeholders:** WCS, SCS

Concept Author: NatureServe Western Ecology Team **LeadResp:** WCS

S036 ROCKY MOUNTAIN PONDEROSA PINE WOODLAND

Division 306, Forest and Woodland, CES306.827

Spatial Scale & Pattern: Matrix **Classification Confidence:** medium

Required Classifiers: Natural/Semi-natural, Vegetated (>10% vasc.), Upland

Diagnostic Classifiers: Ridge/Summit/Upper Slope, Very Shallow Soil, Mineral: W/ A-Horizon <10 cm, Sand Soil Texture, Aridic, Intermediate Disturbance Interval [Periodicity/Polycyclic Disturbance], F-Patch/Medium Intensity, Needle-Leaved Tree, Pinus ponderosa with shrubby understory

Non-Diagnostic Classifiers: Montane [Montane], Montane [Lower Montane], Forest and Woodland (Treed), Temperate [Temperate Continental], Circumneutral Soil, F-Landscape/Low Intensity, Short (50-100 yrs) Persistence

Concept Summary: This very widespread ecological system is most common throughout the cordillera of the Rocky Mountains. It is also found in the Colorado Plateau region, west into scattered locations in the Great Basin, and north into southern British Columbia. These woodlands occur at the lower treeline/ecotone between grassland or shrubland and more mesic coniferous forests typically in warm, dry, exposed sites. Elevations range from less than

500 m in British Columbia to 2800 m in the New Mexico mountains. Occurrences are found on all slopes and aspects, however, moderately steep to very steep slopes or ridgetops are most common. This ecological system generally occurs on igneous, metamorphic, and sedimentary material derived soils, with characteristic features of good aeration and drainage, coarse textures, circumneutral to slightly acid pH, an abundance of mineral material, rockiness, and periods of drought during the growing season. These woodlands in the eastern Cascades, Okanagan and northern Rockies regions receive winter and spring rains, and thus have a greater spring "green-up" than the drier woodlands in the central Rockies. *Pinus ponderosa* is the predominant conifer; *Pseudotsuga menziesii, Pinus edulis,* and *Juniperus* spp. may be present in the tree canopy. The understory is usually shrubby, with *Artemisia nova, Artemisia tridentata, Arctostaphylos patula, Arctostaphylos uva-ursi, Cercocarpus montanus, Cercocarpus ledifolius, Purshia stansburiana, Purshia tridentata, Quercus gambelii, Symphoricarpos oreophilus, Prunus virginiana, Amelanchier alnifolia,* and *Rosa* spp. common species. *Pseudoroegneria spicata* and species of *Hesperostipa, Achnatherum, Festuca, Muhlenbergia,* and *Bouteloua* are some of the common grasses. Mixed fire regimes and ground fires of variable return interval maintain these woodlands, depending on climate, degree of soil development, and understory density.

Comments: This system intergrades with Rocky Mountain Ponderosa Pine Savanna (CES306.826). They are distinguished by the high frequency, surface-fire regime, less steep or rocky environmental setting, and more open grassy understory structure of the savanna system.

DISTRIBUTION

Range: Throughout the cordillera of the Rocky Mountains, Colorado Plateau region, west into scattered locations in the Great Basin, and north into southern British Columbia.
Ecological Divisions: 204, 303, 304, 306
TNC Ecoregions: 10:C, 11:C, 18:C, 19:C, 20:C, 21:C, 25:C, 26:?, 33:?, 4:C, 6:C, 68:C, 7:C, 8:C, 9:C
Subnations/Nations: AB:c, AZ:c, BC:c, CO:c, ID:c, MT:c, ND:c, NE:?, NM:c, NV:c, OR:c, SD:c, UT:c, WA:c, WY:c

CONCEPT

Alliances and Associations:

- PINUS PONDEROSA FOREST ALLIANCE (A.124)
  Pinus ponderosa - Pinus strobiformis Forest (CEGL007091)
  Pinus ponderosa / Arctostaphylos patula - Arctostaphylos viscida Forest (CEGL000061)
  Pinus ponderosa / Calamagrostis rubescens Forest (CEGL000181)
  Pinus ponderosa / Carex rossii Forest (CEGL000183)
  Pinus ponderosa / Elymus glaucus Forest (CEGL000184)
  Pinus ponderosa / Mahonia repens Forest (CEGL000187)
  Pinus ponderosa / Physocarpus malvaceus Forest (CEGL000189)
  Pinus ponderosa / Physocarpus monogynus Forest (CEGL000190)
  Pinus ponderosa / Prunus virginiana Forest (CEGL000192)
  Pinus ponderosa / Ribes cereum Forest (CEGL000199)
  Pinus ponderosa / Spiraea betulifolia Forest (CEGL000202)
  Pinus ponderosa / Symphoricarpos albus Forest (CEGL000203)
  Pinus ponderosa / Symphoricarpos occidentalis Forest (CEGL000204)
  Pinus ponderosa / Symphoricarpos oreophilus Forest (CEGL000205)
- PINUS PONDEROSA WOODLAND ALLIANCE (A.530)
  Pinus ponderosa / Amelanchier alnifolia Woodland (CEGL000840)
  Pinus ponderosa / Arctostaphylos patula - Ceanothus velutinus Woodland (CEGL000062)
  Pinus ponderosa / Arctostaphylos patula - Purshia tridentata Woodland (CEGL000063)
  Pinus ponderosa / Arctostaphylos patula Woodland (CEGL000842)
  Pinus ponderosa / Arctostaphylos pungens Woodland (CEGL000843)
  Pinus ponderosa / Arctostaphylos uva-ursi Woodland (CEGL000844)
  Pinus ponderosa / Artemisia arbuscula Woodland (CEGL000845)
  Pinus ponderosa / Artemisia nova Woodland (CEGL000846)
  Pinus ponderosa / Artemisia tridentata - Purshia tridentata Woodland (CEGL000178)
  Pinus ponderosa / Artemisia tridentata ssp. vaseyana / Poa nervosa Woodland (CEGL000180)
  Pinus ponderosa / Artemisia tridentata ssp. wyomingensis / Hesperostipa comata Woodland (CEGL000179)
  Pinus ponderosa / Bouteloua gracilis Woodland (CEGL000848)
  Pinus ponderosa / Bromus inermis Semi-natural Woodland (CEGL002943)
  Pinus ponderosa / Carex geyeri Woodland (CEGL000182)
  Pinus ponderosa / Carex inops ssp. heliophila Woodland (CEGL000849)

Pinus ponderosa / Ceanothus velutinus - Purshia tridentata Woodland (CEGL000064)
Pinus ponderosa / Cercocarpus ledifolius Woodland (CEGL000850)
Pinus ponderosa / Cercocarpus montanus Woodland (CEGL000851)
Pinus ponderosa / Fallugia paradoxa Woodland (CEGL002999)
Pinus ponderosa / Festuca arizonica Woodland (CEGL000856)
Pinus ponderosa / Festuca campestris Woodland (CEGL000185)
Pinus ponderosa / Festuca idahoensis Woodland (CEGL000857)
Pinus ponderosa / Hesperostipa comata Woodland (CEGL000879)
Pinus ponderosa / Juniperus communis Woodland (CEGL000859)
Pinus ponderosa / Juniperus horizontalis Woodland (CEGL000860)
Pinus ponderosa / Juniperus scopulorum Woodland (CEGL000861)
Pinus ponderosa / Leucopoa kingii Woodland (CEGL000186)
Pinus ponderosa / Muhlenbergia montana Woodland (CEGL000862)
Pinus ponderosa / Muhlenbergia virescens - Festuca arizonica Woodland (CEGL000864)
Pinus ponderosa / Muhlenbergia virescens Woodland (CEGL000863)
Pinus ponderosa / Oryzopsis asperifolia Woodland (CEGL002123)
Pinus ponderosa / Pascopyrum smithii Woodland (CEGL000188)
Pinus ponderosa / Pseudoroegneria spicata Woodland (CEGL000865)
Pinus ponderosa / Pteridium aquilinum Woodland (CEGL002944)
Pinus ponderosa / Purshia stansburiana Woodland (CEGL000854)
Pinus ponderosa / Purshia tridentata / Achnatherum hymenoides Woodland (CEGL000196)
Pinus ponderosa / Purshia tridentata / Carex geyeri Woodland (CEGL002606)
Pinus ponderosa / Purshia tridentata / Carex rossii Woodland (CEGL000194)
Pinus ponderosa / Purshia tridentata / Festuca idahoensis Woodland (CEGL000195)
Pinus ponderosa / Purshia tridentata / Pseudoroegneria spicata Woodland (CEGL000197)
Pinus ponderosa / Purshia tridentata Woodland (CEGL000867)
Pinus ponderosa / Quercus gambelii Woodland (CEGL000870)
Pinus ponderosa / Quercus macrocarpa Woodland (CEGL000873)
Pinus ponderosa / Quercus X pauciloba Woodland (CEGL000874)
Pinus ponderosa / Ribes inerme Scree Woodland (CEGL000876)
Pinus ponderosa / Rockland Woodland (CEGL000877)
Pinus ponderosa / Schizachyrium scoparium Woodland (CEGL000201)
Pinus ponderosa Scree Woodland (CEGL000878)

Environment: This ecological system within the region occurs at the lower treeline/ecotone between grassland or shrubland and more mesic coniferous forests typically in warm, dry, exposed sites at elevations ranging from 1980-2800 m. (6500-9200 feet). It can occur on all slopes and aspects, however, it commonly occurs on moderately steep to very steep slopes or ridgetops. This ecological system generally occurs on igneous, metamorphic, and sedimentary material derived soils, including basalt, basaltic, andesitic flows, intrusive granitoids and porphyrites, and tuffs (Youngblood and Mauk 1985). Characteristic soil features include 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 occurrences 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.

Surface textures are highly variable in this ecological system ranging from sand to loam and silt loam. Exposed rock and bare soil consistently occur to some degree in all the associations. *Pinus ponderosa / Arctostaphylos patula* represents the extreme with typically a high percentage of rock and bare soil present.

Precipitation generally contributes 25-60 cm annually to this system, mostly through winter storms and some monsoonal summer rains. Typically a seasonal drought period occurs throughout this system as well. Fire plays an important role in maintaining the characteristics of these open canopy woodlands. However, soil infertility and drought may contribute significantly in some areas as well.

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, occurrences have become denser. Presently, many occurrences 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 occurrence structures have affected fuel loads and alter fire regimes. Presettlement 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* (Reid et al. 1999).

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-return intervals have resulted in many occurrences having dense subcanopies of overstocked and unhealthy young *Pinus ponderosa* (Reid et al. 1999).

Mehl (1992) states the following: "Where fire has been present, occurrences will be climax and contain groups of large, old trees with little understory vegetation or down woody material and few occurring dead trees. The age difference of the groups of trees would be large. Where fire is less frequent there will also be smaller size trees in the understory giving the occurrence some structure with various canopy layers. Dead, down material will be present in varying amounts along with some occurring dead trees. In both cases the large old trees will have irregular open, large branched crowns. The bark will be lighter in color, almost yellow, thick and some will like have basal fire scars."

Grace's warbler, Pygmy nuthatch, and flammulated owl are indicators of a healthy ponderosa pine woodland. All of these birds prefer mature trees in an open woodland setting (Winn 1998, Jones 1998, Levad 1998 as cited in Rondeau 2001).

SOURCES

References: Canadian Rockies Ecoregional Plan 2002, Comer et al. 2002, Cooper et al. 1987, Daubenmire and Daubenmire 1968, DeVelice et al. 1986, Hess and Alexander 1986, Hoffman and Alexander 1976, Komarkova et al. 1988b, Marriott and Faber-Langendoen 2000, Mauk and Henderson 1984, Mehl 1992, Meidinger and Pojar 1991, Muldavin et al. 1987, Muldavin et al. 1996, Nachlinger et al. 2001, Neely et al. 2001, Pfister et al. 1977, Reid et al. 1999, Rondeau 2001, Tuhy et al. 2002, Youngblood and Mauk 1985

Last updated: 20 Feb 2003 **Stakeholders:** WCS, MCS, CAN

Concept Author: NatureServe Western Ecology Team **LeadResp:** WCS

S038 SOUTHERN ROCKY MOUNTAIN PINYON-JUNIPER WOODLAND

Division 306, Forest and Woodland, CES306.835

Spatial Scale & Pattern: Matrix **Classification Confidence:** medium

Required Classifiers: Natural/Semi-natural, Vegetated (>10% vasc.), Upland

Diagnostic Classifiers: Forest and Woodland (Treed), Very Shallow Soil, Shallow Soil, Mineral: W/ A-Horizon <10 cm, Aridic, Long Disturbance Interval, Needle-Leaved Tree, Pinus edulis, Juniperus monosperma

Non-Diagnostic Classifiers: Lowland [Foothill], Butte, Escarpment, Foothill(s), Midslope, Ridge, Temperate [Temperate Continental], Unglaciated, F-Patch/Medium Intensity, F-Landscape/Medium Intensity

Concept Summary: This southern Rocky Mountain ecological system occurs on dry mountains and foothills in southern Colorado east of the Continental Divide, in mountains and plateaus of northern New Mexico, and extends out onto limestone breaks in the Great Plains. These woodlands occur on warm, dry sites on mountain slopes, mesas, plateaus, and ridges. Severe climatic events occurring during the growing season, such as frosts and drought, are thought to limit the distribution of pinyon-juniper woodlands to relatively narrow altitudinal belts on mountainsides. Soils supporting this system vary in texture ranging from stony, cobbly, gravelly sandy loams to clay loam or clay. *Pinus edulis* and/or *Juniperus monosperma* dominate the tree canopy. *Juniperus scopulorum* may codominate or replace *Juniperus monosperma* at higher elevations. In transitional areas along the Mogollon Rim and in northern New Mexico, *Juniperus deppeana* becomes common. Understory layers are variable and may be dominated by shrubs, graminoids, or be absent. Associated species include *Artemisia tridentata, Cercocarpus montanus, Quercus gambelii, Achnatherum scribneri, Bouteloua gracilis, Festuca arizonica,* or *Pleuraphis jamesii*.

Distribution

Range: Occurs on dry mountains and foothills in southern Colorado, in mountains and plateaus of northern New Mexico and Arizona, and extends out onto breaks in the Great Plains.

Ecological Divisions: 303, 304, 306

TNC Ecoregions: 19:C, 20:C, 21:C, 22:P, 27:C, 28:C

Subnations/Nations: AZ:c, CO:c, NM:c, UT:c

CONCEPT

Alliances and Associations:

- JUNIPERUS MONOSPERMA WOODLAND ALLIANCE (A.504)
  Juniperus monosperma - Rhus trilobata / Schizachyrium scoparium Woodland (CEGL002121)

Juniperus monosperma / Agave lechuguilla Woodland (CEGL000703)
Juniperus monosperma / Andropogon hallii Woodland (CEGL000704)
Juniperus monosperma / Artemisia bigelovii Woodland (CEGL000705)
Juniperus monosperma / Artemisia tridentata Woodland (CEGL000706)
Juniperus monosperma / Atriplex confertifolia / Achnatherum hymenoides Woodland (CEGL000707)
Juniperus monosperma / Bouteloua curtipendula Woodland (CEGL000708)
Juniperus monosperma / Bouteloua eriopoda Woodland (CEGL000709)
Juniperus monosperma / Bouteloua gracilis Woodland (CEGL000710)
Juniperus monosperma / Bouteloua hirsuta Woodland (CEGL000711)
Juniperus monosperma / Cercocarpus montanus - Ribes cereum Woodland (CEGL000714)
Juniperus monosperma / Cercocarpus montanus Woodland (CEGL000713)
Juniperus monosperma / Ericameria nauseosa - Fallugia paradoxa Woodland (CEGL000715)
Juniperus monosperma / Fallugia paradoxa / Xanthoparmelia neoconspersa Woodland (CEGL000716)
Juniperus monosperma / Hesperostipa neomexicana Woodland (CEGL000722)
Juniperus monosperma / Krascheninnikovia lanata Woodland (CEGL000712)
Juniperus monosperma / Nolina microcarpa - Agave lechuguilla Woodland (CEGL000718)
Juniperus monosperma / Quercus turbinella Woodland (CEGL000720)
Juniperus monosperma / Quercus X pauciloba Woodland (CEGL000721)

- PINUS EDULIS - (JUNIPERUS SPP.) WOODLAND ALLIANCE (A.516)
  Pinus edulis - (Juniperus monosperma) / Bouteloua gracilis Woodland (CEGL002151)
  Pinus edulis - (Juniperus monosperma, Juniperus osteosperma) / Hesperostipa comata Woodland (CEGL000797)
  Pinus edulis - Juniperus scopulorum Woodland [Provisional] (CEGL002907)
  Pinus edulis - Juniperus spp. / Artemisia tridentata Woodland (CEGL000776)
  Pinus edulis - Juniperus spp. / Cercocarpus montanus Woodland (CEGL000780)
  Pinus edulis - Juniperus spp. / Quercus gambelii Woodland (CEGL000791)
  Pinus edulis - Quercus arizonica / Rhus trilobata Woodland (CEGL000790)
  Pinus edulis / Achnatherum nelsonii ssp. dorei Woodland (CEGL000796)
  Pinus edulis / Achnatherum scribneri Woodland (CEGL000798)
  Pinus edulis / Andropogon hallii Woodland (CEGL000774)
  Pinus edulis / Arctostaphylos pungens Woodland (CEGL000775)
  Pinus edulis / Bouteloua curtipendula Woodland (CEGL000777)
  Pinus edulis / Cercocarpus ledifolius Woodland [Provisional] (CEGL002940)
  Pinus edulis / Festuca arizonica Woodland (CEGL000783)
  Pinus edulis / Leymus ambiguus Woodland (CEGL002908)
  Pinus edulis / Muhlenbergia dubia Woodland (CEGL000784)
  Pinus edulis / Muhlenbergia pauciflora Woodland (CEGL000785)
  Pinus edulis / Nolina microcarpa Woodland (CEGL000786)
  Pinus edulis / Poa fendleriana Woodland (CEGL000787)
  Pinus edulis / Pseudoroegneria spicata Woodland (CEGL000788)
  Pinus edulis / Purshia tridentata Woodland (CEGL000789)
  Pinus edulis / Quercus X pauciloba Woodland (CEGL000793)
  Pinus edulis / Rockland Woodland (CEGL000794)
- PINUS EDULIS FOREST ALLIANCE (A.135)
  Pinus edulis / Sparse Understory Forest (CEGL000795)

SOURCES

References: Alexander 1981, Barbour and Billings 1988, Blackburn and Tueller 1970, Bradley et al. 1992, Commons et al. 1999, Dwyer and Pieper 1967, Eager 1999, Erdman 1962, Hess and Wasser 1982, Ladyman and Muldavin 1996, Lindauer et al. 1982, Mehl 1992, Muldavin et al. 1992, Muldavin et al. 1996, Neely et al. 2001, Powell 1988b, West 1999, West 1999b, West and Van Pelt 1987, West and Young 2000, Young and Evans 1981

Last updated: 20 Feb 2003 **Stakeholders:** WCS

Concept Author: NatureServe Western Ecology Team **LeadResp:** WCS

S039 COLORADO PLATEAU PINYON-JUNIPER WOODLAND

Division 304, Forest and Woodland, CES304.767

Spatial Scale & Pattern: Matrix **Classification Confidence:** medium

Required Classifiers: Natural/Semi-natural, Vegetated (>10% vasc.), Upland

Diagnostic Classifiers: Montane [Lower Montane], Lowland [Foothill], Mesa, Ridge/Summit/Upper Slope, Sedimentary Rock, Temperate [Temperate Xeric], Aridic, Pinus edulis, Juniperus osteosperma

Non-Diagnostic Classifiers: Forest and Woodland (Treed), Foothill(s), Piedmont, Plateau, Sideslope, Alkaline Soil, Long Disturbance Interval, F-Patch/Medium Intensity

Concept Summary: This ecological system occurs on dry mountains and foothills of the Colorado Plateau region from the Western Slope of Colorado to the Wasatch Range, south to the Mogollon Rim and east into the NW corner of New Mexico. It is typically found at lower elevations ranging from 1500-2440 m. These woodlands occur on warm, dry sites on mountain slopes, mesas, plateaus, and ridges. Severe climatic events occurring during the growing season, such as frosts and drought, are thought to limit the distribution of pinyon-juniper woodlands to relatively narrow altitudinal belts on mountainsides. Soils supporting this system vary in texture ranging from stony, cobbly, gravelly sandy loams to clay loam or clay. *Pinus edulis* and/or *Juniperus osteosperma* dominate the tree canopy. In the southern portion of the Colorado Plateau in northern Arizona and northwestern New Mexico, *Juniperus monosperma* and hybrids of *Juniperus* spp may dominate or codominate tree canopy. *Juniperus scopulorum* may codominate or replace *Juniperus osteosperma* at higher elevations. Understory layers are variable and may be dominated by shrubs, graminoids, or be absent. Associated species include *Arctostaphylos patula, Artemisia tridentata, Cercocarpus intricatus, Cercocarpus montanus, Coleogyne ramosissima, Purshia stansburiana, Purshia tridentata, Quercus gambelii, Bouteloua gracilis, Pleuraphis jamesii,* or *Poa fendleriana*. This system occurs at higher elevations than Great Basin Pinyon-Juniper Woodland (CES304.773) and Colorado Plateau shrubland systems where sympatric.

DISTRIBUTION

Range: Occurs on dry mountains and foothills of the Colorado Plateau region from the Western Slope of Colorado to the Wasatch Range, south to the Mogollon Rim. It is typically found at lower elevations ranging from 1500-2440 m.
Ecological Divisions: 304, 306
TNC Ecoregions: 18:C, 19:C, 20:?
Subnations/Nations: AZ:c, CO:c, NM:c, UT:c

CONCEPT

Alliances and Associations:

- JUNIPERUS MONOSPERMA WOODLAND ALLIANCE (A.504)
  Juniperus monosperma - Rhus trilobata / Schizachyrium scoparium Woodland (CEGL002121)
  Juniperus monosperma / Agave lechuguilla Woodland (CEGL000703)
  Juniperus monosperma / Andropogon hallii Woodland (CEGL000704)
  Juniperus monosperma / Artemisia bigelovii Woodland (CEGL000705)
  Juniperus monosperma / Artemisia tridentata Woodland (CEGL000706)
  Juniperus monosperma / Atriplex confertifolia / Achnatherum hymenoides Woodland (CEGL000707)
  Juniperus monosperma / Bouteloua curtipendula Woodland (CEGL000708)
  Juniperus monosperma / Bouteloua eriopoda Woodland (CEGL000709)
  Juniperus monosperma / Bouteloua gracilis Woodland (CEGL000710)
  Juniperus monosperma / Bouteloua hirsuta Woodland (CEGL000711)
  Juniperus monosperma / Cercocarpus montanus - Ribes cereum Woodland (CEGL000714)
  Juniperus monosperma / Cercocarpus montanus Woodland (CEGL000713)
  Juniperus monosperma / Ericameria nauseosa - Fallugia paradoxa Woodland (CEGL000715)
  Juniperus monosperma / Fallugia paradoxa / Xanthoparmelia neoconspersa Woodland (CEGL000716)
  Juniperus monosperma / Hesperostipa neomexicana Woodland (CEGL000722)
  Juniperus monosperma / Krascheninnikovia lanata Woodland (CEGL000712)
  Juniperus monosperma / Nolina microcarpa - Agave lechuguilla Woodland (CEGL000718)
  Juniperus monosperma / Quercus turbinella Woodland (CEGL000720)
  Juniperus monosperma / Quercus X pauciloba Woodland (CEGL000721)
- JUNIPERUS OSTEOSPERMA WOODED HERBACEOUS ALLIANCE (A.1502)
  Juniperus osteosperma / Hesperostipa comata Wooded Herbaceous Vegetation (CEGL001489)
  Juniperus osteosperma / Leymus salinus ssp. salmonis Wooded Herbaceous Vegetation (CEGL001488)
- JUNIPERUS OSTEOSPERMA WOODED SHRUBLAND ALLIANCE (A.2541)
  Juniperus osteosperma Wooded Shrubland [Placeholder] (CEGL002964)
- JUNIPERUS OSTEOSPERMA WOODLAND ALLIANCE (A.536)
  Juniperus osteosperma - Juniperus monosperma / Sparse Understory Woodland (CEGL000737)
  Juniperus osteosperma / Artemisia arbuscula Woodland (CEGL002757)
  Juniperus osteosperma / Artemisia nova / Rock Woodland (CEGL000729)
  Juniperus osteosperma / Artemisia nova Woodland (CEGL000728)

Juniperus osteosperma / Artemisia tridentata / Achnatherum hymenoides Woodland (CEGL000731)
Juniperus osteosperma / Artemisia tridentata Woodland (CEGL000730)
Juniperus osteosperma / Cercocarpus intricatus Woodland (CEGL000733)
Juniperus osteosperma / Cercocarpus ledifolius Woodland (CEGL000734)
Juniperus osteosperma / Cercocarpus montanus Woodland (CEGL000735)
Juniperus osteosperma / Coleogyne ramosissima Woodland [Provisional] (CEGL002909)
Juniperus osteosperma / Hesperostipa neomexicana Woodland (CEGL000740)
Juniperus osteosperma / Pleuraphis mutica Woodland (CEGL000736)
Juniperus osteosperma / Pseudoroegneria spicata Woodland (CEGL000738)
Juniperus osteosperma / Sparse Understory Woodland (CEGL000732)
Juniperus osteosperma / Symphoricarpos oreophilus Woodland (CEGL000741)
Juniperus osteosperma Woodland (CEGL000727)

- PINUS EDULIS - (JUNIPERUS SPP.) WOODLAND ALLIANCE (A.516)
  Pinus edulis - (Juniperus monosperma) / Bouteloua gracilis Woodland (CEGL002151)
  Pinus edulis - (Juniperus monosperma, Juniperus osteosperma) / Hesperostipa comata Woodland (CEGL000797)
  Pinus edulis - (Juniperus osteosperma) / Bouteloua gracilis Woodland (CEGL000778)
  Pinus edulis - Juniperus osteosperma / Arctostaphylos patula Woodland (CEGL002939)
  Pinus edulis - Juniperus osteosperma / Cercocarpus intricatus Woodland (CEGL000779)
  Pinus edulis - Juniperus osteosperma / Coleogyne ramosissima Woodland (CEGL000781)
  Pinus edulis - Juniperus osteosperma / Purshia stansburiana Woodland (CEGL000782)
  Pinus edulis - Juniperus spp. / Artemisia tridentata Woodland (CEGL000776)
  Pinus edulis - Juniperus spp. / Cercocarpus montanus Woodland (CEGL000780)
  Pinus edulis - Juniperus spp. / Quercus gambelii Woodland (CEGL000791)
  Pinus edulis - Quercus arizonica / Rhus trilobata Woodland (CEGL000790)
  Pinus edulis / Achnatherum nelsonii ssp. dorei Woodland (CEGL000796)
  Pinus edulis / Achnatherum scribneri Woodland (CEGL000798)
  Pinus edulis / Andropogon hallii Woodland (CEGL000774)
  Pinus edulis / Arctostaphylos pungens Woodland (CEGL000775)
  Pinus edulis / Bouteloua curtipendula Woodland (CEGL000777)
  Pinus edulis / Festuca arizonica Woodland (CEGL000783)
  Pinus edulis / Muhlenbergia pauciflora Woodland (CEGL000785)
  Pinus edulis / Nolina microcarpa Woodland (CEGL000786)
  Pinus edulis / Poa fendleriana Woodland (CEGL000787)
  Pinus edulis / Pseudoroegneria spicata Woodland (CEGL000788)
  Pinus edulis / Purshia tridentata Woodland (CEGL000789)
  Pinus edulis / Quercus X pauciloba Woodland (CEGL000793)
  Pinus edulis / Rockland Woodland (CEGL000794)
- PINUS EDULIS FOREST ALLIANCE (A.135)
  Pinus edulis / Sparse Understory Forest (CEGL000795)

SOURCES

References: Baker and Kennedy 1985, Stuever and Hayden 1997a, Tuhy et al. 2002, West et al. 1998
Last updated: 20 Feb 2003 **Stakeholders:** WCS
Concept Author: NatureServe Western Ecology Team **LeadResp:** WCS

S040 GREAT BASIN PINYON-JUNIPER WOODLAND

Division 304, Forest and Woodland, CES304.773

Spatial Scale & Pattern: Matrix **Classification Confidence:** medium
Required Classifiers: Natural/Semi-natural, Vegetated (>10% vasc.), Upland
Diagnostic Classifiers: Montane [Lower Montane], Lowland [Foothill], Forest and Woodland (Treed), Foothill(s), Piedmont, Plateau, Ridge/Summit/Upper Slope, Aridic, Pinus monophylla, Juniperus osteosperma

Non-Diagnostic Classifiers: Sideslope, Temperate [Temperate Continental], Alkaline Soil, Long Disturbance Interval, F-Patch/Medium Intensity

Concept Summary: This ecological system occurs on dry mountain ranges of the Great Basin region and eastern foothills of the Sierra Nevada. It is typically found at lower elevations ranging from 1600-2600 m. These woodlands occur on warm, dry sites on mountain slopes, mesas, plateaus, and ridges. Severe climatic events occurring during the growing season, such as frosts and drought, are thought to limit the distribution of pinyon-juniper woodlands to relatively narrow altitudinal belts on mountainsides. Woodlands dominated by a mix of *Pinus monophylla* and

Juniperus osteosperma, pure or nearly pure occurrences of *Pinus monophylla*, or woodlands dominated solely by *Juniperus osteosperma* comprise this system. *Cercocarpus ledifolius* is a common associate. Understory layers are variable. Associated species include shrubs such as *Arctostaphylos patula, Artemisia arbuscula, Artemisia nova, Artemisia tridentata, Cercocarpus ledifolius, Cercocarpus intricatus, Coleogyne ramosissima, Quercus gambelii, Quercus turbinella*, and bunch grasses *Hesperostipa comata, Festuca idahoensis, Pseudoroegneria spicata, Leymus cinereus (= Elymus cinereus)*, and *Poa fendleriana*. This system occurs at lower elevations than Colorado Plateau Pinyon-Juniper Woodland (CES304.767) where sympatric.

DISTRIBUTION

Range: Occurs on dry mountain ranges of the Great Basin region and eastern foothills of the Sierra Nevada, typically at lower elevations ranging from 1600-2600 m.
Ecological Divisions: 206, 304
TNC Ecoregions: 11:C, 12:C, 18:C
Subnations/Nations: CA:c, NV:c, UT:c

CONCEPT

Alliances and Associations:

- JUNIPERUS OSTEOSPERMA WOODLAND ALLIANCE (A.536)
  Juniperus osteosperma / Artemisia arbuscula Woodland (CEGL002757)
  Juniperus osteosperma / Artemisia nova / Rock Woodland (CEGL000729)
  Juniperus osteosperma / Artemisia nova Woodland (CEGL000728)
  Juniperus osteosperma / Artemisia tridentata / Achnatherum hymenoides Woodland (CEGL000731)
  Juniperus osteosperma / Cercocarpus intricatus Woodland (CEGL000733)
  Juniperus osteosperma / Pseudoroegneria spicata Woodland (CEGL000738)
  Juniperus osteosperma / Sparse Understory Woodland (CEGL000732)
- JUNIPERUS SCOPULORUM TEMPORARILY FLOODED WOODLAND ALLIANCE (A.563)
  Juniperus scopulorum Temporarily Flooded Woodland [Placeholder] (CEGL002777)
- PINUS MONOPHYLLA - (JUNIPERUS OSTEOSPERMA) WOODLAND ALLIANCE (A.543)
  Pinus monophylla - Juniperus osteosperma - Quercus gambelii / Artemisia tridentata Woodland (CEGL000837)
  Pinus monophylla - Juniperus osteosperma / (Shepherdia rotundifolia, Amelanchier utahensis) Woodland (CEGL002942)
  Pinus monophylla - Juniperus osteosperma / Artemisia arbuscula Woodland (CEGL000830)
  Pinus monophylla - Juniperus osteosperma / Artemisia nova Woodland (CEGL000831)
  Pinus monophylla - Juniperus osteosperma / Artemisia tridentata ssp. vaseyana / Pseudoroegneria spicata Woodland (CEGL000833)
  Pinus monophylla - Juniperus osteosperma / Artemisia tridentata Woodland (CEGL000832)
  Pinus monophylla - Juniperus osteosperma / Cercocarpus ledifolius / Pseudoroegneria spicata Woodland (CEGL000834)
  Pinus monophylla - Juniperus osteosperma / Cercocarpus montanus - Quercus gambelii Woodland [Provisional] (CEGL002968)
  Pinus monophylla - Juniperus osteosperma / Coleogyne ramosissima Woodland [Provisional] (CEGL002971)
  Pinus monophylla - Juniperus osteosperma / Gutierrezia sarothrae / Pleuraphis jamesii Woodland [Provisional] (CEGL002970)
  Pinus monophylla - Juniperus osteosperma / Hesperostipa comata Woodland (CEGL002969)
  Pinus monophylla - Juniperus osteosperma / Prunus virginiana Woodland (CEGL000836)
  Pinus monophylla - Juniperus osteosperma / Quercus turbinella Woodland (CEGL002941)
  Pinus monophylla - Juniperus osteosperma / Sparse Understory Woodland (CEGL000829)
  Pinus monophylla - Quercus gambelii / Artemisia tridentata Woodland (CEGL000838)
  Pinus monophylla / Amelanchier alnifolia / Arctostaphylos patula Woodland (CEGL000826)
  Pinus monophylla / Artemisia tridentata Woodland (CEGL000827)
  Pinus monophylla / Cercocarpus ledifolius Woodland (CEGL000828)
  Pinus monophylla / Symphoricarpos oreophilus - Artemisia tridentata Woodland (CEGL000839)
  Pinus monophylla Woodland (CEGL000825)
- PINUS MONOPHYLLA WOODED TALL HERBACEOUS ALLIANCE (A.1487)
  Pinus monophylla - Juniperus osteosperma / Leymus cinereus Wooded Herbaceous Vegetation (CEGL000835)
- QUERCUS TURBINELLA SHRUBLAND ALLIANCE (A.793)
  Quercus turbinella - Juniperus osteosperma Shrubland (CEGL000981)

- **California community types:**
- Singleleaf Pinyon Woodland (87.040.00)
- Singleleaf Pinyon / Big Sagebrush (87.040.02)
- Singleleaf Pinyon / Green Ephedra (87.040.03)
- Singleleaf Pinyon / Waxberry - Desert Gooseberry (87.040.04)
- Singleleaf Pinyon / Silk Tassle Bush (87.040.05)

- Singleleaf Pinyon / Utah Juniper / Big Sagebrush - Blackbush (87.040.06)
- Singleleaf Pinyon / Utah Juniper / Black Sagebrush (87.040.07)
- Singleleaf Pinyon / Utah Juniper / Antelope Brush (87.040.07)
- Singleleaf Pinyon / Muller Oak (87.040.08)
- Singleleaf Pinyon / Muller Oak / California Fiddleleaf (87.040.09)
- Singleleaf Pinyon / Desert Almond (87.040.10)
- Singleleaf Pinyon / Desert Gooseberry (87.040.11)
- Singleleaf Pinyon / Curl-leaf Mountain Mahogany / Big Sagebrush - Antelope Bitterbrush (87.040.12)
- Juniper Woodlands (89.000.00)
- Utah Juniper (89.300.01)
- Utah Juniper / Big Sagebrush - Green Ephedra (89.300.02)
- Utah Juniper / Big Sagebrush - Desert Bitterbrush - Nevada Ephedra (89.300.03)
- Utah Juniper / California Buckwheat (89.300.04)
- Utah Juniper / Sticky Snakeweed (89.300.05)
- Utah Juniper / Shadscale (89.300.06)
- Utah Juniper / White Bursage (89.300.07)
- Utah Juniper / Blackbush (89.300.08)
- Utah Juniper / Blackbush / Galleta (89.300.09)
- Utah Juniper / Spanish Bayonet (89.300.10)
- Utah Juniper / Nevada Ephedra / Desert Needlegrass (89.300.11)
- Singleleaf Pinyon - Utah Juniper Woodland (89.500.00)

SOURCES

References: Barbour and Major 1977, Holland and Keil 1995

Last updated: 20 Feb 2003 **Stakeholders:** WCS

Concept Author: NatureServe Western Ecology Team **LeadResp:** WCS

S051 MADREAN ENCINAL

Division 305, Forest and Woodland, CES305.795

Spatial Scale & Pattern: Large Patch **Classification Confidence:** medium

Required Classifiers: Natural/Semi-natural, Vegetated (>10% vasc.), Upland

Diagnostic Classifiers: Montane [Lower Montane], Lowland [Foothill], Tropical/Subtropical [Tropical Xeric], Xeric, F-Patch/Medium Intensity, Broad-Leaved Evergreen Tree, Graminoid, Quercus arizonica, Q. emoryi, Q. grisea, Q. oblongifolia Q. toumeyi

Non-Diagnostic Classifiers: Forest and Woodland (Treed), Shrubland (Shrub-dominated), Sideslope, Intermediate Disturbance Interval

Concept Summary: Madrean Encinal occurs on foothills, canyons, bajadas and plateaus in the Sierra Madre Occidentale and Sierra Madre Orientale in Mexico, extending north intoTrans-Pecos Texas, southern New Mexico and sub-Mogollon Arizona. These woodlands are dominated by Madrean evergreen oaks along a low-slope transition below Madrean Pine-Oak Forest and Woodland (CES305.796) and Madrean Pinyon-Juniper Woodland (CES305.797). Lower elevation stands are typically open woodlands or savannas where they transition into desert grasslands, chaparral or is some case desertscrub. Common evergreen oak species include *Quercus arizonica, Quercus emoryi,Quercus intricata, Quercus grisea, Quercus oblongifolia, Quercus toumeyi* and in Mexico, *Quercus chihuahuaensis* and *Quercus albocincta*. Madrean pine, Arizona cypress, pinyon and juniper trees may be present, but do not codominate. Chaparral species such as *Arctostaphylos pungens, Cercocarpus montanus, Purshia* spp. *Garrya wrightii, Quercus turbinella, Frangula betulifolia (=Syn Rhamnus betulifolia),* or *Rhus* spp. may be present, but do not dominate. The graminoid layer is usually prominent between trees is grassland or steppe that is dominated by warm-season grasses such as *Aristida* spp., *Bouteloua gracilis, Bouteloua curtipendula, Bouteloua rothrockii, Digitaria californica, Eragrostis intermedia, Hilaria belangeri, Leptochloa dubia, Muhlenbergia* spp., *Pleuraphis jamesii*, or *Schizachyrium cirratum;* species typical of Chihuahuan Piedmont Semi-Desert Grassland (CES302.735). This system includes seral stands dominated by shrubby Madrean oaks typically with strong graminoid layer. In transition areas with dryer chaparral systems, stands of chaparral are not dominated by Madrean oaks, however Madrean encinal may extend down along drainages.

Comments: Although some stands may be shrubby especially in the north, E. Muldavin says encinal is considered woodland in Mexico.

DISTRIBUTION

Range: Sierra Madre Occidentale and Sierra Madre Orientale in Mexico, Trans-Pecos Texas, southern New Mexico and southeastern Arizona.
Ecological Divisions: 305
TNC Ecoregions: 22:C, 23:C, 24:C, 30:P
Subnations/Nations: AZ:c, NM:c, nMX:c, TX:c

CONCEPT

Alliances and Associations:

- CUPRESSUS ARIZONICA FOREST ALLIANCE (A.163)
  Cupressus arizonica / Quercus hypoleucoides Forest (CEGL000352)
  Cupressus arizonica / Quercus turbinella Forest (CEGL000353)
- QUERCUS ARIZONICA WOODLAND ALLIANCE (A.482)
  Quercus arizonica / Bouteloua curtipendula Woodland (CEGL000680)
  Quercus arizonica / Muhlenbergia emersleyi Woodland (CEGL000681)
- QUERCUS EMORYI WOODLAND ALLIANCE (A.483)
  Quercus emoryi / Arctostaphylos pungens Woodland (CEGL000682)
  Quercus emoryi / Bouteloua curtipendula Woodland (CEGL000683)
  Quercus emoryi / Dasylirion wheeleri Woodland (CEGL000684)
  Quercus emoryi / Muhlenbergia emersleyi Woodland (CEGL000685)
  Quercus emoryi / Piptochaetium fimbriatum Woodland (CEGL000686)
  Quercus emoryi / Schizachyrium cirratum Woodland (CEGL000687)
  Quercus emoryi / Sporobolus flexuosus Woodland (CEGL000688)
- QUERCUS GRISEA WOODLAND ALLIANCE (A.478)
  Quercus grisea / Bouteloua curtipendula Woodland (CEGL000689)
  Quercus grisea / Cercocarpus montanus Woodland (CEGL000690)
  Quercus grisea / Juniperus deppeana Woodland (CEGL003521)
  Quercus grisea / Rhus trilobata Woodland (CEGL000691)
- QUERCUS INTRICATA SHRUBLAND ALLIANCE (A.781)
  Quercus intricata - Dasylirion leiophyllum Shrubland (CEGL004530)
- QUERCUS OBLONGIFOLIA SHRUBLAND ALLIANCE (A.791)
  Quercus oblongifolia / Bouteloua curtipendula Shrubland (CEGL000973)
  Quercus oblongifolia / Dasylirion wheeleri Shrubland (CEGL000974)
- QUERCUS PUNGENS SHRUBLAND ALLIANCE (A.783)
  Quercus pungens - Cercocarpus montanus Shrubland (CEGL003832)
- QUERCUS TOUMEYI SHRUBLAND ALLIANCE (A.792)
  Quercus toumeyi / Bouteloua curtipendula Shrubland (CEGL000975)
  Quercus toumeyi / Muhlenbergia emersleyi Shrubland (CEGL000976)

SOURCES

References: Barbour and Billings 2000, Brown 1982, Brown et al. 1980, Brown et al. 1998
Last updated: 20 Feb 2003 **Stakeholders:** WCS, SCS
Concept Author: NatureServe Western Ecology Team **LeadResp:** WCS

S111 MADREAN UPPER MONTANE CONIFER-OAK FOREST AND WOODLAND

Division 305, Forest and Woodland, CES305.798

Spatial Scale & Pattern: Large Patch **Classification Confidence:** medium
Required Classifiers: Natural/Semi-natural, Vegetated (>10% vasc.), Upland
Diagnostic Classifiers: Montane [Montane], Forest and Woodland (Treed), Tropical/Subtropical [Tropical Xeric], Xeric, F-Patch/Medium Intensity, Abies coahuilensis, Quercus hypoleucoides, Q. rugosa

Non-Diagnostic Classifiers: Sideslope, Toeslope/Valley Bottom, Mesotrophic Soil, Deep Soil, Sand Soil Texture, Long Disturbance Interval

Concept Summary: This system occurs at the upper elevations in the Sierra Madre Occidentale and Sierra Madre Orientale. In the U.S., it is restricted to north and east aspects at high elevations (1980-2440 m) in the Sky Islands (Chiricahua, Huachuca, Pinaleno, Santa Catalina, and Santa Rita mountains) and along the Nantanes Rim. It is more common in Mexico and does not occur in Arizona central highlands. The vegetation is characterized by large- and small-patch forests and woodlands dominated by *Pseudotsuga menziesii*, *Abies coahuilensis*, or *Abies concolor* and

Madrean oaks such as *Quercus hypoleucoides* and *Quercus rugosa*. It is similar to Rocky Mountain Montane Dry-Mesic Mixed Conifer Forest and Woodland (CES306.823).

DISTRIBUTION

Range: Sierra Madre Occidentale and Sierra Madre Orientale; in the U.S., it is restricted to north and east aspects at high elevations (1980-2440 m) in the Sky Islands (Chiricahua, Huachuca, Pinaleno, Santa Catalina, and Santa Rita mountains) and along the Nantanes Rim.
Ecological Divisions: 305
TNC Ecoregions: 22:C
Subnations/Nations: AZ:c, NM:, nMX:c

CONCEPT

Alliances and Associations:

- PSEUDOTSUGA MENZIESII FOREST ALLIANCE (A.157)
  Pseudotsuga menziesii / Quercus hypoleucoides Forest (CEGL000453)
  Pseudotsuga menziesii / Quercus rugosa Forest (CEGL000454)

SOURCES

Last updated: 20 Feb 2003 **Stakeholders:** WCS, SCS
Concept Author: NatureServe Western Ecology Team **LeadResp:** WCS

S112 MADREAN PINYON-JUNIPER WOODLAND

Division 305, Forest and Woodland, CES305.797

Spatial Scale & Pattern: Matrix **Classification Confidence:** medium
Required Classifiers: Natural/Semi-natural, Vegetated (>10% vasc.), Upland
Diagnostic Classifiers: Montane [Lower Montane], Tropical/Subtropical [Tropical Xeric], Shallow Soil, Xeric, F-Patch/Medium Intensity, Needle-Leaved Tree, Evergreen Sclerophyllous Shrub, Pinus cembroides, Juniperus deppeana

Non-Diagnostic Classifiers: Forest and Woodland (Treed), Shrubland (Shrub-dominated), Sideslope, Intermediate Disturbance Interval, Broad-Leaved Evergreen Tree, Xeromorphic Shrub

Concept Summary: This system occurs on foothills, mountains and plateaus in the Sierra Madre Occidentale and Sierra Madre Orientale in Mexico, Trans-Pecos Texas, southern New Mexico and in southern and central Arizona, from the Mogollon Rim south to the Sky Islands. Substrates are variable, but soils are generally dry and rocky. The presence of *Pinus cembroides*, *Pinus discolor*, or other Madrean trees and shrubs is diagnostic of this woodland system. *Juniperus coahuilensis*, *Juniperus deppeana*, *Juniperus pinchotii*, *Juniperus monosperma*, and/or *Pinus edulis* may be present to dominant. Madrean oaks such as *Quercus arizonica*, *Quercus emoryi*, *Quercus grisea* or Quercus mohriana may be codominant. *Pinus ponderosa* is absent or sparse. If present, understory layers are variable and may be dominated by shrubs or graminoids.

DISTRIBUTION

Range: Sierra Madre Occidentale and Sierra Madre Orientale in Mexico, Trans-Pecos Texas, southern New Mexico and Arizona, generally south of the Mogollon Rim.
Ecological Divisions: 305
TNC Ecoregions: 22:C, 24:C, 30:C
Subnations/Nations: AZ:c, NM:c, nMX:c, TX:c

CONCEPT

Alliances and Associations:

- CUPRESSUS ARIZONICA FOREST ALLIANCE (A.163)
  Cupressus arizonica / Quercus hypoleucoides Forest (CEGL000352)
  Cupressus arizonica / Quercus turbinella Forest (CEGL000353)
- JUNIPERUS COAHUILENSIS WOODLAND ALLIANCE (A.503)
  Juniperus coahuilensis / Bouteloua curtipendula - Bouteloua gracilis Woodland (CEGL004584)
  Juniperus coahuilensis / Bouteloua eriopoda Woodland (CEGL000700)
  Juniperus coahuilensis / Canotia holacantha Woodland (CEGL000701)
  Juniperus coahuilensis / Quercus turbinella Woodland (CEGL000702)

- JUNIPERUS DEPPEANA WOODLAND ALLIANCE (A.534)
  Juniperus deppeana - Juniperus monosperma - Quercus grisea / Rhus trilobata Woodland (CEGL000696)
  Juniperus deppeana - Juniperus monosperma / Cercocarpus montanus - Ceanothus greggii Woodland (CEGL000695)
  Juniperus deppeana / Arctostaphylos pungens Woodland (CEGL000692)
  Juniperus deppeana / Muhlenbergia emersleyi Woodland (CEGL000697)
  Juniperus deppeana / Panicum obtusum Woodland (CEGL000698)
- JUNIPERUS MONOSPERMA WOODLAND ALLIANCE (A.504)
  Juniperus monosperma - Quercus mohriana Woodland (CEGL002120)
  Juniperus monosperma / Agave lechuguilla Woodland (CEGL000703)
  Juniperus monosperma / Larrea tridentata Woodland (CEGL000717)
  Juniperus monosperma / Nolina microcarpa - Agave lechuguilla Woodland (CEGL000718)
  Juniperus monosperma / Prosopis glandulosa Woodland (CEGL000719)
- JUNIPERUS PINCHOTII WOODLAND ALLIANCE (A.505)
  Juniperus pinchotii / Bouteloua curtipendula - Bouteloua hirsuta Woodland (CEGL004940)
  Juniperus pinchotii / Bouteloua gracilis Woodland (CEGL002122)
- PINUS CEMBROIDES - QUERCUS GRAVESII FOREST ALLIANCE (A.392)
  Pinus cembroides - Quercus gravesii - Juniperus flaccida / Salvia regla / Piptochaetium fimbriatum Forest (CEGL004600)
- PINUS CEMBROIDES WOODLAND ALLIANCE (A.510)
  Pinus cembroides - Quercus grisea - Juniperus flaccida / Salvia regla / Muhlenbergia emersleyi Woodland (CEGL004596)
  Pinus cembroides - Quercus grisea - Quercus emoryi - Juniperus flaccida / Salvia regla / Bouteloua curtipendula Woodland (CEGL004597)
  Pinus cembroides - Quercus grisea - Quercus emoryi / Mimosa dysocarpa / Bouteloua gracilis Woodland (CEGL004598)
  Pinus cembroides - Quercus grisea / Agave lechuguilla / Bouteloua curtipendula Woodland (CEGL003551)
  Pinus cembroides - Quercus grisea / Muhlenbergia montana - Piptochaetium pringlei Woodland (CEGL004599)
- PINUS DISCOLOR WOODLAND ALLIANCE (A.538)
  Pinus (discolor, cembroides) / Quercus arizonica / Muhlenbergia emersleyi Woodland (CEGL000769)
  Pinus discolor / Muhlenbergia emersleyi Woodland (CEGL000767)
  Pinus discolor / Piptochaetium fimbriatum Woodland (CEGL000768)
  Pinus discolor / Quercus gambelii Woodland (CEGL000770)
  Pinus discolor / Quercus hypoleucoides Woodland (CEGL000771)
  Pinus discolor / Quercus rugosa Woodland (CEGL000772)
  Pinus discolor / Quercus toumeyi Woodland (CEGL000773)
- PINUS EDULIS - (JUNIPERUS SPP.) WOODLAND ALLIANCE (A.516)
  Pinus edulis - Quercus arizonica / Rhus trilobata Woodland (CEGL000790)
- PINUS REMOTA WOODLAND ALLIANCE (A.523)
  Pinus remota / Juniperus pinchotii - Quercus mohriana Woodland (CEGL004585)

SOURCES

Last updated: 20 Feb 2003 **Stakeholders:** WCS, SCS
Concept Author: NatureServe Western Ecology Team **LeadResp:** WCS

S121 MEDITERRANEAN CALIFORNIA RED FIR FOREST AND WOODLAND

Division 206, Forest and Woodland, CES206.913

Spatial Scale & Pattern: Large Patch **Classification Confidence:** medium
Required Classifiers: Natural/Semi-natural, Vegetated (>10% vasc.), Upland
Diagnostic Classifiers: Montane [Upper Montane], Forest and Woodland (Treed), Mediterranean [Mediterranean Pluviseasonal-Oceanic], Deep Soil, Ustic, Long Disturbance Interval, Abies magnifica (= var. magnifica)

Non-Diagnostic Classifiers: Sideslope, Toeslope/Valley Bottom, Sand Soil Texture, F-Patch/High Intensity, W-Patch/High Intensity

Concept Summary: This system includes high-elevation (1600-2700 m [4850-8200 feet]) forests and woodlands dominated by *Abies magnifica (= var. magnifica), Abies X shastensis (= Abies magnifica var. shastensis), Abies procera*, and *Pinus contorta var. murrayana*. It is typically found on deep, well-drained soils throughout this elevation zone from the central Sierra Nevada north and west into southern Oregon. Heavy snowpack is a major source of soil moisture throughout the growing season. Driving ecological processes are occasional blow-down, insect outbreaks and stand-replacing fire. Common understory species include *Lonicera conjugialis, Quercus vacciniifolia, Ribes viscosissimum*, and *Symphoricarpos rotundifolius*. This system commonly occurs above mixed conifer forests with *Abies concolor* and overlaps in elevation with forests and woodlands of *Pinus contorta var. murrayana*.

DISTRIBUTION

Range: It is typically found on deep, well-drained soils throughout the high-elevation zone (1600-2700 m [4850-8200 feet]) from the central Sierra Nevada north and west into southern Oregon.
Ecological Divisions: 206
TNC Ecoregions: 12:C, 5:C
Subnations/Nations: CA:c, NV:c, OR:c

CONCEPT

- **California community types:**
- Huckleberry Oak (37.414.01)
- Jeffrey Pine - Red Fir (87.205.01)
- Jeffrey Pine - White Fir - Red Fir (87.205.03)
- Red Fir Forest (88.200.00)
- Shasta Fir / Sadler Oak (88.200.01)
- Shasta Fir / Thinleaf Huckleberry (88.200.02)
- Shasta Fir / Vanilla Leaf (88.200.03)
- Shasta Fir / Prince's-pine (88.200.05)
- Shasta Fir / Slender Penstemon (88.200.06)
- Red Fir / Sadler Oak (88.200.08)
- Red Fir / Sadler Oak - Pinemat Manzanita (88.200.09)
- Red Fir - Incense-cedar (88.200.10)
- Red Fir / One-sided Shinleaf (88.200.11)
- Red Fir / Rhododendron (88.200.12)
- Red Fir - Brewer Spruce / Sadler Oak -Thinleaf Huckleberry (88.200.14)
- Red Fir -Mountain Hemlock / One-sided Shinleaf (88.200.15)
- Red Fir (88.200.23)
- Red Fir / Lodgepole Pine / Whiteflower Hawkweed (88.200.24)
- Red Fir / Lodgepole Pine (88.200.25)
- Red Fir / Mule's Ears (88.200.26)
- Red Fir / Pinemat Manzanita (88.200.27)
- Red Fir / Western White Pine / Pinemat Manzanita (88.200.28)
- Red Fir - Western White Pine - Lodgepole Pine (88.200.29)
- Red Fir - Western White Pine (88.200.30)
- Red Fir / Western White Pine / Bush Chinquapin (88.200.31)
- Shasta Fir / Black-laurel (88.200.35)
- Shasta Fir / Huckleberry Oak (88.200.36)
- Shasta Fir / Twinflower (88.200.37)
- Shasta Fir / White-veined Shinleaf (88.200.38)
- Shasta Fir / Pinemat Manzanita (88.200.39)
- Red Fir / Silver Bush Lupine (88.200.41)
- Red Fir / White-veined Shinleaf (88.200.42)
- Red Fir - White Fir Forest (88.520.00)
- Red Fir - White Fir (88.520.01)
- Red Fir - White Fir / Bracken (88.520.02)
- Red Fir - White Fir / Heartleaf Arnica (88.520.03)
- Red Fir - White Fir / Creeping Snowberry / White-veined Shinleaf (88.520.04)
- Red Fir - White Fir / Creeping Snowberry - Wild Rose (88.520.05)
- Red Fir - White Fir / Sadler Oak (88.520.06)
- Red Fir - White Fir / Pinemat Manzanita (88.520.07)
- Red Fir - White Fir / Vanilla Leaf (88.520.08)
- Red Fir - White Fir - Jeffrey Pine (88.520.09)
- Red Fir - White Fir - Sugar Pine (88.520.10)
- Shasta Fir - White Fir / Mountain Maple (88.520.11)
- Shasta Fir - White Fir / Pinemat Manzanita (88.520.12)
- Shasta Fir - White Fir / Trail Penstemon - Mountain Monardella (88.520.13)
- White Fir - Shasta Fir / Sadler Oak (88.520.14)
- White Fir - Shasta Fir / White-veined Shinleaf (88.520.15)
- White Fir - Shasta Fir / Threeleaf Anemone (88.520.16)

SOURCES

References: Barbour and Billings 2000, Barbour and Major 1988, Holland and Keil 1995, Sawyer and Keeler-Wolf 1995

Last updated: 17 Mar 2003 **Stakeholders:** WCS

Concept Author: P. Comer, T. Keeler-Wolf **LeadResp:** WCS

S122 SIERRA NEVADA SUBALPINE LODGEPOLE PINE FOREST AND WOODLAND

Division 206, Forest and Woodland, CES206.912

Spatial Scale & Pattern: Large Patch **Classification Confidence:** medium

Required Classifiers: Natural/Semi-natural, Vegetated (>10% vasc.), Upland

Diagnostic Classifiers: Montane [Upper Montane], Mediterranean [Mediterranean Xeric-Oceanic], Shallow Soil, Xeric, Short Disturbance Interval [Periodicity/Irregular Disturbance], Pinus contorta

Non-Diagnostic Classifiers: Forest and Woodland (Treed), Acidic Soil, Sand Soil Texture, F-Patch/High Intensity, Avalanche, Needle-Leaved Tree

Concept Summary: This system is widespread in glacial basins at upper montane to subalpine elevations of the central and northern Sierra Nevada and Peninsular Ranges where cold-dry conditions exist (1800-2450 m [6000-8000 feet] in the north and 2450-3600 m [8000-12,000 feet] in the south). These forests are dominated by *Pinus contorta var. murrayana* with shrub, grass, or barren understories. Soils are often shallow and coarse-textured. Avalanche, as well as tree mortality from insect outbreak and disease, drought and associated wildfire, are drivers of community structure and composition. Associated plant species include *Arctostaphylos nevadensis*, *Ceanothus cordulatus*, *Cercocarpus ledifolius*, *Chrysolepis sempervirens*, *Phyllodoce breweri*, and *Ribes montigenum*.

DISTRIBUTION

Range: Glacial basins at upper montane to subalpine elevations of the central and northern Sierra Nevada and Peninsular Ranges where cold-dry conditions exist (1800-2450 m [6000-8000 feet] in the north and 2450-3600 m [8000-12,000 feet] in the south).

Ecological Divisions: 206

TNC Ecoregions: 12:C, 4:C, 5:C

Subnations/Nations: CA:c, NV:c, OR:c

CONCEPT

- **California community types:**
- Aspen - Lodgepole Pine / Big Sagebrush / Kentucky blue-grass (61.111.11)
- Curlleaf Mountain-Mahogany - Big Sagebrush (76.200.01)
- Curlleaf Mountain-Mahogany / Roundleaf Snowberry (76.200.02)
- Lodgepole Pine Forest and Woodland (87.080.00)
- Lodgepole Pine (87.080.01)
- Lodgepole Pine / Big Sagebrush (87.080.02)
- Lodgepole Pine / Gray Lovage (87.080.03)
- Lodgepole Pine / Open (87.080.04)
- Lodgepole Pine / Pussypaws (87.080.05)
- Lodgepole Pine / Ross Sedge (87.080.06)
- Lodgepole Pine / Fendler Meadow-rue (87.080.07)
- Lodgepole Pine / Labrador-Tea (87.080.08)
- Lodgepole Pine / Shorthair Sedge (87.080.10)
- Lodgepole Pine / Mountain Pride Penstemon (87.080.12)

SOURCES

References: Barbour and Billings 2000, Barbour and Major 1988, Holland and Keil 1995, Sawyer and Keeler-Wolf 1995

Last updated: 17 Mar 2003 **Stakeholders:** WCS

Concept Author: P. Comer, T. Keeler-Wolf **LeadResp:** WCS

S123 MEDITERRANEAN CALIFORNIA PONDEROSA-JEFFREY PINE FOREST AND WOODLAND

Division 206, Forest and Woodland, CES206.918

Spatial Scale & Pattern: Large Patch **Classification Confidence:** medium
Required Classifiers: Natural/Semi-natural, Vegetated (>10% vasc.), Upland
Diagnostic Classifiers: Forest and Woodland (Treed), Shrubland (Shrub-dominated), Mediterranean [Mediterranean Xeric-Oceanic], F-Patch/Low Intensity, Needle-Leaved Tree, Broad-Leaved Evergreen Shrub, Pinus jeffreyi

Non-Diagnostic Classifiers: Montane [Montane], Montane [Lower Montane], Acidic Soil, F-Patch/Medium Intensity, Graminoid

Concept Summary: These forests are found on warm, xeric sites in foothills and mountains from southern Oregon (600-1830 m [1800-5000 feet]) south throughout the Transverse Ranges and into northern Baja California (1200-2740 m [4000-8300 feet]). While the two dominant pines tend to segregate by soil fertility and temperature regimes, they may co-occur in certain areas (e.g., Modoc Plateau). *Pinus jeffreyi* replaces *Pinus ponderosa* as dominant at higher elevations. Understory species include *Arctostaphylos patula, Ceanothus cordulatus, Ceanothus prostratus, Ceanothus integerrimus, Eriogonum wrightii, Frangula rubra (= Rhamnus rubra), Lupinus elatus*, and *Symphoricarpos rotundifolius var. parishii (= Symphoricarpos parishii)*. Historically, frequent localized ground fires maintained these systems.

DISTRIBUTION

Range: Foothills and mountains from southern Oregon (600-1830 m [1800-5000 feet]) south throughout the Transverse Ranges and into northern Baja California (1200-2740 m [4000-8300 feet]).
Ecological Divisions: 206
TNC Ecoregions: 12:C, 14:C, 15:C, 16:C, 5:C
Subnations/Nations: CA:c, MXBC:c, NV:c, OR:c

CONCEPT

- **California community types:**
- Ponderosa Pine / Antelope Bitterbrush / Bolander Bedstraw (87.010.01)
- Ponderosa Pine / Mountain Misery (87.010.02)
- Ponderosa Pine / Greenleaf Manzanita - Mountain Misery (87.010.03)
- Ponderosa Pine / Big Sagebrush (87.010.04)
- Ponderosa Pine / Antelope Bitterbrush (87.010.05)
- Ponderosa Pine / California Brome (87.010.06)
- Ponderosa Pine / Shrubby Bedstraw (87.010.07)
- Ponderosa Pine/ Mahala Carpet (87.010.08)
- Ponderosa Pine / Wedgeleaf Ceanothus (87.010.09)
- Ponderosa Pine / Antelope Bitterbrush / Arrowleaf Balsam Root (87.010.10)
- Ponderosa Pine / Antelope Bitterbrush - Choke Cherry /Orcutt Brome (87.010.11)
- Ponderosa Pine / Antelope Bitterbrush / Columbia Needlegrass / Pumice (87.010.12)
- Ponderosa Pine / Antelope Bitterbrush - Greenleaf Manzanita / Columbia Needlegrass (87.010.13)
- Ponderosa Pine / Antelope Bitterbrush - Tobacco Brush (87.010.14)
- Ponderosa Pine / Antelope Bitterbrush / Tower Butterweed/ Granite (87.010.15)
- Ponderosa Pine / Antelope Bitterbrush - Wax Currant /Orcutt Brome (87.010.16)
- Ponderosa Pine - Black Oak / Curlleaf Mountain-mahogany (87.010.17)
- Ponderosa Pine / Columbia Needlegrass (87.010.18)
- Ponderosa Pine / Curlleaf Mountain-mahogany - Antelope Bitterbrush / Idaho Fescue (87.010.19)
- Ponderosa Pine / Curlleaf Mountain-mahogany / Blue Wheatgrass (87.010.20)
- Ponderosa Pine - Douglas-fir / Antelope Bitterbrush /Mule's Ears (87.010.21)
- Ponderosa Pine - Interior Live Oak (87.010.22)
- Ponderosa Pine - Lodgepole Pine / Service Berry (87.010.23)
- Ponderosa Pine / Mountain Big Sagebrush / Idaho Fescue (87.010.24)
- Ponderosa Pine / Mountain Big Sagebrush - Antelope Bitterbrush (87.010.25)
- Ponderosa Pine / Service Berry - Choke Cherry (87.010.26)
- Ponderosa Pine / Service Berry - Creeping Oregon-grape /Heartleaf Arnica (87.010.27)
- Ponderosa Pine / Tobacco Bush / Columbia Needlegrass (87.010.28)
- Ponderosa Pine / Desert Snowberry (87.010.29)
- Ponderosa Pine - Canyon Live Oak (87.010.30)
- Ponderosa Pine / Whiteleaf Manzanita / Ripgut Brome (87.010.36)
- Ponderosa Pine - Incense Cedar Forest (87.015.00)
- Ponderosa Pine - Incense Cedar-Canyon Oak / Mountain Misery (87.015.04)
- Jeffrey Pine Forest and Woodland (87.020.00)

- Jeffrey Pine / Sadler Oak / Bear-grass (87.020.01)
- Jeffrey Pine / Idaho Fescue (87.020.03)
- Jeffrey Pine / Greenleaf Manzanita (87.020.09)
- Jeffrey Pine / Mountain Whitethorn (87.020.10)
- Jeffrey Pine / Antelope Bitterbrush/ Mule's Ears (87.020.12)
- Jeffrey Pine / Antelope Bitterbrush - Curlleaf Mountain-mahogany / Western Needlegrass (87.020.13)
- Jeffrey Pine / Antelope Bitterbrush - Desert Snowberry / Wheeler Bluegrass (87.020.14)
- Jeffrey Pine - Black Oak / One-sided Bluegrass (87.020.15)
- Jeffrey Pine - Black Oak / Basket Bush (87.020.16)
- Jeffrey Pine / Curlleaf Mountain-mahogany (87.020.17)
- Jeffrey Pine / Mountain Big Sagebrush / Idaho Fescue (87.020.19)
- Jeffrey Pine / Bush Chinquapin (87.020.20)
- Jeffrey Pine / Antelope Bitterbrush (87.020.21)
- Jeffrey Pine / Serpentine-Haplopappus (87.020.22)
- Jeffrey Pine / Tufted Reedgrass (87.020.23)
- Jeffrey Pine / Pinemat Manzanita (87.020.24)
- Jeffrey Pine - Singleleaf Pinyon (87.020.26)
- Washoe Pine Woodland (87.120.00)
- Washoe Pine / Tailed Lupine (87.120.01)
- Washoe Pine / Desert Snowberry / Sticky Starwort (87.120.02)
- Washoe Pine / Pinemat Manzanita (87.120.03)
- Jeffrey Pine - Ponderosa Pine Forest and Woodland (87.200.00)
- Jeffrey Pine - Ponderosa Pine / Arrowleaf Balsam Root (87.200.01)
- Jeffrey Pine - Ponderosa Pine / Antelope Bitterbrush /Idaho Fescue (87.200.02)
- Jeffrey Pine - Ponderosa Pine / Antelope Bitterbrush /Idaho Fescue / Granite (87.200.03)
- Jeffrey Pine - Ponderosa Pine / Modoc Coffeeberry / One-sided Bluegrass (87.200.04)
- Jeffrey Pine - Ponderosa Pine / Huckleberry Oak (87.200.05)
- Jeffrey Pine - Ponderosa Pine / Columbia Needlegrass / Oregon Ash (87.200.06)
- Jeffrey Pine - Ponderosa Pine / Creeping Snowberry /Mule's Ears (87.200.07)

SOURCES

References: Barbour and Billings 2000, Barbour and Major 1988, Holland and Keil 1995, Sawyer and Keeler-Wolf 1995

Last updated: 17 Mar 2003 **Stakeholders:** WCS

Concept Author: P. Comer, T. Keeler-Wolf **LeadResp:** WCS

S125 ROCKY MOUNTAIN FOOTHILL LIMBER PINE-JUNIPER WOODLAND

Division 306, Forest and Woodland, CES306.955

Spatial Scale & Pattern: Large Patch **Classification Confidence:** low

Required Classifiers: Natural/Semi-natural, Vegetated (>10% vasc.), Upland

Diagnostic Classifiers: Lowland [Foothill], Forest and Woodland (Treed), Very Shallow Soil, Mineral: W/ A-Horizon <10 cm, Sand Soil Texture, Aridic, Long Disturbance Interval, F-Patch/High Intensity, Needle-Leaved Tree, Pinus flexilis, Juniperus scopulorum, J. osteosperma

Non-Diagnostic Classifiers: Montane [Lower Montane], Escarpment, Hillslope bedrock outcrop, Ridgetop bedrock outcrop, Ridge/Summit/Upper Slope, Sideslope, Temperate [Temperate Continental], Loam Soil Texture

Concept Summary: This ecological system occurs in foothill and lower montane zones in the Rocky Mountains from northern Montana south to central Colorado and on escarpments across Wyoming extending out into the western Great Plains. Elevation ranges from 1000-2400 m. It is restricted to shallow soils and fractured bedrock derived from a variety of parent material including limestone, sandstone, dolomite, granite and colluvium. Soils have a high rock component (typically over 50% cover) and are coarse to fine-textured, often gravelly and calcareous. Slopes are typically moderately steep to steep. At higher elevations it is limited to the most xeric aspects on rock outcrops, and at lower elevations to the relatively mesic north aspects. Fire is infrequent and spotty because rocky substrates prevent a continuous vegetation canopy needed to spread. Vegetation is characterized by an open tree canopy or patchy woodland that is dominated by either *Pinus flexilis, Juniperus osteosperma*, or *Juniperus scopulorum*. *Pinus edulis* is not present. A sparse to moderately dense short-shrub layer, if present, may include a variety of shrubs, such as *Artemisia nova, Artemisia tridentata, Cercocarpus ledifolius, Cercocarpus montanus,*

Cornus sericea, Ericameria nauseosa, Purshia tridentata, Rhus trilobata, or *Rosa woodsii*. Herbaceous layers are generally sparse, but range to moderately dense and are typically dominated by perennial graminoids such as *Bouteloua gracilis, Leucopoa kingii, Hesperostipa comata, Koeleria macrantha, Piptatherum micranthum, Poa secunda*, or *Pseudoroegneria spicata*. Within this ecological system there may be small patches of grassland or shrubland composed of some of the above species.

DISTRIBUTION

Range: Occurs in foothill and lower montane zones in the Rocky Mountains from northern Montana south to central Colorado and on escarpments across Wyoming extending out into the western Great Plains. Elevation ranges from 1000-2400 m.
Ecological Divisions: 303, 306
TNC Ecoregions: 10:C, 20:C, 25:P, 26:C, 27:C, 8:C, 9:C
Subnations/Nations: CO:c, MT:c, ND:p, SD:p, WY:c

CONCEPT

Alliances and Associations:

- JUNIPERUS OSTEOSPERMA WOODLAND ALLIANCE (A.536)
  Juniperus osteosperma / Artemisia tridentata Woodland (CEGL000730)
  Juniperus osteosperma / Cercocarpus ledifolius Woodland (CEGL000734)
  Juniperus osteosperma / Cercocarpus montanus Woodland (CEGL000735)
  Juniperus osteosperma / Pseudoroegneria spicata Woodland (CEGL000738)
- JUNIPERUS SCOPULORUM TEMPORARILY FLOODED WOODLAND ALLIANCE (A.563)
  Juniperus scopulorum / Cornus sericea Woodland (CEGL000746)
- JUNIPERUS SCOPULORUM WOODLAND ALLIANCE (A.506)
  Juniperus scopulorum / Artemisia nova Woodland (CEGL000742)
  Juniperus scopulorum / Artemisia tridentata Woodland (CEGL000743)
  Juniperus scopulorum / Cercocarpus ledifolius Woodland (CEGL000744)
  Juniperus scopulorum / Cercocarpus montanus Woodland (CEGL000745)
  Juniperus scopulorum / Piptatherum micranthum Woodland (CEGL000747)
  Juniperus scopulorum / Pseudoroegneria spicata Woodland (CEGL000748)
  Juniperus scopulorum / Purshia tridentata Woodland (CEGL000749)
  Juniperus scopulorum / Schizachyrium scoparium Woodland (CEGL000750)
- KRASCHENINNIKOVIA LANATA DWARF-SHRUBLAND ALLIANCE (A.1104)
  Krascheninnikovia lanata / Phlox spp. Dwarf-shrubland (CEGL001325)
- PINUS FLEXILIS WOODLAND ALLIANCE (A.540)
  Pinus flexilis / Cercocarpus ledifolius Woodland (CEGL000804)
  Pinus flexilis / Festuca campestris Woodland (CEGL000806)
  Pinus flexilis / Festuca idahoensis Woodland (CEGL000805)
  Pinus flexilis / Juniperus communis Woodland (CEGL000807)
  Pinus flexilis / Juniperus osteosperma Woodland (CEGL000808)
  Pinus flexilis / Juniperus scopulorum Woodland (CEGL000809)
  Pinus flexilis / Leucopoa kingii Woodland (CEGL000810)
  Pinus flexilis / Pseudoroegneria spicata Woodland (CEGL000813)
  Pinus flexilis / Scree Woodland (CEGL000815)

SOURCES

References: Canadian Rockies Ecoregional Plan 2002, DeVelice and Lesica 1993, Hansen and Hoffman 1988, Knight 1994, Knight et al. 1987, Thilenius et al. 1995
Last updated: 20 Mar 2003 **Stakeholders:** WCS, CAN
Concept Author: G. Jones, K. Schulz **LeadResp:** WCS

NLCD Mixed Forest Types

Areas dominated by trees generally greater than 5 meters tall, and greater than 20% of total vegetation cover. Neither deciduous nor evergreen species are greater than 75 percent total tree cover.

S042 INTER-MOUNTAIN WEST ASPEN-MIXED CONIFER FOREST AND WOODLAND COMPLEX

Spatial Scale & Pattern: Matrix/Large and Small Patch

This SW Regional GAP Landcover Type is complex of Ecological Systems from the Intermountain Basins and Southern Rocky Mountains. Throughout most of the project area this landcover type is synonymous with the Inter-Mountain Basins Aspen-Mixed Conifer Forest and Woodland ecological system (eastern Nevada and Utah and extreme western Colorado) as described below. In Southern Rockies, northern Arizona and northern New Mexico, it also represents larger patches of mixed stands of aspen and conifers trees that are included in concepts of S028 Rocky Mountain Subalpine Dry-Mesic Spruce-Fir Forest and Woodland, S030 Rocky Mountain Subalpine Mesic Spruce-Fir Forest and Woodland, S031 Rocky Mountain Lodgepole Pine Forest, S032 Rocky Mountain Montane Dry-Mesic Mixed Conifer Forest and Woodland, S034 Rocky Mountain Montane Mesic Mixed Conifer Forest and Woodland, and S036 Rocky Mountain Ponderosa Pine Woodland (see descriptions). This complex of systems is intended to capture the important habitat characteristists of mixed aspen-conifer stands that occur throughout the region without the complicating the ledgend and mapping process.

Inter-Mountain Basins Aspen-Mixed Conifer Forest and Woodland

Division 304, Forest and Woodland, (CES304.776)
Spatial Scale & Pattern: Matrix
Required Classifiers: Natural/Semi-natural, Vegetated (>10% vasc.), Upland
Diagnostic Classifiers: Forest and Woodland (Treed), Needle-Leaved Tree, Broad-Leaved Deciduous Tree, Aspen - Conifer Mix

Non-Diagnostic Classifiers: Montane [Upper Montane], Montane [Montane], Montane [Lower Montane], Sideslope, Toeslope/Valley Bottom, Temperate [Temperate Continental]

Concept Summary: This Inter-Mountain Basins Aspen-Mixed Conifer Forest and Woodland ecological system occurs on montane slopes and plateaus in Utah, western Colorado, northern Arizona, eastern Nevada, southern Idaho and western Wyoming. Elevations range from 1700 to 2800 m. Occurrences are typically on gentle to steep slopes on any aspect, but are often found on clay-rich soils in intermontane valleys. Soils are derived from alluvium, colluvium and residuum from a variety of parent materials, but most typically occur on sedimentary rocks. The tree canopy is composed of a mix of deciduous and coniferous species, codominated by *Populus tremuloides* and conifers, including *Pseudotsuga menziesii, Abies concolor, Abies lasiocarpa, Picea engelmannii, Picea pungens, Pinus contorta, Pinus flexilis,* and *Pinus ponderosa*. As the occurrences age, *Populus tremuloides* is slowly reduced until the conifer species become dominant. Common shrubs include *Amelanchier alnifolia, Prunus virginiana, Acer grandidentatum, Symphoricarpos oreophilus, Juniperus communis, Paxistima myrsinites, Rosa woodsii, Spiraea betulifolia, Symphoricarpos albus*, or *Mahonia repens*. Herbaceous species include *Bromus carinatus, Calamagrostis rubescens, Carex geyeri, Elymus glaucus, Poa* spp. and *Stipa* spp., *Achillea millefolium, Arnica cordifolia*, Asteraceae spp., *Erigeron* spp., *Galium boreale, Geranium viscosissimum, Lathyrus* spp., *Lupinus argenteus, Mertensia arizonica, Mertensia lanceolata, Maianthemum stellatum, Osmorhiza berteroi (= Osmorhiza chilensis)*, and *Thalictrum fendleri*. Most occurrences at present represent a late-seral stage of aspen changing to a pure conifer occurrence. Nearly a hundred years of fire suppression and livestock grazing have converted much of the pure aspen occurrences to the present-day aspen-conifer forest and woodland ecological system.

DISTRIBUTION

Range: Occurs on montane slopes and plateaus in Utah, eastern Nevada, southern Idaho and western Wyoming. Elevations range from 1700 to 2800 m.
Ecological Divisions: 304, 306?
TNC Ecoregions: 11:C, 18:C, 19:P, 6:C, 9:C
Subnations/Nations: ID:c, NV:c, UT:c, WY:c

CONCEPT

Alliances and Associations:

- ABIES CONCOLOR - POPULUS TREMULOIDES FOREST ALLIANCE (A.419)
  Populus tremuloides - Abies concolor / Arctostaphylos patula Forest (CEGL000522)
  Populus tremuloides - Abies concolor / Poa pratensis Semi-natural Forest (CEGL002947)
  Populus tremuloides - Abies concolor / Symphoricarpos oreophilus Forest (CEGL000523)

- ABIES LASIOCARPA - POPULUS TREMULOIDES FOREST ALLIANCE (A.422)
  Populus tremuloides - Abies lasiocarpa / Amelanchier alnifolia Forest (CEGL000524)
  Populus tremuloides - Abies lasiocarpa / Carex geyeri Forest (CEGL000525)
  Populus tremuloides - Abies lasiocarpa / Carex rossii Forest (CEGL000526)
  Populus tremuloides - Abies lasiocarpa / Juniperus communis Forest (CEGL000527)
  Populus tremuloides - Abies lasiocarpa / Pedicularis racemosa Forest (CEGL000528)
  Populus tremuloides - Abies lasiocarpa / Shepherdia canadensis Forest (CEGL000529)
  Populus tremuloides - Abies lasiocarpa / Symphoricarpos oreophilus / Bromus carinatus Forest (CEGL000530)
  Populus tremuloides - Abies lasiocarpa / Symphoricarpos oreophilus / Tall Forbs Forest (CEGL000531)
  Populus tremuloides - Abies lasiocarpa / Symphoricarpos oreophilus / Thalictrum fendleri Forest (CEGL000532)
  Populus tremuloides - Abies lasiocarpa / Tall Forbs Forest (CEGL000533)
  Populus tremuloides - Abies lasiocarpa / Thalictrum fendleri Forest (CEGL000534)
- PICEA PUNGENS - POPULUS TREMULOIDES FOREST ALLIANCE (A.423)
  Populus tremuloides - Picea pungens Forest (CEGL000535)
- PINUS CONTORTA - POPULUS TREMULOIDES FOREST ALLIANCE (A.424)
  Populus tremuloides - Pinus contorta / Carex geyeri Forest (CEGL000536)
  Populus tremuloides - Pinus contorta / Juniperus communis Forest (CEGL000537)
  Populus tremuloides - Pinus contorta / Symphoricarpos oreophilus Forest (CEGL000538)
  Populus tremuloides - Pinus contorta / Thalictrum fendleri Forest (CEGL000539)
- PINUS FLEXILIS - POPULUS TREMULOIDES FOREST ALLIANCE (A.425)
  Populus tremuloides - Pinus flexilis Forest (CEGL000540)
- PINUS PONDEROSA - POPULUS TREMULOIDES FOREST ALLIANCE (A.399)
  Pinus ponderosa - Populus tremuloides / Carex spp. - (Poa spp.) Forest (CEGL000191)
  Populus tremuloides - Pinus ponderosa Rocky Mountain Forest (CEGL000541)
- POPULUS TREMULOIDES - PSEUDOTSUGA MENZIESII FOREST ALLIANCE (A.426)
  Populus tremuloides - Pseudotsuga menziesii / Amelanchier alnifolia Forest (CEGL000543)
  Populus tremuloides - Pseudotsuga menziesii / Calamagrostis rubescens Forest (CEGL000544)
  Populus tremuloides - Pseudotsuga menziesii / Juniperus communis Forest (CEGL000545)
  Populus tremuloides - Pseudotsuga menziesii / Symphoricarpos oreophilus Forest (CEGL000546)

Environment: The aspen-conifer forest and woodland ecological system is very similar to the aspen forest ecological system with regards to environmental characteristics. It is usually found on montane slopes and plateaus in western Wyoming, Idaho, Utah, eastern Nevada. Elevations range from 1700 to 2800 m. Climate is temperate with cold winters. Mean annual precipitation is greater than 38 cm and typically greater than 50 cm. Occurrences are typically on gentle to steep slopes on any aspect. Soils are derived from alluvium, colluvium and residuum from a variety of parent materials, but most typically occur on sedimentary rocks.

Distribution of this ecological system is primarily limited by adequate soil moisture required to meet its high evapotranspiration demand (Mueggler 1988). Secondarily, its range is limited by the length of the growing season; or low temperatures (Mueggler 1988). Topography is variable, sites range from level to steep slopes. Aspect varies according to the limiting factors. Occurrences at high elevations are restricted by cold temperatures and are found on warmer southern aspects. At lower elevations aspen is restricted by lack of moisture and is found on cooler north aspects and mesic microsites. The soils are typically deep and well-developed with rock often absent from the soil. Soil texture ranges from sandy loam to clay 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).

Vegetation: The open to moderately closed, mixed evergreen needle-leaved and deciduous broad-leaved tree canopy is composed of short to moderately tall trees, and is codominated by *Populus tremuloides* and conifers, including *Pseudotsuga menziesii, Abies concolor, Abies lasiocarpa, Picea engelmannii, Picea pungens, Pinus contorta, Pinus flexilis*, and *Pinus ponderosa*. As the occurrences age, *Populus tremuloides* is slowly reduced until the conifer species becomes dominant (Mueggler 1988).

The sparse to moderately dense understory may be structurally complex and includes tall-shrub, short-shrub and herbaceous layers, or simple with just an herbaceous layer. Because of the open growth form of *Populus tremuloides*, more light can penetrate the canopy than in a pure conifer occurrence. Typically the understory is usually denser in younger occurrences that are dominated by *Populus tremuloides*, and in more mesic sites with open canopies. If present the tall-shrub layer may be dominated by *Amelanchier alnifolia, Prunus virginiana*, or *Acer grandidentatum*, and short-shrub by *Symphoricarpos oreophilus, Juniperus communis*, or *Mahonia repens*. Other common shrubs include *Paxistima myrsinites, Rosa woodsii, Spiraea betulifolia, Symphoricarpos albus*, and

in wet areas *Salix scouleriana*. Where dense, the herbaceous layer is often dominated by graminoids such as *Bromus carinatus, Calamagrostis rubescens, Carex geyeri, Elymus glaucus, Poa* spp., and *Stipa* spp. More sparse herbaceous layers are generally a more even mixture of forbs like *Achillea millefolium, Arnica cordifolia, Eucephalus engelmannii (= Aster engelmannii), Erigeron speciosus, Fragaria vesca, Galium boreale, Geranium viscosissimum, Lathyrus* spp., *Lupinus argenteus, Mertensia arizonica, Mertensia lanceolata, Maianthemum stellatum, Osmorhiza berteroi (= Osmorhiza chilensis),* and *Thalictrum fendleri*. Annuals are typically uncommon. The exotic species *Poa pratensis* and *Taraxacum officinale* are more common in livestock-impacted occurrences (Mueggler 1988).

Dynamics: *Populus tremuloides* is thin-barked and readily killed by fire. It is a fire-adapted species that generally needs a large disturbance to establish and maintain dominance in a forest. These mixed forests are generally seral and, in the absence of stand-replacing disturbance such as fire, will slowly convert to a conifer-dominated forest (Mueggler 1988). The natural fire-return interval is approximately 20 to 50 years for seral occurrences (USFS 1996). Intervals that approach 100 years are typical of late-seral occurrences (USFS 1996). Although the young conifer trees in these occurrences are susceptible to fire, older individuals develop self-pruned lower branches and develop a thick corky bark that make them resistant to ground fires. Most of the occurrences sampled by Mueggler (1988) have had a history of livestock grazing as evidenced by relative abundance of the exotic plants *Taraxacum officinale, Poa pratensis,* and other grazing-tolerant plants, and the scarcity of grazing-susceptible plants (Mueggler 1988). Most occurrences that we see today represent a late-seral stage of aspen changing to a pure conifer occurrence. Nearly a hundred years of fire suppression and livestock grazing have converted much of the pure aspen occurrences to the present-day aspen-conifer forest and woodland ecological system.

SPATIAL CHARACTERISTICS

Adjacent Ecological Systems: Adjacent occurrences above or beside these mixed forests are typically pure aspen forest or mixed-conifer forest, or subalpine spruce-fir forest and woodlands, while lower elevations may include grasslands and shrublands.

SOURCES

References: Bartos and Cambell 1998, DeByle and Winokur 1985, DeVelice et al. 1986, Henderson et al. 1977, Mueggler 1988, Tuhy et al. 2002, Youngblood and Mauk 1985, Youngblood and Mueggler 1981

Last updated: 20 Feb 2003 **Stakeholders:** WCS

Concept Author: NatureServe Western Ecology Team **LeadResp:** WCS

NLCD Shrub/Scrub Types

Areas dominated by shrubs; less than 5 meters tall with shrub canopy typically greater than 20% of total vegetation. This class includes true shrubs, young trees in an early sucesional stage or trees stunted from environmental conditions.

S043 ROCKY MOUNTAIN ALPINE DWARF-SHRUBLAND

Division 306, Shrubland, CES306.810

Clarify if Salgla then Salpla and Salbra should be included. Clarify which associations. Clarify subalpine riparian does not include isolated shrublands.

Spatial Scale & Pattern: Large Patch **Classification Confidence:** medium

Required Classifiers: Natural/Semi-natural, Vegetated (>10% vasc.), Upland

Diagnostic Classifiers: Alpine/AltiAndino [Alpine/AltiAndino], Patterned ground (undifferentiated), Glaciated, Acidic Soil, Udic, Very Long Disturbance Interval, Dwarf-Shrub, Alpine Slopes

Non-Diagnostic Classifiers: Shrubland (Shrub-dominated), Temperate [Temperate Continental], Mineral: W/ A-Horizon >10 cm, Bryophyte

Concept Summary: This widespread ecological system occurs above upper timberline throughout the Rocky Mountain cordillera, including alpine areas of ranges in Utah and Nevada, and north into Canada. Elevations are above 3360 m in the Colorado Rockies, but drop to less than 2250 m in southeastern British Columbia. This system

occurs in areas of level or concave glacial topography, with late-lying snow, and sub-irrigation from surrounding slopes. Soils have become relatively stabilized in these sites, are moist, but well-drained, strongly acid, and often with substantial peat layers. Vegetation in these areas is controlled by snow retention, wind desiccation, permafrost, and a short growing season. This ecological system is characterized by a semi-continuous layer of ericaceous dwarf-shrubs, or dwarf willows which form a heath type ground cover less than 0.5 m in height. Stands of short willow (*Salix brachycarpa , S. glauca* and *S. planifolia*) that are isolated from subalpine riparian adjacent headwaters areas may be included in this system. Dense tuffs of graminoids and scattered forbs occur. *Dryas octopetala* or *Dryas integrifolia* communities are included here, although they occur on more wind-swept and drier sites than the heath communities. Within these communities *Cassiope mertensiana, Dryas integrifolia, Dryas octopetala, Salix arctica, Salix reticulata,* or *Phyllodoce empetriformis* can be dominant shrubs. *Vaccinium* spp., *Ledum glandulosum, Phyllodoce glanduliflora,* and *Kalmia microphylla* may also be shrub associates. The herbaceous layer is a mixture of forbs and graminoids, especially sedges, including, *Erigeron* spp., *Luetkea pectinata, Antennaria lanata, Oreostemma alpigenum (= Aster alpigenus), Pedicularis* spp., *Castilleja* spp., *Deschampsia caespitosa, Caltha leptosepala, Erythronium* spp., *Juncus parryi, Luzula piperi, Carex spectabilis, Carex nigricans,* and *Polygonum bistortoides*. Fell-fields often intermingle with the alpine dwarf-shrubland.

DISTRIBUTION

Range: Occurs above upper timberline throughout the Rocky Mountain cordillera, including alpine areas of ranges in Utah and Nevada, and north into Canada. Elevations are above 3360 m in the Colorado Rockies, but drop to less than 2250 m in southeastern British Columbia.
Ecological Divisions: 304, 306
TNC Ecoregions: 11:C, 19:C, 20:C, 21:C, 4:P, 68:P, 7:C, 8:C, 9:C
Subnations/Nations: AB:c, BC:c, CO:c, ID:c, MT:c, NM:c, NV:c, OR:c, UT:c, WA:c, WY:c

CONCEPT

Alliances and Associations:

- CASSIOPE MERTENSIANA DWARF-SHRUBLAND ALLIANCE (A.1081)
  Cassiope mertensiana - Phyllodoce empetriformis Dwarf-shrubland (CEGL001398)
- CASSIOPE MERTENSIANA TEMPORARILY FLOODED DWARF-SHRUBLAND ALLIANCE (A.1089)
  Cassiope mertensiana / Carex paysonis Dwarf-shrubland (CEGL001396)
- DRYAS INTEGRIFOLIA DWARF-SHRUB HERBACEOUS ALLIANCE (A.1576)
  Dryas integrifolia - Carex spp. Dwarf-shrub Herbaceous Vegetation (CEGL001890)
- DRYAS OCTOPETALA DWARF-SHRUB HERBACEOUS ALLIANCE (A.1577)
  Dryas octopetala - Carex rupestris Dwarf-shrub Herbaceous Vegetation (CEGL001892)
  Dryas octopetala - Carex spp. Dwarf-shrub Herbaceous Vegetation (CEGL001893)
  Dryas octopetala - Polygonum viviparum Dwarf-shrub Herbaceous Vegetation (CEGL001894)
  Dryas octopetala Dwarf-shrub Herbaceous Vegetation (CEGL001891)
- KALMIA MICROPHYLLA SATURATED DWARF-SHRUBLAND ALLIANCE (A.1096)
  Kalmia microphylla / Carex scopulorum Dwarf-shrubland (CEGL001403)
- PHYLLODOCE EMPETRIFORMIS DWARF-SHRUBLAND ALLIANCE (A.1083)
  Phyllodoce empetriformis / Antennaria lanata Dwarf-shrubland (CEGL001405)
  Phyllodoce empetriformis / Lupinus latifolius Dwarf-shrubland (CEGL001406)
  Phyllodoce empetriformis / Vaccinium deliciosum Dwarf-shrubland (CEGL001407)
  Phyllodoce empetriformis Parkland Dwarf-shrubland (CEGL001404)
- PHYLLODOCE GLANDULIFLORA DWARF-SHRUBLAND ALLIANCE (A.1084)
  Phyllodoce glanduliflora / Oreostemma alpigenum Dwarf-shrubland (CEGL001408)
- SALIX ARCTICA DWARF-SHRUBLAND ALLIANCE (A.1117)
  Salix arctica - Salix nivalis Dwarf-shrubland (CEGL001432)
  Salix arctica / Geum rossii Dwarf-shrubland (CEGL001430)
  Salix arctica / Polygonum bistortoides Dwarf-shrubland (CEGL001431)
- SALIX ARCTICA SATURATED DWARF-SHRUBLAND ALLIANCE (A.1124)
  Salix arctica / Caltha leptosepala Dwarf-shrubland (CEGL001429)
- SALIX GLAUCA TEMPORARILY FLOODED SHRUBLAND ALLIANCE (A.963)
  Salix glauca Shrubland (CEGL001136)
- SALIX BRACHYCARPA SEASONALLY FLOODED SHRUBLAND ALLIANCE (A.998)
  Salix brachycarpa / Carex aquatilis Shrubland (CEGL001244)
  Salix brachycarpa / Mesic Forbs Shrubland (CEGL001135)
- SALIX PLANIFOLIA SEASONALLY FLOODED SHRUBLAND ALLIANCE (A.1008)
  Salix planifolia / Caltha leptosepala Shrubland (CEGL002665)
  Salix planifolia / Carex aquatilis Shrubland (CEGL001227)

Salix planifolia / Carex scopulorum Shrubland (CEGL001229)
Salix planifolia / Mesic Forbs Shrubland [Provisional] (CEGL002893)
Salix planifolia Shrubland (CEGL001224)

- SALIX PLANIFOLIA TEMPORARILY FLOODED SHRUBLAND ALLIANCE (A.982)
  Salix planifolia / Calamagrostis canadensis Shrubland (CEGL001225)
  Salix planifolia / Deschampsia caespitosa Shrubland (CEGL001230)
- SALIX RETICULATA SATURATED DWARF-SHRUBLAND ALLIANCE (A.1125)
  Salix reticulata / Caltha leptosepala Dwarf-shrubland (CEGL001435)
- VACCINIUM (CAESPITOSUM, SCOPARIUM) DWARF-SHRUBLAND ALLIANCE (A.1114)
  Vaccinium (caespitosum, scoparium) Dwarf-shrubland (CEGL001140)

SOURCES

References: Anderson 1999, Bamberg 1961, Bamberg and Major 1968, Canadian Rockies Ecoregional Plan 2002, Cooper et al. 1997, Komarkava 1980, Komarkova 1976, Meidinger and Pojar 1991, Neely et al. 2001, Schwan and Costello 1951, Thilenius 1975, Willard 1963

Last updated: 20 Feb 2003 **Stakeholders:** WCS, CAN

Concept Author: NatureServe Western Ecology Team **LeadResp:** WCS

S045 INTER-MOUNTAIN BASINS MAT SALTBUSH SHRUBLAND

Division 304, Shrubland, CES304.783

Spatial Scale & Pattern: Matrix **Classification Confidence:** low

Required Classifiers: Natural/Semi-natural, Vegetated (>10% vasc.), Upland

Diagnostic Classifiers: Lowland [Lowland], Shrubland (Shrub-dominated), Alluvial flat, Alluvial plain, Plain, Alkaline Soil, Saline Substrate Chemistry, Calcareous, Silt Soil Texture, Clay Soil Texture, Dwarf-Shrub, Atriplex spp.

Non-Diagnostic Classifiers: Basin floor, Temperate [Temperate Continental], Oligotrophic Soil

Concept Summary: This ecological system occurs on gentle slopes and rolling plains in the northern Colorado Plateau and Uinta Basin on Mancos Shale and arid, wind-swept basins and plains across parts of Wyoming. Substrates are shallow, typically saline, alkaline, fine-textured soils developed from shale or alluvium and may be associated with shale badlands. Infiltration rate is typically low. These landscapes that typically support dwarf-shrublands composed of relatively pure stands of *Atriplex* spp. such as *Atriplex corrugata* or *Atriplex gardneri*. Other dominant or codominant dwarf-shrubs may include *Artemisia longifolia, Artemisia pedatifida*, or *Picrothamnus desertorum*, sometimes with a mix of other low shrubs such as *Krascheninnikovia lanata* or *Tetradymia spinosa*. *Atriplex confertifolia* or *Atriplex canescens* may be present, but do not codominate. The herbaceous layer is typically sparse. Scattered perennial forbs occur, such as *Xylorhiza glabriuscula* and *Sphaeralcea grossulariifolia*, and the perennial grasses *Achnatherum hymenoides, Bouteloua gracilis, Elymus elymoides, Elymus lanceolatus ssp. lanceolatus, Pascopyrum smithii*, or *Sporobolus airoides* may dominate the herbaceous layer. In less saline areas, there may be inclusions grasslands dominated by *Hesperostipa comata, Leymus salinus, Pascopyrum smithii*, or *Pseudoroegneria spicata*. In Wyoming and possibly elsewhere, inclusions of non-saline, gravelly barrens or rock outcrops dominated by cushion plants such as *Arenaria hookeri* and *Phlox hoodii* without dwarf-shrubs may be present. Annuals are seasonally present and may include *Eriogonum inflatum, Plantago tweedyi*, and the introduced annual grass *Bromus tectorum*.

DISTRIBUTION

Range: Occurs on gentle slopes and rolling plains in the northern Colorado Plateau and Uinta Basin on Mancos Shale and arid, wind-swept basins and plains across parts of Wyoming.

Ecological Divisions: 304

TNC Ecoregions: 10:C, 19:C

Subnations/Nations: AZ:c, CO:c, NM:c, UT:c, WY:c

CONCEPT

Alliances and Associations:

- ATRIPLEX CORRUGATA DWARF-SHRUBLAND ALLIANCE (A.1109)
  Atriplex corrugata Dwarf-shrubland (CEGL001437)
- ATRIPLEX CUNEATA SHRUBLAND ALLIANCE (A.871)
  Atriplex cuneata - Frankenia jamesii / Sporobolus airoides Shrubland (CEGL001316)

- ATRIPLEX GARDNERI DWARF-SHRUBLAND ALLIANCE (A.1110)
  Atriplex gardneri - Picrothamnus desertorum Dwarf-shrubland (CEGL001439)
  Atriplex gardneri / Achnatherum hymenoides Dwarf-shrubland (CEGL001444)
  Atriplex gardneri / Artemisia tridentata Dwarf-shrubland (CEGL001440)
  Atriplex gardneri / Leymus salinus Dwarf-shrubland (CEGL001442)
  Atriplex gardneri / Monolepis nuttalliana Dwarf-shrubland (CEGL001443)
  Atriplex gardneri / Pascopyrum smithii Dwarf-shrubland (CEGL001445)
  Atriplex gardneri / Pleuraphis jamesii Dwarf-shrubland (CEGL001441)
  Atriplex gardneri / Xylorhiza venusta Dwarf-shrubland (CEGL001446)
  Atriplex gardneri Dwarf-shrubland (CEGL001438)

Environment: This ecological system occurs on gentle slopes and rolling plains in the northern Colorado Plateau and Uinta Basin on Mancos Shale and arid, wind-swept plains and basins across parts of Wyoming. Substrates are shallow, typically saline, alkaline, fine-textured soils developed from shale or alluvium and may be associated with shale badlands. Infiltration rate is typically low. In Wyoming and possibly elsewhere inclusions of non-saline, gravelly barrens or rock outcrops may be present.

Vegetation: This ecological system typically supports dwarf-shrublands composed of relatively pure stands of *Atriplex* spp. such as *Atriplex corrugata* or *Atriplex gardneri*. Other dominant or codominant dwarf-shrub may include *Artemisia longifolia, Artemisia pedatifida,* or *Picrothamnus desertorum*, sometimes with a mix of other low shrubs such as *Krascheninnikovia lanata*, or *Tetradymia spinosa*. *Atriplex confertifolia* or *Atriplex canescens* may be present, but do not codominate. The herbaceous layer is typically sparse. Scattered perennial forbs occur, such as *Xylorhiza glabriuscula* and *Sphaeralcea grossulariifolia*, and the perennial grasses *Achnatherum hymenoides, Bouteloua gracilis, Elymus elymoides, Elymus lanceolatus ssp. lanceolatus, Pascopyrum smithii*, or *Sporobolus airoides* may dominate the herbaceous layer. In less saline areas, there may be inclusions grasslands dominated by *Hesperostipa comata, Leymus salinus, Pascopyrum smithii*, or *Pseudoroegneria spicata*. In Wyoming and possibly elsewhere, vegetation dominated by cushion plants such as *Arenaria hookeri, Phlox hoodii* without dwarf-shrubs may be present and occur on inclusions of non-saline, gravelly barrens or rock outcrops. Annuals are seasonally present and may include *Eriogonum inflatum, Plantago tweedyi*, and the introduced annual grass *Bromus tectorum*.

SOURCES

References: Branson et al. 1976, Knight 1994, Potter et al. 1985, Welsh 1957
Last updated: 20 Feb 2003 **Stakeholders:** WCS
Concept Author: NatureServe Western Ecology Team **LeadResp:** WCS

S046 ROCKY MOUNTAIN GAMBEL OAK-MIXED MONTANE SHRUBLAND

Division 306, Shrubland, CES306.818

Spatial Scale & Pattern: Large Patch **Classification Confidence:** medium
Required Classifiers: Natural/Semi-natural, Vegetated (>10% vasc.), Upland
Diagnostic Classifiers: Shrubland (Shrub-dominated), Shallow Soil, Mineral: W/ A-Horizon <10 cm, Sand Soil Texture, Loam Soil Texture, Ustic, Unconsolidated, Intermediate Disturbance Interval [Periodicity/Polycyclic Disturbance], Broad-Leaved Deciduous Shrub

Non-Diagnostic Classifiers: Montane [Montane], Montane [Lower Montane], Lowland [Foothill], Ridge/Summit/Upper Slope, Sideslope, Temperate [Temperate Continental], F-Patch/Medium Intensity, F-Landscape/Medium Intensity, Short (50-100 yrs) Persistence

Concept Summary: This ecological system occurs in the mountains, plateaus and foothills in the southern Rocky Mountains and Colorado Plateau including the Uinta and Wasatch ranges and the Mogollon Rim. These shrublands are most commonly found along dry foothills, lower mountain slopes, and at the edge of the western Great Plains from approximately 2000 to 2900 m in elevation, and are often situated above pinyon-juniper woodlands. Substrates are variable and include soil types ranging from calcareous, heavy, fine-grained loams to sandy loams, gravelly loams, clay loams, deep alluvial sand, or coarse gravel. The vegetation is typically dominated by *Quercus gambelii* alone or codominant with *Amelanchier alnifolia, Amelanchier utahensis, Artemisia tridentata, Cercocarpus montanus, Prunus virginiana, Purshia stansburiana, Purshia tridentata, Robinia neomexicana, Symphoricarpos oreophilus,* or *Symphoricarpos rotundifolius*. There may be inclusions of other mesic montane shrublands with *Quercus gambelii* absent or as a relatively minor component. This ecological system intergrades with the lower montane-foothills shrubland system and shares many of the same site characteristics. Density and cover of *Quercus gambelii* and *Amelanchier* spp. often increase after fire.

DISTRIBUTION

Range: Occurs in the mountains, plateaus and foothills in the southern Rocky Mountains and Colorado Plateau including the Uinta and Wasatch ranges and the Mogollon Rim.
Ecological Divisions: 304, 306
TNC Ecoregions: 10:P, 18:C, 19:C, 20:C, 21:C
Subnations/Nations: AZ:c, CO:c, NM:c, UT:c, WY:p

CONCEPT

Alliances and Associations:

- AMELANCHIER ALNIFOLIA SHRUBLAND ALLIANCE (A.913)
  Amelanchier alnifolia / Artemisia tridentata / Festuca idahoensis Shrubland (CEGL001064)
  Amelanchier alnifolia / Pseudoroegneria spicata Shrubland (CEGL001065)
- AMELANCHIER UTAHENSIS SHRUBLAND ALLIANCE (A.916)
  Amelanchier utahensis - Cercocarpus montanus Shrubland (CEGL001070)
  Amelanchier utahensis / Carex geyeri Shrubland (CEGL001068)
  Amelanchier utahensis / Pseudoroegneria spicata Shrubland (CEGL001069)
  Amelanchier utahensis Shrubland (CEGL001067)
- ARCTOSTAPHYLOS PATULA SHRUBLAND ALLIANCE (A.788)
  Arctostaphylos patula - Quercus gambelii - (Amelanchier utahensis) Shrubland (CEGL002695)
- JUNIPERUS SCOPULORUM WOODLAND ALLIANCE (A.506)
  Juniperus scopulorum - Quercus gambelii Woodland [Provisional] (CEGL002967)
- QUERCUS GAMBELII SHRUBLAND ALLIANCE (A.920)
  Quercus gambelii - Cercocarpus montanus / (Carex geyeri) Shrubland (CEGL001113)
  Quercus gambelii / Amelanchier alnifolia Shrubland (CEGL001109)
  Quercus gambelii / Amelanchier utahensis Shrubland (CEGL001110)
  Quercus gambelii / Artemisia tridentata Shrubland (CEGL001111)
  Quercus gambelii / Carex inops Shrubland (CEGL001112)
  Quercus gambelii / Hesperostipa comata Shrubland [Provisional] (CEGL002915)
  Quercus gambelii / Paxistima myrsinites Shrubland (CEGL001114)
  Quercus gambelii / Poa fendleriana Shrubland [Provisional] (CEGL002949)
  Quercus gambelii / Robinia neomexicana / Symphoricarpos rotundifolius Shrubland (CEGL001116)
  Quercus gambelii / Robinia neomexicana Shrubland (CEGL001115)
  Quercus gambelii / Symphoricarpos oreophilus Shrubland (CEGL001117)

Environment: This ecological system typically occupies the lower slope positions of the foothill and lower montane zones. They may occur on level to steep slopes, cliffs, escarpments, rimrock slopes, rocky outcrops, and scree slopes. Climate is semi-arid and characterized by mostly hot-dry summers with mild to cold winters and annual precipitation of 25 to 70 cm. Precipitation mostly occurs as winter snows but may also consist of some late summer rains. Soils are typically poorly developed, rocky to very rocky, and well-drained. Parent materials include alluvium, colluvium, and residuum derived from igneous, metamorphic, or sedimentary rocks such as granite, gneiss, limestone, quartz, monzonite, rhyolite, sandstone, schist, and shale. Although this is a shrub-dominated system, some trees may be present. In older occurrences, or occurrences on mesic sites, some of the shrubs may acquire tree-like sizes. Adjacent communities often include woodlands or forests of *Abies concolor, Pinus ponderosa, Pseudotsuga menziesii*, or *Populus tremuloides* at higher elevations, and *Pinus edulis* and *Juniperus osteosperma* on the lower and adjacent elevations. Shrublands of *Artemisia tridentata* or grasslands of *Festuca* sp., *Stipa* sp., or *Pseudoroegneria* sp. may also be present at the lower elevations.

Vegetation: Vegetation types in this system may occur as sparse to dense shrublands composed of moderate to tall shrubs. Occurrences may be multi-layered, with some short shrubby species occurring in the understory of the dominant overstory species. In many occurrences of this system, the canopy is dominated by the broad-leaved deciduous shrub *Quercus gambelii*, which occasionally reaches small tree size. Occurrences can 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, or be singularly dominant, include *Amelanchier alnifolia, Amelanchier utahensis, Arctostaphylos patula, Artemisia tridentata, Cercocarpus montanus, Ptelea trifoliata, Prunus virginiana, Purshia stansburiana, Robinia neomexicana, Rosa* spp., *Symphoricarpos oreophilus*, and *Symphoricarpos rotundifolius*. The herbaceous layer is sparse to moderately dense, ranging from 1-40% cover. Perennial graminoids are the most abundant species, particularly *Bouteloua curtipendula, Bouteloua eriopoda, Bouteloua 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, and weedy annuals are often present, at least seasonally.

Dynamics: Fire typically plays an important role in this system, causing die-back of the dominant shrub species in some areas, promoting stump sprouting of the dominant shrubs in other areas, and controlling the invasion of trees into the shrubland system. Natural fires typically result in a system with a mosaic of dense shrub clusters and openings dominated by herbaceous species. In some instances these associations may be seral to the adjacent *Pinus ponderosa, Abies concolor*, and *Pseudotsuga menziesii* woodlands and forests. Ream (1964) noted that on many sites in Utah, Gambel oak may be successional and replaced by bigtooth maple (*Acer grandidentatum)*.

SOURCES

References: Christensen 1955, Comer et al. 2002, Johnston and Hendzel 1985, Kunzler and Harper 1980, Kunzler et al. 1981, McKell 1950, Neely et al. 2001, Price and Brotherson 1987, Ream 1960, Ream 1964, Rondeau 2001, Shepperd 1990, Tuhy et al. 2002

Last updated: 20 Feb 2003 **Stakeholders:** WCS

Concept Author: NatureServe Western Ecology Team **LeadResp:** WCS

S047 ROCKY MOUNTAIN LOWER MONTANE-FOOTHILL SHRUBLAND

Division 306, Shrubland, CES306.822

Spatial Scale & Pattern: Large Patch **Classification Confidence:** medium

Required Classifiers: Natural/Semi-natural, Vegetated (>10% vasc.), Upland

Diagnostic Classifiers: Montane [Lower Montane], Lowland [Foothill], Shrubland (Shrub-dominated), Very Shallow Soil, Aridic, Intermediate Disturbance Interval [Periodicity/Polycyclic Disturbance]

Non-Diagnostic Classifiers: Canyon, Colluvial slope, Foothill(s), Gulch, Midslope, Ridge, Temperate [Temperate Continental], Mineral: W/ A-Horizon <10 cm, Short (50-100 yrs) Persistence

Concept Summary: This ecological system is found in the foothills, canyon slopes and lower mountain slopes of the Rocky Mountains and on outcrops and canyon slopes in the western Great Plains. It ranges from southern New Mexico extending north into Wyoming, and west into the Intermountain region. These shrublands occur between 1500-2900 m elevations and are usually associated with exposed sites, rocky substrates, and dry conditions, which limit tree growth. It is common where *Quercus gambelii* is absent such as the northern Colorado Front Range and in drier foothills and prairie hills. This system is generally drier than Rocky Mountain Gambel Oak-Mixed Montane Shrubland (CES306.818). Scattered trees or inclusions of grassland patches or steppe may be present, but the vegetation is typically dominated by a variety of shrubs including *Amelanchier utahensis, Cercocarpus montanus, Purshia tridentata, Rhus trilobata, Ribes cereum, Symphoricarpos oreophilus,* or *Yucca glauca*. In northeastern Wyoming and north into adjacent Montana, *Cercocarpus ledifolius*, usually with *Artemisia tridentata*, is the common dominant shrub. Grasses are represented as species of *Muhlenbergia, Bouteloua, Hesperostipa*, and *Pseudoroegneria spicata*. Fires play an important role in this system as the dominant shrubs usually have a severe die-back, although some plants will stump sprout. *Cercocarpus montanus* requires a disturbance such as fire to reproduce, either by seed sprout or root crown sprouting. Fire suppression may have allowed an invasion of trees into some of these shrublands, but in many cases sites are too xeric for tree growth.

DISTRIBUTION

Range: Found in the foothills, canyon slopes and lower mountains of the Rocky Mountains and on outcrops and canyon slopes in the western Great Plains. It ranges from southern New Mexico extending north into Wyoming, and west into the Intermountain region.

Ecological Divisions: 303, 306

TNC Ecoregions: 10:C, 20:C, 21:C, 25:C, 26:C, 27:C

Subnations/Nations: CO:c, MT:p, NE:?, NM:c, SD:c, WY:c

CONCEPT

Alliances and Associations:

- ARTEMISIA FRIGIDA SHRUBLAND ALLIANCE (A.2565)
  Artemisia frigida / Bouteloua gracilis Shrubland [Provisional] (CEGL002782)

- ARTEMISIA NOVA SHRUB HERBACEOUS ALLIANCE (A.1567)
  Artemisia nova / Leymus salinus ssp. salmonis Shrub Herbaceous Vegetation (CEGL001421)
- CERCOCARPUS MONTANUS SHRUB HERBACEOUS ALLIANCE (A.1538)
  Cercocarpus montanus / Muhlenbergia emersleyi Shrub Herbaceous Vegetation (CEGL001500)
- CERCOCARPUS MONTANUS SHRUBLAND ALLIANCE (A.896)
  Cercocarpus montanus - Rhus trilobata / Andropogon gerardii Shrubland (CEGL002912)
  Cercocarpus montanus / Achnatherum scribneri Shrubland (CEGL002913)
  Cercocarpus montanus / Bouteloua curtipendula Shrubland (CEGL001086)
  Cercocarpus montanus / Elymus lanceolatus ssp. lanceolatus Shrubland (CEGL001087)
  Cercocarpus montanus / Garrya flavescens Shrubland (CEGL001088)
  Cercocarpus montanus / Hesperostipa comata Shrubland (CEGL001092)
  Cercocarpus montanus / Hesperostipa neomexicana Shrubland (CEGL002911)
  Cercocarpus montanus / Muhlenbergia montana Shrubland (CEGL002914)
  Cercocarpus montanus / Muhlenbergia pauciflora Shrubland (CEGL001089)
  Cercocarpus montanus / Pseudoroegneria spicata Shrubland (CEGL001090)
  Cercocarpus montanus / Rhus trilobata var. trilobata Shrubland (CEGL001091)
  Cercocarpus montanus var. paucidentatus / Petrophyton caespitosum Shrubland (CEGL004589)
- ELAEAGNUS COMMUTATA SHRUBLAND ALLIANCE (A.918)
  Elaeagnus commutata / Pascopyrum smithii Shrubland (CEGL001099)
- ELAEAGNUS COMMUTATA TEMPORARILY FLOODED SHRUBLAND ALLIANCE (A.956)
  Elaeagnus commutata Shrubland (CEGL001098)
- PRUNUS VIRGINIANA SHRUBLAND ALLIANCE (A.919)
  Prunus virginiana - (Prunus americana) Shrubland (CEGL001108)
- PURSHIA TRIDENTATA SHRUBLAND ALLIANCE (A.825)
  Purshia tridentata / Artemisia frigida / Hesperostipa comata Shrubland (CEGL001055)
  Purshia tridentata / Muhlenbergia montana Shrubland (CEGL001057)
- RHUS TRILOBATA SHRUB HERBACEOUS ALLIANCE (A.1537)
  Rhus trilobata / Festuca idahoensis Shrub Herbaceous Vegetation (CEGL001505)
  Rhus trilobata / Pseudoroegneria spicata Shrub Herbaceous Vegetation (CEGL001120)
  Rhus trilobata Rocky Mountain Shrub Herbaceous Vegetation [Provisional] (CEGL002910)
- RIBES CEREUM SHRUBLAND ALLIANCE (A.923)
  Ribes cereum / Leymus ambiguus Shrubland (CEGL001124)
- SYMPHORICARPOS OCCIDENTALIS TEMPORARILY FLOODED SHRUBLAND ALLIANCE (A.961)
  Symphoricarpos occidentalis Shrubland (CEGL001131)

SOURCES

References: Dick-Peddie 1993, Hess 1981, Hess and Wasser 1982, Hoffman and Alexander 1987, Marriott and Faber-Langendoen 2000, Mueggler and Stewart 1980, Muldavin 1994, Muldavin et al. 2000b, Neely et al. 2001, Roughton 1972, Thilenius et al. 1995

Last updated: 20 Feb 2003 **Stakeholders:** WCS, MCS

Concept Author: NatureServe Western Ecology Team **LeadResp:** WCS

S048 WESTERN GREAT PLAINS SANDHILL SHRUBLAND

Division 303, Shrubland, CES303.671

Spatial Scale & Pattern: Large Patch **Classification Confidence:** high

Required Classifiers: Natural/Semi-natural, Vegetated (>10% vasc.), Upland

Non-Diagnostic Classifiers: Shrubland (Shrub-dominated), Sand Soil Texture, Ustic, F-Landscape/Medium Intensity, G-Landscape/Medium Intensity

Concept Summary: This system is found mostly in south-central areas of the Western Great Plains Division ranging from the Nebraska Sandhill region south to central Texas, although some examples may reach as far north as the Badlands of South Dakota. The climate is semi-arid to arid for much of the region in which this system occurs. This system is found on somewhat excessively to excessively well-drained, deep sandy soils that are often associated with dune systems and ancient floodplains. In some areas, this system may actually occur as a result of overgrazing in Western Great Plains Tallgrass Prairie (CES303.673) or Western Great Plains Sand Prairie (CES303.670). This system is characterized by a sparse to moderately dense woody layer dominated by *Artemisia filifolia*. Associated species can vary with geography, amount and season of precipitation, disturbance and soil texture. Several graminoid species such as *Andropogon hallii, Schizachyrium scoparium, Sporobolus cryptandrus, Calamovilfa gigantea, Hesperostipa comata*, and *Bouteloua* spp. can be connected with this system. Other shrub

species may also be present including *Yucca glauca, Prosopis glandulosa, Rhus trilobata,* and *Prunus angustifolia*. In the southern range of this system, *Quercus havardii* may also be present and represents one succession pathway that develops over time following a disturbance. *Quercus havardii* is able to resprout following a fire and thus may persist for long periods of time once established. Fire and grazing are the most important dynamic processes for this type, although drought stress can impact this system significantly in some areas. Overgrazing can lead to decreasing dominance of some of the grass species such as *Andropogon hallii, Calamovilfa gigantea,* and *Schizachyrium scoparium.*

Comments: This system may overlap in concept with Crosstimbers Southern Xeric Sandhill (CES205.897).

DISTRIBUTION

Range: This system is found primarily within the south-central areas of the Western Great Plains Division ranging from the Nebraska Sandhills south into central Texas. However, examples of this system can be found as far north as the Badlands in South Dakota.
Ecological Divisions: 303
TNC Ecoregions: 26:C, 27:C, 28:C, 33:C
Subnations/Nations: CO:c, KS:c, NE:c, OK:c, TX:?

CONCEPT

Alliances and Associations:

- ARTEMISIA FILIFOLIA SHRUBLAND ALLIANCE (A.816)
  Artemisia filifolia / Andropogon hallii Shrubland (CEGL001459)
  Artemisia filifolia / Bouteloua (curtipendula, gracilis) Shrubland (CEGL002176)
  Artemisia filifolia / Calamovilfa longifolia Shrubland (CEGL002177)
  Artemisia filifolia / Schizachyrium scoparium - Andropogon hallii Shrubland (CEGL002178)
  Artemisia filifolia / Sporobolus cryptandrus Shrubland (CEGL002179)
- PRUNUS ANGUSTIFOLIA SHRUBLAND ALLIANCE (A.1884)
  Prunus angustifolia / Schizachyrium scoparium Shrubland (CEGL002180)
- QUERCUS HAVARDII SHRUBLAND ALLIANCE (A.780)
  Quercus havardii / Sporobolus cryptandrus - Schizachyrium scoparium Shrubland (CEGL002171)

Environment: This system is found primarily in semi-arid to arid areas of the Western Great Plains Division. It occurs on somewhat excessively to excessively well-drained and deep sandy soils. This system is often found associated with dune systems and/or ancient floodplains but may occur in soils derived from sandstone residuum.

Vegetation: This system is distinguished by a sparse to a moderately dense shrub layer dominated by *Artemisia filifolia*. Graminoid species such as *Andropogon hallii, Schizachyrium scoparium, Sporobolus cryptandrus, Calamovilfa gigantea, Hesperostipa comata,* and *Bouteloua* spp. can also be found within this system. Other shrub species such as *Yucca glauca, Rhus trilobata,* and *Prunus angustifolia* may be present. *Quercus havardii* and *Prosopis glandulosa* may also be present in the southern extent of this system.

Dynamics: Fire and grazing constitute the most important processes impacting this system. Burning shrublands reduces cover of *Artemisia filifolia* for several years resulting in grassland patches that form a mosaic pattern with shrublands. Composition of grasslands depends on precipitation and management. Drought stress can also influence this system in some areas.

SOURCES

References: Ramaley 1939b, Sims et al. 1976, Tolstead 1942
Last updated: 05 Mar 2003 **Stakeholders:** MCS, WCS
Concept Author: S. Menard and K. Kindscher **LeadResp:** MCS

S050 INTER-MOUNTAIN BASINS MOUNTAIN MAHOGANY WOODLAND AND SHRUBLAND

Division 304, Forest and Woodland, CES304.772

Spatial Scale & Pattern: Large Patch **Classification Confidence:** medium
Required Classifiers: Natural/Semi-natural, Vegetated (>10% vasc.), Upland
Diagnostic Classifiers: Montane [Lower Montane], Lowland [Foothill], Aridic, Cercocarpus ledifolius

Non-Diagnostic Classifiers: Forest and Woodland (Treed), Shrubland (Shrub-dominated), Foothill(s), Piedmont, Plateau, Ridge/Summit/Upper Slope, Sideslope, Temperate [Temperate Continental], Long Disturbance Interval, F-Patch/Medium Intensity

Concept Summary: This ecological system occurs in hills and mountain ranges of the Intermountain basins from the eastern foothills of the Sierra Nevada northeast to the foothills of the Big Horn Mountains. It typically occurs from 600 m to over 2650 m in elevation on rocky outcrops or escarpments and forms small- to large-patch stands in forested areas. Most stands occur as shrublands on ridges and steep rimrock slopes, but it may occur as a small tree in steppe areas. This system includes both woodlands and shrublands dominated by *Cercocarpus ledifolius*. *Artemisia tridentata ssp. vaseyana*, *Purshia tridentata*, with species of *Arctostaphylos*, *Ribes*, or *Symphoricarpos* are often present. Scattered junipers or pines may also occur. *Cercocarpus ledifolius* is a slow-growing, drought-tolerant species that generally does not resprout after burning and needs the protection from fire that rocky sites provide.

DISTRIBUTION

Range: Occurs in hills and mountain ranges of the Intermountain basins from the eastern foothills of the Sierra Nevada northeast to the foothills of the Big Horn Mountains.
Ecological Divisions: 206?, 304, 306
TNC Ecoregions: 10:P, 11:C, 12:C, 6:P, 9:C
Subnations/Nations: CA:c, CO:c, ID:?, MT:c, NV:c, OR:?, UT:c, WY:c

CONCEPT

Alliances and Associations:

- CERCOCARPUS LEDIFOLIUS SHRUBLAND ALLIANCE (A.828)
  Artemisia arbuscula - Cercocarpus ledifolius / Pseudoroegneria spicata - Poa secunda Shrubland (CEGL001487)
  Cercocarpus ledifolius / Mahonia repens Shrubland (CEGL000965)
  Cercocarpus ledifolius / Prunus virginiana Shrubland (CEGL000966)
  Cercocarpus ledifolius / Pseudoroegneria spicata Shrubland (CEGL000967)
  Cercocarpus ledifolius / Symphoricarpos longiflorus Shrubland (CEGL000969)
- CERCOCARPUS LEDIFOLIUS WOODLAND ALLIANCE (A.586)
  Cercocarpus ledifolius / Artemisia tridentata ssp. vaseyana Woodland (CEGL001022)
  Cercocarpus ledifolius / Artemisia tridentata Woodland (CEGL000960)
  Cercocarpus ledifolius / Calamagrostis rubescens Woodland (CEGL000961)
  Cercocarpus ledifolius / Festuca idahoensis Woodland (CEGL000962)
  Cercocarpus ledifolius / Holodiscus dumosus Woodland (CEGL000963)
  Cercocarpus ledifolius / Leymus salinus ssp. salmonis Woodland (CEGL000964)
  Cercocarpus ledifolius / Pseudoroegneria spicata - Festuca idahoensis Woodland (CEGL000968)
  Cercocarpus ledifolius / Symphoricarpos oreophilus Woodland (CEGL000970)
  Cercocarpus ledifolius Woodland [Placeholder] (CEGL003038)

SOURCES

References: Knight 1994, Knight et al. 1987, Lewis 1975, Mueggler and Stewart 1980
Last updated: 20 Feb 2003 **Stakeholders:** WCS
Concept Author: NatureServe Western Ecology Team **LeadResp:** WCS

S052 COLORADO PLATEAU PINYON-JUNIPER SHRUBLAND

Division 304, Shrubland, CES304.766

Spatial Scale & Pattern: Matrix **Classification Confidence:** low
Required Classifiers: Natural/Semi-natural, Vegetated (>10% vasc.), Upland
Diagnostic Classifiers: Lowland [Foothill], Mesa, Ridge/Summit/Upper Slope, Sedimentary Rock, Temperate [Temperate Xeric], Aridic, Pinus edulis, Juniperus osteosperma

Non-Diagnostic Classifiers: Shrubland (Shrub-dominated), Foothill(s), Sideslope, Alkaline Soil, Long Disturbance Interval, F-Patch/Medium Intensity

Concept Summary: This ecological system is characteristic of the rocky mesa tops and slopes on the Colorado Plateau and western slope of Colorado, but these stunted tree shrublands may extend further upslope along the low-elevation margins of taller pinyon-juniper woodlands. Sites are drier than Colorado Plateau Pinyon-Juniper Woodland (CES304.767). Substrates are shallow/rocky and shaley soils at lower elevations (1200-2000 m). Sparse examples of the system grade into Colorado Plateau Mixed Bedrock Canyon and Tableland (CES304.765). The vegetation is dominated by dwarfed (usually <3 m tall) *Pinus edulis* and/or *Juniperus osteosperma* trees forming extensive tall shrublands in the region along low-elevation margins of pinyon-juniper woodlands. Other shrubs, if present, may include *Artemisia nova*, *Artemisia tridentata ssp. wyomingensis*, *Chrysothamnus viscidiflorus*, or

Coleogyne ramosissima. Herbaceous layers are sparse to moderately dense and typically composed of xeric graminoids.

DISTRIBUTION

Range: Rocky mesa tops and slopes on the Colorado Plateau.
Ecological Divisions: 304, 306?
TNC Ecoregions: 18:C, 19:C, 20:?
Subnations/Nations: AZ:c, CO:c, NM:c, UT:c

CONCEPT

Alliances and Associations:

- JUNIPERUS OSTEOSPERMA WOODLAND ALLIANCE (A.536)
  Juniperus osteosperma / Cercocarpus intricatus Woodland (CEGL000733)
- PINUS EDULIS - (JUNIPERUS SPP.) WOODLAND ALLIANCE (A.516)
  Pinus edulis - Juniperus osteosperma / Arctostaphylos patula Woodland (CEGL002939)
  Pinus edulis - Juniperus osteosperma / Cercocarpus intricatus Woodland (CEGL000779)
  Pinus edulis - Juniperus osteosperma / Coleogyne ramosissima Woodland (CEGL000781)
  Pinus edulis - Juniperus osteosperma / Purshia stansburiana Woodland (CEGL000782)
  Pinus edulis - Juniperus spp. / Cercocarpus montanus Woodland (CEGL000780)
  Pinus edulis / Arctostaphylos pungens Woodland (CEGL000775)
  Pinus edulis / Purshia tridentata Woodland (CEGL000789)
  Pinus edulis / Rockland Woodland (CEGL000794)

SOURCES

References: Tuhy et al. 2002, West et al. 1998
Last updated: 20 Feb 2003 **Stakeholders:** WCS
Concept Author: NatureServe Western Ecology Team **LeadResp:** WCS

S053 GREAT BASIN SEMI-DESERT CHAPARRAL
Division 304, Shrubland, CES304.001

Spatial Scale & Pattern: Large Patch
Required Classifiers: Natural/Semi-natural, Vegetated (>10% vasc.), Upland
Diagnostic Classifiers: Montane [Lower Montane], Lowland [Foothill], Shrubland (Shrub-dominated), Temperate [Temperate Continental], Broad-Leaved Evergreen Shrub

Concept Summary: This system includes chaparral on sideslopes transitioning from low-elevation desert landscapes up into pinyon-juniper woodlands of the western and central Great Basin. There are limited occurrences extending as far west as the inner Coast Ranges in central California. These are typically fairly open-canopy shrublands with open spaces either bare or supporting patchy grasses and forbs. Characteristic species may include *Arctostaphylos patula, Arctostaphylos pungens, Ceanothus greggii, Cercocarpus montanus var. glaber, Cercocarpus intricatus, Eriogonum fasciculatum, Garrya flavescens, Quercus turbinella, Purshia stansburiana,* and *Rhus trilobata*. *Cercocarpus ledifolius* is generally absent. Typical fire regime in these systems varies with the amount of organic accumulation.

DISTRIBUTION

Range: Western and central Great Basin.
Ecological Divisions: 206, 304
TNC Ecoregions: 11:C, 12:C, 15:P
Subnations/Nations: CA:c, NV:c

CONCEPT

Alliances and Associations:

- ARCTOSTAPHYLOS PATULA SHRUBLAND ALLIANCE (A.788)
  Arctostaphylos patula - Artemisia tridentata ssp. vaseyana Shrubland (CEGL002694)
  Arctostaphylos patula - Quercus gambelii - (Amelanchier utahensis) Shrubland (CEGL002695)
  Arctostaphylos patula / Ceanothus velutinus - Ceanothus prostratus Shrubland (CEGL000957)
  Arctostaphylos patula Shrubland (CEGL002696)
- ARCTOSTAPHYLOS PUNGENS SHRUBLAND ALLIANCE (A.789)
  Arctostaphylos pungens Shrubland (CEGL000958)

- CEANOTHUS GREGGII - FREMONTODENDRON CALIFORNICUM SHRUBLAND ALLIANCE (A.766)
  Ceanothus greggii - Fremontodendron californicum Shrubland [Placeholder] (CEGL003026)
- CEANOTHUS LEUCODERMIS SHRUBLAND ALLIANCE (A.767)
  Ceanothus leucodermis Shrubland [Placeholder] (CEGL003028)
- CERCOCARPUS MONTANUS - ERIOGONUM FASCICULATUM SHRUBLAND ALLIANCE (A.848)
  Cercocarpus montanus var. glaber - Eriogonum fasciculatum Shrubland [Placeholder] (CEGL003036)
- PURSHIA (STANSBURIANA, MEXICANA) SHRUBLAND ALLIANCE (A.833)
  Purshia stansburiana / Pseudoroegneria spicata Shrubland (CEGL001053)
  Purshia stansburiana Shrubland [Provisional] (CEGL002957)
- QUERCUS TURBINELLA SHRUBLAND ALLIANCE (A.793)
  Quercus turbinella - (Amelanchier utahensis) Colluvial Shrubland (CEGL002950)
  Quercus turbinella - Ephedra viridis Shrubland (CEGL000980)
  Quercus turbinella - Juniperus osteosperma Shrubland (CEGL000981)

- **California community types:**
- Tobacco Brush Montane Chaparral (37.210.00)
- Tobacco Brush (37.210.01)
- Tobacco Brush - Bitter Cherry (37.210.02)

SOURCES

References: Barbour and Major 1977, Sawyer and Keeler-Wolf 1995
Last updated: 24 Mar 2003 **Stakeholders:** WCS
Concept Author: K. Schulz, P. Comer **LeadResp:** WCS

S054 INTER-MOUNTAIN BASINS BIG SAGEBRUSH SHRUBLAND

Division 304, Shrubland, CES304.777

Spatial Scale & Pattern: Matrix **Classification Confidence:** medium
Required Classifiers: Natural/Semi-natural, Vegetated (>10% vasc.), Upland
Diagnostic Classifiers: Lowland [Lowland], Shrubland (Shrub-dominated), Toeslope/Valley Bottom, Deep Soil, Aridic, Artemisia tridentata ssp. tridentata

Non-Diagnostic Classifiers: Alluvial plain, Plain, Temperate [Temperate Continental], Alkaline Soil, Xeromorphic Shrub

Concept Summary: This ecological system occurs throughout much of the western U.S., typically in broad basins between mountain ranges, plains and foothills between 1500-2300 m elevation. Soils are typically deep, well-drained and non-saline. These shrublands are dominated by *Artemisia tridentata ssp. tridentata* and/or *Artemisia tridentata ssp. wyomingensis*. Scattered Juniper spp., *Sarcobatus vermiculatus* and *Atriplex* spp. may be present in some stands. *Ericameria nauseosa, Chrysothamnus viscidiflorus, Purshia tridentata,* or *Symphoricarpos oreophilus* may codominate disturbed stands. Perennial herbaceous components typically contribute less than 25% vegetative cover. Common graminoid species include *Achnatherum hymenoides, Bouteloua gracilis, Elymus lanceolatus, Festuca idahoensis, Hesperostipa comata, Leymus cinereus, Pleuraphis jamesii, Pascopyrum smithii, Poa secunda,* or *Pseudoroegneria spicata*.

DISTRIBUTION

Range: Occurs throughout much of the western U.S., typically in broad basins between mountain ranges, plains and foothills between 1500-2300 m elevation.
Ecological Divisions: 303, 304, 306
TNC Ecoregions: 10:C, 11:C, 18:C, 19:C, 20:C, 26:C, 27:C, 4:C, 6:C, 8:C, 9:C
Subnations/Nations: CA:c, CO:c, ID:c, MT:c, NV:c, OR:c, UT:c, WA:c, WY:c

CONCEPT

Alliances and Associations:
- ARTEMISIA TRIDENTATA (SSP. TRIDENTATA, SSP. XERICENSIS) SHRUB HERBACEOUS ALLIANCE (A.1522)
  Artemisia tridentata (ssp. tridentata, ssp. xericensis) / Pseudoroegneria spicata - Poa secunda Shrub Herbaceous Vegetation (CEGL001019)
  Artemisia tridentata (ssp. tridentata, ssp. xericensis) / Pseudoroegneria spicata Shrub Herbaceous Vegetation (CEGL001018)
- ARTEMISIA TRIDENTATA (SSP. TRIDENTATA, SSP. XERICENSIS) SHRUBLAND ALLIANCE (A.830)
  Artemisia tridentata ssp. tridentata - Grayia spinosa Shrubland (CEGL001004)
  Artemisia tridentata ssp. tridentata / Distichlis spicata Shrubland (CEGL001000)

Artemisia tridentata ssp. tridentata / Festuca idahoensis Shrubland (CEGL001014)
Artemisia tridentata ssp. tridentata / Hesperostipa comata Shrubland (CEGL002966)
Artemisia tridentata ssp. tridentata / Leymus cinereus Shrubland (CEGL001016)
Artemisia tridentata ssp. tridentata / Pascopyrum smithii - (Elymus lanceolatus) Shrubland (CEGL001017)
Artemisia tridentata ssp. tridentata / Pleuraphis jamesii Shrubland (CEGL001015)
Artemisia tridentata ssp. tridentata / Poa secunda Shrubland (CEGL001008)

- ARTEMISIA TRIDENTATA SHRUB HERBACEOUS ALLIANCE (A.1521)
  Artemisia tridentata / Festuca idahoensis Shrub Herbaceous Vegetation (CEGL001530)
  Artemisia tridentata / Leymus cinereus Shrub Herbaceous Vegetation (CEGL001458)
- ARTEMISIA TRIDENTATA SHRUBLAND ALLIANCE (A.829)
  Artemisia tridentata - (Ericameria nauseosa) / Bromus tectorum Semi-natural Shrubland (CEGL002699)
  Artemisia tridentata / Achnatherum hymenoides Shrubland (CEGL001006)
  Artemisia tridentata / Achnatherum lettermanii Shrubland (CEGL001011)
  Artemisia tridentata / Bouteloua gracilis - Pascopyrum smithii Shrubland (CEGL000997)
  Artemisia tridentata / Bouteloua gracilis - Pleuraphis jamesii Shrubland (CEGL000996)
  Artemisia tridentata / Bouteloua gracilis Shrubland (CEGL000995)
  Artemisia tridentata / Chrysothamnus viscidiflorus / Poa secunda Shrubland (CEGL000999)
  Artemisia tridentata / Elymus elymoides Shrubland (CEGL001001)
  Artemisia tridentata / Ericameria nauseosa Shrubland (CEGL000998)
  Artemisia tridentata / Pleuraphis jamesii Shrubland (CEGL001005)
  Artemisia tridentata / Symphoricarpos longiflorus Shrubland (CEGL001012)
  Artemisia tridentata Shrubland (CEGL000991)
  Artemisia tridentata Upperzone Community Shrubland (CEGL001013)
- ARTEMISIA TRIDENTATA SSP. WYOMINGENSIS SHRUB HERBACEOUS ALLIANCE (A.1527)
  Artemisia tridentata ssp. wyomingensis / Mixed Grasses Shrub Herbaceous Vegetation (CEGL001534)
  Artemisia tridentata ssp. wyomingensis / Pascopyrum smithii Shrub Herbaceous Vegetation (CEGL001047)
  Artemisia tridentata ssp. wyomingensis / Pseudoroegneria spicata Shrub Herbaceous Vegetation (CEGL001535)
- ARTEMISIA TRIDENTATA SSP. WYOMINGENSIS SHRUBLAND ALLIANCE (A.832)
  Artemisia tridentata ssp. wyomingensis - Atriplex confertifolia Shrubland (CEGL001040)
  Artemisia tridentata ssp. wyomingensis - Peraphyllum ramosissimum / Festuca idahoensis Shrubland (CEGL001048)
  Artemisia tridentata ssp. wyomingensis - Purshia tridentata / Pseudoroegneria spicata Shrubland (CEGL001050)
  Artemisia tridentata ssp. wyomingensis / Achnatherum hymenoides Shrubland (CEGL001046)
  Artemisia tridentata ssp. wyomingensis / Achnatherum thurberianum Shrubland (CEGL001052)
  Artemisia tridentata ssp. wyomingensis / Balsamorhiza sagittata Shrubland (CEGL000994)
  Artemisia tridentata ssp. wyomingensis / Carex filifolia Shrubland (CEGL001042)
  Artemisia tridentata ssp. wyomingensis / Elymus albicans Shrubland (CEGL001044)
  Artemisia tridentata ssp. wyomingensis / Elymus elymoides Shrubland (CEGL001043)
  Artemisia tridentata ssp. wyomingensis / Hesperostipa comata Shrubland (CEGL001051)
  Artemisia tridentata ssp. wyomingensis / Leymus ambiguus Shrubland (CEGL001045)
  Artemisia tridentata ssp. wyomingensis / Poa secunda Shrubland (CEGL001049)
  Artemisia tridentata ssp. wyomingensis / Pseudoroegneria spicata Shrubland (CEGL001009)
- ATRIPLEX CANESCENS SHRUBLAND ALLIANCE (A.869)
  Artemisia tridentata - Atriplex canescens - Sarcobatus vermiculatus / (Achnatherum hymenoides) Shrubland (CEGL001355)
- EPHEDRA NEVADENSIS SHRUBLAND ALLIANCE (A.857)
  Artemisia tridentata - Ephedra nevadensis Shrubland (CEGL001002)
- EPHEDRA VIRIDIS SHRUBLAND ALLIANCE (A.858)
  Artemisia tridentata - Ephedra viridis Shrubland (CEGL001003)
- ERICAMERIA NAUSEOSA SHRUBLAND ALLIANCE (A.835)
  Ericameria nauseosa Shrubland [Provisional] (CEGL002713)

- **California community types:**
- Big Sagebrush - Desert Snowberry (35.110.04)
- Big Sagebrush - Antelope Bitterbrush (35.110.07)
- Antelope Bitterbrush Scrub (35.200.00)
- Antelope Bitterbrush - Big Sagebrush - Horesebush (35.200.01)
- Antelope Bitterbrush - Big Sagebrush / Indian Ricegrass (35.200.02)
- Antelope Bitterbrush - Big Sagebrush - Round-leaf Snowberry (35.200.03)
- Antelope Bitterbrush / Nelson's Needlegrass (35.200.04)
- Antelope Bitterbrush / Sulphur-flower Buckwheat (35.200.05)
- Rubber Rabbitbrush Scrub (35.310.00)
- Parry Rabbitbrush Dwarf Scrub (35.320.00)
- Needle-leaved Rabbitbrush (35.330.00)
- Blackstem Rabbitbrush (35.340.00)

SOURCES

References: Barbour and Billings 1988, Barbour and Major 1977, Holland and Keil 1995, West 1983a
Last updated: 20 Feb 2003 **Stakeholders:** WCS, MCS
Concept Author: NatureServe Western Ecology Team **LeadResp:** WCS

S055 GREAT BASIN XERIC MIXED SAGEBRUSH SHRUBLAND

Division 304, Shrubland, CES304.774

Spatial Scale & Pattern: Large Patch **Classification Confidence:** medium
Required Classifiers: Natural/Semi-natural, Vegetated (>10% vasc.), Upland
Diagnostic Classifiers: Lowland [Foothill], Shrubland (Shrub-dominated), Ridge/Summit/Upper Slope, Aridic, Low Artemisia spp.

Non-Diagnostic Classifiers: Montane [Montane], Montane [Lower Montane], Alluvial fan, Alluvial plain, Foothill(s), Hill(s), Piedmont, Plain, Plateau, Sideslope, Temperate [Temperate Continental], Alkaline Soil, Shallow Soil

Concept Summary: This ecological system occurs in the Great Basin on dry flats and plains, alluvial fans, rolling hills, rocky hill slopes, saddles and ridges at elevations between 1000-2600 m. Sites are dry, often exposed to desiccating winds, with typically shallow, rocky, non-saline soils. Shrublands are dominated by *Artemisia nova* (mid and low elevations), *Artemisia arbuscula* (higher elevation), and may be codominated by *Artemisia tridentata ssp. wyomingensis* or *Chrysothamnus viscidiflorus*. Other shrubs that may be present include *Atriplex confertifolia, Ephedra* spp., *Ericameria* spp., *Grayia spinosa, Lycium shockleyi, Picrothamnus desertorum, Sarcobatus vermiculatus*, and *Tetradymia* spp. The herbaceous layer is likely sparse and composed of perennial bunch grasses such as *Achnatherum hymenoides, Achnatherum speciosum, Achnatherum thurberianum, Elymus elymoides*, or *Poa secunda*.

DISTRIBUTION

Range: Occurs in the Great Basin on dry flats and plains, alluvial fans, rolling hills, rocky hill slopes, saddles and ridges at elevations between 1000-2600 m.
Ecological Divisions: 206, 304
TNC Ecoregions: 11:C, 12:C, 18:C, 6:C
Subnations/Nations: CA:c, ID:c, NV:c, OR:c, UT:c

CONCEPT

Alliances and Associations:

- ARTEMISIA ARBUSCULA SSP. ARBUSCULA SHRUB HERBACEOUS ALLIANCE (A.1566)
  Artemisia arbuscula ssp. arbuscula - Purshia tridentata / Pseudoroegneria spicata - Festuca idahoensis Shrub Herbaceous Vegetation (CEGL001518)
  Artemisia arbuscula ssp. arbuscula / Achnatherum thurberianum Shrub Herbaceous Vegetation (CEGL001413)
  Artemisia arbuscula ssp. arbuscula / Festuca idahoensis Shrub Herbaceous Vegetation (CEGL001409)
  Artemisia arbuscula ssp. arbuscula / Leymus salinus ssp. salmonis Shrub Herbaceous Vegetation (CEGL001410)
  Artemisia arbuscula ssp. arbuscula / Poa secunda Shrub Herbaceous Vegetation (CEGL001411)
  Artemisia arbuscula ssp. arbuscula / Pseudoroegneria spicata Shrub Herbaceous Vegetation (CEGL001412)
- ARTEMISIA ARBUSCULA SSP. ARBUSCULA SHRUBLAND ALLIANCE (A.2547)
  Artemisia arbuscula ssp. arbuscula - Artemisia tridentata ssp. wyomingensis / Festuca idahoensis Shrubland [Provisional] (CEGL002983)
- ARTEMISIA ARBUSCULA SSP. LONGICAULIS SHRUBLAND ALLIANCE (A.2548)
  Artemisia arbuscula ssp. longicaulis - Grayia spinosa Shrubland (CEGL002984)
  Artemisia arbuscula ssp. longicaulis / Bromus tectorum Semi-natural Shrubland (CEGL002985)
  Artemisia arbuscula ssp. longicaulis / Elymus elymoides Shrubland (CEGL002986)
- ARTEMISIA ARBUSCULA SSP. LONGILOBA SHRUB HERBACEOUS ALLIANCE (A.2552)
  Artemisia arbuscula ssp. longiloba / Festuca idahoensis Shrub Herbaceous Vegetation (CEGL001522)
  Artemisia arbuscula ssp. longiloba / Pascopyrum smithii Shrub Herbaceous Vegetation (CEGL001415)
  Artemisia arbuscula ssp. longiloba / Poa secunda Shrub Herbaceous Vegetation (CEGL001523)
  Artemisia arbuscula ssp. longiloba / Pseudoroegneria spicata Shrub Herbaceous Vegetation (CEGL001416)
- ARTEMISIA ARBUSCULA SSP. LONGILOBA SHRUBLAND ALLIANCE (A.2549)
  Artemisia arbuscula ssp. longiloba Shrubland (CEGL001414)
- ARTEMISIA NOVA SHRUBLAND ALLIANCE (A.1105)
  Artemisia nova - Ericameria nana Shrubland (CEGL002773)

Artemisia nova - Gutierrezia sarothrae / Bouteloua gracilis - Pleuraphis jamesii Shrubland (CEGL001419)
Artemisia nova / Achnatherum hymenoides Shrubland (CEGL001422)
Artemisia nova / Elymus elymoides Shrubland (CEGL001418)
Artemisia nova / Hesperostipa comata Shrubland (CEGL001425)
Artemisia nova / Pleuraphis jamesii Shrubland (CEGL001420)
Artemisia nova / Poa fendleriana Shrubland (CEGL002698)
Artemisia nova / Poa secunda Shrubland (CEGL001423)
Artemisia nova / Pseudoroegneria spicata Shrubland (CEGL001424)
Artemisia nova Shrubland (CEGL001417)

- ARTEMISIA TRIDENTATA SSP. WYOMINGENSIS SHRUB HERBACEOUS ALLIANCE (A.1527)
  Artemisia tridentata ssp. wyomingensis / Mixed Grasses Shrub Herbaceous Vegetation (CEGL001534)
  Artemisia tridentata ssp. wyomingensis / Pseudoroegneria spicata Shrub Herbaceous Vegetation (CEGL001535)
- ARTEMISIA TRIDENTATA SSP. WYOMINGENSIS SHRUBLAND ALLIANCE (A.832)
  Artemisia tridentata ssp. wyomingensis - Atriplex confertifolia Shrubland (CEGL001040)
  Artemisia tridentata ssp. wyomingensis - Purshia tridentata / Pseudoroegneria spicata Shrubland (CEGL001050)
  Artemisia tridentata ssp. wyomingensis / Achnatherum hymenoides Shrubland (CEGL001046)
  Artemisia tridentata ssp. wyomingensis / Achnatherum thurberianum Shrubland (CEGL001052)
  Artemisia tridentata ssp. wyomingensis / Balsamorhiza sagittata Shrubland (CEGL000994)
  Artemisia tridentata ssp. wyomingensis / Bouteloua gracilis Shrubland (CEGL001041)
  Artemisia tridentata ssp. wyomingensis / Elymus elymoides Shrubland (CEGL001043)
  Artemisia tridentata ssp. wyomingensis / Hesperostipa comata Shrubland (CEGL001051)
  Artemisia tridentata ssp. wyomingensis / Poa secunda Shrubland (CEGL001049)
  Artemisia tridentata ssp. wyomingensis / Pseudoroegneria spicata Shrubland (CEGL001009)
- GRAYIA SPINOSA SHRUBLAND ALLIANCE (A.1038)
  Grayia spinosa / Artemisia nova / Achnatherum speciosum Shrubland (CEGL001344)

- **California community types:**
- Black Sagebrush Dwarf Scrub (35.130.00)
- Southern Montane Black Sagebrush Pebble Plains (35.130.01)
- Black Sagebrush - Engelmann's Hedgehog Cactus (35.130.02)
- Black Sagebrush - Cheesebush (35.130.03)

Environment: This ecological system is widely distributed in the western United States. Climate is generally arid with 20 to 30 cm of annual precipitation and warm summers and cold winters. This shrubland system occurs at elevations from 1000 to 2600 m in the southwestern United States. It occupies flat to steeply sloping upland sites, on a wide variety of landform positions. These include toeslopes, lower and middle slopes, badly eroded badland slopes, and foothills. Sites with little slope tend to have deep soils, while those with steeper slopes have shallow to moderately deep soils that are well-drained. Sloping sites tend to have southerly aspects. Soil texture is loam, sandy loam, or clay loam (Hansen and Hoffman 1988), and there is often a significant amount of coarse fragments in the soil profile. Hironaka et al. (1983) reported that most of the habitat occurred on calcareous soils, often with a cemented duripan or silica hardpan at about 1 m in depth.

Dynamics: This shrubland system is associated with shallow, rocky soils which experience extreme drought in summer. The plants are low and widely spaced, which tends to decrease the risk of fire (Chappell et al. 1997). Barbour and Major (1988) report that *Artemisia nova* is utilized by livestock to a much greater degree than other species of *Artemisia*, resulting in low, pruned plants. *Artemisia nova* dwarf-shrublands grow in more xeric sites than other *Artemisia* shrublands. Blackburn and Tueller (1970) noted rapid invasion of these communities by *Juniperus osteosperma* and *Pinus monosperma* in Nevada, citing overgrazing coupled with fire suppression, and possibly climate change as causative variables.

SOURCES

References: Baker and Kennedy 1985, Barbour and Major 1988, Blackburn and Tueller 1970, Chappell et al. 1997, Hansen and Hoffman 1988, Hironaka et al. 1983, West 1983a

Last updated: 20 Feb 2003 **Stakeholders:** WCS
Concept Author: NatureServe Western Ecology Team **LeadResp:** WCS

S056 COLORADO PLATEAU MIXED LOW SAGEBRUSH SHRUBLAND

Division 304, Shrubland, CES304.762

Spatial Scale & Pattern: Large Patch **Classification Confidence:** medium
Required Classifiers: Natural/Semi-natural, Vegetated (>10% vasc.), Upland

Diagnostic Classifiers: Montane [Lower Montane], Lowland [Foothill], Shrubland (Shrub-dominated), Ridge/Summit/Upper Slope, Temperate [Temperate Xeric], Aridic

Non-Diagnostic Classifiers: Alkaline Soil

Concept Summary: This ecological system occurs in the Colorado Plateau, Tavaputs Plateau and Uinta Basin in canyons, gravelly draws, hilltops, and dry flats at elevations generally below 1800 m. Soils are often rocky, shallow, and alkaline. This type extends across northern New Mexico into the southern Great Plains on limestone hills. It includes open shrublands and steppe dominated by *Artemisia nova* or *Artemisia bigelovii* sometimes with *Artemisia tridentata ssp. wyomingensis* codominant. Semi-arid grasses such as *Achnatherum hymenoides, Aristida purpurea, Bouteloua gracilis, Hesperostipa comata, Pleuraphis jamesii*, or *Poa fendleriana* are often present and may form a graminoid layer with over 25% cover.

DISTRIBUTION

Range: Occurs in the Colorado Plateau, Tavaputs Plateau and Uinta Basin in canyons, gravelly draws, hilltops, and dry flats at elevations generally below 1800 m.
Ecological Divisions: 303, 304
TNC Ecoregions: 18:C, 19:C, 20:C, 27:C, 28:C
Subnations/Nations: AZ:c, CO:c, NM:c

CONCEPT

Alliances and Associations:

- ARTEMISIA BIGELOVII SHRUBLAND ALLIANCE (A.1103)
  Artemisia bigelovii / Achnatherum hymenoides Shrubland (CEGL000990)
  Artemisia bigelovii Shrubland [Placeholder] (CEGL000276)
- ARTEMISIA NOVA SHRUBLAND ALLIANCE (A.1105)
  Artemisia nova - Ericameria nana Shrubland (CEGL002773)
  Artemisia nova - Gutierrezia sarothrae / Bouteloua gracilis - Pleuraphis jamesii Shrubland (CEGL001419)
  Artemisia nova / Achnatherum hymenoides Shrubland (CEGL001422)
  Artemisia nova / Elymus elymoides Shrubland (CEGL001418)
  Artemisia nova / Hesperostipa comata Shrubland (CEGL001425)
  Artemisia nova / Pleuraphis jamesii Shrubland (CEGL001420)
  Artemisia nova / Poa secunda Shrubland (CEGL001423)
  Artemisia nova / Pseudoroegneria spicata Shrubland (CEGL001424)
  Artemisia nova Shrubland (CEGL001417)
- BOUTELOUA ERIOPODA DWARF-SHRUB HERBACEOUS ALLIANCE (A.1570)
  Artemisia bigelovii / Bouteloua eriopoda Dwarf-shrub Herbaceous Vegetation (CEGL001741)
- BOUTELOUA GRACILIS DWARF-SHRUB HERBACEOUS ALLIANCE (A.1571)
  Artemisia bigelovii / Bouteloua gracilis Dwarf-shrub Herbaceous Vegetation (CEGL001742)

SOURCES

References: Brown 1982, Dick-Peddie 1993, Francis 1986
Last updated: 20 Feb 2003 **Stakeholders:** WCS
Concept Author: NatureServe Western Ecology Team **LeadResp:** WCS

S057 MOGOLLON CHAPARRAL

Division 302, Shrubland, CES302.741

Spatial Scale & Pattern: Matrix **Classification Confidence:** medium
Required Classifiers: Natural/Semi-natural, Vegetated (>10% vasc.), Upland
Diagnostic Classifiers: Montane [Lower Montane], Lowland [Foothill], Intermediate Disturbance Interval, F-Patch/High Intensity, Evergreen Sclerophyllous Shrub

Non-Diagnostic Classifiers: Montane [Montane], Shrubland (Shrub-dominated), Temperate [Temperate Continental], Temperate [Temperate Xeric], Aridic, Xeric, Broad-Leaved Evergreen Shrub

Concept Summary: This ecological system occurs across central Arizona (Mogollon Rim), western New Mexico and southwestern Utah and southeast Nevada. It often dominants along the mid-elevation transition from the Mojave, Sonoran, and northern Chihuahuan deserts into mountains (1000-2200 m). It occurs on foothills, mountain slopes and canyons in dryer habitats below the encinal and *Pinus ponderosa* woodlands. Stands are often associated with more xeric and coarse-textured substrates such as limestone, basalt or alluvium, especially in transition areas

with more mesic woodlands. The moderate to dense shrub canopy includes species such as *Quercus turbinella, Quercus toumeyi, Cercocarpus montanus, Canotia holacantha, Ceanothus greggii, Forestiera pubescens (= Forestiera neomexicana), Garrya wrightii, Juniperus deppeana, Purshia stansburiana, Rhus ovata, Rhus trilobata,* and *Arctostaphylos pungens* and *Arctostaphylos pringlei* at higher elevations. Most chaparral species are fire-adapted, resprouting vigorously after burning or producing fire-resistant seeds. Stands occurring within montane woodlands are seral and a result of recent fires.

DISTRIBUTION

Range: Occurs across central Arizona (Mogollon Rim), western New Mexico and southern Utah. It often dominants along the mid-elevation transition from the Mojave, Sonoran, and northern Chihuahuan deserts into mountains (1000-2200 m).
Ecological Divisions: 302, 304, 306
TNC Ecoregions: 17:C, 19:C, 21:C, 22:C, 23:C, 24:C
Subnations/Nations: AZ:c, CA:?, MXSO:?, NM:c, NV:c, UT:c

CONCEPT

Alliances and Associations:

- ARCTOSTAPHYLOS PATULA SHRUBLAND ALLIANCE (A.788)
  Arctostaphylos patula - Quercus gambelii - (Amelanchier utahensis) Shrubland (CEGL002695)
  Arctostaphylos patula Shrubland (CEGL002696)
- ARCTOSTAPHYLOS PUNGENS SHRUBLAND ALLIANCE (A.789)
  Arctostaphylos pungens Shrubland (CEGL000958)
- CERCOCARPUS MONTANUS SHRUBLAND ALLIANCE (A.896)
  Cercocarpus montanus / Garrya flavescens Shrubland (CEGL001088)
  Cercocarpus montanus / Muhlenbergia pauciflora Shrubland (CEGL001089)
- MORTONIA SEMPERVIRENS SHRUBLAND ALLIANCE (A.859)
  Mortonia scabrella / Dasylirion wheeleri Shrubland (CEGL001279)
- PURSHIA (STANSBURIANA, MEXICANA) SHRUBLAND ALLIANCE (A.833)
  Purshia stansburiana - Arctostaphylos patula Shrubland (CEGL002948)
- QUERCUS PUNGENS SHRUBLAND ALLIANCE (A.783)
  Quercus pungens - Cercocarpus montanus Shrubland (CEGL003832)
- QUERCUS TOUMEYI SHRUBLAND ALLIANCE (A.792)
  Quercus toumeyi / Bouteloua curtipendula Shrubland (CEGL000975)
- QUERCUS TURBINELLA SHRUBLAND ALLIANCE (A.793)
  Quercus turbinella - (Amelanchier utahensis) Colluvial Shrubland (CEGL002950)
  Quercus turbinella - Cercocarpus montanus Shrubland (CEGL000979)
  Quercus turbinella - Coleogyne ramosissima Shrubland (CEGL000982)
  Quercus turbinella - Ephedra viridis Shrubland (CEGL000980)
  Quercus turbinella - Garrya flavescens - Arctostaphylos pungens Shrubland (CEGL000977)
  Quercus turbinella - Juniperus osteosperma Shrubland (CEGL000981)
  Quercus turbinella / Bouteloua eriopoda Shrubland (CEGL000978)

SOURCES

References: Carmichael et al. 1978, Dick-Peddie 1993, Muldavin et al. 1994a, Muldavin et al. 2000b
Last updated: 20 Feb 2003 **Stakeholders:** WCS
Concept Author: NatureServe Western Ecology Team **LeadResp:** WCS

S058 APACHERIAN-CHIHUAHUAN MESQUITE UPLAND SCRUB

Division 302, Shrubland, CES302.733

Spatial Scale & Pattern: Matrix **Classification Confidence:** low
Required Classifiers: Natural/Semi-natural, Vegetated (>10% vasc.), Upland
Diagnostic Classifiers: Lowland [Foothill], Lowland [Lowland], Shrubland (Shrub-dominated), Thorn Shrub, Prosopis spp.-dominated

Non-Diagnostic Classifiers: Tropical/Subtropical [Tropical Xeric], Temperate [Temperate Xeric], Aridic, Intermediate Disturbance Interval, F-Patch/High Intensity [Seasonality/Winter Fire]

Concept Summary: This ecological system occurs as upland shrublands that are concentrated in the extensive grassland-shrubland transition in foothills and piedmont in the Chihuahuan Desert. It extends into the Sky Island

region to the west, and the Edwards Plateau to the east. Substrates are typically derived from alluvium, often gravelly without a well-developed argillic or calcic soil horizon that would limit infiltration and storage of winter precipitation in deeper soil layers. *Prosopis* spp. and other deep-rooted shrubs exploit this deep soil moisture that is unavailable to grasses and cacti. Vegetation is typically dominated by *Prosopis glandulosa* or *Prosopis velutina* and succulents. Other desert scrub that may codominate or dominate includes *Acacia neovernicosa*, *Acacia constricta*, *Juniperus monosperma*, or *Juniperus coahuilensis*. Grass cover is typically low. During the last century, the area occupied by this system has increased through conversion of desert grasslands as a result of drought, overgrazing by livestock, and/or decreases in fire frequency. It is similar to Chihuahuan Mixed Desert and Thorn Scrub (CES302.734), but is generally found at higher elevations where *Larrea tridentata* and other desert scrub is not codominant. It is also similar to Chihuahuan Stabilized Coppice Dune and Sand Flat Scrub (CES302.737), but does not occur on eolian-deposited substrates.

DISTRIBUTION

Range: Foothills and piedmont in the Chihuahuan Desert, extending into the Sky Island region and into lower Mogollon Rim to the west, and the Edwards Plateau to the east.
Ecological Divisions: 302
TNC Ecoregions: 22:C, 24:C, 29:P, 30:P
Subnations/Nations: AZ:c, MXCH:c, MXSO:p, NM:c, TX:c

CONCEPT

Alliances and Associations:

- ACACIA NEOVERNICOSA SHRUBLAND ALLIANCE (A.1037)
  Acacia neovernicosa / Flourensia cernua Shrubland (CEGL001341)
  Acacia neovernicosa / Muhlenbergia porteri Shrubland (CEGL001342)
- JUNIPERUS COAHUILENSIS WOODLAND ALLIANCE (A.503)
  Juniperus coahuilensis / Canotia holacantha Woodland (CEGL000701)
- JUNIPERUS MONOSPERMA WOODLAND ALLIANCE (A.504)
  Juniperus monosperma / Bouteloua eriopoda Woodland (CEGL000709)
  Juniperus monosperma / Prosopis glandulosa Woodland (CEGL000719)
- PROSOPIS GLANDULOSA SHRUBLAND ALLIANCE (A.1031)
  Prosopis glandulosa / Atriplex canescens Shrubland (CEGL001382)
  Prosopis glandulosa / Bouteloua gracilis Shrubland (CEGL001383)
  Prosopis glandulosa / Muhlenbergia porteri Shrubland (CEGL001511)
  Prosopis glandulosa / Sporobolus airoides Shrubland (CEGL001385)
  Prosopis glandulosa / Sporobolus flexuosus Shrubland (CEGL001386)
  Prosopis glandulosa var. torreyana Shrubland (CEGL001381)
- PROSOPIS VELUTINA SHRUBLAND ALLIANCE (A.1043)
  Prosopis velutina - Acacia greggii Shrubland (CEGL001388)
  Prosopis velutina / Celtis laevigata var. reticulata Shrubland (CEGL001390)
  Prosopis velutina / Muhlenbergia porteri Shrubland (CEGL001391)

SOURCES

References: MacMahon 1988, McAuliffe 1995, McPherson 1995, Muldavin et al. 2002
Last updated: 20 Feb 2003 **Stakeholders:** WCS, SCS, LACD
Concept Author: NatureServe Western Ecology Team **LeadResp:** WCS

S059 COLORADO PLATEAU BLACKBRUSH-MORMON-TEA SHRUBLAND

Division 304, Shrubland, CES304.763

Spatial Scale & Pattern: Large Patch **Classification Confidence:** medium
Required Classifiers: Natural/Semi-natural, Vegetated (>10% vasc.), Upland
Diagnostic Classifiers: Lowland [Foothill], Shrubland (Shrub-dominated), Temperate [Temperate Xeric], Aridic

Non-Diagnostic Classifiers: Ridge/Summit/Upper Slope, Sideslope, Alkaline Soil, Sand Soil Texture, Very Long Disturbance Interval, F-Patch/High Intensity

Concept Summary: This ecological system occurs in the Colorado Plateau on benchlands, colluvial slopes, pediments or bajadas. Elevation ranges from 560-1650 m. Substrates are shallow, typically calcareous, non-saline and gravelly or sandy soils over sandstone or limestone bedrock, caliche or limestone alluvium. It also occurs in deeper soils on sandy plains where it may have invaded desert grasslands. The vegetation is characterized by

extensive open shrublands dominated by *Coleogyne ramosissima* often with *Ephedra viridis*, *Ephedra torreyana*, or *Grayia spinosa*. Sandy portions may include *Artemisia filifolia* as codominant. Within a blackbrush shrubland disturbed patches are dominated by shrubs such as *Chrysothamnus viscidiflorus, Ericameria* spp., *Ephedra* spp., *Grayia spinosa, Poliomintha incana* or exotic annual grasses. The herbaceous layer is sparse and composed of graminoids such as *Achnatherum hymenoides, Pleuraphis jamesii*, or *Sporobolus cryptandrus*.

DISTRIBUTION

Range: Occurs in the Colorado Plateau on benchlands, colluvial slopes, pediments or bajadas. Elevation ranges from 560-1600 m.
Ecological Divisions: 304
TNC Ecoregions: 18:C, 19:C
Subnations/Nations: AZ:c, CO:c, NM:c, UT:c

CONCEPT

Alliances and Associations:

- ACHNATHERUM HYMENOIDES SHRUB HERBACEOUS ALLIANCE (A.1543)
  Ephedra viridis / Achnatherum hymenoides - Bouteloua gracilis Shrub Herbaceous Vegetation (CEGL001648)
  Ephedra viridis / Achnatherum hymenoides - Sporobolus cryptandrus Shrub Herbaceous Vegetation (CEGL001649)
- ARTEMISIA FILIFOLIA SHRUBLAND ALLIANCE (A.816)
  Artemisia filifolia / Bouteloua eriopoda Shrubland (CEGL001077)
  Artemisia filifolia Colorado Plateau Shrubland (CEGL002697)
- BOUTELOUA ERIOPODA XEROMORPHIC SHRUB HERBACEOUS ALLIANCE (A.1553)
  Ephedra torreyana / Bouteloua eriopoda Shrub Herbaceous Vegetation (CEGL001731)
- COLEOGYNE RAMOSISSIMA SHRUBLAND ALLIANCE (A.874)
  Coleogyne ramosissima / Pleuraphis jamesii Shrubland (CEGL001334)
  Coleogyne ramosissima Shrubland (CEGL001332)
- EPHEDRA NEVADENSIS - EPHEDRA VIRIDIS SHRUBLAND ALLIANCE (A.856)
  Ephedra nevadensis - Ephedra viridis - Salvia dorrii - Lycium andersonii Shrubland (CEGL001256)
- EPHEDRA NEVADENSIS SHRUBLAND ALLIANCE (A.857)
  Ephedra nevadensis / Achnatherum hymenoides Shrubland (CEGL001255)
- EPHEDRA VIRIDIS SHRUBLAND ALLIANCE (A.858)
  Ephedra viridis / Pleuraphis rigida Shrubland (CEGL001257)
- POLIOMINTHA INCANA SHRUBLAND ALLIANCE (A.862)
  Poliomintha incana / (Pleuraphis jamesii) Shrubland (CEGL002930)

Environment: This ecological system typically occurs on gentle to steep, bouldery or rocky slopes of mountains, canyons, and mesas with varying aspects. This system is an evergreen, microphyllous desert scrub with succulents, half-shrubs, and scattered deciduous shrubs typically found at elevations ranging from 580 to 1600 m. (1903-5249 feet). This shrubland system occurs in an arid to semi-arid climate with annual precipitation in the form of summer monsoons and winter storms averaging approximately 20 cm. Soils are highly variable and parent materials may include shale, sandstone, limestone, quartzites, and igneous rocks. Soils are generally coarse-textured, often rocky, shallow and well-drained. Effective soil moisture appears to be primarily controlled by regolith depth and position in relation to the water table. This brushland system occupies most sites where regolith is uniformly shallow. In association with blackbrush (*Coleogyne ramosissima*) sites, the soil moisture is concentrated on top of impermeable bedrock at a shallow depth. This perching effect allows for gradual uptake of moisture by the plants roots (Loope and West 1979). This permits growth of plants with more mesic habitat requirements (Warren et al. 1982). On sites with deep soil, blackbrush may occur in almost pure occurrences with only a few associated species (Warren et al. 1982). Dark-colored cryptogamic soil crusts, composed of lichens, mosses, fungi, and algae, are often present in this system in fairly undisturbed areas. Sandy soils may have more cryptogamic crusts than clayish or silty soil surfaces.

Vegetation: This ecological system is dominated by sparse to moderately dense shrubs. Dominant shrubs include *Coleogyne ramosissima, Ephedra nevadensis*, and *Ephedra viridis* (which may codominate with *Grayia spinosa, Salvia dorrii*, and *Lycium andersonii*). There is usually a sparse herbaceous layer with some perennial grasses and forbs. Annual grasses and forbs are present seasonally. Some characteristic species associated with this system include the shrubs *Gutierrezia sarothrae, Chrysothamnus viscidiflorus, Yucca baccata*, and *Krameria grayi*, succulents such as *Ferocactus cylindraceus (= Ferocactus acanthodes), Opuntia* spp., *Echinocereus* spp., *Echinocactus* spp., and *Agave* spp., the graminoid *Pleuraphis rigida*, and perennial forbs such as *Machaeranthera pinnatifida* and *Sphaeralcea ambigua*.

Dynamics: Fire does not appear to play a role in maintenance of shrublands within this system. Topographic breaks dissect the landscape, and isolated pockets of vegetation are separated by rock walls or steep canyons. Blackbrush is fire-intolerant (Loope and West 1979). Following fires, these communities are often colonized by non-native grasses, which serve to encourage recurrent fires and delay shrub regeneration (IVC 1999). In shallow regolith situations, secondary succession, in the sense of site preparation by seral plants, may not occur at all (Loope and West 1979).

SPATIAL CHARACTERISTICS

Adjacent Ecological Systems: Adjacent vegetation often includes *Atriplex* dominated shrubland communities and upland areas of pinyon-juniper woodlands. Grasslands dominated by *Pleuraphis jamesii*, *Hesperostipa comata*, and *Achnatherum hymenoides* also occur.

SOURCES

References: Loope and West 1979, Thatcher 1975, Tuhy and MacMahon 1988, Tuhy et al. 2002, Warren et al. 1982, West 1983d

Last updated: 20 Feb 2003 **Stakeholders:** WCS

Concept Author: NatureServe Western Ecology Team **LeadResp:** WCS

S060 MOJAVE MID-ELEVATION MIXED DESERT SCRUB

Division 302, Shrubland, CES302.742

Spatial Scale & Pattern: Large Patch **Classification Confidence:** low

Required Classifiers: Natural/Semi-natural, Vegetated (>10% vasc.), Upland

Diagnostic Classifiers: Lowland [Foothill], Shrubland (Shrub-dominated), Evergreen Sclerophyllous Tree

Non-Diagnostic Classifiers: Sideslope, Temperate [Temperate Xeric], Aridic, Xeromorphic Shrub, Succulent Shrub

Concept Summary: This ecological system represents the extensive desert scrub in the transition zone above *Larrea tridentata - Ambrosia dumosa* desert scrub and below the lower montane woodlands (700-1800 m elevations) that occurs in the eastern and central Mojave Desert. It is also common on lower piedmont slopes in the transition zone into the southern Great Basin. The vegetation in this ecological systems is quite variable. Codominants and diagnostic species include *Coleogyne ramosissima, Eriogonum fasciculatum, Ephedra nevadensis, Grayia spinosa, Menodora spinescens, Nolina* spp., *Opuntia acanthocarpa, Salazaria mexicana, Viguiera parishii, Yucca brevifolia*, or *Yucca schidigera*. Desert grasses, including *Achnatherum hymenoides, Achnatherum speciosum, Muhlenbergia porteri, Pleuraphis jamesii, Pleuraphis rigida*, or *Poa secunda*, may form an herbaceous layer. Scattered *Juniperus osteosperma* or desert scrub species may also be present.

DISTRIBUTION

Range: Eastern and central Mojave Desert and on lower piedmont slopes in the transition zone into the southern Great Basin.

Ecological Divisions: 206, 302, 304

TNC Ecoregions: 11:C, 12:P, 17:C, 23:P

Subnations/Nations: AZ:c, CA:c, NV:c, UT:c

CONCEPT

Alliances and Associations:

- ARTEMISIA TRIDENTATA (SSP. TRIDENTATA, SSP. XERICENSIS) SHRUBLAND ALLIANCE (A.830)
  Artemisia tridentata ssp. tridentata - Grayia spinosa Shrubland (CEGL001004)
- COLEOGYNE RAMOSISSIMA SHRUBLAND ALLIANCE (A.874)
  Coleogyne ramosissima - Eriogonum fasciculatum Shrubland (CEGL001333)
  Coleogyne ramosissima - Purshia stansburiana Shrubland (CEGL002720)
  Coleogyne ramosissima - Thamnosma montana Shrubland (CEGL002718)
  Coleogyne ramosissima Shrubland (CEGL001332)
- EPHEDRA NEVADENSIS SHRUBLAND ALLIANCE (A.857)
  Ephedra nevadensis - Ericameria cooperi Shrubland (CEGL001253)
  Ephedra nevadensis - Eriogonum fasciculatum Shrubland (CEGL001254)
  Ephedra nevadensis / Achnatherum hymenoides Shrubland (CEGL001255)

- EPHEDRA VIRIDIS SHRUBLAND ALLIANCE (A.858)
  Ephedra viridis / Pleuraphis rigida Shrubland (CEGL001257)
- ERICAMERIA PARRYI SHRUBLAND ALLIANCE (A.818)
  Ericameria parryi Shrubland [Provisional] (CEGL003040)
- ERICAMERIA TERETIFOLIA SHRUBLAND ALLIANCE (A.2540)
  Ericameria teretifolia Shrubland [Placeholder] (CEGL002963)
- ERIOGONUM FASCICULATUM SHRUBLAND ALLIANCE (A.868)
  Eriogonum fasciculatum Rock Outcrop Shrubland (CEGL001260)
  Eriogonum fasciculatum Shrubland (CEGL001258)
- GRAYIA SPINOSA INTERMITTENTLY FLOODED SHRUBLAND ALLIANCE (A.1045)
  Grayia spinosa - Lycium andersonii Shrubland (CEGL001347)
  Grayia spinosa - Lycium pallidum Shrubland (CEGL001348)
- GRAYIA SPINOSA SHRUBLAND ALLIANCE (A.1038)
  Grayia spinosa - Menodora spinescens Shrubland (CEGL001349)
- JUNIPERUS CALIFORNICA WOODED SHRUBLAND ALLIANCE (A.502)
  Juniperus californica Wooded Shrubland (CEGL003058)
- MENODORA SPINESCENS DWARF-SHRUBLAND ALLIANCE (A.2515)
  Menodora spinescens Dwarf-shrubland [Placeholder] (CEGL002767)
- NOLINA BIGELOVII SHRUBLAND ALLIANCE (A.2534)
  Nolina bigelovii Shrubland [Placeholder] (CEGL003064)
- NOLINA PARRYI SHRUBLAND ALLIANCE (A.2535)
  Nolina parryi Shrubland [Placeholder] (CEGL002956)
- PEUCEPHYLLUM SCHOTTII SHRUBLAND ALLIANCE (A.2516)
  Peucephyllum schottii Shrubland [Placeholder] (CEGL002722)
- SALAZARIA MEXICANA SHRUBLAND ALLIANCE (A.2538)
  Salazaria mexicana Shrubland [Placeholder] (CEGL002961)
- VIGUIERA PARISHII SHRUBLAND ALLIANCE (A.2526)
  Viguiera parishii Shrubland [Placeholder] (CEGL002721)
- YUCCA BREVIFOLIA WOODED HERBACEOUS ALLIANCE (A.2527)
  Yucca brevifolia / Pleuraphis rigida Wooded Herbaceous Vegetation (CEGL002725)
- YUCCA BREVIFOLIA WOODED SHRUBLAND ALLIANCE (A.884)
  Yucca brevifolia - Juniperus osteosperma / Artemisia tridentata Wooded Shrubland (CEGL002744)
  Yucca brevifolia Wooded Shrubland [Placeholder] (CEGL003116)
- YUCCA SCHIDIGERA SHRUBLAND ALLIANCE (A.881)
  Yucca schidigera Shrubland [Placeholder] (CEGL003117)

- **California community types:**
- California Buckwheat Scrub (32.040.00)
- California Buckwheat - California Figwort - Phacelia (32.040.01)
- California Buckwheat (32.040.02)
- California Buckwheat - Big Sagebrush (32.040.03)
- California Buckwheat Alluvial Fan (32.040.04)
- California Buckwheat-White Bursage (32.040.05)
- California Buckwheat - Bladder Sage (32.040.06)
- Creosote Bush - Nevada Ephedra (33.010.10)
- Creosote Bush - Mojave Yucca - Desert Tea (33.010.11)
- Blackbush High Desert Scrub (33.020.00)
- Sonoran Blackbush (33.020.01)
- Blackbush - Shadscale (33.020.02)
- Blackbush - Nevada Ephedra (33.020.03)
- Blackbush - Nevada Ephedra - California Buckwheat (33.020.04)
- Blackbush - California Buckwheat (33.020.05)
- Blackbush - Creosote Bush - California Buckwheat (33.020.06)
- Blackbush - Creosote Bush - White Bursage (33.020.07)
- Blackbush - Anderson’s Wolfberry (33.020.08)
- Blackbush - Bladder Sage (33.020.09)
- Virgin River Encelia Scrub (33.025.00)
- Virgin River Encelia (33.025.01)
- Virgin River Encelia - Blue Sage (33.025.02)
- Creosote Bush - Brittlebush Scrub (33.027.00)
- Creosote Bush - Brittlebush / Arizona Honeysweet (33.027.01)
- Creosote Bush - Brittlebush - Sweetbush (33.027.02)
- Creosote Bush - Brittlebush - White Bursage (33.027.03)

- Creosote Bush - Brittlebush - Ocotillo (33.027.04)
- Brittlebush Drought Deciduous Scrub (33.030.00)
- Brittlebush-succulent scrub (33.030.01)
- Brittlebush-Desert Fir (33.030.02)
- Brittlebush-California Buckwheat-Agave (33.030.03)
- Acton Encelia (33.031.00)
- Desert Sunflower Drought Deciduous Scrub (33.032.00)
- Desert Sunflower-Agave (33.032.01)
- Desert Sunflower-California Buckwheat (33.032.02)
- Net-veined Viguiera Scrub (33.033.00)
- Net-veined Viguiera (33.033.01)
- Mojave Yucca (33.070.01)
- Mojave Yucca - Blackbush (33.070.02)
- Mojave Yucca - Nevada Ephedra (33.070.02)
- Mojave Yucca - White Bursage (33.070.03)
- Mojave Yucca - Creosote Bush - White Bursage (33.070.05)
- Mojave Yucca - Creosote Bush - Nevada Ephedra (33.070.06)
- Mojave Yucca - California Buckwheat (33.070.07)
- Mojave Yucca - Buckhorn Cholla (33.070.08)
- Mojave Yucca - Desert Sunflower (33.070.09)
- Mojave Yucca - Creosote Bush - (Jojoba) (33.070.10)
- Desert Agave succulent-leaved scrub (33.075.00)
- Desert Agave wash terrace (33.075.01)
- Desert Agave-Mojave Yucca (33.075.02)
- Nolina (33.080.00)
- Parry's Nolina (33.080.01)
- Joshua Tree Woodland (33.170.01)
- Joshua Tree / Blackbush (33.170.02)
- Joshua Tree - California Juniper / Blackbush (33.170.03)
- Joshua Tree / Big Sagebrush - Shadscale (33.170.04)
- Joshua Tree / Creosote Bush - Nevada Ephedra (33.170.05)
- Joshua Tree / Buckhorn Cholla (33.170.06)
- Joshua Tree / Galleta spp. (33.170.07)
- Joshua Tree / Anderson's Wolfberry (33.170.08)
- Joshua Tree / Bladder Sage (33.170.09)
- Joshua Tree / Mojave Yucca - Creosote Bush (33.170.10)
- Joshua Tree / Creosote Bush - White Bursage - California Buckwheat (33.170.11)
- Hop-sage (33.180.01)
- Hop-sage - Shadscale (33.180.02)
- Hop-sage - Creosote Bush (33.180.03)
- Hop-sage - Anderson's Wolfberry (33.180.04)
- Hop-sage - Round-leaved Buckwheat (33.180.05)
- Mojave Mixed Woody Scrub (33.211.00)
- California Ephedra (33.270.00)
- California Ephedra - Cheesebush (33.270.01)
- Nevada Ephedra Scrub (33.280.00)
- Nevada Ephedra (33.280.01)
- Nevada Ephedra - Shadscale (33.280.02)
- Nevada Ephedra - Bladder Sage (33.280.03)
- Nevada Ephedra - Wolfberry (33.280.04)
- Spiny Menodora Scrub (33.290.00)
- Big Sagebrush - Blackbush (35.110.05)
- Big Sagebrush - Virgin River Encelia (35.110.06)
- Big Sagebrush - Green Ephedra (35.110.08)
- Mountain Big Sagebrush / Shorthair Sedge (35.110.10)
- Shadscale - Blackbush (36.320.04)
- Shadscale - Sticky Snakeweed - Catclaw Horsebrush (36.320.05)
- Shadscale - Virgin River Encelia - Hop-sage (36.320.09)

SPATIAL CHARACTERISTICS

Spatial Summary: Transition zone shrublands desert scrub above Mojave desert scrub and below the lower montane woodlands.

SOURCES

References: Barbour and Major 1988, Beatley 1976, Holland and Keil 1995, MacMahon 1988, Ostler et al. 2000, Sawyer and Keeler-Wolf 1995, Thomas et al. 2003a

Last updated: 20 Feb 2003 **Stakeholders:** WCS, LACD

Concept Author: NatureServe Western Ecology Team **LeadResp:** WCS

S061 CHIHUAHUAN SUCCULENT DESERT SCRUB

Division 302, Shrubland, CES302.738

Spatial Scale & Pattern: Large Patch **Classification Confidence:** low

Required Classifiers: Natural/Semi-natural, Vegetated (>10% vasc.), Upland

Diagnostic Classifiers: Temperate [Temperate Xeric], Succulent Shrub, Cacti-dominated

Non-Diagnostic Classifiers: Lowland [Foothill], Lowland [Lowland], Shrubland (Shrub-dominated), Tropical/Subtropical [Tropical Xeric], Aridic

Concept Summary: This ecological system is found in the Chihuahuan Desert on colluvial slopes, upper bajadas, sideslopes, ridges, canyons, hills and mesas. Sites are hot and dry. Gravel and rock is often abundant on ground surface. The vegetation is characterized by the relatively high cover of succulent species such as *Agave lechuguilla, Euphorbia antisyphilitica, Ferocactus spp., Fouquieria splendens, Opuntia engelmannii, Opuntia imbricata, Opuntia spinosior, Yucca baccata,* and many others. *Perennial grass cover is generally low*. The abundance of succulents is diagnostic of this desert scrub system, but desert shrubs are usually present. This system does not include desert grasslands or shrub steppe with a strong cacti component.

DISTRIBUTION

Range: Chihuahuan Desert on colluvial slopes, upper bajadas, sideslopes and mesas.

Ecological Divisions: 302

TNC Ecoregions: 22:P, 24:C

Subnations/Nations: AZ:c, MXCH:c, NM:c, TX:c

CONCEPT

Alliances and Associations:

- DASYLIRION LEIOPHYLLUM - (AGAVE LECHUGUILLA, VIGUIERA STENOLOBA) SHRUBLAND ALLIANCE (A.850)
  - Dasylirion leiophyllum - Agave lechuguilla / Bouteloua hirsuta - Bouteloua gracilis - Bouteloua eriopoda Shrubland (CEGL004245)
  - Dasylirion leiophyllum - Viguiera stenoloba - Agave lechuguilla / Bouteloua ramosa Shrubland (CEGL004604)
- LARREA TRIDENTATA SHRUBLAND ALLIANCE (A.851)
  - Larrea tridentata - Agave lechuguilla Shrubland (CEGL004562)
  - Larrea tridentata - Euphorbia antisyphilitica Shrubland (CEGL004564)
  - Larrea tridentata - Opuntia schottii Shrubland (CEGL004567)
- OPUNTIA IMBRICATA SHRUBLAND ALLIANCE (A.878)
  - Opuntia imbricata Shrubland (CEGL004588)

SOURCES

References: MacMahon 1988, Muldavin et al. 2000b, Muldavin et al. 2002

Last updated: 20 Feb 2003 **Stakeholders:** WCS, SCS, LACD

Concept Author: NatureServe Western Ecology Team **LeadResp:** WCS

S062 CHIHUAHUAN CREOSOTEBUSH, MIXED DESERT AND THORN SCRUB

Division 302, Shrubland

Spatial Scale & Pattern: Matrix **Classification Confidence:** medium

Required Classifiers: Natural/Semi-natural, Vegetated (>10% vasc.), Upland

Diagnostic Classifiers: Lowland [Foothill], Lowland [Lowland], Shrubland (Shrub-dominated)

Non-Diagnostic Classifiers: Toeslope/Valley Bottom, Tropical/Subtropical [Tropical Xeric], Temperate [Temperate Xeric], Aridic, Xeromorphic Shrub, Thorn Shrub

Concept Summary: This widespread Chihuahuan Desert land cover type is composed of two ecological systems the Chihuahuan Creosotebush Xeric Basin Desert Scrub (CES302.731) and the Chihuahuan Mixed Desert and Thorn Scrub (CES302.734). This cover type includes xeric creosotebush basins and plains and the mixed desert scrub in the foothill transition zone above, sometimes extending up to the lower montane woodlands. Vegetation is characterized by *Larrea tridentata* alone or mixed with thornscrub and other desert scrub such as *Agave lechuguilla, Aloysia wrightii, Fouquieria splendens, Dasylirion leiophyllum, Flourensia cernua, Leucophyllum minus, Mimosa aculeaticarpa var. biuncifera, Mortonia scabrella (= Mortonia sempervirens ssp. scabrella), Opuntia engelmannii, Parthenium incanum, Prosopis glandulosa,* and *Tiquilia greggii*. Stands of *Acacia constricta Acacia neovernicosa* or *Acacia greggii* dominated thornscrub are included in this system, and limestone substrates appear important for at least these species. Grasses such as *Dasyochloa pulchella, Bouteloua curtipendula, Bouteloua eriopoda, Bouteloua ramosa, Muhlenbergia porteri* and *Pleuraphis mutica* may be common, but generally have lower cover than shrubs.

DISTRIBUTION

Range: This landcover type is characterist of the Chihuahuan Desert.
Ecological Divisions: 302
TNC Ecoregions: 22:C, 24:C
Subnations/Nations: AZ:c, MXCH:c, MXSO:c, NM:c, TX:c

CONCEPT

Alliances and Associations:

- ACACIA NEOVERNICOSA SHRUBLAND ALLIANCE (A.1037)
  Acacia neovernicosa / Flourensia cernua Shrubland (CEGL001341)
  Acacia neovernicosa / Muhlenbergia porteri Shrubland (CEGL001342)
- BOUTELOUA HIRSUTA - BOUTELOUA GRACILIS - BOUTELOUA ERIOPODA SHRUB HERBACEOUS ALLIANCE (A.1548)
  Acacia neovernicosa / Bouteloua hirsuta - Bouteloua gracilis - Bouteloua eriopoda Shrub Herbaceous Vegetation (CEGL004244)
  Larrea tridentata / Bouteloua hirsuta - Bouteloua gracilis - Bouteloua eriopoda Shrub Herbaceous Vegetation (CEGL004246)
- FLOURENSIA CERNUA SHRUBLAND ALLIANCE (A.861)
  Flourensia cernua / Achnatherum eminens Shrubland (CEGL001338)
  Flourensia cernua / Bouteloua curtipendula Shrubland (CEGL001336)
  Flourensia cernua / Pleuraphis mutica Shrubland (CEGL001541)
  Flourensia cernua / Sporobolus airoides Shrubland (CEGL001337)
- FOUQUIERIA SPLENDENS SHRUBLAND ALLIANCE (A.863)
  Fouquieria splendens / Bouteloua curtipendula Shrubland (CEGL001376)
  Fouquieria splendens / Bouteloua hirsuta Shrubland (CEGL001377)
  Fouquieria splendens / Parthenium incanum Shrubland (CEGL001378)
  Fouquieria splendens / Petrophyton caespitosum Shrubland (CEGL001379)
- LARREA TRIDENTATA SHRUBLAND ALLIANCE (A.851)
  Larrea tridentata - Flourensia cernua Shrubland (CEGL001270)
  Larrea tridentata - Hechtia texensis Shrubland (CEGL004565)
  Larrea tridentata - Jatropha dioica var. graminea Shrubland (CEGL004566)
  Larrea tridentata - Parthenium incanum Shrubland (CEGL001274)
  Larrea tridentata - Prosopis glandulosa Shrubland (CEGL001275)
  Larrea tridentata / Bouteloua eriopoda Shrubland (CEGL001265)
  Larrea tridentata / Bouteloua gracilis Shrubland (CEGL001266)
  Larrea tridentata / Bouteloua ramosa Shrubland (CEGL004563)
  Larrea tridentata / Dasyochloa pulchella Shrubland (CEGL001269)
  Larrea tridentata / Muhlenbergia porteri Shrubland (CEGL001272)
  Larrea tridentata / Sparse Understory Shrubland (CEGL001276)
  Larrea tridentata / Sporobolus airoides Shrubland (CEGL001277)
- Larrea tridentata / Tiquilia hispidissima Shrubland (CEGL001267)
- MORTONIA SEMPERVIRENS SHRUBLAND ALLIANCE (A.859)
  Mortonia scabrella / Dasylirion wheeleri Shrubland (CEGL001279)

SOURCES

References: Brown 1982, Dick-Peddie 1993, MacMahon 1988, Muldavin et al. 2000b, Muldavin et al. 2002
Last updated: 20 Feb 2003 **Stakeholders:** WCS, SCS, LACD
Concept Author: NatureServe Western Ecology Team **LeadResp:** WCS

S063 SONORAN PALOVERDE-MIXED CACTI DESERT SCRUB

Division 302, Shrubland, CES302.761

Spatial Scale & Pattern: Matrix **Classification Confidence:** medium
Required Classifiers: Natural/Semi-natural, Vegetated (>10% vasc.), Upland
Diagnostic Classifiers: Lowland [Foothill], Lowland [Lowland], Shrubland (Shrub-dominated), Tropical/Subtropical [Tropical Xeric], Temperate [Temperate Xeric], Aridic, Xeromorphic Shrub, Succulent Shrub, Cacti-dominated

Non-Diagnostic Classifiers: Sideslope, Toeslope/Valley Bottom, Alkaline Soil, Sand Soil Texture, Broad-Leaved Deciduous Shrub, Succulent Forb

Concept Summary: This ecological system occurs on hillsides, mesas and upper bajadas in southern Arizona and extreme southeastern California. The vegetation is characterized by a diagnostic sparse, emergent tree layer of *Carnegia gigantea* (3-16 m tall) and/or a sparse to moderately dense canopy codominated by xeromorphic deciduous and evergreen tall shrubs *Parkinsonia microphylla* and *Larrea tridentata* with *Prosopis* sp., *Olneya tesota*, and *Fouquieria splendens* less prominent. Other common shrubs and dwarf-shrubs include *Acacia greggii, Ambrosia deltoidea, Ambrosia dumosa* (in drier sites), *Calliandra eriophylla, Jatropha cardiophylla, Krameria erecta, Lycium* spp., *Menodora scabra, Simmondsia chinensis*, and many cacti including *Ferocactus* spp., *Echinocereus* spp., and *Opuntia* spp. (both cholla and prickly pear). The sparse herbaceous layer is composed of perennial grasses and forbs with annuals seasonally present and occasionally abundant. On slopes, plants are often distributed in patches around rock outcrops where suitable habitat is present.

DISTRIBUTION

Range: Southern Arizona and extreme southeastern California.
Ecological Divisions: 302
TNC Ecoregions: 23:C
Subnations/Nations: AZ:c, CA:c, MXBC:c, MXSO:c, NV:?

CONCEPT

Alliances and Associations:

- ACACIA GREGGII SHRUBLAND ALLIANCE (A.1036)
  Acacia greggii - Parkinsonia microphylla Shrubland (CEGL001340)
- AMBROSIA DELTOIDEA SHRUBLAND ALLIANCE (A.852)
  Ambrosia deltoidea / Simmondsia chinensis Shrubland (CEGL000953)
- CARNEGIA GIGANTEA WOODED SHRUBLAND ALLIANCE (A.885)
  Carnegia gigantea / Prosopis velutina Wooded Shrubland (CEGL001389)
- FOUQUIERIA SPLENDENS SHRUBLAND ALLIANCE (A.863)
  Fouquieria splendens / Bouteloua curtipendula Shrubland (CEGL001376)
  Fouquieria splendens / Bouteloua hirsuta Shrubland (CEGL001377)
- LARREA TRIDENTATAWOODED SHRUBLAND ALLIANCE (Proposed)
- OPUNTIA BIGELOVII SHRUBLAND ALLIANCE (A.877)
  Opuntia bigelovii Shrubland [Placeholder] (CEGL003065)
- PARKINSONIA FLORIDA - OLNEYA TESOTA WOODLAND ALLIANCE (A.588)
  Parkinsonia florida - Olneya tesota Woodland [Placeholder] (CEGL003035)
- PARKINSONIA FLORIDA SHRUBLAND ALLIANCE (A.882)
  Parkinsonia florida / Hilaria belangeri Shrubland (CEGL001374)
- PARKINSONIA MICROPHYLLA SHRUBLAND ALLIANCE (A.883)
  Parkinsonia microphylla - Larrea tridentata Shrubland (CEGL001375)
- SIMMONDSIA CHINENSIS SHRUBLAND ALLIANCE (A.853)
  Simmondsia chinensis - Parkinsonia microphylla Shrubland (CEGL000983)

- **California community types:**
- Teddy-bear Cholla Succulent Scrub (33.050.00)
- Ocotillo open-tall scrub (33.090.00)

- All-thorn Tall Scrub Unique Stands (33.100.00)
- Crucifixion-thorn Tall Scrub Unique Stands (33.110.00)
- Elephant Tree Unique Stands (33.120.00)
- Brittlebush - White Bursage Dwarf Scrub (33.130.00)
- Foothill Palo Verde - Saguaro Tall Scrub (33.150.00)
- Sonoran Mixed Woody and Succulent Scrub (33.210.00)

SOURCES

References: Bowers and McLaughlin 1987, Brown 1982, MacMahon 1988, McAuliffe 1993, Niering and Lowe 1984, Robichaux 1999, Shreve and Wiggins 1964

Last updated: 20 Feb 2003 **Stakeholders:** WCS

Concept Author: NatureServe Western Ecology Team **LeadResp:** WCS

S065 INTER-MOUNTAIN BASINS MIXED SALT DESERT SCRUB

Division 304, Shrubland, CES304.784

Spatial Scale & Pattern: Large Patch **Classification Confidence:** medium

Required Classifiers: Natural/Semi-natural, Vegetated (>10% vasc.), Upland

Diagnostic Classifiers: Lowland [Lowland], Shrubland (Shrub-dominated), Alluvial flat, Alluvial plain, Plain, Alkaline Soil, Saline Substrate Chemistry, Calcareous, Silt Soil Texture, Clay Soil Texture, Xeromorphic Shrub, Dwarf-Shrub, Atriplex spp.

Non-Diagnostic Classifiers: Basin floor, Temperate [Temperate Continental], Oligotrophic Soil

Concept Summary: This extensive ecological system includes open-canopied shrublands of typically saline basins, alluvial slopes and plains across the Intermountain western U.S. This type also extends in limited distribution into the southern Great Plains. Substrates are often saline and calcareous, medium- to fine-textured, alkaline soils, but include some coarser-textured soils. The vegetation is characterized by a typically open to moderately dense shrubland composed of one or more *Atriplex* species such as *Atriplex confertifolia, Atriplex canescens, Atriplex polycarpa*, or *Atriplex spinifera*. Other shrubs present to codominate may include *Artemisia tridentata ssp. wyomingensis, Chrysothamnus viscidiflorus, Ericameria nauseosa, Ephedra nevadensis, Grayia spinosa, Krascheninnikovia lanata, Lycium* spp., *Picrothamnus desertorum*, or *Tetradymia* spp. *Sarcobatus vermiculatus* is generally absent, but if present does not codominate. The herbaceous layer varies from sparse to moderately dense and is dominated by perennial graminoids such as *Achnatherum hymenoides, Bouteloua gracilis, Elymus lanceolatus ssp. lanceolatus, Pascopyrum smithii, Pleuraphis jamesii, Pleuraphis rigida, Poa secunda,* or *Sporobolus airoides*. Various forbs are also present.

DISTRIBUTION

Range: Intermountain western U.S., extending in limited distribution into the southern Great Plains.

Ecological Divisions: 303, 304, 306

TNC Ecoregions: 10:C, 11:C, 18:C, 19:C, 20:C, 21:C, 26:C, 27:C, 28:C, 4:?, 6:C, 8:?, 9:C

Subnations/Nations: AZ:c, CA:c, CO:c, ID:c, MT:c, NM:c, NV:c, OR:c, UT:c, WA:c, WY:c

CONCEPT

Alliances and Associations:

- ATRIPLEX (LENTIFORMIS, POLYCARPA) SHRUBLAND ALLIANCE (A.864)
  Atriplex (lentiformis, polycarpa) Shrubland [Placeholder] (CEGL003016)
- ATRIPLEX CANESCENS SHRUBLAND ALLIANCE (A.869)
  Atriplex canescens - Artemisia tridentata Shrubland (CEGL001282)
  Atriplex canescens - Ephedra viridis Shrubland (CEGL001287)
  Atriplex canescens - Krascheninnikovia lanata Shrubland (CEGL001285)
  Atriplex canescens / Achnatherum hymenoides Shrubland (CEGL001289)
  Atriplex canescens / Bouteloua gracilis Shrubland (CEGL001283)
  Atriplex canescens / Calycoseris parryi Shrubland (CEGL001284)
  Atriplex canescens / Parthenium confertum Shrubland (CEGL001290)
  Atriplex canescens / Pleuraphis jamesii Shrubland (CEGL001288)
  Atriplex canescens / Purshia stansburiana Shrubland (CEGL001286)
  Atriplex canescens / Sporobolus airoides Shrubland (CEGL001291)
  Atriplex canescens / Sporobolus wrightii Shrubland (CEGL001292)
  Atriplex canescens Shrubland (CEGL001281)

- ATRIPLEX CONFERTIFOLIA SHRUBLAND ALLIANCE (A.870)
  Atriplex confertifolia - Ephedra nevadensis Shrubland (CEGL001303)
  Atriplex confertifolia - Krascheninnikovia lanata Shrubland (CEGL001301)
  Atriplex confertifolia - Lycium andersonii Shrubland (CEGL001308)
  Atriplex confertifolia - Lycium pallidum / Mirabilis pudica Shrubland (CEGL001309)
  Atriplex confertifolia - Lycium shockleyi Shrubland (CEGL001310)
  Atriplex confertifolia - Picrothamnus desertorum / Achnatherum hymenoides Shrubland (CEGL001297)
  Atriplex confertifolia - Picrothamnus desertorum / Krascheninnikovia lanata Shrubland (CEGL001296)
  Atriplex confertifolia - Picrothamnus desertorum / Sarcobatus vermiculatus Shrubland (CEGL001298)
  Atriplex confertifolia - Picrothamnus desertorum Shrubland (CEGL001295)
  Atriplex confertifolia - Sarcobatus vermiculatus Shrubland (CEGL001313)
  Atriplex confertifolia / Achnatherum hymenoides Shrubland (CEGL001311)
  Atriplex confertifolia / Elymus elymoides Shrubland (CEGL001302)
  Atriplex confertifolia / Ericameria nauseosa Shrubland (CEGL001300)
  Atriplex confertifolia / Hesperostipa comata Shrubland (CEGL001314)
  Atriplex confertifolia / Kochia americana Shrubland (CEGL001305)
  Atriplex confertifolia / Leymus salinus Shrubland (CEGL001307)
  Atriplex confertifolia / Leymus salinus ssp. salmonis Shrubland (CEGL001306)
  Atriplex confertifolia / Pleuraphis jamesii Shrubland (CEGL001304)
  Atriplex confertifolia / Pseudoroegneria spicata Shrubland (CEGL001312)
  Atriplex confertifolia / Tetradymia glabrata Shrubland (CEGL001315)
  Atriplex confertifolia Great Basin Shrubland (CEGL001294)
  Atriplex confertifolia Wyoming Basins Shrubland (CEGL001293)
- ATRIPLEX OBOVATA DWARF-SHRUBLAND ALLIANCE (A.1108)
  Atriplex obovata / Sporobolus airoides - Sporobolus cryptandrus Dwarf-shrubland (CEGL001447)
  Atriplex obovata / Tidestromia carnosa Dwarf-shrubland (CEGL004575)
- ATRIPLEX PARRYI SHRUBLAND ALLIANCE (A.2507)
  Atriplex parryi Shrubland [Placeholder] (CEGL002711)
- ATRIPLEX POLYCARPA SHRUBLAND ALLIANCE (A.873)
  Atriplex polycarpa / Pleuraphis mutica Shrubland (CEGL001319)
  Atriplex polycarpa Shrubland (CEGL001318)
- ATRIPLEX SPINIFERA SHRUBLAND ALLIANCE (A.865)
  Atriplex spinifera Shrubland [Placeholder] (CEGL003015)
- KRASCHENINNIKOVIA LANATA DWARF-SHRUBLAND ALLIANCE (A.1104)
  Krascheninnikovia lanata / Achnatherum hymenoides Dwarf-shrubland (CEGL001323)
  Krascheninnikovia lanata / Hesperostipa comata Dwarf-shrubland (CEGL001327)
  Krascheninnikovia lanata Dwarf-shrubland [Provisional] (CEGL001320)
- PICROTHAMNUS DESERTORUM SHRUBLAND ALLIANCE (A.1128)
  Picrothamnus desertorum / Elymus elymoides Shrubland [Provisional] (CEGL002992)
  Picrothamnus desertorum Shrubland (CEGL001452)
- PLEURAPHIS JAMESII SHRUB HERBACEOUS ALLIANCE (A.1532)
  Atriplex obovata / Pleuraphis jamesii - Sporobolus airoides Shrub Herbaceous Vegetation (CEGL001775)

- **California community types:**
- Fourwing Saltbush Scrub (36.310.00)
- Fourwing Saltbush (36.310.01)
- Shadscale - Fourwing Saltbush (36.320.06)
- Shadscale - Winter Fat (36.320.08)
- Spinescale Scrub (36.350.00)
- Great Valley Spinescale Scrub (36.351.00)
- Winter Fat dwarf scrub (36.500.00)

Environment: This salt-desert shrubland system is a matrix system in the Intermountain West. This system is comprised of arid to semi-arid shrublands on lowland and upland sites usually at elevations between 1520 and 2200 m (4987-7218 feet). Sites can be found on all aspects and include valley bottoms, alluvial and alkaline flats, mesas and plateaus, playas, drainage terraces, washes and interdune basins, bluffs, and gentle to moderately steep sandy or rocky slopes. Slopes are typically gentle to moderately steep, but are sometimes unstable and prone to surface movement. Many areas within this system are degraded due to erosion and may resemble “badlands.” Soil surface is often very barren in occurrences of this system. The interspaces between the characteristic plant clusters are commonly covered by a microphytic crust (West 1982).

This is typically a system of extreme climatic conditions, with warm to hot summers and freezing winters. Annual precipitation ranges from approximately 13-33 cm. In much of the ecological system, the period of greatest moisture will be mid- to late summer, although in the more northern areas a moist period is to be expected in the cold part of the year. However, plotted seasonality of occurrence is probably of less importance on this desert system than in other ecosystems because desert precipitation comes with an extreme irregularity that does not appear in graphs of long-term seasonal or monthly averages (Blaisdell and Holmgren 1984). Soils are shallow to moderately deep, poorly developed, and a product of an arid climate and little precipitation. Soils are often alkaline or saline. Vegetation within this system is tolerant of these soil conditions but not restricted to it. The shallow soils of much of the area are poorly developed Entisols. Vegetation within this system can occur on level pediment remnants where coarse-textured and well-developed soil profiles have been derived from sandstone gravel and are alkaline, or on Mancos shale badlands, where soil profiles are typically fine-textured and non-alkaline throughout (West and Ibrahim 1968). They can also occur in alluvial basins where parent materials from the other habitats have been deposited over Mancos shale and the soils are heavy-textured and saline-alkaline throughout the profile (West and Ibrahim 1968).

Vegetation: Occurrences of this ecological system vary from almost pure occurrences of single species to fairly complex mixtures. The characteristic mix of low shrubs and grasses is sparse, with large open spaces between the plants (Blaisdell and Holmgren 1984). Occurrences have a sparse to moderately dense cover of woody species that is dominated by *Atriplex canescens* (may codominate with *Artemisia tridentata*), *Atriplex confertifolia* (may codominate with *Lycium andersonii*), *Atriplex obovata, Picrothamnus desertorum*, or *Krascheninnikovia lanata*. Other shrubs that may occur within these occurrences include *Purshia stansburiana, Psorothamnus polydenius, Ephedra* spp., *Acacia greggii, Encelia frutescens, Tiquilia latior, Parthenium confertum, Atriplex polycarpa, Atriplex lentiformis, Atriplex spinifera, Picrothamnus desertorum (= Artemisia spinescens), Frankenia salina, Artemisia frigida, Chrysothamnus* spp., *Lycium* ssp., *Suaeda* spp., *Yucca glauca*, and *Tetradymia spinosa*. Dwarf-shrubs include *Gutierrezia sarothrae* and *Eriogonum* spp. Warm-season medium-tall and short perennial grasses dominate in the sparse to moderately dense graminoid layer. The species present depend on the geographic range of the grasses, alkalinity/salinity and past land use. Species may include *Pleuraphis jamesii, Bouteloua gracilis, Sporobolus airoides, Sporobolus cryptandrus, Achnatherum hymenoides, Elymus elymoides, Distichlis spicata, Leymus salinus, Pascopyrum smithii, Hesperostipa comata, Pseudoroegneria spicata, Poa secunda, Leymus ambiguus*, and *Muhlenbergia torreyi*. A number of annual species may also grow in association with the shrubs and grasses of this system, although they are usually rare and confined to areas of recent disturbance (Blaisdell and Holmgren 1984). Forb cover is generally sparse. Perennial forbs that might occur include *Sphaeralcea coccinea, Chaetopappa ericoides, Xylorhiza venusta, Descurainia sophia*, and *Mentzelia* species. Annual natives include *Plantago* spp., *Vulpia octoflora*, or *Monolepis nuttalliana*. Associated halophytic annuals include *Salicornia rubra, Salicornia bigelovii*, and *Suaeda* species. Exotic annuals that may occur include *Salsola kali, Bromus rubens*, and *Bromus tectorum*. Cacti like *Opuntia* spp. and *Echinocereus* spp. may be present in some occurrences. Trees are not usually present but some scattered *Juniperus* spp. may be found.

Dynamics: West (1982) stated that "salt desert shrub vegetation occurs mostly in two kinds of situations that promote soil salinity, alkalinity, or both. These are either at the bottom of drainages in enclosed basins or where marine shales outcrop." However, salt-desert shrub vegetation may be an indication of climatically dry as well as physiologically dry soils (Blaisdell and Holmgren 1984). Not all salt-desert shrub soils are salty, and their hydrologic characteristics may often be responsible for the associated vegetation (Naphan 1966). Species of the salt-desert shrub complex have different degrees of tolerance to salinity and aridity, and they tend to sort themselves out along a moisture/salinity gradient (West 1982). Species and communities are apparently sorted out along physical, chemical, moisture, and topographic gradients through complex relations that are not understood and are in need of further study (Blaisdell and Holmgren 1984).

The winter months within this system are a good time for soil moisture accumulation and storage. There is generally at least one good snow storm per season that will provide sufficient moisture to the vegetation. The winter moisture accumulation amounts will affect spring plant growth. Plants may grow as little as a few inches to 1 m. Unless more rains come in the spring, the soil moisture will be depleted in a few weeks, growth will slow and ultimately cease, and the perennial plants will assume their various forms of dormancy (Blaisdell and Holmgren 1984). If effective rain comes later in the warm season, some of the species will renew their growth from the stage at which it had stopped. Others, having died back, will start over as if emerging from winter dormancy (Blaisdell and Holmgren 1984). *Atriplex confertifolia* shrubs often develop large leaves in the spring, which increase the rate of

photosynthesis. As soil moisture decreases, the leaves are lost, and the plant takes on a dead appearance. During late fall, very small overwintering leaves appear which provide some photosynthetic capability through the remainder of the year (IVC 1999). Other communities are maintained by intra- or inter-annual cycles of flooding followed by extended drought, which favor accumulation of transported salts. The moisture supporting these intermittently flooded wetlands is usually derived off-site, and they are dependent upon natural watershed function for persistence (Reid et al. 1999).

In summary, desert communities of perennial plants are dynamic and changing. The composition within this system may change dramatically and may be both cyclic and unidirectional. Superimposed on the compositional change is great variation from year to year in growth of all the vegetation – the sum of varying growth responses of individual species to specific conditions of different years (Blaisdell and Holmgren 1984). Desert plants grow when temperature is satisfactory, but only if soil moisture is available at the same time. Because amount of moisture is variable from year to year and because different species flourish under different seasons of soil moisture, seldom do all components of the vegetation thrive in the same year (Blaisdell and Holmgren 1984).

SOURCES

References: Barbour and Major 1988, Blaisdell and Holmgren 1984, Branson et al. 1967, Branson et al. 1976, Brown 1982, Campbell 1977, Francis 1986, Holland and Keil 1995, Reid et al. 1999, West 1979, West 1982, West 1983b, West and Ibrahim 1968

Last updated: 20 Feb 2003 **Stakeholders:** WCS, MCS

Concept Author: NatureServe Western Ecology Team **LeadResp:** WCS

S068 CHIHUAHUAN STABILIZED COPPICE DUNE AND SAND FLAT SCRUB

Division 302, Shrubland, CES302.737

Spatial Scale & Pattern: Large Patch **Classification Confidence:** low

Required Classifiers: Natural/Semi-natural, Vegetated (>10% vasc.), Upland

Diagnostic Classifiers: Lowland [Lowland], Shrubland (Shrub-dominated), Plain, Tropical/Subtropical [Tropical Xeric], Temperate [Temperate Xeric], Sand Soil Texture, Aridic, Very Short Disturbance Interval, W-Landscape/High Intensity, Thorn Shrub, Prosopis spp.-dominated

Concept Summary: This ecological system includes the open shrublands of vegetated coppice dunes and sandsheets found in the Chihuahuan Desert. Usually dominated by *Prosopis glandulosa* but includes *Atriplex canescens, Ephedra torreyana, Ephedra trifurca, Poliomintha incana,* and *Rhus microphylla* coppice sand scrub with 10-30% total vegetation cover. *Yucca elata, Gutierrezia sarothrae,* and *Sporobolus flexuosus* are commonly present.

DISTRIBUTION

Range: Dunes and sandsheets found in the Chihuahuan Desert.

Ecological Divisions: 302

TNC Ecoregions: 24:C

Subnations/Nations: MXCH:c, NM:c, TX:c

CONCEPT

Alliances and Associations:

- ATRIPLEX CANESCENS SHRUBLAND ALLIANCE (A.869)
  Atriplex canescens / Sporobolus wrightii Shrubland (CEGL001292)
- EPHEDRA TORREYANA SHRUBLAND ALLIANCE (A.2572)
  Ephedra torreyana - Achnatherum hymenoides Hummock Shrubland (CEGL005802)
- PROSOPIS GLANDULOSA SHRUBLAND ALLIANCE (A.1031)
  Prosopis glandulosa / Atriplex canescens Shrubland (CEGL001382)
  Prosopis glandulosa / Bouteloua gracilis Shrubland (CEGL001383)
  Prosopis glandulosa / Muhlenbergia porteri Shrubland (CEGL001511)
  Prosopis glandulosa / Sporobolus flexuosus Shrubland (CEGL001386)
- PSOROTHAMNUS SCOPARIUS SHRUBLAND ALLIANCE (A.837)
  Psorothamnus scoparius / Sporobolus flexuosus Shrubland (CEGL001695)
- RHUS MICROPHYLLA SHRUBLAND ALLIANCE (A.1040)
  Rhus microphylla / Bouteloua curtipendula Shrubland (CEGL001354)

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SOURCES

References: Bowers 1982, Bowers 1984, Dick-Peddie 1993, Muldavin et al. 2000b
Last updated: 20 Feb 2003 **Stakeholders:** WCS, SCS, LACD
Concept Author: NatureServe Western Ecology Team **LeadResp:** WCS

S069 SONORA-MOJAVE CREOSOTEBUSH-WHITE BURSAGE DESERT SCRUB

Division 302, Shrubland, CES302.756

Spatial Scale & Pattern: Matrix **Classification Confidence:** high
Required Classifiers: Natural/Semi-natural, Vegetated (>10% vasc.), Upland
Diagnostic Classifiers: Lowland [Lowland], Shrubland (Shrub-dominated), Tropical/Subtropical [Tropical Xeric], Temperate [Temperate Xeric], Aridic, Xeromorphic Shrub

Non-Diagnostic Classifiers: Toeslope/Valley Bottom, Alkaline Soil, W-Landscape/Medium Intensity

Concept Summary: This ecological system forms the vegetation matrix in broad valleys, lower bajadas, plains and low hills in the Mojave and lower Sonoran deserts. This desert scrub is characterized by a sparse to moderately dense layer (2-50% cover) of xeromorphic microphyllous and broad-leaved shrubs. *Larrea tridentata* and *Ambrosia dumosa* are typically dominants, but many different shrubs, dwarf-shrubs, and cacti may codominate or form typically sparse understories. Associated species may include *Atriplex canescens*, *Atriplex hymenelytra*, *Encelia farinosa*, *Ephedra nevadensis*, *Fouquieria splendens*, *Lycium andersonii*, and *Opuntia basilaris*. The herbaceous layer is typically sparse, but may be seasonally abundant with ephemerals. Herbaceous species such as *Chamaesyce* spp., *Eriogonum inflatum*, *Dasyochloa pulchella*, *Aristida* spp., *Cryptantha* spp., *Nama* spp., and *Phacelia* spp. are common.

DISTRIBUTION

Range: Broad valleys, lower bajadas, plains and low hills in the Mojave and lower Sonoran deserts.
Ecological Divisions: 302
TNC Ecoregions: 17:C, 23:C
Subnations/Nations: AZ:c, CA:c, MXBC:c, MXSO:c, NV:c, UT:c

CONCEPT

Alliances and Associations:

- AMBROSIA DELTOIDEA SHRUBLAND ALLIANCE (A.852)
  Ambrosia deltoidea / Simmondsia chinensis Shrubland (CEGL000953)
- AMBROSIA DUMOSA DWARF-SHRUBLAND ALLIANCE (A.1102)
  Ambrosia dumosa - Ephedra nevadensis Dwarf-shrubland (CEGL000954)
  Ambrosia dumosa - Larrea tridentata var. tridentata Dwarf-shrubland (CEGL000956)
  Ambrosia dumosa / Pleuraphis rigida Dwarf-shrubland (CEGL000955)
- ERIOGONUM FASCICULATUM SHRUBLAND ALLIANCE (A.868)
  Eriogonum fasciculatum - Purshia glandulosa Shrubland (CEGL001259)
  Eriogonum fasciculatum Rock Outcrop Shrubland (CEGL001260)
  Eriogonum fasciculatum Shrubland (CEGL001258)
- GRAYIA SPINOSA - EPHEDRA VIRIDIS SHRUBLAND ALLIANCE (A.1057)
  Grayia spinosa - Ephedra viridis Shrubland (CEGL001346)
- GRAYIA SPINOSA INTERMITTENTLY FLOODED SHRUBLAND ALLIANCE (A.1045)
  Grayia spinosa - Lycium andersonii Shrubland (CEGL001347)
  Grayia spinosa - Lycium pallidum Shrubland (CEGL001348)
- GRAYIA SPINOSA SHRUBLAND ALLIANCE (A.1038)
  Grayia spinosa - Menodora spinescens Shrubland (CEGL001349)
  Grayia spinosa - Prunus andersonii Shrubland (CEGL001352)
  Grayia spinosa / Achnatherum hymenoides Shrubland (CEGL001350)
  Grayia spinosa / Achnatherum thurberianum Shrubland (CEGL002681)
  Grayia spinosa / Picrothamnus desertorum Shrubland (CEGL001345)
- LARREA TRIDENTATA - AMBROSIA DUMOSA SHRUBLAND ALLIANCE (A.2532)
  Larrea tridentata - Ambrosia dumosa Shrubland [Placeholder] (CEGL002954)
- LARREA TRIDENTATA - ENCELIA FARINOSA SHRUBLAND ALLIANCE (A.2533)
  Larrea tridentata - Encelia farinosa Shrubland [Placeholder] (CEGL002955)

- LARREA TRIDENTATA SHRUBLAND ALLIANCE (A.851)
  Larrea tridentata - Atriplex confertifolia Shrubland (CEGL001263)
  Larrea tridentata - Atriplex hymenelytra Shrubland (CEGL001264)
  Larrea tridentata - Coleogyne ramosissima Shrubland (CEGL002717)
  Larrea tridentata - Ephedra nevadensis Shrubland (CEGL001268)
  Larrea tridentata - Opuntia basilaris - Fouquieria splendens Shrubland (CEGL001273)
  Larrea tridentata / Lycium andersonii - Grayia spinosa Shrubland (CEGL001271)
  Larrea tridentata / Yucca spp. Shrubland (CEGL001278)
  Larrea tridentata Monotype Shrubland (CEGL001261)

- **California community types:**
- Creosote Bush Scrub (33.010.00)
- Creosote Bush with disturbance (33.010.01)
- High Diversity Creosote Scrub (33.010.03)
- Creosote Bush - Shockley's Goldenhead (33.010.18)
- White Bursage -Rayless Goldenhead (33.060.01)
- White Bursage (33.060.02)
- White Bursage - Big Galleta (33.060.04)
- White Bursage - California Buckwheat (33.060.05)
- Creosote Bush - White Bursage Scrub (33.140.00)
- Sonoran Creosote Bush Scrub (33.140.04)
- Uniform Creosote Scrub (33.140.05)
- Mojave Creosote Bush Scrub (33.140.06)
- Creosote Bush - White Bursage - Indigo Bush (33.140.07)
- Creosote Bush - White Bursage - California Croton (33.140.08)
- Creosote Bush - White Bursage - Galium - Lyrocarpa (33.140.10)
- Creosote Bush - White Bursage - Mojave Yucca (33.140.11)
- Creosote Bush - White Bursage - Desert Sunflower (33.140.12)
- Creosote Bush - White Bursage - Spiny Senna (33.140.13)
- Creosote Bush - White Bursage - Bladder Sage (33.140.14)
- Creosote Bush - White Bursage - Mojave indigo-bush (33.140.15)
- Creosote Bush - White Bursage - Fremont's indigo-bush (33.140.16)
- Creosote Bush - White Bursage - Big Galleta (33.140.17)
- Creosote Bush - White Bursage - Pencil Cactus (33.140.18)
- Creosote Bush - White Bursage - Anderson's Wolfberry (33.140.19)
- Creosote Bush - White Bursage - Nevada Ephedra (33.140.20)
- Creosote Bush - White Bursage - Desert Peppergrass (33.140.21)
- Creosote Bush - White Bursage - White Ratany (33.140.22)
- Creosote Bush - White Bursage - Pima Ratany (33.140.23)
- Creosote Bush - White Bursage - Thurber's Sandpaper Plant (33.140.24)
- Creosote Bush - White Bursage - Matchweed spp. (33.140.25)
- Creosote Bush - White Bursage - Hop-sage (33.140.26)
- Creosote Bush - White Bursage - Desert Trumpet (33.140.27)
- Creosote Bush - White Bursage - California Buckwheat (33.140.28)
- Creosote Bush - White Bursage - Death Valley Ephedra (33.140.29)
- Creosote Bush - White Bursage - Desert Tea (33.140.30)
- Creosote Bush - White Bursage - Virgin River Encelia (33.140.31)
- Creosote Bush - White Bursage - Brittlebush (33.140.32)
- Creosote Bush - White Bursage - Barrel Cactus (33.140.33)
- Creosote Bush - White Bursage - Downy Dalea (33.140.34)
- Creosote Bush - White Bursage - Cryptogamic crust (33.140.35)
- Creosote Bush - White Bursage - Sweetbush (33.140.36)
- Creosote Bush - White Bursage - Fremont's Chaff-bush (33.140.40)
- Creosote Bush - White Bursage - Fagonia (33.140.41)

SOURCES

References: Barbour and Major 1988, Brown 1982, Holland and Keil 1995, MacMahon 1988, Thomas et al. 2003a

Last updated: 20 Feb 2003 **Stakeholders:** WCS

Concept Author: NatureServe Western Ecology Team **LeadResp:** WCS

S070 SONORA-MOJAVE MIXED SALT DESERT SCRUB

Division 302, Shrubland, CES302.749

Spatial Scale & Pattern: Large Patch **Classification Confidence:** low

Required Classifiers: Natural/Semi-natural, Vegetated (>10% vasc.), Upland

Diagnostic Classifiers: Lowland [Lowland], Shrubland (Shrub-dominated), Basin floor, Toeslope/Valley Bottom, Temperate [Temperate Xeric], Alkaline Soil, Atriplex spp.

Non-Diagnostic Classifiers: Tropical/Subtropical [Tropical Xeric], Saline Substrate Chemistry, Aridic

Concept Summary: This system includes extensive open-canopied shrublands of typically saline basins in the Mojave and Sonoran deserts. Stands often occur around playas. Substrates are generally fine-textured, saline soils. Vegetation is typically composed of one or more *Atriplex* species such as *Atriplex canescens* or *Atriplex polycarpa* along with other species of *Atriplex*. Species of *Allenrolfea*, *Salicornia*, *Suaeda*, or other halophytic plants are often present to codominant. Graminoid species may include *Sporobolus airoides* or *Distichlis spicata* at varying densities.

Comments: This is a very broad concept. Possibly split Baja maritime salt flats out.

DISTRIBUTION

Range: Saline basins in the Mojave and Sonoran deserts.
Ecological Divisions: 302
TNC Ecoregions: 17:C, 22:C, 23:C
Subnations/Nations: AZ:c, CA:c, MXBC:c, MXSO:c, NV:c, UT:c

CONCEPT

Alliances and Associations:

- ATRIPLEX (LENTIFORMIS, POLYCARPA) SHRUBLAND ALLIANCE (A.864)
  Atriplex (lentiformis, polycarpa) Shrubland [Placeholder] (CEGL003016)
- ATRIPLEX CANESCENS SHRUBLAND ALLIANCE (A.869)
  Atriplex canescens - Artemisia tridentata Shrubland (CEGL001282)
  Atriplex canescens - Ephedra viridis Shrubland (CEGL001287)
  Atriplex canescens - Krascheninnikovia lanata Shrubland (CEGL001285)
  Atriplex canescens / Bouteloua gracilis Shrubland (CEGL001283)
  Atriplex canescens / Calycoseris parryi Shrubland (CEGL001284)
  Atriplex canescens / Pleuraphis jamesii Shrubland (CEGL001288)
  Atriplex canescens Shrubland (CEGL001281)
- ATRIPLEX CONFERTIFOLIA SHRUBLAND ALLIANCE (A.870)
  Atriplex confertifolia - Atriplex polycarpa Shrubland (CEGL001299)
  Atriplex confertifolia - Ephedra nevadensis Shrubland (CEGL001303)
  Atriplex confertifolia - Lycium andersonii Shrubland (CEGL001308)
  Atriplex confertifolia - Sarcobatus vermiculatus Shrubland (CEGL001313)
- ATRIPLEX HYMENELYTRA SHRUBLAND ALLIANCE (A.872)
  Atriplex hymenelytra Shrubland (CEGL001317)
- ATRIPLEX POLYCARPA SHRUBLAND ALLIANCE (A.873)
  Atriplex polycarpa Shrubland (CEGL001318)
- ATRIPLEX SPINIFERA SHRUBLAND ALLIANCE (A.865)
  Atriplex spinifera Shrubland [Placeholder] (CEGL003015)
- DISTICHLIS SPICATA INTERMITTENTLY FLOODED HERBACEOUS ALLIANCE (A.1332)
  Distichlis spicata Herbaceous Vegetation (CEGL001770)

- **California community types:**
- Saltbush - Creosote Bush (33.010.05)
- Creosote Bush - White Ratany - Big Galleta (33.010.07)
- Creosote Bush / Desert Trumpet (33.010.09)
- Creosote Bush - Allscale (33.010.12)
- Creosote Bush - Desert-holly (33.010.16)
- Creosote Bush - Shadscale (33.010.17)
- White Bursage - Desert-holly (33.060.03)
- Creosote Bush - White Bursage - Desert-holly (33.140.09)
- Creosote Bush - White Bursage - Fourwing Saltbush (33.140.37)
- Creosote Bush - White Bursage - Allscale (33.140.38)
- Creosote Bush - White Bursage - Shadscale (33.140.39)

- Anderson's Wolfberry (33.360.00)
- Anderson's Wolfberry - Jojoba - Big Galleta (33.360.01)
- Desert Saltbush Scrub (36.301.00)
- Valley Saltbush Scrub (36.302.00)
- Interior Coast Range Saltbush Scrub (36.303.00)
- Shadscale - Nevada Ephedra (36.320.02)
- Shadscale - White Bursage (36.320.03)
- Desert-holly (36.330.01)
- Desert-holly - White Bursage (36.330.02)
- Desert-holly - Creosote Bush - White Bursage (36.330.03)
- Desert-holly - Arizona Honeysweet (36.330.04)
- Allscale Scrub (36.340.00)
- Great Valley Allscale Scrub (36.341.00)
- Sierra-Tehachapi Saltbush Scrub (36.342.00)
- Allscale - Shadscale (36.360.02)
- Quailbush Scrub (36.370.00)
- Big Saltbush - Allscale Scrub (36.370.01)

SOURCES

References: Barbour and Major 1988, Brown 1982, Holland and Keil 1995, MacMahon 1988, Thomas et al. 2003a

Last updated: 20 Feb 2003 **Stakeholders:** WCS, SCS

Concept Author: NatureServe Western Ecology Team **LeadResp:** WCS

S114 SONORA-MOJAVE-BAJA SEMI-DESERT CHAPARRAL

Division 302, Shrubland, CES302.757

Spatial Scale & Pattern: Large Patch **Classification Confidence:** medium

Required Classifiers: Natural/Semi-natural, Vegetated (>10% vasc.), Upland

Diagnostic Classifiers: Montane [Lower Montane], Lowland [Foothill], Shrubland (Shrub-dominated), Tropical/Subtropical [Tropical Xeric], Temperate [Temperate Xeric], Intermediate Disturbance Interval, F-Patch/High Intensity, Evergreen Sclerophyllous Shrub

Non-Diagnostic Classifiers: Ridge/Summit/Upper Slope, Sideslope, Aridic, Broad-Leaved Deciduous Shrub, Broad-Leaved Evergreen Shrub, Short (50-100 yrs) Persistence

Concept Summary: This ecological system is composed of evergreen shrublands on sideslopes transitioning from low-elevation desert landscapes up into woodlands of the western Mojave and Sonoran deserts. It extends from northeast Kern County, California, into Baja Norte. Associated species include *Quercus john-tuckeri*, *Quercus cornelius-mulleri*, *Quercus berberidifolia*, *Arctostaphylos patula*, *Arctostaphylos pungens*, *Arctostaphylos glauca*, *Rhus ovata*, *Cercocarpus montanus var. glaber (= Cercocarpus betuloides)*, *Ceanothus greggii*, *Garrya flavescens*, *Juniperus californica*, and *Nolina parryi*.

DISTRIBUTION

Range: Western Mojave and Sonoran deserts.

Ecological Divisions: 302

TNC Ecoregions: 17:C, 23:C

Subnations/Nations: AZ:c, CA:c, MXBC:c, MXSO:c, NV:c

CONCEPT

- **California community types:**
- Cupleaf Ceanothus - Fremontia - Oak Chaparral (37.212.00)
- Cupleaf Ceanothus (37.212.01)
- Greenleaf Manzanita Chaparral (37.303.00)
- Greenleaf Manzanita (37.303.01)
- Muller Oak (37.415.00)
- Muller Oak - Brittlebush-Narrowleaf Goldenbush (37.415.02)
- Muller Oak - Mountain Mahogany (37.415.03)
- Tucker Oak Scrub (37.418.00)
- Sugarbush Scrub (37.801.00)

- Shrub Live Oak Scrub (71.095.00)
- Shrub Live Oak - Singleleaf Pinyon (71.095.01)
- Shrub Live Oak - Desert Baccharis (71.095.02)
- California Juniper Woodland and Scrub (89.100.00)
- California Juniper - Desert Agave (89.100.03)
- California Juniper / Blackbush (89.100.04)
- California Juniper - Muller Oak / Blackbush (89.100.05)
- California Juniper / Blackbush - Mojave Yucca (89.100.06)
- California Juniper / Desert Needlegrass (89.100.07)
- California Juniper - Mojave Yucca / Big Galleta (89.100.08)
- California Juniper / California Buckwheat (89.100.10)
- California Juniper / Parry's Nolina (89.100.11)

SOURCES

References: Barbour and Major 1988, Brown 1982, Holland and Keil 1995, MacMahon 1988, Thomas et al. 2003a
Last updated: 20 Feb 2003 **Stakeholders:** WCS
Concept Author: NatureServe Western Ecology Team **LeadResp:** WCS

S116 CHIHUAHUAN MIXED SALT DESERT SCRUB

Division 302, Shrubland, CES302.017

Spatial Scale & Pattern: Large Patch **Classification Confidence:** medium
Required Classifiers: Natural/Semi-natural, Vegetated (>10% vasc.), Upland
Diagnostic Classifiers: Lowland [Lowland], Shrubland (Shrub-dominated), Tropical/Subtropical [Tropical Xeric], Temperate [Temperate Xeric], Atriplex spp.

Concept Summary: This system includes extensive open-canopied shrublands of typically saline basins in the Chihuahuan Desert. Stands often occur on alluvial flats and around playas. Substrates are generally fine-textured, saline soils. Vegetation is typically composed of one or more *Atriplex* species such as *Atriplex canescens, Atriplex obovata*, or *Atriplex polycarpa* along with species of *Allenrolfea, Flourensia, Salicornia, Suaeda*, or other halophytic plants. Graminoid species may include *Sporobolus airoides, Pleuraphis mutica*, or *Distichlis spicata* at varying densities.

DISTRIBUTION

Range: Saline basins in the Chihuahuan Desert.
Ecological Divisions: 302
TNC Ecoregions: 22:C, 24:C, 28:C, 29:P, 30:P
Subnations/Nations: AZ:c, MXCH:c, MXCO:c, MXDU:c, MXNU:c, MXSO:c, NM:c, TX:c

CONCEPT

Alliances and Associations:

- ATRIPLEX CANESCENS SHRUBLAND ALLIANCE (A.869)
  Atriplex canescens / Parthenium confertum Shrubland (CEGL001290)
  Atriplex canescens / Sporobolus airoides Shrubland (CEGL001291)
  Atriplex canescens / Sporobolus wrightii Shrubland (CEGL001292)
- ATRIPLEX OBOVATA DWARF-SHRUBLAND ALLIANCE (A.1108)
  Atriplex obovata / Tidestromia carnosa Dwarf-shrubland (CEGL004575)
- ATRIPLEX POLYCARPA SHRUBLAND ALLIANCE (A.873)
  Atriplex polycarpa / Pleuraphis mutica Shrubland (CEGL001319)
- DISTICHLIS SPICATA INTERMITTENTLY FLOODED HERBACEOUS ALLIANCE (A.1332)
  Distichlis spicata Herbaceous Vegetation (CEGL001770)
- FLOURENSIA CERNUA SHRUBLAND ALLIANCE (A.861)
  Flourensia cernua / Achnatherum eminens Shrubland (CEGL001338)
  Flourensia cernua / Bouteloua curtipendula Shrubland (CEGL001336)
  Flourensia cernua / Pleuraphis mutica Shrubland (CEGL001541)
  Flourensia cernua / Sporobolus airoides Shrubland (CEGL001337)

SOURCES

References: Brown 1982, Dick-Peddie 1993, Muldavin et al. 2000b, Muldavin et al. 2002, Shreve and Wiggins 1964

Last updated: 24 Mar 2003 **Stakeholders:** WCS, LAC

Concept Author: NatureServe Western Ecology Team **LeadResp:** WCS

S117 COAHUILAN CHAPARRAL

Division 302, Shrubland, CES302.031

Spatial Scale & Pattern: Large Patch

Required Classifiers: Natural/Semi-natural, Vegetated (>10% vasc.), Upland

Diagnostic Classifiers: Montane [Lower Montane], Shrubland (Shrub-dominated), Shallow Soil, Xeric, F-Patch/High Intensity

Non-Diagnostic Classifiers: Temperate [Temperate Xeric]

Concept Summary: This ecological system occurs in mountains in southeastern New Mexico (Guadalupe Mtns.) and Trans-Pecos Texas (Davis and Chisos Mtns.). It often dominants along the mid-elevation transition from the Chihuahuan Desert into mountains (1700-2500 m). It occurs on foothills, mountain slopes and canyons in dryer habitats below the encinal and pine woodlands and is often associated with more xeric and coarse-textured substrates such as limestone, basalt or alluvium, especially in transition areas with more mesic woodlands.. The moderate to dense shrub canopy includes many shrub oak species such as *Quercus intricata, Quercus pringlei, Quercus invaginata, Quercus laceyi, Quercus grisea, Quercus emoryi, Quercus toumeyi*, several widespread chaparral species such as *Arctostaphylos pungens, Ceanothus greggii, Fallugia paradoxa*, and *Garrya wrightii*, and species characteristic of this system such as *Arbutus arizonica, Arbutus xalapensis (= Arbutus texana), Fraxinus greggii, Fendlera rigida (= Fendlera linearis), Garrya ovata, Purshia mexicana (= ssp. mexicana), Rhus virens var. choriophylla (= Rhus choriophylla),* and endemics *Salvia lycioides (= Salvia ramosissima), Salvia roemeriana*, and *Salvia regla*. Most chaparral species are fire-adapted, resprouting vigorously after burning or producing fire-resistant seeds. Stands occurring within montane woodlands are seral and a result of recent fires.

DISTRIBUTION

Range: Mountains across southeastern New Mexico and Trans-Pecos Texas. It often dominants along the mid-elevation transition from the Chihuahuan Desert into mountains (1700-2500 m).

Ecological Divisions: 301, 302, 305, 306

TNC Ecoregions: 21:P, 22:P, 24:P

Subnations/Nations: MXCH:, MXCO:, NM:c, TX:?

CONCEPT

Alliances and Associations:

- RHUS VIRENS VAR. CHORIOPHYLLA SHRUBLAND ALLIANCE (A.922)
  Rhus virens var. choriophylla / Cercocarpus montanus var. paucidentatus Shrubland (CEGL001123)

SOURCES

References: Brown 1982, Dick-Peddie 1993, Muldavin et al. 1994a, Muldavin et al. 2000c

Last updated: 26 Mar 2003 **Stakeholders:** WCS, LACD

Concept Author: K. Schulz and P. Comer **LeadResp:** WCS

S128 WYOMING BASINS LOW SAGEBRUSH SHRUBLAND

Division 304, Shrubland, CES304.794

Spatial Scale & Pattern: Large Patch **Classification Confidence:** medium

Required Classifiers: Natural/Semi-natural, Vegetated (>10% vasc.), Upland

Diagnostic Classifiers: Lowland [Foothill], Lowland [Lowland], Shrubland (Shrub-dominated), Hill(s), Ridge/Summit/Upper Slope, Sideslope, Shallow Soil, Silt Soil Texture, Clay Soil Texture, Aridic, W-Landscape/High Intensity, Low Artemisia spp.

Non-Diagnostic Classifiers: Temperate [Temperate Continental], Alkaline Soil, Dwarf-Shrub

Concept Summary: This ecological system is composed of sagebrush dwarf-shrublands that occur in a variety of dry habitats throughout the basins of central and southern Wyoming. *Artemisia tripartita ssp. rupicola*-dominated dwarf-shrublands typically occur on wind-swept ridges and south and west aspect slopes above 2135 m in central and southeastern Wyoming. Substrates are shallow, fine-textured soils. *Artemisia nova*-dominated dwarf-shrublands occur on shallow, coarse-textured, calcareous substrates at lower elevations. Other shrubs and dwarf-shrubs present may include *Purshia tridentata* and other species of *Artemisia*. Common graminoids include *Festuca idahoensis, Koeleria macrantha, Pseudoroegneria spicata*, and *Poa secunda*. Many forbs also occur and may dominate the herbaceous vegetation.

DISTRIBUTION

Range: Throughout the basins of central and southern Wyoming.
Ecological Divisions: 304
TNC Ecoregions: 10:C
Subnations/Nations: CO:c, MT:c, WY:c

CONCEPT

Alliances and Associations:

- ARTEMISIA NOVA SHRUBLAND ALLIANCE (A.1105)
  Artemisia nova / Pseudoroegneria spicata Shrubland (CEGL001424)
- ARTEMISIA TRIPARTITA SSP. RUPICOLA SHRUB HERBACEOUS ALLIANCE (A.2556)
  Artemisia tripartita ssp. rupicola / Festuca idahoensis Shrub Herbaceous Vegetation (CEGL001540)

SOURCES

References: Jones 1992b, Knight 1994, Knight et al. 1987
Last updated: 20 Feb 2003 **Stakeholders:** WCS
Concept Author: NatureServe Western Ecology Team **LeadResp:** WCS

S129 SONORAN MID-ELEVATION DESERT SCRUB

Division 302, Shrubland, CES302.035

Spatial Scale & Pattern: Large Patch
Required Classifiers: Natural/Semi-natural, Vegetated (>10% vasc.), Upland
Diagnostic Classifiers: Montane [Lower Montane], Shrubland (Shrub-dominated), Alkaline Soil

Non-Diagnostic Classifiers: Alluvial fan, Sideslope, Temperate [Temperate Xeric]

Concept Summary: This transitional desert scrub system occurs along the northern edge of the Sonoran Desert in an elevational band along the lower slopes of the Mogollon Rim/Central Highlands region between 750-1300 m. Stands occur in the Bradshaw, Hualapai, and Superstition mountains among other desert ranges and are found above Sonoran Paloverde-Mixed Cacti Desert Scrub (CES302.761) and below Mogollon Chaparral (CES302.741). Sites range from a narrow strip on steep slopes to very broad areas such as the Verde Valley. Climate is too dry for chaparral species to be abundant, and freezing temperatures during winter are too frequent and prolonged for many of the frost-sensitive species that are characteristic of the Paloverde Mixed-Cacti Desert Scrub such as *Carnegia gigantea, Parkinsonia microphylla, Prosopis* spp., *Olneya tesota, Ferocactus* sp. and *Opuntia bigelovii*. Substrates are generally rocky soils derived from parent materials such as limestone, granitic rocks or rhyolite. The vegetation is typically composed of an open shrub layer of *Larrea tridentata, Ericameria linearifolia*, or *Eriogonum fasciculatum* with taller shrub such as *Fourqueria splendens, Canotia holacantha* (limestone or granite) or *Simmondsia chinensis* (rhyolite).. The herbaceous layer is generally sparse.

Comments: Includes Brown's (1982) Jojoba-Mixed Scrub and Creosotebush-Crucifixion-thorn Series.

DISTRIBUTION

Range: Occurs along the northern edge of the Sonoran Desert in an elevational band along the lower slopes of the Mogollon Rim/Central Highlands region between 750-1300 m.
Ecological Divisions: 302, 306
TNC Ecoregions: 22:P, 23:C
Subnations/Nations: AZ:c, MXSO:p

CONCEPT

Alliances and Associations:

- AMBROSIA DELTOIDEA SHRUBLAND ALLIANCE (A.852)
  Ambrosia deltoidea / Simmondsia chinensis Shrubland (CEGL000953)
- CANOTIA HOLACANTHA SHRUBLAND ALLIANCE (Proposed)
- ERIOGONUM FASCICULATUM SHRUBLAND ALLIANCE (A.868)
- SIMMONDSIA CHINENSIS SHRUBLAND ALLIANCE (A.853)
- FOUQUIERIA SPLENDENS SHRUBLAND ALLIANCE (A.863)

SOURCES

References: Brown 1982
Last updated: 26 Mar 2003 **Stakeholders:** WCS, LACD
Concept Author: K. Pohs, K. Schulz, P. Comer **LeadResp:** WCS

S136 SOUTHERN COLORADO PLATEAU SAND SHRUBLAND

Division 304, Shrubland, CES304.793

Spatial Scale & Pattern: Large patch **Classification Confidence:** low
Required Classifiers: Natural/Semi-natural, Vegetated (>10% vasc.), Upland
Diagnostic Classifiers: Lowland [Foothill], Lowland [Lowland], Woody-Herbaceous, Temperate [Temperate Xeric], Alkaline Soil, Aridic, Very Short Disturbance Interval, G-Landscape/High Intensity,

Non-Diagnostic Classifiers: Mechanical Disturbance, Xeromorphic Shrub, Short (50-100 yrs) Persistence

Concept Summary: This large patch ecological system is found on the south-central Colorado Plateau in northeastern Arizona extending into southern Utah. It occurs on windswept mesas, broad basins and plains at low to moderate elevations (1300-1800m). Substrates are stabilized sandsheets or shallow to moderately deep sandy soils that may form small hummocks or small coppice dunes. This semi-arid, open shrubland is typically dominated by short shrubs (10-30 % cover) with a sparse graminoid layer. The woody layer is often a mixture of shrubs and dwarf-shrubs. Characteristic species include *Ephedra cutleri, Ephedra torreyana, Ephedra viridis,* and *Artemisia filifolia. Coleogyne ramosissima* is typically not present. , *Poliomentha incana, Parryella filifolia,* or *Ericameria nauseosa* may be present to dominant locally. Ephedra cutleri and E.viridis often assume a distinctive matty growth form. . Characteristic grasses include *Achnatherum hymenoides, Bouteloua gracilis, Hesperostipa comata,* and *Pleuraphis jamesii.* The general aspect of occurrences is an open low shrubland, but may include small blowouts and dunes. Occasionally grasses may be moderately abundant locally and form a distinct layer. Disturbance may be important in maintaining the woody component. Eolian processes are evident such as pediceled plants, occasional blowouts or small dunes, but the generally higher vegetative cover and less prominent geomorphic features distinguish this system from the Inter-Mountain Basins Active and Stabilized Dunes.

DISTRIBUTION

Range: Occurs in sandy plains and mesas in south-central Colorado Plateau in northeastern Azizona extending into southern Utah.
Ecological Divisions: 304
TNC Ecoregions: 19:C
Subnations/Nations: AZ:c, CO:?, NM:?, UT:c,

CONCEPT

Alliances and Associations:

- ACHNATHERUM HYMENOIDES SHRUB HERBACEOUS ALLIANCE (A.1543)
  Ephedra viridis / Achnatherum hymenoides - Bouteloua gracilis Shrub Herbaceous Vegetation (CEGL001648)
  Ephedra viridis / Achnatherum hymenoides - Sporobolus cryptandrus Shrub Herbaceous Vegetation
- ARTEMISIA FILIFOLIA SHRUBLAND ALLIANCE (A.816)
  Artemisia filifolia - Ephedra (torreyana, viridis) Shrubland (CEGL002786)
- EPHEDRA CUTLERI SHRUBLAND ALLIANCE [PROVISIONAL] (A.2644)
- Ephedra cutleri Shrubland [Provisional] (CEGL005804)
- EPHEDRA TORREYANA SHRUBLAND ALLIANCE (A.2572)
  Ephedra torreyana - Achnatherum hymenoides Hummock Shrubland (CEGL005802)

- EPHEDRA VIRIDIS SHRUBLAND ALLIANCE (A.858)
  Ephedra viridis / Pleuraphis rigida Shrubland (CEGL001257)
- ERICAMERIA NAUSEOSA SHRUBLAND ALLIANCE (A.835)
  Ericameria nauseosa / Leymus flavescens / Psoralidium lanceolatum Shrubland (CEGL001329)
  Ericameria nauseosa Sand Deposit Sparse Shrubland (CEGL002980)
- POLIOMINTHA INCANA SHRUBLAND ALLIANCE (A.862)
  Poliomintha incana / (Pleuraphis jamesii) Shrubland [Provisional] (CEGL002980)

SOURCES

References: Unpublished AZGAP field data 2004, Unpublished UTGAP field data 2004
Last updated: 20 Feb 2004 **Stakeholders:** WCS
Concept Author: K. Pohs, K. Schulz, J.Kirby **LeadResp:** WCS

S138 WESTERN GREAT PLAINS MESQUITE WOODLAND AND SHRUBLAND
Division 303, Shrubland, CES303.668

Spatial Scale & Pattern: Large Patch **Classification Confidence:** high
Required Classifiers: Natural/Semi-natural, Vegetated (>10% vasc.), Upland
Non-Diagnostic Classifiers: Shrubland (Shrub-dominated), F-Patch/Medium Intensity, G-Patch/Medium Intensity

Concept Summary: This system is found primarily in the southern portion of the Western Great Plains Division, primarily in Texas, Oklahoma and eastern New Mexico. This system is dominated by *Prosopis glandulosa* with shortgrass species in the understory. *Ziziphus obtusifolia* and *Atriplex canescens* can codominate in some examples as can *Opuntia* species in heavily grazed areas. Historically this system probably occurred as a natural component on more fertile soils and along drainages.

Comments: With fire suppression and grazing, *Prosopis glandulosa* has been able to extend its range and become dense in examples of the Western Great Plains Shortgrass Prairie (CES303.672) or Central Mixedgrass Prairie (CES303.659). Those areas should still be considered part of the prairie system.

DISTRIBUTION

Range: This system is primarily found in the southern portion of the Western Great Plains division, particularly in Texas, Oklahoma and eastern New Mexico.
Ecological Divisions: 303
TNC Ecoregions: 27:?, 28:C, 29:C, 33:C
Subnations/Nations: NM:c, OK:c, TX:c

CONCEPT

Alliances and Associations:
- ACACIA FARNESIANA WOODLAND ALLIANCE (A.660)
  Acacia farnesiana - (Prosopis glandulosa) Woodland (CEGL002131)
- PROSOPIS GLANDULOSA SHRUBLAND ALLIANCE (A.1031)
  Prosopis glandulosa - Ziziphus obtusifolia Shrubland (CEGL004939)
  Prosopis glandulosa / Bouteloua curtipendula Shrubland (CEGL002194)
  Prosopis glandulosa / Muhlenbergia porteri Shrubland (CEGL001511)
  Prosopis glandulosa var. glandulosa / Bouteloua gracilis - Buchloe dactyloides Shrubland (CEGL003877)
- PROSOPIS GLANDULOSA WOODLAND ALLIANCE (A.611)
  Prosopis glandulosa / Bouteloua curtipendula - Nassella leucotricha Woodland (CEGL002133)

Environment: This system occurs naturally on more fertile soils and along drainages.

Vegetation: This system is dominated by *Prosopis glandulosa* with *Ziziphus obtusifolia*, and *Atriplex canescens* can codominate. *Opuntia* spp. can be prevalent in areas in heavily grazed examples of this system. The understory of this system is often dominated by shortgrass species.

Dynamics: Historically, fire controlled this system and limited the development of woody cover. Likewise, edaphic conditions and topographic factors limited this system to deep alluvial soils in relatively low topographic conditions along broad valley floors.

SOURCES

References: Barbour and Billings 1988
Last updated: 05 Mar 2003 **Stakeholders:** MCS, WCS
Concept Author: S. Menard and K. Kindscher **LeadResp:** MCS

NLCD Grassland/Herbaceous Types

Areas dominated by grammanoid or herbaceous vegetation, generally greater than 80% of total vegetation. These areas are not subject to intensive management such as tilling, but can be utilized for grazing.

S071 INTER-MOUNTAIN BASINS MONTANE SAGEBRUSH STEPPE

Division 304, Steppe/Savanna, CES304.785

Spatial Scale & Pattern: Matrix **Classification Confidence:** medium
Required Classifiers: Natural/Semi-natural, Vegetated (>10% vasc.), Upland
Diagnostic Classifiers: Montane [Upper Montane], Montane [Montane], Montane [Lower Montane], Woody-Herbaceous

Non-Diagnostic Classifiers: Mountainside, Mountain valley, Plateau, Sideslope, Toeslope/Valley Bottom, Temperate [Temperate Continental], Long Disturbance Interval, F-Patch/Medium Intensity, Broad-Leaved Evergreen Shrub, Graminoid, Bunch grasses, Artemisia tridentata ssp. vaseyana

Concept Summary: This ecological system includes sagebrush communities occurring at montane and subalpine elevations across the western U.S. from 1000 m in eastern Oregon and Washington to over 3000 m in the southern Rockies. Climate is cool, semi-arid to subhumid. This system primarily occurs on deep-soiled to stony flats, ridges, nearly flat ridgetops, and mountain slopes. In general this system shows an affinity for mild topography, fine soils, and some source of subsurface moisture. It is composed primarily of mountain sagebrush (*Artemisia tridentata ssp. vaseyana*) and related taxa such as *Artemisia tridentata ssp. spiciformis (= Artemisia spiciformis)*, non-riparian *Artemisia cana ssp. viscidula*, and *Artemisia arbuscula ssp. arbuscula*. *Purshia tridentata* may codominate or even dominate some stands. Other common shrubs include *Symphoricarpos* spp., *Amelanchier* spp., *Ericameria nauseosa, Peraphyllum ramosissimum, Ribes cereum*, and *Chrysothamnus viscidiflorus*. Most stands have an abundant perennial herbaceous layer (over 25% cover), but this system also includes *Artemisia tridentata ssp. vaseyana* shrublands. Common graminoids include *Festuca arizonica, Festuca idahoensis, Hesperostipa comata, Poa fendleriana, Elymus trachycaulus, Bromus carinatus, Poa secunda, Leucopoa kingii, Deschampsia caespitosa*, and *Pseudoroegneria spicata*. Frequent wildfire maintains an open herbaceous-rich steppe condition.

DISTRIBUTION

Range: Montane and subalpine elevations across the western U.S. from 1000 m in eastern Oregon and Washington to over 3000 m in the southern Rockies.
Ecological Divisions: 304, 306
TNC Ecoregions: 12:C, 18:C, 19:C, 20:C, 6:C, 7:C, 8:C, 9:C
Subnations/Nations: AZ:?, CA:c, CO:c, ID:c, MT:c, NM:c, NV:p, OR:c, UT:c, WA:c, WY:c

CONCEPT

Alliances and Associations:

- ARTEMISIA ARBUSCULA SSP. ARBUSCULA SHRUB HERBACEOUS ALLIANCE (A.1566)
  Artemisia arbuscula ssp. arbuscula - Purshia tridentata / Pseudoroegneria spicata - Festuca idahoensis Shrub Herbaceous Vegetation (CEGL001518)
  Artemisia arbuscula ssp. arbuscula / Achnatherum thurberianum Shrub Herbaceous Vegetation (CEGL001413)
  Artemisia arbuscula ssp. arbuscula / Festuca idahoensis Shrub Herbaceous Vegetation (CEGL001409)
  Artemisia arbuscula ssp. arbuscula / Leymus salinus ssp. salmonis Shrub Herbaceous Vegetation (CEGL001410)
  Artemisia arbuscula ssp. arbuscula / Poa secunda Shrub Herbaceous Vegetation (CEGL001411)
  Artemisia arbuscula ssp. arbuscula / Pseudoroegneria spicata Shrub Herbaceous Vegetation (CEGL001412)
- ARTEMISIA ARBUSCULA SSP. ARBUSCULA SHRUBLAND ALLIANCE (A.2547)
  Artemisia arbuscula ssp. arbuscula - Artemisia tridentata ssp. vaseyana / Festuca idahoensis Shrubland [Provisional] (CEGL002982)
- ARTEMISIA ARBUSCULA SSP. THERMOPOLA SHRUB HERBACEOUS ALLIANCE (A.2553)
  Artemisia arbuscula ssp. thermopola / Festuca idahoensis Shrub Herbaceous Vegetation (CEGL001519)

- ARTEMISIA CANA (SSP. BOLANDERI, SSP. VISCIDULA) SHRUB HERBACEOUS ALLIANCE (A.1531)
  Artemisia cana (ssp. bolanderi, ssp. viscidula) - Artemisia tridentata ssp. vaseyana / Poa cusickii Shrub Herbaceous Vegetation [Provisional] (CEGL001549)
  Artemisia cana (ssp. bolanderi, ssp. viscidula) / Poa fendleriana ssp. fendleriana Shrub Herbaceous Vegetation (CEGL001551)
  Artemisia cana ssp. bolanderi / Muhlenbergia richardsonis Shrub Herbaceous Vegetation (CEGL001743)
  Artemisia cana ssp. viscidula / Festuca idahoensis Shrub Herbaceous Vegetation (CEGL001552)
- ARTEMISIA CANA (SSP. BOLANDERI, SSP. VISCIDULA) SHRUBLAND ALLIANCE (A.2557)
  Artemisia cana (ssp. bolanderi, ssp. viscidula) / Leymus cinereus Shrubland (CEGL001460)
  Artemisia cana (ssp. bolanderi, ssp. viscidula) / Poa pratensis Semi-natural Shrubland (CEGL002988)
  Artemisia cana (ssp. bolanderi, ssp. viscidula) / Poa secunda Shrubland (CEGL001548)
  Artemisia cana ssp. bolanderi / Eleocharis palustris Shrubland (CEGL002987)
  Artemisia cana ssp. viscidula - (Salix spp.) / Festuca idahoensis Shrubland (CEGL001075)
  Artemisia cana ssp. viscidula / Deschampsia caespitosa Shrubland (CEGL001074)
  Artemisia cana ssp. viscidula / Festuca ovina Shrubland (CEGL001076)
  Artemisia cana ssp. viscidula / Festuca thurberi Shrubland (CEGL001071)
  Artemisia cana ssp. viscidula / Purshia tridentata Shrubland (CEGL001073)
- ARTEMISIA TRIDENTATA SHRUB HERBACEOUS ALLIANCE (A.1521)
  Artemisia tridentata / Festuca idahoensis Shrub Herbaceous Vegetation (CEGL001530)
- ARTEMISIA TRIDENTATA SHRUBLAND ALLIANCE (A.829)
  Artemisia tridentata Upperzone Community Shrubland (CEGL001013)
- ARTEMISIA TRIDENTATA SSP. SPICIFORMIS SHRUB HERBACEOUS ALLIANCE (A.2555)
  Artemisia tridentata ssp. spiciformis Shrub Herbaceous Vegetation [Provisional] (CEGL002993)
- ARTEMISIA TRIDENTATA SSP. SPICIFORMIS SHRUBLAND ALLIANCE (A.2550)
  Artemisia tridentata ssp. spiciformis / Bromus carinatus Shrubland (CEGL002989)
  Artemisia tridentata ssp. spiciformis / Carex geyeri Shrubland (CEGL002990)
- ARTEMISIA TRIDENTATA SSP. VASEYANA SHRUB HERBACEOUS ALLIANCE (A.1526)
  Artemisia tridentata ssp. vaseyana / Carex geyeri Shrub Herbaceous Vegetation (CEGL001532)
  Artemisia tridentata ssp. vaseyana / Festuca campestris Shrub Herbaceous Vegetation (CEGL001531)
  Artemisia tridentata ssp. vaseyana / Festuca idahoensis Shrub Herbaceous Vegetation (CEGL001533)
- ARTEMISIA TRIDENTATA SSP. VASEYANA SHRUBLAND ALLIANCE (A.831)
  Artemisia tridentata ssp. vaseyana - Purshia tridentata / Pseudoroegneria spicata Shrubland (CEGL001032)
  Artemisia tridentata ssp. vaseyana - Symphoricarpos oreophilus / Bromus carinatus Shrubland (CEGL001035)
  Artemisia tridentata ssp. vaseyana - Symphoricarpos oreophilus / Elymus trachycaulus ssp. trachycaulus Shrubland (CEGL001034)
  Artemisia tridentata ssp. vaseyana - Symphoricarpos oreophilus / Festuca idahoensis Shrubland (CEGL001036)
  Artemisia tridentata ssp. vaseyana - Symphoricarpos oreophilus / Hesperostipa comata Shrubland (CEGL001039)
  Artemisia tridentata ssp. vaseyana - Symphoricarpos oreophilus / Poa secunda Shrubland (CEGL001037)
  Artemisia tridentata ssp. vaseyana - Symphoricarpos oreophilus / Pseudoroegneria spicata Shrubland (CEGL001038)
  Artemisia tridentata ssp. vaseyana / Achnatherum occidentale Shrubland (CEGL001033)
  Artemisia tridentata ssp. vaseyana / Balsamorhiza sagittata Shrubland (CEGL001020)
  Artemisia tridentata ssp. vaseyana / Bromus carinatus Shrubland (CEGL001021)
  Artemisia tridentata ssp. vaseyana / Carex exserta Shrubland (CEGL008651)
  Artemisia tridentata ssp. vaseyana / Festuca idahoensis - Bromus carinatus Shrubland (CEGL001023)
  Artemisia tridentata ssp. vaseyana / Festuca thurberi Shrubland (CEGL001024)
  Artemisia tridentata ssp. vaseyana / Hesperostipa comata Shrubland (CEGL002931)
  Artemisia tridentata ssp. vaseyana / Leucopoa kingii - Koeleria macrantha Shrubland (CEGL001026)
  Artemisia tridentata ssp. vaseyana / Leucopoa kingii Shrubland (CEGL001025)
  Artemisia tridentata ssp. vaseyana / Leymus cinereus Shrubland (CEGL001027)
  Artemisia tridentata ssp. vaseyana / Pascopyrum smithii Shrubland (CEGL001028)
  Artemisia tridentata ssp. vaseyana / Phlox condensata Shrubland (CEGL002770)
  Artemisia tridentata ssp. vaseyana / Poa secunda Shrubland (CEGL001029)
  Artemisia tridentata ssp. vaseyana / Pseudoroegneria spicata - Poa fendleriana Shrubland (CEGL001031)
  Artemisia tridentata ssp. vaseyana / Pseudoroegneria spicata Shrubland (CEGL001030)
- ARTEMISIA TRIDENTATA SSP. WYOMINGENSIS SHRUBLAND ALLIANCE (A.832)
  Artemisia tridentata ssp. wyomingensis - Peraphyllum ramosissimum / Festuca idahoensis Shrubland (CEGL001048)
- SYMPHORICARPOS OREOPHILUS SHRUBLAND ALLIANCE (A.2530)
  Symphoricarpos oreophilus / Poa pratensis Semi-natural Shrubland [Provisional] (CEGL002951)

- **California community types:**
- Wright's Buckwheat Dwarf Scrub (32.041.00)
- Big Sagebrush - Rubber Rabbitbrush (35.110.01)
- Low Sagebrush / Mono Clover (35.120.01)

- Low Sagebrush / Stemless Haplopappus (35.120.02)
- Rothrock Sagebrush Scrub (35.140.00)
- Rothrock Sagebrush / Heretic Penstemon (35.140.01)
- Rothrock Sagebrush / Mountain Monardella (35.140.02)
- Silver Sagebrush Scrub (35.150.00)

Environment: This ecological system occurs in many of the western United States, usually at middle elevations (1000-2500 m). The climate regime is cool, semi-arid to subhumid, with yearly precipitation ranging from 25 to 90 cm/year. Much of this precipitation falls as snow. Temperatures are continental with large annual and diurnal variation. In general this system shows an affinity for mild topography, fine soils, and some source of subsurface moisture. Soils generally are moderately deep to deep, well-drained, and of loam, sandy loam, clay loam, or gravelly loam textural classes; soils often have a substantial volume of coarse fragments, and are derived from a variety of parent materials. This system primarily occurs on deep-soiled to stony flats, ridges, nearly flat ridgetops, and mountain slopes. All aspects are represented, but the higher elevation occurrences may be restricted to south- or west-facing slopes.

Vegetation: Vegetation types within this ecological system are usually less than 1.5 m tall and dominated by *Artemisia tridentata ssp. vaseyana*, *Artemisia cana ssp. viscidula*, or *Artemisia tridentata ssp. spiciformis*. A variety of other shrubs can be found in some occurrences, but these are seldom dominant. They include *Artemisia rigida, Artemisia arbuscula, Ericameria nauseosa, Chrysothamnus viscidiflorus, Symphoricarpos oreophilus, Purshia tridentata, Peraphyllum ramosissimum, Ribes cereum, Rosa woodsii, Ceanothus velutinus,* and *Amelanchier alnifolia*. The canopy cover is usually between 20-80%. The herbaceous layer is usually well represented, but bare ground may be common in particularly arid or disturbed occurrences. Graminoids that can be abundant include *Festuca idahoensis, Festuca thurberi, Festuca ovina, Elymus elymoides, Deschampsia caespitosa, Danthonia intermedia, Danthonia parryi, Stipa* spp., *Pascopyrum smithii, Bromus carinatus, Elymus trachycaulus, Koeleria macrantha, Pseudoroegneria spicata, Poa fendleriana,* or *Poa secunda*, and *Carex* spp. Forbs are often numerous and an important indicator of health. Forb species may include *Castilleja, Potentilla, Erigeron, Phlox, Astragalus, Geum, Lupinus*, and *Eriogonum, Balsamorhiza sagittata, Achillea millefolium, Antennaria rosea*, and *Eriogonum umbellatum, Fragaria virginiana, Artemisia ludoviciana, Hymenoxys hoopesii (= Helenium hoopesii)*, etc.

Dynamics: Healthy sagebrush shrublands are very productive, are often grazed by domestic livestock, and are strongly preferred during the growing season (Padgett et al. 1989). Prolonged livestock use can cause a decrease in the abundance of native bunch grasses and increase in the cover of shrubs and non-native grass species, such as *Poa pratensis*. *Artemisia cana* resprouts vigorously following spring fire, and prescribed burning may increase shrub cover. Conversely, fire in the fall may decrease shrub abundance (Hansen et al. 1995). *Artemisia tridentata* is generally killed by fires and may take over ten years to form occurrences of some 20% cover or more. The condition of most sagebrush steppe has been degraded due to fire suppression and heavy livestock grazing. It is unclear how long restoration will take to restore degraded occurrences.

SOURCES

References: Hansen et al. 1995, Hironaka et al. 1983, Johnston 2001, Mueggler and Stewart 1980, Neely et al. 2001, Padgett et al. 1989, West 1983c

Last updated: 20 Feb 2003 **Stakeholders:** WCS, MCS

Concept Author: NatureServe Western Ecology Team **LeadResp:** WCS

S074 SOUTHERN ROCKY MOUNTAIN JUNIPER WOODLAND AND SAVANNA

Division 306, Steppe/Savanna, CES306.834

Spatial Scale & Pattern: Large Patch **Classification Confidence:** medium

Required Classifiers: Natural/Semi-natural, Vegetated (>10% vasc.), Upland

Diagnostic Classifiers: Lowland [Foothill], Woody-Herbaceous, Shallow Soil, Mineral: W/ A-Horizon <10 cm, Aridic, Needle-Leaved Tree, Graminoid, Juniperus monosperma & grasses

Non-Diagnostic Classifiers: Lowland [Lowland], Temperate [Temperate Continental], Unglaciated, Intermediate Disturbance Interval, Moderate (100-500 yrs) Persistence

Concept Summary: This ecological system occupies the lower and warmest elevations growing from 1370 to 1830 m in a semi-arid climate, primarily along the east and south slopes of the southern Rockies and Arizona-New Mexico mountains. It is best represented just below the lower elevational range of ponderosa pine and often intermingles with grasslands and shrublands. This system is best described as a savanna that has widely spaced

mature (>150 years old) juniper trees and occasionally *Pinus edulis*. *Juniperus monosperma* and *Juniperus scopulorum* (at higher elevation)are the dominant tall shrubs or short trees. These savannas may have inclusions of more dense juniper woodlands and have expanded into adjacent grasslands during in the last century. Graminoid species are similar to those found in Western Great Plains Shortgrass Prairie (CES303.672), with *Bouteloua gracilis* and *Pleuraphis jamesii* being most common. In addition, succulents such as species of *Yucca* and *Opuntia* are typically present.

DISTRIBUTION

Range: Occupies the lower and warmest elevations growing from 1370 to 1830 m in a semi-arid climate, primarily along the east and south slopes of the southern Rockies and Arizona-New Mexico mountains.
Ecological Divisions: 303, 304, 306
TNC Ecoregions: 19:C, 20:C, 21:C, 27:C
Subnations/Nations: AZ:c, CO:c, NM:c, UT:c

CONCEPT

Alliances and Associations:

- JUNIPERUS MONOSPERMA WOODLAND ALLIANCE (A.504)
  Juniperus monosperma / Andropogon hallii Woodland (CEGL000704)
  Juniperus monosperma / Bouteloua curtipendula Woodland (CEGL000708)
  Juniperus monosperma / Bouteloua eriopoda Woodland (CEGL000709)
  Juniperus monosperma / Bouteloua gracilis Woodland (CEGL000710)
  Juniperus monosperma / Cercocarpus montanus - Ribes cereum Woodland (CEGL000714)
  Juniperus monosperma / Cercocarpus montanus Woodland (CEGL000713)
  Juniperus monosperma / Hesperostipa neomexicana Woodland (CEGL000722)

SOURCES

References: Anderson et al. 1985, Barnes 1987, Bassett et al. 1987, Blackburn and Tueller 1970, Commons et al. 1999, Dick-Peddie 1993, Dwyer and Pieper 1967, Eager 1999, Fitzhugh et al. 1987, Francis 1986, Gehlbach 1967, Ladyman and Muldavin 1996, Larson and Moir 1986, Larson and Moir 1987, Mehl 1992, Neely et al. 2001, Rogers 1950, West 1999b, West and Young 2000, Wright and Bailey 1982
Last updated: 20 Feb 2003 **Stakeholders:** WCS
Concept Author: NatureServe Western Ecology Team **LeadResp:** WCS

S075 INTER-MOUNTAIN BASINS JUNIPER SAVANNA

Division 304, Steppe/Savanna, CES304.782

Spatial Scale & Pattern: Large Patch **Classification Confidence:** medium
Required Classifiers: Natural/Semi-natural, Vegetated (>10% vasc.), Upland
Diagnostic Classifiers: Temperate [Temperate Continental], Intermediate Disturbance Interval, F-Landscape/Medium Intensity, Evergreen Sclerophyllous Tree, Graminoid

Non-Diagnostic Classifiers: Lowland [Foothill], Lowland [Lowland], Woody-Herbaceous, Ridge/Summit/Upper Slope, Sideslope, Toeslope/Valley Bottom, Calcareous

Concept Summary: This widespread ecological system occupies dry foothills and sandsheets of western Colorado, central Utah, west into the Great Basin of Nevada and southern Idaho. It is typically found at lower elevations ranging from 1500-2300 m. This system is generally found at lower elevations and more xeric sites than Great Basin Pinyon-Juniper Woodland (CES304.773) or Colorado Plateau Pinyon-Juniper Woodland (CES304.767). These occurrences are found on lower mountain slopes and plateaus. The vegetation is typically open savanna, although there may be inclusions of more dense juniper woodlands. This savanna is dominated by *Juniperus osteosperma* trees with high cover of perennial bunch grasses and forbs, with *Bouteloua gracilis* and *Pleuraphis jamesii* being most common. Species of *Artemisia* are also commonly present. Pinyon trees are typically not present because sites are outside the ecological or geographic range of *Pinus edulis* and *Pinus monophylla*.

DISTRIBUTION

Range: Western Colorado, central Utah, west into the Great Basin of Nevada and southern Idaho at lower elevations, ranging from 1500-2300 m.
Ecological Divisions: 304, 306
TNC Ecoregions: 10:, 11:C, 18:C, 19:C, 20:C, 21:C, 6:C, 9:C

Subnations/Nations: AZ:c, CA:c, CO:c, ID:c, NV:c, OR:c, UT:c, WY:c

CONCEPT

Alliances and Associations:

- JUNIPERUS OSTEOSPERMA WOODED HERBACEOUS ALLIANCE (A.1502)
  Juniperus osteosperma / Hesperostipa comata Wooded Herbaceous Vegetation (CEGL001489)
  Juniperus osteosperma / Leymus salinus ssp. salmonis Wooded Herbaceous Vegetation (CEGL001488)
- JUNIPERUS OSTEOSPERMA WOODLAND ALLIANCE (A.536)
  Juniperus osteosperma / Hesperostipa neomexicana Woodland (CEGL000740)
  Juniperus osteosperma / Pleuraphis mutica Woodland (CEGL000736)
  Juniperus osteosperma / Pseudoroegneria spicata Woodland (CEGL000738)
  Juniperus osteosperma / Symphoricarpos oreophilus Woodland (CEGL000741)
- JUNIPERUS SCOPULORUM WOODLAND ALLIANCE (A.506)
  Juniperus scopulorum / Pseudoroegneria spicata Woodland (CEGL000748)
  Juniperus scopulorum / Schizachyrium scoparium Woodland (CEGL000750)

SOURCES

References: Knight 1994, Tuhy et al. 2002
Last updated: 20 Feb 2003 **Stakeholders:** WCS
Concept Author: NatureServe Western Ecology Team
LeadResp: WCS

S077 APACHERIAN-CHIHUAHUAN PIEDMONT SEMI-DESERT GRASSLAND AND STEPPE

Division 302, Herbaceous, CES302.735

Spatial Scale & Pattern: Large Patch **Classification Confidence:** medium
Required Classifiers: Natural/Semi-natural, Vegetated (>10% vasc.), Upland
Diagnostic Classifiers: Lowland [Foothill], Lowland [Lowland], Herbaceous, Temperate [Temperate Xeric], Short Disturbance Interval, F-Patch/High Intensity [Seasonality/Winter Fire], Graminoid

Non-Diagnostic Classifiers: Tropical/Subtropical [Tropical Xeric], Aridic, Broad-Leaved Evergreen Tree, Xeromorphic Tree, Xeromorphic Shrub, Thorn Shrub, Succulent Shrub

Concept Summary: This ecological system is a broadly defined desert grassland, mixed shrub-succulent or xeromorphic tree savanna that is typical of the Borderlands of Arizona, New Mexico and northern Mexico [Apacherian region], but extends west to the Sonoran Desert, north into the Mogollon Rim and throughout much of the Chihuahuan Desert. It is found on gently sloping bajadas that supported frequent fire throughout the Sky Islands and on mesas and steeper piedmont and foothill slopes in the Chihuahuan Desert. It is characterized by a typically diverse perennial grasses. Common grass species include *Bouteloua eriopoda, B. hirsuta,B. rothrockii, B. curtipendula, B. gracilis, Eragrostis intermedia, Muhlenbergia porteri, Muhlenbergia setifolia, Pleuraphis jamesii, Pleuraphis mutica*, and *Sporobolus airoides*, succulent species of *Agave, Dasylirion*, and *Yucca*, and tall shrub/short tree species of *Prosopis* and various oaks (e.g., *Quercus grisea, Quercus emoryi, Quercus arizonica*). Many of the historical desert grassland and savanna areas have been converted, some to Chihuahuan Mesquite Upland Scrub (CES302.733) (*Prosopis* spp.-dominated), through intensive grazing and other land uses.

DISTRIBUTION

Range: Borderlands of Arizona, New Mexico and northern Mexico [Apacherian region], extending to the Sonoran Desert and throughout much of the Chihuahuan Desert.
Ecological Divisions: 302
TNC Ecoregions: 22:C, 24:C, 28:C
Subnations/Nations: AZ:c, MXCH:c, NM:c, TX:c

CONCEPT

Alliances and Associations:

- BOUTELOUA CURTIPENDULA HERBACEOUS ALLIANCE (A.1244)
  Bouteloua curtipendula - Bothriochloa barbinodis Herbaceous Vegetation (CEGL001590)
  Bouteloua curtipendula - Hilaria belangeri - Bouteloua eriopoda Herbaceous Vegetation (CEGL001591)
  Bouteloua curtipendula - Schizachyrium cirratum Herbaceous Vegetation (CEGL001592)
- BOUTELOUA CURTIPENDULA SHRUB HERBACEOUS ALLIANCE (A.1552)
  Dasylirion wheeleri / Bouteloua curtipendula Shrub Herbaceous Vegetation (CEGL001593)
- BOUTELOUA ERIOPODA DWARF-SHRUB HERBACEOUS ALLIANCE (A.1570)
  Artemisia bigelovii / Bouteloua eriopoda Dwarf-shrub Herbaceous Vegetation (CEGL001741)

- BOUTELOUA ERIOPODA HERBACEOUS ALLIANCE (A.1284)
  Bouteloua eriopoda - Bouteloua curtipendula Herbaceous Vegetation (CEGL001747)
  Bouteloua eriopoda - Bouteloua gracilis Herbaceous Vegetation (CEGL001748)
  Bouteloua eriopoda - Bouteloua hirsuta Herbaceous Vegetation (CEGL001749)
  Bouteloua eriopoda - Bouteloua trifida Herbaceous Vegetation (CEGL001750)
  Bouteloua eriopoda - Hesperostipa neomexicana Herbaceous Vegetation (CEGL001753)
  Bouteloua eriopoda - Pleuraphis jamesii Herbaceous Vegetation (CEGL001751)
  Bouteloua eriopoda Semi-desert Herbaceous Vegetation (CEGL001752)
- BOUTELOUA ERIOPODA XEROMORPHIC SHRUB HERBACEOUS ALLIANCE (A.1553)
  Ayenia microphylla / Bouteloua eriopoda Shrub Herbaceous Vegetation (CEGL001729)
  Dasylirion wheeleri / Bouteloua eriopoda Shrub Herbaceous Vegetation (CEGL001730)
  Parthenium incanum / Bouteloua eriopoda Shrub Herbaceous Vegetation (CEGL001734)
- BOUTELOUA GRACILIS DWARF-SHRUB HERBACEOUS ALLIANCE (A.1571)
  Artemisia bigelovii / Bouteloua gracilis Dwarf-shrub Herbaceous Vegetation (CEGL001742)
- BOUTELOUA GRACILIS HERBACEOUS ALLIANCE (A.1282)
  Bouteloua gracilis - Bouteloua curtipendula Herbaceous Vegetation (CEGL001754)
  Bouteloua gracilis - Bouteloua hirsuta Herbaceous Vegetation (CEGL001755)
  Bouteloua gracilis - Buchloe dactyloides Herbaceous Vegetation (CEGL001756)
  Bouteloua gracilis - Eragrostis intermedia Herbaceous Vegetation (CEGL001758)
  Bouteloua gracilis - Hesperostipa neomexicana Herbaceous Vegetation (CEGL001763)
  Bouteloua gracilis - Sporobolus cryptandrus Herbaceous Vegetation (CEGL001761)
  Bouteloua gracilis - Sporobolus flexuosus Herbaceous Vegetation (CEGL001762)
- BOUTELOUA HIRSUTA - BOUTELOUA GRACILIS - BOUTELOUA ERIOPODA SHRUB HERBACEOUS ALLIANCE (A.1548)
  Yucca faxoniana / Bouteloua hirsuta - Bouteloua gracilis - Bouteloua eriopoda Shrub Herbaceous Vegetation (CEGL004248)
- BOUTELOUA HIRSUTA HERBACEOUS ALLIANCE (A.1285)
  Bouteloua hirsuta - Bouteloua curtipendula Herbaceous Vegetation (CEGL001764)
  Bouteloua hirsuta - Bouteloua radicosa Herbaceous Vegetation (CEGL001765)
  Bouteloua hirsuta - Digitaria californica Herbaceous Vegetation (CEGL001767)
  Bouteloua hirsuta - Hesperostipa neomexicana Herbaceous Vegetation (CEGL001766)
- BOUTELOUA RAMOSA HERBACEOUS ALLIANCE (A.1275)
  Bouteloua ramosa Herbaceous Vegetation (CEGL004522)
- DASYLIRION LEIOPHYLLUM - (AGAVE LECHUGUILLA, VIGUIERA STENOLOBA) SHRUBLAND ALLIANCE (A.850)
  Dasylirion leiophyllum - Agave lechuguilla / Bouteloua hirsuta - Bouteloua gracilis - Bouteloua eriopoda Shrubland (CEGL004245)
  Dasylirion leiophyllum - Viguiera stenoloba - Agave lechuguilla / Bouteloua ramosa Shrubland (CEGL004604)
- FOUQUIERIA SPLENDENS SHRUBLAND ALLIANCE (A.863)
  Fouquieria splendens / Bouteloua curtipendula Shrubland (CEGL001376)
  Fouquieria splendens / Bouteloua hirsuta Shrubland (CEGL001377)
- HESPEROSTIPA NEOMEXICANA HERBACEOUS ALLIANCE (A.1272)
  Hesperostipa neomexicana - Bouteloua curtipendula Herbaceous Vegetation (CEGL001709)
  Hesperostipa neomexicana - Dasylirion wheeleri Herbaceous Vegetation (CEGL001710)
- MUHLENBERGIA EMERSLEYI HERBACEOUS ALLIANCE (A.1259)
  Muhlenbergia emersleyi - Bouteloua curtipendula Herbaceous Vegetation (CEGL001644)
  Muhlenbergia emersleyi - Bouteloua hirsuta Herbaceous Vegetation (CEGL001645)
- MUHLENBERGIA SETIFOLIA / ARTEMISIA BIGELOVII SHRUB HERBACEOUS ALLIANCE (A.1530)
  Artemisia bigelovii / Muhlenbergia setifolia Shrub Herbaceous Vegetation (CEGL001544)
- MUHLENBERGIA SETIFOLIA SHRUB HERBACEOUS ALLIANCE (A.1541)
  Dasylirion wheeleri / Muhlenbergia setifolia Shrub Herbaceous Vegetation (CEGL001512)
  Fouquieria splendens / Muhlenbergia setifolia Shrub Herbaceous Vegetation (CEGL001513)
- PLEURAPHIS JAMESII HERBACEOUS ALLIANCE (A.1287)
  Pleuraphis jamesii - Sporobolus airoides Herbaceous Vegetation (CEGL001778)
- PLEURAPHIS MUTICA SHRUB HERBACEOUS ALLIANCE (A.1551)
  Larrea tridentata / Pleuraphis mutica Shrub Herbaceous Vegetation (CEGL001542)
  Prosopis glandulosa / Pleuraphis mutica Shrub Herbaceous Vegetation (CEGL001641)
- PROSOPIS GLANDULOSA SHRUB HERBACEOUS ALLIANCE (A.1550)
  Prosopis glandulosa / Bouteloua eriopoda Shrub Herbaceous Vegetation (CEGL001510)
- QUERCUS ARIZONICA WOODLAND ALLIANCE (A.482)
  Quercus arizonica / Bouteloua curtipendula Woodland (CEGL000680)
  Quercus arizonica / Muhlenbergia emersleyi Woodland (CEGL000681)

- QUERCUS EMORYI WOODLAND ALLIANCE (A.483)
  Quercus emoryi / Bouteloua curtipendula Woodland (CEGL000683)
  Quercus emoryi / Muhlenbergia emersleyi Woodland (CEGL000685)
  Quercus emoryi / Schizachyrium cirratum Woodland (CEGL000687)
- QUERCUS GRISEA WOODLAND ALLIANCE (A.478)
  Quercus grisea / Bouteloua curtipendula Woodland (CEGL000689)
- SCHIZACHYRIUM SCOPARIUM BUNCH HERBACEOUS ALLIANCE (A.1266)
  Schizachyrium scoparium var. scoparium - Muhlenbergia pungens Herbaceous Vegetation (CEGL001684)
- SPOROBOLUS AIROIDES HERBACEOUS ALLIANCE (A.1267)
  Sporobolus airoides - Muhlenbergia porteri Herbaceous Vegetation (CEGL001689)

SOURCES

References: Brown 1982, Burgess 1995, Dick-Peddie 1993, McAuliffe 1995, McPherson 1995, Muldavin et al. 2000b, Muldavin et al. 2002

Last updated: 20 Feb 2003 **Stakeholders:** WCS, SCS, LACD

Concept Author: NatureServe Western Ecology Team **LeadResp:** WCS

S078 INTER-MOUNTAIN BASINS BIG SAGEBRUSH STEPPE

Division 304, Steppe/Savanna, CES304.778

Spatial Scale & Pattern: Large Patch **Classification Confidence:** medium

Required Classifiers: Natural/Semi-natural, Vegetated (>10% vasc.), Upland

Diagnostic Classifiers: Lowland [Lowland], Deep Soil, Aridic, Xeromorphic Shrub, Bunch grasses, Artemisia tridentata ssp. tridentata

Non-Diagnostic Classifiers: Lowland [Foothill], Woody-Herbaceous, Plain, Plateau, Sideslope, Temperate [Temperate Continental], Alkaline Soil, Forb, Graminoid

Concept Summary: This widespread matrix ecological system occurs throughout much of the Columbia Plateau and northern Great Basin and Wyoming, and is found at slightly higher elevations further south. Soils are typically deep and non-saline often with a microphytic crust. This shrub-steppe is dominated by perennial grasses and forbs (>25% cover) with *Artemisia tridentata ssp. tridentata, Artemisia tridentata ssp. xericensis, Artemisia tridentata ssp. wyomingensis, Artemisia tripartita ssp. tripartita,* and/or *Purshia tridentata* dominating or codominating the open to moderately dense (10-40% cover) shrub layer. *Atriplex confertifolia, Chrysothamnus viscidiflorus, Ericameria nauseosa, Tetradymia* spp., or *Artemisia frigida* may be common especially in disturbed stands. Associated graminoids include *Achnatherum hymenoides, Calamagrostis montanensis, Elymus lanceolatus ssp. lanceolatus, Festuca idahoensis, Festuca campestris, Koeleria macrantha, Poa secunda,* and *Pseudoroegneria spicata*. Common forbs are *Phlox hoodii, Arenaria* spp., and *Astragalus* spp. Areas with deeper soils more commonly support *Artemisia tridentata ssp. tridentata* but have largely been converted for other land uses. Microphytic crust is very important in this ecological system. The natural fire regime of this ecological system likely maintains patchy distribution of shrubs so the general aspect of the vegetation is a grassland. Shrubs may increase following heavy grazing and/or with fire suppression, particularly in moist portions in the northern Columbia Plateau where it forms a landscape mosaic pattern with shallow-soil scabland shrublands.

DISTRIBUTION

Range: Occurs throughout much of the Columbia Plateau and northern Great Basin and Wyoming expending into northern Colorado where it is found at slightly higher elevations further south.

Ecological Divisions: 304, 306

TNC Ecoregions: 10:C, 11:C, 20:C, 26:C, 4:C, 6:C, 8:C, 9:C

Subnations/Nations: CA:c, CO:c, ID:c, MT:c, NV:c, OR:c, UT:c, WA:c, WY:c

CONCEPT

Alliances and Associations:

- ARTEMISIA TRIDENTATA (SSP. TRIDENTATA, SSP. XERICENSIS) SHRUB HERBACEOUS ALLIANCE (A.1522)
  Artemisia tridentata (ssp. tridentata, ssp. xericensis) / Pseudoroegneria spicata - Poa secunda Shrub Herbaceous Vegetation (CEGL001019)
  Artemisia tridentata (ssp. tridentata, ssp. xericensis) / Pseudoroegneria spicata Shrub Herbaceous Vegetation (CEGL001018)
- ARTEMISIA TRIDENTATA (SSP. TRIDENTATA, SSP. XERICENSIS) SHRUBLAND ALLIANCE (A.830)
  Artemisia tridentata ssp. tridentata - Grayia spinosa Shrubland (CEGL001004)
  Artemisia tridentata ssp. tridentata / Distichlis spicata Shrubland (CEGL001000)

Artemisia tridentata ssp. tridentata / Festuca idahoensis Shrubland (CEGL001014)
Artemisia tridentata ssp. tridentata / Hesperostipa comata Shrubland (CEGL002966)
Artemisia tridentata ssp. tridentata / Leymus cinereus Shrubland (CEGL001016)
Artemisia tridentata ssp. tridentata / Pascopyrum smithii - (Elymus lanceolatus) Shrubland (CEGL001017)
Artemisia tridentata ssp. tridentata / Pleuraphis jamesii Shrubland (CEGL001015)
Artemisia tridentata ssp. tridentata / Poa secunda Shrubland (CEGL001008)

- ARTEMISIA TRIDENTATA SHRUB HERBACEOUS ALLIANCE (A.1521)
  Artemisia tridentata / Festuca idahoensis Shrub Herbaceous Vegetation (CEGL001530)
  Artemisia tridentata / Leymus cinereus Shrub Herbaceous Vegetation (CEGL001458)
- ARTEMISIA TRIDENTATA SSP. WYOMINGENSIS SHRUB HERBACEOUS ALLIANCE (A.1527)
  Artemisia tridentata ssp. wyomingensis / Mixed Grasses Shrub Herbaceous Vegetation (CEGL001534)
  Artemisia tridentata ssp. wyomingensis / Pascopyrum smithii Shrub Herbaceous Vegetation (CEGL001047)
  Artemisia tridentata ssp. wyomingensis / Pseudoroegneria spicata Shrub Herbaceous Vegetation (CEGL001535)
- ARTEMISIA TRIPARTITA SSP. TRIPARTITA SHRUB HERBACEOUS ALLIANCE (A.1528)
  Artemisia tripartita ssp. tripartita / Festuca campestris Shrub Herbaceous Vegetation (CEGL001537)
  Artemisia tripartita ssp. tripartita / Festuca idahoensis Shrub Herbaceous Vegetation (CEGL001536)
  Artemisia tripartita ssp. tripartita / Hesperostipa comata Shrub Herbaceous Vegetation (CEGL001539)
  Artemisia tripartita ssp. tripartita / Leymus cinereus Shrub Herbaceous Vegetation (CEGL002994)
  Artemisia tripartita ssp. tripartita / Pseudoroegneria spicata Shrub Herbaceous Vegetation (CEGL001538)
- PURSHIA TRIDENTATA SHRUB HERBACEOUS ALLIANCE (A.1523)
  Purshia tridentata / Festuca campestris Shrub Herbaceous Vegetation (CEGL001494)
  Purshia tridentata / Festuca idahoensis Shrub Herbaceous Vegetation (CEGL002674)
  Purshia tridentata / Hesperostipa comata Shrub Herbaceous Vegetation (CEGL001498)
  Purshia tridentata / Pseudoroegneria spicata Shrub Herbaceous Vegetation (CEGL001495)
- PURSHIA TRIDENTATA SHRUBLAND ALLIANCE (A.825)
  Purshia tridentata / Poa secunda Shrubland (CEGL001059)
- SPOROBOLUS CRYPTANDRUS SHRUB HERBACEOUS ALLIANCE (A.1525)
  Artemisia tridentata / Sporobolus cryptandrus - Achnatherum hymenoides Shrub Herbaceous Vegetation (CEGL001545)

Dynamics: The natural fire regime of this ecological system likely maintains patchy distribution of shrubs so the general aspect of the vegetation is a grassland. Shrubs may increase following heavy grazing and/or with fire suppression, particularly in moist portions in the northern Columbia Plateau where it forms a landscape mosaic pattern with shallow-soil scabland shrublands. Microphytic crust is very important in this ecological system.

SOURCES

References: Barbour and Major 1977, Barbour and Major 1988, Daubenmire 1970, Knight 1994, Mueggler and Stewart 1980, West 1983c

Last updated: 20 Feb 2003 **Stakeholders:** WCS, MCS

Concept Author: NatureServe Western Ecology Team **LeadResp:** WCS

S079 INTER-MOUNTAIN BASINS SEMI-DESERT SHRUB STEPPE

Division 304, Steppe/Savanna, CES304.788

Spatial Scale & Pattern: Large Patch **Classification Confidence:** medium

Required Classifiers: Natural/Semi-natural, Vegetated (>10% vasc.), Upland

Diagnostic Classifiers: Lowland [Foothill], Lowland [Lowland], Woody-Herbaceous, Temperate [Temperate Xeric], Alkaline Soil, Aridic, Very Short Disturbance Interval, G-Landscape/High Intensity, Graminoid

Non-Diagnostic Classifiers: Mechanical Disturbance, Broad-Leaved Evergreen Shrub, Xeromorphic Shrub, Thorn Shrub, Evergreen Sclerophyllous Shrub, Succulent Shrub, Dwarf-Shrub, Forb, Short (50-100 yrs) Persistence

Concept Summary: This ecological system occurs throughout the Intermountain western U.S., typically at lower elevations on alluvial fans and flats with moderate to deep soils. This semi-arid shrub-steppe is typically dominated by graminoids (>25% cover) with an open shrub layer, but includes sparse mixed shrublands without a strong graminoid layer. Characteristic grasses include *Achnatherum hymenoides, Bouteloua gracilis, Distichlis spicata, Hesperostipa comata, Pleuraphis jamesii, Poa secunda*, and *Sporobolus airoides*. The woody layer is often a mixture of shrubs and dwarf-shrubs. Characteristic species include *Atriplex canescens, Artemisia filifolia, Chrysothamnus greenei, Chrysothamnus viscidiflorus, Ephedra* spp., *Ericameria nauseosa, Gutierrezia sarothrae,* and *Krascheninnikovia lanata*. Scattered *Artemisia tridentata* may be present but does not dominate. The general aspect of occurrences may be either open shrubland with patchy grasses or patchy open herbaceous layer.

Disturbance may be important in maintaining the woody component. Microphytic crust is very important in some occurrences.

DISTRIBUTION

Range: Occurs throughout the Intermountain western U.S., typically at lower elevations.
Ecological Divisions: 304
TNC Ecoregions: 10:C, 11:C, 18:C, 19:C, 20:C, 21:C, 4:C, 6:C, 8:C, 9:C
Subnations/Nations: AZ:c, CA:c, CO:c, ID:c, MT:p, NM:c, NV:c, OR:c, UT:c, WA:c, WY:c

CONCEPT

Alliances and Associations:

- ACHNATHERUM HYMENOIDES SHRUB HERBACEOUS ALLIANCE (A.1543)
  Ephedra viridis / Achnatherum hymenoides - Bouteloua gracilis Shrub Herbaceous Vegetation (CEGL001648)
  Ephedra viridis / Achnatherum hymenoides - Sporobolus cryptandrus Shrub Herbaceous Vegetation (CEGL001649)
- ACHNATHERUM SPECIOSUM SHRUB HERBACEOUS ALLIANCE (A.1549)
  Achnatherum speciosum Shrub Herbaceous Vegetation [Placeholder] (CEGL003113)
- ARTEMISIA FILIFOLIA SHRUBLAND ALLIANCE (A.816)
  Artemisia filifolia - Ephedra (torreyana, viridis) Shrubland (CEGL002786)
  Artemisia filifolia Colorado Plateau Shrubland (CEGL002697)
- BOUTELOUA ERIOPODA MICROPHYLLOUS EVERGREEN SHRUB HERBACEOUS ALLIANCE (A.1545)
  Gutierrezia sarothrae - Krascheninnikovia lanata - Atriplex canescens / Bouteloua eriopoda Shrub Herbaceous Vegetation (CEGL001733)
- BOUTELOUA ERIOPODA XEROMORPHIC SHRUB HERBACEOUS ALLIANCE (A.1553)
  Bouteloua eriopoda Coconino Plateau Shrub Herbaceous Vegetation (CEGL002787)
  Ephedra torreyana / Bouteloua eriopoda Shrub Herbaceous Vegetation (CEGL001731)
- BOUTELOUA GRACILIS DWARF-SHRUB HERBACEOUS ALLIANCE (A.1571)
  Artemisia bigelovii / Bouteloua gracilis Dwarf-shrub Herbaceous Vegetation (CEGL001742)
  Bouteloua gracilis Dwarf-shrub Herbaceous Vegetation [Placeholder] (CEGL005810)
- BOUTELOUA GRACILIS HERBACEOUS ALLIANCE (A.1282)
  Bouteloua gracilis - Hesperostipa comata Herbaceous Vegetation [Provisional] (CEGL002932)
- CHRYSOTHAMNUS VISCIDIFLORUS SHRUB HERBACEOUS ALLIANCE (A.1524)
  Chrysothamnus viscidiflorus - Ericameria parryi Shrub Herbaceous Vegetation [Provisional] (CEGL002781)
  Chrysothamnus viscidiflorus / Leymus salinus ssp. salinus Shrub Herbaceous Vegetation (CEGL001501)
  Chrysothamnus viscidiflorus / Poa pratensis Semi-natural Shrub Herbaceous Vegetation [Provisional] (CEGL002933)
- EPHEDRA NEVADENSIS SHRUBLAND ALLIANCE (A.857)
  Ephedra nevadensis / Achnatherum hymenoides Shrubland (CEGL001255)
  Ephedra nevadensis Basalt Shrubland [Provisional] (CEGL002936)
- EPHEDRA TORREYANA SHRUBLAND ALLIANCE (A.2572)
  Ephedra torreyana - Achnatherum hymenoides Hummock Shrubland (CEGL005802)
- ERICAMERIA NAUSEOSA SHRUB SHORT HERBACEOUS ALLIANCE (A.1546)
  Ericameria nauseosa / Bouteloua gracilis Shrub Herbaceous Vegetation (CEGL003495)
  Ericameria nauseosa / Muhlenbergia pungens - Achnatherum hymenoides Shrub Herbaceous Vegetation (CEGL002921)
- ERICAMERIA NAUSEOSA SHRUBLAND ALLIANCE (A.835)
  Ericameria nauseosa / Bromus tectorum Semi-natural Shrubland (CEGL002937)
- ERICAMERIA PARRYI SHRUBLAND ALLIANCE (A.818)
  Ericameria parryi / Pleuraphis jamesii - Bouteloua gracilis Shrubland (CEGL001331)
- GRAYIA SPINOSA SHRUBLAND ALLIANCE (A.1038)
  Grayia spinosa / Poa secunda Shrubland (CEGL001351)
- GUTIERREZIA SAROTHRAE DWARF-SHRUBLAND ALLIANCE (A.2528)
  Gutierrezia sarothrae - (Opuntia spp.) / Pleuraphis jamesii Dwarf-shrubland (CEGL002690)
- KRASCHENINNIKOVIA LANATA DWARF-SHRUB HERBACEOUS ALLIANCE (A.1565)
  Krascheninnikovia lanata / Bouteloua gracilis Dwarf-shrub Herbaceous Vegetation (CEGL001321)
  Krascheninnikovia lanata / Pascopyrum smithii - Bouteloua gracilis Dwarf-shrub Herbaceous Vegetation (CEGL001324)
- KRASCHENINNIKOVIA LANATA DWARF-SHRUBLAND ALLIANCE (A.1104)
  Krascheninnikovia lanata / Pleuraphis jamesii Dwarf-shrubland (CEGL001322)
  Krascheninnikovia lanata / Poa secunda Dwarf-shrubland (CEGL001326)
- PLEURAPHIS JAMESII SHRUB HERBACEOUS ALLIANCE (A.1532)
  Atriplex obovata / Pleuraphis jamesii - Sporobolus airoides Shrub Herbaceous Vegetation (CEGL001775)
  Ericameria nauseosa / Pleuraphis jamesii - (Hesperostipa comata) Shrub Herbaceous Vegetation (CEGL002996)
  Gutierrezia sarothrae / Sporobolus airoides - Pleuraphis jamesii Shrub Herbaceous Vegetation (CEGL001776)
- PLEURAPHIS RIGIDA / GUTIERREZIA SAROTHRAE SHRUB HERBACEOUS ALLIANCE (A.1529)
  Gutierrezia sarothrae / Pleuraphis rigida Shrub Herbaceous Vegetation (CEGL001543)

- SPHAEROMERIA ARGENTEA HERBACEOUS ALLIANCE (A.1654)
  Sphaeromeria argentea - Achnatherum swallenii Herbaceous Vegetation (CEGL001993)
  Sphaeromeria argentea - Artemisia frigida - Poa secunda Herbaceous Vegetation (CEGL001992)

Environment: This ecological system occurs throughout the Intermountain West from the western Great Basin to the northern Rocky Mountains and Colorado Plateau at elevations ranging from 300 m up to 2500 m. The climate where this system occurs is generally hot in summers and cold in winters with low annual precipitation, ranging from 18-40 cm and high inter-annual variation. Much of the precipitation falls as snow, and growing-season drought is characteristic. Temperatures are continental with large annual and diurnal variation. Sites are generally alluvial fans and flats with moderate to deep soils. Some sites can be flat, poorly drained and intermittently flooded with a shallow or perched water table often within 1 m depth (West 1983). Substrates are generally shallow, calcareous, fine-textured soils (clays to silt-loams), derived from alluvium; or deep, fine to medium-textured alluvial soils with some source of sub-irrigation during the summer season. Soils may be alkaline and typically moderately saline (West 1983). Some occurrences occur on deep, sandy soils, or soils that are highly calcareous (Hironaka et al. 1983).

Vegetation: The plant associations in this system are characterized by a somewhat sparse to moderately dense (10-70% cover) shrub layer of *Artemisia filifolia, Ephedra cutleri, Ephedra nevadensis, Ephedra torreyana, Ephedra viridis, Ericameria nauseosa, Chrysothamnus viscidiflorus, Gutierrezia sarothrae, Sarcobatus vermiculatus*, or *Atriplex canescens*. Other shrubs occasionally present include *Purshia tridentata* and *Tetradymia canescens*. *Artemisia tridentata* may be present but does not dominate. Trees are very rarely present in this system, but some individuals of *Pinus ponderosa, Juniperus scopulorum, Juniperus occidentalis*, or *Cercocarpus ledifolius* may occur. The herbaceous layer is dominated by bunch grasses which occupy patches in the shrub matrix. The most widespread species is *Pseudoroegneria spicata*, which occurs from the Columbia Basin to the northern Rockies. Other locally dominant or important species include *Sporobolus airoides, Leymus cinereus, Festuca idahoensis, Pascopyrum smithii, Bouteloua gracilis, Distichlis spicata, Pleuraphis jamesii, Elymus lanceolatus, Elymus elymoides, Koeleria macrantha, Muhlenbergia richardsonis, Hesperostipa comata,* and *Poa secunda*. Annual grasses, especially the exotics *Bromus japonicus* and *Bromus tectorum*, may be present to abundant. Forbs are generally of low importance and are highly variable across the range, but may be diverse in some occurrences. Species that often occur are *Symphyotrichum ascendens (= Aster adscendens), Collinsia parviflora, Penstemon caespitosus, Achillea millefolium, Erigeron compositus, Senecio* spp, and *Taraxacum officinale*. Other important genera include *Astragalus, Oenothera, Eriogonum*, and *Balsamorhiza*. Mosses and lichens may be important ground cover. Forbs are common on disturbed weedy sites. Weedy annual forbs may include the exotics *Descurainia* spp., *Helianthus annuus, Halogeton glomeratus, Lactuca serriola*, and *Lepidium perfoliatum*.

SOURCES

References: Branson et al. 1976, Hanson 1929, Hironaka et al. 1983, Tuhy et al. 2002, West 1983
Last updated: 20 Feb 2003 **Stakeholders:** WCS
Concept Author: NatureServe Western Ecology Team **LeadResp:** WCS

S080 CHIHUAHUAN GYPSOPHILOUS GRASSLAND AND STEPPE

Division 302, Herbaceous, CES302.732

Spatial Scale & Pattern: Large Patch **Classification Confidence:** medium
Required Classifiers: Natural/Semi-natural, Vegetated (>10% vasc.), Upland
Diagnostic Classifiers: Herbaceous, Tropical/Subtropical [Tropical Xeric], Temperate [Temperate Xeric], Alkaline Soil, Gypsiferous, Dwarf-Shrub, Graminoid

Non-Diagnostic Classifiers: Lowland [Foothill], Lowland [Lowland], Oligotrophic Soil, Aridic

Concept Summary: This ecological system is restricted to gypsum outcrops or sandy gypsiferous and/or often alkaline soils that occur in basins and slopes in the Chihuahuan Desert. Elevation range is from 1100-2000 m. These typically sparse grasslands, steppes or dwarf-shrublands are dominated by a variety of gypsophilous plants, many of which are endemic to these habitats. Characteristic species include *Tiquilia hispidissima, Atriplex canescens, Calylophus hartwegii, Ephedra torreyana, Frankenia jamesii, Bouteloua breviseta, Mentzelia perennis, Nama carnosum, Calylophus hartwegii (= Oenothera hartwegii), Selinocarpus lanceolatus, Sporobolus nealleyi, Sporobolus airoides*, and *Sartwellia flaveriae*. This system does not include the sparsely vegetated gypsum dunes that are included in North American Warm Desert Active and Stabilized Dunes (CES302.744).

DISTRIBUTION

Range: Basins and slopes in the Chihuahuan Desert; elevation range from 1100-2000 m.
Ecological Divisions: 302
TNC Ecoregions: 22:P, 24:C
Subnations/Nations: AZ:p, MXCH:c, NM:c, TX:c

CONCEPT

Alliances and Associations:

- ATRIPLEX OBOVATA DWARF-SHRUBLAND ALLIANCE (A.1108)
  Atriplex obovata / Tidestromia carnosa Dwarf-shrubland (CEGL004575)
- BOUTELOUA BREVISETA SPARSELY VEGETATED ALLIANCE (A.1870)
  Bouteloua breviseta Sparse Vegetation (CEGL004609)
- SCHIZACHYRIUM SCOPARIUM BUNCH HERBACEOUS ALLIANCE (A.1266)
  Schizachyrium scoparium var. scoparium - Muhlenbergia pungens Herbaceous Vegetation (CEGL001684)
- SPOROBOLUS AIROIDES HERBACEOUS ALLIANCE (A.1267)
  Sporobolus airoides - Scleropogon brevifolius Herbaceous Vegetation (CEGL001692)
- SPOROBOLUS NEALLEYI HERBACEOUS ALLIANCE (A.1269)
  Sporobolus nealleyi - Bouteloua eriopoda Herbaceous Vegetation (CEGL001697)
  Sporobolus nealleyi - Calylophus hartwegii Herbaceous Vegetation (CEGL001698)
- SPOROBOLUS NEALLEYI SHRUB HERBACEOUS ALLIANCE (A.1542)
  Fouquieria splendens / Sporobolus nealleyi Shrub Herbaceous Vegetation (CEGL001517)
- TIDESTROMIA CARNOSA SPARSELY VEGETATED ALLIANCE (A.1873)
  Tidestromia carnosa - Kallstroemia grandiflora Sparse Vegetation (CEGL004580)
- TIQUILIA HISPIDISSIMA DWARF-SHRUBLAND ALLIANCE (A.1101)
  Tiquilia hispidissima - Yucca torreyi / Sporobolus nealleyi Dwarf-shrubland (CEGL003959)
  Tiquilia hispidissima / Bouteloua breviseta - Mentzelia humilis Dwarf-shrubland (CEGL004573)
  Tiquilia hispidissima / Sporobolus airoides Dwarf-shrubland (CEGL004574)
  Tiquilia hispidissima / Sporobolus nealleyi Dwarf-shrubland (CEGL001546)
  Tiquilia hispidissima Dwarf-shrubland [Provisional] (CEGL008425)

SOURCES

References: Dick-Peddie 1993, Henrickson et al. 1985, MacMahon 1988, Muldavin et al. 2000b, Muldavin et al. 2002, Powell and Turner 1974
Last updated: 20 Feb 2003 **Stakeholders:** WCS, SCS, LACD
Concept Author: NatureServe Western Ecology Team **LeadResp:** WCS

S081 ROCKY MOUNTAIN DRY TUNDRA

Division 306, Herbaceous, CES306.816

Spatial Scale & Pattern: Large Patch **Classification Confidence:** medium
Required Classifiers: Natural/Semi-natural, Vegetated (>10% vasc.), Upland
Diagnostic Classifiers: Alpine/AltiAndino [Alpine/AltiAndino], Oligotrophic Soil, Very Shallow Soil, Mineral: W/ A-Horizon <10 cm, Aridic, Very Long Disturbance Interval, Graminoid, Alpine Slopes

Non-Diagnostic Classifiers: Herbaceous, Temperate [Temperate Continental], Glaciated, Periglacial, Long (>500 yrs) Persistence

Concept Summary: This widespread ecological system occurs above upper timberline throughout the Rocky Mountain cordillera, including alpine areas of ranges in Utah and Nevada, and north into Canada. It is found on gentle to moderate slopes, flat ridges, valleys, and basins, where the soil has become relatively stabilized and the water supply is more or less constant. Vegetation in these areas is controlled by snow retention, wind desiccation, permafrost, and a short growing season. This system is characterized by a dense cover of low-growing, perennial graminoids and forbs. Rhizomatous, sod-forming sedges are the dominant graminoids, and prostrate and mat-forming plants with thick rootstocks or taproots characterize the forbs. Dominant species include *Artemisia arctica, Carex elynoides, Carex siccata, Carex scirpoidea, Carex nardina, Carex rupestris, Deschampsia caespitosa, Festuca brachyphylla, Festuca idahoensis, Geum rossii, Kobresia myosuroides, Phlox pulvinata*, and *Trifolium dasyphyllum*. Although alpine tundra dry meadow is the matrix of the alpine zone, it typically intermingles with alpine bedrock and scree, ice field, fell-field, alpine dwarf-shrubland, and alpine/subalpine wet meadow systems.

DISTRIBUTION

Range: Occurs above upper timberline throughout the Rocky Mountain cordillera, including alpine areas of ranges in Utah and Nevada, and north into Canada.
Ecological Divisions: 306
TNC Ecoregions: 11:C, 20:C, 21:C, 68:C, 7:C, 8:C, 9:C
Subnations/Nations: AB:c, AZ:c, BC:c, CO:c, ID:c, MT:c, NM:c, NV:c, OR:c, UT:c, WA:c, WY:c

CONCEPT

Alliances and Associations:

- ARTEMISIA ARCTICA HERBACEOUS ALLIANCE (A.1624)
  Artemisia arctica ssp. arctica Herbaceous Vegetation (CEGL001848)
- CALAMAGROSTIS PURPURASCENS HERBACEOUS ALLIANCE (A.1301)
  Calamagrostis purpurascens Herbaceous Vegetation (CEGL001850)
- CAREX (EBENEA, HAYDENIANA) HERBACEOUS ALLIANCE (A.1302)
  Carex ebenea - Trifolium parryi Herbaceous Vegetation (CEGL001873)
  Carex haydeniana Herbaceous Vegetation (CEGL001875)
  Carex spp. - Geum rossii Herbaceous Vegetation (CEGL001870)
- CAREX ARAPAHOENSIS HERBACEOUS ALLIANCE (A.1319)
  Carex arapahoensis Herbaceous Vegetation (CEGL001851)
- CAREX DURIUSCULA HERBACEOUS ALLIANCE (A.1283)
  Carex duriuscula - Poa secunda Herbaceous Vegetation (CEGL001736)
- CAREX ELYNOIDES HERBACEOUS ALLIANCE (A.1303)
  Carex elynoides - Geum rossii Herbaceous Vegetation (CEGL001853)
  Carex elynoides - Lupinus argenteus Herbaceous Vegetation (CEGL001854)
  Carex elynoides - Oreoxis spp. Herbaceous Vegetation (CEGL001855)
  Carex elynoides - Oxytropis sericea Herbaceous Vegetation (CEGL001856)
  Carex elynoides Herbaceous Vegetation (CEGL001852)
- CAREX PERGLOBOSA HERBACEOUS ALLIANCE (A.1304)
  Carex perglobosa - Silene acaulis Herbaceous Vegetation (CEGL001858)
- CAREX RUPESTRIS HERBACEOUS ALLIANCE (A.1307)
  Carex rupestris - Geum rossii Herbaceous Vegetation (CEGL001861)
  Carex rupestris - Potentilla ovina Herbaceous Vegetation (CEGL001862)
  Carex rupestris - Trifolium dasyphyllum Herbaceous Vegetation (CEGL001863)
  Carex rupestris var. drummondiana Herbaceous Vegetation (CEGL001864)
- CAREX SCIRPOIDEA HERBACEOUS ALLIANCE (A.1308)
  Carex scirpoidea - Geum rossii Herbaceous Vegetation (CEGL001866)
  Carex scirpoidea - Potentilla diversifolia Herbaceous Vegetation (CEGL001867)
- CAREX SICCATA HERBACEOUS ALLIANCE (A.1298)
  Carex siccata - Geum rossii Herbaceous Vegetation (CEGL001808)
- CAREX VERNACULA HERBACEOUS ALLIANCE (A.1309)
  Carex vernacula Herbaceous Vegetation (CEGL001868)
- CIRSIUM SCOPULORUM HERBACEOUS ALLIANCE (A.1608)
  Cirsium scopulorum - Polemonium viscosum Herbaceous Vegetation (CEGL001959)
- FESTUCA BRACHYPHYLLA HERBACEOUS ALLIANCE (A.1321)
  Festuca brachyphylla - Geum rossii var. turbinatum Herbaceous Vegetation (CEGL001895)
  Festuca brachyphylla - Trisetum spicatum Herbaceous Vegetation (CEGL001896)
  Festuca brachyphylla Herbaceous Vegetation (CEGL001797)
- FESTUCA THURBERI HERBACEOUS ALLIANCE (A.1256)
  Festuca thurberi Subalpine Grassland Herbaceous Vegetation (CEGL001631)
- GEUM ROSSII HERBACEOUS ALLIANCE (A.1645)
  Geum rossii - Carex albonigra Herbaceous Vegetation (CEGL001966)
  Geum rossii - Minuartia obtusiloba Herbaceous Vegetation (CEGL001965)
  Geum rossii - Selaginella densa Herbaceous Vegetation (CEGL001968)
  Geum rossii - Trifolium spp. Herbaceous Vegetation (CEGL001970)
  Geum rossii Herbaceous Vegetation (CEGL001964)
- KOBRESIA MYOSUROIDES HERBACEOUS ALLIANCE (A.1326)
  Kobresia myosuroides - Carex rupestris var. drummondiana Herbaceous Vegetation (CEGL001907)
  Kobresia myosuroides - Geum rossii Herbaceous Vegetation (CEGL001908)
  Kobresia myosuroides - Trifolium dasyphyllum Herbaceous Vegetation (CEGL001909)
- LEUCOPOA KINGII HERBACEOUS ALLIANCE (A.1323)
  Leucopoa kingii - Carex elynoides Herbaceous Vegetation (CEGL001911)

Leucopoa kingii - Oxytropis campestris Herbaceous Vegetation (CEGL001912)
Leucopoa kingii - Phlox pulvinata Herbaceous Vegetation (CEGL001913)
Leucopoa kingii - Poa fendleriana ssp. fendleriana Herbaceous Vegetation (CEGL001914)
Leucopoa kingii Herbaceous Vegetation (CEGL001910)

- MINUARTIA OBTUSILOBA HERBACEOUS ALLIANCE (A.1630)
  Minuartia obtusiloba Herbaceous Vegetation (CEGL001919)
- POA ARCTICA HERBACEOUS ALLIANCE (A.1311)
  Poa arctica ssp. grayana Herbaceous Vegetation (CEGL001924)
- POA LETTERMANII HERBACEOUS ALLIANCE (A.1327)
  Poa lettermanii Herbaceous Vegetation (CEGL001927)
- POA NERVOSA HERBACEOUS ALLIANCE (A.1264)
  Poa nervosa - Achnatherum lettermanii Herbaceous Vegetation (CEGL001656)
- PSEUDOROEGNERIA SPICATA HERBACEOUS ALLIANCE (A.1265)
  Pseudoroegneria spicata - Cushion Plants Herbaceous Vegetation (CEGL001666)
- RIBES MONTIGENUM SHRUBLAND ALLIANCE (A.926)
  Ribes montigenum Shrubland (CEGL001133)
- SAXIFRAGA CHRYSANTHA HERBACEOUS ALLIANCE (A.1632)
  Saxifraga chrysantha Herbaceous Vegetation (CEGL001929)
- SIBBALDIA PROCUMBENS HERBACEOUS ALLIANCE (A.1635)
  Sibbaldia procumbens - Polygonum bistortoides Herbaceous Vegetation (CEGL001933)
- TRIFOLIUM DASYPHYLLUM HERBACEOUS ALLIANCE (A.1637)
  Trifolium dasyphyllum Herbaceous Vegetation (CEGL001935)
- TRIFOLIUM PARRYI HERBACEOUS ALLIANCE (A.1638)
  Trifolium parryi Herbaceous Vegetation (CEGL001936)

SOURCES

References: Anderson 1999, Baker 1980a, Bamberg 1961, Bamberg and Major 1968, Canadian Rockies Ecoregional Plan 2002, Cooper et al. 1997, Komarkava 1980, Komarkova 1976, Meidinger and Pojar 1991, Neely et al. 2001, Schwan and Costello 1951, Thilenius 1975, Willard 1963

Last updated: 20 Feb 2003 **Stakeholders:** WCS, CAN

Concept Author: NatureServe Western Ecology Team **LeadResp:** WCS

S083 ROCKY MOUNTAIN SUBALPINE MESIC MEADOW

Division 306, Herbaceous, CES306.829

Spatial Scale & Pattern: Small Patch **Classification Confidence:** medium

Required Classifiers: Natural/Semi-natural, Vegetated (>10% vasc.), Upland

Diagnostic Classifiers: Montane [Upper Montane], Herbaceous, Silt Soil Texture, Clay Soil Texture, Udic, Forb

Non-Diagnostic Classifiers: Sideslope, Temperate [Temperate Continental], Shallow Soil, Mineral: W/ A-Horizon >10 cm, W-Patch/Medium Intensity, W-Landscape/Medium Intensity

Concept Summary: This Rocky Mountain ecological system is restricted to sites in the subalpine zone where finely textured soils, snow deposition, or wind-swept dry conditions limit tree establishment. It is found typically above 3000 m in elevation in the southern part of its range and above 1500 m in the northern part. These upland communities occur on gentle to moderate-gradient slopes. The soils are typically seasonally moist to saturated in the spring, but if so will dry out later in the growing season. These sites are not as wet as found in Rocky Mountain Alpine-Montane Wet Meadow (CES306.812). Vegetation is typically forb-rich, with forbs contributing more to overall herbaceous cover than graminoids. Important taxa include *Erigeron* spp., Asteraceae spp., *Mertensia* spp., *Penstemon* spp., *Campanula* spp., *Lupinus* spp., *Solidago* spp., *Ligusticum* spp., *Thalictrum occidentale, Valeriana sitchensis, Balsamorhiza sagittata, Wyethia* spp., *Deschampsia caespitosa, Koeleria macrantha,* and *Dasiphora fruticosa*. Burrowing mammals can increase the forb diversity.

DISTRIBUTION

Range: Rocky Mountains.

Ecological Divisions: 304, 306

TNC Ecoregions: 11:C, 18:C, 19:C, 20:C, 21:C, 68:C, 7:C, 8:C, 9:C

Subnations/Nations: AB:c, AZ:c, BC:c, CO:c, ID:c, MT:c, NM:c, NV:c, OR:c, UT:c, WA:c, WY:c

CONCEPT

Alliances and Associations:

- AGASTACHE URTICIFOLIA HERBACEOUS ALLIANCE (A.1602)
  Agastache urticifolia - Heliomeris multiflora Herbaceous Vegetation (CEGL001937)
- ANTENNARIA MICROPHYLLA HERBACEOUS ALLIANCE (A.1623)
  Antennaria microphylla - Artemisia scopulorum Herbaceous Vegetation (CEGL001847)
- DESCHAMPSIA CAESPITOSA SEASONALLY FLOODED HERBACEOUS ALLIANCE (A.1408)
  Deschampsia caespitosa - Ligusticum tenuifolium Herbaceous Vegetation (CEGL001885)
- DESCHAMPSIA CAESPITOSA TEMPORARILY FLOODED HERBACEOUS ALLIANCE (A.1355)
  Deschampsia caespitosa - Achillea millefolium var. occidentalis Herbaceous Vegetation (CEGL001880)
  Deschampsia caespitosa - Geum rossii Herbaceous Vegetation (CEGL001884)
  Deschampsia caespitosa - Mertensia ciliata Herbaceous Vegetation (CEGL001887)
  Deschampsia caespitosa - Phleum alpinum Herbaceous Vegetation (CEGL001888)
  Deschampsia caespitosa - Potentilla diversifolia Herbaceous Vegetation (CEGL001889)
  Deschampsia caespitosa - Symphyotrichum foliaceum Herbaceous Vegetation (CEGL001881)
- GEUM ROSSII HERBACEOUS ALLIANCE (A.1645)
  Geum rossii - Trifolium spp. Herbaceous Vegetation (CEGL001970)
- IVESIA GORDONII HERBACEOUS ALLIANCE (A.1627)
  Ivesia gordonii - Eriogonum caespitosum Herbaceous Vegetation (CEGL001903)
  Ivesia gordonii - Minuartia obtusiloba Herbaceous Vegetation (CEGL001902)
- LIGUSTICUM FILICINUM HERBACEOUS ALLIANCE (A.1604)
  Ligusticum filicinum - Delphinium X occidentale Herbaceous Vegetation (CEGL001941)
- LIGUSTICUM PORTERI HERBACEOUS ALLIANCE (A.1601)
  Ligusticum porteri - Lupinus parviflorus ssp. myrianthus Herbaceous Vegetation (CEGL001915)
  Ligusticum porteri - Vicia americana Herbaceous Vegetation (CEGL001916)
- LIGUSTICUM TENUIFOLIUM HERBACEOUS ALLIANCE (A.1628)
  Ligusticum tenuifolium - Trollius laxus ssp. albiflorus Herbaceous Vegetation (CEGL001917)
- LUPINUS ARGENTEUS HERBACEOUS ALLIANCE (A.1605)
  Lupinus argenteus - Fragaria virginiana Herbaceous Vegetation (CEGL001942)
  Lupinus spp. - Poa spp. Herbaceous Vegetation (CEGL001943)
- MERTENSIA CILIATA HERBACEOUS ALLIANCE (A.1606)
  Mertensia ciliata Herbaceous Vegetation (CEGL001944)
- PHLEUM ALPINUM HERBACEOUS ALLIANCE (A.1310)
  Phleum alpinum - Achillea millefolium Herbaceous Vegetation (CEGL001920)
- TRIFOLIUM DASYPHYLLUM HERBACEOUS ALLIANCE (A.1637)
  Trifolium dasyphyllum Herbaceous Vegetation (CEGL001935)
- TRIFOLIUM PARRYI HERBACEOUS ALLIANCE (A.1638)
  Trifolium parryi Herbaceous Vegetation (CEGL001936)
- WYETHIA AMPLEXICAULIS HERBACEOUS ALLIANCE (A.1607)
  Wyethia amplexicaulis Herbaceous Vegetation (CEGL001947)

SOURCES

References: Buckner 1977, Canadian Rockies Ecoregional Plan 2002, Ellison 1954, Fritz 1981, Hall 1971, Hammerson 1979, Marr 1977a, Meidinger and Pojar 1991, Nachlinger 1985, Neely et al. 2001, Potkin and Munn 1989, Starr 1974

Last updated: 20 Feb 2003 **Stakeholders:** WCS, MCS, CAN

Concept Author: NatureServe Western Ecology Team **LeadResp:** WCS

S085 SOUTHERN ROCKY MOUNTAIN MONTANE-SUBALPINE GRASSLAND

Division 306, Herbaceous, CES306.824

Spatial Scale & Pattern: Large Patch **Classification Confidence:** medium

Required Classifiers: Natural/Semi-natural, Vegetated (>10% vasc.), Upland

Diagnostic Classifiers: Herbaceous, Acidic Soil, Mineral: W/ A-Horizon >10 cm, Loam Soil Texture, Silt Soil Texture, Aridic, Short Disturbance Interval, Graminoid, Cool-season bunch grasses

Non-Diagnostic Classifiers: Montane [Montane], Montane [Lower Montane], Sideslope, Temperate [Temperate Continental], Shallow Soil, F-Patch/Low Intensity, Moderate (100-500 yrs) Persistence

Concept Summary: This Rocky Mountain ecological system typically occurs between 2200-3000 m on flat to rolling plains and parks or on lower sideslopes that are dry, but may extend up to 3350 m on warm aspects. Soils

resemble prairie soils in that the A-horizon is dark brown, relatively high in organic matter, slightly acid, and usually well-drained. An occurrence usually consists of a mosaic of two or three plant associations with one of the following dominant bunch grasses: *Danthonia intermedia*, *Danthonia parryi*, *Festuca idahoensis*, *Festuca arizonica*, *Festuca thurberi*, *Muhlenbergia filiculmis*, or *Pseudoroegneria spicata*. The subdominants include *Muhlenbergia montana*, *Bouteloua gracilis*, and *Poa secunda*. Locally shrubland patches (such as *Symphoricarpos* spp.) may occur within this predominately grassland system. These large-patch grasslands are intermixed with matrix stands of spruce-fir, lodgepole, ponderosa pine, and aspen forests. In limited circumstances (e.g., South Park in Colorado) they form the "matrix" of high-elevation plateaus.

Comments: Montane grasslands are very similar and intergrade with their subalpine counterparts, but are separated here to represent those species that do not occur at higher altitudes.

DISTRIBUTION

Range: Occurs between 2200-3000 m in the Colorado Rockies.
Ecological Divisions: 304, 306
TNC Ecoregions: 18:C, 19:C, 20:C, 21:C
Subnations/Nations: AZ:c, CO:c, NM:c, UT:c, WY:c

CONCEPT

Alliances and Associations:

- AGROSTIS VARIABILIS HERBACEOUS ALLIANCE (A.1318)
  Agrostis variabilis Herbaceous Vegetation (CEGL001846)
- ARTEMISIA FRIGIDA SHRUBLAND ALLIANCE (A.2565)
  Artemisia frigida / Bouteloua gracilis Shrubland [Provisional] (CEGL002782)
- BROMUS INERMIS SEMI-NATURAL HERBACEOUS ALLIANCE (A.3561)
  Bromus inermis - (Pascopyrum smithii) Semi-natural Herbaceous Vegetation (CEGL005264)
- CAREX HOODII HERBACEOUS ALLIANCE (A.1253)
- DANTHONIA INTERMEDIA HERBACEOUS ALLIANCE (A.1315)
  Danthonia intermedia - Solidago multiradiata Herbaceous Vegetation (CEGL001879)
  Danthonia intermedia Herbaceous Vegetation (CEGL001794)
- DANTHONIA PARRYI HERBACEOUS ALLIANCE (A.1316)
  Danthonia parryi Herbaceous Vegetation (CEGL001795)
- DESCHAMPSIA CAESPITOSA SEASONALLY FLOODED HERBACEOUS ALLIANCE (A.1408)
  Deschampsia caespitosa Herbaceous Vegetation (CEGL001599)
- FESTUCA ARIZONICA HERBACEOUS ALLIANCE (A.1245)
  Festuca arizonica - Blepharoneuron tricholepis Herbaceous Vegetation (CEGL004508)
  Festuca arizonica - Muhlenbergia filiculmis Herbaceous Vegetation (CEGL001605)
  Festuca arizonica - Muhlenbergia montana Herbaceous Vegetation (CEGL001606)
- FESTUCA CAMPESTRIS HERBACEOUS ALLIANCE (A.1255)
- FESTUCA IDAHOENSIS ALPINE HERBACEOUS ALLIANCE (A.1313)
  Festuca idahoensis - Delphinium glareosum Herbaceous Vegetation (CEGL001613)
- FESTUCA IDAHOENSIS HERBACEOUS ALLIANCE (A.1251)
  Festuca idahoensis - Carex filifolia Herbaceous Vegetation (CEGL001898)
  Festuca idahoensis - Danthonia intermedia Herbaceous Vegetation (CEGL001612)
  Festuca idahoensis - Festuca thurberi Herbaceous Vegetation (CEGL001617)
  Festuca idahoensis - Geranium viscosissimum Herbaceous Vegetation (CEGL001618)
  Festuca idahoensis - Pseudoroegneria spicata Herbaceous Vegetation (CEGL001624)
- FESTUCA THURBERI HERBACEOUS ALLIANCE (A.1256)
  Festuca thurberi - Lathyrus lanszwertii var. leucanthus Herbaceous Vegetation (CEGL001630)
  Festuca thurberi Subalpine Grassland Herbaceous Vegetation (CEGL001631)
- FESTUCA VIRIDULA HERBACEOUS ALLIANCE (A.1257)
- LEYMUS CINEREUS HERBACEOUS ALLIANCE (A.1204)
  Leymus cinereus Herbaceous Vegetation (CEGL001479)
- LEYMUS SALINUS SSP. SALMONIS SPARSELY VEGETATED ALLIANCE (A.1258)
- MUHLENBERGIA FILICULMIS HERBACEOUS ALLIANCE (A.1288)
  Muhlenbergia filiculmis Herbaceous Vegetation (CEGL001780)
- MUHLENBERGIA MONTANA HERBACEOUS ALLIANCE (A.1260)
  Muhlenbergia (pungens, montana) - Heterotheca villosa Herbaceous Vegetation (CEGL002938)
  Muhlenbergia montana - Hesperostipa comata Herbaceous Vegetation (CEGL001647)
  Muhlenbergia montana Herbaceous Vegetation (CEGL001646)

- PASCOPYRUM SMITHII HERBACEOUS ALLIANCE (A.1232)
  Pascopyrum smithii - Bouteloua gracilis Herbaceous Vegetation (CEGL001578)
- POA FENDLERIANA INTERMITTENTLY FLOODED HERBACEOUS ALLIANCE (A.1336)
  Poa fendleriana Herbaceous Vegetation (CEGL001925)
- PSEUDOROEGNERIA SPICATA HERBACEOUS ALLIANCE (A.1265)
  Pseudoroegneria spicata - Hesperostipa comata Herbaceous Vegetation (CEGL001679)
  Pseudoroegneria spicata - Poa fendleriana Herbaceous Vegetation (CEGL001676)
  Pseudoroegneria spicata Herbaceous Vegetation (CEGL001660)

SOURCES

References: Bowns and Bagley 1986, Comer et al. 2002, Hess 1981, Hess and Wasser 1982, Moir 1967, Neely et al. 2001, Passey et al. 1982, Shepherd 1975, Stewart 1940, Tuhy et al. 2002, Turner 1975, Turner and Dortignac 1954

Last updated: 20 Feb 2003 **Stakeholders:** WCS, MCS

Concept Author: NatureServe Western Ecology Team **LeadResp:** WCS

S086 WESTERN GREAT PLAINS FOOTHILL AND PIEDMONT GRASSLAND

Division 303, Herbaceous, CES303.817

Spatial Scale & Pattern: Large Patch **Classification Confidence:** medium

Required Classifiers: Natural/Semi-natural, Vegetated (>10% vasc.), Upland

Diagnostic Classifiers: Lowland [Foothill], Toeslope/Valley Bottom, Clay Soil Texture, Aridic, Short Disturbance Interval [Periodicity/Irregular Disturbance], F-Patch/Low Intensity, Graminoid

Non-Diagnostic Classifiers: Herbaceous, Temperate [Temperate Continental], Short (50-100 yrs) Persistence

Concept Summary: This system typically occurs between 1600-2200 m in elevation. It is best characterized as a mixed-grass to tallgrass prairie on mostly moderate to gentle slopes, usually at the base of foothill slopes, e.g., the hogbacks of the Rocky Mountain Front Range where it typically occurs as a relatively narrow elevational band between montane woodlands and shrublands and the shortgrass steppe, but extends east on the Front Range piedmont alongside the chalk bluffs along the Colorado-Wyoming border, out into the Great Plains on the Palmer Divide, and on piedmont slopes below mesas and foothills in northeastern New Mexico. A combination of increased precipitation from orographic rain, temperature, and soils limit this system to the lower elevations zone with approximately 40 cm of precipitation/year. It is maintained by frequent fire and associated with well-drained clay soils. Usually occurrences of this system have multiple plant associations that may be dominated by *Andropogon gerardii, Schizachyrium scoparium, Muhlenbergia montana, Nassella viridula, Pascopyrum smithii, Sporobolus cryptandrus, Bouteloua gracilis, Hesperostipa comata,* or *Hesperostipa neomexicana*. In Wyoming, typical grasses found in this system include *Pseudoroegneria spicata, Festuca idahoensis, Hesperostipa comata,* and species of *Poa*. Typical adjacent ecological systems include foothill shrublands, ponderosa pine savannas, juniper savannas, as well as shortgrass prairie.

Comments: Need to incorporate Northern Rockies information.

DISTRIBUTION

Range: This mixed-grass prairie ecological system occurs in the narrow to broad transition band between the Rocky Mountains and the Shortgrass Steppe where increased soil moisture from oreographic lifting and local topography favors tall and mid height grasses. The band is restricted to the Rocky Mountain foothills and piedmont and adjacent plains,extending farther east on the Palmer Divide, north alongside the cChalk Bluffs near the Colorado-Wyoming border, and south on and below mesas and escarpments in southeastern Colorado, northeastern New Mexico and the panhandles of Oklahoma and Texas.

Ecological Divisions: 303, 306

TNC Ecoregions: 10:C, 20:C, 21:C, 24:C, 25:P, 26:P, 27:C, 28:P

Subnations/Nations: AZ:?, CO:c, NM:c, SD:p, TX:?, WY:c

CONCEPT

Alliances and Associations:

- ANDROPOGON GERARDII - (SORGHASTRUM NUTANS) HERBACEOUS ALLIANCE (A.1192)
  Andropogon gerardii - Schizachyrium scoparium Western Great Plains Herbaceous Vegetation (CEGL001463)
  Andropogon gerardii - Sorghastrum nutans Western Great Plains Herbaceous Vegetation (CEGL001464)
  Andropogon gerardii - Sporobolus heterolepis Western Foothills Herbaceous Vegetation (CEGL001465)

- ARTEMISIA FRIGIDA SHRUBLAND ALLIANCE (A.2565)
  Artemisia frigida / Bouteloua gracilis Shrubland [Provisional] (CEGL002782)
- BOUTELOUA GRACILIS HERBACEOUS ALLIANCE (A.1282)
  Bouteloua gracilis - Bouteloua curtipendula Herbaceous Vegetation (CEGL001754)
  Bouteloua gracilis - Bouteloua hirsuta Herbaceous Vegetation (CEGL001755)
  Bouteloua gracilis - Buchloe dactyloides Herbaceous Vegetation (CEGL001756)
  Bouteloua gracilis Herbaceous Vegetation (CEGL001760)
- BOUTELOUA HIRSUTA HERBACEOUS ALLIANCE (A.1285)
  Bouteloua hirsuta - Bouteloua curtipendula Herbaceous Vegetation (CEGL001764)
  Bouteloua hirsuta - Hesperostipa neomexicana Herbaceous Vegetation (CEGL001766)
- HESPEROSTIPA COMATA - BOUTELOUA GRACILIS HERBACEOUS ALLIANCE (A.1234)
  Hesperostipa comata Colorado Front Range Herbaceous Vegetation (CEGL001702)
- HESPEROSTIPA COMATA BUNCH HERBACEOUS ALLIANCE (A.1270)
  Hesperostipa comata - Achnatherum hymenoides Herbaceous Vegetation (CEGL001703)
- HESPEROSTIPA NEOMEXICANA HERBACEOUS ALLIANCE (A.1272)
  Hesperostipa neomexicana Herbaceous Vegetation (CEGL001708)
- NASSELLA VIRIDULA HERBACEOUS ALLIANCE (A.1261)
  Nassella viridula Herbaceous Vegetation (CEGL001713)
- POLIOMINTHA INCANA SHRUBLAND ALLIANCE (A.862)
  Poliomintha incana / Bouteloua gracilis Shrubland (CEGL001339)
- PSEUDOROEGNERIA SPICATA HERBACEOUS ALLIANCE (A.1265)
  Pseudoroegneria spicata - Hesperostipa comata Herbaceous Vegetation (CEGL001679)
  Pseudoroegneria spicata - Pascopyrum smithii Herbaceous Vegetation (CEGL001675)
  Pseudoroegneria spicata - Poa secunda Herbaceous Vegetation (CEGL001677)
  Pseudoroegneria spicata Herbaceous Vegetation (CEGL001660)
- SCHIZACHYRIUM SCOPARIUM - BOUTELOUA CURTIPENDULA HERBACEOUS ALLIANCE (A.1225)
  Schizachyrium scoparium - Bouteloua curtipendula Western Great Plains Herbaceous Vegetation (CEGL001594)
- SCHIZACHYRIUM SCOPARIUM BUNCH HERBACEOUS ALLIANCE (A.1266)
  Schizachyrium scoparium - Muhlenbergia cuspidata Herbaceous Vegetation (CEGL001683)
- YUCCA GLAUCA SHRUB HERBACEOUS ALLIANCE (A.1540)
  Yucca glauca / Pseudoroegneria spicata Shrub Herbaceous Vegetation (CEGL001499)

SOURCES

References: Albertson and Weaver 1956,Anderson 1999, Hess and Wasser 1982, Lauenroth and Milchunas 1992, Mast et al. 1997, Mast et al. 1998, Neely et al. 2001, Opler and Krizek 1984,

Last updated: 20 Feb 2003 **Stakeholders:** WCS

Concept Author: NatureServe Western Ecology Team **LeadResp:** WCS

S087 CENTRAL MIXEDGRASS PRAIRIE

Division 303, Herbaceous, CES303.659

Spatial Scale & Pattern: Matrix **Classification Confidence:** high

Required Classifiers: Natural/Semi-natural, Vegetated (>10% vasc.), Upland

Non-Diagnostic Classifiers: Lowland [Lowland], Herbaceous, Temperate [Temperate Continental], Shallow Soil, Loam Soil Texture, Silt Soil Texture, Ustic, F-Landscape/Medium Intensity, G-Landscape/High Intensity, Graminoid

Concept Summary: This mixedgrass prairie system ranges from South Dakota to northern Texas and is bordered by the shortgrass prairie on the western edge and the tallgrass prairie to the east. The loessal regions in west-central Kansas and central Nebraska, the Red Hills region of south-central Kansas and northern Oklahoma are all located within this system. Because of its proximity to other ecoregions, this system contains elements from both shortgrass and tallgrass prairies, which combine to form the mixedgrass prairie ecological system throughout its range. The distribution, species richness and productivity of plant species within the mixedgrass ecological system is controlled primarily by environmental conditions, in particular soil moisture and topography. Grazing and fire are important dynamic processes in this system. The relative dominance of the various grass and forb species within different associations in the system also can strongly depend on the degree of natural or human disturbance. This system can contain grass species such as *Bouteloua curtipendula, Schizachyrium scoparium, Andropogon gerardii, Hesperostipa comata, Sporobolus heterolepis*, and *Bouteloua gracilis*, although the majority of the associations within the region are dominated by *Pascopyrum smithii* or *Schizachyrium scoparium*. Numerous forb and sedge species (*Carex* spp.) can also occur within the mixedgrass system in the Western Great Plains. Although forbs do

not always significantly contribute to the canopy, they can be very important. Some dominant forb species include *Ambrosia psilostachya*, *Echinacea angustifolia*, and *Lygodesmia juncea*. Oak species such as *Quercus macrocarpa* can occur also in areas protected from fire due to topographic position. This can cause an almost oak savanna situation in certain areas, although fire suppression may allow for a more closed canopy and expansion of bur oak beyond those sheltered areas. In those situations, further information will be needed to determine if those larger areas with a more closed canopy of bur oak should be considered part of Western Great Plains Dry Bur Oak Forest and Woodland (CES303.667). Likewise, within the mixedgrass system, small seeps may occur, especially during the wettest years. Although these are not considered a separate system, the suppression of fire within the region has enabled the invasion of both exotics and some shrub species such as *Juniperus virginiana* and also allowed for the establishment of *Pinus ponderosa* in some northern areas.

DISTRIBUTION

Range: This system is found throughout the central and southern areas of the Western Great Plains ranging from southern South Dakota into northern Texas.
Ecological Divisions: 303
TNC Ecoregions: 27:P, 28:P, 29:C, 32:C, 33:C, 37:P
Subnations/Nations: CO:c, KS:c, NE:c, OK:c, SD:c, TX:c

CONCEPT

Alliances and Associations:

- (COMPLEX)
  Blacktailed Prairie Dog Town Grassland Complex (CECX005703)
- ARTEMISIA TRIDENTATA SSP. WYOMINGENSIS SHRUB HERBACEOUS ALLIANCE (A.1527)
  Artemisia tridentata ssp. wyomingensis / Mixed Grasses Shrub Herbaceous Vegetation (CEGL001534)
- CORNUS DRUMMONDII SHRUBLAND ALLIANCE (A.3558)
  Cornus drummondii - (Rhus glabra, Prunus spp.) Shrubland (CEGL005219)
- CYNODON DACTYLON HERBACEOUS ALLIANCE (A.1279)
  Cynodon dactylon Herbaceous Vegetation (CEGL004701)
- HESPEROSTIPA COMATA - BOUTELOUA GRACILIS HERBACEOUS ALLIANCE (A.1234)
  Hesperostipa comata - Bouteloua gracilis - Carex filifolia Herbaceous Vegetation (CEGL002037)
  Hesperostipa comata - Carex filifolia Herbaceous Vegetation (CEGL001700)
  Hesperostipa comata - Carex inops ssp. heliophila Herbaceous Vegetation (CEGL001701)
  Hesperostipa comata Colorado Front Range Herbaceous Vegetation (CEGL001702)
- HESPEROSTIPA CURTISETA - ELYMUS LANCEOLATUS HERBACEOUS ALLIANCE (A.3523)
  Hesperostipa curtiseta - Elymus lanceolatus Herbaceous Vegetation (CEGL002253)
- JUNIPERUS VIRGINIANA FOREST ALLIANCE (A.137)
  Juniperus virginiana var. virginiana / Schizachyrium scoparium Forest (CEGL003628)
- KRASCHENINNIKOVIA LANATA DWARF-SHRUB HERBACEOUS ALLIANCE (A.1565)
  Krascheninnikovia lanata / Bouteloua gracilis Dwarf-shrub Herbaceous Vegetation (CEGL001321)
- PASCOPYRUM SMITHII HERBACEOUS ALLIANCE (A.1232)
  Pascopyrum smithii - Bouteloua gracilis Herbaceous Vegetation (CEGL001578)
  Pascopyrum smithii - Hesperostipa comata Central Mixedgrass Herbaceous Vegetation (CEGL002034)
  Pascopyrum smithii Herbaceous Vegetation (CEGL001577)
- PLEURAPHIS MUTICA HERBACEOUS ALLIANCE (A.1249)
  Pleuraphis mutica - Buchloe dactyloides Herbaceous Vegetation (CEGL002272)
- POA PALUSTRIS SEMI-NATURAL SEASONALLY FLOODED HERBACEOUS ALLIANCE (A.1409)
  Poa palustris Herbaceous Vegetation (CEGL001659)
- POA PRATENSIS SEMI-NATURAL HERBACEOUS ALLIANCE (A.3562)
  Poa pratensis - (Pascopyrum smithii) Semi-natural Herbaceous Vegetation (CEGL005265)
- QUERCUS MACROCARPA WOODED MEDIUM-TALL HERBACEOUS ALLIANCE (A.1505)
  Quercus macrocarpa / Mixedgrass Loam Wooded Herbaceous Vegetation (CEGL002163)
  Quercus macrocarpa / Mixedgrass Sand Wooded Herbaceous Vegetation (CEGL002162)
  Quercus macrocarpa / Mixedgrass Shale Wooded Herbaceous Vegetation (CEGL002164)
- SARCOBATUS VERMICULATUS INTERMITTENTLY FLOODED SPARSELY VEGETATED ALLIANCE (A.1877)
  Sarcobatus vermiculatus / Sporobolus airoides Sparse Vegetation (CEGL001368)
- SCHIZACHYRIUM SCOPARIUM - BOUTELOUA CURTIPENDULA HERBACEOUS ALLIANCE (A.1225)
  Juniperus virginiana var. virginiana / Schizachyrium scoparium - Bouteloua curtipendula Great Plains Herbaceous Vegetation (CEGL004066)
  Schizachyrium scoparium - Bouteloua (curtipendula, gracilis) - Carex filifolia Herbaceous Vegetation (CEGL001681)
  Schizachyrium scoparium - Bouteloua curtipendula - Bouteloua gracilis Central Plains Herbaceous Vegetation (CEGL002246)

Schizachyrium scoparium - Bouteloua curtipendula - Nassella leucotricha Herbaceous Vegetation (CEGL004070)
Schizachyrium scoparium - Bouteloua curtipendula Chalkflat Herbaceous Vegetation (CEGL002247)
Schizachyrium scoparium - Bouteloua curtipendula Loess Mixedgrass Herbaceous Vegetation (CEGL002036)
Schizachyrium scoparium - Bouteloua curtipendula Red Hills Herbaceous Vegetation (CEGL002248)
Schizachyrium scoparium - Bouteloua curtipendula Western Great Plains Herbaceous Vegetation (CEGL001594)
Schizachyrium scoparium - Lesquerella gordonii - Castilleja purpurea var. citrina Herbaceous Vegetation (CEGL002252)

- YUCCA GLAUCA SHRUB HERBACEOUS ALLIANCE (A.1540)
  Yucca glauca / Calamovilfa longifolia Shrub Herbaceous Vegetation (CEGL002675)

Environment: Differences in topography and soil characteristics also occur across the range of this system. It is often characterized by rolling to extremely hilly landscapes with soils developed from loess, shale, limestone or sandstone parent material. Mollisol soils are most prevalent and range from silt loams and silty clay loams with sandy loams possible on the western edge of the range. The Red Hills region of Kansas and Oklahoma, which contains examples of this system, contains somewhat unique soil characteristics and has developed from a diversity of sources including red shale, red clay, sandy shale, siltstone, or sandstone. These soils have developed a characteristic reddish color from the primary material. These soils can consist of silt, loam, or clay and can have textures ranging from a fine sandy loam to a more clayey surface.

Vegetation: This system contains elements from both Western Great Plains Shortgrass Prairie (CES303.672) and Western Great Plains Tallgrass Prairie (CES303.673). This system typically contains grass species such as *Bouteloua curtipendula, Schizachyrium scoparium, Andropogon gerardii, Hesperostipa comata, Sporobolus heterolepis,* and *Bouteloua gracilis,* although the majority of the associations within the region are dominated by *Pascopyrum smithii* or *Schizachyrium scoparium.* Isolated patches of *Quercus macrocarpa* also can occur.

Dynamics: Fire and grazing are the primary processes occurring within the system. The diversity in this mixedgrass system likely reflects both the short- and long-term responses of the vegetation to these often concurrent disturbance regimes. Fire suppression and overgrazing can lead to the invasion of this system by woody species such as *Juniperus virginiana* and *Pinus ponderosa*. Likewise, fire suppression may lead to a more closed canopy of bur oak.

SOURCES

References: Barbour and Billings 1988, Ricketts et al. 1999, Weaver and Albertson 1956, Weaver and Bruner 1948
Last updated: 05 Mar 2003 **Stakeholders:** MCS
Concept Author: S. Menard and K. Kindscher **LeadResp:** MCS

S088 WESTERN GREAT PLAINS SHORTGRASS PRAIRIE

Division 303, Herbaceous, CES303.672

Spatial Scale & Pattern: Matrix **Classification Confidence:** high
Required Classifiers: Natural/Semi-natural, Vegetated (>10% vasc.), Upland
Non-Diagnostic Classifiers: Herbaceous, Loam Soil Texture, Ustic, F-Landscape/Low Intensity

Concept Summary: This system is found primarily in the western half of the Western Great Plains Division in the rain shadow of the Rocky Mountains and ranges from the Nebraska Panhandle south into Texas and New Mexico, although grazing impacted examples may reach as far north as southern Canada where it grades into Northwestern Great Plains Mixedgrass Prairie (CES303.674). This system occurs primarily on flat to rolling uplands with loamy, ustic soils ranging from sandy to clayey. In much of its range, this system forms the matrix system with *Bouteloua* gracilis dominating this system. Associated graminoids may include*Aristida purpurea, Bouteloua curtipendula, Bouteloua hirsuta, Buchloe dactyloides, Hesperostipa comata, Koeleria macrantha (= Koeleria cristata), Pascopyrum smithii (= Agropyron smithii), Pleuraphis jamesii, Sporobolus airoides* and *Sporobolus cryptandrus.* Although mid-height grass species may be present especially on more mesic land positions and soils, they are secondary in importance to the sod-forming short grasses. Sandy soils have higher cover of *Hesperostipa comata, Sporobolus cryptandrus,* and *Yucca elata.* Scattered shrub and dwarf-dwarf species such as *Artemisia filifolia, Artemisia frigida, Artemisia tridentata, Atriplex canescens, Eriogonium effusum, Gutierrezia sarothrae, Lycium palida,* may also be present. Also, because this system spans a wide range, there can be some differences in the relative dominance of some species from north to south and from east to west. Large-scale processes such as climate, fire and grazing influence this system. High variation in amount and timing of annual precipitation impacts the relative cover of cool and warm season herbaceous species. In contrast to other prairie systems, fire is less important, especially in the western range of this system, because the often dry and xeric climate conditions can

decrease the fuel load and thus the relative fire frequency within the system. However, historically, fires that did occur were often very expansive. Currently, fire suppression and more extensive grazing in the region have likely decreased the fire frequency even more, and it is unlikely that these processes could occur at a natural scale. A large part of the range for this system (especially in the east and near rivers) has been converted to agriculture. Areas of the central and western range have been impacted by the unsuccessful attempts to develop dryland cultivation during the Dust Bowl of the 1930s. The short grasses that dominate this system are extremely drought- and grazing-tolerant. These species evolved with drought and large herbivores and, because of their stature, are relatively resistant to overgrazing. This system in combination with the associated wetland systems represents one of the richest areas for mammals and birds. Endemic bird species to the shortgrass system may constitute one of the fastest declining bird populations.

DISTRIBUTION

Range: This system is found primarily in the western half of the Western Great Plains Division east of the Rocky Mountains and ranges from the Nebraska Panhandle south into panhandles of Oklahoma and Texas and New Mexico, although some examples may reach as far north as southern Canada where it grades into Northwestern Great Plains Mixedgrass Prairie (CES303.674).
Ecological Divisions: 303
TNC Ecoregions: 26:P, 27:C, 28:C, 33:P
Subnations/Nations: CO:c, KS:c, NE:c, NM:c, OK:c, TX:c, WY:c

CONCEPT

Alliances and Associations:

- (COMPLEX)
  Blacktailed Prairie Dog Town Grassland Complex (CECX005703)
- ARISTIDA PURPUREA HERBACEOUS ALLIANCE (A.2570)
  Aristida purpurea Herbaceous Vegetation (CEGL005800)
- BOUTELOUA CURTIPENDULA HERBACEOUS ALLIANCE (A.1244)
  Bouteloua curtipendula - Bouteloua (eriopoda, gracilis) Herbaceous Vegetation (CEGL002250)
- BOUTELOUA ERIOPODA HERBACEOUS ALLIANCE (A.1284)
  Bouteloua eriopoda - Bouteloua gracilis Herbaceous Vegetation (CEGL001748)
  Bouteloua eriopoda - Bouteloua hirsuta Herbaceous Vegetation (CEGL001749)
- BOUTELOUA GRACILIS HERBACEOUS ALLIANCE (A.1282)
  Bouteloua gracilis - Bouteloua curtipendula Herbaceous Vegetation (CEGL001754)
  Bouteloua gracilis - Bouteloua hirsuta Herbaceous Vegetation (CEGL001755)
  Bouteloua gracilis - Buchloe dactyloides - Pleuraphis jamesii Herbaceous Vegetation (CEGL002271)
  Bouteloua gracilis - Buchloe dactyloides Herbaceous Vegetation (CEGL001756)
  Bouteloua gracilis - Buchloe dactyloides Xeric Soil Herbaceous Vegetation (CEGL002270)
  Bouteloua gracilis - Pleuraphis jamesii Herbaceous Vegetation (CEGL001759)
  Bouteloua gracilis Herbaceous Vegetation (CEGL001760)
- BOUTELOUA HIRSUTA HERBACEOUS ALLIANCE (A.1285)
  Bouteloua hirsuta - Bouteloua curtipendula Herbaceous Vegetation (CEGL001764)
  Bouteloua hirsuta Herbaceous Vegetation [Placeholder] (CEGL002673)
- HESPEROSTIPA NEOMEXICANA HERBACEOUS ALLIANCE (A.1272)
  Hesperostipa neomexicana Mixed Prairie Herbaceous Vegetation (CEGL001711)
- SPOROBOLUS AIROIDES HERBACEOUS ALLIANCE (A.1267)
  Sporobolus airoides Southern Plains Herbaceous Vegetation (CEGL001685)
- YUCCA GLAUCA SHRUB HERBACEOUS ALLIANCE (A.1540)
  Yucca glauca / Calamovilfa longifolia Shrub Herbaceous Vegetation (CEGL002675)

Environment: Climate is continental with mean annual precipitation is generally about 300 mm ranging to 500 mm to the south in Texas. Most of the annual precipitation occurs during the growing season as thunderstorms. Precipitation events are mostly <10 cm with occasional larger events.

This system is located on primarily flat to rolling uplands. Soils typically are loamy and ustic and range from sandy to clayey.

Vegetation: This system spans a wide range and thus there can be some differences in the relative dominance of some species from north to south and from east to west. This system is primarily dominated by *Bouteloua* gracilis throughout its range with various associated graminoid species depending on preciptation, soils and management. Associated graminoids may include *Achnatherum hymenoides, Aristida purpurea, Bouteloua curtipendula, Bouteloua hirsuta, Buchloe dactyloides, Carex filifolia, Hesperostipa comata, Koeleria macrantha (= Koeleria*

cristata), Muhlenbergia torreyana, Pascopyrum smithii (= Agropyron smithii), Pleuraphis jamesii, Sporobolus airoides and *Sporobolus cryptandrus*. Although mid-height grass species may be present especially on more mesic land positions and soils, they are secondary in importance to the sod-forming short grasses. Sandy soils have higher cover of *Hesperostipa comata, Sporobolus cryptandrus,* and *Yucca elata.* Scattered shrub and dwarf-dwarf species such as *Artemisia filifolia, Artemisia frigida, Artemisia tridentata, Atriplex canescens, Eriogonium effusum, Gutierrezia sarothrae, Lycium palida,* may also be present. High annual variation in amount and timing of precipitation impacts relative cover of herbaceous species. Cover of cool season grasses are dependant on winter and early spring precipitation.

Dynamics: Climate, fire and grazing constitute the primary processes impacting this system. Drought tolerant shortgrass species have root systems that extend up near the soil surface where they can utilize low precipitation events (Sala and Lauenroth 1982). However, fire is less important in this system compared to other Western Great Plains prairie systems, especially in the western portion of its range. Previous comments in the literature citing *Opuntia* spp. increasing with overgrazing may not be borne out by more recent research (R. Rondeau pers. com.). Conversion to agriculture and pastureland with the subsequent irrigation has degraded and extirpated this system in some areas of its range.

SOURCES

References: Barbour and Billings 1988, Dick-Peddie 1993, Lauenroth and Milchunas 1991, Milchunas et al. 1989, Ricketts et al. 1999, Sala and Lauenroth 1982

Sala, O.E. and W.K. Lauenroth. 1982. Samall rainfall events: an ecological role in semi-arid regions. Oecologia Berlin,
53:301-304.

Last updated: 21 Aug 2003 **Stakeholders:** MCS, WCS
Concept Author: S. Menard and K. Kindscher **LeadResp:** MCS

S089 WESTERN GREAT PLAINS SANDHILL PRAIRIE

Division 303, Shrubland, CES303.671

Spatial Scale & Pattern: Large Patch **Classification Confidence:** high
Required Classifiers: Natural/Semi-natural, Vegetated (>10% vasc.), Upland
Non-Diagnostic Classifiers: Lowland [Lowland], Herbaceous, Sand Soil Texture, Ustic, G-Landscape/Low Intensity, W-Patch/High Intensity

Concept Summary: The sand prairies constitute a very unique system within the Western Great Plains. These sand prairies are often considered part of the tallgrass regions in the Western Great Plains, but can contain elements from both Western Great Plains Shortgrass Prairie (CES303.672) and Central Mixedgrass Prairie (CES303.659). The largest expanse of sand prairies (approximately 5 million ha) can be found in the Sandhills of north-central Nebraska and southwestern South Dakota. These areas are relatively intact. The primary use of this system has been grazing (not cultivation), and areas such as the Nebraska Sandhills can experience less degeneration than other prairie systems. Although greater than 90% of the Sandhills region is privately owned, the known fragility of the soils and the cautions used by ranchers to avoid poor grazing practices have allowed for fewer significant changes in the vegetation of the Sandhills compared to other grassland systems. The distribution, species richness and productivity of plant species within the sand prairie ecological system is controlled primarily by environmental conditions, in particular the temporal and spatial distribution of soil moisture and topography. Soils in the sand prairies can be relatively undeveloped and are highly permeable. Soil texture and drainage along with a species' rooting morphology, photosynthetic physiology, and mechanisms to avoid transpiration loss are highly important in determining the composition and distribution of communities/associations within the sand prairies. Another important aspect of soils in the sand prairies is their susceptibility to wind erosion. Blowouts and sand draws are some of the unique wind-driven disturbances in the sand prairies, particularly the Nebraska Sandhills, which can profoundly impact vegetation composition and succession within this system. Graminoid species dominate the sand prairies, although relative dominance can change due to impacts of wind disturbance. *Andropogon hallii* and *Calamovilfa longifolia* are the most common species, but other grass and forb species such as *Hesperostipa comata, Carex inops ssp. heliophila,* and *Panicum virgatum* may be present. Patches of *Quercus havardii* can also occur

within this system in the southern Great Plains. Fire and grazing constitute the other major dynamic processes that can influence this system.

DISTRIBUTION

Range: This system is found throughout the Western Great Plains Division. The largest and most intact example of this system is found within the Sandhills region of Nebraska and South Dakota.
Ecological Divisions: 303
TNC Ecoregions: 26:C, 27:C, 28:C, 33:C, 34:C
Subnations/Nations: CO:p, KS:c, MT:p, ND:c, NE:c, NM:?, OK:p, SD:c, TX:?, WY:p

CONCEPT

Alliances and Associations:

- ANDROPOGON GERARDII - (CALAMAGROSTIS CANADENSIS, PANICUM VIRGATUM) HERBACEOUS ALLIANCE (A.1191)
  Andropogon gerardii - Panicum virgatum Sandhills Herbaceous Vegetation (CEGL002023)
- ANDROPOGON HALLII HERBACEOUS ALLIANCE (A.1193)
  Andropogon hallii - Calamovilfa gigantea Herbaceous Vegetation (CEGL004016)
  Andropogon hallii - Calamovilfa longifolia Herbaceous Vegetation (CEGL001467)
  Andropogon hallii - Carex inops ssp. heliophila Herbaceous Vegetation (CEGL001466)
- ARTEMISIA CANA SSP. CANA SHRUB HERBACEOUS ALLIANCE (A.2554)
  Artemisia cana ssp. cana / Calamovilfa longifolia Shrub Herbaceous Vegetation (CEGL001555)
  Artemisia cana ssp. cana / Hesperostipa comata Shrub Herbaceous Vegetation (CEGL001553)
- BETULA OCCIDENTALIS SHRUBLAND ALLIANCE (A.914)
  Betula occidentalis - Juniperus horizontalis / Calamovilfa longifolia Shrubland (CEGL002184)
- CALAMOVILFA LONGIFOLIA HERBACEOUS ALLIANCE (A.1201)
  Calamovilfa longifolia - Carex inops ssp. heliophila Herbaceous Vegetation (CEGL001471)
  Calamovilfa longifolia - Hesperostipa comata Herbaceous Vegetation (CEGL001473)
- CAREX PELLITA - (CAREX NEBRASCENSIS) - SCHOENOPLECTUS SPP. SATURATED HERBACEOUS ALLIANCE (A.1466)
  Carex interior - Eleocharis elliptica - Thelypteris palustris Herbaceous Vegetation (CEGL002390)
- QUERCUS HAVARDII SHRUBLAND ALLIANCE (A.780)
  Quercus havardii / Sporobolus cryptandrus - Schizachyrium scoparium Shrubland (CEGL002171)
- SCHIZACHYRIUM SCOPARIUM - (SPOROBOLUS CRYPTANDRUS) HERBACEOUS ALLIANCE (A.1224)
  Schizachyrium scoparium - Aristida basiramea - Sporobolus cryptandrus - Eragrostis trichodes Herbaceous Vegetation (CEGL005221)
- YUCCA GLAUCA SHRUB HERBACEOUS ALLIANCE (A.1540)
  Yucca glauca / Calamovilfa longifolia Shrub Herbaceous Vegetation (CEGL002675)

Environment: This tallgrass system is found primarily on sandy and sandy loam soils that can be relatively undeveloped and highly permeable as compared to Western Great Plains Tallgrass Prairie (CES303.673), which occurs on deeper loams. This system is usually found in areas with a rolling topography and can occur on ridges, midslopes and/or lowland areas within a region. It often occurs on moving sand dunes, especially within the Sandhill region of Nebraska and South Dakota.

Vegetation: This system is distinguished by the dominance of *Andropogon hallii* and *Calamovilfa longifolia*. Other species such as *Hesperostipa comata*, *Carex inops ssp. heliophila*, and *Panicum virgatum* may be present. In the southern range of this system, patches of *Quercus havardii* can also occur. *Penstemon haydenii* is endemic to the sand prairie system and of special conservation concern because of its probable decline due to grazing and fire suppression.

Dynamics: The distribution, species richness and productivity of plant species within the sand prairie ecological system is controlled primarily by environmental conditions, in particular the temporal and spatial distribution of soil moisture and topography. Another important aspect of this system is its susceptibility to wind erosion. Blowouts and sand draws are some of the unique wind-driven disturbances in the sand prairies, particularly the Nebraska Sandhills, which can profoundly impact vegetation composition and succession within this system. Fire and grazing constitute the other major disturbances that can influence this system. Overgrazing, fire and trampling that leads to the removal of vegetation within those areas susceptible to blowouts can either instigate a blowout or perpetuate one already occurring. Overgrazing can also lead to significant erosion.

SOURCES

References: Barbour and Billings 1988, Tolstead 1942
Last updated: 05 Mar 2003 **Stakeholders:** MCS, WCS
Concept Author: S. Menard and K. Kindscher **LeadResp:** MCS

S090 INTER-MOUNTAIN BASINS SEMI-DESERT GRASSLAND

Division 304, Herbaceous, CES304.787

Spatial Scale & Pattern: Large Patch **Classification Confidence:** medium
Required Classifiers: Natural/Semi-natural, Vegetated (>10% vasc.), Upland
Diagnostic Classifiers: Lowland [Foothill], Lowland [Lowland], Herbaceous, Temperate [Temperate Xeric], Alkaline Soil, Aridic, Graminoid

Non-Diagnostic Classifiers: Intermediate Disturbance Interval, F-Landscape/Medium Intensity, G-Landscape/Low Intensity, Forb, Moderate (100-500 yrs) Persistence

Concept Summary: This widespread ecological system occurs throughout the Intermountain western U.S. on dry plains and mesas, at approximately 1450 to 2320 m (4750-7610 feet) in elevation. These grasslands occur in lowland and upland areas and may occupy swales, playas, mesa tops, plateau parks, alluvial flats, and plains, but sites are typically xeric. Substrates are often well-drained sandy- or loamy-textured soils derived from sedimentary parent materials, but are quite variable and may include fine-textured soils derived from igneous and metamorphic rocks. When they occur near foothills grasslands they will be at lower elevations. The dominant perennial bunch grasses and shrubs within this system are all very drought-resistant plants. These grasslands are typically dominated or codominated by *Achnatherum hymenoides*, *Aristida* spp., *Bouteloua gracilis*, *Hesperostipa comata*, *Muhlenbergia torreyana*, or *Pleuraphis jamesii*, and may include scattered shrubs and dwarf-shrubs of species of *Artemisia*, *Atriplex*, *Coleogyne*, *Ephedra*, *Gutierrezia*, or *Krascheninnikovia lanata*.

DISTRIBUTION

Range: Occurs throughout the Intermountain western U.S. on dry plains and mesas, at approximately 1450 to 2320 m (4750-7610 feet) in elevation.
Ecological Divisions: 304, 306
TNC Ecoregions: 10:C, 11:C, 18:C, 19:C, 20:C, 21:C, 4:C, 6:C, 8:C, 9:C
Subnations/Nations: AZ:c, CA:c, CO:c, ID:c, MT:p, NM:c, NV:c, OR:c, UT:c, WA:c, WY:c

CONCEPT

Alliances and Associations:

- ACHNATHERUM HYMENOIDES HERBACEOUS ALLIANCE (A.1262)
  Achnatherum hymenoides - Sporobolus contractus Herbaceous Vegetation (CEGL001652)
- ACHNATHERUM LETTERMANII HERBACEOUS ALLIANCE (A.2524)
  Achnatherum lettermanii - Oxytropis oreophila Herbaceous Vegetation (CEGL002734)
- ACHNATHERUM NELSONII HERBACEOUS ALLIANCE (A.1271)
  Achnatherum nelsonii - Koeleria macrantha Herbaceous Vegetation (CEGL001707)
- ACHNATHERUM SPECIOSUM HERBACEOUS ALLIANCE (A.1290)
  Achnatherum speciosum Herbaceous Vegetation [Placeholder] (CEGL003112)
- ARISTIDA PURPUREA HERBACEOUS ALLIANCE (A.2570)
  Aristida purpurea Herbaceous Vegetation (CEGL005800)
- BOUTELOUA ERIOPODA HERBACEOUS ALLIANCE (A.1284)
  Bouteloua eriopoda - Hesperostipa neomexicana Herbaceous Vegetation (CEGL001753)
  Bouteloua eriopoda - Pleuraphis jamesii Herbaceous Vegetation (CEGL001751)
  Bouteloua eriopoda Semi-desert Herbaceous Vegetation (CEGL001752)
- BOUTELOUA ERIOPODA MICROPHYLLOUS EVERGREEN SHRUB HERBACEOUS ALLIANCE (A.1545)
  Gutierrezia sarothrae - Krascheninnikovia lanata - Atriplex canescens / Bouteloua eriopoda Shrub Herbaceous Vegetation (CEGL001733)
- BOUTELOUA GRACILIS HERBACEOUS ALLIANCE (A.1282)
  Bouteloua gracilis - Bouteloua curtipendula Herbaceous Vegetation (CEGL001754)
  Bouteloua gracilis - Bouteloua hirsuta Herbaceous Vegetation (CEGL001755)
  Bouteloua gracilis - Hesperostipa comata Herbaceous Vegetation [Provisional] (CEGL002932)
  Bouteloua gracilis - Pleuraphis jamesii Herbaceous Vegetation (CEGL001759)
  Bouteloua gracilis Herbaceous Vegetation (CEGL001760)

- BOUTELOUA HIRSUTA HERBACEOUS ALLIANCE (A.1285)
  Bouteloua hirsuta - Bouteloua radicosa Herbaceous Vegetation (CEGL001765)
- BROMUS INERMIS SEMI-NATURAL HERBACEOUS ALLIANCE (A.3561)
  Bromus inermis - (Pascopyrum smithii) Semi-natural Herbaceous Vegetation (CEGL005264)
- BROMUS TECTORUM SEMI-NATURAL HERBACEOUS ALLIANCE (A.1814)
  Bromus tectorum Semi-natural Herbaceous Vegetation [Placeholder] (CEGL003019)
- ERICAMERIA NAUSEOSA SHRUB SHORT HERBACEOUS ALLIANCE (A.1546)
  Ericameria nauseosa / Bouteloua gracilis Shrub Herbaceous Vegetation (CEGL003495)
- HESPEROSTIPA COMATA BUNCH HERBACEOUS ALLIANCE (A.1270)
  Hesperostipa comata - (Bouteloua eriopoda, Pleuraphis jamesii) Herbaceous Vegetation (CEGL002997)
  Hesperostipa comata - Achnatherum hymenoides Herbaceous Vegetation (CEGL001703)
  Hesperostipa comata Great Basin Herbaceous Vegetation (CEGL001705)
- HESPEROSTIPA NEOMEXICANA HERBACEOUS ALLIANCE (A.1272)
  Hesperostipa neomexicana Herbaceous Vegetation (CEGL001708)
- MUHLENBERGIA ASPERIFOLIA INTERMITTENTLY FLOODED HERBACEOUS ALLIANCE (A.1334)
  Muhlenbergia asperifolia Herbaceous Vegetation (CEGL001779)
- MUHLENBERGIA MONTANA HERBACEOUS ALLIANCE (A.1260)
  Muhlenbergia (pungens, montana) - Heterotheca villosa Herbaceous Vegetation (CEGL002938)
- PLEURAPHIS JAMESII HERBACEOUS ALLIANCE (A.1287)
  Pleuraphis jamesii Herbaceous Vegetation (CEGL001777)
- PLEURAPHIS JAMESII SHRUB HERBACEOUS ALLIANCE (A.1532)
  Atriplex obovata / Pleuraphis jamesii - Sporobolus airoides Shrub Herbaceous Vegetation (CEGL001775)
- PLEURAPHIS RIGIDA HERBACEOUS ALLIANCE (A.1246)
  Pleuraphis rigida Herbaceous Vegetation [Placeholder] (CEGL003051)
- PLEURAPHIS RIGIDA SHRUB HERBACEOUS ALLIANCE (A.1539)
  Pleuraphis rigida Shrub Herbaceous Vegetation [Placeholder] (CEGL003052)
- POA FENDLERIANA HERBACEOUS ALLIANCE (A.1263)
  Poa fendleriana ssp. fendleriana Herbaceous Vegetation (CEGL001655)
- POA SECUNDA HERBACEOUS ALLIANCE (A.1291)
  Aristida purpurea var. longiseta - Poa secunda Herbaceous Vegetation (CEGL001781)
- POA SECUNDA SEASONALLY FLOODED HERBACEOUS ALLIANCE (A.1410)
  Poa secunda - Muhlenbergia richardsonis Herbaceous Vegetation (CEGL002755)
  Poa secunda Herbaceous Vegetation (CEGL001657)
- PSEUDOROEGNERIA SPICATA HERBACEOUS ALLIANCE (A.1265)
  Pseudoroegneria spicata - Achnatherum hymenoides Herbaceous Vegetation (CEGL001674)
  Pseudoroegneria spicata ssp. inermis Herbaceous Vegetation (CEGL001661)
- SPOROBOLUS AIROIDES HERBACEOUS ALLIANCE (A.1267)
  Sporobolus airoides Monotype Herbaceous Vegetation (CEGL001688)
- SPOROBOLUS AIROIDES SOD HERBACEOUS ALLIANCE (A.1241)
  Sporobolus airoides - Bouteloua gracilis Herbaceous Vegetation (CEGL001686)
  Sporobolus airoides Sod Herbaceous Vegetation [Placeholder] (CEGL001791)
- SPOROBOLUS CRYPTANDRUS HERBACEOUS ALLIANCE (A.1252)
  Aristida purpurea var. longiseta - Pseudoroegneria spicata - Sporobolus cryptandrus Herbaceous Vegetation (CEGL001589)
  Aristida purpurea var. longiseta - Sporobolus cryptandrus Herbaceous Vegetation (CEGL001515)
  Sporobolus cryptandrus - Poa secunda Herbaceous Vegetation (CEGL001516)
  Sporobolus cryptandrus Great Basin Herbaceous Vegetation (CEGL002691)
- SPOROBOLUS CRYPTANDRUS SHRUB HERBACEOUS ALLIANCE (A.1525)
  Sporobolus cryptandrus Shrub Herbaceous Vegetation (CEGL001514)
- THINOPYRUM INTERMEDIUM SEMI-NATURAL HERBACEOUS ALLIANCE (A.2529)
  Thinopyrum intermedium Semi-natural Herbaceous Vegetation (CEGL002935)

- **California community types:**
- Needle-and-thread (41.130.00)
- Great Basin Grassland (41.300.00)
- Little Galleta Grassland (41.610.00)
- Little Galleta - California Buckwheat (41.610.01)
- Little Galleta - Anderson's Wolfberry (41.610.02)
- Little Galleta - Nevada Ephedra (41.610.03)

Environment: Low-elevation grasslands in the Intermountain West region occur in semi-arid to arid climates at approximately 1450 to 2320 m (4750-7610 feet) in elevation. Grasslands within this system are typically characterized by a sparse to moderately dense herbaceous layer dominated by medium-tall and short bunch grasses, often in a sod-forming growth. These grasslands occur in lowland and upland areas and may occupy swales, playas,

mesa tops, plateau parks, alluvial flats, and plains. These grasslands typically occur on xeric sites. This system experiences cold temperate conditions. Hot summers and cold winters with freezing temperatures and snow are common. Annual precipitation is usually from 20-40 cm (7.9-15.7 inches). A significant portion of the precipitation falls in July through October during the summer monsoon storms, with the rest falling as snow during the winter and early spring months.

These grasslands occur on a variety of aspects and slopes. Sites may range from flat to moderately steep. Soils supporting this system also vary from deep to shallow, and from sandy to finer-textured. The substrate is typically sand- or shale-derived. Some sandy soil occurrences have a high cover of cryptogams on the soil. These cryptogamic species would tend to increase the stability of the highly erodible sandy soils of these grasslands during torrential summer rains and heavy wind storms (Kleiner and Harper 1977). *Muhlenbergia*-dominated grasslands which flood temporarily, combined with high evaporation rates in this dry system, can have accumulations of soluble salts in the soil. Soil salinity depends on the amount and timing of precipitation and flooding.

Dynamics: This system is maintained by frequent fires and sometimes associated with specific soils, often well-drained clay soils. A combination of precipitation, temperature, and soils limits this system to the lower elevations within the region. The dominant perennial bunch grasses and shrubs within this system are all very drought-resistant plants. Grasses that dominate semi-arid grasslands develop a dense network of roots concentrated in the upper parts of the soil where rainfall penetrates most frequently (Blydenstein 1966, Cable 1969, Sala and Lauenroth 1985, as cited by McClaran and Van Devender 1995). *Bouteloua gracilis* is also very grazing-tolerant and generally forms a short sod. *Pleuraphis jamesii* 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). *Achnatherum hymenoides* is one of the most drought-tolerant grasses in the western U.S. (USDA 1937). It is also a valuable forage grass in arid and semi-arid regions. Improperly managed livestock grazing could increase soil erosion, decrease cover of this palatable plant species and increase weedy species (USDA 1937). *Muhlenbergia asperifolia* with its 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. As the saturated soils dry, the salt concentrates until it precipitates out on the soil surface (Dodd and Coupland 1966, Ungar 1968). *Hesperostipa comata* is a deep-rooted grass that uses soil moisture below 0.5 m during the dry summers.

SOURCES

References: Cable 1967, Cable 1969, Cable 1975, Dodd and Coupland 1966, Kleiner and Harper 1977, Mast et al. 1997, Mast et al. 1998, McClaran and Van Devender 1995, Tuhy et al. 2002, Ungar 1968, Weaver and Albertson 1956, West 1983

Last updated: 20 Feb 2003 **Stakeholders:** WCS

Concept Author: NatureServe Western Ecology Team **LeadResp:** WCS

S109 CHIHUAHUAN-SONORAN DESERT BOTTOMLAND AND SWALE GRASSLAND

Division 302, Mixed Upland and Wetland, CES302.746

Spatial Scale & Pattern: Small Patch **Classification Confidence:** medium

Required Classifiers: Natural/Semi-natural, Vegetated (>10% vasc.), Upland, Wetland

Diagnostic Classifiers: Lowland [Lowland], Herbaceous, Swale, Toeslope/Valley Bottom, Depressional

Non-Diagnostic Classifiers: Mesa, Plain, Tropical/Subtropical [Tropical Xeric], Temperate [Temperate Continental], Temperate [Temperate Xeric], Clay Subsoil Texture, Intermittent Flooding [Intermittent interval, Summer Flooding]

Concept Summary: This ecological system occurs throughout the northern Chihuahuan Desert and adjacent Sky Islands and Sonoran Desert, as well as limited areas of the southern Great Plains and Edwards Plateau in relatively small depressions on broad mesas and plains, and valley bottoms that receive runoff from adjacent areas. Water generally infiltrates off relatively quickly. These depressions have deep, fine-textured soils that are neutral to slightly saline/alkaline. Vegetation is typically dominated by *Pleuraphis mutica* (tobosa swales) or other mesic graminoids such as *Pascopyrum smithii, Panicum obtusum, Sporobolus airoides*, or *Sporobolus wrightii*. With tobosa swales, sand-adapted species such as *Yucca elata* may grow at the swale's edge in the deep sandy alluvium

that is deposited there from upland slopes. *Sporobolus airoides* and *Sporobolus wrightii* are more common in alkaline soils.

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DISTRIBUTION

Range: Northern Chihuahuan Desert and adjacent Sky Islands and Sonoran Desert, as well as limited areas of the southern Great Plains and Edwards Plateau.
Ecological Divisions: 302, 303
TNC Ecoregions: 22:C, 23:C, 24:C, 28:C, 29:C
Subnations/Nations: AZ:c, MXCH:c, MXSO:p, NM:c, TX:c

CONCEPT

Alliances and Associations:

- PANICUM OBTUSUM HERBACEOUS ALLIANCE (A.1238)
  Panicum obtusum - Helianthus ciliaris Herbaceous Vegetation (CEGL001574)
  Panicum obtusum - Panicum hirsutum Herbaceous Vegetation (CEGL001576)
- PLEURAPHIS MUTICA HERBACEOUS ALLIANCE (A.1249)
  Pleuraphis mutica - Bouteloua gracilis Herbaceous Vegetation (CEGL001638)
  Pleuraphis mutica - Buchloe dactyloides Herbaceous Vegetation (CEGL002272)
  Pleuraphis mutica - Scleropogon brevifolius Herbaceous Vegetation (CEGL001640)
  Pleuraphis mutica Monotype Herbaceous Vegetation (CEGL001637)
- PLEURAPHIS MUTICA INTERMITTENTLY FLOODED HERBACEOUS ALLIANCE (A.1330)
  Pleuraphis mutica - Panicum obtusum Herbaceous Vegetation (CEGL001639)
- SPOROBOLUS AIROIDES HERBACEOUS ALLIANCE (A.1267)
  Sporobolus airoides - Scleropogon brevifolius Herbaceous Vegetation (CEGL001692)
  Sporobolus airoides Monotype Herbaceous Vegetation (CEGL001688)
  Sporobolus airoides Southern Plains Herbaceous Vegetation (CEGL001685)
- SPOROBOLUS AIROIDES INTERMITTENTLY FLOODED HERBACEOUS ALLIANCE (A.1331)
  Sporobolus airoides - Distichlis spicata Herbaceous Vegetation (CEGL001687)
- SPOROBOLUS AIROIDES SOD HERBACEOUS ALLIANCE (A.1241)
  Sporobolus airoides Sod Herbaceous Vegetation [Placeholder] (CEGL001791)
- SPOROBOLUS WRIGHTII HERBACEOUS ALLIANCE (A.1205)
  Sporobolus wrightii - Panicum hallii Herbaceous Vegetation (CEGL001485)
  Sporobolus wrightii - Panicum obtusum Herbaceous Vegetation (CEGL001486)

SOURCES

References: Brown 1982, Dick-Peddie 1993, MacMahon and Wagner 1985, Muldavin et al. 2000b
Last updated: 20 Feb 2003 **Stakeholders:** WCS, SCS
Concept Author: NatureServe Western Ecology Team **LeadResp:** WCS

S113 CHIHUAHUAN SANDY PLAINS SEMI-DESERT GRASSLAND

Division 302, Herbaceous, CES302.736

Spatial Scale & Pattern: Large Patch **Classification Confidence:** medium
Required Classifiers: Natural/Semi-natural, Vegetated (>10% vasc.), Upland
Diagnostic Classifiers: Herbaceous, Sand Soil Texture, Graminoid

Non-Diagnostic Classifiers: Lowland [Foothill], Lowland [Lowland], Mesa, Plain, Toeslope/Valley Bottom, Tropical/Subtropical [Tropical Xeric], Temperate [Temperate Continental], Temperate [Temperate Xeric], Aridic, Xeromorphic Shrub, Succulent Shrub

Concept Summary: This ecological system occurs across the Chihuahuan Desert and extends into the southern Great Plains where soils have a high sand content. These dry grasslands or steppe are found on sandy plains and sandstone mesas. The graminoid layer is dominated or codominated by *Achnatherum hymenoides, Bouteloua eriopoda, Bouteloua hirsuta, Hesperostipa neomexicana, Pleuraphis jamesii, Sporobolus cryptandrus,* Sporobolus airoides or *Sporobolus flexuosus*. Typically, there are found scattered desert shrubs and stem succulents such as *Ephedra torreyana, Ephedra trifurca, Fallugia paradoxa, Prosopis glandulosa,Yucca elata,* and *Yucca torreyi* that are characteristic of the Chihuahuan Desert.

DISTRIBUTION

Range: Chihuahuan Desert extending into the southern Great Plains where soils have a high sand content.
Ecological Divisions: 302
TNC Ecoregions: 22:C, 24:C, 28:C
Subnations/Nations: AZ:c, MXCH:c, NM:c, TX:c

CONCEPT

Alliances and Associations:

- BOUTELOUA ERIOPODA XEROMORPHIC SHRUB HERBACEOUS ALLIANCE (A.1553)
  Ephedra torreyana / Bouteloua eriopoda Shrub Herbaceous Vegetation (CEGL001731)
  Ephedra trifurca / Bouteloua eriopoda Shrub Herbaceous Vegetation (CEGL001732)
  Yucca elata / Bouteloua eriopoda Shrub Herbaceous Vegetation (CEGL001735)
- SPOROBOLUS FLEXUOSUS HERBACEOUS ALLIANCE (A.1268)
  Sporobolus flexuosus - Paspalum setaceum Herbaceous Vegetation (CEGL001694)
  Sporobolus flexuosus - Sporobolus contractus Herbaceous Vegetation (CEGL001696)

SOURCES

References: Dick-Peddie 1993, Muldavin et al. 2000b, Muldavin et al. 2002
Last updated: 20 Feb 2003 **Stakeholders:** WCS, SCS, LACD
Concept Author: NatureServe Western Ecology Team **LeadResp:** WCS

S115 MADREAN JUNIPER SAVANNA

Division 301, Steppe/Savanna, CES301.730

Spatial Scale & Pattern: Large Patch **Classification Confidence:** medium
Required Classifiers: Natural/Semi-natural, Vegetated (>10% vasc.), Upland
Diagnostic Classifiers: Montane [Lower Montane], Woody-Herbaceous, Tropical/Subtropical [Tropical Xeric], Evergreen Sclerophyllous Tree, Succulent Shrub, Juniperus coahuilensis, J. deppeana, J. pinchotii

Non-Diagnostic Classifiers: Alluvial flat, Alluvial plain, Alluvial terrace, Sideslope, Toeslope/Valley Bottom, Sand Soil Texture, F-Patch/Low Intensity, Graminoid

Concept Summary: This Madrean ecological system occurs in lower foothills and plains of southeastern Arizona, southern New Mexico extending into west Texas and Mexico. These savannas have widely spaced mature juniper trees and moderate to high cover of graminoids (>25% cover). The presence of Madrean *Juniperus* spp. such as *Juniperus coahuilensis*, *Juniperus pinchotii*, and/or *Juniperus deppeana* is diagnostic. *Juniperus monosperma* may be present in some stands and *Juniperus deppeana* has a broader range than this Madrean system and extends north of into southern stands of the Southern Rocky Mountain Juniper Woodland and Savanna (CES306.834). Stands of *Juniperus pinchotii* may be short and resemble a shrubland. Graminoid species are a mix of those found in Western Great Plains Shortgrass Prairie (CES303.672) and Apachierian - Chihuahuan Piedmont Semi-Desert Grassland and Steppe (CES302.735), with *Bouteloua gracilis* and *Pleuraphis jamesii* being most common. In addition, these areas include succulents such as species of *Yucca*, *Opuntia*, and *Agave*. Juniper savanna expansion into grasslands has been documented in the last century.

DISTRIBUTION

Range: Southeastern Arizona, southern New Mexico extending into west Texas and Mexico.
Ecological Divisions: 301
TNC Ecoregions: 22:C, 24:C, 30:P
Subnations/Nations: AZ:c, NM:c, nMX:c, TX:c

CONCEPT

Alliances and Associations:

- JUNIPERUS DEPPEANA WOODLAND ALLIANCE (A.534)
  Juniperus deppeana / Bouteloua gracilis Woodland (CEGL000693)
  Juniperus deppeana / Bouteloua hirsuta Woodland (CEGL000694)
  Juniperus deppeana / Muhlenbergia emersleyi Woodland (CEGL000697)
  Juniperus deppeana / Panicum obtusum Woodland (CEGL000698)
  Juniperus deppeana / Schizachyrium cirratum Woodland (CEGL000699)

- JUNIPERUS MONOSPERMA WOODLAND ALLIANCE (A.504)
  Juniperus monosperma / Bouteloua eriopoda Woodland (CEGL000709)
- QUERCUS MOHRIANA SHRUBLAND ALLIANCE (A.782)
  Quercus mohriana - Juniperus pinchotii / Bouteloua curtipendula Shrubland (CEGL002173)

SOURCES

References: Barbour and Billings 2000, Brown et al. 1979, Brown et al. 1998, Dick-Peddie 1993
Last updated: 20 Feb 2003 **Stakeholders:** WCS, SCS
Concept Author: NatureServe Western Ecology Team **LeadResp:** WCS

S132 WESTERN GREAT PLAINS TALLGRASS PRAIRIE

Division 303, Herbaceous, CES303.673

Spatial Scale & Pattern: Small Patch **Classification Confidence:** high
Required Classifiers: Natural/Semi-natural, Vegetated (>10% vasc.), Upland
Non-Diagnostic Classifiers: Herbaceous, Deep Soil, Loam Soil Texture, Ustic, F-Patch/Low Intensity, G-Patch/Medium Intensity

Concept Summary: This system can be found throughout the Western Great Plains Division. It is found primarily in areas where soil characteristics allow for mesic conditions more typical of the Eastern Great Plains Division and thus are able to sustain tallgrass species. This system may be small patches interspersed within Northwestern Great Plains Mixedgrass Prairie (CES303.674) or Western Great Plains Shortgrass Prairie (CES303.672) and may also be associated with upland terraces above a floodplain system where these more mesic conditions persist. Soils are primarily loamy Mollisols that are moderately deep and rich. Those areas that contain more sandy soils should be considered part of Western Great Plains Sand Prairie (CES303.670). This system is dominated primarily by *Andropogon gerardii* and may also include *Sorghastrum nutans, Schizachyrium scoparium, Pascopyrum smithii, Hesperostipa spartea*, and *Sporobolus heterolepis*. *Andropogon gerardii* often dominates the lowland regions, although *Pascopyrum smithii* can be prolific if conditions are favorable. Forbs in varying density may also be present. The primary dynamics for this system include fire, climate and grazing. Fire suppression in these areas has allowed for the invasion of woody species such as *Juniperus virginiana* and *Prunus* spp. Grazing also has contributed to these changes and likewise led to a decrease of this system as overgrazing favors shortgrass and mixedgrass systems. Conversion to agriculture likewise has probably decreased the range of this system. Thus, this system likely only occurs in small patches and in scattered locations throughout the division. Large-patch occurrences are mostly isolated to slopes and swales of rolling uplands where either grazing or cultivation are more problematic.

DISTRIBUTION

Range: This system occurs throughout the Western Great Plains Division, however, grazing and conversion to agriculture have likely decreased its natural range.
Ecological Divisions: 303
TNC Ecoregions: 26:C, 27:C, 28:?, 33:C, 34:C
Subnations/Nations: CO:p, KS:c, MT:p, ND:c, NE:c, OK:c, TX:?

CONCEPT

Alliances and Associations:

- ANDROPOGON GERARDII - (SORGHASTRUM NUTANS) HERBACEOUS ALLIANCE (A.1192)
  Andropogon gerardii - Panicum virgatum - Schizachyrium scoparium - (Tradescantia tharpii) Herbaceous Vegetation (CEGL005231)
  Andropogon gerardii - Schizachyrium scoparium Northern Plains Herbaceous Vegetation (CEGL002205)
  Andropogon gerardii - Schizachyrium scoparium Western Great Plains Herbaceous Vegetation (CEGL001463)
  Andropogon gerardii - Sorghastrum nutans Western Great Plains Herbaceous Vegetation (CEGL001464)
  Andropogon gerardii - Sporobolus heterolepis - Schizachyrium scoparium - Pascopyrum smithii Herbaceous Vegetation (CEGL002376)
  Andropogon gerardii - Sporobolus heterolepis Western Foothills Herbaceous Vegetation (CEGL001465)
- CORNUS DRUMMONDII SHRUBLAND ALLIANCE (A.3558)
  Cornus drummondii - (Rhus glabra, Prunus spp.) Shrubland (CEGL005219)
- QUERCUS FUSIFORMIS WOODLAND ALLIANCE (A.477)
  Quercus fusiformis - (Quercus stellata) / Schizachyrium scoparium Granite Woodland (CEGL004937)

- SPARTINA PECTINATA TEMPORARILY FLOODED HERBACEOUS ALLIANCE (A.1347)
  Spartina pectinata Western Herbaceous Vegetation (CEGL001476)

Environment: This system is found primarily on loam, moderately deep, and rich Mollisols throughout the Western Great Plains Division. These soils tend to be more mesic and deep than the majority of soils within the Western Great Plains and are more typical of the Eastern Great Plains Division.

Vegetation: The mesic, deep soils allow for dominance by *Andropogon gerardii*. Other species such as *Sorghastrum nutans*, *Schizachyrium scoparium*, *Pascopyrum smithii*, *Hesperostipa spartea*, and *Sporobolus heterolepis* can also be present. In more lowland areas, *Pascopyrum smithii* can become more prevalent. Fire suppression can lead to the invasion of these areas by woody species such as *Juniperus virginiana* and *Prunus* spp.

Dynamics: Fire, climate and grazing constitute the primary dynamic processes impacting this system. Fire suppression can allow for the invasion of woody species such as *Juniperus virginiana* and *Prunus* spp. into the prairie matrix. Overgrazing tends to favor shortgrass and mixedgrass species and can cause the conversion of this system to the Western Great Plains shortgrass or mixedgrass systems. Also, invasion by introduced species such as *Bromus inermis* can become more severe as grazing pressure increases. Likewise, conversion to agriculture has degraded or extirpated many examples of this system.

SOURCES

References: Barbour and Billings 1988, Weaver 1954
Last updated: 05 Mar 2003 **Stakeholders:** MCS, WCS
Concept Author: S. Menard and K. Kindscher **LeadResp:** MCS

S134 NORTH PACIFIC MONTANE GRASSLAND
Division 204, Herbaceous, CES204.100

Spatial Scale & Pattern: Large Patch
Required Classifiers: Natural/Semi-natural, Vegetated (>10% vasc.), Upland
Diagnostic Classifiers: Herbaceous, Temperate [Temperate Oceanic], Mesotrophic Soil, Shallow Soil, Intermediate Disturbance Interval, F-Patch/Low Intensity

Non-Diagnostic Classifiers: Montane [Upper Montane], Montane [Montane], Ustic

Concept Summary: This system includes open dry meadows and grasslands on the west side of the Cascades Mountains and northern Sierra Nevada. They occur in montane elevations up to 3500 m (10,600 feet). Soils tend to be deeper and more well-drained than the surrounding forest soils. Soils can resemble prairie soils in that the A-horizon is dark brown, relatively high in organic matter, slightly acid, and usually well-drained. Dominant species include *Elymus* spp., *Festuca idahoensis*, and *Nassella cernua*. These large-patch grasslands are intermixed with matrix stands of red fir, lodgepole pine, and dry-mesic mixed conifer forests and woodlands.

DISTRIBUTION

Range: West side of the Cascades Mountains and northern Sierra Nevada, in montane elevations up to 3500 m (10,600 feet).
Ecological Divisions: 204, 206
TNC Ecoregions: 12:C, 5:P, 81:C
Subnations/Nations: CA:c, NV:c, OR:c, WA:?

CONCEPT

- **California community types:**
- Nodding Needlegrass (41.140.00)
- Dry Montane Meadow (45.310.13)

SOURCES

References: Barbour and Major 1988, Holland and Keil 1995, Sawyer and Keeler-Wolf 1995
Last updated: 24 Mar 2003 **Stakeholders:** WCS
Concept Author: P. Comer, G. Kittel **LeadResp:** WCS

NLCD Woody Wetland Types

Areas where forest or shrubland vegetation accounts for greater than 20 percent of vegetative cover and the soil or substrate is periodically saturated with or covered with water.

S091 ROCKY MOUNTAIN SUBALPINE-MONTANE RIPARIAN SHRUBLAND

Division 306, Woody Wetland, CES306.832

Spatial Scale & Pattern: Linear **Classification Confidence:** medium

Required Classifiers: Natural/Semi-natural, Vegetated (>10% vasc.), Wetland

Diagnostic Classifiers: Montane [Upper Montane], Montane [Montane], Shrubland (Shrub-dominated), Broad-Leaved Deciduous Shrub, RM Subalpine/Montane Riparian Woodland, Short (50-100 yrs) Persistence, Riverine / Alluvial, Short (<5 yrs) Flooding Interval

Non-Diagnostic Classifiers: Montane [Lower Montane], Alluvial terrace, Drainage bottom (undifferentiated), Erosional stream terrace, Floodplain, Stream terrace (undifferentiated), Valley bottom, Temperate [Temperate Continental], Mineral: W/ A-Horizon <10 cm, Circumneutral Water

Concept Summary: This system is found throughout the Rocky Mountain cordillera from New Mexico north into Montana, and also occurs in mountainous areas of the Intermountain region and Colorado Plateau. These are montane to subalpine riparian shrublands occurring as narrow bands of shrubs lining streambanks and alluvial terraces in narrow to wide, low-gradient valley bottoms and floodplains with sinuous stream channels. Generally it is found at higher elevations, but can be found anywhere from 1700-3475 m. Occurrences can also be found around seeps, fens, and isolated springs on hillslopes away from valley bottoms. Many of the plant associations found within this system are associated with beaver activity. This system often occurs as a mosaic of multiple communities that are shrub- and herb-dominated and includes above-treeline, willow-dominated, snowmelt-fed basins that feed into streams. The dominant shrubs reflect the large elevational gradient and include *Alnus incana, Betula nana, Betula occidentalis, Cornus sericea, Salix bebbiana, Salix boothii, Salix brachycarpa, Salix drummondiana, Salix eriocephala, Salix geyeriana, Salix monticola, Salix planifolia*, and *Salix wolfii*. Generally the upland vegetation surrounding these riparian systems are of either conifer or aspen forests.

DISTRIBUTION

Range: Found throughout the Rocky Mountain cordillera from New Mexico north into Montana, and also occurs in mountainous areas of the Intermountain region and Colorado Plateau.

Ecological Divisions: 304, 306

TNC Ecoregions: 11:C, 18:C, 19:C, 20:C, 21:C, 25:C, 6:P, 68:C, 7:C, 8:C, 9:C

Subnations/Nations: AB:c, AZ:c, BC:c, CO:c, ID:c, MT:c, NM:c, NV:c, OR:c, SD:c, UT:c, WA:c, WY:c

CONCEPT

Alliances and Associations:

- ACER GLABRUM TEMPORARILY FLOODED SHRUBLAND ALLIANCE (A.952)
  Acer glabrum Drainage Bottom Shrubland (CEGL001062)
- ALNUS INCANA SEASONALLY FLOODED SHRUBLAND ALLIANCE (A.986)
  Alnus incana - Salix (monticola, lucida, ligulifolia) Shrubland (CEGL002651)
  Alnus incana / Athyrium filix-femina Shrubland (CEGL002628)
  Alnus incana / Carex scopulorum var. prionophylla Shrubland (CEGL000122)
  Alnus incana / Equisetum arvense Shrubland (CEGL001146)
  Alnus incana / Glyceria striata Shrubland (CEGL000228)
  Alnus incana / Lysichiton americanus Shrubland (CEGL002629)
  Alnus incana / Scirpus microcarpus Shrubland (CEGL000481)
  Alnus incana / Spiraea douglasii Shrubland (CEGL001152)
- ALNUS INCANA TEMPORARILY FLOODED SHRUBLAND ALLIANCE (A.950)
  Alnus incana - Betula occidentalis Shrubland (CEGL001142)
  Alnus incana - Salix drummondiana Shrubland (CEGL002652)
  Alnus incana / Calamagrostis canadensis Shrubland (CEGL001143)
  Alnus incana / Carex (aquatilis, deweyana, lenticularis, luzulina, pellita) Shrubland (CEGL001144)
  Alnus incana / Cornus sericea Shrubland (CEGL001145)
  Alnus incana / Mesic Forbs Shrubland (CEGL001147)
  Alnus incana / Mesic Graminoids Shrubland (CEGL001148)
  Alnus incana / Ribes (inerme, hudsonianum, lacustre) Shrubland (CEGL001151)

Alnus incana / Symphoricarpos albus Shrubland (CEGL001153)
Alnus incana Shrubland (CEGL001141)
Alnus incana ssp. tenuifolia - Salix irrorata Shrubland (CEGL002687)

- ALNUS OBLONGIFOLIA TEMPORARILY FLOODED SHRUBLAND ALLIANCE (A.953)
  Alnus oblongifolia / Symphoricarpos oreophilus Shrubland (CEGL001063)
- ALNUS VIRIDIS SSP. SINUATA TEMPORARILY FLOODED SHRUBLAND ALLIANCE (A.966)
  Alnus viridis ssp. sinuata / Athyrium filix-femina - Cinna latifolia Shrubland (CEGL001156)
  Alnus viridis ssp. sinuata Shrubland [Placeholder] (CEGL001154)
- BETULA NANA SEASONALLY FLOODED SHRUBLAND ALLIANCE (A.995)
  Betula nana / Mesic Forbs - Mesic Graminoids Shrubland (CEGL002653)
- BETULA OCCIDENTALIS SEASONALLY FLOODED SHRUBLAND ALLIANCE (A.996)
  Betula occidentalis - Dasiphora fruticosa ssp. floribunda Shrubland (CEGL001083)
  Betula occidentalis / Mesic Graminoids Shrubland (CEGL002654)
  Betula occidentalis Shrubland (CEGL001080)
- BETULA OCCIDENTALIS TEMPORARILY FLOODED SHRUBLAND ALLIANCE (A.967)
  Betula occidentalis / Cornus sericea Shrubland (CEGL001161)
  Betula occidentalis / Maianthemum stellatum Shrubland (CEGL001162)
- CORNUS SERICEA TEMPORARILY FLOODED SHRUBLAND ALLIANCE (A.968)
  Cornus sericea / Galium triflorum Shrubland (CEGL001166)
  Cornus sericea / Heracleum maximum Shrubland (CEGL001167)
  Cornus sericea Shrubland (CEGL001165)
- CORYLUS CORNUTA TEMPORARILY FLOODED SHRUBLAND ALLIANCE (A.2596)
  Corylus cornuta Shrubland [Provisional] (CEGL002903)
- DASIPHORA FRUTICOSA TEMPORARILY FLOODED SHRUBLAND ALLIANCE (A.958)
  Dasiphora fruticosa ssp. floribunda / Deschampsia caespitosa Shrubland (CEGL001107)
- FRAXINUS ANOMALA TEMPORARILY FLOODED WOODLAND ALLIANCE (A.2511)
  Fraxinus anomala Woodland (CEGL002752)
- RIBES LACUSTRE TEMPORARILY FLOODED SHRUBLAND ALLIANCE (A.970)
  Ribes lacustre - Ribes hudsonianum / Cinna latifolia Shrubland (CEGL003445)
  Ribes lacustre - Ribes hudsonianum / Glyceria striata Shrubland (CEGL003446)
  Ribes lacustre / Mertensia ciliata Shrubland (CEGL001172)
- SALIX BEBBIANA TEMPORARILY FLOODED SHRUBLAND ALLIANCE (A.971)
  Salix bebbiana / Mesic Graminoids Shrubland (CEGL001174)
  Salix bebbiana Shrubland (CEGL001173)
- SALIX BOOTHII SEASONALLY FLOODED SHRUBLAND ALLIANCE (A.1001)
  Salix (boothii, geyeriana) / Carex aquatilis Shrubland (CEGL001176)
  Salix boothii / Calamagrostis canadensis Shrubland (CEGL001175)
  Salix boothii / Carex nebrascensis Shrubland (CEGL001177)
  Salix boothii / Equisetum arvense Shrubland (CEGL002671)
- SALIX BOOTHII TEMPORARILY FLOODED SHRUBLAND ALLIANCE (A.972)
  Salix boothii - Salix eastwoodiae / Carex nigricans Shrubland (CEGL002607)
  Salix boothii - Salix geyeriana / Carex angustata Shrubland (CEGL001185)
  Salix boothii - Salix geyeriana Shrubland (CEGL001184)
  Salix boothii - Salix lemmonii Shrubland (CEGL001186)
  Salix boothii / Carex utriculata Shrubland (CEGL001178)
  Salix boothii / Deschampsia caespitosa - Geum rossii Shrubland (CEGL002904)
  Salix boothii / Maianthemum stellatum Shrubland (CEGL001187)
  Salix boothii / Mesic Forbs Shrubland (CEGL001180)
  Salix boothii / Mesic Graminoids Shrubland (CEGL001181)
  Salix boothii / Poa palustris Shrubland (CEGL001183)
- SALIX BRACHYCARPA SEASONALLY FLOODED SHRUBLAND ALLIANCE (A.998)
  Salix brachycarpa / Carex aquatilis Shrubland (CEGL001244)
  Salix brachycarpa / Mesic Forbs Shrubland (CEGL001135)
- SALIX CANDIDA SEASONALLY FLOODED SHRUBLAND ALLIANCE (A.1002)
  Salix candida / Carex utriculata Shrubland (CEGL001188)
- SALIX COMMUTATA SEASONALLY FLOODED SHRUBLAND ALLIANCE (A.1003)
  Salix commutata / Carex scopulorum Shrubland (CEGL001189)
- SALIX DRUMMONDIANA SEASONALLY FLOODED SHRUBLAND ALLIANCE (A.1004)
  Salix drummondiana / Carex scopulorum var. prionophylla Shrubland (CEGL001584)
  Salix drummondiana / Carex utriculata Shrubland (CEGL002631)
- SALIX DRUMMONDIANA TEMPORARILY FLOODED SHRUBLAND ALLIANCE (A.973)
  Salix drummondiana / Calamagrostis canadensis Shrubland (CEGL002667)

Salix drummondiana / Mesic Forbs Shrubland (CEGL001192)
Salix drummondiana Shrubland [Placeholder] (CEGL001190)

- SALIX ERIOCEPHALA TEMPORARILY FLOODED SHRUBLAND ALLIANCE (A.974)
  Salix eriocephala / Ribes aureum - Rosa woodsii Shrubland (CEGL001233)
- SALIX GEYERIANA SEASONALLY FLOODED SHRUBLAND ALLIANCE (A.1006)
  Salix geyeriana / Calamagrostis canadensis Shrubland (CEGL001205)
  Salix geyeriana / Carex aquatilis Shrubland (CEGL001206)
  Salix geyeriana / Carex utriculata Shrubland (CEGL001207)
- SALIX GEYERIANA TEMPORARILY FLOODED SHRUBLAND ALLIANCE (A.975)
  Salix geyeriana - Salix eriocephala Shrubland (CEGL001213)
  Salix geyeriana - Salix lemmonii / Carex aquatilis var. dives Shrubland (CEGL001212)
  Salix geyeriana - Salix monticola / Calamagrostis canadensis Shrubland (CEGL001247)
  Salix geyeriana - Salix monticola / Mesic Forbs Shrubland (CEGL001223)
  Salix geyeriana / Deschampsia caespitosa Shrubland (CEGL001208)
  Salix geyeriana / Mesic Forbs Shrubland (CEGL002666)
  Salix geyeriana / Mesic Graminoids Shrubland (CEGL001210)
  Salix geyeriana / Poa palustris Shrubland (CEGL001211)
- SALIX GLAUCA TEMPORARILY FLOODED SHRUBLAND ALLIANCE (A.963)
  Salix glauca / Deschampsia caespitosa Shrubland (CEGL001137)
- SALIX LEMMONII SEASONALLY FLOODED SHRUBLAND ALLIANCE (A.2523)
  Salix lemmonii / Mesic-Tall Forbs Shrubland (CEGL002771)
  Salix lemmonii / Rosa woodsii Shrubland (CEGL002772)
- SALIX LIGULIFOLIA TEMPORARILY FLOODED SHRUBLAND ALLIANCE (A.978)
  Salix ligulifolia / Carex utriculata Shrubland [Provisional] (CEGL002975)
  Salix ligulifolia Shrubland (CEGL001218)
- SALIX LUCIDA TEMPORARILY FLOODED SHRUBLAND ALLIANCE (A.979)
  Salix lucida ssp. caudata / Rosa woodsii Shrubland (CEGL002621)
  Salix lucida ssp. caudata Shrubland [Provisional] (CEGL001215)
- SALIX LUTEA SEASONALLY FLOODED SHRUBLAND ALLIANCE (A.1007)
  Salix lutea / Carex utriculata Shrubland (CEGL001220)
- SALIX LUTEA TEMPORARILY FLOODED SHRUBLAND ALLIANCE (A.980)
  Salix lutea / Calamagrostis canadensis Shrubland (CEGL001219)
  Salix lutea / Mesic Forbs Shrubland (CEGL002774)
  Salix lutea / Rosa woodsii Shrubland (CEGL002624)
- SALIX MONTICOLA TEMPORARILY FLOODED SHRUBLAND ALLIANCE (A.981)
  Salix monticola / Angelica ampla Shrubland (CEGL001221)
  Salix monticola / Calamagrostis canadensis Shrubland (CEGL001222)
  Salix monticola / Carex aquatilis Shrubland (CEGL002656)
  Salix monticola / Carex utriculata Shrubland (CEGL002657)
  Salix monticola / Mesic Forbs Shrubland (CEGL002658)
  Salix monticola / Mesic Graminoids Shrubland (CEGL002659)
  Salix monticola Thicket Shrubland (CEGL001139)
- SALIX PLANIFOLIA SEASONALLY FLOODED SHRUBLAND ALLIANCE (A.1008)
  Salix planifolia / Caltha leptosepala Shrubland (CEGL002665)
  Salix planifolia / Carex aquatilis Shrubland (CEGL001227)
  Salix planifolia / Carex scopulorum Shrubland (CEGL001229)
  Salix planifolia / Mesic Forbs Shrubland [Provisional] (CEGL002893)
  Salix planifolia Shrubland (CEGL001224)
- SALIX PLANIFOLIA TEMPORARILY FLOODED SHRUBLAND ALLIANCE (A.982)
  Salix planifolia / Calamagrostis canadensis Shrubland (CEGL001225)
  Salix planifolia / Deschampsia caespitosa Shrubland (CEGL001230)
- SALIX WOLFII SEASONALLY FLOODED SHRUBLAND ALLIANCE (A.1009)
  Salix wolfii / Carex aquatilis Shrubland (CEGL001234)
  Salix wolfii / Carex microptera Shrubland (CEGL001235)
  Salix wolfii / Carex nebrascensis Shrubland (CEGL001236)
  Salix wolfii / Carex utriculata Shrubland (CEGL001237)
  Salix wolfii / Swertia perennis - Pedicularis groenlandica Shrubland (CEGL001242)
- SALIX WOLFII TEMPORARILY FLOODED SHRUBLAND ALLIANCE (A.983)
  Salix wolfii / Deschampsia caespitosa Shrubland (CEGL001238)
  Salix wolfii / Fragaria virginiana Shrubland (CEGL001239)
  Salix wolfii / Mesic Forbs Shrubland (CEGL001240)
  Salix wolfii / Poa palustris Shrubland (CEGL001241)

SOURCES

References: Baker 1988, Baker 1989a, Baker 1989b, Baker 1990, Canadian Rockies Ecoregional Plan 2002, Comer et al. 2002, Crowe and Clausnitzer 1997, Kittel 1993, Kittel 1994, Kittel et al. 1996, Kittel et al. 1999a, Kittel et al. 1999b, Kovalchik 1987, Kovalchik 1993, Kovalchik 2001, Manning and Padgett 1995, Muldavin et al. 2000a, Nachlinger et al. 2001, Neely et al. 2001, Padgett 1982, Padgett et al. 1988a, Padgett et al. 1988b, Rondeau 2001, Szaro 1989, Tuhy et al. 2002, Walford 1996

Last updated: 20 Feb 2003 **Stakeholders:** WCS, MCS

Concept Author: NatureServe Western Ecology Team **LeadResp:** WCS

S092 ROCKY MOUNTAIN SUBALPINE-MONTANE RIPARIAN WOODLAND

Division 306, Woody Wetland, CES306.833

Spatial Scale & Pattern: Linear **Classification Confidence:** medium

Required Classifiers: Natural/Semi-natural, Vegetated (>10% vasc.), Wetland

Diagnostic Classifiers: Montane [Upper Montane], Montane [Montane], Forest and Woodland (Treed), RM Subalpine/Montane Riparian Shrubland, Riverine / Alluvial, Short (<5 yrs) Flooding Interval

Non-Diagnostic Classifiers: Montane [Lower Montane], Drainage bottom (undifferentiated), Floodplain, Stream terrace (undifferentiated), Valley bottom, Temperate [Temperate Continental], Needle-Leaved Tree, Broad-Leaved Deciduous Tree, Circumneutral Water

Concept Summary: This riparian woodland system is comprised of seasonally flooded forests and woodlands found at montane to subalpine elevations of the Rocky Mountain cordillera, from southern New Mexico north into Montana, and west into the Intermountain region and the Colorado Plateau. This system contains the conifer and aspen woodlands that line montane streams. These are communities tolerant of periodic flooding and high water tables. Snowmelt moisture in this system may create shallow water tables or seeps for a portion of the growing season. Stands typically occur at elevations between 1500-3300 m (4920-10,830 feet) and are confined to specific riparian environments occurring on floodplains or terraces of rivers and streams, in V-shaped, narrow valleys and canyons (where there is cold-air drainage). Less frequently, occurrences are found in moderate-wide valley bottoms on large floodplains along broad, meandering rivers, and on pond or lake margins. Dominant tree species include *Abies lasiocarpa, Picea engelmannii, Pseudotsuga menziesii, Picea pungens, Populus tremuloides,* and *Juniperus scopulorum*. Other trees that may be present include *Alnus incana, Abies concolor, Pinus contorta, Populus angustifolia, Acer negundo,* and *Juniperus osteosperma*.

DISTRIBUTION

Range: Found at montane to subalpine elevations of the Rocky Mountain cordillera, from southern New Mexico north into Montana, and west into the Intermountain region and the Colorado Plateau.

Ecological Divisions: 204, 304, 306

TNC Ecoregions: 11:C, 18:C, 19:C, 20:C, 21:C, 25:C, 4:P, 6:P, 68:C, 7:C, 8:C, 9:C

Subnations/Nations: AB:c, AZ:c, BC:c, CO:c, ID:c, MT:c, NM:c, NV:c, OR:c, SD:c, UT:c, WA:c, WY:c

CONCEPT

Alliances and Associations:

- ABIES CONCOLOR FOREST ALLIANCE (A.152)
  Abies concolor - Picea pungens - Populus angustifolia / Acer glabrum Forest (CEGL000255)
- ABIES LASIOCARPA SEASONALLY FLOODED FOREST ALLIANCE (A.190)
  Abies lasiocarpa / Alnus incana Forest (CEGL000296)
  Abies lasiocarpa / Carex aquatilis Forest (CEGL002636)
  Abies lasiocarpa / Ledum glandulosum Forest (CEGL000314)
  Abies lasiocarpa / Oplopanax horridus Forest (CEGL000322)
  Abies lasiocarpa / Salix drummondiana Forest (CEGL000327)
- ABIES LASIOCARPA TEMPORARILY FLOODED FOREST ALLIANCE (A.177)
  Abies lasiocarpa / Alnus viridis ssp. sinuata Forest (CEGL000297)
  Abies lasiocarpa / Mertensia ciliata Forest (CEGL002663)
  Abies lasiocarpa / Streptopus amplexifolius Forest (CEGL000336)
  Abies lasiocarpa / Trautvetteria caroliniensis Forest (CEGL000339)
- PICEA ENGELMANNII SEASONALLY FLOODED FOREST ALLIANCE (A.191)
  Picea (engelmannii X glauca, engelmannii) / Carex disperma Forest (CEGL000405)
  Picea engelmannii / Caltha leptosepala Forest (CEGL000357)

Picea engelmannii / Carex angustata Forest (CEGL000359)
Picea engelmannii / Carex disperma Forest (CEGL000358)
- PICEA ENGELMANNII SEASONALLY FLOODED WOODLAND ALLIANCE (A.572)
  Picea engelmannii / Carex scopulorum var. prionophylla Woodland (CEGL002630)
  Picea engelmannii / Eleocharis quinqueflora Woodland (CEGL000361)
- PICEA ENGELMANNII TEMPORARILY FLOODED FOREST ALLIANCE (A.179)
  Picea engelmannii / Heracleum maximum Forest (CEGL000367)
- PICEA ENGELMANNII TEMPORARILY FLOODED WOODLAND ALLIANCE (A.566)
  Picea engelmannii / Cornus sericea Woodland (CEGL002677)
- PICEA GLAUCA TEMPORARILY FLOODED FOREST ALLIANCE (A.172)
  Picea glauca Alluvial Black Hills Forest (CEGL002057)
- PICEA PUNGENS TEMPORARILY FLOODED WOODLAND ALLIANCE (A.567)
  Picea pungens / Alnus incana Woodland (CEGL000894)
  Picea pungens / Betula occidentalis Woodland (CEGL002637)
  Picea pungens / Cornus sericea Woodland (CEGL000388)
  Picea pungens / Dasiphora fruticosa ssp. floribunda Woodland (CEGL000396)
  Picea pungens / Equisetum arvense Woodland (CEGL000389)
  Picea pungens / Rosa woodsii Woodland (CEGL000398)
- PINUS CONTORTA SEASONALLY FLOODED FOREST ALLIANCE (A.188)
  Pinus contorta / Calamagrostis canadensis Forest (CEGL000138)
- PINUS CONTORTA TEMPORARILY FLOODED FOREST ALLIANCE (A.175)
  Pinus contorta / Deschampsia caespitosa Forest (CEGL000147)
- PINUS CONTORTA TEMPORARILY FLOODED WOODLAND ALLIANCE (A.562)
  Pinus contorta / Carex (aquatilis, angustata) Woodland (CEGL000140)
- POPULUS TREMULOIDES FOREST ALLIANCE (A.274)
  Populus tremuloides / Corylus cornuta Forest (CEGL000583)
- POPULUS TREMULOIDES SEASONALLY FLOODED FOREST ALLIANCE (A.340)
  Populus tremuloides / Calamagrostis canadensis Forest (CEGL000574)
  Populus tremuloides / Carex aquatilis var. aquatilis Forest (CEGL003442)
  Populus tremuloides / Carex obnupta Forest (CEGL003371)
  Populus tremuloides / Equisetum arvense Forest (CEGL000584)
  Populus tremuloides / Ranunculus alismifolius Forest (CEGL000599)
- POPULUS TREMULOIDES TEMPORARILY FLOODED FOREST ALLIANCE (A.300)
  Populus tremuloides / Alnus incana - Salix spp. Forest (CEGL001082)
  Populus tremuloides / Alnus incana / Betula nana - Ribes spp. Forest (CEGL001149)
  Populus tremuloides / Alnus incana Forest (CEGL001150)
  Populus tremuloides / Betula occidentalis Forest (CEGL002650)
  Populus tremuloides / Carex pellita Forest (CEGL000577)
  Populus tremuloides / Cornus sericea Forest (CEGL000582)
  Populus tremuloides / Quercus gambelii / Symphoricarpos oreophilus Forest (CEGL000598)
  Populus tremuloides / Ribes montigenum Forest (CEGL000600)
  Populus tremuloides / Salix drummondiana Forest (CEGL002902)
  Populus tremuloides / Senecio bigelovii var. bigelovii Forest (CEGL000590)
  Populus tremuloides / Veratrum californicum Forest (CEGL000621)
  Populus tremuloides Canyon Formation Forest (CEGL000576)

SOURCES

References: Baker 1988, Baker 1989a, Baker 1989b, Baker 1990, Canadian Rockies Ecoregional Plan 2002, Comer et al. 2002, Crowe and Clausnitzer 1997, Kittel 1993, Kittel et al. 1994, Kittel et al. 1995, Kittel et al. 1999a, Kittel et al. 1999b, Kovalchik 1987, Kovalchik 1993, Kovalchik 2001, Manning and Padgett 1995, Muldavin et al. 2000a, Nachlinger et al. 2001, Neely et al. 2001, Padgett 1982, Padgett et al. 1988a, Padgett et al. 1988b, Rondeau 2001, Tuhy et al. 2002

Last updated: 20 Feb 2003 **Stakeholders:** WCS, MCS

Concept Author: NatureServe Western Ecology Team **LeadResp:** WCS

S093 ROCKY MOUNTAIN LOWER MONTANE RIPARIAN WOODLAND AND SHRUBLAND

Division 306, Woody Wetland, CES306.821

Spatial Scale & Pattern: Linear **Classification Confidence:** medium

Required Classifiers: Natural/Semi-natural, Vegetated (>10% vasc.), Wetland

Diagnostic Classifiers: Montane [Lower Montane], Mineral: W/ A-Horizon <10 cm, Unconsolidated, Short (50-100 yrs) Persistence, Riverine / Alluvial, Short (<5 yrs) Flooding Interval

Non-Diagnostic Classifiers: Forest and Woodland (Treed), Shrubland (Shrub-dominated), Braided channel or stream, Drainage bottom (undifferentiated), Floodplain, Stream terrace (undifferentiated), Valley bottom, Temperate [Temperate Continental], Circumneutral Water

Concept Summary: This system is found throughout the Rocky Mountain and Colorado Plateau regions within a broad elevation range from approximately 900 to 2800 m. This system often occurs as a mosaic of multiple communities that are tree-dominated with a diverse shrub component. This system is dependent on a natural hydrologic regime, especially annual to episodic flooding. Occurrences are found within the flood zone of rivers, on islands, sand or cobble bars, and immediate streambanks. They can form large, wide occurrences on mid-channel islands in larger rivers or narrow bands on small, rocky canyon tributaries and well-drained benches. It is also typically found in backwater channels and other perennially wet but less scoured sites, such as floodplains swales and irrigation ditches. Dominant trees may include *Acer negundo, Populus angustifolia, Populus balsamifera, Populus deltoides, Populus fremontii, Pseudotsuga menziesii, Picea pungens, Salix amygdaloides*, or *Juniperus scopulorum*. Dominant shrubs include *Acer glabrum, Alnus incana, Betula occidentalis, Cornus sericea, Crataegus rivularis, Forestiera pubescens, Prunus virginiana, Rhus trilobata, Salix monticola, Salix drummondiana, Salix exigua, Salix irrorata, Salix lucida, Shepherdia argentea*, or *Symphoricarpos* spp. Exotic trees of *Elaeagnus angustifolia* and *Tamarix* spp. are common in some stands. Generally, the upland vegetation surrounding this riparian system is different and ranges from grasslands to forests.

DISTRIBUTION

Range: Found throughout the Rocky Mountain and Colorado Plateau regions within a broad elevation range from approximately 900 to 2800 m.
Ecological Divisions: 304, 306
TNC Ecoregions: 11:C, 18:C, 19:C, 20:C, 21:C, 25:C, 6:P, 8:C, 9:C
Subnations/Nations: AZ:c, CO:c, ID:c, MT:c, NM:c, NV:c, OR:c, SD:c, UT:c, WY:c

CONCEPT

Alliances and Associations:

- ACER NEGUNDO SEASONALLY FLOODED FOREST ALLIANCE (A.341)
  Acer negundo / Equisetum arvense Forest (CEGL000626)
- ACER NEGUNDO TEMPORARILY FLOODED FOREST ALLIANCE (A.278)
  Acer negundo - Populus angustifolia / Cornus sericea Forest (CEGL000627)
  Acer negundo / Cornus sericea Forest (CEGL000625)
  Acer negundo / Prunus virginiana Forest (CEGL000628)
- ACER NEGUNDO TEMPORARILY FLOODED WOODLAND ALLIANCE (A.642)
  Acer negundo / Betula occidentalis Woodland (CEGL000936)
  Acer negundo / Brickellia grandiflora Woodland [Provisional] (CEGL002692)
  Acer negundo / Disturbed Understory Woodland (CEGL002693)
- BETULA OCCIDENTALIS INTERMITTENTLY FLOODED SHRUBLAND ALLIANCE (A.936)
  Betula occidentalis / Purshia tridentata / Hesperostipa comata Shrubland (CEGL001084)
- BETULA OCCIDENTALIS TEMPORARILY FLOODED SHRUBLAND ALLIANCE (A.967)
  Populus fremontii / Betula occidentalis Wooded Shrubland (CEGL002981)
- BETULA PAPYRIFERA FOREST ALLIANCE (A.267)
  Betula papyrifera / Corylus cornuta Forest (CEGL002079)
- EQUISETUM (ARVENSE, VARIEGATUM) SEMIPERMANENTLY FLOODED HERBACEOUS ALLIANCE (A.3539)
  Equisetum (arvense, variegatum) Herbaceous Vegetation (CEGL005148)
- FORESTIERA PUBESCENS TEMPORARILY FLOODED SHRUBLAND ALLIANCE (A.969)
  Forestiera pubescens Shrubland (CEGL001168)
- FRAXINUS ANOMALA TEMPORARILY FLOODED WOODLAND ALLIANCE (A.2511)
  Fraxinus anomala Woodland (CEGL002752)
- JUNIPERUS SCOPULORUM TEMPORARILY FLOODED WOODLAND ALLIANCE (A.563)
  Juniperus scopulorum / Cornus sericea Woodland (CEGL000746)
  Juniperus scopulorum Temporarily Flooded Woodland [Placeholder] (CEGL002777)
- JUNIPERUS SCOPULORUM WOODLAND ALLIANCE (A.506)
  Juniperus scopulorum Woodland (CEGL003550)
- PINUS PONDEROSA TEMPORARILY FLOODED WOODLAND ALLIANCE (A.565)
  Pinus ponderosa / Alnus incana Woodland (CEGL002638)
  Pinus ponderosa / Cornus sericea Woodland (CEGL000853)

Pinus ponderosa / Crataegus douglasii Woodland (CEGL000855)
Pinus ponderosa / Juglans major Woodland (CEGL000858)
Pinus ponderosa Temporarily Flooded Woodland [Provisional] (CEGL002766)

- POA PRATENSIS SEMI-NATURAL SEASONALLY FLOODED HERBACEOUS ALLIANCE (A.1382)
  Poa pratensis Semi-natural Seasonally Flooded Herbaceous Vegetation [Placeholder] (CEGL003081)
- POPULUS ANGUSTIFOLIA TEMPORARILY FLOODED FOREST ALLIANCE (A.310)
  Populus angustifolia - Populus deltoides - Salix amygdaloides Forest (CEGL000656)
  Populus angustifolia / Acer grandidentatum Forest (CEGL000646)
  Populus angustifolia / Lonicera involucrata Forest (CEGL000650)
  Populus angustifolia Sand Dune Forest (CEGL002643)
- POPULUS ANGUSTIFOLIA TEMPORARILY FLOODED WOODLAND ALLIANCE (A.641)
  Populus angustifolia - Juniperus scopulorum Woodland (CEGL002640)
  Populus angustifolia - Picea pungens / Alnus incana Woodland (CEGL000934)
  Populus angustifolia - Pinus ponderosa Woodland (CEGL000935)
  Populus angustifolia - Pseudotsuga menziesii Woodland (CEGL002641)
  Populus angustifolia / Alnus incana Woodland (CEGL002642)
  Populus angustifolia / Betula occidentalis Woodland (CEGL000648)
  Populus angustifolia / Cornus sericea Woodland (CEGL002664)
  Populus angustifolia / Crataegus rivularis Woodland (CEGL002644)
  Populus angustifolia / Prunus virginiana Woodland (CEGL000651)
  Populus angustifolia / Rhus trilobata Woodland (CEGL000652)
  Populus angustifolia / Salix (monticola, drummondiana, lucida) Woodland (CEGL002645)
  Populus angustifolia / Salix drummondiana - Acer glabrum Woodland (CEGL002646)
  Populus angustifolia / Salix exigua Woodland (CEGL000654)
  Populus angustifolia / Salix irrorata Woodland (CEGL002647)
  Populus angustifolia / Salix ligulifolia - Shepherdia argentea Woodland (CEGL000655)
  Populus angustifolia / Symphoricarpos albus Woodland (CEGL002648)
- POPULUS DELTOIDES TEMPORARILY FLOODED WOODLAND ALLIANCE (A.636)
  Populus deltoides - (Salix amygdaloides) / Salix (exigua, interior) Woodland (CEGL000659)
  Populus deltoides / Symphoricarpos occidentalis Woodland (CEGL000660)
  Populus deltoides ssp. wislizeni / Rhus trilobata Woodland (CEGL000940)
- POPULUS FREMONTII SEASONALLY FLOODED WOODLAND ALLIANCE (A.654)
  Populus fremontii / Leymus triticoides Woodland (CEGL002756)
  Populus fremontii / Salix geyeriana Woodland (CEGL000943)
- POPULUS FREMONTII TEMPORARILY FLOODED FOREST ALLIANCE (A.313)
  Populus fremontii / Salix exigua Forest (CEGL000666)
- PSEUDOTSUGA MENZIESII TEMPORARILY FLOODED WOODLAND ALLIANCE (A.568)
  Pseudotsuga menziesii / Betula occidentalis Woodland (CEGL002639)
  Pseudotsuga menziesii / Cornus sericea Woodland (CEGL000899)
- RHUS TRILOBATA INTERMITTENTLY FLOODED SHRUBLAND ALLIANCE (A.938)
  Rhus trilobata Intermittently Flooded Shrubland (CEGL001121)
- SALIX (EXIGUA, INTERIOR) TEMPORARILY FLOODED SHRUBLAND ALLIANCE (A.947)
  Salix exigua - Salix ligulifolia Shrubland (CEGL002655)
  Salix exigua - Salix lucida ssp. caudata Shrubland (CEGL001204)
  Salix exigua / Agrostis stolonifera Shrubland (CEGL001199)
  Salix exigua / Barren Shrubland (CEGL001200)
  Salix exigua / Elymus X pseudorepens Shrubland (CEGL001198)
  Salix exigua / Equisetum arvense Shrubland (CEGL001201)
  Salix exigua / Mesic Forbs Shrubland (CEGL001202)
  Salix exigua / Mesic Graminoids Shrubland (CEGL001203)
  Salix exigua Temporarily Flooded Shrubland (CEGL001197)
- SALIX AMYGDALOIDES TEMPORARILY FLOODED WOODLAND ALLIANCE (A.645)
  Salix amygdaloides Woodland (CEGL000947)
- SALIX EASTWOODIAE SEASONALLY FLOODED SHRUBLAND ALLIANCE (A.1005)
  Salix eastwoodiae / Carex aquatilis Shrubland (CEGL001195)
  Salix eastwoodiae / Carex utriculata Shrubland (CEGL001196)
  Salix eastwoodiae Shrubland [Provisional] (CEGL001194)
- SALIX IRRORATA TEMPORARILY FLOODED SHRUBLAND ALLIANCE (A.976)
  Salix irrorata Shrubland (CEGL001214)
- SALIX LASIOLEPIS TEMPORARILY FLOODED SHRUBLAND ALLIANCE (A.977)
  Salix lasiolepis - Cornus sericea / Rosa woodsii Shrubland (CEGL003453)

Salix lasiolepis / Barren Ground Shrubland (CEGL001216)
Salix lasiolepis / Rosa woodsii / Mixed Herbs Shrubland (CEGL001217)

- SHEPHERDIA ARGENTEA TEMPORARILY FLOODED SHRUBLAND ALLIANCE (A.960)
  Shepherdia argentea Shrubland (CEGL001128)

Environment: This system is dependent on a natural hydrologic regime, especially annual to episodic flooding. This ecological system is found within the flood zone of rivers, on islands, sand or cobble bars, and immediate streambanks. It can form large, wide occurrences on mid-channel islands in larger rivers or narrow bands on small, rocky canyon tributaries and well-drained benches. It is also typically found in backwater channels and other perennially wet but less scoured sites, such as floodplains swales and irrigation ditches. It may also occur in upland areas of mesic swales and hillslopes below seeps and springs.

The climate of this system is continental with typically cold winters and hot summers.

Surface water is generally high for variable periods. Soils are typically alluvial deposits of sand, clays, silts and cobbles that are highly stratified with depth due to flood scour and deposition. Highly stratified profiles consist of alternating layers of clay loam and organic material with coarser sand or thin layers of sandy loam over very coarse alluvium. Soils are fine-textured with organic material over coarser alluvium. Some soils are more developed due to a slightly more stable environment and greater input of organic matter.

Dynamics: This ecological system contains early-, mid- and late-seral riparian plant associations. It also contains non-obligate riparian species. Cottonwood communities are early-, mid- or late-seral, depending on the age class of the trees and the associated species of the occurrence (Kittel et al. 1998). Cottonwoods, however, do not reach a climax stage as defined by Daubenmire (1952). Mature cottonwood occurrences 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 (Kittel et al. 1999b).

SOURCES

References: Baker 1988, Baker 1989a, Baker 1989b, Baker 1990, Comer et al. 2002, Crowe and Clausnitzer 1997, Daubenmire 1952, Kittel et al. 1999b, Kovalchik 1987, Kovalchik 1992, Manning and Padgett 1995, Muldavin et al. 2000a, Nachlinger et al. 2001, Neely et al. 2001, Padgett et al. 1989, Szaro 1989, Tuhy et al. 2002, Walford 1996, Walford et al. 1997, Walford et al. 2001

Last updated: 20 Feb 2003 **Stakeholders:** WCS, MCS, CAN
Concept Author: NatureServe Western Ecology Team **LeadResp:** WCS

S094 NORTH AMERICAN WARM DESERT LOWER MONTANE RIPARIAN WOODLAND AND SHRUBLAND

Division 302, Woody Wetland, CES302.748

Spatial Scale & Pattern: Linear **Classification Confidence:** medium
Required Classifiers: Natural/Semi-natural, Vegetated (>10% vasc.), Wetland
Diagnostic Classifiers: Forest and Woodland (Treed), Shrubland (Shrub-dominated), Riverine / Alluvial

Non-Diagnostic Classifiers: Lowland [Lowland], Tropical/Subtropical [Tropical Xeric], Temperate [Temperate Xeric], Short (50-100 yrs) Persistence

Concept Summary: This ecological system occurs in mountain canyons and valleys of southern Arizona and New Mexico, and adjacent Mexico and consists of mid- to low-elevation (1100-1800 m) riparian corridors along perennial and seasonally intermittent streams. The vegetation is a mix of riparian woodlands and shrublands. Dominant trees include *Populus angustifolia, Populus deltoides ssp. wislizeni, Populus fremontii, Platanus wrightii, Juglans major, Fraxinus velutina*, and *Sapindus saponaria*. Shrub dominants include *Salix exigua, Prunus* spp., *Alnus oblongifolia*, and *Baccharis salicifolia*. Vegetation is dependent upon annual or periodic flooding and associated sediment scour and/or annual rise in the water table for growth and reproduction.

DISTRIBUTION

Range: Southern Arizona and New Mexico, and adjacent Mexico.
Ecological Divisions: 302
TNC Ecoregions: 17:C, 22:C, 23:C, 24:C
Subnations/Nations: AZ:c, CA:c, MXBC:c, MXBS:c, MXCH:c, MXSO:c, NM:c, NV:c, TX:c

CONCEPT

Alliances and Associations:

- ALHAGI MAURORUM SEMI-NATURAL SHRUBLAND ALLIANCE (A.2567)
  Alhagi maurorum Semi-natural Shrubland (CEGL002784)
- BETULA OCCIDENTALIS TEMPORARILY FLOODED SHRUBLAND ALLIANCE (A.967)
  Populus fremontii / Betula occidentalis Wooded Shrubland (CEGL002981)
- JUGLANS MAJOR TEMPORARILY FLOODED SHRUBLAND ALLIANCE (A.957)
  Juglans major - Pinus edulis / Bromus carinatus Shrubland (CEGL001101)
  Juglans major Shrubland [Provisional] (CEGL001102)
- JUGLANS MICROCARPA TEMPORARILY FLOODED SHRUBLAND ALLIANCE (A.945)
  Juglans microcarpa / Cladium mariscus ssp. jamaicense Shrubland (CEGL004593)
  Juglans microcarpa / Sorghastrum nutans Shrubland (CEGL004594)
  Juglans microcarpa Shrubland (CEGL001103)
- PLATANUS WRIGHTII TEMPORARILY FLOODED FOREST ALLIANCE (A.309)
  Platanus wrightii - Alnus oblongifolia / Baccharis salicifolia Forest (CEGL002686)
  Platanus wrightii - Fraxinus velutina Forest (CEGL000644)
  Platanus wrightii - Juglans major Forest (CEGL000645)
- PLATANUS WRIGHTII TEMPORARILY FLOODED WOODLAND ALLIANCE (A.643)
  Platanus wrightii Woodland (CEGL000937)
- POPULUS ANGUSTIFOLIA TEMPORARILY FLOODED FOREST ALLIANCE (A.310)
  Populus angustifolia / Rosa woodsii Forest (CEGL000653)
- POPULUS ANGUSTIFOLIA TEMPORARILY FLOODED WOODLAND ALLIANCE (A.641)
  Populus angustifolia - Juniperus deppeana / Brickellia californica Woodland (CEGL000933)
  Populus angustifolia / Alnus oblongifolia Woodland (CEGL000938)
  Populus angustifolia / Salix exigua Woodland (CEGL000654)
  Populus angustifolia / Salix irrorata Woodland (CEGL002647)
- POPULUS DELTOIDES SSP. WISLIZENI TEMPORARILY FLOODED FOREST ALLIANCE (A.312)
  Populus deltoides ssp. wislizeni / Baccharis sarothroides Forest (CEGL000663)
- POPULUS DELTOIDES TEMPORARILY FLOODED WOODLAND ALLIANCE (A.636)
  Populus deltoides ssp. wislizeni / Rhus trilobata Woodland (CEGL000940)
- POPULUS FREMONTII SEASONALLY FLOODED WOODLAND ALLIANCE (A.654)
  Populus fremontii / Muhlenbergia rigens Woodland (CEGL001455)
  Populus fremontii / Salix geyeriana Woodland (CEGL000943)
- POPULUS FREMONTII TEMPORARILY FLOODED FOREST ALLIANCE (A.313)
  Populus fremontii - Platanus wrightii Forest (CEGL000665)
  Populus fremontii - Salix gooddingii / Baccharis salicifolia Forest (CEGL002683)
  Populus fremontii - Salix gooddingii / Salix exigua Forest (CEGL002684)
  Populus fremontii / Acer negundo Forest (CEGL000662)
  Populus fremontii Forest [Placeholder] (CEGL000661)
- POPULUS FREMONTII TEMPORARILY FLOODED WOODLAND ALLIANCE (A.644)
  Populus fremontii - Fraxinus velutina Woodland (CEGL000942)
  Populus fremontii - Salix gooddingii Woodland (CEGL000944)
  Populus fremontii / Baccharis emoryi Woodland [Provisional] (CEGL002946)
  Populus fremontii / Baccharis salicifolia Woodland (CEGL000941)
- RHUS TRILOBATA INTERMITTENTLY FLOODED SHRUBLAND ALLIANCE (A.938)
  Rhus trilobata - Prunus serotina Shrubland (CEGL001119)
- ROBINIA NEOMEXICANA SHRUBLAND ALLIANCE (A.924)
  Robinia neomexicana / Thalictrum fendleri Shrubland (CEGL001125)
- SALIX (EXIGUA, INTERIOR) TEMPORARILY FLOODED SHRUBLAND ALLIANCE (A.947)
  Salix exigua / Agrostis stolonifera Shrubland (CEGL001199)
  Salix exigua / Elymus X pseudorepens Shrubland (CEGL001198)
- SALIX BONPLANDIANA TEMPORARILY FLOODED FOREST ALLIANCE (A.314)
  Salix bonplandiana Forest (CEGL000679)
- SALIX EXIGUA SEASONALLY FLOODED WOODLAND ALLIANCE (A.649)
  Salix exigua / Baccharis salicifolia - Baccharis neglecta / Schoenoplectus spp. Woodland (CEGL004587)
- SALIX GOODDINGII TEMPORARILY FLOODED WOODLAND ALLIANCE (A.640)
  Salix gooddingii - Fraxinus velutina Temporarily Flooded Woodland (CEGL003729)
  Salix gooddingii Woodland [Provisional] (CEGL002743)
- SALIX IRRORATA TEMPORARILY FLOODED SHRUBLAND ALLIANCE (A.976)
  Salix irrorata Shrubland (CEGL001214)

- SALIX LAEVIGATA TEMPORARILY FLOODED WOODLAND ALLIANCE (A.646)
  Salix laevigata - Fraxinus velutina Woodland (CEGL000950)
  Salix laevigata Woodland [Provisional] (CEGL002952)
- TAMARIX SPP. SEMI-NATURAL TEMPORARILY FLOODED SHRUBLAND ALLIANCE (A.842)
  Tamarix spp. Temporarily Flooded Shrubland (CEGL003114)

SOURCES

References: Brown 1982, Dick-Peddie 1993, Muldavin et al. 2000a, Szaro 1989, Thomas et al. 2003a
Last updated: 20 Feb 2003 **Stakeholders:** WCS, SCS
Concept Author: NatureServe Western Ecology Team **LeadResp:** WCS

S095 WESTERN GREAT PLAINS RIPARIAN WOODLAND AND SHRUBLAND

Spatial Scale & Pattern: Linear

This SW Regional GAP Landcover Type is complex of two ecological systems, S095 Western Great Plains Riparian Woodland and Shrubland and S120 Western Great Plains Floodplain Herbaceous Wetland. Both of these ecological systems include riparian woodlands, shrubland and herbaceous vegetation, however to facilitate wildlife habitat modeling the complex was split physiognomally. In this landcover type includes only woodland and shrubland vegetation. Riparian herbaceous vegetation is mapped as S120 Western Great Plains Floodplain Herbaceous Wetland. See both ecological system descriptions below:

Western Great Plains Riparian Woodland and Shrubland

Division 303, Mixed Upland and Wetland, CES303.956
Spatial Scale & Pattern: Linear
Required Classifiers: Natural/Semi-natural, Vegetated (>10% vasc.), Upland, Wetland
Diagnostic Classifiers: Woody-Herbaceous, Very Short Disturbance Interval, Flood Scouring, Riparian Mosaic, Riverine / Alluvial

Non-Diagnostic Classifiers: Lowland [Lowland], Forest and Woodland (Treed), Shrubland (Shrub-dominated), Alluvial fan, Arroyo, Floodplain, Fluvial, Toeslope/Valley Bottom, Temperate [Temperate Xeric], Broad-Leaved Deciduous Tree, Broad-Leaved Deciduous Shrub, Evergreen Sclerophyllous Shrub, Graminoid, Intermittent Flooding, Short (<5 yrs) Flooding Interval

Concept Summary: This system is found in the riparian areas of medium and small rivers and streams throughout the Western Great Plains. It is likely most common in the Shortgrass Prairie and Northern Great Plains Steppe, but extends west and as far as the Rio Grande in New Mexico and into the Wyoming Basins in the north. These are found on alluvial soils in highly variable landscape settings, from deep cut ravines to wide, braided streambeds. Hydrologically, these tend to be more flashy with less developed floodplain than on larger rivers, and typically dry down completely for some portion of the year. Dominant vegetation shares much with generally drier portions of larger floodplain systems downstream, but overall abundance of vegetation is generally lower. Communities within this system range from riparian forests and shrublands to gravel/sand flats. Dominant species include *Populus deltoides, Salix* spp., *Artemisia cana ssp. cana*, *Pascopyrum smithii*, *Sporobolus cryptandrus*, and *Schizachyrium scoparium*. These areas are often subjected to heavy grazing and/or agriculture and can be heavily degraded. *Tamarix* spp. and less desirable grasses and forbs can invade degraded examples up through central Colorado. Another factor is that groundwater depletion and lack of fire have created additional species changes.

DISTRIBUTION

Range: Riparian areas of medium and small rivers and streams throughout the Western Great Plains. It is likely most common in the Central Shortgrass Prairie and Northern Great Plains Steppe, but extends west into the Wyoming Basins.
Ecological Divisions: 303, 304
TNC Ecoregions: 10:P, 26:C, 27:C, 28:P
Subnations/Nations: CO:, MT:, NM:, WY:

CONCEPT

Alliances and Associations:

- ARTEMISIA CANA TEMPORARILY FLOODED SHRUBLAND ALLIANCE (A.843)
  Artemisia cana / Pascopyrum smithii Shrubland (CEGL001072)
- COBBLE/GRAVEL SHORE SPARSELY VEGETATED ALLIANCE (A.1850)
  Riverine Gravel Flats Great Plains Sparse Vegetation (CEGL005223)
- POPULUS DELTOIDES TEMPORARILY FLOODED WOODLAND ALLIANCE (A.636)
  Populus deltoides / Panicum virgatum - Schizachyrium scoparium Woodland (CEGL001454)
- SYMPHORICARPOS OCCIDENTALIS TEMPORARILY FLOODED SHRUBLAND ALLIANCE (A.961)
  Symphoricarpos occidentalis Shrubland (CEGL001131)
- TAMARIX SPP. SEMI-NATURAL TEMPORARILY FLOODED SHRUBLAND ALLIANCE (A.842)
  Tamarix spp. Temporarily Flooded Shrubland (CEGL003114)
-

SOURCES

Last updated: 20 Mar 2003 **Stakeholders:** WCS, CAN
Concept Author: P. Comer, G. Kittel **LeadResp:** WCS

Western Great Plains Floodplain

Division 303, Woody Wetland, CES303.678
Spatial Scale & Pattern: Linear **Classification Confidence:** medium
Required Classifiers: Natural/Semi-natural, Vegetated (>10% vasc.), Wetland
Non-Diagnostic Classifiers: Forest and Woodland (Treed), Herbaceous, Floodplain, Riverine / Alluvial, Deep (>15 cm) Water, Long (>25 yrs) Flooding Interval

This SW Regional GAP Landcover Type includes portions of two similar ecological systems, S095 Western Great Plains Riparian Woodland and Shrubland and S120 Western Great Plains Floodplain Herbaceous Wetland, which where combined for facilitate mapping. Both these ecological systems include riparian woodlands, shrubland and herbaceous vegetation. To facilitate wildlife habitat modeling, only woodland and shrubland vegetation was included in this landcover type. Riparian woodland and shrubland vegetation was mapped as S095 Western Great Plains Riparian Woodland and Shrubland

Concept Summary: This system is found in the floodplains of medium and large rivers of the Western Great Plains. Alluvial soils and periodic, intermediate flooding (every 5-25 years) typify this system. Dominant communities within this system range from floodplain forests to wet meadows to gravel/sand flats; however, they are linked by underlying soils and the flooding regime. Dominant species include *Populus deltoides* and *Salix* spp. Grass cover underneath the trees is an important part of this system and is a mix of tallgrass species, including *Panicum virgatum* and *Andropogon gerardii*. *Tamarix* spp. and less desirable grasses and forbs can invade degraded areas within the floodplains, especially in the western portion of the province. These areas are often subjected to heavy grazing and/or agriculture and can be heavily degraded. Another factor is that groundwater depletion and lack of fire have created additional species changes. In most cases, the majority of the wet meadow and prairie communities may be extremely degraded or extirpated from the system.

Comments: Need to review if there needs to be another split of this system into a Central Great Plains Floodplain system and a Southern Great Plains floodplain system. Will need to review in conjunction with Northwestern Great Plains Floodplain.

DISTRIBUTION

Range: This system is found along major river floodplains in the southern and central portions of the Western Great Plains division.
Ecological Divisions: 205, 303
TNC Ecoregions: 27:C, 28:C, 29:P, 32:C, 33:C, 37:C
Subnations/Nations: CO:c, KS:c, NE:c, OK:c, SD:c, TX:p

CONCEPT

Alliances and Associations:

- CAREX NEBRASCENSIS SEASONALLY FLOODED HERBACEOUS ALLIANCE (A.1417)
  Carex nebrascensis Herbaceous Vegetation (CEGL001813)

- CELTIS LAEVIGATA - ULMUS CRASSIFOLIA TEMPORARILY FLOODED FOREST ALLIANCE (A.283)
  Ulmus crassifolia - Celtis laevigata / Ilex decidua / Elymus virginicus Forest (CEGL008468)
- COBBLE/GRAVEL SHORE SPARSELY VEGETATED ALLIANCE (A.1850)
  Riverine Gravel Flats Great Plains Sparse Vegetation (CEGL005223)
- ERICAMERIA NAUSEOSA SHRUBLAND ALLIANCE (A.835)
  Ericameria nauseosa / Pseudoroegneria spicata Shrubland (CEGL001330)
- FRAXINUS PENNSYLVANICA - ULMUS AMERICANA - CELTIS (OCCIDENTALIS, LAEVIGATA) TEMPORARILY FLOODED FOREST ALLIANCE (A.286)
  Ulmus (americana, rubra) - Quercus muehlenbergii Forest (CEGL002091)
  Ulmus americana - Celtis (laevigata, occidentalis) - Fraxinus pennsylvanica Forest (CEGL002090)
- JUGLANS MICROCARPA TEMPORARILY FLOODED SHRUBLAND ALLIANCE (A.945)
  Juglans microcarpa - Brickellia laciniata / Indigofera lindheimeriana Edwards Plateau Shrubland (CEGL004932)
- JUSTICIA AMERICANA TEMPORARILY FLOODED HERBACEOUS ALLIANCE (A.1657)
  Justicia americana - Bacopa monnieri Edwards Plateau Herbaceous Vegetation (CEGL004926)
- PANICUM VIRGATUM TEMPORARILY FLOODED HERBACEOUS ALLIANCE (A.1343)
  Panicum virgatum - Andropogon glomeratus - Cladium mariscus ssp. jamaicense Herbaceous Vegetation (CEGL004928)
- PLATANUS OCCIDENTALIS - (BETULA NIGRA, SALIX SPP.) TEMPORARILY FLOODED WOODLAND ALLIANCE (A.633)
  Platanus occidentalis - (Salix nigra) / Juglans microcarpa - Baccharis salicifolia Woodland (CEGL004930)
  Platanus occidentalis - Juglans major Woodland (CEGL004929)
- PLATANUS OCCIDENTALIS - (FRAXINUS PENNSYLVANICA, CELTIS LAEVIGATA, ACER SACCHARINUM) TEMPORARILY FLOODED FOREST ALLIANCE (A.288)
  Platanus occidentalis - Salix nigra Forest (CEGL002093)
- POPULUS DELTOIDES SSP. WISLIZENI TEMPORARILY FLOODED FOREST ALLIANCE (A.312)
  Populus deltoides / Muhlenbergia asperifolia Forest (CEGL000678)
- POPULUS DELTOIDES TEMPORARILY FLOODED FOREST ALLIANCE (A.290)
  Populus deltoides - Ulmus americana - Celtis laevigata Forest (CEGL002096)
- POPULUS DELTOIDES TEMPORARILY FLOODED WOODLAND ALLIANCE (A.636)
  Populus deltoides - (Salix amygdaloides) / Salix (exigua, interior) Woodland (CEGL000659)
  Populus deltoides - Salix nigra Woodland (CEGL004919)
  Populus deltoides / Carex pellita Woodland (CEGL002649)
  Populus deltoides / Distichlis spicata Woodland (CEGL000939)
  Populus deltoides / Panicum virgatum - Schizachyrium scoparium Woodland (CEGL001454)
  Populus deltoides / Salix exigua Woodland (CEGL002685)
- SALIX (EXIGUA, INTERIOR) TEMPORARILY FLOODED SHRUBLAND ALLIANCE (A.947)
  Salix exigua / Mesic Graminoids Shrubland (CEGL001203)
- SALIX NIGRA TEMPORARILY FLOODED FOREST ALLIANCE (A.297)
  Salix nigra Forest (CEGL002103)
- SAND FLATS TEMPORARILY FLOODED SPARSELY VEGETATED ALLIANCE (A.1864)
  Riverine Sand Flats - Bars Sparse Vegetation (CEGL002049)
- SCHOENOPLECTUS PUNGENS SEMIPERMANENTLY FLOODED HERBACEOUS ALLIANCE (A.1433)
  Schoenoplectus pungens - Suaeda calceoliformis Alkaline Herbaceous Vegetation (CEGL002040)
- SPARTINA PECTINATA TEMPORARILY FLOODED HERBACEOUS ALLIANCE (A.1347)
  Spartina pectinata - Eleocharis spp. - Carex spp. Herbaceous Vegetation (CEGL002223)
- SPOROBOLUS AIROIDES HERBACEOUS ALLIANCE (A.1267)
  Sporobolus airoides Southern Plains Herbaceous Vegetation (CEGL001685)
- SYMPHORICARPOS OCCIDENTALIS TEMPORARILY FLOODED SHRUBLAND ALLIANCE (A.961)
  Symphoricarpos occidentalis Shrubland (CEGL001131)
- TAMARIX SPP. SEMI-NATURAL TEMPORARILY FLOODED SHRUBLAND ALLIANCE (A.842)
  Tamarix spp. Temporarily Flooded Shrubland (CEGL003114)
- TAXODIUM DISTICHUM - (PLATANUS OCCIDENTALIS) TEMPORARILY FLOODED FOREST ALLIANCE (A.298)
  Taxodium distichum - Platanus occidentalis Edwards Plateau Forest (CEGL002104)
- TYPHA (ANGUSTIFOLIA, LATIFOLIA) - (SCHOENOPLECTUS SPP.) SEMIPERMANENTLY FLOODED HERBACEOUS ALLIANCE (A.1436)
  Schoenoplectus acutus - Typha latifolia - (Schoenoplectus tabernaemontani) Sandhills Herbaceous Vegetation (CEGL002030)
  Typha (angustifolia, domingensis, latifolia) - Schoenoplectus americanus Herbaceous Vegetation (CEGL002032)
  Typha latifolia Western Herbaceous Vegetation (CEGL002010)
- TYPHA SPP. - (SCHOENOPLECTUS SPP., JUNCUS SPP.) SEASONALLY FLOODED HERBACEOUS ALLIANCE (A.1394)
  Schoenoplectus tabernaemontani - Typha spp. - (Sparganium spp., Juncus spp.) Herbaceous Vegetation (CEGL002026)

Environment: This system is found primarily along floodplains of medium and large rivers. Soils are primarily alluvial and range from sandy to dense clays.

Vegetation: Dominant woody species occurring within this system include *Populus deltoides* and *Salix* spp. Understory species constitute an important component of this system and include a mixture of tallgrass prairie species such as including *Panicum virgatum* and *Andropogon gerardii*. Sparsely vegetated areas such as gravel and sand flats are also included within this system.

Dynamics: Periodic and intermediate flooding (i.e., every 5-25 years) constitutes the major process influencing this system. Grazing and conversion to agriculture can significantly impact this system and can lead to the degradation or extirpation of the majority of prairie and wet meadow communities from this system.

SOURCES

References: Lauver et al. 1999, Steinauer and Rolfsmeier 2000
Last updated: 05 Mar 2003 **Stakeholders:** MCS, SCS, WCS
Concept Author: S. Menard and K. Kindscher **LeadResp:** MCS

S096 INTER-MOUNTAIN BASINS GREASEWOOD FLAT

Division 304, Mixed Upland and Wetland, CES304.780

Spatial Scale & Pattern: Large Patch **Classification Confidence:** medium
Required Classifiers: Natural/Semi-natural, Vegetated (>10% vasc.), Upland, Wetland
Diagnostic Classifiers: Lowland [Lowland], Shrubland (Shrub-dominated), Toeslope/Valley Bottom, Alkaline Soil, Deep Soil, Xeromorphic Shrub

Non-Diagnostic Classifiers: Alluvial flat, Alluvial plain, Alluvial terrace, Temperate [Temperate Continental], Saline Substrate Chemistry, Sarcobatus vermiculatus, Riverine / Alluvial, Deep (>15 cm) Water

Concept Summary: This ecological system occurs throughout much of the western U.S. in Intermountain basins and extends onto the western Great Plains. It typically occurs near drainages on stream terraces and flats or may form rings around playas. Sites typically have saline soils, a shallow water table and flood intermittently, but remain dry for most growing seasons. This system usually occurs as a mosaic of multiple communities, with open to moderately dense shrublands dominated or codominated by *Sarcobatus vermiculatus*. *Atriplex canescens, Atriplex confertifolia*, or *Krascheninnikovia lanata* may be present to codominant. Occurrences are often surrounded by mixed salt desert scrub. The herbaceous layer, if present, is usually dominated by graminoids. There may be inclusions of *Sporobolus airoides, Distichlis spicata* (where water remains ponded the longest), or *Eleocharis palustris* herbaceous types.

DISTRIBUTION

Range: Occurs throughout much of the western U.S. in Intermountain basins and extends onto the western Great Plains.
Ecological Divisions: 303, 304
TNC Ecoregions: 10:C, 11:C, 19:C, 20:C, 26:C, 4:C, 6:C, 8:C, 9:C
Subnations/Nations: AZ:c, CA:c, CO:c, ID:c, MT:c, NV:c, OR:c, UT:c, WA:c, WY:c

CONCEPT

Alliances and Associations:

- DISTICHLIS SPICATA INTERMITTENTLY FLOODED HERBACEOUS ALLIANCE (A.1332)
  Distichlis spicata - (Scirpus nevadensis) Herbaceous Vegetation (CEGL001773)
  Distichlis spicata - Lepidium perfoliatum Herbaceous Vegetation (CEGL001772)
  Distichlis spicata Herbaceous Vegetation (CEGL001770)
  Distichlis spicata Mixed Herb Herbaceous Vegetation (CEGL001771)
- ELEOCHARIS PALUSTRIS SEASONALLY FLOODED HERBACEOUS ALLIANCE (A.1422)
  Eleocharis palustris Herbaceous Vegetation (CEGL001833)
- ERICAMERIA NAUSEOSA SHRUBLAND ALLIANCE (A.835)
  Ericameria nauseosa / Sporobolus airoides Shrubland [Provisional] (CEGL002918)
- LEYMUS CINEREUS HERBACEOUS ALLIANCE (A.1204)
  Leymus cinereus Herbaceous Vegetation (CEGL001479)
- LEYMUS CINEREUS INTERMITTENTLY FLOODED HERBACEOUS ALLIANCE (A.1329)
  Leymus cinereus - Distichlis spicata Herbaceous Vegetation (CEGL001481)
  Leymus cinereus Bottomland Herbaceous Vegetation (CEGL001480)

- PUCCINELLIA NUTTALLIANA INTERMITTENTLY FLOODED HERBACEOUS ALLIANCE (A.1335)
  Puccinellia nuttalliana Herbaceous Vegetation (CEGL001799)
- SALICORNIA RUBRA SEASONALLY FLOODED HERBACEOUS ALLIANCE (A.1818)
  Salicornia rubra Herbaceous Vegetation (CEGL001999)
- SARCOBATUS VERMICULATUS INTERMITTENTLY FLOODED SHRUB HERBACEOUS ALLIANCE (A.1554)
  Sarcobatus vermiculatus / Pascopyrum smithii - (Elymus lanceolatus) Shrub Herbaceous Vegetation (CEGL001508)
- SARCOBATUS VERMICULATUS INTERMITTENTLY FLOODED SHRUBLAND ALLIANCE (A.1046)
  Sarcobatus vermiculatus - Atriplex parryi / Distichlis spicata Shrubland (CEGL002764)
  Sarcobatus vermiculatus - Psorothamnus polydenius Shrubland (CEGL002763)
  Sarcobatus vermiculatus / Achnatherum hymenoides Shrubland (CEGL001373)
  Sarcobatus vermiculatus / Artemisia tridentata Shrubland (CEGL001359)
  Sarcobatus vermiculatus / Atriplex confertifolia - (Picrothamnus desertorum, Suaeda moquinii) Shrubland (CEGL001371)
  Sarcobatus vermiculatus / Atriplex gardneri Shrubland (CEGL001360)
  Sarcobatus vermiculatus / Distichlis spicata Shrubland (CEGL001363)
  Sarcobatus vermiculatus / Elymus elymoides - Pascopyrum smithii Shrubland (CEGL001365)
  Sarcobatus vermiculatus / Elymus elymoides Shrubland (CEGL001372)
  Sarcobatus vermiculatus / Leymus cinereus Shrubland (CEGL001366)
  Sarcobatus vermiculatus / Nitrophila occidentalis - Suaeda moquinii Shrubland (CEGL001369)
  Sarcobatus vermiculatus / Suaeda moquinii Shrubland (CEGL001370)
  Sarcobatus vermiculatus Shrubland (CEGL001357)
- SARCOBATUS VERMICULATUS INTERMITTENTLY FLOODED SPARSELY VEGETATED ALLIANCE (A.1877)
  Sarcobatus vermiculatus / Juncus balticus Sparse Vegetation (CEGL002919)
  Sarcobatus vermiculatus / Sporobolus airoides Sparse Vegetation (CEGL001368)
- SARCOBATUS VERMICULATUS SHRUBLAND ALLIANCE (A.1041)
  Sarcobatus vermiculatus / Bouteloua gracilis Shrubland (CEGL001361)
  Sarcobatus vermiculatus / Pseudoroegneria spicata Shrubland (CEGL001367)
- SPOROBOLUS AIROIDES HERBACEOUS ALLIANCE (A.1267)
  Sporobolus airoides Southern Plains Herbaceous Vegetation (CEGL001685)
- SPOROBOLUS AIROIDES INTERMITTENTLY FLOODED HERBACEOUS ALLIANCE (A.1331)
  Sporobolus airoides - Distichlis spicata Herbaceous Vegetation (CEGL001687)

- **California community types:**
- Greasewood - Shadscale (36.320.01)
- Greasewood - Saltgrass (41.200.03)

SOURCES

References: Knight 1994, West 1983b
Last updated: 20 Feb 2003 **Stakeholders:** WCS, MCS
Concept Author: NatureServe Western Ecology Team **LeadResp:** WCS

S097 NORTH AMERICAN WARM DESERT RIPARIAN WOODLAND AND SHRUBLAND

Division 302, Woody Wetland, CES302.753

Spatial Scale & Pattern: Linear **Classification Confidence:** medium
Required Classifiers: Natural/Semi-natural, Vegetated (>10% vasc.), Wetland
Diagnostic Classifiers: Lowland [Lowland], Forest and Woodland (Treed), Shrubland (Shrub-dominated), Tropical/Subtropical [Tropical Xeric], Temperate [Temperate Xeric], Riverine / Alluvial

Non-Diagnostic Classifiers: Toeslope/Valley Bottom, Short (50-100 yrs) Persistence

Concept Summary: This ecological system consists of low-elevation (<1200 m) riparian corridors along medium to large perennial streams throughout canyons and the desert valleys of the southwestern United States and adjacent Mexico. The vegetation is a mix of riparian woodlands and shrublands. Dominant trees include *Acer negundo, Fraxinus velutina, Populus fremontii, Salix gooddingii, Salix lasiolepis, Celtis laevigata var. reticulata,* and *Juglans major*. Shrub dominants include *Salix geyeriana, Shepherdia argentea,* and *Salix exigua*. Vegetation is dependent upon annual or periodic flooding and associated sediment scour and/or annual rise in the water table for growth and reproduction.

DISTRIBUTION

Range: Throughout canyons and the desert valleys of the southwestern United States and adjacent Mexico.
Ecological Divisions: 302

TNC Ecoregions: 17:C, 22:C, 23:C, 24:C, 29:P
Subnations/Nations: AZ:c, CA:c, MXBC:c, MXCH:c, MXSO:c, NM:c, NV:c, TX:c

CONCEPT

Alliances and Associations:

- ARUNDO DONAX TEMPORARILY FLOODED HERBACEOUS ALLIANCE (A.1339)
  Arundo donax Riverbank Herbaceous Vegetation (CEGL004101)
- CELTIS LAEVIGATA VAR. RETICULATA SHRUBLAND ALLIANCE (A.1033)
  Celtis laevigata var. reticulata / Celtis pallida Shrubland (CEGL001163)
- JUGLANS MAJOR TEMPORARILY FLOODED SHRUBLAND ALLIANCE (A.957)
  Juglans major - Pinus edulis / Bromus carinatus Shrubland (CEGL001101)
  Juglans major Shrubland [Provisional] (CEGL001102)
- JUGLANS MICROCARPA TEMPORARILY FLOODED SHRUBLAND ALLIANCE (A.945)
  Celtis laevigata var. reticulata - Juglans microcarpa / Leptochloa dubia Shrubland (CEGL002166)
  Juglans microcarpa / Cladium mariscus ssp. jamaicense Shrubland (CEGL004593)
  Juglans microcarpa / Sorghastrum nutans Shrubland (CEGL004594)
  Juglans microcarpa Shrubland (CEGL001103)
- PLATANUS RACEMOSA TEMPORARILY FLOODED WOODLAND ALLIANCE (A.634)
  Platanus racemosa Temporarily Flooded Woodland [Placeholder] (CEGL003079)
- PLATANUS WRIGHTII TEMPORARILY FLOODED FOREST ALLIANCE (A.309)
  Platanus wrightii - Alnus oblongifolia / Baccharis salicifolia Forest (CEGL002686)
  Platanus wrightii - Fraxinus velutina Forest (CEGL000644)
  Platanus wrightii - Juglans major Forest (CEGL000645)
- PLATANUS WRIGHTII TEMPORARILY FLOODED WOODLAND ALLIANCE (A.643)
  Platanus wrightii Woodland (CEGL000937)
- POPULUS DELTOIDES SSP. WISLIZENI TEMPORARILY FLOODED FOREST ALLIANCE (A.312)
  Populus deltoides / Muhlenbergia asperifolia Forest (CEGL000678)
  Populus deltoides ssp. wislizeni / Baccharis sarothroides Forest (CEGL000663)
- POPULUS DELTOIDES TEMPORARILY FLOODED WOODLAND ALLIANCE (A.636)
  Populus deltoides ssp. wislizeni / Rhus trilobata Woodland (CEGL000940)
- POPULUS FREMONTII SEASONALLY FLOODED WOODLAND ALLIANCE (A.654)
  Populus fremontii / Leymus triticoides Woodland (CEGL002756)
  Populus fremontii / Muhlenbergia rigens Woodland (CEGL001455)
- POPULUS FREMONTII TEMPORARILY FLOODED FOREST ALLIANCE (A.313)
  Populus fremontii - Celtis laevigata var. reticulata / Salvia pinguifolia Forest (CEGL000664)
  Populus fremontii - Platanus wrightii Forest (CEGL000665)
  Populus fremontii - Salix gooddingii / Baccharis salicifolia Forest (CEGL002683)
  Populus fremontii - Salix gooddingii / Salix exigua Forest (CEGL002684)
  Populus fremontii / Acer negundo Forest (CEGL000662)
  Populus fremontii Forest [Placeholder] (CEGL000661)
- POPULUS FREMONTII TEMPORARILY FLOODED WOODLAND ALLIANCE (A.644)
  Populus fremontii - Fraxinus velutina Woodland (CEGL000942)
  Populus fremontii - Salix gooddingii Woodland (CEGL000944)
  Populus fremontii / Baccharis salicifolia Woodland (CEGL000941)
- PARKINSONIA FLORIDA - OLNEYA TESOTA WOODLAND ALLIANCE (A.588)
- Parkinsonia florida - Olneya tesota Woodland [Placeholder] (CEGL003035)
- SALIX (EXIGUA, INTERIOR) TEMPORARILY FLOODED SHRUBLAND ALLIANCE (A.947)
  Salix exigua / Agrostis stolonifera Shrubland (CEGL001199)
  Salix exigua / Barren Shrubland (CEGL001200)
- SALIX GOODDINGII TEMPORARILY FLOODED WOODLAND ALLIANCE (A.640)
  Salix gooddingii - Fraxinus velutina Temporarily Flooded Woodland (CEGL003729)
  Salix gooddingii Woodland [Provisional] (CEGL002743)
- TAMARIX SPP. SEMI-NATURAL TEMPORARILY FLOODED SHRUBLAND ALLIANCE (A.842)
  Tamarix spp. Temporarily Flooded Shrubland (CEGL003114)

- **California community types:**
- Sonoran Cottonwood - Willow Riparian (61.130.05)
- Arroyo Willow Riparian Forests and Woodlands (61.201.00)
- Central Coast Arroyo Willow Riparian (61.201.01)
- Southern Arroyo Willow Riparian (61.201.02)
- Arroyo Willow / Blackberry Riparian (61.201.03)
- Arroyo Willow - Shining Willow (61.201.04)
- Black Willow Riparian Forests and Woodlands (61.202.00)

- Red Willow Riparian Forests (61.205.00)
- Red Willow (61.205.01)
- Red Willow / Arroyo Willow (61.205.02)
- Gooding Willow (61.211.01)
- Desert Olive Scrub (61.580.00)
- Desert Olive (61.580.01)
- Oregon Ash Riparian Forest (61.960.00)
- Narrowleaf Willow (63.110.00)
- Narrowleaf Willow - Desert Baccharis (63.110.01)
- Narrow-leaf Willow Riparian Scrub (63.110.02)
- Lemmon's Willow Riparian Scrub (63.113.00)
- Lemmon's Willow (63.113.01)
- Tamarisk Scrubs and Woodlands (63.810.00)
- Shrub Tamarisk (63.810.02)

SOURCES

References: Barbour and Major 1988, Brown 1982, Dick-Peddie 1993, Holland and Keil 1995, Muldavin et al. 2000a, Szaro 1989

Last updated: 20 Feb 2003 **Stakeholders:** WCS, SCS

Concept Author: NatureServe Western Ecology Team **LeadResp:** WCS

S098 NORTH AMERICAN WARM DESERT RIPARIAN MESQUITE BOSQUE

Division 302, Woody Wetland, CES302.752

Spatial Scale & Pattern: Linear **Classification Confidence:** medium

Required Classifiers: Natural/Semi-natural, Vegetated (>10% vasc.), Wetland

Diagnostic Classifiers: Lowland [Lowland], Toeslope/Valley Bottom, Tropical/Subtropical [Tropical Xeric], Temperate [Temperate Xeric], Prosopis spp.-dominated, Riverine / Alluvial

Non-Diagnostic Classifiers: Forest and Woodland (Treed), Shrubland (Shrub-dominated)

Concept Summary: This ecological system consists of low-elevation (<1100 m) riparian corridors along intermittent streams in valleys of southern Arizona and New Mexico, and adjacent Mexico. Dominant trees include *Prosopis glandulosa* and *Prosopis velutina*. Shrub dominants include *Baccharis salicifolia*, *Pluchea sericea*, and *Salix exigua*. Vegetation, especially the mesquites, tap groundwater below the streambed when surface flows stop. Vegetation is dependent upon annual rise in the water table for growth and reproduction.

DISTRIBUTION

Range: Along intermittent streams in valleys of southern Arizona and New Mexico, and adjacent Mexico.

Ecological Divisions: 302

TNC Ecoregions: 17:C, 22:C, 23:C, 24:C

Subnations/Nations: AZ:c, CA:c, MXBC:p, MXCH:c, MXSO:c, NM:c, NV:c, TX:c

CONCEPT

Alliances and Associations:

- BACCHARIS SALICIFOLIA - BACCHARIS NEGLECTA SEASONALLY FLOODED SHRUBLAND ALLIANCE (A.987)
  Baccharis salicifolia - Baccharis neglecta / Eustoma exaltatum Shrubland (CEGL004590)
- BACCHARIS SALICIFOLIA INTERMITTENTLY FLOODED SHRUBLAND ALLIANCE (A.933)
  Baccharis salicifolia / Muhlenbergia rigens Shrubland (CEGL004572)
- BACCHARIS SAROTHROIDES INTERMITTENTLY FLOODED SHRUBLAND ALLIANCE (A.840)
  Baccharis sarothroides - Baccharis salicifolia Shrubland (CEGL001160)
  Baccharis sarothroides - Parkinsonia microphylla Shrubland (CEGL001159)
- BACCHARIS SERGILOIDES INTERMITTENTLY FLOODED SHRUBLAND ALLIANCE (A.2531)
  Baccharis sergiloides Shrubland [Placeholder] (CEGL002953)
- PLEURAPHIS MUTICA SHRUB HERBACEOUS ALLIANCE (A.1551)
  Prosopis glandulosa / Pleuraphis mutica Shrub Herbaceous Vegetation (CEGL001641)
- PLUCHEA SERICEA SEASONALLY FLOODED SHRUBLAND ALLIANCE (A.798)
  Pluchea sericea Seasonally Flooded Shrubland [Placeholder] (CEGL003080)

- PROSOPIS (GLANDULOSA, VELUTINA) WOODLAND ALLIANCE (A.661)
  Prosopis (glandulosa var. torreyana, velutina) Woodland [Placeholder] (CEGL003082)
- PROSOPIS GLANDULOSA SHRUB HERBACEOUS ALLIANCE (A.1550)
  Prosopis glandulosa / Bouteloua eriopoda Shrub Herbaceous Vegetation (CEGL001510)
- PROSOPIS GLANDULOSA SHRUBLAND ALLIANCE (A.1031)
  Prosopis glandulosa - Artemisia filifolia / Sporobolus giganteus Shrubland (CEGL002192)
  Prosopis glandulosa - Atriplex spp. Shrubland (CEGL002193)
  Prosopis glandulosa / Atriplex canescens Shrubland (CEGL001382)
  Prosopis glandulosa / Bouteloua curtipendula Shrubland (CEGL002194)
  Prosopis glandulosa / Bouteloua gracilis Shrubland (CEGL001383)
  Prosopis glandulosa / Mixed Grasses Shrubland (CEGL001384)
  Prosopis glandulosa / Muhlenbergia porteri Shrubland (CEGL001511)
  Prosopis glandulosa / Sporobolus airoides Shrubland (CEGL001385)
  Prosopis glandulosa / Sporobolus flexuosus Shrubland (CEGL001386)
  Prosopis glandulosa var. glandulosa / Bouteloua gracilis - Buchloe dactyloides Shrubland (CEGL003877)
  Prosopis glandulosa var. torreyana Shrubland (CEGL001381)
- PROSOPIS GLANDULOSA TEMPORARILY FLOODED WOODLAND ALLIANCE (A.637)
  Prosopis glandulosa Temporarily Flooded Woodland (CEGL004934)
- PROSOPIS GLANDULOSA WOODLAND ALLIANCE (A.611)
  Prosopis glandulosa / Bouteloua curtipendula - Nassella leucotricha Woodland (CEGL002133)
- PROSOPIS PUBESCENS SHRUBLAND ALLIANCE (A.1042)
  Prosopis pubescens Shrubland (CEGL001387)
- PROSOPIS VELUTINA SHRUBLAND ALLIANCE (A.1043)
  Prosopis velutina - Acacia greggii Shrubland (CEGL001388)
  Prosopis velutina / Celtis laevigata var. reticulata Shrubland (CEGL001390)
  Prosopis velutina / Muhlenbergia porteri Shrubland (CEGL001391)

- **California community types:**
- Mesquite Bosque (61.510.05)
- Mesquite Alkaline (61.510.06)
- Mesquite - Willow (61.510.07)
- Upper Desert Mesquite (61.510.08)
- Honey Mesquite Scrub (61.512.00)
- Honey Mesquite (61.512.01)
- Tornillo Scrub (61.513.00)

SOURCES

References: Barbour and Major 1988, Brown 1982, Dick-Peddie 1993, Muldavin et al. 2000a, Muldavin et al. 2000b, Szaro 1989, Thomas et al. 2003a

Last updated: 20 Feb 2003 **Stakeholders:** WCS, SCS

Concept Author: NatureServe Western Ecology Team **LeadResp:** WCS

S118 GREAT BASIN FOOTHILL AND LOWER MONTANE RIPARIAN WOODLAND AND SHRUBLAND

Division 304, Woody Wetland, CES304.045

Spatial Scale & Pattern: Linear

Required Classifiers: Natural/Semi-natural, Vegetated (>10% vasc.), Wetland

Diagnostic Classifiers: Forest and Woodland (Treed), Riparian Mosaic, Riverine / Alluvial, Short (<5 yrs) Flooding Interval

Non-Diagnostic Classifiers: Montane [Lower Montane], Lowland [Foothill], Temperate [Temperate Continental]

Concept Summary: This system occurs in mountain ranges of the Great Basin and along the eastern slope of the Sierra Nevada within a broad elevation range from about 1220 m (4000 feet) to over 2135 m (7000 feet). This system often occurs as a mosaic of multiple communities that are tree-dominated with a diverse shrub component. The variety of plant associations connected to this system reflects elevation, stream gradient, floodplain width, and flooding events. Dominant trees may include *Abies concolor, Alnus incana, Betula occidentalis, Populus angustifolia, Populus balsamifera ssp. trichocarpa, Populus fremontii, Salix laevigata, Salix gooddingii*, and *Pseudotsuga menziesii*. Dominant shrubs include *Artemisia cana, Cornus sericea, Salix exigua, Salix lasiolepis, Salix lemmonii*, or *Salix lutea*. Herbaceous layers are often dominated by species of *Carex* and *Juncus*, and perennial grasses and mesic forbs such *Deschampsia caespitosa, Elymus trachycaulus, Glyceria striata, Iris missouriensis,*

Maianthemum stellatum, or *Thalictrum fendleri*. Introduced forage species such as *Agrostis stolonifera, Poa pratensis, Phleum pratense*, and the weedy annual *Bromus tectorum* are often present in disturbed stands. These are disturbance-driven systems that require flooding, scour and deposition for germination and maintenance. Livestock grazing is a major influence in altering structure, composition, and function of the community.

DISTRIBUTION

Range: Occurs in mountain ranges of the Great Basin and along the eastern slope of the Sierra Nevada within a broad elevation range from about 1220 m (4000 feet) to over 2135 m (7000 feet).
Ecological Divisions: 304
TNC Ecoregions: 11:C, 12:C, 6:P
Subnations/Nations: CA:c, NV:c, OR:?, UT:c

CONCEPT

Alliances and Associations:

- ALNUS INCANA TEMPORARILY FLOODED SHRUBLAND ALLIANCE (A.950)
  Alnus incana / Cornus sericea Shrubland (CEGL001145)
- ARTEMISIA CANA (SSP. BOLANDERI, SSP. VISCIDULA) SHRUBLAND ALLIANCE (A.2557)
  Artemisia cana (ssp. bolanderi, ssp. viscidula) / Leymus cinereus Shrubland (CEGL001460)
  Artemisia cana ssp. viscidula / Deschampsia caespitosa Shrubland (CEGL001074)
- ARTEMISIA NOVA SHRUBLAND ALLIANCE (A.1105)
  Artemisia nova - Ericameria nana Shrubland (CEGL002773)
- BETULA OCCIDENTALIS SEASONALLY FLOODED SHRUBLAND ALLIANCE (A.996)
  Betula occidentalis / Mesic Graminoids Shrubland (CEGL002654)
- BETULA OCCIDENTALIS TEMPORARILY FLOODED SHRUBLAND ALLIANCE (A.967)
  Betula occidentalis / Cornus sericea Shrubland (CEGL001161)
  Betula occidentalis / Maianthemum stellatum Shrubland (CEGL001162)
- CORNUS SERICEA TEMPORARILY FLOODED SHRUBLAND ALLIANCE (A.968)
  Cornus sericea Shrubland (CEGL001165)
- POPULUS ANGUSTIFOLIA TEMPORARILY FLOODED WOODLAND ALLIANCE (A.641)
  Populus angustifolia / Betula occidentalis Woodland (CEGL000648)
  Populus angustifolia / Rhus trilobata Woodland (CEGL000652)
- POPULUS BALSAMIFERA SSP. TRICHOCARPA TEMPORARILY FLOODED FOREST ALLIANCE (A.311)
  Populus balsamifera ssp. trichocarpa / Alnus incana Forest (CEGL000667)
  Populus balsamifera ssp. trichocarpa / Mixed Herbs Forest (CEGL000675)
- POPULUS FREMONTII SEASONALLY FLOODED WOODLAND ALLIANCE (A.654)
  Populus fremontii / Leymus triticoides Woodland (CEGL002756)
  Populus fremontii / Salix geyeriana Woodland (CEGL000943)
- POPULUS FREMONTII TEMPORARILY FLOODED FOREST ALLIANCE (A.313)
  Populus fremontii / Salix exigua Forest (CEGL000666)
- SALIX LASIOLEPIS TEMPORARILY FLOODED SHRUBLAND ALLIANCE (A.977)
  Salix lasiolepis / Rosa woodsii / Mixed Herbs Shrubland (CEGL001217)
- SALIX LEMMONII SEASONALLY FLOODED SHRUBLAND ALLIANCE (A.2523)
  Salix lemmonii / Mesic-Tall Forbs Shrubland (CEGL002771)
  Salix lemmonii / Rosa woodsii Shrubland (CEGL002772)
- SALIX LUTEA SEASONALLY FLOODED SHRUBLAND ALLIANCE (A.1007)
  Salix lutea / Carex utriculata Shrubland (CEGL001220)
- SALIX LUTEA TEMPORARILY FLOODED SHRUBLAND ALLIANCE (A.980)
  Salix lutea / Mesic Forbs Shrubland (CEGL002774)

SOURCES

References: Barbour and Billings 1988, Barbour and Major 1977, Manning and Padgett 1989, Sawyer and Keeler-Wolf 1995
Last updated: 16 Apr 2003 **Stakeholders:** WCS
Concept Author: J. Nachlinger and K. Schulz **LeadResp:** WCS

S120 WESTERN GREAT PLAINS FLOODPLAIN HERBACEOUS WETLAND

Spatial Scale & Pattern: Linear

This SW Regional GAP Landcover Type is complex of two ecological systems, S095 Western Great Plains Riparian Woodland and Shrubland and S120 Western Great Plains Floodplain Herbaceous Wetland. Both of these ecological systems include riparian woodlands, shrubland and herbaceous vegetation, however to facilitate wildlife habitat modeling the complex was split physiognomally. In this landcover type includes only herbaceous vegetation. . Riparian woodland and shrubland vegetation was mapped as S095 Western Great Plains Riparian Woodland and Shrubland See both ecological system descriptions below:

Western Great Plains Floodplain

Division 303, Woody Wetland, CES303.678

Spatial Scale & Pattern: Linear **Classification Confidence:** medium

Required Classifiers: Natural/Semi-natural, Vegetated (>10% vasc.), Wetland

Non-Diagnostic Classifiers: Forest and Woodland (Treed), Herbaceous, Floodplain, Riverine / Alluvial, Deep (>15 cm) Water, Long (>25 yrs) Flooding Interval

This SW Regional GAP Landcover Type includes portions of two similar ecological systems, S095 Western Great Plains Riparian Woodland and Shrubland and S120 Western Great Plains Floodplain Herbaceous Wetland, which where combined for facilitate mapping. Both these ecological systems include riparian woodlands, shrubland and herbaceous vegetation. To facilitate wildlife habitat modeling, only woodland and shrubland vegetation was included in this landcover type. Riparian woodland and shrubland vegetation was mapped as S095 Western Great Plains Riparian Woodland and Shrubland

Concept Summary: This system is found in the floodplains of medium and large rivers of the Western Great Plains. Alluvial soils and periodic, intermediate flooding (every 5-25 years) typify this system. Dominant communities within this system range from floodplain forests to wet meadows to gravel/sand flats; however, they are linked by underlying soils and the flooding regime. Dominant species include *Populus deltoides* and *Salix* spp. Grass cover underneath the trees is an important part of this system and is a mix of tallgrass species, including *Panicum virgatum* and *Andropogon gerardii*. *Tamarix* spp. and less desirable grasses and forbs can invade degraded areas within the floodplains, especially in the western portion of the province. These areas are often subjected to heavy grazing and/or agriculture and can be heavily degraded. Another factor is that groundwater depletion and lack of fire have created additional species changes. In most cases, the majority of the wet meadow and prairie communities may be extremely degraded or extirpated from the system.

Comments: Need to review if there needs to be another split of this system into a Central Great Plains Floodplain system and a Southern Great Plains floodplain system. Will need to review in conjunction with Northwestern Great Plains Floodplain.

DISTRIBUTION

Range: This system is found along major river floodplains in the southern and central portions of the Western Great Plains division.

Ecological Divisions: 205, 303

TNC Ecoregions: 27:C, 28:C, 29:P, 32:C, 33:C, 37:C

Subnations/Nations: CO:c, KS:c, NE:c, OK:c, SD:c, TX:p

CONCEPT

Alliances and Associations:

- CAREX NEBRASCENSIS SEASONALLY FLOODED HERBACEOUS ALLIANCE (A.1417)
  Carex nebrascensis Herbaceous Vegetation (CEGL001813)
- CELTIS LAEVIGATA - ULMUS CRASSIFOLIA TEMPORARILY FLOODED FOREST ALLIANCE (A.283)
  Ulmus crassifolia - Celtis laevigata / Ilex decidua / Elymus virginicus Forest (CEGL008468)
- COBBLE/GRAVEL SHORE SPARSELY VEGETATED ALLIANCE (A.1850)
  Riverine Gravel Flats Great Plains Sparse Vegetation (CEGL005223)
- ERICAMERIA NAUSEOSA SHRUBLAND ALLIANCE (A.835)
  Ericameria nauseosa / Pseudoroegneria spicata Shrubland (CEGL001330)
- FRAXINUS PENNSYLVANICA - ULMUS AMERICANA - CELTIS (OCCIDENTALIS, LAEVIGATA) TEMPORARILY FLOODED FOREST ALLIANCE (A.286)
  Ulmus (americana, rubra) - Quercus muehlenbergii Forest (CEGL002091)
  Ulmus americana - Celtis (laevigata, occidentalis) - Fraxinus pennsylvanica Forest (CEGL002090)

- JUGLANS MICROCARPA TEMPORARILY FLOODED SHRUBLAND ALLIANCE (A.945)
  Juglans microcarpa - Brickellia laciniata / Indigofera lindheimeriana Edwards Plateau Shrubland (CEGL004932)
- JUSTICIA AMERICANA TEMPORARILY FLOODED HERBACEOUS ALLIANCE (A.1657)
  Justicia americana - Bacopa monnieri Edwards Plateau Herbaceous Vegetation (CEGL004926)
- PANICUM VIRGATUM TEMPORARILY FLOODED HERBACEOUS ALLIANCE (A.1343)
  Panicum virgatum - Andropogon glomeratus - Cladium mariscus ssp. jamaicense Herbaceous Vegetation (CEGL004928)
- PLATANUS OCCIDENTALIS - (BETULA NIGRA, SALIX SPP.) TEMPORARILY FLOODED WOODLAND ALLIANCE (A.633)
  Platanus occidentalis - (Salix nigra) / Juglans microcarpa - Baccharis salicifolia Woodland (CEGL004930)
  Platanus occidentalis - Juglans major Woodland (CEGL004929)
- PLATANUS OCCIDENTALIS - (FRAXINUS PENNSYLVANICA, CELTIS LAEVIGATA, ACER SACCHARINUM) TEMPORARILY FLOODED FOREST ALLIANCE (A.288)
  Platanus occidentalis - Salix nigra Forest (CEGL002093)
- POPULUS DELTOIDES SSP. WISLIZENI TEMPORARILY FLOODED FOREST ALLIANCE (A.312)
  Populus deltoides / Muhlenbergia asperifolia Forest (CEGL000678)
- POPULUS DELTOIDES TEMPORARILY FLOODED FOREST ALLIANCE (A.290)
  Populus deltoides - Ulmus americana - Celtis laevigata Forest (CEGL002096)
- POPULUS DELTOIDES TEMPORARILY FLOODED WOODLAND ALLIANCE (A.636)
  Populus deltoides - (Salix amygdaloides) / Salix (exigua, interior) Woodland (CEGL000659)
  Populus deltoides - Salix nigra Woodland (CEGL004919)
  Populus deltoides / Carex pellita Woodland (CEGL002649)
  Populus deltoides / Distichlis spicata Woodland (CEGL000939)
  Populus deltoides / Panicum virgatum - Schizachyrium scoparium Woodland (CEGL001454)
  Populus deltoides / Salix exigua Woodland (CEGL002685)
- SALIX (EXIGUA, INTERIOR) TEMPORARILY FLOODED SHRUBLAND ALLIANCE (A.947)
  Salix exigua / Mesic Graminoids Shrubland (CEGL001203)
- SALIX NIGRA TEMPORARILY FLOODED FOREST ALLIANCE (A.297)
  Salix nigra Forest (CEGL002103)
- SAND FLATS TEMPORARILY FLOODED SPARSELY VEGETATED ALLIANCE (A.1864)
  Riverine Sand Flats - Bars Sparse Vegetation (CEGL002049)
- SCHOENOPLECTUS PUNGENS SEMIPERMANENTLY FLOODED HERBACEOUS ALLIANCE (A.1433)
  Schoenoplectus pungens - Suaeda calceoliformis Alkaline Herbaceous Vegetation (CEGL002040)
- SPARTINA PECTINATA TEMPORARILY FLOODED HERBACEOUS ALLIANCE (A.1347)
  Spartina pectinata - Eleocharis spp. - Carex spp. Herbaceous Vegetation (CEGL002223)
- SPOROBOLUS AIROIDES HERBACEOUS ALLIANCE (A.1267)
  Sporobolus airoides Southern Plains Herbaceous Vegetation (CEGL001685)
- SYMPHORICARPOS OCCIDENTALIS TEMPORARILY FLOODED SHRUBLAND ALLIANCE (A.961)
  Symphoricarpos occidentalis Shrubland (CEGL001131)
- TAMARIX SPP. SEMI-NATURAL TEMPORARILY FLOODED SHRUBLAND ALLIANCE (A.842)
  Tamarix spp. Temporarily Flooded Shrubland (CEGL003114)
- TAXODIUM DISTICHUM - (PLATANUS OCCIDENTALIS) TEMPORARILY FLOODED FOREST ALLIANCE (A.298)
  Taxodium distichum - Platanus occidentalis Edwards Plateau Forest (CEGL002104)
- TYPHA (ANGUSTIFOLIA, LATIFOLIA) - (SCHOENOPLECTUS SPP.) SEMIPERMANENTLY FLOODED HERBACEOUS ALLIANCE (A.1436)
  Schoenoplectus acutus - Typha latifolia - (Schoenoplectus tabernaemontani) Sandhills Herbaceous Vegetation (CEGL002030)
  Typha (angustifolia, domingensis, latifolia) - Schoenoplectus americanus Herbaceous Vegetation (CEGL002032)
  Typha latifolia Western Herbaceous Vegetation (CEGL002010)
- TYPHA SPP. - (SCHOENOPLECTUS SPP., JUNCUS SPP.) SEASONALLY FLOODED HERBACEOUS ALLIANCE (A.1394)
  Schoenoplectus tabernaemontani - Typha spp. - (Sparganium spp., Juncus spp.) Herbaceous Vegetation (CEGL002026)

Environment: This system is found primarily along floodplains of medium and large rivers. Soils are primarily alluvial and range from sandy to dense clays.

Vegetation: Dominant woody species occurring within this system include *Populus deltoides* and *Salix* spp. Understory species constitute an important component of this system and include a mixture of tallgrass prairie species such as including *Panicum virgatum* and *Andropogon gerardii*. Sparsely vegetated areas such as gravel and sand flats are also included within this system.

Dynamics: Periodic and intermediate flooding (i.e., every 5-25 years) constitutes the major process influencing this system. Grazing and conversion to agriculture can significantly impact this system and can lead to the degradation or extirpation of the majority of prairie and wet meadow communities from this system.

SOURCES

References: Lauver et al. 1999, Steinauer and Rolfsmeier 2000
Last updated: 05 Mar 2003 **Stakeholders:** MCS, SCS, WCS
Concept Author: S. Menard and K. Kindscher **LeadResp:** MCS

Western Great Plains Riparian Woodland and Shrubland

Division 303, Mixed Upland and Wetland, CES303.956
Spatial Scale & Pattern: Linear
Required Classifiers: Natural/Semi-natural, Vegetated (>10% vasc.), Upland, Wetland
Diagnostic Classifiers: Woody-Herbaceous, Very Short Disturbance Interval, Flood Scouring, Riparian Mosaic, Riverine / Alluvial

Non-Diagnostic Classifiers: Lowland [Lowland], Forest and Woodland (Treed), Shrubland (Shrub-dominated), Alluvial fan, Arroyo, Floodplain, Fluvial, Toeslope/Valley Bottom, Temperate [Temperate Xeric], Broad-Leaved Deciduous Tree, Broad-Leaved Deciduous Shrub, Evergreen Sclerophyllous Shrub, Graminoid, Intermittent Flooding, Short (<5 yrs) Flooding Interval

Concept Summary: This system is found in the riparian areas of medium and small rivers and streams throughout the Western Great Plains. It is likely most common in the Central Shortgrass Prairie and Northern Great Plains Steppe, but extends west into the Wyoming Basins. These are found on alluvial soils in highly variable landscape settings, from deep cut ravines to wide, braided streambeds. Hydrologically, these tend to be more flashy with less developed floodplain than on larger rivers, and typically dry down completely for some portion of the year. Dominant vegetation shares much with generally drier portions of larger floodplain systems downstream, but overall abundance of vegetation is generally lower. Communities within this system range from riparian forests and shrublands to gravel/sand flats. Dominant species include *Populus deltoides, Salix* spp., *Artemisia cana ssp. cana, Pascopyrum smithii, Sporobolus cryptandrus,* and *Schizachyrium scoparium.* These areas are often subjected to heavy grazing and/or agriculture and can be heavily degraded. *Tamarix* spp. and less desirable grasses and forbs can invade degraded examples up through central Colorado. Another factor is that groundwater depletion and lack of fire have created additional species changes.

DISTRIBUTION

Range: Riparian areas of medium and small rivers and streams throughout the Western Great Plains. It is likely most common in the Central Shortgrass Prairie and Northern Great Plains Steppe, but extends west into the Wyoming Basins.
Ecological Divisions: 303, 304
TNC Ecoregions: 10:P, 26:C, 27:C, 28:P
Subnations/Nations: CO:, MT:, NM:, WY:

CONCEPT

Alliances and Associations:

- ARTEMISIA CANA TEMPORARILY FLOODED SHRUBLAND ALLIANCE (A.843)
  Artemisia cana / Pascopyrum smithii Shrubland (CEGL001072)
- COBBLE/GRAVEL SHORE SPARSELY VEGETATED ALLIANCE (A.1850)
  Riverine Gravel Flats Great Plains Sparse Vegetation (CEGL005223)
- POPULUS DELTOIDES TEMPORARILY FLOODED WOODLAND ALLIANCE (A.636)
  Populus deltoides / Panicum virgatum - Schizachyrium scoparium Woodland (CEGL001454)
- SYMPHORICARPOS OCCIDENTALIS TEMPORARILY FLOODED SHRUBLAND ALLIANCE (A.961)
  Symphoricarpos occidentalis Shrubland (CEGL001131)
- TAMARIX SPP. SEMI-NATURAL TEMPORARILY FLOODED SHRUBLAND ALLIANCE (A.842)
  Tamarix spp. Temporarily Flooded Shrubland (CEGL003114)

SOURCES

Last updated: 20 Mar 2003 **Stakeholders:** WCS, CAN
Concept Author: P. Comer, G. Kittel **LeadResp:** WCS

NLCD Emergent Herbaceous Wetland Types

Areas where perennial herbaceous vegetation accounts for greater than 80 percent of vegetative cover and the soil or substrate is periodically sturated with or covered with water.

S100 NORTH AMERICAN ARID WEST EMERGENT MARSH

Division 300, Herbaceous Wetland, CES300.729

Spatial Scale & Pattern: Small Patch **Classification Confidence:** high
Required Classifiers: Natural/Semi-natural, Vegetated (>10% vasc.), Wetland
Diagnostic Classifiers: Herbaceous, Mineral: W/ A-Horizon >10 cm, Graminoid, Aquatic Herb, Depressional [Lakeshore], Depressional [Pond], Deep (>15 cm) Water, Saturated Soil

Non-Diagnostic Classifiers: Montane [Montane], Montane [Lower Montane], Lowland [Foothill], Lowland [Lowland], Backwater, Drainage bottom (undifferentiated), Floodplain, Marsh, Oxbow, Pond, Temperate [Temperate Continental], Forb, Alga, Clay Subsoil Texture

Concept Summary: This widespread ecological system occurs throughout much of the arid and semi-arid regions of western North America. Natural marshes may occur in depressions in the landscape (ponds, kettle ponds), as fringes around lakes, and along slow-flowing streams and rivers (such riparian marshes are also referred to as sloughs). Marshes are frequently or continually inundated, with water depths up to 2 m. Water levels may be stable, or may fluctuate 1 m or more over the course of the growing season. Marshes have distinctive soils that are typically mineral, but can also accumulate organic material. Soils have characteristics that result from long periods of anaerobic conditions in the soils (e.g., gleyed soils, high organic content, redoximorphic features). The vegetation is characterized by herbaceous plants that are adapted to saturated soil conditions. Common emergent and floating vegetation includes species of *Scirpus* and/or *Schoenoplectus*, *Typha*, *Juncus*, *Potamogeton*, *Polygonum*, *Nuphar*, and *Phalaris*. This system may also include areas of relatively deep water with floating-leaved plants (*Lemna*, *Potamogeton*, and *Brasenia*) and submergent and floating plants (*Myriophyllum*, *Ceratophyllum*, and *Elodea*).

DISTRIBUTION

Range: Occurs throughout much of the arid and semi-arid regions of western North America.
Ecological Divisions: 301, 302, 303, 304, 305, 306
TNC Ecoregions: 11:C, 17:C, 18:C, 19:C, 20:C, 21:C, 23:C, 24:C, 26:C, 27:C, 28:C, 29:C, 30:C, 6:C, 7:C, 8:C, 9:C
Subnations/Nations: AB:c, AZ:c, BC:c, CA:c, CO:c, ID:c, MT:c, MXBC:c, MXCH:c, MXSO:c, ND:c, NE:c, NM:c, NV:c, OK:c, OR:c, SD:c, TX:c, UT:c, WA:c, WY:c

CONCEPT

Alliances and Associations:

- (POTAMOGETON DIVERSIFOLIUS, STUCKENIA FILIFORMIS) PERMANENTLY FLOODED HERBACEOUS ALLIANCE (A.1763)
  Potamogeton diversifolius Herbaceous Vegetation (CEGL002007)
  Stuckenia filiformis Herbaceous Vegetation (CEGL002008)
- CALAMAGROSTIS CANADENSIS SEASONALLY FLOODED HERBACEOUS ALLIANCE (A.1400)
  Calamagrostis canadensis Western Herbaceous Vegetation (CEGL001559)
- CAREX (ROSTRATA, UTRICULATA) SEASONALLY FLOODED HERBACEOUS ALLIANCE (A.1403)
  Carex utriculata Herbaceous Vegetation (CEGL001562)
- CAREX NEBRASCENSIS SEASONALLY FLOODED HERBACEOUS ALLIANCE (A.1417)
  Carex nebrascensis Herbaceous Vegetation (CEGL001813)
- CAREX VESICARIA SEASONALLY FLOODED HERBACEOUS ALLIANCE (A.2501)
  Carex vesicaria Herbaceous Vegetation (CEGL002661)

- DISTICHLIS SPICATA INTERMITTENTLY FLOODED HERBACEOUS ALLIANCE (A.1332)
  Distichlis spicata - (Scirpus nevadensis) Herbaceous Vegetation (CEGL001773)
- ELEOCHARIS (MONTEVIDENSIS, PALUSTRIS, QUINQUEFLORA) SEASONALLY FLOODED HERBACEOUS ALLIANCE (A.1371)
  Eleocharis (montevidensis, palustris, quinqueflora) Seasonally Flooded Herbaceous Vegetation [Placeholder] (CEGL003050)
- GLYCERIA BOREALIS SEMIPERMANENTLY FLOODED HERBACEOUS ALLIANCE (A.1445)
  Glyceria borealis Herbaceous Vegetation (CEGL001569)
- JUNCUS BALTICUS SEASONALLY FLOODED HERBACEOUS ALLIANCE (A.1374)
  Juncus balticus - Carex rossii Herbaceous Vegetation (CEGL001839)
  Juncus balticus Herbaceous Vegetation (CEGL001838)
- LEMNA SPP. PERMANENTLY FLOODED HERBACEOUS ALLIANCE (A.1747)
  Lemna spp. Permanently Flooded Herbaceous Vegetation (CEGL003059)
- MYRIOPHYLLUM SIBIRICUM PERMANENTLY FLOODED HERBACEOUS ALLIANCE (A.1761)
  Myriophyllum sibiricum Herbaceous Vegetation (CEGL002000)
- NYMPHAEA ODORATA - NUPHAR SPP. PERMANENTLY FLOODED TEMPERATE HERBACEOUS ALLIANCE (A.1984)
  Nuphar lutea ssp. polysepala Herbaceous Vegetation (CEGL002001)
- PHALARIS ARUNDINACEA SEASONALLY FLOODED HERBACEOUS ALLIANCE (A.1381)
  Phalaris arundinacea Western Herbaceous Vegetation (CEGL001474)
- PHRAGMITES AUSTRALIS SEMIPERMANENTLY FLOODED HERBACEOUS ALLIANCE (A.1431)
  Phragmites australis Western North America Temperate Semi-natural Herbaceous Vegetation (CEGL001475)
- POTAMOGETON FOLIOSUS PERMANENTLY FLOODED HERBACEOUS ALLIANCE (A.2518)
  Potamogeton foliosus Herbaceous Vegetation (CEGL002742)
- POTAMOGETON SPP. - CERATOPHYLLUM SPP. - ELODEA SPP. PERMANENTLY FLOODED HERBACEOUS ALLIANCE (A.1754)
  Potamogeton natans Herbaceous Vegetation (CEGL002925)
- RANUNCULUS AQUATILIS SEMIPERMANENTLY FLOODED HERBACEOUS ALLIANCE (A.1679)
  Ranunculus aquatilis - Callitriche palustris Herbaceous Vegetation (CEGL001984)
- RUPPIA (CIRRHOSA, MARITIMA) PERMANENTLY FLOODED HERBACEOUS ALLIANCE (A.1755)
  Ruppia (cirrhosa, maritima) Permanently Flooded Herbaceous Vegetation [Placeholder] (CEGL003119)
- SALICORNIA RUBRA SEASONALLY FLOODED HERBACEOUS ALLIANCE (A.1818)
  Salicornia rubra Herbaceous Vegetation (CEGL001999)
- SCHOENOPLECTUS ACUTUS - (SCHOENOPLECTUS TABERNAEMONTANI) SEMIPERMANENTLY FLOODED HERBACEOUS ALLIANCE (A.1443)
  Schoenoplectus acutus Herbaceous Vegetation (CEGL001840)
  Schoenoplectus tabernaemontani Temperate Herbaceous Vegetation (CEGL002623)
- SCHOENOPLECTUS AMERICANUS SEMIPERMANENTLY FLOODED HERBACEOUS ALLIANCE (A.1432)
  Schoenoplectus americanus - Carex spp. Herbaceous Vegetation (CEGL004144)
  Schoenoplectus americanus - Eleocharis palustris Herbaceous Vegetation (CEGL001585)
  Schoenoplectus americanus - Eleocharis spp. Herbaceous Vegetation (CEGL001586)
  Schoenoplectus americanus - Flaveria chlorifolia - (Helianthus paradoxus) Herbaceous Vegetation (CEGL004592)
  Schoenoplectus americanus Western Herbaceous Vegetation (CEGL001841)
- SCHOENOPLECTUS MARITIMUS SEMIPERMANENTLY FLOODED HERBACEOUS ALLIANCE (A.1444)
  Schoenoplectus maritimus Herbaceous Vegetation (CEGL001843)
- SCHOENOPLECTUS PUNGENS SEMIPERMANENTLY FLOODED HERBACEOUS ALLIANCE (A.1433)
  Schoenoplectus pungens Herbaceous Vegetation (CEGL001587)
- SPARGANIUM ANGUSTIFOLIUM PERMANENTLY FLOODED HERBACEOUS ALLIANCE (A.1760)
  Sparganium angustifolium Herbaceous Vegetation (CEGL001990)
- SPARGANIUM EURYCARPUM PERMANENTLY FLOODED HERBACEOUS ALLIANCE (A.2598)
  Sparganium eurycarpum Herbaceous Vegetation (CEGL003323)
- SPARTINA GRACILIS SEASONALLY FLOODED HERBACEOUS ALLIANCE (A.1407)
  Spartina gracilis Herbaceous Vegetation (CEGL001588)
- SPARTINA PECTINATA TEMPORARILY FLOODED HERBACEOUS ALLIANCE (A.1347)
  Spartina pectinata Western Herbaceous Vegetation (CEGL001476)
- TRIGLOCHIN MARITIMA SEMIPERMANENTLY FLOODED HERBACEOUS ALLIANCE (A.1681)
  Triglochin maritima Herbaceous Vegetation (CEGL001995)
- TYPHA (ANGUSTIFOLIA, LATIFOLIA) - (SCHOENOPLECTUS SPP.) SEMIPERMANENTLY FLOODED HERBACEOUS ALLIANCE (A.1436)
  Schoenoplectus acutus - Typha latifolia - (Schoenoplectus tabernaemontani) Sandhills Herbaceous Vegetation (CEGL002030)
  Typha latifolia Western Herbaceous Vegetation (CEGL002010)

- TYPHA DOMINGENSIS SEASONALLY FLOODED TEMPERATE HERBACEOUS ALLIANCE (A.1392)
  Typha domingensis Western Herbaceous Vegetation (CEGL001845)

SOURCES

References: Brown 1982, Cooper 1986b, Dick-Peddie 1993, Faber-Langendoen et al. 1997, Hansen et al. 1995, Kittel et al. 1994, Neely et al. 2001, Padgett et al. 1989, Rondeau 2001, Szaro 1989, Ungar 1965, Ungar 1972
Last updated: 20 Feb 2003 **Stakeholders:** WCS, SCS
Concept Author: NatureServe Western Ecology Team **LeadResp:** WCS

S102 ROCKY MOUNTAIN ALPINE-MONTANE WET MEADOW

Division 306, Herbaceous Wetland, CES306.812

Spatial Scale & Pattern: Small Patch **Classification Confidence:** medium
Required Classifiers: Natural/Semi-natural, Vegetated (>10% vasc.), Wetland
Diagnostic Classifiers: Alpine/AltiAndino [Alpine/AltiAndino], Montane [Upper Montane], Herbaceous, Graminoid, Seepage-Fed Sloping [Mineral], Depressional [Lakeshore], Depressional [Pond]

Non-Diagnostic Classifiers: Montane [Montane], Temperate [Temperate Continental], Mineral: W/ A-Horizon >10 cm, Mineral: W/ A-Horizon <10 cm, Forb, Mesotrophic Water, Saturated Soil

Concept Summary: These are high-elevation communities found throughout the Rocky Mountains and Intermountain regions, dominated by herbaceous species found on wetter sites with very low-velocity surface and subsurface flows. They range in elevation from montane to alpine (1000-3600 m). These types occur as large meadows in montane or subalpine valleys, as narrow strips bordering ponds, lakes, and streams, and along toeslope seeps. They are typically found on flat areas or gentle slopes, but may also occur on sub-irrigated sites with slopes up to 10%. In alpine regions, sites typically are small depressions located below late-melting snow patches or on snowbeds. Soils of this system may be mineral or organic. In either case, soils show typical hydric soil characteristics, including high organic content and/or low chroma and redoximorphic features. This system often occurs as a mosaic of several plant associations, often dominated by graminoids, including *Calamagrostis stricta, Caltha leptosepala, Cardamine cordifolia, Carex illota, Carex microptera, Carex nigricans, Carex scopulorum, Carex utriculata, Carex vernacula, Deschampsia caespitosa, Eleocharis quinqueflora, Juncus drummondii, Phippsia algida, Rorippa alpina, Senecio triangularis, Trifolium parryi*, and *Trollius laxus*. Often alpine dwarf-shrublands, especially those dominated by *Salix*, are immediately adjacent to the wet meadows. Wet meadows are tightly associated with snowmelt and typically not subjected to high disturbance events such as flooding.

DISTRIBUTION

Range: Found throughout the Rocky Mountains and Intermountain regions, ranging in elevation from montane to alpine (1000-3600 m).
Ecological Divisions: 304, 306
TNC Ecoregions: 11:C, 18:C, 19:C, 20:C, 21:C, 22:P, 25:C, 68:C, 7:C, 8:C, 9:C
Subnations/Nations: AB:c, AZ:c, BC:c, CO:c, ID:c, MT:c, NM:c, NV:c, OR:c, SD:c, UT:c, WA:c, WY:c

CONCEPT

Alliances and Associations:

- AGROSTIS SCABRA TEMPORARILY FLOODED HERBACEOUS ALLIANCE (A.1351)
  Agrostis exarata - Agrostis scabra Herbaceous Vegetation (CEGL001557)
- AGROSTIS STOLONIFERA SEASONALLY FLOODED HERBACEOUS ALLIANCE (A.1405)
  Agrostis stolonifera Herbaceous Vegetation (CEGL001558)
- BETULA NANA SEASONALLY FLOODED SHRUBLAND ALLIANCE (A.995)
  Betula nana / Carex utriculata Shrubland (CEGL001079)
  Betula nana / Mesic Forbs - Mesic Graminoids Shrubland (CEGL002653)
- CALAMAGROSTIS CANADENSIS SEASONALLY FLOODED HERBACEOUS ALLIANCE (A.1400)
  Calamagrostis canadensis - Carex scopulorum - Mertensia ciliata Herbaceous Vegetation (CEGL001560)
  Calamagrostis canadensis - Senecio triangularis Herbaceous Vegetation (CEGL001561)
  Calamagrostis canadensis Western Herbaceous Vegetation (CEGL001559)
- CALAMAGROSTIS STRICTA TEMPORARILY FLOODED HERBACEOUS ALLIANCE (A.2594)
  Calamagrostis stricta Herbaceous Vegetation [Provisional] (CEGL002891)
- CALTHA LEPTOSEPALA SATURATED HERBACEOUS ALLIANCE (A.1698)
  Caltha leptosepala - Deschampsia caespitosa Herbaceous Vegetation (CEGL001955)
  Caltha leptosepala - Polygonum bistortoides Herbaceous Vegetation (CEGL001956)

Caltha leptosepala - Rhodiola rhodantha Herbaceous Vegetation (CEGL001957)
Caltha leptosepala Herbaceous Vegetation (CEGL001954)

- CAMASSIA (CUSICKII, QUAMASH) SEASONALLY FLOODED HERBACEOUS ALLIANCE (A.2587)
  Camassia cusickii Herbaceous Vegetation (CEGL003440)
- CARDAMINE CORDIFOLIA SATURATED HERBACEOUS ALLIANCE (A.1699)
  Cardamine cordifolia - Caltha leptosepala Herbaceous Vegetation (CEGL001958)
  Cardamine cordifolia - Mertensia ciliata Herbaceous Vegetation (CEGL002662)
- CAREX (LACHENALII, CAPILLARIS, ILLOTA) SEASONALLY FLOODED HERBACEOUS ALLIANCE (A.1424)
  Carex capillaris - Polygonum viviparum Herbaceous Vegetation (CEGL001872)
  Carex illota Herbaceous Vegetation (CEGL001876)
  Carex lachenalii Herbaceous Vegetation (CEGL001871)
- CAREX (ROSTRATA, UTRICULATA) SEASONALLY FLOODED HERBACEOUS ALLIANCE (A.1403)
  Carex utriculata Herbaceous Vegetation (CEGL001562)
- CAREX AMPLIFOLIA SATURATED HERBACEOUS ALLIANCE (A.2584)
  Carex amplifolia Herbaceous Vegetation (CEGL003427)
- CAREX APERTA SATURATED HERBACEOUS ALLIANCE (A.1468)
  Carex aperta Herbaceous Vegetation (CEGL001801)
- CAREX AQUATILIS SEASONALLY FLOODED HERBACEOUS ALLIANCE (A.1404)
  Carex aquatilis - Carex utriculata Herbaceous Vegetation (CEGL001803)
  Carex aquatilis - Pedicularis groenlandica Herbaceous Vegetation (CEGL001804)
  Carex aquatilis Herbaceous Vegetation (CEGL001802)
- CAREX AQUATILIS VAR. DIVES SEASONALLY FLOODED HERBACEOUS ALLIANCE (A.1412)
  Carex aquatilis var. dives Herbaceous Vegetation (CEGL001826)
- CAREX ARAPAHOENSIS HERBACEOUS ALLIANCE (A.1319)
- CAREX DOUGLASII HERBACEOUS ALLIANCE (A.1286)
  Carex douglasii Herbaceous Vegetation (CEGL001768)
- CAREX DURIUSCULA HERBACEOUS ALLIANCE (A.1283)
  Carex duriuscula Herbaceous Vegetation (CEGL001874)
- CAREX LASIOCARPA SEASONALLY FLOODED HERBACEOUS ALLIANCE (A.1415)
  Carex lasiocarpa Herbaceous Vegetation (CEGL001810)
- CAREX LIMOSA SEASONALLY FLOODED HERBACEOUS ALLIANCE (A.1416)
  Carex limosa Herbaceous Vegetation (CEGL001811)
- CAREX MICROGLOCHIN SATURATED HERBACEOUS ALLIANCE (A.1470)
  Carex microglochin Herbaceous Vegetation (CEGL001877)
- CAREX MICROPTERA SEASONALLY FLOODED HERBACEOUS ALLIANCE (A.1411)
  Carex microptera Herbaceous Vegetation (CEGL001792)
- CAREX NEBRASCENSIS SEASONALLY FLOODED HERBACEOUS ALLIANCE (A.1417)
  Carex nebrascensis - Carex microptera Herbaceous Vegetation (CEGL001815)
  Carex nebrascensis - Catabrosa aquatica Herbaceous Vegetation (CEGL001814)
  Carex nebrascensis Herbaceous Vegetation (CEGL001813)
  Carex nebrascensis Slope Herbaceous Vegetation (CEGL002890)
- CAREX NIGRICANS SEASONALLY FLOODED HERBACEOUS ALLIANCE (A.1418)
  Carex nigricans - Juncus drummondii Herbaceous Vegetation (CEGL001818)
  Carex nigricans Herbaceous Vegetation (CEGL001816)
- CAREX PELLITA SEASONALLY FLOODED HERBACEOUS ALLIANCE (A.1414)
  Carex pellita Herbaceous Vegetation (CEGL001809)
- CAREX PRAEGRACILIS SEASONALLY FLOODED HERBACEOUS ALLIANCE (A.1419)
  Carex praegracilis - Carex aquatilis Herbaceous Vegetation (CEGL001821)
  Carex praegracilis Herbaceous Vegetation (CEGL002660)
- CAREX PYRENAICA HERBACEOUS ALLIANCE (A.1320)
  Carex pyrenaica Herbaceous Vegetation (CEGL001860)
- CAREX SAXATILIS TEMPORARILY FLOODED HERBACEOUS ALLIANCE (A.1357)
  Carex saxatilis Herbaceous Vegetation (CEGL001769)
- CAREX SCIRPOIDEA SSP. PSEUDOSCIRPOIDEA HERBACEOUS ALLIANCE (A.1306)
  Carex scirpoidea ssp. pseudoscirpoidea Herbaceous Vegetation (CEGL001865)
- CAREX SCOPULORUM SEASONALLY FLOODED HERBACEOUS ALLIANCE (A.1420)
  Carex scopulorum - Caltha leptosepala Herbaceous Vegetation (CEGL001823)
  Carex scopulorum - Elymus trachycaulus Herbaceous Vegetation (CEGL001824)
  Carex scopulorum Herbaceous Vegetation (CEGL001822)
- CAREX SIMULATA SATURATED HERBACEOUS ALLIANCE (A.1469)
  Carex simulata Herbaceous Vegetation (CEGL001825)

- CAREX STRAMINIFORMIS HERBACEOUS ALLIANCE (A.1314)
  Carex straminiformis Herbaceous Vegetation (CEGL001793)
- CAREX VERNACULA HERBACEOUS ALLIANCE (A.1309)
  Carex vernacula - Poa fendleriana Herbaceous Vegetation (CEGL001869)
- CAREX VESICARIA SEASONALLY FLOODED HERBACEOUS ALLIANCE (A.2501)
  Carex vesicaria Herbaceous Vegetation (CEGL002661)
- DASIPHORA FRUTICOSA TEMPORARILY FLOODED SHRUBLAND ALLIANCE (A.958)
  Dasiphora fruticosa ssp. floribunda / Carex spp. Shrubland (CEGL001106)
  Dasiphora fruticosa ssp. floribunda / Deschampsia caespitosa Shrubland (CEGL001107)
  Dasiphora fruticosa ssp. floribunda Shrubland [Provisional] (CEGL001105)
- DESCHAMPSIA CAESPITOSA SATURATED HERBACEOUS ALLIANCE (A.1456)
  Deschampsia caespitosa - Caltha leptosepala Herbaceous Vegetation (CEGL001882)
- DESCHAMPSIA CAESPITOSA SEASONALLY FLOODED HERBACEOUS ALLIANCE (A.1408)
  Deschampsia caespitosa - Carex microptera Herbaceous Vegetation (CEGL001883)
  Deschampsia caespitosa - Carex nebrascensis Herbaceous Vegetation (CEGL001601)
  Deschampsia caespitosa - Ligusticum tenuifolium Herbaceous Vegetation (CEGL001885)
  Deschampsia caespitosa Herbaceous Vegetation (CEGL001599)
- DESCHAMPSIA CAESPITOSA TEMPORARILY FLOODED HERBACEOUS ALLIANCE (A.1355)
  Agrostis pallens Herbaceous Vegetation (CEGL001600)
  Deschampsia caespitosa - Achillea millefolium var. occidentalis Herbaceous Vegetation (CEGL001880)
  Deschampsia caespitosa - Carex douglasii Herbaceous Vegetation (CEGL001602)
  Deschampsia caespitosa - Carex spp. Herbaceous Vegetation (CEGL001603)
  Deschampsia caespitosa - Geum rossii Herbaceous Vegetation (CEGL001884)
  Deschampsia caespitosa - Luzula multiflora Herbaceous Vegetation (CEGL001886)
  Deschampsia caespitosa - Mertensia ciliata Herbaceous Vegetation (CEGL001887)
  Deschampsia caespitosa - Phleum alpinum Herbaceous Vegetation (CEGL001888)
  Deschampsia caespitosa - Potentilla diversifolia Herbaceous Vegetation (CEGL001889)
  Deschampsia caespitosa - Symphyotrichum foliaceum Herbaceous Vegetation (CEGL001881)
  Festuca idahoensis - Deschampsia caespitosa Herbaceous Vegetation (CEGL001900)
- ELEOCHARIS (QUINQUEFLORA, ROSTELLATA) SATURATED HERBACEOUS ALLIANCE (A.1423)
  Eleocharis quinqueflora - Carex scopulorum Herbaceous Vegetation (CEGL001837)
  Eleocharis quinqueflora Herbaceous Vegetation (CEGL001836)
  Eleocharis rostellata Herbaceous Vegetation (CEGL003428)
- ELEOCHARIS ACICULARIS SEASONALLY FLOODED HERBACEOUS ALLIANCE (A.1421)
  Eleocharis acicularis Herbaceous Vegetation (CEGL001832)
- ELEOCHARIS PALUSTRIS SEASONALLY FLOODED HERBACEOUS ALLIANCE (A.1422)
  Eleocharis palustris - Distichlis spicata Herbaceous Vegetation (CEGL001834)
  Eleocharis palustris - Juncus balticus Herbaceous Vegetation (CEGL001835)
  Eleocharis palustris Herbaceous Vegetation (CEGL001833)
- EQUISETUM (ARVENSE, VARIEGATUM) SEMIPERMANENTLY FLOODED HERBACEOUS ALLIANCE (A.3539)
  Equisetum arvense Herbaceous Vegetation (CEGL003314)
- EQUISETUM FLUVIATILE SEMIPERMANENTLY FLOODED HERBACEOUS ALLIANCE (A.1678)
  Equisetum fluviatile Herbaceous Vegetation (CEGL002746)
- GEUM ROSSII HERBACEOUS ALLIANCE (A.1645)
  Geum rossii - Polygonum bistortoides Herbaceous Vegetation (CEGL001967)
  Geum rossii - Sibbaldia procumbens Herbaceous Vegetation (CEGL001969)
- GLYCERIA (GRANDIS, STRIATA) SEASONALLY FLOODED HERBACEOUS ALLIANCE (A.2578)
  Glyceria grandis Herbaceous Vegetation (CEGL003429)
  Glyceria striata Herbaceous Vegetation (CEGL000219)
- GLYCERIA BOREALIS SEMIPERMANENTLY FLOODED HERBACEOUS ALLIANCE (A.1445)
  Glyceria borealis Herbaceous Vegetation (CEGL001569)
- HERACLEUM MAXIMUM TEMPORARILY FLOODED HERBACEOUS ALLIANCE (A.1661)
  Heracleum maximum - Rudbeckia occidentalis Herbaceous Vegetation (CEGL001940)
- JUNCUS BALTICUS SEASONALLY FLOODED HERBACEOUS ALLIANCE (A.1374)
  Juncus balticus - Carex rossii Herbaceous Vegetation (CEGL001839)
  Juncus balticus Herbaceous Vegetation (CEGL001838)
- JUNCUS DRUMMONDII HERBACEOUS ALLIANCE (A.1324)
  Juncus drummondii - Antennaria lanata Herbaceous Vegetation (CEGL001904)
  Juncus drummondii - Carex spp. Herbaceous Vegetation (CEGL001905)
- JUNCUS PARRYI HERBACEOUS ALLIANCE (A.1325)
  Juncus parryi - Erigeron ursinus Herbaceous Vegetation (CEGL001906)

- PHIPPSIA ALGIDA SATURATED HERBACEOUS ALLIANCE (A.2595)
  Phippsia algida Herbaceous Vegetation (CEGL002892)
- PHLEUM ALPINUM TEMPORARILY FLOODED HERBACEOUS ALLIANCE (A.1360)
  Phleum alpinum - Carex aquatilis Herbaceous Vegetation (CEGL001921)
  Phleum alpinum - Carex microptera Herbaceous Vegetation (CEGL001922)
- POA GLAUCA TEMPORARILY FLOODED HERBACEOUS ALLIANCE (A.1361)
  Poa glauca Herbaceous Vegetation (CEGL001926)
- POA PALUSTRIS SEMI-NATURAL SEASONALLY FLOODED HERBACEOUS ALLIANCE (A.1409)
  Poa palustris Herbaceous Vegetation (CEGL001659)
- PRIMULA PARRYI TEMPORARILY FLOODED HERBACEOUS ALLIANCE (A.1665)
  Primula parryi Herbaceous Vegetation (CEGL001983)
- RHODIOLA RHODANTHA TEMPORARILY FLOODED HERBACEOUS ALLIANCE (A.1659)
  Rhodiola rhodantha Herbaceous Vegetation (CEGL001931)
- RORIPPA ALPINA SATURATED HERBACEOUS ALLIANCE (A.1700)
  Rorippa alpina Herbaceous Vegetation (CEGL002009)
- SAXIFRAGA ODONTOLOMA TEMPORARILY FLOODED HERBACEOUS ALLIANCE (A.1666)
  Saxifraga odontoloma Herbaceous Vegetation (CEGL001985)
- SENECIO TRIANGULARIS SEMIPERMANENTLY FLOODED HERBACEOUS ALLIANCE (A.1680)
  Senecio triangularis - Mimulus guttatus Herbaceous Vegetation (CEGL001988)
- SENECIO TRIANGULARIS TEMPORARILY FLOODED HERBACEOUS ALLIANCE (A.1667)
  Senecio triangularis - Veratrum californicum Herbaceous Vegetation (CEGL001989)
  Senecio triangularis Herbaceous Vegetation (CEGL001987)
- TRICHOPHORUM CAESPITOSUM SEMIPERMANENTLY FLOODED HERBACEOUS ALLIANCE (A.1446)
  Trichophorum caespitosum - Carex livida Herbaceous Vegetation (CEGL001842)

Environment: Moisture for these wet meadow community types is acquired from groundwater, stream discharge, overland flow, overbank flow, and on-site precipitation. Salinity and alkalinity are generally low due to the frequent flushing of moisture through the meadow. Depending on the slope, topography, hydrology, soils and substrate, intermittent, ephemeral, or permanent pools may be present. These areas may support species more representative of purely aquatic environments. Standing water may be present during some or all of the growing season, with water tables typically remaining at or near the soil surface. Fluctuations of the water table throughout the growing season are not uncommon, however. On drier sites supporting the less mesic types, the late-season water table may be one meter or more below the surface.

Soils typically possess a high proportion of organic matter, but this may vary considerably depending on the frequency and magnitude of alluvial deposition (Kittel et. al. 1998). Organic composition of the soil may include a thin layer near the soil surface or accumulations of highly sapric material of up to 120 cm thick. Soils may exhibit gleying and/or mottling throughout the profile.

Wet meadow ecological systems provide important water filtration, flow attenuation, and wildlife habitat functions.

Dynamics: Associations in this ecological system are adapted to soils that may be flooded or saturated throughout the growing season. They may also occur on areas with soils that are only saturated early in the growing season, or intermittently. Typically these associations are tolerant of moderate-intensity ground fires and late-season livestock grazing (Kovalchik 1987). Most appear to be relatively stable types, although in some areas these may be impacted by intensive livestock grazing.

SOURCES

References: Canadian Rockies Ecoregional Plan 2002, Comer et al. 2002, Cooper 1986b, Crowe and Clausnitzer 1997, Kittel et al. 1999b, Komarkova 1976, Komarkova 1986, Kovalchik 1987, Kovalchik 1993, Manning and Padgett 1995, Meidinger and Pojar 1991, Nachlinger 1985, Nachlinger et al. 2001, Neely et al. 2001, Padgett et al. 1988a, Reed 1988, Sanderson and Kettler 1996, Tuhy et al. 2002

Last updated: 20 Feb 2003 **Stakeholders:** WCS, CAN, MCS

Concept Author: NatureServe Western Ecology Team **LeadResp:** WCS

S103 TEMPERATE PACIFIC MONTANE WET MEADOW

Division 200, Herbaceous Wetland, CES200.998

Spatial Scale & Pattern: Small Patch

Required Classifiers: Natural/Semi-natural, Vegetated (>10% vasc.), Wetland

Diagnostic Classifiers: Herbaceous, Muck, Graminoid, 30-180-day hydroperiod

Non-Diagnostic Classifiers: Montane, Temperate [Temperate Oceanic], Depressional, Riverine / Alluvial, Circumneutral Water

Concept Summary: Montane wet meadows occur as open wet depressions among montane forests from California's Transverse and Peninsular ranges north to the Alaskan coastal forests at varying elevations depending on latitude. They may have surface water for part of the year, but depths rarely exceed a few centimeters. Soils show typical hydric soil characteristics, including high organic content and/or low chroma and redoximorphic features. This system often occurs as a mosaic of several plant associations with varying dominant herbaceous species that may include *Camassia quamash, Carex bolanderi, Carex utriculata, Carex vesicaria, Dodecatheon jeffreyi, Glyceria striata (= Glyceria elata), Juncus nevadensis, Veratrum californicum*, and *Scirpus* and/or *Schoenoplectus* spp. Wet meadows are tightly associated with snowmelt and typically are not subjected to high disturbance events such as flooding.

DISTRIBUTION

Range: California's Transverse and Peninsular ranges north to the Alaskan coastal forests at varying elevations depending on latitude.
Ecological Divisions: 204, 206
TNC Ecoregions: 12:C, 16:C, 3:C, 4:C, 5:C, 81:C
Subnations/Nations: AK:c, BC:c, CA:c, NV:c, OR:c, WA:c

CONCEPT

Alliances and Associations:

- SENECIO TRIANGULARIS SEMIPERMANENTLY FLOODED HERBACEOUS ALLIANCE (A.1680)
  Senecio triangularis - Mimulus guttatus Herbaceous Vegetation (CEGL001988)
- SENECIO TRIANGULARIS TEMPORARILY FLOODED HERBACEOUS ALLIANCE (A.1667)
  Senecio triangularis - Veratrum californicum Herbaceous Vegetation (CEGL001989)
- VERATRUM CALIFORNICUM TEMPORARILY FLOODED HERBACEOUS ALLIANCE (A.1663)
  Veratrum californicum - Juncus nevadensis Herbaceous Vegetation (CEGL001946)

- **California community types:**
- Tall Mannagrass (41.222.01)
- Tall Mannagrass - Small-fruited Bulrush (41.222.02)
- Tall Mannagrass - Stream Deervetch (41.222.03)
- Canadian Reedgrass (41.224.01)
- Woolly Sedge (45.166.00)
- Water Sedge (45.168.00)
- Inflated Sedge (45.170.01)
- Spikerush (45.210.00)
- Nevada Rush - Spikerush (45.210.01)
- Meadow and Seep Habitats (45.300.00)
- Montane Meadow (45.310.00)
- Bluejoint Reedgrass - Small-fruited Bulrush (45.310.02)
- Wet Montane Meadow (45.310.12)
- Jeffrey Shooting Star - Mertens Rush (45.320.07)
- Wet Subalpine or alpine meadow (45.320.08)
- White Corn-lily (45.423.00)
- White Corn-lily - Arrowhead Butterweed (45.423.01)
- Sierra Rush (45.567.00)
- Freshwater Seep (45.700.00)
- California Bulrush Wetland (52.101.01)
- Beaked Sedge Wetland (52.120.00)
- Beaked Sedge (52.120.01)

SOURCES

References: Barbour and Major 1988, Holland and Keil 1995, Sawyer and Keeler-Wolf 1995
Last updated: 24 Mar 2003 **Stakeholders:** WCS
Concept Author: P. Comer **LeadResp:** WCS

S105 MEDITERRANEAN CALIFORNIA SUBALPINE-MONTANE FEN

Division 206, Herbaceous Wetland, CES206.952

Spatial Scale & Pattern: Small Patch **Classification Confidence:** medium
Required Classifiers: Natural/Semi-natural, Vegetated (>10% vasc.), Wetland
Diagnostic Classifiers: Temperate [Temperate Oceanic], Muck, Bog and Fen Mosaic, Seepage-Fed Sloping, Circumneutral Water, Extreme (Mineral) Rich & Iron-Rich

Non-Diagnostic Classifiers: Montane [Upper Montane], Montane [Montane], Herbaceous, Moss/Lichen (Nonvascular), Organic Peat (>40 cm), Forb, Graminoid, Bryophyte, Long (>500 yrs) Persistence, Saturated Soil

Concept Summary: This system is found in montane to subalpine elevations confined to specific environments defined by groundwater discharge, soil chemistry, and peat accumulation. This system includes extreme rich fens which are quite rare. Fens form at low points in the landscape or near slopes where groundwater intercepts the soil surface. Groundwater inflows maintain a fairly constant water level year-round, with water at or near the surface most of the time. Constant high water levels lead to accumulation of organic material. In addition to peat accumulation and perennially saturated soils, the extreme rich fens have distinct soil and water chemistry, with high levels of one or more minerals such as calcium and/or magnesium. They usually occur as a mosaic of several plant associations dominated by species of *Carex*, *Betula*, *Kobresia*, or *Schoenoplectus*. The surrounding landscape may be ringed with other wetland systems, e.g., riparian shrublands, or a variety of upland systems from grasslands to forests.

DISTRIBUTION

Ecological Divisions: 206
TNC Ecoregions: 12:P, 14:P, 5:P
Subnations/Nations: CA:c, NV:p, OR:c

CONCEPT

- **California community types:**
- Fen Habitat (51.100.00)

SOURCES

References: Barbour and Major 1988, Holland and Keil 1995, Sawyer and Keeler-Wolf 1995
Last updated: 17 Mar 2003 **Stakeholders:** WCS
Concept Author: P. Comer, T. Keeler-Wolf **LeadResp:** WCS

S108 WESTERN GREAT PLAINS SALINE DEPRESSION WETLAND

Division 303, Herbaceous Wetland, CES303.669

Spatial Scale & Pattern: Small Patch **Classification Confidence:** medium
Required Classifiers: Natural/Semi-natural, Vegetated (>10% vasc.), Wetland
Non-Diagnostic Classifiers: Herbaceous, Depression, Saline Water Chemistry

Concept Summary: This system is very similar to Northwestern Great Plains Open Freshwater Depression (CES303.675) and Western Great Plains Closed Depression Wetland (CES303.666). However, strongly saline soils cause both the shallow lakes and depressions and the surrounding areas to be more brackish. Salt encrustations can occur on the surface in some examples of this system, and the soils are severely affected and have poor structure. Species that typify this system are salt-tolerant and halophytic species such as *Distichlis spicata, Sporobolus airoides*, and *Hordeum jubatum*. During exceptionally wet years, an increase in precipitation can dilute the salt concentration in the soils of some of examples of this system which may allow for less salt-tolerant species to occur. Communities found within this system may also occur in floodplains (i.e., more open depressions), but probably should not be considered a separate system unless they transition to areas outside the immediate floodplain.

Comments: Open and emergent saline marshes may be a separate system from saline wet meadows and prairies.

DISTRIBUTION

Range: This system can occur throughout the Western Great Plains, but is likely more prevalent in the south-central portions of the division.
Ecological Divisions: 303

TNC Ecoregions: 26:?, 27:C, 28:C, 33:C, 34:?
Subnations/Nations: CO:c, KS:c, MT:p, ND:c, NE:c, NM:c, OK:c, SD:c, WY:c

CONCEPT

Alliances and Associations:

- CAREX SPP. - PLANTAGO ERIOPODA TEMPORARILY FLOODED HERBACEOUS ALLIANCE (A.1350)
  Calamagrostis stricta - Carex sartwellii - Carex praegracilis - Plantago eriopoda Saline Herbaceous Vegetation (CEGL002255)
- DISTICHLIS SPICATA - (HORDEUM JUBATUM) TEMPORARILY FLOODED HERBACEOUS ALLIANCE (A.1341)
  Distichlis spicata - (Hordeum jubatum, Poa arida, Sporobolus airoides) Herbaceous Vegetation (CEGL002042)
  Distichlis spicata - Hordeum jubatum - (Poa arida, Iva annua) Herbaceous Vegetation (CEGL002031)
  Distichlis spicata - Hordeum jubatum - Puccinellia nuttalliana - Suaeda calceoliformis Herbaceous Vegetation (CEGL002273)
  Distichlis spicata - Schoenoplectus maritimus - Salicornia rubra Herbaceous Vegetation (CEGL002043)
  Distichlis spicata - Spartina spp. Herbaceous Vegetation (CEGL002275)
- DISTICHLIS SPICATA INTERMITTENTLY FLOODED HERBACEOUS ALLIANCE (A.1332)
  Distichlis spicata Herbaceous Vegetation (CEGL001770)
- HORDEUM JUBATUM TEMPORARILY FLOODED HERBACEOUS ALLIANCE (A.1358)
  Hordeum jubatum Herbaceous Vegetation (CEGL001798)
- PASCOPYRUM SMITHII TEMPORARILY FLOODED HERBACEOUS ALLIANCE (A.1354)
  Pascopyrum smithii - Distichlis spicata Herbaceous Vegetation (CEGL001580)
  Pascopyrum smithii - Hordeum jubatum Herbaceous Vegetation (CEGL001582)
- PUCCINELLIA NUTTALLIANA INTERMITTENTLY FLOODED HERBACEOUS ALLIANCE (A.1335)
  Puccinellia nuttalliana Herbaceous Vegetation (CEGL001799)
- SALICORNIA RUBRA SEASONALLY FLOODED HERBACEOUS ALLIANCE (A.1818)
  Salicornia rubra Herbaceous Vegetation (CEGL001999)
- SARCOBATUS VERMICULATUS INTERMITTENTLY FLOODED SHRUB HERBACEOUS ALLIANCE (A.1554)
  Sarcobatus vermiculatus / Pascopyrum smithii - (Elymus lanceolatus) Shrub Herbaceous Vegetation (CEGL001508)
- SARCOBATUS VERMICULATUS SHRUB HERBACEOUS ALLIANCE (A.1535)
  Sarcobatus vermiculatus / Distichlis spicata - (Puccinellia nuttalliana) Shrub Herbaceous Vegetation (CEGL002146)
- SCHOENOPLECTUS AMERICANUS SEMIPERMANENTLY FLOODED HERBACEOUS ALLIANCE (A.1432)
  Schoenoplectus americanus - Carex spp. Herbaceous Vegetation (CEGL004144)
  Schoenoplectus americanus Great Plains Herbaceous Vegetation (CEGL002226)
- SCHOENOPLECTUS MARITIMUS SEMIPERMANENTLY FLOODED HERBACEOUS ALLIANCE (A.1444)
  Schoenoplectus maritimus - Schoenoplectus acutus - (Triglochin maritima) Herbaceous Vegetation (CEGL002227)
  Schoenoplectus maritimus Herbaceous Vegetation (CEGL001843)
- SCHOENOPLECTUS PUNGENS SEMIPERMANENTLY FLOODED HERBACEOUS ALLIANCE (A.1433)
  Schoenoplectus pungens - Suaeda calceoliformis Alkaline Herbaceous Vegetation (CEGL002040)
  Schoenoplectus pungens Herbaceous Vegetation (CEGL001587)
- SCOLOCHLOA FESTUCACEA SEASONALLY FLOODED HERBACEOUS ALLIANCE (A.1401)
  Scolochloa festucacea Herbaceous Vegetation (CEGL002260)
- SPARTINA PECTINATA TEMPORARILY FLOODED HERBACEOUS ALLIANCE (A.1347)
  Spartina pectinata - Schoenoplectus pungens Herbaceous Vegetation (CEGL001478)
- SPOROBOLUS AIROIDES HERBACEOUS ALLIANCE (A.1267)
  Sporobolus airoides Monotype Herbaceous Vegetation (CEGL001688)
  Sporobolus airoides Northern Plains Herbaceous Vegetation (CEGL002274)
  Sporobolus airoides Southern Plains Herbaceous Vegetation (CEGL001685)
- STUCKENIA PECTINATA PERMANENTLY FLOODED HERBACEOUS ALLIANCE (A.1764)
  Stuckenia pectinata - Ruppia maritima Herbaceous Vegetation (CEGL002004)
  Stuckenia pectinata - Zannichellia palustris Herbaceous Vegetation (CEGL002005)
- TYPHA (ANGUSTIFOLIA, LATIFOLIA) - (SCHOENOPLECTUS SPP.) SEMIPERMANENTLY FLOODED HERBACEOUS ALLIANCE (A.1436)
  Typha spp. - Schoenoplectus spp. - Mixed Herbs Great Plains Herbaceous Vegetation (CEGL002228)
  Typha spp. Great Plains Herbaceous Vegetation (CEGL002389)

Environment: This system is distinct from the freshwater depression systems by its brackish nature caused by strongly saline soils. Salt encrustations could occur near the surface in some examples of this system.

Vegetation: Salt-tolerant and halophytic species such as *Distichlis spicata*, *Sporobolus airoides*, and *Hordeum jubatum* typify the system.

Dynamics: Hydrology processes primarily drive this system. Increases in precipitation and/or runoff can dilute the salt concentration and allow for less salt tolerant species to occur. Conversion to agriculture and pastureland can also impact this system, especially when it alters the hydrology of the system.

SOURCES

References: Hoagland 2000, Lauver et al. 1999, Steinauer and Rolfsmeier 2000

Last updated: 05 Mar 2003 **Stakeholders:** MCS, WCS

Concept Author: S. Menard and K. Kindscher **LeadResp:** MCS

REFERENCES:

Agree, J. K. 1982. True fir management for wilderness, water, recreation and wildlife values. Pages 227-237in: D. C. Oliver and R. M. Kenady. Proceedings of the biology and management of true fire in the Pacific Northwest symposium, 1981 February 24-26, S

Alexander, B. G., Jr. 1981. A preliminary forest habitat classification for the Lincoln National Forest, New Mexico. Unpublished thesis, Northern Arizona University, Flagstaff. 94 pp.

Alexander, B. G., Jr., E. L. Fitzhugh, F. Ronco, Jr., and J. A. Ludwig. 1987. A classification of forest habitat types of the northern portion of the Cibola National Forest, NM. USDA Forest Service, Rocky Mountain Forest and Range Experiment Station. General Technical Report RM-143. Fort Collins, CO. 35 pp.

Alexander, B. G., Jr., F. Ronco, Jr., A. S. White, and J. A. Ludwig. 1984b. Douglas-fir habitat types of northern Arizona. USDA Forest Service, Rocky Mountain Forest and Range Experiment Station. General Technical Report RM-108. Fort Collins, CO. 13 pp.

Alexander, B. G., Jr., F. Ronco, Jr., E. L. Fitzhugh, and J. A. Ludwig. 1984a. A classification of forest habitat types of the Lincoln National Forest, New Mexico. USDA Forest Service, Rocky Mountain Forest and Range Experiment Station. General Technical Report RM-104. Fort Collins, CO. 29 pp.

Alexander, R. M. 1986. Classification of the forest vegetation of Wyoming. USDA Forest Service, Rocky Mountain Forest and Range Experiment Station. Research Note RM-466. Fort Collins, CO. 10 pp.

Alexander, R. R., and F. Ronco, Jr. 1987. Classification of the forest vegetation on the national forests of Arizona and New Mexico. USDA Forest Service Research Note RM-469. Rocky Mountain Forest and Range Experiment Station, Fort Collins, CO.

Anderson, L. S., P. L. Warren, and F. W. Riechenbacher. 1985. Vegetation associations of the Muleshoe Ranch Preserve. Unpublished report prepared for The Arizona Nature Conservancy, Tucson. 15 pp.

Anderson, M. G. 1999. Viability and spatial assessment of ecological communities in the northern Appalachian ecoregion. Ph.D. dissertation, University of New Hampshire, Durham.

Andrews, R. R., and R. R. Righter. 1992. Colorado birds. Denver Museum of Natural History, Denver.

Arno, S. F., D. G. Simmerman, and R. E. Keane. 1985. Forest succession on four habitat types in western Montana. USDA Forest Service, Intermountain Forest and Range Experiment Station. General Technical Report INT-177. Ogden, UT. 74 pp.

B. Neely, P. Comer, C. Moritz, M. Lammerts, R. Rondeau, C. Prague, G. Bell, H. Copeland, J. Jumke, S. Spakeman, T. Schulz, D. Theobald, and L. Valutis. 2001. Southern Rocky Mountains: An ecoregional assessment and conservation blueprint. Prepared by The Nature Conservancy with support form the U.S. Forest Service, Rocky Mountain Region, Colorado Division of Wildlife, and Bureau of Land Management.

Baker, W. L. 1980a. Alpine vegetation of the Sangre De Cristo Mountains, New Mexico: Gradient analysis and classification. Unpublished thesis, University of North Carolina, Chapel Hill. 55 pp.

Baker, W. L. 1988. Size-class structure of contiguous riparian woodlands along a Rocky Mountain river. Physical Geography 9(1):1-14.

Baker, W. L. 1989a. Macro- and micro-scale influences on riparian vegetation in western Colorado. Annals of the Association of American Geographers 79(1):65-78.

Baker, W. L. 1989b. Classification of the riparian vegetation of the montane and subalpine zones in western Colorado. Great Basin Naturalist 49(2):214-228.

Baker, W. L. 1990. Climatic and hydrologic effects on the regeneration of ~Populus angustifolia$ James along the Animas River, Colorado. Journal of Biogeography 17:59-73.

Baker, W. L. 1992. Structure, disturbance, and change in the bristlecone pine forests of Colorado. Arctic and Alpine Research 24(1):17-26.

Baker, W. L., and S. C. Kennedy. 1985. Presettlement vegetation of part of northwestern Moffat County, Colorado, described from remnants. Great Basin Naturalist 45(4):747-777.

Bamberg, S. A. 1961. Plant ecology of alpine tundra area in Montana and adjacent Wyoming. Unpublished dissertation, University of Colorado, Boulder. 163 pp.

Bamberg, S. A., and J. Major. 1968. Ecology of the vegetation and soils associated with calcareous parent materials in three alpine regions of Montana. Ecological Monographs 38(2):127-167.

Barbour, M. G., and J. Major, editors. 1977. Terrestrial vegetation of California. John Wiley and Sons, New York. 1002 pp.

Barbour, M. G., and J. Major, editors. 1988. Terrestrial vegetation of California: New expanded edition. California Native Plant Society, Special Publication 9, Sacramento. 1030 pp.

Barbour, M. G., and W. D. Billings, editors. 1988. North American terrestrial vegetation. Cambridge University Press, New York. 434 pp.

Barbour, M. G., and W. D. Billings, editors. 2000. North American terrestrial vegetation. Second edition. Cambridge Univ. Press, New York. 434 pp.

Barnes, F. J. 1987. Carbon and water relations across a pinyon-juniper habitat gradient. Unpublished dissertation, New Mexico State University, Las Cruces.

Barrows, J. S., E. W. Mogren, K. Rowdabaugh, and R. Yancik. 1977. The role of fire in ponderosa pine and mixed conifer ecosystems. Final report, Cooperative report between the National Park Service and Rocky Mountain Forest and Range Experiment Station, Fort Collins, CO. 101 pp.

Bartos, D. L. 1979. Effects of burning on the aspen ecosystem. Pages 47-58 in: Wyoming shrublands. Proceedings of the eighth Wyoming shrub ecology workshop. Range Management Division, University of Wyoming, Laramie.

Bartos, D. L., and R. B. Campbell, Jr. 1998. Decline of quaking aspen in the interior west-examples from Utah. Rangelands 20(1):17-24.

Bartos, D. L., and W. F. Mueggler. 1979. Influence of fire on vegetation production in the aspen ecosystem in western Wyoming. Pages 75-78 in: M.S. Boyce, editor. North American elk: ecology, behavior and management. University of Wyoming, Laramie. 294 pp.

Bassett, D., M. Larson, and W. Moir. 1987. Forest and woodland habitat types of Arizona south of the Mogollon Rim and southwestern New Mexico. Edition 2. USDA Forest Service, Southwestern Region, Albuquerque, NM.

Beasley, R. S., and J. O. Klemmedson. 1980. Ecological relationships of bristlecone pine. The American Midland Naturalist 104(2):242-252.

Beatley, J. C. 1976. Vascular plants of the Nevada Test Site and central-southern Nevada: Ecological and geographic distributions. Technical Information Center, Energy Research and Development Administration. TID-26881. Prepared for Division of Biomedical and Environmental Research. 297 pp.

Blackburn, W. H., and P. T. Tueller. 1970. Pinyon and juniper invasion in black sagebrush communities in east-central Nevada. Ecology 51:841-848.

Blaisdell, J. P., and R. C. Holmgren. 1984. Managing intermountain rangelands-salt-desert shrub ranges. General Technical Report INT-163. USDA Forest Service, Intermountain Forest and Range Experiment Station, Ogden, UT. 52 pp.

Bowers, J. E. 1982. The plant ecology of inland dunes in western North America. Journal of Arid Environments 5:199-220.

Bowers, J. E. 1984. Plant geography of southwestern sand dunes. Desert Plants 6(1):31-42, 51-54.

Bowers, J. E., and S. P. McLaughlin. 1987. Flora and vegetation of The Rincon Mountains, Pima County, Arizona. Desert Plants 8(2):51-95.

Bowns, J. E., and C. F. Bagley. 1986. Vegetation responses to long term sheep grazing on mountain ranges. Journal of Range Management 39:431-434.

Boyce, D. A. 1977. Vegetation of the South Fork of the White River Valley, Colorado. Unpublished dissertation, University of Colorado, Boulder. 312 pp.

Bradley, A. F., N. V. Noste, and W. C. Fischer. 1992. Fire ecology of forests and woodlands in Utah. USDA Forest Service, Intermountain Research Station. General Technical Report INT-287. Ogden, UT. 128 pp.

Brand, C. J., L. B. Keith, and C. A. Fischer. 1976. Lynx responses to changing snowshoe hare densities in central Alberta. Journal of Wildlife Management (40):416-428.

Branson, F. A., R. F. Miller, and I. S. McQueen. 1967. Geographic distribution and factors affecting the distribution of salt desert shrubs in the United States. Journal of Range Management 29(5):287-296.

Branson, F. A., R. F. Miller, and I. S. McQueen. 1976. Moisture relationships in twelve northern desert shrub communities near Grand Junction, Colorado. Ecology 57:1104-1124.

Brown, D. E., C. H. Lowe, and C. P. Pase. 1979. A digitized classification system for the biotic communities of North America with community (series) and association examples for the Southwest. Journal of the Arizona-Nevada Academy of Science 14:1-16.

Brown, D. E., C. H. Lowe, and C. P. Pase. 1980. A digitized systematic classification for ecosystems with an illustrated summary of the natural vegetation of North America. General Technical Report RM-73, USDA Forest Service, Rocky Mountain Forest and Range Experiment Station, Fort Collins, CO. 93 pp.

Brown, D. E., editor. 1982. Biotic communities of the American Southwest-United States and Mexico. Desert Plants Special Issue 4(1-4):1-342.

Brown, D. E., F. Reichenbacher, and S. E. Franson. 1998. A classification of North American biotic communities. The University of Utah Press, Salt Lake City. 141 pp.

Brunstein, C. R., and D. K. Yamaguchi. 1992. The oldest known Rocky Mountain bristlecone pines (~Pinus aristata$ Engelm.). Arctic and Alpine Research 24:253-256.

Buckner, D. L. 1977. Ribbon forest development and maintenance in the central Rocky Mountains of Colorado. Unpublished dissertation, University of Colorado, Boulder. 224 pp.

Bunin, J. E. 1975c. The vegetation of the west slope of the Park Range, Colorado. Unpublished dissertation, University of Colorado, Boulder. 235 pp.

Burgess, T. L. 1995. Desert grassland, mixed shrub savanna, shrub steppe, or semidesert scrub. Pages 31-67 in: M. P. McClaran and T. R. Van Devender, editors. The Desert Grassland. University of Arizona Press, Tucson.

Burns, R. M., and B. H. Honkala, technical coordinators. 1990a. Silvics of North America: Volume 1. Conifers. USDA Forest Service. Agriculture Handbook 654. Washington, DC. 675 pp.

Butler, D. R. 1979. Snow avalanche path terrain and vegetation, Glacier National Park, Montana. Arctic and Alpine Research 11:17-32.

Butler, D. R. 1985. Vegetation and geomorphic change on snow avalanche paths, Glacier National Park, Montana, USA. Great Basin Naturalist 45(2):313-317.

Cable, D. R. 1967. Fire effects on semidesert grasses and shrubs. Journal of Range Management 20:170-176.

Cable, D. R. 1969. Competition in the semidesert grass-shrub type as influenced by root systems, growth habits, and soil moisture extraction. Ecology 50:27-38.

Cable, D. R. 1975. Influence of precipitation on perennial grass production in the semidesert southwest. Ecology 56:981-986.

Campbell, V. O. 1977. Certain edaphic and biotic factors affecting vegetation in the shadscale community of the Kaiparowitz area. Unpublished thesis, Brigham Young University, Provo, UT. 59 pp.

Canadian Rockies Ecoregional Plan. 2002. Canadian Rockies ecoregional plan. The Nature Conservancy of Canada, Victoria, BC

Carmichael, R. S., O. D. Knipe, C. P. Pase, and W. W. Brady. 1978. Arizona chaparral: Plant associations and ecology. USDA Forest Service Research Paper RM-202. 16 pp.

Chappell, C., R. Crawford, J. Kagan, and P. J. Doran. 1997. A vegetation, land use, and habitat classification system for the terrestrial and aquatic ecosystems of Oregon and Washington. Unpublished report prepared for Wildlife habitat and species associations within Oregon and Washington landscapes: Building a common understanding for management. Prepared by Washington and Oregon Natural Heritage Programs, Olympia WA, and Portland, OR. 177 pp.

Christensen, E. M. 1955. Ecological notes on the mountain brush in Utah. Proceedings of the Utah Academy of Science, Arts, and Letters 32:107-111.

Clagg, H. B. 1975. Fire ecology in high-elevation forests in Colorado. Unpublished M.S. thesis, Colorado State University, Fort Collins. 137 pp.

Coles, J., M. Hansen, and K. Thomas. 2003. Wupatki National Monument, Arizona, vegetation classification and distribution: A USGS-NPS Vegetation Mapping Program study. Southwest Biological Science Center, U.S. Geological Survey Open-file Report. In preparation.

Comer, P. J., M. S. Reid, R. J. Rondeau, A. Black, J. Stevens, J. Bell, M. Menefee, and D. Cogan. 2002. A working classification of terrestrial ecological systems in the Northern Colorado Plateau: Analysis of their relation to the National Vegetation Classification System and application to mapping. NatureServe. Report to the National Park Service. 23 pp. plus appendices.

Commons, M. L., R. K. Baydack, and C. E. Braun. 1999. Sage grouse response to pinyon-juniper management. Pages 238-239 in: S. B. Monsen and R. Stevens, editors. Proceedings: Ecology and management of pinyon-juniper communities within the Interior West. Pr

Cooper, D. J. 1986b. Community structure and classification of Rocky Mountain wetland ecosystems. Pages 66-147 in: J. T. Windell, et al. An ecological characterization of Rocky Mountain montane and subalpine wetlands. USDI Fish & Wildlife Service Biological Report 86(11). 298 pp.

Cooper, S. V., K. E. Neiman, R. Steele, and D. W. Roberts. 1987. Forest habitat types of northern Idaho: A second approximation. USDA Forest Service, Intermountain Research Station. General Technical Report INT-236. Ogden, UT. 135 pp. [reprinted in 1991]

Cooper, S. V., P. Lesica, and D. Page-Dumroese. 1997. Plant community classification for alpine vegetation on Beaverhead National Forest, Montana. USDA Forest Service, Intermountain Research Station, Report INT-GTR-362. Ogden, UT. 61 pp.

Crowe, E. A., and R. R. Clausnitzer. 1997. Mid-montane wetland plant associations of the Malheur, Umatilla, and Wallowa-Whitman national forests. USDA Forest Service, Pacific Northwest Region. Technical Paper R6-NR-ECOL-TP-22-97.

Daubenmire, R. 1952. Forest vegetation of northern Idaho and adjacent Washington, and its bearing on concepts of vegetation classification. Ecological Monographs 22(4):301-330.

Daubenmire, R. F. 1970. Steppe vegetation of Washington. Washington State University Agricultural Experiment Station Technical Bulletin No. 62. 131 pp.

Daubenmire, R. F., and J. B. Daubenmire. 1968. Forest vegetation of eastern Washington and northern Idaho. Washington State University Agricultural Experiment Station Technical Bulletin No. 60. 104 pp.

Day, T. A., and R. G. Wright. 1985. The vegetation types of Craters of the Moon National Monument. Forestry, Wildlife, and Range Experiment Station Bulletin No. 38. University of Idaho, Moscow. 6 pp.

DeByle, N. V., and R. P. Winokur, editors. 1985. Aspen: Ecology and management in the western United States. USDA Forest Service General Technical Report RM-119. Rocky Mountain Forest and Range Experiment Station, Fort Collins, CO. 283 pp.

Despain, D. G. 1973a. Vegetation of the Big Horn Mountains, Wyoming, in relation to substrate and climate. Ecological Monographs 43(3):329-354.

Despain, D. G. 1973b. Major vegetation zones of Yellowstone National Park. USDI National Park Service, Yellowstone National Park. Information Paper No. 19.

DeVelice, R. L., and J. Ludwig. 1983c. Late-seral forest series of northern New Mexico and southern Colorado. Pages 45-53 in: W. H. Moir and L. Hendzel. Proceedings of the workshop on southwestern habitat types, April 6-8, 1983, Albuquerque, NM. USDA Fore

DeVelice, R. L., and P. Lesica. 1993. Plant community classification for vegetation on BLM lands, Pryor Mountains, Carbon County, Montana. Unpublished report by Montana Natural Heritage Program, Helena, MT. 78 pp.

DeVelice, R. L., J. A. Ludwig, W. H. Moir, and F. Ronco, Jr. 1986. A classification of forest habitat types of northern New Mexico and southern Colorado. USDA Forest Service, Rocky Mountain Forest and Range Experiment Station. General Technical Report RM-131. Fort Collins, CO. 59 pp.

Dick-Peddie, W. A. 1993. New Mexico vegetation: Past, present, and future. University of New Mexico Press, Albuquerque. 244 pp.

Dieterich, J. H. 1979. Recovery potential of fire-damaged southwestern ponderosa pine. USDA Forest Service Research Note RM-379. Rocky Mountain Forest and Range Experiment Station, Fort Collins, CO. 8 pp.

Dodd, J. D., and R. T. Coupland. 1966. Vegetation of saline areas in Saskatchewan. Ecology 47(6):958-968.

Dwyer, D. D., and R. D. Pieper. 1967. Fire effects on blue gramma-pinyon-juniper rangeland in New Mexico. Journal of Range Management 20:359-362.

Eager, T. J. 1999. Factors affecting the health of pinyon pine trees (~Pinus edulis$) in the pinyon-juniper woodlands of western Colorado. Page 397 in: S. B. Monsen and R. Stevens, editors. Proceedings: Ecology and management of pinyon-juniper communities within the Interior West. USDA Forest Service, Rocky Mountain Research Station. Proceedings RMRS-P-9. Ogden, UT. 411 pp.

Ellison, L. 1954. Subalpine vegetation of the Wasatch Plateau, Utah. Ecological Monographs 24(2):89-104.

Erdman, J. A. 1962. Ecology of the pinyon-juniper woodland of Wetherill Mesa, Mesa Verde National Park, Colorado. Unpublished thesis, University of Colorado, Boulder. 109 pp.

Faber-Langendoen, D., J. Drake, G. Jones, D. Lenz, P. Lesica, and S. Rolfsmeier. 1997. Rare plant communities of the northern Great Plains. Report to Nebraska National Forest, The Nature Conservancy. 155 pp.

Fitzgerald, J. P., C. A. Meaney, and D. M. Armstrong. 1994. Mammals of Colorado. Denver Museum of Natural History and University Press of Colorado, Denver.

Fitzhugh, E. L., W. H. Moir, J. A. Ludwig, and F. Ronco, Jr. 1987. Forest habitat types in the Apache, Gila, and part of the Cibola national forests. USDA Forest Service, Rocky Mountain Forest and Range Experiment Station. General Technical Report RM-145. Fort Collins, CO. 116 pp.

Fowells, H. A. 1965. Silvics of the forest trees of the United States. USDA Forest Service, Agriculture Handbook No. 271. Washington, DC. 762 pp.

Francis, R. E. 1986. Phyto-edaphic communities of the Upper Rio Puerco Watershed, New Mexico. USDA Forest Service, Rocky Mountain Forest and Range Experiment Station. Research Paper RM-272. Fort Collins, CO. 73 pp.

Fritz, R. J. 1981. Alpine vegetational patterns around isolated tree islands on the eastern and western slopes of the Tenmile Range, Summit County, Colorado. Unpublished thesis, University of Colorado, Boulder, CO. 233 pp.

Fryberger, S. G., L. F. Krystinik, and C. J. Schenk. 1990. Modern and ancient eolian deposits: Petroleum exploration and production. Rocky Mountain Section, Society of Economic Paleontologists and Mineralogists, Denver, CO.

Gehlbach, F. R. 1967. Vegetation of the Guadalupe Escarpment, New Mexico-Texas. Ecology 48:404-419.

Giese, T. G. 1975. The ecology of the Middle Blue River Valley, Summit County, Colorado, with an analysis of modifications due to powerline construction. Unpublished thesis, University of Colorado, Boulder. 109 pp.

Graybosch, R. A., and H. Buchanan. 1983. Vegetative types and endemic plants of the Bryce Canyon Breaks. Great Basin Naturalist 43:701-712.

Hall, H. H. 1971. Ecology of a subalpine meadow of the Aquarius Plateau, Garfield and Wayne counties, Utah. Unpublished dissertation, Brigham Young University, Provo, UT.

Hammerson, G. A. 1979. Structure and reproduction of "tree island" populations of Engelmann spruce (~Picea engelmannii$) and subalpine fir (~Abies lasiocarpa$) in the lower alpine tundra of Colorado. Journal of the Colorado-Wyoming Academy of Science 11(1):23-24 (Abstract).

Hansen, P. L., and G. R. Hoffman. 1988. The vegetation of the Grand River/Cedar River, Sioux, and Ashland districts of the Custer National Forest: A habitat type classification. USDA Forest Service, Rocky Mountain Forest and Range Experiment Station. General Technical Report RM-157. Fort Collins, CO. 68 pp.

Hansen, P. L., R. D. Pfister, K. Boggs, B. J. Cook, J. Joy, and D. K. Hinckley. 1995. Classification and management of Montana's riparian and wetland sites. Montana Forest and Conservation Experiment Station, School of Forestry, University of Montana, Miscellaneous Publication No. 54. 646 pp. + posters.

Hanson, H. C. 1929. Range resources of the San Luis Valley. Pages 5-61 in: Range resources of the San Luis Valley. Bulletin 335. Colorado Experiment Station, Fort Collins, CO.

Heinze, D. H., R. E. Eckert, and P. T. Tueller. 1962. The vegetation and soils of the Steptoe Watershed. Unpublished report prepared for the USDI Bureau of Land Management. 40 pp.

Henderson, J. A., S. A. Simon, and S. B. Hartvigsen. 1977. Plant community types and habitat types of the Price District Manti-La Sal National Forest. Unpublished report prepared for Utah State University, Department of Forestry and Outdoor Recreation, Logan.

Henrickson, J., M. C. Johnston, and D. H. Riskind. 1985. Natural vegetation and community types of Texas: Trans-Pecos and the Chihuahuan Desert region. Unpublished working draft. 90 pp.

Hess, K. 1981. Phyto-edaphic study of habitat types of the Arapaho-Roosevelt National Forest, Colorado. Unpublished dissertation, Colorado State University, Fort Collins. 558 pp.

Hess, K., and C. H. Wasser. 1982. Grassland, shrubland, and forest habitat types of the White River-Arapaho National Forest. Unpublished final report 53-82 FT-1-19. USDA Forest Service, Rocky Mountain Forest and Range Experiment Station. Fort Collins, CO. 335 pp.

Hess, K., and R. R. Alexander. 1986. Forest vegetation of the Arapaho and Roosevelt national forests in northcentral Colorado: A habitat type classification. USDA Forest Service, Rocky Mountain Forest and Range Experiment Station. Research Paper RM-266. Fort Collins, CO. 48 pp.

Hironaka, M., M. A. Fosberg, and A. H. Winward. 1983. Sagebrush-grass habitat types of southern Idaho. Forestry, Wildlife, and Range Experiment Station Bulletin No. 15, University of Idaho, Moscow. 44 pp.

Hoagland, B. 2000. The vegetation of Oklahoma: A classification for landscape mapping and conservation planning. The Southwestern Naturalist 45(4):385-420.

Hoffman, G. R., and R. R. Alexander. 1976. Forest vegetation of the Bighorn Mountains, Wyoming: A habitat type classification. USDA Forest Service Research Paper RM-170. Rocky Mountain Forest and Range Experiment Station, Fort Collins, CO. 38 pp.

Hoffman, G. R., and R. R. Alexander. 1980. Forest vegetation of the Routt National Forest in northwestern Colorado: A habitat type classification. USDA Forest Service, Rocky Mountain Forest and Range Experiment Station. General Technical Report RM-221. Fort Collins, CO. 41 pp.

Hoffman, G. R., and R. R. Alexander. 1983. Forest vegetation of the White River National Forest in western Colorado: A habitat type classification. USDA Forest Service, Rocky Mountain Forest and Range Experiment Station. Research Paper RM-249. Fort Collins, CO. 36 pp.

Hoffman, G. R., and R. R. Alexander. 1987. Forest vegetation of the Black Hills National Forest of South Dakota and Wyoming: A habitat type classification. USDA Forest Service, Rocky Mountain Forest and Range Experiment Station. Research Paper RM-276. Fort Collins, CO. 48 pp.

Holland, V. L., and D. J. Keil. 1995. California vegetation. Kendall/Hunt Publishing Company, Dubuque, IA. 516 pp.

Hopkins, W. E. 1982. Ecology of white fir. Pages 35-41 in: D. C. Oliver and R. M. Kenady. Proceedings of the biology and management of true fir in the Pacific Northwest symposium, 1981 February 24-26, Seattle-Tacoma, WA. Contribution No. 5. University of

Johnson, C. G., and R. R. Clausnitzer. 1992. Plant associations of the Blue and Ochoco Mountains. USDA Forest Service, Pacific Northwest Region, Wallowa-Whitman National Forest R6-ERW-TP-036-92. 163 pp. plus appendices.

Johnston, B. C. 1997. Ecological types of the Upper Gunnison Basin. USDA Forest Service, Grand Mesa-Uncompahgre-Gunnison national forests. Review Draft. 539 pp.

Johnston, B. C. 2001. Ecological types of the Upper Gunnison Basin. USDA Forest Service. Technical Report R2-RR-2001-01. Rocky Mountain Region. Denver, CO.

Johnston, B. C., and L. Hendzel. 1985. Examples of aspen treatment, succession and management in western Colorado. USDA Forest Service, Range Wildlife Fisheries and Ecology. Denver, CO. 164 pp.

Jones, G. 1992b. Wyoming plant community classification (Draft). Wyoming Natural Diversity Database, Laramie, WY. 183 pp.

Keammerer, W. R. 1974a. Vegetation of the Grand Valley area. Pages 73-117 in: Ecological inventory of the Grand Valley area Unpublished report prepared for the Colony Development Operation, Atlantic Richfield Company, Denver, CO.

Kingery, H. E., editor. 1998. Colorado breeding bird atlas. Colorado Bird Atlas Partnership and Colorado Division of Wildlife, Denver, CO. 636 pp.

Kittel, G. 1993. A preliminary classification of the riparian vegetation of the White River Basin. Unpublished report prepared for the Colorado Department of Natural Resources and the Environmental Protection Agency by the Colorado Natural Heritage Program. 106 pp.

Kittel, G. M. 1994. Montane vegetation in relation to elevation and geomorphology along the Cache la Poudre River, Colorado. Unpublished thesis, University of Wyoming, Laramie.

Kittel, G., E. Van Wie, M. Damm, R. Rondeau, S. Kettler, A. McMullen, and J. Sanderson. 1999b. A classification of riparian and wetland plant associations of Colorado: A user's guide to the classification project. Colorado Natural Heritage Program, Colorado State University, Fort Collins CO. 70 pp. plus appendices.

Kittel, G., E. Van Wie, M. Damm, R. Rondeau, S. Kettler, and J. Sanderson. 1999a. A classification of the riparian plant associations of the Rio Grande and Closed Basin watersheds, Colorado. Unpublished report prepared by the Colorado Natural Heritage Program, Colorado State University, Fort Collins.

Kittel, G., R. Rondeau, and A. McMullen. 1996. A classification of the riparian vegetation of the Lower South Platte and parts of the Upper Arkansas River basins, Colorado. Submitted to Colorado Department of Natural Resources and the Environmental Protection Agency, Region VIII. Prepared by Colorado Natural Heritage Program, Fort Collins. 243 pp.

Kittel, G., R. Rondeau, and S. Kettler. 1995. A classification of the riparian vegetation of the Gunnison River Basin, Colorado. Submitted to Colorado Department of Natural Resources and the Environmental Protection Agency. Prepared by Colorado Natural Heritage Program, Fort Collins. 114 pp.

Kittel, G., R. Rondeau, N. Lederer, and D. Randolph. 1994. A classification of the riparian vegetation of the White and Colorado River basins, Colorado. Final report submitted to Colorado Department of Natural Resources and the Environmental Protection Agency. Colorado Natural Heritage Program, Boulder. 166 pp.

Kleiner, E. F., and K. T. Harper. 1977. Occurrence of four major perennial grasses in relation to edaphic factors in a pristine community. Journal of Range Management 30(4):286-289.

Knight, D. H. 1994. Mountains and plains: Ecology of Wyoming landscapes. Yale University Press, New Haven, MA. 338 pp.

Knight, D. H., G. P. Jones, Y. Akashi, and R. W. Myers. 1987. Vegetation ecology in the Bighorn Canyon National Recreation Area. Unpublished report prepared for the USDI National Park Service and University of Wyoming-National Park Service Research.

Komarkava, V. 1980. Classification and ordination in the Indian Peaks area, Colorado Rocky Mountains. Vegetatio 42:149-163.

Komarkova, V. 1976. Alpine vegetation of the Indian Peaks Area, Front Range, Colorado Rocky Mountains. Unpublished dissertation, University of Colorado, Boulder. 655 pp.

Komarkova, V. 1986. Habitat types on selected parts of the Gunnison and Uncompahgre national forests. Unpublished final report prepared for USDA Forest Service, Rocky Mountain Forest and Range Experiment Station. Fort Collins, CO. 270 pp. plus appendices.

Komarkova, V. K., R. R. Alexander, and B. C. Johnston. 1988b. Forest vegetation of the Gunnison and parts of the Uncompahgre national forests: A preliminary habitat type classification. USDA Forest Service. Research Paper RM-163. 65 pp.

Kovalchik, B. L. 1987. Riparian zone associations - Deschutes, Ochoco, Fremont, and Winema national forests. USDA Forest Service Technical Paper 279-87. Pacific Northwest Region, Portland, OR. 171 pp.

Kovalchik, B. L. 1992. Riparian zone associations on the national forests of eastern Washington. USDA Forest Service, Pacific Northwest Region. Draft. 203 pp.

Kovalchik, B. L. 1993. Riparian plant associations on the national forests of eastern Washington - Draft version 1. USDA Forest Service, Colville National Forest, Colville, WA. 203 pp.

Kovalchik, B. L. 2001. Classification and management of aquatic, riparian and wetland sites on the national forests of eastern Washington. Part 1: The series descriptions. 429 pp. plus appendix. http://www.reo.gov/col/wetland_classification/wetland_classi fication.pdf.

Krebs, P. H. 1972. Dendrochronology and the distribution of bristlecone pine (~Pinus aristata$ Engelm.) in Colorado. Unpublished dissertation, University of Colorado, Boulder. 211 pp.

Kunzler, L. M., and K. T. Harper. 1980. Recovery of Gambel oak after fire in central Utah. Great Basin Naturalist 40:127-130.

Kunzler, L. M., K. T. Harper, and D. B. Kunzler. 1981. Compositional similarity within the oakbrush type in central and northern Utah. Great Basin Naturalist 41(1):147-153.

Ladyman, J. A. R., and E. Muldavin. 1996. Terrestrial cryptograms of Pinyon-Juniper woodlands in the Southwestern United States: A review. USDA Forest Service General Technical Report RM-GTR-280. Rocky Mountain Forest and Range Experiment Station, Fort Collins, CO. 33 pp.

LaMarche, V. C., Jr., and H. A. Mooney. 1972. Recent climatic change and development of the bristlecone pine (~P. longaeva$ (Bailey)) krummholz zone, Mount Washington, Nevada. Arctic and Alpine Research 4(1):61-72.

Lanner, R. M., and S. B. Vander Wall. 1980. Dispersal of limber pine seed by Clark's nutcracker. Journal of Forestry 78(10):637-639.

Larson, M., and W. H. Moir. 1986. Forest and woodland habitat types (plant associations) of southern New Mexico and central Arizona (north of the Mogollon Rim). USDA Forest Service, Southwestern Region, Albuquerque, NM. 76 pp.

Larson, M., and W. H. Moir. 1987. Forest and woodland habitat types of northern New Mexico and northern Arizona. Edition 2. USDA Forest Service, Southwestern Region, Albuquerque, NM.

Lauenroth, W. K., and D. G. Milchunas. 1991. The shortgrass steppe. Pages 183-226 in: R. T. Coupland, editor. Natural Grasslands, Introduction and Western Hemisphere Ecosystems of the World 8A. Elsevier, Amsterdam.

Lauver, C. L., K. Kindscher, D. Faber-Langendoen, and R. Schneider. 1999. A classification of the natural vegetation of Kansas. The Southwestern Naturalist 44:421-443.

Lewis, M. E. 1975. Flora of the Santa Rosa Mountains, Humbolt National Forest. Unpublished report compiled for USDA Forest Service, Region IV, Ogden, UT. 19 pp.

Lindauer, I. E., C. E. Olmsted, III, W. A. Kelley, and W. F. Grey. 1982. Terrestrial ecosystems of northwest Colorado: An annotated bibliography and vegetation classification. Unpublished report prepared for the Bureau of Land Management by UNC-Greeley. 123 pp.

Loope, W. L., and N. E. West. 1979. Vegetation in relation to environments of Canyonlands National Park. Pages 195-199 in: R. M. Linn, editor. Proceedings of the First Conference of Scientific Resources in the National Parks, Volume I. November 9-13, 1976, New Orleans. USDI National Park Service Transactions and Proceedings Series 5.

MacMahon, J. A. 1988. Warm deserts. Pages 232-264 in M. G. Barbour and W. D. Billings, editors. North American terrestrial vegetation. Cambridge University Press, New York.

MacMahon, J. A., and F. H. Wagner. 1985. The Mojave, Sonoran and Chihuahuan deserts of North America. Pages 105-202 in: M. Evenari and D. W. Goodall, editors. Ecosystems of the world 12A: Hot deserts and arid shrublands. Elsevier, New York.

Major, J. T., J. D. Steventon, and K. M. Wynne. 1981. Comparison of marten home ranges calculated from recaptures and radio locations. Transactions of the Northeast Section of the Wildlife Society 38:109.

Malanson, G. P., and D. R. Butler. 1984. Transverse pattern vegetation on avalanche paths in the northern Rocky Mountains, Montana. Great Basin Naturalist 44(3):453-458.

Manning, M. E., and W. G. Padgett. 1989. Preliminary riparian community type classification for Nevada. Draft report prepared for USDA Forest Service, Intermountain Region, Ogden, UT. 134 pp.

Manning, M. E., and W. G. Padgett. 1995. Riparian community type classification for Humboldt and Toiyabe national forests, Nevada and eastern California. USDA Forest Service, Intermountain Region. 306 pp.

Marr, J. W. 1977a. The development and movement of tree islands near the upper limit of tree growth in the southern Rocky Mountains. Ecology 58:1159-1164.

Marriott, H. J. 2000. Survey of Black Hills montane grasslands. Prepared for the Wildlife Division, South Dakota Department of Game, Fish and Parks, Pierre, SD.

Marriott, H. J., and D. Faber-Langendoen. 2000. The Black Hills community inventory. Volume 2: Plant community descriptions. The Nature Conservancy, Midwest Conservation Science Center and Association for Biodiversity Information, Minneapolis, MN. 326 pp.

Mast, J. N., T. T. Veblen, and M. E. Hodgson. 1997. Tree invasion within a pine/grassland ecotone: an approach with historic aerial photography and GIS modeling. Forest Ecology and Management 93:181-94

Mast, J. N., T. T. Veblen, and M. E. Hodgson. 1997. Tree invasion within a pine/grassland ecotone: An approach with historic aerial photography and GIS modeling. Forest Ecology and Management 93:181-94.

Mast, J. N., T. T. Veblen, and Y. B. Linhart. 1998. Disturbance and climatic influences on age structure of ponderosa pine at the pine/grassland ecotone, Colorado Front Range. Journal of Biogeography 25:743-755.

Mauk, R. L., and J. A. Henderson. 1984. Coniferous forest habitat types of northern Utah. USDA Forest Service. General Technical Report INT-170. Intermountain Forest and Range Experiment Station, Ogden, UT. 89 pp.

McAuliffe, J. R. 1993. Case study of research, monitoring, and management programs associated with the saguaro cactus (~Carnegia gigantea$) at Saguaro National Monument, Arizona. USDI National Park Service, Technical Report NPS/WRUA/NRTR-93/01, Tucson, AZ. 50 pp.

McAuliffe, J. R. 1995. Landscape evolution, soil formation, and Arizona's desert grasslands. Pages 100-129 in: M. P. McClaran and T. R. Van Devender, editors. The Desert Grassland. University of Arizona Press, Tucson.

McClaran, M. P. and T. R. Van Devender. 1995. The Desert Grassland. The University of Arizona Press, Tucson, AZ. 346 pp.

McKell, C. M. 1950. A study of plant succession in the oak brush (~Quercus gambelii$) zone after fire. Unpublished thesis, University of Utah, Salt Lake City. 79 pp.

McLean, A. 1970. Plant communities of the Similkameen Valley, British Columbia, and their relationships to soils. Ecological Monographs 40(4):403-424.

McPherson, G. R. 1995. The role of fire in the desert grasslands. Pages 130-151 in: M. P. McClaran and T. R. Van Devender, editors. The Desert Grassland. University of Arizona Press, Tucson.

Mehl, M. S. 1992. Old-growth descriptions for the major forest cover types in the Rocky Mountain Region. Pages 106-120 in: Proceedings of the old-growth forests in the Rocky Mountains and Southwest conference, Portal, AZ. March 9-13, 1992.

Meidinger, D., and J. Pojar, editors. 1991. Ecosystems of British Columbia. British Columbia Ministry of Forests Special Report Series No. 6. 330 pp.

Milchunas, D. G., W. K. Lauenroth, P. L. Chapman, and M. K. Kazempour. 1989. Effects of grazing, topography, and precipitation on the structure of a semiarid grassland. Vegetatio 80:11-23.

Moir, W. H. 1967. The subalpine tall grass, ~Festuca thurberi$ community of Sierra Blanca, New Mexico. Southwestern Naturalist 12(3):321-328.

Moir, W. H. 1969a. The lodgepole pine zone in Colorado. The American Midland Naturalist 81(1):87-99.

Moir, W. H., and J. A. Ludwig. 1979. A classification of spruce-fir and mixed conifer habitat types of Arizona and New Mexico. USDA Forest Service, Rocky Mountain Forest and Range Experiment Station. Research Paper RM-207. Fort Collins, CO. 47 pp.

Mueggler, W. F. 1988. Aspen community types of the Intermountain Region. USDA Forest Service General Technical Report INT-250. Intermountain Research Station, Ogden, UT. 135 pp.

Mueggler, W. F., and C. A. Harris. 1969. Some vegetation and soil characteristics of mountain grasslands in central Idaho. Ecology 50:671-678.

Mueggler, W. F., and W. L. Stewart. 1980. Grassland and shrubland habitat types of western Montana. USDA Forest Service, General Technical Report INT-66. Intermountain Forest and Range Experiment Station. Ogden, UT. 154 pp.

Muldavin E., G. Bell, et al. 2002. Draft ecoregional conservation assessment of the Chihuahuan Desert. Pronatura Noreste. 87 pp.

Muldavin, E. 1994. Organ Mountains sensitive species and plant community inventory. Unpublished report prepared by the New Mexico Natural Heritage Program, Albuquerque.

Muldavin, E. H., R. L. DeVelice, and F. Ronco, Jr. 1992. A classification of forest habitat types of southern Arizona and portions of the Colorado Plateau. Draft General Technical Report RM-GTR-287, USDA Forest Service, Rocky Mountain Forest and Range Experiment Station. 68 pp. plus appendices.

Muldavin, E. H., R. L. DeVelice, and F. Ronco, Jr. 1996. A classification of forest habitat types southern Arizona and portions of the Colorado Plateau. USDA Forest Service General Technical Report RM-GTR-287. Rocky Mountain Forest and Range Experiment Station, Fort Collins, CO. 130 pp.

Muldavin, E., G. Harper, P. Nivelle, and Y. Chauvin. 2000c. The vegetation of White Sands Missile Range, New Mexico. Volume II: Vegetation map. U.S. Fish and Wildlife Service, Cooperative Agreement No. 14-16-002-91-233. New Mexico. 68 pp.

Muldavin, E., P. Durkin, M. Bradley, M. Stuever, and P. Mehlhop. 2000a. Handbook of wetland vegetation communities of New Mexico: Classification and community descriptions (volume 1). Final report to the New Mexico Environment Department and the Environmental Protection Agency prepared by the New Mexico Natural Heritage Program, University of New Mexico, Albuquerque, NM.

Muldavin, E., P. Mehlhop, and E. DeBruin. 1994a. A survey of sensitive species and vegetation communities in the Organ Mountains of Fort Bliss. Volume III: Vegetation communities. Report prepared for Fort Bliss, Texas, by New Mexico Natural Heritage Program, Albuquerque.

Muldavin, E., R. DeVelice, and W. Dick-Peddie. 1987. Forest habitat types of the Prescott, Tonto and western Coronado national forests, Arizona. Unpublished final report prepared for Rocky Mountain Forest and Range Experiment Station, CO. 71 pp.

Muldavin, E., Y. Chauvin, and G. Harper. 2000b. Vegetation of White Sands Missile Range, New Mexico: Volume I Handbook of vegetation communities. Final Report to White Sands Missile Range by New Mexico Natural Heritage Program, University of New Mexico, New Mexico. 192 pp.

Nachlinger, J. L. 1985. The ecology of subalpine meadows in the Lake Tahoe region, California and Nevada. Unpublished thesis, University of Nevada, Reno. 151 pp.

Nachlinger, J. L., and G. A. Reese. 1996. Plant community classification of the Spring Mountains National Recreation Area, Clark and Nye counties, Nevada. Unpublished report submitted to USDA Forest Service, Humboldt-Toiyabe National Forest, Spring Mountains National Recreation Area, Las Vegas, NV. The Nature Conservancy, Northern Nevada Office, Reno, NV. 85 pp. plus figures and appendices.

Nachlinger, J., K. Sochi, P. Comer, G. Kittel, and D. Dorfman. 2001. Great Basin: An ecoregion-based conservation blueprint. The Nature Conservancy, Reno, NV. 160 pp. plus appendices.

Nelson, D. L. 1998. Brown-capped Rosy-Finch. Pages 522-523 in: H. E. Kingery, editor. Colorado breeding bird atlas. Colorado Bird Atlas Partnership and Colorado Division of Wildlife, Denver, CO. 636 pp.

Niering, W. A., and C. H. Lowe. 1984. Vegetation of the Santa Catalina Mountains: Community types and dynamics. Vegetatio 58:3-28.

Opler, P. A., and G. O. Krizek. 1984. Butterflies east of the Great Plains: An illustrated Natural history. The John Hopkins University Press, Baltimore, MD. 294 pp.

Ostler, W. K., D. J. Hansen, D. C. Anderson, and D. B. Hall. 2000. Classification of Vegetation on the Nevada Test Site. U.S. Department of Energy, DOE/NV/11718-477. Bechtel Nevada Ecologial Services, Las Vegas, NV. 102 pp.

Padgett, W. G. 1982. Ecology of riparian plant communities in southern Malheur National Forest. Unpublished thesis, Oregon State University, Corvallis. 143 pp.

Padgett, W. G., A. P. Youngblood, and A. H. Winward. 1988a. Riparian community type classification of Utah and southeastern Idaho. Research Paper R4-ECOL-89-0. USDA Forest Service, Intermountain Region, Ogden, UT.

Padgett, W. G., A. P. Youngblood, and A. H. Winward. 1988b. Riparian community type classification of Utah. USDA Forest Service, Intermountain Region Publication R4-ECOL-88-01. Ogden, UT.

Padgett, W. G., A. P. Youngblood, and A. H. Winward. 1989. Riparian community type classification of Utah and southeastern Idaho. USDA Forest Service, Intermountain Region. Report R4-ECOL-89-01. Ogden, UT. 191 pp.

Parson, D. J., and S. H. DeBenedetti. 1979. Impact of fire suppression in a mixed-conifer forest. Forest Ecology and Management 2:21-33.

Passey, H. B., V. K. Hugie, E. W. Williams, and D. E. Ball. 1982. Relationships between soil, plant community, and climate on rangelands of the Intermountain West. USDA Soil Conservation Service, Technical Bulletin 1669. Salt Lake City, UT. 123 pp.

Peet, R. K. 1978a. Latitudinal variation in southern Rocky Mountain forests. Journal of Biogeography 5:275-289.

Peet, R. K. 1981. Forest vegetation of the Colorado Front Range. Vegetatio 45:3-75.

Pfister, R. D. 1972. Vegetation and soils in the subalpine forests of Utah. Unpublished dissertation, Washington State University, Pullman. 98 pp.

Pfister, R. D., B. L. Kovalchik, S. F. Arno, and R. C. Presby. 1977. Forest habitat types of Montana. USDA Forest Service. General Technical Report INT-34. Intermountain Forest and Range Experiment Station, Ogden, UT. 174 pp.

Pineada, P. M., R. J. Rondeau, and A. Ochs. 1999. A biological inventory and conservation recommendations for the Great Sand Dunes and San Luis Lakes, Colorado. Report prepared for The Nature Conservancy, San Luis Valley Program. Colorado Natural Heritage

Potkin, M., and L. Munn. 1989. Subalpine and alpine plant communities in the Bridger Wilderness, Wind River Range, Wyoming. USDA Forest Service Contract No. 53-8555-3-00015. Department of Plant, Soil, and Insect Sciences, University of Wyoming, Laramie. 117 pp. plus appendix.

Potter, D. A. 1994. Guide to forested communities of the upper montane in the central and southern Sierra Nevada. Technical Publication R5-ECOL-TP-003. USDA Forest Service, Pacific Southwest Region, San Francisco, CA.

Potter, L. D., R. C. Reynolds, and E. T. Louderbough. 1985. Mancos shale and plant community relationships: Analysis of shale, soil, and vegetation transects. Journal of Arid Environments 9:147-165.

Powell, A. M. 1988b. Trees and shrubs of Trans-Pecos Texas including Big Bend and Guadalupe Mountains national parks. Big Bend Natural History Assoc., Inc. 536 pp.

Powell, A. M., and B. L. Turner. 1974. Aspects of the plant biology of the gypsum outcrops of the Chihuahuan Desert. Pages 315-325 in: R. H. Wauer and D. H. Riskind, editors. Transactions of the Symposium on the Biological Resources of the Chihuahuan Desert region, United States and Mexico. USDI National Park Service, Washington, DC.

Powell, D. C. 1988a. Aspen community types of the Pike and San Isabel national forests in south-central Colorado. USDA Forest Service, Rocky Mountain Region, Report R2-ECOL-88-01. 254 pp.

Price, K. P., and J. D. Brotherson. 1987. Habitat and community relationships of cliffrose (~Cowania mexicana var. stansburiana$) in central Utah. Great Basin Naturalist 47(1):132-151.

Ramaley, F. 1939b. Sand-hill vegetation of northeastern Colorado. Ecological Monographs 9:1-51.

Ranne, B. M. 1995. Natural variability of vegetation, soils, and physiography in the bristlecone pine forests of the Rocky Mountains. University of Wyoming, Laramie, WY. 68 pp

Ranne, B. M., W. L. Baker, T. Andrews, and M. G. Ryan. 1997. Natural variability of vegetation, soils, and physiography in the bristlecone pine forests of the Rocky Mountains. Great Basin Naturalist 57(1):21-37.

Ream, R. D. 1960. An ordination of the oak communities of the Wasatch Mountains. M.S. thesis, University of Utah, Salt Lake City. 52 pp.

Ream, R. R. 1964. The vegetation of the Wasatch Mountains, Utah and Idaho. Unpublished Ph.D. dissertation, University of Wisconsin, Madison. 190 pp.

Reed, P. B., Jr. 1988. National list of plant species that occur in wetlands: 1988 national summary. USDI Fish & Wildlife Service. Biological Report 88(24).

Reid, M. S., K. A. Schulz, P. J. Comer, M. H. Schindel, D. R. Culver, D. A. Sarr, and M. C. Damm. 1999. An alliance level classification of vegetation of the coterminous western United States. Unpublished final report to the University of Idaho Cooperative Fish and Wildlife Research Unit and National Gap Analysis Program, in fulfillment of Cooperative Agreement 1434-HQ-97-AG-01779. The Nature Conservancy, Western Conservation Science Department, Boulder, CO.

Ricketts, T. H., E. Dinerstein, D. M. Olson, C. J. Loucks, and W. Eichbaum. 1999. Terrestrial ecoregions of North America: A conservation assessment. Island Press, Washington DC. 485 pp.

Robichaux, R. H., editor. 1999. Ecology of Sonoran Desert plants and plant communities. University of Arizona Press. 303 pp.

Rogers, C. M. 1950. The vegetation of the Mesa de Maya region of Colorado, New Mexico, and Oklahoma. Unpublished dissertation, University of Michigan, Ann Arbor. 125 pp.

Romme, W. H. 1982. Fire and landscape diversity in subalpine forests of Yellowstone National Park. Ecological Monographs 52:199-221.

Rondeau, R. 2001. Ecological system viability specifications for Southern Rocky Mountain ecoregion. First Edition. Colorado Natural Heritage Program, Colorado State University, Fort Collins, CO. 181 pp.

Roughton, R. D. 1972. Shrub age structures on a mule deer winter range in Colorado. Ecology 53(4):615-625.

Sanderson, J., and S. Kettler. 1996. A preliminary wetland vegetation classification for a portion of Colorado's west slope. Report prepared for Colorado Department of Natural Resources, Denver, CO, and U.S. Environmental Protection Agency, Region VIII, Denver, CO. Colorado Natural Heritage Program, Ft. Collins, CO. 243 pp.

Sawyer, J. O., and T. Keeler-Wolf. 1995. A manual of California vegetation. California Native Plant Society, Sacramento. 471 pp.

Schaupp, W. C., Jr., M. Frank, and S. Johnson. 1999. Evaluation of the spruce beetle in 1998 within the Routt divide blowdown of October 1997, on the Hahns Peak and Bears Ears Ranger Districts, Routt National Forest, Colorado. Biological Evaluation R2-99-

Schwan, H. E., and D. F. Costello. 1951. The Rocky Mountain alpine type: Range conditions, trends and land use (a preliminary report). Unpublished report prepared for USDA Forest Service, Rocky Mountain Region (R2), Denver, CO. 18 pp.

Shepherd, H. R. 1975. Vegetation of two dissimilar bighorn sheep ranges in Colorado. Colorado Division of Wildlife Report 4. 223 pp.

Shepperd, W. D. 1990. Initial growth, development, and clonal dynamics of regenerated aspen in the Rocky Mountains. USDA Forest Service Research Paper RM-312. Rocky Mountain Forest and Range Experiment Station, Fort Collins, CO. 8 pp.

Shreve, F., and I. L. Wiggins. 1964. Vegetation and flora of the Sonoran Desert. Stanford University Press, Stanford, CA. 840 pp.

Shute, D., and N. E. West. 1977. The application of ECOSYM vegetation classifications to rangelands near Price, Utah. Appendix reports 14 and 16 in: J. A. Henderson, L. S. Davis, and E. M. Ryberg, editors. ECOSYM: A classification and information system for wildland resource management. Utah State University, Logan. 53 pp.

Sims, P. L., B. E. Dahl, and A. H. Denham. 1976. Vegetation and livestock response at three grazing intensities on sandhill rangeland in eastern Colorado. Colorado Agricultural Experiment Station. Technical Bulletin 130. 48 pp.

Starr, C. R. 1974. Subalpine meadow vegetation in relation to environment at Headquarters Park, Medicine Bow Mountains, Wyoming. Unpublished thesis, University of Wyoming, Laramie.

Steele, R., and K. Geier-Hayes. 1995. Major Douglas-fir habitat types of central Idaho: A summary of succession and management. USDA Forest Service General Technical Report INT-GTR-331. USDA Forest Service Intermountain Research Station, Ogden, UT.

Steele, R., R. D. Pfister, R. A. Ryker, and J. A. Kittams. 1981. Forest habitat types of central Idaho. USDA Forest Service General Technical Report INT-114. Intermountain Forest and Range Experiment Station, Ogden, UT. 138 pp.

Steinauer, G., and S. Rolfsmeier. 2000. Terrestrial natural communities of Nebraska. Unpublished report of the Nebraska Game and Parks Commission. Lincoln, NE. 143 pp.

Stewart, B. K. 1940. Plant ecology and paleoecology of the Creede Valley, Colorado. Unpublished dissertation, University of Colorado, Boulder. 154 pp.

Stuever, M. C., and J. S. Hayden. 1997a. Plant associations of Arizona and New Mexico. Volume 2: Woodlands. USDA Forest Service, Southwestern Region, Habitat Typing Guides. 196 pp.

Szaro, R. C. 1989. Riparian forest and scrubland community types of Arizona and New Mexico. Desert Plants Special Issue 9(3-4):70-139.

Thatcher, A. P. 1975. The amount of blackbrush in the natural plant community is largely controlled by edaphic conditions. Pages 155-156 in: Proceedings Wildland Shrubs: Symposium and workshop. USDA Forest Service, Provo, UT.

Thilenius, J. F. 1975. Alpine range management in the western United States--principles, practices, and problems: The status of our knowledge. USDA Forest Service Research Paper RM-157. Rocky Mountain Forest and Range Experiment Station, Fort Collins, CO.

Thilenius, J. F., G. R. Brown, and A. L. Medina. 1995. Vegetation on semi-arid rangelands, Cheyenne River Basin, Wyoming. USDA Forest Service. General Technical Report RM-GTR-263. Rocky Mountain Forest and Range Experiment Station, Fort Collins, CO. 60 pp.

Thomas, K., J. Coles, and M. Hansen. 2003c. Sunset Crater National Monument, Arizona, vegetation classification and distribution: A USGS-NPS Vegetation Mapping Program study. Southwest Biological Science Center, U.S. Geological Survey Open-file Report. In preparation.

Thomas, K., J. Franklin, T. Keeler-Wolf, and P. Stine. 2003a. Mojave Desert Ecosystem Program: Central Mojave Vegetation Mapping Project. USGS Open-file Report. In press.

Thorne Ecological Institute. 1973a. Environmental setting of the Parachute Creek Valley: An ecological inventory. Unpublished report prepared for Colony Development Operations, Atlantic Richfield Company, by Thorne Ecological Institute, Boulder, CO. [Veg.: pages 36-40, map].

Tisdale, E. W. 1947. The grasslands of the southern interior of British Columbia. Ecology 28(4):346-382.

Tisdale, E. W. 1982. Grasslands of western North America: The Pacific Northwest bunchgrass. Pages 223-245 in: A. C. Nicholson, A. Mclean, and T. E. Baker, editors. Grassland Ecology and Classification Symposium, Kamloops, BC.

Tisdale, E. W., M. Hironaka, and M. A. Fosberg. 1965. An area of pristine vegetation in Craters of the Moon National Monument, Idaho. Ecology 46(3):349-352.

Tolstead, W. L. 1942. Vegetation of the northern part of Cherry County, Nebraska. Ecological Monographs 12(3):257-292.

Tuhy, J. S., and J. A. MacMahon. 1988. Vegetation and relict communities of Glen Canyon National Recreation Area. Unpublished final report prepared for USDI National Park Service, Rocky Mountain Region, Lakewood, CO. Utah State University, Logan. 299 pp.

Tuhy, J., P. Comer, D. Dorfman, M. Lammert, B. Neely, L. Whitham, S. Silbert, G. Bell, J. Humke, B. Baker, and B. Cholvin. 2002. An ecoregional assessment of the Colorado Plateau. The Nature Conservancy, Moab Project Office. 112 pp. plus maps and appendices.

Turner G. T. 1975. Mountain grassland ecosystem. USDA Forest Service, Research Paper RM-161, Rocky Mountain Forest and Range Experiment Station, Fort Collins, CO.

Turner, G. T., and E. J. Dortignac. 1954. Infiltration, erosion and herbage production of some mountain grasslands in western Colorado. Journal of Forestry 52:858-860.

Ungar, I. A. 1965. An ecological study of the vegetation of the Big Sapt Marsh, Stafford County, Kansas. University of Kansas Science Bulletin 116(1):1-99.

Ungar, I. A. 1968. Species-soil relationships on the Great Salt Plains of northern Oklahoma. The American Midland Naturalist 80(2):392-407.

Ungar, I. A. 1972. The vegetation of inland saline marshes of North America, north of Mexico. Pages 397-411.

Veblen, T. T. 1986. Age and size structure of subalpine forests in the Colorado Front Range. Bulletin of the Torrey Botanical Club 113(3):225-240.

Walford, G. M. 1996. Statewide classification of riparian and wetland dominance types and plant communities - Bighorn Basin segment. Report submitted to the Wyoming Department of Environmental Quality, Land Quality Division by the Wyoming Natural Diversity Database. 185 pp.

Walford, G., G. Jones, W. Fertig, and K. Houston. 1997. Riparian and wetland plant community types of the Shoshone National Forest. Unpublished report. Wyoming Natural Diversity Database for The Nature Conservancy, and the USDA Forest Service. Wyoming Natural Diversity Database, Laramie. 227 pp.

Walford, G., G. Jones, W. Fertig, S. Mellman-Brown, and K. Houston. 2001. Riparian and wetland plant community types of the Shoshone National Forest. General Technical Report RMRS-GTR-85. USDA Forest Service, Rocky Mountain Research Station, Fort Collins, CO. 122 pp.

Warren, P. L., K. L. Reichhardt, D. A. Mouat, B. T. Brown, and R. R. Johnson. 1982. Vegetation of Grand Canyon National Park. Cooperative National Park Resources Studies Unit Technical Report 9. Tucson, AZ. 140 pp.

Weaver, J. E. 1954. North American prairie. Johnsen Publishing Co., Lincoln, NE. 348 pp.

Weaver, J. E., and F. W. Albertson. 1956. Grasslands of the Great Plains: Their nature and use. Johnsen Publishing Co., Lincoln, NE. 395 pp.

Weaver, J. E., and W. E. Bruner. 1948. Prairies and pastures of the dissected loess plains of central Nebraska. Ecological Monographs 18(4):507-549.

Welsh, S. L. 1957. An ecological survey of the vegetation of the Dinosaur National Monument, Utah. Unpublished thesis, Brigham Young University, Provo, UT. 86 pp.

Welsh, S. L. 1979. Endangered and threatened plants of Utah: A case study. Great Basin Naturalist Memoirs 3:64-80.

Welsh, S. L., and L. M. Chatterly. 1985. Utah's rare plants. Great Basin Naturalist 45(2):173-236.

West, N. E. 1979. Survival patterns of major perennials in salt desert shrub communities of southwestern Utah. Journal of Range Management 32(6):442-445.

West, N. E. 1982. Approaches to synecological characterization of wildlands in the Intermountain West. Pages 633-643 in: In-place resource inventories: Principles & practices. A national workshop, University of Maine, Orono. Society of American Foresters, McClean, VA. August 9-14, 1981.

West, N. E. 1983. Southeastern Utah galleta-threeawn shrub steppe. Pages 413-421 in: N. E. West, editor. Temperate deserts and semi-deserts. Ecosystems of the World, Volume 5. Elsevier Publishing Company, Amsterdam.

West, N. E. 1983a. Great Basin-Colorado Plateau sagebrush semi-desert. Pages 331-349 in: N. E. West, editor. Temperate deserts and semi-deserts. Ecosystems of the world, Volume 5. Elsevier Publishing Company, Amsterdam.

West, N. E. 1983b. Intermountain salt desert shrublands. Pages 375-397 in: N. E. West, editor. Temperate deserts and semi-deserts. Ecosystems of the world, Volume 5. Elsevier Publishing Company, Amsterdam.

West, N. E. 1983c. Western Intermountain sagebrush steppe. Pages 351-374 in: N. E. West, editor. Temperate deserts and semi-deserts. Ecosystems of the world, Volume 5. Elsevier Publishing Company, Amsterdam.

West, N. E. 1983d. Colorado Plateau-Mohavian blackbrush semi-desert. Pages 399-412 in: N. E. West, editor. Temperate deserts and semi-deserts. Ecosystems of the world, Volume 5. Elsevier Publishing Company, Amsterdam.

West, N. E. 1999. Juniper pinon savannas and woodlands of western North America. Pages 288-308 in: R. C. Anderson, editor. Savannas, barrens, and rock outcrop plant communities of North America. Cambridge University Press, New York.

West, N. E. 1999b. Distribution, composition, and classification of current juniper-pinyon woodlands and savannas across western North America. Pages 20-23 in: S. B. Monsen and R. Stevens, editors. Proceedings: Ecology and management of pinyon-juniper com

West, N. E., and J. A. Young. 2000. Intermountain valleys and lower mountain slopes. Page 255-284 in: M. G. Barbour and W. D. Billings, editors. North American Terrestrial Vegetation, second edition. Cambridge University Press, Cambridge.

West, N. E., and K. I. Ibrahim. 1968. Soil-vegetation relationships in the shadscale zone of southeastern Utah. Ecology 49(3):445-456.

West, N. E., and N. S. Van Pelt. 1987. Successional patterns in pinyon-juniper woodlands. Pages 43-52 in: Proceedings of Pinyon-juniper Conference. USDA Forest Service General Technical Report INT-215. Intermountain Research Station, Ogden, UT.

West, N. E., R. J. Tausch, and P. T. Tueller. 1998. A management-oriented classificaton of pinyon-juniper woodlands of the Great Basin. USDA Forest Service General Technical Report RMRS-GTR-12. USDA Forest Service, Rocky Mountain Research Station, Ogden, UT. 42 pp.

Whipple, S. A. 1975. The influence of environmental gradients on vegetational structure in the subalpine forest of the southern Rocky Mountains. Unpublished dissertation, Colorado State University, Fort Collins.

Whipple, S. A., and R. L. Dix. 1979. Age structure and successional dynamics of a Colorado subalpine forest. The American Midland Naturalist 101(1):142-158.

Willard, B. E. 1963. Phytosociology of the alpine tundra of Trail Ridge, Rocky Mountain National Park, Colorado. Unpublished dissertation, University of Colorado, Boulder.

Williams, C. K., and B. G. Smith. 1990. Forested plant associations of the Wenatchee National Forest. Unpublished draft prepared by the USDA Forest Service, Pacific Northwest Region, Portland, OR. 217 pp.

Wright, H. A., and A. W. Bailey. 1982. Pinyon-juniper. Pages 195-208 in: Fire ecology: United States and southern Canada. Wiley-Interscience Publication, John Wiley and Sons, New York. 501 pp.

Young, J. A., and R. A. Evans. 1981. Demography and fire history of a western juniper stand. Journal of Range Management 34(6):501-505.

Youngblood, A. P., and R. L. Mauk. 1985. Coniferous forest habitat types of central and southern Utah. USDA Forest Service, Intermountain Research Station. General Technical Report INT-187. Ogden, UT. 89 pp.

Youngblood, A. P., and W. F. Mueggler. 1981. Aspen community types on the Bridger-Teton National Forest in western Wyoming. USDA Forest Service. Research Paper INT-272. Intermountain Forest and Range Experiment Station, Ogden, UT. 34 pp.